PACOIMA DAM
AERIAL TRAMWAY

OPERATION
AND
MAINTENANCE

MANUAL

1999

POMA

MAINTENANCE MANUAL

OMA of America, Inc.

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POMA
OF AMERICA

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Section 1

TECHNICAL DATA

LIFT DATA SHEET

NAME: ***Pacoima Tram***

TYPE: Aerial Tram

LINE:	Slope Length	2091.57 ft.	(637.51 m)
	Vertical Rise	519.06 ft.	(158.21 m)
	Average Grade	25.80%	
SPEED		400 fpm	(2.03 m/S)
CAPACITY		60 p/hour	
NUMBER OF CARRIERS		1	
POWER OF ELECTRIC MOTOR		50 HP @ 1745 rpm	
POWER OF EVAC. ENGINE		25 HP @ 3600 rpm	
DIAMETER OF TRACK ROPE		26 mm	
DIAMETER OF HAUL ROPE		16 mm	
HYDRAULIC TENSION			
	TRACK ROPE RAM	1415 psi	(98 bars)
	LORRY RAM	1415 psi	(98 bars)
LINE GAUGE		4.10 ft.	(1.25 m)
DIRECTION OF ROTATION		CW	

ORIGIN OF PROFILE : Poma of America, Inc.

PROFILE NUMBER : C51013

DATE : February 1998

I. *Lift Operation*

Speeds

* speed		2.03 m/sec.	400 ft/min.
* over-speed	speed x 1.1 =	2.23 m/sec.	440 ft/min.
* emergency speed		0.508 m/sec.	100 ft/min.

II. *Hydraulic Tension of the Cables*

Track rope tension system

* OPERATING PRESSURE in the ram .... 98 bars (1415 psi)

* LOW PRESSURE SWITCH (on the hydraulic unit)
  Must trip and cause the stopping of the lift if the pressure falls to:
  .... 88 bars (1274 psi)

  This corresponds to an operating pressure decrease of 10%.

* HIGH PRESSURE SWITCH (on the hydraulic unit)
  Must trip and cause the stopping of the lift if the pressure rises to:
  .... 108 bars (1557 psi)

  This corresponds to an operating pressure increase of 10%.

Haul rope tension

* OPERATING PRESSURE in the rams .... 98 bars (1415 psi)

* LOW PRESSURE SWITCH (on the hydraulic unit)
  Must trip and cause the stopping of the lift if the pressure falls to:
  .... 88 bars (1274 psi)

  This corresponds to an operating pressure decrease of 10%.

* HIGH PRESSURE SWITCH (on the hydraulic unit)
  Must trip and cause the stopping of the lift if the pressure rises to:
  .... 108 bars (1557 psi)

  This corresponds to an operating pressure increase of 10%.

III. *Adjustment of the Bullwheel Brakes*

* Pressure A : Braking pressure
  (when the pads are in contact with the braking track) 100 bars(1450 psi)

* Pressure B: Brake clearance pressure
  (the pads are not in contact with the braking track) 170 bars (2465 psi)

The brake pressures listed here are based on assumptions about shoe friction. This friction may vary due to environmental factors such as water, ice, snow, rust, oils or greases on the braking surface or brake shoes. These values should be used as guidelines only. The brakes shall be adjusted to produce the holding force listed in the Brake Test Procedures in this section.

IV. *Cable Tensions and Loads*

The tensions and the loads on the equipment given below are the most extreme, considering all loading conditions.

NOTE: Releasing the hydraulic rams can reduce the tensions and loads.
ATTENTION: However, doing so makes the tensions and loads very difficult to predict.

- CABLE TENSION:

Track Rope

at the drive terminal	16650 daN	(37431 lbs.)
at the return terminal	18126 daN	(40749 lbs.)

Haul Rope

at the drive terminal	2280 daN	(5126 lbs.)
at the return terminal	2380 daN	(5350 lbs.)

- LOADS ON STRUCTURES

Track Rope Reaction

at the drive tower	7386 daN	(16604 lbs.)
at tower 1	7691 daN	(17290 lbs.)
at tower 2	3628 daN	(8156 lbs.)
at the return tower	18074 daN	(40632 lbs.)

Haul Rope Reaction

at the drive tower	4259 daN	(9575 lbs.)
at tower 1	1969 daN	(4426 lbs.)
at tower 2	756 daN	(1700 lbs.)
at the return tower	4737 daN	(10649lbs.)

V. *Internal Combustion Engines*

Evac Engine .... Kohler CH25

Genset .... Cummins 50KW

VI. *Drive Belt Tensioning*

- Electric motor (normal operation)

Motor Sprocket Teeth # 48

Gearbox Sprocket Teeth #...................................... 50

Belts: Number .... 1 Size........... Poly Chain 14M-1960-20

Shaft Center Distance... 25.08 in.

Belt Tension - max .... 201.6 lbs.

Deflection at the center of the span .... 0.39 in.

New Belt Installation Force .... 20.4 lbs.

Used Belt Retensioning Force................................ 17.9 lbs

- Hydraulic motor (evacuation operation)

Motor Sprocket Teeth # 48

Gearbox Sprocket Teeth #...................................... 50

Belts: Number .... 1 Size........... Poly Chain 14M-1750-20

Shaft Center Distance... 25.94 in.

Belt Tension - max .... 195.58 lbs.

Deflection at the center of the span .... 0.33 in.

New Belt Installation Force .... 19.7 lbs.

Used Belt Retensioning Force................................ 17.2 lbs

VII. *Brake Testing Values* (Minimum Test Values)

Bullwheel Brakes... 110 ft-lbs.

Track Rope Brake .... 3200 lbs.

Note: Bullwheel Brake test values are given in torque applied to the electric motor shaft.

VIII. *Haul Rope* shall comply with all provisions of ANSI B77.1, Section 7.1 or CAN/CSA-Z98-96 and CSA-G4.

Manufacturer: Fatzer

Construction: 6 x 19 Seale

Wire

King Wire .... 1860 N/mm^2

Inner, Outer Wire .... 1960 N/mm^2

Core .... Polypropylene

Lay .... Right Lang

Diameter .... 16mm +2% / -1%

Strength .... 17659daN (39700 lbs.)

Length .... 4225 ft.

Lightly lubricated with Elaskon 20BB.

IX. *Track Rope* shall comply with all provisions of ANSI B77.1, Section 7.1 or CAN/CSA-Z98-96 and CSA-G4.

Manufacturer: Bridon

Construction: Full Lock Aerial rope

Wire

King Wire .... 1960 N/mm^2

Outer Wire.................................... 1570 N/mm^2

Inner Wire .... 1960 N/mm^2

Lay .... Full lock RH

Diameter .... 26mm +2% / -1%

Strength .... 64723daN (145504 lbs.)

Length .... 2107.5 ft.

Lightly lubricated with castor oil.

X. *Electric Motor*

Brand..General Electric

Frame size...CD328AT

HP.. 50 Hp

RPM .... 1750 rpm

Voltage 500

XI. *Gear Reducer*

Brand .... Kissling

Model T-246

Ratio 53.97:1

MONTHLY BRAKE TEST PROCEDURES

AREA : **Pacoima Dam**

LIFT : **Pacoima Aerial Tram**

CAPACITY/
SPEED : ***60pph / 400fpm***

CONTENTS:

THESE PROCEDURES SHALL BE PERFORMED BY TRAINED AND COMPETENT PERSONNEL AS REQUIRED BY ANSI B77.1-1992, SECTION 2.3.3.2.

I. *INTRODUCTION*

These procedures provide static tests of the holding power of the service brake and the emergency brake.

These tests shall be conducted at least monthly and immediately prior to the operating season. In the event any repairs, adjustments or modifications are made to any brake system at any time, these tests shall be successfully completed prior to opening the lift for transportation of any person or persons.

The intent of these procedures is to demonstrate that the brake systems will perform properly and hold the load for which the lift was designed.

There are to be no passengers on the lift during these tests.

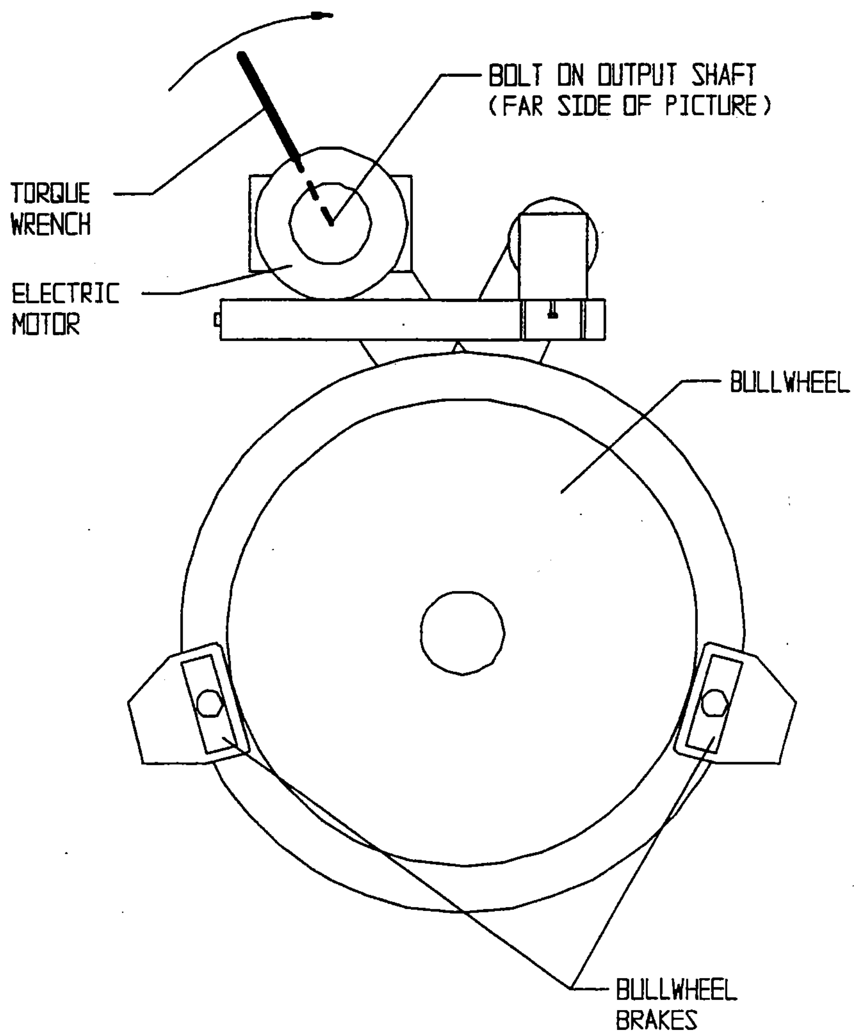
FAILURE TO SUCCESSFULLY PERFORM THESE TESTS MAY RESULT IN SERIOUS INJURY OR DEATH TO PERSONS ON OR NEAR THIS LIFT.

Lift Name:	**Pacoima Aerial Tram**
Capacity/speed:	**60 pph/400fpm**

II. *BULLWHEEL BRAKE TEST*

1. Locate empty cabin at drive terminal approximately 15 inches from the docked position.
2. Open main power disconnect.
3. Turn the OPERATIONS MODE SELECTOR switch to AUXILIARY.
4. Push the RESET BUTTON.
5. Pump up the bullwheel brakes using the hand pump.
6. Apply the one bullwheel brake by opening one dump valve, and be certain the second bullwheel brake remains released. Note: On some models of bullwheel brake pumps, it may be necessary to manually hold the bullwheel back stop brake solenoid valve closed.
7. Set a torque wrench to 110 ft-lbs. Position the torque wrench on the bolt on the output shaft of the electric motor. Rotate the torque wrench and observe desired torque is attained and the bullwheel does not move. (See Brake Test Diagram)
8. If the bullwheel brake slips, re-adjust them following the procedure in the OPERATION AND MAINTENANCE MANUAL, then repeat the test.
9. After successfully completing this test, remove the test equipment. Prior to opening the lift for transportation, operate the lift through a series of starts and stops to be certain that all brake systems are operating properly. Check stopping distance.

III. BULLWHEEL BRAKE TEST DIAGRAM



IV. *TRACK ROPE BRAKE TEST*

1. Locate empty cabin at drive terminal approximately 4-6 feet from the docked position at the drive terminal.

2. Manually set the track rope brake by opening the valve in the cabin.

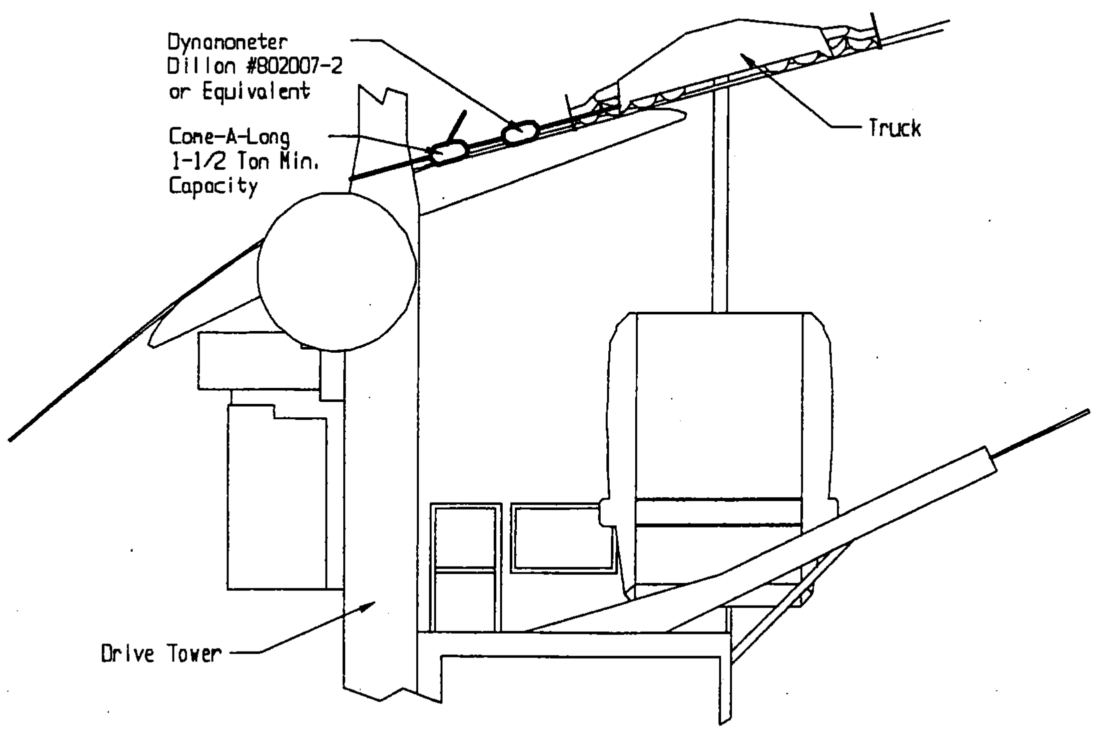
3. Place a come-a-long with a dynamometer between the truck and drive tower. Make sure the come-a-long and dynamometer are as close as possible to the axis of the track rope. **Use rigging rated at a minimum of 4,000 lbs**. (See Track Rope Brake Test Diagram).

4. Tension the set up using the come-a-long to a value of **<u>3200 lbs</u>**. Verify that the brake did not slip on the track rope. *Note the value given is adjusted for the angle of rope at the drive. The test must be preformed at the drive or the pull test value will change.*

5. If the track rope brake slips prior to reaching this value, adjust brake and repeat test. (See Carrier section of Maintenance Manual)

6. After successfully completing this test, remove the test equipment. Prior to opening the lift for transportation, operate the lift through a series of starts and stops to be certain that all brake systems are operating properly.

V. *TRACK ROPE BRAKE TEST DIAGRAM*



Section 2

LIFT OPERATIONS MANUAL

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POMA

April 15, 1999

POMA OF AMERICA, INC.

Ms. Reem Shamma
LA County Department of Public Works
900 South Fremont Ave.
Alhambra, CA 91803-1331

Dear Reem:

Regarding operation of the Pacoima tram in winds, we offer the following. As you are aware, the tram has been designed for operation in winds up to 67 mph. However, wind effects on aerial lifts involve many variables. These include wind speed, wind direction, wind exposure, gust to average speed differences, period of gusts, lift speed and line loading. Any attempt to calculate safe wind speeds involves so many assumptions that the results are inaccurate and possibly dangerous in the sense that they create an attitude of reliance on wind speed and direction measurements at specific points of the lift line and a chart of recommended lifts speed versus wind speed rather than visual observation of the lift as it operates. Wind speed and direction measurements provide valuable input to the lift supervisor's judgment of safe wind speed, but they cannot remove his/her responsibility to operate the lift in a safe manner.

The Pacoima tram has been designed to allow 7° lateral swing, 30° longitudinal swing and the combination of 7° lateral and 30° longitudinal swing of the carriers without contact with towers or line equipment. The terminals can accommodate this swing at the entrance of the terminals with the stabilization rail extensions. This lift has been designed to safely resist 100-MPH winds without failure of the terminals, towers or foundations. However, many combinations of wind speed, direction, exposure, lift speed and line loading can generate carrier swings in excess of 7°. Carrier swing greater that 7° can cause carriers to contact towers and other equipment possibly resulting in equipment damage or injury and/or death to passengers. Accordingly, it is the burden of the lift supervisor to reduce speed or cease operations when conditions warrant. The following chart of wind speed versus line speed should be used only as a general guideline. In the event of high winds, visual monitoring of the lift line and terminals is essential to allow the lift supervisor to use his/her judgement on safe speed and when to reduce or cease operation.

Wind Speed (MPH)	Maximum Line Speed (ft./min)
0 - 30	400
30 - 35	250
35 - 40	180
40 - 67	100
Above 67	Cease Operation

If you have additional questions, please let me know.

Sincerely,

R. Jefferson Smith, P.E.

cc: JF Mugnier

2510 FORESIGHT CIRCLE GRAND JUNCTION, CO 81505 (970) 241-4442 · FAX (970) 241-3023
EASTERN OFFICE: P.O. BOX 35, ROUTE 100 & 107, STOCKBRIDGE, VT 05772 (802) 746-7955 - FAX (802) 746-7958

OPERATOR CONTROLS

This section describes the operator controls, fault annunciator and meters for Poma lifts. There are control stations located at the drive and return load/unload platforms, electrical cabinet and inside the cabin. Each station has an Emergency Stop, Normal Stop, up, down, open door and close door. Sound powered phones and signal buttons are located at the drive and return load/unload platforms and electrical cabinet.

EMERGENCY STOP: This button should be pressed when an emergency situation exists. It will bring the lift to an abrupt stop by releasing the hydraulic pressure which holds the bullwheel E-brake open and by disconnecting the power from the main electric motor or by shutting off the fuel supply to the evac engine. It will also cause all auxiliary motors and pumps such as the Tension Pump to shut off.

NORMAL STOP: This button will cause the lift to come to a smooth stop by using the deceleration ramp in the DC Drive. If Evac Mode is selected, the fuel will be shut off to the evac engine and the service brake will apply.

UP: This button will cause the lift to operate in a clockwise motion (cabin moving uphill), unless the cabin is docked at the return. When pressed the lift will auto-reset and, if no faults remain active, an audible bell will sound at the drive and return for three seconds. After the alarm has sounded, the brakes will be pumped and the lift will accelerate to the percent of full speed selected on the speed control potentiometer in drive control cabin (full speed = 400 fpm). The cabin will travel at the selected speed until reaching the return or until a fault/operator stop is initiated. The exception to this being when the cabin is traveling over a tower, at which point it will decelerate to a preset speed to accommodate a smooth ride. Note that the auto-reset process can take as long as 20 seconds and therefore the UP button is inactive for a period of 20 seconds after being pressed.

DOWN: This button will cause the lift to operate in a counter clockwise motion (cabin moving downhill), unless the cabin is docked at the drive. When pressed the lift will auto-reset and, if no faults remain active, an audible bell will sound at the drive and return for three seconds. After the alarm has sounded, the brakes will be pumped and the lift will accelerate to the percent of full speed selected on the speed control potentiometer in drive control cabin (full speed = 400 fpm). The cabin will travel at the selected speed until reaching the return or until a fault/operator stop is initiated. The exception to this being when the cabin is traveling over a tower, at which point it will decelerate to a preset speed to accommodate a smooth ride. Note that the auto-reset process can take as long as 20 seconds and therefore the DOWN button is inactive for a period of 20 seconds after being pressed.

RESET: The reset button is located in the electrical cabinet on the drive platform. This button is used to reset lift safeties. A valid reset can only occur if the lift is stopped (zero speed detected by the PLC) and the service brake is set. If these conditions are not met when the Reset Button is pressed, a **Reset Fault** will be annunciated. There is a 3-second time delay between a reset and when the lift can be run. This time delay prevents restarting the lift too quickly after a stop. Note that the brake position faults, which indicate that the brakes are set, can not be reset using this button. The brakes are not pumped until all other safeties are clear and a run command is received.

MODE SELECT: This switch selects the operating mode: Electric or Evac. Ensure the gearbox is coupled properly.

CONTROL POWER: This key switch energizes the +24 VDC control circuits. It must be turned on in order to run the lift.

SIGNAL: This button will sound the signal buzzers located in each load/unload area and electrical cabinet on drive platform. It is used to initiate contact via the sound powered phones.

PHONES: There are sound-powered phones located at the unload/load areas and in electrical cabinet on drive platform.

LIFT SPEED METER: The lift speed is indicated in fpm (feet per minute) on the electrical cabinet located on the drive platform. The meter also has two thumbwheels which control the setpoints for cable tach overspeed and cable rollback.

WARNING: Only qualified personnel should adjust the setpoints. Failure to properly adjust the setpoints may result in loss of life or extensive damage to equipment.

CONTROL VOLTS METER: The +24 VDC control system voltage is indicated on this meter which is located on the main drive cabinet. The normal operating range is between 23-28 VDC.

TRIP COUNTER: The trip counter registers the total number of trips. One trip is defined as the carrier leaving the drive, docking at the return and then returning and docking at the drive.

HOUR METER: This meter indicates total running lift hours. There is also an hour meter located on the evac engine and genset which indicates how many hours the engine has been running.

FAULT ANNUNCIATOR: The annunciator is located in the electrical cabinet located on the drive platform. The annunciator is a two-line VFD display, which show current faults and lift status. The annunciator has function keys that allow the operator to select bypasses and check stop distance and stop time.

Refer to the Electrical Section for a detailed explanation of how to use the fault annunciator.

WARNING: Use of safeties bypass may result in severe damage to equipment or personal injury including death.

OPERATING PROCEDURES

INTRODUCTION

This lift has been designed for the uphill and downhill transportation of up to 6 passengers and light freight with a total weight capacity including passengers and freight of 2240 lbs. **NO OTHER USE OF THIS LIFT IS PERMITTED** without written consent from Poma of America, Inc.

This installation requires operation by trained, competent and experienced personnel operating strictly in accordance with: 1) its current design specifications, 2) its current operation instructions, 3) its current maintenance instructions and 4) all applicable statutes, ordinances, rules, regulations and requirements of authorities having jurisdiction.

* No safety system may be jumpered out during operation.
* All required inspections and maintenance must have been performed.
* All required operating personnel must be at their proper position, fully trained and experienced in all normal operation and emergency procedures, and in a physical condition which would not prevent his/her performance of duties.

These operating procedures are in accordance with ANSI B77.1 section 2.3 *Operation and Maintenance* of reversible aerial tramways. It is imperative that operating and maintenance personnel be familiar with the applicable provisions of this section.

Operation and maintenance of aerial ropeway equipment can be dangerous to personnel performing these tasks. Procedures for performing these functions shall require precautionary measures necessary to assure the safety of the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

Failure to follow these instructions could result in an accident causing serious injury to persons or serious damage to property including the lift.

SPECIFIC INSTRUCTIONS FOR OPERATORS AND ATTENDANTS

Aerial lifts shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. One or more persons familiar with emergency procedures shall be on the site at all times when the facility is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific lift.

SUPERVISOR

One individual, representing the owner, shall be in responsible charge for all operating personnel and attendants. The supervisor shall be responsible for safe operation, and shall have the authority to deny access to the lift to any person who, in the supervisor's opinion, is not fit or competent to use the facilities without danger to self, others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the lift under adverse weather or operational conditions. Although authority may be delegated to others, the supervisor has the final responsibility.

OPERATORS

An operator shall be in charge of the lift. This operator shall be trained and experienced in normal operational and emergency procedures.

ATTENDANTS

An attendant shall be assigned particular duties under the direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to this assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within view.

CONDUCTOR

At least one passenger in the cabin during any period of tram operation shall be trained and competent in lift evacuation procedures. The evacuation equipment must be in the cabin and in good condition during any operation of the tram for passenger service.

FIRST AID

One or more persons trained to administer first aid shall be available at all times when a lift is operating and transporting passengers. There shall be ready access to first aid supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

MINIMUM OPERATING PERSONNEL

The following personnel are the minimum that shall be required per ANSI B77.1 section 2.3 code for reversible tramways:

- An operator shall be in charge of each aerial lift.
- One attendant shall be on duty at each loading /unloading platform.
- One conductor trained in evacuation procedures shall be present in the cabin during operation.

An operator may serve concurrently as an operator and attendant at a loading or unloading area that may be adjacent to the operator's station unless the duties of that area preclude maintaining reasonable surveillance of the entire lift operation.

DUTIES OF OPERATING PERSONNEL

SUPERVISOR

The duties of the supervisor shall be as follows:

1) To determine that all lifts are operational and that all operating personnel are trained, equipped and fit to perform their duties.

2) To discontinue operations of any lift due to physical, weather, personnel or other reasons.

3) To enforce operational, maintenance and safety rules.

OPERATOR

The duties of the operator shall be as follows:

1) To assume responsible charge of the lift.

2) To assign and supervise all attendants on his/her lift.

3) To maintain an operational log book as required in later paragraphs of this section.

4) To advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation.

ATTENDANT

The duties of the attendant shall be as follows:

1) To maintain orderly passenger traffic conditions within his/her area of jurisdiction.

2) To advise and assist passengers, as required.

3) To maintain surveillance of his/her area of jurisdiction.

CONDUCTOR

The duties of the conductor shall be as follows:

1) To be in charge of evacuation if rope evacuation is required.

2) To advise and assist passengers, as required.

The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground or snow surface conditions.

PRE-OPERATING INSTRUCTIONS

AFTER THE INSTALLATION HAS BEEN COMPLETED, THE FOLLOWING MUST BE DONE:

1. Recheck that all structures, nuts and bolts, and electrical circuits are properly installed and functioning, all towers aligned, and all foundations inspected.

2. Any construction materials which may have been left on towers and other structures shall be removed.

3. All required signs shall be installed.

4. The top and bottom terminals shall be cleaned up, circuits in place, and required fencing in place for the loading and unloading areas.

BREAKING-IN PERIOD:

During the first week of operation, a thorough inspection should be done on the entire lift, paying attention to the following points:

1. Re-tighten all bolted connections.

2. Check alignment of all saddles and sheave assemblies.

3. Check all drive shafts and belts for alignment, lubrication and bolt torque.

4. Check and inspect the cabin truck (per Maintenance Manual).

5. Check and inspect all connections and fasteners on drive station and return station.

6. Check and inspect haul rope and track rope.

7. Check lubrication of all moving parts.

8. Check haul rope alignment at entrance and exit of bullwheels.

9. Check all electrical connections.

OPERATIONAL PROCEDURES

PASSENGER CONTROL

Each lift shall have a definite method of marshalling passengers for safe loading and unloading. Fences and gates may be required to implement the system.

FIRST AID

There shall be ready access to first aid supplies and equipment, including provisions for transporting an injured person to an enclosed and, if necessary, heated shelter.

DAILY PRE-OPERATIONAL INSPECTION

Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection consists of the following:

1. A visual inspection of each terminal, station and the entire length of the lift.

2. Assure that tensioning systems are functional and have adequate travel with clearance at both ends of travel.

3. Operate all manual and automatic switches in terminals, stations and loading and unloading areas.

   A. All stop buttons
   B. Start, stop and speed control switches
   C. Safety gate

4. Test braking systems. Check brake adjustments.

5. Check the communication systems.

6. Check poly chain tension and alignment.

7. Check oil levels in all gearboxes.

8. Check fluid level in all hydraulic systems.

9. Check pressure and fluid levels in all braking systems.

10. Run the lift, visually inspecting all ropes and the carrier.

11. **Ride up lift and check general conditions of the following:**

A. Saddles and sheave assemblies, haul rope and track rope alignment
B. Tensioning system
C. Condition of carrier

The first person riding the lift each day must be a competent and trained operator or attendant who has a radio which can transmit to, or is in visual or voice contact with, an operator at a control station.

This attendant should carefully observe the haul rope, track rope, cabin truck, saddles, sheave assemblies, derail switches, signs, carrier clearance and should listen carefully for unusual sounds. If any unusual condition is noticed, the lift must be stopped immediately and the lift supervisor must give clearance before restarting.

12. Inspect the cabin truck as required by maintenance instructions.

13. Check each control circuit for circuit continuity and integrity at its most remote terminal on a daily basis.

14. Check oil, coolant, battery level, fan belts, hoses and fuel level on evac engine and genset.

15. After all inspections, enter any irregularities into the log book noting the following:

A. Service has been done
B. Service to be done

The fuel supply of internal combustion engines should be verified. For primary power units, there shall be sufficient fuel to operate for the expected time period of operation without refueling. For evac only internal combustion engines, the fuel supply shall be adequate to unload the lift. During refueling, power units should be shut down.

The evacuation engine shall be checked during this inspection and the lift should be run with the auxiliary power at least once each week. The lift shall be operated using the auxiliary unit for at least 30 minutes a month.

Loading and unloading areas shall be inspected and, if necessary, cleared of ice and snow to permit the safe ingress and egress of passengers. Carriers shall be cleared of ice to the extent necessary to permit safe operation, and mechanical components shall be inspected and checked.

Inspection and checking the mechanical features of the carriers for correct operation.

General

The supervisor and operator of the lift shall review the requirements of 2.1 and section 7 of the ANSI B77.1 to ascertain that original design and installation conditions have not been altered in a manner such as to violate the requirements of the standard.

STARTING THE LIFT

No lift shall be started except by the direction of or following clearance by the operator. Aerial lifts while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance and emergency operations.

STOPS

After any stop of a lift, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

DAMAGE TO CARRIER

Should any carrier become damaged or otherwise rendered unfit for passenger transportation during normal operations, it shall be clearly and distinctly marked, and not used for passengers until repaired or replaced. It shall be removed or repaired, as soon as feasible.

HAZARDOUS CONDITIONS

When wind or icing conditions are such as might endanger passengers or equipment, all passengers shall be unloaded and lift operation discontinued. Criteria to establish this degree of danger shall be **predetermined** based on the area's operational experience and the manufacturers design considerations. If necessary under the predetermined criteria, device(s) shall be installed at appropriate location(s) to ascertain wind velocity and direction when aerial lifts are operated.

No lift shall be operated when there is an electrical storm in the immediate vicinity.

Should such conditions develop while the lift is in operation, passenger loading should cease immediately and operation continued only as long as necessary to discharge all passengers.

When such a shutdown has been caused by an electrical storm, grounding of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to the resumption of passenger operations.

In the event of an earthquake, STOP THE LIFT. Inspect the terminals, structures, foundations and all towers for damage and for proper alignment. If this inspection reveals no damage and correct tower alignment, the lift may be restarted and passenger transport resumed. If damage is evident and risk to passengers may exist if the lift were operated, the passengers should be evacuated from the lift and the lift closed for repairs.

STARTING THE LIFT

NOTICE

It is the supervisor's responsibility to operate the lift safely and to reduce speed or to cease operations if conditions warrant.

No lift shall be started except by the direction of, or following clearance by the operator. Aerial lifts while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance and emergency operations.

DAILY START-UP PROCEDURES

These drives must not be started until the authorized supervisor or his/her delegated representative has ascertained that the lift is safe and operable.

1. Turn the **Control Power** switch to **ON** and select the desired operating mode, (electrical or evacuation).

2. If the ***electrical*** mode is selected, make sure that the MAIN CIRCUIT BREAKER ON THE SIDE OF THE DRIVE CABINET is in the ***ON*** position. Make sure AUXILIARY COUPLING is **UNCOUPLED**. Select electrical or generator power on transfer switch on side of Generator set. If Generator power is selected start the generator set.

3. If the ***evacuation*** position is selected, Make sure AUXILIARY COUPLING is **COUPLED** and that the auxiliary engine is fueled and ready to run. Turn the throttle on the Evacuation engine to low position and push the reset button and then the down button in the drive cabinet then hand pump the emergency brake until it is at 170 Bars. Start the evacuation engine and turn to full throttle. Stroke the hydraulic pump with the handle on the side of the hydraulic unit and return the cabin to the bottom terminal. ***Do not run the cabin uphill beyond tower 1 using the evacuation drive the operator must remain in visual contact with the cabin at all times when using the evacuation drive.***

4. For electrical operation, preset the speed potentiometer to the desired percent of full speed. (100% = 400 fpm).

5. Push and release either the ***UP*** or ***DOWN*** button.

6. If, after 20 seconds the lift fails to start, check the ANNUNCIATOR and see which faults are displayed: normal stop, remote stop, emergency brake fault, etc. Note that the ***Reset*** button in the drive control cabinet can be used to manually reset faults (excluding brake position faults) without a run command being issued upon safeties OK.

7. Clear the remaining faults, if any. Push and release either the ***UP*** or ***DOWN*** button.

8. With the lift running at its normal speed, initiate normal stops and E-stops at all stations to determine correct operation. Restart the lift and continue to the return station, ensuring that the cabin slows while going over towers and docks smoothly at the top docking station.

9. To SHUT DOWN the lift, dock the cabin at the drive terminal and turn the **Control Power** switch to the **Off** position.

OPERATING PROHIBITIONS

When operating the lift, the following general prohibitions must be respected.

1. Do not load or unload passengers or freight except with the lift fully stopped and the cabin in the docked position.

2. Do not load passengers with loose clothing or equipment, which might catch on the carrier.

3. Do not load passengers unless the loading operator is within reach of the lift controls.

4. Do not operate the lift with more than the designed number of passengers or more than a total of 2240lbs in the carrier.

5. Do not restart or speed up the lift until all stations have been contacted.

6. Do not load passengers who are intoxicated or otherwise incapacitated.

7. Do not load handicapped passengers without making necessary arrangements for their safety while loading, unloading or riding on the lift.

8. Do not operate the lift if lightning is present. Do not load passengers. Unload lift as soon as possible. Verify this by visual and auditory inspection.

9. Do not operate the lift in any winds that cause carrier to swing excessively or to hit guards. Verify this by visual and auditory inspection; wind gauges.

10. Do not operate the lift if the carrier is observed swinging sufficiently to cause contact with guard or tower. Verify this by visual and auditory inspection.

11. Do not operate the lift if carrier is observed bouncing up and down abnormally.

12. Do not operate if the bullwheels are covered with snow or ice. Verify this by visual inspection.

13. Do not operate the lift if icing is apparent on cable, carrier, tower machinery, crossarms, bullwheels, tensioning system or any other critical component which may prevent proper operation or injure passengers.

14. Do not operate the lift for passengers if it requires immediate maintenance. See maintenance requirements in the appropriate sections of this Maintenance Manual.

15. Do not operate lift for passengers or maintenance without the prescribed number of carriers on the line.

16. Do not use Poma tools or equipment (including maintenance tools) on any other make of lift and do not use other manufacturers' tools or equipment on Poma lifts.

17. Do not modify any lift component or design feature without written approval from Poma of America, Inc.

18. Do not operate if there are any abnormal conditions; loose, missing or damaged components; or obstructions to operation. Verify this by visual inspection of the line and the terminal.

19. Do not operate if adequate tension carriage travel is not available or if the tensioning system is not operating freely. Verify this by visual inspection of the tensioning system and compliance with the relevant instructions.

20. Do not operate if the service brake is not working properly. Consult service brake operating and service manual for complete instructions.

21. Do not operate if the emergency brake is not working properly. Consult the emergency brake operating and service manual for complete instructions.

22. Do not operate if the haul rope or track rope reveals any abnormal conditions. Verify this as follows: visually inspect for broken or damaged wires, abnormal tension carriage position or movement, cable twist indicated by the carrier not hanging vertically.

23. Do not operate if any cable slippage is apparent. Verify this as follows: inspect truck location as compared with a paint mark on the haul cable indicating the original truck location.

24. Do not operate if the carrier is loose, damaged or defective. Verify this by visual and auditory inspection.

25. Do not operate if all communication systems are not working properly. Verify this by making test calls.

26. Do not operate if the operator controls are not working properly. Verify this as follows: test all "up", "down" and "stop", controls and any other controls provided at each terminal.

27. Do not operate if any required warning signs are not in place. Verify this by visual inspection.

28. Do not operate the lift if the travel limit stop switches are not in their proper place and functioning properly. Verify this by visual inspection and check operation.

29. Do not operate the lift if the tower safety system is inoperable. Verify this by visual inspection and check operation of each switch at least annually.

30. Do not operate the lift if unusual vibrations or noise are observed. Verify this by visual and auditory inspection.

31. Do not operate the lift if any safety system component is by-passed. Verify this as follows: inspect and test safety systems.

32. Do not operate the lift if any saddle or sheave assembly is misaligned. Visually verify that the cable is in its proper position in the sheave liner.

33. Do not operate the lift if the load meter shows an abnormal load reading during start-up or normal operation or above 100% during operation at maximum capacity. Verify this by visual inspection.

34. After severe icing conditions, heavy snowfalls, severe temperature changes or high winds, do not operate the lift until a visual inspection has been completed of all towers, sheaves, sheave frames, carriers and the cable. After such inspection, do not operate the lift at full speed until a trial run is completed at slow speed to check for abnormal load readings.

WARNING

Failure to follow these instructions could result in an accident causing serious injury or death to persons and serious damage to property, including this lift.

EMERGENCY EVACUATION

Provisions shall be made for the emergency evacuation of aerial lifts. These shall include a detailed plan of evacuation, equipment necessary for evacuation and adequate training of personnel. Evacuation drills shall be conducted at established intervals not to exceed one each 12 calendar months, and such drills recorded in the operational log of each lift.

TERMINATION OF DAILY OPERATIONS

Procedures shall be established and approved by the authority having jurisdiction for terminating daily operations to be sure that passengers will not be left on the lift after it has been shut down. Loading platform, as required, shall be closed and so marked.

OPERATIONAL LOG

A log book shall be maintained for each lift. Daily entries shall be made giving the following minimum information:

1. Date
2. Names and duty stations of operating personnel
3. Operating hours and purpose of operations
4. Temperature, wind and weather conditions
5. Record of compliance with daily operational inspections
6. Position and condition of the tension carriage or other tensioning devices
7. Accidents, malfunctions or abnormal occurrences during operation
8. Signature of operator.

WIRE ROPE LOG

A log book shall be maintained for each lift giving the following information on each rope:

1. Approved specification
2. Copy of certified test report
3. Date installed
4. Splicing certificate for each splice
5. Record of lubrication, including type of lubricant and date applied, if required
6. Record of maintenance inspections
7. Report of wire rope inspection
8. Report of accidents or injury to rope.
9. Documentation of end attachment

MAINTENANCE LOG

A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of components. A record shall be kept of replacement of components.

Section 3

ELECTRIC MOTOR

Maintenance of the Electric Motor

Refer to Manufacturer's Manual.

Manufacturer: GE

Model #: CD328AT

HP: 50

Maintenance Schedule

Frequency	*Maintenance Activity*
DAILY	Check for unusual noises

FOR ALL OTHER MAINTENANCE, REFER TO MANUFACTURER'S MANUAL.

1999

GE Motors

MARCH 3, 1998

Industrial Motors
General Electric Company
3001 East Lake Road, Erie, PA 16531

REFER TO G.E. REQN. NO IN CORRESPONDENCE

..OMER:

ARGO INTERNATIONAL CORP
INDUSTRIAL DIV
5770 LAMAR STREET
ARVADA, CO 80002

CUSTOMER ORDER	CUSTOMER REQN	G.E. CONTRACT	G.E. REQUISITION
2148309			695-17655

☐ FOR APPROVAL [XX] FOR INSTALLATION ☐ 780129473001

RETURN "FOR APPROVAL" PRINTS TO THE GE OFFICE WITH WHOM YOUR ORDER IS PLACED. ORDER IS ON HOLD UNTIL PRINTS ARE APPROVED. WHEN APPROVED PRINTS ARE RETURNED, LEAD TIMES IN EFFECT WILL APPLY.
Drawings are intended to be in accordance with applicable purchase order specifications. Comments are solicited concerning any departures in this respect. Features not covered by purchase order specifications portray General Electric Company standard design practice. Any requested changes from the purchase order specifications, resulting in additional engineering and/or manufacturing costs will entail an increase in price and the extenstion of the shipping schedule. PRINTS ARE NOT TO SCALE, are loaded subject to return upon demand, and the express condition that they will not be used in any way detrimental to the General Electric Company. "The export of technical information contained in these prints is subject to the rules and regulations of the United States Department of Commerce, Office of Export Control."

ITEM 1 DC MOTOR MODEL 5CD184TA094B027

36A167945AA002 -OUTLINE-
SPLASHPROOF FULLY GUARDED - BALL BEARINGS
CONDUIT BOX ON RIGHT HAND SIDE FACING COMMUTATOR END
STANDARD SHAFT DRIVE END ONLY - WITH FEET
)328AT -DC MACHINE-
HP 50 - RPM 1750/2100 - VOLTS 500 - AMPS 83.7
WOUND SHUNT - DUTY CONTINUOUS
MAXIMUM AMBIENT 40 C - CLASS F INSULATION
NEMA POWER SUPPLY CODE: D -FIELD VOLTS 300/150
WITH:
THERMOSTAT- NORMALLY CLOSED, AC RATING- 600V MAX-.5A, 250V-1.5A, OR 125V-3A, DC RATING- 30V MAX-1.5A.MAXIMUM CURRENT BASED ON INDUCTIVE LOADS UP TO AND INCLUDING NEMA NO.5 CONTACTOR.
36A167771AA001 -ENCLOSURE AND MOUNTING ASSEMBLY.
36A167760CB501 -CONNECTION DIAGRAM REVERSIBLE ROTATION.
GEH3967 -INSTRUCTION BOOK.

4 PRINTS & 1 I/B TO: ARGO INTERNATIONAL CORP
INDUSTRIAL DIV
5770 LAMAR STREET
ARVADA, CO 80002
ATTN: D WILSON

1 PRINT TO: KEVIN MAHONEY, C&ISD, BLDG 4-6, FORT WAYNE OFFICE

..PY OF M/S TO D J WEED, BLDG 9-3, ERIE WORKS

BY V. LEIGHTON/AS, ERIE WORKS

NO S.O. GENERAL ELECTRIC

36A167945AA 001 THRU 003

5	JULY 14, 1980	NO S.O.
RETRACING TO DUAL DIMENSIONING		
6	AUG 16, 1984	NO S.O.
CORRECTED DIM		

THIRD ANGLE PROJECTION

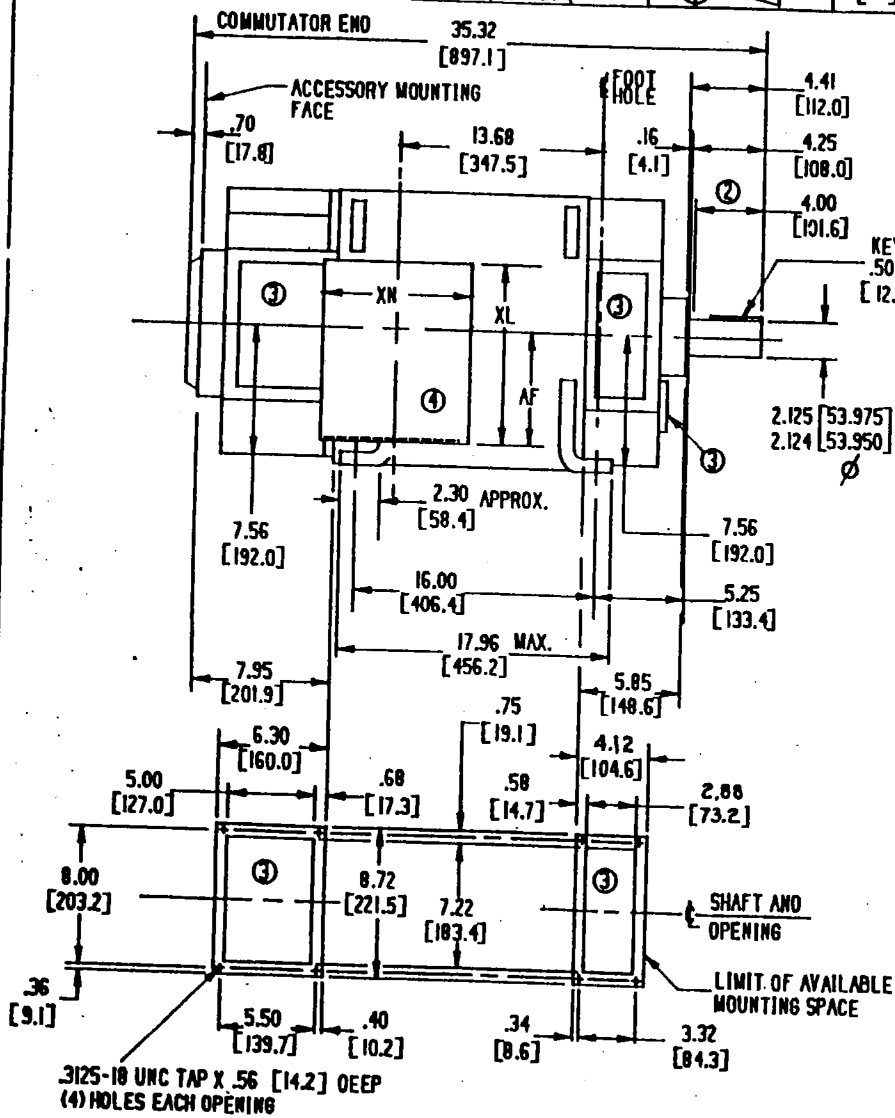
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
[X.XX] ARE MILLIMETRES

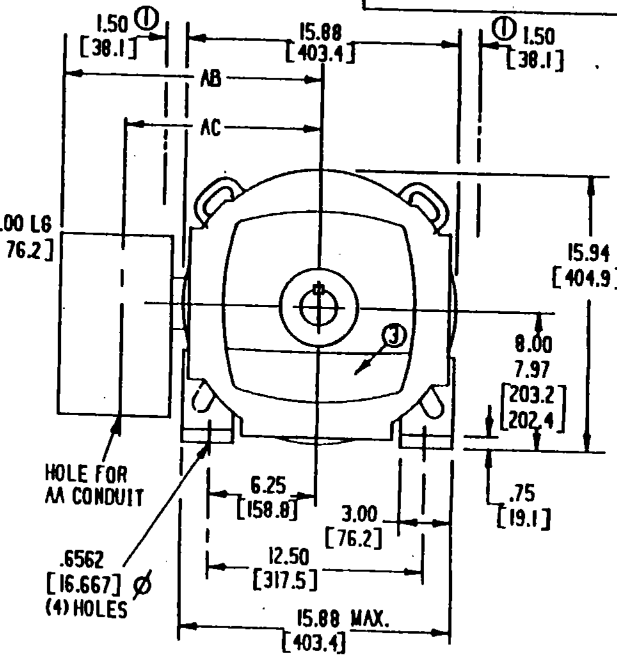
REV. 6

36A167945AA 001 THRU 003

TITLE
OUTLINE

FIRST MADE FOR CD328AT DE-STD





1. SPLASHPROOF FULLY GUARDED MACHINES WILL HAVE ADDITIONAL COVERS INCREASING THE OVERALL WIDTH AT THE COMMUTATOR END AND DRIVE END SIDE AIR OPENINGS.
2. REPRESENTS MINIMUM LENGTH OF SHAFT AVAILABLE FOR HUBS.
3. AIR OPENING, FOR ENCLOSURE TYPE AND MOUNTING POSITION, SEE ENCLOSURE AND MOUNTING ASSEMBLY.
4. CONDUIT BOX MAY BE TURNED SO THAT ENTRANCE CAN BE MADE UPWARD, DOWNWARD, FROM COMMUTATOR END OR DRIVE END, PROVIDING MOUNTING CONDITIONS PERMIT. CONDUIT BOX WILL BE ASSEMBLED ON OPPOSITE SIDE OF FRAME IF SO SPECIFIED. (SEE ENCLOSURE AND MOUNTING ASSEMBLY.)
5. SHAFT RUNOUT SHALL NOT EXCEED 0.003 INCH [0.076] mm TOTAL INDICATOR READING ON DRIVE END AND COMMUTATOR END.
6. COMMUTATOR END BEARING BRACKET AND SHAFT ARE PREPARED FOR ACCESSORY MOUNTING, SEE INSTRUCTION BOOK.

APPROX. NET WT.: 767 LBS. [348.22 kg]

PRT NO.	AA	AB	AC	AF	XL	XN
001	2.00	13.44 [341.4]	10.88 [276.4]	4.62 [117.3]	7.38 [187.5]	5.38 [136.7]
002	3.00	15.12 [384]	11.50 [292.1]	6.62 [168.1]	10.50 [266.7]	8.56 [217.4]
003	SEE SUPPLEMENTARY OUTLINE					

PRINTS TO	
	CAD
	4240 - 1W
	4911 - 1W
	4252 - 1W
	1949 - 1W

MADE BY JOHN MAY JUNE-26-1969
RE CAD [signature] JULY 14, 1980

FILE 32-18

DIRECT CURRENT MOTOR & GENERATOR DEPT.
ERIE LOCATION

36A167945AA 001 THRU 003

PLAN. REF. 36A167942AA

DWG.A.36A167945AAR05
PLOT SCL=.1384

36A167945AA 001 THRU 003

ND

GENERAL ELECTRIC

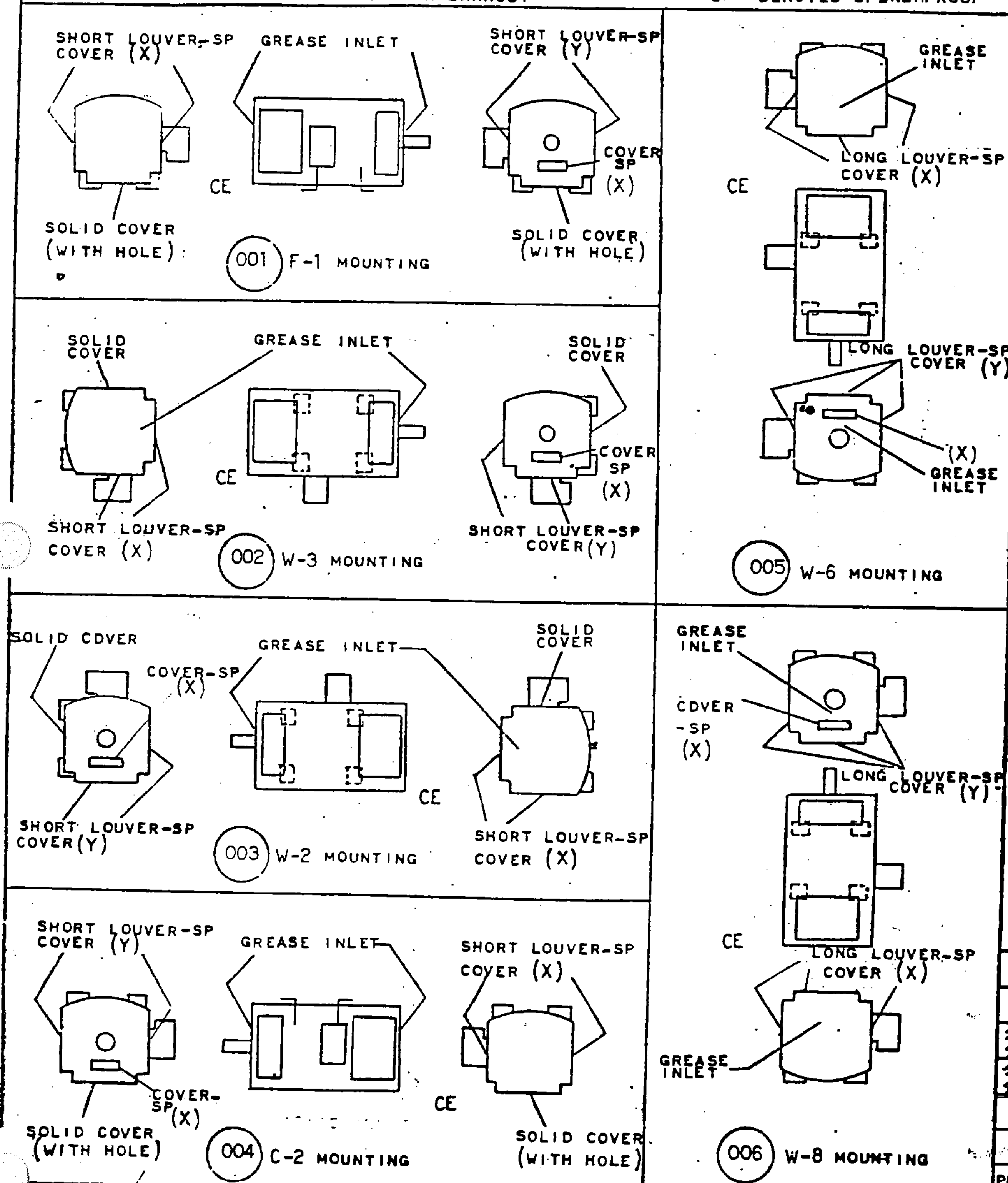
36A167771AA
001 THRU 006
CONT ON SHEET SH NO.

REV NO. 0 1

36A167771AA
001 THRU 006
CONT ON SHEET SH NO.

TITLE (ASSEMBLY)
ENCLOSURE AND MOUNTING
FIRST MADE FOR SPLASHPROOF FULLY GUARDED
CND BOX RH SIDE

NOTE - "X" DENOTES LOCATION OF AIR INTAKE
"Y" DENOTES LOCATION OF AIR EXHAUST
"CE" DENOTES COMM END
"SP" DENOTES SPLASHPROOF



REVISIONS

1 MAR 30 '71 REM CON ON DE IN P5

4240 (2BW)
4911 (1BW)
4252-1W 4949-3W
4161-5W 4487-5W
SUM. (1BW)

PRINTS TO

MADE BY	APPROVALS			
Paulus Karabedian May 7 1969	FILE	DIRECT CURRENT MOTOR & GENERATOR	DIV OR DEPT.	36A167771AA 001 THRU 006
ISSUED Paulus Karabedian Aug. 22, 1969	KC15-1	ERIE	LOCATION	CONT ON SHEET SH NO.

NO S.O.

GENERAL ELECTRIC

36A167760CB501
CONT ON SHEET SH NO.

REV NO. 2

36A167760CB501
CONT ON SHEET SH NO.

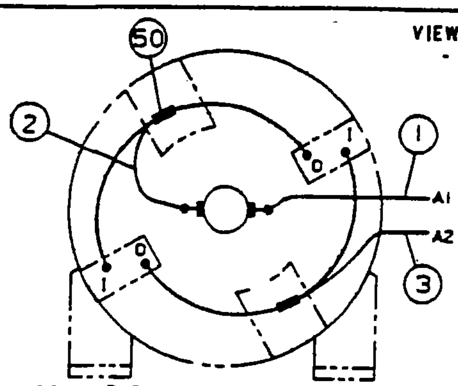
TITLE

CONNECTION DIAGRAM

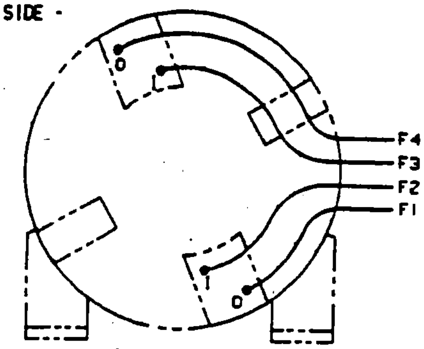
FIRST MADE FOR 2 POLE

DIRECT CURRENT MOTOR AND GENERATOR - SHUNT WOUND
1 OR 2 CIRCUIT SHUNT FIELD - 2 CIRCUIT COMMUTATING FIELD

VIEWS FACING COMMUTATOR END
- LEADS OUT RIGHT SIDE -

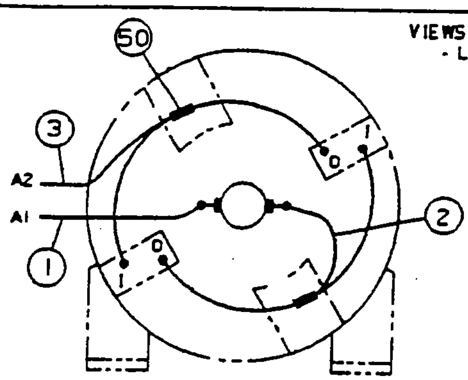


COMMUTATING FIELD AND ARMATURE

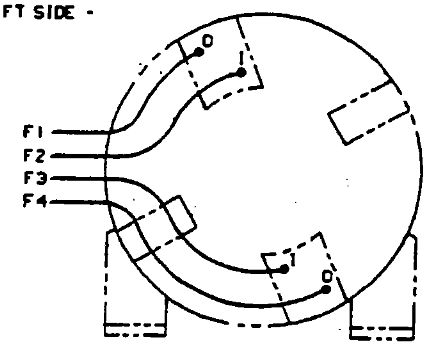


SHUNT FIELD

VIEWS FACING COMMUTATOR END
- LEADS OUT LEFT SIDE -



COMMUTATING FIELD AND ARMATURE



SHUNT FIELD

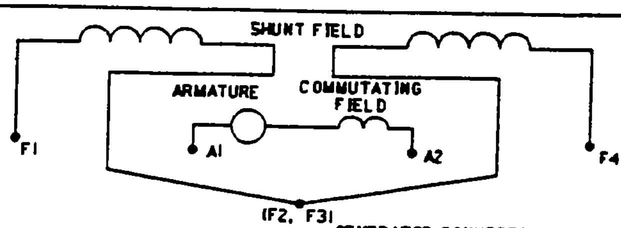
ALL EXTERNAL LEADS ARE MARKED. ALL CONNECTIONS AND TERMINATIONS EXTERNAL TO MAGNET FRAME MUST BE INSULATED PER NATIONAL ELECTRICAL CODE AND SOUND LOCAL PRACTICES.

SPACE HEATERS, WHEN SPECIFIED, WILL HAVE LEADS WITH TERMINAL MARKINGS H1 AND H2.

THERMOSTAT, WHEN SPECIFIED, WILL HAVE LEADS WITH TERMINAL MARKINGS P1 AND P2.

ENCIRCLED NUMBERS MAY BE USED FOR PART IDENTIFICATION.

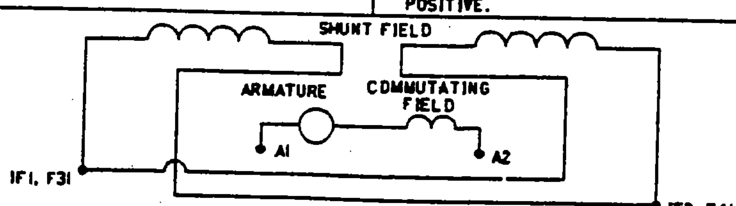
FOR HIGH NAMEPLATE EXCITATION VOLTAGE CONNECT SHUNT FIELD LEADS AS INDICATED



MOTOR CONNECTIONS:
FOR CCW ROTATION FACING COMMUTATOR END, MAKE LEADS F1 AND A1 THE SAME POLARITY.
FOR CW ROTATION FACING COMMUTATOR END, MAKE LEADS F1 AND A2 THE SAME POLARITY.

GENERATOR CONNECTIONS:
FOR CW ROTATION FACING COMMUTATOR END, F1 POSITIVE WILL MAKE A2 POSITIVE.
FOR CCW ROTATION FACING COMMUTATOR END, F1 POSITIVE WILL MAKE A1 POSITIVE.

FOR LOW NAMEPLATE EXCITATION VOLTAGE CONNECT SHUNT FIELD LEADS AS INDICATED



MOTOR CONNECTIONS:
FOR CCW ROTATION FACING COMMUTATOR END, MAKE LEADS (F1,F3) & A1 SAME POLARITY.
CW ROTATION FACING COMMUTATOR END, MAKE LEADS (F1,F3) & A2 SAME POLARITY.

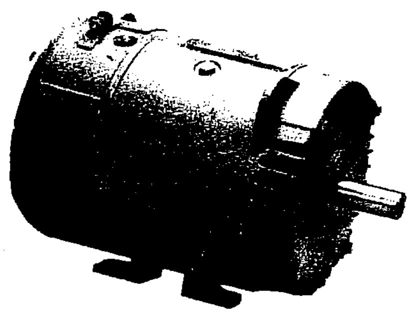
GENERATOR CONNECTIONS:
FOR CW ROTATION FACING COMMUTATOR END, (F1,F3) POSITIVE WILL MAKE A2 POSITIVE.
FOR CCW ROTATION FACING COMMUTATOR END, (F1,F3) POSITIVE WILL MAKE A1 POSITIVE.

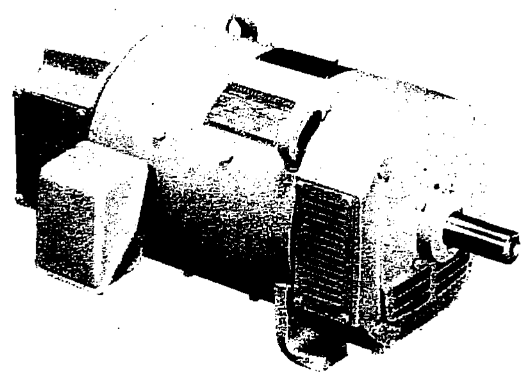
10-11-94 R.D.BOLLA	NO S.O. RETR		QC(1) CAD
MADE BY P.HARABEDIAN 3-19-69	FILE KC13-1	GE MOTORS (DIV OR DEPT) ERIE (LOCATION)	36A167760CB501 CONT ON SHEET SH NO.
RE-ISSUED CAD/ R.D.BOLLA 10-11-94			

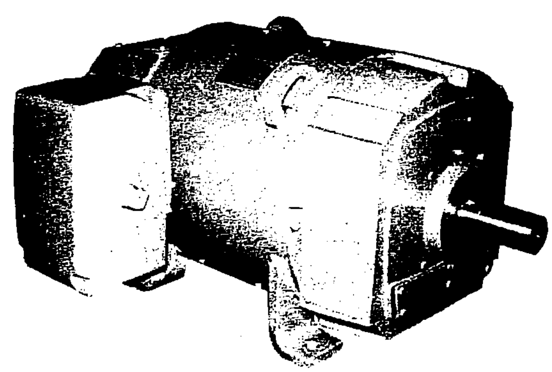
GE Motors

Instructions

Direct-Current Motors and Generators Frames CD180AT to CD500AT







GEH-3967N

SAFETY PRECAUTIONS

WARNING

High voltage and rotating parts can cause serious or fatal injury. The use of electric machinery, like all other utilizations of concentrated power and rotating equipment, can be hazardous. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel, in accordance with applicable provisions of the National Electrical Code and sound local practices.

For equipment covered by this instruction book, it is important to observe safety precautions to protect personnel from possible injury. Among the many considerations, personnel should be instructed to:

- Avoid contact with energized circuits or rotating parts,
- Not by-pass or render inoperative any safeguards or protection devices,
- Avoid extended exposure in close proximity to machinery with high noise levels, and
- Use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment.

Safe maintenance practices with qualified personnel is imperative. Before starting maintenance procedures, be positive that:

- Equipment connected to the shaft will not cause mechanical rotation,
- Main machine windings have been disconnected and secured from all electrical power sources, (lock out drive), and
- All accessory devices associated with the work area have been de-energized.

If high potential insulation test is required, procedures and precautions outlined in NEMA standards MG-1 should be followed.

Failure to properly ground the frame of this machine can cause serious or fatal injury to personnel. Grounding of the machine frame and structure should be in accordance with the National Electrical Code and consistent with sound local practices.

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

CONTENTS

DIRECT CURRENT MOTORS AND GENERATORS FRAMES CD180AT - CD500AT

INTRODUCTION

This instruction book covers the CD180AT-CD500AT line of DC motors and generators.

WARNING: High voltage and rotating parts can cause serious or fatal injury. The use of electric machinery, like all other utilizations of concentrated power and rotating equipment, can be hazardous. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA safety standards for construction and guide for selection, installation, and use of integral HP motors and generators, the National Electrical Code, and sound local practices is recommended.

RECEIVING

The equipment should be placed under adequate cover immediately upon receipt as packing coverings are NOT suitable for out-of-doors or unprotected storage. Standard factory packing methods **do not** allow for stacking of motors.

Each shipment should be carefully examined upon arrival. Any damage should be reported promptly to the carrier and to the nearest office of GE Motors-DM&G. Shipping damage is not covered under the standard warranty. A claim must be filed with the carrier.

Storage

During installation or when in storage, the machine and its parts must be protected from the following:

1. Dirt of all kinds.
2. Wetness and temperature extremes.

Protection from dirt can be achieved by covering the machine with a tarpaulin or polyethylene sheet or keeping it where the surrounding area is clean.

Protection from wetness and temperature extremes includes moisture from the surrounding atmosphere condensing onto cooler machine surfaces. This condensation on machine surfaces can result in rusting or corrosion and the electrical windings may suffer serious damage.

Where wetness and/or cold conditions are present, the machine and its parts must be protected by a safe reliable heating system which, at all times, will keep the machine temperature slightly above that of the surrounding atmosphere. If a space heater is included in the machine, it should be energized per the voltage specified on the motor nameplate.

Smaller machines shipped in paper cartons are protected from condensing-type wetness by the insulating characteristics of the carton. To avoid sweating where these have been exposed to low temperatures for an extended period, **allow a few hours for the machine and carton to attain room temperature before unpacking.**

Brushes should not remain in contact with the commutator during prolonged storage, because corrosion may occur and later result in flat spots on the commutator. Release the brush springs and lift the brushes, when prolonged storage occurs.

All exposed machined-steel parts are slushed with a rust preventive before shipment. These surfaces should be examined carefully for signs of rust and moisture, and reslushed if necessary. Once started, rust will continue if the surface is reslushed without first removing all rust and moisture. Rust may be removed by carefully using fine abrasive paper. Slushing compound can be removed by using a suitable solvent such as mineral spirits.

CAUTION: Many motors are shipped with drive end grounding brushes. These brushes and the surfaces they ride on must be free of any slushing compound before operation.

WARNING: Mineral spirits are flammable and moderately toxic. The usual precautions for handling chemicals of this type must be observed. These include:

1. Avoid excessive contact with skin.
2. Use in well-ventilated areas.
3. Take necessary precautions to prevent fire or explosion hazards.

Extreme care must be exercised in removing rust on shaft extensions near shaft seals, since it is difficult, and sometimes impossible, to remove rust from these surfaces without damaging or deforming them.

Burrs or bumps on other machined surfaces should be carefully removed by using a fine file or scraper.

Machines in storage should be inspected, have the insulation resistance checked at frequent and regular intervals, and a log kept of pertinent data.

CAUTION: When stored, it is suggested that the armature be rotated a few revolutions every three months to prevent loss of grease protection on the bearings and races. Loss of grease or oil protection may cause rust.

Long Term Storage Considerations

1. Provide blocks, such as railroad ties, to store the machine off the ground. This will minimize moisture pickup from the ground and make inspections easier to accomplish. Be sure there is sufficient drainage.
2. Megger the unit before storing and record the values every three months. If the megger reading indicates a decreasing insulation resistance, move the machine to a drier location.
3. Wrap Mylar around the commutator and tape it to itself. Do not tape the Mylar to the commutator.
4. Rotate the armature every three months to prevent loss of grease protection on the bearings and races. Loss of grease protection causes rust. <u>Note</u>: **Rotate the armature in the direction which will not snag the Mylar wrapping on the commutator.**

TABLE 1

APPROXIMATE NET WEIGHTS*

FRAME SIZE	ARMATURE WEIGHT lbs.	ARMATURE WEIGHT kgs.	MOTOR WEIGHT lbs.	MOTOR WEIGHT kgs.
CDL182AT	17	8	80	36
CD186AT	25	11	102	46
CDL186AT	35	16	128	58
CD189AT	45	20	162	74
CD218AT	50	23	240	106
CD219AT	56	25	250	114
CD2110AT	63	29	280	127
CD258AT	78	35	360	164
CD259AT	89	40	400	183
CD287AT	113	51	500	225
CD288AT	130	59	550	250
CD289AT	175	80	660	300
CD2811AT	210	95	790	360
CD327AT	158	72	690	315
CD328AT	181	82	770	350
CD365AT	220	100	750	340
CD366AT	260	120	860	390
CD368AT	300	140	1020	465
CD3610AT	400	130	1310	595
CD3612AT	530	240	1650	750
CD407AT	400	180	1300	590
CDL407AT	400	180	1350	610
CD409AT	500	225	1600	725
CDL409AT	500	225	1650	750
CD4012AT	780	350	3210	1460
CD504AT	590	265	1900	860
CDL504AT	590	265	2070	940
CD506AT	720	330	2290	1040
CDL506AT	720	330	2440	1110
CD508AT	890	405	2810	1275
CDL508AT	890	405	2970	1350
CD5010AT	1200	545	4260	1935

*Approximate weights for typical motors in each frame size. Does not include weights of accessories such as tachometers, blowers, heat exchangers, etc. For specific weights, refer to certified outline.

Handling

Complete motors or generators can be lifted by using hooks or slings in the lifting lugs on top of the unit. The lifting lugs are designed to safely carry the weight of the individual machine. <u>**Do not lift the machine with the shaft extensions**</u>.

WARNING: Motor-generator sets or units with heavy attachments such as gear boxes or pumps must NOT be lifted by using the lifting lugs of the individual machines.

Motor-generator set bases have lifting holes to be used with spreader bars or hooks. Care must be taken in handling to avoid twisting bases. (Refer to **Table 1** for approximate weights of armatures and motors.)

INSTALLATION

Installation should be in accordance with the National Electrical Code and consistent with all local codes. Coupling, belt, and chain guards should be installed as needed to protect against accidental contact with moving parts. Machines accessible to the public should be further guarded by screens, guard rails, etc., to prevent personnel from coming into contact with the equipment. Fully guarded covers are supplied on motors and generators. Shaft guards are supplied on MG sets.

Totally enclosed and waterproof motors must have all covers securely in place with gaskets intact in order to exclude dirt, oil, and water. It is generally preferred to remove plugs from drain holes at the bottom of the frame to insure that condensation does not collect inside the motor. However, if the installation requires plugs to be installed, they must be removed periodically to make certain that all water is eliminated.

Location/Ventilation

WARNING: The use of electrical equipment in hazardous locations is restricted by the National Electrical Code, Article 500. Original equipment manufacturers and user customers must read, understand, and apply these rules for installation and use of all equipment in such locations and consult local code inspection and enforcement agencies as necessary to insure compliance. Motors listed by Underwriters Laboratories, Inc. for use in specific locations have been designed, tested, and approved for use in such locations only.

Sections 501-8 and 502-8 now permit the use of totally enclosed motors with positive pressure ventilation or totally enclosed inert-gas-filled motors (Class I locations only) when installation and operation conform to certain requirements.

Motors for Class I locations must have leads sealed at the frame exit and an explosion proof conduit box. (Refer to **Sections 501-4 and 501-5.**)

Motors for Class II locations must have leads sealed at the frame exit and a dust-ignition-proof conduit box. (Refer to **Sections 502-4 and 502-5.**)

CAUTION: Silicone vapor may be present and originate from sealing compounds, electrical cables, and room transformers. These sources must be eliminated. Silicone vapor interferes with commutation and high brush wear may result.

Motors and generators should be installed so that they are readily accessible for routine inspection and maintenance. They are suitable for use in ambient temperatures from 0°C (32°F) to 40°C (104°F). An adequate supply of clean, dry room air (at temperatures from 0°C to 40°C) is required for self-ventilated and blown motors. Where motors must operate in dirty, wet, or contaminated environments, protection in the form of filters or totally enclosed construction must be used to insure long life with normal maintenance.

Do not obstruct ventilating openings.

When filters are supplied, service them regularly. Dirty filters shut off ventilating air.

Beware of recirculation. Install motors so that hot exhaust air will not re-enter the motor.

Protection

CAUTION: Windings, commutator, brush rigging, and bearings should be carefully protected during installation to avoid damage from paint spray, weld splatter, welding rod butts, or metal chips from files and grinders. Metal particals which lodge in windings can cause either immediate or premature failures. Paint or oil on commutators can be very detrimental to good commutation.

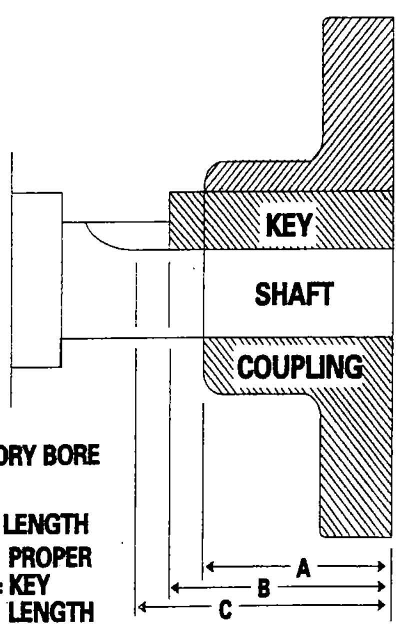
Mounting

Motors and generators should be mounted on rigid and solid foundations. Level the base (or the machine). Hold-down bolts should be inspected regularly and kept tight. The feet of the machine may be doweled to the foundation plates or base when alignment procedures are completed. Sliding bases, when used, should be securely anchored to the foundation.

Motors are suitable for mounting as ordered. Special assembly of the conduit box, endshields, and covers is provided when the motor is so ordered. Do not rotate commutator-end endshield with respect to the frame, since brush position is affected. (Refer any questions regarding the allowable mounting orientations for your motor to GE Motors-DM&G.)

Alignment

CAUTION: Be sure to align or check alignment carefully on either motors or MG sets. Misalignment can cause excessive vibration, damaging forces on shafts and bearings, and rapid brush wear. Time taken to assure good alignment will be returned in reduced downtime.



A=ACCESSORY BORE LENGTH

C=KEYWAY LENGTH

$B=\frac{(C+A)}{2}$ = PROPER KEY LENGTH

Fig. 1 Selecting the Proper Key Length

Coupled Drive

When a motor and a driven unit together have four or more bearings, flexible couplings must be used to facilitate alignment. Three-bearing construction requires a rigid coupling.

CAUTION: Careful alignment of machines when using either solid (rigid) or flexible couplings is essential to prevent excessive vibration, hot bearings, or shaft failures.

Motors are balanced in the factory using a half-height key of full length. To preserve the original dynamic balance of the motor, select the coupling hub key length "B" according to the formula in **Fig. 1.**

V-Belt Drives

The V-belt system produces a heavy shaft and bearing loading, making it necessary that these factors be considered carefully for proper application. Since belt drives impose a bending moment on the motor shaft, it is always desirable to have the motor sheave located as close to the motor bearing as possible to minimize both bearing load and shaft stress. This will result in increased bearing life. For the load centered 2" in toward the bearing from the end of the shaft instead of at the end of the shaft, the bearing load is reduced by 10% and the life increased by 33%. The bearing life curves which follow assume that the load is centered at the end of the shaft. New improved V-belts are now on the market that significantly reduce the number and size of belts required for a given load. These new belts should always be considered, since the sheave will be shorter and the load centered closer to the bearing.

It should also be noted that the radial load on the motor bearing is directly proportional to the diameter of the sheave. A larger diameter sheave means less radial load on the shaft.

The standard NEMA shaft extension is designed for belted loads. Dimensions are provided on the standard dimension sheets. A sliding base is available as an accessory to facilitate belt adjustment.

Bearing Life

Bearing life for belted drives is determined by calculating the radial load at the end of the shaft.

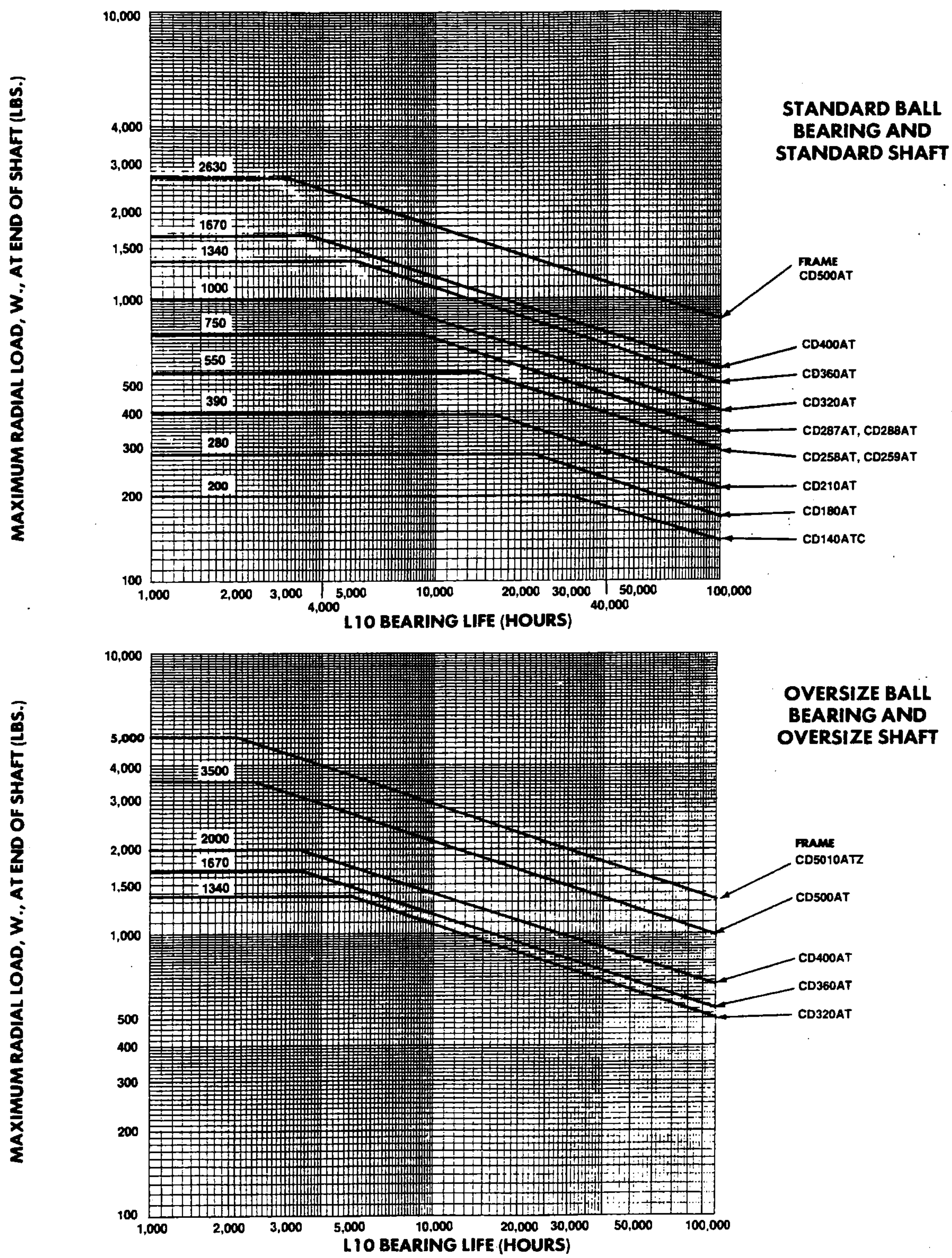


Fig. 2A Bearing Life at 1750 RPM Average Speed vs. Load, W
(For other Average Speeds, multiply Life by 1750/average speed.)

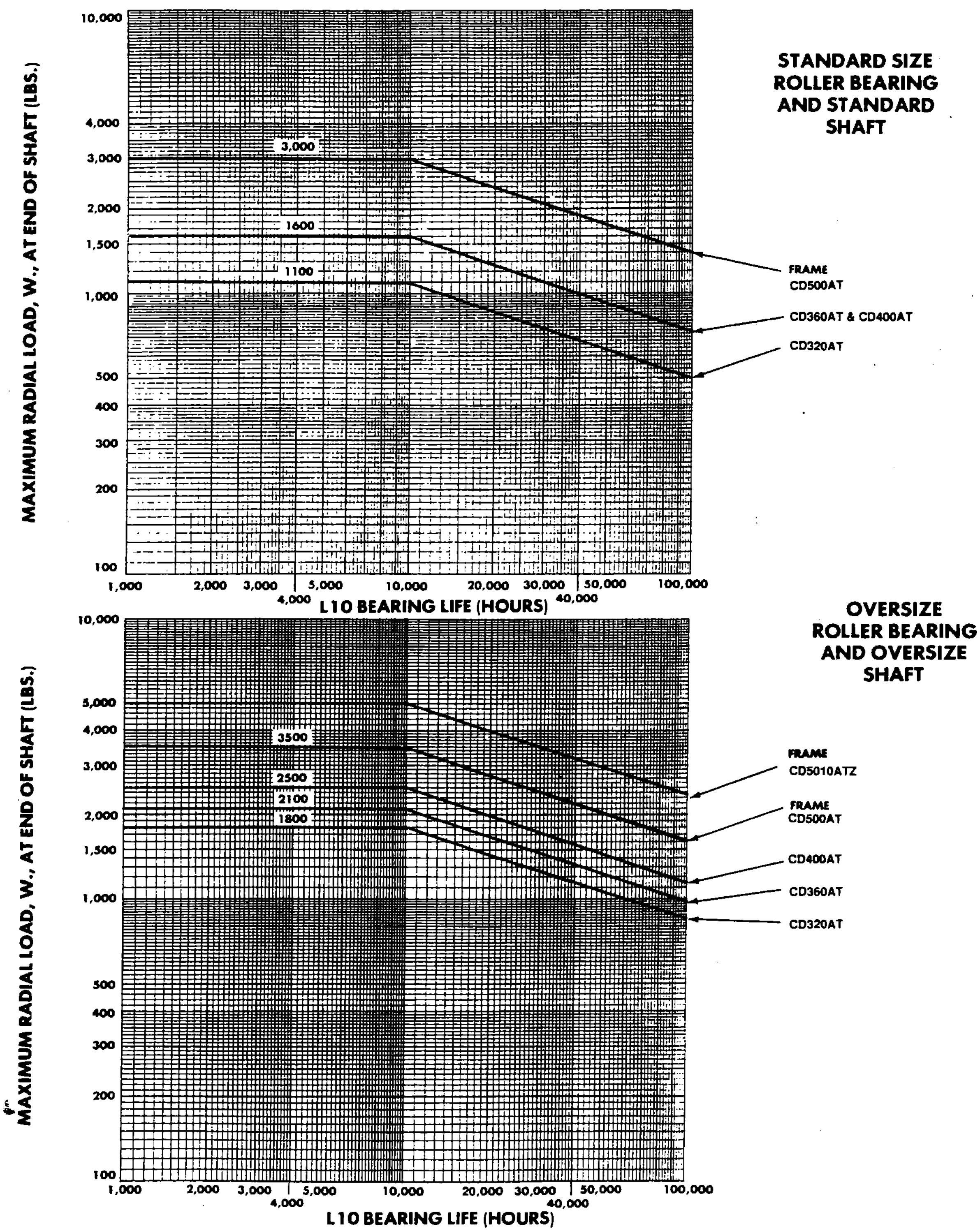


Fig. 2B Bearing Life at 1750 RPM Average Speed vs. Load, W
(For other Average Speeds, multiply Life by 1750/average speed.)

TABLE 2 BELT TENSION FACTORS	
1.0	Chain and Sprocket Drive
1.2	Timing Belt
1.5	V-Belt, 1:1 Ration
1.8	V-Belt, 2:1 Speed Decreased Ratio
2.0	Flat Belts

The radial load, "W", produced by the belts, when tightened just enough to transmit the load without slipping, is given by the relation:

$$W = \frac{126{,}000 \times HP}{D \times RPM} \times K_b \text{ lbs}$$

Where:

D = Sheave pitch diameter in inches for V-belt applications.

$\frac{HP}{RPM}$ = Maximum ratio of horsepower, **including overloads**, to the minimum speed at which that power occurs.

K_b = Belt tension factor from **Table 2**.

The curves in **Fig. 2** can be used to determine the anticipated L10 life, which is the life in hours that 90% of bearings with this load would be expected to exceed without failure. The standard ball bearing and standard shaft option will be the most economical, if acceptable life is obtained from the curve. A good, commonly used design figure is 20,000 hours. However, calculated life of as low as 5,000 hours has sometimes been necessary for special applications. The curves are drawn for 1750 RPM average speed. If the application has some other average speed, the life can be adjusted by multiplying by the 1750/average speed.

It is important to know that the bearing life for V-belt applications is independent of the motor load. Once the belts have been tightened just enough to prevent slipping when the maximum torque is being delivered by the motor, the radial load, "W", on the shaft and bearing is there and remains constant regardless of the motor load. For timing belts and chain drives, the radial load, "W", does vary somewhat with motor load, and so the motor load duty cycle, as well as the average speed should be considered to estimate bearing life.

For special applications belt tension should be checked and adjusted following the belt manufacturer's recommendations.

If slippage occurs after the belt tension has been correctly adjusted, the belts and pulleys have not been chosen properly for the application.

CAUTION: Over-tightening to avoid this slippage may result in early failures of belts, shafts, and bearings.

There is normally a drop in tension during the first 24 to 48 hours of operation. During this "run-in" period, the belts seat themselves in the sheave grooves and initial stretch is removed. Belt tension should be re-checked after a day or two of operation.

Matched belts run smoother, and last longer. Longer belt life results, if the belts and sheaves are kept clean and the belts are prevented from rubbing against the belt guards or other obstructions.

Mounting may be either horizontal or vertical for these bearing life determinations, as long as no axial load other than the weight of the armature is present if vertical.

Special Load Considerations

Where the load is overhung beyond the motor shaft extension or greater bearing life is desired, the application should be referred to GE Motors-DM&G.

Thrust Loads

Due to the mounting position or type of drive arrangement, a thrust load may be applied to the motor shaft. The Kinamatic motor is designed to permit a limited amount of thrust load. This permissible load will vary by mounting position and direction of the load due to the weight of the armature. The permissible load is tabulated in **Table 3** by frame diameter and mounting position. These apply to standard size ball bearings only.

For vertical mounting, the data is tabulated with a plus or minus constant. If the force of the load is acting up (against gravity), then the constant should be plus. If the load is acting down (with gravity), then the constant should be minus.

For applications combining thrust and radial loads or where thrust loads exceed the values shown in the table, refer all details to GE Motors-DM&G.

TABLE 3
THRUST CAPACITY IN POUNDS

HORIZONTAL MOUNTING					VERTICAL MOUNTING			
	RPM				RPM			
FRAME	2500	1750	1150	850	2500	1750	1150	850
CD180AT	145	172	210	240	150±17	175±17	214±17	240±17
CD210AT	190	220	270	310	200±64	240±64	285±64	330±64
CD250AT	225	265	325	370	250±93	285±93	345±93	390±93
CD280AT	300	355	430	490	330±135	380±135	460±135	525±135
CD320AT	355	410	500	580	390±190	460±190	545±190	620±335
CD360AT	630	740	880	1040	700±335	820±335	970±335	1110±335
CD400AT	580	690	840	970	700±526	820±526	970±526	1110±526
CD500AT	890	1050	1310	1510	------------- REFER TO GE MOTORS-DM&G -------------			

Motor-Generator Sets

MG sets are properly aligned before shipment. Check the alignment before operating a set to be sure that shipping, handling, and installation have not misaligned the units. (Refer to the **Alignment Procedure** section of this Instruction Book.)

Two types of MG set bases are used. One is called "non-self-supporting" and, as the name implies, is not rigid. The non-self-supporting base is designed to act only as a spacer between the foundation and the units of the MG set and must not be trusted to carry any weight unless well supported at all of the mounting pads on its underside. This type of base should be securely bolted to the foundation and, if convenient, grouted in after alignment. Grouting tends to make the base more solid and less liable to later vibration troubles. Be careful not to distort the base during handling or the ability to properly align the MG set will be destroyed.

The other type of base is called "self-supporting" and usually has three pads on its underside forming a three-point support. A self-supporting base is rigid enough so that it needs support only at the pads. The entire weight of the MG set is supported on just these three points and the foundation must be designed to take these high loads.

Two kinds of couplings are used to connect units of MG sets. Some MG sets will be made up of two-bearing units coupled together with flexible couplings. Others will use single-bearing generators connected with rigid (solid) couplings. With each kind of coupling and each kind of base design, a slightly different alignment procedure is required. (Refer to the **Alignment Procedure** section of this Instruction Book.)

Grouting

On concrete foundations, a minimum of 1" should be allowed for grouting.

A rich, non-shrink grout should be used. High-grade grout mixtures are available commercially. If the grout is to be prepared at the site, a cement-sand ratio of 1:2 is recommended. Only enough water should be used to give a stiff mixture. The clean, but rough surface of the foundations should be wet and the grout forced or puddled under the base.

Alignment Procedure

> **CAUTION: Alignment specifications supplied with couplings are for suitable coupling life. These numbers usually greatly exceed alignment criteria for good bearing life and minimal vibration.**

Flexible Coupling

Before grouting the base, the alignment should be checked as follows:

1. Slide the sleeve from the coupling so that the hub faces are exposed.

2. Check that the coupling hub spacing is in accordance with the outline dimensions with the units in the mechanical center of their end play.

3. Start with the coupling next to the largest unit (usually the motor) or near the middle of a long set. Check the radial alignment by using a straightedge across the hubs at both vertical and horizontal locations or by clamping a dial indicator to one hub and indicating the other hub on its outside diameter. Be sure that the dial indicator supports do not bend or sag, since this will give inaccurate readings.

4. Use a dial indicator at hub faces and rotate both units together 90°, 180°, 270°, and 360°; or measure the gap at each position by inserting a feeler gauge. The reading should not vary more than 0.002 ".

5. Correct any misalignment by shimming between the base and the foundation. If shimming between the base and foundation will not correct misalignment, the unit has moved during shipment and should be shifted on the base.

6. Repeat Steps #2, 3, and 4 on each coupling, working away from the motor or center unit.

7. Recheck the couplings on long sets after completing the above checks, because shimming on subsequent units may affect those already checked. After the set has been aligned within the specified limits, the coupling shells may be bolted together.

The generators may then be doweled, if desired.

Solid Flanged Couplings

Before grouting the base, the alignment should be checked as follows:

1. Loosen all coupling bolts enough to assure that the bolts are not holding the couplings together.

2. Start with the coupling next to the largest unit (usually the motor) or near the middle of a long set, tap the coupling flange with a rawhide or similar non-metallic mallet until the coupling halves separate 0.005" to 0.010".

3. Measure the distance between the coupling faces at four points spaced 90° apart around the coupling rim with a feeler gauge; measuring to the nearest 0.001". The maximum variation between any two readings should not exceed 0.002".

4. Rotate the coupling 90°, 180°, 270°, and 360° and take similar readings. The maximum variation should not exceed 0.002".

5. Correct any misalignment by shimming between the base and the foundation. If shimming between the base and the foundation does not correct misalignment, the unit has moved during shipment and should be shifted on the base.

6. Repeat Steps #2, 3, and 4 on each coupling, working away from the motor or center unit.

7. Recheck the couplings on long sets after completing the above checks, because shimming on subsequent units may affect those already checked. After the set has been aligned within the specified limits, tighten the coupling bolts.

The generators may then be doweled, if desired.

> **CAUTION:** Do not draw the two coupling halves together unless the variation in measurements is 0.002" or less. If there is a variation greater than 0.002", excessive vibration and possible shaft fatigue can occur.

OPERATION

> **WARNING:** Disconnect power before touching any internal part. High voltage may be present even when the machine is not rotating. If used with a rectified power supply, disconnect all AC line connections to power supply. With other power supplies, disconnect all DC line and field connections. Also disconnect power from auxiliary devices.

> **WARNING:** Ground the machine properly to avoid serious injury to personnel. Grounding must be in accordance with the National Electrical Code and consistent with sound local practices. One of the bolts holding the conduit box to the unit, accessible from inside the conduit box, is identified and may be used for attaching a grounding cable.

> **WARNING:** Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off.

Inspection Before Starting

These inspection procedures should be followed before starting the machine for the first time, after an extended shutdown, or after a teardown for extensive maintenance or repair.

Bearings and Couplings

Machines with ball or roller bearings are greased at the factory and will need no attention until relubrication is necessary as suggested under the **Maintenance** section. (Refer to **Table 11**).

Flexible couplings should be checked to see that they contain the proper amount of lubricant.

Make sure that all grease plugs are tight.

The oil suspended in grease may leak out after extended periods of motor storage. Because of this, it is not unusual to find puddles of oil below the bearings. If the motor has been stored for over six months, the grease drains should be checked to see they are not plugged with a waxy residue. After ensuring the openings are clear and free, a small amount of grease should be pumped through.

Commutator and Brushes

Brushes should be worn in to have at least 85% contact over the brush surface and continuous contact from heel to toe. The commutator surface and undercut mica should be clean and free from dirt, grease, paint spots, or brush dust.

Brushes should be free to move in the holders and all springs should be down and latched. Brush pigtail connections should be tight, and the pigtails should not interfere with the action of the spring or brush and should be clear of any other part of the machine.

Rectified Power Supplies

When DC motors are operated from rectified power supplies, the pulsating voltage and current wave forms effect the motor performance by increasing motor heating and degrading commutation. Because of these effects, it is necessary that the motors be designed or specially selected to suit this type of operation.

The ratings of DC motors intended for operation from rectified power supplies are based upon motor tests using a suitable power supply. The specific characteristics for three-phase rectified power supplies described below in the **Power Supply Identification** section are in common use. For operation of motors from rectified power supplies other than those given in this section, refer to GE Motors-DM&G.

A motor may, under some conditions, be operated from a power supply different from that indicated on the nameplate. Letters used to identify power supplies in common use have been chosen in alphabetical order of increasing magnitude of ripple current. Power supply compatibility can be judged by **Table 4**.

TABLE 4

POWER SUPPLY AVAILABLE

NP RATING CODE	A	C	D	E	K
A	✔	✱	✱	✱	✱
C	✔	✔	✱	✱	✱
D	✔	✔	✔	✱	✱
E	✔	✔	✔	✔	✱
K	✔	✔	✔	✔	✔

✔ Compatible Power Supply

✱ External inductance may be necessary to limit ripple current

Power Supply Identification

The nameplates of DC motors intended for operation from rectified power supplies will be stamped with a Power Supply Identification as described below:

A. When the power supply used as the basis of rating is one of the four described below, a single letter "C", "D", "E", or "K" will be used to identify it on the nameplate.

Power Supply Identification Letter "C"

This designates a three-phase, 60 hertz input, full-wave power supply having 6 total (controlled) pulses per cycle. The power supply has no free wheeling and no series inductance added externally to the motor armature circuit inductance. The input line-to-line AC voltage to the rectifier shall be 230 volts for 240 volt DC motor ratings, and 460 volts for 500 or 550 volt DC motor ratings.

Power Supply Identification Letter "D"

This designates a three-phase, 60 hertz input, semi-bridge power supply having 3 controlled pulses per cycle. The supply has free wheeling with no series inductance added externally to the motor armature circuit. The input line-to-line AC voltage to the rectifier shall be 230 volts for 240 volt DC motor ratings and 460 volts for 500 or 550 volt DC motor ratings.

Power Supply Identification Letter "E"

This designates a three-phase, single-way (half-wave) power supply having 3 total pulses per cycle and 3 controlled pulses per cycle. The power supply has no free wheeling and no series inductance added externally to the motor armature circuit inductance. The input line-to-line AC voltage to the rectifier shall be 460 volts for 240 volt DC motor ratings.

Power Supply Identification Letter "K"

This designates a single-phase, full-wave power supply having 2 total (controlled) pulses per cycle with free wheeling 60 hertz input with no series inductance added externally to the motor armature circuit. The input AC voltage to the rectifier shall be 230 volts for 180 volt DC ratings.

B. When intended for use on a power supply other than "C", "D", "E", or "K", the motor will be identified as follows:

M/N F — V — H — L

Where:

M = a digit indicating total pulses per cycle.

N = a digit indicating controlled pulses per cycle.

F = free wheeling (this letter appears only if free wheeling is used).

V = 3 digits indicating nominal line-to-line AC voltage to the rectifier.

H = 2 digits indicating input frequency in hertz.

L = 1, 2, or 3 digits indicating the series inductance in millihenries (may be zero) to be added externally to the motor armature circuit inductance.

Connections

Terminal connections should be checked against the connection diagram shipped with the machine. Bolted connections must be tight. When fixed termination (terminal boards) is not specified, then the exposed connections should be appropriately insulated. Grounding screws or studs do not need to be insulated. When more than one terminal is marked with the same identification, they **should be** joined in the same connection. (Refer to Table 5 for identification of winding leads.)

When series leads are not being used (example: a stabilized shunt or a compound wound unit being used as a straight shunt), the lead should be individually insulated. Do **not** connect together.

TABLE 5
LEAD MARKERS

FUNCTION	WINDING
Armature	A1, A2, A3, A4, etc.
Control signal lead attached to commutating winding - one lead only.	C
More than one signal lead	C1, C2, C3, C4, etc.
Field (shunt)	F1, F2, F3, F4, etc.
Field (series)	S1, S2, S3, S4, etc.
ACCESSORIES & SPECIAL DEVICE MARKINGS	
Blower Motors, Type AN tachometer generator	T1, T2, T3, T4, etc.
Tachometer generator, direct current, to terminal board	A1, A2, A3, A4, etc.
Brake coil leads	B1, B2, B3, B4, etc.
Heater, brake space heater	BH1, BH2, BH3, BH4, etc.
Brake interlock switch	BS1, BS2, BS3, BS4, etc.
Heater, space heater in the machine	H1, H2, H3, H4, etc.
Thermostat	P1, P2, P3, P4, etc.
Resistance Temperature Detector (RTD)	R1, R2, R3, R4, etc.

Protective Devices

See that all protective devices (overspeed devices, bearing temperature relays, etc.) are connected and will function properly. Be sure all coupling guards, shaft protectors, grounding connectors, covers, and other safety devices are properly attached.

CAUTION: Motor Field Heating - Unless specifically ordered, motors are **NOT** capable of continuous standstill excitation at rated field current. When the motor is shut down for more than 30 minutes, one of the following options must be used:

1. De-energize the fields completely.
2. Use field economy relays to limit the field current to a maximum of 50% of the nameplate rating.
3. When applicable, fields may remain fully energized if the motor ventilation system (blower or customer duct) remains in operation.

Thermostats

The thermostat is a device that may be used in alarm or protective relay circuits within rating limits shown in **Table 6**. It is not intended to limit motor loading or provide normal insulation life. When supplied, it is mounted in contact with a commutating coil which is the only accessible part of the armature circuit. Since factors such as shaft speed, ventilation (blower or shaft fan), current ripple (SCR phase-back), and short-time overload affect the temperature relationship between the armature and commutating field, complete protection from all conditions resulting from over-temperature is not possible. The device is especially useful in guarding against loss of normal ventilation air, high ambient temperature, and prolonged operation of self-ventilated motors at very low speeds.

WARNING: Thermostats automatically reset after the motor has cooled somewhat. In order to prevent property damage or injury to personnel, the control circuit should be designed to prevent the automatic starting of the motor when the thermostat resets.

TABLE 6

MAXIMUM CURRENT RATINGS FOR SPEED LIMIT SWITCHES & THERMOSTATS ON DRIPPROOF & TOTALLY ENCLOSED MOTORS (Normally open or normally closed contacts)

LOAD	125 VAC	250 VAC	600 VAC	30 VDC
Do not use above 600 VAC or 30 VDC				
Resistive	5 AMPS	2.5 AMPS	1 AMP	5 AMPS
* Inductive	3 AMPS	1.5 AMPS	0.5 AMP	1.5 AMPS

* Suitable for pilot duty only (relay coils)

Speed Limit Device

The standard mechanical speed limit device is non-adjustable. Tripping speed is specified by a note on the print certification for each specific order and on the motor nameplate.

The speed limit electrical contacts are normally closed and are usually connected in relay or holding circuits. Current ratings are the same as **Table 6**.

WARNING: The contacts of the speed limit device automatically reclose after the speed has fallen below the trip value. In order to prevent property damage or injury to personnel, the control circuit should be designed to prevent re-energizing the motor until the cause of the overspeed has been corrected.

Space Heater

When furnished, refer to the **Print Certification for Electrical Rating** or the motor nameplate.

WARNING: The surface of a space heater block becomes hot when the heater is energized. The temperature rise above the ambient temperature may be as high as 400°C. Avoid touching heater blocks which have recently been energized to prevent burns. Also, to prevent fire or explosion, ignitable dust or lint should not be allowed to collect around the surface of the heaters.

Ventilation System

Blowers or central systems must be in operation to supply cooling air before loading force-ventilated machines. Air filters should be in place. Blowers should be checked for correct rotation. (Refer to **Fig. 3** for correct direction of rotation.)

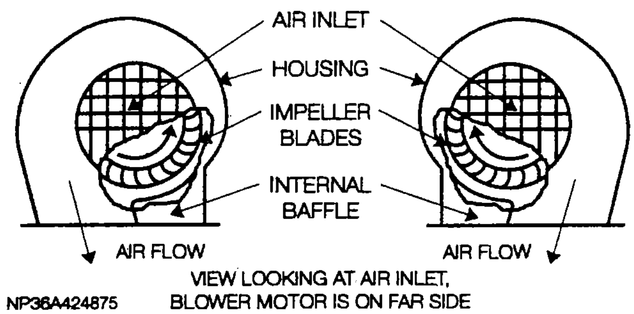


Fig. 3 **Correct Arrangement of Blower Housing, Impeller Blades and Direction of Rotation to Obtain Proper Pressure and Air Flow**

AC Blower Motors (If Equipped)

CAUTION: Remove drain plugs from the frame or endshields of enclosed motors used outdoors or in other high moisture areas.

Mounting

When bases are removed on enclosed motors, the enclosure must be maintained by plugging the bolt holes with the plastic plugs from Kit No. 1821BPK1.

WARNING: Do not replace the bolts in the frame with the base removed.

Power Supply and Connections

The nameplate voltage and frequency should agree with power supply. Motors will operate satisfactorily on line voltage within + - 10% of the nameplate value or frequency within + - 5% combined variation not to exceed + - 10%.

Dual voltage motors can be connected for the desired voltage using instructions on the nameplate or connection diagram.

Wiring of motor, control, overload protection, and grounding should meet the National Electrical Code and local building codes.

Maintenance

Inspection

Inspect the motor at regular intervals. Keep motor clean and ventilating openings clear.

Lubrication

Ball bearing motors are adequately lubricated at the factory. Motors, if equipped with grease fittings, should be relubricated at intervals consistent with type of service (refer to **Table 7**) to provide maximum bearing life. Excessive or too frequent lubrication may damage the motor.

Relubricate the motor with GE-D6-A2C5 grease unless special grease is specified on the nameplate. For best purging of old grease, relubricate while the motor is warm and the shaft stationary.

WARNING: Do not relubricate while the motor running.

Remove caps on the fan cover for access to the grease plugs. On the drive end and opposite drive end of motors with pipe plugs, insert a lubrication fitting. Remove the other plug for grease relief of all motors. Clean grease relief opening of any hardened grease. Be sure fittings are clean and free of dirt. Using a low pressure, hand operated grease gun, pump in clean recommended grease until new grease appears at the relief hole. After relubricating, allow the motor to run for ten minutes before replacing relief plug.

TABLE 7

BLOWER MOTOR LUBRICATION GUIDE

Type of Service	Typical Examples	HP Range	Lubrication Interval Horizontal	Vertical
STADARD	1 or 2 Shifts	.5 - 7.5	7 yrs.	3 yrs.
Severe	Continuous Duty and/or Severe Vibration	.5 - 7.5	4 yrs.	1.5 yrs.
Very Severe	Dirt and Vibration and/or High Ambient	.5 - 7.5	9 mos.	6 mos.

Motor windings

To clean motors, use a soft brush and, if necessary, a slow acting solvent in a well ventilated room.

> **WARNING:** Do not use solvents on windings of the DC motor.

Brake

Flange-mounted brakes may be mounted on the accessory rabbet. Since the accessory stub shaft is not suitable for use with a brake, the standard NEMA commutator end shaft extension should be ordered when such use is planned. Standard brakes are designed for horizontal floor mounting only. When motors are sidewall or ceiling mounted, the brake must be reassembled to maintain its relation to the horizontal. Where motors are to be mounted with the shaft vertical up or down, special brakes should be specified. Brakes used on severe applications, such as outdoor gantry cranes, have many special features.

> **WARNING:** Improper selection or installation of a brake and/or lack of maintenance may cause brake failure which can result in damage to property and/or injury to personnel. **Brake questions should be referred to GE Motors-DM&G or the brake manufacturer along with the brake model and serial number.**

General Mechanical Inspection

Check the inside of the machine for tools, metal chips, or any other foreign material that may have accumulated during storage or installation. Make sure that all rotating parts have clearance from any stationary parts. Turn the machine over by hand, if possible, and check for scraping noises or any other signs of mechanical interference. Check the tightness of the bolts in th feet, couplings, bearing housings, and any other bolts that may have been disturbed. (Refer to **Table 8**) Also check the torque of the yoke bolts. When non-metallic parts or brush holders are bolted to metallic parts use the reduced torque from Table 8A

Check the tightness of the main and commutating pole bolts (as listed in **Table 9**) at start-up. Loose pole bolts could be a source of objectionable noise when motors are supplied from rectified power. Also check the torque of the yoke bolts.

TABLE 8

GRADE 5 HARDWARE TORQUE VALUES

BOLT THREAD SIZE (inches)	HEX HEAD DIMENSION	TORQUE LB. FT.
1/4 - 20	7/16	7 TO 9
5/16 - 18	1/2	13 TO 17
3/8 - 16	9/16	24 TO 30
1/2 - 13	3/4	60 TO 75
5/8 - 11	15/16	120 TO 150
3/4 - 10	1 1/8	210 TO 260
1 - 8	1 1/2	460 TO 580

TABLE 8A

NON-METALIC PARTS AND BRUSH HOLDERS

BOLT THREAD SIZE (inches)	HEX HEAD DIMENSION	TORQUE LB.FT.
1/4 - 20	7/16	5 TO 7
5/16 - 18	1/2	7 TO 9
3/8 - 16	9/16	13 TO 17
1/2 - 13	3/4	24 TO 30
5/8 - 11	15/16	60 TO 75

TABLE 9
COMMUTATING AND MAIN POLE BOLT TORQUE

FRAME	BOLT SIZE	TORQUE (lb-ft) A	TORQUE (lb-ft) B
CD180AT	3/8-16	24-30	16-20
CD210AT	3/8-16	24-30	16-20
CD250AT	3/8-16	24-30	16-20
CD280AT	1/2-13	60-75	36-45
CD320AT	1/2-13	60-75	36-45
* CD360AT/CD400AT	3/8-16	35-42	23-28
** CD360AT/CD400AT	3/8-16	24-30	16-20
CD500AT	1/2-13	60-75	36-45

A. For steel bolts when assembled without lubricant (dry threads)
B. For steel bolts when assembled with lubricated threads
* 6 radial slashes on bolt head. (Grade 8)
** 3 radial slashes on bolt head. (Grade 5)

CAUTION: Standard motors, as shipped, are assembled with bolts without lubricant (dry threads). Bolts may be replaced when necessary with bolts with dry threads, or with bolts lubricated with a motor oil or other suitable thread lubricant. When lubricated threads are used, the lower torque values in **column B** will apply. The higher torque values in **column A**, when applied to bolts with lubricated threads, can cause excessive bolt tension and possible bolt breakage.

Accessory Mounting

Provisions for mounting accessories on the commutator end shield is a standard feature on frames CD210AT and above. The rabbet has NEMA Type FC face mounting dimensions, including the mounting bolt holes as shown in **Fig. 4**. The standard stub shaft also permits coupling certain accessories.

WARNING: To prevent injury from rotating shaft, the stub shaft cover must be maintained in position when the accessory mounting is not used.

ndard accessories are available as kits. These include a .iety of tachometers and speed limit switches. A mounting adapter, which can be machined for various accessories, can be ordered separately.

Inspection After Starting

The following items should be checked after the machine is running:

Bearings

Ball-bearing or roller-bearing housing temperature should not be more than 80°C (176°F). Check alignment and lubrication if temperature exceeds this limit. Do not over-grease. (Refer to the **Regreasing Procedure** section of this Instruction Book.)

Noise and Vibration

Check for unusual vibration or noises that might indicate rubbing or interference.

Vibration of new machines at the bearing housings, as measured by a vibration meter, should not exceed the values shown in **Table 10**. (The motor is mounted alone on rubber per NEMA method.)

The most likely cause of vibration in new machines is misalignment due to improper installation, loose foot bolts, uneven shimming under feet, or damage to machine during shipment or installation. Current ripple due to rectified power supply may also be a source of vibration and audio noise.

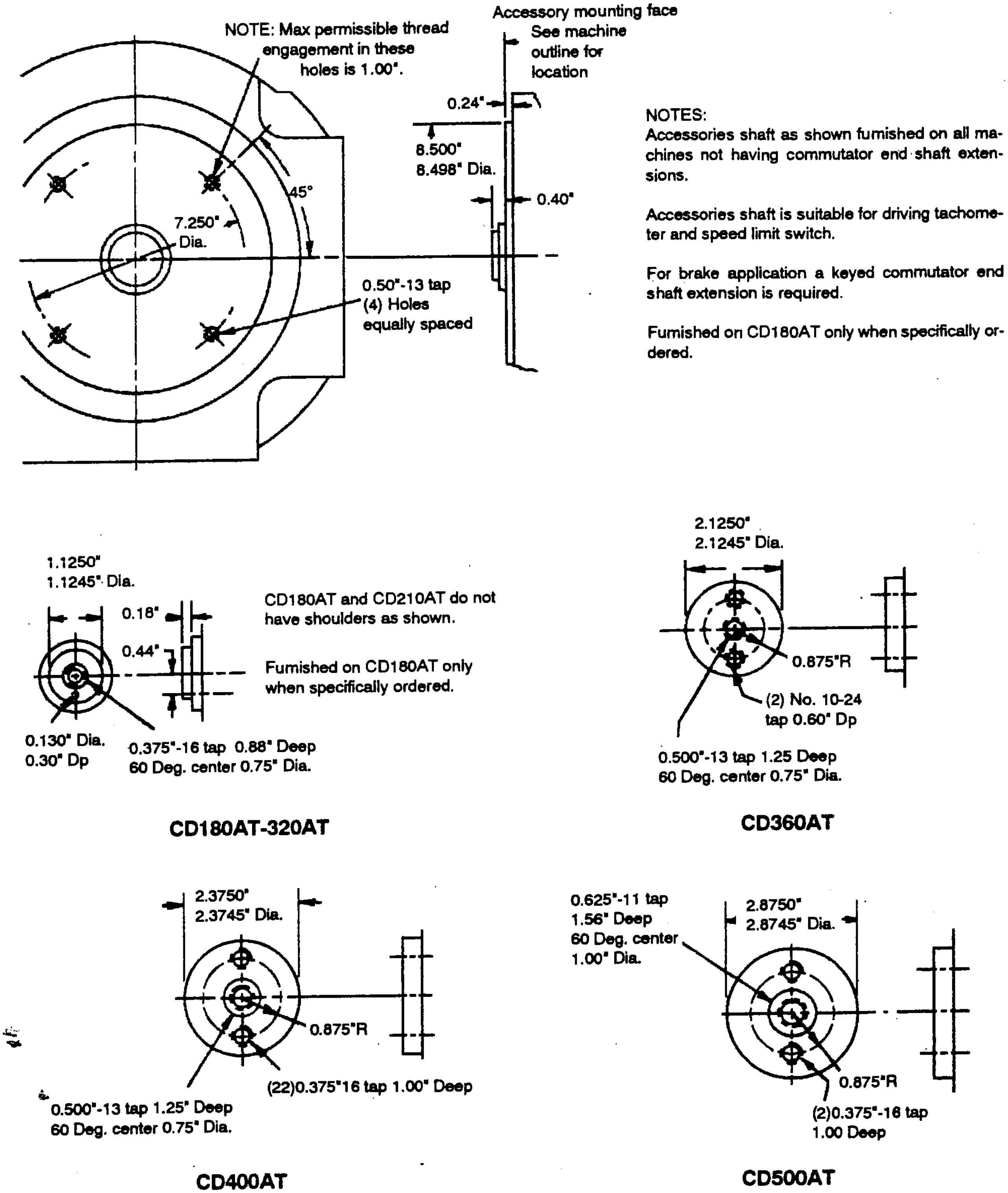
TABLE 10
VIBRATION VALUES

RPM	MAXIMUM AMPLITUDE IN INCHES (PEAK TO PEAK)
3000 - 4000 incl.	.001
1500 - 2999 incl.	.0015
1000 - 1499 incl.	.002
999 and below	.0025

Inspection After Short Time in Service

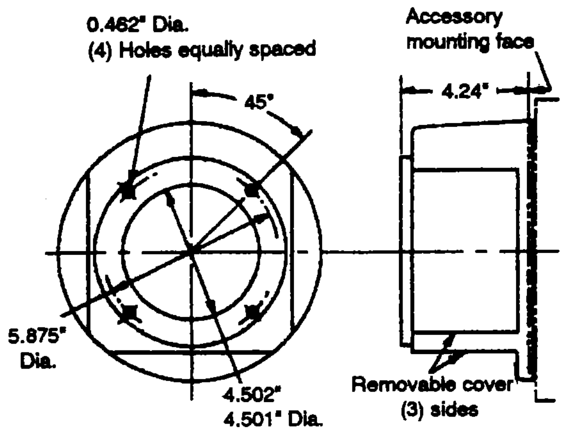
New machines may smell warm or have the odor of varnish, but should not smell scorched.

After a machine has been operating for a short time, an inspection should be made to ascertain that there have



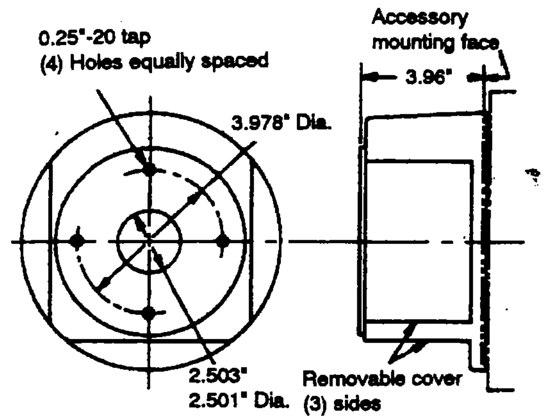
Standard commutator-end bracket and accessory shaft extension.

Fig. 4A Accessory Mounting CD180AT - CD500AT



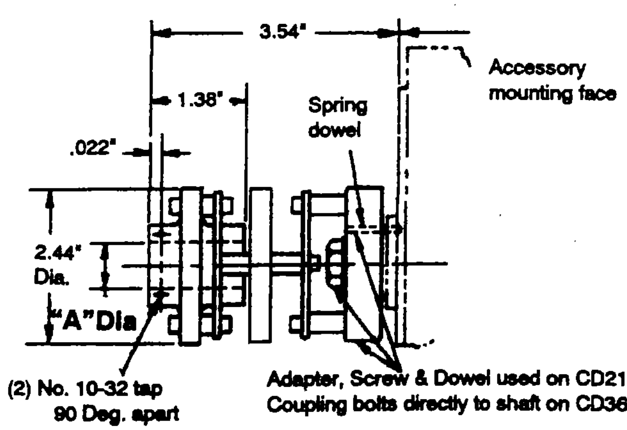
BC42/BC46 Tachometer adapter
mounts on bracket shown in Fig. 5A

Fig. 4B



Form "Y" Tachometer adapter
mounts on bracket shown in Fig. 5A

Fig. 4C



Adapter, Screw & Dowel used on CD210AT-320AT only.
Coupling bolts directly to shaft on CD360-500AT.

"A"	KEY WAY	
	WIDTH	DEPTH
.6255 .6250	.1875	.0937
.7505 .7500	.1875	.0937
.5005 .5000	OMIT	
.3130 .3125	OMIT	

Torsionally rigid coupling rated at
.17 HP per 100 RPM.

Fig. 4D

Fig. 4B-D Accessory Mounting CD180AT - CD500AT been no changes since installation. Re-torque all main and commutating pole bolts. (Refer to **Table 9.**) Also check the torque of the yoke bolts. (Refer to **Table 8.**) Check for increased vibration, signs of change in alignment or foundation settling, bolts that may have loosened, rubbing parts, loose connections, and worsened commutation, and take the proper steps to correct the trouble. Also, check condition of air filters on blower ventilated machines. The amount of dirt in the air varies widely between installations.

MAINTENANCE

WARNING: High voltage electric shock may cause serious or fatal injury. Disconnect power before touching any internal part. High voltage may be present even when the machine is not rotating. If used with a rectified power supply, disconnect all AC line connections to power supply. With other power supplies, disconnect all DC line and field connections. Also, disconnect power from auxiliary devices.

WARNING: Ground the machine properly to avoid serious injury to personnel. Grounding must be in accordance with the National Electrical Code and consistent with sound local practices.

WARNING: Replace covers and protective devices before operating.

Bearings (Frames CD180AT-CD210AT)

Double shielded bearings are standard in these frame sizes. The bearings are lubricated by the bearing manufacturer and are not regreasable. These bearings should be replaced whenever the motor is disassembled for servicing.

Bearings (Frames CD250AT-CD500AT)

Bearing housings are packed with grease at the factory. Greasing is not required before the motor is put into service. Since the oil in the grease will ultimately become depleted, it is necessary to relubricate bearings periodically depending on the frame size of the motor, average operating speed, and the type of bearing (ball or roller). (Refer to **Table 11.**)

Motors operating in ambient temperatures above 40°C should reduce interval listed in **Table 11** by half.

TABLE 11

RECOMMENDED REGREASING PERIODS

FRAME SIZE	AVERAGE RPM	RELUBRICATION INTERVAL IN HOURS OF OPERATION	
		BALL BEARING	ROLLER BEARING
CD250AT, CD280AT & CD320AT	500	36000	18000
	1150	15000	7500
	1750	10000	5000
	3000	5000	2500
CD360AT & CD400AT	500	30000	15000
	1150	12000	6000
	1750	6000	3000
	3000	2500	1250
CD500AT & CD5010AT	500	25000	12500
	1150	8000	4000
	1750	4000	2000
	2000	2600	1300

For best lubrication results, regrease with GE grease No. D6A2C5 or an equivalent lithium base ball bearing grease. (Refer to **Table 12.**) Avoid mixing different kinds of grease. Lubricate motor at standstill. Make sure the grease fitting is clean and free from dirt. Remove lower grease relief plug (relief pipe on fan-cooled motor). Free the relief hole from any hardened grease. Use a hand-operated grease gun only. Pump in grease until new grease appears at lower grease hole. (Insert pipe occasionally on fan-cooled motors to check for appearance of new grease.) After greasing, allow motor to run about ten minutes before replacing grease relief plug (or pipe) to permit excess grease to drain out.

CAUTION: If a large amount of grease is pumped into the motor and none appears at the drain, then remove the handhole covers and visually inspect the area where the shaft protrudes thru the cap and endshield for grease leakage. This would indicate that the drain is plugged up. If this occurs, then remove bearing cap and clean all dried grease out of the cavity and drain hole. Refill 1/3 full. Be sure to wipe away any grease leakage before reassembling the handhole covers. Repeat cleaning after 12-24 hours of operation.

Replacement of Bearings

After the bearing brackets have been removed, a bearing puller may be used to pull the bearings from the shaft. Protect the shaft center while using the puller. On frames CD360AT through CD500AT, it may be necessary to remove the bearing retaining snap ring before pulling the bearing. Discard the old bearing. The new bearing and all mating parts should be kept extremely clean during reassembly. (Refer to **Table 13** when selecting replacement bearings.)

To install a new bearing, heat the bearing to 116-127°C (240-260°F) in oil or in an oven. Then slip or press the bearing on the shaft. The bearing should be mounted tightly against the shoulder on the shaft.

After the bearing has cooled, re-install the retaining ring where used. Fill the grease reservoir in the inner bearing cap or cartridge 1/3 to 1/2 full of grease. Butter the bearings and fill the grease reservoir in the bearing bracket 1/3 to 1/2 full of grease.

Brushes (Refer to **Figs. 5, 6, and 7.**)

Good brush performance is dependent on the care used in fitting and adjusting the brushes before the machines are put into service. An initial inspection of brush condition

WARNING: Extreme pressure (EP) greases should not be used in DC machines. Insulation deterioration and increased brush wear may result from the presence of silicones.

TABLE 12

SOURCES OF SUPPLY FOR BEARING GREASES

Temperature	GE Designation	Supplier	Supplier's Designation
STANDARD TEMPERATURE 15°F to 212°F -10°C to 100°C	D6A2C5	GE Supply 158 Gaither Drive Mt. Laurel, NJ 08054 1-800-341-1010	GE Ball Bearing Grease (supplied in small tubes and cans
		Shell Oil Company P.O. Box 2463 One Shell Plaza Houston, TX 77002 (713) 241-4201	Alvania No. 2
		Texaco, Inc. 200 Westchester Avenue White Plains, NY 10650 (914) 253-4000	Regal AFB-2
LOW TEMPERATURE -60°F to 200°F -51°C to 93°C	D6A4	Shell Oil Company P.O. Box 2463 One Shell Plaza Houston, TX 77002 (713) 241-4201	Aeroshell No. 7
HIGH TEMPERATURE -20°F to 350°F -28°C to 176°C	D6A2C13	Standard Oil Company 225 Bush Street San Francisco, CA 94120 (415) 894-7700	Chevron "SRI II"

TABLE 13

STANDARD BALL BEARINGS FOR KINAMATIC MOTORS*

NEMA FRAME DIAMETER	STANDARD COMM END BEARING	AFBMA #	STANDARD DRIVE END BEARING	AFBMA #
180AT	6206	30BC02JPP3	6206	30BC02JPP3
210AT	6206	30BC02JPP3	6207	35BC02JPP3
250AT	6207	35BC02X3	6209	45BC02X3
280AT	6209	45BC02X3	6210	50BC02X3
320AT	6210	50BC02X3	6211	55BC02X3
360AT	6211	55BC02X3	6213	65BC02X3
3610AT	6211	55BC02X3	6214	70BC02X3
3612AT	6213	65BC02X3	6214	70BC02X3
400AT	6213	65BC02X3	6214	70BC02X3
4012AT	6214	70BC02X3	6217	85BC02X3
500AT	6216	80BC02X3	6218	90BC02X3
5010AT	6218	90BC02X3	6222	110BC02X3

*** Motors sometimes have oversize ball bearing and roller bearing options**

TABLE 14

MINIMUM BRUSH LENGTH (in inches)

FRAME	MINIMUM BRUSH LENGTH*
CD180AT	.68
CD210AT-250AT	.70
CD280AT-320AT	.90
CD360AT	1.10
CD400AT	1.50
CD500AT	1.60

*Refer to **Figs. 5, 6, 7** for drawing

and another inspection after the first two months of service is recommended to determine how often subsequent inspections are needed. Wear markers are provided on the brush pigtail. (Refer to **Figs. 6 and 7.**) When the crimped marker approaches entry into the brushholder, brush replacement should be investigated. For future ordering, record the brush part number which is stamped on the brush. (Refer to **Table 18.**)

CAUTION: DC motors and generators operated for long periods of time at light loads or in contaminated atmospheres may be subject to abnormal brush and commutator wear. This can result in the need for excessive maintenance and/or commutator damage. If the application requires operation under these conditions, GE Motors-DM&G will be pleased to suggest a change in brush grade or other measures to minimize the problem.

WARNING: High voltage and rotating machinery can cause serious or fatal injury. Brushes may not be touched or replaced while the machine is energized or rotating.

CAUTION: The presence of silicone in DC motors, particularly totally enclosed constructions, will cause rapid brush wear. Sources of silicone include oils, RTV compounds, hand creams, mold release agents, grease, and some insulating varnishes. These silicone substances must be avoided to insure proper motor performance.

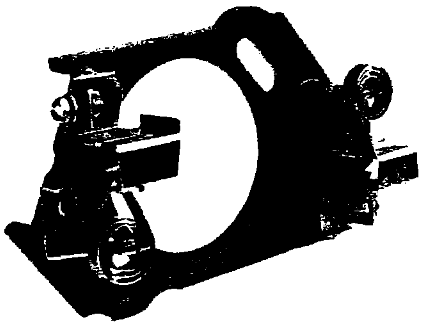


Fig. 5
Frame CD180AT

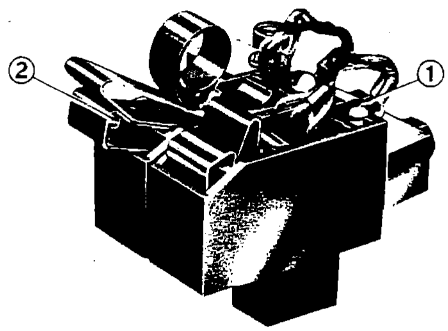


Fig. 6
Frames CD210AT-320AT

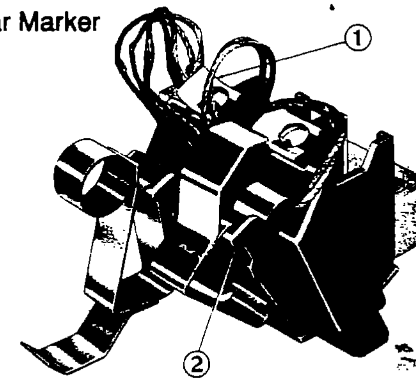


Fig. 7
Frames CD360AT-500AT

Measure Brush Length Here:

Fig. 5, 6, 7 **Brushholder Assemblies**

With Machines Stopped and Power Off:

(Refer to **Figs. 5, 6, and 7.**)

1. Unfasten pigtail (Refer to ①).
2. Release spring by pushing in slightly to disengage locking tab (Refer to ②), then pull spring back.
3. Remove brush.

Brush Installation:

1. Place brush in holder with bevel towards spring. Brushes should move freely in holder.
2. CD180AT - Release spring to original position against brush. CD210AT-CD500AT - Push spring into position until lock tab (Refer to ②) engages slot and locks.
3. Connect pigtail

NOTE: If the brushholders have been disassembled, it may be necessary to readjust the height of the holder from the commutator surface. Loosen the brush stud to holder screw and adjust the holder until a gap of .070" to .080" is obtained. Retighten the screw and recheck the gap. (Refer to Fig. 8.)

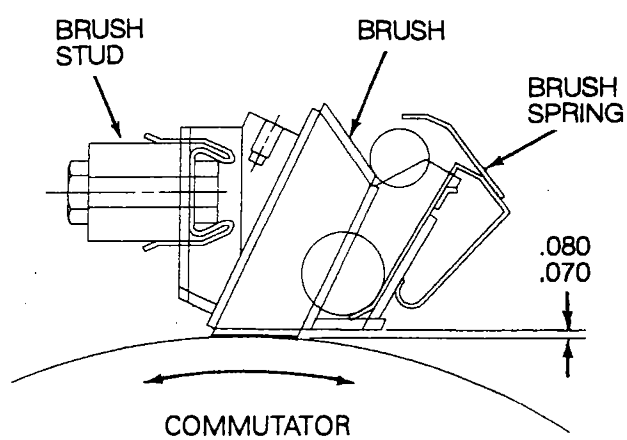


Fig. 8 **Correct Spacing of Brushholder to Commutator**

Brush Seating

Brushes should have their commutator contact surfaces curved to exactly fit the commutator surface. This is accomplished by "sanding in" the brushes in each brushholder separately. Draw a sheet of coarse non-metallic sandpaper (100-150 grit) under the brushes with the rough side toward the brush, while the brushes are pressed firmly toward the commutator. **Do not use emery cloth.** When sanding brushes, do not get carbon dust into the windings. The motor should be thoroughly blown out after sanding the brushes. This can be accomplished by cleaning the dust from the commutator, brushholders, and adjacent parts with a vacuum cleaner, air blast, or other suitable means. After the rough sanding, the brushes should be finely ground to fit using a brush seater. Rotate motor at around nameplate RPM. Make sure there is no load on the machine (armature current is nil). Carefully and lightly rub the brush seater across the entire commutator surface for 10 or 15 seconds. Repeat between each and every set of brush studs. Reverse motor rotation and repeat. Stop motor and cut all power to the motor and check brush face. Continue seating until brush face is 85% seated. Again, motor must be thoroughly blown out after brush seating, the same as with sanding.

> **CAUTION:** Avoid inhaling carbon and seater dust. Recommend using a dust mask during sanding, seating and blowing, or vacuuming.

> **WARNING:** High voltage and rotating parts can cause serious or fatal injury. The use of all electric machinery, like all other utilization of concentrated power and rotating equipment, can be hazardous. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA safety standards for construction and guide for selection, installation and use of integral HP motors and generators, National Electrical Code, and sound local practices is recommended.

> **CAUTION:** Do not use liquid solvents of any kind. Solvents will not remove carbon dust accumulations, but will spread and wash them into critical areas.

Commutator

Keep the commutator clean. Ordinarily, the commutator will require only occasional wiping with a piece of canvas or other nonlinting cloth. **Do not use lubricant or solvent on the commutator.** Check the commutator for roughness while running by feeling the brushes with a fibre stick, avoiding contact with live electrical or moving mechani-cal parts. Jumping brushes give advance warning of deterioration of commutator surface. (Refer to the **Commutator Check Chart, GEA-7053** for commutator surface marking and causes of poor commutator condition.) Commutator runout over .003" T.I.R. (Total Indicator Reading) and bar to bar readings over .0003" indicate need for repair. (Refer to **Table 15.**)

> **CAUTION:** The presence of silicone in DC motors, particularly totally enclosed constructions, will cause rapid brush wear. Sources of silicone include oils, RTV compounds, hand creams, mold release agents, grease, and some insulating varnishes. These silicone substances must be avoided to insure proper motor performance.

TABLE 15

COMMUTATOR DIAMETERS (IN INCHES)

FRAME	NEW	MINIMUM
CD180AT	2.76	2.62
CD210AT	4.50	4.27
CD250AT	5.00	4.75
CD280AT	5.78	5.49
CD320AT	6.50	6.17
CD360AT	7.50	7.13
CD400AT	8.32	7.92
CD500AT	10.25	9.75

Commutator Undercutting Specifications

If the commutator is resurfaced, or during inspection or overhaul, insure the mica segments are undercut below the commutator surface. Commutator undercutting should be made to a depth of .040 - .050". Following commutator resurfacing (stoning/turning), the segments should be "scarfed" by lightly breaking the sharp corners of the copper segments with a knife or tool made for that purpose. Scarfing segments will reduce carbon brush dust buildup and improve brush life.

Mechanical

Check the condition of air filters and replace them if they are dirty. Check for unusual noises which were not present when the unit was originally installed. Check all electrical connections for tightness. Clean out any dirt from screens, louvers, etc. which would interfere with flow of cooling air.

Shaft End Play

Standard endplay should be measured with a dial indicator. The limits are:

1. CD180AT thru CD320AT .005" to .040"
2. CD360AT thru CD500AT .000" to .015"

Some designs may use a wavy washer (preload spring) to eliminate endplay. The above limits do not include the axial endplay of the bearing itself which is approx. .002".

Waterproof Machines

Waterproof machines require the use of sealing devices to exclude water from the bearings and from entering openings in the magnet frame. When a waterproof machine has been disassembled, it will be necessary to remove the old sealing compound from around the mating surfaces of the bearing brackets and magnet frame; from underneath the field pole bolt heads and bearing cap to bearing bracket bolt heads; and from around the conduit box adapter threads to the magnet frame. Reapply new sealant (use Titeseal T20-66, light weight, GE part # 905A999AC009) to these areas and wipe excess sealant with a clean rag slightly dampened with mineral spirits. When accessories such as brakes and tachometers are disassembled, it will be necessary to reseal at the accessory mounting face. Prior to reassembly, inspect for damage at gaskets around enclosure covers and at shaft rubbing seals located in the bearing caps.

Lubrication of Flexible Couplings

Flexible couplings are normally lubricated with a semi-fluid grease or an oil. The coupling manufacturer's instructions should be followed in choosing a lubricant and setting relubrication intervals. GE ball bearing grease D6A2C5 is a suitable lubricant for flexible couplings in most applications.

Flexible couplings which join a small machine to a large one may have two different size coupling halves joined by an adapter plate. Couplings of this type have a separate lubricant supply for each half, so that both halves must be lubricated separately.

Insulation

CAUTION: Eliminate sources of contamination and moisture for maximum insulation life. Air filters for blowers, air piped from cleaner locations, shielding from water leaks or spray, proper use of space heaters during downtime, etc., will all help prolong insulation life.

Premature failure of insulation is due to:

1. Contamination
2. Mechanical factors
3. High temperatures

Contamination includes excessive moisture, oily vapors, conducting and non-conducting dust, chips, and chemical fumes. Contamination is best avoided by proper enclosure and ventilation. Filters, ventilation from a remote clean air source, unit coolers, and a totally enclosed construction are all possible means of protecting DC machines in adverse environments. Space heaters protect against moisture damage by maintaining the machine above dew-point during storage or when idle. They should be arranged so that they are automatically energized whenever power is removed from the motor. Space heaters do not supply enough heat for drying out windings which have been water-soaked.

Mechanical factors include shock, vibration, overspeed, etc. Maintaining machines in good mechanical repair, including isolation from excessive external shock and maintenance of smooth running conditions, will contribute to long insulation life.

The insulation system in these machines is capable of withstanding some short time periods of operation at temperatures higher than that used for the basis of machine rating. Prolonged or excessively high temperature will cause the insulation to become brittle and crack, leading to premature failure. Application data is available from GE Motors-DM&G for any particular machine giving suggested maximum loads for various operating conditions. Operation within these maximum loads will limit the temperature to suitable values.

Testing Methods

Visual Inspection

Visual inspection is recommended as the quickest means of finding insulation systems troubles. Visual inspection may not sound like a test method, but a careful visual inspection done by a competent person is one of the most valuable means of judging insulation condition.

In addition to collecting contaminants, insulation shrinks, cracks, and becomes brittle with heat and age. These changes allow movement of coils, loose filler strips, loose ties, chafing, and abrasion, all of which can be picked up by visual inspection.

Experience and judgment can be gained by careful observation and comparing results of visual inspections with insulation resistance measurement. GE service shops have personnel who can inspect equipment and point out potential trouble areas. Their services can help build experience and judgment for future visual inspections.

Insulation Resistance Measurement

A method of measuring the insulation resistance is described in **Report 43, "Recommended Practice for Testing Insulation Resistance of Rotating Machinery"**, published by IEEE, 345 E. 47th Street, New York, NY 10017. The resistance measurements should be taken with a 500- or 1000-volt megger and corrected to 104°F (40°C).

The insulation resistance measurements are affected by the following:

1. Magnitude of test voltage.
2. Time the test voltage is applied.
3. Temperature.
4. Surface condition (contaminants).
5. Moisture.

When a 1000-volt megger is used, taking readings of one minute and converting the data to 40°C (104°F), the data will evaluate the other two factors, i.e., the contaminants and the moisture present.

The insulation resistance varies inversely with the winding temperature. That is, as the temperature decreases, the insulation resistance increases in accordance with **Table 16.**

TABLE 16

EFFECT OF TEMPERATURE ON INSULATION RESISTANCE

WINDING TEMPERATURE DEGREE C	MULTIPLYING FACTOR TO OBTAIN INSULATION RESISTANCE AT 40°C (104°F)
80	10.00
70	5.50
60	3.10
50	1.70
40	1.00
30	0.55
20	0.31
10	0.17

Note that for a 104°F (40°C) decrease in temperature, the insulation resistance is increased by a multiplier of ten.

The insulation resistance of a machine is affected by its design. The insulation resistance of the armature circuit corrected to 104°F (40°C) should measure at least 1.5 megohms or cleaning is required.

If the measurements are less than this limit, the machine should be dried or cleaned to attempt to increase the insulation resistance. Regular, periodic measurements of insulation resistance can give a useful indication of the rate of insulation system deterioration. External connections should be removed to isolate the windings to be tested and megger value logged. A sudden drop or consistent trend toward low values of insulation resistance, although possibly caused by moisture or contamination, generally gives evidence that the insulation system is deteriorating and that failure may be eminent.

High-potential tests are not recommended on machines which have been in use. If such a test is made immediately after installation, the test voltage should not exceed 85% of the original factory test of two times the rated voltage plus 1000 volts.

NOTE: Surge testing and AC impedance tests of windings to detect shorts should be performed only by trained personnel.

Cleaning of Windings

If windings become contaminated, suitable cleaning methods can be used to alleviate the problem.

The machine should be de-energized and slowly rotated by hand to permit maximum dust removal. Dry dirt, dust, or carbon should first be vacuumed - without disturbing adjacent areas or redistributing the contamination. Use a small nozzle or tube connected to the vacuum cleaner to enter into narrow openings (i.e., between commutator risers). A soft brush on the vacuum nozzle will loosen and allow removal of dirt more firmly attached.

This vacuum cleaning may be supplemented by blowing with compressed air (air pressure should be in accordance with OSHA standards), which has passed through a dryer to remove moisture before entering the motor.

Dirt can collect on the inside surface of the drive-end coil support and on the underside of the armature coils. This dirt can be easily removed with compressed air or a vacuum. Dirt may also accumulate in the axial vent holes which pass all the way through the armature core and commutator. It usually will be necessary to use compressed air to blow this dirt out. The commutator vent holes can best be cleaned by directing air from the commutator end.

It is important to realize that when blowing out a machine, dirt may settle in a previously cleaned area and it may be necessary to repeat the cleaning process to ensure that a thorough job is done.

Dirt can be removed from stationary parts of the machine by either compressed air or a vacuum nozzle or a combination of both. Air should be directed between the stator coils, into the pocket corners of bearing brackets, around the cables, and onto the brush rigging. Special care should be taken to keep the commutator clean. The commutator should be wiped with a clean lint-free cloth after blowing out.

> **WARNING:** High voltage electric shock can cause serious or fatal injury. Electrical circuits must be de-energized prior to cleaning or other maintenance activities. Ground electrical circuits prior to cleaning or maintenance to discharge capacitors. Failure to observe these precautions may result in injury to personnel.

> **CAUTION:** Liquid solvents should not be directly applied to the commutator, armature, field coils, or any part of a DC machine. Liquid solvents carry conducting contaminants (metal dust, carbon, etc.) deep into hidden areas to produce shorts and grounds, thus causing machine failure. Mechanical components may be cleaned by a wiping rag barely moistened (not wet) with a solvent.

> **WARNING:** Solvents may be flammable and moderately toxic. The usual precautions for handling chemicals of this type must be observed. These include:
>
> 1. Avoid excessive contact with skin.
> 2. Use in well-ventilated areas.
> 3. Take necessary precautions to prevent fire or explosion hazards.

> **WARNING:** Safety glasses and/or other protective equipment should be used to prevent injury to eyes and respiratory organs.

Oily Dirt

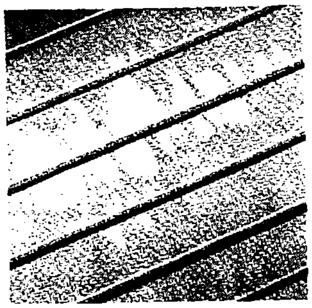
The presence of oil makes thorough, effective cleaning of machines in service virtually impossible and service shop conditioning is recommended. Oil on a surface forms a "fly paper effect", which attracts and holds firmly any entrained dust. Neither suction nor compressed air is effective. Consequently, only accessible areas may be cleaned. First, remove as much of the dirt as possible by scraping or brushing the dirty surfaces. Then, wipe away as much dirt as possible with dry rags. For surfaces not readily accessible, a rag on a hook wire can be used to clean dirt out of holes and crevices. Rags should be changed frequently for clean ones so that contamination picked up from one area is not carried to other less dirty areas.

To simplify removal of oily dirt, solvents are commonly prescribed.

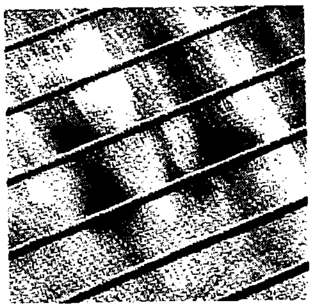
GE Motors
Commutator Check Chart

For Comparing Commutator Surface Markings

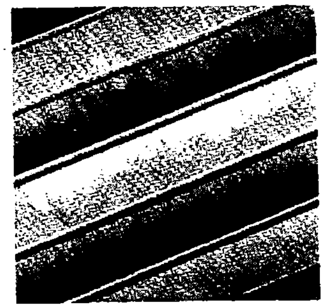
SATISFACTORY COMMUTATOR SURFACES



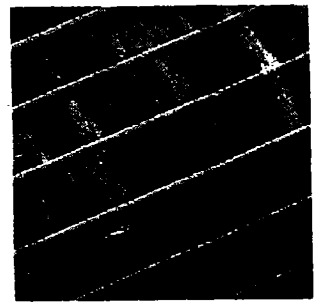
LIGHT TAN FILM over entire commutator surface is one of many normal conditions often seen on a well-functioning machine.



MOTTLED SURFACE with random film pattern is probably the most frequently observed condition of commutators in industry.

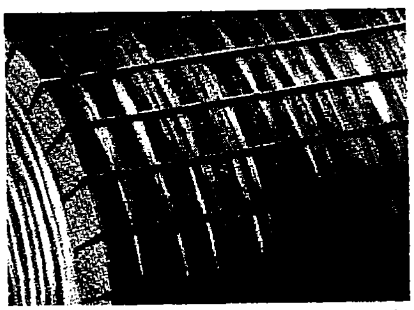


SLOT BAR-MARKING, a slightly darker film, appears on bars in a definite pattern related to number of conductors per slot.

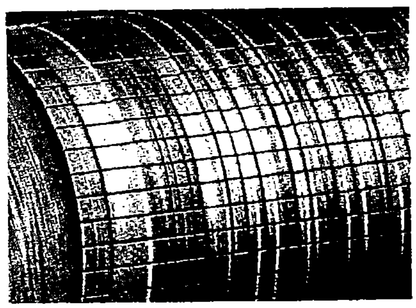


HEAVY FILM can appear over entire area of efficient and normal commutator and, if uniform, is quite acceptable.

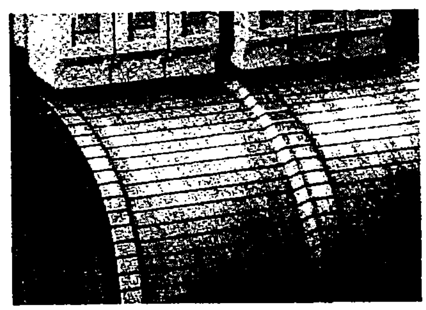
WATCH FOR THESE DANGER SIGNS



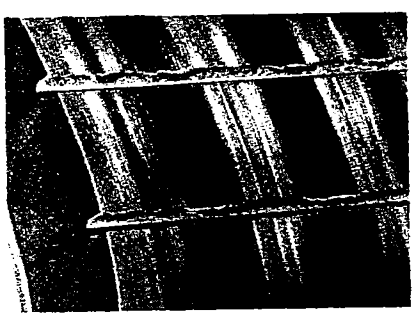
STREAKING on the commutator surface signals the beginning of serious metal transfer to the carbon brush. Check the chart below for possible causes.



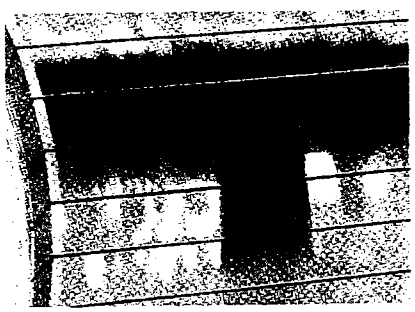
THREADING of commutator with fine lines results when excessive metal transfer occurs. It usually leads to resurfacing of commutator and rapid brush wear.



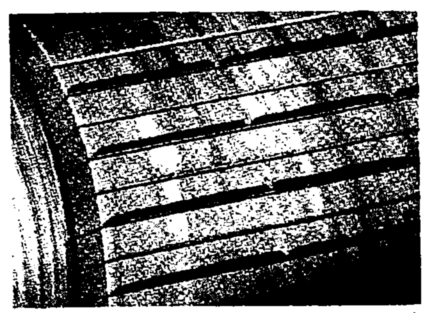
GROOVING is a mechanical condition caused by abrasive material in the brush or atmosphere. If grooves form, start corrective action.



COPPER DRAG, an abnormal build-up of commutator material, forms most often at trailing edge of bar. Condition is rare, but can cause flashover if not checked.



PITCH BAR-MARKING produces low or burned spots on the commutator surface. The number of these markings equals half or all the number of poles on the motor.



HEAVY SLOT BAR-MARKING can involve etching of trailing edge of commutator bar. Pattern is related to number of conductors per slot.

CAUSES OF POOR COMMUTATOR CONDITION

Frequent visual inspection of commutator surfaces can warn you when any of the above conditions are developing so that you can take early corrective action. The chart below may indicate some possible causes of these conditions, suggesting the proper productive maintenance.

	Electrical Adjustment	Electrical Overload	Light Electrical Load	Armature Connection	Unbalanced Shunt Field	Brush Presure (light)	Vibration	Type of Brush In Use: Abrasive Brush	Type of Brush In Use: Porous Brush	Contamination: Gas	Contamination: Abrasive Dust
Streaking			X			X		X	X	X	X
Threading			X			X			X	X	
Grooving								X			X
Copper Drag						X	X	X		X	
Pitch Bar-Marking				X	X	X	X	X			
Slot Bar-Marking	X	X								X	

GE Motors
3001 East Lake Road
Erie, PA 16531
Phone: 814-875-3129

HOW TO GET THE MOST VALUE FROM THIS CHART

The purpose of the Commutator Check Chart is to help you spot undesirable commutator conditions as they develop so you can take corrective action before the condition becomes serious. This chart will also serve as an aid in recognizing satisfactory surfaces.

The box chart above indicates the importance of selecting the correct brush and having the right operating conditions for optimum brush life and commutator wear.

For additional information or help with carbon brush application or commutation problems, contact your

WARNING: While FREON TF® is considered to be non-flammable and has a relatively low order of toxicity, it should be used only in well-ventilated areas that are free from open flames. Avoid prolonged exposure to vapors. Failure to observe these precautions may result in injury to personnel.

FREON TF is the recommended solvent for cleaning because it is nonflammable, has good solvency for grease and oil, is considered safe with most varnishes and insulations, and has a low order of toxicity. Stoddard Solvent has good solvency, but is flammable and moderately toxic. Before using any solvent, consult the Material Safety Data Sheet. Steam cleaning is not recommended because, as with liquid solvents, conducting contaminants may be carried deep into inaccessible areas resulting in shorts and grounds.

FREON TF is a chlorofluorocarbon. Chlorofluorocarbons have been identified as upper atmosphere ozone depletors. The use of Freon in industry is expected to be greatly reduced in the future. The availability of Freon may be limited, and its use could be prohibited by regulations.

CAUTION: Carbon brush performance may be ruined by absorbed solvents. Remove brushes prior to solvent wiping.

Drying of Windings

Drying of machines is most effectively done by application of heat. The windings and insulation should be heated so that their temperature does not exceed 225°F (125°C) at any location. (Do not make local hot spots.) The machine's own frame and the addition of some covers usually will make an effective enclosure to contain the heat, if an oven cannot be used. Some flow of air is desirable to allow moisture to be carried away. Methods of generating heat include blowing hot air through the machine, heating with heat lamps, passing current through the main-field-coil windings, etc.

If temperatures as high as 225°F (125°C) can be attained, they should be limited to six or eight hours duration. Lower temperatures will cause correspondingly longer drying times.

® Registered trademark of the E.I. Dupont Co.

Drying out can be ended when the insulation resistance to ground (corrected to 40°C) is restored to a satisfactory value as described in the **Insulation Resistance** section. If these values do not reach a proper level, then a thorough cleaning or complete reconditioning may be necessary.

Service Shop Cleaning

When the cleaning or drying methods described in preceding paragraphs do not result in restoration of acceptable insulation resistance and/or when machines are extremely dirty or contaminated, it is recommended that the reconditioning services of a GE service shop be obtained. Service shops are knowledgeable and equipped for more sophisticated restoration methods, such as hot water detergent wash, solvent and abrasive cleaning, revarnishing, and rewinding if necessary.

Repair

Repairs should be made only by qualified personnel using the materials and processes for which the motor was designed. To protect the warranty during the warranty period, all repairs must be made in a GE service shop or approved repair facility. Many repairs can be easily performed with only assembly operations, if GE replacement parts are available. If major repairs are undertaken (such as rewinding an armature), proper facilities should be available and suitable precautions observed.

WARNING: When burning off old insulation materials or when welding near insulation during rewinding, adequate ventilation must be provided to avoid exposing personnel to noxious fumes. Combustion of exhaust fumes must be complete and adequately vented to the outside atmosphere.

WARNING: Exposure of personnel to airborne inorganic fibers must be avoided by adequate ventilation or by wetting the remaining insulation components following the burning off of the organic materials.

Failure

WARNING: An extreme overload or electrical failure may result in heating or arcing, which can cause the insulation to give off noxious fumes. All power should be removed from the motor circuit as a precaution, even though the circuit has overload protection. Personnel should not approach the motor until adequate ventilation of the area has purged the air of fumes. When covers of a totally enclosed motor are removed after a failure, care should be observed to avoid breathing fumes from inside the motor. Preferably, time should be allowed for the motor to cool before attempting any examination or repair.

WARNING: Water should not be applied to any electrically energized equipment because electric shock could result in serious or fatal injury. In case of fire, disconnect all power and use a carbon dioxide extinguisher to quench to flame.

Before operating any motor after a suspected failure, it should be inspected for damage. Remove covers and make visual inspections of the brushes, commutator, connections, and windings. Electrical tests of each winding to check for open or short circuit or grounds should be made. Any arc damage should be cleaned up and repaired as necessary. Brushes may need reseating before operation.

RENEWAL PARTS

Using genuine GE renewal parts assures continued high performance and the full benefits of the long operating life designed into your GE motor.

Downtime can be minimized by having a protective stock of parts available for replacement. (Refer to **Table 17**.)

The permanently attached nameplate on your GE motor displays the model and serial number, providing all the information you need for ordering. Parts are available directly from authorized GE-DM&G parts distributors. Direct electronic access to the factory database of motor information and warehouse inventories enables the distributor to quickly identify part numbers, delivery times, and order status.

Distributor location is available to you at (814) 875-2387 (and toll free outside Pennsylvania at 1-800-458-0451).

For your convenience, **Table 18** outlines standard brush and brush spring part numbers to assist in ordering renewal parts.

SPARE PARTS

TABLE 17

RECOMMENDED SPARE PARTS

As insurance against costly downtime, it is strongly recommended that spare parts be kept on hand in accordance with the chart below:

DESCRIPTION	NUMBER OF DUPLICATE MOTORS IN SERVICE				
	1	2-4	5-10	11-20	More than 20
WITH OR WITHOUT ELECTRICAL SHOP FACILITIES					
Complete Machine	-	-	-	1	2
Drive End Ball Bearing	1	1	1	2	3
Front End Ball Bearing	1	1	1	2	3
Brushes (Sets)	2	4	6	8	10
Brushholders (Sets)	-	1/2	1/2	1	1
Brushholder Springs (Sets)	1/2	1	1	2	2
Main Field Coil and Pole	-	1	1	2	3
Commutating Field Coil and Pole	-	1	1	2	3
Armature Complete*	-	1	1	2	2
Blower Vent, motors					
Blower motors	-	1	1	2	2
WITH ELECTRICAL SHOP FACILITIES					
Shaft**	-	-	-	1	1
Armature Rewinding Supplies	-	1	1	2	3

*If shop facilities are available, the quantity of armatures may be reduced by stocking the armature parts listed in the second group.
**Shaft not replaceable in CD180AT thru CD250AT.

TABLE 18

STANDARD BRUSH AND BRUSH SPRING PART NUMBERS

FRAME SIZE	STANDARD BRUSH PART NUMBER*	BRUSH SPRING PART NUMBER
CD180AT	36A167400AA001	36B467022AB001
CD210AT	36A167401AA008	36B467020AA001
CD250AT	36A167401AA008	36B467020AA001
CD280AT	36A167402AA004	36B467021AA001
CD320AT	36A167402AA004	36B467021AA001
CD360AT	36A164456AA021	36B465486AA001
CD400AT	36A164451AB018	36B465481AD001
CD500AT	36A164452AA021	36B465482AA001

*Brush part numbers are for most applications. Special applications such as papermills, pump motors, diesel-driven generators and others may require special brush grades. Before ordering brushes, check the part number stamped on the brush to ensure the correct brush replacement.

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Exploded views found on pages 34 & 35

	Name	Qty. Per Motor
1.	Brush	2
2.	Brush Spring	2
3.	Bearing C.E.	1
4.	Bearing D.E.	1
5.	Armature	1
6.	Coil & Pole Comm.	2
7.	Coil Main	2
8.	Bearing Bracket (CE)	1
9.	Access Cover	1
10.	Brush Rigging	1
11.	Armature Fan	1
12.	Bearing Bracket (DE)	1
13.	Wound Frame Assembly	1

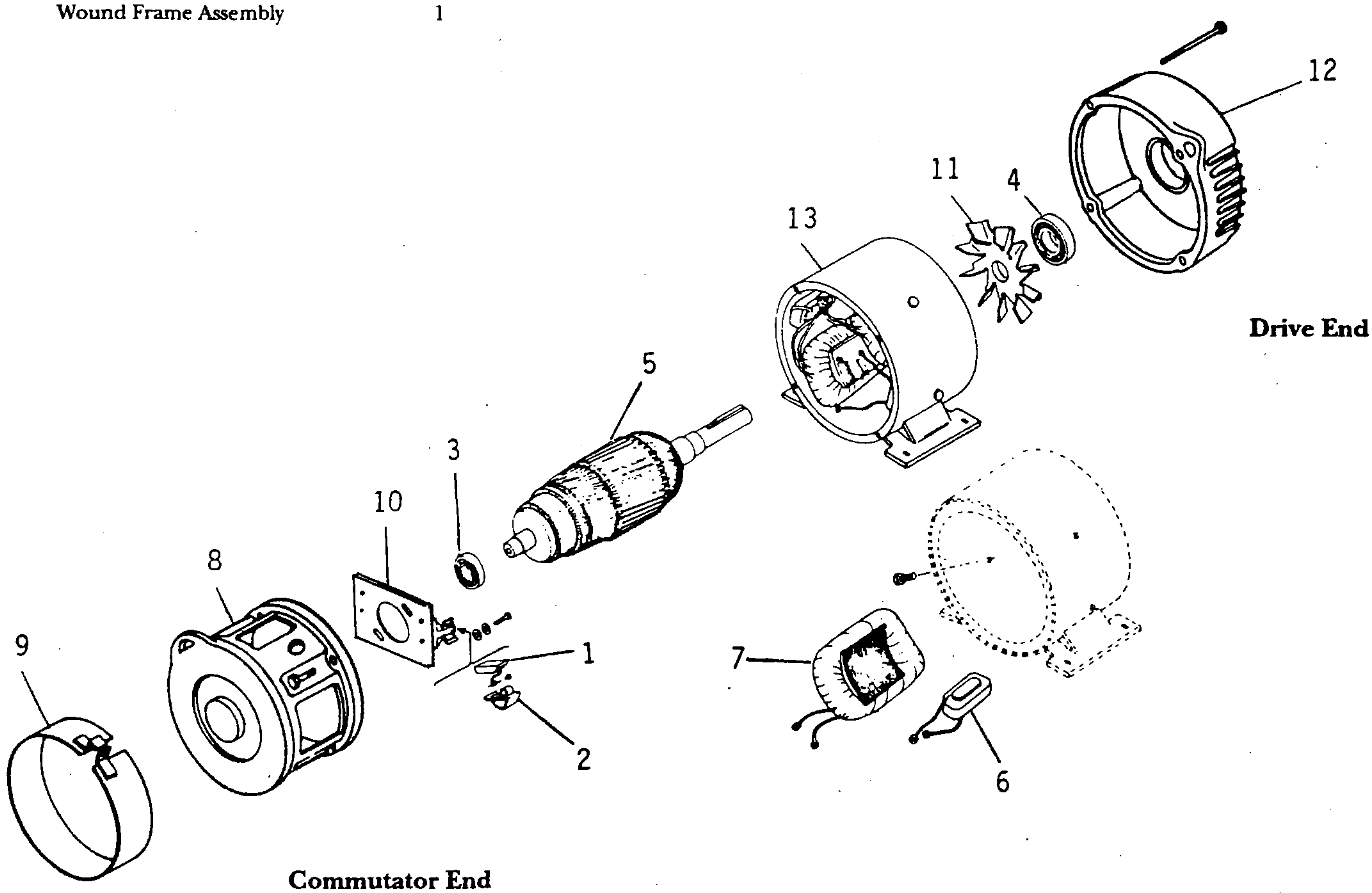


Fig. 9 CD180AT Frame, Exploded View

Section 4

POLY CHAIN ASSEMBLY

Poly Chain Transmission

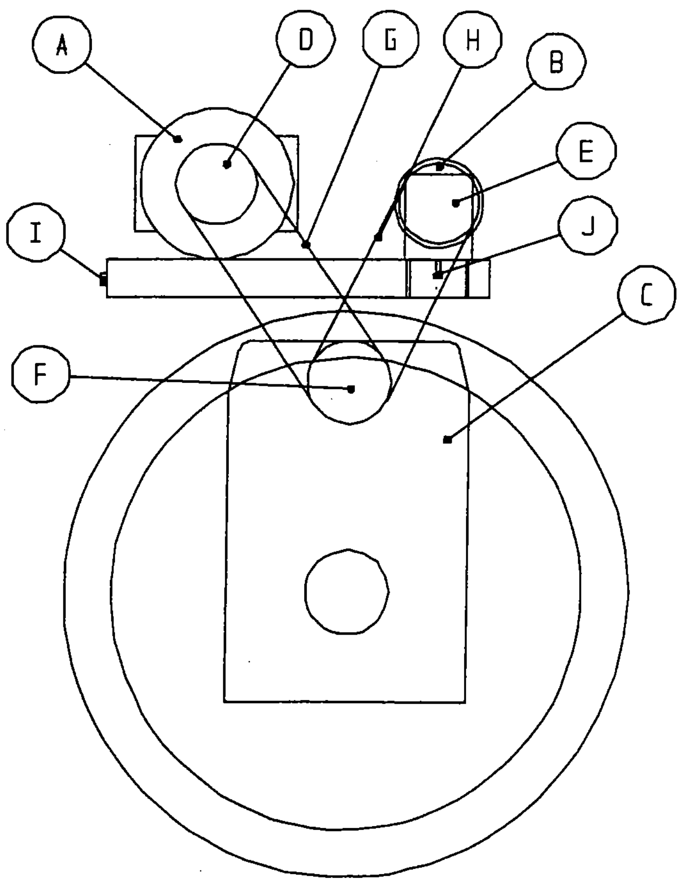
General Description

Power from the electric motor and evacuation motor to the gear reducer is transmitted by a poly chain belt and sprocket. The sprockets are specially designed to give your installation the optimum gear ratio.

Do not change these sheaves without the approval of POMA of AMERICA.

Parts (All part numbers are Gates Rubber Company numbers)

•	Electric motor sprocket (D)		**Part #: 14M-48S-20**
•	Evacuation motor sprocket (E)		**Part #: 14M-48S-20**
•	Gear reducer sprocket (F)		**Part #: 14M-50S-68**
•	Poly chain belts:	Electric (G)	**Part #: 14M-1960-20**
		Evacuation (H)	**Part #: 14M-1750-20**



A: Electric Motor
B: Evacuation Motor (Hydraulic Motor)
C: Gearbox
D: Electric motor sprocket
E: Evacuation motor sprocket
F: Gear reducer sprocket
G: Electric Poly Chain belt
H: Evacuation Poly Chain Belt
I: Elec. tension adjustment bolt
J: Evac. tension adjustment bolt

FIGURE 4-1

Assembly

Electric Motor Sheave

Install the Poly chain sprocket on the electric motor output shaft as close as possible to the motor housing without interference.

- Make sure the tapered-cone surface of the bushing and the mating bore of the sprocket are free of all foreign substances, such as dirt, excess paint accumulations, metal chips, lubricants, etc.

- For POSITION ONE or POSITION TWO, whichever applies (see figure 4-1), line up the unthreaded holes (C) with the threaded holes (T) and insert cap screws with lock washers engaging only 2 or 3 threads. Screw heads should be mounted outside to enable disassembly.

- With key in shaft keyway, slide the loosely assembled unit onto shaft and position for good belt alignment. **Do not** use lubricants or anti-seize compounds on threads or tapered surfaces.

- Carefully tighten the cap screws alternately and progressively until tapers are seated (at approximately half the recommended torque).

- Check alignment and sheave run-out (wobble) and correct as necessary.

- NOTE: When properly mounted, there will be a gap between bushing flange and sheave after screws are tightened.

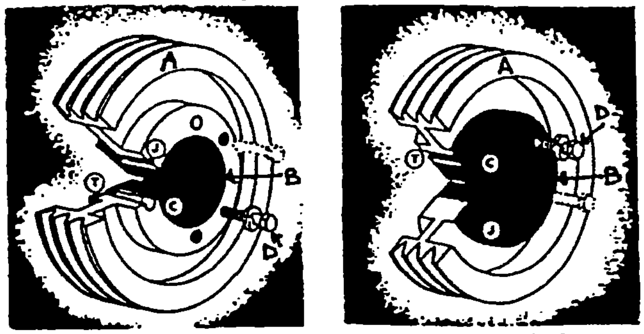
  CAUTION: Use of lubricants and/or excessive screw torque can cause breakage.

- Tighten the set screw, when available, to hold key securely during operation.

Removal of Bushings

- Loosen and remove all mounting cap screws.
- Insert cap screw in all threaded jackscrew holes (J).
- Start with the screw furthest from the bushing saw slot and tighten all jack screws alternately and progressively. Keep turning the screws in small equal amounts until the tapered surfaces disengage.

  CAUTION: Excessive or unequal pressure on the jackscrews can break the bushing flange, making removal nearly impossible without destroying the sheave.



POSITION ONE POSITION TWO

FIGURE 4-2

Recommended Wrench Torque Values To Use in Tightening QD Bushings

Bushing Size	Cap Screw Size & Thread	Ft./Lbs. Wrench Torque Normal Applications
JA	No. 10-24	5
SH-SDS-SD	1/4-20	9
SK	5/16-20	15
SF	3/8-16	30
E	1/2-13	60
F	9/16-12	75
J	5/8-11	135
M	3/4-10	225
N	7/8-9	300
P	1-8	450
W	1 1/8-7	600
S	1 1/4-7	750

CAUTION: Excessive cap-screw torque can cause sheave and/or bushing breakage.

CAUTION: The use of lubricants can cause sheave breakage. Therefore, **USE NO LUBRICANTS** in this installation.

FIGURE 4-3

Note: Pacoima QD bushing #

Electric motor sprocket:	E-Ø 2.125in
Evacuation motor sprocket:	E-Ø 1.250in
Gearbox sprocket:	F-Ø 40mm

Installing Poly Chain Belts.

Note: During normal operation (Electric Motor) only the electric Poly Chain belt 14M-1960-20 is installed. During evacuation use (hydraulic motor) only the evacuation Poly Chain belt 14M-1750-20 is needed. During evacuation operation both belts may be on the sprockets provided the electric motor has not seized. (Figure 4-1)

Loosen tension bolts. (figure 4-1)

Place the belt on the sprockets. Be careful not to use force, as this can damage the belt fibers. **Only use the 14M-48S-20 belt on the electric motor and 14M-1750-20 on the evacuation motor.**

Before tightening, mark two fine lines across the back of the belt in the middle of the set. (figure 4-4)

Tighten the belt in small increments by tightening the tension bolts. Rotate the transmission (about 1 mm) after each tightening, until the length between the two lines has increased by 1 mm for the electric motor belt and 0.8 mm for the evacuation motor belt. (figure 4-5).

After 24 operating hours, check and retighten if necessary.

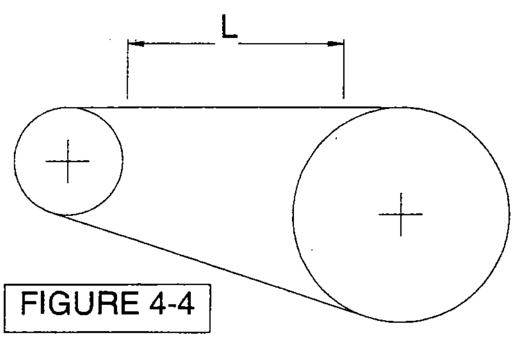


FIGURE 4-4

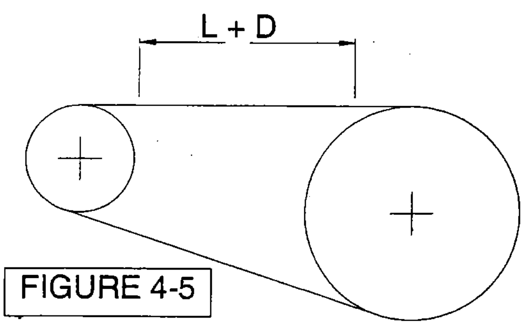


FIGURE 4-5

Electric motor belt D=1.0mm
Evacuation motor belt D=0.8mm

Aligning the Sprockets

An improper alignment of the sprockets results in the premature wearing of the belts.

Before the final tightening of the bolts that fix the motor, check the alignment of the sheaves as indicated in figure 4-6.

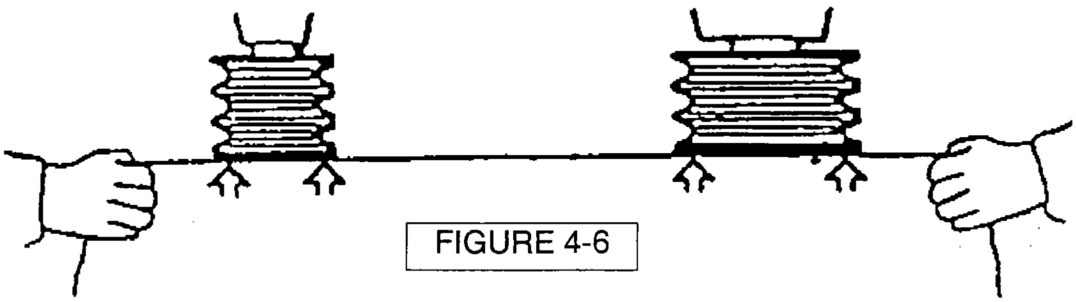


FIGURE 4-6

Maintenance

Run lift for at least 30 minutes (no load) after changing a belt.

Recheck belt tension daily for first week and monthly thereafter.

Maintenance Schedule

Frequency	*Maintenance Activity*
DAILY	Inspect belts for abrasions, cracking and separation. Check belt sprockets for damage, loose bolts, and foreign material (grease, oil, etc.) Check belt tension.
ANNUALLY	Remove belts for inspection. Thoroughly inspect belt sprockets for damage, heat cracks and distortion. Check bushing bolt torque on electric motor sprocket. Check alignment of motor sprocket to gearbox sheave.

EVACUATION ENGINE

EVACUATION POWER UNIT

General Description:

The auxiliary power unit for this lift is an internal combustion engine. The primary function of this engine is to operate or to evacuate the lift in the event of a power failure. The entire lift system will function without primary electrical power, while all safety systems remain fully operational.

The power unit is connected to the Eaton hydraulic pump.

Parts:

INTERNAL COMBUSTION ENGINE

See accompanying manufacturer's manual.

Quick Reference (Write information from your equipment in the spaces below:)

- Oil filter:____________________________________
- Oil:__________________________ Capacity:__________
- Fuel:__________________________ Capacity:__________
- Fuel filter:____________________________________
- Fuel line hose:________________________________
- Air filter:____________________________________
- Spark plugs:__________________________________
- Belts:______________________________________
- Coolant:________________________ Capacity:__________
- Standard adjustments:____________________________

Spare parts are available from POMA of AMERICA.

Adjustment/Maintenance of Evacuation Engine:

See manufacturer's manual in the Hydraulic Tension System section of this manual, for specific engine and adjustments.

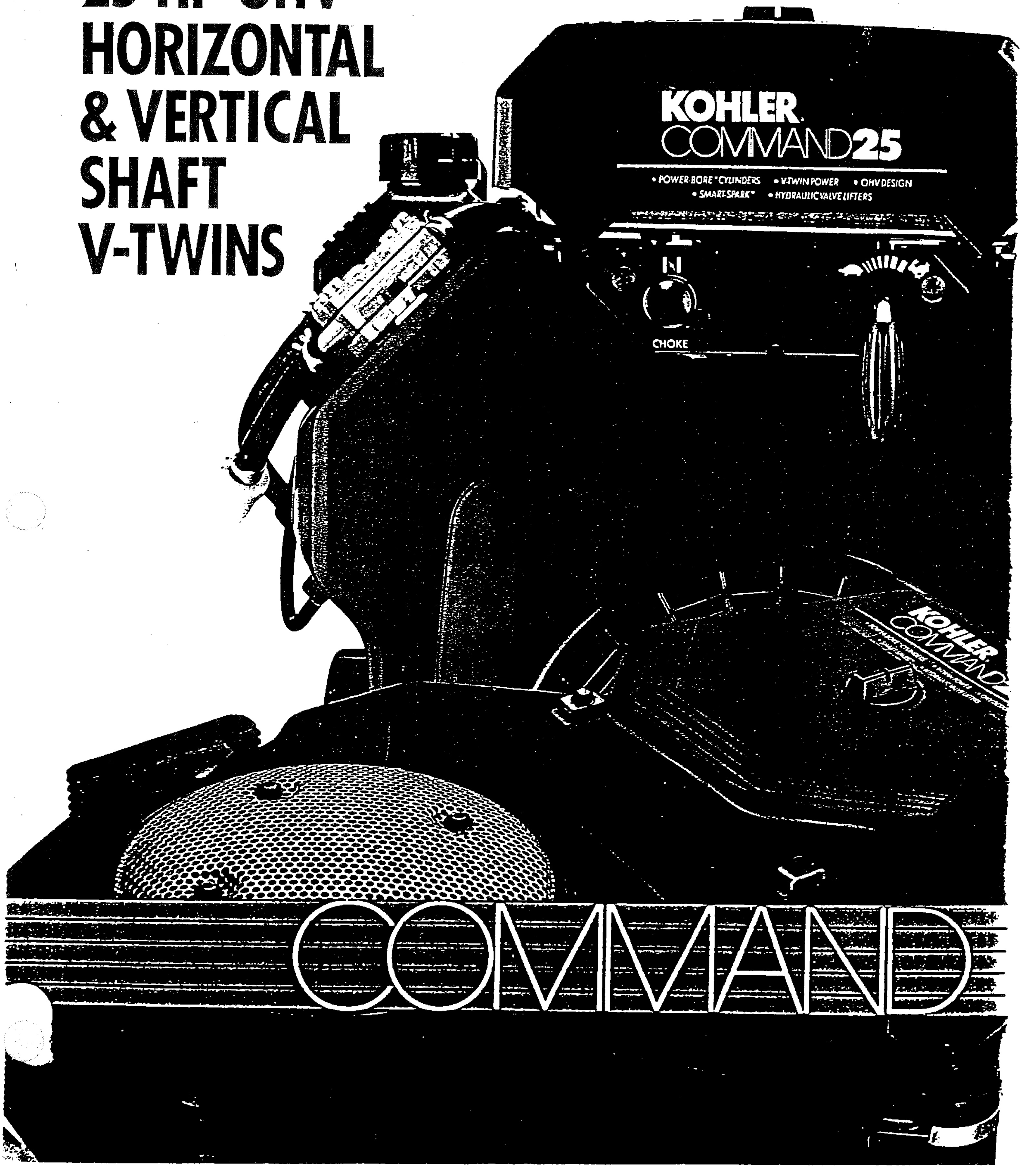
For authorized service and maintenance, contact POMA of AMERICA or a local manufacturer's representative.

Maintenance Schedule of Hydraulic Evacuation Drive

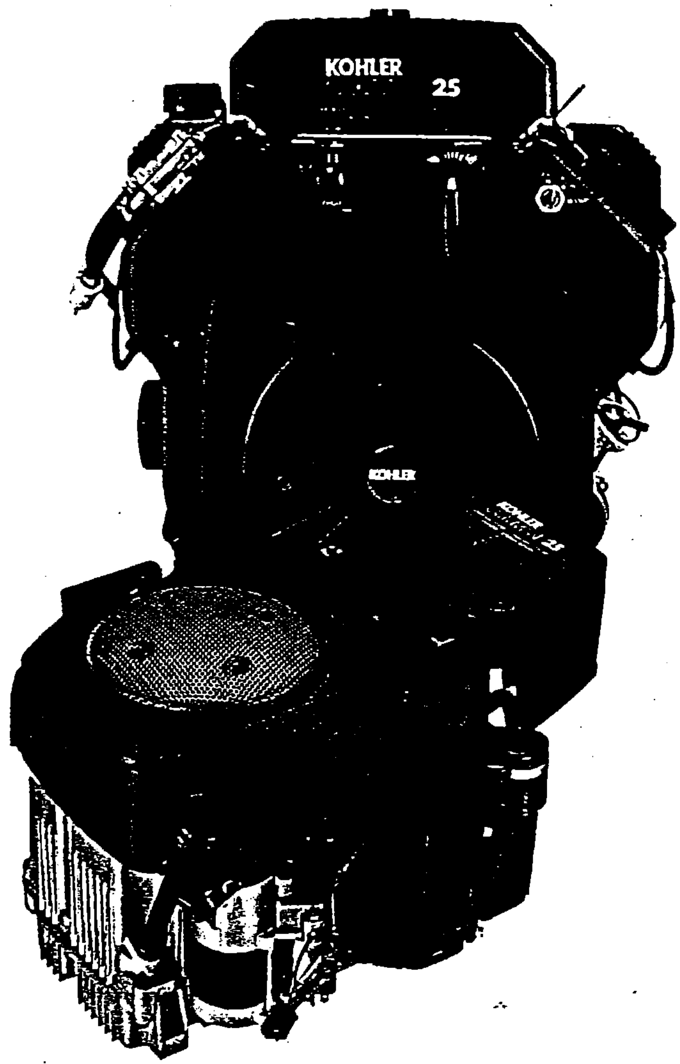
Frequency	*Maintenance Activity*
DAILY	* Fuel level * Oil level * Coolant level * Battery level * Hydraulic oil level
ONCE A WEEK	Run the evacuation engine 10 minutes to ensure it will operate properly. Do **not** engage the hydraulic motor to the gearbox for this.
ONCE A MONTH or as required	Run the lift for 15 minutes powered by the evacuation drive. Check the emergency stop safety circuits. **Note:** An open emergency stop circuit will kill the engine, set the service brake and the emergency brake. Check the speed controls. Check the rpm's. All other inspections shall be performed in accordance with the manufacturer's manual.
LUBRICATION	See the manufacturer's manual.

KOHLER engines

25 HP OHV HORIZONTAL & VERTICAL SHAFT V-TWINS



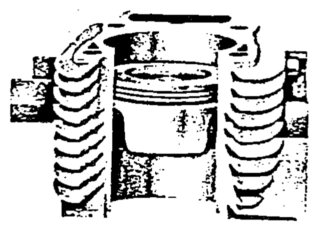
KOHLER'S POWER ALTERNATIVE...



THE COMMAND 25 HP OHV V-TWINS

The Command 25. Finally there's an alternative to imported OHVs and U.S. L-heads in the under 30 HP category. Available in both vertical and horizontal shaft configuration, Kohler's new high-performance Command 25 engines offer OHV design, V-twin power, made-in America quality, and a variety of exclusive features.

POWER-BORE™ CYLINDERS



Plated with resilient nickel-silicon, an exclusive in Kohler's class of engines, POWER-BORE cylinders give you:

- Increased power
- Virtually permanent cylinder life
- Superior oil control
- Reduced exhaust emissions

This plating is also used on high performance race cars like Porsche, Ferrari, Lamborghini, Maserati and "Formula 1" cars.

SMART-CHOKE™ CARBURETOR

All Command V-Twins feature SMART-CHOKE, a self-relieving choke carburetor. SMART-CHOKE adjusts the air-fuel ratio automatically for optimum starting and prevents overchoking when a warm engine is restarted.

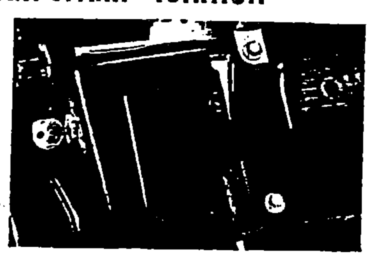
OVERHEAD VALVE DESIGN

OHV design maximizes fuel combustion to ensure even burning for greater fuel efficiency. It also means virtually no carbon build up. The result... reduced maintenance costs.

HYDRAULIC VALVE LIFTERS

Kohler hydraulic valve lifters reduce valve train noise and eliminate valve adjustment. This makes Command's valve train nearly maintenance free.

ELECTRONIC SMART-SPARK™ IGNITION



SMART-SPARK ignition retards the spark for optimum starting and slow-speed running, while advancing the timing for peak efficiency and power during high-speed operation. This means faster all-weather starts, improved power and lower emissions.

TEN EXCLUSIVE REASONS TO CHOOSE KOHLER

1. Nickel-silicon POWER-BORE cylinders for power and durability.
2. Electronic SMART-SPARK ignition for broad RPM response.
3. SMART-CHOKE carburetor for consistent all-weather starting.
4. Hydraulic valve lifters for quiet, maintenance-free operation.
5. Specially-designed oil cooler for heavy-duty power demands.
6. Overhead valve design for greater fuel efficiency and lower emissions.
7. Compact size. An ideal companion to Command 18-20-22 models in virtually the same envelope space.
8. Worldwide service network with 10,000 skilled dealers and distributors offering genuine Kohler replacement parts.
9. Broad Kohler product line (6HP and up, single and twin-cylinder) to complement your power needs.
10. Only American-made OHV engine in its class.

MODEL SPECIFICATIONS

ENGINE TYPE:	4-Cycle, Twin Cylinder, Overhead Valve, Air-Cooled, Gasoline, Horizontal and Vertical Shaft, Aluminum Crankcase with POWER-BORE Cylinders.
MODEL:	**CH25/CV25**
POWER (@ 3600 RPM) hp (kW)	25 (18.4)*
DISPLACEMENT cu. in. (cc)	44 (725)
BORE in. (mm)	3.27 (83)
STROKE in. (mm)	2.64 (67)
MAX TORQUE lbs. ft. (N•m)	39.5 (54) @ 2400 RPM
COMPRESSION RATIO	9:1
DRY WEIGHT lbs. (kg)	94 (43)
OIL CAPACITY (w/filter) U.S. qts. (l)	2.1 (2)

*Horsepower ratings (shown as gross) are in accordance with Society of Automotive Engineers - Small Engine Test Code J1349.
Kohler Co. reserves the right to change product specifications, designs, and standard equipment without notice and without incurring obligation.

STANDARD FEATURES

- Overhead valve design
- POWER-BORE cylinders
- Oil cooler
- Electronic SMART-SPARK ignition
- Easy access oil fill
- Dual element air cleaner
- Fixed jet SMART-CHOKE carburetor
- Hydraulic valve lifters
- 12V solenoid-shift starter
- 15A charging system
- Dual oil drains
- Spin-on oil filter

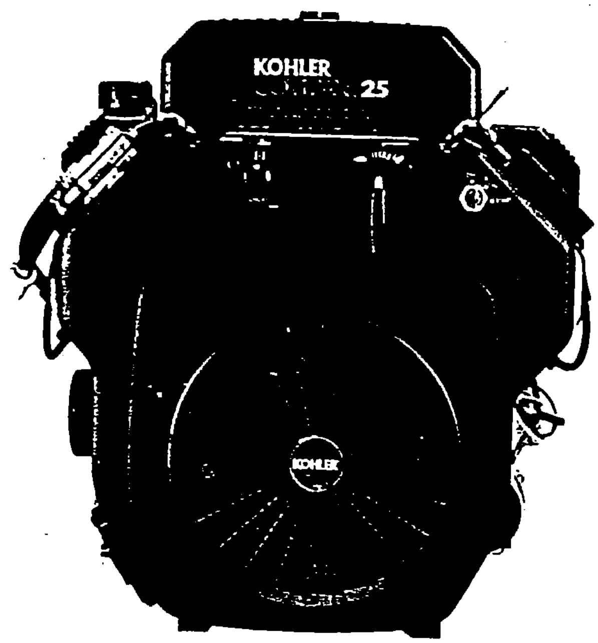
POPULAR FACTORY OPTIONS**

- Mufflers
- Close regulation governor
- High altitude kit
- Choice of crankshafts
- Remote oil filter
- In-line fuel filter
- Engine-mounted controls w/ignition key switch
- Oil Sentry™ system
- Muffler exhaust deflector
- Muffler spark arrestor
- 25A charging system
- Flywheel-mounted PTOs
- PTO thrust bearing (600 lbs)
- SAE A/B pump mounts w/spline crankshafts

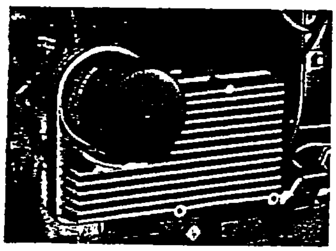
** Standard on some distributor basic engines, optional on OEM engines. Varies between vertical and horizontal shaft engines.

25 HP
HORIZONTAL SHAFT V-TWIN

When you choose Kohler's Command 25 hp horizontal shaft V-Twin, you're choosing the industry's environmental leader in engine power.



SPECIALLY-DESIGNED OIL COOLER

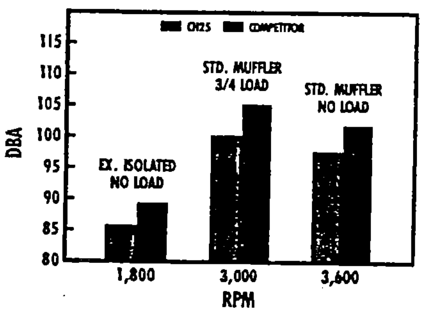


Kohler's specially-designed oil cooler helps maintain the lowest possible oil temperature during the entire power range, regardless of application or duty cycle. It also protects the environment by extending oil change intervals.

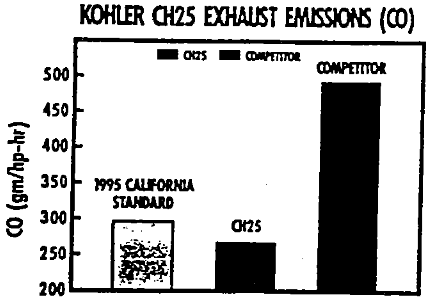
ENVIRONMENTAL LEADERSHIP

Command's CO and HC + NOx exhaust emissions are lower than California's standards and well below the emissions of the competition. Command is also the "quiet" winner in noise emissions. (Competitive product purchased randomly from manufacturer's source of supply. Based on a 1992 test.)

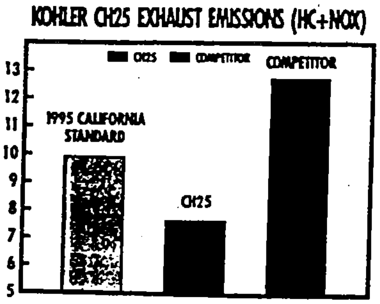
KOHLER CH25 ACOUSTIC EVALUATION



KOHLER CH25 EXHAUST EMISSIONS (CO)

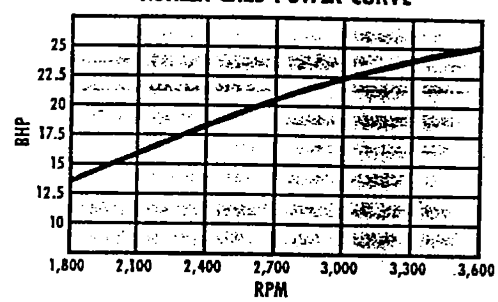


KOHLER CH25 EXHAUST EMISSIONS (HC+NOX)

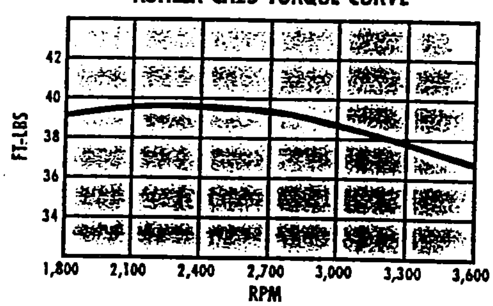


PERFORMANCE DATA

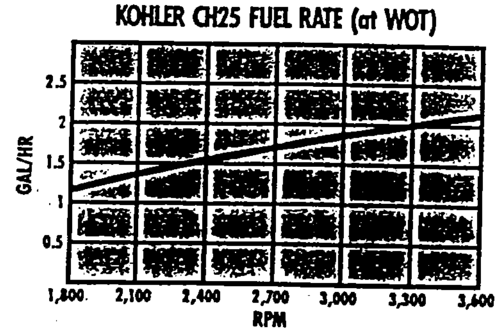
KOHLER CH25 POWER CURVE



KOHLER CH25 TORQUE CURVE

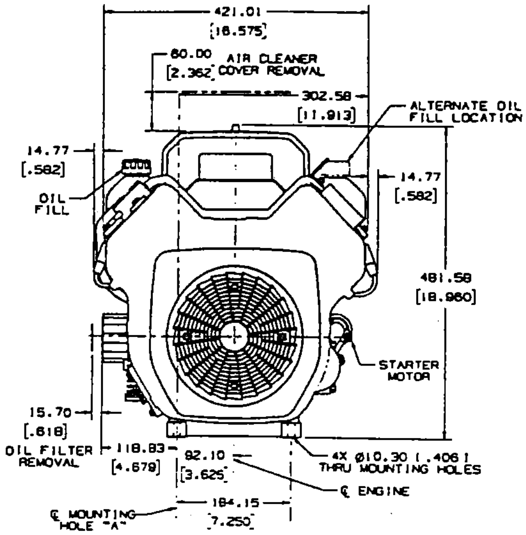


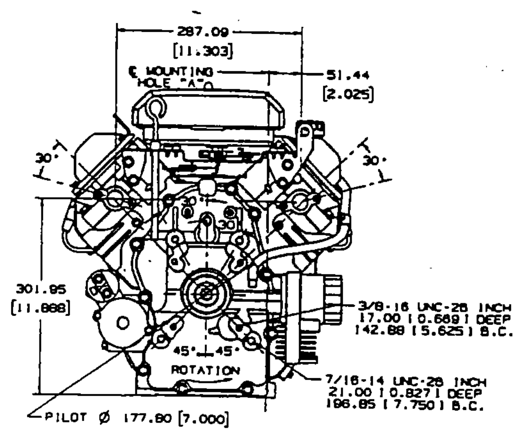
KOHLER CH25 FUEL RATE (at WOT)

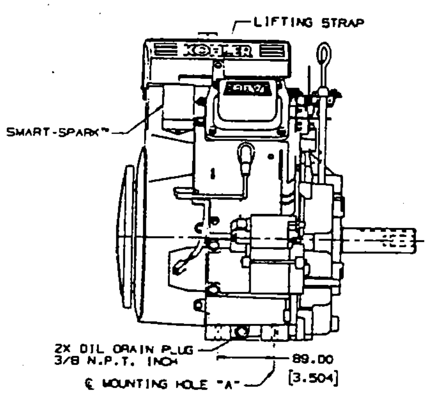


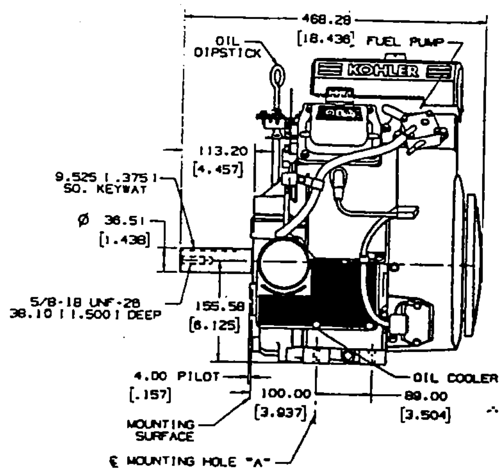
HORIZONTAL SHAFT DIMENSIONS

(Base engine illustrated)







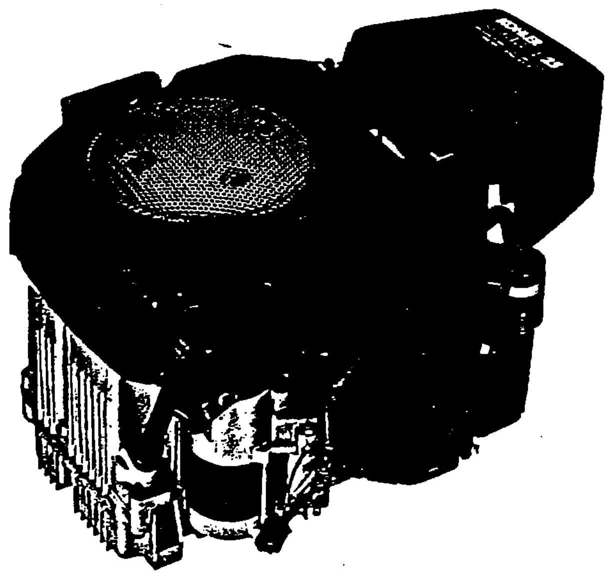


DIMENSIONS IN MILLIMETERS
INCH EQUIVALENT SHOWN IN [ ]

CRANKSHAFT/MOUNTING FACE OPTIONS				
DIMENSIONS:	MM (IN)			
MODEL: CH25	(SPEC SERIES 685XX)			
SPEC VARIATION:	00/01/07	03	04	06
PTO TYPE:	STRAIGHT	STRAIGHT	TAPER	SPLINE
PTO DIAMETER:	36.5 (1.438)	28.6 (1.125)	38.1 (1.50)	38.1 (1.50)
PTO LGTH (TO FACE):	113.2 (4.453)	101.5 (4.00)	100.0 (3.94)	11.5 (0.452)
PTO TAPER:	N/A	N/A	(2.25)/FOOT	N/A
PTO TOOTH/ADAPTOR	N/A	N/A	N/A	13/TYPE "B"
PTO DRILL & TAP:	5/8-18 UNF-2B	7/16-20 UNF-2B	5/16-24 UNF-2B	N/A
TAP DEPTH:	38.1 (1.50)	38.1 (1.50)	15.9 (0.625)	N/A
PTO KEYWAY WIDTH:	9.53 (0.375)	6.35 (0.25)	N/A	N/A
BOLT CIRCLE DIA.:	(5.625. 7.75)	(5.625, 7.75)	(5.625, 7.75)	(5.625, 7.75)
PILOT DIA.:	(7.00)	(7.00)	(6.437)	N/A

NOTE: Contact Kohler representative for special crankshafts or mounting faces not shown here.

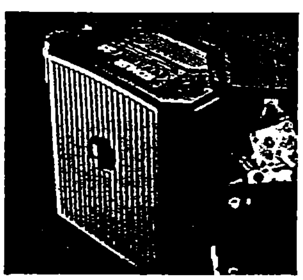
25 HP
VERTICAL SHAFT V-TWIN



Kohler's Command 25 hp vertical shaft engine is designed to last even under extreme conditions, specifically in lawn tractor and commercial mowing applications. With full-pressure lubrication, POWER-BORE cylinders, and Kohler's proven overhead valve design, your Command vertical shaft V-Twin will deliver the horsepower you need throughout its long life.

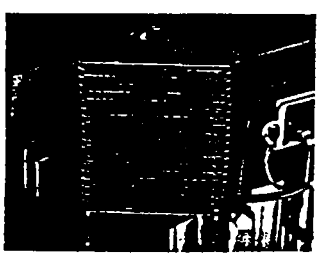
HIGH-EFFICIENCY AIR FILTER

hler vertical shaft V-Twins are available with standard or commercial mower cleaner designs. Both feature dual element filtering to trap dust and dirt as ...ne as 2 microns... that's 1/30th the diameter of a human hair.



- Standard design (shown left) allows engine to fit compactly into nearly any application.
- Commercial mower design (shown above, right) features a larger capacity, 425 square inch filter area. The extra capacity is ideal for mowing operations and the "out-front" position makes regular maintenance quick and easy.

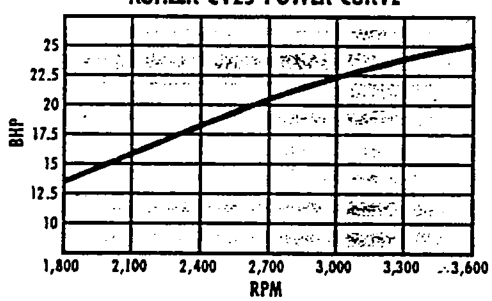
SPECIALLY-DESIGNED OIL COOLER



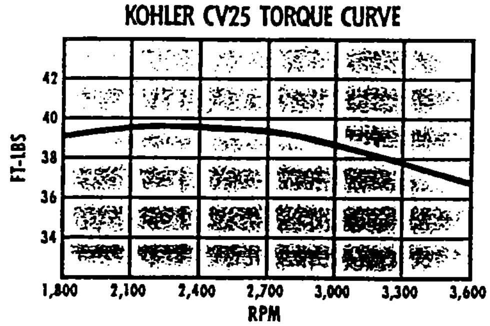
Kohler's specially-designed oil cooler helps maintain the lowest possible oil temperatures during the entire power range, regardless of application or duty cycle. It requires less maintenance by extending oil change intervals.

PERFORMANCE DATA

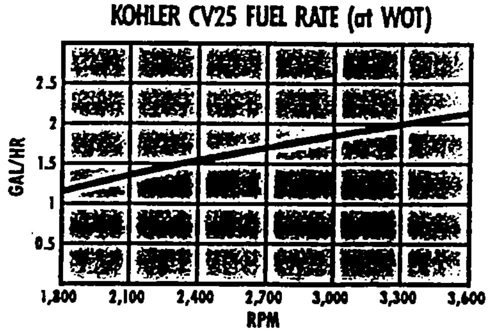
KOHLER CV25 POWER CURVE



KOHLER CV25 TORQUE CURVE

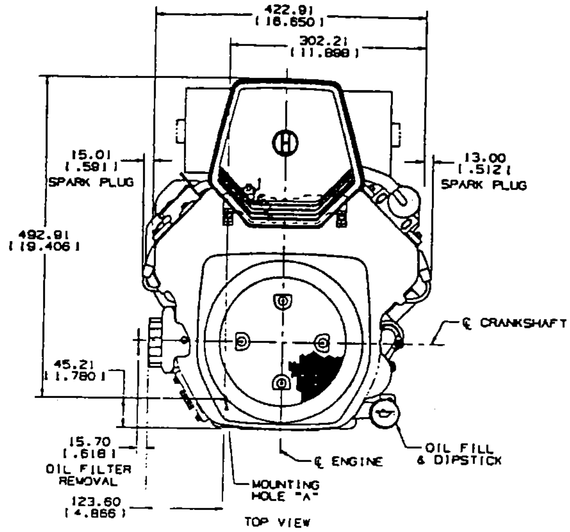


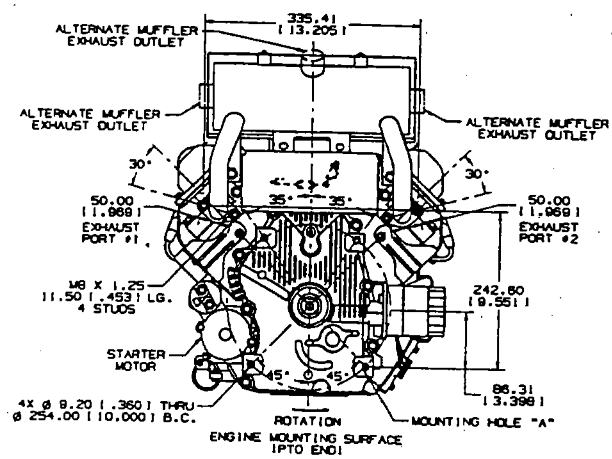
KOHLER CV25 FUEL RATE (at WOT)

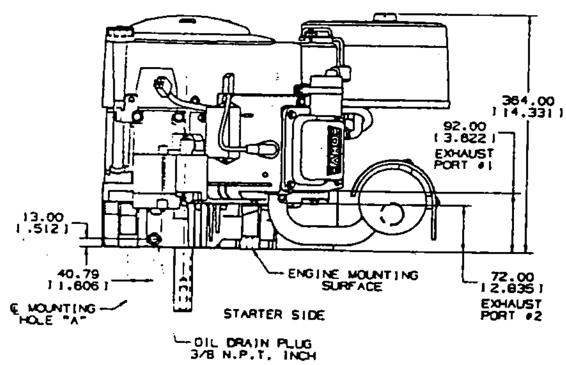


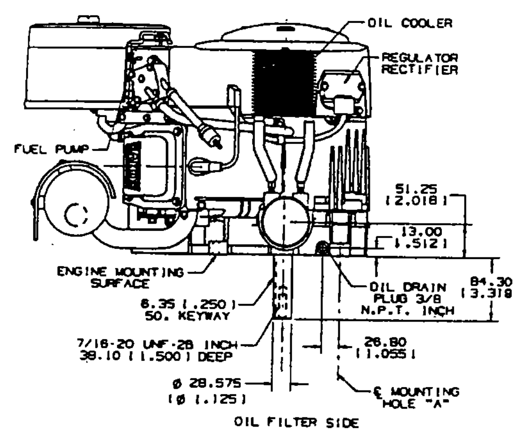
VERTICAL SHAFT DIMENSIONS

(Commercial mowing engine illustrated)









DIMENSIONS IN MILLIMETERS
INCH EQUIVALENT SHOWN IN ( )

CRANKSHAFT/MOUNTING FACE OPTIONS	
DIMENSIONS:	MM (IN)
MODEL: CV25	(SPEC SERIES 695XX)
SPEC VARIATION:	00/01
PTO TYPE:	STRAIGHT
PTO DIAMETER:	28.6 (1.125)
PTO LGTH (TO FACE):	84.3 (3.32)
PTO DRILL & TAP:	7/16-20 UNF-2B
TAP DEPTH:	38.1 (1.50)
PTO KEYWAY WIDTH:	6.35 (0.25)
BOLT CIRCLE DIA.:	254.0 (10.0)
PILOT DIA.:	N/A

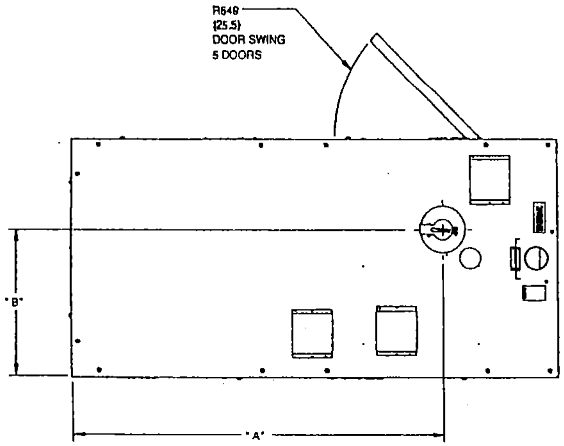
NOTE: Contact Kohler representative for special crankshafts or mounting faces not shown here.

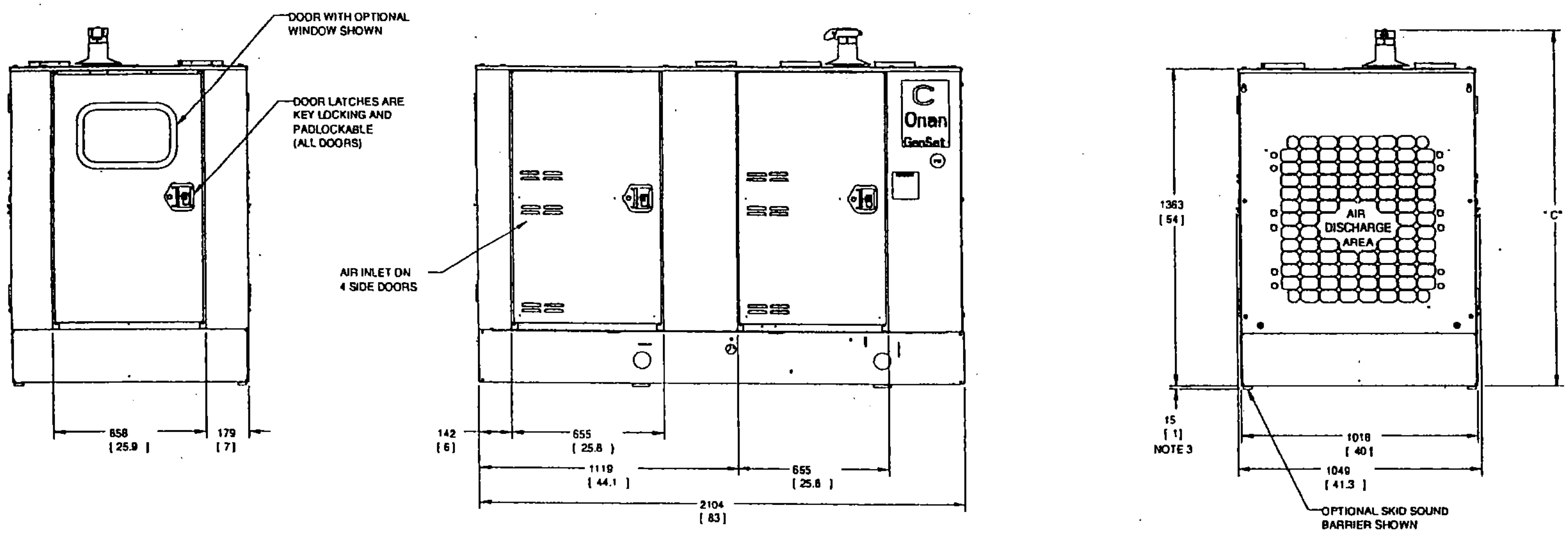
73646	A	1	PRODUCTION RELEASE	-	DAH	DAH	RKE	11-18-96
76024	B	1	ADD MODELS GGFB,FC	2A	DAH	DAH	GILLETT	04-24-97
		2	ADD DIMS FOR MODELS TO TAB	2C	DAH	DAH	GILLETT	04-24-97

NOTE:

1. DIMENSIONS SHOWN IN [ ] ARE INCHES.
2. HOUSING AND MUFFLER WEIGHT: 141 kg [310 lbs]
3. HEIGHT INCREASE OF 14.6 [0.6] WHEN OPTIONAL SKID SOUND BARRIER IS USED.

TABULATION			
MODEL	DIM "A"	DIM "B"	DIM "C"
DGBB,BC	1625 [64.0]	625 [24.6]	1481 [58.3]
DGCA,CB	1607 [63.3]	630 [32.7]	1517 [59.7]
DGCC	1638 [64.5]	630 [32.7]	1517 [59.7]
GGFB,FC	1034 [40.7]	186 [7.30]	1505 [59.3]





APPROVED R_ENGELMANN 11-18-96

METRIC DWG

Pro/ENGINEER

DO NOT SCALE PRINT

D_HOFMEISTER 11-18-96

S_JULIK 11-18-96

R_ENGELMANN 11-18-96

Minneapolis, Minnesota 55432

Onan

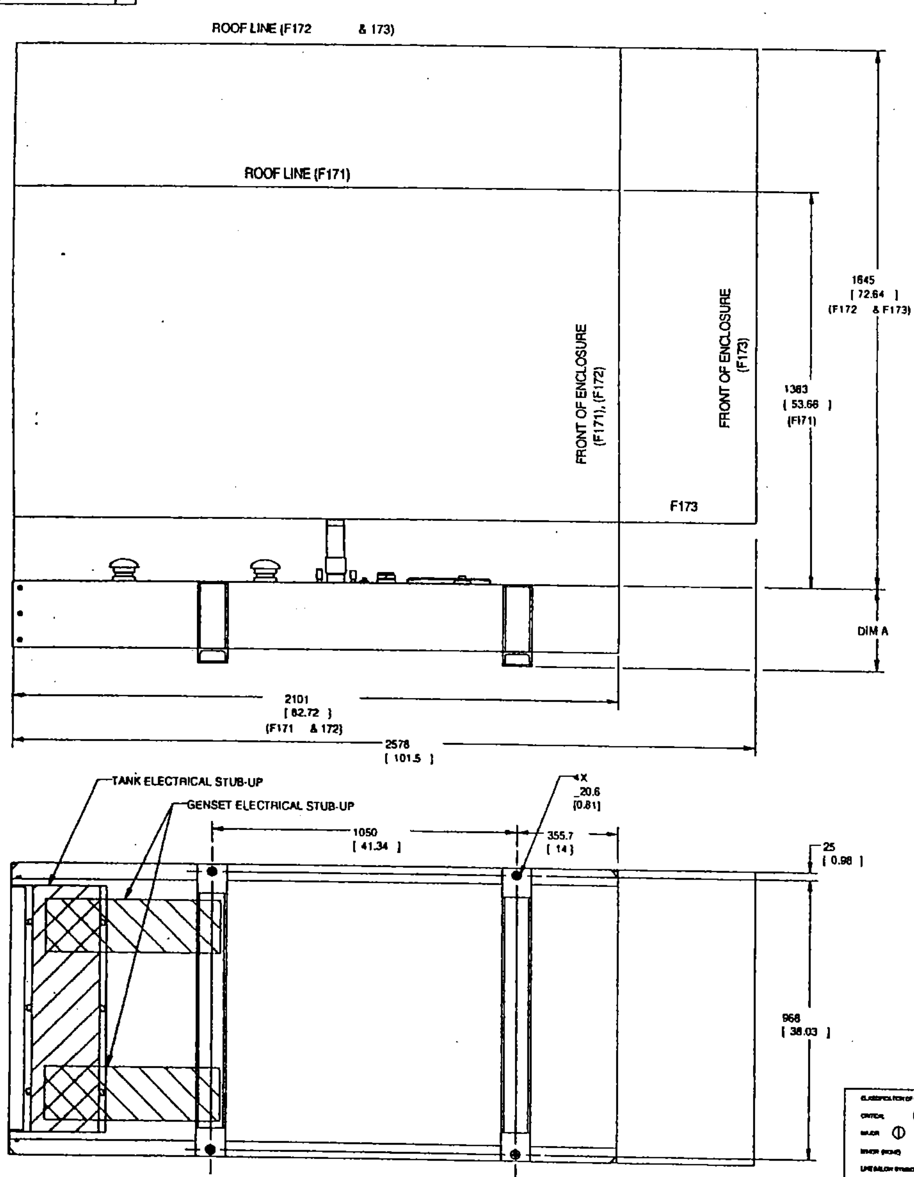
OUTLINE-HOUSING

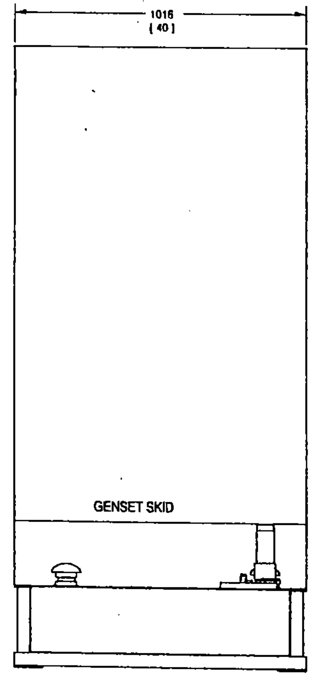
DGBB,CA,CC,GGFB,FC

0500_3171

D

Genset supplied 3/99





73846	A	1	PRODUCTION_RELEASE	CSERKE	11-20-96
74639	B	-			

FOR ENCLOSURE DETAILS SEE ENCLOSURE OUTLINE DRAWINGS.

CLASSIFICATION OF CHARACTERISTICS

APPROVED R_ENGELMANN 11-20-96

METRIC DWG

Pro/ENGINEER

DO NOT SCALE PRINT

C.EDWARDS 11-20-96

S_JULIK 11-20-96

R_ENGELMANN 11-20-96

DGBB,BC,CA,CB

Onan

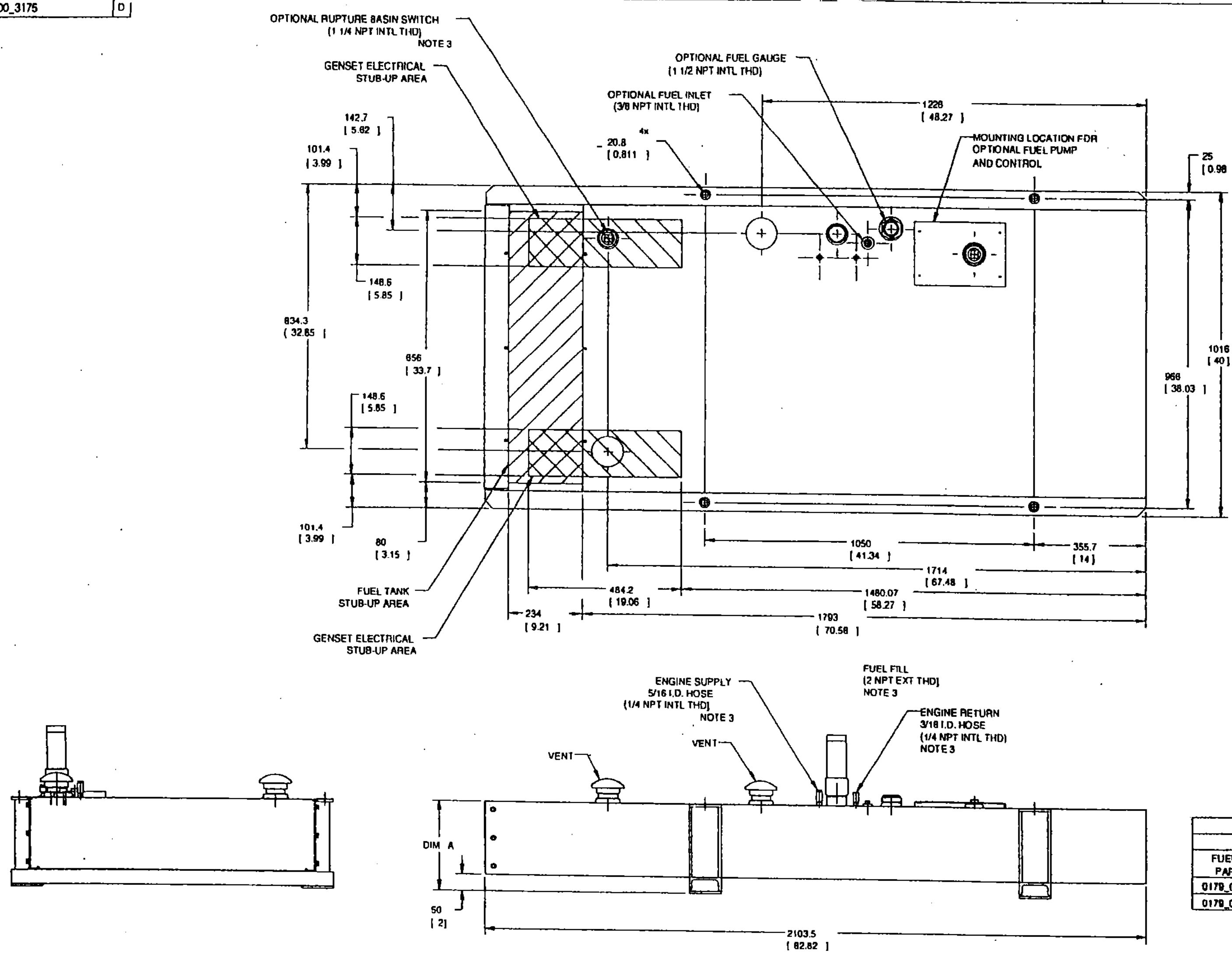
Minneapolis, Minnesota 55432

OUTLINE-FUEL_TANK

0500_3175

D

73548	A	1	PRODUCTION_RELEASE	-	CSB	RKE	RKE	11-20-96
74630	B	1	MODEL DGBB,BC,CA,CB WAS DGCC	8A	CC	BG	GILLETT	06-17-97



NOTES:

1. TANKS ARE UL142 LISTED. SECONDARY CONTAINMENT GENERATOR BASE TANK. REFER TO TANK LABELS AND LOCAL CODE TO DETERMINE VENTING REQUIREMENTS FOR BOTH COMPARTMENTS.

2. SUB BASE FUEL TANK MOUNTING. EXCESSIVE TWISTING OF THE FUEL TANK, WHEN FASTENING IT TO A FOUNDATION, MAY RESULT IN STRUCTURAL FAILURE OF THE TANK. TO INSURE THE INSTALLATION DOES NOT EXCESSIVELY TWIST THE FUEL TANK, THE FOLLOWING PROCEDURE MUST BE OBSERVED:

2.1 REFER TO ONAN APPLICATION MANUAL T030 FOR GENERAL SET MOUNTING GUIDELINES.

2.2 AFTER PLACING SET ON FOUNDATION, VERIFY ALL FOUR MOUNTING PADS CONTACT FOUNDATION.

2.3 THERE ARE 8 SHIMS (.0747 INCH THK) ATTACHED TO EACH FUEL TANK. THESE ARE INTENDED TO FILL ANY GAP BETWEEN THE MOUNTING PADS AND FOUNDATION. IF MORE SHIMS ARE REQUIRED OBTAIN ADDITIONAL P/N 159-1378 FUEL TANK SHIMS.

2.4 INSERT THE MAXIMUM HEIGHT STACK OF SHIMS THAT WILL SLIDE INTO THE GAP.

2.5 TIGHTEN TANK HOLD DOWN MOUNTING FASTENERS.

3. INDICATES PIPE SIZE OF INTERFACE PORT ON FUEL TANK FOR FEATURE OR OPTION INDICATED.

4. DIMENSIONS IN [ ] ARE IN INCHES.

TABULATION

FUEL TANK PART NO.	DIM A	VENT SIZE NOTE 3	TANK VOLUME (GAL) NOMINAL	TANK VOLUME (GAL) EFFECTIVE	DRY WEIGHT kg lb
0179_0749_01	285.72	2"	75	70	227 500
0179_0749_02	487.02	3"	145	140	295 650

APPROVED R_ENGELMANN 11-20-96

METRIC DWG

Pro/ENGINEER

DO NOT SCALE PRINT

C.EDWARDS 11-20-96

S_JULIK 11-20-96

R_ENGELMANN 11-20-96

DGBB,BC,CA,CB

Onan

Minneapolis, Minnesota 55432

OUTLINE-FUEL TANK

0500_3175

D

Section 6

GENSET

GENSET

General Description:

The genset power unit for this lift is an internal combustion engine.. The primary function of this engine is to supply electrical power to operate the lift in the event of a power failure. The entire lift system will function without primary electrical power, while all safety systems remain fully operational.

Parts:

INTERNAL COMBUSTION ENGINE

See accompanying manufacturer's manual.

Quick Reference (Write information from your equipment in the spaces below:)

- Oil filter:______________________________
- Oil:____________________ Capacity:________
- Fuel:____________________ Capacity:________
- Fuel filter:______________________________
- Fuel line hose:____________________________
- Air filter:______________________________
- Belts:______________________________
- Coolant:____________________ Capacity:________
- Standard adjustments:________________________

Spare parts are available from POMA of AMERICA.

Adjustment/Maintenance of Genset Engine:

See manufacturer's manual for specific engine and adjustments.

For authorized service and maintenance, contact POMA of AMERICA or a local manufacturer's representative.

Maintenance Schedule of Hydraulic Evacuation Drive

Frequency	*Maintenance Activity*
DAILY	* Fuel level * Oil level * Coolant level * Battery level
ONCE A WEEK	Run the evacuation engine 10 minutes to ensure it will operate properly.
ONCE A MONTH or as required	Run the lift for 15 minutes powered by the genset drive. Check for proper power supply to lift. All other inspections shall be performed in accordance with the manufacturer's manual.
LUBRICATION	See the manufacturer's manual.

Industrial Business Group Worldwide Warranty

Commercial/Industrial Generator Sets and Systems

Limited Warranty

Base Coverage

Coverage Period

This is a limited warranty which applies to all Onan® and Cummins® brand Industrial generator sets and associated switches, switchgear, and accessories (hereafter referred to as "Products".) Products will be free from defects in material and workmanship for a period of one year from the date of initial start–up of the Product. In the case of units used for rental or demonstration purposes, the one year coverage period begins on the date the unit is first used for such rental or demonstration purposes. This warranty is extended to all subsequent owners of the unit during the coverage period.

Repair or replacement parts are warranted for ninety (90) days from date of purchase, excluding labor and travel expenses.

Onan's Responsibilities

Onan's liability and owner's sole remedy are limited to the repair or replacement, at Onan's option, of the Product or parts that do not conform to this warranty.

In accordance with Onan's Warranty Administration policies, Onan will pay for the parts and labor required to repair the unit and, when necessary, reasonable labor expenses associated with the removal and reinstallation of the Product if such work is done by an authorized Cummins/Onan Distributor or designated service representative.

In accordance with Onan's Warranty Administration policies, Onan will pay limited travel expenses* when necessary to make on–site repairs. See your Distributor for details.

The cost of maintenance items such as oil, filter elements, belts, and hoses will be paid for by Onan when such items are not reusable because of the warrantable failure.

*EXCLUDES mobile applications.

*Travel for TGHAA series including transfer switch is limited to 2-1/2 hours travel time and 100 miles round trip.

Owner's Responsibilities

The owner is obligated to install, operate and maintain the Product in accordance with the recommendations published by Onan, including, without limitation, operating within power rating designation set out in Power Rating section, below. The owner is responsible for the costs associated with such maintenance and any adjustments which may be required.

Prior to expiration of the applicable warranty and within 30 days after discovery of the warrantable failure, the owner must notify an authorized Cummins/Onan Distributor or designated repair facility of any warrantable failure and have the repair or replacement made by such facility.

Installation inspection and initial start–up of Commercial–Industrial genset or power systems must be conducted by an authorized Cummins/Onan distributor, or designated representative.

The owner is responsible for payment of any of the following expenses that might be incurred as a result of a failure under the terms of this warranty:

1. Rental equipment used to replace the equipment being repaired, other downtime expenses, and all business costs and losses.
2. Telephone, communication, living and travel expenses incurred by the owner.
3. The premium costs for overtime labor requested by the owner.
4. The cost of air freight or other extraordinary expenses for shipment of parts over and above premium surface transportation.
5. Any other consequential or incidental amounts.

Power Ratings

Onan generator sets must be applied within the following rating designations:

Standby Power Rating

The standby power rating is applicable for supplying emergency power for the duration of normal power interruption.

No sustained overload capability is available for this rating. This rating is applicable to installations served by a reliable normal utility source. This rating is only applicable to variable loads with an average load factor of 80% of the standby rating for a maximum of 200 hours of operation per year. In installations served by unreliable utility sources (where outages last longer or occur more frequently), where operation is likely to exceed 200 hours per year, the prime power rating should be applied. The standby rating is only applicable for emergency and standby applications where the generator set serves as the back-up to the normal utility source. No sustained utility parallel operation is permitted with this rating. For applications requiring sustained utility parallel operation, the prime power or base load rating must be utilized.

Prime Power Rating

The prime power rating is applicable for supplying electric power in lieu of commercially purchased power as set out below.

The number of allowable operating hours per year is unlimited for variable load applications but is limited for constant load applications as described below:

Unlimited Running Time Power

Prime power is available for an unlimited number of annual operating hours in variable load applications. Applications requiring any utility parallel operation at constant load are subject to running time limitations. In variable load applications, the average load factor should not exceed 70% of the prime power rating. A 10% overload capability is available for a period of one hour within a twelve hour period of operation, but not to exceed 25 hours per year. The operating time at or above the Prime Power Rating must not exceed 500 hours per year.

Limited Running Time Prime Power

Prime power is available for a limited number of annual operating hours in constant load applications such as interruptible, load curtailment, peak shaving and other applications that normally involve utility parallel operation. Generator sets may operate in parallel with the utility source up to 750 hours per year at power levels not to exceed the Prime Power Rating. Any application requiring more than 750 hours of operation per year at the Prime Power Rating should use the Base Load Power Rating.

Base Load Power Rating

The base load power rating is applicable for supplying power continuously to a load up to 100% of the base rating for unlimited hours.

No sustained overload capability is available at this rating. This rating is applicable for utility base load operation. In these applications, generator sets are operated in parallel with a utility source and run under constant loads for extended periods of time.

Note: In determining average load factor, loads of less than 30% are considered as 30% and time at standstill is not counted.

Limitations

Onan is not responsible for the repair or replacement of units required because of normal wear, accident, misuse, abuse, improper installation, lack of maintenance, unauthorized modifications, improper storage, negligence, improper or contaminated fuel, or use of parts that do not meet Onan specifications

NORMAL WEAR:

This warranty will not cover repair where normal use has exhausted the life of a part or product. All mechanical devices need periodic parts replacement and service to perform well.

It should be remembered that the service life of any product is dependent on the care it receives and the conditions under which it has to operate. Coolant heaters will be covered for a period of one year from date of start–up. This warranty shall not apply to starting batteries.

THERE IS NO OTHER EXPRESS WARRANTY, AND NO PERSON IS AUTHORIZED TO GIVE ANY OTHER WARRANTIES OR TO ASSUME ANY OTHER LIABILITIES ON ONAN'S BEHALF UNLESS MADE OR ASSUMED IN WRITING BY AN OFFICER OF ONAN.

IMPLIED WARRANTIES INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO THE PERIODS OF COVERAGE SET FORTH ABOVE, AND TO THE EXTENT PERMITTED BY LAW, ANY AND ALL IMPLIED WARRANTIES ARE EXCLUDED. IN NO EVENT IS ONAN LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

This warranty gives the owner specific legal rights. The owner may also have other rights which vary depending on local laws. In some areas, local laws do not allow limitations on how long an implied warranty lasts or do not allow the exclusion of incidental or consequential damages, so the above limitations may not apply to you.

Extended Coverage

Features

Several levels of Extended Coverage are available on Industrial Products.**Comprehensive, Basic, Major Components, Prime Power and Utility Load Management. Major components, Prime Power and Utility Load Management.

Extended Coverage programs are available only in the United States and Canada. Onan provides total system component coverage. There are NO deductibles applied to these programs.

**EXCLUDES TGHAA series including transfer switch.

Coverage Period

Emergency Standby Applications: Both Comprehensive and Basic Extended Coverage are available for gensets/systems used exclusively for emergency standby applications, for 5 years or 1500 hours, whichever occurs first, from date of initial start–up. Comprehensive coverage is also available for 2 years or 1500 hours, whichever occurs first from initial system start–up. Major Component Extended Coverage is also available for diesel gensets/systems rated at 200 kW/60 Hz and above, for 10 years or 3000 hours, whichever occurs first, from date of initial start–up. See your Distributor for details.

Prime Power Applications: Extended Coverage is available for diesel gensets used in prime power applications, for 2 years or 6000 hours, whichever occurs first, from date of initial start–up. See your Distributor for details.

Utility Load Management Applications: Both Comprehensive and Basic Extended Coverage are available for diesel gensets/systems rated at 200 kW/ 60 Hz and above used exclusively in Utility Load Management Applications, for 5 years or 4000 hours, whichever occurs first, from the date of initial system start–up. Comprehensive coverage is also available for 2 years or 1500 hours, whichever occurs first from initial system start–up. See your Distributor for details.

Onan's Responsibilities

Comprehensive Extended Coverage incorporates the identical features contained in the Base Warranty, subject to the above coverage period limitations.

Basic Extended Coverage provides only replacement parts as specified under the Base Warranty. Labor to remove/replace the failed warrantable part is covered as specified in the Base Warranty for 2 years from date of initial start–up.

Major Components Extended Coverage incorporates the identical features contained in Basic Extended Coverage up to year 5 or 1500 hours. In years 6 through 10, or hours beyond 1500 up to 3000, Major Components Extended Coverage provides only replacement parts for the following major components: Engine – cylinder block, camshaft, crankshaft, connecting rods, and flywheel; Alternator – main rotor, main stator, and drive disk; Transfer Switch – actuator motor and main contacts; and Switchgear – buswork and main circuit breaker.

Prime Power Extended Coverage provides replacement parts and labor to remove/replace the failed warrantable part as specified in the Base Warranty.

Owner's Responsibilities

Under Comprehensive Extended Coverage owner responsibilities are identical to those noted under the Base Warranty.

Under Basic Extended Coverage the owner is responsible for all expenses beyond the Base Warranty period except the cost of the failed warrantable part and the labor to remove/replace such failed part through the second year, as specified in the Base Warranty.

Under Major Components Extended Coverage the owner responsibilities are identical to those listed under Basic Extended Coverage up to year 5 or 1500 hours, whichever occurs first. In years 6 through 10 or hours exceeding 1500, up to 3000, the owner is responsible for all expenses except the cost of the failed warrantable major component as specified under Onan's Responsibilities.

Under Prime Power Extended Coverage the owner is responsible for all expenses beyond the Base Warranty period except the cost of the failed warrantable part and the labor to remove/replace such failed part as specified in the Base Warranty.

For all Extended Coverage programs, the owner is responsible for providing written documentation showing that the product has been maintained in accordance with Onan's published recommendations.

Limitations

Extended Coverage options for Standby Applications apply only to Cummins/Onan brand gensets and systems used exclusively in emergency standby power applications. 10 year Extended Coverage applies only to Cummins/Onan brand diesel gensets rated 200 kW/60 Hz and above.

Extended Coverage options for Utility Load Management Applications apply only to Cummins/Onan brand diesel gensets and systems rated at 200 kW/60 Hz and above used exclusively in Utility Load Management Applications.

2 year Prime Power Extended Coverage applies only to Cummins/Onan brand diesel gensets and packages, including set mounted controls.

Gensets/systems must be registered within the Base Warranty period. See your Cummins/Onan distributor for details.

10 year Major Components, 2 year Prime Power and all Utility Load Management Extended Coverage programs are available only in the United States and Canada.

ALL LIMITATIONS OF BASE WARRANTY ALSO APPLY TO EXTENDED COVERAGE.

Onan

Onan Corporation
1400 73rd Avenue N. E.
Minneapolis, MN 55432
612-574-5000
Telex: 275477
Fax: 612-574-8087

Section 7

GEAR REDUCERS AND DRIVE BULLWHEELS

Gear Reducer

Putting into Service:

Before the initial operation of the gearbox, and after it has been filled with oil, the oil circuit must be purged. To do this:

* Operate the reduction gear with no load for about 10 minutes
* Loosen oil line to input bearing and verify oil flow.
* Tighten fitting.
* Check and adjust oil flow indicator.

Lubricating the Gearbox:

The gears and bearings are splash lubricated or lubricated by an attached pump. These gearboxes have no grease fittings.

Recommended Oil

* Quality: Use an extreme pressure oil for hypoid gears. If a synthetic oil is desired use Mobil SHC 7590, meeting A.P.I. GL5.

* Viscosity: ISO scale: 68 to 100 Cst at 40° C
SAE transmissions scale: 80 W

* Leading brands:

SHELL	Spirax HD 80 W	GULF	EP Lubricant HD 100
ARAL	Getriebeol Hyp. 80	KLUBER	Syntheso D 200 EP
ASBOL	Topress VG 100	MOBIL	Mobil HD 80 W 90
BP	Hypogear EP 80	SUNOCO	MP-GL 580 VG 68
ELF	Tranself B 80 W	TEXACO	Multigear EP 80
ESSO	Gear Oil GX 80 W	TOTAL	Transmission TM 80/90

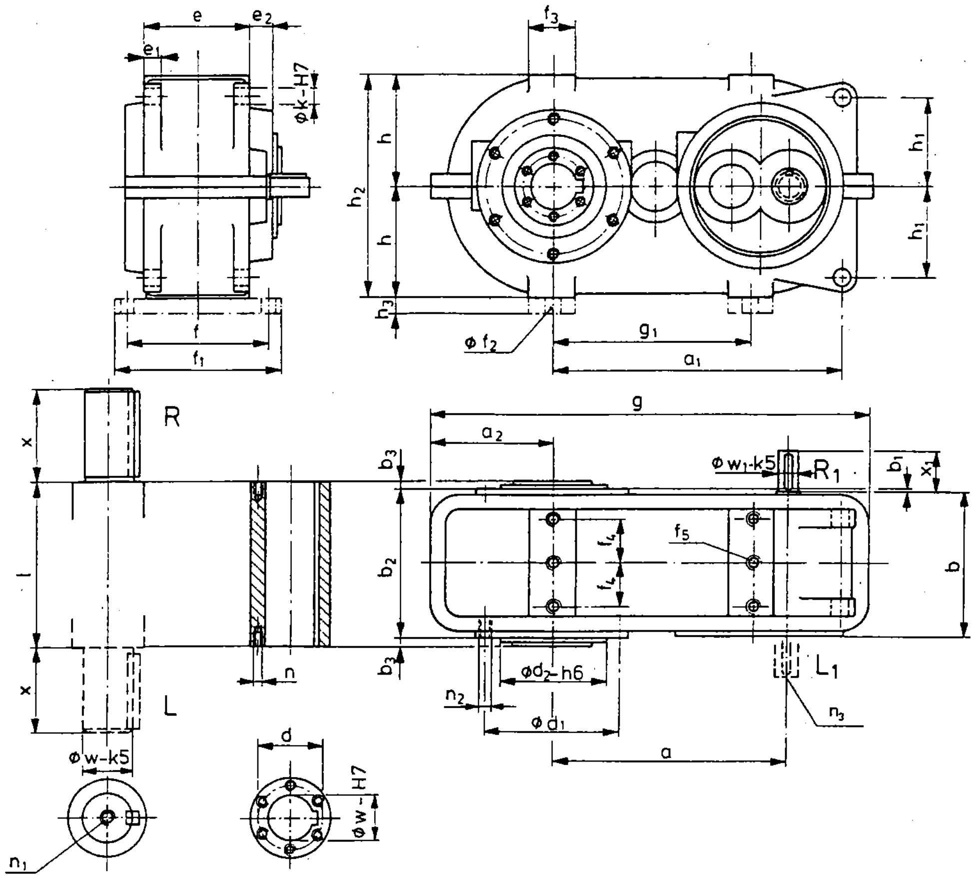
* Quantity of oil: Oil quantities may vary depending on the type or input box and cooling system supplied. Check nameplate for approximate quantity in liters for each reducer.

T/ZT 135–246
Stirnrad-Schmalgetriebe

Z.. = Abtriebshohlwelle

T/ZT 135–246
Compact helical gear reducers

Z.. = hollow output shaft



Keile nach VSM 15161
(DIN 6885)
Keys acc. to VSM 15161
(DIN 6885)

Zentrierung d_2–h6 nur für Z-Ausführung

Centering d_2–h6 for Z execution only

Typen ***Types***	**a**	**a_1**	**a_2**	**b**	**b_1**	**b_2**	**b_3**	**d**	**d_1**	**d_2**	**e**	**e_1**	**e_2**	**f**	**f_1**	**f_2**	**f_3**	**f_4**
T/ZT 135	309	390	159	206	5	206	7	86	180	138	138	20	34	175	215	18	60	55
T/ZT 154	353	430	181	217	3	223	6	100	210	160	152	25	35,5	200	240	22	70	60
T/ZT 180	415	495	213	269	10	276	6	110	240	185	192	30	42	250	290	22	80	80
T/ZT 210	478	572	231	293	12	302	9	120	280	210	214	32	44	280	330	27	90	90
T/ZT 246	561	635	315	336	25	358	6	150	330	230	244	37	57	320	380	35	100	100

	f_5	**g**	**g_1**	**h**	**h_1**	**h_2**	**h_3**	**k**	**l**	**n**	**n_1**	**n_2**	**n_3**	**w**	**w_1**
T/TZ 135	M12×15	590	290	152	125	304	32	20	220	M10×15	M20×40	M 8×15	M 8×18	70	25
T/ZT 154	M16×20	665	310	170	140	340	42	25	235	M10×15	M20×40	M12×18	M 8×18	80	30
T/ZT 180	M16×20	773	350	195	160	390	50	30	288	M12×18	M24×47	M16×22	M10×22	90	35
T/ZT 210	M20×28	870	420	243	200	486	35	35	320	M12×18	M24×47	M16×22	M10×22	100	35
T/ZT 246	M24×32	1040	480	327	260	654	40	40	370	M12×18	M24×47	M16×22	M10×22	120	40

	x	**x_1**
T/ZT 135	120	55
T/ZT 154	130	70
T/ZT 180	150	80
T/ZT 210	160	80
T/ZT 246	180	90

Checking the Oil Level

Check oil at the sight gauge visible through the hole in the gearbox plate. Oil level should be near the middle of the glass

Draining

The gearbox must be drained at the end of the first season and then after 5000 hours of operation, or every 5 years, whichever occurs first.

To drain:

- With the oil still at its operating temperature, open the drain cock a quarter of a turn, and take remove cap to let air in.
- Pour in a little fresh oil to clear away any residues; drain off.
- Close the drain cock.

Filling

This is required before the initial start-up and then for each oil change.

To fill:

- Fill gearbox through filler hole with appropriate quantity of oil.
- Check the oil level at the sight gauge.
- Run lift for 5 minutes and check oil level again.

Oil Pump

After any extended shut down period (one week or more) oil flow must be verified during start-up.

Disassembling/ Reassembling

All internal gearbox work should be performed by a qualified technician.

All gear set work may be performed without detensioning the drive bullwheel. However, it is necessary to detension the drive bullwheel if the output shaft bearings need changing.

Maintenance of the Gearbox

Frequency	*Maintenance Activity*
DAILY	Check for leaks and housing discoloration.
MONTHLY	Check the oil level. Verify oil pump pressure visually by inspecting pressure guage.
END OF 1ST SEASON	Change the oil.
START OF SEASON	Verify oil flow from lubrication pump.
5 YEARS OR 5000 OPERATING HOURS.	Drain and change oil

Drive Bullwheel

The bullwheel is lined with a rubber lining which assures good adherence between the haul rope and the bullwheel.

Aligning the Haul Rope in the Bullwheel

With the use of the guide sheaves, raise or lower the haul rope entering and exiting the bullwheel until the plane of the haul rope matches the plane of the bullwheel.

Checking the Adjustment

When the bullwheel is properly aligned, the haul rope should ride in the groove correctly and enter and exit the bullwheel without twisting.

Maintenance of the Bullwheel

Frequency	*Maintenance Activity*
MONTHLY & AT BEGINNING & END OF SEASON	Verify the correct alignment of the cable in the bullwheel
MONTHLY	Check general condition of the bullwheel lining. Replace if more than 1¼" (30mm) is worn from original surface, less than 3/4" (20mm) thickness remaining. See Line Equipment and Towers Section in this manual for liner removal procedure.

Section 8

BULLWHEEL BRAKE

Bullwheel Brakes
4 ton

General Description

The lift is equipped with two bullwheel brakes. These brakes are mounted on the side of the drive bullwheel and apply braking force to the flange of the bullwheel.

These brakes are hydraulically released and held in the ready position by a solenoid valve. The bullwheel brakes are spring-applied when the hydraulic pressure is released due to an normal stop, emergency stop, rollback, over-speed, or an opening of the manual valves.

Mounting

Mount in accordance with Drawing 3038.869.

Adjustment of Brakes (Drawing 3038.869)

1. Pump brake hydraulic system up to braking pressure listed in Section 1, *Lift Data*, of this manual.

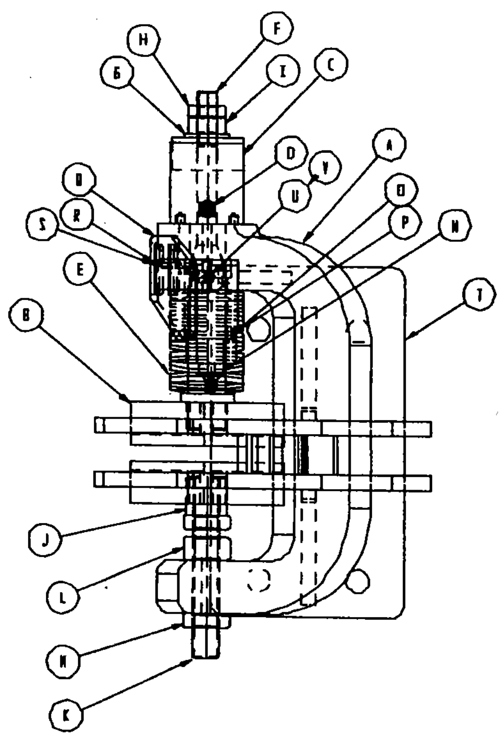
2. Tighten bolt (K) until the shoes just touch the braking flange (both shoes must be touching the braking track).

3. Tighten lock nut (M).

4. Pump hydraulic system up to opening pressure listed in Section 1 of this manual.

5. Loosen the 8mm bolts (R) on the switch bracket and adjust switch (N) to be completely depressed when open and not touching when the brake is applied. See the electrical schematics for wiring diagram.

6. Inspect brake to insure nothing is impeding the travel of the full brake assembly. When brake is applied both shoes need to make full contact with the brake flange.



INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
V	1	NUT HM8 8.8 PLATED	/	/	058004	/
U	1	PAULSTRA	/	/	051011	/
T	1	BRAKE MOUNT	/	/	4075.877	C
S	2	LOCKWASHER JCZ8 PLATED	/	/	059284	/
R	2	BOLT HM8 x 20/20 8.8 PLATED	/	/	057002	/
Q	1	SWITCH BRACKET	/	/	3225.543	A
P	2	LOCKWASHER JCZ5 PLATED	/	/	059282	/
O	2	BOLT CM5 x 45/22 5.8 PLATED	/	/	5107237	/
N	1	MICRO SWITCH LSV1A	/	/	5208201	/
M	2	NUT LOW 1" - 12 NF GR. 5 PLATED	/	/	5058124	/
L	1	NUT 1" -12 NF GR. 5 PLATED	/	/	5058123	/
K	1	ALLTHREAD 1"-12 NF x 8-3/4" LG. GR. 5 PLATED	/	/	5107737	/
J	1	ADAPTER, BRAKE PAD	/	/	3225.542	A
I	1	NUT LOW 3/4" - 10 NF GR. 8 PLATED	/	/	5058120	/
H	1	NUT 3/4" 10 NF- GR. 8 PLATED	/	/	5058085	/
G	1	WASHER 3/4" PLATED	/	/	5058089	/
F	1	BRAKE SHAFT, HYD CYL.	/	/	3225.541	B
E	20	SPRING WASHER 70/35.5/4 PLATED	/	/	058063	/
D	1	ELBOW 90° 4MP-4MJ	/	/	5050277	/
C	1	HYDRAULIC CYLINDER ENERPAC RWH-121	/	/	5300953	/
B	2	BRAKE SHOE	/	/	3065.308	A3
A	1	BRAKE FRAME	/	/	3225.540	B

PRODUCTION USE ONLY

QUANTITY:
ORDER FOR:
DUE DATE:

REV	DESCRIPTION OF REVISION	DATE	BY
/			
/			

TOLERANCES • UNLESS INDICATED •

• FABRICATION •
FRACTIONAL ..... ±1/16
ANGULAR .... ±1/2°

• MACHINING •
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR .... ±.1°

ORIG. YEAR 1999

SERVICE/E-BRAKE ASSEMBLY

4 TON

• This DRAWING and the DESIGN are Proprietary to POMA OF AMERICA • Duplication without the Permission of POMA OF AMERICA is Prohibited •

CABLE TRANSPORT SYSTEMS

CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA

DRAWN BY: SMITH J.
CHECKED BY: TUSBERG N.
DATE: 3/10/99
SCALE: 1/4

FORMAT: B
DRAWING NUMBER: 3038.869
REVISION: /

Maintenance of Bullwheel Brakes

Frequency	*Maintenance*
DAILY	Observe operation of brakes; check for missing pads, broken springs or other damage, leaks in hoses or fittings, foreign material including ice on bullwheel braking track, or missing parts. Check oil level.
MONTHLY	Check oil level in reservoir. Pump brakes up to braking pressure (listed in Sect. 1 of this manual). Both shoes must be touching brake track. If they are not, adjust brakes to compensate for shoe wear. Check brake pad thickness. If worn to less than 3/16" thickness, replacement is necessary. NOTE: Replacement shoes and pads must be supplied by Poma of America, Inc. IN ORDER TO MAINTAIN BRAKE INTEGRITY, NO SUBSTITUTIONS OF SHOES OR PADS ARE ALLOWED. Check adjustment of brake shoe contact switches. Pull test brakes to at least minimum test value listed in Section 1. Adjust if necessary.
ANNUALLY	Relubricate Schnorr washer friction surfaces and main shafts with anti-seize. Check condition of hanger bolts, springs and brake assembly for loose, broken or missing parts. Check hydraulic system for proper oil level, leaks, dirt. Check hoses and fittings for leaks, abrasions or damage. Check adjustment of contact switches. Check for worn brake shoes. Check for proper operation, including braking pressure and opening pressure. Check Maintenance Section of Ethywag hydraulic system for additional tests and checks.
EVERY 5 YEARS	Replace Schnorr washers and perform annual maintenance as specified above.

BRAKE CONTROL SYSTEMS

Applying the Brake

The brakes can be triggered while running under normal conditions, as well as with the standby motor, in the following ways using the systems described below.

As soon as the solenoid valve supply is opened by one of the brake control devices, the hydraulic circuit is returned to the tank, which relieves the elastic washers and applies the brake shoes.

Normal Stop

This can be controlled from the end terminals and cabin by a push button.

The action of these systems starts a regenerative state of the electric motor and applies the brake when zero speed is achieved.

While operating the lift using the evacuation motor, all stops are emergency stops.

Emergency Stop

This can be controlled from the end terminals by a manual reset push button. Once triggered, this type of knob has to be reset manually to be able to release the brakes and to start up the lift again.

The action of these systems cuts the power supply to the unit's solenoid valve. This will set the emergency brake immediately and the service brake at zero speed, and cuts the power supply to the electric motor or kills the auxiliary motor.

Overspeed or Anti-rollback Stop

Operation and Adjustments

A cable tach generator, driven by a round-belt engaged on a sheave of the main cable, supplies a speed setpoint meter located on the control panel with a control voltage.

The setpoint meter has two adjustable indexes:

- one is set at the overspeed value, i.e. normal speed + 10%,
- the other is set at approx. -0.3 m/sec. to detect any backward movement of the lift.

As the speed of the lift increases, the tach generator speed also increases and the speed reference moves towards the overspeed setpoint. If the speed reaches the setpoint, value the device triggers the brake and stops the lift.

If the lift starts moving backwards relative to the direction of desired travel, the polarity at the tach generator terminals is reversed, and the device reaches the anti-rollback setpoint. When this happens, the device also triggers the brake and stops the lift.

Testing

To test that the system functions correctly, start up the lift and move the overspeed setpoint of the device (using the adjusting knob) below the actual speed of the lift. The brakes should be triggered immediately.

Stopping due to Service Brake Failure

If the service brake fails to apply or fails to stop the lift within the preset amount of time for any reason, the emergency brake will apply automatically.

BULLWHEEL BRAKE HYDRAULIC UNITS

General Description (Drawing 3038.877)

The brake hydraulic unit includes a system to operate each bullwheel brake.

When the E-brake pump button is depressed, the 24 volt electric motor starts driving a pump which sends pressurized oil into the circuit. Solenoid valve (7) is supplied with 24 V DC to close the brake circuit and allow the brakes to be released as long as safeties remain OK. Either the hand pump or the electric pump may be used to charge the system to the bullwheel brake operating pressure as set on relief valve (4).

When the lift starts valve (7) closes to send pressurized oil to open the service brake, and hold it open.

During a normal stop, the electrical motor will go into a regenerative state to stop the lift. After zero speed is detected valve (7) will open and set the brake. If a pre-determined deceleration is not detected during motor regen, then the brake will set.

During an E-stop the emergency brake will be set by de-energizing the solenoid (7) which allows oil to return to the tank via flow valve (8), this allows the rate of application of the emergency brake to be adjusted.

In a rollback situation, solenoid (7) will de-energized instantly on both brake units, applying the brakes as soon as possible before the lift has a chance to accelerate.

Lockout valves (10) allow either the emergency brake or service brake to be locked open to perform brake tests or maintenance. Switch (9) monitors the proper position of these valves and will prevent the lift from starting or running if they are not in the proper position. The manual dump valve (14) allow the emergency and/or service brake to be released manually.

Maintenance of the Service and Bullwheel Brake Hydraulic Unit and Bullwheel Brakes

Frequency	*Maintenance Activity*
DAILY	Check the oil level in the unit and check for leaks. Check the reading on the unit's pressure gauge for both the service brake and emergency brake. Visually check for broken or missing springs. Visually check condition of brake shoes. Check for proper operation of the brakes. Check condition of the braking tracks on the bullwheel.
MONTHLY	Carry out a brake pull test. See section 1 of this manual.
ANNUALLY	Check the condition of the cable tach generator V-belt. Check for leaks Check the condition of the braking tracks on the bullwheel. Check the oil level and condition. Inspect hoses for deterioration.
EVERY 1200 HOURS OR 2 YEARS	Change oil in reservoir. Thoroughly clean reservoir.

PUTTING HYDRAULIC UNIT INTO SERVICE

Initial Start-up

Before the first start-up of the lift, and after each oil change, service or repair; carry out the following procedure, in the order given below.

- Insure the bullwheel braking track is clean of all paint, protectants, oil and foreign materials.

- Check that all connectors and hoses are tight.

- Fill the tank with oil until the maximum level is indicated in the sight gauge.

- Close the dump valve (14).

- Loosen hose fittings at rams and pump up by hand to purge air.

- Obtain green safeties ok light.

- Check that the solenoid valve (7) is closed.
  (Center pin in top of valve must be down.)

Pressurize the circuit

- Remove cap and loosen jam nut on relief valve (4) and turn adjusting screw counterclockwise 2 full turns.

- For <u>unit with motor-driven pump</u>: Run the electric motor (1) by pressing the "***e-brake pump***" button in the electrical cabinet.

- Adjust the relief valve (4) until the pressure gauge (11) shows the required opening pressure, corresponding to the adjustment listed in Section 1, *Lift Data.*

- To adjust the brakes, see applicable brake section.

- Adjust the speed of release of the brake cylinders.

- Set the brakes by pressing the emergency stop button.

- Screw in flow control valve screw (8) to slow activation.

- Unscrew (8) to speed up activation.

- Check correct operation of brake shoe contact switch by slowly opening valve (14).

- Check once again that the opening and setting of the brakes function correctly.

Standby Start-up

When it is impossible to use the unit's electric motor, use the hand pump (6) to pressurize the circuit and open the brakes.

Pump until desired pressure is attained on gauge (11). Note: When using the hand pump the pressure relief valve is bypassed so pressure needs to be monitored at the gauge (11) at all times.

Recommended Oil

Use the same oil as used in the tensioning hydraulic unit. Which may be:

- either hydraulic oil with viscosity index > or = 150
  and viscosity 32 or 37 at 40° C

- or a hydraulic oil "aviation" type or "low temperature",
  13-16 Cst at 40° C and 400-500 Cst at -40° C.

Oil Change

Change the oil periodically, removing the drain plug and fill through the breather.
Check the level through the sight gauge.

Daily Start-up

Check the oil level through the sight gauge of the tank and top up if necessary.

The dump valve (14) must be closed.

Start up the unit and check the operating pressure on the pressure gauge (11).

ADJUSTMENT OF THE RELIEF VALVE

Determination of the pressure required depends on the adjustment of the brakes (see Section 1, *Lift Data*).

To adjust the pressure, follow this procedure on the relief valve (4) on the front of the manifold.

- Loosen the lock nut.

- Start-up the unit.

- Turn the adjusting screw (4): IN to increase or OUT to decrease the pressure reading on the gauge and obtain the opening pressure listed in Section 1, *Lift Data*. Oil leakage on the threading during adjustment is normal.

- Next tighten the lock nut.

ADJUSTMENT OF THE RELEASE SPEED OF THE BRAKE CYLINDERS

Use the adjusting screw located on the flow regulator (8) for this adjustment.

LOCKING THE CIRCUIT

To lock the brakes in the open position (hydraulic circuit pressurized), close the isolating valve (10).

This releases the safety switches (9) which will not allow the lift to operate.

RETURN TO THE TANK

To lower the pressure in the circuit and cause braking from the unit, throw the lever of the dump valve (14) to the open position.

The safety switch on each brake then prevents the lift from starting up again.

Section 9

HYDRAULIC TENSION SYSTEMS

Hydraulic Tension System

General Description

The lift is equipped with a constant tension system designed by Poma of America, Inc. The system operates continually during lift operation on 480 volts AC to maintain the correct tension on the haul rope.

NOTICE: Electrical troubleshooting should be performed by a qualified electrician.

Constant Running Pump Systems

Operation (See drawing 3038.547)

The electric motor (17) drives the variable displacement hydraulic pump (12) which pressurizes the system to design pressure. Design pressure is controlled by the pressure compensated pump (12). A back-up relief valve (11) is adjusted to open at a pressure approximately 10% - 20% higher than design pressure. This arrangement provides additional safety against over pressure. During normal operation, relief valve (11) should remain closed and the pressure is regulated by the pressure compensated pump.

Two Barksdale electrical switches (14) are provided. One switch is adjusted to stop the lift if the pressure of the system drops 10% below design pressure. A second switch is adjusted to stop the lift if the pressure exceeds design pressure by 10%. The system pressure is shown on the gauge (15). **These switches should never be readjusted without written permission and instructions from Poma of America, Inc.**

Caution must be taken to ensure that the hydraulic system pressure, as well as under pressure shutdown, over pressure shutdown and pressure compensated pump (12) are adjusted to design specifications at all times.

> **Failure to maintain design pressure specifications can increase loads on terminals, towers, and haul rope and can cause serious injury or death as well as equipment damage.**

These valves and switches are preset during load test and do not normally require further adjustment. However, if adjustments are required, please contact Poma of America, Inc. to verify system settings.

In the event of a power failure, a hand pump (6) is provided to maintain system pressure. If the lift is operating without electric power, the system pressure must be checked periodically because the pressure will change as the lift loading changes. The hand pump must be used to maintain system pressure within design tolerances.

A cooling system (7) consisting of a radiator and the cooling fan of the electric motor is provided to maintain the system temperature. A two-way valve (9) is provided to bleed pressure out of the system. A solenoid valve (10) opens when the electric pump is running to allow fluid to be pumped either direction through the pump, depending if the cylinders are extending or retracting. Once the system is static, the pump will go to zero stroke and only pump to maintain pressure.

NOTE: **Because the haul rope applies load to the tension terminal, and the track rope applies load directly to the ram, the rams are under pressure at all times. Opening valves, fittings or hose connections can cause serious injury, death or equipment damage. The tension carriage must be against the stops and track cable ram fully extended and at end of travel before opening any fitting or hose.**

To move the carriage to the stops and extend the track rope ram, slowly open decompression valve (9). This will move the carriage up and track rope ram to extend. This process has to be done slowly in order not to set the velocity fuses on the rams. Visually inspect extension of rams. The system pressure will then drop to zero.

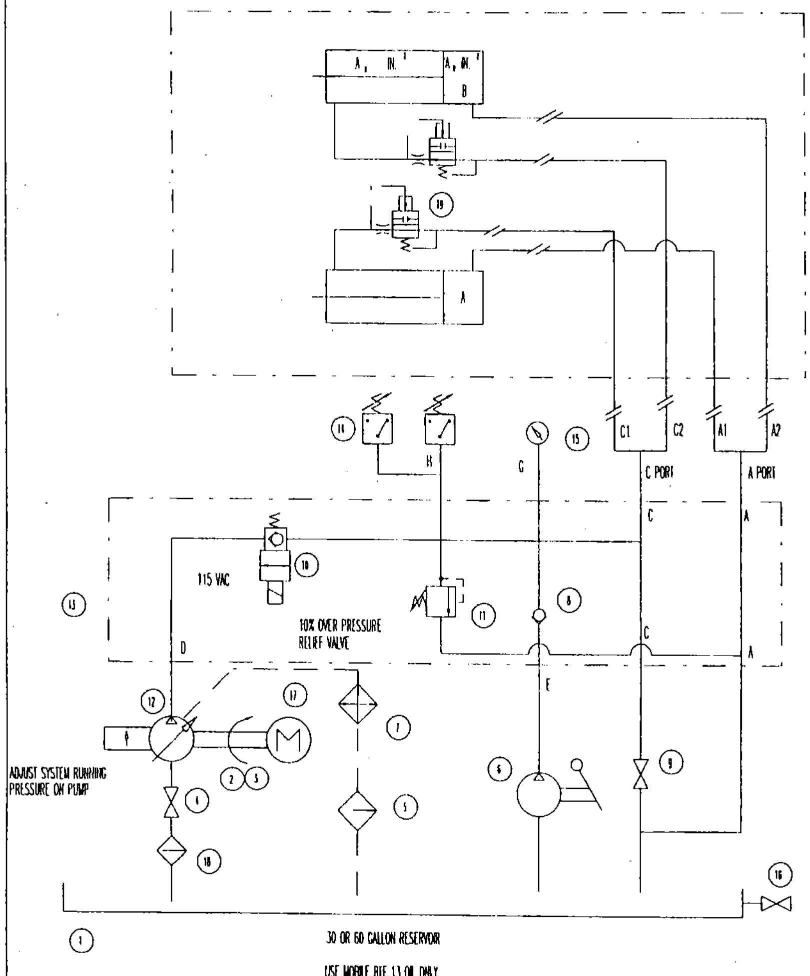
To clamp the track rope, contact Poma of America, Inc. for cable clamp and procedure.

NOTE: **Never detention the rams with anybody in the cabin. Failure to do so could result in injury or death.**

A filter (5) is provided to filter the oil as it returns to the tank.

Velocity fuses (19) are installed on the retract piston end of the rams. These valves will close and lock the carriage in case of a hose failure, or any time that the flow out of the rams exceeds a certain value, typically 3 or 5 gallons per minute.

SPARE PARTS: All hydraulic tension system replacement parts are available from Poma of America, Inc.



INDEX	REQ'D	DESCRIPTION	MANUF. PART NUMBER	POMA PART NUMBER
19	2	POW-R-OIL VELOCITY FUSE (FOR MEMORY)	52919-33	5300.171
18	1	ZINGA SUCTION STRAINER	SS-100-03-100	5300.207
17	1	LEESON ELEC. MTR. 3HP/230/460/3/182TC W/ A16H178 HOFFMAN ENCL.	130326	5001.037
16	1	LHA BALL VALVE 3/4" NPT	BV-12N	5300.199
15	1	LENZ PRESSURE GAUGE 0-3000	BAC-3M-25	5300.198
14	2	BARKSDALE PRESSURE SWITCH	B1T H32	5300.197
13	1	TEI CUSTOM MANIFOLD (COMP. 1)		5300.196
12	1	DENISON PUMP	PV 6 2UC C00-SP1673	5300.195
11	1	STERLING HYDRAULICS RELIEF VALVE WITH TAMPER PROOF CAP	MODEL ASB0207N /RC1125	5300.194
10	1	STERLING HYDRAULICS SOLENOID VALVE 115VAC	GS02080N - SOLENOID CCS-115-0	5300.193
9	1	STAUFF 1/2" BALL VALVE	BBV-2008001	5300.192
8	1	STERLING HYDRAULICS CHECK VALVE	02A025 0.2N	5300.191
7	1	AMERICAN INDUSTRIAL AIR/OIL HEAT EXCHANGER	AORN-20-S	5300.190
6	1	BRAND HAND PUMP	HP-61 OA R	5300.153
5	1	MPS RETURN FILTER ASSEMBLY	MPS-505-RG7/CS650-P10A/CI-20	5300.251
4	1	B&K GATE VALVE 3/4"	NPT 100-004	5300.188
3	1	VESCOR PUMP/MOTOR ADAPTOR	1960	5300.187
2	1	HAYES COUPLING	7AN 13-07	5300.186
1	1	VESCOR 30 OR 60 GALLON RESERVOIR	10030 OR 10060	5300.160 OR .136

REV.	DESCRIPTION OF REVISION	DATE	BY
A	UPDATE 5, 17 FOR 1995	5/18/95	CWT

1994

HYDRAULIC SCHEMATIC

COMPETITION II TENSIONING UNITS

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AERIAL TRAMWAY SYSTEMS

2510 FORESIGHT CIRCLE
GRAND JUNCTION, COLORADO U.S.A.

POMA OF AMERICA

Putting a New System into Service

ASSEMBLY:

Fill tank with oil. Mount rams to the drive unit and track rope anchor. Be certain to secure linking pins with roll pins or cotter pins. Connect hoses between ram and pump unit.

NOTE: Be sure that all hoses are connected properly: piston end hoses are connected to pressure ports on the pump unit. Anchor end hoses are connected to return ports on pump unit. Flush clear oil through hoses prior to connecting to rams and pump.

Extend ram by pumping oil into anchor end. **NOTE:** This procedure must only be performed while the tension is held on the service cables on track rope and lorry is against the stops. This procedure will fill the backside of rams with oil and evacuate the air.

Connect ram piston rod to track rope socket anchor (track rope) and drive tower anchor (haul rope). Again secure the linking pins with roll pins or cotter pins.

INITIAL START-UP:

Before start-up, check that all hoses are correctly connected.

Check that the reservoir is full of oil. Choose a hydraulic oil which has the following characteristics:

- very high viscosity index: > 150
- viscosity: from 32 to 37 Cst at 40° C
- aniline point: 94 to 100 approx.
- pour point: < -35° C
- flash point: > 190° C approx.

Close decompression valve (9).

Start-up electric motor.

When the cable is under tension, check the oil pressure.

Check that there is no external leakage at hose connections.

Check oil level in reservoir and, if necessary, add oil to maintain tank between 2/3 and 3/4 full.

CHECKING THE TRIP SYSTEM:

Pressurize the circuit and open the decompression valve (9), to decrease the pressure slowly. The pressure switch should stop the lift when the nominal pressure is lowered by 10%. Increase the system pressure by screwing the allen head adjustment screw on the pump in until the pressure is increased 10%. The pressure switch should stop the lift.

SAFETY VALVE FITTED ON RAMS:

The safety valves (19), fitted on the rams, close if the hose between the rams and the unit fails.

To test that the safety valves work properly, open the decompression valve (9) suddenly; the carriage and track rope should lock in position. **NOTE: <u>Never</u> use safety valves to hold the carriage while working on the pump.**

Limit Switch

GENERAL DESCRIPTION

This device serves to stop the lift before the ram reaches either of its end positions.

- Ram mounted:	Figure 9-1: These switches are attached directly to the track rope ram.
- Carriage mounted:	Figure 9-2: These switches are attached directly to the carriage guide.

RAM MOUNTED LIMIT SWITCHES

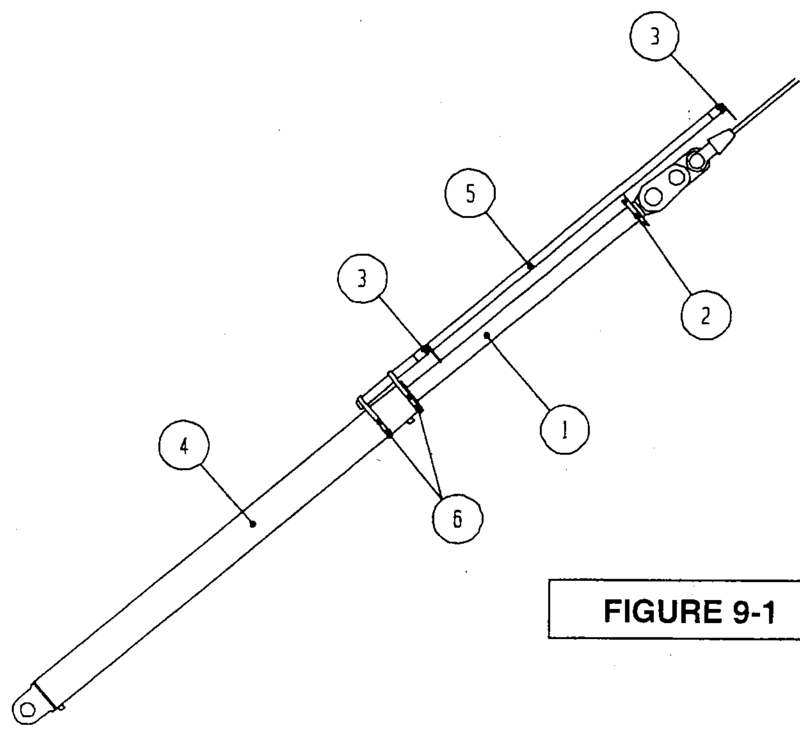


FIGURE 9-1

OPERATION (see figure 9-1)

When the ram piston (1) is extended or retracted.

- As the ram is extended the collar (2) attached to the piston (1) will move away from the ram housing (4). A rod (5) is attached to the ram housing (4) with two mounting brackets (6). Therefore the rod (5) remains stationary with respect to the piston (1). Switches (3) are mounted to the stationary rod. As the piston (1) is extended or retracted, the collar (2) will move with it. As the collar (2) passes the switches (3) the switches are tripped before the end of travel of the ram is reached.

ADJUSTMENT:

- Clamp the switches (3) on the fixed rod (5) in a position so the collar (2) will trip the switches before end of travel is reached.

- Fully load the cabin (without people) and run the lift to the return. Mark the maximum extent of the ram collar (2) with respect to the fixed rod (5). Adjust the switch (closest to the track rope) 4-6in from the mark towards the track rope.

- Dock the cabin at the drive and completely unload it. Adjust the switch (farthest from the track rope) 4-6in from the collar away from the track rope.

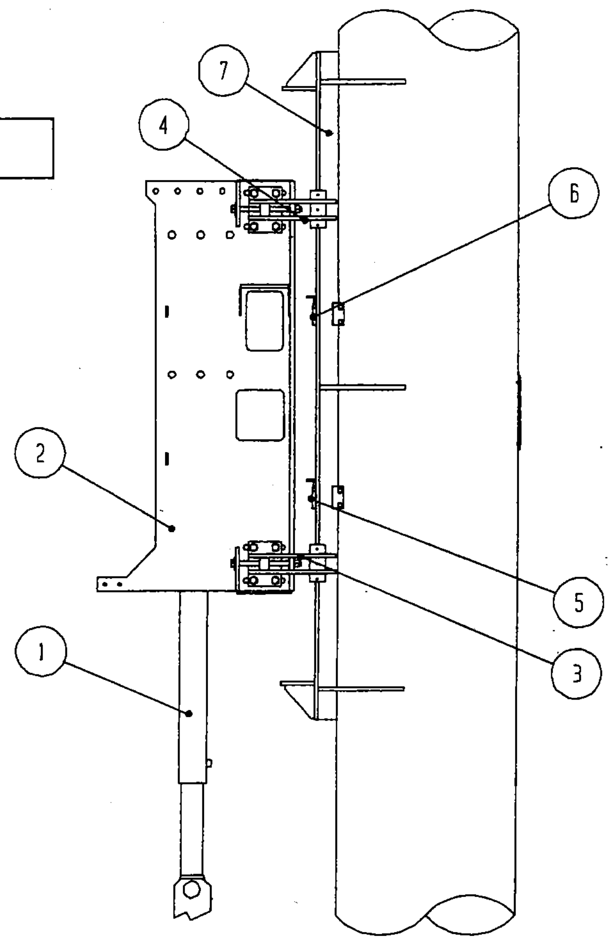
- Make note of the distance between the switches after adjustment. This distance should be maintained considering temperature and rope stretch.

- Trip the switches by hand to check that it actually stops the lift.

NOTE: Track rope ram maximum extension = 217in center of pin to center of pin.
Minimum retraction = 119 3/8in center of pin to center of pin

CARRIAGE MOUNTED LIMIT SWITCHES

FIGURE 9-2



OPERATION (see figure 9-2)

When the ram (1) is extended or retracted.

- As the ram is extended the carriage (2) moves up. The bottom carriage guide (3) passes by and trips the limit switch (5) mounted to the rail (7) attached to the drive tower. When the ram is retracted the carriage (2) moves down. The top carriage guide (4) passes by and trips the limit switch (6) mounted to the rail (7) attached to the drive tower. The switches are tripped before end of travel is reached.

ADJUSTMENT: (See Figure 9-2)

- Clamp the switches (5,6) on the rail (7) in a position so the carriage guides (3,4) will trip the switches before end of travel is reached.

- Fully load the cabin (without people) and run the lift to the return. Mark the maximum extent of the bottom carriage guide (3) with respect to the rail (7). Adjust the bottom switch 2in above the mark.

- Dock the cabin at the drive and completely unload it. Adjust the top switch 2in below the top carriage guide (4).

- Make note of the distance between the switches after adjustment. This distance should be maintained considering temperature and rope stretch.

- Trip the switches by hand to check that it actually stops the lift.

NOTE: Carriage ram maximum extension = 58.38in center of pin to center of pin.
Minimum retraction = 34.38in center of pin to center of pin

Do not allow ram to extend completely. Always stop at a minimum of 2" from maximum position.

Troubleshooting the Tensioning System

PROBLEMS	CAUSES	REMEDIES
The system cannot be pressurized	Lack of oil	Top off the oil level and check that there is no leak.
	Incorrect operation	Check that the valve (9) is fully closed.
	Defective relief valve	Check the condition of relief valve unit (i.e. O-rings, dirt).
	Defective pump	Replace the pump.

Maintenance Schedule for Tensioning System

Frequency	*Maintenance Activity*
AFTER THE FIRST 10 HOURS	Check the filter element as follows: - stop hydraulic pump operation - remove filter - if necessary, change element (never attempt to clean it as this may damage element) - clean magnetic core (if applicable) with a cloth - re-assemble
DAILY	Operating pressure: check the value on the pressure gauge. Verify that it matches design pressure. Rams and carriage: make sure they have not reached their end position. Check that there is no leakage. Check motor and pump for any abnormal noises. Check the oil level.
MONTHLY	Pressure switch: check for correct operation. Check valve (10): check that the pressure reading on the pressure gauge is maintained when the lift is stopped. Safety valves (19) fitted on rams: check for correct operation. Limit switch: check general condition and that tripping the switch stops the lift. Grease spherical bushings on rams with MOBIL MOBILITH SHC 460 or equivalent. Visually inspect hydraulic hoses and fittings for signs of wear.
AFTER EVERY 1000 HOURS	Change filter element.
AFTER EVERY 1000 HOURS or 2 YEARS	Empty hydraulic reservoir and refill with new hydraulic oil. **NOTE: NEVER MIX DIFFERENT BRANDS OF OIL.**

TEI ENGINEERED PRODUCTS INCORPORATED

Poma of America
Integral Mini-Evac / Comp II
OPERATIONS & MAINTENANCE MANUAL

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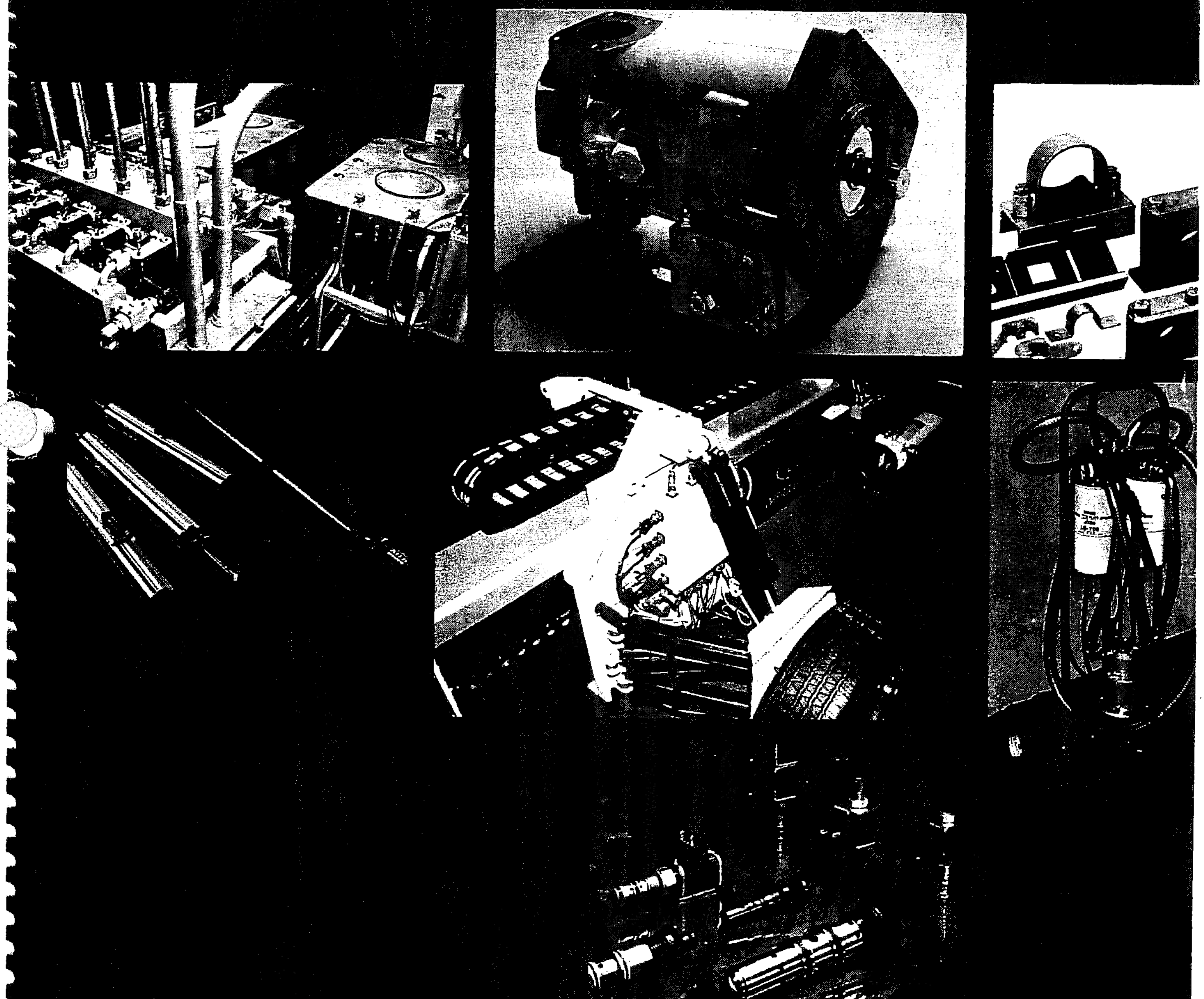
T E I ENGINEERED PRODUCTS, INC.

The Successful Application of Today's
Technology for Practical Solutions in Industry.



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Poma of America
Integral Mini-Evac / Comp II

Manufactured By:

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1.0 Introduction

Congratulations, on the purchase of your TEI Engineered Products, Inc. Hydraulic Power Unit (HPU). In addition to the HPU, you have also received access to these additional benefits:

Factory Trained/Certified Technicians:
Our technicians are fully trained in all aspects of hydraulic component operations including pumps, motors, valves and cylinders. With over 25 years of service in the shop and the engineering support including Professional Engineers to back them up, we can service all of your hydraulic needs, in a timely fashion and with guaranteed results.

Large Component Part Inventory:
TEI maintains one of the largest hydraulic parts inventories in the Rocky Mountain Region. Many pumps/motors/valves are maintained in component stock so we can pull immediately for rebuilding our customer's equipment. In addition, we maintain pumps and motors in a rebuilt state to sell in a Rebuilt-Exchange Program (RBX). This provides you with a quicker turn-around and lower down-time, thus saving you money.

On-Site Training:
New systems always work as designed, but later after warranty runs out and repairs are needed we are certainly available to assist with service or we can provide training for your service/maintenance personnel. By providing this training, you will find improved up-time, lower cost of operation, and higher moral.

1.1 Unpacking and Inspection

On receiving the unit, inspect the unit thoroughly for external damage.

When unpacking your Cabinet be careful not to damage any electronics, valve handles, etc. which may protruding from the Cabinet.

Once the unit has been unpacked, inspect it to ensure that no damage has occurred during freight. If you discover damage has occurred, take a photograph of the damaged area and notify the freight carrier immediately.

Table of Contents

1.2 Warranty and Service

TEI Engineered Product, Inc. (TEI) warrants the equipment or parts supplied by TEI against defects in design material and workmanship for a period of twelve (12) months from date of shipment from TEI. If the original purchaser, within twelve (12) months of original shipment by TEI, reships the product as a component of a machine manufactured by such purchaser or from the original purchaser's stock, the warranty will be extended for a period equal to six (6) months from the date of shipment from the original purchaser. For the extension of warranty to be effective, documentation will be required to verify the purchase of such equipment from TEI and subsequent sale by such purchaser. If the equipment is rebuilt or repaired by TEI during the original new product warranty, the warranty shall continue for the balance of the original warranty period or for a period equal to six (6) months, whichever is longer. Repairs made outside the warranty period will be warranted against defects in material and workmanship for a period of six (6) months from the date of repair.

If any failure to conform with the applicable warranty develops during the specified period under normal and proper use and provided the equipment has been properly stored, installed, and maintained, TEI shall, if given prompt notice by purchaser within the warranty period set forth herein, correct such non-conformity at its option, either by repair or replacement, F.O.B. repair facility or by refund of the purchase price of the nonconforming equipment or part.

When the nature of the defect is such that it is appropriate in the judgment of TEI to do so, repairs will be made, at TEI's option, at the equipment site. Repair or replacement under applicable warranty shall be made at no charge to customer for replacement of defective parts and warranty labor when work is performed during normal working hours 8:00 a.m. to 4:30 p.m., Monday through Friday, exclusive of holidays. Labor performed at other times at the request of purchaser will be billed at the applicable rate then prevailing for services of TEI personnel. Serviceman travel time, transportation and living costs are the sole responsibility of the purchaser and will be billed at a rate of 10% above actual costs incurred. Replaced equipment or parts become the property of TEI.

The warranty contained herein shall not apply to: defects in materials provided by purchaser; design stipulated by purchaser; or sale of used equipment or components furnished by TEI, but not manufactured by TEI.

The warranty contained herein shall terminate if the equipment failure giving rise to a claim under warranty results from (a) unauthorized modification, repair or alteration, (b) improper operation, application, maintenance or installation, (c) damage during shipment, (d) operation, handling or other dealings with the equipment in a negligent manner, or (e) abnormal conditions or temperature, moisture, dirt or corrosive matter.

The warranty contained herein shall not apply to damages as a result of acts of God, War, or Civil Insurrection, nor shall it apply to products which, in the sole judgment of TEI, have been subject to negligence, abuse, accident, tampering or alteration, nor to other than normal application, use, and service.

THE WARRANTIES, RIGHTS AND REMEDIES SET FORTH ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, REPRESENTATIONS, CONDITIONS, RIGHTS AND REMEDIES WITH RESPECT TO THE EQUIPMENT, EXPRESS OR IMPLIED OR STATUTORY OR OTHER WISE AND WHETHER WRITTEN OR ORAL, AND ALL OTHER WARRANTIES, REPRESENTATIONS, CONDITIONS, RIGHTS AND REMEDIES, INCLUDING, BUT NOT LIMITED TO , ANY WARRANTY OF MERCHANTABILITY, DURABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY EXPRESSLY DISCLAIMED, EXCLUDED AND WAIVED BY PURCHASER TO THE FULLEST EXTENT PERMITTED BY LAW.

EXCEPT TO THE EXTENT SPECIFICALLY SET FORTH IN THIS LIMITED WARRANTY, TEI SHALL NOT BE LIABLE AND DISCLAIMS ALL LIABILITY FOR CONSEQUENTIAL DAMAGE OR INJURY (FATAL OR OTHERWISE) OF EVERY KIND (WHETHER CLASSIFIED AS DIRECT, SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES).

Correction of non-conformities in the manner and for the period of time provided above shall be purchaser's exclusive remedy and shall constitute fulfillment of all liabilities of TEI, whether in warranty, contract, negligence, tort or otherwise with respect to the quality of the equipment.

TEI shall not be responsible for providing working access to the defect, including disassembly and re-assembly of the equipment or for providing transportation to and from repair facility, all of which shall be at purchaser's expense.

1.3 *Using this Manual*

Using this manual is very simple. Look through it completely before any action occurs with the system. Become familiar with the table of contents, start-up instruction, maintenance procedures, and the specifications. By following all instructions carefully, there is less risk to the machinery.

1.4 *Introduction to the HPU*

To become more familiar with the unit, locate the general arrangement and hydraulic schematic drawings, located in the Specifications section of this manual. Locate all critical locations and components on the HPU (i.e. electrical connection, customer hydraulic connections, etc.). Familiarize yourself with the hydraulic symbols on the schematic and correlate those symbols to the components on the system.

2.0 Fluids and Filtration

2.1 *Fluid Recommendation*

The fluid recommended for this HPU is Mobile DTE 25

All hydraulic oil has a definite, useful life span, and when it has deteriorated to near the danger point, it should be discarded.

One major cause of short oil life is operation at too high a temperature. This speeds up the oxidation process, which forms acids and sludge in the oil, causing rapid wear and corrosion to moving parts within the system. Depending upon the oil selected, the oil temperature should range from 120° to 140° F. Check your oil temperature occasionally with a thermometer, or by simply placing your hand on the reservoir. At 120° F it is uncomfortable to leave your hand on the reservoir for more than two or three seconds. If the tank is too hot to be touched at all, check it with a thermometer.

2.2 *Fluid Cleanliness*

Fluid must be cleaned before and continuously during operation by filters that maintain a cleanliness level of NAS 1638 Class 8. This approximately corresponds to ISO 17/14. Better cleanliness levels will significantly extend the life of the components. As contaminant entrainment and contaminant generation may vary with each application, each must be analyzed to determine proper filtration to maintain the required cleanliness level.

COMPARISON OF SOLID CONTAMINATION CLASSIFICATION SYSTEMS

NATIONAL AEROSPACE STANDARD (NAS) 1683

		CLASS													
		00	0	1	2	3	4	5	6	7	8	9	10	11	12
PARTICLE SIZE RANGE	5-15μm	125	250	500	1000	2000	4000	8000	16000	32000	64000	128000	256000	512000	1024000
	15-25μm	22	44	89	178	356	712	1425	2850	5700	11400	22800	45600	91200	182400
	25-50μm	4	3	16	32	63	126	253	506	1012	2025	4050	8100	16200	32400
	50-100μm	1	2	3	6	11	22	45	90	180	360	720	1440	2880	5760
	>100μm	0	0	1	1	2	4	8	16	32	64	128	256	512	1024
MAXIMUM PARTICLES	>5μm	152	304	609	1217	2432	4864	9731	19462	38924	77849	155698	311396	622792	1245584
	>15μm	27	54	109	217	432	864	1731	3462	6924	13849	27698	55396	110792	221584

ISO: DIS 4406; SAE J1165

		ISO SOLID CONTAMINANT CODE														
		8/5	9/6	10/7	11/8	12/9	13/10	14/11	15/12	16/13	17/14	18/15	19/16	20/17	21/18	22/19
MAX	>5μm	250	500	1000	2000	4000	8000	16000	32000	64000	130000	250000	500000	1000000	2000000	4000000
PART.	>15μm	32	64	130	250	500	1000	2000	4000	8000	16000	32000	64000	130000	250000	500000

NOTE: ALL MEASUREMENTS ARE FOR A 100 ML SAMPLE SIZE

Make a visual inspection of the oil every month. Compare the color and body with an unused sample of the same oil. A slight darkening is usually not serious, but a deep, dark color or a noticeable thickening may indicate a serious deterioration. Feel a smudge of oil between your fingers to detect small pieces of grit. If metal flakes and/or grit is found, the oil should be cleaned using a filter cart.

2.3 The Importance of Filtration

Proper filtration of the hydraulic fluid will help ensure long life of the system, assuming proper oil is used at the proper temperature. The minimum filtration requirement for any hydraulic system is return line filtration of 10 micron nominal, but under no circumstances should oil cleanliness levels exceed ISO 17/14. It is recommended that the following maintenance schedule be adopted: Change filter element after first 50 hours of service, then every 1,000 hours or every 3 months, which ever comes first. If filter is fitted with a clogging/bypass indicator, then element must be changed when indicator shows that filter is plugged or bypassing, even though above time has not passed.

WARNING Scrupulous cleanliness is essential during element change. Dirt on the downstream side of the element will pass into the system; Dirt on the upstream side will reduce the effective life of the element.

IMPORTANT On systems operating in heavily contaminated environments, such as mobile equipment, foundries, steel mills, etc. it is recommended the above filter life be de-rated to 500 hours/1.5 months.

2.3.1 Element Installation Instructions

SPIN-ON CANISTER TYPE FILTERS

1. Make sure filter's rubber gasket is seated in place.
2. Clean and inspect gasket contact surface on filter head
3. Lubricate filter gasket with clean hydraulic fluid.
4. Use no tools. Install by hand until gasket contacts mounting base - then tighten 1/2 turn (14 ft-lb).
5. Run system: Check for leaks, let 5 minutes elapse, and check again.
6. Check reservoir oil level.

NOTE: Most states have laws requiring the crushing of filter elements to remove the majority of the oil. Also, hydraulic fluid must be handled as a hazardous waste.

ELEMENT-IN-BOWL TYPE FILTERS

1. Place suitable receptacle beneath filter to catch spillage
2. Remove lid screws and lift-off lid, unscrew bowl, or remove bowl-to-head screws and drop bowl.
3. Remove element and discard in an environmentally friendly way.
4. On fixed bowl types, wipe out thoroughly with clean linen rag. On removable bowl types, thoroughly wash interior of bowl with cleaning solvent.

5. Inspect the O-Ring and contact surface for nicks and scratches and replace or dress-up to achieve sealing. Lubricate O-Ring with clean hydraulic fluid.
6. Reverse above instructions for re-assembly
7. Function system to expel air and check filter for external leaks
8. Check reservoir oil level.

WARNING Disposable elements must be properly disposed of. NO attempt whatsoever should be made at cleaning the element.

3.0 Internal Settings

The HPU has been designed to accomplish a function. The specifications to this particular HPU are:

Comp II

HYDRAULIC SPECIFICATIONS		PRIME MOVER SPECIFICATIONS	
Maximum System Pressure:	3000 psig	Prime Mover Type:	Electric
Normal Operating Pressure	1723 psig	Horse Power:	3
Maximum Flow:	2.25 GPM	Voltage:	208-230 / 460
Normal Operating Flow:	2.00 GPM	Shaft Speed (RPM):	1740

Mini-Evac

HYDRAULIC SPECIFICATIONS		PRIME MOVER SPECIFICATIONS	
Maximum System Pressure:	2500 psig	Prime Mover Type:	Internal Comb.
Normal Operating Pressure	2000 psig	Horse Power:	25
Maximum Flow:	20.0 GPM	Fuel:	Gas – Unleaded
Normal Operating Flow:	10.0 GPM	Shaft Speed (RPM):	1250 - 3000

NOTE: See Specifications sections for more detailed information on the individual components

4.0 Installation and Start-Up of HPU

Safety should be first and foremost during installation and start-up. Safety glasses and protective clothing should be worn at all times during installation, start-up, tuning, and normal running conditions. All personnel should be clear of any dangerous areas BEFORE any start-up. All guards and protection devices should be in their proper place. Always ensure someone is standing ready by emergency shutdown switches in case of emergency.

Documentation is also very important during installation and start-up. Record all pertinent readings after initial flushing/run-in period for maintenance records. These readings include: Pressures, voltage, amps, flow, noise level, oil temperature, amount of fluid needed to fill system, and part numbers on all consumables (i.e. filters). Machine cycle time should also be noted to be used in trouble shooting situations.

4.1 Installation of HPU

Place the unit in the place where it is to be installed. Level unit using shims if necessary. Attach hoses or tubing to the customer connections provided. Install the electrical power to motor and wire all electrical devices. Fill the reservoir with specified oil.

! **WARNING** Warranties are not valid unless proper starting and maintenance procedures are followed.

4.2 Start-Up Procedure

Once the unit has been installed, the proper connections made, and the reservoir filled, it is ready for start-up. To start the HPU use the following procedures:

INITIAL START UP

1. Double check to see that the reservoir is filled with the proper hydraulic fluid. Oil level should be midway on the sight gauge.
2. Always check engine oil level before starting. The engine is equipped with low level protection and will not run if oil level is low
3. Make sure heat exchanger is clean an air flow is unobstructed. The two temperature switches should be adjusted to 90° F and 105° F, each controlling two separate fans powered by 24 VDC source.
4. Be sure hydraulic connections are tight.
5. Turn bypass valve handle into the open or horizontal position.
6. Insure that pump stroke arm is vertical or neutral position.
7. Make sure pump suction valve is full open.
8. Adjust engine throttle to ¼ on, and pull choke out as needed for starting.
9. Fueling: Gas tank is removable to facilitate filling and can be transported horizontally or vertically. Always close vent on filler cap when transporting. When fuel tank is installed the fuel line connected (simple plug-in quick disconnect) always make sure that the vent is open.
10. Start Engine: allow engine to warm up 2 to 3 minutes at fast idle.
11. Make sure stroke control is in neutral and slowly close bypass valve.

DURING NORMAL OPERATION

1. Check fluid levels.
2. Open bypass valve.
3. Start engine: allow engine to warm up 2 to3 minutes at fast idle.
4. Make sure stroke control is in neutral and slowly close bypass valve.
5. Forward and reverse movements are controlled by the direction stroke control lever is moved. Speed is a function of stroke. Engine speed also is directly proportional to output flow

SHUT DOWN

1. Move stroke control into neutral position
2. Open bypass valve.
3. Turn engine throttle to lowest setting
4. Turn engine key to OFF position.

! **WARNING** Warranties are not valid unless proper starting and maintenance procedures are followed.

5.0 Maintenance of HPU

Safety should be first and foremost during maintenance of the system. Safety glasses and protective clothing should be worn at all times during maintenance and normal running conditions. All system lock out devices must be utilized before any maintenance operations occur. If there are no lock outs, remove power fuses to ensure system is not energized during maintenance. All personnel should be clear of any dangerous areas BEFORE the system is energized. All guards and protective devices should be in their proper place. Always ensure someone is standing ready by emergency shutdown switches in case of emergency.

Documentation is also very important during maintenance. Record all pertinent readings after any maintenance. These readings include: Pressures, voltage, amps, flow, noise level, and oil temperature, amount of fluid needed to fill system. Machine cycle time should also be noted (to be used in trouble shooting situations).

SEASONAL MAINTENANCE

1. Change engine oil: Remove oil tube plug and remove oil with oil suction. Change oil filter every year.
2. Check bolts and linkages and tighten/adjust as needed.
3. Check and clean air filter. Wash in warm soap water and carefully dry.
4. Check battery connections and clean/tighten as necessary.
5. When engine will be shut down for greater than 30 days, fuel stabilizer should be added or fuel should be drained.
6. Clead dust and debris for heat exchanger.

MAINTENANCE TIPS

1. Maintain as low a system pressure as possible to achieve adequate performance.
2. Prohibit unauthorized personnel from making adjustments on the hydraulic system.
3. Maintain adequate oil level. When adding oil, be sure it is new and clean and if possible, pump into the unit through a 10 μ (micron) filter cart. 3 μ (micron) filtration should be used on servo valve systems.
4. Keep fittings tightened.
5. Maintain clean fluid in system by: changing filter elements when indicated; cleaning strainer elements; changing oil if any foreign material enter the system; clean or replace reservoir air breathers regularly. Ensure that no foreign material enters reservoir when adding oil.
6. Lubricate all grease zerks regularly if applicable.
7. Check system regularly for overheating. Seal damage may occur over 165° F.
8. Keep HPU clean.
9. The three most important indicators of where trouble points are located are Heat, Noise and Leakage

If problems or questions arise, call:

TEI ENGINEERED PRODUCTS, INC.
Phone (303) 693-1491
Fax (303) 680-7577

6.0 Troubleshooting

Trouble encountered in hydraulic systems results in a loss of efficiency of machines and/or down time. The following chart has been compiled to enable field engineers to locate and remedy troubles quickly. The symptoms and remedies suggested should be evaluated with reference to a particular hydraulic circuit.

SYMPTOMS	CAUSES	REMEDIES IN THE FIELD
Noisy Pump	Cavitation	Larger suction strainer. Larger suction line. Use oil of lower viscosity
	Restricted Suction	Clean suction strainer
	Air leak at intake pipe connection	Tighten suction line fittings. Pour oil over joints with pump running and pinpoint leaking fitting
	Air leak at pump shaft seal	Accurately align pump and motor shaft. Replace shaft seal.
	Air drawn into system from reservoir	Raise oil level in reservoir. Ensure discharge is below oil level. Does oil have anti-foam additive?
	Worn valves, vanes, pistons, gears	Replace worn parts. Replace filters
	Sticking valves or vanes	Check for impurities or metal particles in oil. Clean filters
Excessive heating of pump	Internal pump leakage	Renew worn parts, such as gears, vanes, pistons, valves, etc.
	Relief valve set above compensator	Set relief valve 250 psi above compensator setting
	Internal leakage caused by thin oil	Use heavier bodied oil. Check pressure relief valve setting. Check pressure relief valve for leakage
	Insufficient clearance of moving parts	Check assembly of pump parts
Diminished or insufficient delivery of pump	Prime mover not at correct speed	Check prime mover RPM
	Pump parts worn out, or system bypassing oil	Renew worn parts Check orifice in relief valve
Erratic & sluggish operation	Air trapped in pilot lines	Bleed pilot lines
	Oil viscosity to high or insufficient input power	Use lower viscosity oil
Diminished delivery pressure of pump	Short circuit in pump, or system bypassing	Check seal between inlet and outlet ports of pump. Check orifice in relief valve.
Low or no pressure in system	Relief valve jammed or orifice plugged	Re-set pressure settings after cleaning relief valve.
	Low oil level	Add oil to reservoir
Fluctuating pressure	Air or water in system	Check seals and pipe connections. Check for jams or obstructions in system (collapsed hose/tube?)
Erratic movements	Insufficient oil in system or improper kind of oil. Water or air present	Check vent valve. Check oil level. Test oil.

Maximum pressure below expectations	Relief valve not functioning properly. Internal pump leakage Excessive frictional losses in system. Oil velocity too high	Check poppet for sticking and spring for proper adjustment. Move HPU closer to hydraulic components. Use larger lines on machinery.
Frequent leaks in lines	Cavitation Decompression shocks Vibration in the machine	Larger suction strainer. Larger suction line. Use oil of lower viscosity Adjust decompression valve if installed or reduce orifice size in bleed down path Fasten oil lines securely with tubing clamps
Overheating of oil. (Efficient normal operating temp is about 120° to 140 ° F)	Too much oil discharging over relief valve. Insufficient oil or oil level too low High pressure held too long Oil too light Obstructions or restrictions to flow of oil in pump lines	Check relief valve for pressure and leakage. Check pressure at which pump should operate. Add a heat exchanger to system. Add oil Check machinery operation Use heavier oil Check position of control valve for neutral locations and overloads. Pump parts may be worn. Check back pressure valve for high pressure.
Excessive internal leakage in the system	Oil too light, valves, pumps worn out.	Check clearances. Use heavier oil if leakage is still excessive.
Irregular, erratic or uncertain feeds	Pumps, valves worn out Low external pilot pressure	Check for excessive internal leakage. Check kind of oil used; use oil recommended Check external pilot pressure.
Slow acting machine	Starting temp. of oil (too cold) Oil too heavy causing excessive frictional resistance in system Oil too thin causing excessive internal leakage.	Verify oil heater is working if used. Set controls so that oil is discharging across relief valve until oil heats. Use lighter oil Use heavier oil
Jerky operation of working cylinders, motors, etc.	Friction in seals/ways Air in system Improper adjustment of control valves	Check oil level, may be too low. See that seals are not binding. Check for worn or scored rods, seals, and broken piston rings. Bleed cylinders Adjust control valving to proper setting
Rapid traverse and reversing valve troubles	Worn/broken components	Check for broken springs. Valve plunger depressed to far. Cams and/or rollers worn. Valve remaining partly open.
Acceleration too slow	Low volume set on pump Relief valve set too low	Set volume adjustment to proper setting. Check relief valve setting.
Acceleration too fast	High volume set on pump Relief valve set too high	Set volume adjustment to proper setting Check relief valve setting
3 and 4 - way valve troubles.	Worn out parts/seals, broken parts	Excessive wear of spools or body.

Overheating of solenoid operated valves; indicated by hum or buzz		Broken springs. Leaky seals. Binding resulting from varnish coating.-Polish spool or poppet.
Check valve troubles	Worn seat	Check condition of valve seat. If worn or ball of poppet is in poor conditions, reseat new ball or replace
Flow control valve troubles	Dirty oil or worn parts	Pressure compensator binding caused by dirt. Plungers worn. Clean orifice, polish spool
Metering valve not functioning properly	Dirty oil	Dirt lodged in eccentric grooves or orifice. Clean oil
Needle valve won't control or shut off	Worn parts	Needle worn - regrind and relap, or replace
Fluctuating pressure of relief valve	Worn parts	Relief pressure control spring(s). Check for proper adjustment. Clean orifice. Check pilot cone.
Pressure reducing valves trouble	Improper adjustment/ broken spring	Set correctly. Check drain line. Check for broken springs.

7.0 Specifications

The following pages contain hydraulic schematics and general arrangement drawings of the integral Mini-Evac / Comp II.

Worldwide Distributor
Sales and Service Directory

The Cummins®/Onan® Distributor and Dealer Network - Ready and Qualified to Serve You

Give your power generation and control equipment the care that it deserves by having it serviced by one of our authorized distributors and dealers, who are also your source for parts.

For sales support, our distributors and dealers provide information, technical data and application assistance.

Our distributor and dealer network is designed with the needs and the historic business relationships of your region in mind. In some cases, a combined Cummins/Onan distributor provideds sales and Onan brand products. In other cases, Cummins-only distributors or Onan-only distributors offer support for their respective brands.

Selecting a Distributor

This directory is a key with which you can locate the appropriate distributorship for your sales and service requirements.

If a C, O, or C/O symbol appears next to the distributor name, this will help you identify the products and services offered by the distributor.

C/O All Onan RV, Marine and Portable Generators, Engines and other consumer products. All Onan and Cummins standby or prime power generator sets, transfer switches, paralleling switchgear and accessories.
O All Onan RV, Marine and Portable Generators, Engines and other consumer products. All Onan standby or prime power generator sets, transfer switches, paralleling switchgear and accessories.
C All Cummins standby or prime power generator sets, transfer switches, paralleling switchgear and accessories.

Service

Follow these steps to resolve your service and warranty concerns:

1. Contact your nearby original selling distributor or dealer.

2. Consult the Yellow Pages. Typicallly product distributors are located under :

   GENERATORS - ELECTRIC; ENGINES - GASOLINE OR DIESEL
   OR RECREATIONAL VEHICLES - EQUIPMENT PARTS & SERVICE

3. Check this Sales and Service Directory. Each distributor listed for service in this directory can refer you to the nearest authorized dealer, if applicable.

4. To contact your local Cummins/Onan or Onan-only distributor in the United States or Canada, call 1-800-888-ONAN. You will be automatically connected to the distributor nearest you.

For outside North America, call Onan Corporation, 1-612-574-5000,7:30 am to 4:00 pm, Central Standard Time, Monday through Friday. Or, send a fax to Onan using the fax number 1-612-574-5282.

United States

Alabama

C/O Cummins Alabama, Inc.
Birmingham
Phone: 205-841-0421
Fax: 205-849-5926

C/OCummins Alabama, Inc.
Mobile
Phone: 334-452-6426
Fax: 334-473-6657

C/O Cummins Alabama, Inc.
Montgomery
Phone: 334-263-2594
Fax: 334-263-2594, Ext 124

Alaska

C/O Cummins Northwest, Inc.
Anchorage
Phone: 907-279-7594
Fax: 907-276-6340

Arizona

C/O Cummins Southwest, Inc.
Phoenix
Phone: 602-252-8021
Fax: 602-258-1010

C/O Cummins Southwest, Inc.
Tucson
Phone: 520-887-7440
Fax: 520-887-4173

Arkansas

C/O Cummins Mid–South, Inc.
Little Rock
Phone: 501-569-5600
Fax: 501–565–2199

California

O Cummins Cal Pacific, Inc.
Montebello
Phone: 213-728-8111
Fax: 213-889-7422

C/O Cummins Cal Pacific, Inc.
Rialto
Phone: 909-877-0433
Fax: 909-877-3787

C/O Cummins Cal Pacific, Inc.
El Cajon
Phone: 619-593-3093
Fax: 619-593-0600

C/O Cummins Cal Pacific, Inc.
Irvine
Phone: 714-253-6000
Fax: 714-253-6080

C/OCummins Cal Pacific, Inc.
Ventura
Phone:805-644-7281
Fax: 805-644-7284

C/OCummins West, Inc.
Arcata
Phone: 800-595-5050
Fax: 707-822-7585

C/OCummins West, Inc.
Bakersfield
Phone: 805-325-9404
Fax: 805-861-8719

C/O Cummins West, Inc.
Fresno
Phone: 800-595-5050
Fax: 209-486-7402

C/OCummins West, Inc.
Redding
Phone: 916-222-4070
Fax: 916-224-4075

C/O Cummins West, Inc.
West Sacramento
Phone: 916-371-0630
Fax: 916-371-2849

C/O Cummins West, Inc.
San Leandro
Phone: 510-351-6101
Fax: 510-352-3925

C/O Cummins West, Inc.
Stockton
Phone: 800-595-5050
Fax: 209-478–2454

O ODC of California
An ONAN Company
Irvine
Phone: 714-757-7375
Fax: 714-757-5940

Colorado

C/O Cummins Rocky Mountain, Inc.
Commerce City
Phone: 303-286-7697
Fax: 303-287-4837

C/O Cummins Rocky Mountain, Inc.
Durango
Phone: 970-259-7470
Fax: 970-259-7482

C/O Cummins Rocky Mountain, Inc.
Grand Junction
Phone: 970-242-5776
Fax: 970-243-5494

Connecticut

C/O Cummins Metropower, Inc.
Hartford
Phone: 860-529-7474
Fax: 860-529-7524

C/O Cummins Metropower Inc.
Rocky Hill, CT
Phone: 860-529-7474
Fax: 860-529-7574

Delaware

C/O Cummins Power Systems
Glen Burnie, MD
Phone: 410-590-8700
Fax: 410-590-8723

Florida

C/O Cummins SE Power, Inc.
Hialeah Gardens
Phone: 305-821-4200
Fax: 305-557-2992

C/O Cummins SE Power, Inc.
Jacksonville
Phone: 904-355-3437
Fax: 904-354-4594

C/O Cummins SE Power, Inc.
Ocala
Phone: 352-861-1122
Fax: 352-861-1130

C/O Cummins SE Power, Inc.
Orlando
Phone: 407-298-2080
Fax: 407-290-8727

C/O Cummins SE Power, Inc.
Tampa
Phone: 813-621-7202
Fax: 813-621-8250

C/O Cummins SE Power, Inc.
Tampa
Phone: 813-626-1101
Fax: 813-628-4183

C/O Cummins SE Power, Inc.
Ft. Meyers
Phone: 941-337-1211
Fax: 941-337-5374

O RDC of Florida
Tampa
Phone: 813-628-4040
Fax: 813-628-0965

Georgia

C/O Cummins South, Inc.
Albany
Phone: 912-888-6210
Fax: 912-883-1670

C/O Cummins South, Inc.
Augusta
Phone: 706-722-8825
Fax: 706-722-7553

C/O Cummins Onan South Power Systems
College Park
Phone: 404-763-0233
Fax: 404-763-0711

C/O Cummins South, Inc.
Savannah
Phone: 912-232-7424
Fax: 912-232-5145

Hawaii

C/O Cummins Hawaii Diesel Power, Inc.
Kapolei
Phone: 808-682-8110
Fax: 808-682-8477

Idaho

C/O GenPlus
Division of Cummins Intermountain, Inc.
Boise
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Fax: 208-338-5436

C/O GenPlus
Division of Cummins Intermountain, Inc.
Pocatello
Phone: 208-234-1661
Fax: 208-234-1662

Illinois

C/O Cummins/Onan Northern Illinois
Justice
Phone: 708-563-7070
Fax: 708-563-7095

C/O Cummins Mid-States Power, Inc
Normal
Phone: 309-452-4454
Fax:309-452-1642

C/O Gateway Industrial Power
Collinsville
Phone: 618-345-0123
Fax: 314-531-6604

C/O Cummins Great Plains Diesel, Inc
Rock Island
Phone: 309-787-4300
Fax: 309-787-4397

Indiana

O Onan-Indiana
Elkhart
Phone: 219-262-4611
Fax: 219-295-8000

C/O Cummins Cumberland
Evansville
Phone: 812-867-4400
Fax: 812-867-4411

C/O Cummins Mid-States Power, Inc.
Indianapolis
Phone: 317-243-7979
Fax: 317-240-1925

C/O Mid-States Power & Refrig
Indianapolis
Phone: 317-240-1967
Fax: 317-240-1975

Iowa

C/O Cummins Great Plains Diesel, Inc.
Cedar Rapids
Phone: 319-366-7537
Fax: 319-366-7562

C/O Midwestern Power Division
Cummins Great Plains Diesel, Inc.
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Phone: 515-264-1650
Fax: 515-264-1651

Kansas

C/O Cummins Mid–America, LLC
Colby
Phone: 913-462-3945
Fax: 913-462-3970

C/O Cummins Mid-America, LLC
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Phone: 316-275-2277
Fax: 316-275-2533

C/O Cummins Mid-America, LLC
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Phone: 316-838-0875
Fax: 316-838-0704

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C/O Cummins Cumberland
Hazard
Phone: 606-436-5718
Fax: 606-436-5048

C/O Cummins Cumberland
Louisville
Phone: 502-491-4263
Fax: 502-499-0896

Louisiana

C/O Cummins Mid-South, Inc.
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C/O Cummins Mid-South, Inc.
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Fax: 504-465-3408

Maine

C/O Cummins Northeast, Inc.
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Fax: 410-590-8723

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C/O Cummins Northeast, Inc.
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Phone: 781-329-1750
Fax: 781-329-4428

C/O Cummins Northeast, Inc.
Springfield
Phone: 413-737-2659
Fax: 413-731-1082

Michigan

C/O Standby Power, Inc.
Grand Rapids
Phone: 616-281-2211
Fax: 616-281-3177

C/O Cummins Great Lakes, Inc.
Iron Mountain
Phone: 906-774-2424
Fax: 906-774-1190

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Redford
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Fax: 406-452-9911

C/O Cummins Northwest, Inc.
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Phone: 406-728-1300
Fax: 406-728-8523

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Fax: 308-234-5776

C/O Cummins Great Plains Diesel, Inc.
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Phone: 402-551-7678
Fax: 402-551-1952

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Fax: 702-738-1719

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Fax: 702-399-7457

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Fax: 702-331-7429

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Fax: 617-329-4428

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Fax: 201-578-8873

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C/O Cummins Southwest, Inc.
Albuquerque
Phone: 505-247-2441
Fax: 505-842-0436

C/O Cummins Southwest, Inc.
Farmington
Phone: 505-327-7331
Fax: 505-326-2948

New York

C/O Cummins Metropower, Inc.
Bronx
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Fax: 718-892-0055

C/O Cummins Northeast, Inc.
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Phone: 518-459-1710
Fax: 518-459-7815

C/O Cummins Northeast, Inc.
Syracuse
Phone: 315-437-2751
Fax: 315-437-8141

C/O Cummins Northeast, Inc.
Williamsville (Buffalo)
Phone: 716-631-3211
Fax: 716-626-0799

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C/O Atlantic Power Generation
Charlotte
Phone: 704-588-1240
Fax: 704-588-3879

C/O Cummins Atlantic, Inc.
Greensboro
Phone: 910-375-6909
Fax: 910-375-7879

C/O Cummins Atlantic, Inc.
Wilson
Phone: 919-237-9111
Fax: 919-237-9132

C/O Emergency Generator Services
Division of Atlantic Power Gen.
Greensboro
Phone: 910-375-6909
Fax: 910-375-7879

North Dakota

C/O Cummins Diesel Sales, Inc.
Fargo
Phone: 701-282-2466
Fax: 701-282-2472

Ohio

C/O Cummins Interstate Power
Cincinnati
Phone: 513-563-9303
Fax: 513-563-6898

C/O Cummins Interstate Power
Cleveland
Phone: 216-439-6800
Fax: 216-439-7390

C/O Cummins Interstate Power
Hilliard
Phone: 614-771-1000
Fax: 614-771-0769

C/O Cummina Interstate Power
Hubbard
Phone: 330-534-1935
Fax: 330-534-5606

C/O Cummins Interstate Power
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Phone: 419-893-8711
Fax: 419-893-5362

C/O Cummins Interstate Power
Strasburg
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Fax: 216-364-1433

Oklahoma

C/O Southern Plains Power
Oklahoma City
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Fax: 405-946-3336

C/O Southern Plains Power
Tulsa
Phone: 918-234-3240
Fax: 918-234-2342

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C/O Cummins Northwest, Inc.
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Fax: 503-389-1909

C/O Cummins Northwest, Inc.
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Phone: 503-687-0000
Fax: 503-687-1977

C/O Cummins Northwest, Inc.
Portland
Phone: 503-289-0900
Fax: 503-286-5938

C/O Cummins Northwest, Inc.
Pendelton
Phone: 503-276-2561
Fax: 503-276-2564

C/O Cummins Northwest, Inc.
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Phone: 503-779-0151
Fax: 503-772-2395

Pennsylvania

C/O Cummins Interstate Power, Inc.
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Fax: 412-820-9137

C/O Cummins Power Systems, Inc.
Harrisburg Branch
Harrisburg
Phone: 717-564-1344
Fax: 717-558-8217

C/O Cummins Power Systems, Inc.
Bristol
Phone 215-785-6005
Fax: 215-785-4728

Rhode Island

C/O Cummins Northeast
Dedham, MA
Phone: 617-329-1750
Fax: 617-329-4428

South Carolina

C/O Atlantic Power Generation
Charleston
Phone: 803-554-9804
Fax: 803-745-0745

C/O Cummins Atlantic, Inc.
Columbia
Phone: 803-799-2410
Fax: 803-779-3427

South Dakota

C/O Cummins Great Plains Diesel, Inc.
Sioux Falls
Phone: 605-336-1715
Fax: 605-336-1748

Tennessee

C/O Cummins South, Inc.
Chattanooga
Phone: 423-629-1447
Fax: 423-629-1494

C/O Cummins Cumberland, Inc.
Knoxville
Phone: 423-523-0446
Fax: 423-523-0343

C/O Cummins Mid-South Inc.
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Phone: 901-345-7424
Fax: 901-346-4735

C/O Cummins Cumberland, Inc.
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Fax: 615-366-5693

Texas

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Houston
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Fax: 713-956-0266

C/O Southern Plains Power
Arlington
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Fax: 817-640-6852

C/O Southern Plains Power
Dallas
Phone: 214-631-6400
Fax: 214-631-2322

C/O Southern Plains Power
Fort Worth
Phone: 817–624–2107
Fax: 817–624–3296

C/O Southern Plains Power
Mesquite
Phone: 214–321–5555
Fax: 214–328–2732

C/O Southern Plains Power
San Antonio
Phone: 210–655–5420
Fax: 210–655–3865

C/O Southern Plains Power
Odessa
Phone: 915–332–9121
Fax: 915–333–4655

C/O Southern Plains Power
Amarillo
Phone: 806–373–3793
Fax: 806–372–8547

C/O Cummins Southwest, Inc.
El Paso
Phone: 915–852–4200
Fax: 915–852–3295

Utah

C/O GenPlus
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Salt Lake City
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Fax: 801–524–1359

C/O Gen Plus
Division of Cummins
Intermountain, Inc.
Vernal
Phone: 801–789–5732
Fax: 801–789–2853

Vermont

C/O Cummins Northeast
Springfield, MA
Phone: 413–737–2659
Fax: 413–731–1082

Virginia

C/O Atlantic Power Generation
Chesapeake
Phone: 804–485–4548
Fax: 804–485–5085

C/O Cummins Atlantic, Inc.
Richmond
Phone: 804–232–7891
Fax: 804–232–7428

C/O Cummins Atlantic, Inc.
Cloverdale
Phone:540–966–3169
Fax: 540–966–3749

Washington

C/O Cummins Northwest, Inc.
Renton
Phone: 425–235–3400
Fax: 425–235–8202

C/O Cummins Northwest, Inc.
Spokane
Phone: 509–624–4411
Fax: 509–624–4681

C/O Cummins Northwest, Inc.
Tacoma
Phone: 253–922–2191
Fax: 253–922–2379

C/O Cummins Northwest, Inc.
Yakima
Phone: 509–248–9033
Fax: 509–248–9035

C/O Cummins Northwest, Inc.
Chehalis
Phone: 360–748–8841
Fax: 360–748–7015

West Virginia

C/O Cummins Cumberland, Inc
South Charleston
Phone: 304–744–6373
Fax: 304–744–8605

C/O Cummins Cumberland, Inc.
Fairmont
Phone: 304–367–0196
Fax: 304–367–1077

Wisconsin

C/O Cummins Great Lakes, Inc.
DePere
Phone: 920–337–1991
Fax: 920–337–9746

C/O Cummins Great Lakes, Inc.
Oak Creek
Phone: 414–768–7400
Fax: 414–768–9441

Wyoming

C/O Cummins Rocky Mountain, Inc.
Gillette
Phone: 307–682–9611
Fax: 307–682–8242

C/O GenPlus
Division of Cummins
Intermountain, Inc.
Rock Springs
Phone: 307–362–5168
Fax: 307–382–7900

Canada

Alberta

C/O Cummins Alberta
Calgary
Phone: 403–569–1122
Fax: 403–569–0027

C/O Cummins Alberta
Edmonton
Phone: 403–455–2151
Fax: 403–454–9512

British Columbia

C/O Cummins British Columbia
Surrey
Phone: 604–882–5000
Fax: 604–882–5080

C/O Cummins British Columbia
Kamloops
Phone: 604–828–2388
Fax: 604–828–6713

C/O Cummins British Columbia
Tumbler Ridge
Phone: 604–242–4217
Fax: 604–242–4906

C/O Cummins British Columbia
Sparwood
Phone: 604–425–0522
Fax: 604–425–0323

Manitoba

C/O Pryme Power Division
Cummins Mid–Canada Ltd.
Winnepeg
Phone: 204–632–5470
Fax: 204–694–7029

New Brunswick

C/O Onan Eastern Canada
Fredericton
Phone: 506–451–1929
Fax: 506–451–1921

Newfoundland

C/O Onan Eastern Canada
Mount Pearl
Phone: 709–747–0176
Fax: 709–747–2283

Nova Scotia

C/O Onan Eastern Canada
Phone: 902–468–7938
Fax: 902–468–5177

Ontario

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Onan Ontario Division
Oakkville
Phone: 905–844–5851
Fax: 905–844–7040

C/OCummins Ontario, Inc.
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Fax: 613–736–1202

Quebec

C/O Onan Eastern Canada, Inc.
Dorval
Phone: 514–631–5000
Fax: 514–631–0104

C/O Onan Eastern Canada, Inc.
Val d' Or
Phone: 819–825–0993
Fax: 819–825 8488

Saskatchewan

C/O Pryme Power Division
Cummins Mid–Canada Ltd.
Saskatoon
Phone: 306–933–4022
Fax: 306–242–1722

C/O Cummins Mid–Canada Ltd.
Regina
Phone: 306–721–9710
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Mexico

O Selmec Mexico
Industrial Products Only
Mexico, D.F.
(Industrial Products Only)
Phone: (525) 705–2093
Fax: (525) 566–3600

O Selmec Puebla
Puebla, Pue.
(Industrial Products Only)
Phone: 440470
Fax: 444570

O Selmec Hermosillio
Hermosillo, Son
(Industrial Products Only)
Phone: 50694
Fax: 54826

O Selmec Queretaro
Queretaro, Qro.
(Industrial Products Only)
Phone: 61189
61296
151247
151248
Fax: 150718

O Selmec Merida
Merida, Yuc
(Industrial Products Only)
Phone: 258018
Fax: 258015

O Selmec Guadalajara
Guadalajara, Jal.
(Industrial Products Only)
Phone: 194116
194903
194218
Fax: N/A

O Selmec Culiacan
Culiacan, Sin
(Industrial Products Only)
Phone: 46494
Fax: 42185

O Selmac Aguascalientes
Aguascalientes, Ags.
(Industrial Products Only)
Phone: 140256
Fax: 140177

O Selmec Monterrey
Monterrey, N.L.
(Industrial Products Only)
Phone: 585808
582868
Fax: 588062

O Selmec Tampico
Tampico, Tamps.
(Industrial Products Only)
Phone: 32032
Fax: 30022

O Selmec Durango
Durango.
(Industrial Products Only)
Phone: 194451
Fax: 1194452

Selmec Chihauhua
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C/O Electromotor, Inc.
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C/O Societe Generale De Distribution,
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O Appliance Traders Ltd.
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Telephone: (876) 926–3370,

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C/O West India Mach. & Supply Co.
Santurce
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Telephone: (787) 721–7640

C/O Cummins Diesel
Puerto Nuevo
Fax: 787–793–1072
Telephone: 787–793–0300

St. Croix, U.S.V.I.
O Quality Electric Supply, Inc.
Christiansted
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Telephone: (809) 773–4630

St. Maarten
O Electec N. V.
Philipsburg
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Fax: (5995) 43319
Telephone: (5995) 70946/70225

Trinidad & Tobago
C General Diesel Ltd.
La Romaine
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Industrial Agencies, Inc.
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O Adria Univerzal d.o.o.
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O Sim Holland, BV.
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C/O Cummins Diesel S.A.
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O Sim Deutschland GmbH
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O Dudleys, American Motor Homes
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C/O Jaidah Motors & Trading Co.
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C/O General Contracting Co.
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C/O Hamamcioglu Muessesderi
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Telephone: (90216) 3943451/2/3

O Tatko
Istanbul
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C/O Zubieri Trading Co.
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C/O Multilink Int'l. Co. Ltd.
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O Viking Diesel & Electrics Pty. Ltd.
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Wodonga, Victoria
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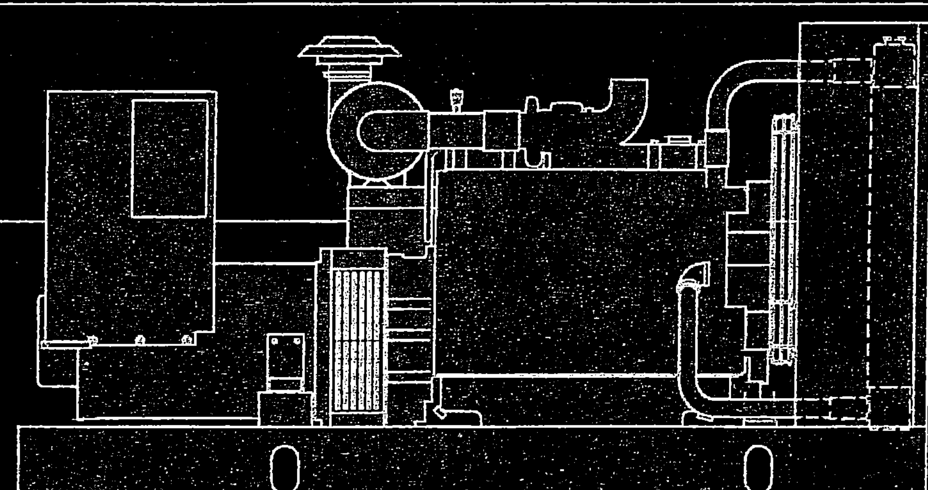
Onan Installation Manual

GENERATOR SETS

Models
DGBB
DGBC
DGCA
DGCB
DGCC
DGDA
DGDB
DGEA
DGFA
DGFB
DGFC



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960-0618 5-98

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California

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ DANGER ***This symbol warns of immediate hazards which will result in severe personal injury or death.***

⚠WARNING ***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***

⚠ CAUTION ***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

FUEL AND FUMES ARE FLAMMABLE

Fire, explosion, and personal injury or death can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Be sure all fuel supplies have a positive shutoff valve.
- Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc..

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.
- Engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect battery charger from its AC source, then disconnect starting batteries, negative (-) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. Do not operate a diesel-powered genset where a flammable vapor environment can be created by fuel spill, leak, etc., unless the genset is equipped with an automatic safety device to block the air intake and stop the engine. The owners and operators of the genset are solely responsible for operating the genset safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag and lock open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

MEDIUM VOLTAGE GENERATOR SETS (601V to 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training is required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Due to the nature of medium voltage electrical equipment, induced voltage remains even after the equipment is disconnected from the power source. Plan the time for maintenance with authorized personnel so that the equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.
- Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breath or ingest or come into contact with exhaust gases.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

This manual provides installation instructions for the DG Series generator sets. This includes the following information:

Mounting Recommendations - for fastening generator set to base and space requirements for normal operation and service.

Mechanical Connections - Location of connection points for fuel, exhaust, ventilation, and cooling.

Electrical Connections – Location of electrical connection points for the control, generator, and starting system.

Prestart – Checklist of items or procedures needed to prepare generator set for operation.

Initial Startup – Test complete system to ensure proper installation, satisfactory performance, and safe operation. Refer to Operators Manual for troubleshooting information.

Installation Checklist – Reference checks upon completion of installation.

This manual contains separate DC Control Wiring and Prestart Preparation sections for gensets using the PowerCommand Control (PCC), the Sentinel control or the Detector control (Figure 1-1). Refer to the Table of Contents for specific information relating to your genset. The remaining sections apply to all versions.

This manual DOES NOT provide application information for selecting a generator set or designing the complete installation. If it is necessary to design the various integrated systems (fuel, exhaust, cooling, etc.), additional information is required. Review standard installation practices. For engineering data specific to the generator set, refer to the specification and product data sheets. For application information, refer to Application Manual T-030, "Liquid Cooled Generator Sets".

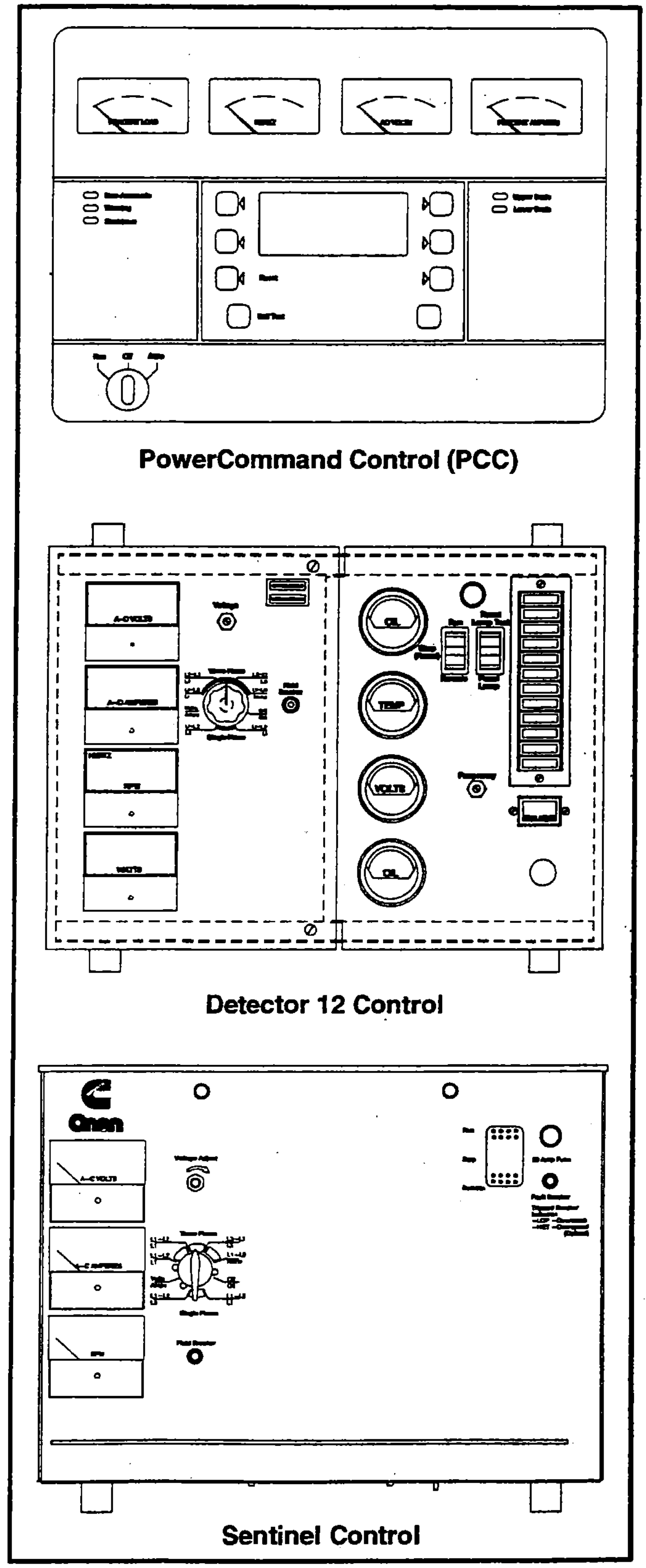


FIGURE 1-1. CONTROL PANEL CONFIGURATIONS

INSTALLATION OVERVIEW

These installation recommendations apply to typical installations with standard model generator sets. Whenever possible, these recommendations also cover factory designed options or modifications. However, because of the many variables in any installation, it is not possible to provide specific recommendations for every situation. If there are any questions not answered by this manual, contact your nearest Cummins/Onan dealer or distributor for assistance.

Application and Installation

A standby power system must be carefully planned and correctly installed for proper operation. This involves two essential elements: application and installation.

Application (as it applies to generator set installations) refers to the design of the complete standby power system that usually includes power distribution equipment, transfer switches, ventilation equipment, mounting pads, and cooling, exhaust, and fuel systems. Each component must be correctly designed so the complete system will function as intended. Application and design is an engineering function generally done by specifying engineers or other trained specialists. Specifying engineers are responsible for the design of the complete standby system and for selecting the materials and products required.

Installation refers to the actual set-up and assembly of the standby power system. The installers set up and connect the various components of the system as specified in the system design plan. The complexity of the standby system normally requires the special skills of qualified electricians, plumbers, sheetmetal workers, etc. to complete the various segments of the installation. This is necessary so all components are assembled using standard methods and practices.

Safety Considerations

The generator set has been carefully designed to provide safe and efficient service when properly installed, maintained, and operated. However, the overall safety and reliability of the complete system is dependent on many factors outside the control of the generator set manufacturer. To avoid possible safety hazards, make all mechanical and electrical connections to the generator set exactly as specified in this manual. All systems external to the generator (fuel, exhaust, electrical, etc.) must comply with all applicable codes. Make certain all required inspections and tests have been completed and all code requirements have been satisfied before certifying the installation is complete and ready for service.

2. Specifications

MODEL	35 DGBB	40 DGBC	50 DGCA	60 DGCB
Engine Cummins Diesel Series	4B3.9	4B3.9	4BT3.9	4BT3.9
Generator (Standby Rating) 3 Phase, 60 Hz (Standby/Prime) (kVA @ 0.8 PF)	35/32 kW (44 kVA)	40/35 kW (50 kVA)	50/45 kW (63 kVA)	60/55 kW (75 kVA)
3 Phase, 50 Hz (Standby/Prime) (kVA @ 0.8 PF)	28/25 kW (35 kVA)	32/29 kW (40 kVA)	40/36 kW (50 kVA)	50/45 kW (63 kVA)
Fuel Pump Inlet Fitting Size Return Fitting Size Maximum Fuel Lift	 5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)	 5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)	 5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)	 5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)
Exhaust Outlet Size Max. Allowable Back Pressure	 3 inch O.D. 41 inch H_2O	 3 inch O.D. 41 inch H_2O	 3 inch O.D. 41 inch H_2O	 3 inch O.D. 41 inch H_2O
Electrical System Starting Voltage Battery Cold Cranking Amps	 12 Volts DC One, 12 Volt 625	 12 Volts DC One, 12 Volt 625	 12 Volts DC One, 12 Volt 625	 12 Volts DC One, 12 Volt 625
Cooling System Capacity with Standard Radiator	5.5 Gal (21 L)	5.5 Gal (21 L)	5.5 Gal (21 L)	5.5 Gal (21 L)
Lubricating System Oil Capacity with Filters Oil Type*	12 Qts (11 L)	12 Qts (11 L)	12 Qts (11 L)	12 Qts (11 L)

* Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

MODEL	70 DGCC	80 DGDA	100 DGDB
Engine			
Cummins Diesel Series	4BTA3.9	6BT5.9	6BT5.9
Generator (Standby Rating)			
3 Phase, 60 Hz (Standby/Prime) (kVA @ 0.8 PF)	70/63 kW (88 kVA)	80/72 kW (100 kVA)	100/90 kW (125 kVA)
3 Phase, 50 Hz (Standby/Prime) (kVA @ 0.8 PF)	62/56 kW (77 kVA)	65/60 kW (81 kVA)	85/80 kW (106 kVA)
Fuel Pump			
Inlet Fitting Size	5/8 Inverted Flare	5/8 Inverted Flare	5/8 Inverted Flare
Return Fitting Size	0.18 O.D. Tube	0.18 O.D. Tube	0.18 O.D. Tube
Maximum Fuel Lift	5 ft. (1.525 m)	5 ft. (1.525 m)	5 ft. (1.525 m)
Exhaust			
Outlet Size	3 inch O.D.	3 inch O.D.	3 inch O.D.
Max. Allowable Back Pressure	41 inch H_2O	41 inch H_2O	41 inch H_2O
Electrical System			
Starting Voltage	12 Volts DC	12 Volts DC	12 Volts DC
Battery	One, 12 Volt	One, 12 Volt	One, 12 Volt
Cold Cranking Amps	625	800	800
Cooling System			
Capacity with Standard Radiator	5.7 Gal (22 L)	6.5 Gal (25 L)	6.5 Gal (25 L)
Lubricating System			
Oil Capacity with Filters	12 Qts (11 L)	17 Qts (16 L)	17 Qts (16 L)
Oil Type*			

* Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

MODEL	125 DGEA	150 DGFA	175 DGFB	200 DGFC
Engine Cummins Diesel Series	6CT8.3	6CTA8.3	6CTA8.3	6CTAA8.3
Generator (Standby Rating) 3 Phase, 60 Hz (Standby/Prime) (kVA @ 0.8 PF) 3 Phase, 50 Hz (Standby/Prime) (kVA @ 0.8 PF)	125/113 kW (156 kVA) 110/100 kW (138 kVA)	150/135 kW (188 kVA) 140/125 kW (175 kVA)	175/160 kW (219 kVA) 150/135 kW (188 kVA)	200/180 kW (250 kVA) 175/160 kW (219 kVA)
Fuel Pump Inlet Fitting Size Return Fitting Size Maximum Fuel Lift	5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)	5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)	5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)	5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)
Exhaust Outlet Size Max. Allowable Back Pressure	4 inch O.D. 41 inch H_2O	4 inch O.D. 41 inch H_2O	4 inch O.D. 41 inch H_2O	4 inch O.D. 41 inch H_2O
Electrical System Starting Voltage Battery Cold Cranking Amps	12 Volts DC One, 12 Volt 900	12 Volts DC One, 12 Volt 900	12 Volts DC One, 12 Volt 900	12 Volts DC One, 12 Volt 900
Cooling System Capacity with Standard Radiator	6.8 Gal (26 L)	7.5 Gal (28 L)	7.5 Gal (28 L)	6.8 Gal (26 L)
Lubricating System Oil Capacity with Filters Oil Type*	20 Qts (19 L)	20 Qts (19 L)	20 Qts (19 L)	20 Qts (19 L)

* Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

IMPORTANT

DEPENDING ON YOUR LOCATION AND INTENDED USE, FEDERAL, STATE OR LOCAL LAWS AND REGULATIONS MAY REQUIRE YOU TO OBTAIN AN AIR QUALITY EMISSIONS PERMIT BEFORE BEGINNING INSTALLATION OF YOUR GENSET. BE SURE TO CONSULT WITH LOCAL POLLUTION CONTROL OR AIR QUALITY AUTHORITIES BEFORE COMPLETING YOUR CONSTRUCTION PLANS.

3. Mounting the Generator Set

GENERAL

Most generator set installations must be engineered so the generator set will function properly under the expected load conditions. Use these instructions as a general guide only. Follow the instructions of the consulting engineer when locating or installing any components. The complete installation must comply with all local and state building codes, fire ordinances, and other applicable regulations. Consider these requirements before installation:

- Level mounting surface
- Adequate cooling air
- Adequate fresh induction air
- Discharge of circulated air
- Discharge of exhaust gases
- Electrical connections
- Accessibility for operation and servicing
- Noise levels
- Vibration isolation

LOCATION

Generator set location is decided mainly by related systems such as ventilation, wiring, fuel, and exhaust. The set should be located as near as possible to the main power fuse box.

Provide a location away from extreme ambient temperatures and protect the generator set from adverse weather conditions. An optional housing is available for outside operation.

⚠WARNING

INCORRECT INSTALLATION, SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND MECHANICAL COMPONENT INSTALLATION.

MOUNTING

Generator sets are mounted on a steel skid that provides proper support. The engine-generator assembly is isolated from the skid frame by rubber mounts that provide adequate vibration isolation for normal installations. For critical installations, install vibration isolators between the skid base and foundation.

Mount the genset on a substantial and level base such as a concrete pad.

Use 3/4-inch diameter, anchored mounting bolts to secure the generator set skid to the floor to prevent movement. Secure the skid using a flat washer and a hex nut for each bolt (Figure 3-1).

ACCESS TO SET

Plan for access to the genset for servicing and provide adequate lighting around the unit.

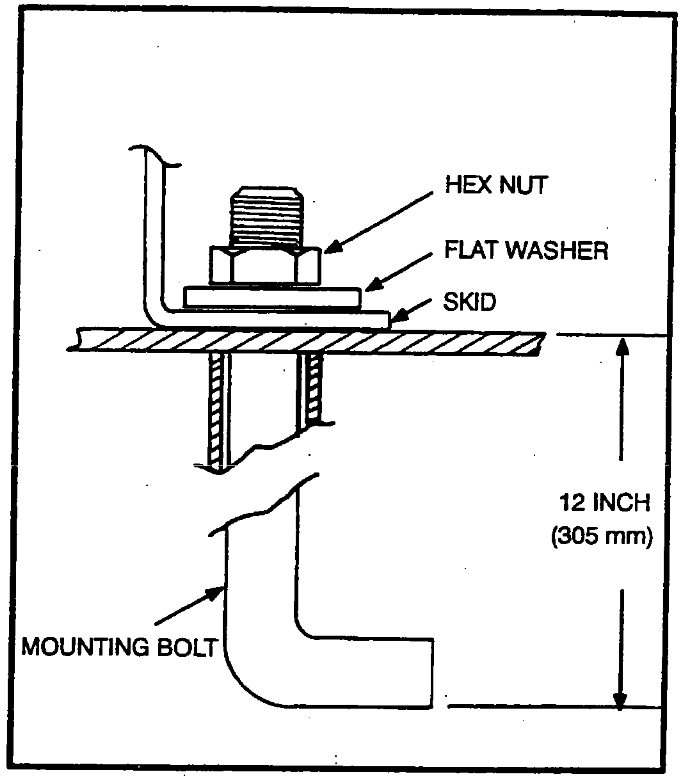


FIGURE 3-1. BOLT DIAGRAM

4. Mechanical Connections

GENERAL

The generator set mechanical system installation includes connecting the fuel, exhaust, ventilation and cooling systems. Before starting any type of fuel installation, all pertinent state and local codes must be complied with and the installation must be inspected before the unit is put in service.

FUEL SYSTEM

Cummins engines used on DG series generator sets normally use ASTM No. 2 diesel fuel. They will, however, operate on alternate diesel fuels within the specifications shown in the engine manual.

In all fuel system installations, cleanliness is of the upmost importance. Make every effort to prevent entrance of moisture, dirt or contaminants of any kind. Clean all fuel system components before installing.

Use only compatible metal fuel lines to avoid electrolysis when fuel lines must be buried. Buried fuel lines must be protected from corrosion. Use a flexible section of tubing (hose) between the engine and fuel supply line to provide vibration isolation. Refer to your generator set outline drawing for sizes and locations.

⚠ CAUTION ***Never use galvanized or copper fuel lines, fittings or fuel tanks. Condensation in the tank and lines combines with the sulfur in diesel fuel to produce sulfuric acid. The molecular structure of the copper or galvanized lines or tanks reacts with the acid and contaminates the fuel.***

An electric solenoid valve in the supply line is recommended for all installations and required for indoor automatic or remote starting installations. Connect the solenoid wires to the battery run circuit to open the valve during generator set operation.

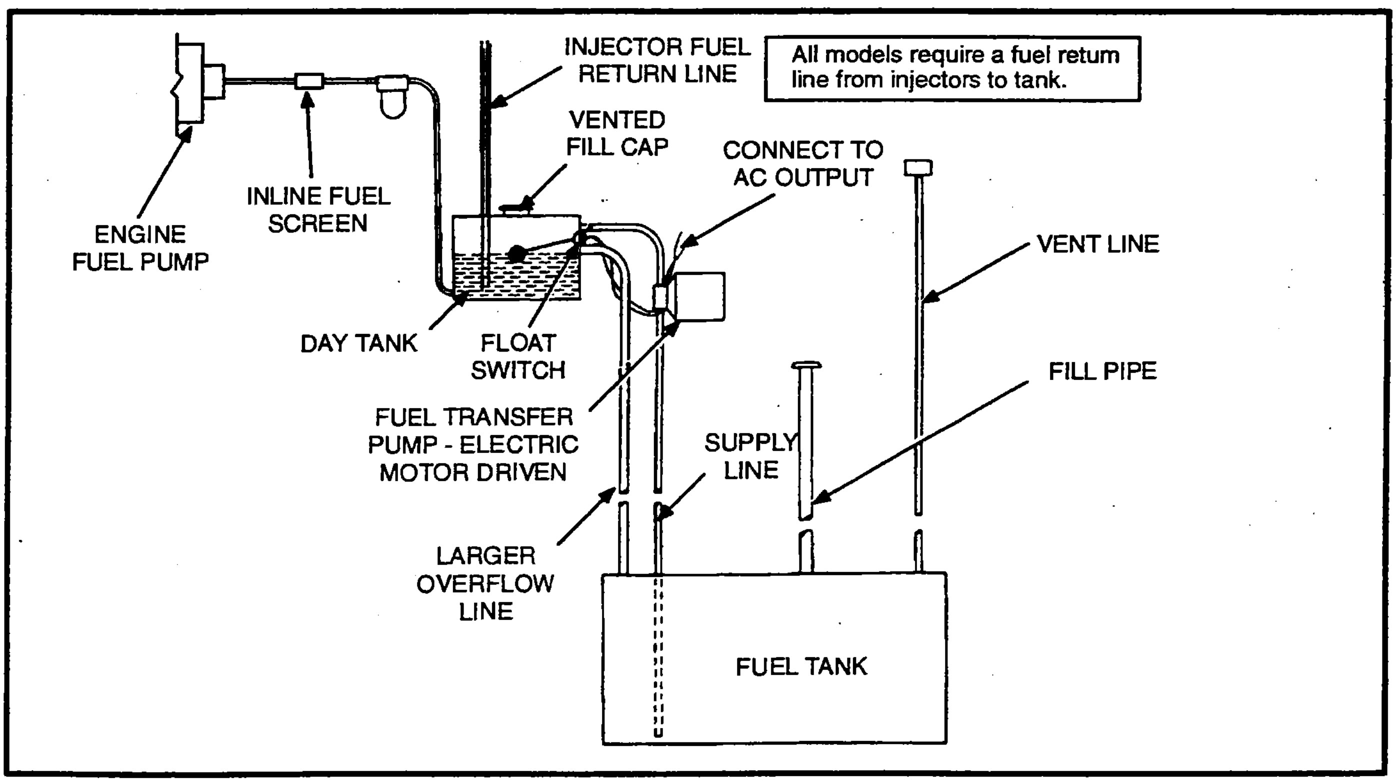


FIGURE4-1. TYPICAL FUEL SUPPLY INSTALLATION

Supply Tank

Locate the fuel tank as close as possible to the generator set and within the 5 foot (1.5 m) lift capacity of the fuel pump. Install a fuel tank that has sufficient capacity to keep the generator set operating continuously at full load for at least 36 hours. Refer to product Specification Sheet for fuel consumption data.

WARNING ***Fuel leaks create fire and explosion hazards which can result in severe personal injury or death. Always use flexible tubing between engine and fuel supply to avoid line failure and leaks due to vibration. The fuel system must meet applicable codes.***

WARNING ***Spilled fuel can create environmental hazards. Check local requirements for containment and prevention of draining to sewer and ground water.***

If the main fuel tank is installed below the lift capabilities of the standard fuel transfer pump, a transfer tank (referred to as a day tank) and auxiliary pump will also be required. If an overhead main fuel tank is installed, a transfer tank and float valve will be required to prevent fuel head pressures from being placed on the fuel system components.

Day Tank (If Used)

Fuel day tanks are used when the standard engine fuel pump does not have the capacity to draw the fuel from the supply tank, or the supply tank is overhead and presents problems of high fuel head pressure for the fuel return.

Supply Tank Lower Than Engine: With this installation, the day tank is installed near the generator set and within the engine fuel pump lift capability, but below the fuel injection system. Install an auxiliary fuel pump as close as possible to the supply tank to pump fuel from the supply tank to the day tank. A float switch in the day tank controls operation of the auxiliary fuel pump.

The supply tank top must be below the day tank top to prevent siphoning from the fuel supply to the day tank.

Provide a return line from the engine injection system return connection to the day tank. Plumb the return line to the bottom of day tank as shown in Figure 4-1. Provide a day tank overflow line to the supply tank in case the float switch fails to shut off the fuel transfer pump.

WARNING ***Spilled fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Provide an overflow line to the supply tank from the day tank.***

Supply Tank Higher Than Engine: Install the day tank near the generator set, but below the fuel injection system. Use fuel line at least as large as the fuel pump inlet. The engine fuel return line must enter the day tank.

Engine Fuel Connections

Identification tags are attached to the fuel supply line and fuel return line connections by the factory. Flexible lines for connecting between the engine and the stationary fuel line are supplied as standard equipment. The flexible supply line incorporates a fuel screen, which screens the fuel prior to the engine fuel transfer pump. Do not operate generator set without fuel screen installed in supply line. Refer to *Specifications* for the fitting sizes.

EXHAUST SYSTEM

Pipe exhaust gases to the outside of any enclosure. Locate the exhaust outlets away from any air inlets to avoid gases re-entering the enclosure. Exhaust installations are subject to various detrimental conditions such as extreme heat, infrequent operation and light loads. Regularly inspect the exhaust system both visually and audibly to see that the entire system remains fume tight and safe for operation.

⚠WARNING ***Inhalation of exhaust gases can result in severe personal injury or death. Use extreme care during installation to provide a tight exhaust system. Terminate exhaust pipe away from enclosed or sheltered areas, windows, doors and vents.***

Use an approved thimble (Figure 4-2) where exhaust pipes pass through wall or partitions. Refer to NFPA 37, Section 6-3. "Stationary Combustion Engines and Gas Turbines" for accepted design practices. Build according to the code requirements in effect at the installation site.

⚠WARNING ***Hot exhaust pipes can start a fire and cause severe injury or death if improperly routed through walls. Use an approved thimble where exhaust pipes pass through walls or partitions.***

⚠WARNING ***Inhalation of exhaust gases can result in severe personal injury or death. Do not use exhaust heat to warm a room, compartment or storage area.***

Rain caps are available for the discharge end of vertical exhaust pipes. The rain cap clamps onto the end of the pipe and opens due to exhaust discharge force from the generator set. When the generator set is stopped, the rain cap automatically closes, protecting the exhaust system from rain, snow, etc.

Use a section of flexible exhaust pipe between the engine and remainder of exhaust system. Support exhaust system to prevent weight applied to engine exhaust outlet elbow/turbocharger connection.

⚠CAUTION ***Weight applied to the engine manifold can result in turbocharger damage. Support the muffler and exhaust piping so no weight or stress is applied to engine exhaust elbow.***

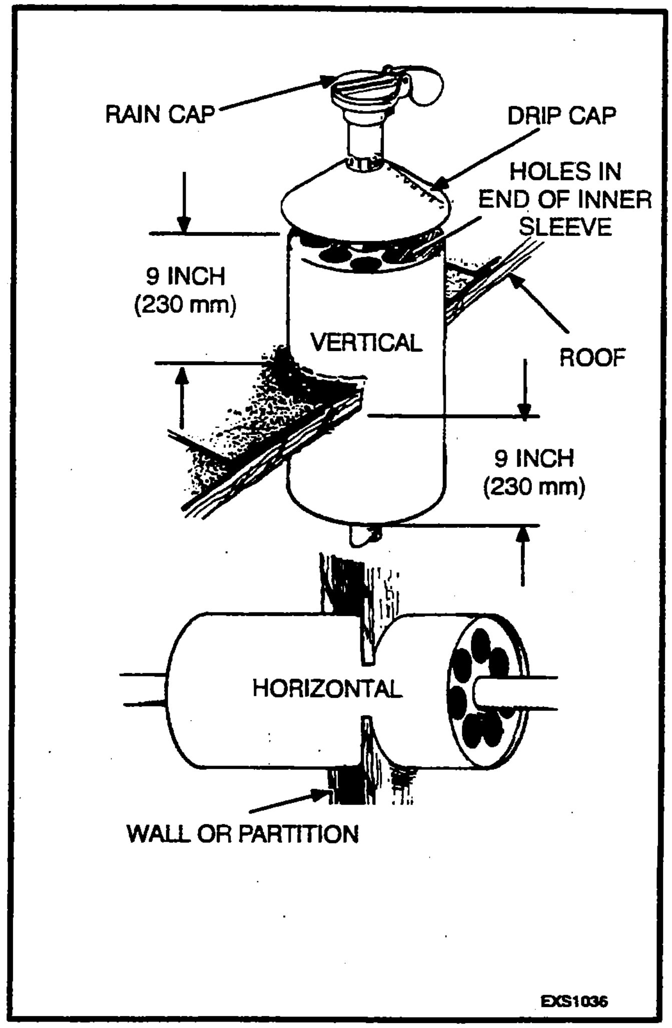


FIGURE 4-2. MOUNTING EXHAUST THIMBLE

Avoid sharp bends by using sweeping, long radius elbows and provide adequate support for muffler and tailpipe. Pitch a horizontal run of exhaust pipe DOWNWARD (away from engine) to allow any moisture condensation to drain away from the engine. If an exhaust pipe must be turned upward, install a condensation trap at the point where the rise begins (Figure 4-3).

Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 12 inches (305 mm) of clearance if the pipes pass close to a combustible wall or partition.

WARNING ***Exhaust pipes are very hot and they can cause severe personal injury or death from direct contact or from fire hazard. Shield or insulate exhaust pipes if there is danger of personal contact or when routed through walls or near other combustible materials.***

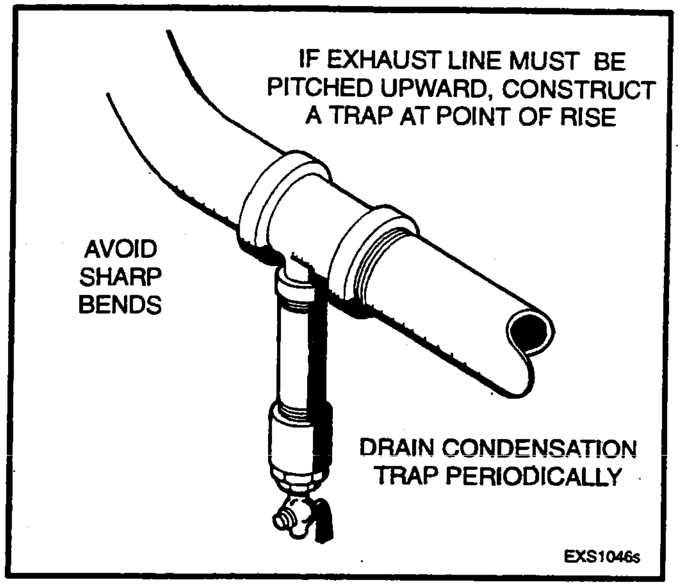


FIGURE 4-3. CONDENSATION TRAP

VENTILATION AND COOLING

Generator sets create considerable heat that must be removed by proper ventilation. Outdoor installations rely on natural air circulation but indoor installations need properly sized and positioned vents for required airflow.

Vents and Ducts

For indoor installations, locate vents so incoming air passes through the immediate area of the installation before exhausting. Install the air outlet higher than the air inlet to allow for convection air movement.

Size the vents and ducts so they are large enough to allow the required flow rate of air. The "free area" of ducts must be as large as the exposed area of the radiator. Refer to the DG series Specification Sheet for the airflow requirements and allowed airflow restriction.

Wind will restrict free airflow if it blows directly into the air outlet vent. Locate the outlet vent so the effects of wind are eliminated. See Figure 4-4.

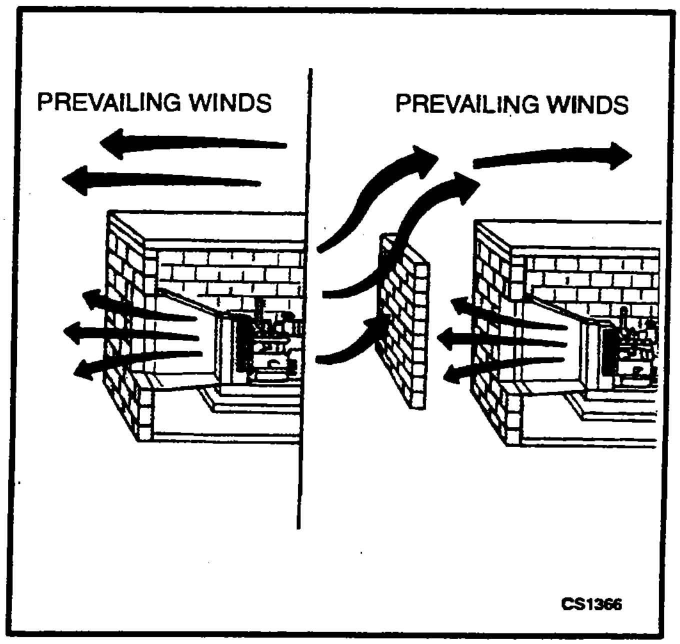


FIGURE 4-4. WIND BARRIER

Dampers

Dampers or louvres protect the generator set and equipment room from the outside environment. Their operation of opening and closing should be controlled by operation of the generator set.

In cooler climates movable or discharge dampers are used. These dampers allow the air to be recirculated back to the equipment room. This enables the equipment room to be heated while the generator set engine is still cold, increasing the engine efficiency.

Radiator Set Requirements

Radiator set cooling air is drawn past the rear of the set by a pusher fan that blows air through the radiator (Figure 4-5). Locate the air inlet to the rear of the set. Make the inlet vent opening 1-1/2 times larger than the radiator area.

Louvers and screens over air inlet and outlet openings restrict air flow and vary widely in performance. A louver assembly with narrow vanes, for example, tends to be more restrictive than one with wide vanes. The effective open area specified by the louver or screen manufacturer should be used.

Locate the cooling air outlet directly in front of the radiator and as close as possible. The outlet opening must be at least as large as the radiator area. Length and shape of the air outlet duct should offer minimum restriction to airflow.

Attach a canvas or sheet metal duct to the air outlet opening using screws and nuts so duct can be removed for maintenance purposes. The duct prevents recirculation of heated air. Before installing the duct, remove the radiator core guard.

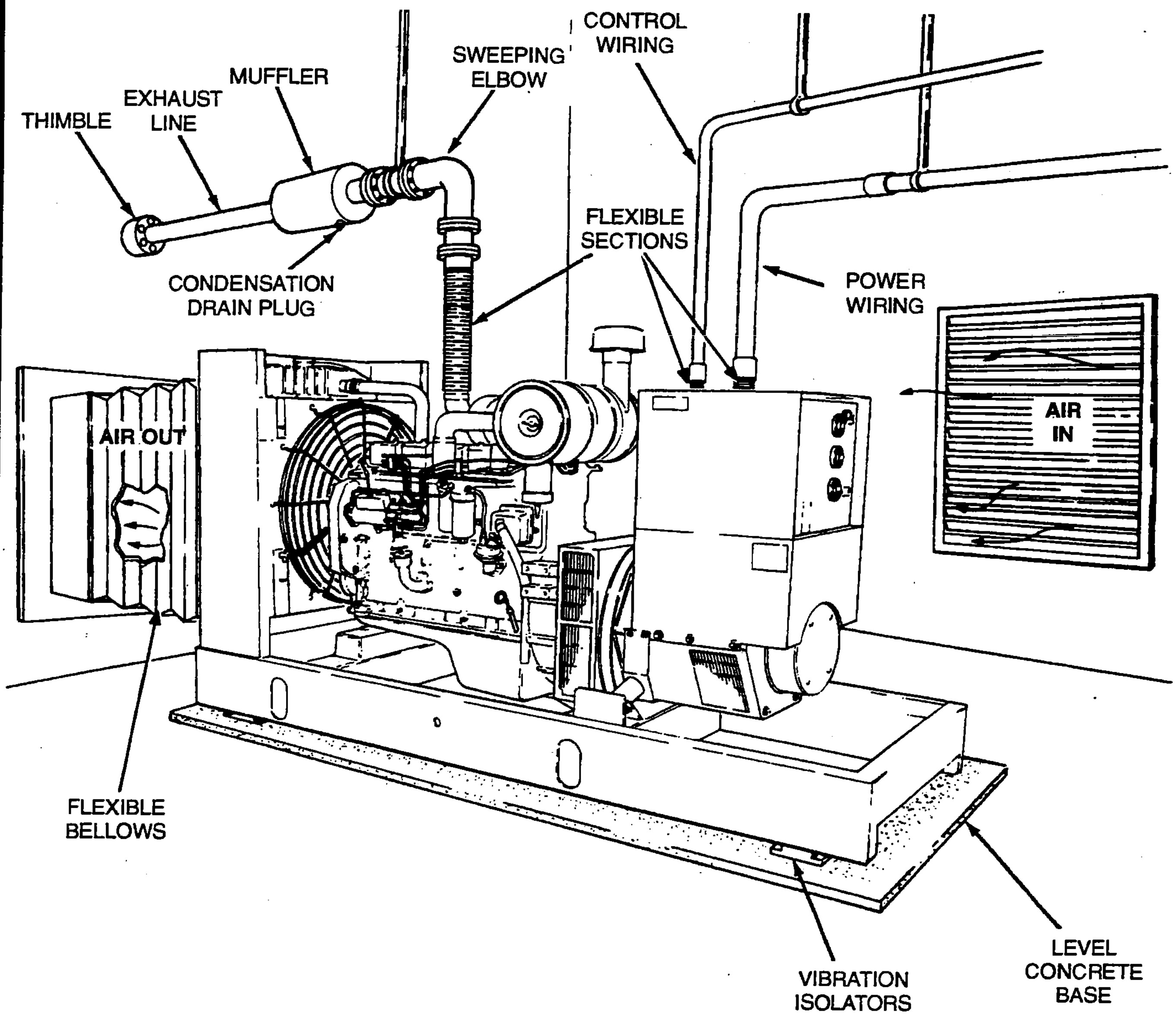
Remote Radiator Cooling (Optional) substitutes a remote mounted radiator and an electrically driven fan for the set mounted components. Removal of the radiator and the fan from the set reduces noise levels without forcing dependence on a continuous cooling water supply. The remote radiator installation must be completely protected against freezing.

Remote radiator plumbing will vary with installation. Follow recommendations given in Application Manual T-030. See product Specification sheet for friction head and static head limits.

Before filling cooling system, check all hardware for security. This includes hose clamps, capscrews, fittings and connections. Use flexible coolant lines with heat exchanger or remote mounted radiator.

Water Jacket Heater (Optional)

An optional water jacket heater can be installed to keep the engine warm for starting under adverse weather conditions. Connect the heater to a power source that will be on when the engine is NOT running.



IMPORTANT!

COOLING AIR INLET MUST BE AT LEAST 1-1/2 TIMES LARGER THAN RADIATOR DUCT OUTLET AREA ON RADIATOR-COOLED MODELS.

FLOW OF COOLING AIR AND HEATED AIR MAY BE CONTROLLED BY AUTOMATICALLY OPERATED LOUVRES.

FIGURE 4-5. TYPICAL RADIATOR SET INSTALLATION

5. DC Control Wiring (PCC)

CONTROL WIRING

The generator set accessory box (Figure 5-1), which is located on the backside of the control housing, contains connection points for remote control and monitor options.

CAUTION ***Stranded copper wire must be used for all customer connections to the Accessory Box. Solid copper wire may break due to genset vibration.***

TB1 REMOTE MONITOR/CONTROL CONNECTIONS

Customer monitor/control connections are attached to terminal block TB1 (Figure 5-1). Optional equipment such as a remote annunciator panel, sensing devices used to monitor genset operation, remote start/stop switches, control box heater, battery charger, etc. are attached to TB1. Refer to PCC Customer Connections diagram in Section 12.

TB1 Wiring

CAUTION ***Always run control circuit wiring in a separate metal conduit from AC power cables to avoid inducing currents that could cause problems within the control.***

Digital Connections: Connection points, other than relayed outputs, network, switched B+ and B+ are considered digital connections to terminal strip TB1. The type/gauge wire to use for these connections are:

- Less than 1000 feet (305m), use 20 gauge stranded copper wire.
- 1000 to 2000 feet (305 to 610m), use 18 gauge stranded copper wire.

Relay Connections: Due to the wide variety of devices that can be attached to the relay outputs of TB1, the electrical contractor must determine the gauge of the **stranded copper** wire that is used at this installation site. Refer to PCC Customer Connections diagram in Section 12 for the relay specifications.

Network Connections: Refer to Onan 900-0366 *PowerCommand Network Installation and Operation* manual for the type/gauge wire to use for these connections.

Switched B+: (Fused at 10 amps.) Same as Relay Connection description.

B+: (Fused at 20 amps.) Same as Relay Connection description.

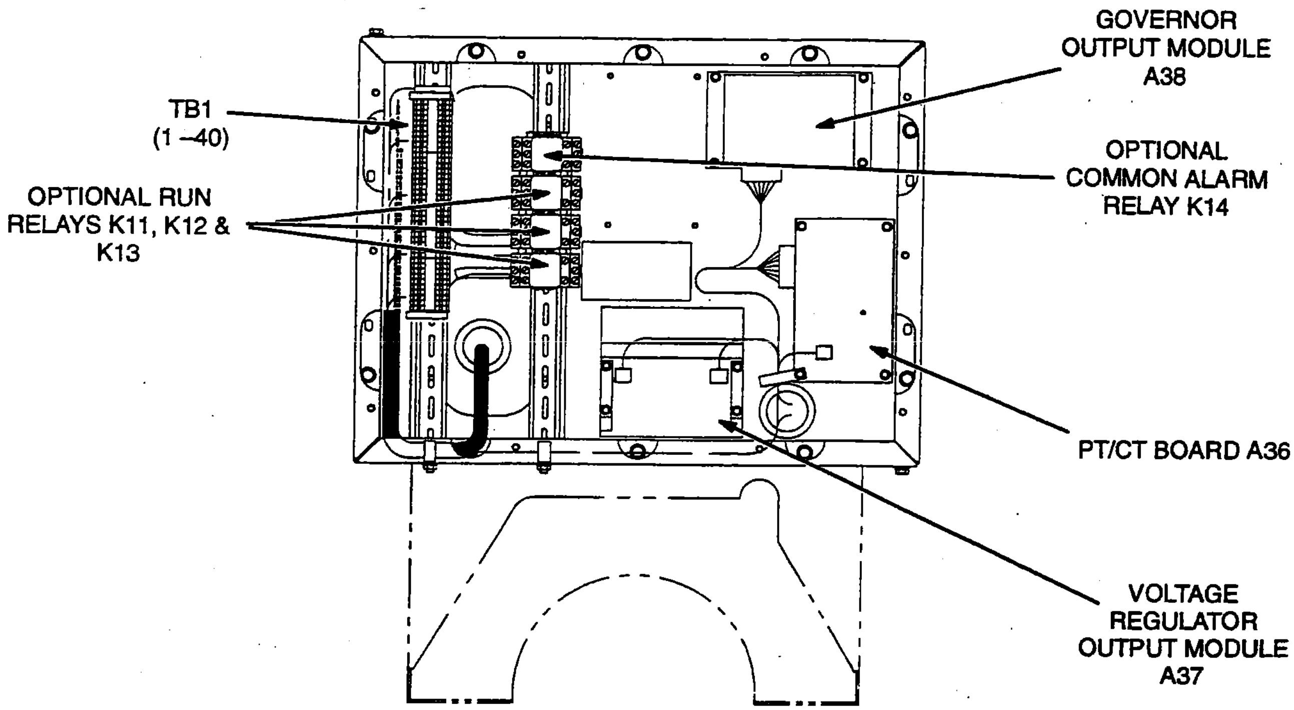


FIGURE 5-1. ACCESSORY BOX

The optional run relays are rail mounted inside the accessory box (Figure 5-1). The rail mount allows you to easily remove and replace the snap-on relays. The generator set can be equipped with one, two or three run relays.

The three-pole, double-throw run relays (Figure 5-2) are used to control auxiliary equipment such as fans, pumps and motorized air dampers. The run relays are energized when the generator set reaches operating speed.

The contacts are rated:

- 10 amps at 28 VDC or 120 VAC, 80%PF
- 6 amps at 240 VAC, 80%PF
- 3 amps at 480/600 VAC, 80%PF

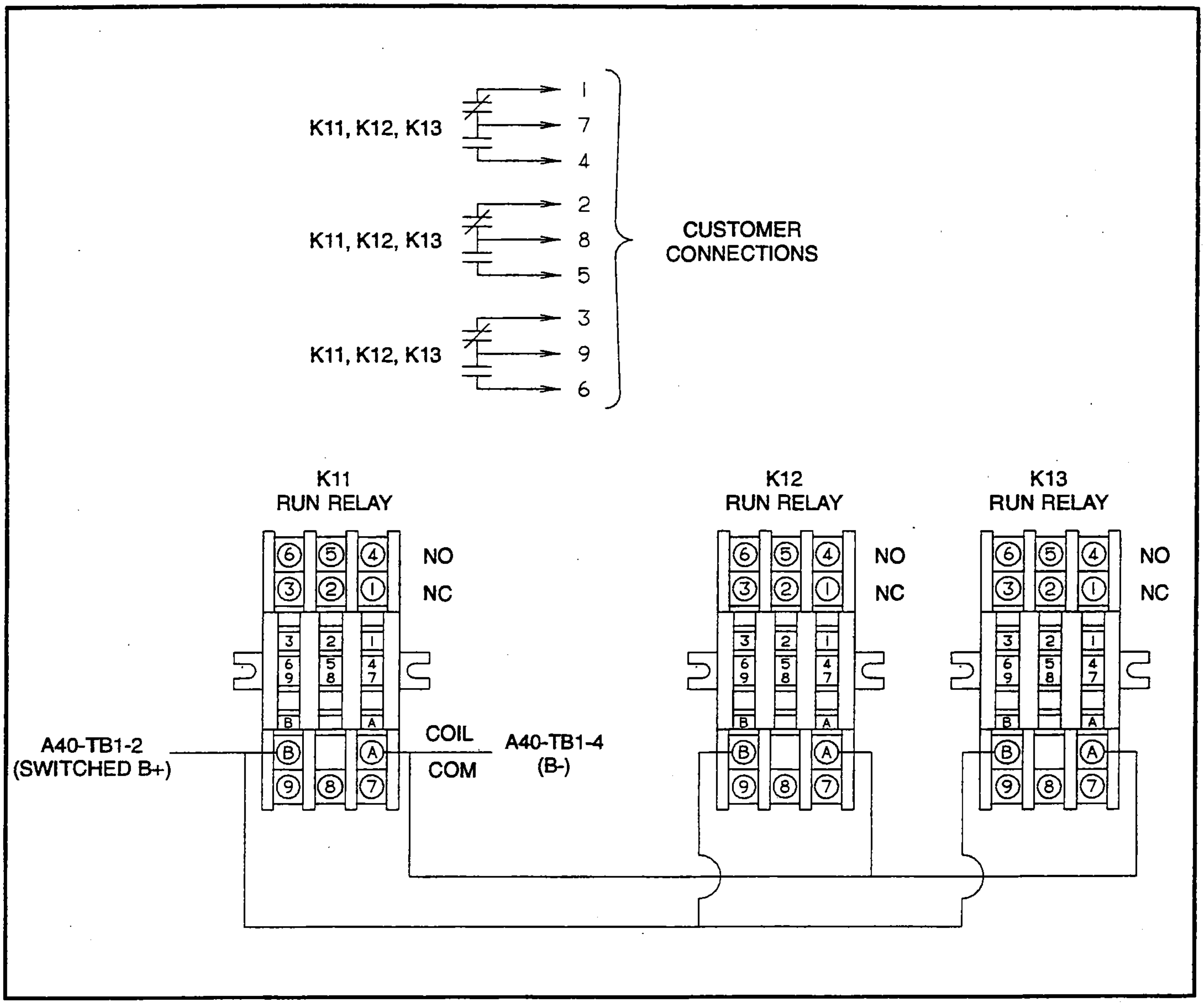


FIGURE 5-2. OPTIONAL RUN RELAYS (K11, K12, K13)

ALARM RELAY (K14)

The optional alarm relay is rail mounted inside the accessory box (Figure 5-1). The rail mount allows you to easily remove and replace the snap-on relay.

The three-pole, double-throw alarm relay (Figure 5-3) is often used to energize warning devices such as audible alarms. Any generator set warning or shutdown will energize the alarm relay.

The contacts are rated:

- 10 amps at 28 VDC or 120 VAC, 80%PF
- 6 amps at 240 VAC, 80%PF
- 3 amps at 480/600 VAC, 80%PF

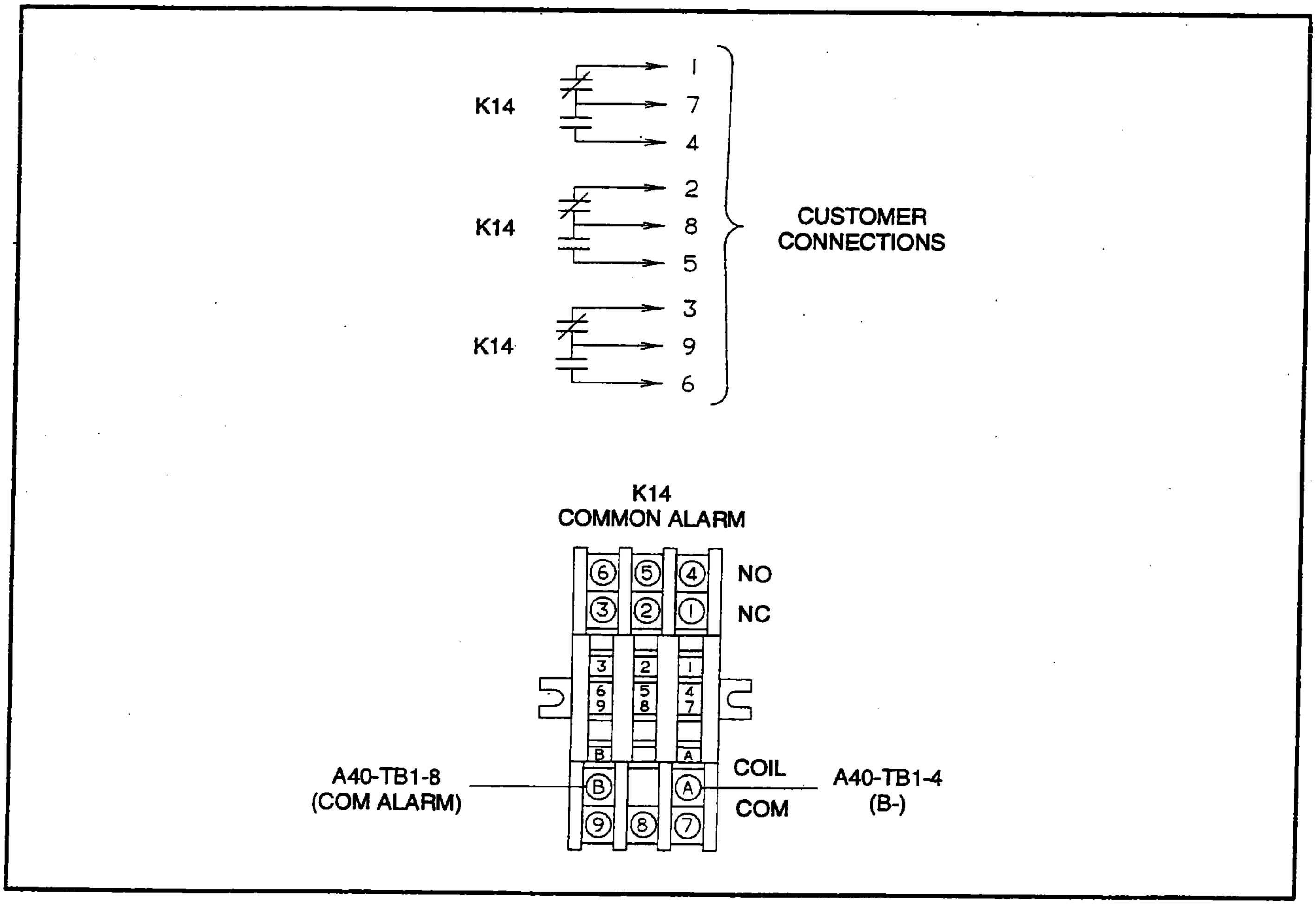


FIGURE 5-3. OPTIONAL ALARM RELAY (K14)

6. DC Control Wiring (Detector Control)

CONTROL WIRING

The generator set control panel box contains connection points for remote control and monitor options. These connection points are located on the engine control monitor board (ECM), the time-delay module and the optional auxiliary relay board (ARB). (Note that if the optional ARB is installed, no remote monitor connections are attached to the ECM. The ARB provides all remote monitor connection points.)

CAUTION ***Stranded copper wire must be used for all customer connections to the control panel box. Solid copper wire may break due to genset vibration.***

The type/gauge wire to use for these connections are:

- Less than 1000 feet (305m), use 18 gauge stranded copper wire.
- 1000 to 2000 feet (305 to 610m), use 16 gauge stranded copper wire.

CAUTION ***Always run control circuit wiring in a separate metal conduit from AC power cables to avoid inducing currents that could cause problems within the control.***

WARNING ***HAZARDOUS VOLTAGE Touching uninsulated high voltage parts inside the control panel box can result in severe personal injury or death. Control wire installation must be done with care to avoid touching uninsulated live parts.***

For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.

ENGINE CONTROL MONITOR BOARD (ECM-A11)

The heart of the engine control system is the engine monitor (A11). It is a printed circuit board assembly mounted on the back wall of the control box (Figure 6-1). It starts and stops the engine in response to the control panel switches, engine sensors and remote control signals.

Remote Monitor Connections

The Detector control provides the capability of attaching a remote monitor panel. Connections are made on the terminal blocks **TB1** and **TB2** located on the ECM board. A detailed connection diagram for the ECM board is provided in Section 12. (If the optional ARB is installed, remote monitor connections attach to the ARB, not the ECM.)

Remote Start Connections

Connect remote start switch between A11-TB1-9 (B+) and A11-TB1-6 (RMT).

Function Selection Jumpers

The ECM board has six selection jumpers that can be repositioned to provide the following timed or non-timed warnings or timed or non-timed shutdowns with warnings:

W1 (12 light only) Jumper Position (jumper **W8** must be in the **B** position):

- **A** Non-timed warning under **FLT 2** conditions.
- **B** (12 light only) Non-timed shutdown under **FLT 2** conditions.
- **C** Timed warning under **FLT 2** conditions.
- **D** Timed shutdown under **FLT 2** conditions.

W2 Jumper Position (jumper **W9** must be in the **B** position):

- **A** Non-timed warning under **FLT 1** conditions.
- **B** Non-timed shutdown under **FLT 1** conditions.
- **C** Timed warning under **FLT 1** conditions.
- **D** Timed shutdown under **FLT 1** conditions.

W6 Jumper Position:

- **A** Warning under **Pre-High Engine Temperature** conditions.
- **B** Shutdown under **Pre-High Engine Temperature** conditions.

W7 Jumper Position:

- **A** Warning under **Pre-Low Oil Pressure** conditions.
- **B** Shutdown under **Pre-Low Oil Pressure** conditions.

W8 (12 light only) Jumper Position:

- **A** Warning while running or during standby under **FLT 2** conditions.
- **B** Allows selection of functions with **W1** jumper.

W9 (12 light only) Jumper Position:

- **A** Warning while running or during standby under **FLT 1** conditions.
- **B** Allows selection of functions with **W2** jumper.

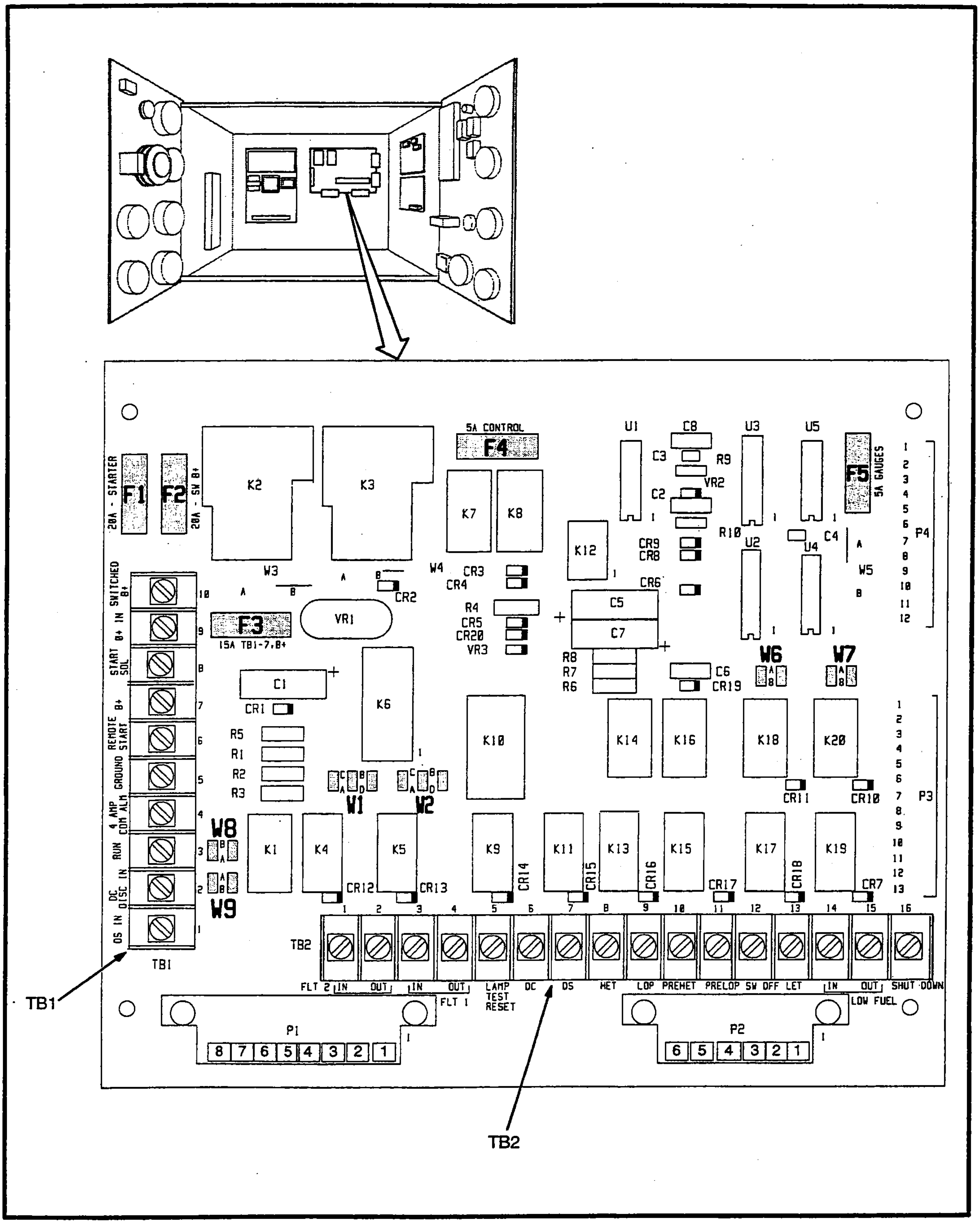


FIGURE 6-1. ENGINE CONTROL MONITOR BOARD (ECM)

AUXILIARY RELAY BOARD (OPTIONAL)

The following describes the design/functional criteria for the auxiliary relay board (ARB) with a Detector control. The board is mounted directly on top of the ECM using standoffs and has access holes for the fuses located on the ECM. A detailed connection diagram for the ARB is provided in Section 12.

Terminal Blocks:

- **TB1** – ARB TB1 and engine monitor TB1 are identically numbered and provide the same remote control connection points. Note that additional terminals are provided for terminals 5, 7, and 10 of ARB TB1.
- **TB2 through TB5** – Connection points for relays K1 through K3. TB2 provides the N/O and N/C connections (three form 'C' contacts for each relay). TB3 through TB5 provide the common connection points (TB3 for K1, TB4 for K2 and TB5 for K3).
- **TB6 and TB7** – Connection points for fault relays K4 through K15. Three terminals are provided for each relay, which are labeled COM, N/C, N/O.

Plug-In Relays (K1, K2, K3): The ARB can be equipped with one to three 3-pole, double-throw relays. These relays (K1, K2, K3) are field changeable plug-in relays for easy field addition and replacement.

Each relay can be operated as a RUN, COMMON ALARM, or ISOLATED COIL with the changing of a jumper.

The relay contact ratings are:

- 10 amps at 28 VDC or 120 VAC, 80% PF
- 6 amps at 240 VAC, 80% PF
- 3 amps at 480 VAC, 80% PF

Jumper Positions for Plug-In Relays: Jumpers W1, W2 and W3 perform the same functions for their respective relays, W1 for relay K1, W2 for relay K2, and W3 for relay K3. They can be located in any of 3 positions (A, B, C) independently of each other.

- **Jumper Position A (Run)** – The relay operates as a Run relay, energizing when SW B+ is applied from the engine monitor.
- **Jumper Position B (Common Alarm)** – The relay operates as a Common Alarm relay. The relay energizes any time there is an engine shutdown.
- **Jumper Position C (Isolated)** – The relay operates as an Isolated relay. The relay coil is energized by a customer applied B+ signal through the terminal block; TB3-1 for relay K1, TB4-1 for relay K2, and TB6-1 for relay K3.

Jumpers W11, W12, and W13 perform the same functions for their respective relays; W11 for relay K1, W12 for relay K2, and W13 for relay K3. They can be located in two different positions (A, B) independently of one another.

- **Jumper Position A** – The relay operates isolated from the board. The customer provides the circuit completion through terminal block; TB3 for relay K1, TB4-5 for relay K2, and TB6-5 for relay K3. The customer can operate the relay with switched ground logic or use this relay in the middle of more complex logic circuits if needed.
- **Jumper Position B** – The relays operate with the coils connected to ground through the board connections. The coil will require a B+ signal to energize with the jumper in this position.

Fault Relays (K4 through K15): These relay modules are used to operate a remote alarm annunciator that has an independent power source. This allows the use of either AC or DC for alarm drives. The relays are energized through the latching relays on the engine monitor and provided N/O and N/C contacts for each external alarm connection.

The 12 relays with form 'C' contacts are rated:

- 10 Amp, 120 VAC
- 10 Amp. 30 VDC

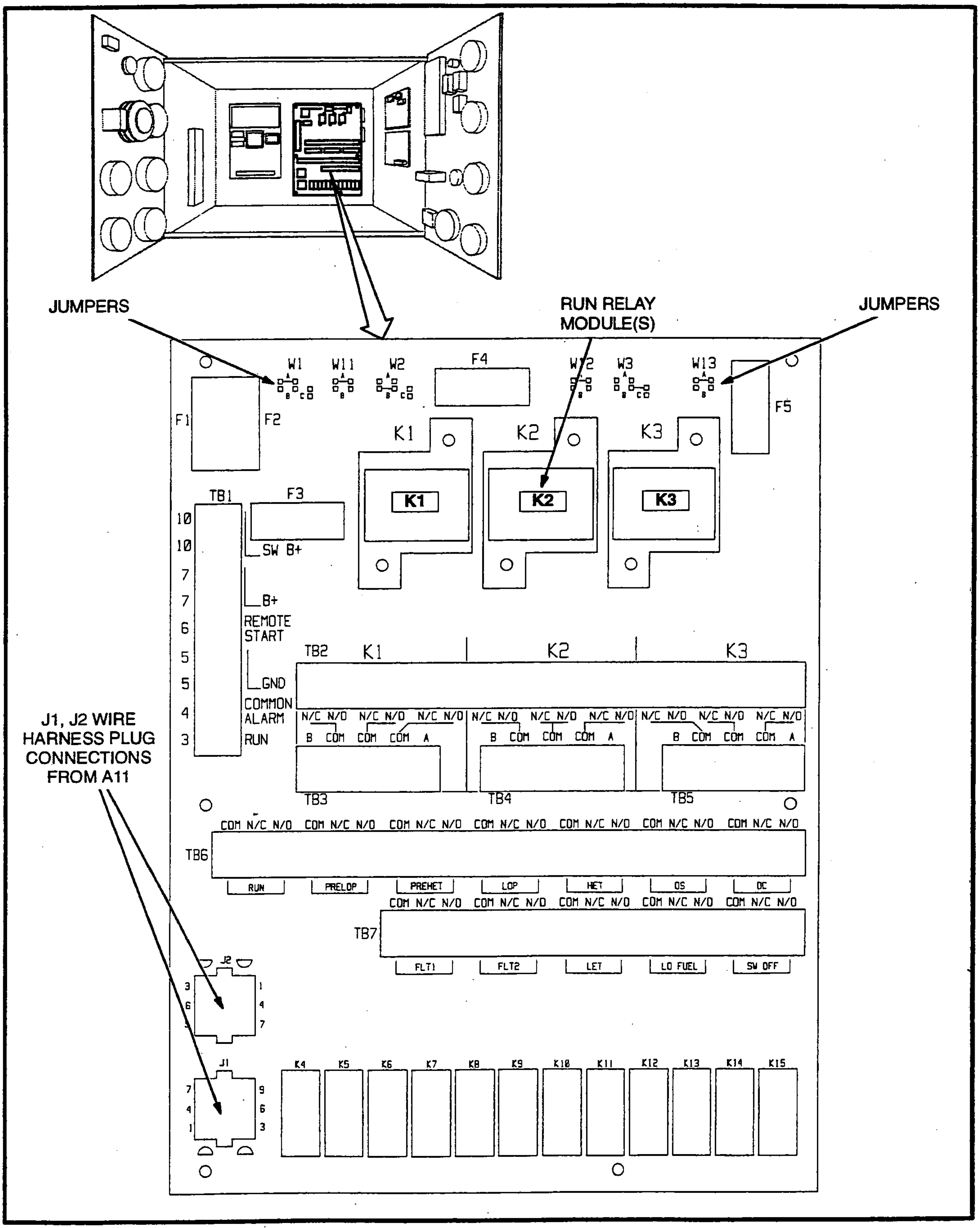


FIGURE 6-2. AUXILIARY RELAY BOARD (ARB)

TIME-DELAY MODULE (A15) (OPTIONAL)

The start delay module is adjustable from 5 to 15 seconds and the stop delay from 30 seconds to 30 minutes. Turn the delay adjusting potentiometers clockwise to increase delay and counterclockwise to decrease delay.

Remote Control Connections

Remote control connections are made at the terminal block (TB1) that is located on the time-delay module (Figure 6-3). Connect one or more remote switches across the remote terminal (TB1-5) of the time-delay module and the B+ terminal of the ECM (A11).

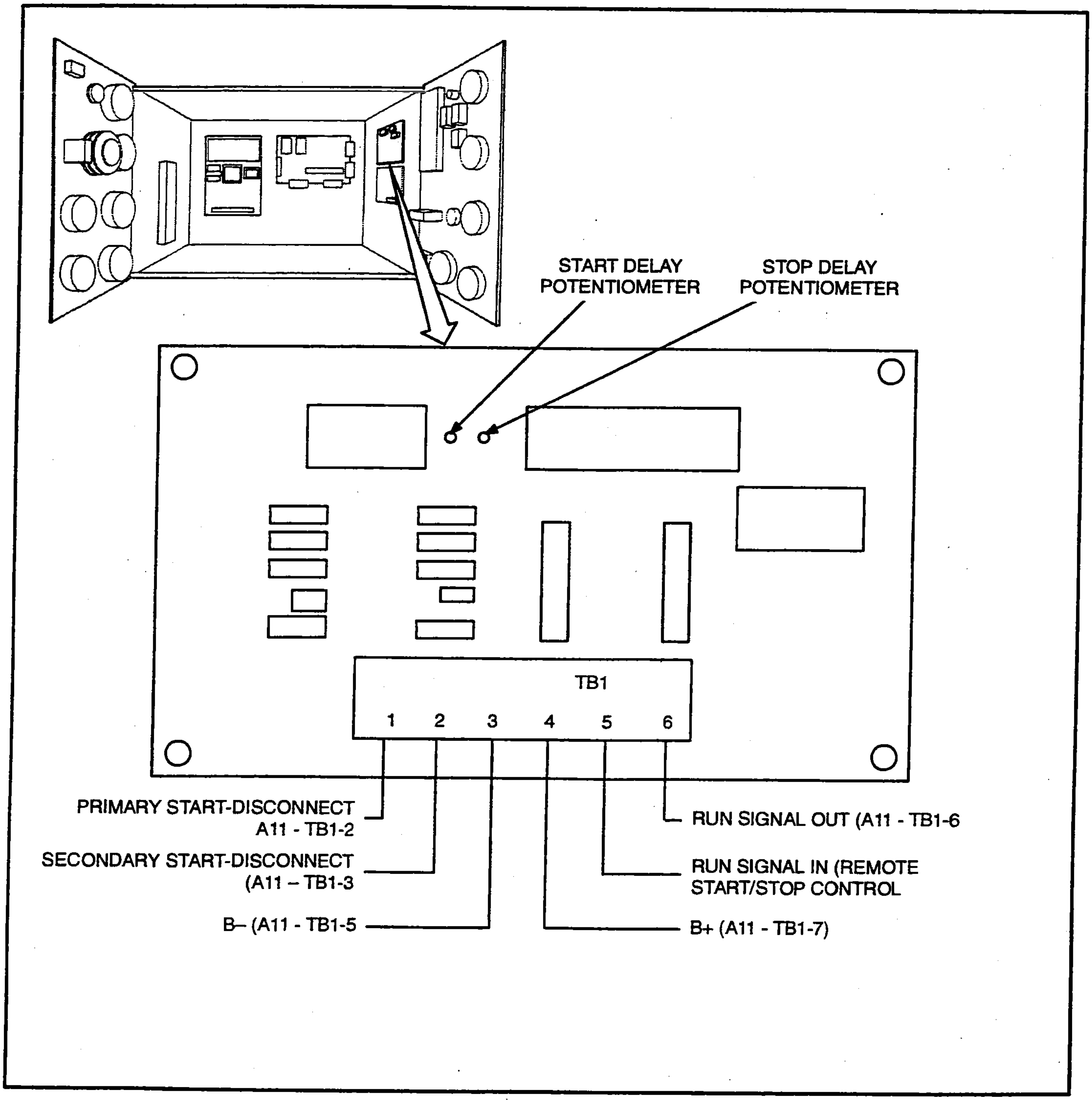


FIGURE 6-3. PREHEAT/TIME-DELAY MODULE

7. DC Control Wiring (Sentinel Control)

CONTROL WIRING

The generator set control panel box contains connection points for remote starting and switched B+ connections. Connections are made on the terminal block (TB1) located inside the control box (Figure 7-1).

Connect a remote switch across remote terminal (TB1-4) and B+ (TB1-3) for remote starting. Switched B+ auxiliary power is available when the generator set is running. When connecting customer accessories to the 12 volt B+ auxiliary terminals (TB1-1 & 2), do not exceed the following current levels:

- 7 amps maximum with electronic governor.
- 12 amps maximum without electronic governor.

If the distance between the genset and the remote station is less than 1000 feet (305 m), use 18 gauge stranded copper wire. If the distance is 1000 to 2000 feet (305 to 610 m), use 16 gauge stranded copper wire. Always run control circuit wiring in a separate metal conduit from AC power cables to avoid inducing currents that could cause problems within the control.

⚠WARNING ***HAZARDOUS VOLTAGE Touching uninsulated high voltage parts inside the control panel box can result in severe personal injury or death. Control wire installation must be done with care to avoid touching uninsulated live parts.***

For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.

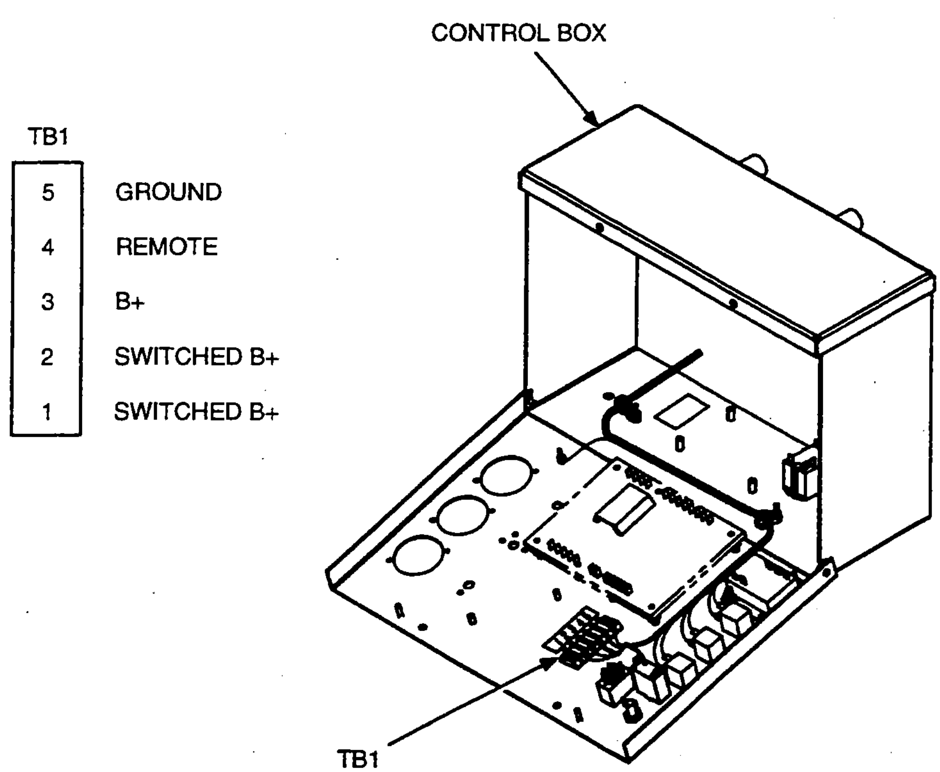


FIGURE 7-1. REMOTE CONTROL CONNECTION POINTS

8. AC Electrical Connections

GENERAL

This section provides the procedure that is used to connect the AC electrical system of the genset.

Disconnect the battery charger and the battery cables (negative [–] first) to prevent accidental starting while working on the set.

CAUTION ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

WARNING ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).***

Make certain battery area has been well-ventilated before servicing battery. Arcing can ignite explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur when cable is removed or re-attached, or when negative (–) battery cable is connected and a tool used to connect or disconnect positive (+) battery cable touches frame or other grounded metal part of the set. Always remove negative (–) cable first, and reconnect it last. Make certain hydrogen from battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if battery has been connected to battery charger.

WARNING ***Each of the operations described in this section should be done only by persons trained and experienced in electrical maintenance. Improper procedures may result in property damage, bodily injury or death.***

Connecting the genset AC electrical system involves:

- Installation of transfer switch (standby service only)
- Generator voltage connections
- Load connection
- Standard and optional AC equipment connections (e.g., control box heater, coolant heater, etc.).

Local regulations often require that wiring connections be made by a licensed electrician, and that the installation be inspected and approved before operation. All connections, wire sizes, materials used, etc. must conform to the requirements of electrical codes in effect at the installation site.

WARNING ***Improper wiring can cause a fire or electrocution, resulting in severe personal injury or death and/or property and equipment damage.***

Before starting the genset, verify that all electrical connections are secure, and that all wiring is complete. Replace and secure any access panels that have been removed during installation. Check that the load cables from the genset are properly connected.

WARNING ***Backfeed to utility system can cause electrocution or property damage. Do not connect to any building electrical system except through an approved device and after building main switch is opened.***

TRANSFER SWITCH

If the installation is for standby service, a transfer switch must be used for switching the load from the normal power source to the genset (see Figure 8-1). Either a manual or automatic transfer switch may be used. Follow the installation instructions provided with the transfer switch when connecting the load and control wiring.

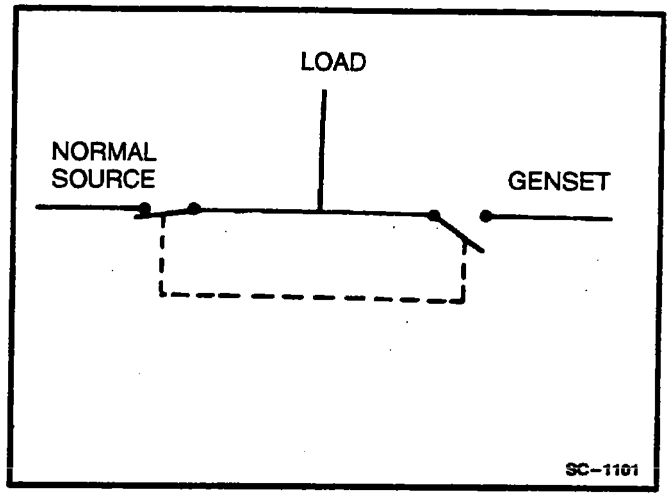


FIGURE 8-1. TYPICAL LOAD TRANSFER FUNCTION

AC WIRING

Generator Voltage Connections

The generator output voltage and maximum current rating are specified on the generator set nameplate. Line-to-neutral voltage is always the lower voltage shown and line-to-line voltage is the higher rating.

These generators can be configured for the voltages shown in the Reconnection Diagram on the side access cover of the control housing. Most of these voltages must be reconnected by the installer to give the voltage required by the installation. Before shipping, the factory tests the generator set output by connecting the generator to produce a particular test voltage. The generator may be connected at the factory to produce a specified voltage per customer order. The installer must always check the stator lead terminal block connections and perform any necessary reconnect to obtain the voltage desired.

Some generator sets are capable of producing a wide range of voltages and connection configurations, others have specific limited capabilities. Refer to wiring diagram and generator voltages (from the nameplate) when reviewing the voltage connection information and use the electrical schematic supplied with your generator set when actually performing load connections.

⚠ CAUTION ***Reconnecting factory connected generator sets to higher voltages can exceed the voltage capability of the specific generator windings and damage the generator. Consult with your distributor before performing reconnection for a different voltage.***

⚠ CAUTION ***Reconnecting factory connected generator sets to lower voltages can reduce set ratings, and also render line circuit breakers too small. Consult with your distributor before performing reconnection for a different voltage.***

Load Connections

Flexible conduit and stranded conductors must be used for connections to take up movement of the generator set.

All loads are connected to the generator by bolting **stranded** load wires to the appropriate terminals on the generator reconnection terminal block. The terminals are stamped U, V, W and N to indicate the line and neutral connections. (Reference: U, V, and W correspond with L1, L2 and L3; and N with L0 respectively).

Load Balancing

When connecting loads to the generator set, balance the loads so the current flow from each line terminal (L1, L2 and L3) is about the same. This is especially important if both single phase and three phase loads are connected. Any combination of single phase and three phase loading can be used as long as each line current is about the same, within 10 percent of median value and no line current exceeds the nameplate rating of the generator. Check the current flow from each line after connections by observing the control panel ammeter.

Current Transformers

Current transformers (CT's) are required on gensets that contain AC meters. The CT's must be installed as noted in the following CT Installation Requirements.

Refer to the Reconnection Diagram to identify the output leads/phase that must be routed through each CT, and also appropriate transformer post selection for meter sensing leads. The transformers are labeled CT21, CT22 and CT23 on the reconnection wiring diagram. (The Reconnection Diagram is located on the upper side cover of the control housing.)

<u>CT Installation Requirements:</u>

A. The CT has a dot on one side. This dot must be facing toward the generator (conventional current flowing into the dot). A dot is also used to indicate pin 1 of the CT.

B. CT21 – U load leads (A phase),
CT22 – V load leads (B phase)
CT23 – W load leads (C phase)

C. Route the appropriate load wires through each CT.

D. The CT's have dual secondaries (3 pins). The CT secondary wire marked 1 is connected to pin 1 of the CT. CT secondary wire marked 2/3 is connected to pin 2 for high voltage gensets or to pin 3 for low voltage gensets. (Refer to Reconnection Diagram.)

Grounding

The following is a brief description of system and equipment grounding of permanently installed AC generators within a facility wiring system. It is important to follow the requirements of the local electrical code.

Figure 8-2 illustrates typical system grounding for a 3-pole and a 4-pole automatic transfer switch (ATS). In the 3-pole ATS, note that the generator neutral is connected to the ATS and is NOT bonded to ground at the generator. In the 4-pole ATS system, a grounding electrode conductor and a bonding jumper are used to connect the generator neutral to ground. In some installations, a CT may be required for ground fault monitoring (refer to Figure 8-2 for CT location).

⚠WARNING ***Contact with electrical equipment can result in severe personal injury or death. It is extremely important that bonding and equipment grounding be properly done. All metallic parts that could become energized under abnormal conditions must be properly grounded.***

Typical requirements for bonding and grounding are given in the National Electrical Code, Article 250. All connections, wire sizes, etc. must conform to the requirements of the electrical codes in effect at the installation site.

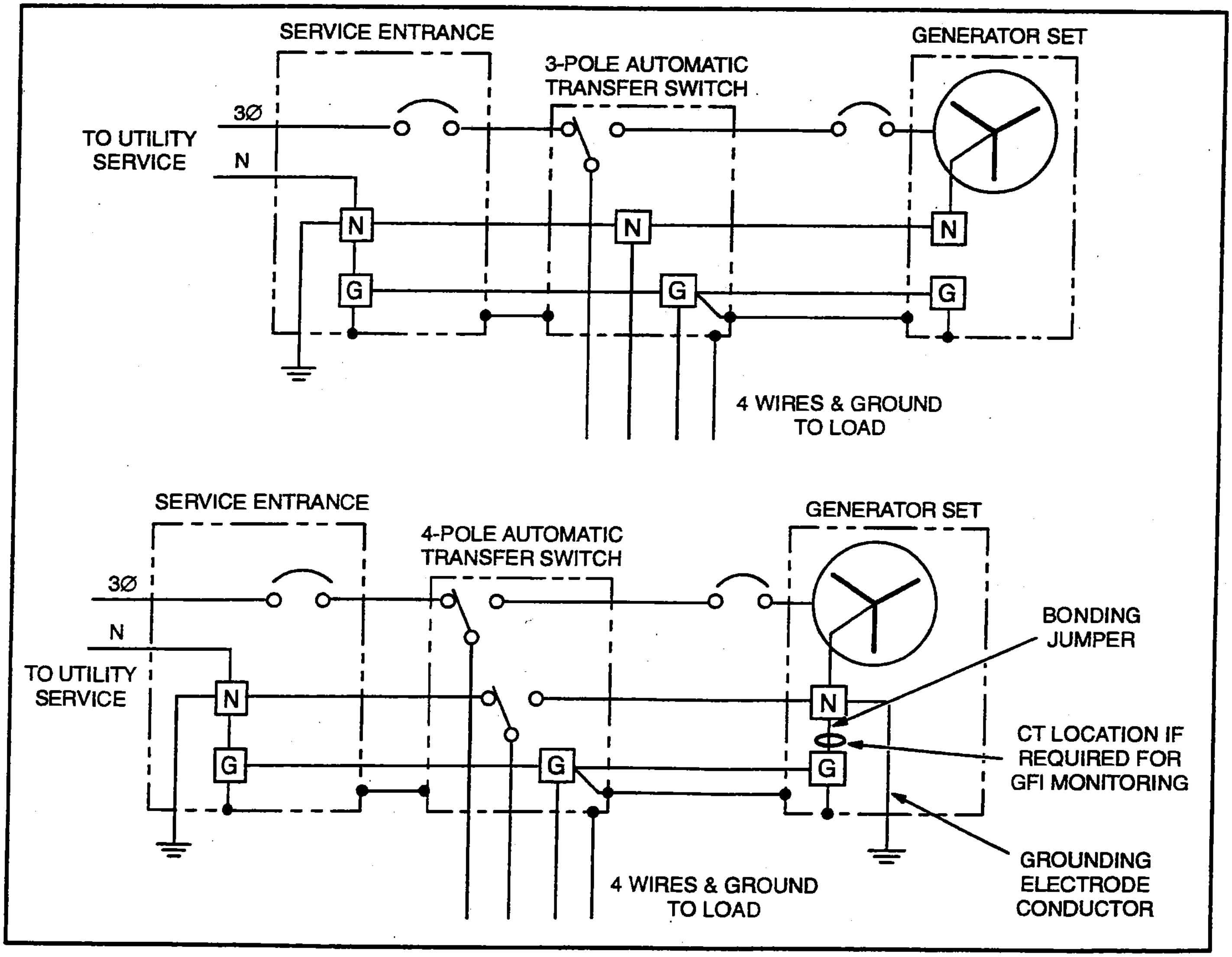


FIGURE 8-2. TYPICAL SYSTEM GROUNDING ONE-LINE DIAGRAMS

CONTROL HEATER (OPTIONAL)

A control heater (Figure 8-3) provides a means of humidity /temperature control of the control box interior. It protects the components and ensures their effectiveness when the generator set is subjected to varying ambient air conditions during extended periods of non-use.

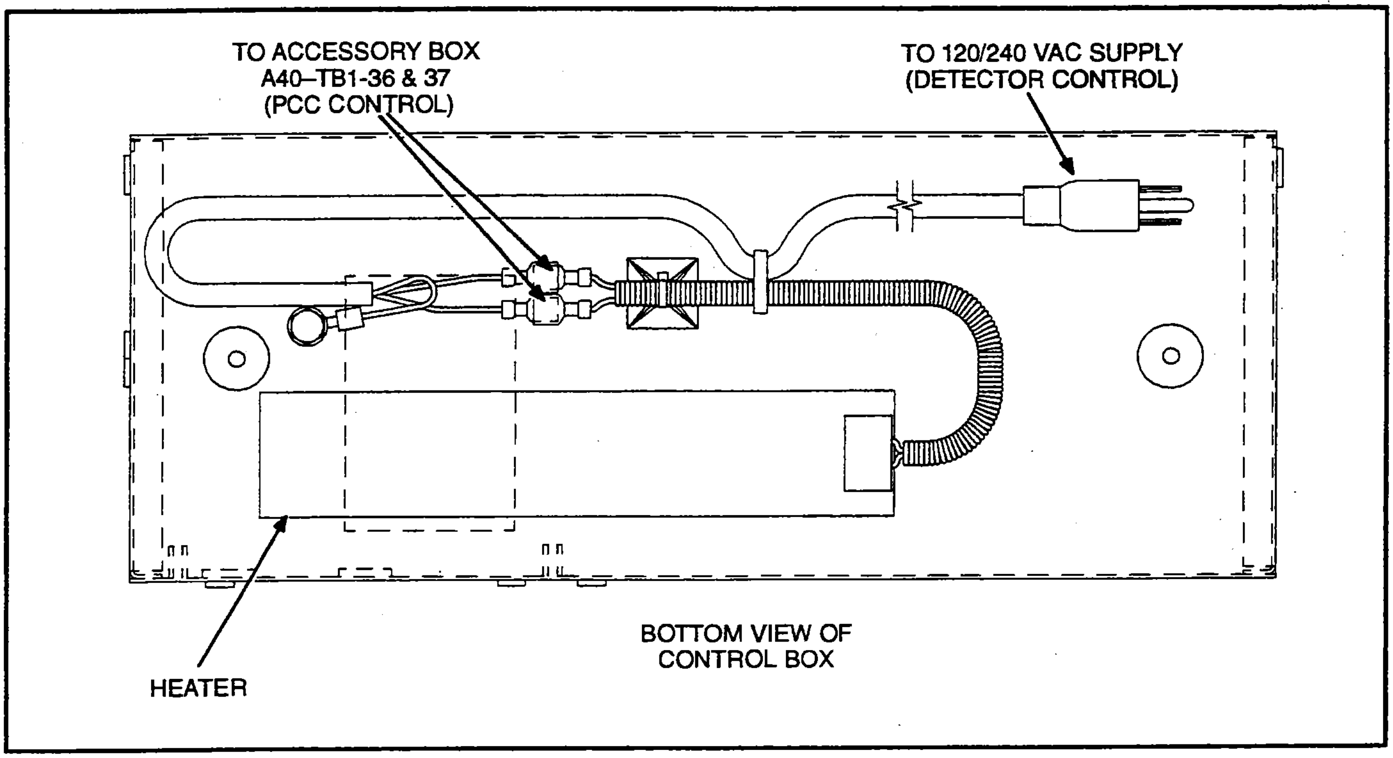


FIGURE 8-3. OPTIONAL CONTROL HEATER

COOLANT HEATER (OPTIONAL)

A coolant heater (emersion or tank) is used to keep the engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine. This reduces startup time and lessens engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

WARNING ***The coolant heater must not be operated while the cooling system is empty or damage to the heater will occur.***

Figure 8-4 shows the heater line connections. Connect the heater to a source of power that will be on during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating.

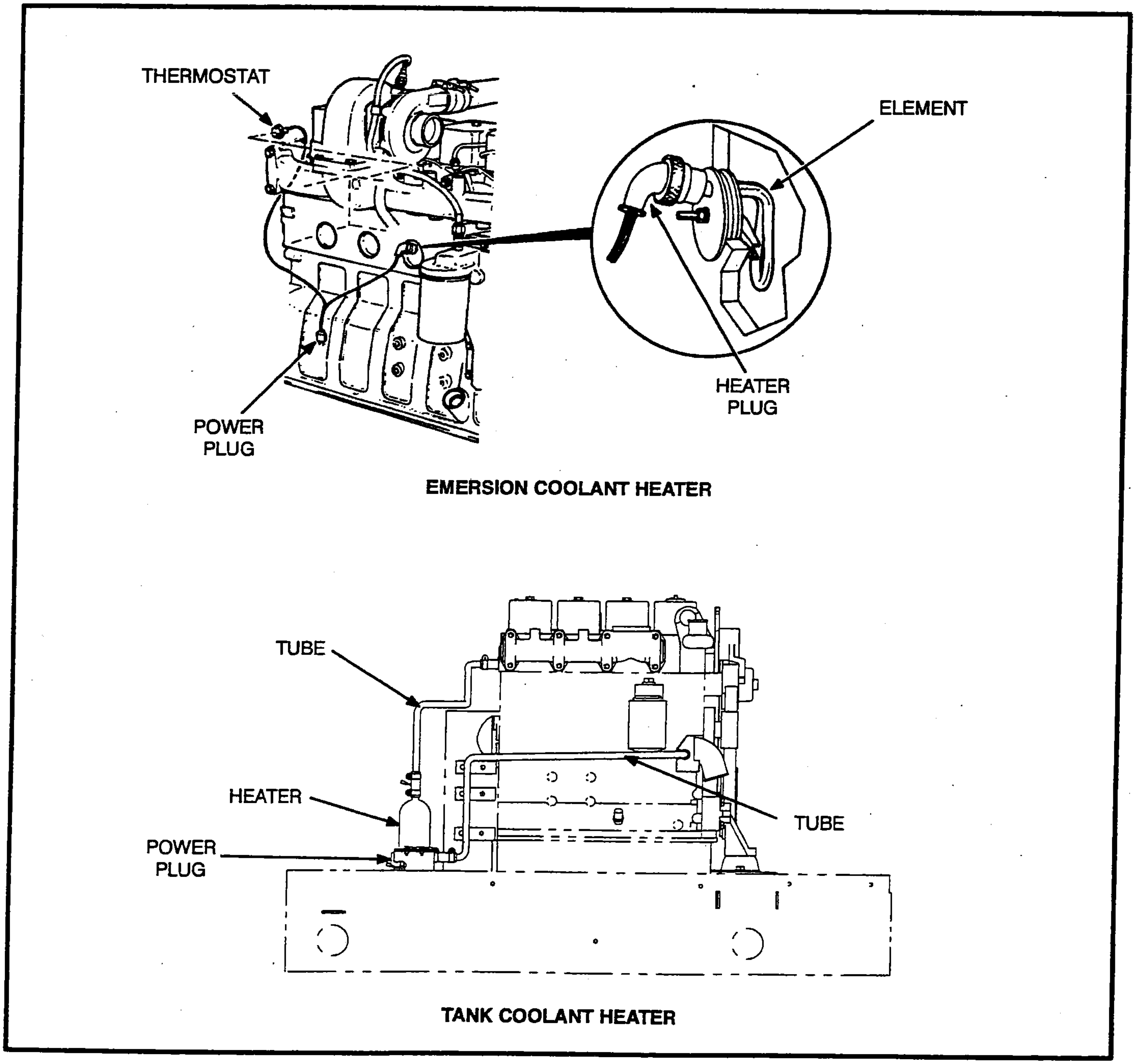


FIGURE 8-4. COOLANT HEATER

GENERATOR HEATER (OPTIONAL)

A generator heater(s) is used to help keep the generator free of condensation when the generator set is not running. During cool and humid conditions, condensation can form within a generator, creating flashing and shock hazards.

⚠WARNING ***Water or moisture inside a generator increases the possibility of flashing and electrical shock, which can cause equipment damage and severe personal injury or death. Do not use a generator which is not dry inside and out.***

Figure 8-5 illustrates the installation of two heater elements. Connect the heater(s) to a source of power that will be on during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating.

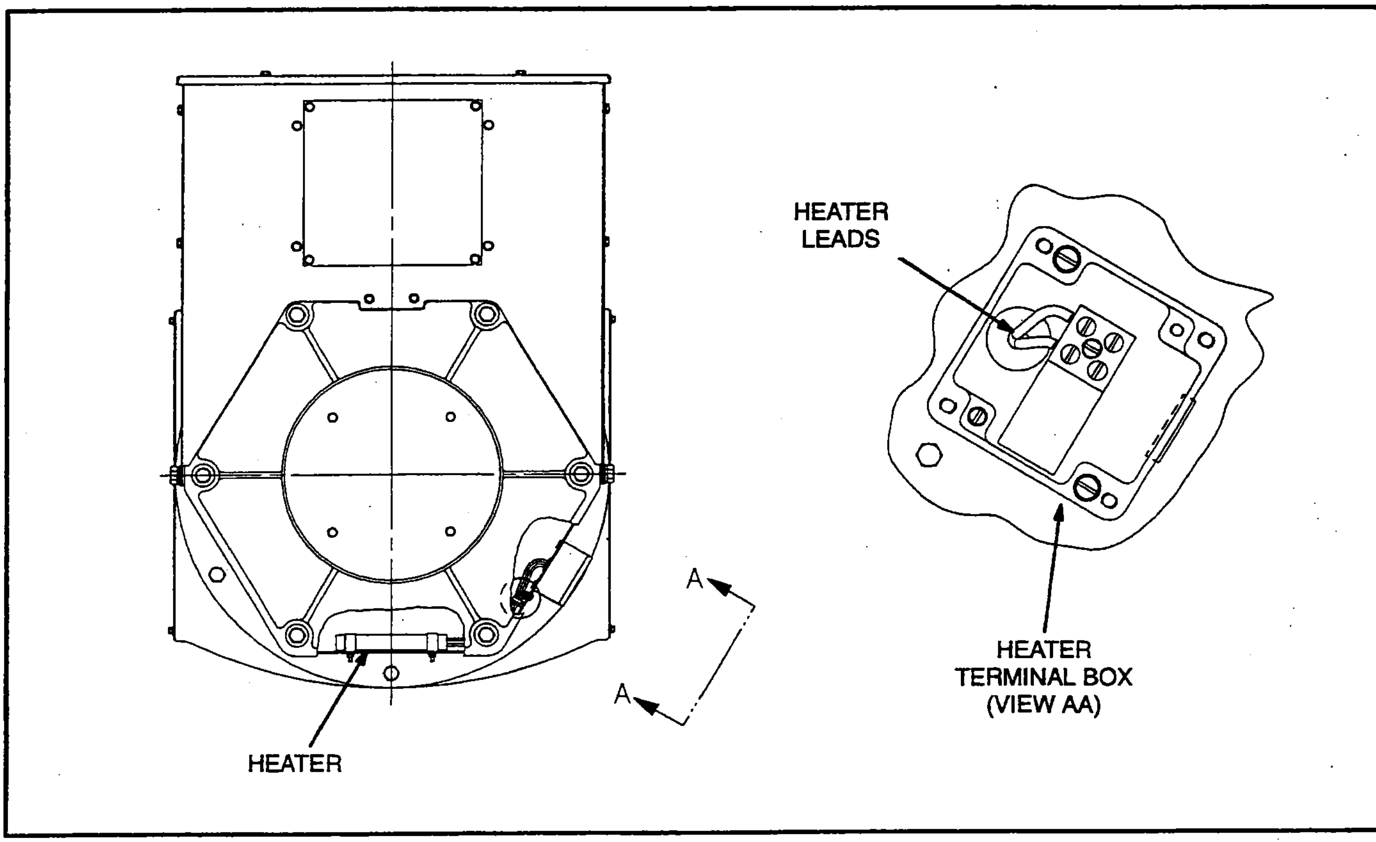


FIGURE 8-5. TYPICAL GENERATOR HEATER INSTALLATION

FUEL TRANSFER PUMP (OPTIONAL)

A fuel transfer pump and control are available as an option when a sub-base or in-skid day tank are provided. The automatic control operates the fuel pump to maintain a reservoir of fuel in the day tank.

⚠WARNING ***Diesel fuel is highly combustible. Improper installation of this kit can lead to spillage of large quantities of fuel and loss of life and property if the fuel is accidentally ignited. Installation and service must be performed by qualified persons in accordance with the applicable codes.***

Do not smoke near fuel and keep flames, sparks, pilot lights, arcing switches and equipment, and other sources of ignition well away.

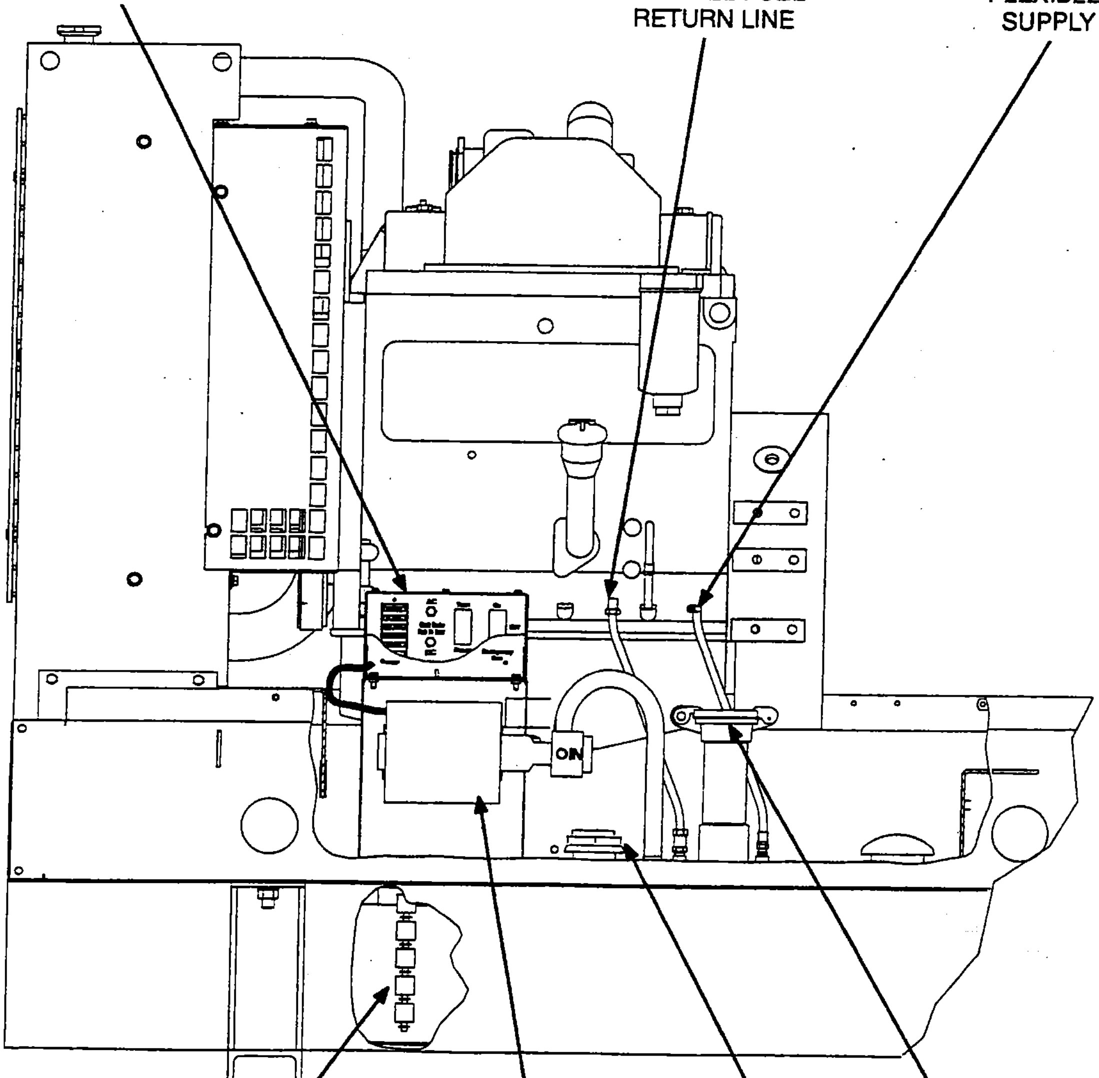


FIGURE 8-6. TYPICAL SUB-BASE INSTALLATION

Fuel Pump Control AC Connections

The control can be powered by 120 VAC or 240 VAC. The control is set up at the factory for connection to 240 VAC.

1. To convert the day tank controller from 240 VAC to 120 VAC, perform the following steps.

   A. Remove the two jumpers between terminals **TB1-6** and **TB1-7** in the control box and connect one between terminals **TB1-5** and **TB1-6** and the other between terminals **TB1-7** and **TB1-8**.

   B. Move selector switch **S103** on the control PCB to the up position for 120V.

   C. If the control is equipped with a transformer, remove the two jumpers between terminals **H2** and **H3** and connect one between **H1** and **H3** and the other between **H2** and **H4**.

2. To convert the day tank controller from 120 VAC to 240 VAC, perform the following steps.

   A. Remove the jumpers between terminals **TB1-5** and **TB1-6**, and **TB1-7** and **TB1-8** in the control box and connect the two jumpers between terminals **TB1-6** and **TB1-7.**

   B. Move selector switch S103 on the control PCB to the down position for 240 VAC.

   C. If the control is equipped with a transformer, remove the jumpers between terminals **H1** and **H3**, and **H2** and **H4** and connect the two jumpers between **H2** and **H3**.

3 Attach a tag to the control box indicating the supply voltage.

4 Terminals **TB1-8** and **TB1-5** are available for connection of a 120 or 240 VAC electric fuel shutoff valve rated not more than 0.5 amps. The voltage rating of the valve must correspond with the voltage utilized for the pump. See Item 2 above.

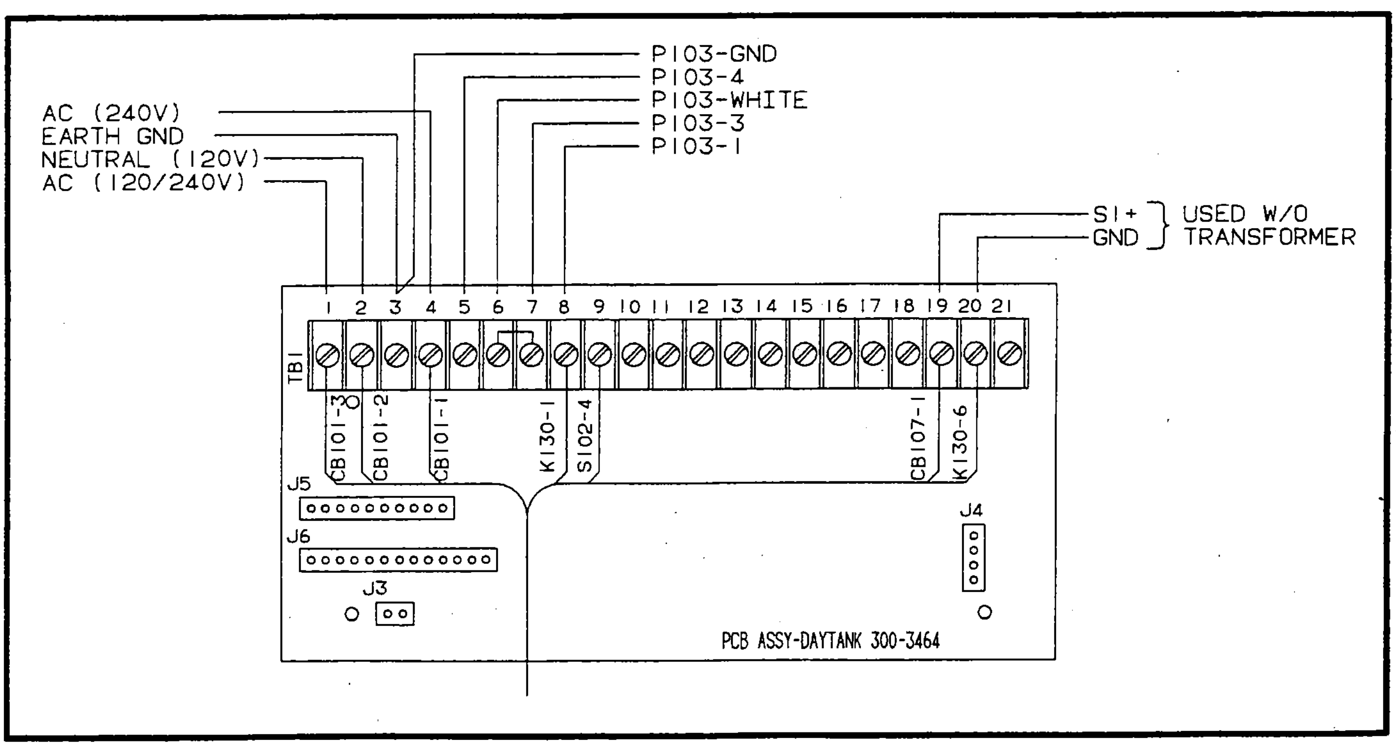


FIGURE 8-7. FUEL PUMP CONTROL TERMINAL BOARD

9. Prestart Preparation (PCC)

GENERAL

Before attempting the initial start of the generator set, be sure to complete the *Installation Checklist* in *Section 11.*

ELECTRICAL SYSTEM

Verify all electrical connections are secure and all wiring is complete and inspected. Replace and secure any access panels that may have been removed during installation.

Battery Connections

WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Make sure that the Run/Off/Auto switch on the control panel is set to the Off position before connecting the battery cables.***

Starting the unit requires a 12 volt battery. Connect positive battery cable before connecting negative battery cable to prevent arcing.

Service the battery as necessary. If an automatic transfer switch is installed without a built-in charge circuit, connect a separate battery charger. A battery charger is required when the PowerCommand control is set to the Power On (awake) mode.

WARNING ***Ignition of explosive battery gases can cause severe personal injury. Always connect battery negative last to prevent arcing.***

WARNING ***Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.. Ignition of these gases can cause severe personal injury.***

PCC OPTIONS PRESTART CHECKS

All generator set configuration options are set at the factory except for site related options, (e.g., Start/ Stop Time Delays, Cycle Crank, Customer Fault 1 and 2, etc.. The following setup procedures describe how to modify only the options that are required to complete the genset installation. Do not modify any other menus other than the following.

The default display messages for Customer Faults 1 through 4 can be edited to display the desired fault condition. If the default message does not represent the fault condition, contact an authorized service center.

Adjust Menu

To adjust the start and stop delays, press the button next to the word "ADJUST" in the Main Menu. Figure 9-1 shows a block representation of the ADJUST menu. After you press the button next to the word "ADJUST" in the display, the VOLTAGE submenu will appear.

As shown in the diagram, the ADJUST menu has five submenus, including a save/exit procedure. To move through the VOLTAGE and FREQUENCY submenus, press the button next to the '>>' to display the STOP DELAY submenu.

START DELAY submenu: This delay applies only to remote starting in the Auto mode. Use the buttons next to the "⇑" and "⇓" symbols to set the start delay. The start delay adjustment range is 0 to 300 seconds.

STOP DELAY submenu: This delay applies only to remote stopping in the Auto mode. From the START DELAY submenu, press the button next to the ">>" in the display to move to the STOP DELAY submenu. Use the buttons next to the "⇑" and "⇓" symbols to set the stop delay. The stop delay adjustment range is 0 to 600 seconds.

IDLE SPEED submenu: From the STOP DELAY submenu, press the button next to the ">>" in the display to move to the IDLE SPEED submenu. Use the buttons next to the "⇑" and "⇓" symbols to set the idle speed. The idle speed adjustment range is 800 RPM ±100 RPM. (Default value is 800 RPM.)

The idle speed can be adjusted only when the generator set is running in the idle mode. When not in idle mode, N/A is displayed in RPM field.

SAVE/EXIT submenu: From the STOP DELAY submenu, press the button next to the ">>" in the display to move to the SAVE/EXIT submenu. Select SAVE to save your changes. At the CHANGES SAVED submenu, select EXIT to return to the Main menu.

If you select SAVE, the adjustments will be retained after shutdown, and will be in effect when the set is restarted. If you select EXIT without saving first, the adjustments will remain in effect until the genset is shut down and return to the previous settings when the set is restarted.

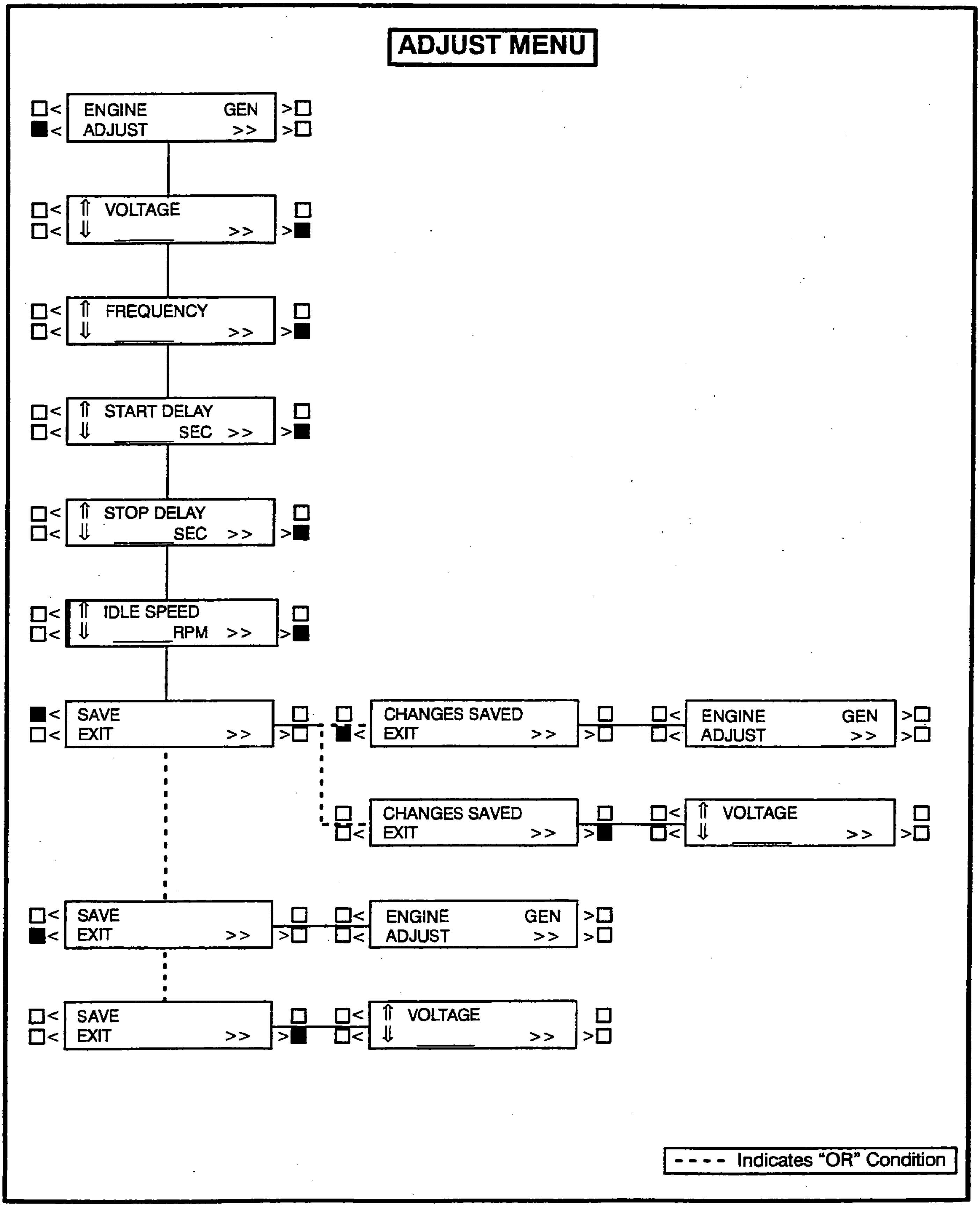


FIGURE 9-1. ADJUST MENU

PCC POWER ON / STANDBY MODE

CAUTION ***Electrostatic discharge will damage circuit boards. To prevent this damage, always wear a grounding wrist strap when working inside control box.***

Set the Power On / Standby Mode switch (S5 in Figure 9-2) to the desired position.

Power On Mode: Slide the switch to the left to select the Power On (awake) mode. It is recommended that switch S5 be left in the Power On mode in all applications, except those where battery charging is not available.

The PCC will initialize the operating software and permit operation of the menu display panel. Power will stay on until the switch is reset to the Standby Mode.

Standby Mode: Slide the switch to the right to select the Standby (sleep) Mode. In this mode, the PCC operating software will be initiated by:

- moving the Run/Off/Auto switch to the Run position,
- pressing the Self Test button,
- a remote start input signal (genset in Auto mode), or
- any one of several "wake-up" signals from external switches.

With the switch set to Standby mode, pressing the Self Test button will allow you to activate and view the menu displays without starting the generator set. If no menu selections are made, a software timer will shut down the power after 30 seconds.

When left in the Standby Mode, and a "Warning" signal is sensed by the PCC (for example, low engine temp), the control will wake up and display the warning message. The control will remain active until the warning condition is corrected and the Reset button is pressed to clear the warning message.

STARTING

Refer to the generator set *Operator's* manual for important safety precautions and recommended procedures for starting the genset and verifying proper operation. Start the generator set and verify all engine and generator gauges are displaying the correct values.

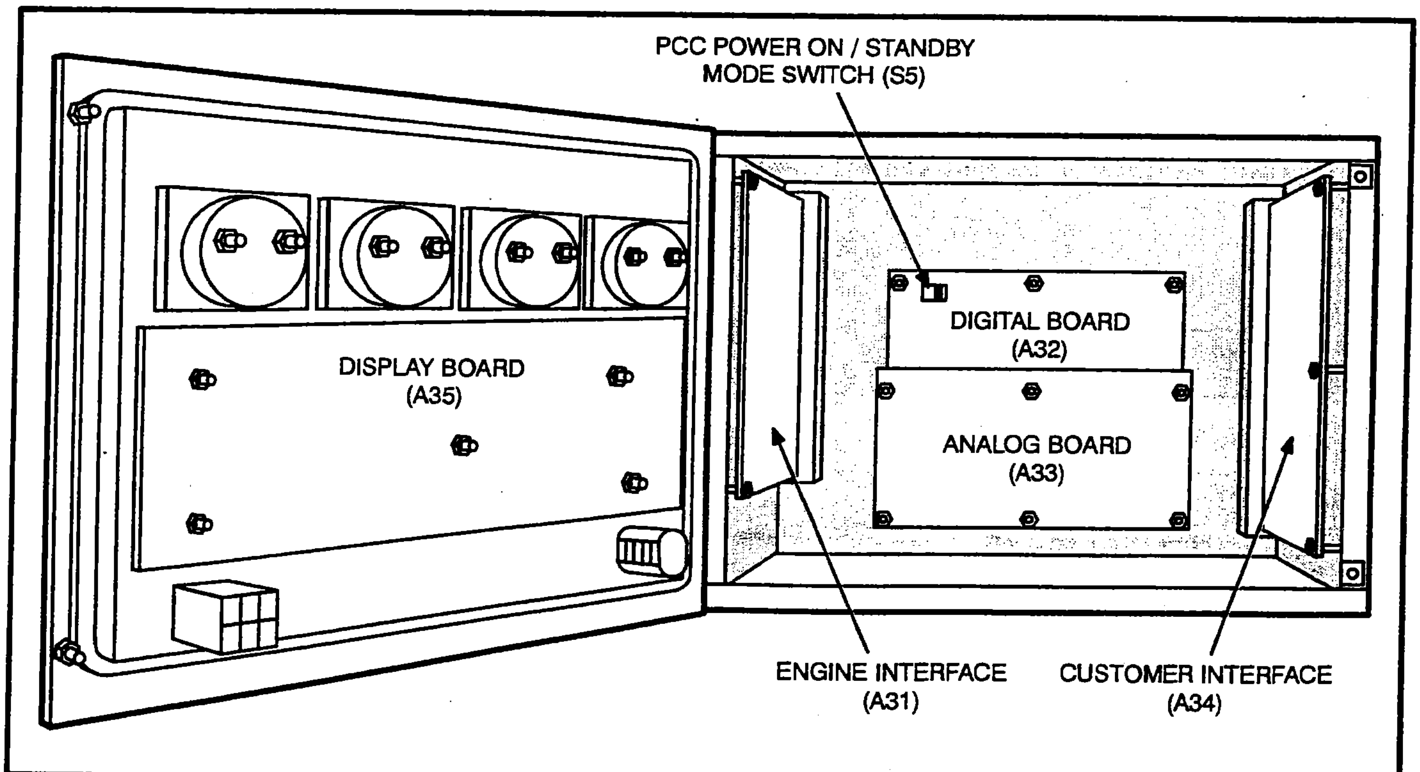


FIGURE 9-2. CABINET INTERIOR

10. Prestart Preparation (Detector/Sentinel)

GENERAL

Before attempting the initial start of the generator set, be sure to complete the *Installation Checklist* in *Section 11.*

ELECTRICAL SYSTEM

Verify all electrical connections are secure and all wiring is complete and inspected. Replace and secure any access panels that may have been removed during installation.

Battery Connections

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Make sure that the Run/Off/Auto switch on the control panel is set to the Off position before connecting the battery cables.***

Starting the unit requires a 12 volt battery. Connect positive battery cable before connecting negative battery cable to prevent arcing.

Service the battery as necessary. If an automatic transfer switch is installed without a built-in charge circuit, connect a separate battery charger.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Always connect battery negative last to prevent arcing.***

⚠WARNING ***Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.. Ignition of these gases can cause severe personal injury.***

STARTING

Refer to the generator set *Operator's* manual for important safety precautions and recommended procedures to start the genset and to confirm proper operation. Start the generator set and verify all engine and generator gauges are displaying the correct values.

11. Installation Checklist

GENERAL

- ☐ Generator set wattage capacity is sufficient to handle maximum anticipated load.
- ☐ At least 3 feet of clearance is provided around entire generator set for servicing and ventilation.
- ☐ Generator set is located in an area not subject to flooding.
- ☐ All operating personnel have read and are familiar with Operator's Manual.
- ☐ All operators have been thoroughly briefed on correct operation and exercise procedures.
- ☐ All operators have been thoroughly briefed on preventive maintenance procedures.
- ☐ All operators have read and understand all Safety Precautions in Operator's Manual.

GENERATOR SET SUPPORT

- ☐ Floor, roof or earth on which the generator set rests is strong enough and will not allow shifting or movement. Observe local codes on soil bearing capacity due to freezing and thawing.
- ☐ Generator set is properly supported and retained to approved base which is separate and independent of the surface on which it sits. Vibration isolators are installed between base and set.
- ☐ Supporting base is large enough - extends 12-inches all around set.

COOLING AIR FLOW

- ☐ Generator set air inlet is faced into direction of strongest, prevailing winds.
- ☐ Air inlet openings are unrestricted and at least 1-1/2 times larger than air outlet area.
- ☐ Cooling air outlet is on downwind side of building (if not, wind barrier is constructed).
- ☐ Proper ducting material (sheet metal, canvas) is used between radiator and air outlet.

DIESEL FUEL SYSTEM

- ☐ Fuel tanks meet or exceed all Local, State or National codes.
- ☐ Fuel lines are properly installed, supported and protected against damage.
- ☐ Flexible fuel line is installed between main fuel supply line and generator set to protect against vibration, expansion and contraction.
- ☐ Strainer or fuel screen (100 to 120 mesh) is installed in the fuel supply line to protect the fuel lift pump, day tank transfer pump or float valve seat from fuel supply tank debris.
- ☐ Fuel line shutoff valves are installed to prevent fuel flow in case of leaks.
- ☐ External fuel pumps are connected and operational at all times (generator set started or shut down).
- ☐ Fuel system is properly primed.
- ☐ No fuel leaks are found in supply line or engine fuel system.

EXHAUST SYSTEM

- ☐ Operators are thoroughly briefed on the dangers of carbon monoxide gas, preventing the buildup of this gas in inhabited areas.
- ☐ Areas around set are well ventilated. No possibility of exhaust fumes entering building doors, windows, or intake fans.
- ☐ Exhaust gases are piped safely outside and away from building.
- ☐ The correct length of approved rigid pipe is connected to the generator set flexible pipe using approved securing methods with no weight resting on engine exhaust components. There are no bends in flex section.
- ☐ Condensation drain is provided in lowest section of exhaust piping.
- ☐ Exhaust piping is insulated to guard against burns to personnel.
- ☐ Exhaust piping passing through walls or ceilings have approved fire-proof materials and are in compliance with all codes.
- ☐ Exhaust piping is large enough in diameter to prevent back pressure on engine.

AC AND DC WIRING

- ☐ Wire sizes, insulation, conduits and connection methods all meet applicable codes.
- ☐ AC and DC wires are separated in their own conduit to prevent electrical induction.
- ☐ All load, line and generator connections are proper and correct.
- ☐ Flexible conduit between generator set and building or surrounding structure.

GENERATOR SET PRESTART

- ☐ Generator set engine is properly serviced with oil and coolant.
- ☐ Batteries are properly installed, serviced and charged.
- ☐ Battery charger and engine coolant heater are connected and operational.
- ☐ All generator set covers and safety shields are installed properly.
- ☐ All fuel and coolant shutoff valves are operational.
- ☐ Fuel system is primed.

ITEM	QTY.	U/M	PART NUMBER	DESCRIPTION
1	1	ea	NA	Reservoir: Integral to Comp II
2	1	ea	SS-120-3-100	Suction Strainer: 1 1/4" NPT 23 GPM 100 Mesh
3	1	ea	CH256/SPEC 68501	Engine: Gasoline, 25 hp, Extended Front Shaft
4	1	ea	24-189-01	Adapter: Spark Arresting
5	1	ea	24-786-11	Muffler: Exhaust
6	1	ea	52-755-79	Tank: Gasoline 6.6 Gallon
7	1	ea	24-584-11	Ignition Module: Engine
8	1	ea	52-704-01	Oil Sentry: Installed
9	1	ea	24-755-08	Front Shaft: Generator Takeoff
10	1	ea	WAI24-1104	Pulley: Generator Takoff
11	1	ea	WAI24-1109	Pulley: Generator Takoff
12	1	ea	110-462	Alternater: 24 VDC, 35 A
13	1	ea	4L280	Belt: Alternater V Groove FHP Belt
14	1	ea	T-13790-01	Guard: Belt & Pulley
15	1	ea	T-13790-02	Framework: Custom Weldment
16	1	ea	70142-RFCT/PPV124	Pump: Manual Stroke, Closed Loop, Integral Charge Pump
17	1	ea	BBV-2004-0001M	Valve: Bypass, Manual
18	1	ea	A8B060ZN	Valve: Hot Oil Shuttle Relief, Cartridge
19	1	ea	K3A125200N	Valve: Hot Oil Shuttle, Cartridge
20	1	ea	LB10-248A	Line Body: Hot Oil Shuttle, Anodized Aluminum
21	1	ea	BAC-600-25	Gauge: 0-500 PSI - HOS
22	2	ea	BAC-5M-25	Gauge: 0-5000 PSI Gauge - Motor Loop
23	1	ea	HB-05075410	Motor: Hydraulic 5.4 in3/rev, 1 1/16 - 12 ports, 1 1/4 Keyed Shaft
24	1	ea	CSG70-P10A	Return Filter, 10 Micron Spin-on Filter, MP
25	1	ea	MPS-050-RG2 / 5300251	3/4" NPT Filter Head, MP
26	1	ea	CI-20	Indicator, MP
27	1	ea	AOMF-4-SAE-24	Heat Exchanger SAE 24 VDC
28	1	ea	B402-120	Temperature Switch
29	1	ea	150-0110	Hand Lever/Pump stroker control
30	1	ea	100-0432-074.5"	Cable: xxx length
31	1	ea	6G181	Female studded rod end 3/8-24
32	1	ea	RC3-0875-250	Reuland Coupling Half
33	1	ea	RC3-1437-375	Reuland Coupling Half
34	1	ea	RG3-H5	Reuland Insert Hytrel
35	1	ea	VEM-700-70-2A	Vescor Adapter
36		ft		Tubing
37	1	lot	TBD	Fittings
38	1	ea	WAI25-100	Fan
39	1	ea	7545	battery
40	1	ea	711614	bat cable
41	1	ea	784236	terminal
42	1	ea	728197	protective cap

TEI ENGINEERED PRODUCTS, INC.

MISSION STATEMENT

TEI Engineered Products, Inc. employees work in three (3) different operating units; Distribution, Fabrication, and Service, each involved in the hydraulic/electronic control industry.

Each operating unit has the expressed goal of providing the highest level of customer service and satisfaction available in our industry. To that end we will provide superior technical support, a whatever-it-takes customer service attitude, and the highest quality components available.

The end result of our employees' effort is the establishment of positive, long-term relationships with our primary vendors and customer base.

TEI ENGINEERED PRODUCTS INCORPORATED

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(303) 693-1491 • FAX (303) 680-7577

Section 10

DRIVE TERMINAL

Maintenance

Frequency	*Maintenance Activity*
WEEKLY	- Bullwheel alignment - Deflection sheave alignment - Deflection sheave bearings - Position of arrival photo eye
MONTHLY	- Drive terminal structural welds - Guidage - Drive carriage slide pads - Bullwheel liner wear - Motor tach coupling - Lorry frame welds - Tension ram connections - Motor tach coupling - Lubricate deflection sheaves - Deflection sheave liner wear - Function and alignment of battery charger socket - Mounting of impulse generator - Test cable position switches and check hardware
AFTER 1st 2 MONTHS	- Perform a thorough visual inspection of all structural componets. - Check tightness of all bolted connections.
EVERY 6 MONTHS	- Check all structure nuts and bolts - Track rope saddle - Visually inspect track rope socket - Deflection sheave hardware and welds.

Maintenance and Inspection

Structure

- Check tightness of all nuts and bolts.
- Visually inspect structural welds.
- Inspect guidage for worn or damaged pad material and broken or missing hardware.
- Inspect track rope saddle for signs of saddle wear by checking each end of saddle for displaced liner material

Driver Bullwheel/Carriage

- Check carriage slide pads for wear. If clearance is greater that 1/16" per side, pad must be replaced
- Check gearbox, bullwheel and motor mounting bolts for tightness and integrity.
- Inspect bullwheel liner for wear. Groove depth greater than 1/3 rope diameter is an indication that liner needs to be replaced. Groove depth should be checked at a location NOT in contact with the haul rope. For liner replacement procedure refer to Line Tower section of this manual.
- Visually inspect motor/gearbox coupling for integrity.
- Visually inspect weldments.
- Visually inspect tension ram connections and weldments.
- Check haul rope alignment on bullwheel.

Deflection Sheaves

- Check tightness of nuts, bolts and hardware.
- Visually inspect weldments.
- Verify proper cable to sheave alignment. Sheave must be in same plane as cable and cable must be in center of sheave liner for maximum liner life.
- While lift is running, listen to sheave for indications of bearing failure.
- Grease sheaves with Mobil Mobilith SHC 480 or equivalent grease.
- Inspect liner for wear. Groove depth greater than 1/3 rope diameter is an indication that liner needs to be replaced. Groove depth should be checked at a location NOT in contact with the haul rope. For liner replacement procedure refer to Line Tower section of this manual.

Charger Socket

- Visually inspect for integrity (spring, bolts, etc.)
- Verify smooth operation when cabin docks.
- Check tightness of switch mounting bolts.
- Verify proper function of battery charger socket. Make sure cabin contacts are making good contact with socket contact plates. Check terminal connections.

Section 11

RETURN TERMINAL

Return Terminal

Maintenance

Frequency	*Maintenance Activity*
WEEKLY	- Bullwheel alignment - Position of arrival photo eye
MONTHLY	- Return terminal structural welds - Guidage - Bullwheel liner wear - Inspect tension rods, including hardware and anchorage - Lubricate deflection sheaves - Deflection sheave liner wear - Function and alignment of battery charger socket
AFTER 1st 2 MONTHS	- Perform a thorough visual inspection of all structural componets. - Check tightness of all bolted connections.
EVERY 6 MONTHS	- Check all structure nuts and bolts - Track rope saddle - Visually inspect track rope socket - Deflection sheave hardware and welds.

Maintenance and Inspection

Structure

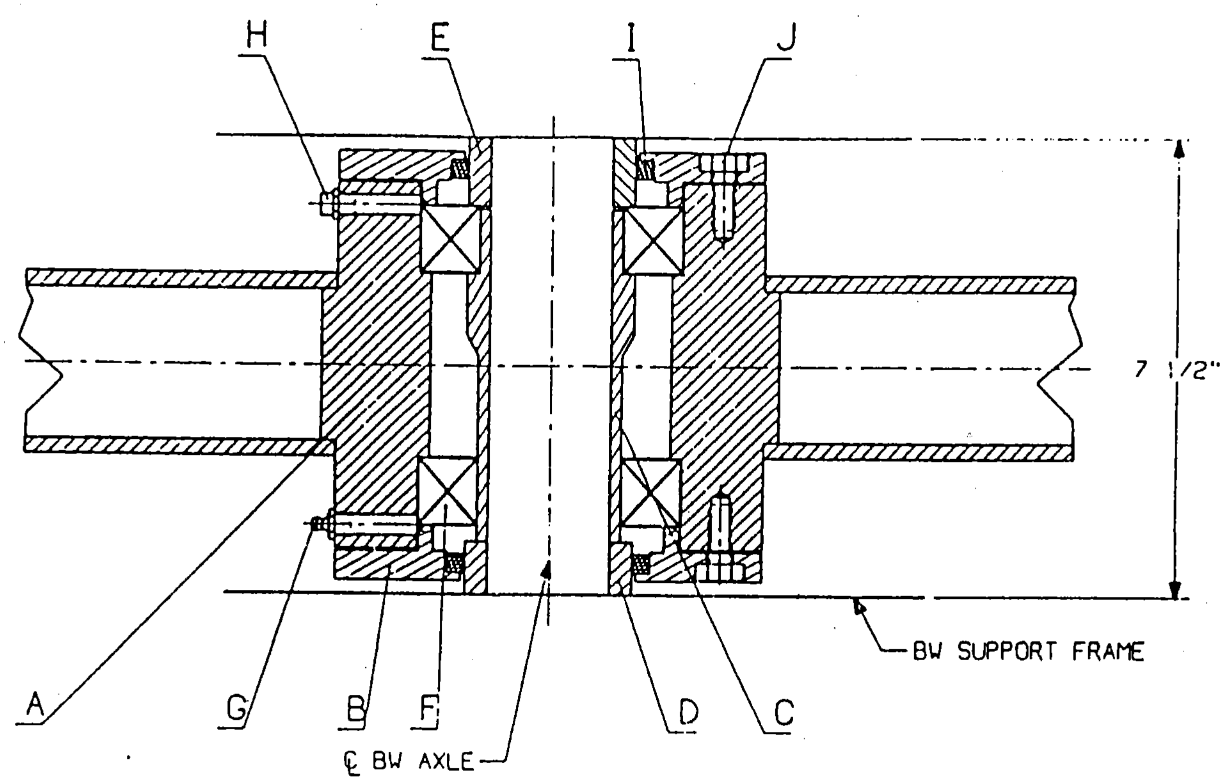
- Check tightness of all nuts and bolts.
- Visually inspect weldments of bullwheel frame and anchorage.
- Inspect guidage for worn or damaged pad material and broken or missing parts.

Return Bullwheel

- Check cable alignment.
- Check guide sheave alignment.
- Lubricate bullwheel with Mobil Mobilith SHC 460 or equivalent grease. Remove relief fitting and pump fresh grease through the bearings, purging the used grease out the relief-fitting hole until fresh grease is visible. Re-install relief-fitting. Clear the bullwheel of personnel and equipment and run the lift for one complete round trip of the cabin. Repeat the greasing procedure. (See Drawing 3038.411)

Charger Socket

- Visually inspect for integrity (spring, bolts, etc.)
- Verify smooth operation when cabin docks.
- Check tightness of switch mounting bolts.
- Verify proper function of battery charger socket. Make sure cabin contacts are making good contact with socket contact plates. Check terminal connections.



INDEX	REQ'D	DESCRIPTION	MATERIAL	WT.LBS.	REFERENCE	Format
J	16	BOLT CHc M10 x 20/20 cl.8.8			057493	
I	2	GREASE SEAL 85 x 70 x 8 -CRW1.R.27710			5065104	
H	1	GREASE RELIEF FITTING 1/8"NPT - 5 psi			5350048	
G	1	GREASE ZERK 1/8" NPT			5350001	
F	2	BEARING 110 x 60 x 28 -SKF 22212 CC			5060028	
E	1	AXLE SPACER x 1.13"lg.			3222309	A
D	1	AXLE SPACER x 0.87"lg.			3110656	A
C	1	AXLE SLEEVE			3222308	B
B	2	BEARING CAP			3222310	C
A	1	RETURN BULLWHEEL Dia. 1.25m - 6.5T			3071625	D

Rev.	Description Of Revision	Date	By

Total Weight / Pounds.
Treatment.
Assembly Reference.
Other Reference.

RETURN BULLWHEEL ASSEMBLY
Dia. 1.25m - 6.5T

Dwn. By. MPC | Ck. By.
Date. 3/4/91 | Scale. 1/2

AERIAL TRAMWAY SYSTEMS
2510 FORESIGHT CIRCLE
GRAND JUNCTION, COLORADO U.S.A.
POMA OF AMERICA

FORMAT B | Dwg.No. US 3038411

Section 12

LINE EQUIPMENT AND TOWERS

Line Equipment & Towers

Description

Tubular structures with attached half crossarm and saddle (see Drawings 3038.782 and 3038.783)

The purpose is to maintain the position of the haul rope and track rope, while allowing free passage of the carriers.

Maintenance

Frequency	*Maintenance Activity*
DAILY	Check for proper alignment and correct if necessary. Check for loose or broken parts.
MONTHLY	Check saddle axle SADDLE: Visually inspect the saddle of any cracks and proper rope alignment. Verify that the track rope passes freely over the saddle during operation of lift. SHEAVES: Check that the haul rope passes correctly in the middle of the sheave. Adjust sheaves accordingly SHEAVES: Check for wear on rubber lining. Replace if more than 3/4" or 20mm is worn from original surface. Check proper seating of retaining rings. SHEAVES: While lift is in operation, listen for unusual noises (i.e. bearings, liners, rattles, etc.) STEEL STRUCTURE/TOWERS/BRACKETS/CATWALKS: Check the general exterior condition - paint, rust, loose anchor or assembly bolts, cracks, etc.

EVERY 600 HRS.	SADDLE: Check the free articulation of the saddle components. CONDITION OF THE SHEAVE BEARINGS: Change if necessary. ATTENTION: Use only the POMA sealed bearings. The quality and quantity of grease they contain have been especially designed for POMA to meet strict specifications.

Lubrication

NOTE: Sheave assemblies must be unloaded to grease

Frequency	*Grease points*
MONTHLY	SHEAVES: The sheaves themselves are sealed bearings and require no greasing. However, grease the outer surface when installing to prevent rust. SADDLES: Grease saddle bushings on main axle with Shell SHC 460 or equivalent grease. There are two grease fittings on each saddle. See drawings 3038.782 and 3038.783 for location.
TWO TIMES PER YEAR	Lift rope off saddles and grease saddles with Shell SHC 460 grease.
EVERY 600 HRS.	All axles with grease fittings: MOBIL MOBILITH SHC 460 or equivalent grease.

Lifting Off the Cables

The tower crossarms can be used as a hoisting tackle. *See "Loads on Structures" in section 1 of this manual for appropriate rigging loads.* To lift off the cable, proceed as follows:

- Use a "Tirfor" type hoisting winch or a come-along.
- Use the appropriate hole in lifting gantry and mount the dead end of hoist to crossarm. The hole closets to tower is for haul rope. The hole farthest from tower is for track rope. (See Figure 12-1)
- To lift the track rope on tower 1 remove the knock outs (index S on drawing 3038.782). Attach hoist to outside hole in cross arm. Wrap appropriate slings around the cable and attach to hoist. Use a 39-1/2in spreader bar to keep slings in proper position. (See Figure 12-1)
- To lift the track rope on tower 2 attach hoist to outside hole in cross arm. Wrap appropriate slings around the cable and attach to hoist. Use at a minimum of a 55in spreader bar to keep slings in proper position.
- To lift the haul rope use the inside hole on the cross arm to attach hoist.

* **Failure to follow these procedures could result in damage to equipment and serious injury or death to personnel.**

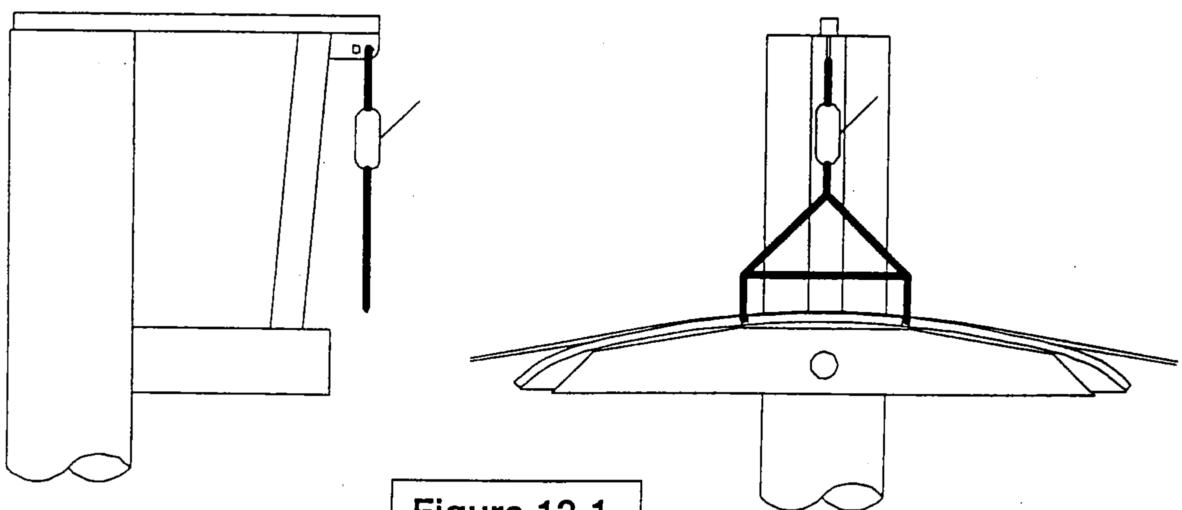


Figure 12-1

Maintenance and Adjustment

Track Rope

- Visually inspect entire length of track rope. A thorough inspection of the rope at end connections and saddle locations is of the utmost important.

Haul Rope

- Visually inspect entire length of haul rope, including a thorough inspection of the haul rope in the truck area and including the haul rope clamps.
- Lubricate haul rope. Drip or brush a very light film of castor oil onto the rope. It is best to lubricate rope during warm weather. It is very important that the lift no run for 24 hours after the application of the castor oil.

Line towers

- Visually inspect all weldments.
- Check tightness of all nuts and bolts.
- Check alignment of haul and track ropes.
- Grease saddle axle using Shell Avania #3 or equivalent. It is necessary to unload saddle prior to greasing. This will allow for the grease to flow around the entire bushing.
- Check sheave liner wear. If the groove in the liner is worn to a depth of 1/3 the rope diameter, the liner must be replaced. Refer to Diagram A for relining procedure for the 200mm diameter sheave, bullwheel, and return sheaves.
- Check sheave bearings. Lift haul rope off each sheave and spin the sheave listen for any unusual noises.
- Inspect track rope saddle. Look for indications of excessive surface wear. Check tightness of mounting bolts and position of track rope straps. (See Drawings 3038.782 and 3038.783)

LEITNER
POMA

LEITNER-POMA OF AMERICA, INC.

March 23, 2005

Mr. Jorg Ludwig
Senior Safety Engineer
State of California
Department of Industrial Relations
Tramway Unit
P.O. Box 11227
Truckee, CA 96162

Dear Mr. Ludwig,

This letter is in reference to the Pacoima Dam Tram (A-807) and the questions concerning the track rope brake adjustment and track rope saddle retention.

Track Rope Brake Adjustment - I have reviewed the brake pad clearance requirement that is outlined in the "Pacoima Aerial Tramway Operation and Maintenance Manual" (OM manual) and have revised this clearance from 3.5mm each side 7.0mm total to 2.5mm each side 5.0mm total minimum. See the enclosed revised Section 13, Page 6A. The brake pull test value was determined during the acceptance test. This "real" value is different than the theoretical calculated value and reflects fiction and other "real" conditions on site. Enclosed are the brake force calculations.

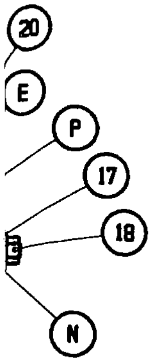
Track Rope Saddle Retention – We included calculations for the retention of the track rope in the saddles as part of the original submittal packages for certification of the tramway. Enclosed are copies of the submitted calculations. Furthermore, it was determined by the certifying design engineer, by calculation and during the load test, that the track rope retention straps were not required for adequate safety to deropement, and might even constitute a hazard for the track rope brake. Leitner Poma technicians inspecting the tramway checked the condition of the remaining straps, during monthly service visits, and removed them as they became a problem. Leitner Poma is now requiring that all remaining track rope retention straps must be removed wherever they interfere with passage of the track rope brake. Enclosed is revised Section 12, Page 4A removing the "check position of track rope straps" requirement, and revised saddle assembly drawings US3038.782A and US3038.783A.

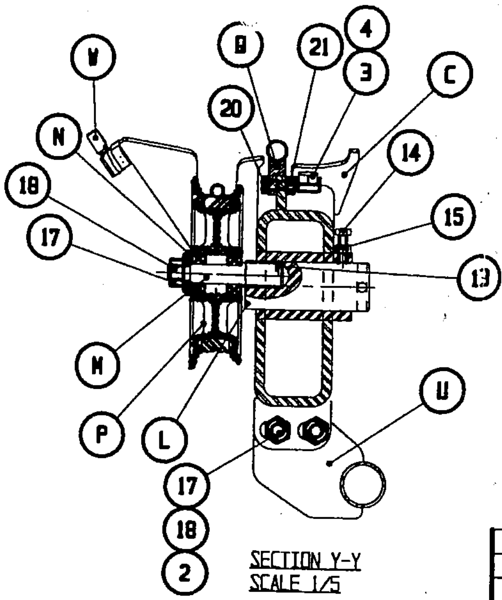
For your records, we are sending revised OM manual pages, revised drawings and resending copies of pertinent calculations. These will be also sent to Sam Kats and Sam Huber of LA County I.S.D.

Sincerely,

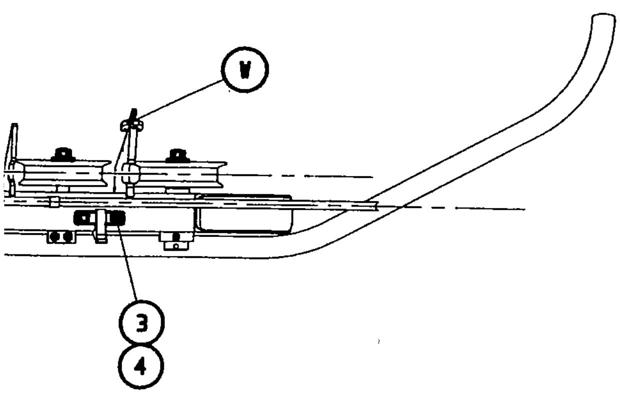
Nelson Tusberg, P.E.
Manager of R&D Engineering

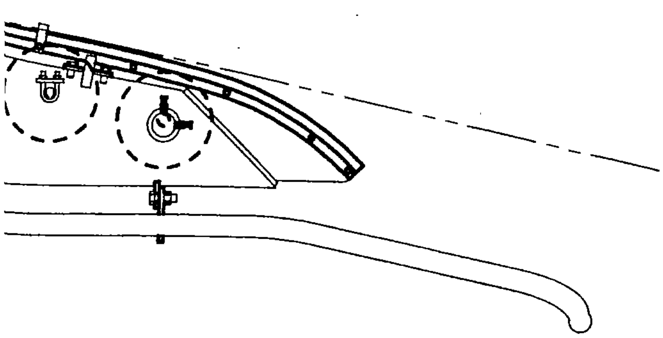
2510 FORESIGHT CIRCLE • GRAND JUNCTION, CO 81505 • (970) 241-4442 • FAX (970) 241-3023
EASTERN OFFICE: P.O. BOX 35, ROUTE 100 & 107 • STOCKBRIDGE, VT 05772 • (802) 746-7955 • FAX (802) 746-7958





SECTION Y-Y
SCALE 1/5





INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./LBS.	REFERENCE	FORMAT
23	2	NUT LOW HH 10 8.8 PLATED			058051	
22	2	BOLT HH 10x20/20 8.8 PLATED			057211	
21	23	NYLON LOCKNUT M12 8.8 PLATED			058188	
20	23	BOLT HH 12x40/40 8.8 PLATED			057030	
19	18	NYLON LOCKNUT M10 8.8 PLATED			058185	
18	18	NYLON LOCKNUT M20 8.8 PLATED			058192	
17	18	FLAT WASHER M20U PLATED			058118	
16	8	U-BOLT M10-15/16 x 2-3/4/1 PLATED		1.8	UK 3110.838	A
15	4	NUT LOW HH 12 8.8 PLATED			058052	
14	4	BOLT HH 12 x 30/30 8.8 PLATED			057271	
13	2	ROLL PIN 8mm x 15mm			080059	
12	2	NYLON LOCKNUT 1.5-12NF A325 PLATED			5058047	
11	1	BOLT 1.5-12NF-18/18 A325 PLATED			5057738	
10	1	BOLT 1.5-12NF-20/20 A325 PLATED			5057573	
9	4	NYLON LOCKNUT M27 8.8 PLATED			058201	
8	3	BOLT HH 18x45/30 8.8 PLATED			5057140	
7	2	U-BOLT/RD M27, 7-3/8x13-11/16x3-3/4		18.8	UK 3110.828	A
6	2	NUT HU M8 8.8 PLATED			058004	
5	2	WASHER M80 PLATED			058103	
4	8	LOCKWASHER JEC18 PLATED			059088	
3	8	BOLT HH 18x30/30 8.8 PLATED			057288	
2	8	BOLT HH 20x60/48 8.8 PLATED			057082	
1	2	GREASE ZERK 1/8" NPT			3530081	
W	3	BRITTLE BAR			1031120	
V	1	CABIN GUIDE CONNECTION TUBE		4.7	UK 3325.477	A
U	2	CABIN GUIDE		80	UK 4075.838	B
T	4	TRACK ROPE DERAILMENT STRAPS		0.3	UK 3325.823	A
S	2	685 mm SADDLE "CHECK OUT"		1.4	UK 3325.473	A
R	1	880mm SADDLE, MIDDLE PIECE, R18'		13.5	UK 3325.472	B
Q	2	880mm SADDLE, END PIECE, R18'		40.8	UK 3325.471	B
P	10	STANDARD 8" ALUMINUM SHEAVE ASSM.			2031185	
O	8	6000 mm SHEAVE AXLE		22.4	UK 3325.483	B
N	10	NYLON DUST SEAL WASHER		0.25	UK 3110.837	A
M	2	ECCENTRIC AXLE SHAFT		3	UK 3325.482	B
L	2	ECCENTRIC AXLE BODY - 880mm SHEAVE		18.2	UK 3325.451	B
K	4	CROSS ARM WASHER 18 x 1 8/16 x 1/2		28	UK 3110.848	A
J	2	BUSHING SKF GLY.PG 180/185/80 A			5048078	
I	1	LOCK PLATE		0.4	UK 3325.481	A
H	1	AXLE END PLATE		9	UK 3325.480	A
G	1	AXLE SPACER		1.7	UK 3325.479	A
F	1	10 SHEAVE SADDLE AXLE		394	UK 3325.478	B
E	1	BRITTLE BAR EXTENSION 8m ALLTHREAD		0.07	UK 3325.824	A
D	1	TRACK ROPE BRITTLE BAR MOUNT		0.7	UK 4075.728	A
C	4	TRACK ROPE CATCHER		8.8	UK 4075.730	B
B	1	GREASE ZERK HOUSING		0.5	UK 3325.470	A
A	1	10 SHEAVE SADDLE		740.7	UK 4075.885	B

REV	DESCRIPTION OF REVISION	DATE	BY

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES UNLESS INDICATED

• FABRICATION •
PRACTIONAL ..... ±1/16
ANGULAR .... ±1/2°

• MACHINING •
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR .... ±.1°

AERIAL TRAM

10 SHEAVE SADDLE ASSEMBLY

1998

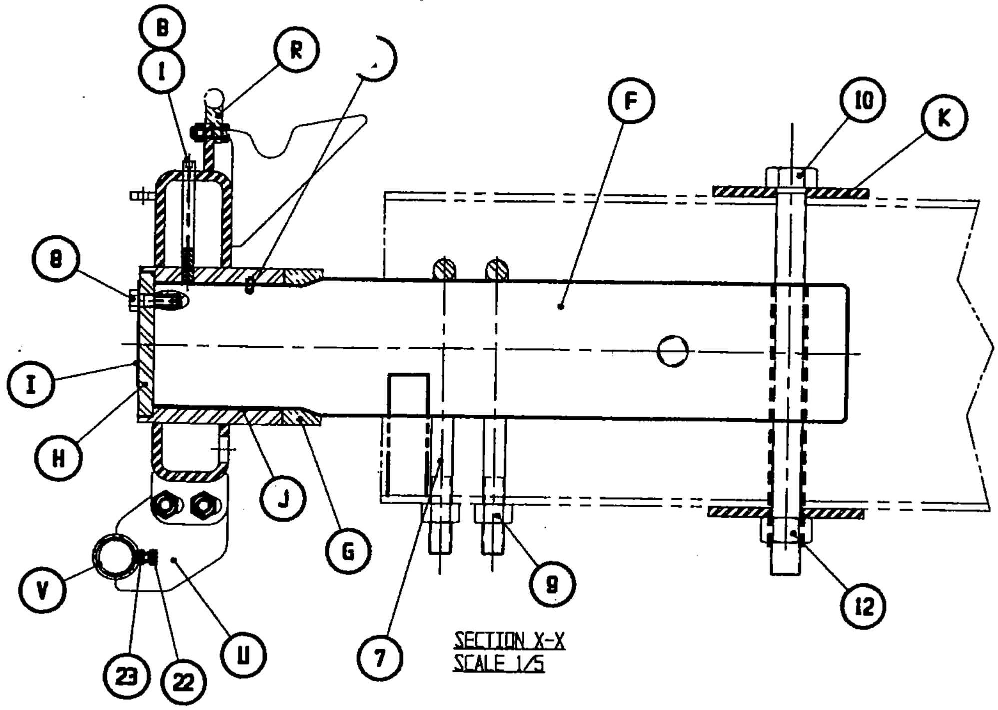
CABLE TRANSPORT SYSTEMS — SKILIFTS, CHAIRLIFTS, GONDOLAS, TRAMWAYS

POMA

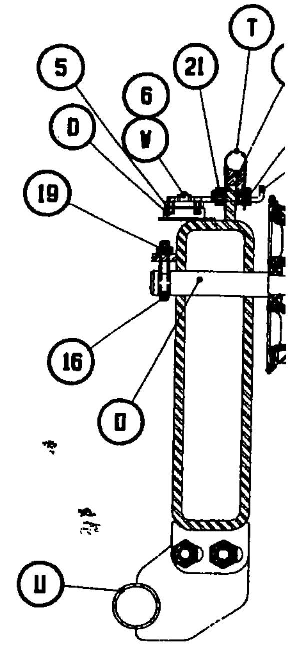
DRAWN BY: LYNCH-SCHNABEN
DESIGNED BY: J.COPELAND
DATE: 5.28.98

TOTAL WT./LBS.: ~1370

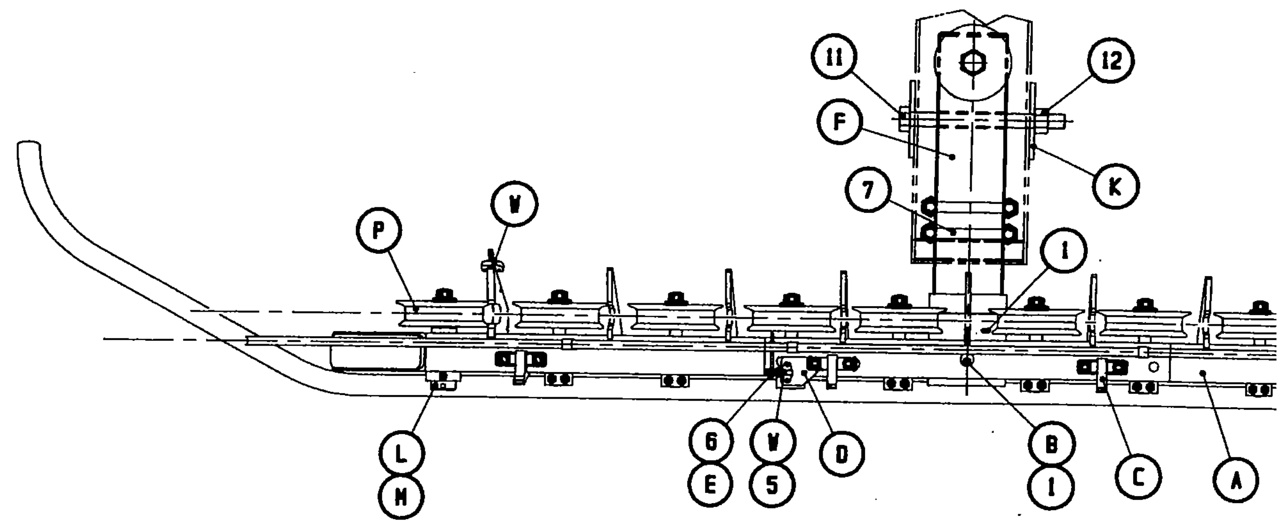
FORMAT: D
DRAWING NUMBER: 3038.782
REVISION: /

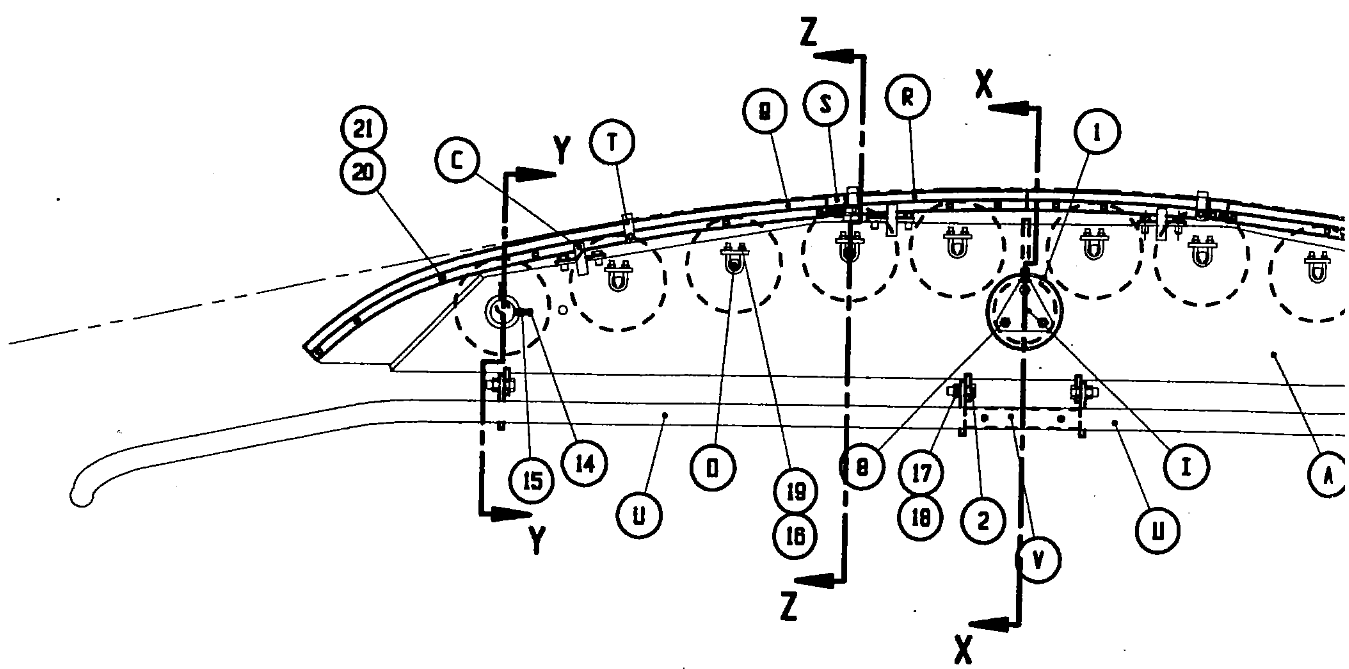


SECTION X-X
SCALE 1/5

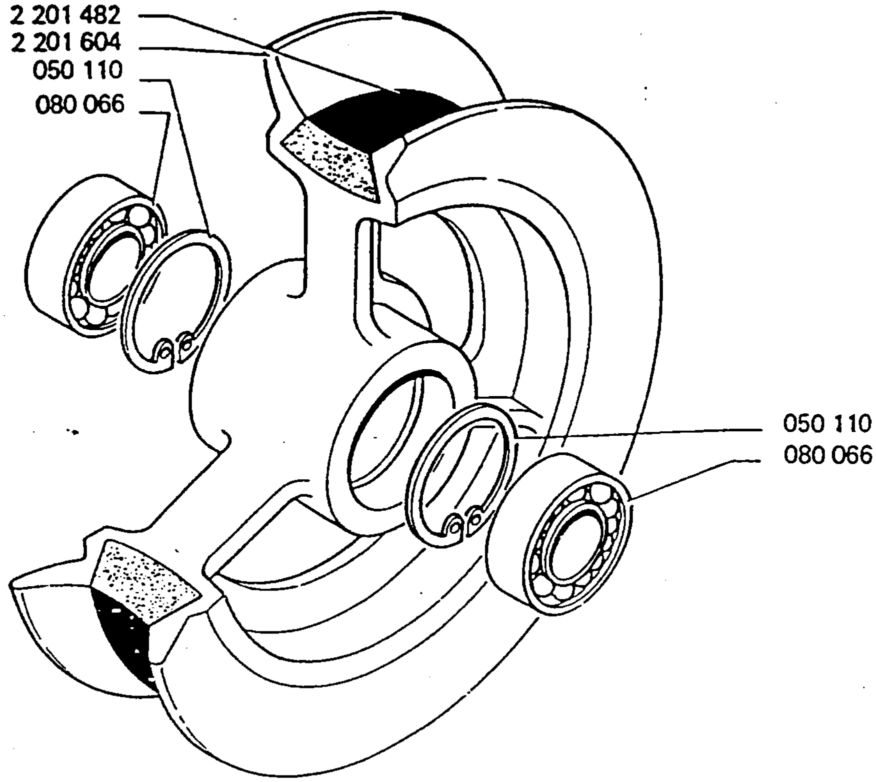


SECTION Z-Z
SCALE 1/5





2 031 195
Ø 200

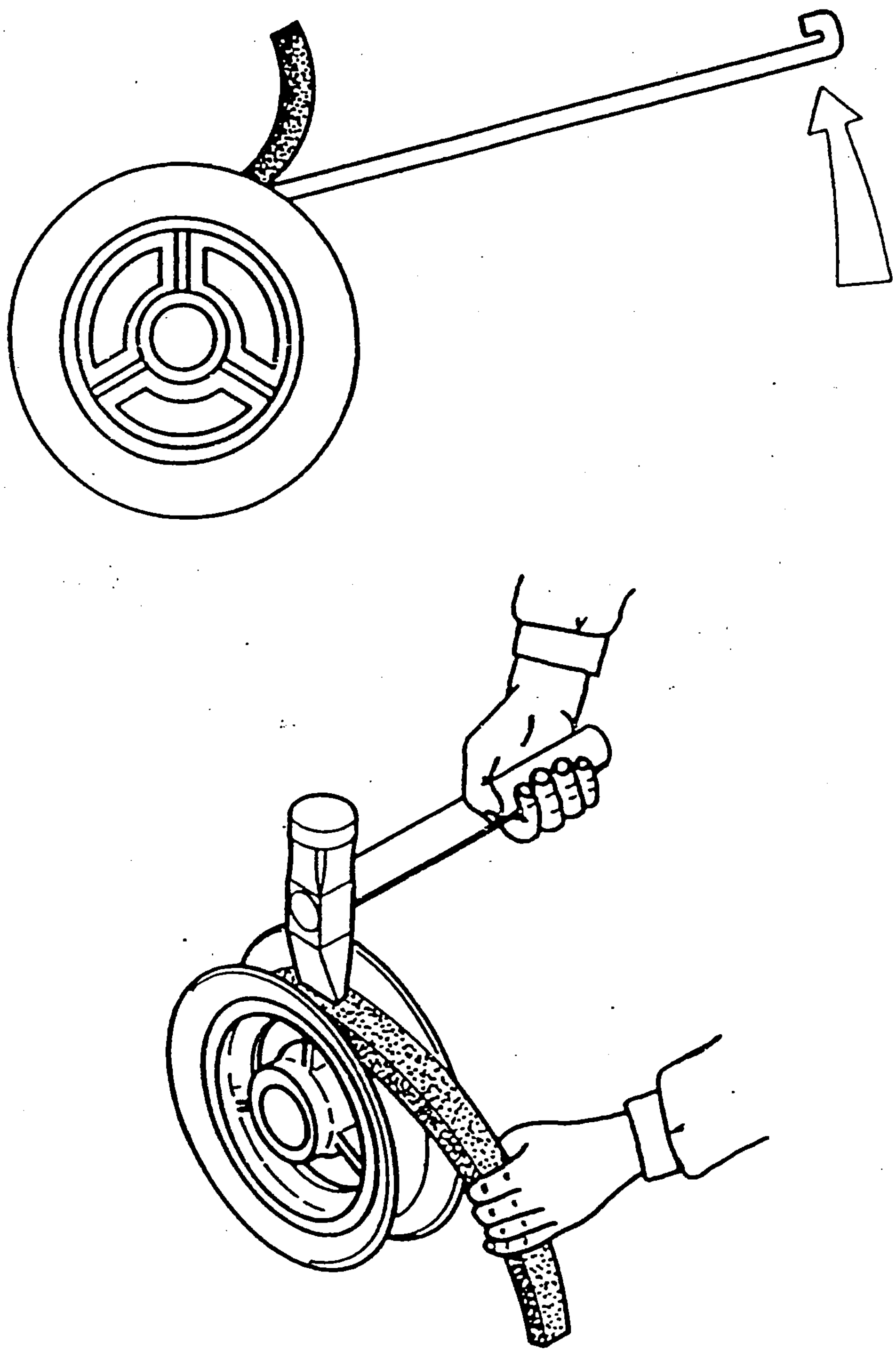


sheave devices

SHEAVE DIA. 200
AND DIA. 500

Rep. Nb.	Ref.	
	2 031 195	ASSEMBLY SHEAVE DIA. 200 comprising :
1	2 201 604	sheave
1	2 201 482	rubber lining
2	050 110	inner circlips dia. 52 type 7000
2	080 066	ball bearings 6 205 EE
Not shown 2	3110837	Nylon dust washers

DIAGRAM A



Section 13

CARRIER

Carrier

Description

One cabin with 8 sheave truck and track rope brake.

Maintenance Schedule

Frequency	*Maintenance Activity*
EVERY TRIP	Verify track rope brake system pressure.
DAILY	Track rope brake: check for system leaks Haul rope safety: Check that the pins release smoothly and lanyard is securely attached to the haul rope. Cabin: general inspection
MONTHLY	Truck/hanger: Inspect battery charging plug. Check torque on haul rope clamps. Track rope brake: Check oil levels Manual activation of brake. Pull test Pressure switch Cabin: Frame Haul Rope Clamps: Verify torque of haul rope clamp, bolts and cable clamps on tails of haul rope Visually inspect haul rope at clamps and at bottom truck structure for broken wires or other damage
EVERY 6 MONTHS	Truck/hanger: Inspect truck sheaves Track rope brake: Verify automatic activation
YEARLY	Truck/hanger: NDT hanger axles and thoroughly check hanger head bushings. Grease hanger head bushings Cabin: Check door opening mechanism

Maintenance, Inspections and Adjustments

Truck/Hanger

General Inspection

Visually check hanger to truck and cabin connection for any loose hardware and integrity of welds.

Check sheaves and rockers for complete rotation.

Check sheave liners for wear and replace as necessary.

Hanger Axles

Non-destructively test (NDT) hanger axles. The testing shall be performed by at least a level II Examiner as specified by the ASNT TC-1A. Any linear or transverse indication shall be cause for rejection of an axle.

The hanger to truck axle shall be tested, both visually and ultrasonically.

Hanger Head And Bushings

Grease hanger to truck connection with Aero Shell #14 or Equivalent. It is important that the cabin is pushed perpendicular both directions when applying grease to allow grease to completely lubricate the bushings. (See Figure 13-1)

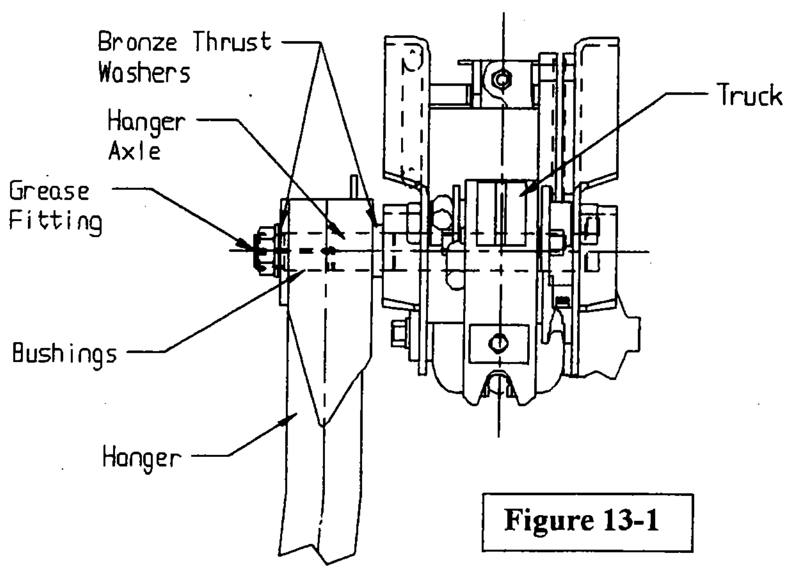


Figure 13-1

Charge Plug Inspect plug. Pay particular attention to wire terminations, position of plug in socket and condition of copper components. Make sure copper contact pads are clean and free of foreign material.

Truck Sheaves Lift one side of each 2 rocker and check for free movement of the sheaves. Inspect sheaves, bearings, and liners. Replace components as needed. See the section 11 of this manual for criteria and replacement procedures. (See Figure 13-2)

Rockers Check for free articulation of each rocker. (See Figure 13-2)

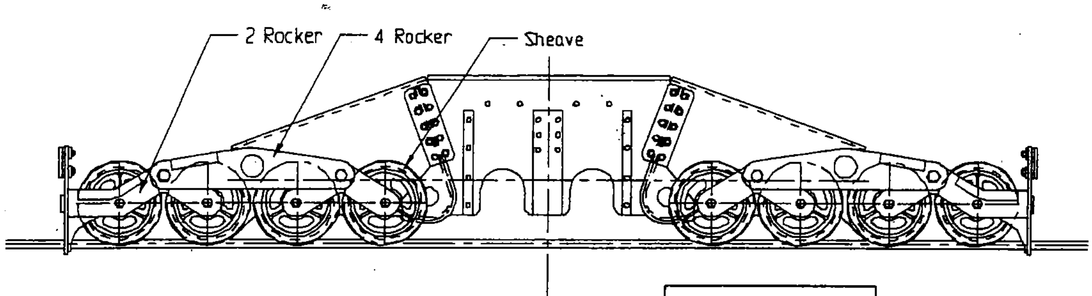


Figure 13-2

Haul Rope Clamps Check torque of the ten M14 bolts on the clamps. Torque value is 70 foot-pounds **with clean dry threads**. Follow the pattern in figure 13-3 for tightening the bolts. Repeat pattern until torque is achieved on all bolts. The gap between the plates has to be consistent through out. (See Figure 13-3)

Check clamps above truck between cables for tightness of bolts.

Inspect rope in clamp area. **Report any deformation or failure of rope strands to Poma of America, Inc. and cease lift operation until approved by Poma.**

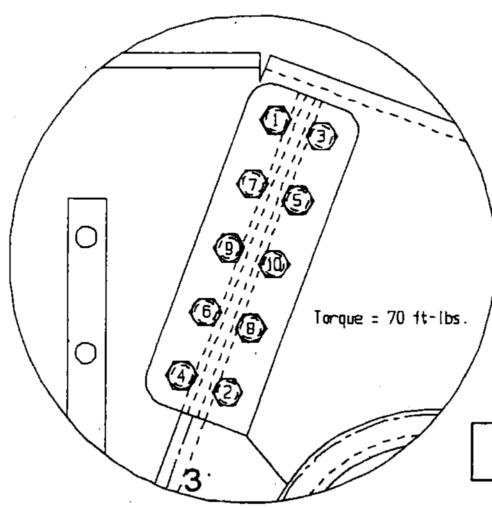


Figure 13-3

Track Rope Brake

System Leaks

Visually check all components for external leaks. Repair as needed.

Oil Levels

Pump Unit: With brake applied, oil lever should be 1/2in to 1in from the top of the reservoir.

When adding or changing oil, use Mobil DTE13 or equivalent.

Manual Activation Of Brake

With system at normal operating pressure, turn red handle on ball valve and verify system pressure drops to zero and track rope brake sets correctly. (See Figure 13-4 and Drawings 3038.768, 3038.868)

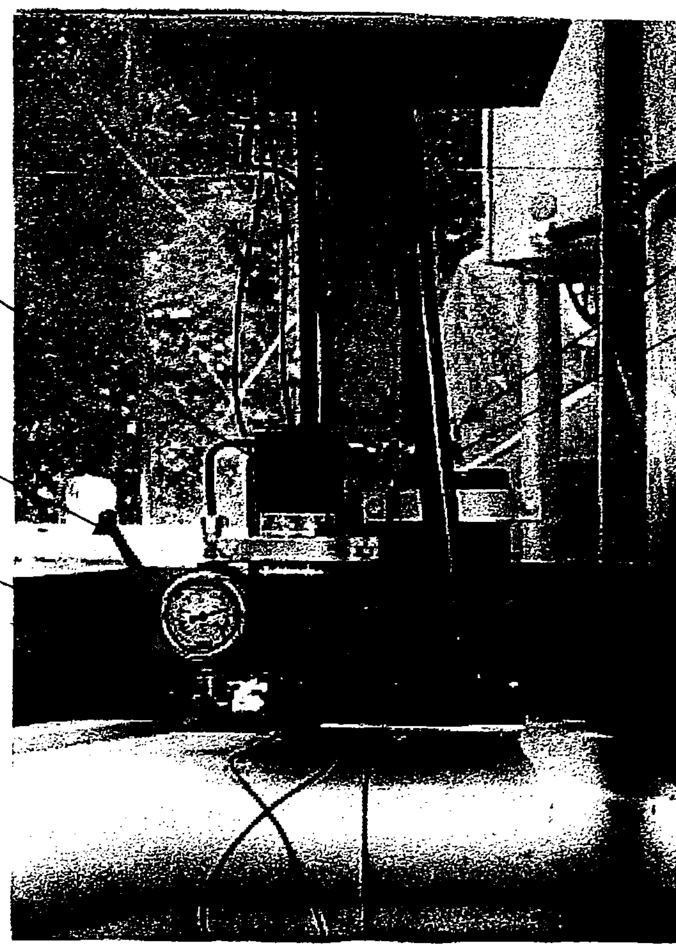


Figure 13-4

LEITNER POMA

LEITNER-POMA OF AMERICA, INC.

March 23, 2005

Mr. Jorg Ludwig
Senior Safety Engineer
State of California
Department of Industrial Relations
Tramway Unit
P.O. Box 11227
Truckee, CA 96162

Dear Mr. Ludwig,

This letter is in reference to the Pacoima Dam Tram (A-807) and the questions concerning the track rope brake adjustment and track rope saddle retention.

Track Rope Brake Adjustment - I have reviewed the brake pad clearance requirement that is outlined in the "Pacoima Aerial Tramway Operation and Maintenance Manual" (OM manual) and have revised this clearance from 3.5mm each side 7.0mm total to 2.5mm each side 5.0mm total minimum. See the enclosed revised Section 13, Page 6A. The brake pull test value was determined during the acceptance test. This "real" value is different than the theoretical calculated value and reflects fiction and other "real" conditions on site. Enclosed are the brake force calculations.

Track Rope Saddle Retention – We included calculations for the retention of the track rope in the saddles as part of the original submittal packages for certification of the tramway. Enclosed are copies of the submitted calculations. Furthermore, it was determined by the certifying design engineer, by calculation and during the load test, that the track rope retention straps were not required for adequate safety to deropement, and might even constitute a hazard for the track rope brake. Leitner Poma technicians inspecting the tramway checked the condition of the remaining straps, during monthly service visits, and removed them as they became a problem. Leitner Poma is now requiring that all remaining track rope retention straps must be removed wherever they interfere with passage of the track rope brake. Enclosed is revised Section 12, Page 4A removing the "check position of track rope straps" requirement, and revised saddle assembly drawings US3038.782A and US3038.783A.

For your records, we are sending revised OM manual pages, revised drawings and resending copies of pertinent calculations. These will be also sent to Sam Kats and Sam Huber of LA County I.S.D.

Sincerely,

Nelson Tusberg, P.E.
Manager of R&D Engineering

2510 FORESIGHT CIRCLE • GRAND JUNCTION, CO 81505 • (970) 241-4442 • FAX (970) 241-3023
EASTERN OFFICE: P.O. BOX 35, ROUTE 100 & 107 • STOCKBRIDGE, VT 05772 • (802) 746-7955 • FAX (802) 746-7958

Brake Adjustment

When brake is released, the brake pads grooves should 2.5 be centered on the track rope with a minimum of ~~3~~.5mm of clearance each side. If the pad grooves are more than an 1/8in out of vertical alignment then replace roller (Index P) and pads. (See Drawing 3038.868)

Slowly set the brake with the dump valve. Verify that the brake sets properly with the track rope correctly seated in the brake pad grooves. (See Figure 13-4)

Adjustment of the brake should coincide with values determined during pull test. To increase braking pressure tighten nut (Index X) while backing up bolt (Index I) with appropriate wrenches. To decrease pressure loosen nut (Index X). (See Drawing 3038.868)

System Pressure

To determine system pressure, pull test the truck and adjust brake. Pump up the brake until 3.5mm of clearance per side between the track rope and brake pads is achieved. Note pressure shown on gauge. This pressure will be the release pressure until next pull test. If system pressure is determined to be above 5000psi the system may not be working properly and a thorough check of the system is needed before lift may resume operation. **Never exceed maximum pressure on gauge.**

See March 23 Letter

Cabin

General Inspections

Check for free and proper operation of door.
Check general condition of cabin.
Check battery charger for proper charge

Door Emergency Pins

Verify that emergency release pins are fully engaged (See Figure 13-6)

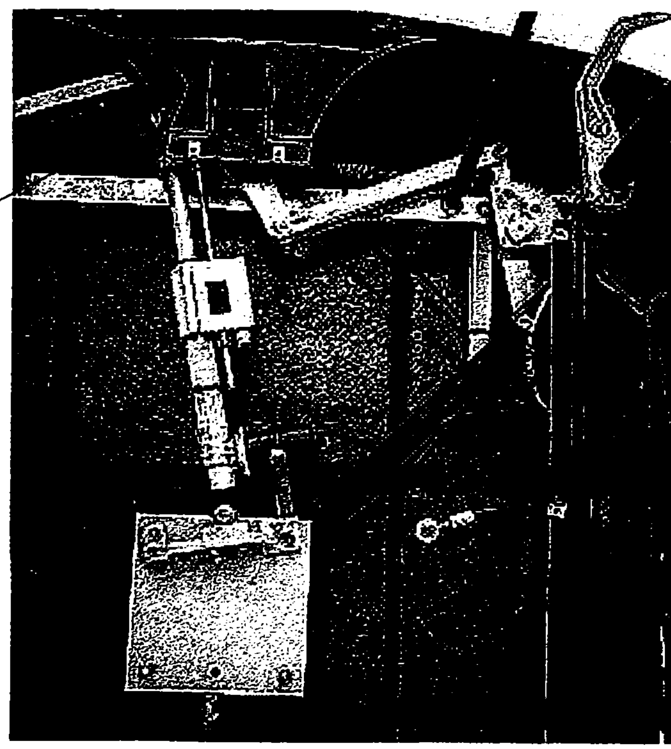
Frame

Carefully inspect frame and frame connections for cracks, loose or missing hardware and integrity of safety cables. (See Figure 13-6)

Door Opening Mechanism

Lubricate areas noted on figure 13-6. A light film brushed on is sufficient.
Lubricate spring arm at grease fitting

Release Pin



Grease Area

Safety Cable

Grease Fitting

Figure 13-6

ACCEPTANCE/REJECTION CRITERIA FOR HANGERS

2.3.4.3. ANSI B77 CODE

1. **Qualifications for Testing Personnel**

All inspectors should be at least a Level II Examiner, as specified by the American Society of Non-Destructive Testing TC-1A.

2. **Sampling Size and Method of Obtaining the Sample**

The test sampling method shall identify the parts tested to assure a rotating minimum test sample on each lift of 10 hangers or 10% of all the total hangers per year, whichever is greater.

3. **Allowable Rejection Rate and Retest Procedures**

If any of the 10 or 10%, whichever is greater, is rejected, another 10 or 10%, whichever is greater, shall be tested.

4. **Types of Inspections to Be Performed and the Procedures to Be Used**

- Visual inspection of every hanger once a year.
- Non-destructive testing by means of magnetic particle and/or liquid penetrant to the critical areas per blueprint.
- Procedures for non-destructive testing shall be done according to the American Society of Non-Destructive Testing TC-1A.

5. **Criteria for Acceptance/Rejection of Samples**

Welded stress parts:

- Any linear indications
- Transverse indication with 1 dimension greater than 1/8 inch.
- 3 or more aligned indications with the distance between being less than 1/8 inch edge-to-edge, or extending for more than 5/8 inch if this distance is between 1/8 and 1/4 inch.
- 2 separate indications are considered as one if the distance which separates them is less than 2 times the length of the smaller one. The cumulative length of the indications is equal to the measured

Section 14

HAUL ROPE AND TRACK ROPE

PACOIMA DAM AERIAL TRAMWAY

OPERATION AND MAINTENANCE MANUAL

1999

POMA

MAINTENANCE MANUAL

POMA of America, Inc.

2510 Foresight Circle, Grand Junction, Colorado 81505

PHONE: (970) 241-4442 FAX: (970) 241-3023 WEB: http://www.poai.com

POMA OF AMERICA

PACOIMA DAM AERIAL TRAMWAY OPERATION AND MAINTENANCE MAUAL 1999

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Section Number

Section 1

TECHNICAL DATA

LIFT DATA SHEET

NAME: ***Pacoima Tram***

TYPE: Aerial Tram

LINE:	Slope Length	2091.57 ft.	(637.51 m)
	Vertical Rise	519.06 ft.	(158.21 m)
	Average Grade	25.80%	
SPEED		400 fpm	(2.03 m/S)
CAPACITY		60 p/hour	
NUMBER OF CARRIERS		1	
POWER OF ELECTRIC MOTOR		50 HP @ 1745 rpm	
POWER OF EVAC. ENGINE		25 HP @ 3600 rpm	
DIAMETER OF TRACK ROPE		26 mm	
DIAMETER OF HAUL ROPE		16 mm	
HYDRAULIC TENSION			
	TRACK ROPE RAM	1415 psi	(98 bars)
	LORRY RAM	1415 psi	(98 bars)
LINE GAUGE		4.10 ft.	(1.25 m)
DIRECTION OF ROTATION		CW	

ORIGIN OF PROFILE : Poma of America, Inc.

PROFILE NUMBER : C51013

DATE : February 1998

I. *Lift Operation*

Speeds

* speed		2.03 m/sec.	400 ft/min.
* over-speed	speed x 1.1 =	2.23 m/sec.	440 ft/min.
* emergency speed		0.508 m/sec.	100 ft/min.

II. *Hydraulic Tension of the Cables*

Track rope tension system

* OPERATING PRESSURE in the ram .... 98 bars (1415 psi)

* LOW PRESSURE SWITCH (on the hydraulic unit)
Must trip and cause the stopping of the lift if the pressure falls to:
.... 88 bars (1274 psi)

This corresponds to an operating pressure decrease of 10%.

* HIGH PRESSURE SWITCH (on the hydraulic unit)
Must trip and cause the stopping of the lift if the pressure rises to:

.... 108 bars (1557 psi)

This corresponds to an operating pressure increase of 10%.

Haul rope tension

* OPERATING PRESSURE in the rams .... 98 bars (1415 psi)

* LOW PRESSURE SWITCH (on the hydraulic unit)
Must trip and cause the stopping of the lift if the pressure falls to:
.... 88 bars (1274 psi)

This corresponds to an operating pressure decrease of 10%.

* HIGH PRESSURE SWITCH (on the hydraulic unit)
Must trip and cause the stopping of the lift if the pressure rises to:

.... 108 bars (1557 psi)

This corresponds to an operating pressure increase of 10%.

III. *Adjustment of the Bullwheel Brakes*

* Pressure A : Braking pressure (when the pads are in contact with the braking track)	100 bars(1450 psi)
* Pressure B: Brake clearance pressure (the pads are not in contact with the braking track)	170 bars (2465 psi)

The brake pressures listed here are based on assumptions about shoe friction. This friction may vary due to environmental factors such as water, ice, snow, rust, oils or greases on the braking surface or brake shoes. These values should be used as guidelines only. The brakes shall be adjusted to produce the holding force listed in the Brake Test Procedures in this section.

IV. *Cable Tensions and Loads*

The tensions and the loads on the equipment given below are the most extreme, considering all loading conditions.

NOTE: Releasing the hydraulic rams can reduce the tensions and loads.
ATTENTION: However, doing so makes the tensions and loads very difficult to predict.

- CABLE TENSION:

Track Rope			
	at the drive terminal	16650 daN	(37431 lbs.)
	at the return terminal	18126 daN	(40749 lbs.)
Haul Rope			
	at the drive terminal	2280 daN	(5126 lbs.)
	at the return terminal	2380 daN	(5350 lbs.)

- LOADS ON STRUCTURES

Track Rope Reaction			
	at the drive tower	7386 daN	(16604 lbs.)
	at tower 1	7691 daN	(17290 lbs.)
	at tower 2	3628 daN	(8156 lbs.)
	at the return tower	18074 daN	(40632 lbs.)
Haul Rope Reaction			
	at the drive tower	4259 daN	(9575 lbs.)
	at tower 1	1969 daN	(4426 lbs.)
	at tower 2	756 daN	(1700 lbs.)
	at the return tower	4737 daN	(10649lbs.)

V. *Internal Combustion Engines*

Evac Engine .... Kohler CH25

Genset .... Cummins 50KW

VI. *Drive Belt Tensioning*

- Electric motor (normal operation)

Motor Sprocket Teeth # 48

Gearbox Sprocket Teeth #...................................... 50

Belts: Number .... 1 Size........... Poly Chain 14M-1960-20

Shaft Center Distance... 25.08 in.

Belt Tension - max .... 201.6 lbs.

Deflection at the center of the span .... 0.39 in.

New Belt Installation Force .... 20.4 lbs.

Used Belt Retensioning Force .... 17.9 lbs

- Hydraulic motor (evacuation operation)

Motor Sprocket Teeth # 48

Gearbox Sprocket Teeth #...................................... 50

Belts: Number .... 1 Size........... Poly Chain 14M-1750-20

Shaft Center Distance... 25.94 in.

Belt Tension - max .... 195.58 lbs.

Deflection at the center of the span .... 0.33 in.

New Belt Installation Force .... 19.7 lbs.

Used Belt Retensioning Force .... 17.2 lbs

VII. *Brake Testing Values* (Minimum Test Values)

Bullwheel Brakes... 110 ft-lbs.

Track Rope Brake .... 3200 lbs.

Note: Bullwheel Brake test values are given in torque applied to the electric motor shaft.

VIII. *Haul Rope* shall comply with all provisions of ANSI B77.1, Section 7.1 or CAN/CSA-Z98-96 and CSA-G4.

Manufacturer: Fatzer

Construction: 6 x 19 Seale

Wire

King Wire .... 1860 N/mm^2

Inner, Outer Wire .... 1960 N/mm^2

Core .... Polypropylene

Lay .... Right Lang

Diameter .... 16mm +2% / -1%

Strength .... 17659daN (39700 lbs.)

Length .... 4225 ft.

Lightly lubricated with Elaskon 20BB.

IX. *Track Rope* shall comply with all provisions of ANSI B77.1, Section 7.1 or CAN/CSA-Z98-96 and CSA-G4.

Manufacturer: Bridon

Construction: Full Lock Aerial rope

Wire

King Wire .... 1960 N/mm^2

Outer Wire.................................... 1570 N/mm^2

Inner Wire .... 1960 N/mm^2

Lay .... Full lock RH

Diameter .... 26mm +2% / -1%

Strength .... 64723daN (145504 lbs.)

Length .... 2107.5 ft.

Lightly lubricated with castor oil.

X. *Electric Motor*

Brand..General Electric

Frame size...CD328AT

HP.. 50 Hp

RPM .... 1750 rpm

Voltage 500

XI. *Gear Reducer*

Brand	Kissling
Model	T-246
Ratio	53.97:1

MONTHLY BRAKE TEST PROCEDURES

AREA : **Pacoima Dam**

LIFT : **Pacoima Aerial Tram**

CAPACITY/
SPEED : ***60pph / 400fpm***

CONTENTS:

THESE PROCEDURES SHALL BE PERFORMED BY TRAINED AND COMPETENT PERSONNEL AS REQUIRED BY ANSI B77.1-1992, SECTION 2.3.3.2.

I. *INTRODUCTION*

These procedures provide static tests of the holding power of the service brake and the emergency brake.

These tests shall be conducted at least monthly and immediately prior to the operating season. In the event any repairs, adjustments or modifications are made to any brake system at any time, these tests shall be successfully completed prior to opening the lift for transportation of any person or persons.

The intent of these procedures is to demonstrate that the brake systems will perform properly and hold the load for which the lift was designed.

There are to be no passengers on the lift during these tests.

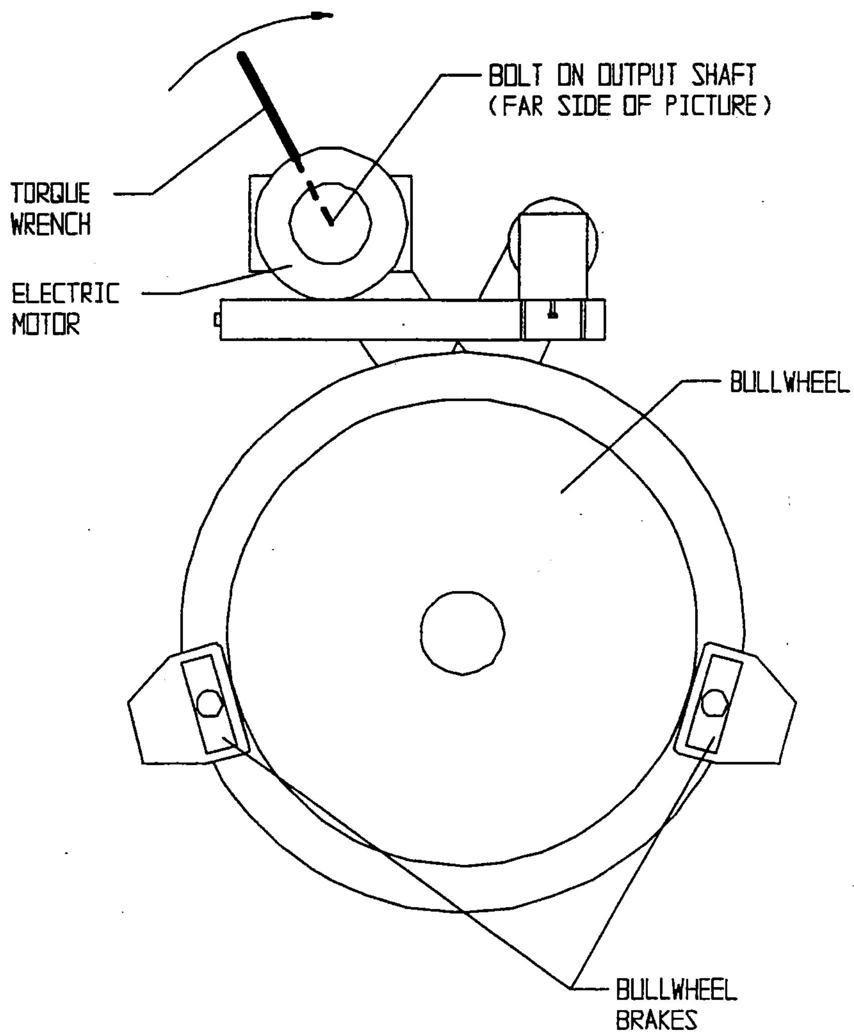
FAILURE TO SUCCESSFULLY PERFORM THESE TESTS MAY RESULT IN SERIOUS INJURY OR DEATH TO PERSONS ON OR NEAR THIS LIFT.

Lift Name: **Pacoima Aerial Tram**
Capacity/speed: **60 pph/400fpm**

II. *BULLWHEEL BRAKE TEST*

1. Locate empty cabin at drive terminal approximately 15 inches from the docked position.
2. Open main power disconnect.
3. Turn the OPERATIONS MODE SELECTOR switch to AUXILIARY.
4. Push the RESET BUTTON.
5. Pump up the bullwheel brakes using the hand pump.
6. Apply the one bullwheel brake by opening one dump valve, and be certain the second bullwheel brake remains released. Note: On some models of bullwheel brake pumps, it may be necessary to manually hold the bullwheel back stop brake solenoid valve closed.
7. Set a torque wrench to 110 ft-lbs. Position the torque wrench on the bolt on the output shaft of the electric motor. Rotate the torque wrench and observe desired torque is attained and the bullwheel does not move. (See Brake Test Diagram)
8. If the bullwheel brake slips, re-adjust them following the procedure in the OPERATION AND MAINTENANCE MANUAL, then repeat the test.
9. After successfully completing this test, remove the test equipment. Prior to opening the lift for transportation, operate the lift through a series of starts and stops to be certain that all brake systems are operating properly. Check stopping distance.

III. *BULLWHEEL BRAKE TEST DIAGRAM*



IV. *TRACK ROPE BRAKE TEST*

1. Locate empty cabin at drive terminal approximately 4-6 feet from the docked position at the drive terminal.

2. Manually set the track rope brake by opening the valve in the cabin.

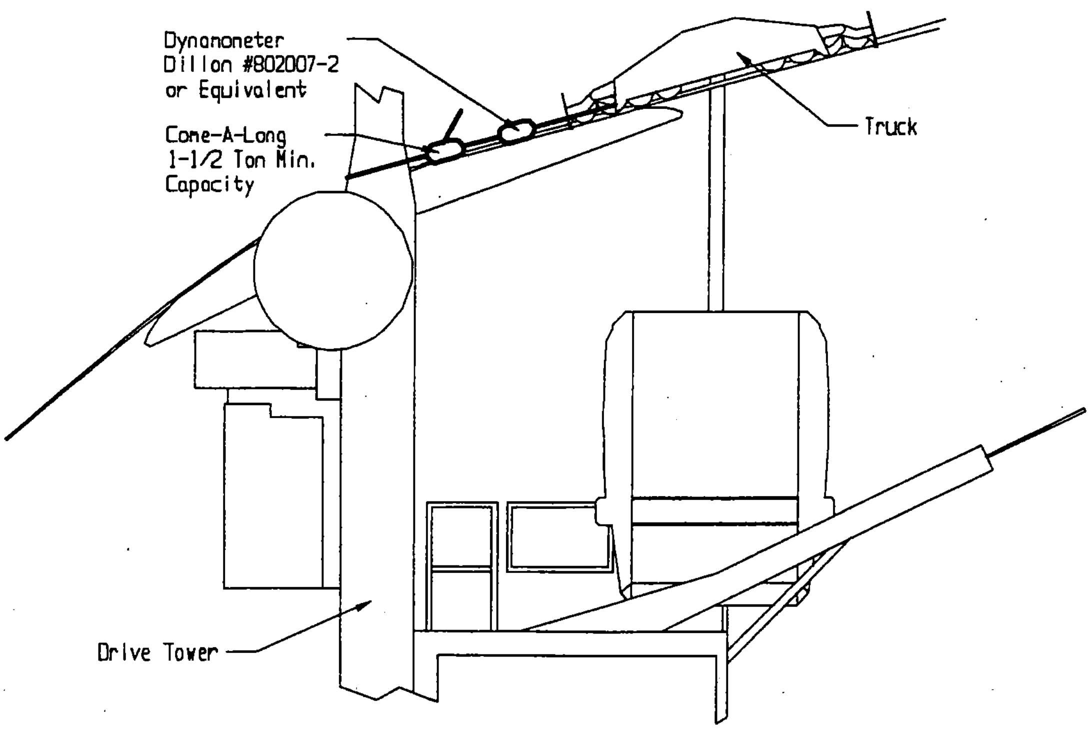
3. Place a come-a-long with a dynamometer between the truck and drive tower. Make sure the come-a-long and dynamometer are as close as possible to the axis of the track rope. **Use rigging rated at a minimum of 4,000 lbs**. (See Track Rope Brake Test Diagram).

4. Tension the set up using the come-a-long to a value of **3200 lbs**. Verify that the brake did not slip on the track rope. *Note the value given is adjusted for the angle of rope at the drive. The test must be preformed at the drive or the pull test value will change.*

5. If the track rope brake slips prior to reaching this value, adjust brake and repeat test. (See Carrier section of Maintenance Manual)

6. After successfully completing this test, remove the test equipment. Prior to opening the lift for transportation, operate the lift through a series of starts and stops to be certain that all brake systems are operating properly.

V. *TRACK ROPE BRAKE TEST DIAGRAM*



Section 2

LIFT OPERATIONS MANUAL

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POMA

April 15, 1999

POMA OF AMERICA, INC.

Ms. Reem Shamma
LA County Department of Public Works
900 South Fremont Ave.
Alhambra, CA 91803-1331

Dear Reem:

Regarding operation of the Pacoima tram in winds, we offer the following. As you are aware, the tram has been designed for operation in winds up to 67 mph. However, wind effects on aerial lifts involve many variables. These include wind speed, wind direction, wind exposure, gust to average speed differences, period of gusts, lift speed and line loading. Any attempt to calculate safe wind speeds involves so many assumptions that the results are inaccurate and possibly dangerous in the sense that they create an attitude of reliance on wind speed and direction measurements at specific points of the lift line and a chart of recommended lifts speed versus wind speed rather than visual observation of the lift as it operates. Wind speed and direction measurements provide valuable input to the lift supervisor's judgment of safe wind speed, but they cannot remove his/her responsibility to operate the lift in a safe manner.

The Pacoima tram has been designed to allow 7° lateral swing, 30° longitudinal swing and the combination of 7° lateral and 30° longitudinal swing of the carriers without contact with towers or line equipment. The terminals can accommodate this swing at the entrance of the terminals with the stabilization rail extensions. This lift has been designed to safely resist 100-MPH winds without failure of the terminals, towers or foundations. However, many combinations of wind speed, direction, exposure, lift speed and line loading can generate carrier swings in excess of 7°. Carrier swing greater that 7° can cause carriers to contact towers and other equipment possibly resulting in equipment damage or injury and/or death to passengers. Accordingly, it is the burden of the lift supervisor to reduce speed or cease operations when conditions warrant. The following chart of wind speed versus line speed should be used only as a general guideline. In the event of high winds, visual monitoring of the lift line and terminals is essential to allow the lift supervisor to use his/her judgement on safe speed and when to reduce or cease operation.

Wind Speed (MPH)	Maximum Line Speed (ft./min)
0 - 30	400
30 - 35	250
35 - 40	180
40 - 67	100
Above 67	Cease Operation

If you have additional questions, please let me know.

Sincerely,

R. Jefferson Smith, P.E.

cc: JF Mugnier

2510 FORESIGHT CIRCLE GRAND JUNCTION, CO 81505 (970) 241-4442 · FAX (970) 241-3023
EASTERN OFFICE: P.O. BOX 35, ROUTE 100 & 107, STOCKBRIDGE, VT 05772 (802) 746-7955 - FAX (802) 746-7958

OPERATOR CONTROLS

This section describes the operator controls, fault annunciator and meters for Poma lifts. There are control stations located at the drive and return load/unload platforms, electrical cabinet and inside the cabin. Each station has an Emergency Stop, Normal Stop, up, down, open door and close door. Sound powered phones and signal buttons are located at the drive and return load/unload platforms and electrical cabinet.

EMERGENCY STOP: This button should be pressed when an emergency situation exists. It will bring the lift to an abrupt stop by releasing the hydraulic pressure which holds the bullwheel E-brake open and by disconnecting the power from the main electric motor or by shutting off the fuel supply to the evac engine. It will also cause all auxiliary motors and pumps such as the Tension Pump to shut off.

NORMAL STOP: This button will cause the lift to come to a smooth stop by using the deceleration ramp in the DC Drive. If Evac Mode is selected, the fuel will be shut off to the evac engine and the service brake will apply.

UP: This button will cause the lift to operate in a clockwise motion (cabin moving uphill), unless the cabin is docked at the return. When pressed the lift will auto-reset and, if no faults remain active, an audible bell will sound at the drive and return for three seconds. After the alarm has sounded, the brakes will be pumped and the lift will accelerate to the percent of full speed selected on the speed control potentiometer in drive control cabin (full speed = 400 fpm). The cabin will travel at the selected speed until reaching the return or until a fault/operator stop is initiated. The exception to this being when the cabin is traveling over a tower, at which point it will decelerate to a preset speed to accommodate a smooth ride. Note that the auto-reset process can take as long as 20 seconds and therefore the UP button is inactive for a period of 20 seconds after being pressed.

DOWN: This button will cause the lift to operate in a counter clockwise motion (cabin moving downhill), unless the cabin is docked at the drive. When pressed the lift will auto-reset and, if no faults remain active, an audible bell will sound at the drive and return for three seconds. After the alarm has sounded, the brakes will be pumped and the lift will accelerate to the percent of full speed selected on the speed control potentiometer in drive control cabin (full speed = 400 fpm). The cabin will travel at the selected speed until reaching the return or until a fault/operator stop is initiated. The exception to this being when the cabin is traveling over a tower, at which point it will decelerate to a preset speed to accommodate a smooth ride. Note that the auto-reset process can take as long as 20 seconds and therefore the DOWN button is inactive for a period of 20 seconds after being pressed.

RESET: The reset button is located in the electrical cabinet on the drive platform. This button is used to reset lift safeties. A valid reset can only occur if the lift is stopped (zero speed detected by the PLC) and the service brake is set. If these conditions are not met when the Reset Button is pressed, a **Reset Fault** will be annunciated. There is a 3-second time delay between a reset and when the lift can be run. This time delay prevents restarting the lift too quickly after a stop. Note that the brake position faults, which indicate that the brakes are set, can not be reset using this button. The brakes are not pumped until all other safeties are clear and a run command is received.

MODE SELECT: This switch selects the operating mode: Electric or Evac. Ensure the gearbox is coupled properly.

CONTROL POWER: This key switch energizes the +24 VDC control circuits. It must be turned on in order to run the lift.

SIGNAL: This button will sound the signal buzzers located in each load/unload area and electrical cabinet on drive platform. It is used to initiate contact via the sound powered phones.

PHONES: There are sound-powered phones located at the unload/load areas and in electrical cabinet on drive platform.

LIFT SPEED METER: The lift speed is indicated in fpm (feet per minute) on the electrical cabinet located on the drive platform. The meter also has two thumbwheels which control the setpoints for cable tach overspeed and cable rollback.

WARNING: Only qualified personnel should adjust the setpoints. Failure to properly adjust the setpoints may result in loss of life or extensive damage to equipment.

CONTROL VOLTS METER: The +24 VDC control system voltage is indicated on this meter which is located on the main drive cabinet. The normal operating range is between 23-28 VDC.

TRIP COUNTER: The trip counter registers the total number of trips. One trip is defined as the carrier leaving the drive, docking at the return and then returning and docking at the drive.

HOUR METER: This meter indicates total running lift hours. There is also an hour meter located on the evac engine and genset which indicates how many hours the engine has been running.

FAULT ANNUNCIATOR: The annunciator is located in the electrical cabinet located on the drive platform. The annunciator is a two-line VFD display, which show current faults and lift status. The annunciator has function keys that allow the operator to select bypasses and check stop distance and stop time.

Refer to the Electrical Section for a detailed explanation of how to use the fault annunciator.

WARNING: Use of safeties bypass may result in severe damage to equipment or personal injury including death.

OPERATING PROCEDURES

INTRODUCTION

This lift has been designed for the uphill and downhill transportation of up to 6 passengers and light freight with a total weight capacity including passengers and freight of 2240 lbs. **NO OTHER USE OF THIS LIFT IS PERMITTED** without written consent from Poma of America, Inc.

This installation requires operation by trained, competent and experienced personnel operating strictly in accordance with: 1) its current design specifications, 2) its current operation instructions, 3) its current maintenance instructions and 4) all applicable statutes, ordinances, rules, regulations and requirements of authorities having jurisdiction.

* No safety system may be jumpered out during operation.
* All required inspections and maintenance must have been performed.
* All required operating personnel must be at their proper position, fully trained and experienced in all normal operation and emergency procedures, and in a physical condition which would not prevent his/her performance of duties.

These operating procedures are in accordance with ANSI B77.1 section 2.3 *Operation and Maintenance* of reversible aerial tramways. It is imperative that operating and maintenance personnel be familiar with the applicable provisions of this section.

Operation and maintenance of aerial ropeway equipment can be dangerous to personnel performing these tasks. Procedures for performing these functions shall require precautionary measures necessary to assure the safety of the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

Failure to follow these instructions could result in an accident causing serious injury to persons or serious damage to property including the lift.

SPECIFIC INSTRUCTIONS FOR OPERATORS AND ATTENDANTS

Aerial lifts shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. One or more persons familiar with emergency procedures shall be on the site at all times when the facility is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific lift.

SUPERVISOR

One individual, representing the owner, shall be in responsible charge for all operating personnel and attendants. The supervisor shall be responsible for safe operation, and shall have the authority to deny access to the lift to any person who, in the supervisor's opinion, is not fit or competent to use the facilities without danger to self, others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the lift under adverse weather or operational conditions. Although authority may be delegated to others, the supervisor has the final responsibility.

OPERATORS

An operator shall be in charge of the lift. This operator shall be trained and experienced in normal operational and emergency procedures.

ATTENDANTS

An attendant shall be assigned particular duties under the direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to this assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within view.

CONDUCTOR

At least one passenger in the cabin during any period of tram operation shall be trained and competent in lift evacuation procedures. The evacuation equipment must be in the cabin and in good condition during any operation of the tram for passenger service.

FIRST AID

One or more persons trained to administer first aid shall be available at all times when a lift is operating and transporting passengers. There shall be ready access to first aid supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

MINIMUM OPERATING PERSONNEL

The following personnel are the minimum that shall be required per ANSI B77.1 section 2.3 code for reversible tramways:

- An operator shall be in charge of each aerial lift.
- One attendant shall be on duty at each loading /unloading platform.
- One conductor trained in evacuation procedures shall be present in the cabin during operation.

An operator may serve concurrently as an operator and attendant at a loading or unloading area that may be adjacent to the operator's station unless the duties of that area preclude maintaining reasonable surveillance of the entire lift operation.

DUTIES OF OPERATING PERSONNEL

SUPERVISOR

The duties of the supervisor shall be as follows:

1) To determine that all lifts are operational and that all operating personnel are trained, equipped and fit to perform their duties.

2) To discontinue operations of any lift due to physical, weather, personnel or other reasons.

3) To enforce operational, maintenance and safety rules.

OPERATOR

The duties of the operator shall be as follows:

1) To assume responsible charge of the lift.

2) To assign and supervise all attendants on his/her lift.

3) To maintain an operational log book as required in later paragraphs of this section.

4) To advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation.

ATTENDANT

The duties of the attendant shall be as follows:

1) To maintain orderly passenger traffic conditions within his/her area of jurisdiction.

2) To advise and assist passengers, as required.

3) To maintain surveillance of his/her area of jurisdiction.

CONDUCTOR

The duties of the conductor shall be as follows:

1) To be in charge of evacuation if rope evacuation is required.

2) To advise and assist passengers, as required.

The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground or snow surface conditions.

PRE-OPERATING INSTRUCTIONS

AFTER THE INSTALLATION HAS BEEN COMPLETED, THE FOLLOWING MUST BE DONE:

1. Recheck that all structures, nuts and bolts, and electrical circuits are properly installed and functioning, all towers aligned, and all foundations inspected.

2. Any construction materials which may have been left on towers and other structures shall be removed.

3. All required signs shall be installed.

4. The top and bottom terminals shall be cleaned up, circuits in place, and required fencing in place for the loading and unloading areas.

BREAKING-IN PERIOD:

During the first week of operation, a thorough inspection should be done on the entire lift, paying attention to the following points:

1. Re-tighten all bolted connections.

2. Check alignment of all saddles and sheave assemblies.

3. Check all drive shafts and belts for alignment, lubrication and bolt torque.

4. Check and inspect the cabin truck (per Maintenance Manual).

5. Check and inspect all connections and fasteners on drive station and return station.

6. Check and inspect haul rope and track rope.

7. Check lubrication of all moving parts.

8. Check haul rope alignment at entrance and exit of bullwheels.

9. Check all electrical connections.

OPERATIONAL PROCEDURES

PASSENGER CONTROL

Each lift shall have a definite method of marshalling passengers for safe loading and unloading. Fences and gates may be required to implement the system.

FIRST AID

There shall be ready access to first aid supplies and equipment, including provisions for transporting an injured person to an enclosed and, if necessary, heated shelter.

DAILY PRE-OPERATIONAL INSPECTION

Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection consists of the following:

1. A visual inspection of each terminal, station and the entire length of the lift.

2. Assure that tensioning systems are functional and have adequate travel with clearance at both ends of travel.

3. Operate all manual and automatic switches in terminals, stations and loading and unloading areas.

   A. All stop buttons
   B. Start, stop and speed control switches
   C. Safety gate

4. Test braking systems. Check brake adjustments.

5. Check the communication systems.

6. Check poly chain tension and alignment.

7. Check oil levels in all gearboxes.

8. Check fluid level in all hydraulic systems.

9. Check pressure and fluid levels in all braking systems.

10. Run the lift, visually inspecting all ropes and the carrier.

11. **Ride up lift and check general conditions of the following:**

A. Saddles and sheave assemblies, haul rope and track rope alignment
B. Tensioning system
C. Condition of carrier

The first person riding the lift each day must be a competent and trained operator or attendant who has a radio which can transmit to, or is in visual or voice contact with, an operator at a control station.

This attendant should carefully observe the haul rope, track rope, cabin truck, saddles, sheave assemblies, derail switches, signs, carrier clearance and should listen carefully for unusual sounds. If any unusual condition is noticed, the lift must be stopped immediately and the lift supervisor must give clearance before restarting.

12. Inspect the cabin truck as required by maintenance instructions.

13. Check each control circuit for circuit continuity and integrity at its most remote terminal on a daily basis.

14. Check oil, coolant, battery level, fan belts, hoses and fuel level on evac engine and genset.

15. After all inspections, enter any irregularities into the log book noting the following:

A. Service has been done
B. Service to be done

The fuel supply of internal combustion engines should be verified. For primary power units, there shall be sufficient fuel to operate for the expected time period of operation without refueling. For evac only internal combustion engines, the fuel supply shall be adequate to unload the lift. During refueling, power units should be shut down.

The evacuation engine shall be checked during this inspection and the lift should be run with the auxiliary power at least once each week. The lift shall be operated using the auxiliary unit for at least 30 minutes a month.

Loading and unloading areas shall be inspected and, if necessary, cleared of ice and snow to permit the safe ingress and egress of passengers. Carriers shall be cleared of ice to the extent necessary to permit safe operation, and mechanical components shall be inspected and checked.

Inspection and checking the mechanical features of the carriers for correct operation.

General

The supervisor and operator of the lift shall review the requirements of 2.1 and section 7 of the ANSI B77.1 to ascertain that original design and installation conditions have not been altered in a manner such as to violate the requirements of the standard.

STARTING THE LIFT

No lift shall be started except by the direction of or following clearance by the operator. Aerial lifts while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance and emergency operations.

STOPS

After any stop of a lift, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

DAMAGE TO CARRIER

Should any carrier become damaged or otherwise rendered unfit for passenger transportation during normal operations, it shall be clearly and distinctly marked, and not used for passengers until repaired or replaced. It shall be removed or repaired, as soon as feasible.

HAZARDOUS CONDITIONS

When wind or icing conditions are such as might endanger passengers or equipment, all passengers shall be unloaded and lift operation discontinued. Criteria to establish this degree of danger shall be **predetermined** based on the area's operational experience and the manufacturers design considerations. If necessary under the predetermined criteria, device(s) shall be installed at appropriate location(s) to ascertain wind velocity and direction when aerial lifts are operated.

No lift shall be operated when there is an electrical storm in the immediate vicinity.

Should such conditions develop while the lift is in operation, passenger loading should cease immediately and operation continued only as long as necessary to discharge all passengers.

When such a shutdown has been caused by an electrical storm, grounding of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to the resumption of passenger operations.

In the event of an earthquake, STOP THE LIFT. Inspect the terminals, structures, foundations and all towers for damage and for proper alignment. If this inspection reveals no damage and correct tower alignment, the lift may be restarted and passenger transport resumed. If damage is evident and risk to passengers may exist if the lift were operated, the passengers should be evacuated from the lift and the lift closed for repairs.

STARTING THE LIFT

NOTICE

It is the supervisor's responsibility to operate the lift safely and to reduce speed or to cease operations if conditions warrant.

No lift shall be started except by the direction of, or following clearance by the operator. Aerial lifts while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance and emergency operations.

DAILY START-UP PROCEDURES

These drives must not be started until the authorized supervisor or his/her delegated representative has ascertained that the lift is safe and operable.

1. Turn the **Control Power** switch to **ON** and select the desired operating mode, (electrical or evacuation).

2. If the ***electrical*** mode is selected, make sure that the MAIN CIRCUIT BREAKER ON THE SIDE OF THE DRIVE CABINET is in the ***ON*** position. Make sure AUXILIARY COUPLING is **UNCOUPLED**. Select electrical or generator power on transfer switch on side of Generator set. If Generator power is selected start the generator set.

3. If the ***evacuation*** position is selected, Make sure AUXILIARY COUPLING is **COUPLED** and that the auxiliary engine is fueled and ready to run. Turn the throttle on the Evacuation engine to low position and push the reset button and then the down button in the drive cabinet then hand pump the emergency brake until it is at 170 Bars. Start the evacuation engine and turn to full throttle. Stroke the hydraulic pump with the handle on the side of the hydraulic unit and return the cabin to the bottom terminal. ***Do not run the cabin uphill beyond tower 1 using the evacuation drive the operator must remain in visual contact with the cabin at all times when using the evacuation drive.***

4. For electrical operation, preset the speed potentiometer to the desired percent of full speed. (100% = 400 fpm).

5. Push and release either the ***UP*** or ***DOWN*** button.

6. If, after 20 seconds the lift fails to start, check the ANNUNCIATOR and see which faults are displayed: normal stop, remote stop, emergency brake fault, etc. Note that the ***Reset*** button in the drive control cabinet can be used to manually reset faults (excluding brake position faults) without a run command being issued upon safeties OK.

7. Clear the remaining faults, if any. Push and release either the ***UP*** or ***DOWN*** button.

8. With the lift running at its normal speed, initiate normal stops and E-stops at all stations to determine correct operation. Restart the lift and continue to the return station, ensuring that the cabin slows while going over towers and docks smoothly at the top docking station.

9. To SHUT DOWN the lift, dock the cabin at the drive terminal and turn the **Control Power** switch to the **Off** position.

OPERATING PROHIBITIONS

When operating the lift, the following general prohibitions must be respected.

1. Do not load or unload passengers or freight except with the lift fully stopped and the cabin in the docked position.

2. Do not load passengers with loose clothing or equipment, which might catch on the carrier.

3. Do not load passengers unless the loading operator is within reach of the lift controls.

4. Do not operate the lift with more than the designed number of passengers or more than a total of 2240lbs in the carrier.

5. Do not restart or speed up the lift until all stations have been contacted.

6. Do not load passengers who are intoxicated or otherwise incapacitated.

7. Do not load handicapped passengers without making necessary arrangements for their safety while loading, unloading or riding on the lift.

8. Do not operate the lift if lightning is present. Do not load passengers. Unload lift as soon as possible. Verify this by visual and auditory inspection.

9. Do not operate the lift in any winds that cause carrier to swing excessively or to hit guards. Verify this by visual and auditory inspection; wind gauges.

10. Do not operate the lift if the carrier is observed swinging sufficiently to cause contact with guard or tower. Verify this by visual and auditory inspection.

11. Do not operate the lift if carrier is observed bouncing up and down abnormally.

12. Do not operate if the bullwheels are covered with snow or ice. Verify this by visual inspection.

13. Do not operate the lift if icing is apparent on cable, carrier, tower machinery, crossarms, bullwheels, tensioning system or any other critical component which may prevent proper operation or injure passengers.

14. Do not operate the lift for passengers if it requires immediate maintenance. See maintenance requirements in the appropriate sections of this Maintenance Manual.

15. Do not operate lift for passengers or maintenance without the prescribed number of carriers on the line.

16. Do not use Poma tools or equipment (including maintenance tools) on any other make of lift and do not use other manufacturers' tools or equipment on Poma lifts.

17. Do not modify any lift component or design feature without written approval from Poma of America, Inc.

18. Do not operate if there are any abnormal conditions; loose, missing or damaged components; or obstructions to operation. Verify this by visual inspection of the line and the terminal.

19. Do not operate if adequate tension carriage travel is not available or if the tensioning system is not operating freely. Verify this by visual inspection of the tensioning system and compliance with the relevant instructions.

20. Do not operate if the service brake is not working properly. Consult service brake operating and service manual for complete instructions.

21. Do not operate if the emergency brake is not working properly. Consult the emergency brake operating and service manual for complete instructions.

22. Do not operate if the haul rope or track rope reveals any abnormal conditions. Verify this as follows: visually inspect for broken or damaged wires, abnormal tension carriage position or movement, cable twist indicated by the carrier not hanging vertically.

23. Do not operate if any cable slippage is apparent. Verify this as follows: inspect truck location as compared with a paint mark on the haul cable indicating the original truck location.

24. Do not operate if the carrier is loose, damaged or defective. Verify this by visual and auditory inspection.

25. Do not operate if all communication systems are not working properly. Verify this by making test calls.

26. Do not operate if the operator controls are not working properly. Verify this as follows: test all "up", "down" and "stop", controls and any other controls provided at each terminal.

27. Do not operate if any required warning signs are not in place. Verify this by visual inspection.

28. Do not operate the lift if the travel limit stop switches are not in their proper place and functioning properly. Verify this by visual inspection and check operation.

29. Do not operate the lift if the tower safety system is inoperable. Verify this by visual inspection and check operation of each switch at least annually.

30. Do not operate the lift if unusual vibrations or noise are observed. Verify this by visual and auditory inspection.

31. Do not operate the lift if any safety system component is by-passed. Verify this as follows: inspect and test safety systems.

32. Do not operate the lift if any saddle or sheave assembly is misaligned. Visually verify that the cable is in its proper position in the sheave liner.

33. Do not operate the lift if the load meter shows an abnormal load reading during start-up or normal operation or above 100% during operation at maximum capacity. Verify this by visual inspection.

34. After severe icing conditions, heavy snowfalls, severe temperature changes or high winds, do not operate the lift until a visual inspection has been completed of all towers, sheaves, sheave frames, carriers and the cable. After such inspection, do not operate the lift at full speed until a trial run is completed at slow speed to check for abnormal load readings.

WARNING

Failure to follow these instructions could result in an accident causing serious injury or death to persons and serious damage to property, including this lift.

EMERGENCY EVACUATION

Provisions shall be made for the emergency evacuation of aerial lifts. These shall include a detailed plan of evacuation, equipment necessary for evacuation and adequate training of personnel. Evacuation drills shall be conducted at established intervals not to exceed one each 12 calendar months, and such drills recorded in the operational log of each lift.

TERMINATION OF DAILY OPERATIONS

Procedures shall be established and approved by the authority having jurisdiction for terminating daily operations to be sure that passengers will not be left on the lift after it has been shut down. Loading platform, as required, shall be closed and so marked.

OPERATIONAL LOG

A log book shall be maintained for each lift. Daily entries shall be made giving the following minimum information:

1. Date
2. Names and duty stations of operating personnel
3. Operating hours and purpose of operations
4. Temperature, wind and weather conditions
5. Record of compliance with daily operational inspections
6. Position and condition of the tension carriage or other tensioning devices
7. Accidents, malfunctions or abnormal occurrences during operation
8. Signature of operator.

WIRE ROPE LOG

A log book shall be maintained for each lift giving the following information on each rope:

1. Approved specification
2. Copy of certified test report
3. Date installed
4. Splicing certificate for each splice
5. Record of lubrication, including type of lubricant and date applied, if required
6. Record of maintenance inspections
7. Report of wire rope inspection
8. Report of accidents or injury to rope.
9. Documentation of end attachment

MAINTENANCE LOG

A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of components. A record shall be kept of replacement of components.

Section 3

ELECTRIC MOTOR

Maintenance of the Electric Motor

Refer to Manufacturer's Manual.

Manufacturer: GE

Model #: CD328AT

HP: 50

Maintenance Schedule

Frequency	*Maintenance Activity*
DAILY	Check for unusual noises

FOR ALL OTHER MAINTENANCE, REFER TO MANUFACTURER'S MANUAL.

1999

GE Motors

MARCH 3, 1998

Industrial Motors
General Electric Company
3001 East Lake Road, Erie, PA 16531

REFER TO G.E. REQN. NO IN CORRESPONDENCE

...OMER:

ARGO INTERNATIONAL CORP
INDUSTRIAL DIV
5770 LAMAR STREET
ARVADA, CO 80002

CUSTOMER ORDER	CUSTOMER REQN	G.E. CONTRACT	G.E. REQUISITION
2148309			695-17655

☐ FOR APPROVAL XX FOR INSTALLATION ☐ 780129473001

RETURN "FOR APPROVAL" PRINTS TO THE GE OFFICE WITH WHOM YOUR ORDER IS PLACED. ORDER IS ON HOLD UNTIL PRINTS ARE APPROVED. WHEN APPROVED PRINTS ARE RETURNED, LEAD TIMES IN EFFECT WILL APPLY.
Drawings are intended to be in accordance with applicable purchase order specifications. Comments are solicited concerning any departures in this respect. Features not covered by purchase order specifications portray General Electric Company standard design practice. Any requested changes from the purchase order specifications, resulting in additional engineering and/or manufacturing costs will entail an increase in price and the extenstion of the shipping schedule. PRINTS ARE NOT TO SCALE, are loaded subject to return upon demand, and the express condition that they will not be used in any way detrimental to the General Electric Company. "The export of technical information contained in these prints is subject to the rules and regulations of the United States Department of Commerce, Office of Export Control."

ITEM 1 DC MOTOR MODEL 5CD184TA094B027

36A167945AA002 -OUTLINE-
SPLASHPROOF FULLY GUARDED - BALL BEARINGS
CONDUIT BOX ON RIGHT HAND SIDE FACING COMMUTATOR END
STANDARD SHAFT DRIVE END ONLY - WITH FEET
...328AT -DC MACHINE-
HP 50 - RPM 1750/2100 - VOLTS 500 - AMPS 83.7
WOUND SHUNT - DUTY CONTINUOUS
MAXIMUM AMBIENT 40 C - CLASS F INSULATION
NEMA POWER SUPPLY CODE: D -FIELD VOLTS 300/150
WITH:
THERMOSTAT- NORMALLY CLOSED, AC RATING- 600V MAX-.5A, 250V-1.5A, OR 125V-3A, DC RATING- 30V MAX-1.5A.MAXIMUM CURRENT BASED ON INDUCTIVE LOADS UP TO AND INCLUDING NEMA NO.5 CONTACTOR.
36A167771AA001 -ENCLOSURE AND MOUNTING ASSEMBLY.
36A167760CB501 -CONNECTION DIAGRAM REVERSIBLE ROTATION.
GEH3967 -INSTRUCTION BOOK.

4 PRINTS & 1 I/B TO: ARGO INTERNATIONAL CORP
INDUSTRIAL DIV
5770 LAMAR STREET
ARVADA, CO 80002
ATTN: D WILSON

1 PRINT TO: KEVIN MAHONEY, C&ISD, BLDG 4-6, FORT WAYNE OFFICE

...OPY OF M/S TO D J WEED, BLDG 9-3, ERIE WORKS

BY V. LEIGHTON/AS, ERIE WORKS

36A167945AA 001 THRU 003

5	JULY 14 1980	NO S.O.	RETRACING TO DUAL DIMENSIONING
6	AUG 16 1984	NO S.O.	CORRECTED DIM

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
[X.XX] ARE MILLIMETRES

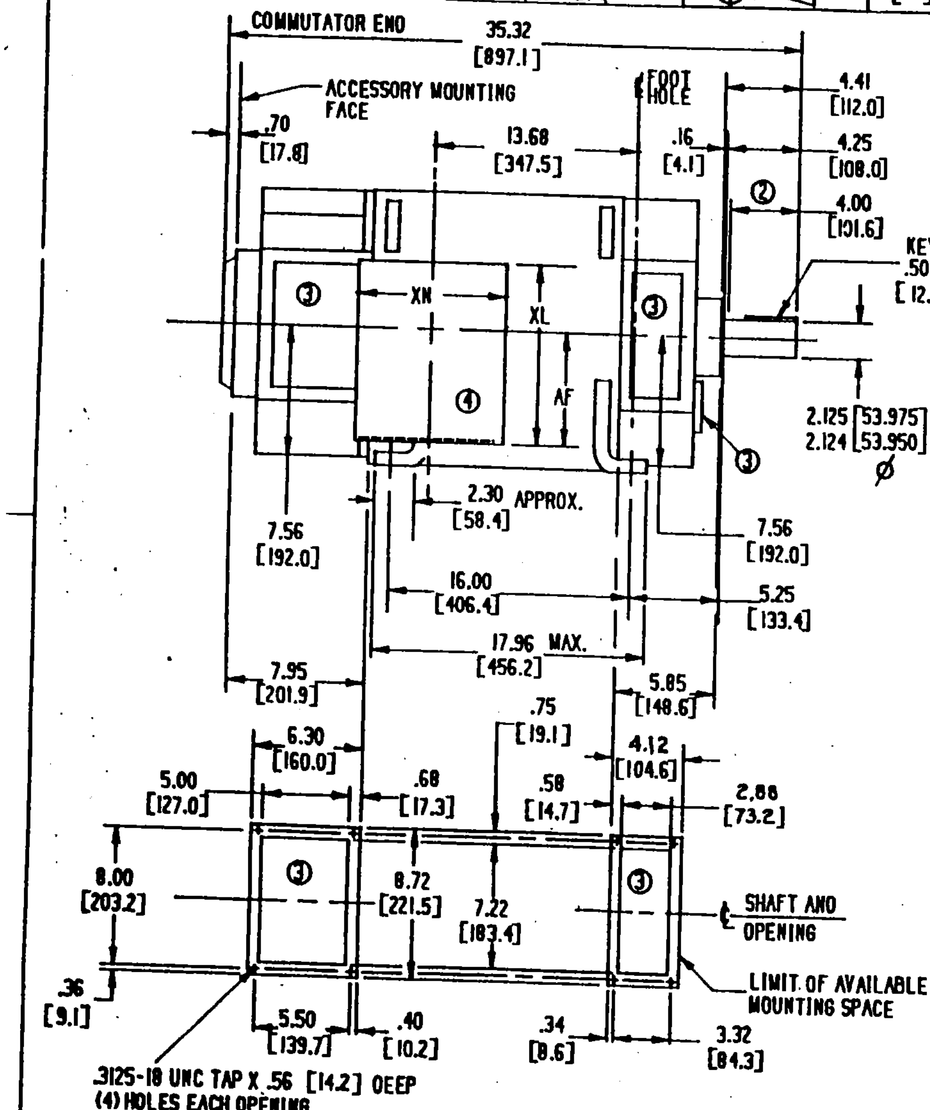
REV 5 6
36A167945AA 001 THRU 003

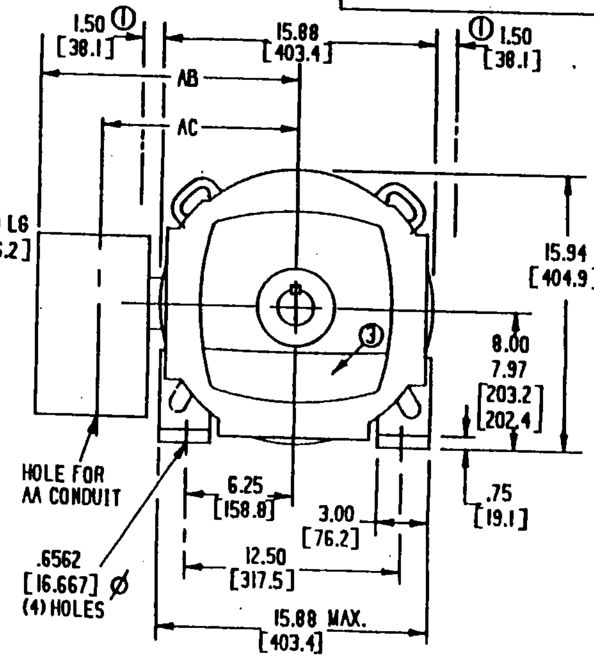
NO S.O. GENERAL ELECTRIC

36A167945AA 001 THRU 003

TITLE
OUTLINE

FIRST MADE FOR CD328AT DE-STD





① SPLASHPROOF FULLY GUARDED MACHINES WILL HAVE ADDITIONAL COVERS INCREASING THE OVERALL WIDTH AT THE COMMUTATOR END AND DRIVE F SIDE AIR OPENINGS.

② REPRESENTS MINIMUM LENGTH OF SHAFT AVAILABLE FOR HUBS.

③ AIR OPENING, FOR ENCLOSURE TYPE AND MOUNTING POSITION,SEE ENCLOSURE AND MOUNTING ASSEMBLY.

④ CONDUIT BOX MAY BE TURNED SO THAT ENTRANCE CAN BE MADE UPWARD, DOWNWARD, FROM COMMUTATOR END OR DRIVE END, PROVIDING MOUNTING CONDITIONS PERMIT. CONDUIT BOX WILL BE ASSEMBLED ON OPPOSITE SIDE OF FRAME IF SO SPECIFIED. (SEE ENCLOSURE AND MOUNTING ASSEMBLY.)

⑤ SHAFT RUNOUT SHALL NOT EXCEED 0.003 INCH [0.076] mm TOTAL INDICATOR READING ON DRIVE END AND COMMUTATOR END.

⑥ COMMUTATOR END BEARING BRACKET AND SHAFT ARE PREPARED FOR ACCESSORY MOUNTING, SEE INSTRUCTION BOOK.

APPROX.NET WT.:767 LBS. [348.22 kg]

PRT NO.	AA	AB	AC	AF	XL	XN
001	2.00	13.44 [341.4]	10.88 [276.4]	4.62 [117.3]	7.38 [187.5]	5.38 [136.7]
002	3.00	15.12 [384]	11.50 [292.1]	6.62 [168.1]	10.50 [266.7]	8.56 [217.4]
003	SEE SUPPLEMENTARY OUTLINE					

PRINTS TO	
	CAD
	4240 · IW
	4911 · IW
	4252 · IW
	1949-91

MADE BY JOHN MAY JUNE-26-1969	FILE 32-18	DIRECT CURRENT MOTOR & GENERATOR DEPT. ERIE	36A167945AA 001 THRU 003
RE CAD [signature] JULY 14,1980			

PLAN. REF. 36A167942AA

DWG.A.36A167945AAR05
PLOT SCL=.1384

ND

GENERAL (GE) ELECTRIC

36A167771AA
001 THRU 006
CONT ON SHEET SH NO.

REV NO. 01

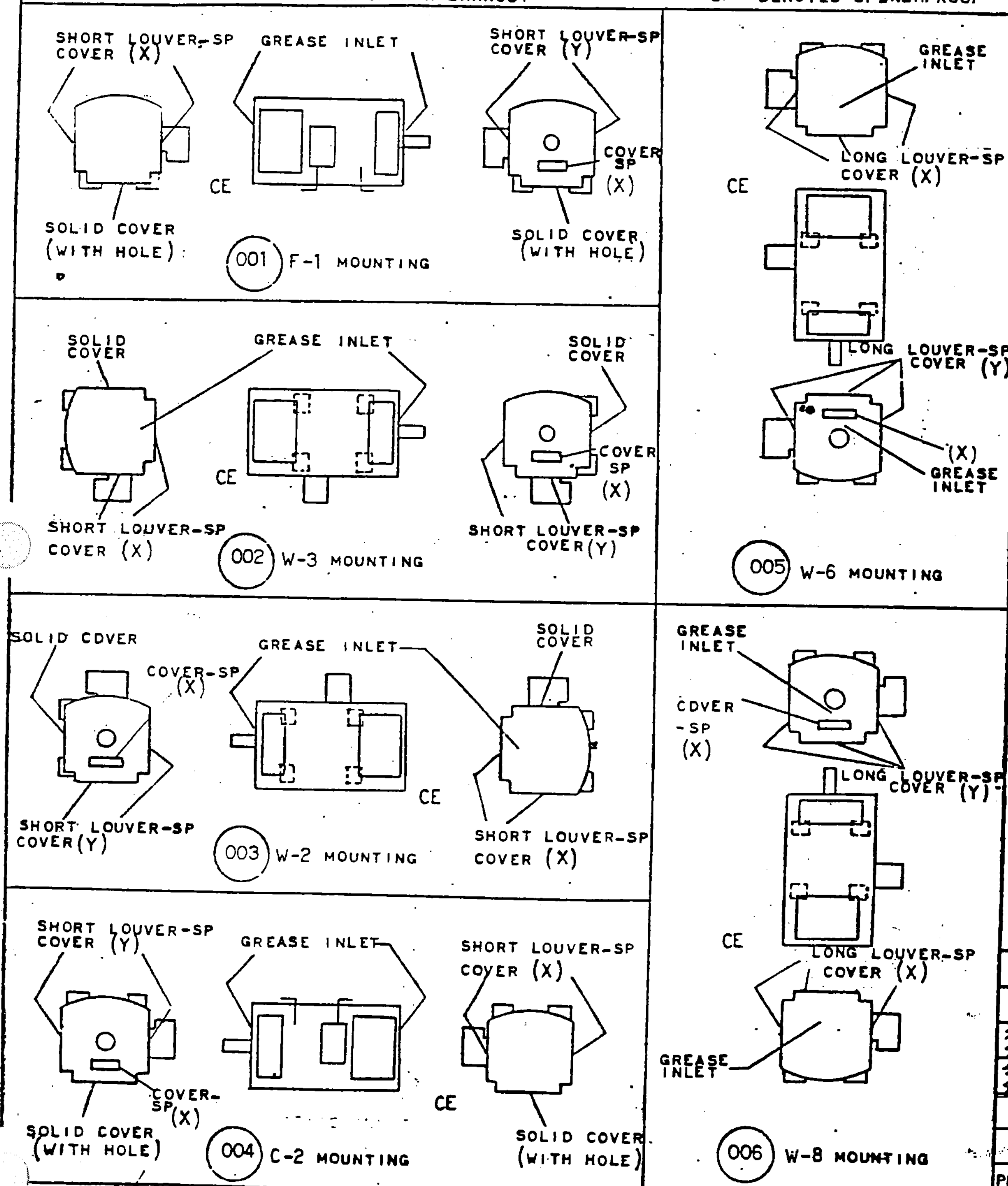
36A167771AA
001 THRU 006
CONT ON SHEET SH NO.

TITLE (ASSEMBLY)
ENCLOSURE AND MOUNTING

CND BOX RH SIDE

FIRST MADE FOR SPLASHPROOF FULLY GUARDED

NOTE - "X" DENOTES LOCATION OF AIR INTAKE
"Y" DENOTES LOCATION OF AIR EXHAUST
"CE" DENOTES COMM END
"SP" DENOTES SPLASHPROOF



REVISIONS
1 MAR 30, 77 REM CON ON DE IN P5

4240 (2BW)
4911 (1BW)
4252-1W 4949-3W
4161-5W 4487-5W
SUM. (1BW)
PRINTS TO

MADE BY Paulus Narabedian May 7 1969
ISSUED Kaulus Narabedian Aug. 22, 1969

APPROVALS FILE KC15-1

DIRECT CURRENT MOTOR & GENERATOR DIV OR DEPT.
ERIE LOCATION

36A167771AA
001 THRU 006
CONT ON SHEET SH NO.

NO S.O. **GENERAL ELECTRIC** 36A167760CB501 CONT ON SHEET SH NO.

REV NO 2

36A167760CB501

CONT ON SHEET SH NO.

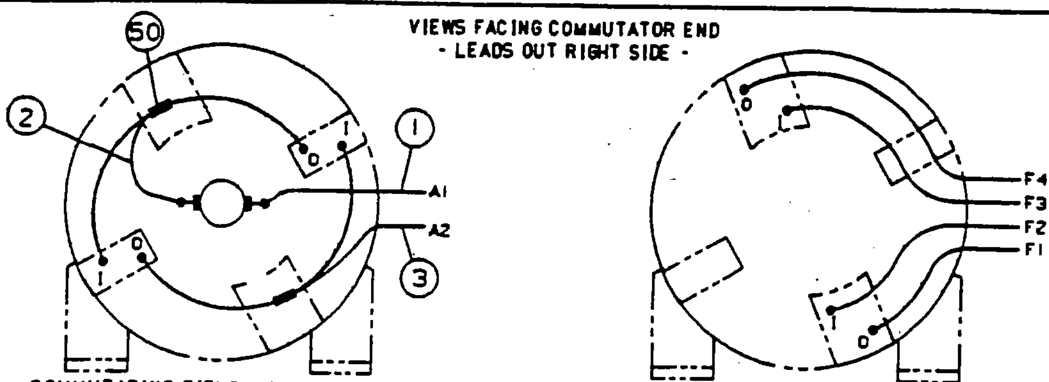
TITLE

CONNECTION DIAGRAM

FIRST MADE FOR 2 POLE

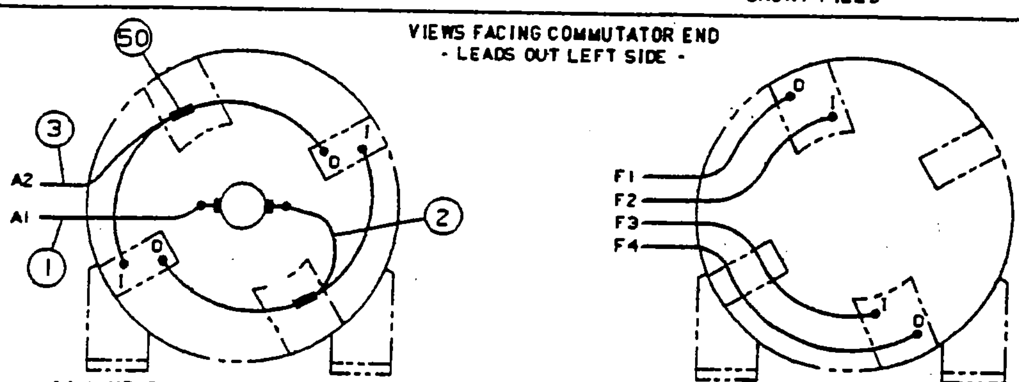
DIRECT CURRENT MOTOR AND GENERATOR - SHUNT WOUND
1 OR 2 CIRCUIT SHUNT FIELD - 2 CIRCUIT COMMUTATING FIELD

VIEWS FACING COMMUTATOR END
- LEADS OUT RIGHT SIDE -



COMMUTATING FIELD AND ARMATURE SHUNT FIELD

VIEWS FACING COMMUTATOR END
- LEADS OUT LEFT SIDE -



COMMUTATING FIELD AND ARMATURE SHUNT FIELD

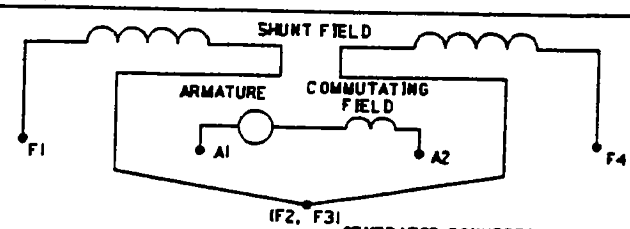
ALL EXTERNAL LEADS ARE MARKED. ALL CONNECTIONS AND TERMINATIONS EXTERNAL TO MAGNET FRAME MUST BE INSULATED PER NATIONAL ELECTRICAL CODE AND SOUND LOCAL PRACTICES.

SPACE HEATERS, WHEN SPECIFIED, WILL HAVE LEADS WITH TERMINAL MARKINGS H1 AND H2.

THERMOSTAT, WHEN SPECIFIED, WILL HAVE LEADS WITH TERMINAL MARKINGS P1 AND P2.

ENCIRCLED NUMBERS MAY BE USED FOR PART IDENTIFICATION.

FOR HIGH NAMEPLATE EXCITATION VOLTAGE CONNECT SHUNT FIELD LEADS AS INDICATED



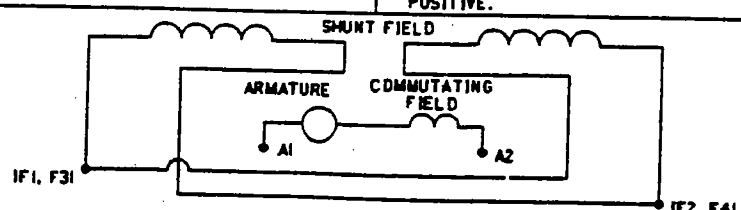
MOTOR CONNECTIONS:

FOR CCW ROTATION FACING COMMUTATOR END, MAKE LEADS F1 AND A1 THE SAME POLARITY.
FOR CW ROTATION FACING COMMUTATOR END, MAKE LEADS F1 AND A2 THE SAME POLARITY.

GENERATOR CONNECTIONS:

FOR CW ROTATION FACING COMMUTATOR END, F1 POSITIVE WILL MAKE A2 POSITIVE.
FOR CCW ROTATION FACING COMMUTATOR END, F1 POSITIVE WILL MAKE A1 POSITIVE.

FOR LOW NAMEPLATE EXCITATION VOLTAGE CONNECT SHUNT FIELD LEADS AS INDICATED



MOTOR CONNECTIONS:

FOR CCW ROTATION FACING COMMUTATOR END, MAKE LEADS (F1,F3) & A1 THE SAME POLARITY.
FOR CW ROTATION FACING COMMUTATOR END, MAKE LEADS (F1,F3) & A2 THE SAME POLARITY.

GENERATOR CONNECTIONS:

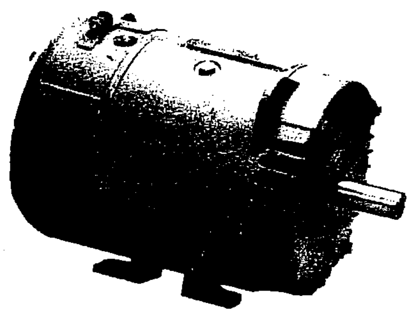
FOR CW ROTATION FACING COMMUTATOR END, (F1,F3) POSITIVE WILL MAKE A2 POSITIVE.
FOR CCW ROTATION FACING COMMUTATOR END, (F1,F3) POSITIVE WILL MAKE A1 POSITIVE.

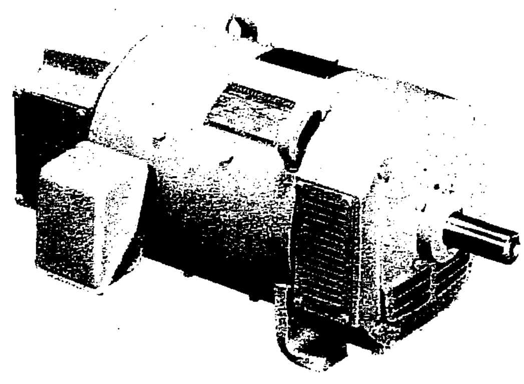
10-11-94 R.D.BOLLA	NO S.O. RETR		QC(1) CAD
MADE BY P.HARABEDIAN 3-19-69	FILE KC13-1	GE MOTORS DIV OR DEPT	36A167760CB501
RE-ISSUED CAD/ R.D.BOLLA 10-11-94		ERIE LOCATION	CONT ON SHEET SH NO.

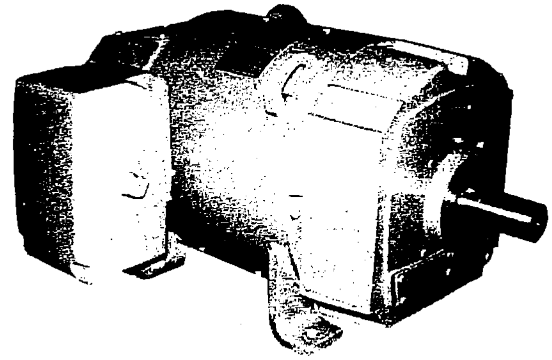
GE Motors

Instructions

Direct-Current Motors and Generators Frames CD180AT to CD500AT







GEH-3967N

SAFETY PRECAUTIONS

WARNING

High voltage and rotating parts can cause serious or fatal injury. The use of electric machinery, like all other utilizations of concentrated power and rotating equipment, can be hazardous. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel, in accordance with applicable provisions of the National Electrical Code and sound local practices.

For equipment covered by this instruction book, it is important to observe safety precautions to protect personnel from possible injury. Among the many considerations, personnel should be instructed to:

- Avoid contact with energized circuits or rotating parts,
- Not by-pass or render inoperative any safeguards or protection devices,
- Avoid extended exposure in close proximity to machinery with high noise levels, and
- Use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment.

Safe maintenance practices with qualified personnel is imperative. Before starting maintenance procedures, be positive that:

- Equipment connected to the shaft will not cause mechanical rotation,
- Main machine windings have been disconnected and secured from all electrical power sources, (lock out drive), and
- All accessory devices associated with the work area have been de-energized.

If high potential insulation test is required, procedures and precautions outlined in NEMA standards MG-1 should be followed.

Failure to properly ground the frame of this machine can cause serious or fatal injury to personnel. Grounding of the machine frame and structure should be in accordance with the National Electrical Code and consistent with sound local practices.

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

CONTENTS

DIRECT CURRENT MOTORS AND GENERATORS FRAMES CD180AT - CD500AT

INTRODUCTION

This instruction book covers the CD180AT-CD500AT line of DC motors and generators.

> **WARNING:** High voltage and rotating parts can cause serious or fatal injury. The use of electric machinery, like all other utilizations of concentrated power and rotating equipment, can be hazardous. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA safety standards for construction and guide for selection, installation, and use of integral HP motors and generators, the National Electrical Code, and sound local practices is recommended.

RECEIVING

The equipment should be placed under adequate cover immediately upon receipt as packing coverings are <u>NOT</u> suitable for out-of-doors or unprotected storage. Standard factory packing methods **do not** allow for stacking of motors.

Each shipment should be carefully examined upon arrival. Any damage should be reported promptly to the carrier and to the nearest office of GE Motors-DM&G. Shipping damage is not covered under the standard warranty. A claim must be filed with the carrier.

Storage

During installation or when in storage, the machine and its parts must be protected from the following:

1. Dirt of all kinds.
2. Wetness and temperature extremes.

Protection from dirt can be achieved by covering the machine with a tarpaulin or polyethylene sheet or keeping it where the surrounding area is clean.

Protection from wetness and temperature extremes includes moisture from the surrounding atmosphere condensing onto cooler machine surfaces. This condensation on machine surfaces can result in rusting or corrosion and the electrical windings may suffer serious damage.

Where wetness and/or cold conditions are present, the machine and its parts must be protected by a safe reliable heating system which, at all times, will keep the machine temperature slightly above that of the surrounding atmosphere. If a space heater is included in the machine, it should be energized per the voltage specified on the motor nameplate.

Smaller machines shipped in paper cartons are protected from condensing-type wetness by the insulating characteristics of the carton. To avoid sweating where these have been exposed to low temperatures for an extended period, **<u>allow a few hours for the machine and carton to attain room temperature before unpacking.</u>**

Brushes should not remain in contact with the commutator during prolonged storage, because corrosion may occur and later result in flat spots on the commutator. Release the brush springs and lift the brushes, when prolonged storage occurs.

All exposed machined-steel parts are slushed with a rust preventive before shipment. These surfaces should be examined carefully for signs of rust and moisture, and reslushed if necessary. Once started, rust will continue if the surface is reslushed without first removing all rust and moisture. Rust may be removed by carefully using fine abrasive paper. Slushing compound can be removed by using a suitable solvent such as mineral spirits.

> **CAUTION:** Many motors are shipped with drive end grounding brushes. These brushes and the surfaces they ride on must be free of any slushing compound before operation.

WARNING: Mineral spirits are flammable and moderately toxic. The usual precautions for handling chemicals of this type must be observed. These include:

1. Avoid excessive contact with skin.
2. Use in well-ventilated areas.
3. Take necessary precautions to prevent fire or explosion hazards.

Extreme care must be exercised in removing rust on shaft extensions near shaft seals, since it is difficult, and sometimes impossible, to remove rust from these surfaces without damaging or deforming them.

Burrs or bumps on other machined surfaces should be carefully removed by using a fine file or scraper.

Machines in storage should be inspected, have the insulation resistance checked at frequent and regular intervals, and a log kept of pertinent data.

CAUTION: When stored, it is suggested that the armature be rotated a few revolutions every three months to prevent loss of grease protection on the bearings and races. Loss of grease or oil protection may cause rust.

Long Term Storage Considerations

1. Provide blocks, such as railroad ties, to store the machine off the ground. This will minimize moisture pickup from the ground and make inspections easier to accomplish. Be sure there is sufficient drainage.
2. Megger the unit before storing and record the values every three months. If the megger reading indicates a decreasing insulation resistance, move the machine to a drier location.
3. Wrap Mylar around the commutator and tape it to itself. Do not tape the Mylar to the commutator.
4. Rotate the armature every three months to prevent loss of grease protection on the bearings and races. Loss of grease protection causes rust. <u>Note:</u> **Rotate the armature in the direction which will not snag the Mylar wrapping on the commutator.**

TABLE 1

APPROXIMATE NET WEIGHTS*

FRAME SIZE	ARMATURE WEIGHT lbs.	ARMATURE WEIGHT kgs.	MOTOR WEIGHT lbs.	MOTOR WEIGHT kgs.
CDL182AT	17	8	80	36
CD186AT	25	11	102	46
CDL186AT	35	16	128	58
CD189AT	45	20	162	74
CD218AT	50	23	240	106
CD219AT	56	25	250	114
CD2110AT	63	29	280	127
CD258AT	78	35	360	164
CD259AT	89	40	400	183
CD287AT	113	51	500	225
CD288AT	130	59	550	250
CD289AT	175	80	660	300
CD2811AT	210	95	790	360
CD327AT	158	72	690	315
CD328AT	181	82	770	350
CD365AT	220	100	750	340
CD366AT	260	120	860	390
CD368AT	300	140	1020	465
CD3610AT	400	130	1310	595
CD3612AT	530	240	1650	750
CD407AT	400	180	1300	590
CDL407AT	400	180	1350	610
CD409AT	500	225	1600	725
CDL409AT	500	225	1650	750
CD4012AT	780	350	3210	1460
CD504AT	590	265	1900	860
CDL504AT	590	265	2070	940
CD506AT	720	330	2290	1040
CDL506AT	720	330	2440	1110
CD508AT	890	405	2810	1275
CDL508AT	890	405	2970	1350
CD5010AT	1200	545	4260	1935

*Approximate weights for typical motors in each frame size. Does not include weights of accessories such as tachometers, blowers, heat exchangers, etc. For specific weights, refer to certified outline.

Handling

Complete motors or generators can be lifted by using hooks or slings in the lifting lugs on top of the unit. The lifting lugs are designed to safely carry the weight of the individual machine. <u>**Do not lift the machine with the shaft extensions**</u>.

WARNING: Motor-generator sets or units with heavy attachments such as gear boxes or pumps must NOT be lifted by using the lifting lugs of the individual machines.

Motor-generator set bases have lifting holes to be used with spreader bars or hooks. Care must be taken in handling to avoid twisting bases. (Refer to **Table 1** for approximate weights of armatures and motors.)

INSTALLATION

Installation should be in accordance with the National Electrical Code and consistent with all local codes. Coupling, belt, and chain guards should be installed as needed to protect against accidental contact with moving parts. Machines accessible to the public should be further guarded by screens, guard rails, etc., to prevent personnel from coming into contact with the equipment. Fully guarded covers are supplied on motors and generators. Shaft guards are supplied on MG sets.

Totally enclosed and waterproof motors must have all covers securely in place with gaskets intact in order to exclude dirt, oil, and water. It is generally preferred to remove plugs from drain holes at the bottom of the frame to insure that condensation does not collect inside the motor. However, if the installation requires plugs to be installed, they must be removed periodically to make certain that all water is eliminated.

Location/Ventilation

WARNING: The use of electrical equipment in hazardous locations is restricted by the National Electrical Code, Article 500. Original equipment manufacturers and user customers must read, understand, and apply these rules for installation and use of all equipment in such locations and consult local code inspection and enforcement agencies as necessary to insure compliance. Motors listed by Underwriters Laboratories, Inc. for use in specific locations have been designed, tested, and approved for use in such locations only.

Sections 501-8 and 502-8 now permit the use of totally enclosed motors with positive pressure ventilation or totally enclosed inert-gas-filled motors (Class I locations only) when installation and operation conform to certain requirements.

Motors for Class I locations must have leads sealed at the frame exit and an explosion proof conduit box. (Refer to **Sections 501-4 and 501-5.**)

Motors for Class II locations must have leads sealed at the frame exit and a dust-ignition-proof conduit box. (Refer to **Sections 502-4 and 502-5.**)

CAUTION: Silicone vapor may be present and originate from sealing compounds, electrical cables, and room transformers. These sources must be eliminated. Silicone vapor interferes with commutation and high brush wear may result.

Motors and generators should be installed so that they are readily accessible for routine inspection and maintenance. They are suitable for use in ambient temperatures from 0°C (32°F) to 40°C (104°F). An adequate supply of clean, dry room air (at temperatures from 0°C to 40°C) is required for self-ventilated and blown motors. Where motors must operate in dirty, wet, or contaminated environments, protection in the form of filters or totally enclosed construction must be used to insure long life with normal maintenance.

Do not obstruct ventilating openings.

When filters are supplied, service them regularly. Dirty filters shut off ventilating air.

Beware of recirculation. Install motors so that hot exhaust air will not re-enter the motor.

Protection

CAUTION: Windings, commutator, brush rigging, and bearings should be carefully protected during installation to avoid damage from paint spray, weld splatter, welding rod butts, or metal chips from files and grinders. Metal particals which lodge in windings can cause either immediate or premature failures. Paint or oil on commutators can be very detrimental to good commutation.

Mounting

Motors and generators should be mounted on rigid and solid foundations. Level the base (or the machine). Hold-down bolts should be inspected regularly and kept tight. The feet of the machine may be doweled to the foundation plates or base when alignment procedures are completed. Sliding bases, when used, should be securely anchored to the foundation.

Motors are suitable for mounting as ordered. Special assembly of the conduit box, endshields, and covers is provided when the motor is so ordered. Do not rotate commutator-end endshield with respect to the frame, since brush position is affected. (Refer any questions regarding the allowable mounting orientations for your motor to GE Motors-DM&G.)

Alignment

> **CAUTION:** Be sure to align or check alignment carefully on either motors or MG sets. Misalignment can cause excessive vibration, damaging forces on shafts and bearings, and rapid brush wear. Time taken to assure good alignment will be returned in reduced downtime.

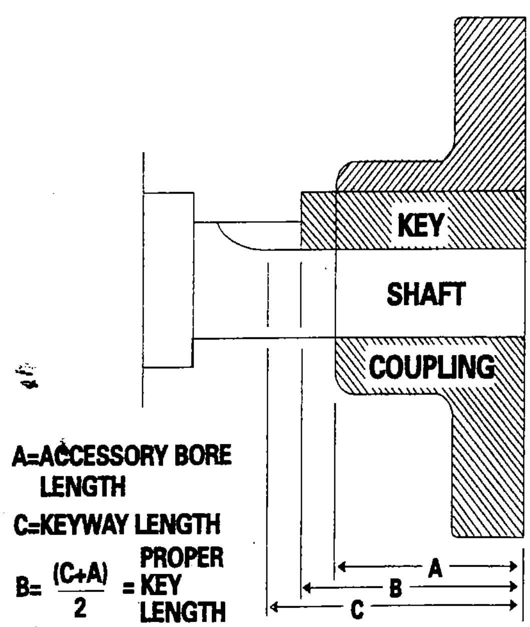


Fig. 1 **Selecting the Proper Key Length**

Coupled Drive

When a motor and a driven unit together have four or more bearings, flexible couplings must be used to facilitate alignment. Three-bearing construction requires a rigid coupling.

> **CAUTION:** Careful alignment of machines when using either solid (rigid) or flexible couplings is essential to prevent excessive vibration, hot bearings, or shaft failures.

Motors are balanced in the factory using a half-height key of full length. To preserve the original dynamic balance of the motor, select the coupling hub key length "B" according to the formula in **Fig. 1.**

V-Belt Drives

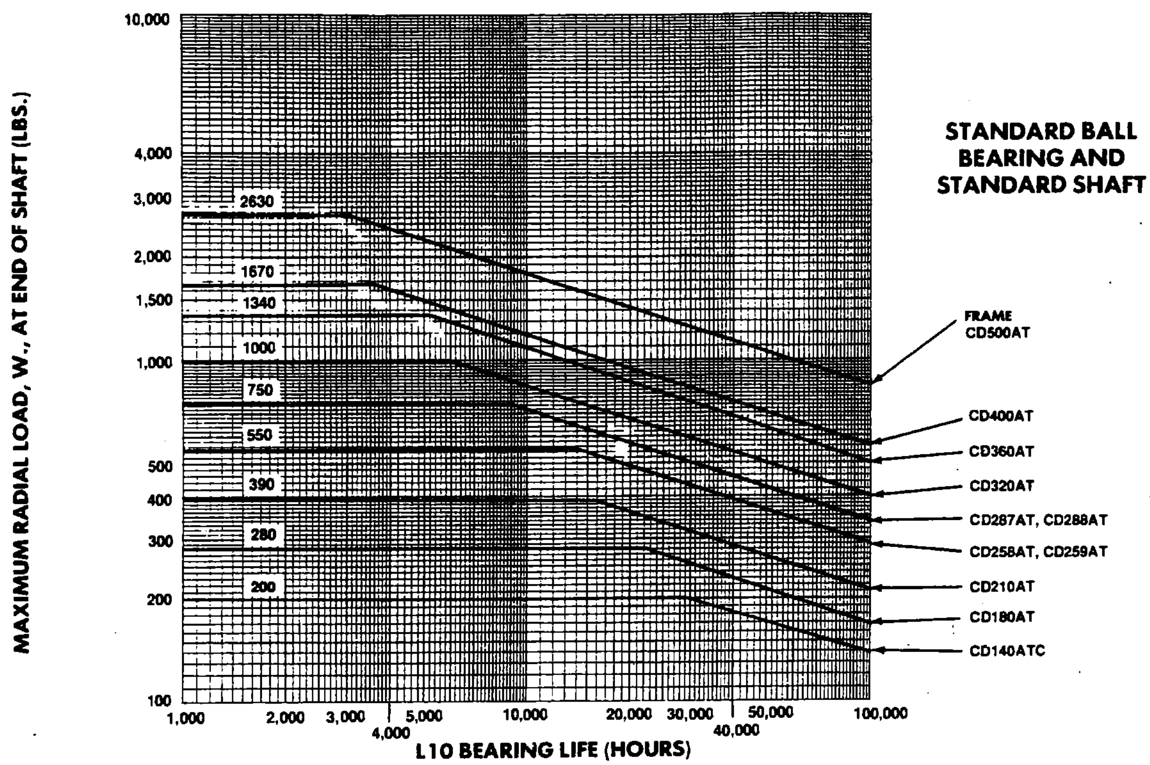
The V-belt system produces a heavy shaft and bearing loading, making it necessary that these factors be considered carefully for proper application. Since belt drives impose a bending moment on the motor shaft, it is always desirable to have the motor sheave located as close to the motor bearing as possible to minimize both bearing load and shaft stress. This will result in increased bearing life. For the load centered 2" in toward the bearing from the end of the shaft instead of at the end of the shaft, the bearing load is reduced by 10% and the life increased by 33%. The bearing life curves which follow assume that the load is centered at the end of the shaft. New improved V-belts are now on the market that significantly reduce the number and size of belts required for a given load. These new belts should always be considered, since the sheave will be shorter and the load centered closer to the bearing.

It should also be noted that the radial load on the motor bearing is directly proportional to the diameter of the sheave. A larger diameter sheave means less radial load on the shaft.

The standard NEMA shaft extension is designed for belted loads. Dimensions are provided on the standard dimension sheets. A sliding base is available as an accessory to facilitate belt adjustment.

Bearing Life

Bearing life for belted drives is determined by calculating the radial load at the end of the shaft.



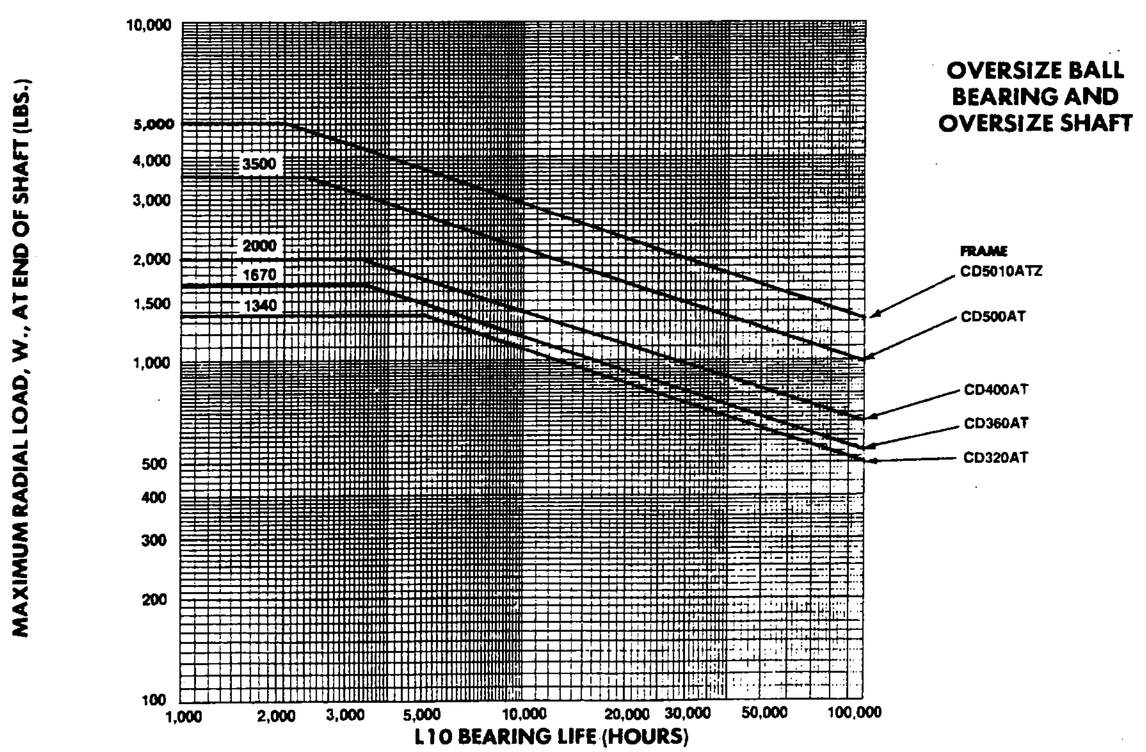
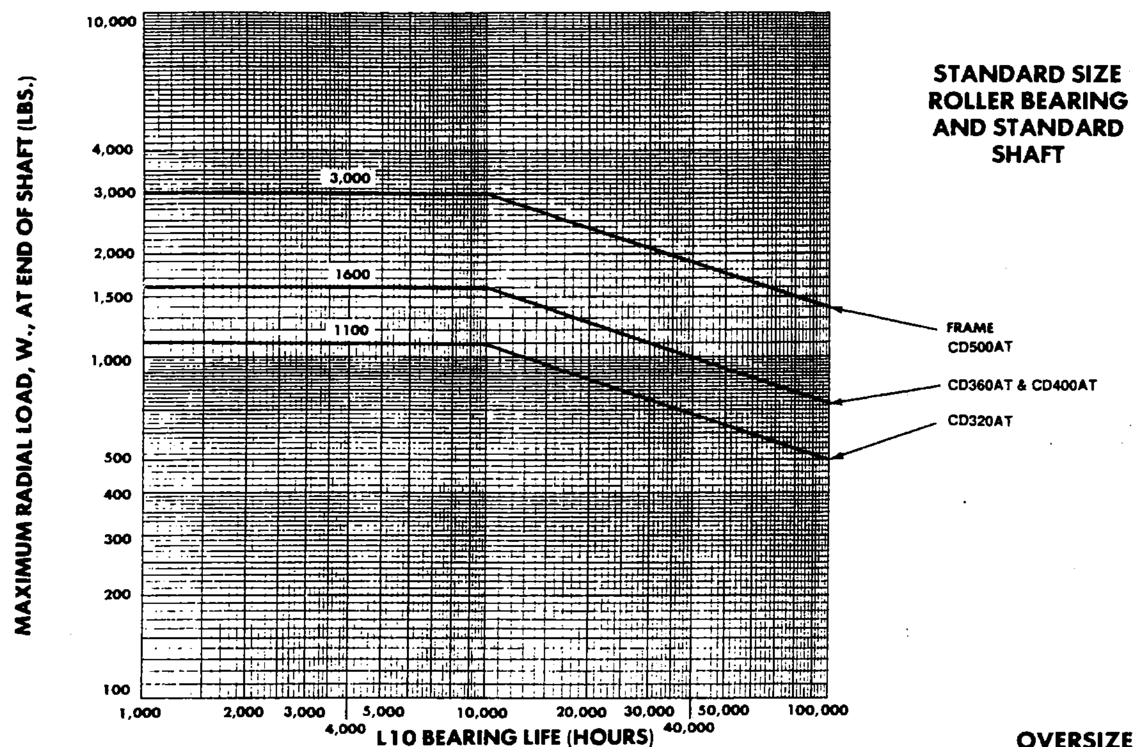


Fig. 2A Bearing Life at 1750 RPM Average Speed vs. Load, W
(For other Average Speeds, multiply Life by 1750/average speed.)



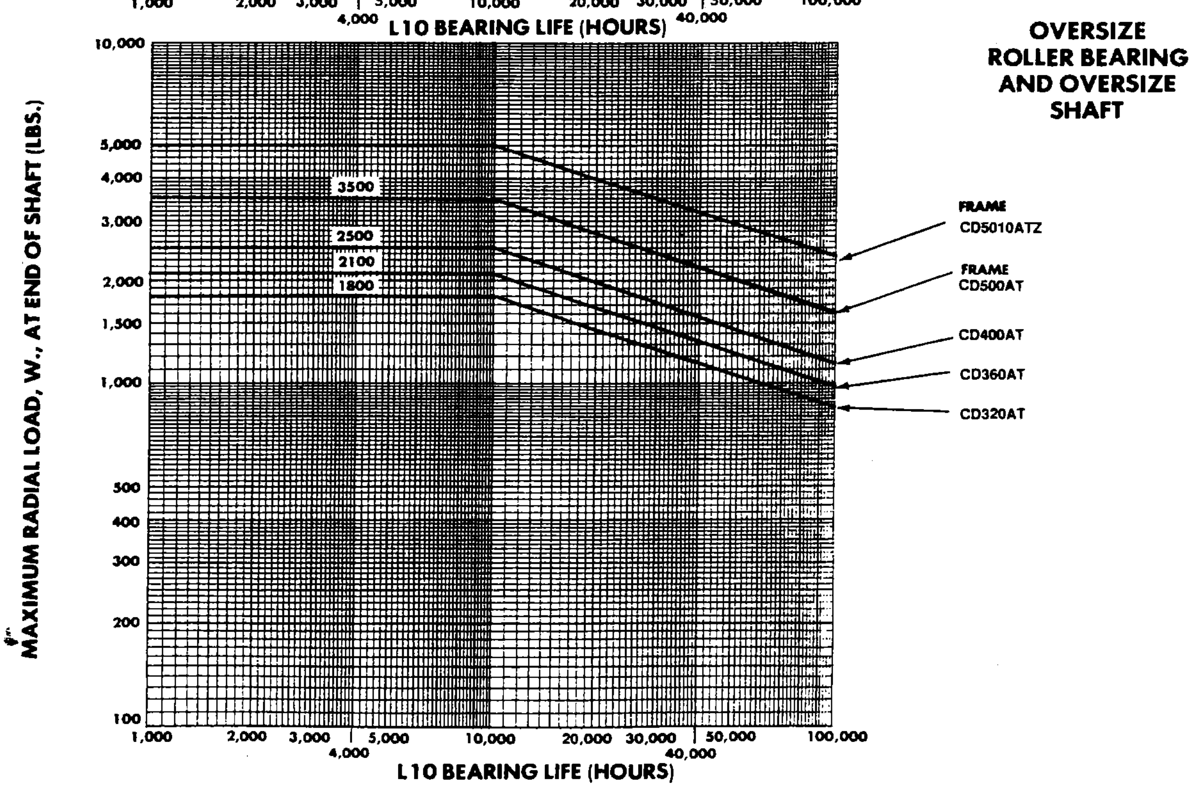


Fig. 2B Bearing Life at 1750 RPM Average Speed vs. Load, W
(For other Average Speeds, multiply Life by 1750/average speed.)

TABLE 2 BELT TENSION FACTORS	
1.0	Chain and Sprocket Drive
1.2	Timing Belt
1.5	V-Belt, 1:1 Ration
1.8	V-Belt, 2:1 Speed Decreased Ratio
2.0	Flat Belts

The radial load, "W", produced by the belts, when tightened just enough to transmit the load without slipping, is given by the relation:

$$W = \frac{126{,}000 \times HP}{D \times RPM} \times K_b \text{ lbs}$$

Where:

D = Sheave pitch diameter in inches for V-belt applications.

$\frac{HP}{RPM}$ = Maximum ratio of horsepower, **including overloads**, to the minimum speed at which that power occurs.

K_b = Belt tension factor from **Table 2**.

The curves in **Fig. 2** can be used to determine the anticipated L10 life, which is the life in hours that 90% of bearings with this load would be expected to exceed without failure. The standard ball bearing and standard shaft option will be the most economical, if acceptable life is obtained from the curve. A good, commonly used design figure is 20,000 hours. However, calculated life of as low as 5,000 hours has sometimes been necessary for special applications. The curves are drawn for 1750 RPM average speed. If the application has some other average speed, the life can be adjusted by multiplying by the 1750/average speed.

It is important to know that the bearing life for V-belt applications is independent of the motor load. Once the belts have been tightened just enough to prevent slipping when the maximum torque is being delivered by the motor, the radial load, "W", on the shaft and bearing is there and remains constant regardless of the motor load. For timing belts and chain drives, the radial load, "W", does vary somewhat with motor load, and so the motor load duty cycle, as well as the average speed should be considered to estimate bearing life.

For special applications belt tension should be checked and adjusted following the belt manufacturer's recommendations.

If slippage occurs after the belt tension has been correctly adjusted, the belts and pulleys have not been chosen properly for the application.

CAUTION: Over-tightening to avoid this slippage may result in early failures of belts, shafts, and bearings.

There is normally a drop in tension during the first 24 to 48 hours of operation. During this "run-in" period, the belts seat themselves in the sheave grooves and initial stretch is removed. Belt tension should be re-checked after a day or two of operation.

Matched belts run smoother, and last longer. Longer belt life results, if the belts and sheaves are kept clean and the belts are prevented from rubbing against the belt guards or other obstructions.

Mounting may be either horizontal or vertical for these bearing life determinations, as long as no axial load other than the weight of the armature is present if vertical.

Special Load Considerations

Where the load is overhung beyond the motor shaft extension or greater bearing life is desired, the application should be referred to GE Motors-DM&G.

Thrust Loads

Due to the mounting position or type of drive arrangement, a thrust load may be applied to the motor shaft. The Kinamatic motor is designed to permit a limited amount of thrust load. This permissible load will vary by mounting position and direction of the load due to the weight of the armature. The permissible load is tabulated in **Table 3** by frame diameter and mounting position. These apply to standard size ball bearings only.

For vertical mounting, the data is tabulated with a plus or minus constant. If the force of the load is acting up (against gravity), then the constant should be plus. If the load is acting down (with gravity), then the constant should be minus.

For applications combining thrust and radial loads or where thrust loads exceed the values shown in the table, refer all details to GE Motors-DM&G.

TABLE 3

THRUST CAPACITY IN POUNDS

	HORIZONTAL MOUNTING				VERTICAL MOUNTING			
	RPM				RPM			
FRAME	2500	1750	1150	850	2500	1750	1150	850
CD180AT	145	172	210	240	150±17	175±17	214±17	240±17
CD210AT	190	220	270	310	200±64	240±64	285±64	330±64
CD250AT	225	265	325	370	250±93	285±93	345±93	390±93
CD280AT	300	355	430	490	330±135	380±135	460±135	525±135
CD320AT	355	410	500	580	390±190	460±190	545±190	620±335
CD360AT	630	740	880	1040	700±335	820±335	970±335	1110±335
CD400AT	580	690	840	970	700±526	820±526	970±526	1110±526
CD500AT	890	1050	1310	1510	------------- REFER TO GE MOTORS-DM&G -------------			

Motor-Generator Sets

MG sets are properly aligned before shipment. Check the alignment before operating a set to be sure that shipping, handling, and installation have not misaligned the units. (Refer to the **Alignment Procedure** section of this Instruction Book.)

Two types of MG set bases are used. One is called "non-self-supporting" and, as the name implies, is not rigid. The non-self-supporting base is designed to act only as a spacer between the foundation and the units of the MG set and must not be trusted to carry any weight unless well supported at all of the mounting pads on its underside. This type of base should be securely bolted to the foundation and, if convenient, grouted in after alignment. Grouting tends to make the base more solid and less liable to later vibration troubles. Be careful not to distort the base during handling or the ability to properly align the MG set will be destroyed.

The other type of base is called "self-supporting" and usually has three pads on its underside forming a three-point support. A self-supporting base is rigid enough so that it needs support only at the pads. The entire weight of the MG set is supported on just these three points and the foundation must be designed to take these high loads.

Two kinds of couplings are used to connect units of MG sets. Some MG sets will be made up of two-bearing units coupled together with flexible couplings. Others will use single-bearing generators connected with rigid (solid) couplings. With each kind of coupling and each kind of base design, a slightly different alignment procedure is required. (Refer to the **Alignment Procedure** section of this Instruction Book.)

Grouting

On concrete foundations, a minimum of 1" should be allowed for grouting.

A rich, non-shrink grout should be used. High-grade grout mixtures are available commercially. If the grout is to be prepared at the site, a cement-sand ratio of 1:2 is recommended. Only enough water should be used to give a stiff mixture. The clean, but rough surface of the foundations should be wet and the grout forced or puddled under the base.

Alignment Procedure

> **CAUTION: Alignment specifications supplied with couplings are for suitable coupling life. These numbers usually greatly exceed alignment criteria for good bearing life and minimal vibration.**

Flexible Coupling

Before grouting the base, the alignment should be checked as follows:

1. Slide the sleeve from the coupling so that the hub faces are exposed.

2. Check that the coupling hub spacing is in accordance with the outline dimensions with the units in the mechanical center of their end play.

3. Start with the coupling next to the largest unit (usually the motor) or near the middle of a long set. Check the radial alignment by using a straightedge across the hubs at both vertical and horizontal locations or by clamping a dial indicator to one hub and indicating the other hub on its outside diameter. Be sure that the dial indicator supports do not bend or sag, since this will give inaccurate readings.

4. Use a dial indicator at hub faces and rotate both units together 90°, 180°, 270°, and 360°; or measure the gap at each position by inserting a feeler gauge. The reading should not vary more than 0.002 ".

5. Correct any misalignment by shimming between the base and the foundation. If shimming between the base and foundation will not correct misalignment, the unit has moved during shipment and should be shifted on the base.

6. Repeat Steps #2, 3, and 4 on each coupling, working away from the motor or center unit.

7. Recheck the couplings on long sets after completing the above checks, because shimming on subsequent units may affect those already checked. After the set has been aligned within the specified limits, the coupling shells may be bolted together.

The generators may then be doweled, if desired.

Solid Flanged Couplings

Before grouting the base, the alignment should be checked as follows:

1. Loosen all coupling bolts enough to assure that the bolts are not holding the couplings together.

2. Start with the coupling next to the largest unit (usually the motor) or near the middle of a long set, tap the coupling flange with a rawhide or similar non-metallic mallet until the coupling halves separate 0.005" to 0.010".

3. Measure the distance between the coupling faces at four points spaced 90° apart around the coupling rim with a feeler gauge; measuring to the nearest 0.001". The maximum variation between any two readings should not exceed 0.002".

4. Rotate the coupling 90°, 180°, 270°, and 360° and take similar readings. The maximum variation should not exceed 0.002".

5. Correct any misalignment by shimming between the base and the foundation. If shimming between the base and the foundation does not correct misalignment, the unit has moved during shipment and should be shifted on the base.

6. Repeat Steps #2, 3, and 4 on each coupling, working away from the motor or center unit.

7. Recheck the couplings on long sets after completing the above checks, because shimming on subsequent units may affect those already checked. After the set has been aligned within the specified limits, tighten the coupling bolts.

The generators may then be doweled, if desired.

CAUTION: Do not draw the two coupling halves together unless the variation in measurements is 0.002" or less. If there is a variation greater than 0.002", excessive vibration and possible shaft fatigue can occur.

OPERATION

WARNING: Disconnect power before touching any internal part. High voltage may be present even when the machine is not rotating. If used with a rectified power supply, disconnect all AC line connections to power supply. With other power supplies, disconnect all DC line and field connections. Also disconnect power from auxiliary devices.

WARNING: Ground the machine properly to avoid serious injury to personnel. Grounding must be in accordance with the National Electrical Code and consistent with sound local practices. One of the bolts holding the conduit box to the unit, accessible from inside the conduit box, is identified and may be used for attaching a grounding cable.

> **WARNING:** Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off.

Inspection Before Starting

These inspection procedures should be followed before starting the machine for the first time, after an extended shutdown, or after a teardown for extensive maintenance or repair.

Bearings and Couplings

Machines with ball or roller bearings are greased at the factory and will need no attention until relubrication is necessary as suggested under the **Maintenance** section. (Refer to **Table 11**).

Flexible couplings should be checked to see that they contain the proper amount of lubricant.

Make sure that all grease plugs are tight.

The oil suspended in grease may leak out after extended periods of motor storage. Because of this, it is not unusual to find puddles of oil below the bearings. If the motor has been stored for over six months, the grease drains should be checked to see they are not plugged with a waxy residue. After ensuring the openings are clear and free, a small amount of grease should be pumped through.

Commutator and Brushes

Brushes should be worn in to have at least 85% contact over the brush surface and continuous contact from heel to toe. The commutator surface and undercut mica should be clean and free from dirt, grease, paint spots, or brush dust.

Brushes should be free to move in the holders and all springs should be down and latched. Brush pigtail connections should be tight, and the pigtails should not interfere with the action of the spring or brush and should be clear of any other part of the machine.

Rectified Power Supplies

When DC motors are operated from rectified power supplies, the pulsating voltage and current wave forms effect the motor performance by increasing motor heating and degrading commutation. Because of these effects, it is necessary that the motors be designed or specially selected to suit this type of operation.

The ratings of DC motors intended for operation from rectified power supplies are based upon motor tests using a suitable power supply. The specific characteristics for three-phase rectified power supplies described below in the **Power Supply Identification** section are in common use. For operation of motors from rectified power supplies other than those given in this section, refer to GE Motors-DM&G.

A motor may, under some conditions, be operated from a power supply different from that indicated on the nameplate. Letters used to identify power supplies in common use have been chosen in alphabetical order of increasing magnitude of ripple current. Power supply compatibility can be judged by **Table 4**.

TABLE 4

POWER SUPPLY AVAILABLE

NP RATING CODE	A	C	D	E	K
A	✔	*	*	*	*
C	✔	✔	*	*	*
D	✔	✔	✔	*	*
E	✔	✔	✔	✔	*
K	✔	✔	✔	✔	✔

✔ Compatible Power Supply

* External inductance may be necessary to limit ripple current

Power Supply Identification

The nameplates of DC motors intended for operation from rectified power supplies will be stamped with a Power Supply Identification as described below:

A. When the power supply used as the basis of rating is one of the four described below, a single letter "C", "D", "E", or "K" will be used to identify it on the nameplate.

Power Supply Identification Letter "C"

This designates a three-phase, 60 hertz input, full-wave power supply having 6 total (controlled) pulses per cycle. The power supply has no free wheeling and no series inductance added externally to the motor armature circuit inductance. The input line-to-line AC voltage to the rectifier shall be 230 volts for 240 volt DC motor ratings, and 460 volts for 500 or 550 volt DC motor ratings.

Power Supply Identification Letter "D"

This designates a three-phase, 60 hertz input, semi-bridge power supply having 3 controlled pulses per cycle. The supply has free wheeling with no series inductance added externally to the motor armature circuit. The input line-to-line AC voltage to the rectifier shall be 230 volts for 240 volt DC motor ratings and 460 volts for 500 or 550 volt DC motor ratings.

Power Supply Identification Letter "E"

This designates a three-phase, single-way (half-wave) power supply having 3 total pulses per cycle and 3 controlled pulses per cycle. The power supply has no free wheeling and no series inductance added externally to the motor armature circuit inductance. The input line-to-line AC voltage to the rectifier shall be 460 volts for 240 volt DC motor ratings.

Power Supply Identification Letter "K"

This designates a single-phase, full-wave power supply having 2 total (controlled) pulses per cycle with free wheeling 60 hertz input with no series inductance added externally to the motor armature circuit. The input AC voltage to the rectifier shall be 230 volts for 180 volt DC ratings.

B. When intended for use on a power supply other than "C", "D", "E", or "K", the motor will be identified as follows:

M/N F — V — H — L

Where:

M = a digit indicating total pulses per cycle.

N = a digit indicating controlled pulses per cycle.

F = free wheeling (this letter appears only if free wheeling is used).

V = 3 digits indicating nominal line-to-line AC voltage to the rectifier.

H = 2 digits indicating input frequency in hertz.

L = 1, 2, or 3 digits indicating the series inductance in millihenries (may be zero) to be added externally to the motor armature circuit inductance.

Connections

Terminal connections should be checked against the connection diagram shipped with the machine. Bolted connections must be tight. When fixed termination (terminal boards) is not specified, then the exposed connections should be appropriately insulated. Grounding screws or studs do not need to be insulated. When more than one terminal is marked with the same identification, they <u>should be</u> joined in the same connection. (Refer to Table 5 for identification of winding leads.)

When series leads are not being used (example: a stabilized shunt or a compound wound unit being used as a straight shunt), the lead should be individually insulated. Do <u>not</u> connect together.

TABLE 5

LEAD MARKERS

FUNCTION	WINDING
Armature	A1, A2, A3, A4, etc.
Control signal lead attached to commutating winding - one lead only.	C
More than one signal lead	C1, C2, C3, C4, etc.
Field (shunt)	F1, F2, F3, F4, etc.
Field (series)	S1, S2, S3, S4, etc.
ACCESSORIES & SPECIAL DEVICE MARKINGS	
Blower Motors, Type AN tachometer generator	T1, T2, T3, T4, etc.
Tachometer generator, direct current, to terminal board	A1, A2, A3, A4, etc.
Brake coil leads	B1, B2, B3, B4, etc.
Heater, brake space heater	BH1, BH2, BH3, BH4, etc.
Brake interlock switch	BS1, BS2, BS3, BS4, etc.
Heater, space heater in the machine	H1, H2, H3, H4, etc.
Thermostat	P1, P2, P3, P4, etc.
Resistance Temperature Detector (RTD)	R1, R2, R3, R4, etc.

Protective Devices

See that all protective devices (overspeed devices, bearing temperature relays, etc.) are connected and will function properly. Be sure all coupling guards, shaft protectors, grounding connectors, covers, and other safety devices are properly attached.

CAUTION: Motor Field Heating - Unless specifically ordered, motors are **NOT** capable of continuous standstill excitation at rated field current. When the motor is shut down for more than 30 minutes, one of the following options must be used:

1. De-energize the fields completely.
2. Use field economy relays to limit the field current to a maximum of 50% of the nameplate rating.
3. When applicable, fields may remain fully energized if the motor ventilation system (blower or customer duct) remains in operation.

Thermostats

The thermostat is a device that may be used in alarm or protective relay circuits within rating limits shown in **Table 6**. It is not intended to limit motor loading or provide normal insulation life. When supplied, it is mounted in contact with a commutating coil which is the only accessible part of the armature circuit. Since factors such as shaft speed, ventilation (blower or shaft fan), current ripple (SCR phase-back), and short-time overload affect the temperature relationship between the armature and commutating field, complete protection from all conditions resulting from over-temperature is not possible. The device is especially useful in guarding against loss of normal ventilation air, high ambient temperature, and prolonged operation of self-ventilated motors at very low speeds.

WARNING: Thermostats automatically reset after the motor has cooled somewhat. In order to prevent property damage or injury to personnel, the control circuit should be designed to prevent the automatic starting of the motor when the thermostat resets.

TABLE 6

MAXIMUM CURRENT RATINGS FOR SPEED LIMIT SWITCHES & THERMOSTATS ON DRIPPROOF & TOTALLY ENCLOSED MOTORS (Normally open or normally closed contacts)

LOAD	125 VAC	250 VAC	600 VAC	30 VDC
Do not use above 600 VAC or 30 VDC				
Resistive	5 AMPS	2.5 AMPS	1 AMP	5 AMPS
* Inductive	3 AMPS	1.5 AMPS	0.5 AMP	1.5 AMPS

* Suitable for pilot duty only (relay coils)

Speed Limit Device

The standard mechanical speed limit device is non-adjustable. Tripping speed is specified by a note on the print certification for each specific order and on the motor nameplate.

The speed limit electrical contacts are normally closed and are usually connected in relay or holding circuits. Current ratings are the same as **Table 6**.

WARNING: The contacts of the speed limit device automatically reclose after the speed has fallen below the trip value. In order to prevent property damage or injury to personnel, the control circuit should be designed to prevent re-energizing the motor until the cause of the overspeed has been corrected.

Space Heater

When furnished, refer to the **Print Certification for Electrical Rating** or the motor nameplate.

WARNING: The surface of a space heater block becomes hot when the heater is energized. The temperature rise above the ambient temperature may be as high as 400°C. Avoid touching heater blocks which have recently been energized to prevent burns. Also, to prevent fire or explosion, ignitable dust or lint should not be allowed to collect around the surface of the heaters.

Ventilation System

Blowers or central systems must be in operation to supply cooling air before loading force-ventilated machines. Air filters should be in place. Blowers should be checked for correct rotation. (Refer to **Fig. 3** for correct direction of rotation.)

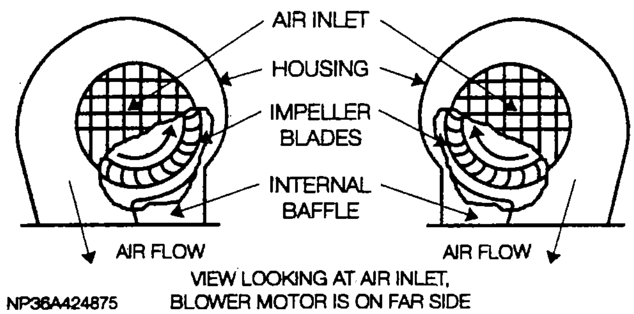


Fig. 3 Correct Arrangement of Blower Housing, Impeller Blades and Direction of Rotation to Obtain Proper Pressure and Air Flow

AC Blower Motors (If Equipped)

CAUTION: Remove drain plugs from the frame or endshields of enclosed motors used outdoors or in other high moisture areas.

Mounting

When bases are removed on enclosed motors, the enclosure must be maintained by plugging the bolt holes with the plastic plugs from Kit No. 1821BPK1.

WARNING: Do not replace the bolts in the frame with the base removed.

Power Supply and Connections

The nameplate voltage and frequency should agree with power supply. Motors will operate satisfactorily on line voltage within + - 10% of the nameplate value or frequency within + - 5% combined variation not to exceed + - 10%.

Dual voltage motors can be connected for the desired voltage using instructions on the nameplate or connection diagram.

Wiring of motor, control, overload protection, and grounding should meet the National Electrical Code and local building codes.

Maintenance

Inspection

Inspect the motor at regular intervals. Keep motor clean and ventilating openings clear.

Lubrication

Ball bearing motors are adequately lubricated at the factory. Motors, if equipped with grease fittings, should be relubricated at intervals consistent with type of service (refer to **Table 7**) to provide maximum bearing life. Excessive or too frequent lubrication may damage the motor.

Relubricate the motor with GE-D6-A2C5 grease unless special grease is specified on the nameplate. For best purging of old grease, relubricate while the motor is warm and the shaft stationary.

WARNING: Do not relubricate while the motor running.

Remove caps on the fan cover for access to the grease plugs. On the drive end and opposite drive end of motors with pipe plugs, insert a lubrication fitting. Remove the other plug for grease relief of all motors. Clean grease relief opening of any hardened grease. Be sure fittings are clean and free of dirt. Using a low pressure, hand operated grease gun, pump in clean recommended grease until new grease appears at the relief hole. After relubricating, allow the motor to run for ten minutes before replacing relief plug.

TABLE 7 BLOWER MOTOR LUBRICATION GUIDE				
Type of Service	Typical Examples	HP Range	Lubrication Interval Horizontal	Vertical
STADARD	1 or 2 Shifts	.5 - 7.5	7 yrs.	3 yrs.
Severe	Continuous Duty and/or Severe Vibration	.5 - 7.5	4 yrs.	1.5 yrs.
Very Severe	Dirt and Vibration and/or High Ambient	.5 - 7.5	9 mos.	6 mos.

Motor windings

To clean motors, use a soft brush and, if necessary, a slow acting solvent in a well ventilated room.

> **WARNING:** Do not use solvents on windings of the DC motor.

Brake

Flange-mounted brakes may be mounted on the accessory rabbet. Since the accessory stub shaft is not suitable for use with a brake, the standard NEMA commutator end shaft extension should be ordered when such use is planned. Standard brakes are designed for horizontal floor mounting only. When motors are sidewall or ceiling mounted, the brake must be reassembled to maintain its relation to the horizontal. Where motors are to be mounted with the shaft vertical up or down, special brakes should be specified. Brakes used on severe applications, such as outdoor gantry cranes, have many special features.

> **WARNING:** Improper selection or installation of a brake and/or lack of maintenance may cause brake failure which can result in damage to property and/or injury to personnel. **Brake questions should be referred to GE Motors-DM&G or the brake manufacturer along with the brake model and serial number.**

General Mechanical Inspection

Check the inside of the machine for tools, metal chips, or any other foreign material that may have accumulated during storage or installation. Make sure that all rotating parts have clearance from any stationary parts. Turn the machine over by hand, if possible, and check for scraping noises or any other signs of mechanical interference. Check the tightness of the bolts in th feet, couplings, bearing housings, and any other bolts that may have been disturbed. (Refer to **Table 8**) Also check the torque of the yoke bolts. When non-metallic parts or brush holders are bolted to metallic parts use the reduced torque from Table 8A

Check the tightness of the main and commutating pole bolts (as listed in **Table 9**) at start-up. Loose pole bolts could be a source of objectionable noise when motors are supplied from rectified power. Also check the torque of the yoke bolts.

TABLE 8

GRADE 5 HARDWARE TORQUE VALUES

BOLT THREAD SIZE (inches)	HEX HEAD DIMENSION	TORQUE LB. FT.
1/4 - 20	7/16	7 TO 9
5/16 - 18	1/2	13 TO 17
3/8 - 16	9/16	24 TO 30
1/2 - 13	3/4	60 TO 75
5/8 - 11	15/16	120 TO 150
3/4 - 10	1 1/8	210 TO 260
1 - 8	1 1/2	460 TO 580

TABLE 8A

NON-METALIC PARTS AND BRUSH HOLDERS

BOLT THREAD SIZE (inches)	HEX HEAD DIMENSION	TORQUE LB.FT.
1/4 - 20	7/16	5 TO 7
5/16 - 18	1/2	7 TO 9
3/8 - 16	9/16	13 TO 17
1/2 - 13	3/4	24 TO 30
5/8 - 11	15/16	60 TO 75

TABLE 9

COMMUTATING AND MAIN POLE BOLT TORQUE

FRAME	BOLT SIZE	TORQUE (lb-ft) A	TORQUE (lb-ft) B
CD180AT	3/8-16	24-30	16-20
CD210AT	3/8-16	24-30	16-20
CD250AT	3/8-16	24-30	16-20
CD280AT	1/2-13	60-75	36-45
CD320AT	1/2-13	60-75	36-45
* CD360AT/CD400AT	3/8-16	35-42	23-28
** CD360AT/CD400AT	3/8-16	24-30	16-20
CD500AT	1/2-13	60-75	36-45

A. For steel bolts when assembled without lubricant (dry threads)
B. For steel bolts when assembled with lubricated threads
* 6 radial slashes on bolt head. (Grade 8)
** 3 radial slashes on bolt head. (Grade 5)

CAUTION: Standard motors, as shipped, are assembled with bolts without lubricant (dry threads). Bolts may be replaced when necessary with bolts with dry threads, or with bolts lubricated with a motor oil or other suitable thread lubricant. When lubricated threads are used, the lower torque values in **column B** will apply. The higher torque values in **column A**, when applied to bolts with lubricated threads, can cause excessive bolt tension and possible bolt breakage.

Accessory Mounting

Provisions for mounting accessories on the commutator end shield is a standard feature on frames CD210AT and above. The rabbet has NEMA Type FC face mounting dimensions, including the mounting bolt holes as shown in **Fig. 4**. The standard stub shaft also permits coupling certain accessories.

WARNING: To prevent injury from rotating shaft, the stub shaft cover must be maintained in position when the accessory mounting is not used.

ndard accessories are available as kits. These include a .iety of tachometers and speed limit switches. A mounting adapter, which can be machined for various accessories, can be ordered separately.

Inspection After Starting

The following items should be checked after the machine is running:

Bearings

Ball-bearing or roller-bearing housing temperature should not be more than 80°C (176°F). Check alignment and lubrication if temperature exceeds this limit. __Do not overgrease.__ (Refer to the **Regreasing Procedure** section of this Instruction Book.)

Noise and Vibration

Check for unusual vibration or noises that might indicate rubbing or interference.

Vibration of new machines at the bearing housings, as measured by a vibration meter, should not exceed the values shown in **Table 10**. (The motor is mounted alone on rubber per NEMA method.)

The most likely cause of vibration in new machines is misalignment due to improper installation, loose foot bolts, uneven shimming under feet, or damage to machine during shipment or installation. Current ripple due to rectified power supply may also be a source of vibration and audio noise.

TABLE 10

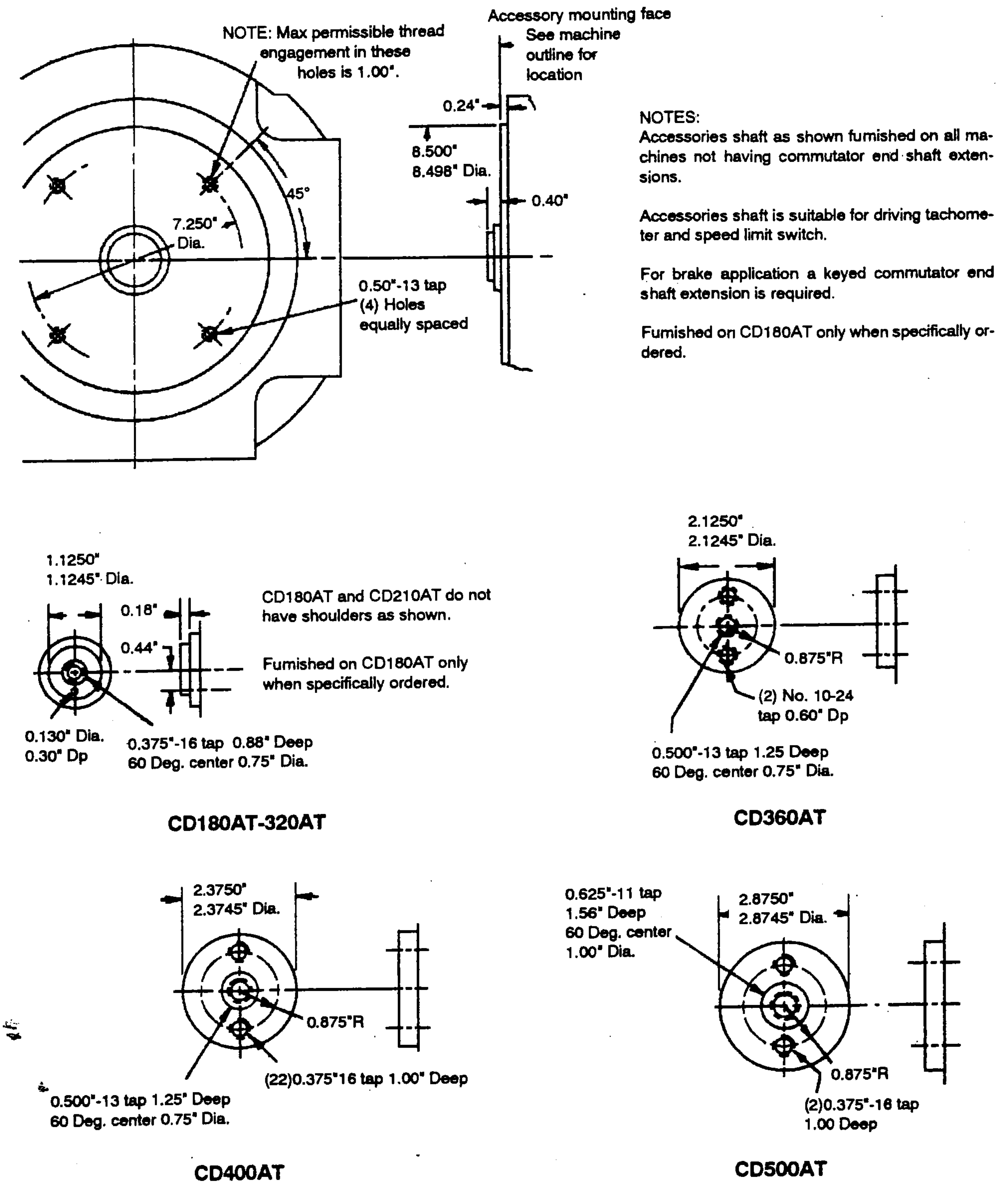
VIBRATION VALUES

RPM	MAXIMUM AMPLITUDE IN INCHES (PEAK TO PEAK)
3000 - 4000 incl.	.001
1500 - 2999 incl.	.0015
1000 - 1499 incl.	.002
999 and below	.0025

Inspection After Short Time in Service

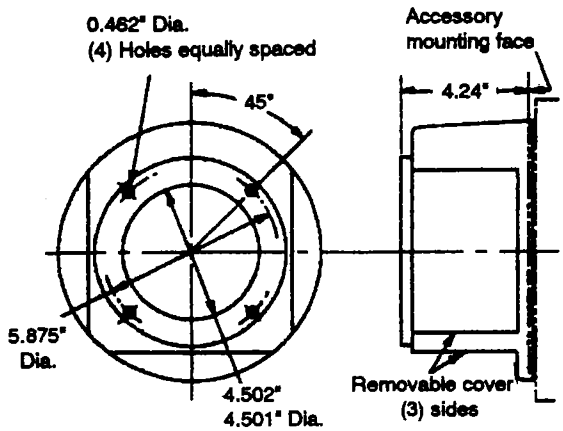
New machines may smell warm or have the odor of varnish, but should not smell scorched.

After a machine has been operating for a short time, an inspection should be made to ascertain that there have



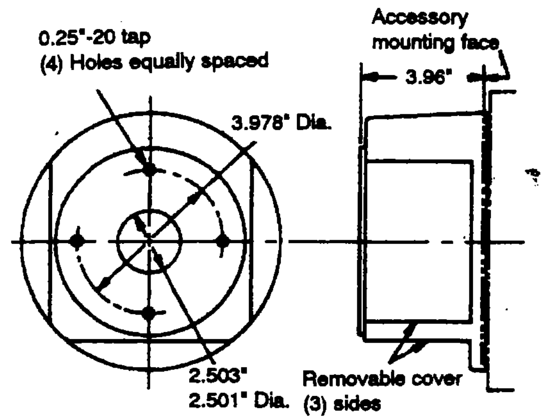
Standard commutator-end bracket and accessory shaft extension.

Fig. 4A Accessory Mounting CD180AT - CD500AT



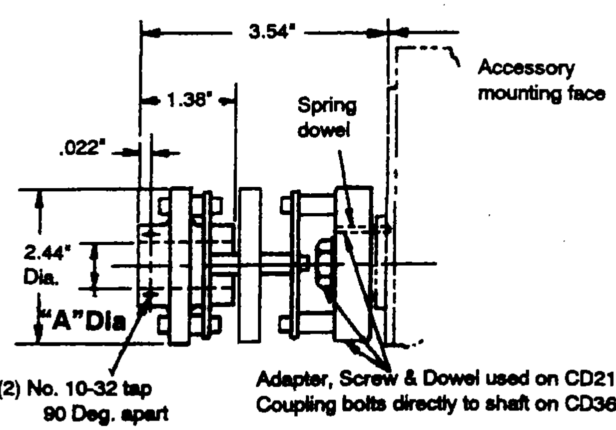
BC42/BC46 Tachometer adapter
mounts on bracket shown in Fig. 5A

Fig. 4B



Form "Y" Tachometer adapter
mounts on bracket shown in Fig. 5A

Fig. 4C



Adapter, Screw & Dowel used on CD210AT-320AT only.
Coupling bolts directly to shaft on CD360-500AT.

"A"	KEY WAY	
	WIDTH	DEPTH
.6255 .6250	.1875	.0937
.7505 .7500	.1875	.0937
.5005 .5000	OMIT	
.3130 .3125	OMIT	

Torsionally rigid coupling rated at
.17 HP per 100 RPM.

Fig. 4D

Fig. 4B-D Accessory Mounting CD180AT - CD500AT been no changes since installation. Re-torque all main and commutating pole bolts. (Refer to **Table 9.**) Also check the torque of the yoke bolts. (Refer to **Table 8.**) Check for increased vibration, signs of change in alignment or foundation settling, bolts that may have loosened, rubbing parts, loose connections, and worsened commutation, and take the proper steps to correct the trouble. Also, check condition of air filters on blower ventilated machines. The amount of dirt in the air varies widely between installations.

MAINTENANCE

WARNING: High voltage electric shock may cause serious or fatal injury. Disconnect power before touching any internal part. High voltage may be present even when the machine is not rotating. If used with a rectified power supply, disconnect all AC line connections to power supply. With other power supplies, disconnect all DC line and field connections. Also, disconnect power from auxiliary devices.

WARNING: Ground the machine properly to avoid serious injury to personnel. Grounding must be in accordance with the National Electrical Code and consistent with sound local practices.

WARNING: Replace covers and protective devices before operating.

Bearings (Frames CD180AT-CD210AT)

Double shielded bearings are standard in these frame sizes. The bearings are lubricated by the bearing manufacturer and are not regreasable. These bearings should be replaced whenever the motor is disassembled for servicing.

Bearings (Frames CD250AT-CD500AT)

Bearing housings are packed with grease at the factory. Greasing is not required before the motor is put into service. Since the oil in the grease will ultimately become depleted, it is necessary to relubricate bearings periodically depending on the frame size of the motor, average operating speed, and the type of bearing (ball or roller). (Refer to **Table 11.**)

Motors operating in ambient temperatures above 40°C should reduce interval listed in **Table 11** by half.

TABLE 11

RECOMMENDED REGREASING PERIODS

		RELUBRICATION INTERVAL IN HOURS OF OPERATION	
FRAME SIZE	AVERAGE RPM	BALL BEARING	ROLLER BEARING
CD250AT, CD280AT & CD320AT	500	36000	18000
	1150	15000	7500
	1750	10000	5000
	3000	5000	2500
CD360AT & CD400AT	500	30000	15000
	1150	12000	6000
	1750	6000	3000
	3000	2500	1250
CD500AT & CD5010AT	500	25000	12500
	1150	8000	4000
	1750	4000	2000
	2000	2600	1300

For best lubrication results, regrease with GE grease No. D6A2C5 or an equivalent lithium base ball bearing grease. (Refer to **Table 12.**) Avoid mixing different kinds of grease. Lubricate motor at standstill. Make sure the grease fitting is clean and free from dirt. Remove lower grease relief plug (relief pipe on fan-cooled motor). Free the relief hole from any hardened grease. Use a hand-operated grease gun only. Pump in grease until new grease appears at lower grease hole. (Insert pipe occasionally on fan-cooled motors to check for appearance of new grease.) After greasing, allow motor to run about ten minutes before replacing grease relief plug (or pipe) to permit excess grease to drain out.

CAUTION: If a large amount of grease is pumped into the motor and none appears at the drain, then remove the handhole covers and visually inspect the area where the shaft protrudes thru the cap and endshield for grease leakage. This would indicate that the drain is plugged up. If this occurs, then remove bearing cap and clean all dried grease out of the cavity and drain hole. Refill 1/3 full. Be sure to wipe away any grease leakage before reassembling the handhole covers. Repeat cleaning after 12-24 hours of operation.

Replacement of Bearings

After the bearing brackets have been removed, a bearing puller may be used to pull the bearings from the shaft. Protect the shaft center while using the puller. On frames CD360AT through CD500AT, it may be necessary to remove the bearing retaining snap ring before pulling the bearing. Discard the old bearing. The new bearing and all mating parts should be kept extremely clean during reassembly. (Refer to **Table 13** when selecting replacement bearings.)

To install a new bearing, heat the bearing to 116-127°C (240-260°F) in oil or in an oven. Then slip or press the bearing on the shaft. The bearing should be mounted tightly against the shoulder on the shaft.

After the bearing has cooled, re-install the retaining ring where used. Fill the grease reservoir in the inner bearing cap or cartridge 1/3 to 1/2 full of grease. Butter the bearings and fill the grease reservoir in the bearing bracket 1/3 to 1/2 full of grease.

Brushes (Refer to **Figs. 5, 6, and 7.**)

Good brush performance is dependent on the care used in fitting and adjusting the brushes before the machines are put into service. An initial inspection of brush condition

WARNING: Extreme pressure (EP) greases should not be used in DC machines. Insulation deterioration and increased brush wear may result from the presence of silicones.

TABLE 12

SOURCES OF SUPPLY FOR BEARING GREASES

Temperature	GE Designation	Supplier	Supplier's Designation
STANDARD TEMPERATURE 15°F to 212°F -10°C to 100°C	D6A2C5	GE Supply 158 Gaither Drive Mt. Laurel, NJ 08054 1-800-341-1010	GE Ball Bearing Grease (supplied in small tubes and cans
		Shell Oil Company P.O. Box 2463 One Shell Plaza Houston, TX 77002 (713) 241-4201	Alvania No. 2
		Texaco, Inc. 200 Westchester Avenue White Plains, NY 10650 (914) 253-4000	Regal AFB-2
LOW TEMPERATURE -60°F to 200°F -51°C to 93°C	D6A4	Shell Oil Company P.O. Box 2463 One Shell Plaza Houston, TX 77002 (713) 241-4201	Aeroshell No. 7
HIGH TEMPERATURE -20°F to 350°F -28°C to 176°C	D6A2C13	Standard Oil Company 225 Bush Street San Francisco, CA 94120 (415) 894-7700	Chevron "SRI II"

TABLE 13

STANDARD BALL BEARINGS FOR KINAMATIC MOTORS*

NEMA FRAME DIAMETER	STANDARD COMM END BEARING	AFBMA #	STANDARD DRIVE END BEARING	AFBMA #
180AT	6206	30BC02JPP3	6206	30BC02JPP3
210AT	6206	30BC02JPP3	6207	35BC02JPP3
250AT	6207	35BC02X3	6209	45BC02X3
280AT	6209	45BC02X3	6210	50BC02X3
320AT	6210	50BC02X3	6211	55BC02X3
360AT	6211	55BC02X3	6213	65BC02X3
3610AT	6211	55BC02X3	6214	70BC02X3
3612AT	6213	65BC02X3	6214	70BC02X3
400AT	6213	65BC02X3	6214	70BC02X3
4012AT	6214	70BC02X3	6217	85BC02X3
500AT	6216	80BC02X3	6218	90BC02X3
5010AT	6218	90BC02X3	6222	110BC02X3

*** Motors sometimes have oversize ball bearing and roller bearing options**

TABLE 14

MINIMUM BRUSH LENGTH (in inches)

FRAME	MINIMUM BRUSH LENGTH*
CD180AT	.68
CD210AT-250AT	.70
CD280AT-320AT	.90
CD360AT	1.10
CD400AT	1.50
CD500AT	1.60

*Refer to **Figs. 5, 6, 7** for drawing

and another inspection after the first two months of service is recommended to determine how often subsequent inspections are needed. Wear markers are provided on the brush pigtail. (Refer to **Figs. 6 and 7.**) When the crimped marker approaches entry into the brushholder, brush replacement should be investigated. For future ordering, record the brush part number which is stamped on the brush. (Refer to **Table 18.**)

CAUTION: DC motors and generators operated for long periods of time at light loads or in contaminated atmospheres may be subject to abnormal brush and commutator wear. This can result in the need for excessive maintenance and/or commutator damage. If the application requires operation under these conditions, GE Motors-DM&G will be pleased to suggest a change in brush grade or other measures to minimize the problem.

WARNING: High voltage and rotating machinery can cause serious or fatal injury. Brushes may not be touched or replaced while the machine is energized or rotating.

CAUTION: The presence of silicone in DC motors, particularly totally enclosed constructions, will cause rapid brush wear. Sources of silicone include oils, RTV compounds, hand creams, mold release agents, grease, and some insulating varnishes. These silicone substances must be avoided to insure proper motor performance.

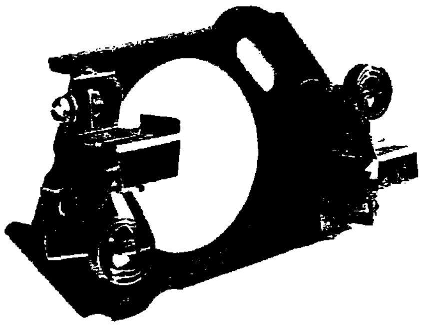


Fig. 5
Frame CD180AT

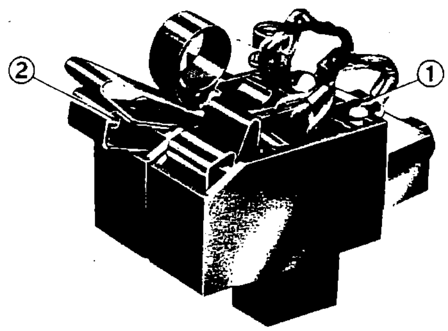


Fig. 6
Frames CD210AT-320AT

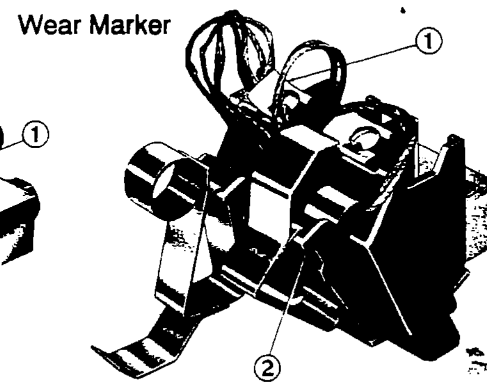


Fig. 7
Frames CD360AT-500AT

Measure Brush Length Here:

Fig. 5, 6, 7 **Brushholder Assemblies**

With Machines Stopped and Power Off:

(Refer to **Figs. 5, 6, and 7.**)

1. Unfasten pigtail (Refer to ①).
2. Release spring by pushing in slightly to disengage locking tab (Refer to ②), then pull spring back.
3. Remove brush.

Brush Installation:

1. Place brush in holder with bevel towards spring. Brushes should move freely in holder.
2. CD180AT - Release spring to original position against brush. CD210AT-CD500AT - Push spring into position until lock tab (Refer to ②) engages slot and locks.
3. Connect pigtail

<u>NOTE</u>: If the brushholders have been disassembled, it may be necessary to readjust the height of the holder from the commutator surface. Loosen the brush stud to holder screw and adjust the holder until a gap of .070" to .080" is obtained. Retighten the screw and recheck the gap. (Refer to Fig. 8.)

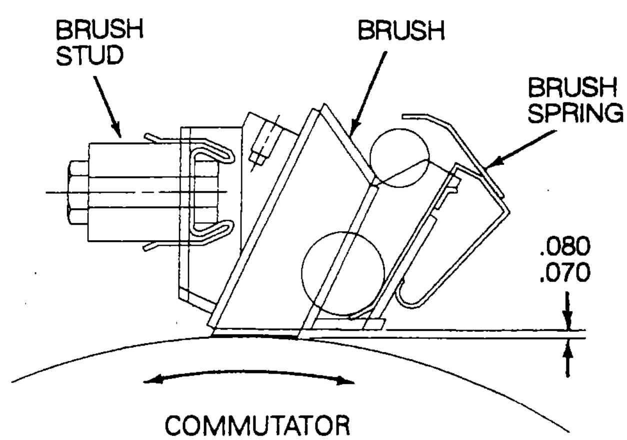


Fig. 8 **Correct Spacing of Brushholder to Commutator**

Brush Seating

Brushes should have their commutator contact surfaces curved to exactly fit the commutator surface. This is accomplished by "sanding in" the brushes in each brushholder separately. Draw a sheet of coarse non-metallic sandpaper (100-150 grit) under the brushes with the rough side toward the brush, while the brushes are pressed firmly toward the commutator. **Do not use emery cloth.** When sanding brushes, do not get carbon dust into the windings. The motor should be thoroughly blown out after sanding the brushes. This can be accomplished by cleaning the dust from the commutator, brushholders, and adjacent parts with a vacuum cleaner, air blast, or other suitable means. After the rough sanding, the brushes should be finely ground to fit using a brush seater. Rotate motor at around nameplate RPM. Make sure there is no load on the machine (armature current is nil). Carefully and lightly rub the brush seater across the entire commutator surface for 10 or 15 seconds. Repeat between each and every set of brush studs. Reverse motor rotation and repeat. Stop motor and cut all power to the motor and check brush face. Continue seating until brush face is 85% seated. Again, motor must be thoroughly blown out after brush seating, the same as with sanding.

CAUTION: Avoid inhaling carbon and seater dust. Recommend using a dust mask during sanding, seating and blowing, or vacuuming.

WARNING: High voltage and rotating parts can cause serious or fatal injury. The use of all electric machinery, like all other utilization of concentrated power and rotating equipment, can be hazardous. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA safety standards for construction and guide for selection, installation and use of integral HP motors and generators, National Electrical Code, and sound local practices is recommended.

CAUTION: Do not use liquid solvents of any kind. Solvents will not remove carbon dust accumulations, but will spread and wash them into critical areas.

Commutator

Keep the commutator clean. Ordinarily, the commutator will require only occasional wiping with a piece of canvas or other nonlinting cloth. **Do not use lubricant or solvent on the commutator.** Check the commutator for roughness while running by feeling the brushes with a fibre stick, avoiding contact with live electrical or moving mechani-cal parts. Jumping brushes give advance warning of deterioration of commutator surface. (Refer to the **Commutator Check Chart, GEA-7053** for commutator surface marking and causes of poor commutator condition.) Commutator runout over .003" T.I.R. (Total Indicator Reading) and bar to bar readings over .0003" indicate need for repair. (Refer to **Table 15.**)

CAUTION: The presence of silicone in DC motors, particularly totally enclosed constructions, will cause rapid brush wear. Sources of silicone include oils, RTV compounds, hand creams, mold release agents, grease, and some insulating varnishes. These silicone substances must be avoided to insure proper motor performance.

TABLE 15

COMMUTATOR DIAMETERS (IN INCHES)

FRAME	NEW	MINIMUM
CD180AT	2.76	2.62
CD210AT	4.50	4.27
CD250AT	5.00	4.75
CD280AT	5.78	5.49
CD320AT	6.50	6.17
CD360AT	7.50	7.13
CD400AT	8.32	7.92
CD500AT	10.25	9.75

Commutator Undercutting Specifications

If the commutator is resurfaced, or during inspection or overhaul, insure the mica segments are undercut below the commutator surface. Commutator undercutting should be made to a depth of .040 - .050". Following commutator resurfacing (stoning/turning), the segments should be "scarfed" by lightly breaking the sharp corners of the copper segments with a knife or tool made for that purpose. Scarfing segments will reduce carbon brush dust buildup and improve brush life.

Mechanical

Check the condition of air filters and replace them if they are dirty. Check for unusual noises which were not present when the unit was originally installed. Check all electrical connections for tightness. Clean out any dirt from screens, louvers, etc. which would interfere with flow of cooling air.

Shaft End Play

Standard endplay should be measured with a dial indicator. The limits are:

1. CD180AT thru CD320AT .005" to .040"
2. CD360AT thru CD500AT .000" to .015"

Some designs may use a wavy washer (preload spring) to eliminate endplay. The above limits do not include the axial endplay of the bearing itself which is approx. .002".

Waterproof Machines

Waterproof machines require the use of sealing devices to exclude water from the bearings and from entering openings in the magnet frame. When a waterproof machine has been disassembled, it will be necessary to remove the old sealing compound from around the mating surfaces of the bearing brackets and magnet frame; from underneath the field pole bolt heads and bearing cap to bearing bracket bolt heads; and from around the conduit box adapter threads to the magnet frame. Reapply new sealant (use Titeseal T20-66, light weight, GE part # 905A999AC009) to these areas and wipe excess sealant with a clean rag slightly dampened with mineral spirits. When accessories such as brakes and tachometers are disassembled, it will be necessary to reseal at the accessory mounting face. Prior to reassembly, inspect for damage at gaskets around enclosure covers and at shaft rubbing seals located in the bearing caps.

Lubrication of Flexible Couplings

Flexible couplings are normally lubricated with a semi-fluid grease or an oil. The coupling manufacturer's instructions should be followed in choosing a lubricant and setting relubrication intervals. GE ball bearing grease D6A2C5 is a suitable lubricant for flexible couplings in most applications.

Flexible couplings which join a small machine to a large one may have two different size coupling halves joined by an adapter plate. Couplings of this type have a separate lubricant supply for each half, so that both halves must be lubricated separately.

Insulation

> **CAUTION:** Eliminate sources of contamination and moisture for maximum insulation life. Air filters for blowers, air piped from cleaner locations, shielding from water leaks or spray, proper use of space heaters during downtime, etc., will all help prolong insulation life.

Premature failure of insulation is due to:

1. Contamination
2. Mechanical factors
3. High temperatures

Contamination includes excessive moisture, oily vapors, conducting and non-conducting dust, chips, and chemical fumes. Contamination is best avoided by proper enclosure and ventilation. Filters, ventilation from a remote clean air source, unit coolers, and a totally enclosed construction are all possible means of protecting DC machines in adverse environments. Space heaters protect against moisture damage by maintaining the machine above dew-point during storage or when idle. They should be arranged so that they are automatically energized whenever power is removed from the motor. Space heaters do not supply enough heat for drying out windings which have been water-soaked.

Mechanical factors include shock, vibration, overspeed, etc. Maintaining machines in good mechanical repair, including isolation from excessive external shock and maintenance of smooth running conditions, will contribute to long insulation life.

The insulation system in these machines is capable of withstanding some short time periods of operation at temperatures higher than that used for the basis of machine rating. Prolonged or excessively high temperature will cause the insulation to become brittle and crack, leading to premature failure. Application data is available from GE Motors-DM&G for any particular machine giving suggested maximum loads for various operating conditions. Operation within these maximum loads will limit the temperature to suitable values.

Testing Methods

Visual Inspection

Visual inspection is recommended as the quickest means of finding insulation systems troubles. Visual inspection may not sound like a test method, but a careful visual inspection done by a competent person is one of the most valuable means of judging insulation condition.

In addition to collecting contaminants, insulation shrinks, cracks, and becomes brittle with heat and age. These changes allow movement of coils, loose filler strips, loose ties, chafing, and abrasion, all of which can be picked up by visual inspection.

Experience and judgment can be gained by careful observation and comparing results of visual inspections with insulation resistance measurement. GE service shops have personnel who can inspect equipment and point out potential trouble areas. Their services can help build experience and judgment for future visual inspections.

Insulation Resistance Measurement

A method of measuring the insulation resistance is described in **Report 43, "Recommended Practice for Testing Insulation Resistance of Rotating Machinery"**, published by IEEE, 345 E. 47th Street, New York, NY 10017. The resistance measurements should be taken with a 500- or 1000-volt megger and corrected to 104°F (40°C).

The insulation resistance measurements are affected by the following:

1. Magnitude of test voltage.
2. Time the test voltage is applied.
3. Temperature.
4. Surface condition (contaminants).
5. Moisture.

When a 1000-volt megger is used, taking readings of one minute and converting the data to 40°C (104°F), the data will evaluate the other two factors, i.e., the contaminants and the moisture present.

The insulation resistance varies inversely with the winding temperature. That is, as the temperature decreases, the insulation resistance increases in accordance with **Table 16.**

TABLE 16

EFFECT OF TEMPERATURE ON INSULATION RESISTANCE

WINDING TEMPERATURE DEGREE C	MULTIPLYING FACTOR TO OBTAIN INSULATION RESISTANCE AT 40°C (104°F)
80	10.00
70	5.50
60	3.10
50	1.70
40	1.00
30	0.55
20	0.31
10	0.17

Note that for a 104°F (40°C) decrease in temperature, the insulation resistance is increased by a multiplier of ten.

The insulation resistance of a machine is affected by its design. The insulation resistance of the armature circuit corrected to 104°F (40°C) should measure at least 1.5 megohms or cleaning is required.

If the measurements are less than this limit, the machine should be dried or cleaned to attempt to increase the insulation resistance. Regular, periodic measurements of insulation resistance can give a useful indication of the rate of insulation system deterioration. External connections should be removed to isolate the windings to be tested and megger value logged. A sudden drop or consistent trend toward low values of insulation resistance, although possibly caused by moisture or contamination, generally gives evidence that the insulation system is deteriorating and that failure may be eminent.

High-potential tests are not recommended on machines which have been in use. If such a test is made immediately after installation, the test voltage should not exceed 85% of the original factory test of two times the rated voltage plus 1000 volts.

<u>NOTE</u>: **Surge testing and AC impedance tests of windings to detect shorts should be performed only by trained personnel.**

Cleaning of Windings

If windings become contaminated, suitable cleaning methods can be used to alleviate the problem.

The machine should be de-energized and slowly rotated by hand to permit maximum dust removal. Dry dirt, dust, or carbon should first be vacuumed - without disturbing adjacent areas or redistributing the contamination. Use a small nozzle or tube connected to the vacuum cleaner to enter into narrow openings (i.e., between commutator risers). A soft brush on the vacuum nozzle will loosen and allow removal of dirt more firmly attached.

This vacuum cleaning may be supplemented by blowing with compressed air (air pressure should be in accordance with OSHA standards), which has passed through a dryer to remove moisture before entering the motor.

Dirt can collect on the inside surface of the drive-end coil support and on the underside of the armature coils. This dirt can be easily removed with compressed air or a vacuum. Dirt may also accumulate in the axial vent holes which pass all the way through the armature core and commutator. It usually will be necessary to use compressed air to blow this dirt out. The commutator vent holes can best be cleaned by directing air from the commutator end.

It is important to realize that when blowing out a machine, dirt may settle in a previously cleaned area and it may be necessary to repeat the cleaning process to ensure that a thorough job is done.

Dirt can be removed from stationary parts of the machine by either compressed air or a vacuum nozzle or a combination of both. Air should be directed between the stator coils, into the pocket corners of bearing brackets, around the cables, and onto the brush rigging. Special care should be taken to keep the commutator clean. The commutator should be wiped with a clean lint-free cloth after blowing out.

WARNING: High voltage electric shock can cause serious or fatal injury. Electrical circuits must be de-energized prior to cleaning or other maintenance activities. Ground electrical circuits prior to cleaning or maintenance to discharge capacitors. Failure to observe these precautions may result in injury to personnel.

CAUTION: Liquid solvents should not be directly applied to the commutator, armature, field coils, or any part of a DC machine. Liquid solvents carry conducting contaminants (metal dust, carbon, etc.) deep into hidden areas to produce shorts and grounds, thus causing machine failure. Mechanical components may be cleaned by a wiping rag barely moistened (not wet) with a solvent.

WARNING: Solvents may be flammable and moderately toxic. The usual precautions for handling chemicals of this type must be observed. These include:

1. Avoid excessive contact with skin.
2. Use in well-ventilated areas.
3. Take necessary precautions to prevent fire or explosion hazards.

WARNING: Safety glasses and/or other protective equipment should be used to prevent injury to eyes and respiratory organs.

Oily Dirt

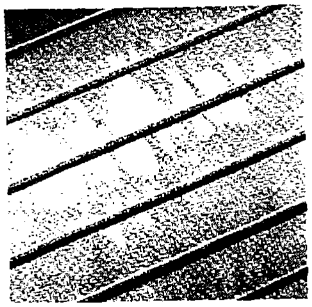
The presence of oil makes thorough, effective cleaning of machines in service virtually impossible and service shop conditioning is recommended. Oil on a surface forms a "fly paper effect", which attracts and holds firmly any entrained dust. Neither suction nor compressed air is effective. Consequently, only accessible areas may be cleaned. First, remove as much of the dirt as possible by scraping or brushing the dirty surfaces. Then, wipe away as much dirt as possible with dry rags. For surfaces not readily accessible, a rag on a hook wire can be used to clean dirt out of holes and crevices. Rags should be changed frequently for clean ones so that contamination picked up from one area is not carried to other less dirty areas.

To simplify removal of oily dirt, solvents are commonly prescribed.

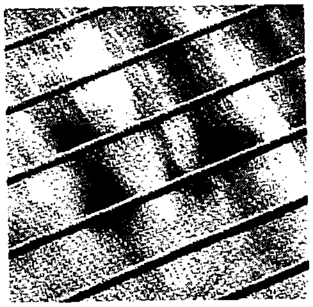
GE Motors
Commutator Check Chart

For Comparing Commutator Surface Markings

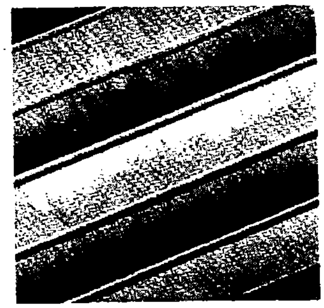
SATISFACTORY COMMUTATOR SURFACES



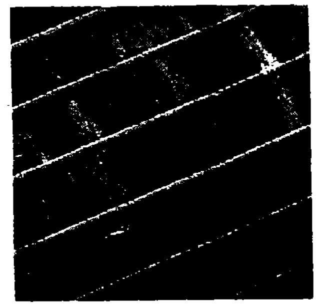
LIGHT TAN FILM over entire commutator surface is one of many normal conditions often seen on a well-functioning machine.



MOTTLED SURFACE with random film pattern is probably the most frequently observed condition of commutators in industry.

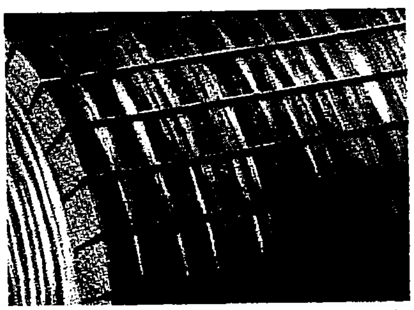


SLOT BAR-MARKING, a slightly darker film, appears on bars in a definite pattern related to number of conductors per slot.

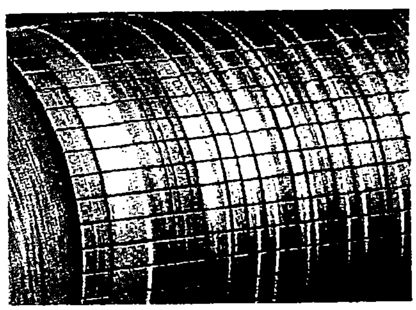


HEAVY FILM can appear over entire area of efficient and normal commutator and, if uniform, is quite acceptable.

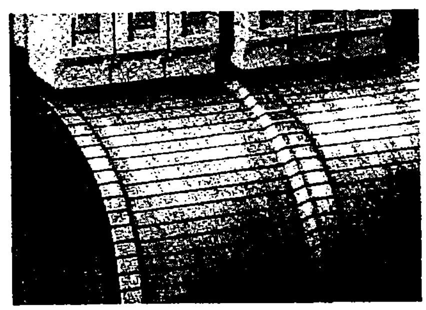
WATCH FOR THESE DANGER SIGNS



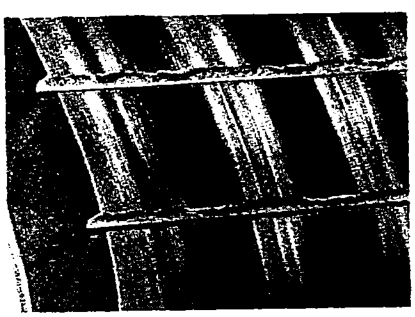
STREAKING on the commutator surface signals the beginning of serious metal transfer to the carbon brush. Check the chart below for possible causes.



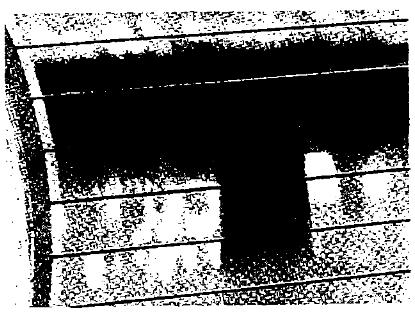
THREADING of commutator with fine lines results when excessive metal transfer occurs. It usually leads to resurfacing of commutator and rapid brush wear.



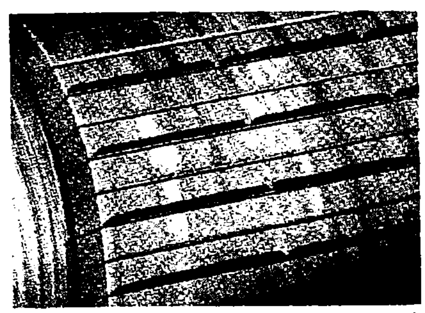
GROOVING is a mechanical condition caused by abrasive material in the brush or atmosphere. If grooves form, start corrective action.



COPPER DRAG, an abnormal build-up of commutator material, forms most often at trailing edge of bar. Condition is rare, but can cause flashover if not checked.



PITCH BAR-MARKING produces low or burned spots on the commutator surface. The number of these markings equals half or all the number of poles on the motor.



HEAVY SLOT BAR-MARKING can involve etching of trailing edge of commutator bar. Pattern is related to number of conductors per slot.

CAUSES OF POOR COMMUTATOR CONDITION

Frequent visual inspection of commutator surfaces can warn you when any of the above conditions are developing so that you can take early corrective action. The chart below may indicate some possible causes of these conditions, suggesting the proper productive maintenance.

	Electrical Adjustment	Electrical Overload	Light Electrical Load	Armature Connection	Unbalanced Shunt Field	Brush Presure (light)	Vibration	Type of Brush In Use		Contamination	
								Abrasive Brush	Porous Brush	Gas	Abrasive Dust
Streaking			X			X		X	X	X	X
Threading			X			X			X	X	
Grooving								X			X
Copper Drag						X	X	X		X	
Pitch Bar-Marking				X	X	X	X	X			
Slot Bar-Marking	X	X								X	

GE Motors
3001 East Lake Road
Erie, PA 16531
Phone: 814-875-3129

HOW TO GET THE MOST VALUE FROM THIS CHART

The purpose of the Commutator Check Chart is to help you spot undesirable commutator conditions as they develop so you can take corrective action before the condition becomes serious. This chart will also serve as an aid in recognizing satisfactory surfaces.

The box chart above indicates the importance of selecting the correct brush and having the right operating conditions for optimum brush life and commutator wear.

For additional information or help with carbon brush application or commutation problems, contact your

WARNING: While FREON TF® is considered to be non-flammable and has a relatively low order of toxicity, it should be used only in well-ventilated areas that are free from open flames. Avoid prolonged exposure to vapors. Failure to observe these precautions may result in injury to personnel.

FREON TF is the recommended solvent for cleaning because it is nonflammable, has good solvency for grease and oil, is considered safe with most varnishes and insulations, and has a low order of toxicity. Stoddard Solvent has good solvency, but is flammable and moderately toxic. Before using any solvent, consult the Material Safety Data Sheet. Steam cleaning is not recommended because, as with liquid solvents, conducting contaminants may be carried deep into inaccessible areas resulting in shorts and grounds.

FREON TF is a chlorofluorocarbon. Chlorofluorocarbons have been identified as upper atmosphere ozone depletors. The use of Freon in industry is expected to be greatly reduced in the future. The availability of Freon may be limited, and its use could be prohibited by regulations.

CAUTION: Carbon brush performance may be ruined by absorbed solvents. Remove brushes prior to solvent wiping.

Drying of Windings

Drying of machines is most effectively done by application of heat. The windings and insulation should be heated so that their temperature does not exceed 225°F (125°C) at any location. (Do not make local hot spots.) The machine's own frame and the addition of some covers usually will make an effective enclosure to contain the heat, if an oven cannot be used. Some flow of air is desirable to allow moisture to be carried away. Methods of generating heat include blowing hot air through the machine, heating with heat lamps, passing current through the main-field-coil windings, etc.

If temperatures as high as 225°F (125°C) can be attained, they should be limited to six or eight hours duration. Lower temperatures will cause correspondingly longer drying times.

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Drying out can be ended when the insulation resistance to ground (corrected to 40°C) is restored to a satisfactory value as described in the **Insulation Resistance** section. If these values do not reach a proper level, then a thorough cleaning or complete reconditioning may be necessary.

Service Shop Cleaning

When the cleaning or drying methods described in preceding paragraphs do not result in restoration of acceptable insulation resistance and/or when machines are extremely dirty or contaminated, it is recommended that the reconditioning services of a GE service shop be obtained. Service shops are knowledgeable and equipped for more sophisticated restoration methods, such as hot water detergent wash, solvent and abrasive cleaning, revarnishing, and rewinding if necessary.

Repair

Repairs should be made only by qualified personnel using the materials and processes for which the motor was designed. To protect the warranty during the warranty period, all repairs must be made in a GE service shop or approved repair facility. Many repairs can be easily performed with only assembly operations, if GE replacement parts are available. If major repairs are undertaken (such as rewinding an armature), proper facilities should be available and suitable precautions observed.

WARNING: When burning off old insulation materials or when welding near insulation during rewinding, adequate ventilation must be provided to avoid exposing personnel to noxious fumes. Combustion of exhaust fumes must be complete and adequately vented to the outside atmosphere.

WARNING: Exposure of personnel to airborne inorganic fibers must be avoided by adequate ventilation or by wetting the remaining insulation components following the burning off of the organic materials.

Failure

WARNING: An extreme overload or electrical failure may result in heating or arcing, which can cause the insulation to give off noxious fumes. All power should be removed from the motor circuit as a precaution, even though the circuit has overload protection. Personnel should not approach the motor until adequate ventilation of the area has purged the air of fumes. When covers of a totally enclosed motor are removed after a failure, care should be observed to avoid breathing fumes from inside the motor. Preferably, time should be allowed for the motor to cool before attempting any examination or repair.

WARNING: Water should not be applied to any electrically energized equipment because electric shock could result in serious or fatal injury. In case of fire, disconnect all power and use a carbon dioxide extinguisher to quench to flame.

Before operating any motor after a suspected failure, it should be inspected for damage. Remove covers and make visual inspections of the brushes, commutator, connections, and windings. Electrical tests of each winding to check for open or short circuit or grounds should be made. Any arc damage should be cleaned up and repaired as necessary. Brushes may need reseating before operation.

RENEWAL PARTS

Using genuine GE renewal parts assures continued high performance and the full benefits of the long operating life designed into your GE motor.

Downtime can be minimized by having a protective stock of parts available for replacement. (Refer to **Table 17**.)

The permanently attached nameplate on your GE motor displays the model and serial number, providing all the information you need for ordering. Parts are available directly from authorized GE-DM&G parts distributors. Direct electronic access to the factory database of motor information and warehouse inventories enables the distributor to quickly identify part numbers, delivery times, and order status.

Distributor location is available to you at (814) 875-2387 (and toll free outside Pennsylvania at 1-800-458-0451).

For your convenience, **Table 18** outlines standard brush and brush spring part numbers to assist in ordering renewal parts.

SPARE PARTS

TABLE 17

RECOMMENDED SPARE PARTS

As insurance against costly downtime, it is strongly recommended that spare parts be kept on hand in accordance with the chart below:

DESCRIPTION	NUMBER OF DUPLICATE MOTORS IN SERVICE				
	1	2-4	5-10	11-20	More than 20
WITH OR WITHOUT ELECTRICAL SHOP FACILITIES					
Complete Machine	-	-	-	1	2
Drive End Ball Bearing	1	1	1	2	3
Front End Ball Bearing	1	1	1	2	3
Brushes (Sets)	2	4	6	8	10
Brushholders (Sets)	-	1/2	1/2	1	1
Brushholder Springs (Sets)	1/2	1	1	2	2
Main Field Coil and Pole	-	1	1	2	3
Commutating Field Coil and Pole	-	1	1	2	3
Armature Complete*	-	1	1	2	2
Blower Vent, motors					
Blower motors	-	1	1	2	2
WITH ELECTRICAL SHOP FACILITIES					
Shaft**	-	-	-	1	1
Armature Rewinding Supplies	-	1	1	2	3

*If shop facilities are available, the quantity of armatures may be reduced by stocking the armature parts listed in the second group.

**Shaft not replaceable in CD180AT thru CD250AT.

TABLE 18

STANDARD BRUSH AND BRUSH SPRING PART NUMBERS

FRAME SIZE	STANDARD BRUSH PART NUMBER*	BRUSH SPRING PART NUMBER
CD180AT	36A167400AA001	36B467022AB001
CD210AT	36A167401AA008	36B467020AA001
CD250AT	36A167401AA008	36B467020AA001
CD280AT	36A167402AA004	36B467021AA001
CD320AT	36A167402AA004	36B467021AA001
CD360AT	36A164456AA021	36B465486AA001
CD400AT	36A164451AB018	36B465481AD001
CD500AT	36A164452AA021	36B465482AA001

*Brush part numbers are for most applications. Special applications such as papermills, pump motors, diesel-driven generators and others may require special brush grades. Before ordering brushes, check the part number stamped on the brush to ensure the correct brush replacement.

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Exploded views found on pages 34 & 35

	Name	Qty. Per Motor
1.	Brush	2
2.	Brush Spring	2
3.	Bearing C.E.	1
4.	Bearing D.E.	1
5.	Armature	1
6.	Coil & Pole Comm.	2
7.	Coil Main	2
8.	Bearing Bracket (CE)	1
9.	Access Cover	1
10.	Brush Rigging	1
11.	Armature Fan	1
12.	Bearing Bracket (DE)	1
13.	Wound Frame Assembly	1

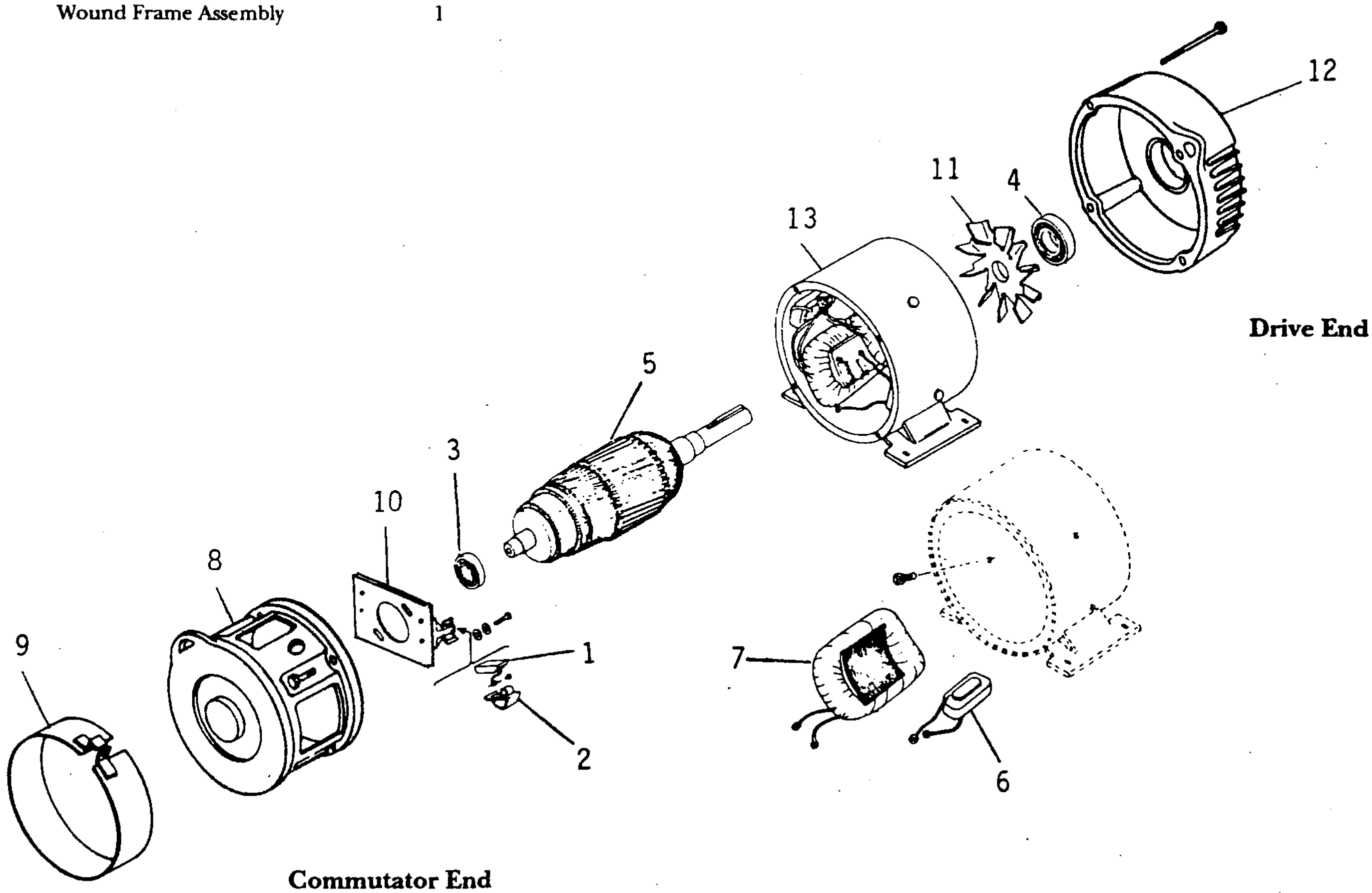


Fig. 9 CD180AT Frame, Exploded View

Section 4

POLY CHAIN ASSEMBLY

Poly Chain Transmission

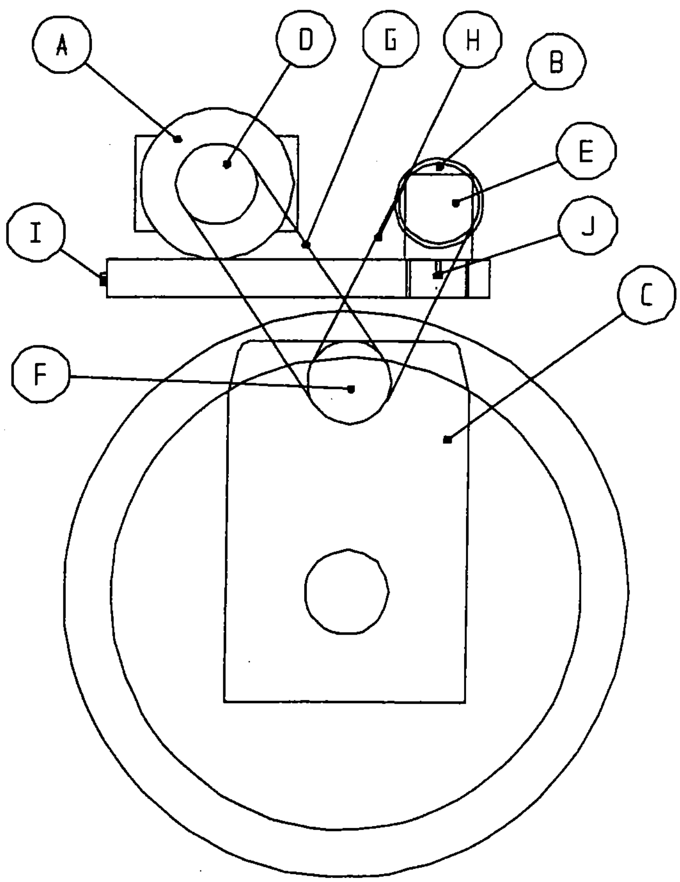
General Description

Power from the electric motor and evacuation motor to the gear reducer is transmitted by a poly chain belt and sprocket. The sprockets are specially designed to give your installation the optimum gear ratio.

Do not change these sheaves without the approval of POMA of AMERICA.

Parts (All part numbers are Gates Rubber Company numbers)

• Electric motor sprocket (D)		**Part #: 14M-48S-20**
• Evacuation motor sprocket (E)		**Part #: 14M-48S-20**
• Gear reducer sprocket (F)		**Part #: 14M-50S-68**
• Poly chain belts:	Electric (G)	**Part #: 14M-1960-20**
	Evacuation (H)	**Part #: 14M-1750-20**



A: Electric Motor
B: Evacuation Motor (Hydraulic Motor)
C: Gearbox
D: Electric motor sprocket
E: Evacuation motor sprocket
F: Gear reducer sprocket
G: Electric Poly Chain belt
H: Evacuation Poly Chain Belt
I: Elec. tension adjustment bolt
J: Evac. tension adjustment bolt

FIGURE 4-1

Assembly

Electric Motor Sheave

Install the Poly chain sprocket on the electric motor output shaft as close as possible to the motor housing without interference.

- Make sure the tapered-cone surface of the bushing and the mating bore of the sprocket are free of all foreign substances, such as dirt, excess paint accumulations, metal chips, lubricants, etc.

- For POSITION ONE or POSITION TWO, whichever applies (see figure 4-1), line up the unthreaded holes (C) with the threaded holes (T) and insert cap screws with lock washers engaging only 2 or 3 threads. Screw heads should be mounted outside to enable disassembly.

- With key in shaft keyway, slide the loosely assembled unit onto shaft and position for good belt alignment. **Do not** use lubricants or anti-seize compounds on threads or tapered surfaces.

- Carefully tighten the cap screws alternately and progressively until tapers are seated (at approximately half the recommended torque).

- Check alignment and sheave run-out (wobble) and correct as necessary.

- NOTE: When properly mounted, there will be a gap between bushing flange and sheave after screws are tightened.

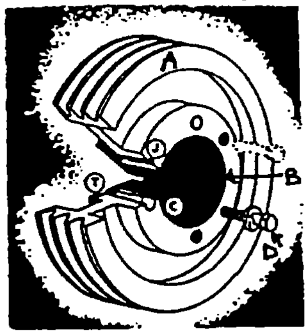
  CAUTION: Use of lubricants and/or excessive screw torque can cause breakage.

- Tighten the set screw, when available, to hold key securely during operation.

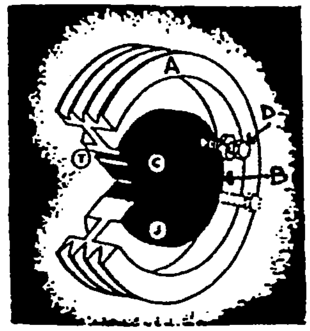
Removal of Bushings

- Loosen and remove all mounting cap screws.
- Insert cap screw in all threaded jackscrew holes (J).
- Start with the screw furthest from the bushing saw slot and tighten all jack screws alternately and progressively. Keep turning the screws in small equal amounts until the tapered surfaces disengage.

  CAUTION: Excessive or unequal pressure on the jackscrews can break the bushing flange, making removal nearly impossible without destroying the sheave.



POSITION ONE



POSITION TWO

FIGURE 4-2

Recommended
Wrench Torque Values
To Use in Tightening QD Bushings

Bushing Size	Cap Screw Size & Thread	Ft/Lbs. Wrench Torque Normal Applications
JA	No. 10-24	5
SH-SDS-SD	1/4-20	9
SK	5/16-20	15
SF	3/8-16	30
E	1/2-13	60
F	9/16-12	75
J	5/8-11	135
M	3/4-10	225
N	7/8-9	300
P	1-8	450
W	1 1/8-7	600
S	1 1/4-7	750

CAUTION: Excessive cap-screw torque can cause sheave and/or bushing breakage.

CAUTION: The use of lubricants can cause sheave breakage. Therefore, **USE NO LUBRICANTS** in this installation.

FIGURE 4-3

Note: Pacoima QD bushing #

Electric motor sprocket: E-Ø 2.125in
Evacuation motor sprocket: E-Ø 1.250in
Gearbox sprocket: F-Ø 40mm

Installing Poly Chain Belts.

Note: During normal operation (Electric Motor) only the electric Poly Chain belt 14M-1960-20 is installed. During evacuation use (hydraulic motor) only the evacuation Poly Chain belt 14M-1750-20 is needed. During evacuation operation both belts may be on the sprockets provided the <u>electric motor has not seized</u>. (Figure 4-1)

Loosen tension bolts. (figure 4-1)

Place the belt on the sprockets. Be careful not to use force, as this can damage the belt fibers. **Only use the 14M-48S-20 belt on the electric motor and 14M-1750-20 on the evacuation motor.**

Before tightening, mark two fine lines across the back of the belt in the middle of the set. (figure 4-4)

Tighten the belt in small increments by tightening the tension bolts. Rotate the transmission (about 1 mm) after each tightening, until the length between the two lines has increased by 1 mm for the electric motor belt and 0.8 mm for the evacuation motor belt. (figure 4-5).

After 24 operating hours, check and retighten if necessary.

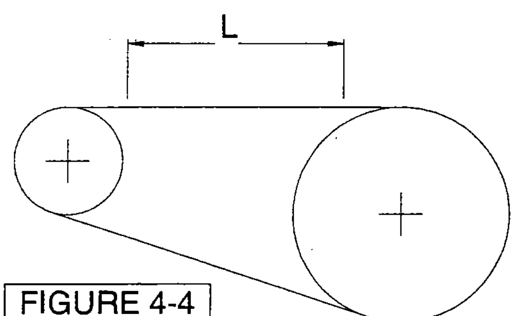


FIGURE 4-4

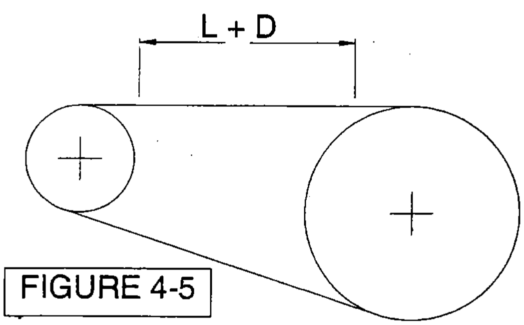


FIGURE 4-5

Electric motor belt D=1.0mm
Evacuation motor belt D=0.8mm

Aligning the Sprockets

An improper alignment of the sprockets results in the premature wearing of the belts.

Before the final tightening of the bolts that fix the motor, check the alignment of the sheaves as indicated in figure 4-6.

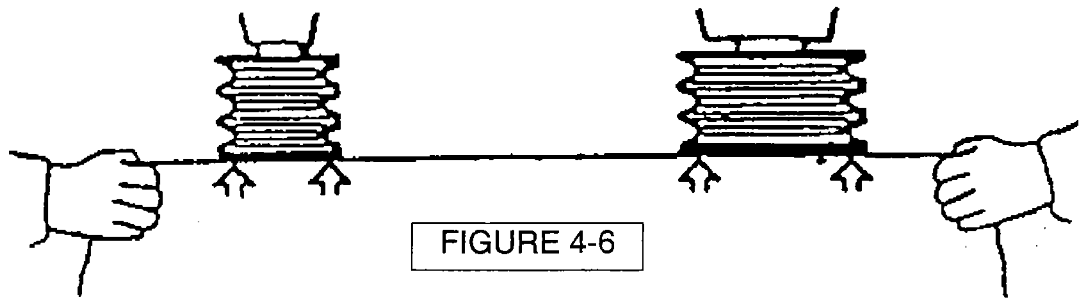


FIGURE 4-6

Maintenance

Run lift for at least 30 minutes (no load) after changing a belt.

Recheck belt tension daily for first week and monthly thereafter.

Maintenance Schedule

Frequency	*Maintenance Activity*
DAILY	Inspect belts for abrasions, cracking and separation. Check belt sprockets for damage, loose bolts, and foreign material (grease, oil, etc.) Check belt tension.
ANNUALLY	Remove belts for inspection. Thoroughly inspect belt sprockets for damage, heat cracks and distortion. Check bushing bolt torque on electric motor sprocket. Check alignment of motor sprocket to gearbox sheave.

Section 5

EVACUATION ENGINE

EVACUATION POWER UNIT

General Description:

The auxiliary power unit for this lift is an internal combustion engine. The primary function of this engine is to operate or to evacuate the lift in the event of a power failure. The entire lift system will function without primary electrical power, while all safety systems remain fully operational.

The power unit is connected to the Eaton hydraulic pump.

Parts:

INTERNAL COMBUSTION ENGINE

See accompanying manufacturer's manual.

Quick Reference (Write information from your equipment in the spaces below:)

- Oil filter:______________________________
- Oil:____________________ Capacity:__________
- Fuel:____________________ Capacity:__________
- Fuel filter:______________________________
- Fuel line hose:______________________________
- Air filter:______________________________
- Spark plugs:______________________________
- Belts:______________________________
- Coolant:____________________ Capacity:__________
- Standard adjustments:______________________________

Spare parts are available from POMA of AMERICA.

Adjustment/Maintenance of Evacuation Engine:

See manufacturer's manual in the Hydraulic Tension System section of this manual, for specific engine and adjustments.

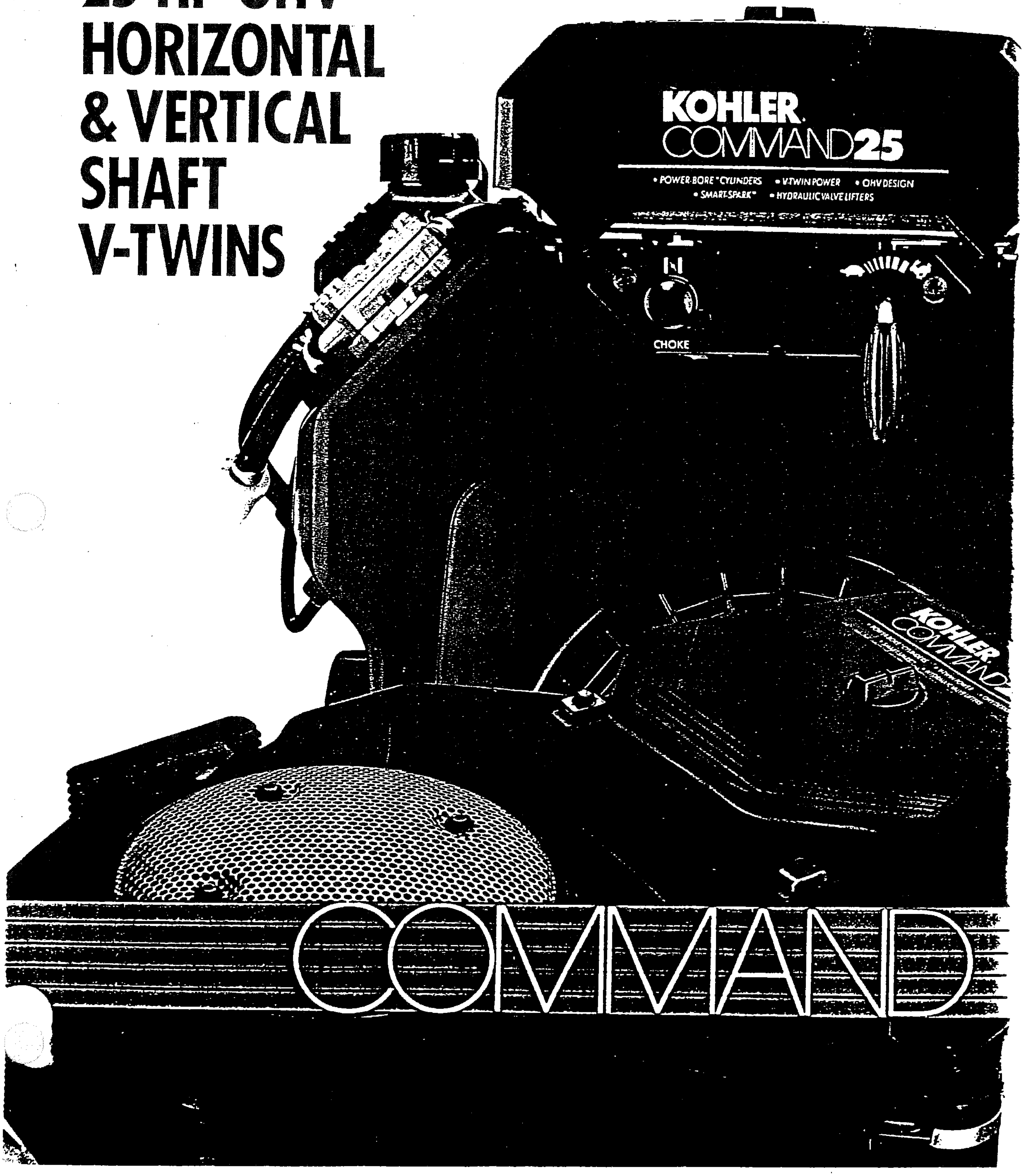
For authorized service and maintenance, contact POMA of AMERICA or a local manufacturer's representative.

Maintenance Schedule of Hydraulic Evacuation Drive

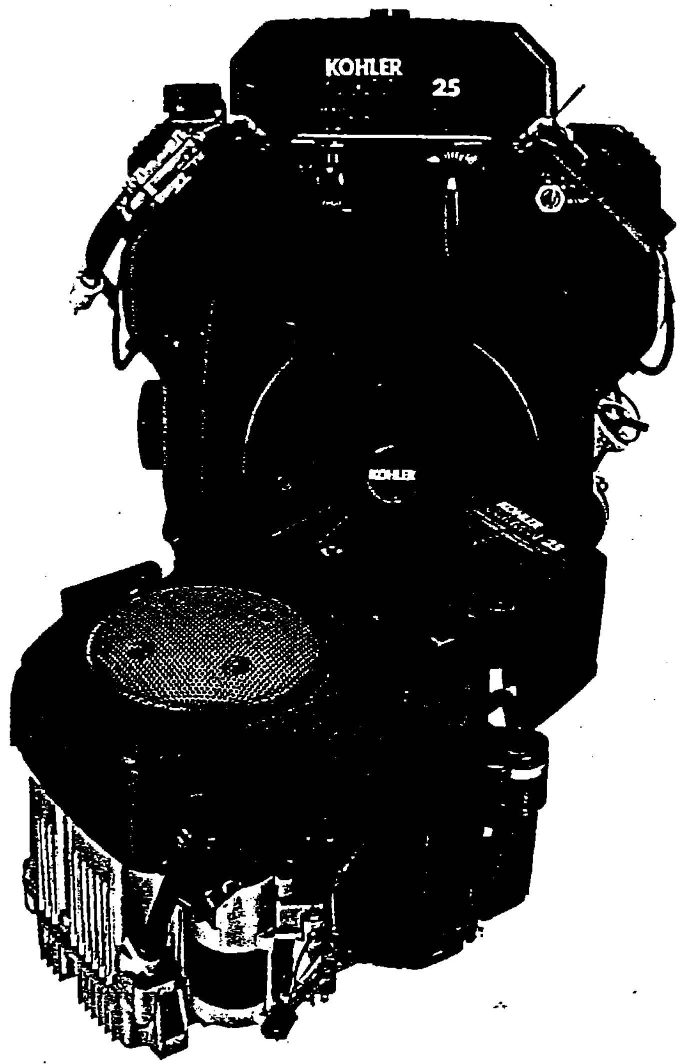
Frequency	*Maintenance Activity*
DAILY	* Fuel level * Oil level * Coolant level * Battery level * Hydraulic oil level
ONCE A WEEK	Run the evacuation engine 10 minutes to ensure it will operate properly. Do **not** engage the hydraulic motor to the gearbox for this.
ONCE A MONTH or as required	Run the lift for 15 minutes powered by the evacuation drive. Check the emergency stop safety circuits. **Note:** An open emergency stop circuit will kill the engine, set the service brake and the emergency brake. Check the speed controls. Check the rpm's. All other inspections shall be performed in accordance with the manufacturer's manual.
LUBRICATION	See the manufacturer's manual.

KOHLER engines

25 HP OHV HORIZONTAL & VERTICAL SHAFT V-TWINS



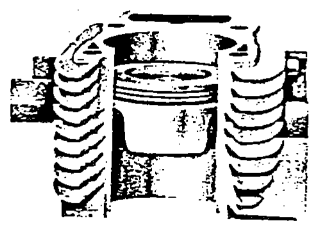
KOHLER'S POWER ALTERNATIVE...



THE COMMAND 25 HP OHV V-TWINS

The Command 25. Finally there's an alternative to imported OHVs and U.S. L-heads in the under 30 HP category. Available in both vertical and horizontal shaft configuration, Kohler's new high-performance Command 25 engines offer OHV design, V-twin power, made-in America quality, and a variety of exclusive features.

POWER-BORE™ CYLINDERS



Plated with resilient nickel-silicon, an exclusive in Kohler's class of engines, POWER-BORE cylinders give you:

- Increased power
- Virtually permanent cylinder life
- Superior oil control
- Reduced exhaust emissions

This plating is also used on high performance race cars like Porsche, Ferrari, Lamborghini, Maserati and "Formula 1" cars.

SMART-CHOKE™ CARBURETOR

All Command V-Twins feature SMART-CHOKE, a self-relieving choke carburetor. SMART-CHOKE adjusts the air-fuel ratio automatically for optimum starting and prevents overchoking when a warm engine is restarted.

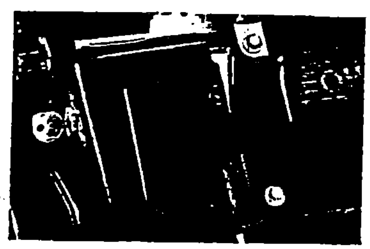
OVERHEAD VALVE DESIGN

OHV design maximizes fuel combustion to ensure even burning for greater fuel efficiency. It also means virtually no carbon build up. The result... reduced maintenance costs.

HYDRAULIC VALVE LIFTERS

Kohler hydraulic valve lifters reduce valve train noise and eliminate valve adjustment. This makes Command's valve train nearly maintenance free.

ELECTRONIC SMART-SPARK™ IGNITION



SMART-SPARK ignition retards the spark for optimum starting and slow-speed running, while advanc-ng the timing for peak efficiency nd power during high-speed operation. This means faster all-weather starts, improved power and lower emissions.

TEN EXCLUSIVE REASONS TO CHOOSE KOHLER

1. Nickel-silicon POWER-BORE cylinders for power and durability.
2. Electronic SMART-SPARK ignition for broad RPM response.
3. SMART-CHOKE carburetor for consistent all-weather starting.
4. Hydraulic valve lifters for quiet, maintenance-free operation.
5. Specially-designed oil cooler for heavy-duty power demands.
6. Overhead valve design for greater fuel efficiency and lower emissions.
7. Compact size. An ideal companion to Command 18-20-22 models in virtually the same envelope space.
8. Worldwide service network with 10,000 skilled dealers and distributors offering genuine Kohler replacement parts.
9. Broad Kohler product line (6HP and up, single and twin-cylinder) to complement your power needs.
10. Only American-made OHV engine in its class.

MODEL SPECIFICATIONS

ENGINE TYPE:	4-Cycle, Twin Cylinder, Overhead Valve, Air-Cooled, Gasoline, Horizontal and Vertical Shaft, Aluminum Crankcase with POWER-BORE Cylinders.
MODEL:	**CH25/CV25**
POWER (@ 3600 RPM) hp (kW)	25 (18.4)*
DISPLACEMENT cu. in. (cc)	44 (725)
BORE in. (mm)	3.27 (83)
STROKE in. (mm)	2.64 (67)
MAX TORQUE lbs. ft. (N•m)	39.5 (54) @ 2400 RPM
COMPRESSION RATIO	9:1
DRY WEIGHT lbs. (kg)	94 (43)
OIL CAPACITY (w/filter) U.S. qts. (l)	2.1 (2)

*Horsepower ratings (shown as gross) are in accordance with Society of Automotive Engineers - Small Engine Test Code J1349.
Kohler Co. reserves the right to change product specifications, designs, and standard equipment without notice and without incurring obligation.

STANDARD FEATURES

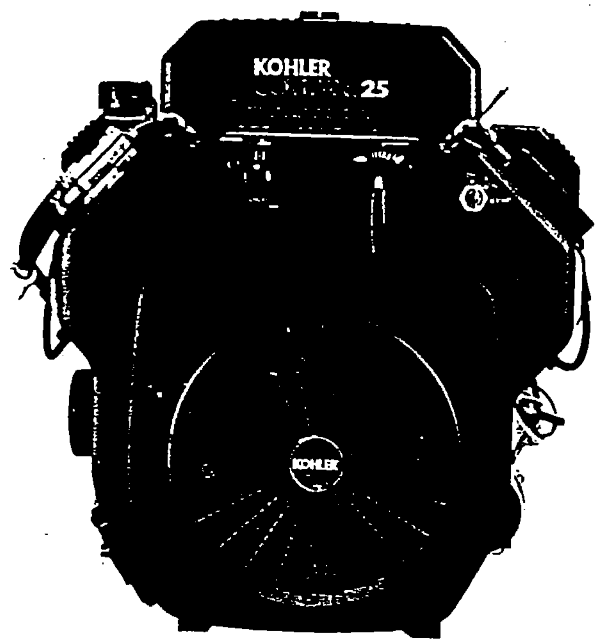
- Overhead valve design
- POWER-BORE cylinders
- Oil cooler
- Electronic SMART-SPARK ignition
- Easy access oil fill
- Dual element air cleaner
- Fixed jet SMART-CHOKE carburetor
- Hydraulic valve lifters
- 12V solenoid-shift starter
- 15A charging system
- Dual oil drains
- Spin-on oil filter

POPULAR FACTORY OPTIONS**

- Mufflers
- Close regulation governor
- High altitude kit
- Choice of crankshafts
- Remote oil filter
- In-line fuel filter
- Engine-mounted controls w/ignition key switch
- Oil Sentry™ system
- Muffler exhaust deflector
- Muffler spark arrestor
- 25A charging system
- Flywheel-mounted PTOs
- PTO thrust bearing (600 lbs)
- SAE A/B pump mounts w/spline crankshafts

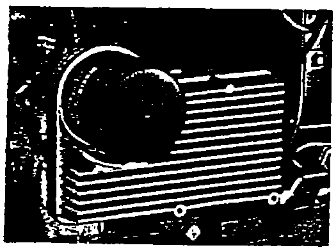
** Standard on some distributor basic engines, optional on OEM engines. Varies between vertical and horizontal shaft engines.

25 HP
HORIZONTAL SHAFT V-TWIN



When you choose Kohler's Command 25 hp horizontal shaft V-Twin, you're choosing the industry's environmental leader in engine power.

SPECIALLY-DESIGNED OIL COOLER

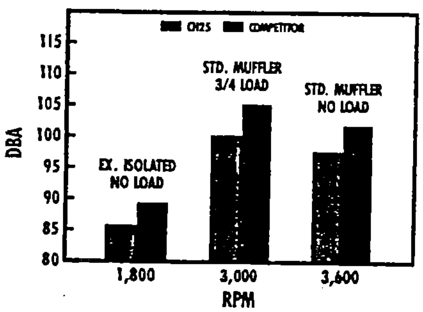


Kohler's specially-designed oil cooler helps maintain the lowest possible oil temperature during the entire power range, regardless of application or duty cycle. It also protects the environment by extending oil change intervals.

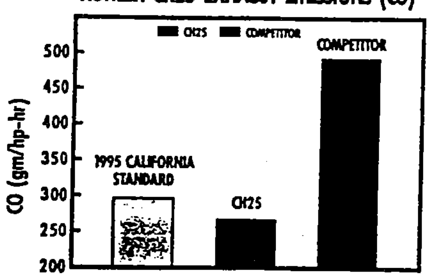
ENVIRONMENTAL LEADERSHIP

Command's CO and HC + NOx exhaust emissions are lower than California's standards and well below the emissions of the competition. Command is also the "quiet" winner in noise emissions. (Competitive product purchased randomly from manufacturer's source of supply. Based on a 1992 test.)

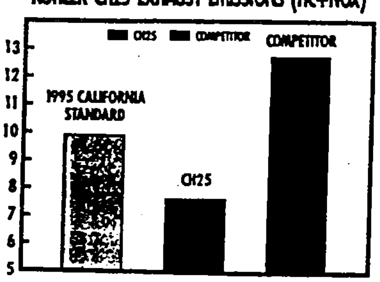
KOHLER CH25 ACOUSTIC EVALUATION



KOHLER CH25 EXHAUST EMISSIONS (CO)

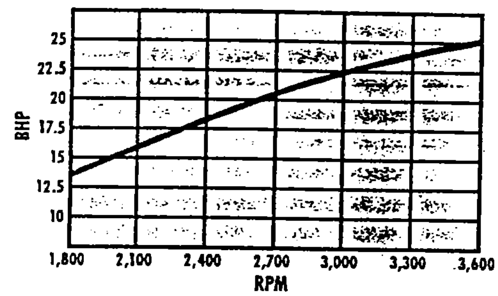


KOHLER CH25 EXHAUST EMISSIONS (HC+NOX)

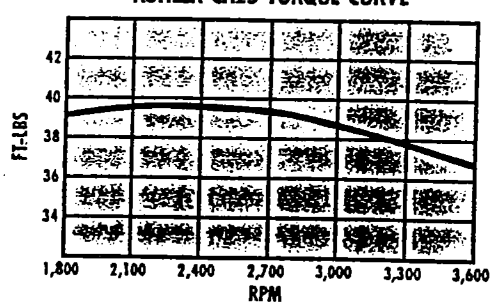


PERFORMANCE DATA

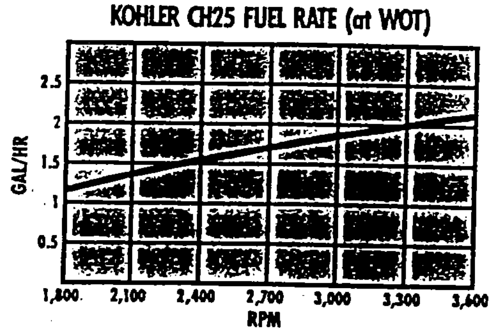
KOHLER CH25 POWER CURVE



KOHLER CH25 TORQUE CURVE

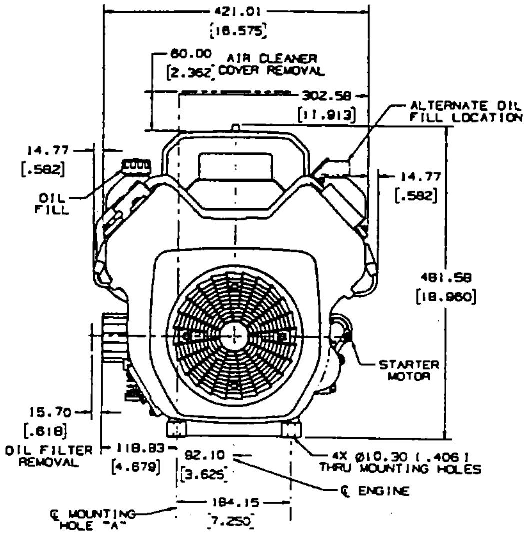


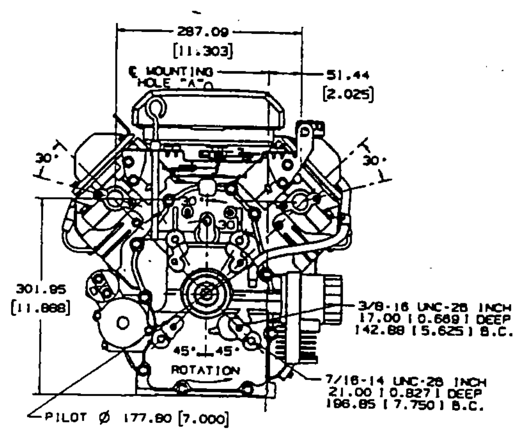
KOHLER CH25 FUEL RATE (at WOT)

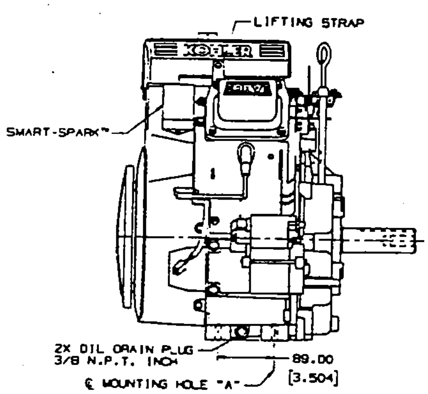


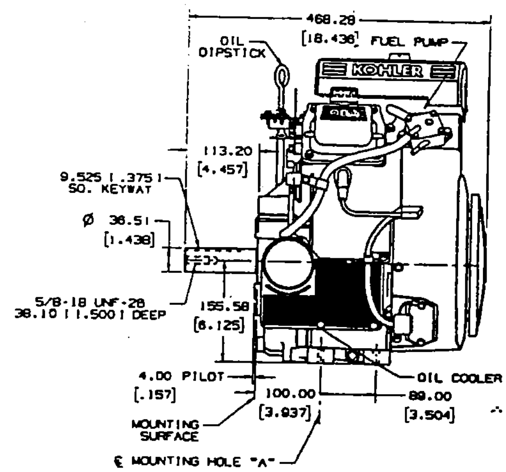
HORIZONTAL SHAFT DIMENSIONS

(Base engine illustrated)







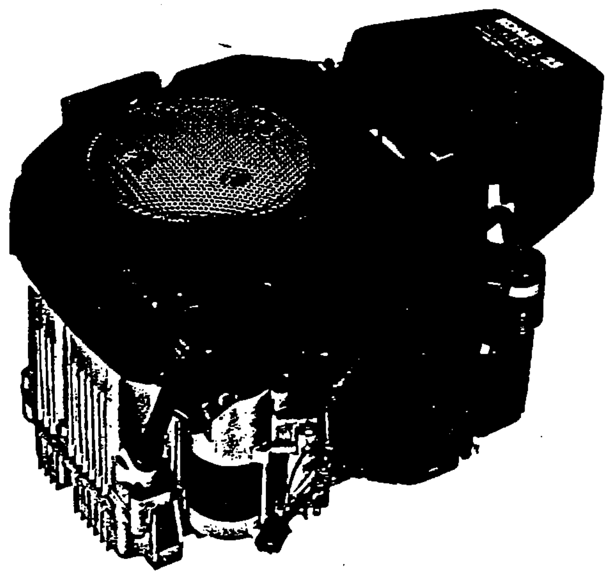


DIMENSIONS IN MILLIMETERS
INCH EQUIVALENT SHOWN IN [ ]

CRANKSHAFT/MOUNTING FACE OPTIONS				
DIMENSIONS:	MM (IN)			
MODEL: CH25	(SPEC SERIES 685XX)			
SPEC VARIATION:	00/01/07	03	04	06
PTO TYPE:	STRAIGHT	STRAIGHT	TAPER	SPLINE
PTO DIAMETER:	36.5 (1.438)	28.6 (1.125)	38.1 (1.50)	38.1 (1.50)
PTO LGTH (TO FACE):	113.2 (4.453)	101.5 (4.00)	100.0 (3.94)	11.5 (0.452)
PTO TAPER:	N/A	N/A	(2.25)/FOOT	N/A
PTO TOOTH/ADAPTOR	N/A	N/A	N/A	13/TYPE "B"
PTO DRILL & TAP:	5/8-18 UNF-2B	7/16-20 UNF-2B	5/16-24 UNF-2B	N/A
TAP DEPTH:	38.1 (1.50)	38.1 (1.50)	15.9 (0.625)	N/A
PTO KEYWAY WIDTH:	9.53 (0.375)	6.35 (0.25)	N/A	N/A
BOLT CIRCLE DIA.:	(5.625. 7.75)	(5.625, 7.75)	(5.625, 7.75)	(5.625, 7.75)
PILOT DIA.:	(7.00)	(7.00)	(6.437)	N/A

NOTE: Contact Kohler representative for special crankshafts or mounting faces not shown here.

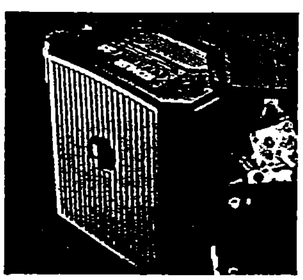
25 HP
VERTICAL SHAFT V-TWIN



Kohler's Command 25 hp vertical shaft engine is designed to last even under extreme conditions, specifically in lawn tractor and commercial mowing applications. With full-pressure lubrication, POWER-BORE cylinders, and Kohler's proven overhead valve design, your Command vertical shaft V-Twin will deliver the horsepower you need throughout its long life.

HIGH-EFFICIENCY AIR FILTER

...hler vertical shaft V-Twins are available with standard or commercial mower ... cleaner designs. Both feature dual element filtering to trap dust and dirt as ...ne as 2 microns... that's 1/30th the diameter of a human hair.



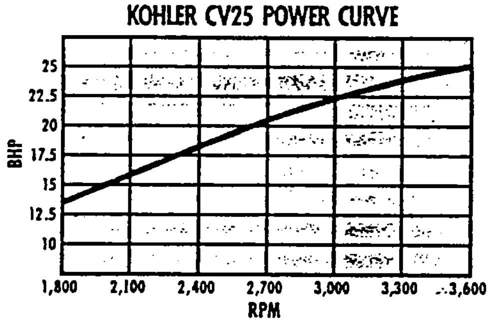
- Standard design (shown left) allows engine to fit compactly into nearly any application.
- Commercial mower design (shown above, right) features a larger capacity, 425 square inch filter area. The extra capacity is ideal for mowing operations and the "out-front" position makes regular maintenance quick and easy.

SPECIALLY-DESIGNED OIL COOLER

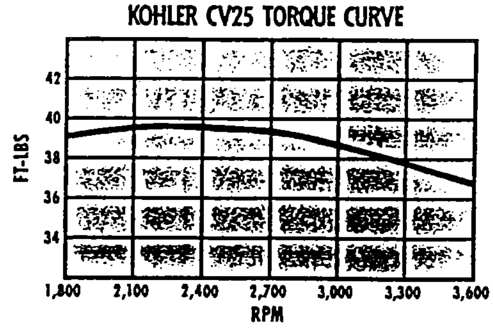
Kohler's specially-designed oil cooler helps maintain the lowest possible oil temperatures during the entire power range, regardless of application or duty cycle. It requires less maintenance by extending oil change intervals.

PERFORMANCE DATA

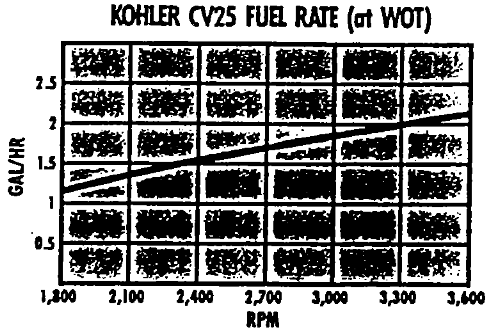
KOHLER CV25 POWER CURVE



KOHLER CV25 TORQUE CURVE

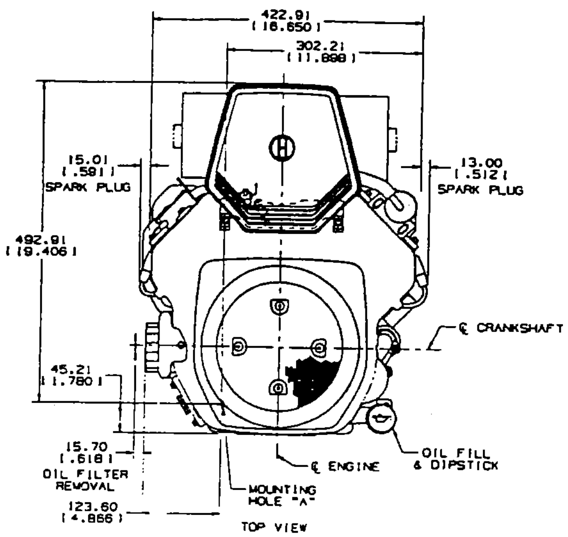


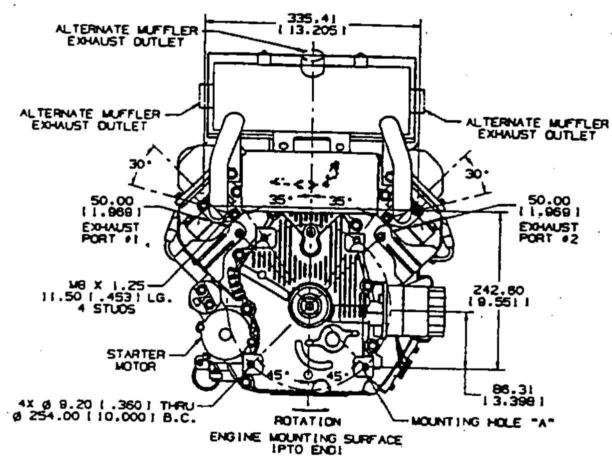
KOHLER CV25 FUEL RATE (at WOT)

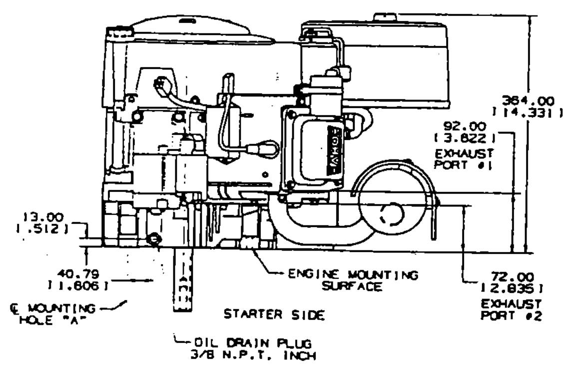


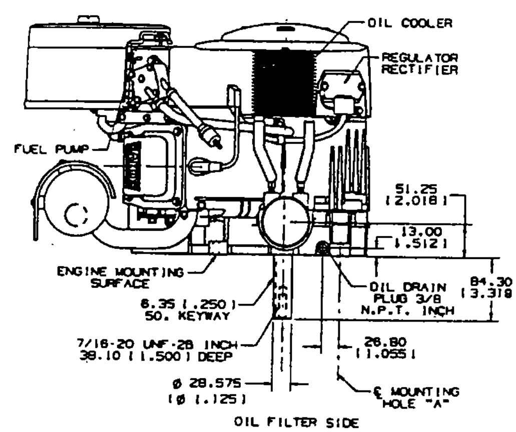
VERTICAL SHAFT DIMENSIONS

(Commercial mowing engine illustrated)







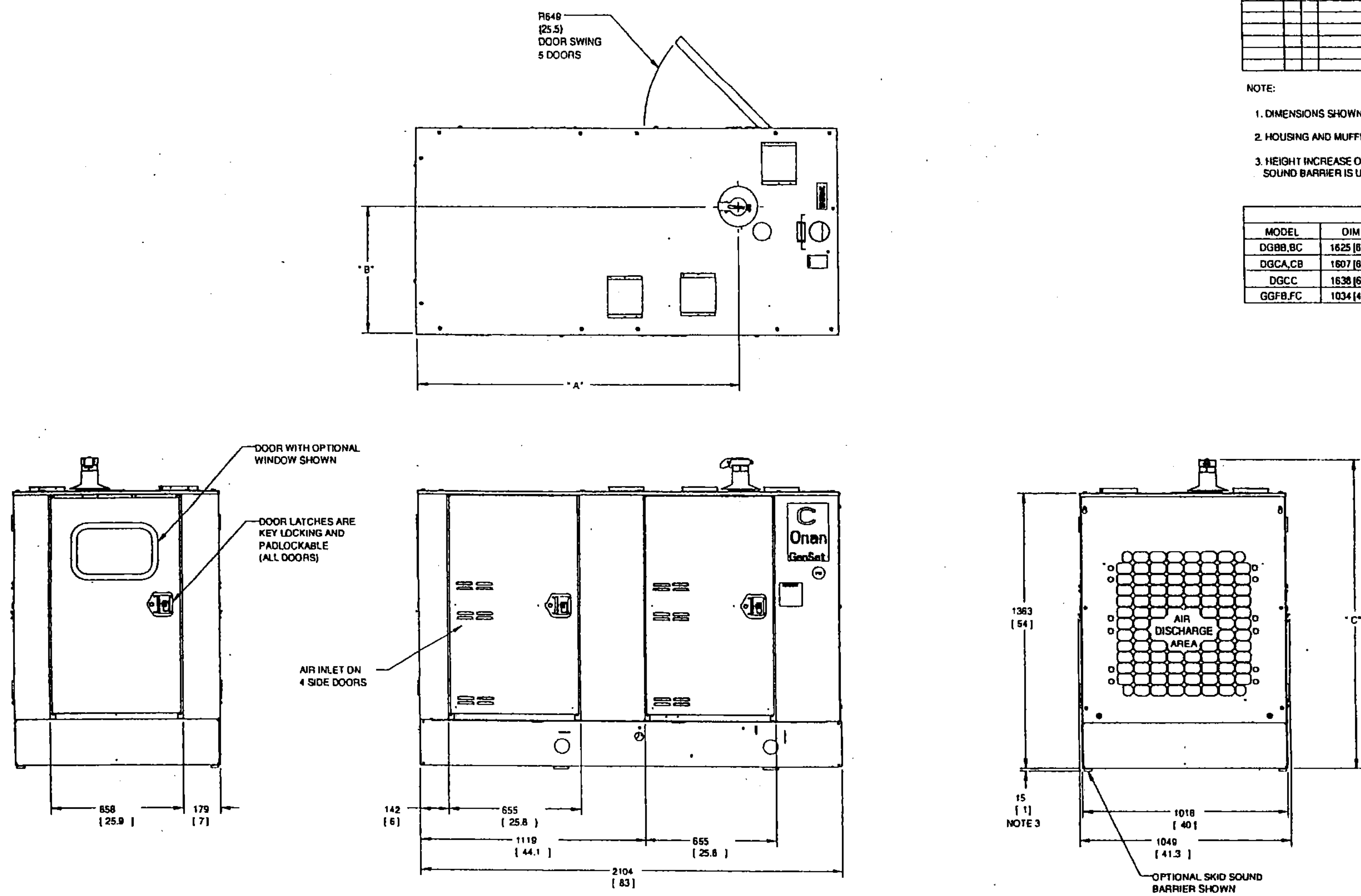


DIMENSIONS IN MILLIMETERS
INCH EQUIVALENT SHOWN IN ( )

CRANKSHAFT/MOUNTING FACE OPTIONS	
DIMENSIONS:	MM (IN)
MODEL: CV25	(SPEC SERIES 695XX)
SPEC VARIATION:	00/01
PTO TYPE:	STRAIGHT
PTO DIAMETER:	28.6 (1.125)
PTO LGTH (TO FACE):	84.3 (3.32)
PTO DRILL & TAP:	7/16-20 UNF-2B
TAP DEPTH:	38.1 (1.50)
PTO KEYWAY WIDTH:	6.35 (0.25)
BOLT CIRCLE DIA.:	254.0 (10.0)
PILOT DIA.:	N/A

NOTE: Contact Kohler representative for special crankshafts or mounting faces not shown here.

LTR	REV	REVISION	DATE
A	1	PRODUCTION RELEASE	11-18-96
B	1	ADD MODELS GGFB,FC	04-24-97
	2	ADD DIMS FOR MODELS TO TAB	04-24-97



NOTE:

1. DIMENSIONS SHOWN IN [ ] ARE INCHES.
2. HOUSING AND MUFFLER WEIGHT: 141 kg [310 lbs]
3. HEIGHT INCREASE OF 14.6 [0.6] WHEN OPTIONAL SKID SOUND BARRIER IS USED.

TABULATION			
MODEL	DIM "A"	DIM "B"	DIM "C"
DGBB,BC	1625 [64.0]	625 [24.6]	1481 [58.3]
DGCA,CB	1607 [63.3]	630 [32.7]	1517 [59.7]
DGCC	1638 [64.5]	630 [32.7]	1517 [59.7]
GGFB,FC	1034 [40.7]	186 [7.30]	1505 [59.3]

APPROVED R_ENGELMANN 11-18-96

METRIC DWG

Pro/ENGINEER

DO NOT SCALE PRINT

D_HOFMEISTER 11-18-96
S_JULIK 11-18-96
R_ENGELMANN 11-18-96

Onan

Minneapolis, Minnesota 55432

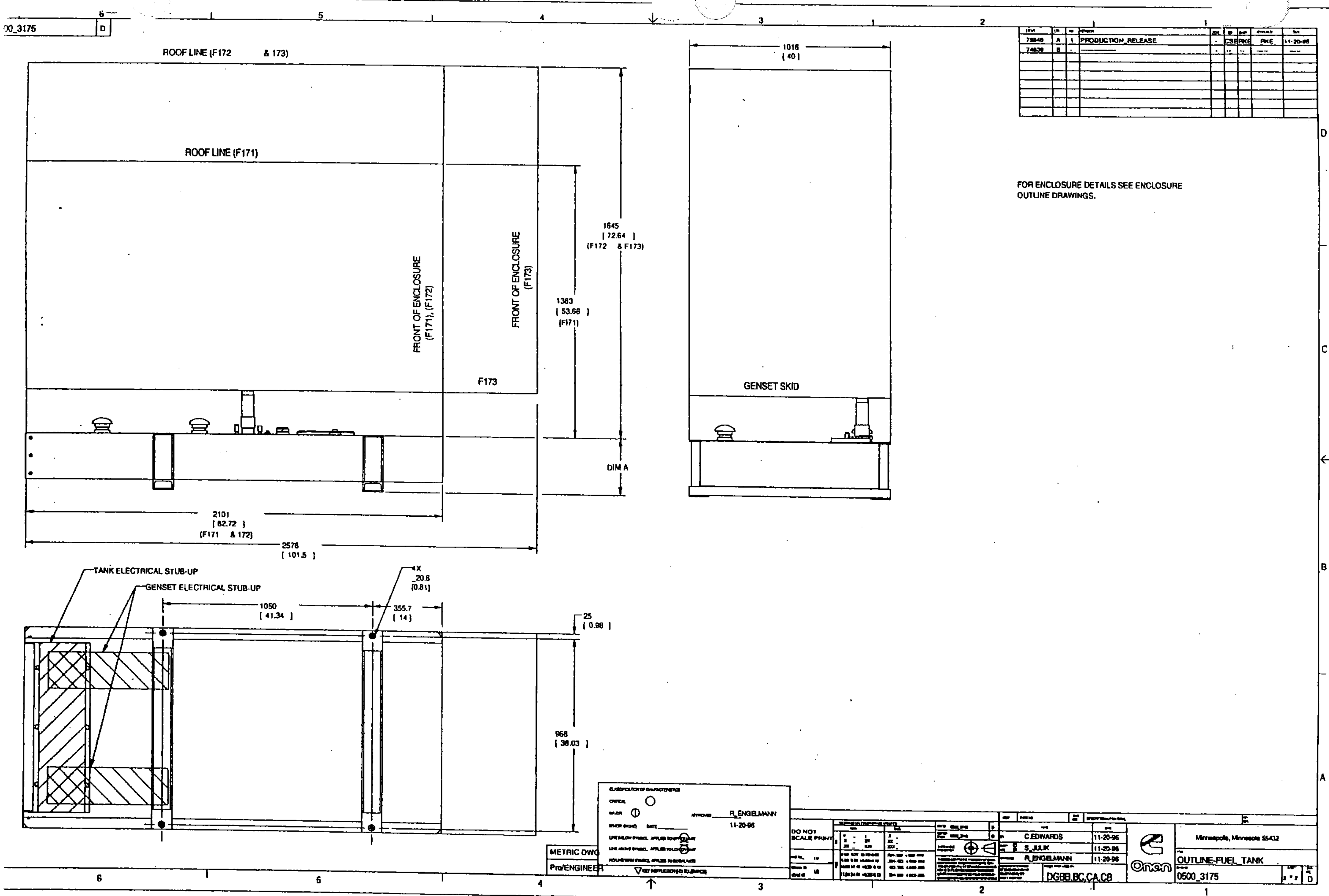
OUTLINE-HOUSING

DGBB,CA,CC,GGFB,FC

0500_3171

D

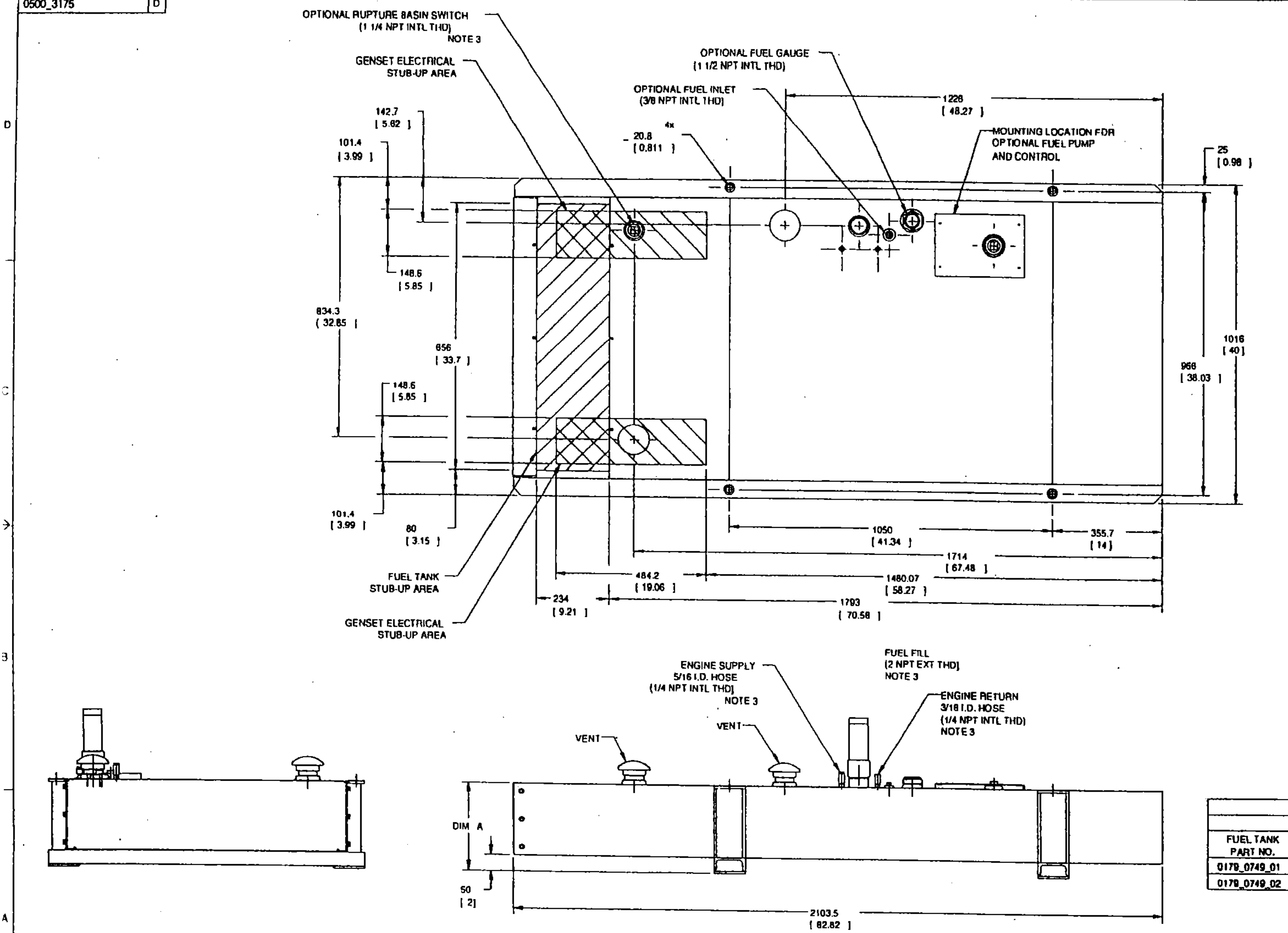
Genset supplied 3/99



00_3175
ROOF LINE (F172 & 173)
ROOF LINE (F171)
FRONT OF ENCLOSURE (F171), (F172)
FRONT OF ENCLOSURE (F173)
F173
1645 [72.64] (F172 & F173)
1363 [53.66] (F171)
DIM A
2101 [82.72] (F171 & 172)
2578 [101.5]
1016 [40]
GENSET SKID
TANK ELECTRICAL STUB-UP
GENSET ELECTRICAL STUB-UP
1050 [41.34]
4X 20.6 [0.81]
355.7 [14]
25 [0.98]
968 [38.03]
PRODUCTION_RELEASE
FOR ENCLOSURE DETAILS SEE ENCLOSURE OUTLINE DRAWINGS.
R_ENGELMANN
11-20-96
METRIC DWG
Pro/ENGINEER
DO NOT SCALE PRINT
C.EDWARDS
S_JULIK
R_ENGELMANN
11-20-96
DGBB,BC,CA,CB
Onan
Minneapolis, Minnesota 55432
OUTLINE-FUEL_TANK
0500_3175

0500_3175 D

73548	A	1	PRODUCTION RELEASE	-	CSE	RKE	RKE	11-20-96
74639	B	1	MODEL DGBB,BC,CA,CB WAS DGCC	8A	CC	BG	GILLETT	06-17-97



NOTES:

1. TANKS ARE UL142 LISTED, SECONDARY CONTAINMENT GENERATOR BASE TANK. REFER TO TANK LABELS AND LOCAL CODE TO DETERMINE VENTING REQUIREMENTS FOR BOTH COMPARTMENTS.

2. SUB BASE FUEL TANK MOUNTING. EXCESSIVE TWISTING OF THE FUEL TANK, WHEN FASTENING IT TO A FOUNDATION, MAY RESULT IN STRUCTURAL FAILURE OF THE TANK. TO INSURE THE INSTALLATION DOES NOT EXCESSIVELY TWIST THE FUEL TANK, THE FOLLOWING PROCEDURE MUST BE OBSERVED:

2.1 REFER TO ONAN APPLICATION MANUAL T030 FOR GENERAL SET MOUNTING GUIDELINES.

2.2 AFTER PLACING SET ON FOUNDATION, VERIFY ALL FOUR MOUNTING PADS CONTACT FOUNDATION.

2.3 THERE ARE 8 SHIMS (.0747 INCH THK) ATTACHED TO EACH FUEL TANK. THESE ARE INTENDED TO FILL ANY GAP BETWEEN THE MOUNTING PADS AND FOUNDATION. IF MORE SHIMS ARE REQUIRED OBTAIN ADDITIONAL P/N 159-1378 FUEL TANK SHIMS.

2.4 INSERT THE MAXIMUM HEIGHT STACK OF SHIMS THAT WILL SLIDE INTO THE GAP.

2.5 TIGHTEN TANK HOLD DOWN MOUNTING FASTENERS.

3. INDICATES PIPE SIZE OF INTERFACE PORT ON FUEL TANK FOR FEATURE OR OPTION INDICATED.

4. DIMENSIONS IN [ ] ARE IN INCHES.

TABULATION

FUEL TANK PART NO.	DIM A	VENT SIZE NOTE 3	TANK VOLUME (GAL) NOMINAL	EFFECTIVE	DRY WEIGHT kg lb
0179_0749_01	285.72	2"	75	70	227 500
0179_0749_02	487.02	3"	145	140	295 650

R_ENGELMANN 11-20-96

METRIC DWG

Pro/ENGINEER

DO NOT SCALE PRINT

C.EDWARDS 11-20-96

S_JULIK 11-20-96

R_ENGELMANN 11-20-96

DGBB,BC,CA,CB

Onan

Minneapolis, Minnesota 55432

OUTLINE-FUEL TANK

0500_3175

1 of 2 D

Section 6

GENSET

GENSET

General Description:

The genset power unit for this lift is an internal combustion engine. The primary function of this engine is to supply electrical power to operate the lift in the event of a power failure. The entire lift system will function without primary electrical power, while all safety systems remain fully operational.

Parts:

INTERNAL COMBUSTION ENGINE
See accompanying manufacturer's manual.

Quick Reference (Write information from your equipment in the spaces below:)

- Oil filter:____
- Oil:____________________________ Capacity:__________
- Fuel:____________________________ Capacity:__________
- Fuel filter:____
- Fuel line hose:____________________________________
- Air filter:____
- Belts:____
- Coolant:_________________________ Capacity:__________
- Standard adjustments:______________________________

Spare parts are available from POMA of AMERICA.

Adjustment/Maintenance of Genset Engine:

See manufacturer's manual for specific engine and adjustments.

For authorized service and maintenance, contact POMA of AMERICA or a local manufacturer's representative.

Maintenance Schedule of Hydraulic Evacuation Drive

Frequency	*Maintenance Activity*
DAILY	* Fuel level * Oil level * Coolant level * Battery level
ONCE A WEEK	Run the evacuation engine 10 minutes to ensure it will operate properly.
ONCE A MONTH or as required	Run the lift for 15 minutes powered by the genset drive. Check for proper power supply to lift. All other inspections shall be performed in accordance with the manufacturer's manual.
LUBRICATION	See the manufacturer's manual.

Industrial Business Group Worldwide Warranty

Commercial/Industrial Generator Sets and Systems

Limited Warranty

Base Coverage

Coverage Period

This is a limited warranty which applies to all Onan® and Cummins® brand Industrial generator sets and associated switches, switchgear, and accessories (hereafter referred to as "Products".) Products will be free from defects in material and workmanship for a period of one year from the date of initial start–up of the Product. In the case of units used for rental or demonstration purposes, the one year coverage period begins on the date the unit is first used for such rental or demonstration purposes. This warranty is extended to all subsequent owners of the unit during the coverage period.

Repair or replacement parts are warranted for ninety (90) days from date of purchase, excluding labor and travel expenses.

Onan's Responsibilities

Onan's liability and owner's sole remedy are limited to the repair or replacement, at Onan's option, of the Product or parts that do not conform to this warranty.

In accordance with Onan's Warranty Administration policies, Onan will pay for the parts and labor required to repair the unit and, when necessary, reasonable labor expenses associated with the removal and reinstallation of the Product if such work is done by an authorized Cummins/Onan Distributor or designated service representative.

In accordance with Onan's Warranty Administration policies, Onan will pay limited travel expenses* when necessary to make on–site repairs. See your Distributor for details.

The cost of maintenance items such as oil, filter elements, belts, and hoses will be paid for by Onan when such items are not reusable because of the warrantable failure.

*EXCLUDES mobile applications.
*Travel for TGHAA series including transfer switch is limited to 2-1/2 hours travel time and 100 miles round trip.

Owner's Responsibilities

The owner is obligated to install, operate and maintain the Product in accordance with the recommendations published by Onan, including, without limitation, operating within power rating designation set out in Power Rating section, below. The owner is responsible for the costs associated with such maintenance and any adjustments which may be required.

Prior to expiration of the applicable warranty and within 30 days after discovery of the warrantable failure, the owner must notify an authorized Cummins/Onan Distributor or designated repair facility of any warrantable failure and have the repair or replacement made by such facility.

Installation inspection and initial start–up of Commercial–Industrial genset or power systems must be conducted by an authorized Cummins/Onan distributor, or designated representative.

The owner is responsible for payment of any of the following expenses that might be incurred as a result of a failure under the terms of this warranty:

1. Rental equipment used to replace the equipment being repaired, other downtime expenses, and all business costs and losses.
2. Telephone, communication, living and travel expenses incurred by the owner.
3. The premium costs for overtime labor requested by the owner.
4. The cost of air freight or other extraordinary expenses for shipment of parts over and above premium surface transportation.
5. Any other consequential or incidental amounts.

Power Ratings

Onan generator sets must be applied within the following rating designations:

Standby Power Rating

The standby power rating is applicable for supplying emergency power for the duration of normal power interruption.

No sustained overload capability is available for this rating. This rating is applicable to installations served by a reliable normal utility source. This rating is only applicable to variable loads with an average load factor of 80% of the standby rating for a maximum of 200 hours of operation per year. In installations served by unreliable utility sources (where outages last longer or occur more frequently), where operation is likely to exceed 200 hours per year, the prime power rating should be applied. The standby rating is only applicable for emergency and standby applications where the generator set serves as the back-up to the normal utility source. No sustained utility parallel operation is permitted with this rating. For applications requiring sustained utility parallel operation, the prime power or base load rating must be utilized.

Prime Power Rating

The prime power rating is applicable for supplying electric power in lieu of commercially purchased power as set out below.

The number of allowable operating hours per year is unlimited for variable load applications but is limited for constant load applications as described below:

Unlimited Running Time Power

Prime power is available for an unlimited number of annual operating hours in variable load applications. Applications requiring any utility parallel operation at constant load are subject to running time limitations. In variable load applications, the average load factor should not exceed 70% of the prime power rating. A 10% overload capability is available for a period of one hour within a twelve hour period of operation, but not to exceed 25 hours per year. The operating time at or above the Prime Power Rating must not exceed 500 hours per year.

Limited Running Time Prime Power

Prime power is available for a limited number of annual operating hours in constant load applications such as interruptible, load curtailment, peak shaving and other applications that normally involve utility parallel operation. Generator sets may operate in parallel with the utility source up to 750 hours per year at power levels not to exceed the Prime Power Rating. Any application requiring more than 750 hours of operation per year at the Prime Power Rating should use the Base Load Power Rating.

Base Load Power Rating

The base load power rating is applicable for supplying power continuously to a load up to 100% of the base rating for unlimited hours.

No sustained overload capability is available at this rating. This rating is applicable for utility base load operation. In these applications, generator sets are operated in parallel with a utility source and run under constant loads for extended periods of time.

Note: In determining average load factor, loads of less than 30% are considered as 30% and time at standstill is not counted.

Limitations

Onan is not responsible for the repair or replacement of units required because of normal wear, accident, misuse, abuse, improper installation, lack of maintenance, unauthorized modifications, improper storage, negligence, improper or contaminated fuel, or use of parts that do not meet Onan specifications

NORMAL WEAR:

This warranty will not cover repair where normal use has exhausted the life of a part or product. All mechanical devices need periodic parts replacement and service to perform well.

It should be remembered that the service life of any product is dependent on the care it receives and the conditions under which it has to operate. Coolant heaters will be covered for a period of one year from date of start–up. This warranty shall not apply to starting batteries.

THERE IS NO OTHER EXPRESS WARRANTY, AND NO PERSON IS AUTHORIZED TO GIVE ANY OTHER WARRANTIES OR TO ASSUME ANY OTHER LIABILITIES ON ONAN'S BEHALF UNLESS MADE OR ASSUMED IN WRITING BY AN OFFICER OF ONAN.

IMPLIED WARRANTIES INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO THE PERIODS OF COVERAGE SET FORTH ABOVE, AND TO THE EXTENT PERMITTED BY LAW, ANY AND ALL IMPLIED WARRANTIES ARE EXCLUDED. IN NO EVENT IS ONAN LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

This warranty gives the owner specific legal rights. The owner may also have other rights which vary depending on local laws. In some areas, local laws do not allow limitations on how long an implied warranty lasts or do not allow the exclusion of incidental or consequential damages, so the above limitations may not apply to you.

Extended Coverage

Features

Several levels of Extended Coverage are available on Industrial Products.**Comprehensive, Basic, Major Components, Prime Power and Utility Load Management. Major components, Prime Power and Utility Load Management.

Extended Coverage programs are available only in the United States and Canada. Onan provides total system component coverage. There are NO deductibles applied to these programs.

**EXCLUDES TGHAA series including transfer switch.

Coverage Period

Emergency Standby Applications: Both Comprehensive and Basic Extended Coverage are available for gensets/systems used exclusively for emergency standby applications, for 5 years or 1500 hours, whichever occurs first, from date of initial start–up. Comprehensive coverage is also available for 2 years or 1500 hours, whichever occurs first from initial system start–up. Major Component Extended Coverage is also available for diesel gensets/systems rated at 200 kW/60 Hz and above, for 10 years or 3000 hours, whichever occurs first, from date of initial start–up. See your Distributor for details.

Prime Power Applications: Extended Coverage is available for diesel gensets used in prime power applications, for 2 years or 6000 hours, whichever occurs first, from date of initial start–up. See your Distributor for details.

Utility Load Management Applications: Both Comprehensive and Basic Extended Coverage are available for diesel gensets/systems rated at 200 kW/ 60 Hz and above used exclusively in Utility Load Management Applications, for 5 years or 4000 hours, whichever occurs first, from the date of initial system start–up. Comprehensive coverage is also available for 2 years or 1500 hours, whichever occurs first from initial system start–up. See your Distributor for details.

Onan's Responsibilities

Comprehensive Extended Coverage incorporates the identical features contained in the Base Warranty, subject to the above coverage period limitations.

Basic Extended Coverage provides only replacement parts as specified under the Base Warranty. Labor to remove/replace the failed warrantable part is covered as specified in the Base Warranty for 2 years from date of initial start–up.

Major Components Extended Coverage incorporates the identical features contained in Basic Extended Coverage up to year 5 or 1500 hours. In years 6 through 10, or hours beyond 1500 up to 3000, Major Components Extended Coverage provides only replacement parts for the following major components: Engine – cylinder block, camshaft, crankshaft, connecting rods, and flywheel; Alternator – main rotor, main stator, and drive disk; Transfer Switch – actuator motor and main contacts; and Switchgear – buswork and main circuit breaker.

Prime Power Extended Coverage provides replacement parts and labor to remove/replace the failed warrantable part as specified in the Base Warranty.

Owner's Responsibilities

Under Comprehensive Extended Coverage owner responsibilities are identical to those noted under the Base Warranty.

Under Basic Extended Coverage the owner is responsible for all expenses beyond the Base Warranty period except the cost of the failed warrantable part and the labor to remove/replace such failed part through the second year, as specified in the Base Warranty.

Under Major Components Extended Coverage the owner responsibilities are identical to those listed under Basic Extended Coverage up to year 5 or 1500 hours, whichever occurs first. In years 6 through 10 or hours exceeding 1500, up to 3000, the owner is responsible for all expenses except the cost of the failed warrantable major component as specified under Onan's Responsibilities.

Under Prime Power Extended Coverage the owner is responsible for all expenses beyond the Base Warranty period except the cost of the failed warrantable part and the labor to remove/replace such failed part as specified in the Base Warranty.

For all Extended Coverage programs, the owner is responsible for providing written documentation showing that the product has been maintained in accordance with Onan's published recommendations.

Limitations

Extended Coverage options for Standby Applications apply only to Cummins/Onan brand gensets and systems used exclusively in emergency standby power applications. 10 year Extended Coverage applies only to Cummins/Onan brand diesel gensets rated 200 kW/60 Hz and above.

Extended Coverage options for Utility Load Management Applications apply only to Cummins/Onan brand diesel gensets and systems rated at 200 kW/60 Hz and above used exclusively in Utility Load Management Applications.

2 year Prime Power Extended Coverage applies only to Cummins/Onan brand diesel gensets and packages, including set mounted controls.

Gensets/systems must be registered within the Base Warranty period. See your Cummins/Onan distributor for details.

10 year Major Components, 2 year Prime Power and all Utility Load Management Extended Coverage programs are available only in the United States and Canada.

ALL LIMITATIONS OF BASE WARRANTY ALSO APPLY TO EXTENDED COVERAGE.

Onan Corporation
1400 73rd Avenue N. E.
Minneapolis, MN 55432
612-574-5000
Telex: 275477
Fax: 612-574-8087

Section 7

GEAR REDUCERS AND DRIVE BULLWHEELS

Gear Reducer

Putting into Service:

Before the initial operation of the gearbox, and after it has been filled with oil, the oil circuit must be purged. To do this:

* Operate the reduction gear with no load for about 10 minutes
* Loosen oil line to input bearing and verify oil flow.
* Tighten fitting.
* Check and adjust oil flow indicator.

Lubricating the Gearbox:

The gears and bearings are splash lubricated or lubricated by an attached pump. These gearboxes have no grease fittings.

Recommended Oil

* Quality: Use an extreme pressure oil for hypoid gears. If a synthetic oil is desired use Mobil SHC 7590, meeting A.P.I. GL5.

* Viscosity: ISO scale: 68 to 100 Cst at 40° C
SAE transmissions scale: 80 W

* Leading brands:

SHELL	Spirax HD 80 W	GULF	EP Lubricant HD 100
ARAL	Getriebeol Hyp. 80	KLUBER	Syntheso D 200 EP
ASBOL	Topress VG 100	MOBIL	Mobil HD 80 W 90
BP	Hypogear EP 80	SUNOCO	MP-GL 580 VG 68
ELF	Tranself B 80 W	TEXACO	Multigear EP 80
ESSO	Gear Oil GX 80 W	TOTAL	Transmission TM 80/90

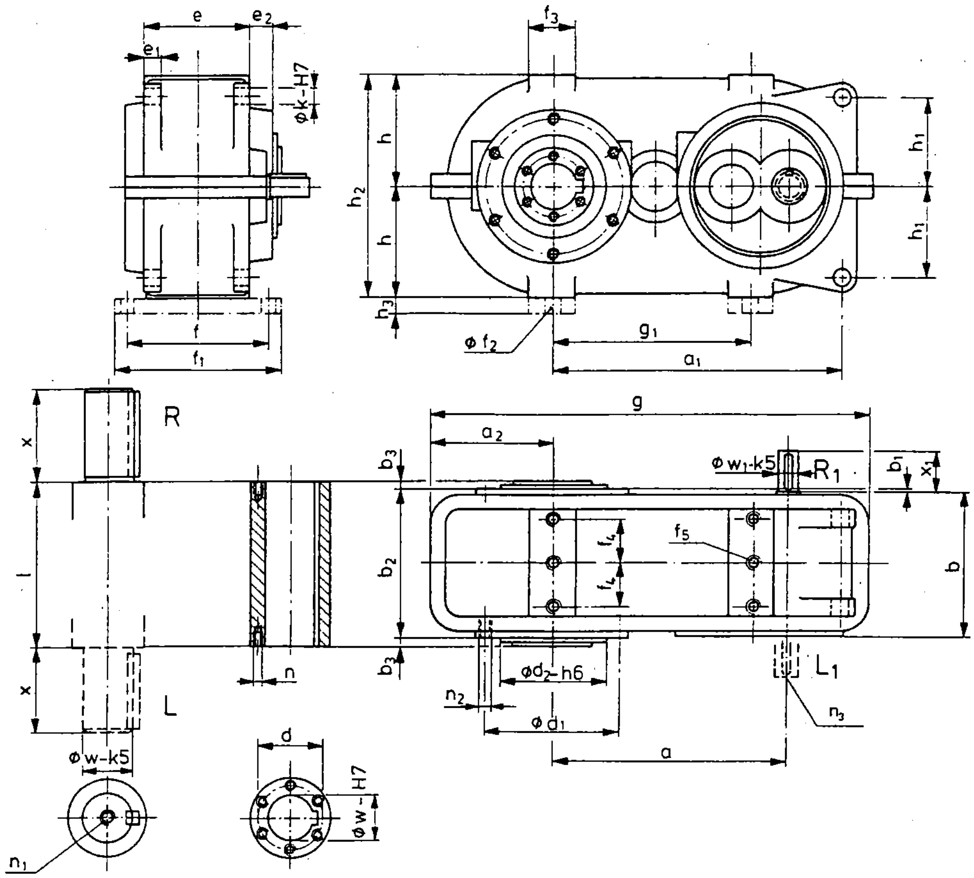
* Quantity of oil: Oil quantities may vary depending on the type or input box and cooling system supplied. Check nameplate for approximate quantity in liters for each reducer.

T/ZT 135–246
Stirnrad-Schmalgetriebe

Z.. = Abtriebshohlwelle

T/ZT 135–246
Compact helical gear reducers

Z.. = hollow output shaft



Keile nach VSM 15161
(DIN 6885)
Keys acc. to VSM 15161
(DIN 6885)

Zentrierung d_2–h6 nur für Z-Ausführung

Centering d_2–h6 for Z execution only

Typen ***Types***	**a**	**a1**	**a2**	**b**	**b1**	**b2**	**b3**	**d**	**d1**	**d2**	**e**	**e1**	**e2**	**f**	**f1**	**f2**	**f3**	**f4**
T/ZT 135	309	390	159	206	5	206	7	86	180	138	138	20	34	175	215	18	60	55
T/ZT 154	353	430	181	217	3	223	6	100	210	160	152	25	35,5	200	240	22	70	60
T/ZT 180	415	495	213	269	10	276	6	110	240	185	192	30	42	250	290	22	80	80
T/ZT 210	478	572	231	293	12	302	9	120	280	210	214	32	44	280	330	27	90	90
T/ZT 246	561	635	315	336	25	358	6	150	330	230	244	37	57	320	380	35	100	100

	f5	**g**	**g1**	**h**	**h1**	**h2**	**h3**	**k**	**l**	**n**	**n1**	**n2**	**n3**	**w**	**w1**
T/TZ 135	M12×15	590	290	152	125	304	32	20	220	M10×15	M20×40	M 8×15	M 8×18	70	25
T/ZT 154	M16×20	665	310	170	140	340	42	25	235	M10×15	M20×40	M12×18	M 8×18	80	30
T/ZT 180	M16×20	773	350	195	160	390	50	30	288	M12×18	M24×47	M16×22	M10×22	90	35
T/ZT 210	M20×28	870	420	243	200	486	35	35	320	M12×18	M24×47	M16×22	M10×22	100	35
T/ZT 246	M24×32	1040	480	327	260	654	40	40	370	M12×18	M24×47	M16×22	M10×22	120	40

	x	**x1**
T/ZT 135	120	55
T/ZT 154	130	70
T/ZT 180	150	80
T/ZT 210	160	80
T/ZT 246	180	90

Checking the Oil Level

Check oil at the sight gauge visible through the hole in the gearbox plate. Oil level should be near the middle of the glass

Draining

The gearbox must be drained at the end of the first season and then after 5000 hours of operation, or every 5 years, whichever occurs first.

To drain:

- With the oil still at its operating temperature, open the drain cock a quarter of a turn, and take remove cap to let air in.
- Pour in a little fresh oil to clear away any residues; drain off.
- Close the drain cock.

Filling

This is required before the initial start-up and then for each oil change.

To fill:

- Fill gearbox through filler hole with appropriate quantity of oil.
- Check the oil level at the sight gauge.
- Run lift for 5 minutes and check oil level again.

Oil Pump

After any extended shut down period (one week or more) oil flow must be verified during start-up.

Disassembling/ Reassembling

All internal gearbox work should be performed by a qualified technician.

All gear set work may be performed without detensioning the drive bullwheel. However, it is necessary to detension the drive bullwheel if the output shaft bearings need changing.

Maintenance of the Gearbox

Frequency	*Maintenance Activity*
DAILY	Check for leaks and housing discoloration.
MONTHLY	Check the oil level. Verify oil pump pressure visually by inspecting pressure guage.
END OF 1ST SEASON	Change the oil.
START OF SEASON	Verify oil flow from lubrication pump.
5 YEARS OR 5000 OPERATING HOURS.	Drain and change oil

Drive Bullwheel

The bullwheel is lined with a rubber lining which assures good adherence between the haul rope and the bullwheel.

Aligning the Haul Rope in the Bullwheel

With the use of the guide sheaves, raise or lower the haul rope entering and exiting the bullwheel until the plane of the haul rope matches the plane of the bullwheel.

Checking the Adjustment

When the bullwheel is properly aligned, the haul rope should ride in the groove correctly and enter and exit the bullwheel without twisting.

Maintenance of the Bullwheel

Frequency	*Maintenance Activity*
MONTHLY & AT BEGINNING & END OF SEASON	Verify the correct alignment of the cable in the bullwheel
MONTHLY	Check general condition of the bullwheel lining. Replace if more than 1¼" (30mm) is worn from original surface, less than 3/4" (20mm) thickness remaining. See Line Equipment and Towers Section in this manual for liner removal procedure.

Section 8

BULLWHEEL BRAKE

Bullwheel Brakes
4 ton

General Description

The lift is equipped with two bullwheel brakes. These brakes are mounted on the side of the drive bullwheel and apply braking force to the flange of the bullwheel.

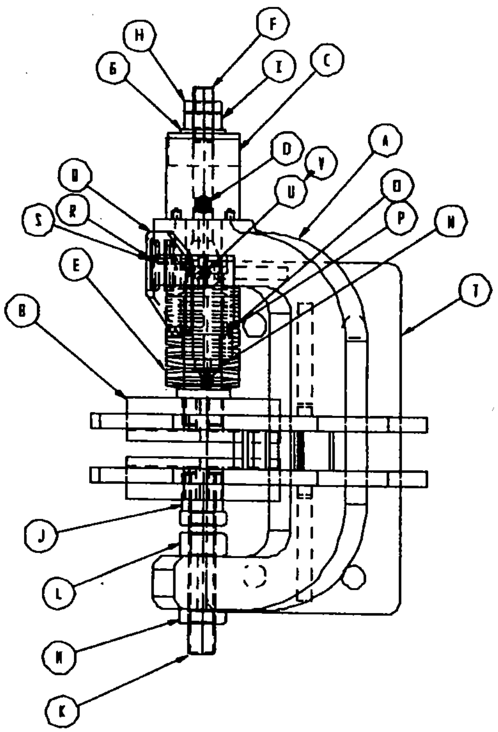
These brakes are hydraulically released and held in the ready position by a solenoid valve. The bullwheel brakes are spring-applied when the hydraulic pressure is released due to an normal stop, emergency stop, rollback, over-speed, or an opening of the manual valves.

Mounting

Mount in accordance with Drawing 3038.869.

Adjustment of Brakes (Drawing 3038.869)

1. Pump brake hydraulic system up to braking pressure listed in Section 1, *Lift Data*, of this manual.
2. Tighten bolt (K) until the shoes just touch the braking flange (both shoes must be touching the braking track).
3. Tighten lock nut (M).
4. Pump hydraulic system up to opening pressure listed in Section 1 of this manual.
5. Loosen the 8mm bolts (R) on the switch bracket and adjust switch (N) to be completely depressed when open and not touching when the brake is applied. See the electrical schematics for wiring diagram.
6. Inspect brake to insure nothing is impeding the travel of the full brake assembly. When brake is applied both shoes need to make full contact with the brake flange.



INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
V	1	NUT HAMB 8.8 PLATED	/	/	058004	/
U	1	PAULSTRA	/	/	051011	/
T	1	BRAKE MOUNT	/	/	4075.877	C
S	2	LOCKWASHER JCZ8 PLATED	/	/	059284	/
R	2	BOLT HM8 x 20/20 8.8 PLATED	/	/	057002	/
Q	1	SWITCH BRACKET	/	/	3225.543	A
P	2	LOCKWASHER JCZ5 PLATED	/	/	059282	/
O	2	BOLT CHS x 45/22 5.8 PLATED	/	/	5087237	/
N	1	MICRO SWITCH LSV1A	/	/	5208201	/
M	2	NUT LOW 1" - 12 NF GR. 5 PLATED	/	/	5058124	/
L	1	NUT 1" -12 NF GR. 5 PLATED	/	/	5058123	/
K	1	ALLTHREAD 1"-12 NF x 8-3/4" LG. GR. 5 PLATED	/	/	5087737	/
J	1	ADAPTER, BRAKE PAD	/	/	3225.542	A
I	1	NUT LOW 3/4" - 10 NF GR. 8 PLATED	/	/	5058128	/
H	1	NUT 3/4" 10 NF- GR. 8 PLATED	/	/	5058085	/
G	1	WASHER 3/4" PLATED	/	/	5058089	/
F	1	BRAKE SHAFT, HYD CYL.	/	/	3225.541	B
E	20	SPRING WASHER 70/35.5/4 PLATED	/	/	058063	/
D	1	ELBOW 90° 4MP-4MJ	/	/	5050277	/
C	1	HYDRAULIC CYLINDER ENERPAC RWH-121	/	/	5300353	/
B	2	BRAKE SHOE	/	/	3085.308	A3
A	1	BRAKE FRAME	/	/	3225.540	B

REV	DESCRIPTION OF REVISION	DATE	BY
/			
/			

PRODUCTION USE ONLY

TOLERANCES • UNLESS INDICATED •

• FABRICATION •
FRACTIONAL ...... ±1/16
ANGULAR .... ±1/2°

• MACHINING •
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR .... ±.1°

ORIG. YEAR 1999

SERVICE/E-BRAKE ASSEMBLY

4 TON

CABLE TRANSPORT SYSTEMS

POMA OF AMERICA

DRAWN BY: SMITH J.
CHECKED BY: TUSBERG N.
DATE: 3/10/99
SCALE: 1/4

FORMAT: B
DRAWING NUMBER: 3038.869
REVISION: /

Maintenance of Bullwheel Brakes

Frequency	*Maintenance*
DAILY	Observe operation of brakes; check for missing pads, broken springs or other damage, leaks in hoses or fittings, foreign material including ice on bullwheel braking track, or missing parts. Check oil level.
MONTHLY	Check oil level in reservoir. Pump brakes up to braking pressure (listed in Sect. 1 of this manual). Both shoes must be touching brake track. If they are not, adjust brakes to compensate for shoe wear. Check brake pad thickness. If worn to less than 3/16" thickness, replacement is necessary. NOTE: Replacement shoes and pads must be supplied by Poma of America, Inc. IN ORDER TO MAINTAIN BRAKE INTEGRITY, NO SUBSTITUTIONS OF SHOES OR PADS ARE ALLOWED. Check adjustment of brake shoe contact switches. Pull test brakes to at least minimum test value listed in Section 1. Adjust if necessary.
ANNUALLY	Relubricate Schnorr washer friction surfaces and main shafts with anti-seize. Check condition of hanger bolts, springs and brake assembly for loose, broken or missing parts. Check hydraulic system for proper oil level, leaks, dirt. Check hoses and fittings for leaks, abrasions or damage. Check adjustment of contact switches. Check for worn brake shoes. Check for proper operation, including braking pressure and opening pressure. Check Maintenance Section of Ethywag hydraulic system for additional tests and checks.
EVERY 5 YEARS	Replace Schnorr washers and perform annual maintenance as specified above.

BRAKE CONTROL SYSTEMS

Applying the Brake

The brakes can be triggered while running under normal conditions, as well as with the standby motor, in the following ways using the systems described below.

As soon as the solenoid valve supply is opened by one of the brake control devices, the hydraulic circuit is returned to the tank, which relieves the elastic washers and applies the brake shoes.

Normal Stop

This can be controlled from the end terminals and cabin by a push button.

The action of these systems starts a regenerative state of the electric motor and applies the brake when zero speed is achieved.

While operating the lift using the evacuation motor, all stops are emergency stops.

Emergency Stop

This can be controlled from the end terminals by a manual reset push button. Once triggered, this type of knob has to be reset manually to be able to release the brakes and to start up the lift again.

The action of these systems cuts the power supply to the unit's solenoid valve. This will set the emergency brake immediately and the service brake at zero speed, and cuts the power supply to the electric motor or kills the auxiliary motor.

Overspeed or Anti-rollback Stop

Operation and Adjustments

A cable tach generator, driven by a round-belt engaged on a sheave of the main cable, supplies a speed setpoint meter located on the control panel with a control voltage.

The setpoint meter has two adjustable indexes:

- one is set at the overspeed value, i.e. normal speed + 10%,

- the other is set at approx. -0.3 m/sec. to detect any backward movement of the lift.

As the speed of the lift increases, the tach generator speed also increases and the speed reference moves towards the overspeed setpoint. If the speed reaches the setpoint, value the device triggers the brake and stops the lift.

If the lift starts moving backwards relative to the direction of desired travel, the polarity at the tach generator terminals is reversed, and the device reaches the anti-rollback setpoint. When this happens, the device also triggers the brake and stops the lift.

Testing

To test that the system functions correctly, start up the lift and move the overspeed setpoint of the device (using the adjusting knob) below the actual speed of the lift. The brakes should be triggered immediately.

Stopping due to Service Brake Failure

If the service brake fails to apply or fails to stop the lift within the preset amount of time for any reason, the emergency brake will apply automatically.

BULLWHEEL BRAKE HYDRAULIC UNITS

General Description (Drawing 3038.877)

The brake hydraulic unit includes a system to operate each bullwheel brake.

When the E-brake pump button is depressed, the 24 volt electric motor starts driving a pump which sends pressurized oil into the circuit. Solenoid valve (7) is supplied with 24 V DC to close the brake circuit and allow the brakes to be released as long as safeties remain OK. Either the hand pump or the electric pump may be used to charge the system to the bullwheel brake operating pressure as set on relief valve (4).

When the lift starts valve (7) closes to send pressurized oil to open the service brake, and hold it open.

During a normal stop, the electrical motor will go into a regenerative state to stop the lift. After zero speed is detected valve (7) will open and set the brake. If a pre-determined deceleration is not detected during motor regen, then the brake will set.

During an E-stop the emergency brake will be set by de-energizing the solenoid (7) which allows oil to return to the tank via flow valve (8), this allows the rate of application of the emergency brake to be adjusted.

In a rollback situation, solenoid (7) will de-energized instantly on both brake units, applying the brakes as soon as possible before the lift has a chance to accelerate.

Lockout valves (10) allow either the emergency brake or service brake to be locked open to perform brake tests or maintenance. Switch (9) monitors the proper position of these valves and will prevent the lift from starting or running if they are not in the proper position. The manual dump valve (14) allow the emergency and/or service brake to be released manually.

Maintenance of the Service and Bullwheel Brake Hydraulic Unit and Bullwheel Brakes

Frequency	*Maintenance Activity*
DAILY	Check the oil level in the unit and check for leaks. Check the reading on the unit's pressure gauge for both the service brake and emergency brake. Visually check for broken or missing springs. Visually check condition of brake shoes. Check for proper operation of the brakes. Check condition of the braking tracks on the bullwheel.
MONTHLY	Carry out a brake pull test. See section 1 of this manual.
ANNUALLY	Check the condition of the cable tach generator V-belt. Check for leaks Check the condition of the braking tracks on the bullwheel. Check the oil level and condition. Inspect hoses for deterioration.
EVERY 1200 HOURS OR 2 YEARS	Change oil in reservoir. Thoroughly clean reservoir.

PUTTING HYDRAULIC UNIT INTO SERVICE

Initial Start-up

Before the first start-up of the lift, and after each oil change, service or repair; carry out the following procedure, in the order given below.

- Insure the bullwheel braking track is clean of all paint, protectants, oil and foreign materials.

- Check that all connectors and hoses are tight.

- Fill the tank with oil until the maximum level is indicated in the sight gauge.

- Close the dump valve (14).

- Loosen hose fittings at rams and pump up by hand to purge air.

- Obtain green safeties ok light.

- Check that the solenoid valve (7) is closed.
  (Center pin in top of valve must be down.)

Pressurize the circuit

- Remove cap and loosen jam nut on relief valve (4) and turn adjusting screw counterclockwise 2 full turns.

- For <u>unit with motor-driven pump</u>: Run the electric motor (1) by pressing the "***e-brake pump***" button in the electrical cabinet.

- Adjust the relief valve (4) until the pressure gauge (11) shows the required opening pressure, corresponding to the adjustment listed in Section 1, *Lift Data.*

- To adjust the brakes, see applicable brake section.

- Adjust the speed of release of the brake cylinders.

- Set the brakes by pressing the emergency stop button.

- Screw in flow control valve screw (8) to slow activation.

- Unscrew (8) to speed up activation.

- Check correct operation of brake shoe contact switch by slowly opening valve (14).

- Check once again that the opening and setting of the brakes function correctly.

Standby Start-up

When it is impossible to use the unit's electric motor, use the hand pump (6) to pressurize the circuit and open the brakes.

Pump until desired pressure is attained on gauge (11). Note: When using the hand pump the pressure relief valve is bypassed so pressure needs to be monitored at the gauge (11) at all times.

Recommended Oil

Use the same oil as used in the tensioning hydraulic unit. Which may be:

- either hydraulic oil with viscosity index > or = 150 and viscosity 32 or 37 at 40° C

- or a hydraulic oil "aviation" type or "low temperature", 13-16 Cst at 40° C and 400-500 Cst at -40°C.

Oil Change

Change the oil periodically, removing the drain plug and fill through the breather. Check the level through the sight gauge.

Daily Start-up

Check the oil level through the sight gauge of the tank and top up if necessary.

The dump valve (14) must be closed.

Start up the unit and check the operating pressure on the pressure gauge (11).

ADJUSTMENT OF THE RELIEF VALVE

Determination of the pressure required depends on the adjustment of the brakes (see Section 1, *Lift Data*).

To adjust the pressure, follow this procedure on the relief valve (4) on the front of the manifold.

- Loosen the lock nut.

- Start-up the unit.

- Turn the adjusting screw (4): IN to increase or OUT to decrease the pressure reading on the gauge and obtain the opening pressure listed in Section 1, *Lift Data*. Oil leakage on the threading during adjustment is normal.

- Next tighten the lock nut.

ADJUSTMENT OF THE RELEASE SPEED OF THE BRAKE CYLINDERS

Use the adjusting screw located on the flow regulator (8) for this adjustment.

LOCKING THE CIRCUIT

To lock the brakes in the open position (hydraulic circuit pressurized), close the isolating valve (10).

This releases the safety switches (9) which will not allow the lift to operate.

RETURN TO THE TANK

To lower the pressure in the circuit and cause braking from the unit, throw the lever of the dump valve (14) to the open position.

The safety switch on each brake then prevents the lift from starting up again.

Section 9

HYDRAULIC TENSION SYSTEMS

Hydraulic Tension System

General Description

The lift is equipped with a constant tension system designed by Poma of America, Inc. The system operates continually during lift operation on 480 volts AC to maintain the correct tension on the haul rope.

NOTICE: Electrical troubleshooting should be performed by a qualified electrician.

Constant Running Pump Systems

Operation (See drawing 3038.547)

The electric motor (17) drives the variable displacement hydraulic pump (12) which pressurizes the system to design pressure. Design pressure is controlled by the pressure compensated pump (12). A back-up relief valve (11) is adjusted to open at a pressure approximately 10% - 20% higher than design pressure. This arrangement provides additional safety against over pressure. During normal operation, relief valve (11) should remain closed and the pressure is regulated by the pressure compensated pump.

Two Barksdale electrical switches (14) are provided. One switch is adjusted to stop the lift if the pressure of the system drops 10% below design pressure. A second switch is adjusted to stop the lift if the pressure exceeds design pressure by 10%. The system pressure is shown on the gauge (15). **These switches should never be readjusted without written permission and instructions from Poma of America, Inc.**

Caution must be taken to ensure that the hydraulic system pressure, as well as under pressure shutdown, over pressure shutdown and pressure compensated pump (12) are adjusted to design specifications at all times.

> **Failure to maintain design pressure specifications can increase loads on terminals, towers, and haul rope and can cause serious injury or death as well as equipment damage.**

These valves and switches are preset during load test and do not normally require further adjustment. However, if adjustments are required, please contact Poma of America, Inc. to verify system settings.

In the event of a power failure, a hand pump (6) is provided to maintain system pressure. If the lift is operating without electric power, the system pressure must be checked periodically because the pressure will change as the lift loading changes. The hand pump must be used to maintain system pressure within design tolerances.

A cooling system (7) consisting of a radiator and the cooling fan of the electric motor is provided to maintain the system temperature. A two-way valve (9) is provided to bleed pressure out of the system. A solenoid valve (10) opens when the electric pump is running to allow fluid to be pumped either direction through the pump, depending if the cylinders are extending or retracting. Once the system is static, the pump will go to zero stroke and only pump to maintain pressure.

NOTE: **Because the haul rope applies load to the tension terminal, and the track rope applies load directly to the ram, the rams are under pressure at all times. Opening valves, fittings or hose connections can cause serious injury, death or equipment damage. The tension carriage must be against the stops and track cable ram fully extended and at end of travel before opening any fitting or hose.**

To move the carriage to the stops and extend the track rope ram, slowly open decompression valve (9). This will move the carriage up and track rope ram to extend. This process has to be done slowly in order not to set the velocity fuses on the rams. Visually inspect extension of rams. The system pressure will then drop to zero.

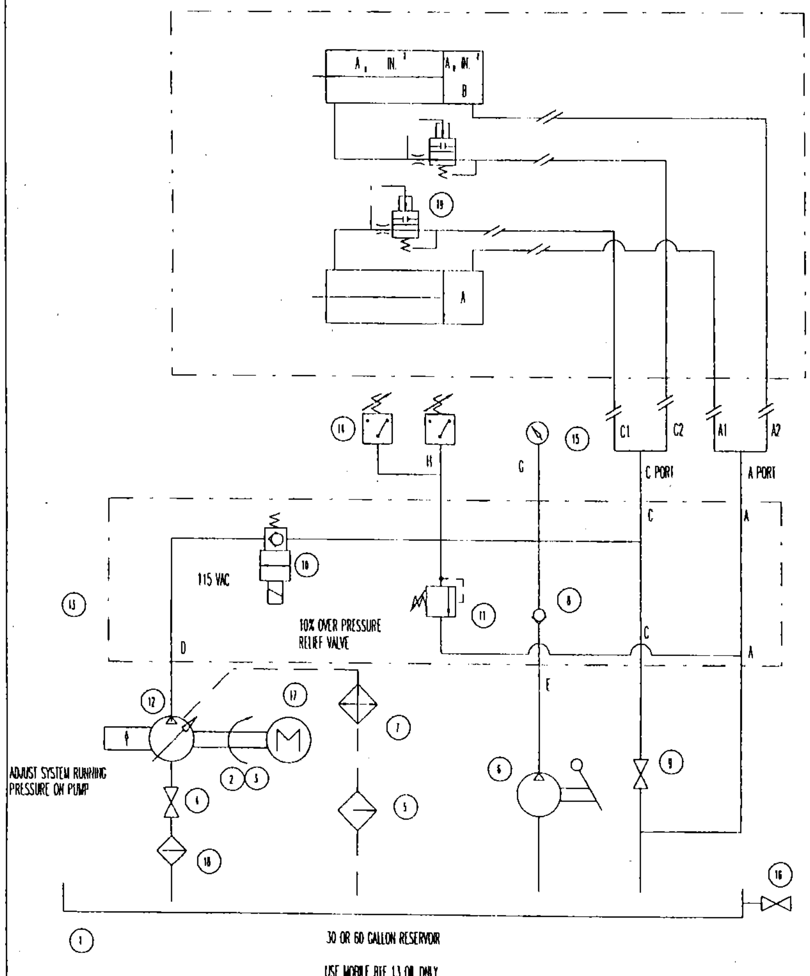
To clamp the track rope, contact Poma of America, Inc. for cable clamp and procedure.

NOTE: **Never detention the rams with anybody in the cabin. Failure to do so could result in injury or death.**

A filter (5) is provided to filter the oil as it returns to the tank.

Velocity fuses (19) are installed on the retract piston end of the rams. These valves will close and lock the carriage in case of a hose failure, or any time that the flow out of the rams exceeds a certain value, typically 3 or 5 gallons per minute.

SPARE PARTS: All hydraulic tension system replacement parts are available from Poma of America, Inc.



INDEX	REQ'D	DESCRIPTION	MANUF. PART NUMBER	POMA PART NUMBER
19	2	POW-R-OIL VELOCITY FUSE (FOR MEMORY)	52919-3.3	5300.171
18	1	ZINGA SUCTION STRAINER	SS-100-03-100	5300.207
17	1	LEESON ELEC. MTR. 3HP/230/460/3/182TC W/ A160178 FOOTMAN ENCL.	130326	5001.037
16	1	LHA BALL VALVE 3/4" NPT	BV-12N	5300.199
15	1	LENZ PRESSURE GAUGE 0-3000	BAC-3M-25	5300.198
14	2	BARKSDALE PRESSURE SWITCH	B1T 1132	5300.197
13	1	TEI CUSTOM MANIFOLD (COMP. 1)		5300.196
12	1	DENISON PUMP	PV 6 2UC C00-SP1675	5300.195
11	1	STERLING HYDRAULICS RELIEF VALVE WITH TAMPER PROOF CAP	MODEL A5B020TN /RC1125	5300.194
10	1	STERLING HYDRAULICS SOLENOID VALVE 115VAC	GS02080DN - SOLENOID CCS-115-0	5300.193
9	1	SAUTT 1/2" BALL VALVE	BBV-2008001	5300.192
8	1	STERLING HYDRAULICS CHECK VALVE	D2A025 0.2N	5300.191
7	1	AMERICAN INDUSTRIAL AIR/OIL HEAT EXCHANGER	AORM-20-5	5300.190
6	1	BRAND HAND PUMP	HP-61 OA R	5300.153
5	1	MPS RETURN FILTER ASSEMBLY	MPS-505-RG7/CS650-P10A/CI-20	5300.251
4	1	B&K GATE VALVE 3/4"	NPT 100-004	5300.188
3	1	VESCOR PUMP/MOTOR ADAPTOR	1960	5300.187
2	1	HAYES COUPLING	2AN 13-07	5300.186
1	1	VESCOR 30 OR 60 GALLON RESERVOIR	10030 OR 10060	5300.160 OR .136

REV.	DESCRIPTION OF REVISION	DATE	BY
A	UPDATE 5, 17 FOR 1995	5/18/95	CWT

1994

HYDRAULIC SCHEMATIC

COMPETITION II TENSIONING UNITS

THIS DRAWING AND ITS DESIGN ARE PROPRIETARY TO POMA OF AMERICA. DUPLICATION WITHOUT THE PERMISSION OF POMA OF AMERICA IS PROHIBITED.

CHECKED BY: RJ SMITH
DATE: 5.94
SCALE: N/S
FORMAT: B
DRAWING NUMBER: US 3038.547

2510 FORESIGHT CIRCLE
GRAND JUNCTION, COLORADO U.S.A.

POMA OF AMERICA

Putting a New System into Service

ASSEMBLY:

Fill tank with oil. Mount rams to the drive unit and track rope anchor. Be certain to secure linking pins with roll pins or cotter pins. Connect hoses between ram and pump unit.

NOTE: Be sure that all hoses are connected properly: piston end hoses are connected to pressure ports on the pump unit. Anchor end hoses are connected to return ports on pump unit. Flush clear oil through hoses prior to connecting to rams and pump.

Extend ram by pumping oil into anchor end. **NOTE:** This procedure must only be performed while the tension is held on the service cables on track rope and lorry is against the stops. This procedure will fill the backside of rams with oil and evacuate the air.

Connect ram piston rod to track rope socket anchor (track rope) and drive tower anchor (haul rope). Again secure the linking pins with roll pins or cotter pins.

INITIAL START-UP:

Before start-up, check that all hoses are correctly connected.

Check that the reservoir is full of oil. Choose a hydraulic oil which has the following characteristics:

- very high viscosity index: > 150
- viscosity: from 32 to 37 Cst at 40° C
- aniline point: 94 to 100 approx.
- pour point: < -35° C
- flash point: > 190° C approx.

Close decompression valve (9).

Start-up electric motor.

When the cable is under tension, check the oil pressure.

Check that there is no external leakage at hose connections.

Check oil level in reservoir and, if necessary, add oil to maintain tank between 2/3 and 3/4 full.

CHECKING THE TRIP SYSTEM:

Pressurize the circuit and open the decompression valve (9), to decrease the pressure slowly. The pressure switch should stop the lift when the nominal pressure is lowered by 10%. Increase the system pressure by screwing the allen head adjustment screw on the pump in until the pressure is increased 10%. The pressure switch should stop the lift.

SAFETY VALVE FITTED ON RAMS:

The safety valves (19), fitted on the rams, close if the hose between the rams and the unit fails.

To test that the safety valves work properly, open the decompression valve (9) suddenly; the carriage and track rope should lock in position. **NOTE: Never use safety valves to hold the carriage while working on the pump.**

Limit Switch

GENERAL DESCRIPTION

This device serves to stop the lift before the ram reaches either of its end positions.

- Ram mounted:	Figure 9-1: These switches are attached directly to the track rope ram.
- Carriage mounted:	Figure 9-2: These switches are attached directly to the carriage guide.

RAM MOUNTED LIMIT SWITCHES

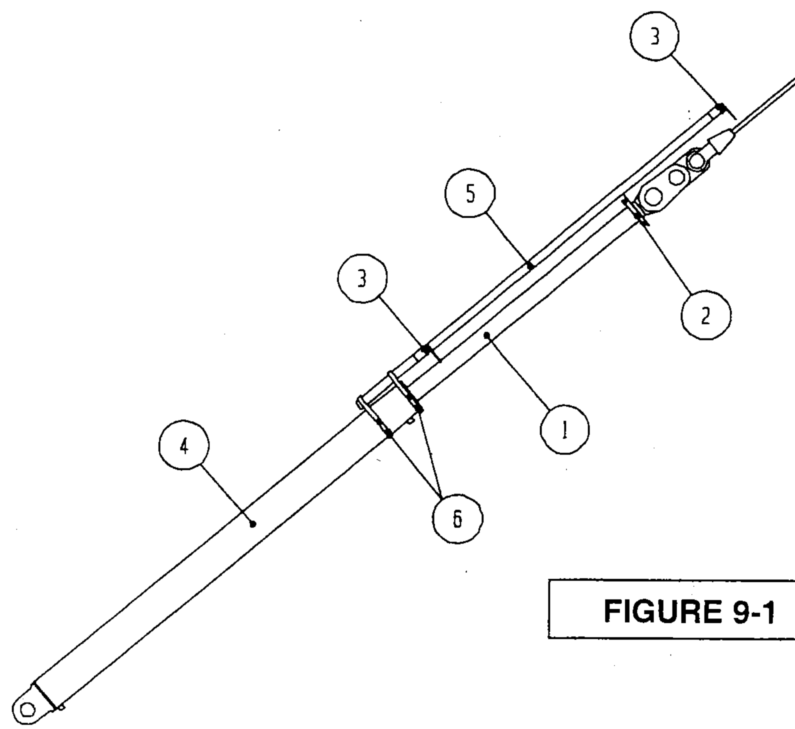


FIGURE 9-1

OPERATION (see figure 9-1)

When the ram piston (1) is extended or retracted.

- As the ram is extended the collar (2) attached to the piston (1) will move away from the ram housing (4). A rod (5) is attached to the ram housing (4) with two mounting brackets (6). Therefore the rod (5) remains stationary with respect to the piston (1). Switches (3) are mounted to the stationary rod. As the piston (1) is extended or retracted, the collar (2) will move with it. As the collar (2) passes the switches (3) the switches are tripped before the end of travel of the ram is reached.

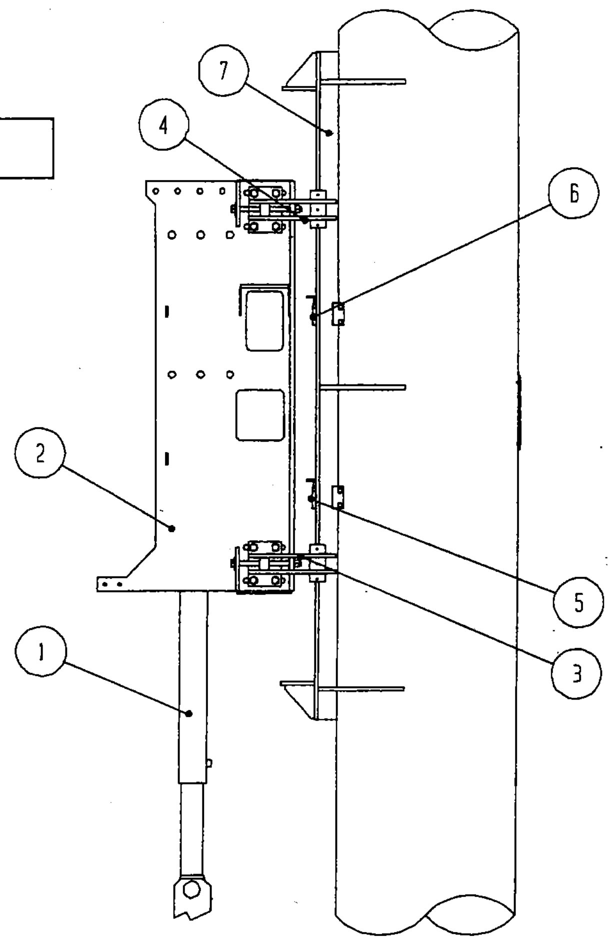
ADJUSTMENT:

- Clamp the switches (3) on the fixed rod (5) in a position so the collar (2) will trip the switches before end of travel is reached.
- Fully load the cabin (without people) and run the lift to the return. Mark the maximum extent of the ram collar (2) with respect to the fixed rod (5). Adjust the switch (closest to the track rope) 4-6in from the mark towards the track rope.
- Dock the cabin at the drive and completely unload it. Adjust the switch (farthest from the track rope) 4-6in from the collar away from the track rope.
- Make note of the distance between the switches after adjustment. This distance should be maintained considering temperature and rope stretch.
- Trip the switches by hand to check that it actually stops the lift.

NOTE: Track rope ram maximum extension = 217in center of pin to center of pin.
Minimum retraction = 119 3/8in center of pin to center of pin

CARRIAGE MOUNTED LIMIT SWITCHES

FIGURE 9-2



OPERATION (see figure 9-2)

When the ram (1) is extended or retracted.

- As the ram is extended the carriage (2) moves up. The bottom carriage guide (3) passes by and trips the limit switch (5) mounted to the rail (7) attached to the drive tower. When the ram is retracted the carriage (2) moves down. The top carriage guide (4) passes by and trips the limit switch (6) mounted to the rail (7) attached to the drive tower. The switches are tripped before end of travel is reached.

ADJUSTMENT: (See Figure 9-2)

- Clamp the switches (5,6) on the rail (7) in a position so the carriage guides (3,4) will trip the switches before end of travel is reached.

- Fully load the cabin (without people) and run the lift to the return. Mark the maximum extent of the bottom carriage guide (3) with respect to the rail (7). Adjust the bottom switch 2in above the mark.

- Dock the cabin at the drive and completely unload it. Adjust the top switch 2in below the top carriage guide (4).

- Make note of the distance between the switches after adjustment. This distance should be maintained considering temperature and rope stretch.

- Trip the switches by hand to check that it actually stops the lift.

NOTE: Carriage ram maximum extension = 58.38in center of pin to center of pin.
Minimum retraction = 34.38in center of pin to center of pin

Do not allow ram to extend completely. Always stop at a minimum of 2" from maximum position.

Troubleshooting the Tensioning System

PROBLEMS	CAUSES	REMEDIES
The system cannot be pressurized	Lack of oil	Top off the oil level and check that there is no leak.
	Incorrect operation	Check that the valve (9) is fully closed.
	Defective relief valve	Check the condition of relief valve unit (i.e. O-rings, dirt).
	Defective pump	Replace the pump.

Maintenance Schedule for Tensioning System

Frequency	*Maintenance Activity*
AFTER THE FIRST 10 HOURS	Check the filter element as follows: - stop hydraulic pump operation - remove filter - if necessary, change element (never attempt to clean it as this may damage element) - clean magnetic core (if applicable) with a cloth - re-assemble
DAILY	Operating pressure: check the value on the pressure gauge. Verify that it matches design pressure. Rams and carriage: make sure they have not reached their end position. Check that there is no leakage. Check motor and pump for any abnormal noises. Check the oil level.
MONTHLY	Pressure switch: check for correct operation. Check valve (10): check that the pressure reading on the pressure gauge is maintained when the lift is stopped. Safety valves (19) fitted on rams: check for correct operation. Limit switch: check general condition and that tripping the switch stops the lift. Grease spherical bushings on rams with MOBIL MOBILITH SHC 460 or equivalent. Visually inspect hydraulic hoses and fittings for signs of wear.
AFTER EVERY 1000 HOURS	Change filter element.
AFTER EVERY 1000 HOURS or 2 YEARS	Empty hydraulic reservoir and refill with new hydraulic oil. **NOTE: <u>NEVER</u> MIX DIFFERENT BRANDS OF OIL.**

TEI
ENGINEERED
PRODUCTS
INCORPORATED

Poma of America
Integral Mini-Evac / Comp II
OPERATIONS & MAINTENANCE MANUAL

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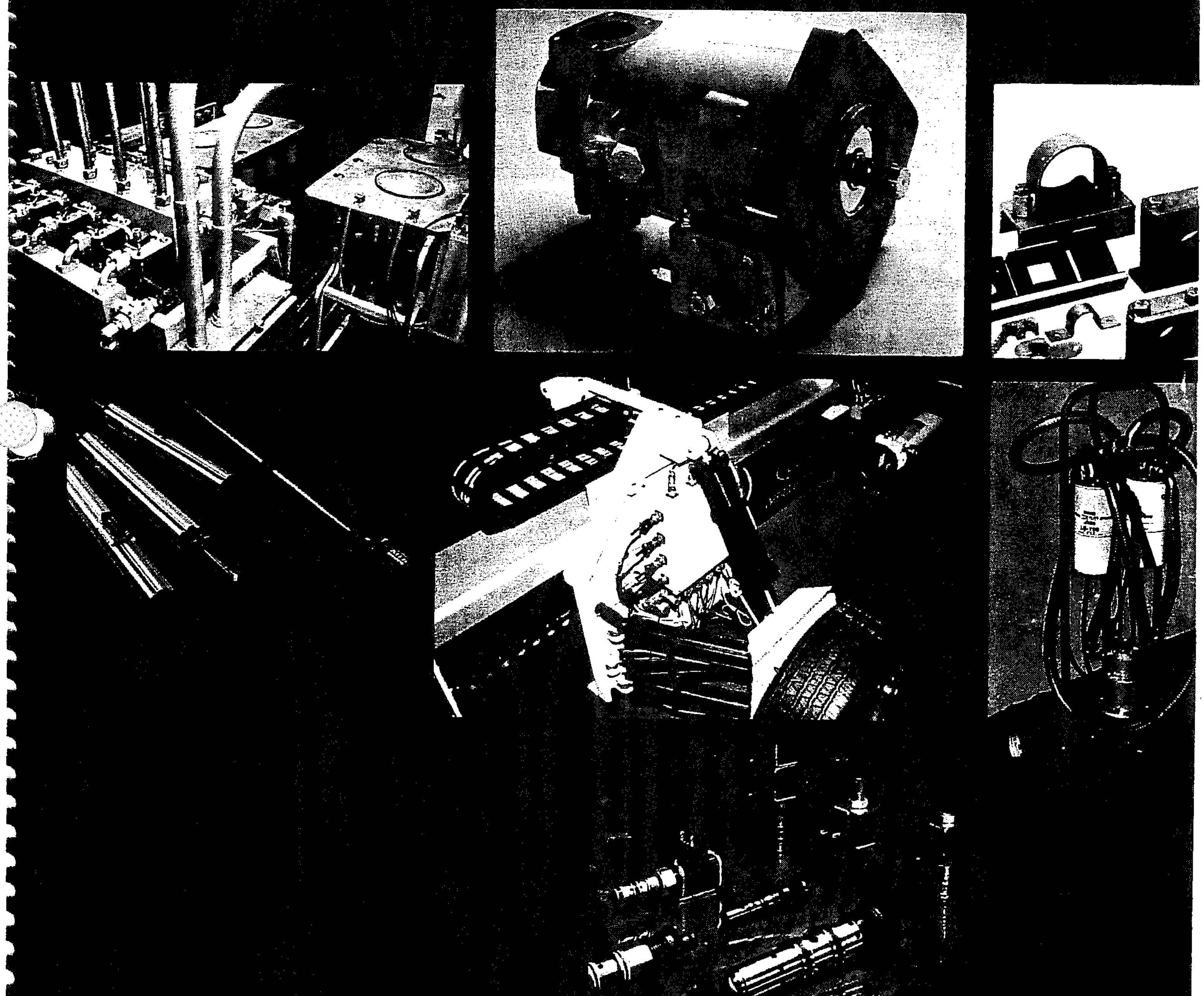
T E I ENGINEERED PRODUCTS, INC.

The Successful Application of Today's
Technology for Practical Solutions in Industry.



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Poma of America
Integral Mini-Evac / Comp II

Manufactured By:

TEI
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PRODUCTS
INCORPORATED

1.0 Introduction

Congratulations, on the purchase of your TEI Engineered Products, Inc. Hydraulic Power Unit (HPU). In addition to the HPU, you have also received access to these additional benefits:

Factory Trained/Certified Technicians:
Our technicians are fully trained in all aspects of hydraulic component operations including pumps, motors, valves and cylinders. With over 25 years of service in the shop and the engineering support including Professional Engineers to back them up, we can service all of your hydraulic needs, in a timely fashion and with guaranteed results.

Large Component Part Inventory:
TEI maintains one of the largest hydraulic parts inventories in the Rocky Mountain Region. Many pumps/motors/valves are maintained in component stock so we can pull immediately for rebuilding our customer's equipment. In addition, we maintain pumps and motors in a rebuilt state to sell in a Rebuilt-Exchange Program (RBX). This provides you with a quicker turn-around and lower down-time, thus saving you money.

On-Site Training:
New systems always work as designed, but later after warranty runs out and repairs are needed we are certainly available to assist with service or we can provide training for your service/maintenance personnel. By providing this training, you will find improved up-time, lower cost of operation, and higher moral.

1.1 Unpacking and Inspection

On receiving the unit, inspect the unit thoroughly for external damage.

When unpacking your Cabinet be careful not to damage any electronics, valve handles, etc. which may protruding from the Cabinet.

Once the unit has been unpacked, inspect it to ensure that no damage has occurred during freight. If you discover damage has occurred, take a photograph of the damaged area and notify the freight carrier immediately.

Table of Contents

1.2 Warranty and Service

TEI Engineered Product, Inc. (TEI) warrants the equipment or parts supplied by TEI against defects in design material and workmanship for a period of twelve (12) months from date of shipment from TEI. If the original purchaser, within twelve (12) months of original shipment by TEI, reships the product as a component of a machine manufactured by such purchaser or from the original purchaser's stock, the warranty will be extended for a period equal to six (6) months from the date of shipment from the original purchaser. For the extension of warranty to be effective, documentation will be required to verify the purchase of such equipment from TEI and subsequent sale by such purchaser. If the equipment is rebuilt or repaired by TEI during the original new product warranty, the warranty shall continue for the balance of the original warranty period or for a period equal to six (6) months, whichever is longer. Repairs made outside the warranty period will be warranted against defects in material and workmanship for a period of six (6) months from the date of repair.

If any failure to conform with the applicable warranty develops during the specified period under normal and proper use and provided the equipment has been properly stored, installed, and maintained, TEI shall, if given prompt notice by purchaser within the warranty period set forth herein, correct such non-conformity at its option, either by repair or replacement, F.O.B. repair facility or by refund of the purchase price of the nonconforming equipment or part.

When the nature of the defect is such that it is appropriate in the judgment of TEI to do so, repairs will be made, at TEI's option, at the equipment site. Repair or replacement under applicable warranty shall be made at no charge to customer for replacement of defective parts and warranty labor when work is performed during normal working hours 8:00 a.m. to 4:30 p.m., Monday through Friday, exclusive of holidays. Labor performed at other times at the request of purchaser will be billed at the applicable rate then prevailing for services of TEI personnel. Serviceman travel time, transportation and living costs are the sole responsibility of the purchaser and will be billed at a rate of 10% above actual costs incurred. Replaced equipment or parts become the property of TEI.

The warranty contained herein shall not apply to: defects in materials provided by purchaser; design stipulated by purchaser; or sale of used equipment or components furnished by TEI, but not manufactured by TEI.

The warranty contained herein shall terminate if the equipment failure giving rise to a claim under warranty results from (a) unauthorized modification, repair or alteration, (b) improper operation, application, maintenance or installation, (c) damage during shipment, (d) operation, handling or other dealings with the equipment in a negligent manner, or (e) abnormal conditions or temperature, moisture, dirt or corrosive matter.

The warranty contained herein shall not apply to damages as a result of acts of God, War, or Civil Insurrection, nor shall it apply to products which, in the sole judgment of TEI, have been subject to negligence, abuse, accident, tampering or alteration, nor to other than normal application, use, and service.

THE WARRANTIES, RIGHTS AND REMEDIES SET FORTH ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, REPRESENTATIONS, CONDITIONS, RIGHTS AND REMEDIES WITH RESPECT TO THE EQUIPMENT, EXPRESS OR IMPLIED OR STATUTORY OR OTHER WISE AND WHETHER WRITTEN OR ORAL, AND ALL OTHER WARRANTIES, REPRESENTATIONS, CONDITIONS, RIGHTS AND REMEDIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY, DURABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY EXPRESSLY DISCLAIMED, EXCLUDED AND WAIVED BY PURCHASER TO THE FULLEST EXTENT PERMITTED BY LAW.

EXCEPT TO THE EXTENT SPECIFICALLY SET FORTH IN THIS LIMITED WARRANTY, TEI SHALL NOT BE LIABLE AND DISCLAIMS ALL LIABILITY FOR CONSEQUENTIAL DAMAGE OR INJURY (FATAL OR OTHERWISE) OF EVERY KIND (WHETHER CLASSIFIED AS DIRECT, SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES).

Correction of non-conformities in the manner and for the period of time provided above shall be purchaser's exclusive remedy and shall constitute fulfillment of all liabilities of TEI, whether in warranty, contract, negligence, tort or otherwise with respect to the quality of the equipment.

TEI shall not be responsible for providing working access to the defect, including disassembly and re-assembly of the equipment or for providing transportation to and from repair facility, all of which shall be at purchaser's expense.

1.3 *Using this Manual*

Using this manual is very simple. Look through it completely before any action occurs with the system. Become familiar with the table of contents, start-up instruction, maintenance procedures, and the specifications. By following all instructions carefully, there is less risk to the machinery.

1.4 *Introduction to the HPU*

To become more familiar with the unit, locate the general arrangement and hydraulic schematic drawings, located in the Specifications section of this manual. Locate all critical locations and components on the HPU (i.e. electrical connection, customer hydraulic connections, etc.). Familiarize yourself with the hydraulic symbols on the schematic and correlate those symbols to the components on the system.

2.0 Fluids and Filtration

2.1 *Fluid Recommendation*

The fluid recommended for this HPU is Mobile DTE 25

All hydraulic oil has a definite, useful life span, and when it has deteriorated to near the danger point, it should be discarded.

One major cause of short oil life is operation at too high a temperature. This speeds up the oxidation process, which forms acids and sludge in the oil, causing rapid wear and corrosion to moving parts within the system. Depending upon the oil selected, the oil temperature should range from 120° to 140° F. Check your oil temperature occasionally with a thermometer, or by simply placing your hand on the reservoir. At 120° F it is uncomfortable to leave your hand on the reservoir for more than two or three seconds. If the tank is too hot to be touched at all, check it with a thermometer.

2.2 *Fluid Cleanliness*

Fluid must be cleaned before and continuously during operation by filters that maintain a cleanliness level of NAS 1638 Class 8. This approximately corresponds to ISO 17/14. Better cleanliness levels will significantly extend the life of the components. As contaminant entrainment and contaminant generation may vary with each application, each must be analyzed to determine proper filtration to maintain the required cleanliness level.

COMPARISON OF SOLID CONTAMINATION CLASSIFICATION SYSTEMS

NATIONAL AEROSPACE STANDARD (NAS) 1683

		CLASS													
		00	0	1	2	3	4	5	6	7	8	9	10	11	12
PARTICLE SIZE RANGE	5-15μm	125	250	500	1000	2000	4000	8000	16000	32000	64000	128000	256000	512000	1024000
	15-25μm	22	44	89	178	356	712	1425	2850	5700	11400	22800	45600	91200	182400
	25-50μm	4	3	16	32	63	126	253	506	1012	2025	4050	8100	16200	32400
	50-100μm	1	2	3	6	11	22	45	90	180	360	720	1440	2880	5760
	>100μm	0	0	1	1	2	4	8	16	32	64	128	256	512	1024
MAXIMUM PARTICLES	>5μm	152	304	609	1217	2432	4864	9731	19462	38924	77849	155698	311396	622792	1245584
	>15μm	27	54	109	217	432	864	1731	3462	6924	13849	27698	55396	110792	221584

ISO: DIS 4406; SAE J1165

		ISO SOLID CONTAMINANT CODE														
		8/5	9/6	10/7	11/8	12/9	13/10	14/11	15/12	16/13	17/14	18/15	19/16	20/17	21/18	22/19
MAX	>5μm	250	500	1000	2000	4000	8000	16000	32000	64000	130000	250000	500000	1000000	2000000	4000000
PART.	>15μm	32	64	130	250	500	1000	2000	4000	8000	16000	32000	64000	130000	250000	500000

NOTE: ALL MEASUREMENTS ARE FOR A 100 ML SAMPLE SIZE

Make a visual inspection of the oil every month. Compare the color and body with an unused sample of the same oil. A slight darkening is usually not serious, but a deep, dark color or a noticeable thickening may indicate a serious deterioration. Feel a smudge of oil between your fingers to detect small pieces of grit. If metal flakes and/or grit is found, the oil should be cleaned using a filter cart.

2.3 The Importance of Filtration

Proper filtration of the hydraulic fluid will help ensure long life of the system, assuming proper oil is used at the proper temperature. The minimum filtration requirement for any hydraulic system is return line filtration of 10 micron nominal, but under no circumstances should oil cleanliness levels exceed ISO 17/14. It is recommended that the following maintenance schedule be adopted: Change filter element after first 50 hours of service, then every 1,000 hours or every 3 months, which ever comes first. If filter is fitted with a clogging/bypass indicator, then element must be changed when indicator shows that filter is plugged or bypassing, even though above time has not passed.

WARNING Scrupulous cleanliness is essential during element change. Dirt on the downstream side of the element will pass into the system; Dirt on the upstream side will reduce the effective life of the element.

IMPORTANT On systems operating in heavily contaminated environments, such as mobile equipment, foundries, steel mills, etc. it is recommended the above filter life be de-rated to 500 hours/1.5 months.

2.3.1 Element Installation Instructions

SPIN-ON CANISTER TYPE FILTERS

1. Make sure filter's rubber gasket is seated in place.
2. Clean and inspect gasket contact surface on filter head
3. Lubricate filter gasket with clean hydraulic fluid.
4. Use no tools. Install by hand until gasket contacts mounting base - then tighten 1/2 turn (14 ft-lb).
5. Run system: Check for leaks, let 5 minutes elapse, and check again.
6. Check reservoir oil level.

NOTE: Most states have laws requiring the crushing of filter elements to remove the majority of the oil. Also, hydraulic fluid must be handled as a hazardous waste.

ELEMENT-IN-BOWL TYPE FILTERS

1. Place suitable receptacle beneath filter to catch spillage
2. Remove lid screws and lift-off lid, unscrew bowl, or remove bowl-to-head screws and drop bowl.
3. Remove element and discard in an environmentally friendly way.
4. On fixed bowl types, wipe out thoroughly with clean linen rag. On removable bowl types, thoroughly wash interior of bowl with cleaning solvent.

5. Inspect the O-Ring and contact surface for nicks and scratches and replace or dress-up to achieve sealing. Lubricate O-Ring with clean hydraulic fluid.
6. Reverse above instructions for re-assembly
7. Function system to expel air and check filter for external leaks
8. Check reservoir oil level.

WARNING Disposable elements must be properly disposed of. NO attempt whatsoever should be made at cleaning the element.

3.0 Internal Settings

The HPU has been designed to accomplish a function. The specifications to this particular HPU are:

Comp II

HYDRAULIC SPECIFICATIONS		PRIME MOVER SPECIFICATIONS	
Maximum System Pressure:	3000 psig	Prime Mover Type:	Electric
Normal Operating Pressure	1723 psig	Horse Power:	3
Maximum Flow:	2.25 GPM	Voltage:	208-230 / 460
Normal Operating Flow:	2.00 GPM	Shaft Speed (RPM):	1740

Mini-Evac

HYDRAULIC SPECIFICATIONS		PRIME MOVER SPECIFICATIONS	
Maximum System Pressure:	2500 psig	Prime Mover Type:	Internal Comb.
Normal Operating Pressure	2000 psig	Horse Power:	25
Maximum Flow:	20.0 GPM	Fuel:	Gas – Unleaded
Normal Operating Flow:	10.0 GPM	Shaft Speed (RPM):	1250 - 3000

NOTE: See Specifications sections for more detailed information on the individual components

4.0 Installation and Start-Up of HPU

Safety should be first and foremost during installation and start-up. Safety glasses and protective clothing should be worn at all times during installation, start-up, tuning, and normal running conditions. All personnel should be clear of any dangerous areas BEFORE any start-up. All guards and protection devices should be in their proper place. Always ensure someone is standing ready by emergency shutdown switches in case of emergency.

Documentation is also very important during installation and start-up. Record all pertinent readings after initial flushing/run-in period for maintenance records. These readings include: Pressures, voltage, amps, flow, noise level, oil temperature, amount of fluid needed to fill system, and part numbers on all consumables (i.e. filters). Machine cycle time should also be noted to be used in trouble shooting situations.

4.1 Installation of HPU

Place the unit in the place where it is to be installed. Level unit using shims if necessary. Attach hoses or tubing to the customer connections provided. Install the electrical power to motor and wire all electrical devices. Fill the reservoir with specified oil.

! **WARNING** Warranties are not valid unless proper starting and maintenance procedures are followed.

4.2 Start-Up Procedure

Once the unit has been installed, the proper connections made, and the reservoir filled, it is ready for start-up. To start the HPU use the following procedures:

INITIAL START UP

1. Double check to see that the reservoir is filled with the proper hydraulic fluid. Oil level should be midway on the sight gauge.
2. Always check engine oil level before starting. The engine is equipped with low level protection and will not run if oil level is low
3. Make sure heat exchanger is clean an air flow is unobstructed. The two temperature switches should be adjusted to 90° F and 105° F, each controlling two separate fans powered by 24 VDC source.
4. Be sure hydraulic connections are tight.
5. Turn bypass valve handle into the open or horizontal position.
6. Insure that pump stroke arm is vertical or neutral position.
7. Make sure pump suction valve is full open.
8. Adjust engine throttle to ¼ on, and pull choke out as needed for starting.
9. Fueling: Gas tank is removable to facilitate filling and can be transported horizontally or vertically. Always close vent on filler cap when transporting. When fuel tank is installed the fuel line connected (simple plug-in quick disconnect) always make sure that the vent is open.
10. Start Engine: allow engine to warm up 2 to 3 minutes at fast idle.
11. Make sure stroke control is in neutral and slowly close bypass valve.

DURING NORMAL OPERATION

1. Check fluid levels.
2. Open bypass valve.
3. Start engine: allow engine to warm up 2 to3 minutes at fast idle.
4. Make sure stroke control is in neutral and slowly close bypass valve.
5. Forward and reverse movements are controlled by the direction stroke control lever is moved. Speed is a function of stroke. Engine speed also is directly proportional to output flow

SHUT DOWN

1. Move stroke control into neutral position
2. Open bypass valve.
3. Turn engine throttle to lowest setting
4. Turn engine key to OFF position.

! **WARNING** Warranties are not valid unless proper starting and maintenance procedures are followed.

5.0 Maintenance of HPU

Safety should be first and foremost during maintenance of the system. Safety glasses and protective clothing should be worn at all times during maintenance and normal running conditions. All system lock out devices must be utilized before any maintenance operations occur. If there are no lock outs, remove power fuses to ensure system is not energized during maintenance. All personnel should be clear of any dangerous areas BEFORE the system is energized. All guards and protective devices should be in their proper place. Always ensure someone is standing ready by emergency shutdown switches in case of emergency.

Documentation is also very important during maintenance. Record all pertinent readings after any maintenance. These readings include: Pressures, voltage, amps, flow, noise level, and oil temperature, amount of fluid needed to fill system. Machine cycle time should also be noted (to be used in trouble shooting situations).

SEASONAL MAINTENANCE

1. Change engine oil: Remove oil tube plug and remove oil with oil suction. Change oil filter every year.
2. Check bolts and linkages and tighten/adjust as needed.
3. Check and clean air filter. Wash in warm soap water and carefully dry.
4. Check battery connections and clean/tighten as necessary.
5. When engine will be shut down for greater than 30 days, fuel stabilizer should be added or fuel should be drained.
6. Clead dust and debris for heat exchanger.

MAINTENANCE TIPS

1. Maintain as low a system pressure as possible to achieve adequate performance.
2. Prohibit unauthorized personnel from making adjustments on the hydraulic system.
3. Maintain adequate oil level. When adding oil, be sure it is new and clean and if possible, pump into the unit through a 10 μ (micron) filter cart. 3 μ (micron) filtration should be used on servo valve systems.
4. Keep fittings tightened.
5. Maintain clean fluid in system by: changing filter elements when indicated; cleaning strainer elements; changing oil if any foreign material enter the system; clean or replace reservoir air breathers regularly. Ensure that no foreign material enters reservoir when adding oil.
6. Lubricate all grease zerks regularly if applicable.
7. Check system regularly for overheating. Seal damage may occur over 165° F.
8. Keep HPU clean.
9. The three most important indicators of where trouble points are located are Heat, Noise and Leakage

If problems or questions arise, call:

TEI ENGINEERED PRODUCTS, INC.
Phone (303) 693-1491
Fax (303) 680-7577

6.0 Troubleshooting

Trouble encountered in hydraulic systems results in a loss of efficiency of machines and/or down time. The following chart has been compiled to enable field engineers to locate and remedy troubles quickly. The symptoms and remedies suggested should be evaluated with reference to a particular hydraulic circuit.

SYMPTOMS	CAUSES	REMEDIES IN THE FIELD
Noisy Pump	Cavitation	Larger suction strainer. Larger suction line. Use oil of lower viscosity
	Restricted Suction	Clean suction strainer
	Air leak at intake pipe connection	Tighten suction line fittings. Pour oil over joints with pump running and pinpoint leaking fitting
	Air leak at pump shaft seal	Accurately align pump and motor shaft. Replace shaft seal.
	Air drawn into system from reservoir	Raise oil level in reservoir. Ensure discharge is below oil level. Does oil have anti-foam additive?
	Worn valves, vanes, pistons, gears	Replace worn parts. Replace filters
	Sticking valves or vanes	Check for impurities or metal particles in oil. Clean filters
Excessive heating of pump	Internal pump leakage	Renew worn parts, such as gears, vanes, pistons, valves, etc.
	Relief valve set above compensator	Set relief valve 250 psi above compensator setting
	Internal leakage caused by thin oil	Use heavier bodied oil. Check pressure relief valve setting. Check pressure relief valve for leakage
	Insufficient clearance of moving parts	Check assembly of pump parts
Diminished or insufficient delivery of pump	Prime mover not at correct speed	Check prime mover RPM
	Pump parts worn out, or system bypassing oil	Renew worn parts Check orifice in relief valve
Erratic & sluggish operation	Air trapped in pilot lines	Bleed pilot lines
	Oil viscosity to high or insufficient input power	Use lower viscosity oil
Diminished delivery pressure of pump	Short circuit in pump, or system bypassing	Check seal between inlet and outlet ports of pump. Check orifice in relief valve.
Low or no pressure in system	Relief valve jammed or orifice plugged	Re-set pressure settings after cleaning relief valve.
	Low oil level	Add oil to reservoir
Fluctuating pressure	Air or water in system	Check seals and pipe connections. Check for jams or obstructions in system (collapsed hose/tube?)
Erratic movements	Insufficient oil in system or improper kind of oil. Water or air present	Check vent valve. Check oil level. Test oil.

Maximum pressure below expectations	Relief valve not functioning properly. Internal pump leakage Excessive frictional losses in system. Oil velocity too high	Check poppet for sticking and spring for proper adjustment. Move HPU closer to hydraulic components. Use larger lines on machinery.
Frequent leaks in lines	Cavitation	Larger suction strainer. Larger suction line. Use oil of lower viscosity
	Decompression shocks	Adjust decompression valve if installed or reduce orifice size in bleed down path
	Vibration in the machine	Fasten oil lines securely with tubing clamps
Overheating of oil. (Efficient normal operating temp is about 120° to 140 ° F)	Too much oil discharging over relief valve.	Check relief valve for pressure and leakage. Check pressure at which pump should operate. Add a heat exchanger to system.
	Insufficient oil or oil level too low	Add oil
	High pressure held too long	Check machinery operation
	Oil too light	Use heavier oil
	Obstructions or restrictions to flow of oil in pump lines	Check position of control valve for neutral locations and overloads. Pump parts may be worn. Check back pressure valve for high pressure.
Excessive internal leakage in the system	Oil too light, valves, pumps worn out.	Check clearances. Use heavier oil if leakage is still excessive.
Irregular, erratic or uncertain feeds	Pumps, valves worn out	Check for excessive internal leakage. Check kind of oil used; use oil recommended
	Low external pilot pressure	Check external pilot pressure.
Slow acting machine	Starting temp. of oil (too cold)	Verify oil heater is working if used. Set controls so that oil is discharging across relief valve until oil heats.
	Oil too heavy causing excessive frictional resistance in system	Use lighter oil
	Oil too thin causing excessive internal leakage.	Use heavier oil
Jerky operation of working cylinders, motors, etc.	Friction in seals/ways	Check oil level, may be too low. See that seals are not binding. Check for worn or scored rods, seals, and broken piston rings.
	Air in system	Bleed cylinders
	Improper adjustment of control valves	Adjust control valving to proper setting
Rapid traverse and reversing valve troubles	Worn/broken components	Check for broken springs. Valve plunger depressed to far. Cams and/or rollers worn. Valve remaining partly open.
Acceleration too slow	Low volume set on pump	Set volume adjustment to proper setting.
	Relief valve set too low	Check relief valve setting.
Acceleration too fast	High volume set on pump	Set volume adjustment to proper setting
	Relief valve set too high	Check relief valve setting
3 and 4 - way valve troubles.	Worn out parts/seals, broken parts	Excessive wear of spools or body.

Overheating of solenoid operated valves; indicated by hum or buzz		Broken springs. Leaky seals. Binding resulting from varnish coating,-Polish spool or poppet.
Check valve troubles	Worn seat	Check condition of valve seat. If worn or ball of poppet is in poor conditions, reseat new ball or replace
Flow control valve troubles	Dirty oil or worn parts	Pressure compensator binding caused by dirt. Plungers worn. Clean orifice, polish spool
Metering valve not functioning properly	Dirty oil	Dirt lodged in eccentric grooves or orifice. Clean oil
Needle valve won't control or shut off	Worn parts	Needle worn - regrind and relap, or replace
Fluctuating pressure of relief valve	Worn parts	Relief pressure control spring(s). Check for proper adjustment. Clean orifice. Check pilot cone.
Pressure reducing valves trouble	Improper adjustment/ broken spring	Set correctly. Check drain line. Check for broken springs.

7.0 Specifications

The following pages contain hydraulic schematics and general arrangement drawings of the integral Mini-Evac / Comp II.

Worldwide Distributor Sales and Service Directory

The Cummins®/Onan® Distributor and Dealer Network - Ready and Qualified to Serve You

Give your power generation and control equipment the care that it deserves by having it serviced by one of our authorized distributors and dealers, who are also your source for parts.

For sales support, our distributors and dealers provide information, technical data and application assistance.

Our distributor and dealer network is designed with the needs and the historic business relationships of your region in mind. In some cases, a combined Cummins/Onan distributor provideds sales and Onan brand products. In other cases, Cummins-only distributors or Onan-only distributors offer support for their respective brands.

Selecting a Distributor

This directory is a key with which you can locate the appropriate distributorship for your sales and service requirements.

If a C, O, or C/O symbol appears next to the distributor name, this will help you identify the products and services offered by the distributor.

C/O All Onan RV, Marine and Portable Generators, Engines and other consumer products. All Onan and Cummins standby or prime power generator sets, transfer switches, paralleling switchgear and accessories.
O All Onan RV, Marine and Portable Generators, Engines and other consumer products. All Onan standby or prime power generator sets, transfer switches, paralleling switchgear and accessories.
C All Cummins standby or prime power generator sets, transfer switches, paralleling switchgear and accessories.

Service

Follow these steps to resolve your service and warranty concerns:

1. Contact your nearby original selling distributor or dealer.

2. Consult the Yellow Pages. Typicallly product distributors are located under :

   GENERATORS - ELECTRIC; ENGINES - GASOLINE OR DIESEL
   OR RECREATIONAL VEHICLES - EQUIPMENT PARTS & SERVICE

3. Check this Sales and Service Directory. Each distributor listed for service in this directory can refer you to the nearest authorized dealer, if applicable.

4. To contact your local Cummins/Onan or Onan-only distributor in the United States or Canada, call 1-800-888-ONAN. You will be automatically connected to the distributor nearest you.

For outside North America, call Onan Corporation, 1-612-574-5000,7:30 am to 4:00 pm, Central Standard Time, Monday through Friday. Or, send a fax to Onan using the fax number 1-612-574-5282.

United States

Alabama

C/O Cummins Alabama, Inc.
Birmingham
Phone: 205-841-0421
Fax: 205-849-5926

C/OCummins Alabama, Inc.
Mobile
Phone: 334-452-6426
Fax: 334-473-6657

C/O Cummins Alabama, Inc.
Montgomery
Phone: 334-263-2594
Fax: 334-263-2594, Ext 124

Alaska

C/O Cummins Northwest, Inc.
Anchorage
Phone: 907-279-7594
Fax: 907-276-6340

Arizona

C/O Cummins Southwest, Inc.
Phoenix
Phone: 602-252-8021
Fax: 602-258-1010

C/O Cummins Southwest, Inc.
Tucson
Phone: 520-887-7440
Fax: 520-887-4173

Arkansas

C/O Cummins Mid–South, Inc.
Little Rock
Phone: 501-569-5600
Fax: 501–565–2199

California

O Cummins Cal Pacific, Inc.
Montebello
Phone: 213-728-8111
Fax: 213-889-7422

C/O Cummins Cal Pacific, Inc.
Rialto
Phone: 909-877-0433
Fax: 909-877-3787

C/O Cummins Cal Pacific, Inc.
El Cajon
Phone: 619-593-3093
Fax: 619-593-0600

C/O Cummins Cal Pacific, Inc.
Irvine
Phone: 714-253-6000
Fax: 714-253-6080

C/OCummins Cal Pacific, Inc.
Ventura
Phone:805-644-7281
Fax: 805-644-7284

C/OCummins West, Inc.
Arcata
Phone: 800-595-5050
Fax: 707-822-7585

C/OCummins West, Inc.
Bakersfield
Phone: 805-325-9404
Fax: 805-861-8719

C/O Cummins West, Inc.
Fresno
Phone: 800-595-5050
Fax: 209-486-7402

C/OCummins West, Inc.
Redding
Phone: 916-222-4070
Fax: 916-224-4075

C/O Cummins West, Inc.
West Sacramento
Phone: 916-371-0630
Fax: 916-371-2849

C/O Cummins West, Inc.
San Leandro
Phone: 510-351-6101
Fax: 510-352-3925

C/O Cummins West, Inc.
Stockton
Phone: 800-595-5050
Fax: 209-478–2454

O ODC of California
An ONAN Company
Irvine
Phone: 714-757-7375
Fax: 714-757-5940

Colorado

C/O Cummins Rocky Mountain, Inc.
Commerce City
Phone: 303-286-7697
Fax: 303-287-4837

C/O Cummins Rocky Mountain, Inc.
Durango
Phone: 970-259-7470
Fax: 970-259-7482

C/O Cummins Rocky Mountain, Inc.
Grand Junction
Phone: 970-242-5776
Fax: 970-243-5494

Connecticut

C/O Cummins Metropower, Inc.
Hartford
Phone: 860-529-7474
Fax: 860-529-7524

C/O Cummins Metropower Inc.
Rocky Hill, CT
Phone: 860-529-7474
Fax: 860-529-7574

Delaware

C/O Cummins Power Systems
Glen Burnie, MD
Phone: 410-590-8700
Fax: 410-590-8723

Florida

C/O Cummins SE Power, Inc.
Hialeah Gardens
Phone: 305-821-4200
Fax: 305-557-2992

C/O Cummins SE Power, Inc.
Jacksonville
Phone: 904-355-3437
Fax: 904-354-4594

C/O Cummins SE Power, Inc.
Ocala
Phone: 352-861-1122
Fax: 352-861-1130

C/O Cummins SE Power, Inc.
Orlando
Phone: 407-298-2080
Fax: 407-290-8727

C/O Cummins SE Power, Inc.
Tampa
Phone: 813-621-7202
Fax: 813-621-8250

C/O Cummins SE Power, Inc.
Tampa
Phone: 813-626-1101
Fax: 813-628-4183

C/O Cummins SE Power, Inc.
Ft. Meyers
Phone: 941-337-1211
Fax: 941-337-5374

O RDC of Florida
Tampa
Phone: 813-628-4040
Fax: 813-628-0965

Georgia

C/O Cummins South, Inc.
Albany
Phone: 912-888-6210
Fax: 912-883-1670

C/O Cummins South, Inc.
Augusta
Phone: 706-722-8825
Fax: 706-722-7553

C/O Cummins Onan South Power Systems
College Park
Phone: 404-763-0233
Fax: 404-763-0711

C/O Cummins South, Inc.
Savannah
Phone: 912-232-7424
Fax: 912-232-5145

Hawaii

C/O Cummins Hawaii Diesel Power, Inc.
Kapolei
Phone: 808-682-8110
Fax: 808-682-8477

Idaho

C/O GenPlus
Division of Cummins Intermountain, Inc.
Boise
Phone: 208-336-5000
Fax: 208-338-5436

C/O GenPlus
Division of Cummins Intermountain, Inc.
Pocatello
Phone: 208-234-1661
Fax: 208-234-1662

Illinois

C/O Cummins/Onan Northern Illinois
Justice
Phone: 708-563-7070
Fax: 708-563-7095

C/O Cummins Mid-States Power, Inc
Normal
Phone: 309-452-4454
Fax:309-452-1642

C/O Gateway Industrial Power
Collinsville
Phone: 618-345-0123
Fax: 314-531-6604

C/O Cummins Great Plains Diesel, Inc
Rock Island
Phone: 309-787-4300
Fax: 309-787-4397

Indiana

O Onan-Indiana
Elkhart
Phone: 219-262-4611
Fax: 219-295-8000

C/O Cummins Cumberland
Evansville
Phone: 812-867-4400
Fax: 812-867-4411

C/O Cummins Mid-States Power, Inc.
Indianapolis
Phone: 317-243-7979
Fax: 317-240-1925

C/O Mid-States Power & Refrig
Indianapolis
Phone: 317-240-1967
Fax: 317-240-1975

Iowa

C/O Cummins Great Plains Diesel, Inc.
Cedar Rapids
Phone: 319-366-7537
Fax: 319-366-7562

C/O Midwestern Power Division
Cummins Great Plains Diesel, Inc.
Des Moines
Phone: 515-264-1650
Fax: 515-264-1651

Kansas

C/O Cummins Mid–America, LLC
Colby
Phone: 913-462-3945
Fax: 913-462-3970

C/O Cummins Mid-America, LLC
Garden City
Phone: 316-275-2277
Fax: 316-275-2533

C/O Cummins Mid-America, LLC
Wichita
Phone: 316-838-0875
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Fax: 313-538-3966

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Installation Manual

GENERATOR SETS

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DGCA
DGCB
DGCC
DGDA
DGDB
DGEA
DGFA
DGFB
DGFC

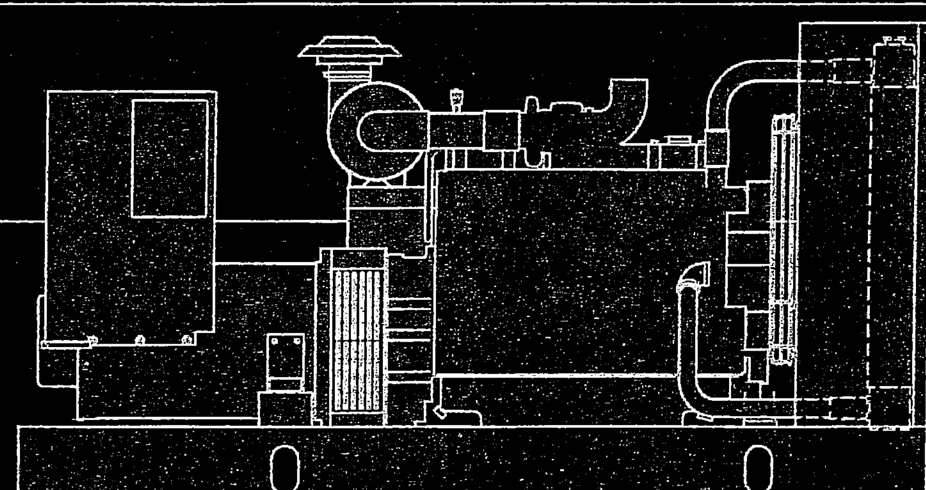

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Table of Contents

California
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

DANGER ***This symbol warns of immediate hazards which will result in severe personal injury or death.***

WARNING ***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***

CAUTION ***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

FUEL AND FUMES ARE FLAMMABLE

Fire, explosion, and personal injury or death can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Be sure all fuel supplies have a positive shutoff valve.
- Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc..

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.
- Engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect battery charger from its AC source, then disconnect starting batteries, negative (-) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. Do not operate a diesel-powered genset where a flammable vapor environment can be created by fuel spill, leak, etc., unless the genset is equipped with an automatic safety device to block the air intake and stop the engine. The owners and operators of the genset are solely responsible for operating the genset safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag and lock open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

MEDIUM VOLTAGE GENERATOR SETS (601V to 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training is required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Due to the nature of medium voltage electrical equipment, induced voltage remains even after the equipment is disconnected from the power source. Plan the time for maintenance with authorized personnel so that the equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.
- Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breath or ingest or come into contact with exhaust gases.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

This manual provides installation instructions for the DG Series generator sets. This includes the following information:

- **Mounting Recommendations** - for fastening generator set to base and space requirements for normal operation and service.
- **Mechanical Connections** - Location of connection points for fuel, exhaust, ventilation, and cooling.
- **Electrical Connections** – Location of electrical connection points for the control, generator, and starting system.
- **Prestart** – Checklist of items or procedures needed to prepare generator set for operation.
- **Initial Startup** – Test complete system to ensure proper installation, satisfactory performance, and safe operation. Refer to Operators Manual for troubleshooting information.
- **Installation Checklist** – Reference checks upon completion of installation.

This manual contains separate DC Control Wiring and Prestart Preparation sections for gensets using the PowerCommand Control (PCC), the Sentinel control or the Detector control (Figure 1-1). Refer to the Table of Contents for specific information relating to your genset. The remaining sections apply to all versions.

This manual DOES NOT provide application information for selecting a generator set or designing the complete installation. If it is necessary to design the various integrated systems (fuel, exhaust, cooling, etc.), additional information is required. Review standard installation practices. For engineering data specific to the generator set, refer to the specification and product data sheets. For application information, refer to Application Manual T-030, "Liquid Cooled Generator Sets".

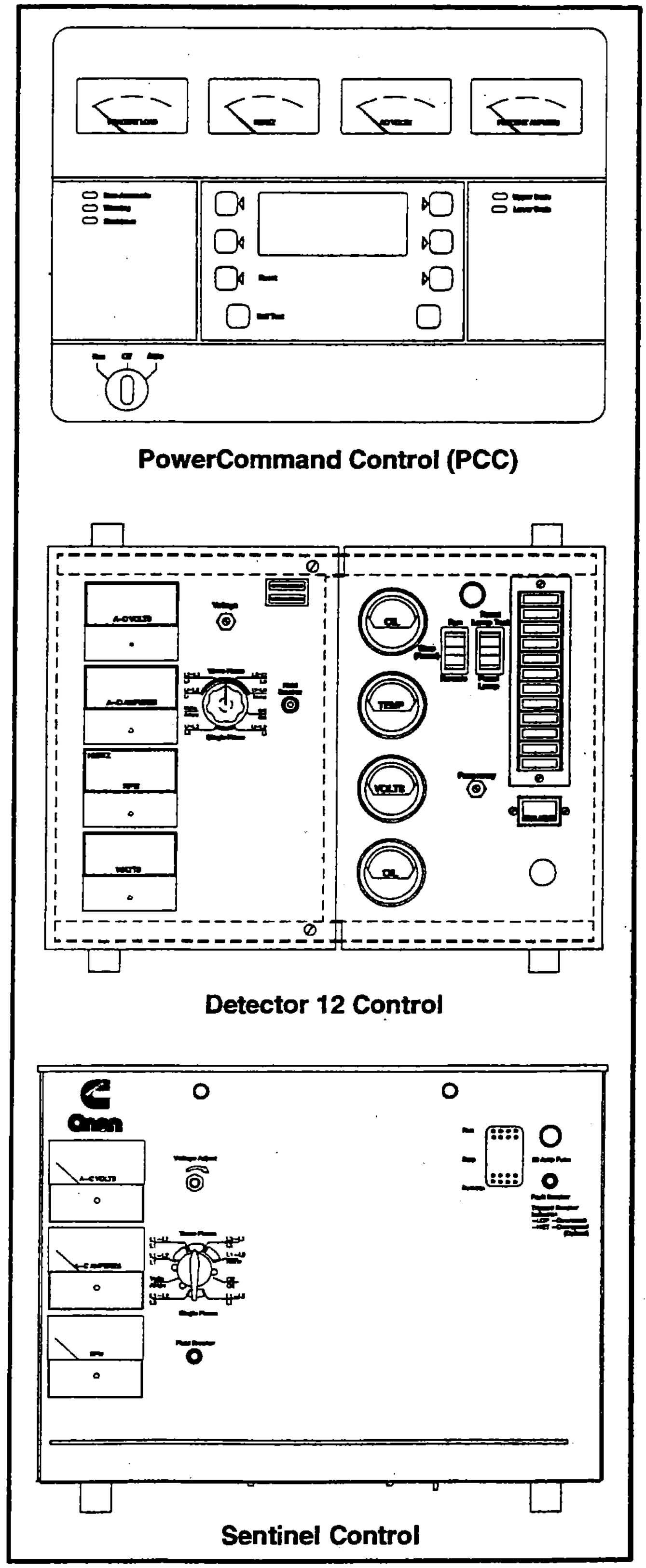


FIGURE 1-1. CONTROL PANEL CONFIGURATIONS

INSTALLATION OVERVIEW

These installation recommendations apply to typical installations with standard model generator sets. Whenever possible, these recommendations also cover factory designed options or modifications. However, because of the many variables in any installation, it is not possible to provide specific recommendations for every situation. If there are any questions not answered by this manual, contact your nearest Cummins/Onan dealer or distributor for assistance.

Application and Installation

A standby power system must be carefully planned and correctly installed for proper operation. This involves two essential elements: application and installation.

Application (as it applies to generator set installations) refers to the design of the complete standby power system that usually includes power distribution equipment, transfer switches, ventilation equipment, mounting pads, and cooling, exhaust, and fuel systems. Each component must be correctly designed so the complete system will function as intended. Application and design is an engineering function generally done by specifying engineers or other trained specialists. Specifying engineers are responsible for the design of the complete standby system and for selecting the materials and products required.

Installation refers to the actual set-up and assembly of the standby power system. The installers set up and connect the various components of the system as specified in the system design plan. The complexity of the standby system normally requires the special skills of qualified electricians, plumbers, sheetmetal workers, etc. to complete the various segments of the installation. This is necessary so all components are assembled using standard methods and practices.

Safety Considerations

The generator set has been carefully designed to provide safe and efficient service when properly installed, maintained, and operated. However, the overall safety and reliability of the complete system is dependent on many factors outside the control of the generator set manufacturer. To avoid possible safety hazards, make all mechanical and electrical connections to the generator set exactly as specified in this manual. All systems external to the generator (fuel, exhaust, electrical, etc.) must comply with all applicable codes. Make certain all required inspections and tests have been completed and all code requirements have been satisfied before certifying the installation is complete and ready for service.

2. Specifications

MODEL	35 DGBB	40 DGBC	50 DGCA	60 DGCB
Engine				
Cummins Diesel Series	4B3.9	4B3.9	4BT3.9	4BT3.9
Generator (Standby Rating)				
3 Phase, 60 Hz (Standby/Prime) (kVA @ 0.8 PF)	35/32 kW (44 kVA)	40/35 kW (50 kVA)	50/45 kW (63 kVA)	60/55 kW (75 kVA)
3 Phase, 50 Hz (Standby/Prime) (kVA @ 0.8 PF)	28/25 kW (35 kVA)	32/29 kW (40 kVA)	40/36 kW (50 kVA)	50/45 kW (63 kVA)
Fuel Pump				
Inlet Fitting Size	5/8 Inverted Flare	5/8 Inverted Flare	5/8 Inverted Flare	5/8 Inverted Flare
Return Fitting Size	0.18 O.D. Tube	0.18 O.D. Tube	0.18 O.D. Tube	0.18 O.D. Tube
Maximum Fuel Lift	5 ft. (1.525 m)	5 ft. (1.525 m)	5 ft. (1.525 m)	5 ft. (1.525 m)
Exhaust				
Outlet Size	3 inch O.D.	3 inch O.D.	3 inch O.D.	3 inch O.D.
Max. Allowable Back Pressure	41 inch H_2O	41 inch H_2O	41 inch H_2O	41 inch H_2O
Electrical System				
Starting Voltage	12 Volts DC	12 Volts DC	12 Volts DC	12 Volts DC
Battery	One, 12 Volt	One, 12 Volt	One, 12 Volt	One, 12 Volt
Cold Cranking Amps	625	625	625	625
Cooling System				
Capacity with Standard Radiator	5.5 Gal (21 L)	5.5 Gal (21 L)	5.5 Gal (21 L)	5.5 Gal (21 L)
Lubricating System				
Oil Capacity with Filters	12 Qts (11 L)	12 Qts (11 L)	12 Qts (11 L)	12 Qts (11 L)
Oil Type*				

* Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

MODEL	70 DGCC	80 DGDA	100 DGDB
Engine			
Cummins Diesel Series	4BTA3.9	6BT5.9	6BT5.9
Generator (Standby Rating)			
3 Phase, 60 Hz (Standby/Prime) (kVA @ 0.8 PF)	70/63 kW (88 kVA)	80/72 kW (100 kVA)	100/90 kW (125 kVA)
3 Phase, 50 Hz (Standby/Prime) (kVA @ 0.8 PF)	62/56 kW (77 kVA)	65/60 kW (81 kVA)	85/80 kW (106 kVA)
Fuel Pump			
Inlet Fitting Size	5/8 Inverted Flare	5/8 Inverted Flare	5/8 Inverted Flare
Return Fitting Size	0.18 O.D. Tube	0.18 O.D. Tube	0.18 O.D. Tube
Maximum Fuel Lift	5 ft. (1.525 m)	5 ft. (1.525 m)	5 ft. (1.525 m)
Exhaust			
Outlet Size	3 inch O.D.	3 inch O.D.	3 inch O.D.
Max. Allowable Back Pressure	41 inch H_2O	41 inch H_2O	41 inch H_2O
Electrical System			
Starting Voltage	12 Volts DC	12 Volts DC	12 Volts DC
Battery	One, 12 Volt	One, 12 Volt	One, 12 Volt
Cold Cranking Amps	625	800	800
Cooling System			
Capacity with Standard Radiator	5.7 Gal (22 L)	6.5 Gal (25 L)	6.5 Gal (25 L)
Lubricating System			
Oil Capacity with Filters	12 Qts (11 L)	17 Qts (16 L)	17 Qts (16 L)
Oil Type*			

* Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

MODEL	125 DGEA	150 DGFA	175 DGFB	200 DGFC
Engine Cummins Diesel Series	6CT8.3	6CTA8.3	6CTA8.3	6CTAA8.3
Generator (Standby Rating) 3 Phase, 60 Hz (Standby/Prime) (kVA @ 0.8 PF) 3 Phase, 50 Hz (Standby/Prime) (kVA @ 0.8 PF)	125/113 kW (156 kVA) 110/100 kW (138 kVA)	150/135 kW (188 kVA) 140/125 kW (175 kVA)	175/160 kW (219 kVA) 150/135 kW (188 kVA)	200/180 kW (250 kVA) 175/160 kW (219 kVA)
Fuel Pump Inlet Fitting Size Return Fitting Size Maximum Fuel Lift	5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)	5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)	5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)	5/8 Inverted Flare 0.18 O.D. Tube 5 ft. (1.525 m)
Exhaust Outlet Size Max. Allowable Back Pressure	4 inch O.D. 41 inch H_2O	4 inch O.D. 41 inch H_2O	4 inch O.D. 41 inch H_2O	4 inch O.D. 41 inch H_2O
Electrical System Starting Voltage Battery Cold Cranking Amps	12 Volts DC One, 12 Volt 900	12 Volts DC One, 12 Volt 900	12 Volts DC One, 12 Volt 900	12 Volts DC One, 12 Volt 900
Cooling System Capacity with Standard Radiator	6.8 Gal (26 L)	7.5 Gal (28 L)	7.5 Gal (28 L)	6.8 Gal (26 L)
Lubricating System Oil Capacity with Filters Oil Type*	20 Qts (19 L)	20 Qts (19 L)	20 Qts (19 L)	20 Qts (19 L)

* Refer to Cummins engine *Operation and Maintenance Manual* for lubricating oil recommendations/specifications.

IMPORTANT

DEPENDING ON YOUR LOCATION AND INTENDED USE, FEDERAL, STATE OR LOCAL LAWS AND REGULATIONS MAY REQUIRE YOU TO OBTAIN AN AIR QUALITY EMISSIONS PERMIT BEFORE BEGINNING INSTALLATION OF YOUR GENSET. BE SURE TO CONSULT WITH LOCAL POLLUTION CONTROL OR AIR QUALITY AUTHORITIES BEFORE COMPLETING YOUR CONSTRUCTION PLANS.

3. Mounting the Generator Set

GENERAL

Most generator set installations must be engineered so the generator set will function properly under the expected load conditions. Use these instructions as a general guide only. Follow the instructions of the consulting engineer when locating or installing any components. The complete installation must comply with all local and state building codes, fire ordinances, and other applicable regulations. Consider these requirements before installation:

- Level mounting surface
- Adequate cooling air
- Adequate fresh induction air
- Discharge of circulated air
- Discharge of exhaust gases
- Electrical connections
- Accessibility for operation and servicing
- Noise levels
- Vibration isolation

LOCATION

Generator set location is decided mainly by related systems such as ventilation, wiring, fuel, and exhaust. The set should be located as near as possible to the main power fuse box.

Provide a location away from extreme ambient temperatures and protect the generator set from adverse weather conditions. An optional housing is available for outside operation.

⚠WARNING

INCORRECT INSTALLATION, SERVICE OR REPLACEMENT OF PARTS CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND MECHANICAL COMPONENT INSTALLATION.

MOUNTING

Generator sets are mounted on a steel skid that provides proper support. The engine-generator assembly is isolated from the skid frame by rubber mounts that provide adequate vibration isolation for normal installations. For critical installations, install vibration isolators between the skid base and foundation.

Mount the genset on a substantial and level base such as a concrete pad.

Use 3/4-inch diameter, anchored mounting bolts to secure the generator set skid to the floor to prevent movement. Secure the skid using a flat washer and a hex nut for each bolt (Figure 3-1).

ACCESS TO SET

Plan for access to the genset for servicing and provide adequate lighting around the unit.

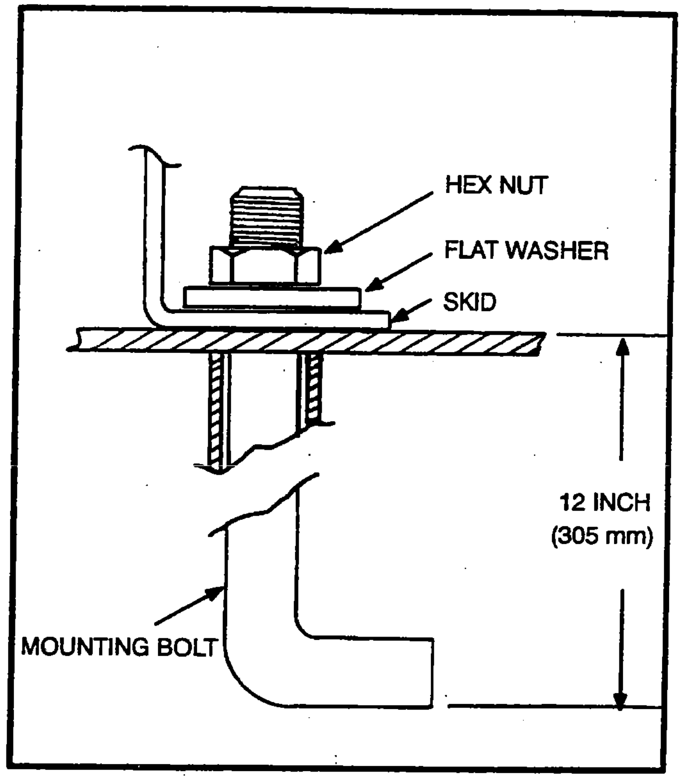


FIGURE 3-1. BOLT DIAGRAM

4. Mechanical Connections

GENERAL

The generator set mechanical system installation includes connecting the fuel, exhaust, ventilation and cooling systems. Before starting any type of fuel installation, all pertinent state and local codes must be complied with and the installation must be inspected before the unit is put in service.

FUEL SYSTEM

Cummins engines used on DG series generator sets normally use ASTM No. 2 diesel fuel. They will, however, operate on altemate diesel fuels within the specifications shown in the engine manual.

In all fuel system installations, cleanliness is of the upmost importance. Make every effort to prevent entrance of moisture, dirt or contaminants of any kind. Clean all fuel system components before installing.

Use only compatible metal fuel lines to avoid electrolysis when fuel lines must be buried. Buried fuel lines must be protected from corrosion. Use a flexible section of tubing (hose) between the engine and fuel supply line to provide vibration isolation. Refer to your generator set outline drawing for sizes and locations.

CAUTION ***Never use galvanized or copper fuel lines, fittings or fuel tanks. Condensation in the tank and lines combines with the sulfur in diesel fuel to produce sulfuric acid. The molecular structure of the copper or galvanized lines or tanks reacts with the acid and contaminates the fuel.***

An electric solenoid valve in the supply line is recommended for all installations and required for indoor automatic or remote starting installations. Connect the solenoid wires to the battery run circuit to open the valve during generator set operation.

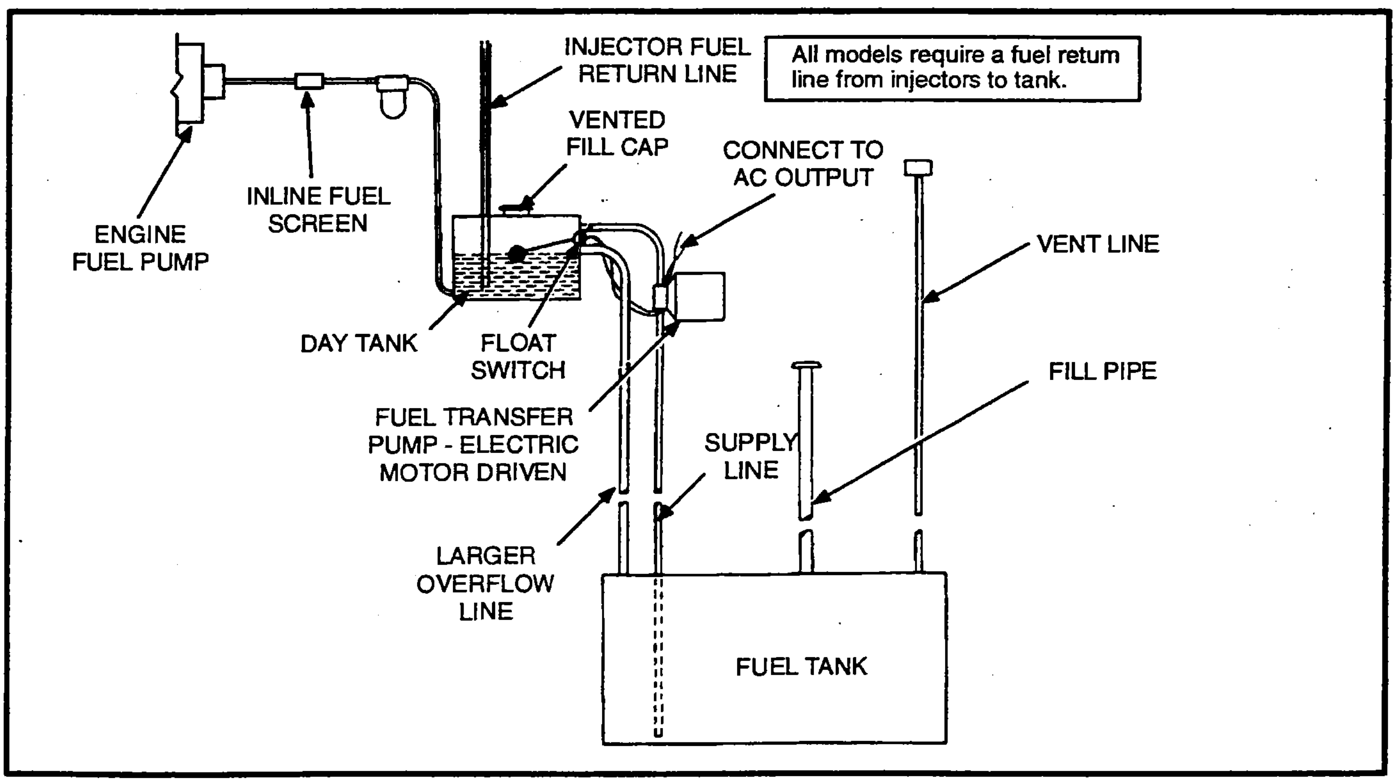


FIGURE4-1. TYPICAL FUEL SUPPLY INSTALLATION

Supply Tank

Locate the fuel tank as close as possible to the generator set and within the 5 foot (1.5 m) lift capacity of the fuel pump. Install a fuel tank that has sufficient capacity to keep the generator set operating continuously at full load for at least 36 hours. Refer to product Specification Sheet for fuel consumption data.

WARNING ***Fuel leaks create fire and explosion hazards which can result in severe personal injury or death. Always use flexible tubing between engine and fuel supply to avoid line failure and leaks due to vibration. The fuel system must meet applicable codes.***

WARNING ***Spilled fuel can create environmental hazards. Check local requirements for containment and prevention of draining to sewer and ground water.***

If the main fuel tank is installed below the lift capabilities of the standard fuel transfer pump, a transfer tank (referred to as a day tank) and auxiliary pump will also be required. If an overhead main fuel tank is installed, a transfer tank and float valve will be required to prevent fuel head pressures from being placed on the fuel system components.

Day Tank (If Used)

Fuel day tanks are used when the standard engine fuel pump does not have the capacity to draw the fuel from the supply tank, or the supply tank is overhead and presents problems of high fuel head pressure for the fuel return.

Supply Tank Lower Than Engine: With this installation, the day tank is installed near the generator set and within the engine fuel pump lift capability, but below the fuel injection system. Install an auxiliary fuel pump as close as possible to the supply tank to pump fuel from the supply tank to the day tank. A float switch in the day tank controls operation of the auxiliary fuel pump.

The supply tank top must be below the day tank top to prevent siphoning from the fuel supply to the day tank.

Provide a return line from the engine injection system return connection to the day tank. Plumb the return line to the bottom of day tank as shown in Figure 4-1. Provide a day tank overflow line to the supply tank in case the float switch fails to shut off the fuel transfer pump.

WARNING ***Spilled fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Provide an overflow line to the supply tank from the day tank.***

Supply Tank Higher Than Engine: Install the day tank near the generator set, but below the fuel injection system. Use fuel line at least as large as the fuel pump inlet. The engine fuel return line must enter the day tank.

Engine Fuel Connections

Identification tags are attached to the fuel supply line and fuel return line connections by the factory. Flexible lines for connecting between the engine and the stationary fuel line are supplied as standard equipment. The flexible supply line incorporates a fuel screen, which screens the fuel prior to the engine fuel transfer pump. Do not operate generator set without fuel screen installed in supply line. Refer to *Specifications* for the fitting sizes.

EXHAUST SYSTEM

Pipe exhaust gases to the outside of any enclosure. Locate the exhaust outlets away from any air inlets to avoid gases re-entering the enclosure. Exhaust installations are subject to various detrimental conditions such as extreme heat, infrequent operation and light loads. Regularly inspect the exhaust system both visually and audibly to see that the entire system remains fume tight and safe for operation.

⚠WARNING ***Inhalation of exhaust gases can result in severe personal injury or death. Use extreme care during installation to provide a tight exhaust system. Terminate exhaust pipe away from enclosed or sheltered areas, windows, doors and vents.***

Use an approved thimble (Figure 4-2) where exhaust pipes pass through wall or partitions. Refer to NFPA 37, Section 6-3. "Stationary Combustion Engines and Gas Turbines" for accepted design practices. Build according to the code requirements in effect at the installation site.

⚠WARNING ***Hot exhaust pipes can start a fire and cause severe injury or death if improperly routed through walls. Use an approved thimble where exhaust pipes pass through walls or partitions.***

⚠WARNING ***Inhalation of exhaust gases can result in severe personal injury or death. Do not use exhaust heat to warm a room, compartment or storage area.***

Rain caps are available for the discharge end of vertical exhaust pipes. The rain cap clamps onto the end of the pipe and opens due to exhaust discharge force from the generator set. When the generator set is stopped, the rain cap automatically closes, protecting the exhaust system from rain, snow, etc.

Use a section of flexible exhaust pipe between the engine and remainder of exhaust system. Support exhaust system to prevent weight applied to engine exhaust outlet elbow/turbocharger connection.

⚠CAUTION ***Weight applied to the engine manifold can result in turbocharger damage. Support the muffler and exhaust piping so no weight or stress is applied to engine exhaust elbow.***

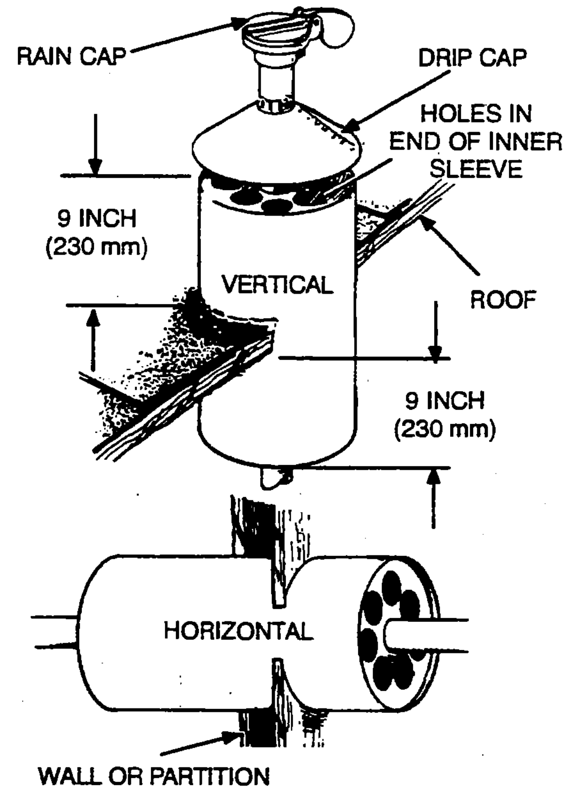


FIGURE 4-2. MOUNTING EXHAUST THIMBLE

Avoid sharp bends by using sweeping, long radius elbows and provide adequate support for muffler and tailpipe. Pitch a horizontal run of exhaust pipe DOWNWARD (away from engine) to allow any moisture condensation to drain away from the engine. If an exhaust pipe must be turned upward, install a condensation trap at the point where the rise begins (Figure 4-3).

Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 12 inches (305 mm) of clearance if the pipes pass close to a combustible wall or partition.

WARNING ***Exhaust pipes are very hot and they can cause severe personal injury or death from direct contact or from fire hazard. Shield or insulate exhaust pipes if there is danger of personal contact or when routed through walls or near other combustible materials.***

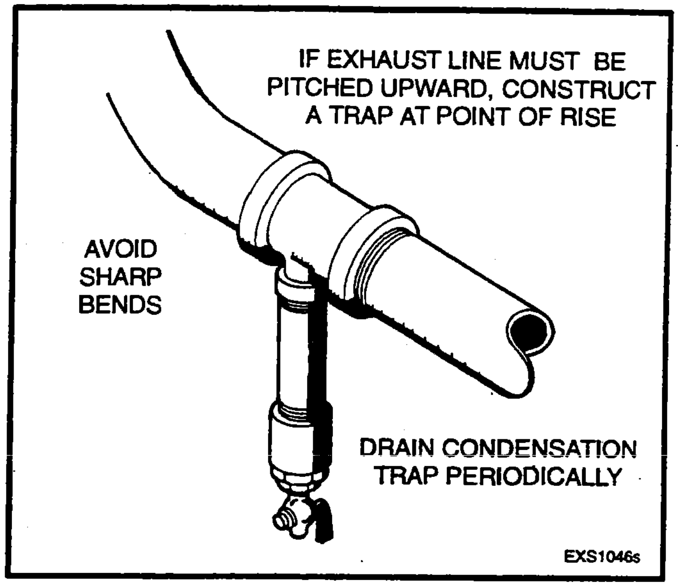


FIGURE 4-3. CONDENSATION TRAP

VENTILATION AND COOLING

Generator sets create considerable heat that must be removed by proper ventilation. Outdoor installations rely on natural air circulation but indoor installations need properly sized and positioned vents for required airflow.

Vents and Ducts

For indoor installations, locate vents so incoming air passes through the immediate area of the installation before exhausting. Install the air outlet higher than the air inlet to allow for convection air movement.

Size the vents and ducts so they are large enough to allow the required flow rate of air. The "free area" of ducts must be as large as the exposed area of the radiator. Refer to the DG series Specification Sheet for the airflow requirements and allowed airflow restriction.

Wind will restrict free airflow if it blows directly into the air outlet vent. Locate the outlet vent so the effects of wind are eliminated. See Figure 4-4.

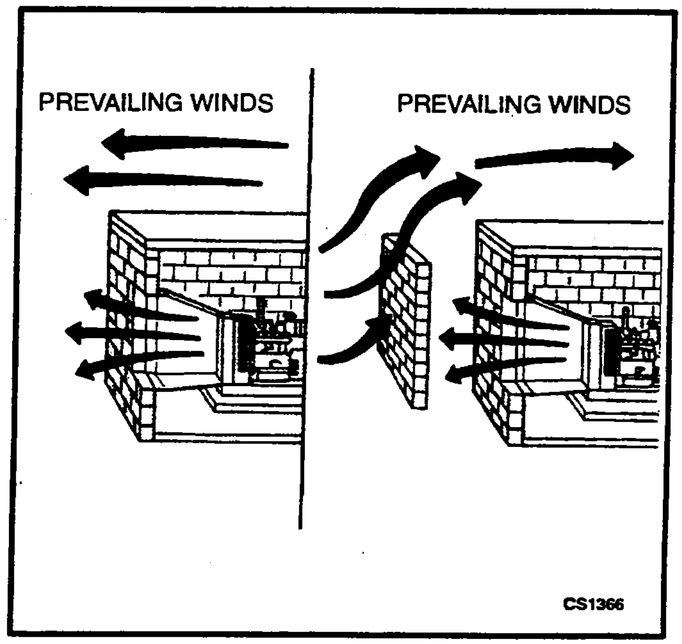


FIGURE 4-4. WIND BARRIER

Dampers

Dampers or louvres protect the generator set and equipment room from the outside environment. Their operation of opening and closing should be controlled by operation of the generator set.

In cooler climates movable or discharge dampers are used. These dampers allow the air to be recirculated back to the equipment room. This enables the equipment room to be heated while the generator set engine is still cold, increasing the engine efficiency.

Radiator Set Requirements

Radiator set cooling air is drawn past the rear of the set by a pusher fan that blows air through the radiator (Figure 4-5). Locate the air inlet to the rear of the set. Make the inlet vent opening 1-1/2 times larger than the radiator area.

Louvers and screens over air inlet and outlet openings restrict air flow and vary widely in performance. A louver assembly with narrow vanes, for example, tends to be more restrictive than one with wide vanes. The effective open area specified by the louver or screen manufacturer should be used.

Locate the cooling air outlet directly in front of the radiator and as close as possible. The outlet opening must be at least as large as the radiator area. Length and shape of the air outlet duct should offer minimum restriction to airflow.

Attach a canvas or sheet metal duct to the air outlet opening using screws and nuts so duct can be removed for maintenance purposes. The duct prevents recirculation of heated air. Before installing the duct, remove the radiator core guard.

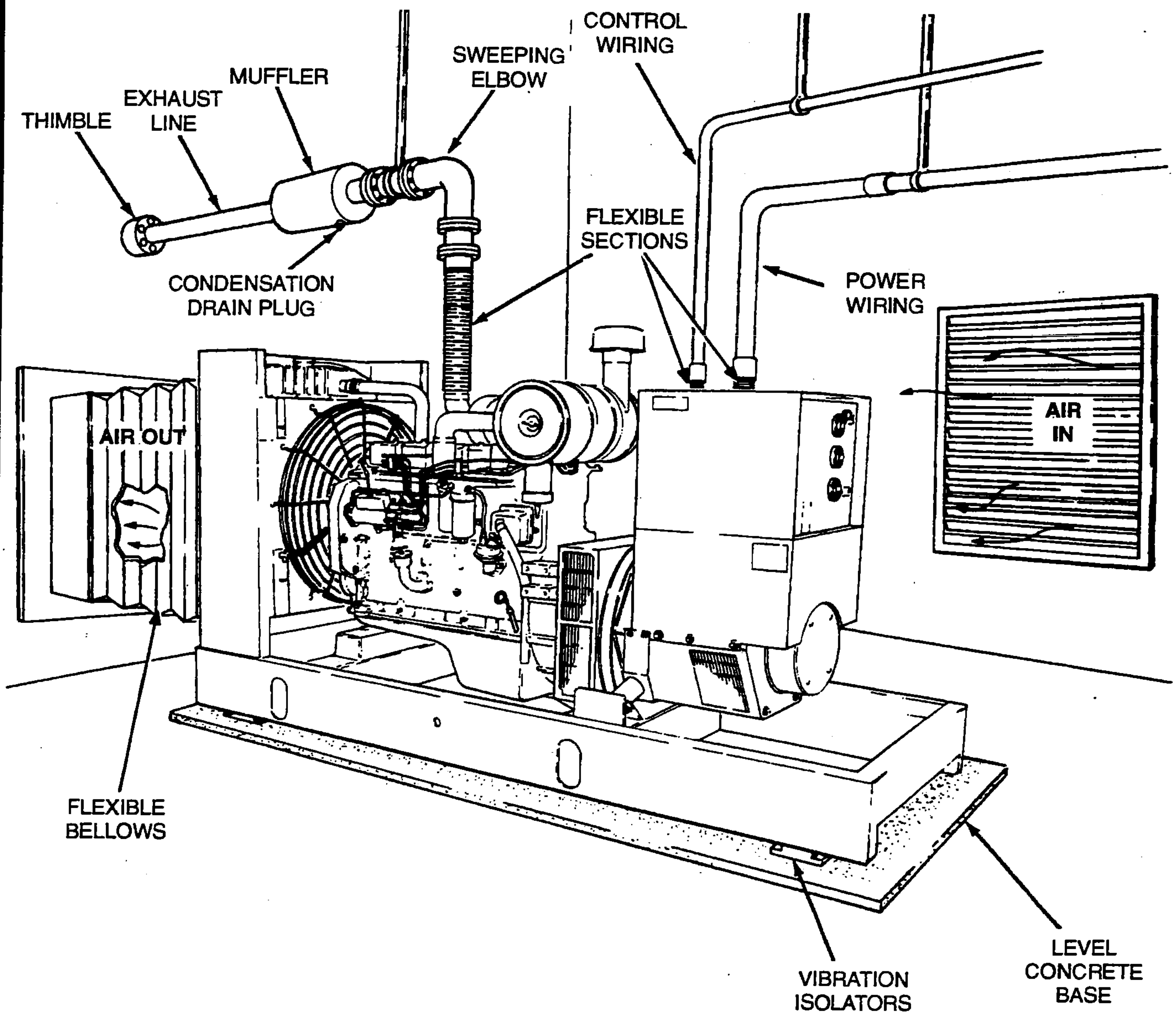
Remote Radiator Cooling (Optional) substitutes a remote mounted radiator and an electrically driven fan for the set mounted components. Removal of the radiator and the fan from the set reduces noise levels without forcing dependence on a continuous cooling water supply. The remote radiator installation must be completely protected against freezing.

Remote radiator plumbing will vary with installation. Follow recommendations given in Application Manual T-030. See product Specification sheet for friction head and static head limits.

Before filling cooling system, check all hardware for security. This includes hose clamps, capscrews, fittings and connections. Use flexible coolant lines with heat exchanger or remote mounted radiator.

Water Jacket Heater (Optional)

An optional water jacket heater can be installed to keep the engine warm for starting under adverse weather conditions. Connect the heater to a power source that will be on when the engine is NOT running.



IMPORTANT!

COOLING AIR INLET MUST BE AT LEAST 1-1/2 TIMES LARGER THAN RADIATOR DUCT OUTLET AREA ON RADIATOR-COOLED MODELS.

FLOW OF COOLING AIR AND HEATED AIR MAY BE CONTROLLED BY AUTOMATICALLY OPERATED LOUVRES.

FIGURE 4-5. TYPICAL RADIATOR SET INSTALLATION

5. DC Control Wiring (PCC)

CONTROL WIRING

The generator set accessory box (Figure 5-1), which is located on the backside of the control housing, contains connection points for remote control and monitor options.

CAUTION ***Stranded copper wire must be used for all customer connections to the Accessory Box. Solid copper wire may break due to genset vibration.***

TB1 REMOTE MONITOR/CONTROL CONNECTIONS

Customer monitor/control connections are attached to terminal block TB1 (Figure 5-1). Optional equipment such as a remote annunciator panel, sensing devices used to monitor genset operation, remote start/stop switches, control box heater, battery charger, etc. are attached to TB1. Refer to PCC Customer Connections diagram in Section 12.

TB1 Wiring

CAUTION ***Always run control circuit wiring in a separate metal conduit from AC power cables to avoid inducing currents that could cause problems within the control.***

Digital Connections: Connection points, other than relayed outputs, network, switched B+ and B+ are considered digital connections to terminal strip TB1. The type/gauge wire to use for these connections are:

- Less than 1000 feet (305m), use 20 gauge stranded copper wire.
- 1000 to 2000 feet (305 to 610m), use 18 gauge stranded copper wire.

Relay Connections: Due to the wide variety of devices that can be attached to the relay outputs of TB1, the electrical contractor must determine the gauge of the **stranded copper** wire that is used at this installation site. Refer to PCC Customer Connections diagram in Section 12 for the relay specifications.

Network Connections: Refer to Onan 900-0366 *PowerCommand Network Installation and Operation* manual for the type/gauge wire to use for these connections.

Switched B+: (Fused at 10 amps.) Same as Relay Connection description.

B+: (Fused at 20 amps.) Same as Relay Connection description.

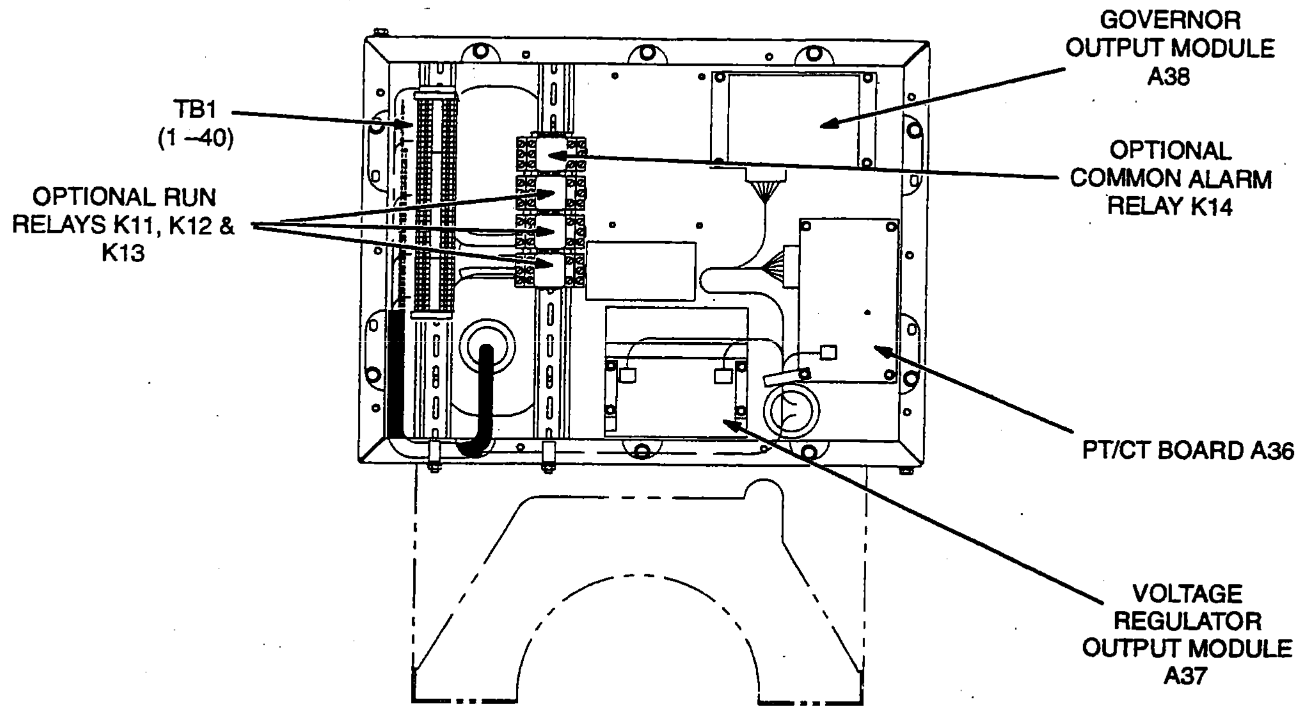


FIGURE 5-1. ACCESSORY BOX

The optional run relays are rail mounted inside the accessory box (Figure 5-1). The rail mount allows you to easily remove and replace the snap-on relays. The generator set can be equipped with one, two or three run relays.

The three-pole, double-throw run relays (Figure 5-2) are used to control auxiliary equipment such as fans, pumps and motorized air dampers. The run relays are energized when the generator set reaches operating speed.

The contacts are rated:

- 10 amps at 28 VDC or 120 VAC, 80%PF
- 6 amps at 240 VAC, 80%PF
- 3 amps at 480/600 VAC, 80%PF

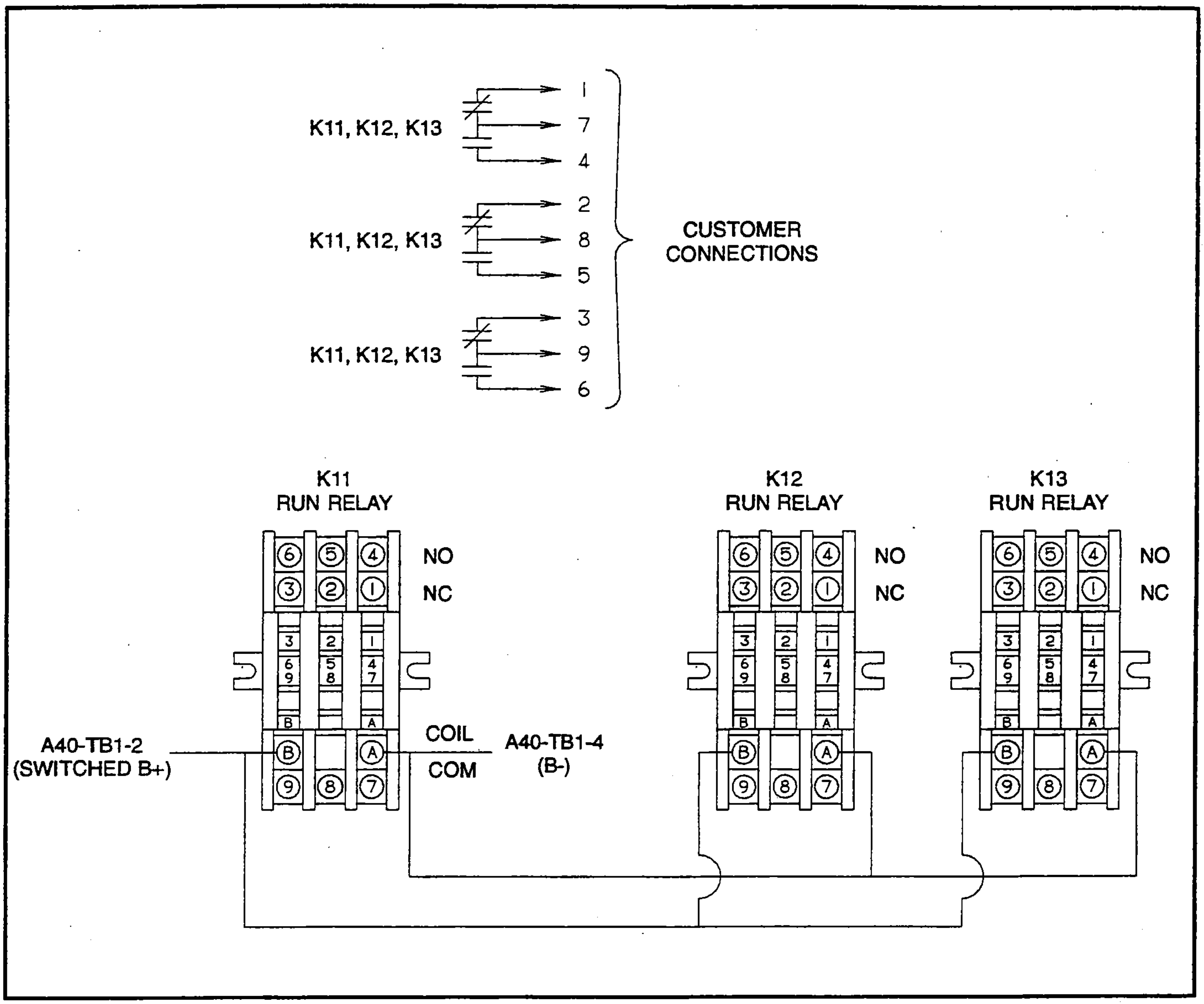


FIGURE 5-2. OPTIONAL RUN RELAYS (K11, K12, K13)

ALARM RELAY (K14)

The optional alarm relay is rail mounted inside the accessory box (Figure 5-1). The rail mount allows you to easily remove and replace the snap-on relay.

The three-pole, double-throw alarm relay (Figure 5-3) is often used to energize warning devices such as audible alarms. Any generator set warning or shutdown will energize the alarm relay.

The contacts are rated:

- 10 amps at 28 VDC or 120 VAC, 80%PF
- 6 amps at 240 VAC, 80%PF
- 3 amps at 480/600 VAC, 80%PF

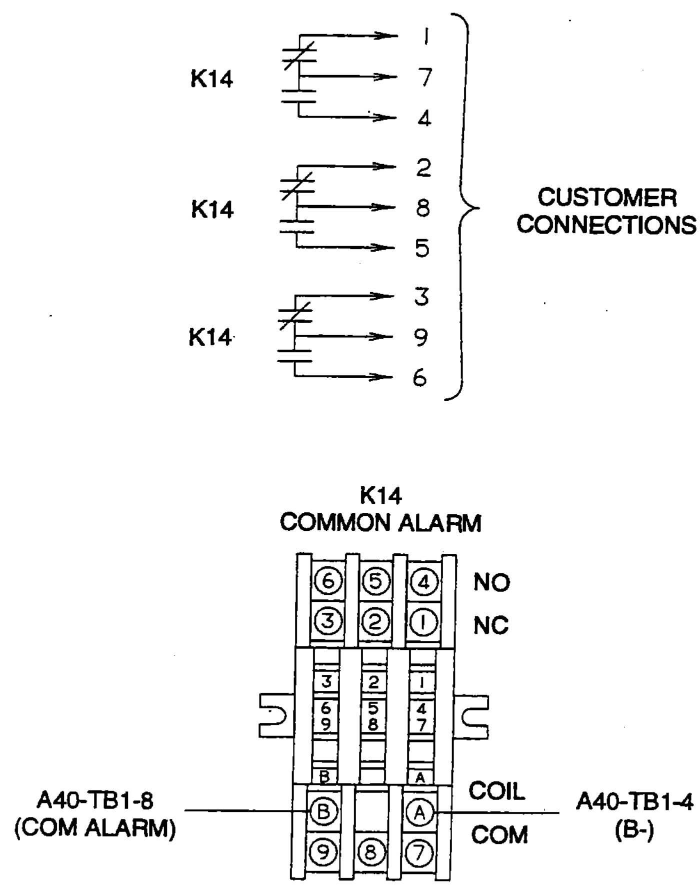


FIGURE 5-3. OPTIONAL ALARM RELAY (K14)

6. DC Control Wiring (Detector Control)

CONTROL WIRING

The generator set control panel box contains connection points for remote control and monitor options. These connection points are located on the engine control monitor board (ECM), the time-delay module and the optional auxiliary relay board (ARB). (Note that if the optional ARB is installed, no remote monitor connections are attached to the ECM. The ARB provides all remote monitor connection points.)

CAUTION ***Stranded copper wire must be used for all customer connections to the control panel box. Solid copper wire may break due to genset vibration.***

The type/gauge wire to use for these connections are:

- Less than 1000 feet (305m), use 18 gauge stranded copper wire.
- 1000 to 2000 feet (305 to 610m), use 16 gauge stranded copper wire.

CAUTION ***Always run control circuit wiring in a separate metal conduit from AC power cables to avoid inducing currents that could cause problems within the control.***

WARNING ***HAZARDOUS VOLTAGE Touching uninsulated high voltage parts inside the control panel box can result in severe personal injury or death. Control wire installation must be done with care to avoid touching uninsulated live parts.***

For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.

ENGINE CONTROL MONITOR BOARD (ECM-A11)

The heart of the engine control system is the engine monitor (A11). It is a printed circuit board assembly mounted on the back wall of the control box (Figure 6-1). It starts and stops the engine in response to the control panel switches, engine sensors and remote control signals.

Remote Monitor Connections

The Detector control provides the capability of attaching a remote monitor panel. Connections are made on the terminal blocks **TB1** and **TB2** located on the ECM board. A detailed connection diagram for the ECM board is provided in Section 12. (If the optional ARB is installed, remote monitor connections attach to the ARB, not the ECM.)

Remote Start Connections

Connect remote start switch between A11-TB1-9 (B+) and A11-TB1-6 (RMT).

Function Selection Jumpers

The ECM board has six selection jumpers that can be repositioned to provide the following timed or non-timed warnings or timed or non-timed shutdowns with warnings:

W1 (12 light only) Jumper Position (jumper **W8** must be in the **B** position):

- **A** Non-timed warning under **FLT 2** conditions.
- **B** (12 light only) Non-timed shutdown under **FLT 2** conditions.
- **C** Timed warning under **FLT 2** conditions.
- **D** Timed shutdown under **FLT 2** conditions.

W2 Jumper Position (jumper **W9** must be in the **B** position):

- **A** Non-timed warning under **FLT 1** conditions.
- **B** Non-timed shutdown under **FLT 1** conditions.
- **C** Timed warning under **FLT 1** conditions.
- **D** Timed shutdown under **FLT 1** conditions.

W6 Jumper Position:

- **A** Warning under **Pre-High Engine Temperature** conditions.
- **B** Shutdown under **Pre-High Engine Temperature** conditions.

W7 Jumper Position:

- **A** Warning under **Pre-Low Oil Pressure** conditions.
- **B** Shutdown under **Pre-Low Oil Pressure** conditions.

W8 (12 light only) Jumper Position:

- **A** Warning while running or during standby under **FLT 2** conditions.
- **B** Allows selection of functions with **W1** jumper.

W9 (12 light only) Jumper Position:

- **A** Warning while running or during standby under **FLT 1** conditions.
- **B** Allows selection of functions with **W2** jumper.

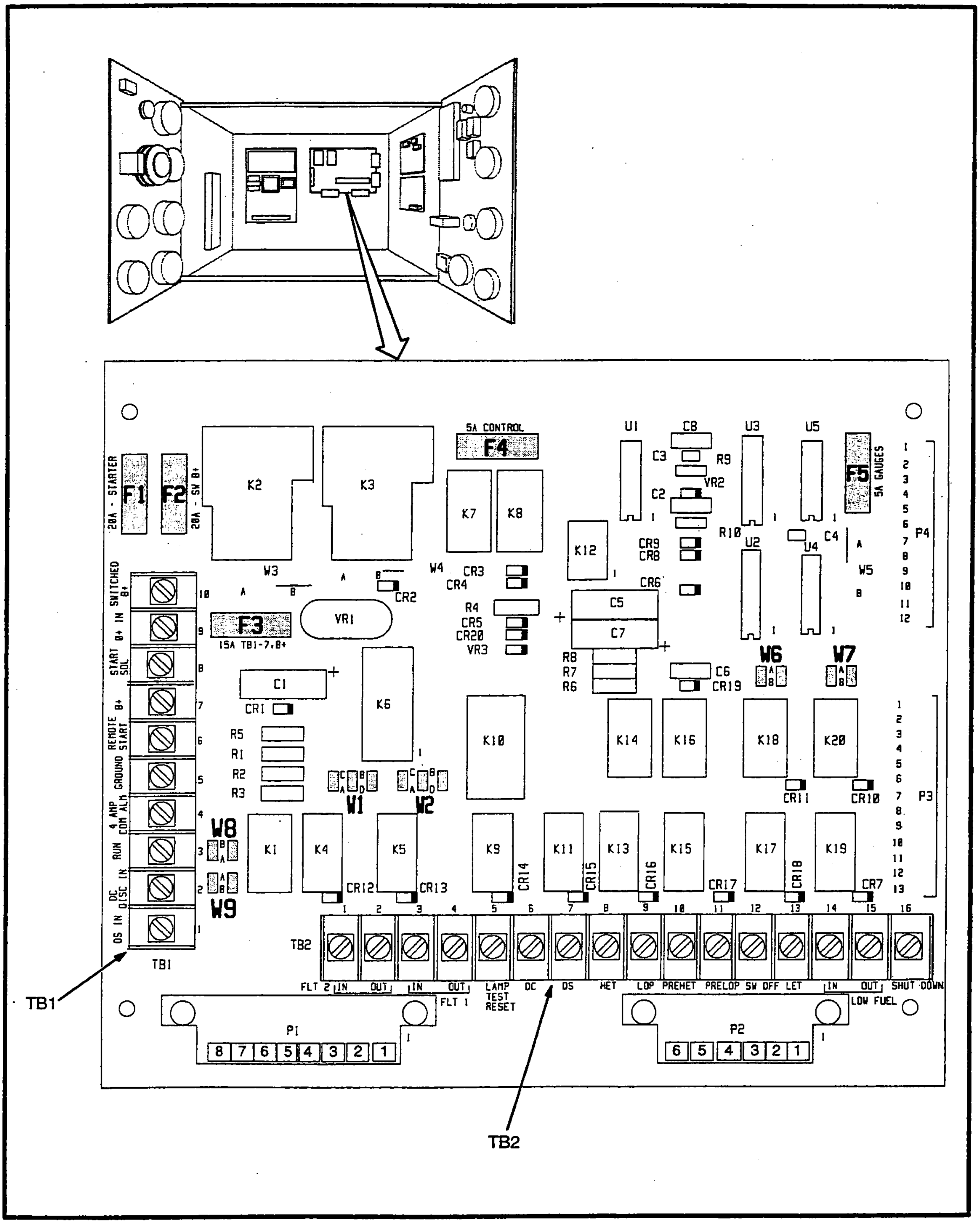


FIGURE 6-1. ENGINE CONTROL MONITOR BOARD (ECM)

AUXILIARY RELAY BOARD (OPTIONAL)

The following describes the design/functional criteria for the auxiliary relay board (ARB) with a Detector control. The board is mounted directly on top of the ECM using standoffs and has access holes for the fuses located on the ECM. A detailed connection diagram for the ARB is provided in Section 12.

Terminal Blocks:

- **TB1** – ARB TB1 and engine monitor TB1 are identically numbered and provide the same remote control connection points. Note that additional terminals are provided for terminals 5, 7, and 10 of ARB TB1.
- **TB2 through TB5** – Connection points for relays K1 through K3. TB2 provides the N/O and N/C connections (three form 'C' contacts for each relay). TB3 through TB5 provide the common connection points (TB3 for K1, TB4 for K2 and TB5 for K3).
- **TB6 and TB7** – Connection points for fault relays K4 through K15. Three terminals are provided for each relay, which are labeled COM, N/C, N/O.

Plug-In Relays (K1, K2, K3): The ARB can be equipped with one to three 3-pole, double-throw relays. These relays (K1, K2, K3) are field changeable plug-in relays for easy field addition and replacement.

Each relay can be operated as a RUN, COMMON ALARM, or ISOLATED COIL with the changing of a jumper.

The relay contact ratings are:

- 10 amps at 28 VDC or 120 VAC, 80% PF
- 6 amps at 240 VAC, 80% PF
- 3 amps at 480 VAC, 80% PF

Jumper Positions for Plug-In Relays: Jumpers W1, W2 and W3 perform the same functions for their respective relays, W1 for relay K1, W2 for relay K2, and W3 for relay K3. They can be located in any of 3 positions (A, B, C) independently of each other.

- **Jumper Position A (Run)** – The relay operates as a Run relay, energizing when SW B+ is applied from the engine monitor.
- **Jumper Position B (Common Alarm)** – The relay operates as a Common Alarm relay. The relay energizes any time there is an engine shutdown.
- **Jumper Position C (Isolated)** – The relay operates as an Isolated relay. The relay coil is energized by a customer applied B+ signal through the terminal block; TB3-1 for relay K1, TB4-1 for relay K2, and TB6-1 for relay K3.

Jumpers W11, W12, and W13 perform the same functions for their respective relays; W11 for relay K1, W12 for relay K2, and W13 for relay K3. They can be located in two different positions (A, B) independently of one another.

- **Jumper Position A** – The relay operates isolated from the board. The customer provides the circuit completion through terminal block; TB3 for relay K1, TB4-5 for relay K2, and TB6-5 for relay K3. The customer can operate the relay with switched ground logic or use this relay in the middle of more complex logic circuits if needed.
- **Jumper Position B** – The relays operate with the coils connected to ground through the board connections. The coil will require a B+ signal to energize with the jumper in this position.

Fault Relays (K4 through K15): These relay modules are used to operate a remote alarm annunciator that has an independent power source. This allows the use of either AC or DC for alarm drives. The relays are energized through the latching relays on the engine monitor and provided N/O and N/C contacts for each external alarm connection.

The 12 relays with form 'C' contacts are rated:

- 10 Amp, 120 VAC
- 10 Amp. 30 VDC

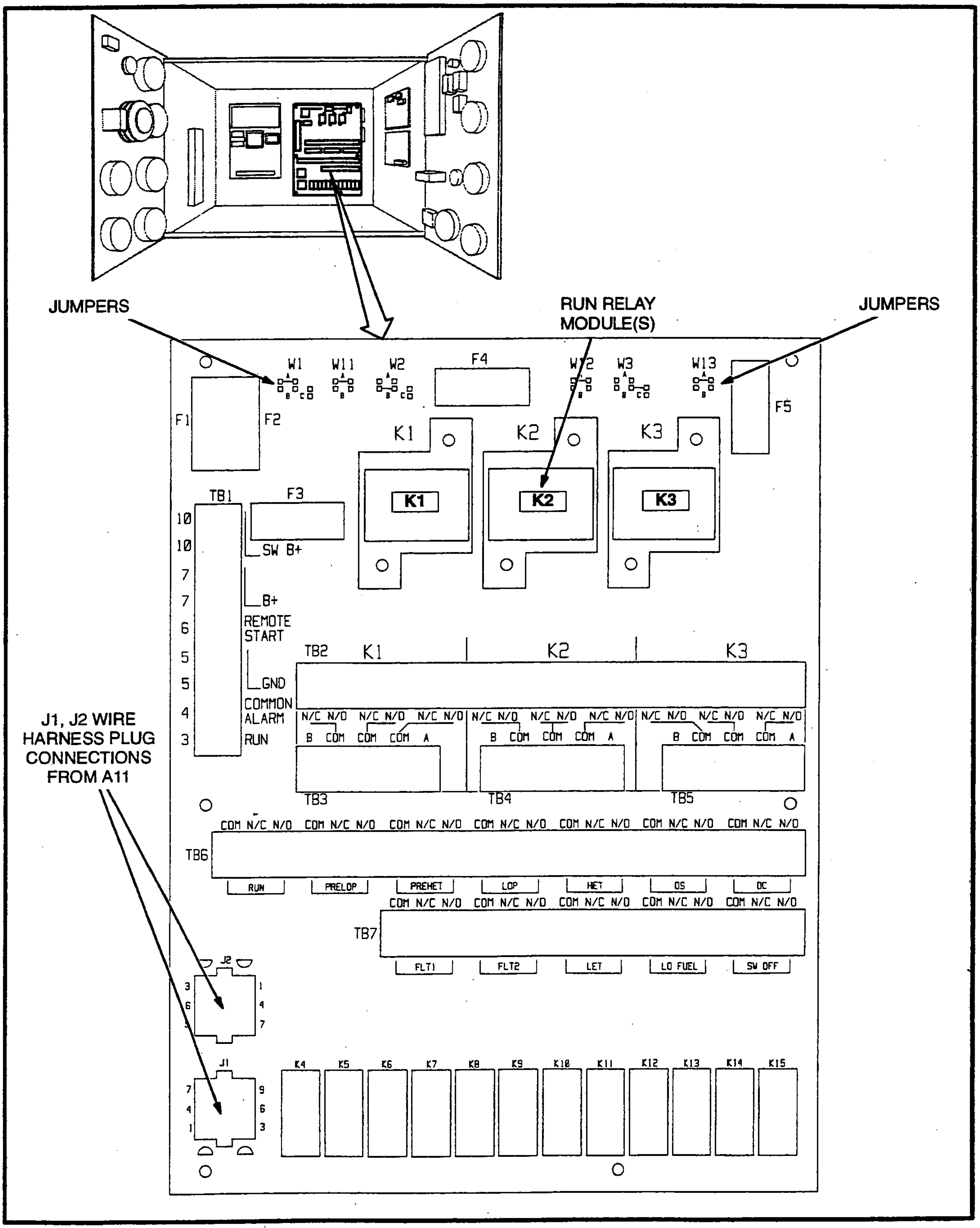


FIGURE 6-2. AUXILIARY RELAY BOARD (ARB)

TIME-DELAY MODULE (A15) (OPTIONAL)

The start delay module is adjustable from 5 to 15 seconds and the stop delay from 30 seconds to 30 minutes. Turn the delay adjusting potentiometers clockwise to increase delay and counterclockwise to decrease delay.

Remote Control Connections

Remote control connections are made at the terminal block (TB1) that is located on the time-delay module (Figure 6-3). Connect one or more remote switches across the remote terminal (TB1-5) of the time-delay module and the B+ terminal of the ECM (A11).

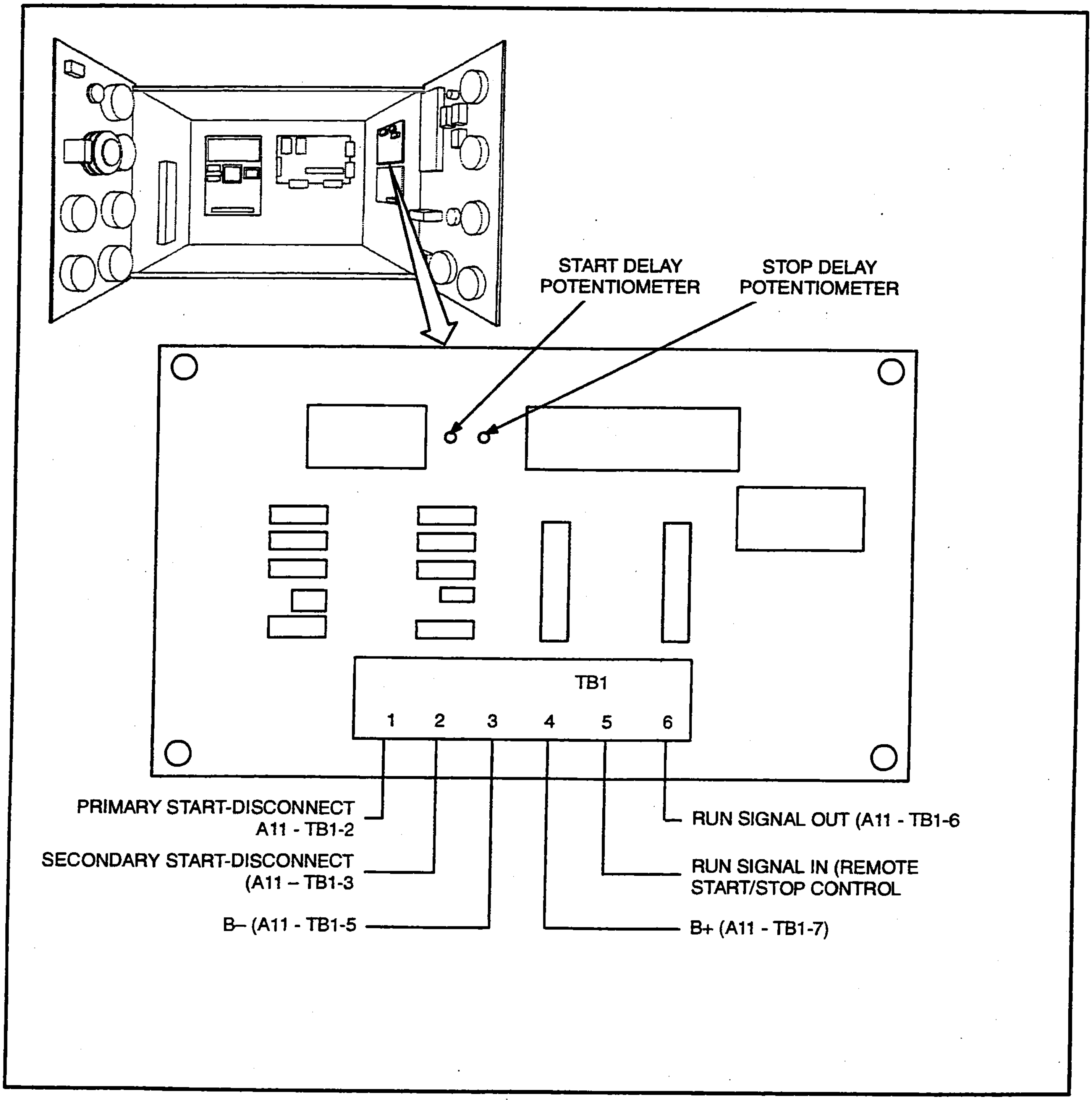


FIGURE 6-3. PREHEAT/TIME-DELAY MODULE

7. DC Control Wiring (Sentinel Control)

CONTROL WIRING

The generator set control panel box contains connection points for remote starting and switched B+ connections. Connections are made on the terminal block (TB1) located inside the control box (Figure 7-1).

Connect a remote switch across remote terminal (TB1-4) and B+ (TB1-3) for remote starting. Switched B+ auxiliary power is available when the generator set is running. When connecting customer accessories to the 12 volt B+ auxiliary terminals (TB1-1 & 2), do not exceed the following current levels:

- 7 amps maximum with electronic governor.
- 12 amps maximum without electronic governor.

If the distance between the genset and the remote station is less than 1000 feet (305 m), use 18 gauge stranded copper wire. If the distance is 1000 to 2000 feet (305 to 610 m), use 16 gauge stranded copper wire. Always run control circuit wiring in a separate metal conduit from AC power cables to avoid inducing currents that could cause problems within the control.

WARNING ***HAZARDOUS VOLTAGE Touching uninsulated high voltage parts inside the control panel box can result in severe personal injury or death. Control wire installation must be done with care to avoid touching uninsulated live parts.***

For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.

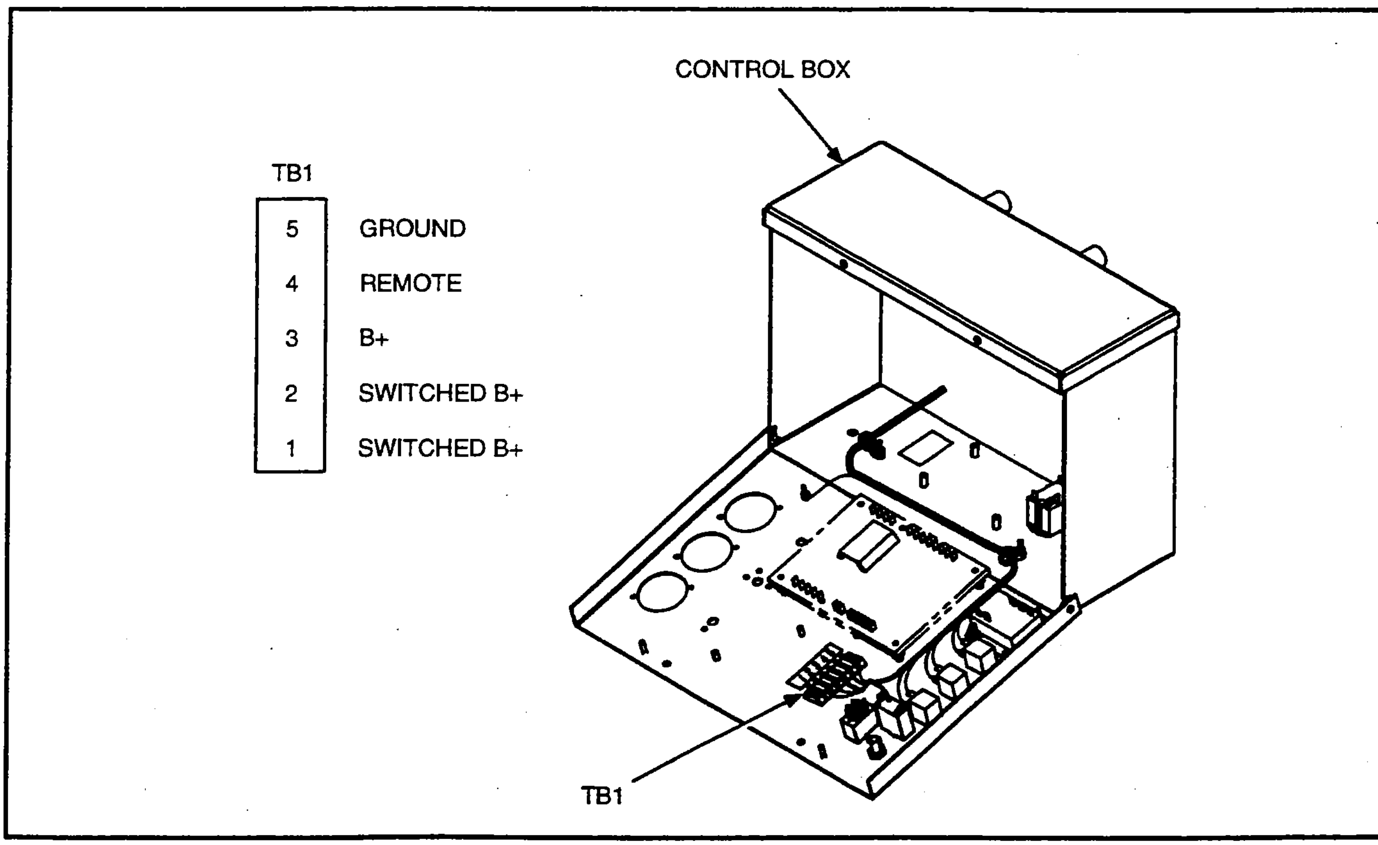


FIGURE 7-1. REMOTE CONTROL CONNECTION POINTS

8. AC Electrical Connections

GENERAL

This section provides the procedure that is used to connect the AC electrical system of the genset.

Disconnect the battery charger and the battery cables (negative [–] first) to prevent accidental starting while working on the set.

CAUTION ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

WARNING ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).***

Make certain battery area has been well-ventilated before servicing battery. Arcing can ignite explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur when cable is removed or re-attached, or when negative (–) battery cable is connected and a tool used to connect or disconnect positive (+) battery cable touches frame or other grounded metal part of the set. Always remove negative (–) cable first, and reconnect it last. Make certain hydrogen from battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if battery has been connected to battery charger.

WARNING ***Each of the operations described in this section should be done only by persons trained and experienced in electrical maintenance. Improper procedures may result in property damage, bodily injury or death.***

Connecting the genset AC electrical system involves:

- Installation of transfer switch (standby service only)
- Generator voltage connections
- Load connection
- Standard and optional AC equipment connections (e.g., control box heater, coolant heater, etc.).

Local regulations often require that wiring connections be made by a licensed electrician, and that the installation be inspected and approved before operation. All connections, wire sizes, materials used, etc. must conform to the requirements of electrical codes in effect at the installation site.

WARNING ***Improper wiring can cause a fire or electrocution, resulting in severe personal injury or death and/or property and equipment damage.***

Before starting the genset, verify that all electrical connections are secure, and that all wiring is complete. Replace and secure any access panels that have been removed during installation. Check that the load cables from the genset are properly connected.

WARNING ***Backfeed to utility system can cause electrocution or property damage. Do not connect to any building electrical system except through an approved device and after building main switch is opened.***

TRANSFER SWITCH

If the installation is for standby service, a transfer switch must be used for switching the load from the normal power source to the genset (see Figure 8-1). Either a manual or automatic transfer switch may be used. Follow the installation instructions provided with the transfer switch when connecting the load and control wiring.

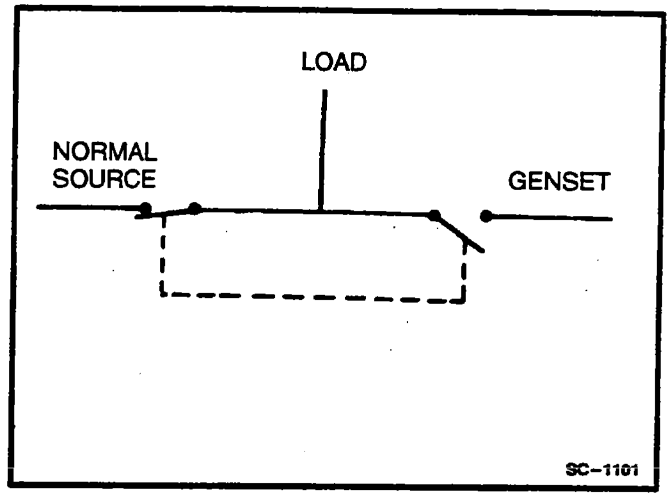


FIGURE 8-1. TYPICAL LOAD TRANSFER FUNCTION

AC WIRING

Generator Voltage Connections

The generator output voltage and maximum current rating are specified on the generator set nameplate. Line-to-neutral voltage is always the lower voltage shown and line-to-line voltage is the higher rating.

These generators can be configured for the voltages shown in the Reconnection Diagram on the side access cover of the control housing. Most of these voltages must be reconnected by the installer to give the voltage required by the installation. Before shipping, the factory tests the generator set output by connecting the generator to produce a particular test voltage. The generator may be connected at the factory to produce a specified voltage per customer order. The installer must always check the stator lead terminal block connections and perform any necessary reconnect to obtain the voltage desired.

Some generator sets are capable of producing a wide range of voltages and connection configurations, others have specific limited capabilities. Refer to wiring diagram and generator voltages (from the nameplate) when reviewing the voltage connection information and use the electrical schematic supplied with your generator set when actually performing load connections.

⚠ CAUTION ***Reconnecting factory connected generator sets to higher voltages can exceed the voltage capability of the specific generator windings and damage the generator. Consult with your distributor before performing reconnection for a different voltage.***

⚠ CAUTION ***Reconnecting factory connected generator sets to lower voltages can reduce set ratings, and also render line circuit breakers too small. Consult with your distributor before performing reconnection for a different voltage.***

Load Connections

Flexible conduit and stranded conductors must be used for connections to take up movement of the generator set.

All loads are connected to the generator by bolting **stranded** load wires to the appropriate terminals on the generator reconnection terminal block. The terminals are stamped U, V, W and N to indicate the line and neutral connections. (Reference: U, V, and W correspond with L1, L2 and L3; and N with L0 respectively).

Load Balancing

When connecting loads to the generator set, balance the loads so the current flow from each line terminal (L1, L2 and L3) is about the same. This is especially important if both single phase and three phase loads are connected. Any combination of single phase and three phase loading can be used as long as each line current is about the same, within 10 percent of median value and no line current exceeds the nameplate rating of the generator. Check the current flow from each line after connections by observing the control panel ammeter.

Current Transformers

Current transformers (CT's) are required on gensets that contain AC meters. The CT's must be installed as noted in the following CT Installation Requirements.

Refer to the Reconnection Diagram to identify the output leads/phase that must be routed through each CT, and also appropriate transformer post selection for meter sensing leads. The transformers are labeled CT21, CT22 and CT23 on the reconnection wiring diagram. (The Reconnection Diagram is located on the upper side cover of the control housing.)

CT Installation Requirements:

A. The CT has a dot on one side. This dot must be facing toward the generator (conventional current flowing into the dot). A dot is also used to indicate pin 1 of the CT.

B. CT21 – U load leads (A phase),
CT22 – V load leads (B phase)
CT23 – W load leads (C phase)

C. Route the appropriate load wires through each CT.

D. The CT's have dual secondaries (3 pins). The CT secondary wire marked 1 is connected to pin 1 of the CT. CT secondary wire marked 2/3 is connected to pin 2 for high voltage gensets or to pin 3 for low voltage gensets. (Refer to Reconnection Diagram.)

Grounding

The following is a brief description of system and equipment grounding of permanently installed AC generators within a facility wiring system. It is important to follow the requirements of the local electrical code.

Figure 8-2 illustrates typical system grounding for a 3-pole and a 4-pole automatic transfer switch (ATS). In the 3-pole ATS, note that the generator neutral is connected to the ATS and is NOT bonded to ground at the generator. In the 4-pole ATS system, a grounding electrode conductor and a bonding jumper are used to connect the generator neutral to ground. In some installations, a CT may be required for ground fault monitoring (refer to Figure 8-2 for CT location).

WARNING ***Contact with electrical equipment can result in severe personal injury or death. It is extremely important that bonding and equipment grounding be properly done. All metallic parts that could become energized under abnormal conditions must be properly grounded.***

Typical requirements for bonding and grounding are given in the National Electrical Code, Article 250. All connections, wire sizes, etc. must conform to the requirements of the electrical codes in effect at the installation site.

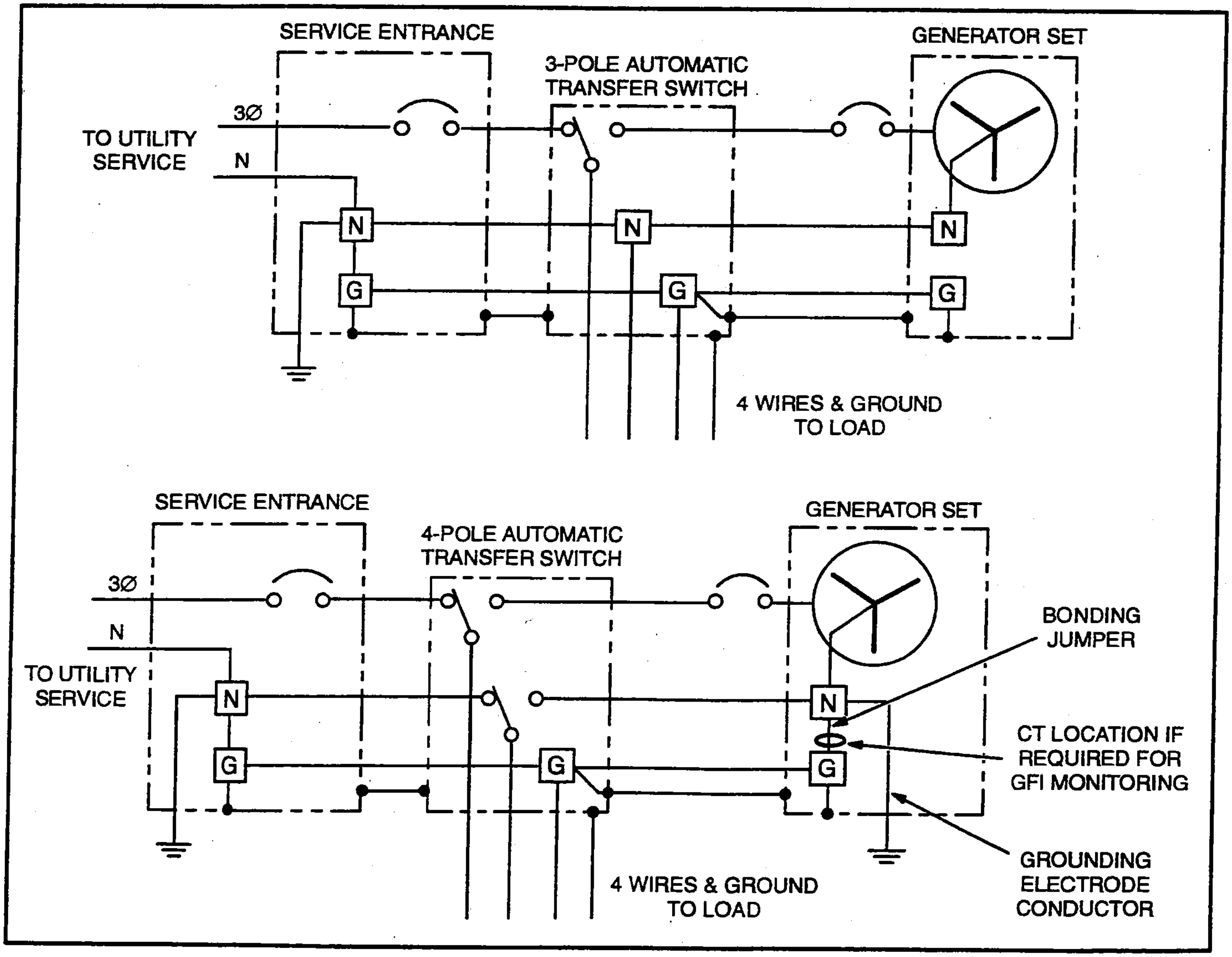


FIGURE 8-2. TYPICAL SYSTEM GROUNDING ONE-LINE DIAGRAMS

CONTROL HEATER (OPTIONAL)

A control heater (Figure 8-3) provides a means of humidity /temperature control of the control box interior. It protects the components and ensures their effectiveness when the generator set is subjected to varying ambient air conditions during extended periods of non-use.

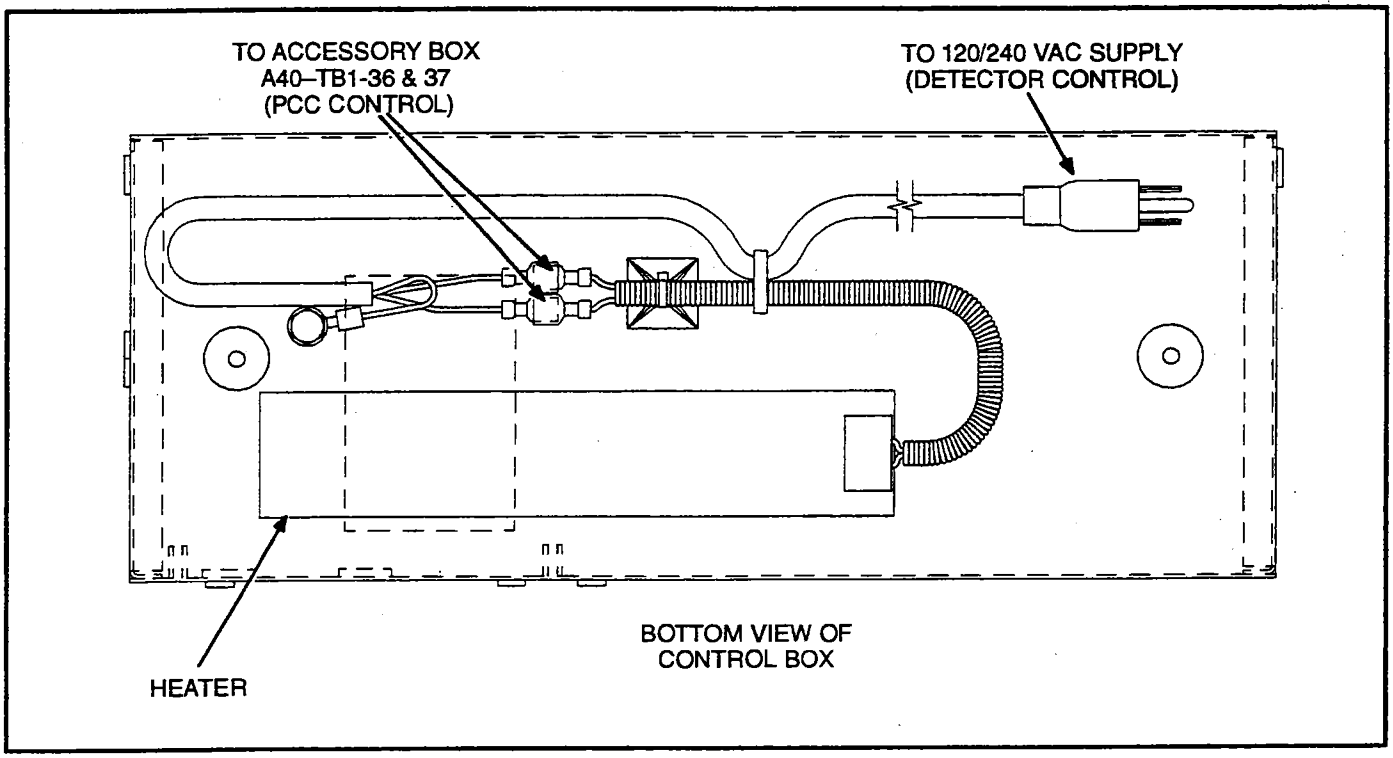


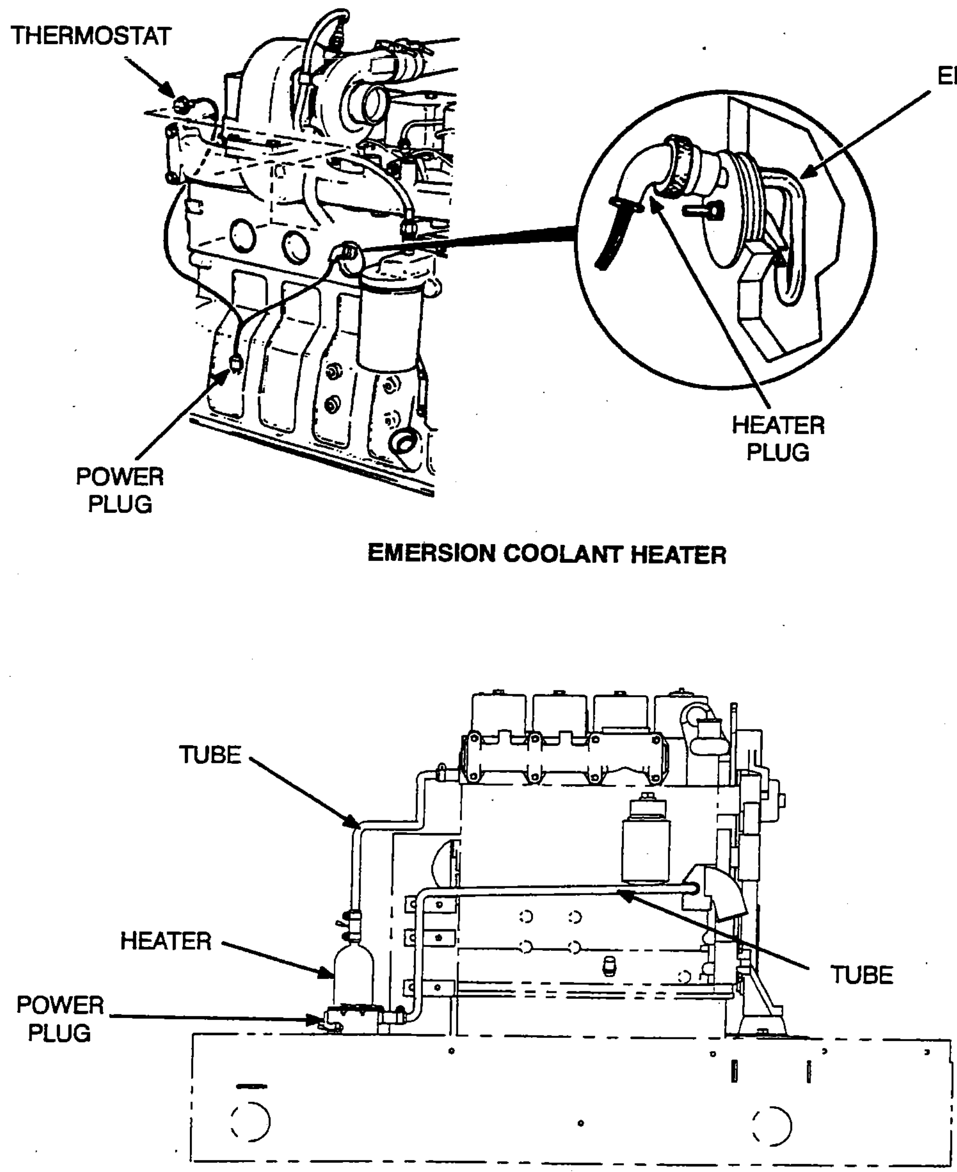
FIGURE 8-3. OPTIONAL CONTROL HEATER

COOLANT HEATER (OPTIONAL)

A coolant heater (emersion or tank) is used to keep the engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine. This reduces startup time and lessens engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

⚠WARNING ***The coolant heater must not be operated while the cooling system is empty or damage to the heater will occur.***

Figure 8-4 shows the heater line connections. Connect the heater to a source of power that will be on during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating.



EMERSION COOLANT HEATER

TANK COOLANT HEATER

FIGURE 8-4. COOLANT HEATER

GENERATOR HEATER (OPTIONAL)

A generator heater(s) is used to help keep the generator free of condensation when the generator set is not running. During cool and humid conditions, condensation can form within a generator, creating flashing and shock hazards.

⚠WARNING ***Water or moisture inside a generator increases the possibility of flashing and electrical shock, which can cause equipment damage and severe personal injury or death. Do not use a generator which is not dry inside and out.***

Figure 8-5 illustrates the installation of two heater elements. Connect the heater(s) to a source of power that will be on during the time the engine is not running. Be sure the voltage rating is correct for the heater element rating.

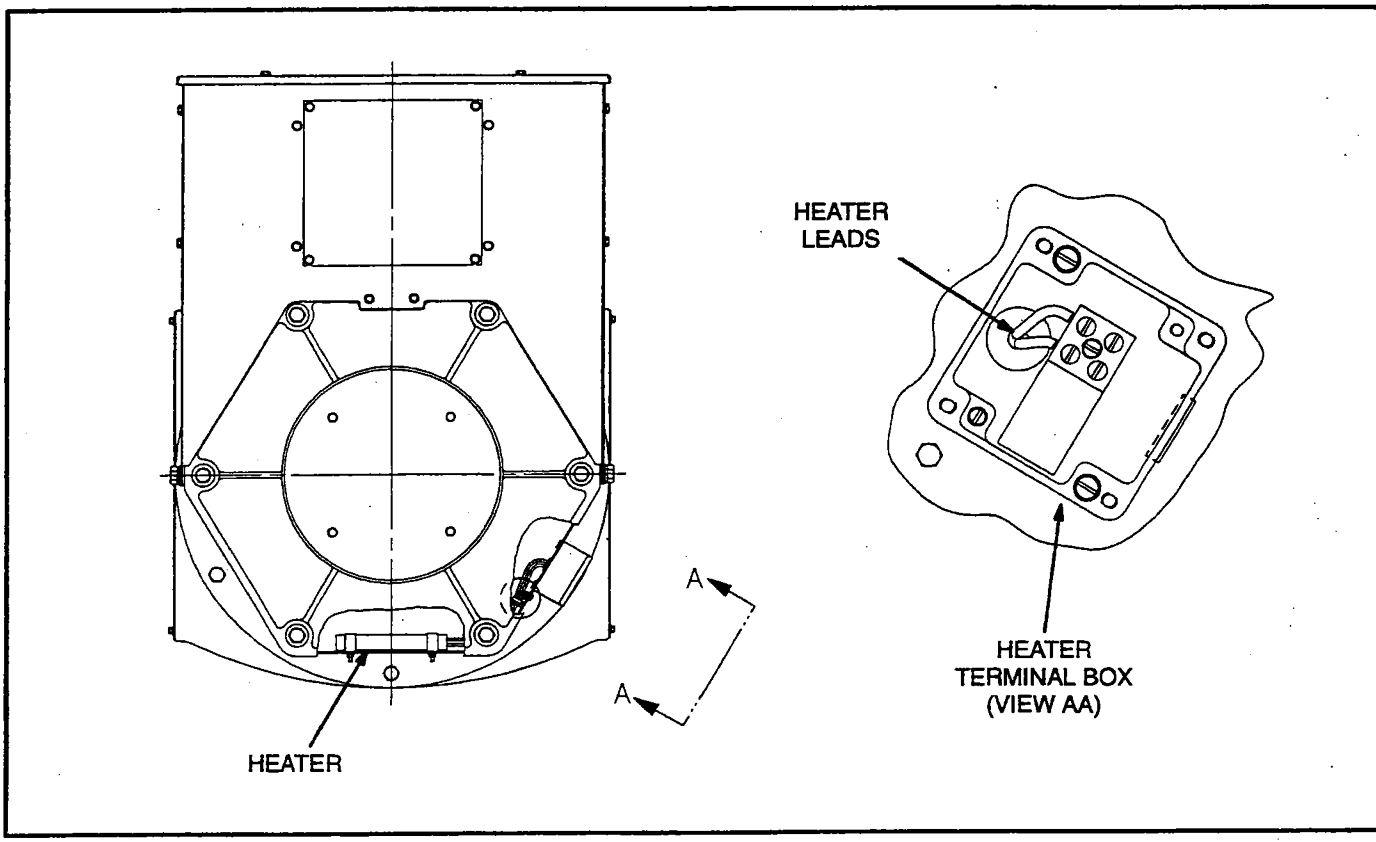


FIGURE 8-5. TYPICAL GENERATOR HEATER INSTALLATION

FUEL TRANSFER PUMP (OPTIONAL)

A fuel transfer pump and control are available as an option when a sub-base or in-skid day tank are provided. The automatic control operates the fuel pump to maintain a reservoir of fuel in the day tank.

⚠WARNING ***Diesel fuel is highly combustible. Improper installation of this kit can lead to spillage of large quantities of fuel and loss of life and property if the fuel is accidentally ignited. Installation and service must be performed by qualified persons in accordance with the applicable codes.***

Do not smoke near fuel and keep flames, sparks, pilot lights, arcing switches and equipment, and other sources of ignition well away.

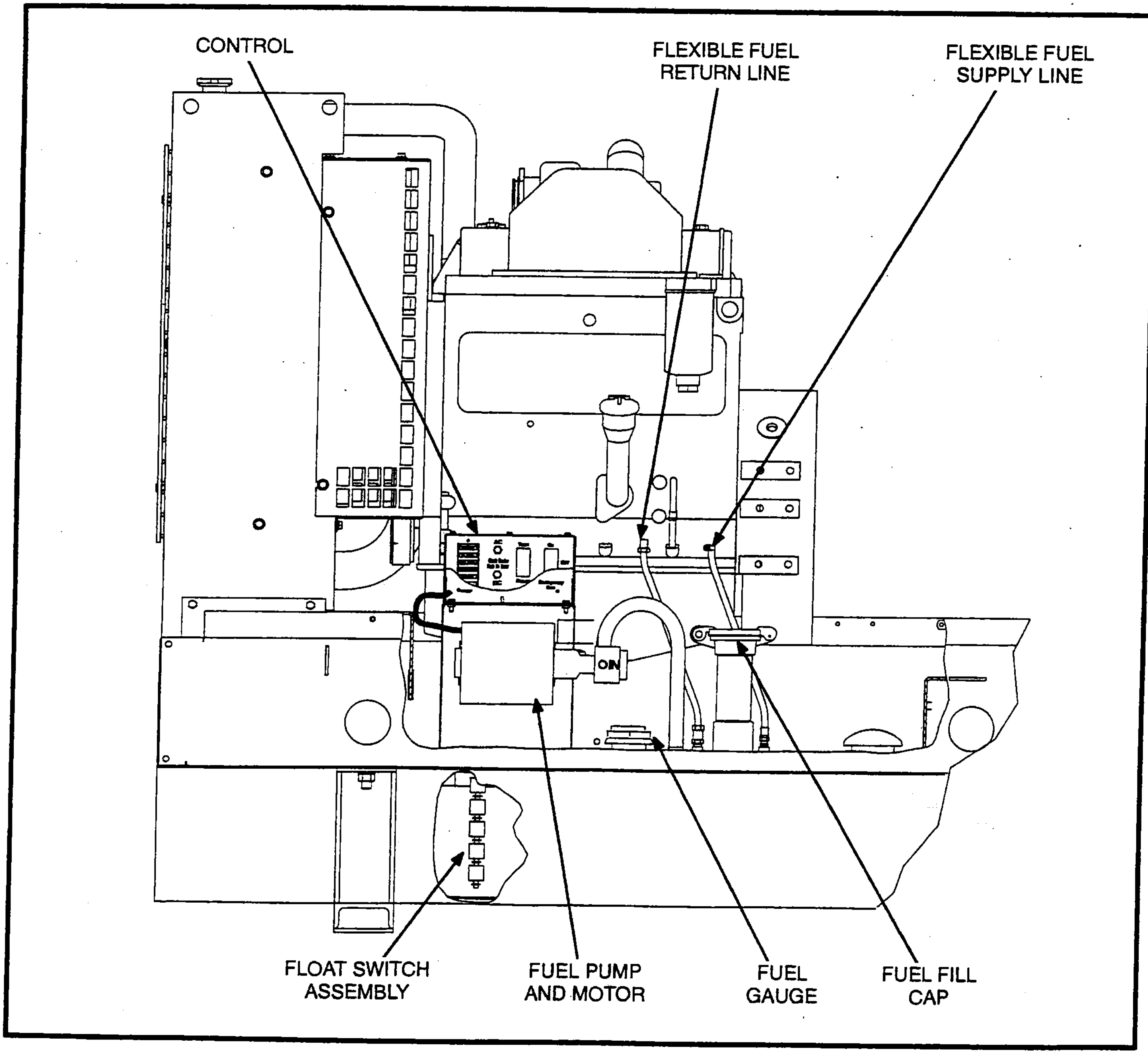


FIGURE 8-6. TYPICAL SUB-BASE INSTALLATION

Fuel Pump Control AC Connections

The control can be powered by 120 VAC or 240 VAC. The control is set up at the factory for connection to 240 VAC.

1. To convert the day tank controller from 240 VAC to 120 VAC, perform the following steps.

   A. Remove the two jumpers between terminals **TB1-6** and **TB1-7** in the control box and connect one between terminals **TB1-5** and **TB1-6** and the other between terminals **TB1-7** and **TB1-8**.

   B. Move selector switch **S103** on the control PCB to the up position for 120V.

   C. If the control is equipped with a transformer, remove the two jumpers between terminals **H2** and **H3** and connect one between **H1** and **H3** and the other between **H2** and **H4**.

2. To convert the day tank controller from 120 VAC to 240 VAC, perform the following steps.

   A. Remove the jumpers between terminals **TB1-5** and **TB1-6**, and **TB1-7** and **TB1-8** in the control box and connect the two jumpers between terminals **TB1-6** and **TB1-7.**

   B. Move selector switch S103 on the control PCB to the down position for 240 VAC.

   C. If the control is equipped with a transformer, remove the jumpers between terminals **H1** and **H3**, and **H2** and **H4** and connect the two jumpers between **H2** and **H3**.

3 Attach a tag to the control box indicating the supply voltage.

4 Terminals **TB1-8** and **TB1-5** are available for connection of a 120 or 240 VAC electric fuel shutoff valve rated not more than 0.5 amps. The voltage rating of the valve must correspond with the voltage utilized for the pump. See Item 2 above.

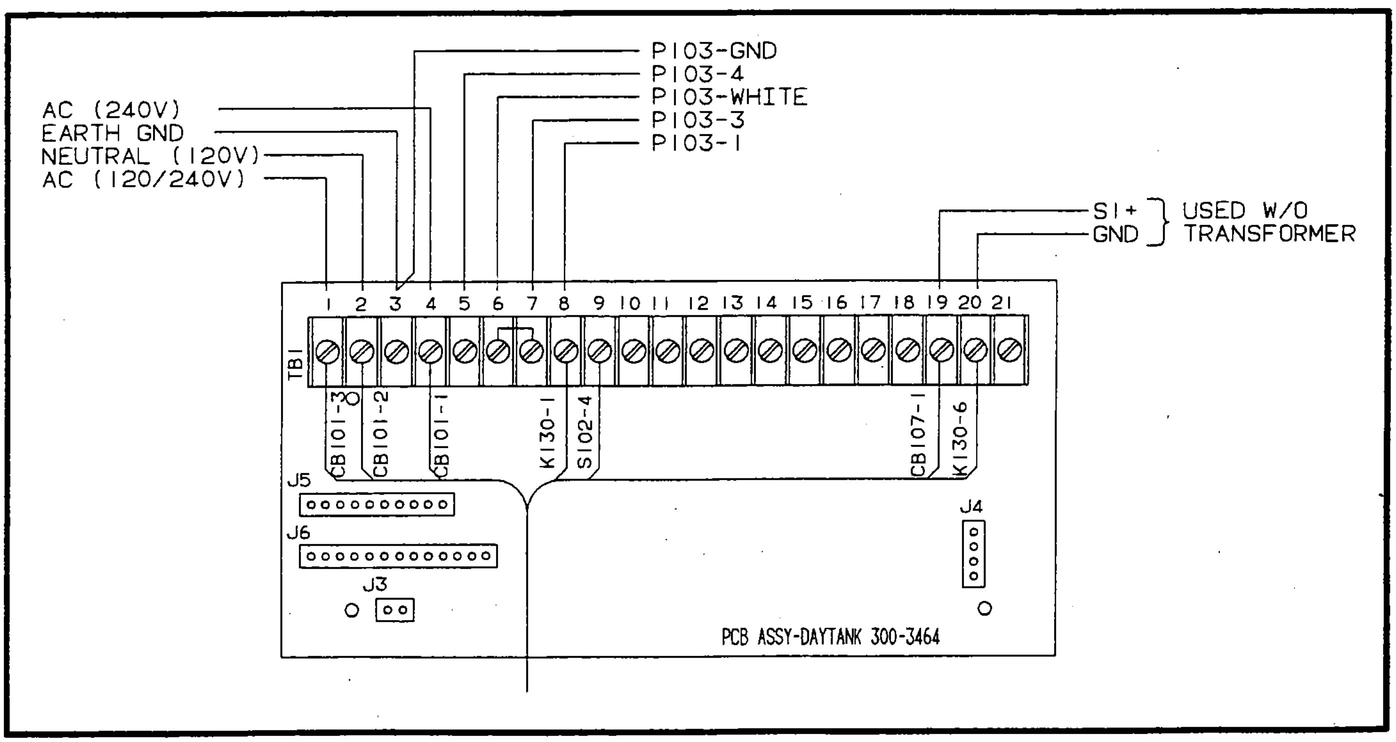


FIGURE 8-7. FUEL PUMP CONTROL TERMINAL BOARD

9. Prestart Preparation (PCC)

GENERAL

Before attempting the initial start of the generator set, be sure to complete the *Installation Checklist* in *Section 11*.

ELECTRICAL SYSTEM

Verify all electrical connections are secure and all wiring is complete and inspected. Replace and secure any access panels that may have been removed during installation.

Battery Connections

WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Make sure that the Run/Off/Auto switch on the control panel is set to the Off position before connecting the battery cables.***

Starting the unit requires a 12 volt battery. Connect positive battery cable before connecting negative battery cable to prevent arcing.

Service the battery as necessary. If an automatic transfer switch is installed without a built-in charge circuit, connect a separate battery charger. A battery charger is required when the PowerCommand control is set to the Power On (awake) mode.

WARNING ***Ignition of explosive battery gases can cause severe personal injury. Always connect battery negative last to prevent arcing.***

WARNING ***Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.. Ignition of these gases can cause severe personal injury.***

PCC OPTIONS PRESTART CHECKS

All generator set configuration options are set at the factory except for site related options, (e.g., Start/ Stop Time Delays, Cycle Crank, Customer Fault 1 and 2, etc.. The following setup procedures describe how to modify only the options that are required to complete the genset installation. Do not modify any other menus other than the following.

The default display messages for Customer Faults 1 through 4 can be edited to display the desired fault condition. If the default message does not represent the fault condition, contact an authorized service center.

Adjust Menu

To adjust the start and stop delays, press the button next to the word "ADJUST" in the Main Menu. Figure 9-1 shows a block representation of the ADJUST menu. After you press the button next to the word "ADJUST" in the display, the VOLTAGE submenu will appear.

As shown in the diagram, the ADJUST menu has five submenus, including a save/exit procedure. To move through the VOLTAGE and FREQUENCY submenus, press the button next to the '>>' to display the STOP DELAY submenu.

START DELAY submenu: This delay applies only to remote starting in the Auto mode. Use the buttons next to the "⇑" and "⇓" symbols to set the start delay. The start delay adjustment range is 0 to 300 seconds.

STOP DELAY submenu: This delay applies only to remote stopping in the Auto mode. From the START DELAY submenu, press the button next to the ">>" in the display to move to the STOP DELAY submenu. Use the buttons next to the "⇑" and "⇓" symbols to set the stop delay. The stop delay adjustment range is 0 to 600 seconds.

IDLE SPEED submenu: From the STOP DELAY submenu, press the button next to the ">>" in the display to move to the IDLE SPEED submenu. Use the buttons next to the "⇑" and "⇓" symbols to set the idle speed. The idle speed adjustment range is 800 RPM ±100 RPM. (Default value is 800 RPM.)

The idle speed can be adjusted only when the generator set is running in the idle mode. When not in idle mode, N/A is displayed in RPM field.

SAVE/EXIT submenu: From the STOP DELAY submenu, press the button next to the ">>" in the display to move to the SAVE/EXIT submenu. Select SAVE to save your changes. At the CHANGES SAVED submenu, select EXIT to return to the Main menu.

If you select SAVE, the adjustments will be retained after shutdown, and will be in effect when the set is restarted. If you select EXIT without saving first, the adjustments will remain in effect until the genset is shut down and return to the previous settings when the set is restarted.

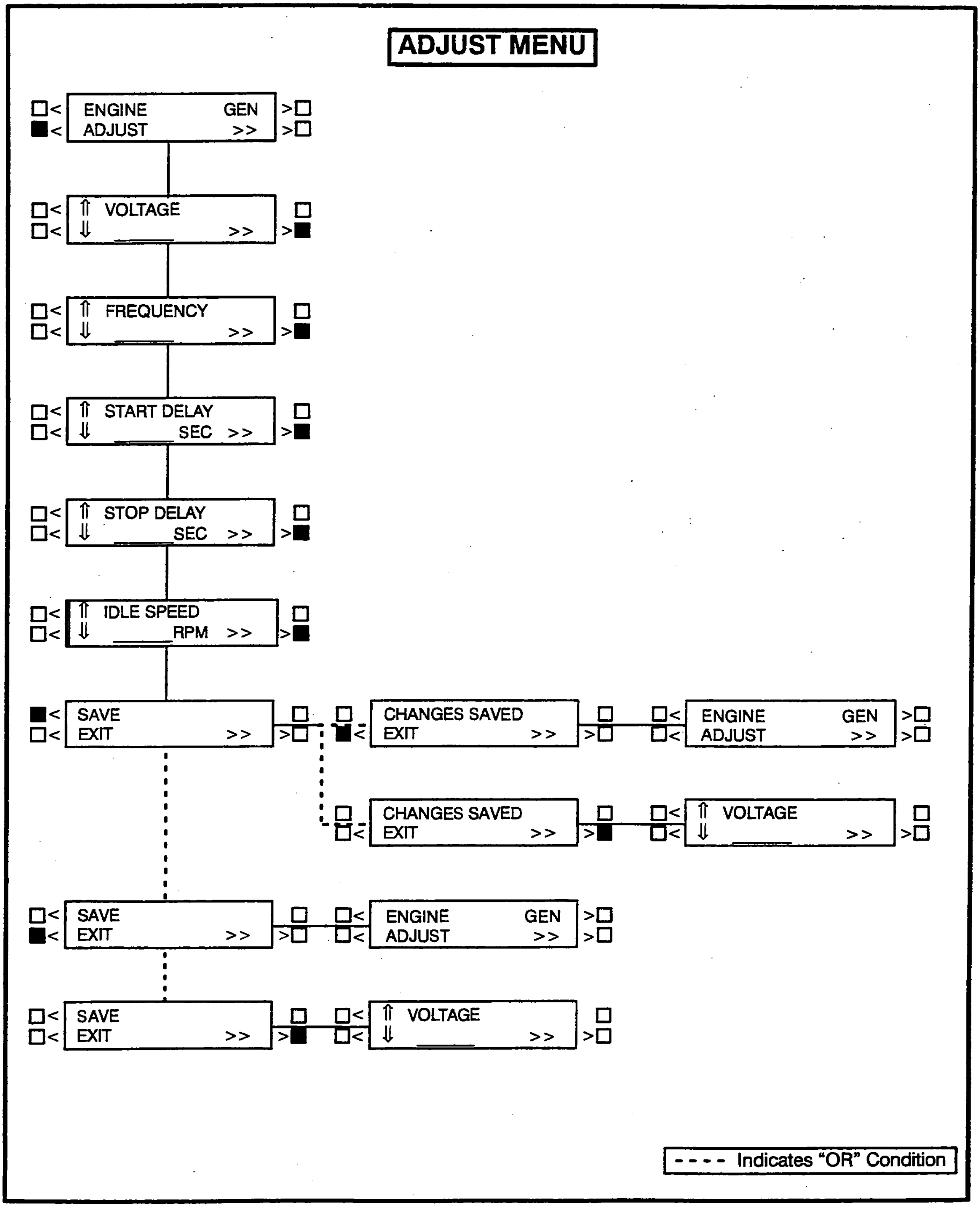


FIGURE 9-1. ADJUST MENU

PCC POWER ON / STANDBY MODE

⚠ CAUTION ***Electrostatic discharge will damage circuit boards. To prevent this damage, always wear a grounding wrist strap when working inside control box.***

Set the Power On / Standby Mode switch (S5 in Figure 9-2) to the desired position.

Power On Mode: Slide the switch to the left to select the Power On (awake) mode. It is recommended that switch S5 be left in the Power On mode in all applications, except those where battery charging is not available.

The PCC will initialize the operating software and permit operation of the menu display panel. Power will stay on until the switch is reset to the Standby Mode.

Standby Mode: Slide the switch to the right to select the Standby (sleep) Mode. In this mode, the PCC operating software will be initiated by:

- moving the Run/Off/Auto switch to the Run position,
- pressing the Self Test button,
- a remote start input signal (genset in Auto mode), or
- any one of several "wake-up" signals from external switches.

With the switch set to Standby mode, pressing the Self Test button will allow you to activate and view the menu displays without starting the generator set. If no menu selections are made, a software timer will shut down the power after 30 seconds.

When left in the Standby Mode, and a "Warning" signal is sensed by the PCC (for example, low engine temp), the control will wake up and display the warning message. The control will remain active until the warning condition is corrected and the Reset button is pressed to clear the warning message.

STARTING

Refer to the generator set *Operator's* manual for important safety precautions and recommended procedures for starting the genset and verifying proper operation. Start the generator set and verify all engine and generator gauges are displaying the correct values.

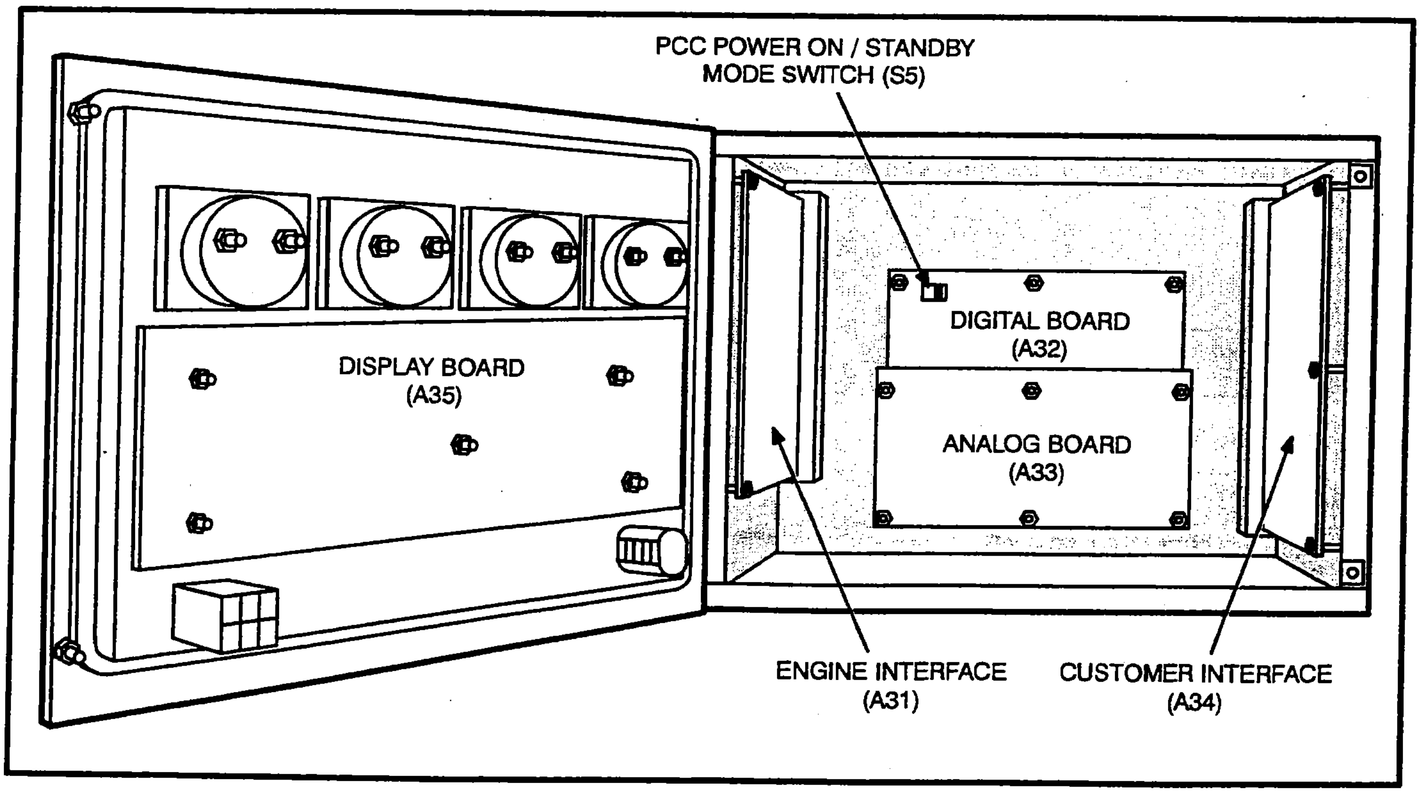


FIGURE 9-2. CABINET INTERIOR

10. Prestart Preparation (Detector/Sentinel)

GENERAL

Before attempting the initial start of the generator set, be sure to complete the *Installation Checklist* in *Section 11.*

ELECTRICAL SYSTEM

Verify all electrical connections are secure and all wiring is complete and inspected. Replace and secure any access panels that may have been removed during installation.

Battery Connections

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Make sure that the Run/Off/Auto switch on the control panel is set to the Off position before connecting the battery cables.***

Starting the unit requires a 12 volt battery. Connect positive battery cable before connecting negative battery cable to prevent arcing.

Service the battery as necessary. If an automatic transfer switch is installed without a built-in charge circuit, connect a separate battery charger.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Always connect battery negative last to prevent arcing.***

⚠WARNING ***Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.. Ignition of these gases can cause severe personal injury.***

STARTING

Refer to the generator set *Operator's* manual for important safety precautions and recommended procedures to start the genset and to confirm proper operation. Start the generator set and verify all engine and generator gauges are displaying the correct values.

11. Installation Checklist

GENERAL

- ☐ Generator set wattage capacity is sufficient to handle maximum anticipated load.
- ☐ At least 3 feet of clearance is provided around entire generator set for servicing and ventilation.
- ☐ Generator set is located in an area not subject to flooding.
- ☐ All operating personnel have read and are familiar with Operator's Manual.
- ☐ All operators have been thoroughly briefed on correct operation and exercise procedures.
- ☐ All operators have been thoroughly briefed on preventive maintenance procedures.
- ☐ All operators have read and understand all Safety Precautions in Operator's Manual.

GENERATOR SET SUPPORT

- ☐ Floor, roof or earth on which the generator set rests is strong enough and will not allow shifting or movement. Observe local codes on soil bearing capacity due to freezing and thawing.
- ☐ Generator set is properly supported and retained to approved base which is separate and independent of the surface on which it sits. Vibration isolators are installed between base and set.
- ☐ Supporting base is large enough - extends 12-inches all around set.

COOLING AIR FLOW

- ☐ Generator set air inlet is faced into direction of strongest, prevailing winds.
- ☐ Air inlet openings are unrestricted and at least 1-1/2 times larger than air outlet area.
- ☐ Cooling air outlet is on downwind side of building (if not, wind barrier is constructed).
- ☐ Proper ducting material (sheet metal, canvas) is used between radiator and air outlet.

DIESEL FUEL SYSTEM

- ☐ Fuel tanks meet or exceed all Local, State or National codes.
- ☐ Fuel lines are properly installed, supported and protected against damage.
- ☐ Flexible fuel line is installed between main fuel supply line and generator set to protect against vibration, expansion and contraction.
- ☐ Strainer or fuel screen (100 to 120 mesh) is installed in the fuel supply line to protect the fuel lift pump, day tank transfer pump or float valve seat from fuel supply tank debris.
- ☐ Fuel line shutoff valves are installed to prevent fuel flow in case of leaks.
- ☐ External fuel pumps are connected and operational at all times (generator set started or shut down).
- ☐ Fuel system is properly primed.
- ☐ No fuel leaks are found in supply line or engine fuel system.

EXHAUST SYSTEM

- ☐ Operators are thoroughly briefed on the dangers of carbon monoxide gas, preventing the buildup of this gas in inhabited areas.
- ☐ Areas around set are well ventilated. No possibility of exhaust fumes entering building doors, windows, or intake fans.
- ☐ Exhaust gases are piped safely outside and away from building.
- ☐ The correct length of approved rigid pipe is connected to the generator set flexible pipe using approved securing methods with no weight resting on engine exhaust components. There are no bends in flex section.
- ☐ Condensation drain is provided in lowest section of exhaust piping.
- ☐ Exhaust piping is insulated to guard against burns to personnel.
- ☐ Exhaust piping passing through walls or ceilings have approved fire-proof materials and are in compliance with all codes.
- ☐ Exhaust piping is large enough in diameter to prevent back pressure on engine.

AC AND DC WIRING

- ☐ Wire sizes, insulation, conduits and connection methods all meet applicable codes.
- ☐ AC and DC wires are separated in their own conduit to prevent electrical induction.
- ☐ All load, line and generator connections are proper and correct.
- ☐ Flexible conduit between generator set and building or surrounding structure.

GENERATOR SET PRESTART

- ☐ Generator set engine is properly serviced with oil and coolant.
- ☐ Batteries are properly installed, serviced and charged.
- ☐ Battery charger and engine coolant heater are connected and operational.
- ☐ All generator set covers and safety shields are installed properly.
- ☐ All fuel and coolant shutoff valves are operational.
- ☐ Fuel system is primed.

Mini Evac Bill of Material
Level 1

ITEM	QTY.	U/M	PART NUMBER	DESCRIPTION
1	1	ea	NA	Reservoir: Integral to Comp II
2	1	ea	SS-120-3-100	Suction Strainer: 1 1/4" NPT 23 GPM 100 Mesh
3	1	ea	CH256/SPEC 68501	Engine: Gasoline, 25 hp, Extended Front Shaft
4	1	ea	24-189-01	Adapter: Spark Arresting
5	1	ea	24-786-11	Muffler: Exhaust
6	1	ea	52-755-79	Tank: Gasoline 6.6 Gallon
7	1	ea	24-584-11	Ignition Module: Engine
8	1	ea	52-704-01	Oil Sentry: Installed
9	1	ea	24-755-08	Front Shaft: Generator Takeoff
10	1	ea	WAI24-1104	Pulley: Generator Takoff
11	1	ea	WAI24-1109	Pulley: Generator Takoff
12	1	ea	110-462	Alternater: 24 VDC, 35 A
13	1	ea	4L280	Belt: Alternater V Groove FHP Belt
14	1	ea	T-13790-01	Guard: Belt & Pulley
15	1	ea	T-13790-02	Framework: Custom Weldment
16	1	ea	70142-RFCT/PPV124	Pump: Manual Stroke, Closed Loop, Integral Charge Pump
17	1	ea	BBV-2004-0001M	Valve: Bypass, Manual
18	1	ea	A8B060ZN	Valve: Hot Oil Shuttle Relief, Cartridge
19	1	ea	K3A125200N	Valve: Hot Oil Shuttle, Cartridge
20	1	ea	LB10-248A	Line Body: Hot Oil Shuttle, Anodized Aluminum
21	1	ea	BAC-600-25	Gauge: 0-500 PSI - HOS
22	2	ea	BAC-5M-25	Gauge: 0-5000 PSI Gauge - Motor Loop
23	1	ea	HB-05075410	Motor: Hydraulic 5.4 in3/rev, 1 1/16 - 12 ports, 1 1/4 Keyed Shaft
24	1	ea	CSG70-P10A	Return Filter, 10 Micron Spin-on Filter, MP
25	1	ea	MPS-050-RG2 / 5300251	3/4" NPT Filter Head, MP
26	1	ea	CI-20	Indicator, MP
27	1	ea	AOMF-4-SAE-24	Heat Exchanger SAE 24 VDC
28	1	ea	B402-120	Temperature Switch
29	1	ea	150-0110	Hand Lever/Pump stroker control
30	1	ea	100-0432-074.5"	Cable: xxx length
31	1	ea	6G181	Female studded rod end 3/8-24
32	1	ea	RC3-0875-250	Reuland Coupling Half
33	1	ea	RC3-1437-375	Reuland Coupling Half
34	1	ea	RG3-H5	Reuland Insert Hytrel
35	1	ea	VEM-700-70-2A	Vescor Adapter
36		ft		Tubing
37	1	lot	TBD	Fittings
38	1	ea	WAI25-100	Fan
39	1	ea	7545	battery
40	1	ea	711614	bat cable
41	1	ea	784236	terminal
42	1	ea	728197	protective cap

TEI ENGINEERED PRODUCTS, INC.

MISSION STATEMENT

TEI Engineered Products, Inc. employees work in three (3) different operating units; Distribution, Fabrication, and Service, each involved in the hydraulic/electronic control industry.

Each operating unit has the expressed goal of providing the highest level of customer service and satisfaction available in our industry. To that end we will provide superior technical support, a whatever-it-takes customer service attitude, and the highest quality components available.

The end result of our employees' effort is the establishment of positive, long-term relationships with our primary vendors and customer base.

TEI ENGINEERED PRODUCTS INCORPORATED

6920 So. Jordan Rd., Suite C. • Englewood, CO 80112
(303) 693-1491 • FAX (303) 680-7577

Section 10

DRIVE TERMINAL

Drive Terminal

Maintenance

Frequency	*Maintenance Activity*
WEEKLY	- Bullwheel alignment - Deflection sheave alignment - Deflection sheave bearings - Position of arrival photo eye
MONTHLY	- Drive terminal structural welds - Guidage - Drive carriage slide pads - Bullwheel liner wear - Motor tach coupling - Lorry frame welds - Tension ram connections - Motor tach coupling - Lubricate deflection sheaves - Deflection sheave liner wear - Function and alignment of battery charger socket - Mounting of impulse generator - Test cable position switches and check hardware
AFTER 1st 2 MONTHS	- Perform a thorough visual inspection of all structural componets. - Check tightness of all bolted connections.
EVERY 6 MONTHS	- Check all structure nuts and bolts - Track rope saddle - Visually inspect track rope socket - Deflection sheave hardware and welds.

Maintenance and Inspection

Structure

- Check tightness of all nuts and bolts.
- Visually inspect structural welds.
- Inspect guidage for worn or damaged pad material and broken or missing hardware.
- Inspect track rope saddle for signs of saddle wear by checking each end of saddle for displaced liner material

Driver Bullwheel/Carriage

- Check carriage slide pads for wear. If clearance is greater that 1/16" per side, pad must be replaced
- Check gearbox, bullwheel and motor mounting bolts for tightness and integrity.
- Inspect bullwheel liner for wear. Groove depth greater than 1/3 rope diameter is an indication that liner needs to be replaced. Groove depth should be checked at a location NOT in contact with the haul rope. For liner replacement procedure refer to Line Tower section of this manual.
- Visually inspect motor/gearbox coupling for integrity.
- Visually inspect weldments.
- Visually inspect tension ram connections and weldments.
- Check haul rope alignment on bullwheel.

Deflection Sheaves

- Check tightness of nuts, bolts and hardware.
- Visually inspect weldments.
- Verify proper cable to sheave alignment. Sheave must be in same plane as cable and cable must be in center of sheave liner for maximum liner life.
- While lift is running, listen to sheave for indications of bearing failure.
- Grease sheaves with Mobil Mobilith SHC 480 or equivalent grease.
- Inspect liner for wear. Groove depth greater than 1/3 rope diameter is an indication that liner needs to be replaced. Groove depth should be checked at a location NOT in contact with the haul rope. For liner replacement procedure refer to Line Tower section of this manual.

Charger Socket

- Visually inspect for integrity (spring, bolts, etc.)
- Verify smooth operation when cabin docks.
- Check tightness of switch mounting bolts.
- Verify proper function of battery charger socket. Make sure cabin contacts are making good contact with socket contact plates. Check terminal connections.

Section 11

RETURN TERMINAL

Return Terminal

Maintenance

Frequency	*Maintenance Activity*
WEEKLY	- Bullwheel alignment - Position of arrival photo eye
MONTHLY	- Return terminal structural welds - Guidage - Bullwheel liner wear - Inspect tension rods, including hardware and anchorage - Lubricate deflection sheaves - Deflection sheave liner wear - Function and alignment of battery charger socket
AFTER 1st 2 MONTHS	- Perform a thorough visual inspection of all structural componets. - Check tightness of all bolted connections.
EVERY 6 MONTHS	- Check all structure nuts and bolts - Track rope saddle - Visually inspect track rope socket - Deflection sheave hardware and welds.

Maintenance and Inspection

Structure

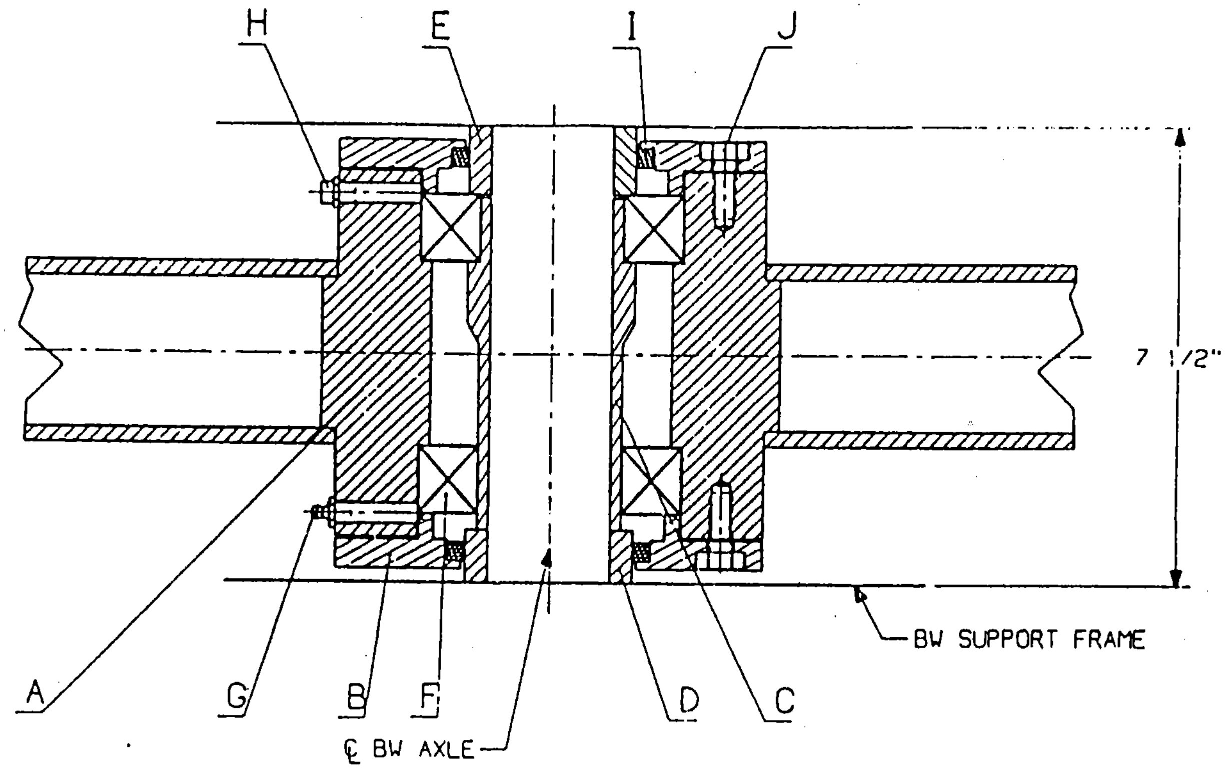
- Check tightness of all nuts and bolts.
- Visually inspect weldments of bullwheel frame and anchorage.
- Inspect guidage for worn or damaged pad material and broken or missing parts.

Return Bullwheel

- Check cable alignment.
- Check guide sheave alignment.
- Lubricate bullwheel with Mobil Mobilith SHC 460 or equivalent grease. Remove relief fitting and pump fresh grease through the bearings, purging the used grease out the relief-fitting hole until fresh grease is visible. Re-install relief-fitting. Clear the bullwheel of personnel and equipment and run the lift for one complete round trip of the cabin. Repeat the greasing procedure. (See Drawing 3038.411)

Charger Socket

- Visually inspect for integrity (spring, bolts, etc.)
- Verify smooth operation when cabin docks.
- Check tightness of switch mounting bolts.
- Verify proper function of battery charger socket. Make sure cabin contacts are making good contact with socket contact plates. Check terminal connections.



INDEX	REQ'D	DESCRIPTION	MATERIAL	WT.LBS.	REFERENCE	Format
J	16	BOLT CHc M10 x 20/20 cl.8.8			057493	
I	2	GREASE SEAL 85 x 70 x 8 -CRW1.R.27710			5065104	
H	1	GREASE RELIEF FITTING 1/8"NPT - 5 psi			5350048	
G	1	GREASE ZERK 1/8" NPT			5350001	
F	2	BEARING 110 x 60 x 28 -SKF 22212 CC			5060026	
E	1	AXLE SPACER x 1.13"lg.			3222309	A
D	1	AXLE SPACER x 0.87"lg.			3110656	A
C	1	AXLE SLEEVE			3222308	B
B	2	BEARING CAP			3222310	C
A	1	RETURN BULLWHEEL Dia. 1.25m - 6.5T			3071625	D

Rev.	Description Of Revision	Date	By

Total Weight / Pounds.

Treatment.

Assembly Reference.

Other Reference.

RETURN BULLWHEEL ASSEMBLY
Dia. 1.25m - 6.5T

THIS DRAWING AND ITS DESIGN ARE PROPRIETARY TO POMA OF AMERICA. DUPLICATION WITHOUT THE PERMISSION OF POMA OF AMERICA IS PROHIBITED.

Dwn. By: MPC
Ck. By:
Date: 3/4/91
Scale: 1/2

AERIAL TRAMWAY SYSTEMS

2510 FORESIGHT CIRCLE
GRAND JUNCTION, COLORADO U.S.A.

POMA OF AMERICA

Format: B
Dwg.No.: US 3038411

Section 12

LINE EQUIPMENT AND TOWERS

Description

Tubular structures with attached half crossarm and saddle (see Drawings 3038.782 and 3038.783)

The purpose is to maintain the position of the haul rope and track rope, while allowing free passage of the carriers.

Maintenance

Frequency	*Maintenance Activity*
DAILY	Check for proper alignment and correct if necessary. Check for loose or broken parts.
MONTHLY	Check saddle axle SADDLE: Visually inspect the saddle of any cracks and proper rope alignment. Verify that the track rope passes freely over the saddle during operation of lift. SHEAVES: Check that the haul rope passes correctly in the middle of the sheave. Adjust sheaves accordingly SHEAVES: Check for wear on rubber lining. Replace if more than 3/4" or 20mm is worn from original surface. Check proper seating of retaining rings. SHEAVES: While lift is in operation, listen for unusual noises (i.e. bearings, liners, rattles, etc.) STEEL STRUCTURE/TOWERS/BRACKETS/CATWALKS: Check the general exterior condition - paint, rust, loose anchor or assembly bolts, cracks, etc.

EVERY 600 HRS.	SADDLE: Check the free articulation of the saddle components. CONDITION OF THE SHEAVE BEARINGS: Change if necessary. ATTENTION: Use only the POMA sealed bearings. The quality and quantity of grease they contain have been especially designed for POMA to meet strict specifications.

Lubrication NOTE: Sheave assemblies must be unloaded to grease

Frequency	*Grease points*
MONTHLY	SHEAVES: The sheaves themselves are sealed bearings and require no greasing. However, grease the outer surface when installing to prevent rust. SADDLES: Grease saddle bushings on main axle with Shell SHC 460 or equivalent grease. There are two grease fittings on each saddle. See drawings 3038.782 and 3038.783 for location.
TWO TIMES PER YEAR	Lift rope off saddles and grease saddles with Shell SHC 460 grease.
EVERY 600 HRS.	All axles with grease fittings: MOBIL MOBILITH SHC 460 or equivalent grease.

Lifting Off the Cables

The tower crossarms can be used as a hoisting tackle. *See "Loads on Structures" in section 1 of this manual for appropriate rigging loads.* To lift off the cable, proceed as follows:

- Use a "Tirfor" type hoisting winch or a come-along.
- Use the appropriate hole in lifting gantry and mount the dead end of hoist to crossarm. The hole closets to tower is for haul rope. The hole farthest from tower is for track rope. (See Figure 12-1)
- To lift the track rope on tower 1 remove the knock outs (index S on drawing 3038.782). Attach hoist to outside hole in cross arm. Wrap appropriate slings around the cable and attach to hoist. Use a 39-1/2in spreader bar to keep slings in proper position. (See Figure 12-1)
- To lift the track rope on tower 2 attach hoist to outside hole in cross arm. Wrap appropriate slings around the cable and attach to hoist. Use at a minimum of a 55in spreader bar to keep slings in proper position.
- To lift the haul rope use the inside hole on the cross arm to attach hoist.

* **Failure to follow these procedures could result in damage to equipment and serious injury or death to personnel.**

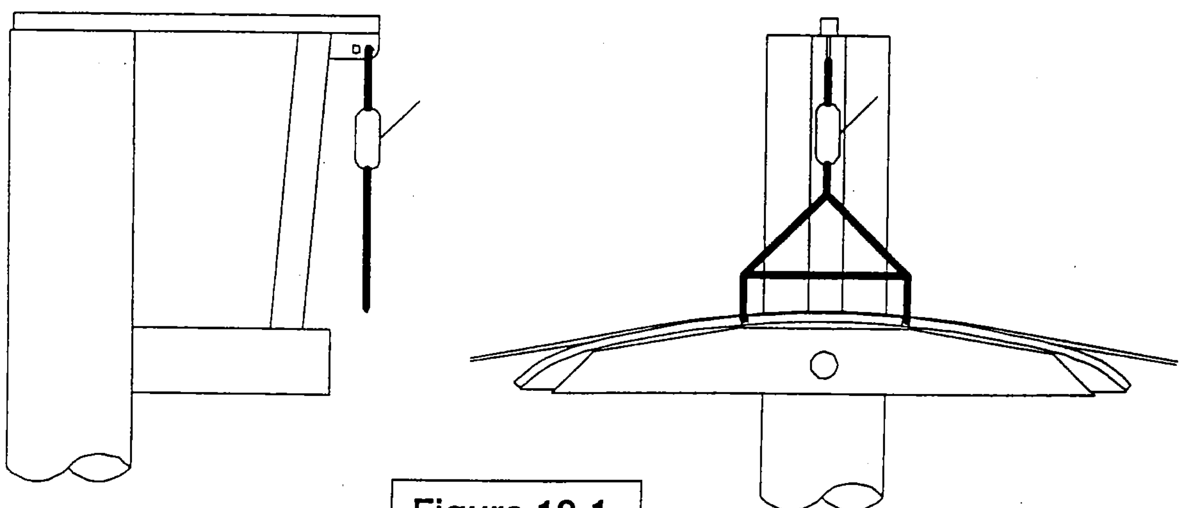


Figure 12-1

Maintenance and Adjustment

Track Rope

- Visually inspect entire length of track rope. A thorough inspection of the rope at end connections and saddle locations is of the utmost important.

Haul Rope

- Visually inspect entire length of haul rope, including a thorough inspection of the haul rope in the truck area and including the haul rope clamps.
- Lubricate haul rope. Drip or brush a very light film of castor oil onto the rope. It is best to lubricate rope during warm weather. It is very important that the lift no run for 24 hours after the application of the castor oil.

Line towers

- Visually inspect all weldments.
- Check tightness of all nuts and bolts.
- Check alignment of haul and track ropes.
- Grease saddle axle using Shell Avania #3 or equivalent. It is necessary to unload saddle prior to greasing. This will allow for the grease to flow around the entire bushing.
- Check sheave liner wear. If the groove in the liner is worn to a depth of 1/3 the rope diameter, the liner must be replaced. Refer to Diagram A for relining procedure for the 200mm diameter sheave, bullwheel, and return sheaves.
- Check sheave bearings. Lift haul rope off each sheave and spin the sheave listen for any unusual noises.
- Inspect track rope saddle. Look for indications of excessive surface wear. Check tightness of mounting bolts and position of track rope straps. (See Drawings 3038.782 and 3038.783)

LEITNER POMA

LEITNER-POMA OF AMERICA, INC.

March 23, 2005

Mr. Jorg Ludwig
Senior Safety Engineer
State of California
Department of Industrial Relations
Tramway Unit
P.O. Box 11227
Truckee, CA 96162

Dear Mr. Ludwig,

This letter is in reference to the Pacoima Dam Tram (A-807) and the questions concerning the track rope brake adjustment and track rope saddle retention.

Track Rope Brake Adjustment - I have reviewed the brake pad clearance requirement that is outlined in the "Pacoima Aerial Tramway Operation and Maintenance Manual" (OM manual) and have revised this clearance from 3.5mm each side 7.0mm total to 2.5mm each side 5.0mm total minimum. See the enclosed revised Section 13, Page 6A. The brake pull test value was determined during the acceptance test. This "real" value is different than the theoretical calculated value and reflects fiction and other "real" conditions on site. Enclosed are the brake force calculations.

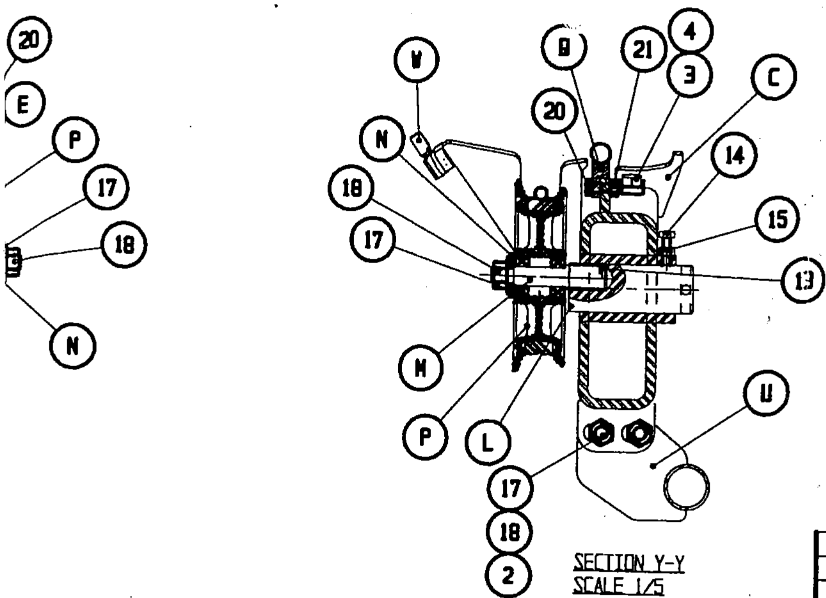
Track Rope Saddle Retention – We included calculations for the retention of the track rope in the saddles as part of the original submittal packages for certification of the tramway. Enclosed are copies of the submitted calculations. Furthermore, it was determined by the certifying design engineer, by calculation and during the load test, that the track rope retention straps were not required for adequate safety to deropement, and might even constitute a hazard for the track rope brake. Leitner Poma technicians inspecting the tramway checked the condition of the remaining straps, during monthly service visits, and removed them as they became a problem. Leitner Poma is now requiring that all remaining track rope retention straps must be removed wherever they interfere with passage of the track rope brake. Enclosed is revised Section 12, Page 4A removing the "check position of track rope straps" requirement, and revised saddle assembly drawings US3038.782A and US3038.783A.

For your records, we are sending revised OM manual pages, revised drawings and resending copies of pertinent calculations. These will be also sent to Sam Kats and Sam Huber of LA County I.S.D.

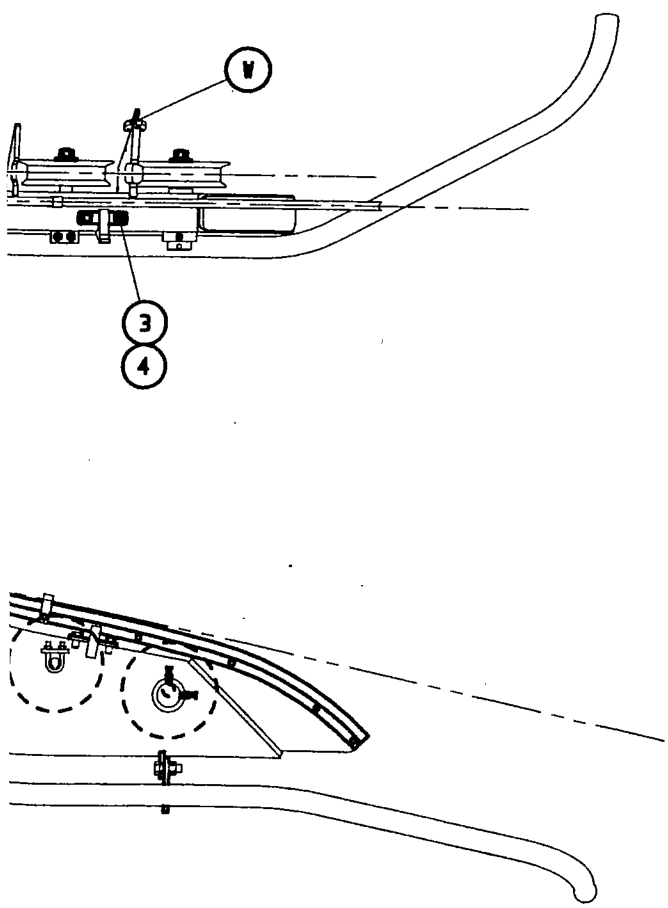
Sincerely,

Nelson Tusberg, P.E.
Manager of R&D Engineering

2510 FORESIGHT CIRCLE • GRAND JUNCTION, CO 81505 • (970) 241-4442 • FAX (970) 241-3023
EASTERN OFFICE: P.O. BOX 35, ROUTE 100 & 107 • STOCKBRIDGE, VT 05772 • (802) 746-7965 • FAX (802) 746-7958



SECTION Y-Y
SCALE 1/5



23	2	NUT LOW HM 10 8.8 PLATED			058051	
22	2	BOLT HM 10x20/20 8.8 PLATED			057211	
21	23	NYLON LOCKNUT M12 8.8 PLATED			058036	
20	23	BOLT HM 12x40/40 8.8 PLATED			057090	
19	16	NYLON LOCKNUT M10 8.8 PLATED			058185	
18	38	NYLON LOCKNUT M20 8.8 PLATED			058182	
17	38	FLAT WASHER M20U PLATED			058110	
16	8	U-BOLT M10-15/16 x 2-3/4/1 PLATED		1.8	UK 3110.830	A
15	4	NUT LOW HM 12 8.8 PLATED			058052	
14	4	BOLT HM 12 x 30/30 8.8 PLATED			057271	
13	2	ROLL PIN 6mm x 15mm			060058	
12	2	NYLON LOCKNUT 1.5-12NF A325 PLATED			5058047	
11	1	BOLT 1.5-12NF-10/10 A325 PLATED			5057738	
10	1	BOLT 1.5-12NF-20/20 A325 PLATED			5057573	
9	4	NYLON LOCKNUT M27 8.8 PLATED			058201	
8	3	BOLT HM 16x45/30 8.8 PLATED			5057140	
7	2	U-BOLT/HD M27, 7-3/8x13-11/16x3-3/4		10.8	UK 3110.828	A
6	2	NUT HU M8 8.8 PLATED			058004	
5	2	WASHER M8 PLATED			058103	
4	8	LOCKWASHER JEC16 PLATED			058088	
3	8	BOLT HM 16x30/30 8.8 PLATED			057288	
2	8	BOLT HM 20x60/40 8.8 PLATED			057082	
1	2	GREASE ZERK 1/8" NPT			3530001	

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
W	3	BRITTLE BAR			1031120	
V	1	CABIN GUIDE CONNECTION TUBE		4.7	UK 3225.477	A
U	2	CABIN GUIDE		80	UK 4075.838	B
T	4	TRACK ROPE DEROPEMENT STRAPS		0.3	UK 3225.823	A
S	2	600 mm SADDLE "CHECK OUT"		1.4	UK 3225.473	A
R	1	600mm SADDLE, MIDDLE PIECE, R19'		13.5	UK 3225.472	B
Q	2	600mm SADDLE, END PIECE, R19'		40.8	UK 3225.471	B
P	10	STANDARD 8" ALUMINUM SHEAVE ASSM.			2031105	
O	8	600 mm SHEAVE AXLE		22.4	UK 3225.483	B
N	10	NYLON DUST SEAL WASHER		0.25	UK 3110.837	A
M	2	ECCENTRIC AXLE SHAFT		3	UK 3225.482	B
L	2	ECCENTRIC AXLE BODY - 600mm SHEAVE		18.2	UK 3225.481	B
K	4	CROSS ARM WASHER 60 x 1 0/16 x 1/2		28	UK 3110.848	A
J	2	BUSHING SKF GLY.PG 100/105/60 A			5040070	
I	1	LOCK PLATE		0.4	UK 3225.481	A
H	1	AXLE END PLATE		9	UK 3225.480	A
G	1	AXLE SPACER		1.7	UK 3225.479	A
F	1	10 SHEAVE SADDLE AXLE		204	UK 3225.478	B
E	1	BRITTLE BAR EXTENSION 8m ALLTHREAD		0.07	UK 3225.824	A
D	1	TRACK ROPE BRITTLE BAR MOUNT		0.7	UK 4075.728	A
C	4	TRACK ROPE CATCHER		8.8	UK 4075.730	B
B	1	GREASE ZERK HOUSING		0.5	UK 3225.470	A
A	1	10 SHEAVE SADDLE		740.7	UK 4075.835	B

QUANTITY:
USED FOR:
USE DWG:
PRODUCTION USE ONLY

REV | DESCRIPTION OF REVISION | DATE | BY

TOLERANCES UNLESS INDICATED
• FABRICATION •
FRACTIONAL ..... ±1/16
ANGULAR .... ±1/2°
• MACHINING •
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR .... ±.1°

AERIAL TRAM

ORIG. YEAR 1998

10 SHEAVE SADDLE ASSEMBLY

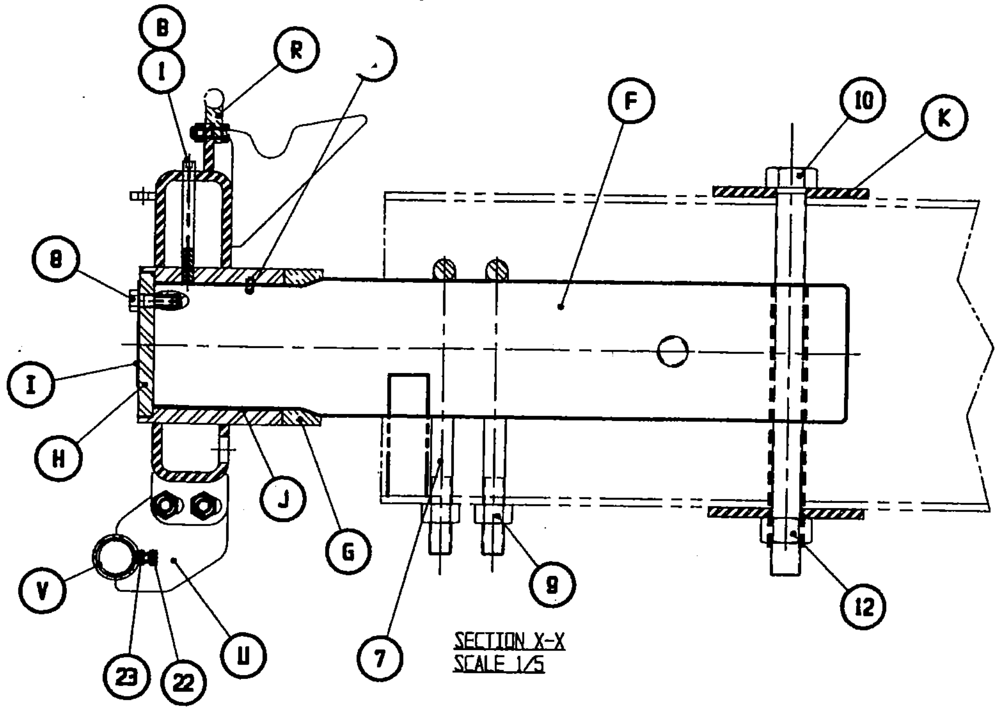
CABLE TRANSPORT SYSTEMS
SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA

DRAWN BY: LINCH-[illegible]
CHECKED BY: J.COPELAND
DATE: 5.28.98

TREATMENT:
TOTAL WT./LBS.: ~1370
DRAWING REF.:
QTY. REF.:
WORK LOCATION:
OTHER REF.:

FORMAT: D
DRAWING NUMBER: 3038.782
REVISION: /



SECTION X-X
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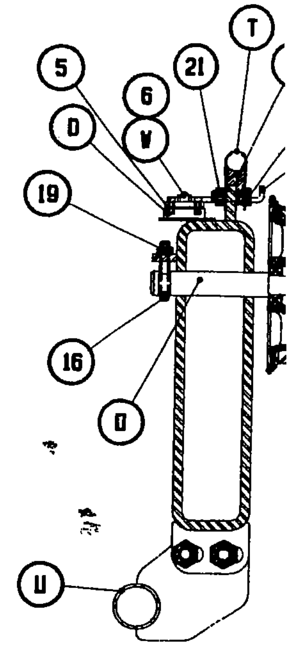

SECTION Z-Z
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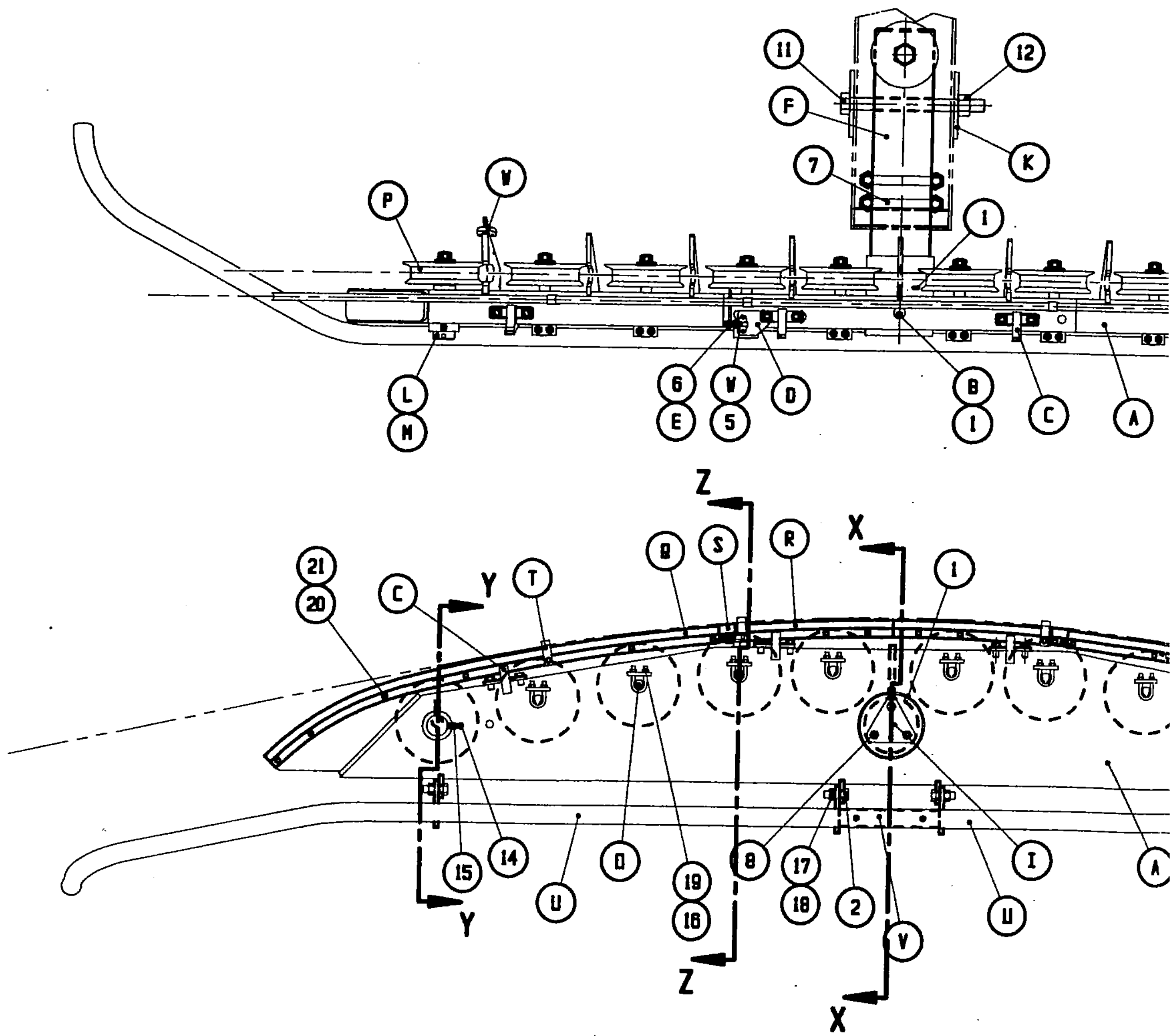
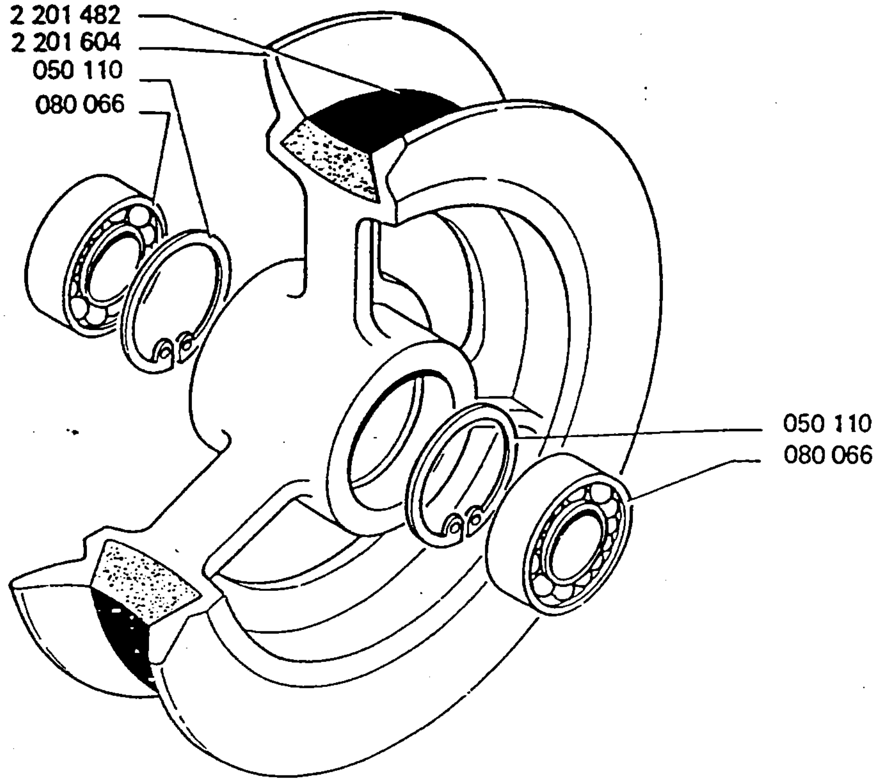




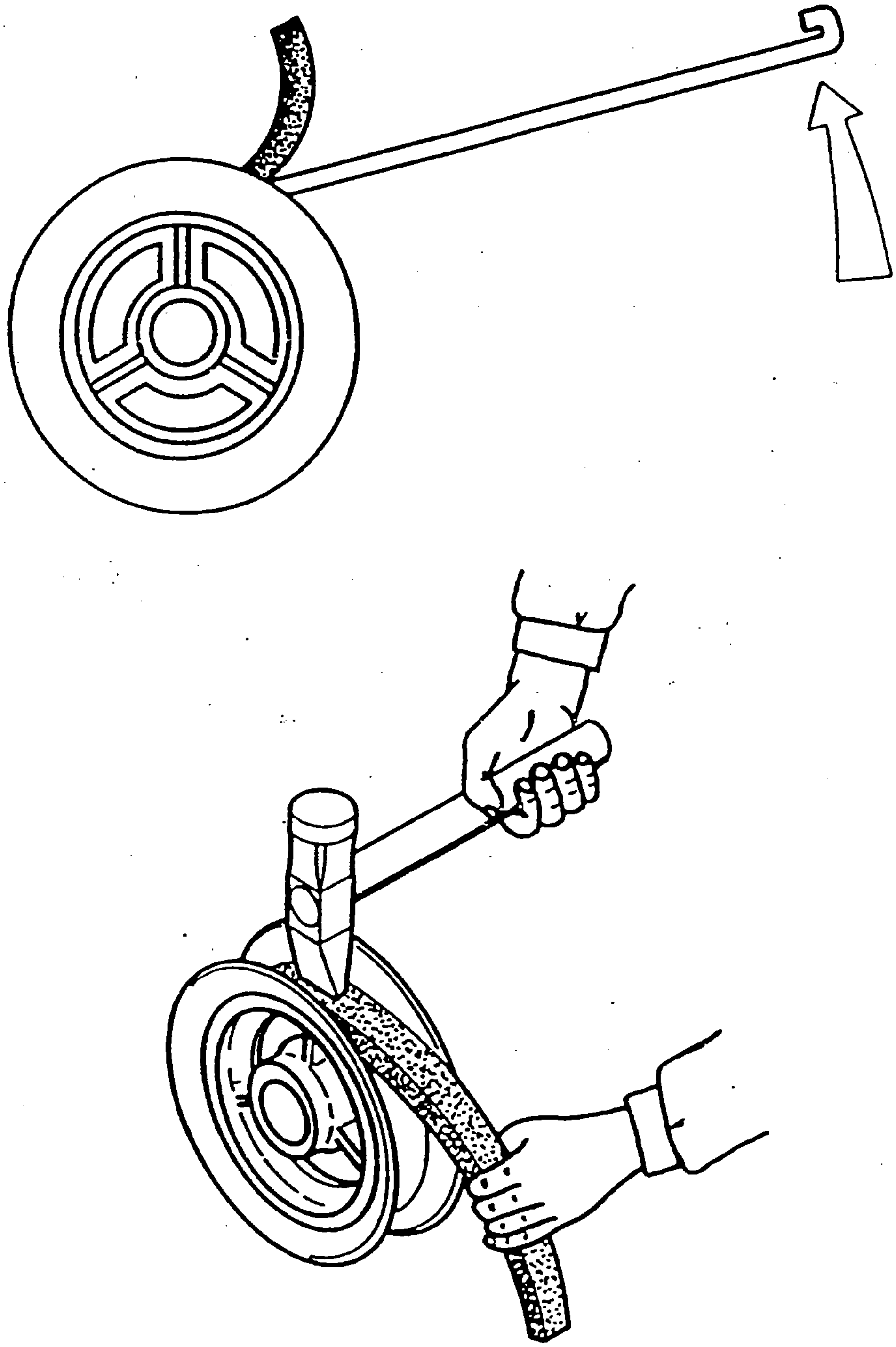
2 031 195
Ø 200

sheave devices

SHEAVE DIA. 200
AND DIA. 500

Rep. Nb.	Ref.	
	2 031 195	ASSEMBLY SHEAVE DIA. 200 comprising :
1	2 201 604	sheave
1	2 201 482	rubber lining
2	050 110	inner circlips dia. 52 type 7000
2	080 066	ball bearings 6 205 EE
Not shown 2	3110837	Nylon dust washers

DIAGRAM A



Section 13

CARRIER

Carrier

Description

One cabin with 8 sheave truck and track rope brake.

Maintenance Schedule

Frequency	*Maintenance Activity*
EVERY TRIP	Verify track rope brake system pressure.
DAILY	Track rope brake: check for system leaks Haul rope safety: Check that the pins release smoothly and lanyard is securely attached to the haul rope. Cabin: general inspection
MONTHLY	Truck/hanger: Inspect battery charging plug. Check torque on haul rope clamps. Track rope brake: Check oil levels Manual activation of brake. Pull test Pressure switch Cabin: Frame Haul Rope Clamps: Verify torque of haul rope clamp, bolts and cable clamps on tails of haul rope Visually inspect haul rope at clamps and at bottom truck structure for broken wires or other damage
EVERY 6 MONTHS	Truck/hanger: Inspect truck sheaves Track rope brake: Verify automatic activation
YEARLY	Truck/hanger: NDT hanger axles and thoroughly check hanger head bushings. Grease hanger head bushings Cabin: Check door opening mechanism

Maintenance, Inspections and Adjustments

Truck/Hanger

General Inspection

Visually check hanger to truck and cabin connection for any loose hardware and integrity of welds.

Check sheaves and rockers for complete rotation.

Check sheave liners for wear and replace as necessary.

Hanger Axles

Non-destructively test (NDT) hanger axles. The testing shall be performed by at least a level II Examiner as specified by the ASNT TC-1A. Any linear or transverse indication shall be cause for rejection of an axle.

The hanger to truck axle shall be tested, both visually and ultrasonically.

Hanger Head And Bushings

Grease hanger to truck connection with Aero Shell #14 or Equivalent. It is important that the cabin is pushed perpendicular both directions when applying grease to allow grease to completely lubricate the bushings. (See Figure 13-1)

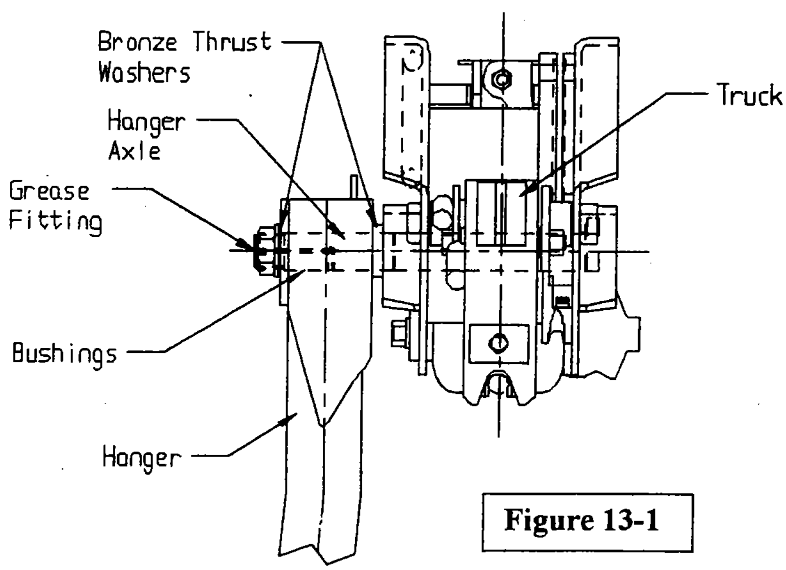


Figure 13-1

Charge Plug Inspect plug. Pay particular attention to wire terminations, position of plug in socket and condition of copper components. Make sure copper contact pads are clean and free of foreign material.

Truck Sheaves Lift one side of each 2 rocker and check for free movement of the sheaves. Inspect sheaves, bearings, and liners. Replace components as needed. See the section 11 of this manual for criteria and replacement procedures. (See Figure 13-2)

Rockers Check for free articulation of each rocker. (See Figure 13-2)

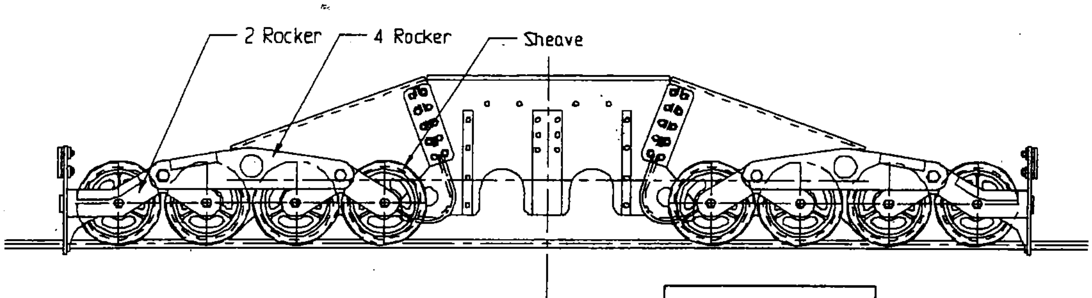


Figure 13-2

Haul Rope Clamps Check torque of the ten M14 bolts on the clamps. Torque value is 70 foot-pounds **with clean dry threads**. Follow the pattern in figure 13-3 for tightening the bolts. Repeat pattern until torque is achieved on all bolts. The gap between the plates has to be consistent through out. (See Figure 13-3)

Check clamps above truck between cables for tightness of bolts.

Inspect rope in clamp area. **Report any deformation or failure of rope strands to Poma of America, Inc. and cease lift operation until approved by Poma.**

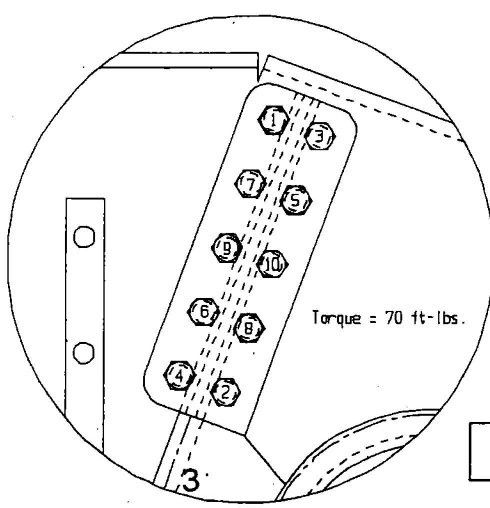


Figure 13-3

Track Rope Brake

System Leaks

Visually check all components for external leaks. Repair as needed.

Oil Levels

Pump Unit: With brake applied, oil lever should be 1/2in to 1in from the top of the reservoir.

When adding or changing oil, use Mobil DTE13 or equivalent.

Manual Activation Of Brake

With system at normal operating pressure, turn red handle on ball valve and verify system pressure drops to zero and track rope brake sets correctly. (See Figure 13-4 and Drawings 3038.768, 3038.868)

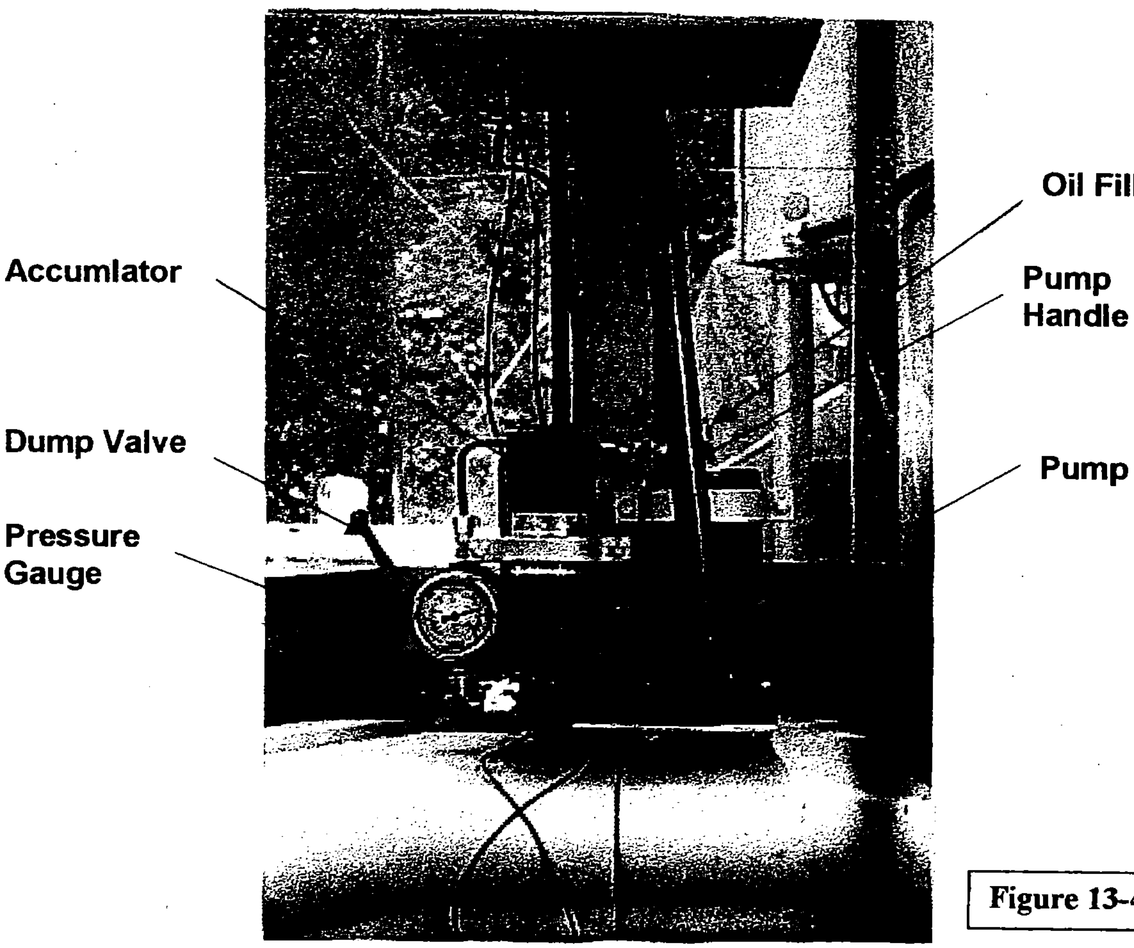


Figure 13-4

LEITNER POMA

LEITNER-POMA OF AMERICA, INC.

March 23, 2005

Mr. Jorg Ludwig
Senior Safety Engineer
State of California
Department of Industrial Relations
Tramway Unit
P.O. Box 11227
Truckee, CA 96162

Dear Mr. Ludwig,

This letter is in reference to the Pacoima Dam Tram (A-807) and the questions concerning the track rope brake adjustment and track rope saddle retention.

Track Rope Brake Adjustment - I have reviewed the brake pad clearance requirement that is outlined in the "Pacoima Aerial Tramway Operation and Maintenance Manual" (OM manual) and have revised this clearance from 3.5mm each side 7.0mm total to 2.5mm each side 5.0mm total minimum. See the enclosed revised Section 13, Page 6A. The brake pull test value was determined during the acceptance test. This "real" value is different than the theoretical calculated value and reflects fiction and other "real" conditions on site. Enclosed are the brake force calculations.

Track Rope Saddle Retention – We included calculations for the retention of the track rope in the saddles as part of the original submittal packages for certification of the tramway. Enclosed are copies of the submitted calculations. Furthermore, it was determined by the certifying design engineer, by calculation and during the load test, that the track rope retention straps were not required for adequate safety to deropement, and might even constitute a hazard for the track rope brake. Leitner Poma technicians inspecting the tramway checked the condition of the remaining straps, during monthly service visits, and removed them as they became a problem. Leitner Poma is now requiring that all remaining track rope retention straps must be removed wherever they interfere with passage of the track rope brake. Enclosed is revised Section 12, Page 4A removing the "check position of track rope straps" requirement, and revised saddle assembly drawings US3038.782A and US3038.783A.

For your records, we are sending revised OM manual pages, revised drawings and resending copies of pertinent calculations. These will be also sent to Sam Kats and Sam Huber of LA County I.S.D.

Sincerely,

Nelson Tusberg, P.E.
Manager of R&D Engineering

2510 FORESIGHT CIRCLE • GRAND JUNCTION, CO 81505 • (970) 241-4442 • FAX (970) 241-3023
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Brake Adjustment

When brake is released, the brake pads grooves should 2.5 be centered on the track rope with a minimum of ~~3.5~~mm of clearance each side. If the pad grooves are more than an 1/8in out of vertical alignment then replace roller (Index P) and pads. (See Drawing 3038.868)

Slowly set the brake with the dump valve. Verify that the brake sets properly with the track rope correctly seated in the brake pad grooves. (See Figure 13-4)

Adjustment of the brake should coincide with values determined during pull test. To increase braking pressure tighten nut (Index X) while backing up bolt (Index I) with appropriate wrenches. To decrease pressure loosen nut (Index X). (See Drawing 3038.868)

System Pressure

To determine system pressure, pull test the truck and adjust brake. Pump up the brake until 3.5mm of clearance per side between the track rope and brake pads is achieved. Note pressure shown on gauge. This pressure will be the release pressure until next pull test. If system pressure is determined to be above 5000psi the system may not be working properly and a thorough check of the system is needed before lift may resume operation. **Never exceed maximum pressure on gauge.**

See March 23 Letter

Cabin

General Inspections — Check for free and proper operation of door.
Check general condition of cabin.
Check battery charger for proper charge

Door Emergency Pins — Verify that emergency release pins are fully engaged (See Figure 13-6)

Frame — Carefully inspect frame and frame connections for cracks, loose or missing hardware and integrity of safety cables. (See Figure 13-6)

Door Opening Mechanism — Lubricate areas noted on figure 13-6. A light film brushed on is sufficient.
Lubricate spring arm at grease fitting

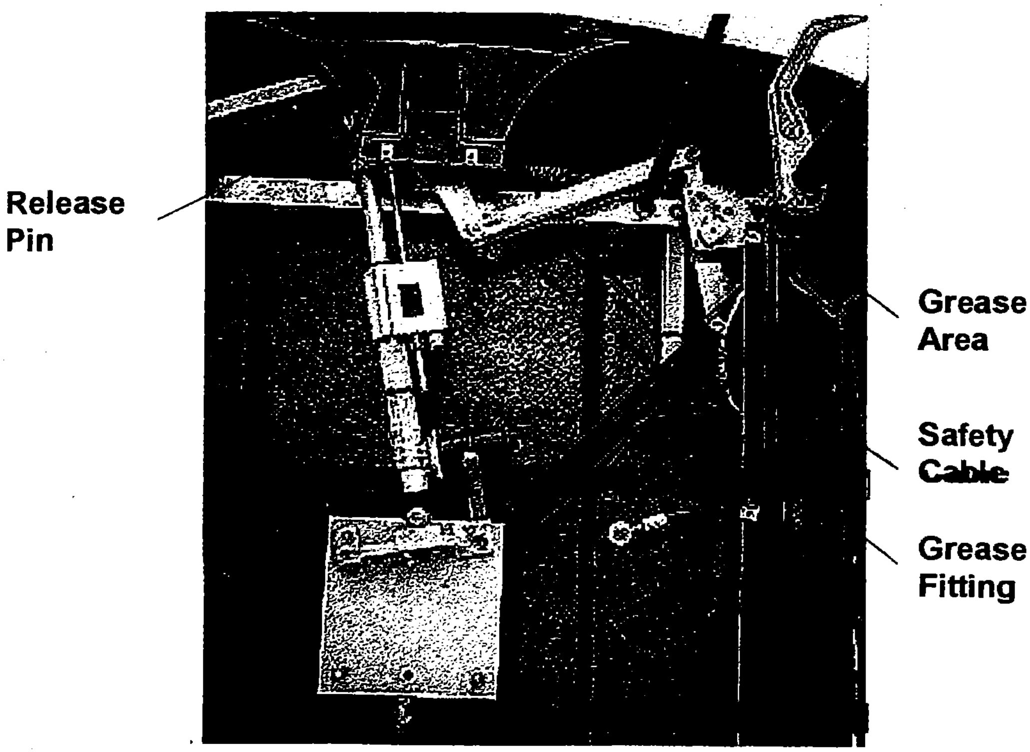


Figure 13-6

ACCEPTANCE/REJECTION CRITERIA FOR HANGERS

2.3.4.3. ANSI B77 CODE

1. **Qualifications for Testing Personnel**

All inspectors should be at least a Level II Examiner, as specified by the American Society of Non-Destructive Testing TC-1A.

2. **Sampling Size and Method of Obtaining the Sample**

The test sampling method shall identify the parts tested to assure a rotating minimum test sample on each lift of 10 hangers or 10% of all the total hangers per year, whichever is greater.

3. **Allowable Rejection Rate and Retest Procedures**

If any of the 10 or 10%, whichever is greater, is rejected, another 10 or 10%, whichever is greater, shall be tested.

4. **Types of Inspections to Be Performed and the Procedures to Be Used**

- Visual inspection of every hanger once a year.
- Non-destructive testing by means of magnetic particle and/or liquid penetrant to the critical areas per blueprint.
- Procedures for non-destructive testing shall be done according to the American Society of Non-Destructive Testing TC-1A.

5. **Criteria for Acceptance/Rejection of Samples**

Welded stress parts:

- Any linear indications
- Transverse indication with 1 dimension greater than 1/8 inch.
- 3 or more aligned indications with the distance between being less than 1/8 inch edge-to-edge, or extending for more than 5/8 inch if this distance is between 1/8 and 1/4 inch.
- 2 separate indications are considered as one if the distance which separates them is less than 2 times the length of the smaller one. The cumulative length of the indications is equal to the measured

Section 14

HAUL ROPE AND TRACK ROPE

Haul Rope and Track Rope

Description

The characteristics of the wire ropes for this lift are described in Section 1, *Lift Data.*

Maintenance of the Haul Rope

Frequency	Activity
DAILY	Check for free travel of the tension sheave.
ANNUALLY IN IN ACCORDANCE WITH ANSI B77.1-7.4	Check general condition of haul rope for rust, broken wires, internal condition. Check splices and repairs.
EVERY 6000 HRS	EWRT, Electromagnetic Wire Rope Test

Maintenance of the Track Rope

Frequency	Activity
DAILY	Check for free travel of the tension sheave.
ANNUALLY IN IN ACCORDANCE WITH ANSI B77.1-7.4	Check general condition of haul rope for rust, broken wires, internal condition. Check socketed connections.
EVERY 6000 HRS	EWRT, Electromagnetic Wire Rope Test

Protection

POMA strongly advises against greasing the ***haul rope*** since this will impair cable adherence on the drive sheave. In addition, the abrasive wear of the sheave and bullwheel linings can cause the grease to form an amalgamate that can hinder the evaporation of internal moisture from the cable.

POMA recommends brushing, dripping or spraying a thin coating of an anti-corrosion protective fluid, such as Shell ENSIS Fluid MD, on the cable if your lift is not to be used for an extended period of time.

- If your lift is equipped with a **TECNOR haul rope**, has a solid plastic or poly core and is used for year-round operation, it is best **NOT** to put any lubricants or protectants on the rope.

- If your lift is equipped with a **TECNOR haul rope** with a solid plastic or poly core, is not to be used for an extended period of time and if your area has climactic conditions which cause severe corrosion, then use of lubricants or protectants is appropriate.

NOTE: Shell ENSIS fluid may not be readily available in all areas. If this is the case, it is permissible to use a high quality pure vegetable castor oil but **only** if the lift is **not** to be operated for at least 2 weeks immediately after application of the castor oil. It is imperative that a very minimal amount of castor oil be used - just enough to provide a thin coat.

WARNING

When using castor oil as a protective fluid, only apply a minimal amount of the oil to the cable. Application of castor oil must only be done if the lift is not to be run for at least 2 weeks immediately following such application. Failure to follow these instructions could lead to serious equipment damage and/or personal injury.

Section 15

LUBRICATION SPECIFICATIONS

LUBRICATION

Introduction

Lubrication of moving mechanical parts has an important influence on the life of the lifts and their safety in operation. Consequently, Poma and our suppliers have carried out studies, research and tests to recommend lubricants complying with the requirements of our specifications.

Therefore, it is important to follow the recommendations and instructions given in the present and other Poma maintenance documents.

Following the basic information given hereafter, **the operator will find characteristic data and tables concerning the products recommended by Poma for the lubrication of our standard equipment.**

POMA Supply

Unless otherwise specified, Poma carries out the first lubrications and greasing of the lifts installed.

For further lubrications, the operator may obtain the recommended oils and greases from Poma or local suppliers.

Recommendations

Storage

Lubricants must be stored in such a way as to protect them from contaminants and in accordance with local, state and federal requirements.

Water must not be allowed to accumulate around the covers and caps of the various containers. The drums must be laid horizontal or semi-horizontal.

It is important to keep the labels on the containers in good condition in order to identify the lubricants.

Lubrication

Spray lubrication systems for reducers must be checked at regular intervals.

Piping between bearings and grease fittings on certain components must not be disconnected or flattened: check before first start-up and after each servicing involving the component.

Never mix two oils or especially two greases of different quality.

Check oil levels in gear housings regularly.

Do not top up oil as soon as the lift has stopped.

Change oil when still warm, at recommended intervals.

Definitions

Viscosity

This property defines the resistance of a fluid to flow, therefore its natural speed of flow. It is determined by measuring the time a specified volume of oil, at a given temperature, takes to flow through a hole of specified diameter.

The higher the viscosity number, the higher the viscosity of the fluid, i.e. a 220 Cst oil is more viscous than a 68 Cst oil.

For oils known as "gear housing oils" and hydraulic oils, the International Standards Organization (ISO) has established a classification of industrial lubricants based on a viscosity scale at 40° C, expressed in centistoke (Cst). This scale comprises a series of grades representing mean viscosity values; each grade covers a viscosity range of +/- 10% of the grade value. To assist users in readily identifying their oils, most brands include the grade value in the product brand name: for instance, Shell Omala 68 oil is a lubricant with a mean viscosity of 68 Cst at 40° C.

Gearbox and bridge oils (used in Kissling reducers) are classified by the Society of Automotive Engineers (S.A.E.) depending on their viscosity at a temperature of 100° C. A cold viscosity stress is added for grades followed by the letter W (winter). Thus the viscosity of an 80 W oil is:

- less than or equal to 150,000 centiposes at -26° C
- greater than or equal to 7 centistokes at 100° C.

Viscosity Index

This is a conventional number indicating how viscosity varies with changes in temperature. The higher the index, the smaller the variation in viscosity.

Aniline Point

This indicates how elastomeric seals will react when in contact with the oil. With a low aniline point oil, they tend to swell; with a high aniline point oil, they tend to harden and contract.

Grade

The NLGI scale classifies the consistency of a grease. The lower the grease number, the softer the grease.

Prescribed Hydraulic Oils

Constant Hydraulic Tension System with Electric Pump

Oil Characteristics

- Hydraulic control oil with a very high viscosity index $\geq$ 150
- Viscosity at 104° F = 32 to 37 Cst
- Pour point: $\leq$ -31° F

Main Brands

SHELL	Tellus T37
MOBIL	DTE 13
ELF	SHF 32
ESSO	Univis HP 46
FINA	Hydrau HW 32
TOTAL	Equivis ZS 32

Constant Hydraulic Tension System with Accumulator(s)

Oil Characteristics

- Hydraulic oil "aviation" type or type for low temperatures
- Viscosity at 104° F = 13 to 16 Cst
- Viscosity at -40° F = 400 to 500 Cst

Main Brands

SHELL	Fluid H2798
MOBIL	Aero HFE
ELF	Aviation hydraulic oil 20
TOTAL	Aero hydraulic 520

Emergency Brakes

The emergency brakes use the same oil as the hydraulic tension systems cited above.

Prescribed Lubrication for Speed Reducers

POMA-Kissling speed reducers require a high pressure oil made for hypoid gears. It must meet the requirements of API Service GL5.

Popular Brands of SAE 80 W

SHELL	Spirax HD 80 W: viscosity index 91, flow point (-28° F)
ARAL	Getriebeol Hyp. 80
ASEOL	Topress 80 W
BP	Hypogear EP 80 W
ELF	Tranself B 80 W
ESSO	Gear oil GX 80 W
GULF	EP Lubricant HD 100
KLUBER	Synthesco D 220 EP (not to be mixed with others)
MOBIL	Mobil HD 80/90 W
SUNOCO	MP-GL 580 VG 68
TEXACO	Multigear EP-80
TOTAL	Transmission TM multigrade

NOTE: Bearings are oiled automatically from within the gearbox on all POMA-Kissling units.

If a synthetic oil is desired, use MOBIL SHC 7590 meeting A.P.I. Service GL5.

Prescribed Greases, Oil and Fluids

for Carrier Hanger
Haul Rope

Carrier Hanger

AERO SHELL GREASE 14

Haul Rope

POMA and our suppliers do not allow greasing the cables for two reasons:

1) To keep the same adhesion coefficient on the drive bullwheel, and

2) To avoid grease packing between the strands due to the abrasion of the sheave linings. This would prevent the ventilation of the internal humidity from the cable.

POMA recommends the use of a thin coat of SHELL ENSIS Fluid MD. Refer to Haul Rope Section for specific requirements.

NOTE: Shell ENSIS fluid may not be readily available in all areas. If this is the case, it is permissible to use a high quality pure vegetable castor oil but **only** if the lift is **not** to be operated for at least 2 weeks immediately after application of the castor oil. It is imperative that a very minimal amount of castor oil be used - just enough to provide a thin coat.

WARNING

When using castor oil as a protective fluid, only apply a minimal amount of the oil to the cable. Application of castor oil must only be done if the lift is not to be run for at least 2 weeks immediately following such application. Failure to follow these instructions could lead to serious equipment damage and/or personal injury.

MOBIL MOBILITH SHC 460

Characteristics

Grade NLGI:	1-1/2
Ingredients:	Synthetic base fluid with a lithium complex soap thickener with additives for anticorrosion, antioxidation and durability
Drip point:	246° C (475° F)

Excellent resistance to water, oxidation, the effects of cold temperatures and high pressure.

Applications

Electric motor bearings

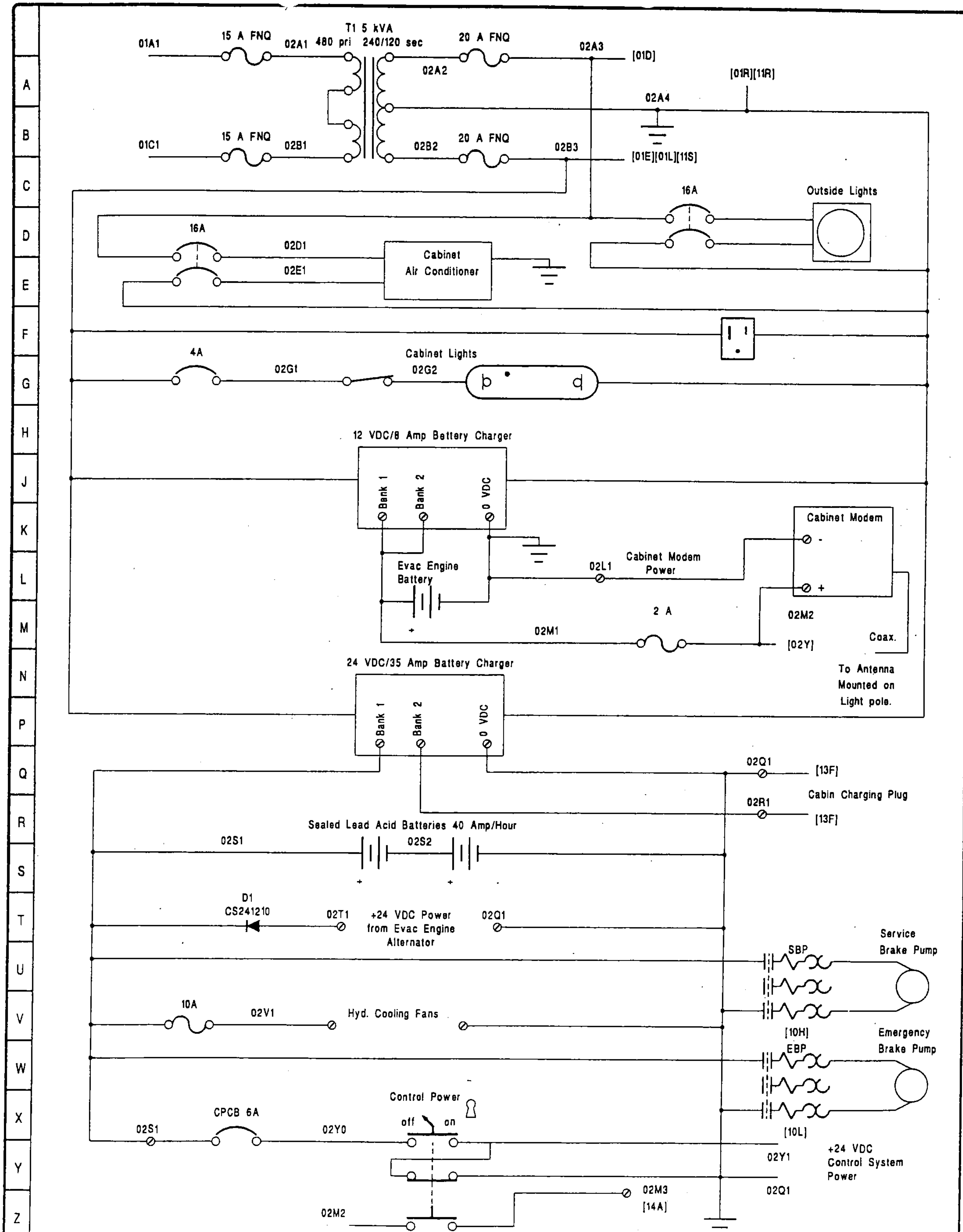
Bearings in the reducers (when necessary)

U-joints

All shafts and axles of the sheave assemblies

Adjusting screws

Schnorr washers used in fixed grips



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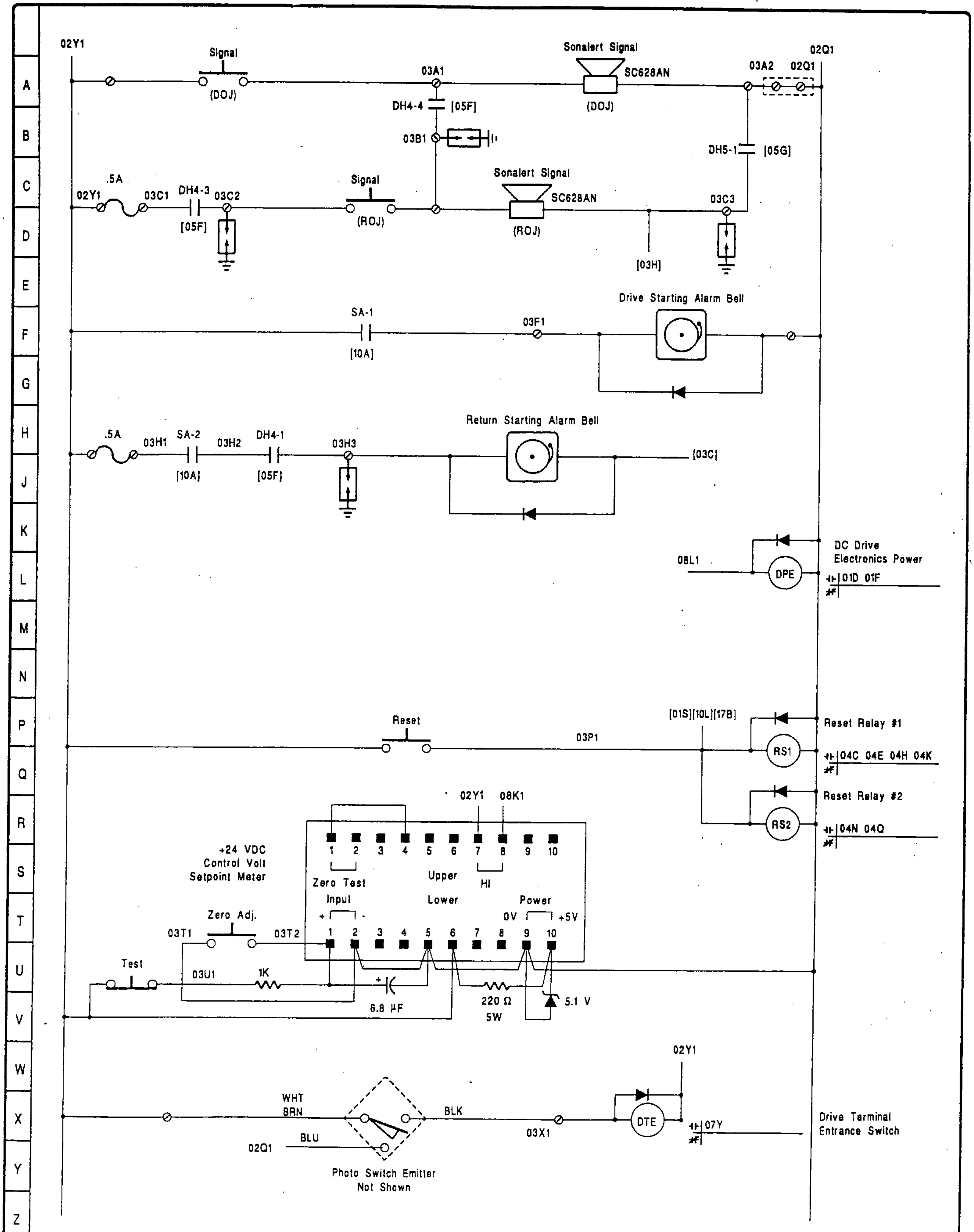

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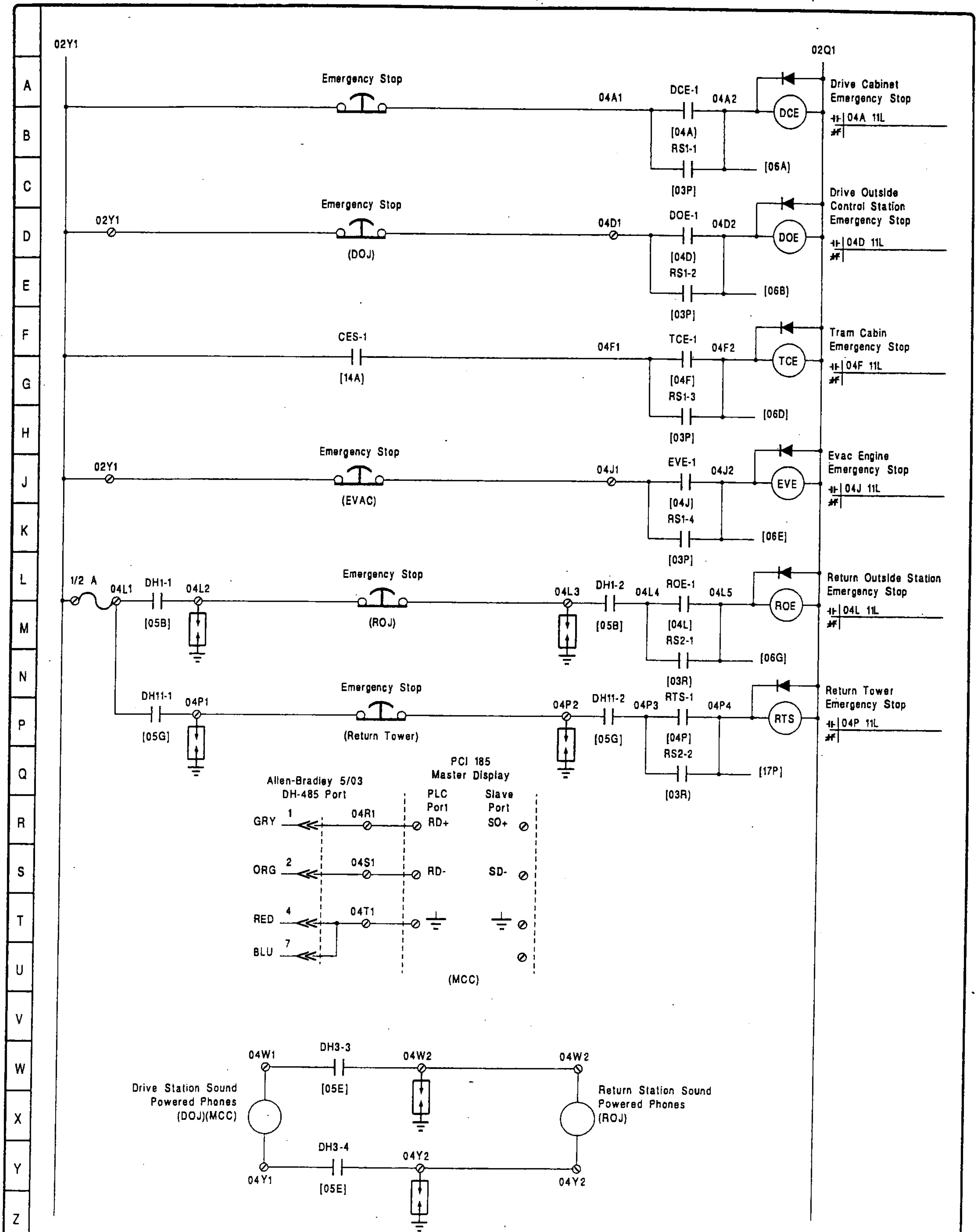

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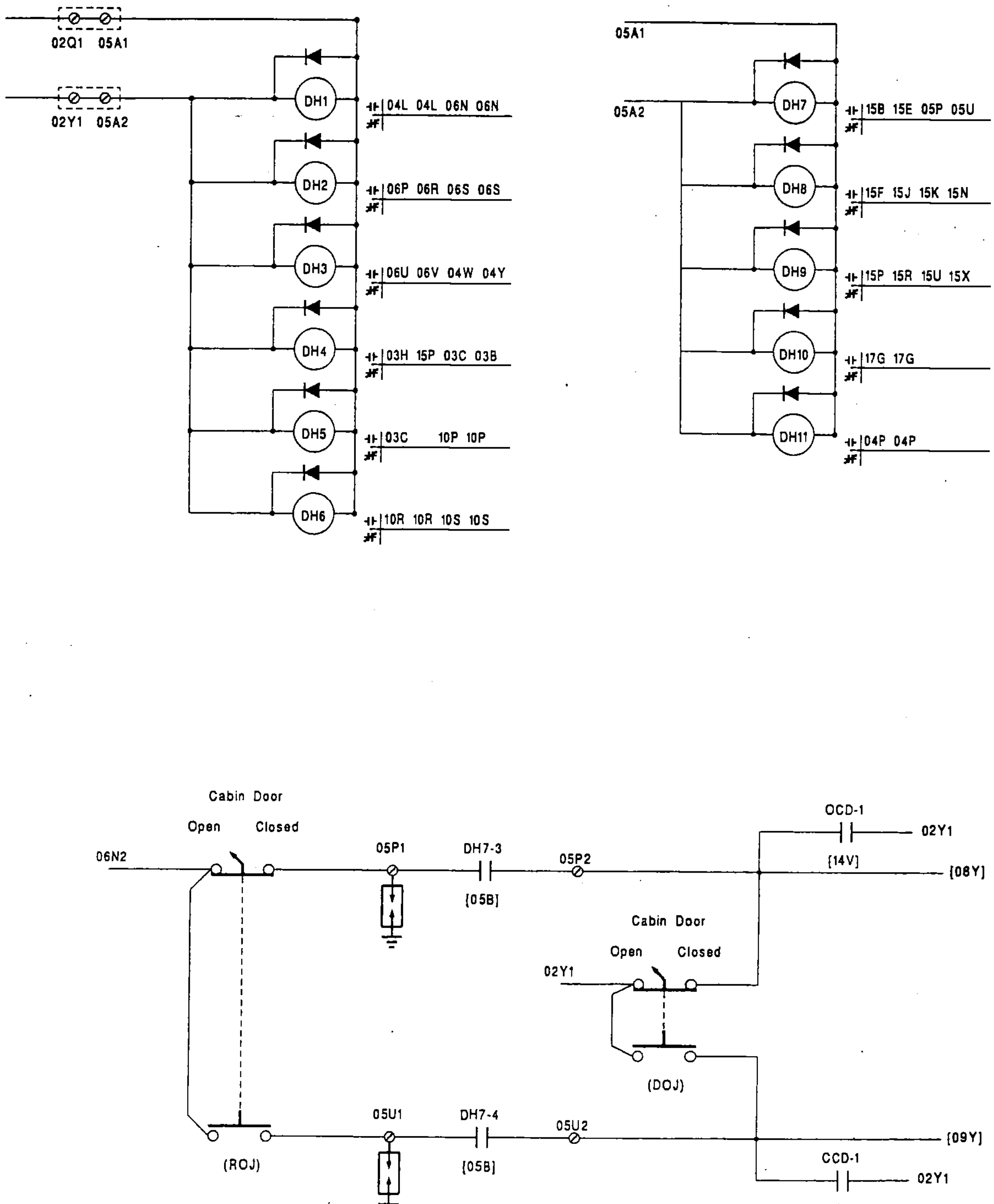

Cabin Door Switches

	Top Contact	Bottom Contact
Left Or "Open" Position	Closed	Open
Right Or "Closed" Position	Open	Closed
Up (Neither)	Open	Open

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Grand Junction, CO. 81505

Pacoima Tram
Los Angeles, CA.

Lightning Protection
Isolation Relays

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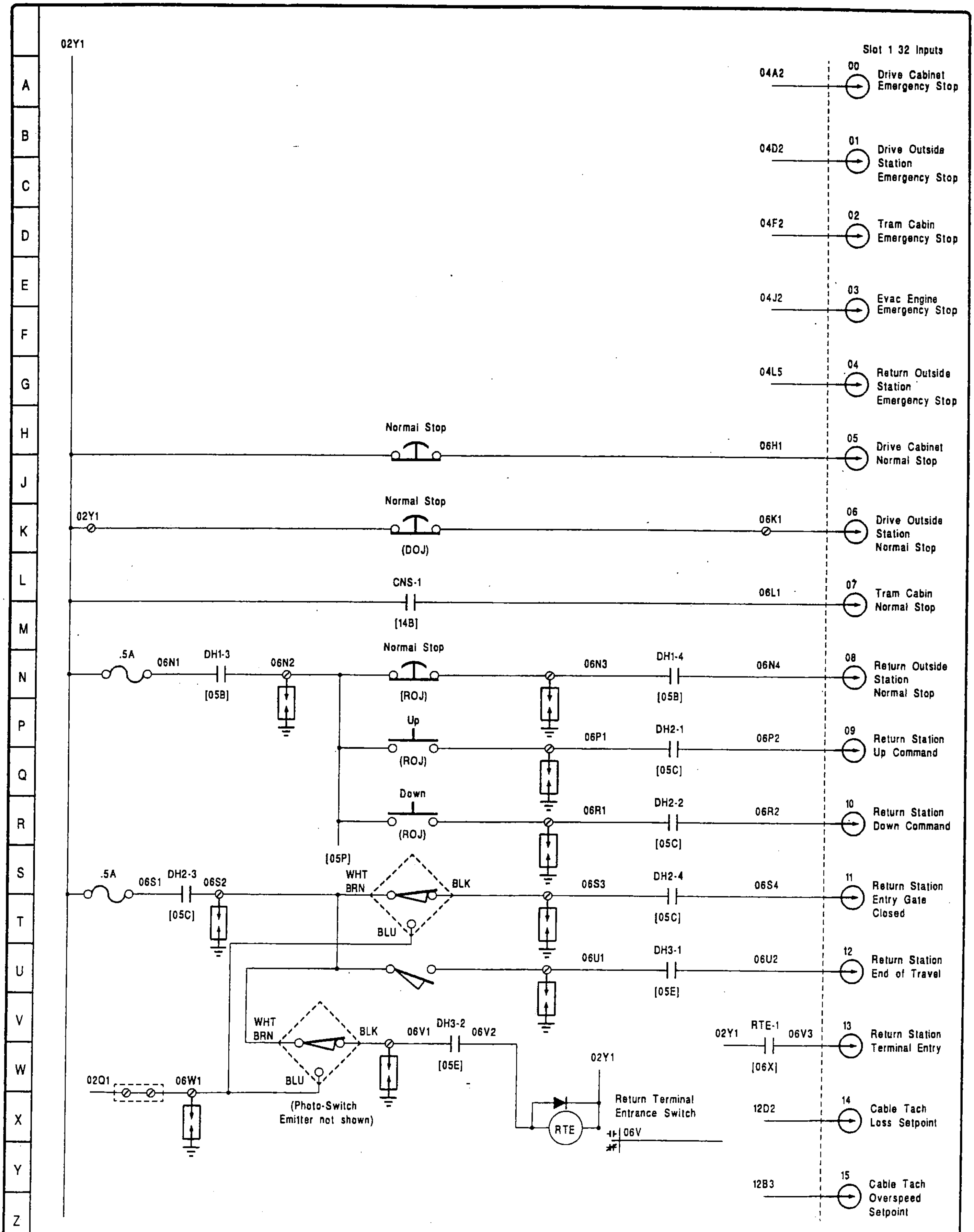

POMA of America, Inc.
2510 Foresight Circle
Grand Junction, CO. 81505

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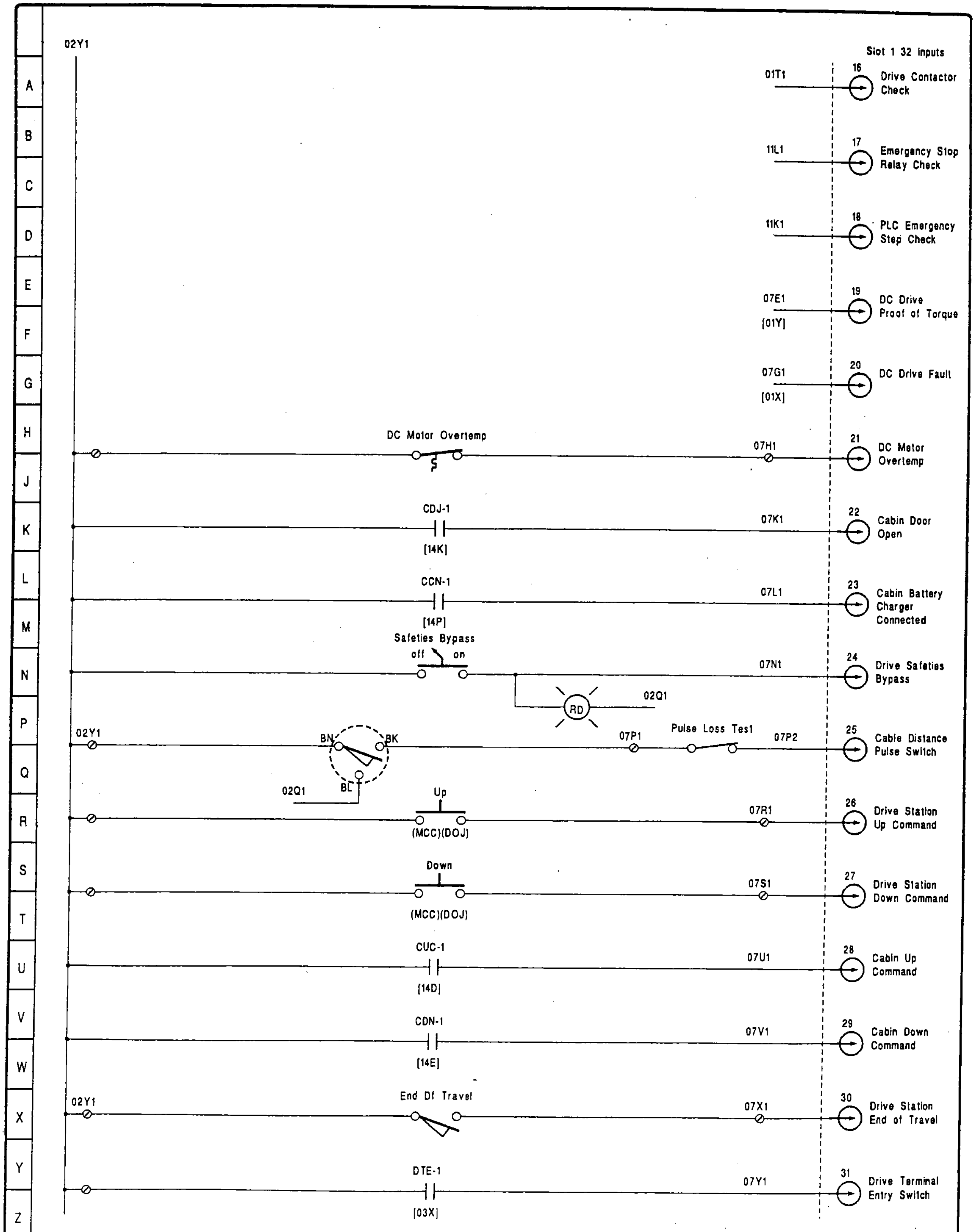

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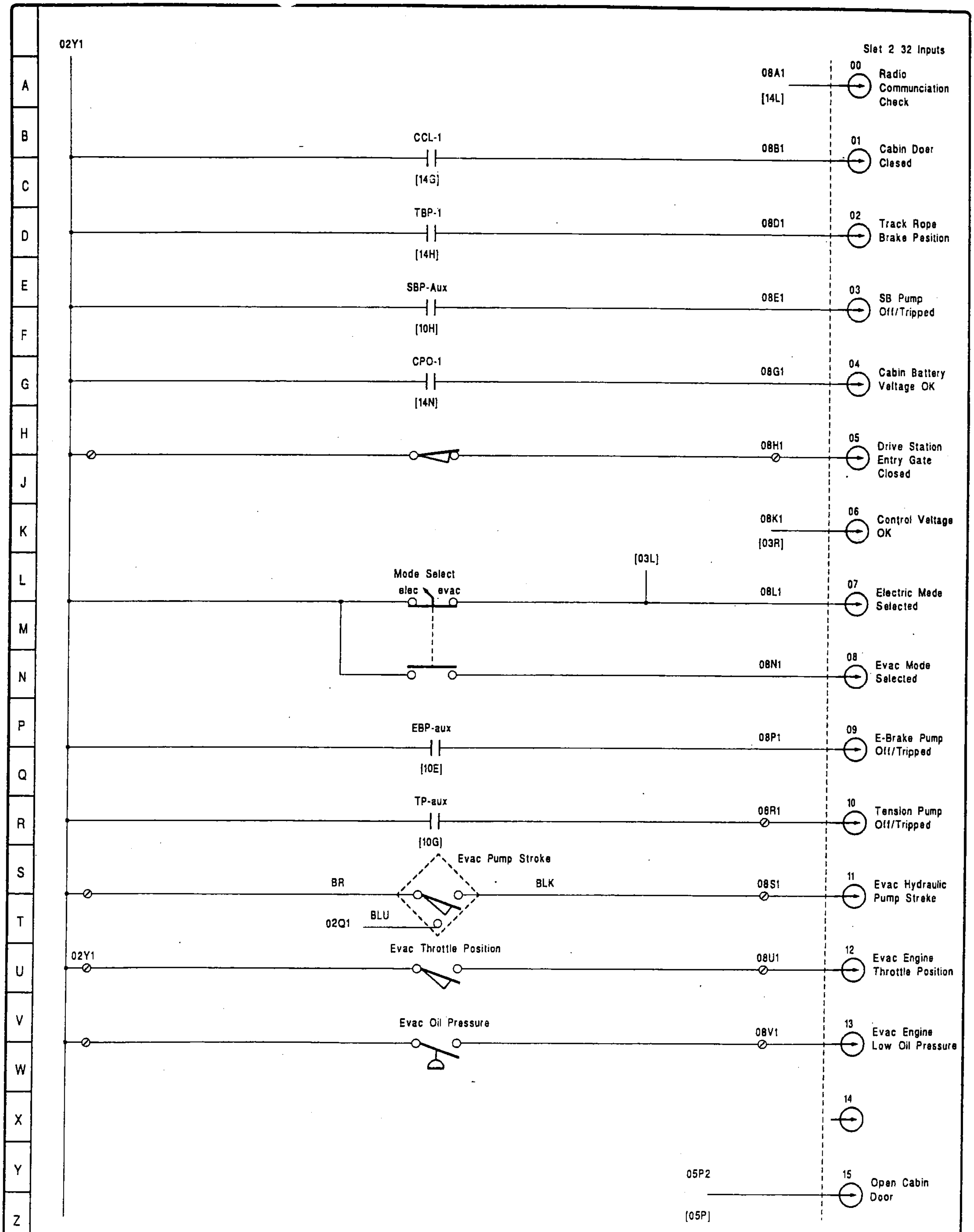

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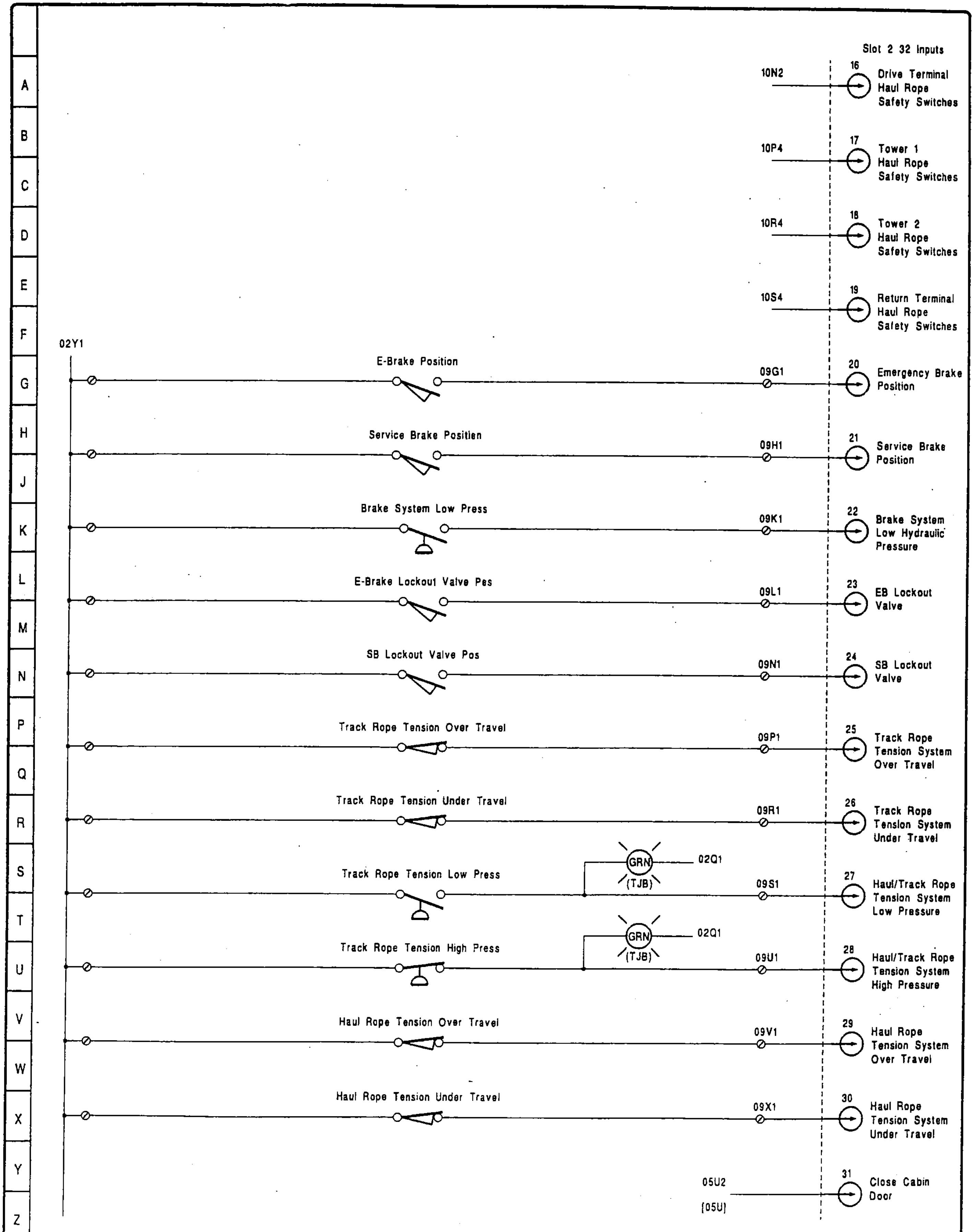

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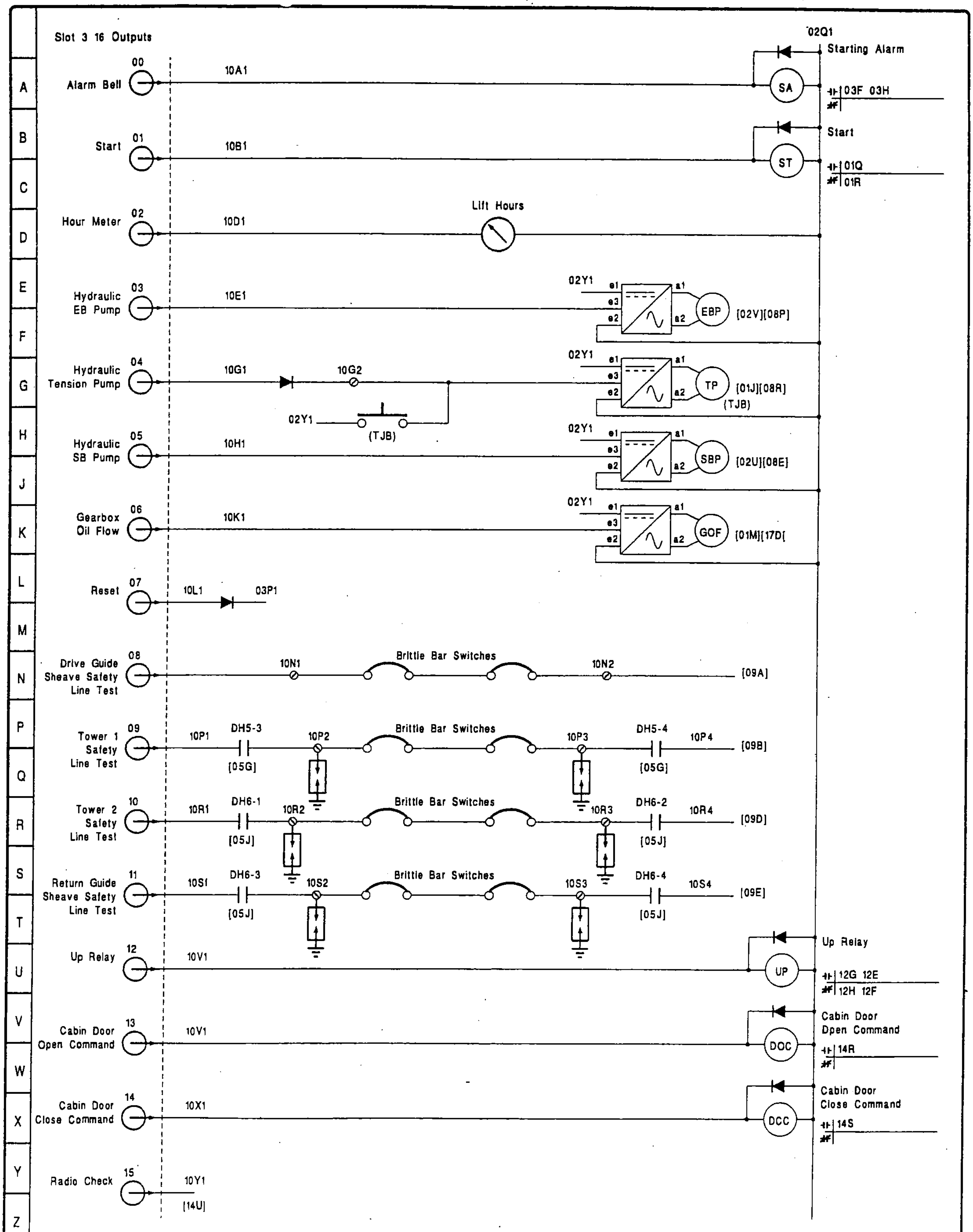

POMA of America, Inc.
2510 Foresight Circle
Grand Junction, CO. 81505

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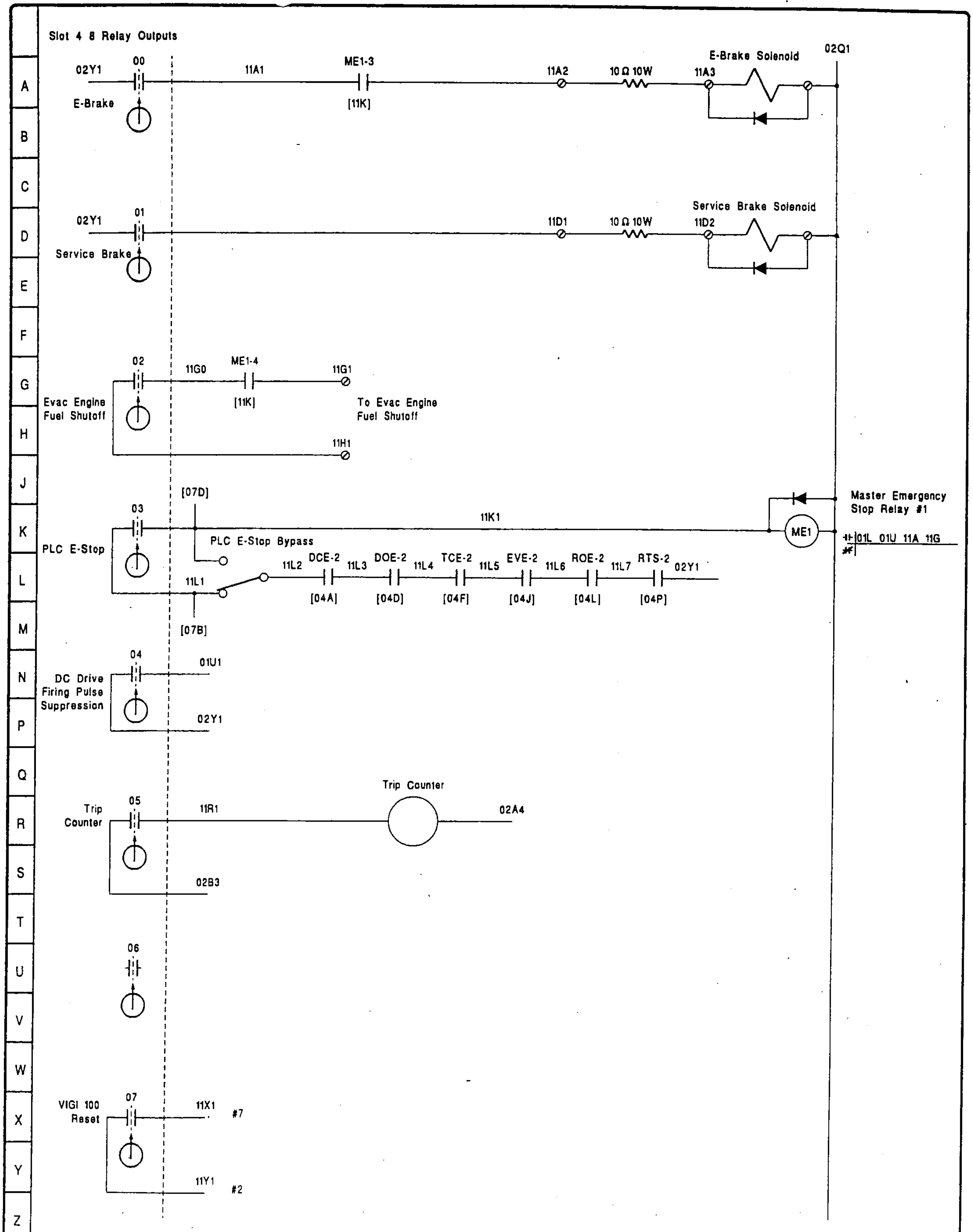

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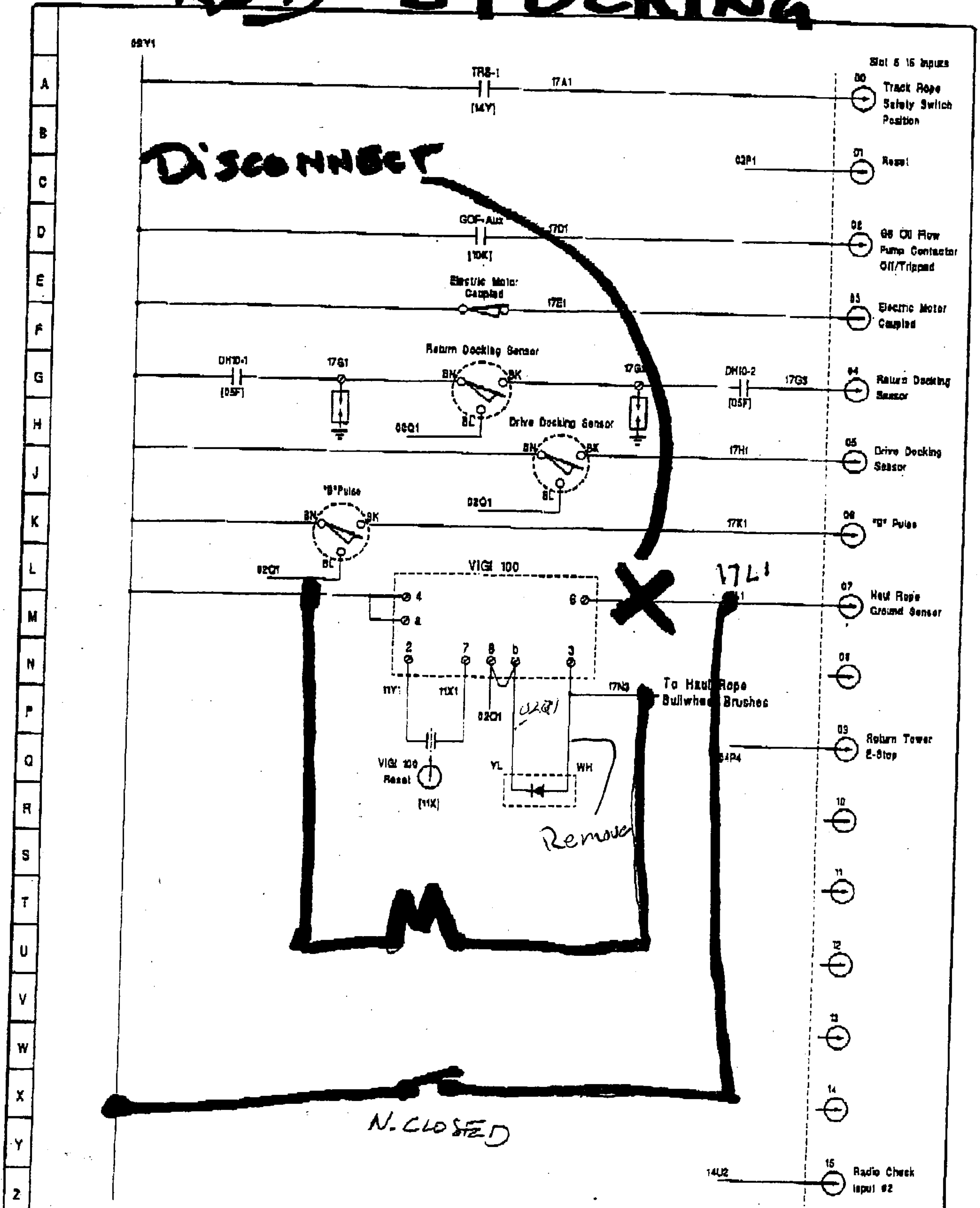
RED STOCKING



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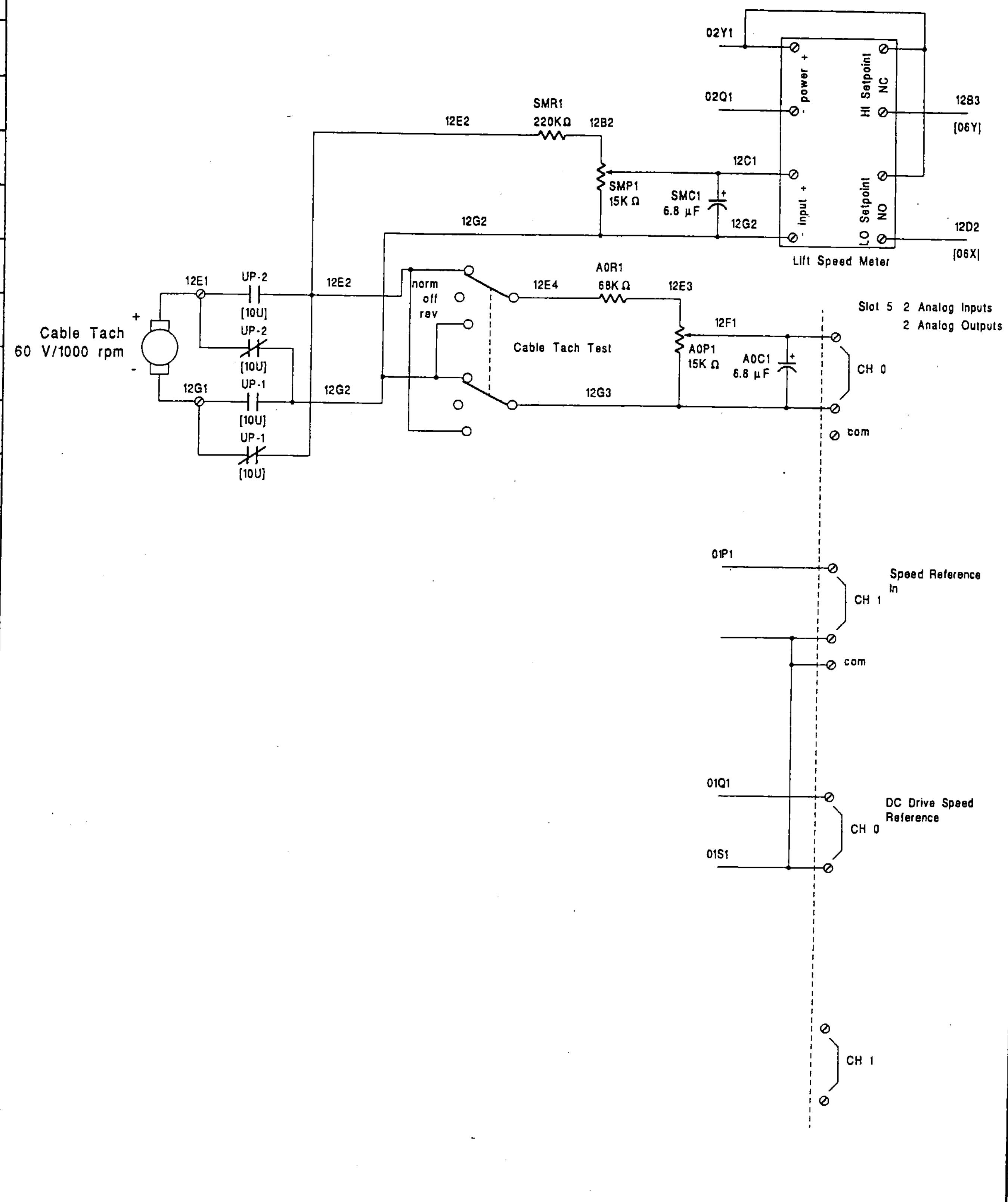

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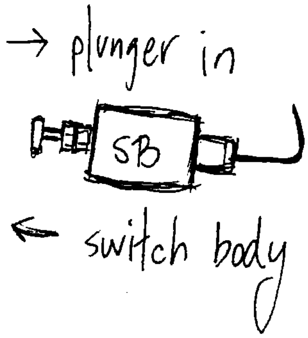
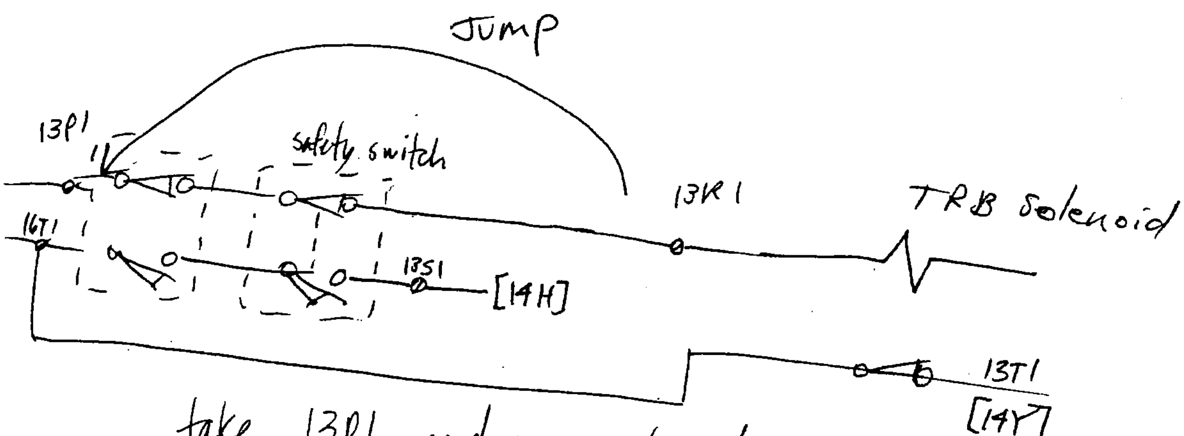
Slot 2

input 21 serv. bk. pos.

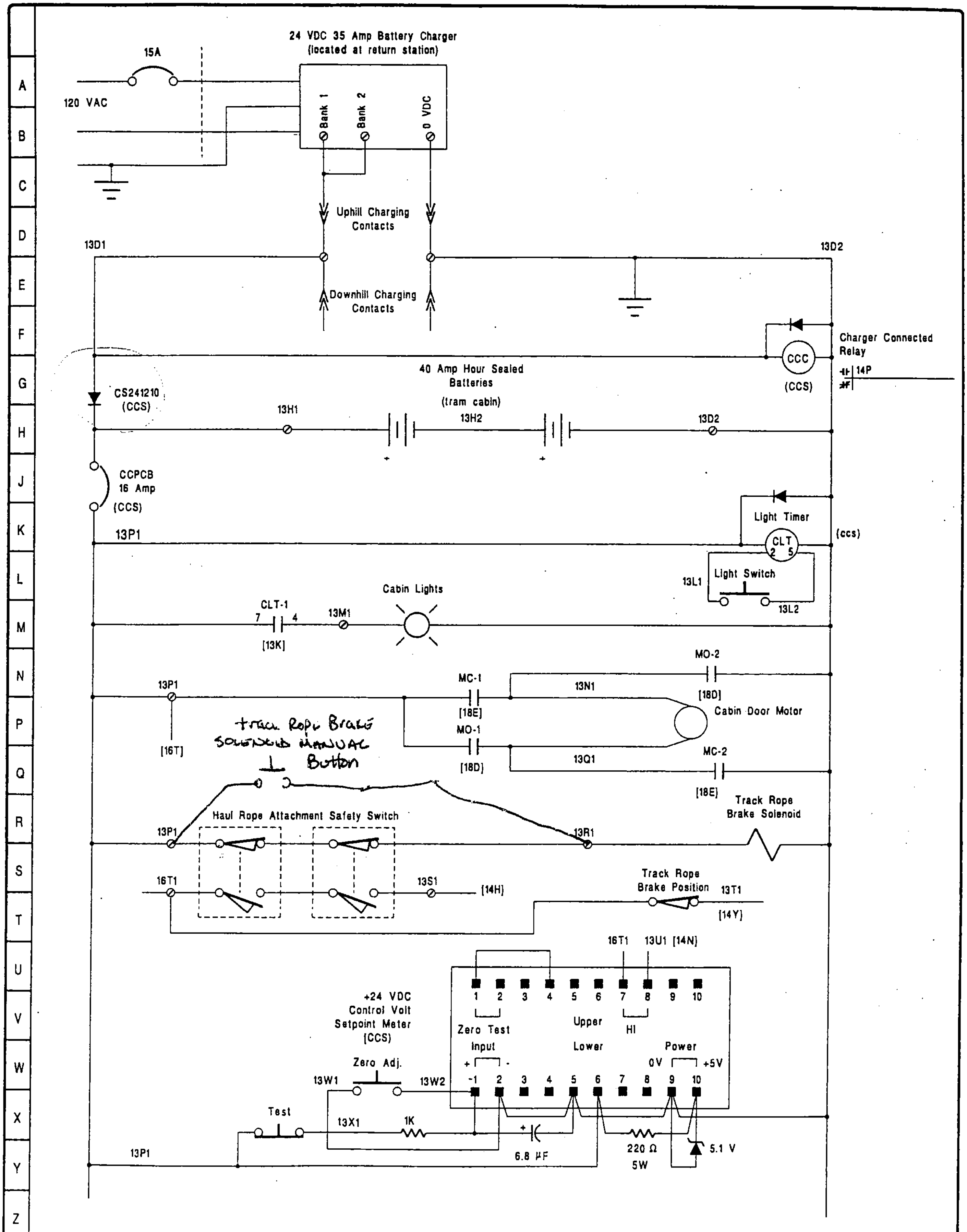
#145





take 13R1 and connect w/ 13P1

13R1 not labeled



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2510 Foresight Circle
Grand Junction, CO. 81505

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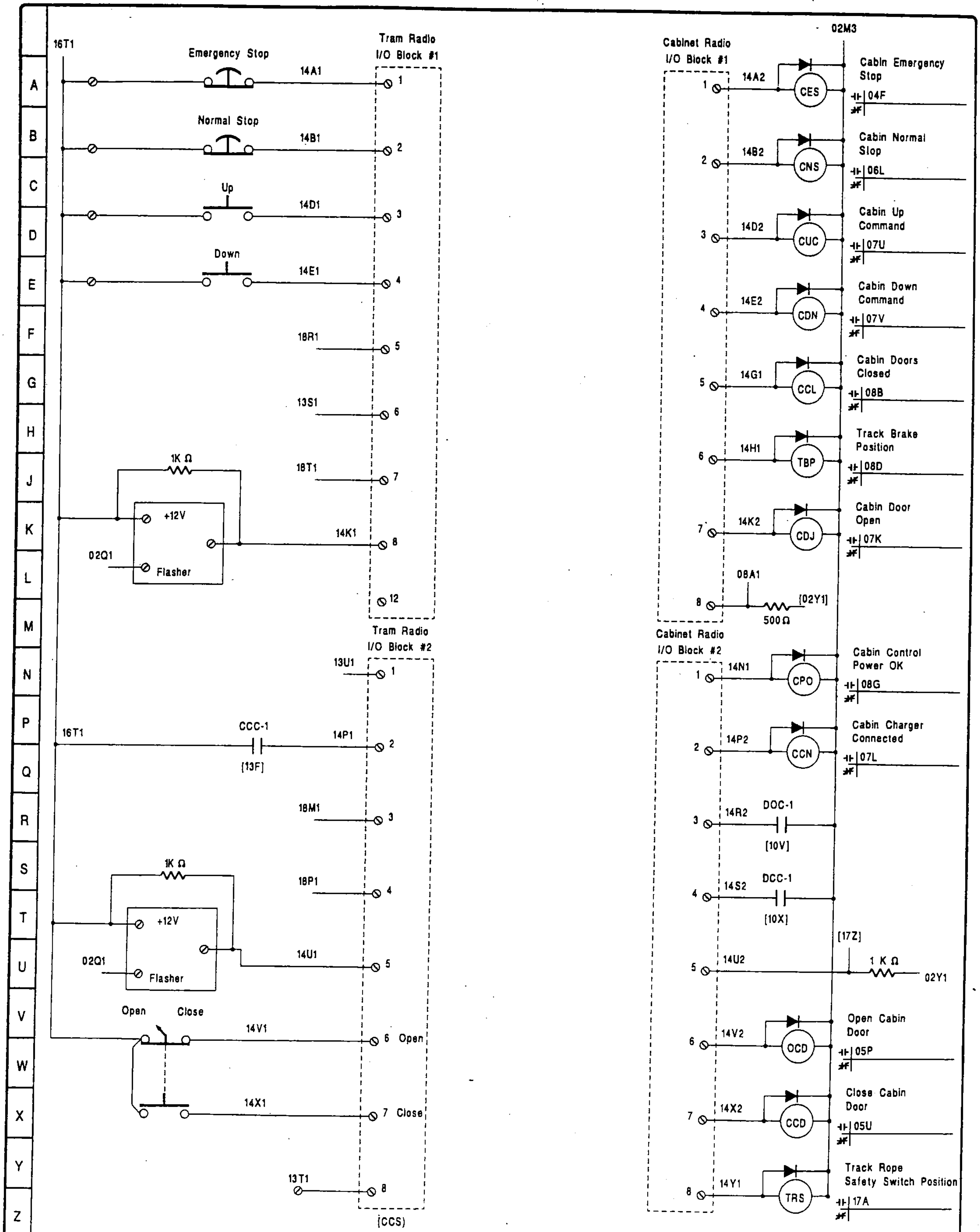

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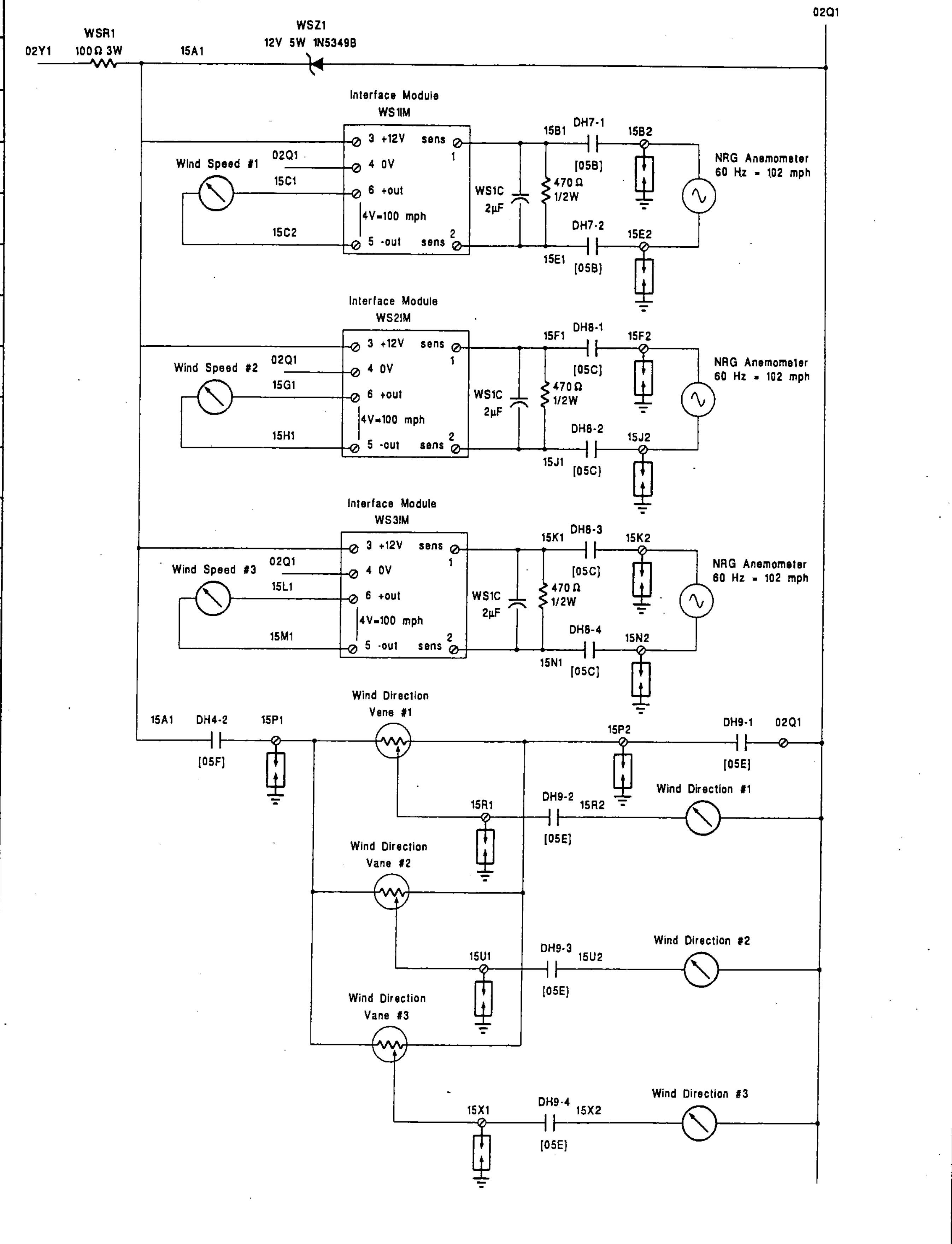

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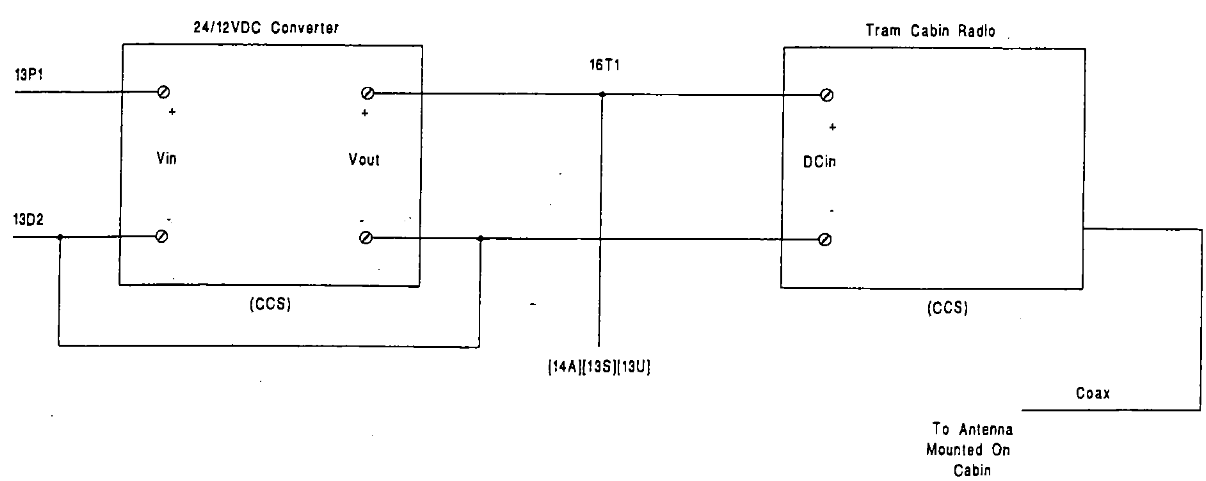

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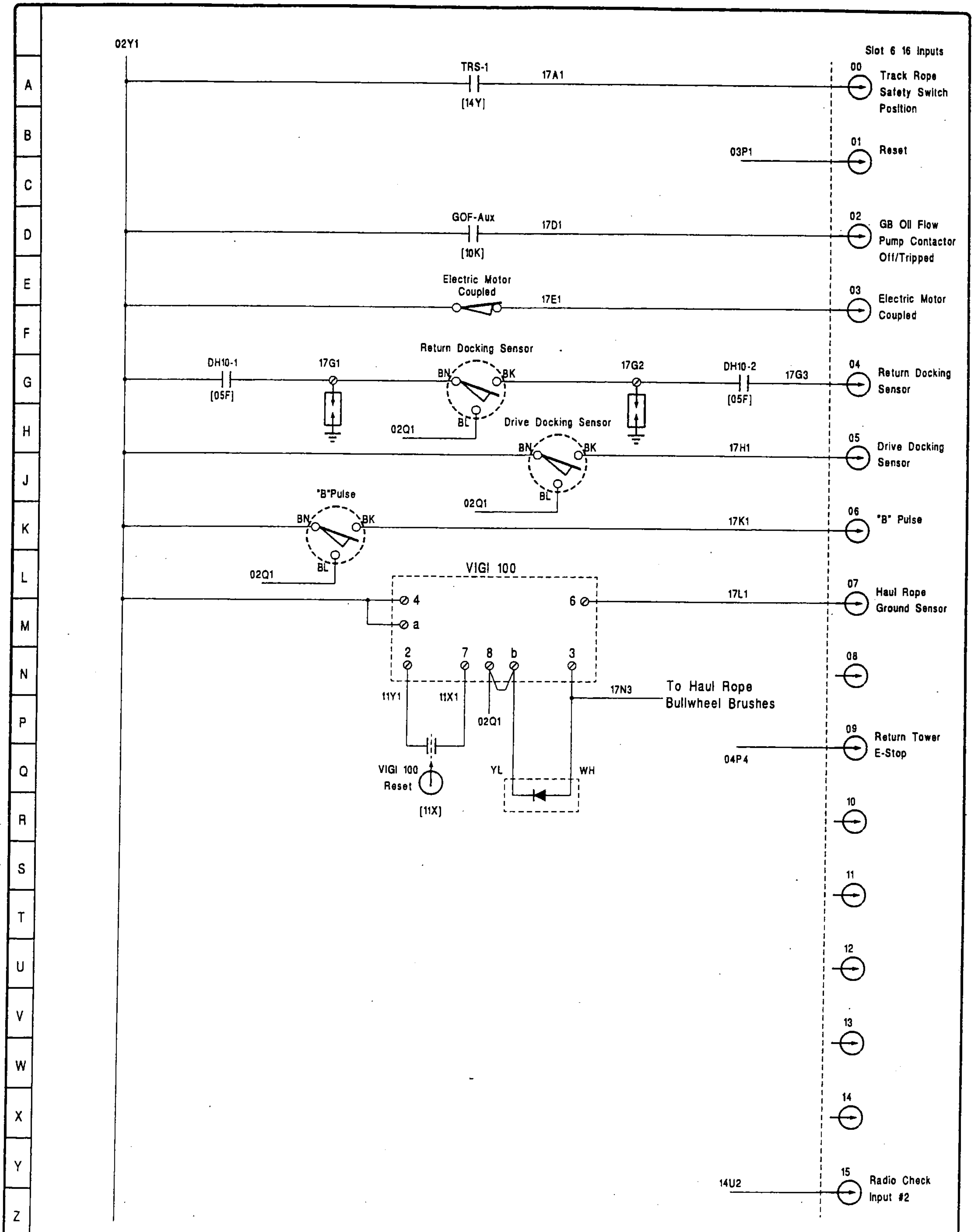

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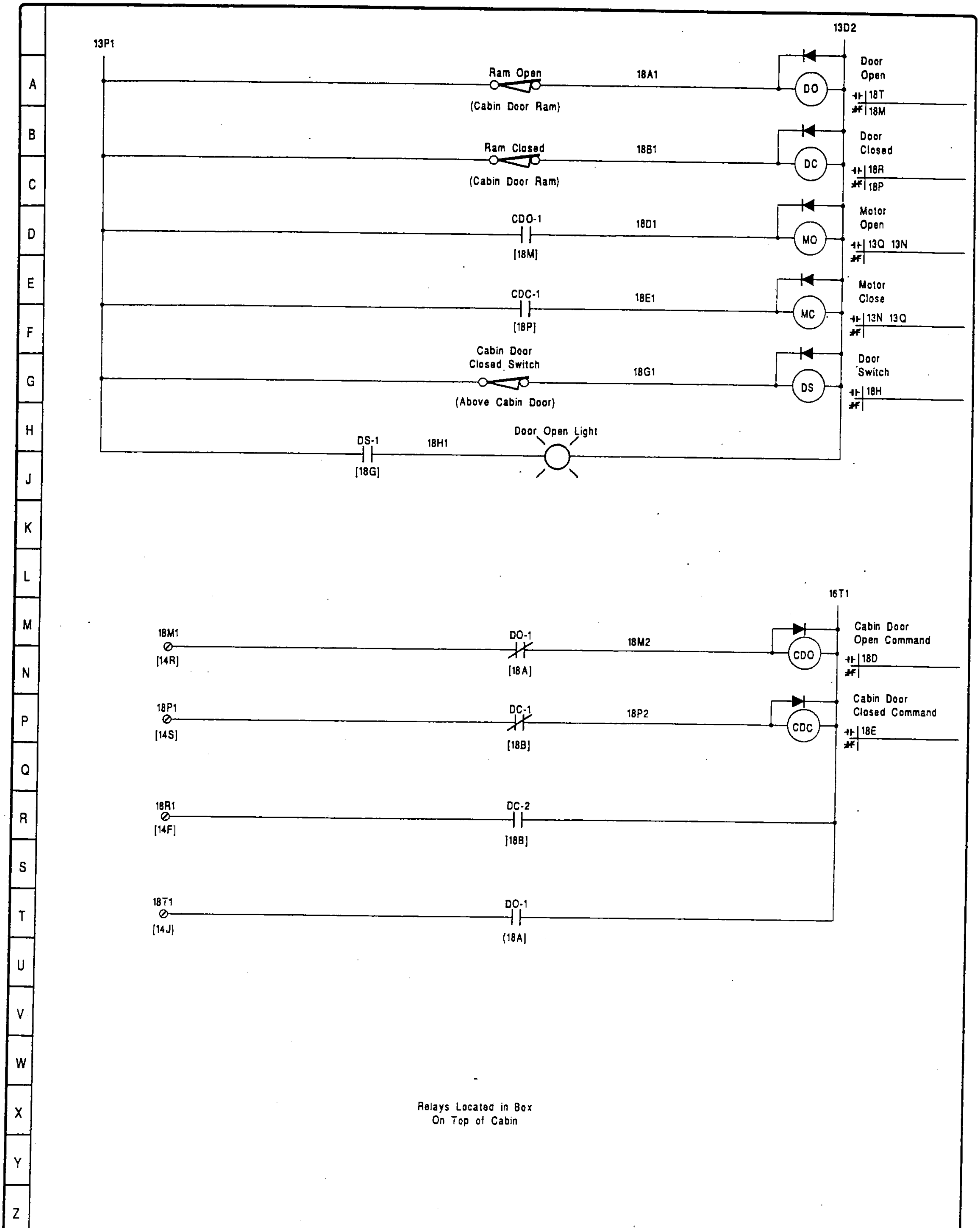

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Section 16

ELECTRICAL SYSTEM

Section 17

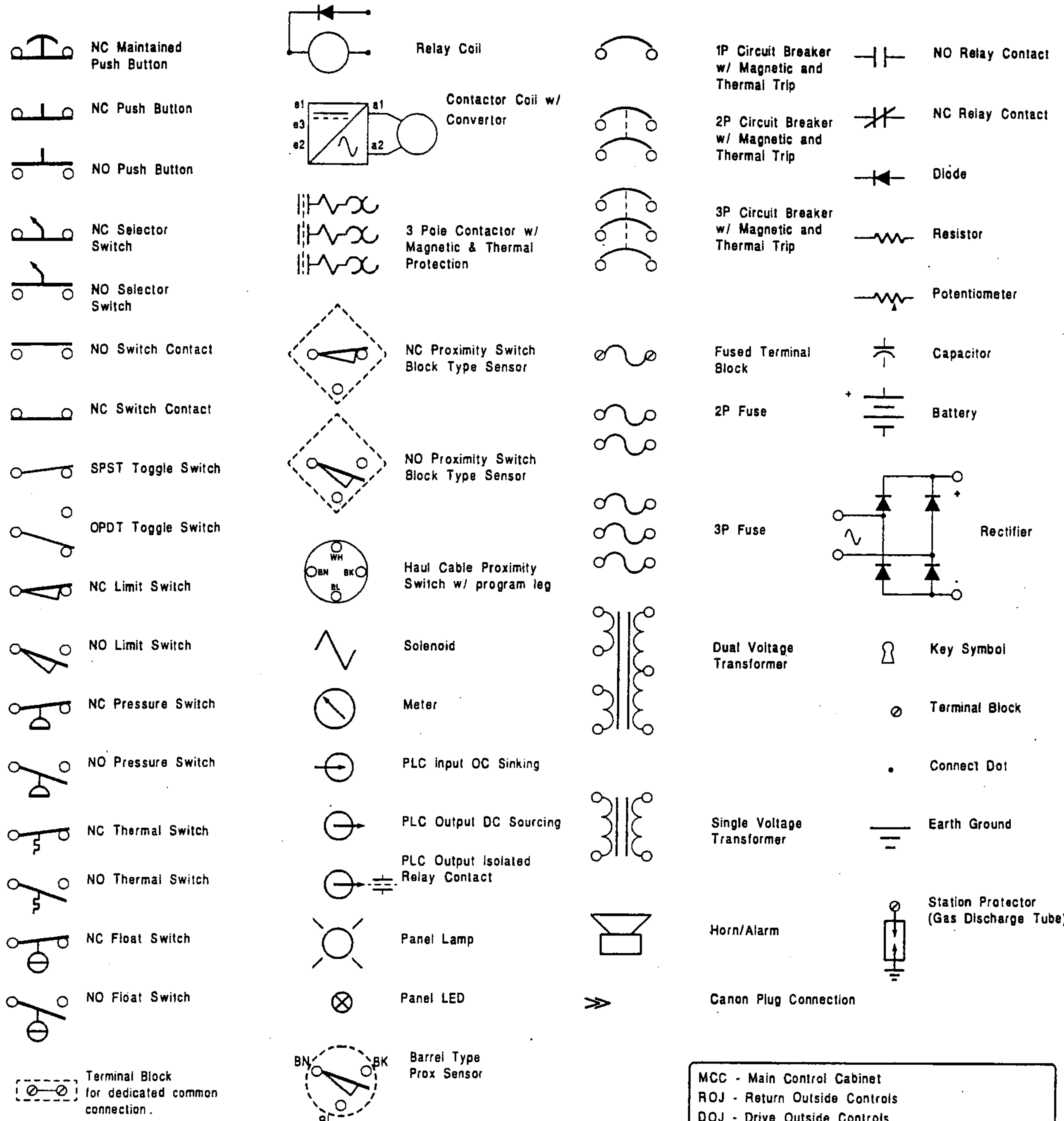
ELECTRICAL SCHEMATICS

POMA

Bottom Drive Tram
35 HP @ 1750 RPM
400 FPM
Lift Installation 1999

Pacoima Tram
Los Angeles, CA

Electrical Schematics
Dwg. 5.290.171 January 3, 2000



MCC - Main Control Cabinet
ROJ - Return Outside Controls
DOJ - Drive Outside Controls
CCS - Cabin Control Station
TJB - Tension J-Box

Notes:
1. All diodes 1N4004 or 1N4007 unless otherwise noted.
2. Blue wire indicates +24 VDC control circuits.
3. Red/White wire indicates 120/240 VAC circuits.
4. Black wire indicates 480 VAC or over 50 VDC circuits.
5. Wire numbers are given in the format PPRC where PP refers to the page number, R refers to the row and C refers to the column.
6. Characters appearing in parentheses refer to a physical location cross reference. e.g. - (DIC) would indicate the component is located at the Drive Inside Control desk. If a component does not have a physical location cross-reference, it is located in the MCC (main control cabinet).
7. Characters appearing in square brackets refer to a drawing cross reference. e.g. - [11A] indicates the component also has connections appearing on page 11, row A.
8. This drawing and its design are proprietary to Poma of America, Inc. Use of this design, or copying this drawing without permission from Poma is prohibited.

POMA of America, Inc. 2510 Foresight Circle Grand Junction, CO. 81505	Pacoima Tram Los Angeles, CA.	Notes and Drawing Symbols	Dwg: 5.290.171	by: SLA	Date: 1/3/00
			file: pacoima.gcd	rev:	page II of VI

Slot 1 32 Inputs Address I:1/0-31

00	Drive Cabinet Emergency Stop
	Drive Outside Station Emergency Stop
	Cabin E-Stop
	Evac Engine E-Stop
	Return Station E-Stop
	Drive Cabinet N-Stop
	Drive Outside Station N-Stop
	Cabin N-Stop
	Return Station N-Stop
	Return Station Up Command
	Return Station Down Command
	Return Station Entry Gate Closed
	Return Station End of Travel
	Return Station Terminal Entry
	Cable Tach Loss
15	Cable Tach Overspeed

Slot 1 (continued)

16	Main Contactor Check
	E-Stop Relay Check
	PLC E-Stop Check
	DC Drive Proof of Torque
	DC Drive Fault
	DC Motor Overtemp
	Cabin Door Open
	Cabin Battery Charger Connected
	Drive Safeties Bypass
	Cable Distance Pulse Switch
	Drive Up Command
	Drive Down Command
	Cabin Up Command
	Cabin Down Command
	Drive Station End of Travel
31	Drive Station Terminal Entry

Slot 2 32 Inputs Address I:2/0-31

00	Radio Communications OK
	Cabin Door Closed
	Track Rope Brake Position
	Service Brake Contactor
	Cabin Battery Voltage OK
	Drive Entry Gate Closed
	Control Voltage OK
	Electric Mode Selected
	Evac Mode Selected
	Hydraulic Brake Pump Off/Tripped
	Hydraulic Tension Pump Off/Tripped
	Evac Hydraulic Pump Stroke
	Evac Engine Throttle
	Evac Low Oil Pressure
15	Open Cabin Door

Slot 2 (continued)

16	Drive Terminal Safety Switches
	Tower 1 Safety Switches
	Tower 2 Safety Switches
	Return Terminal Safety Switches
	Emergency Brake Position
	Service Brake Position
	Brake System Low Hydraulic Pressure
	EB Lockout Valve
	SB Lockout Valve
	Track Rope Tension Overtravel Limit
	Track Rope Tension Undertravel Limit
	Haul/Track Rope Tension Low Pressure
	Haul/Track Rope Tension High Pressure
	Haul Rope Tension Overtravel Limit
	Haul Rope Tension Undertravel Limit
31	Close Cabin Door

Slot 3 16 Outputs Address O:3/0-15

00	Starting Alarm Signal
	Start Relay
	Hour Meter
	Hydraulic Brake Pump ON
	Hydraulic Tension Pump ON
	Hydraulic Service Brake Pump
	Gearbox Oil Flow
	Reset Relay
	Drive Guide Sheave Safety Line Check
	Tower 1 Safety Line Check
	Tower 2 Safety Line Check
	Return Guide Sheave Safety Line Check
	UP Relay
	Cabin Door Open Command
	Cabin Door Close Command
15	Radio Communication Check

Slot 4 8 Isolated Relay Address O:4/0-7

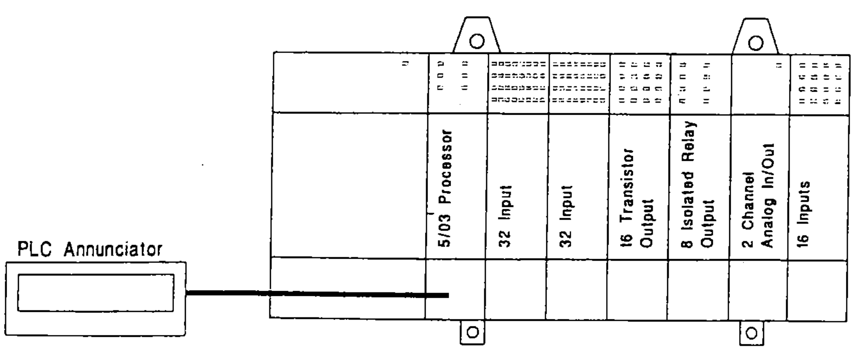
00	Emergency Brake Solenoid
	Service Brake Solenoid
	Evac Fuel Shutoff
	PLC Emergency Stop
	DC Drive Regulator Blocking
	Trip Counter
07	VIGI 100

Slot 5 2 Channel Analog Input/Output

CH0 In	Cable Speed
CH1 In	Speed Reference In
CH0 Out	Speed Reference Out
CH1 Out	

Slot 6 16 Outputs Address I:6/0-15

00	Track Rope Safety Switch Position
	Reset
	Gearbox Oil Flow Pump Cntctr Check
	Electric Motor Coupled
	Return Docking Sensor
	Drive Docking Sensor
	"B" Pulses
	Haul Rope Ground Sensor
	Return Tower E-Stop
15	Radio Communications Input Check #2



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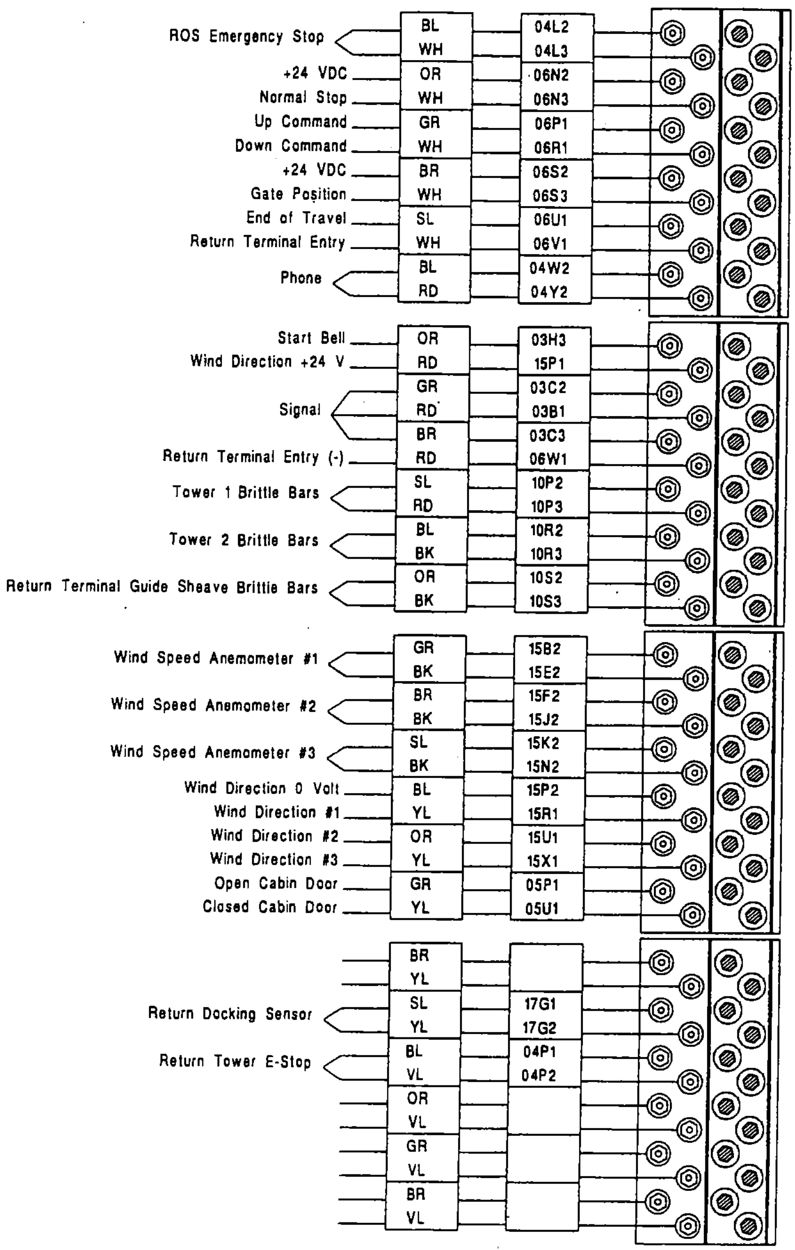
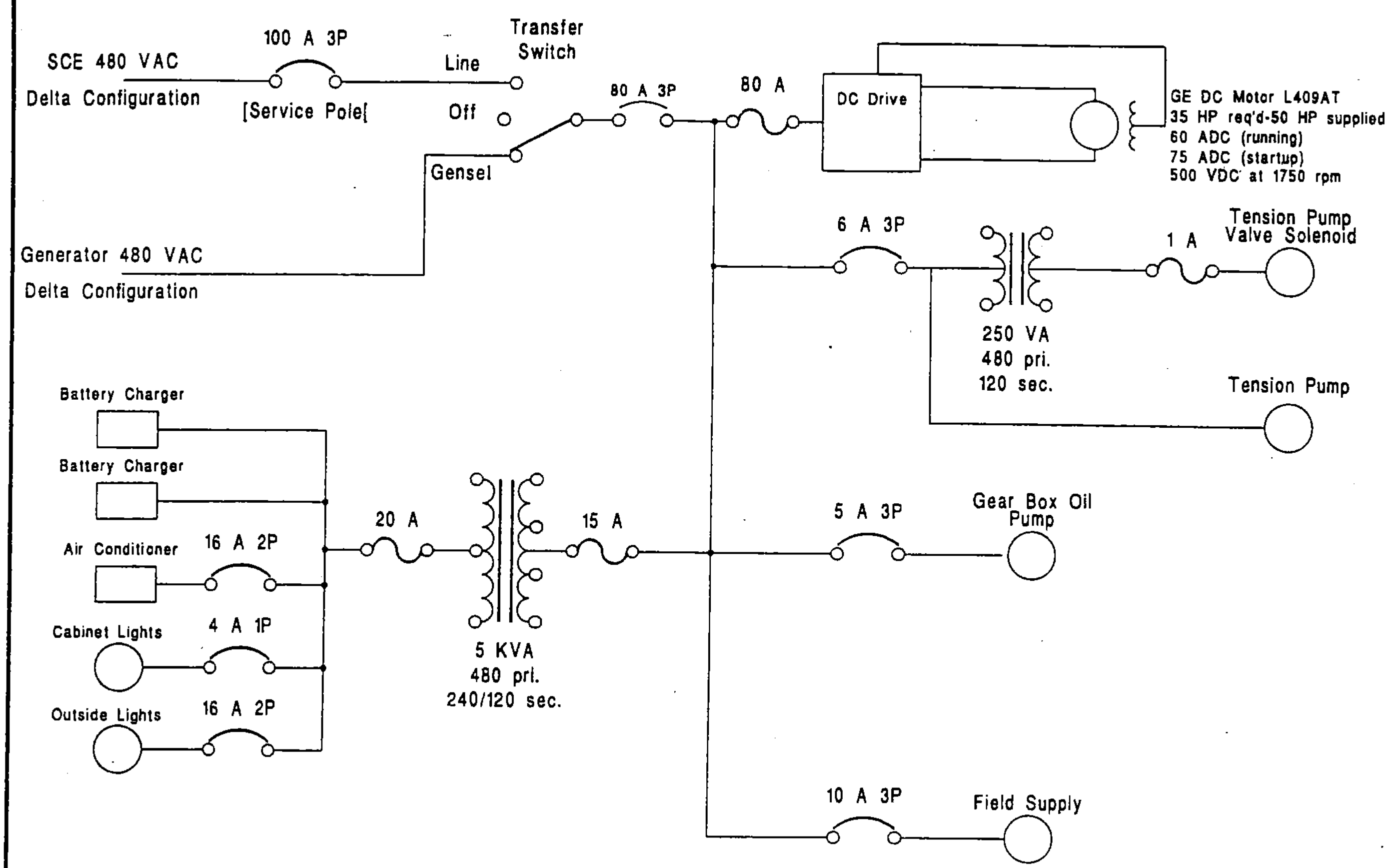
			file: pacoima.gcd	rev:	page III of VI



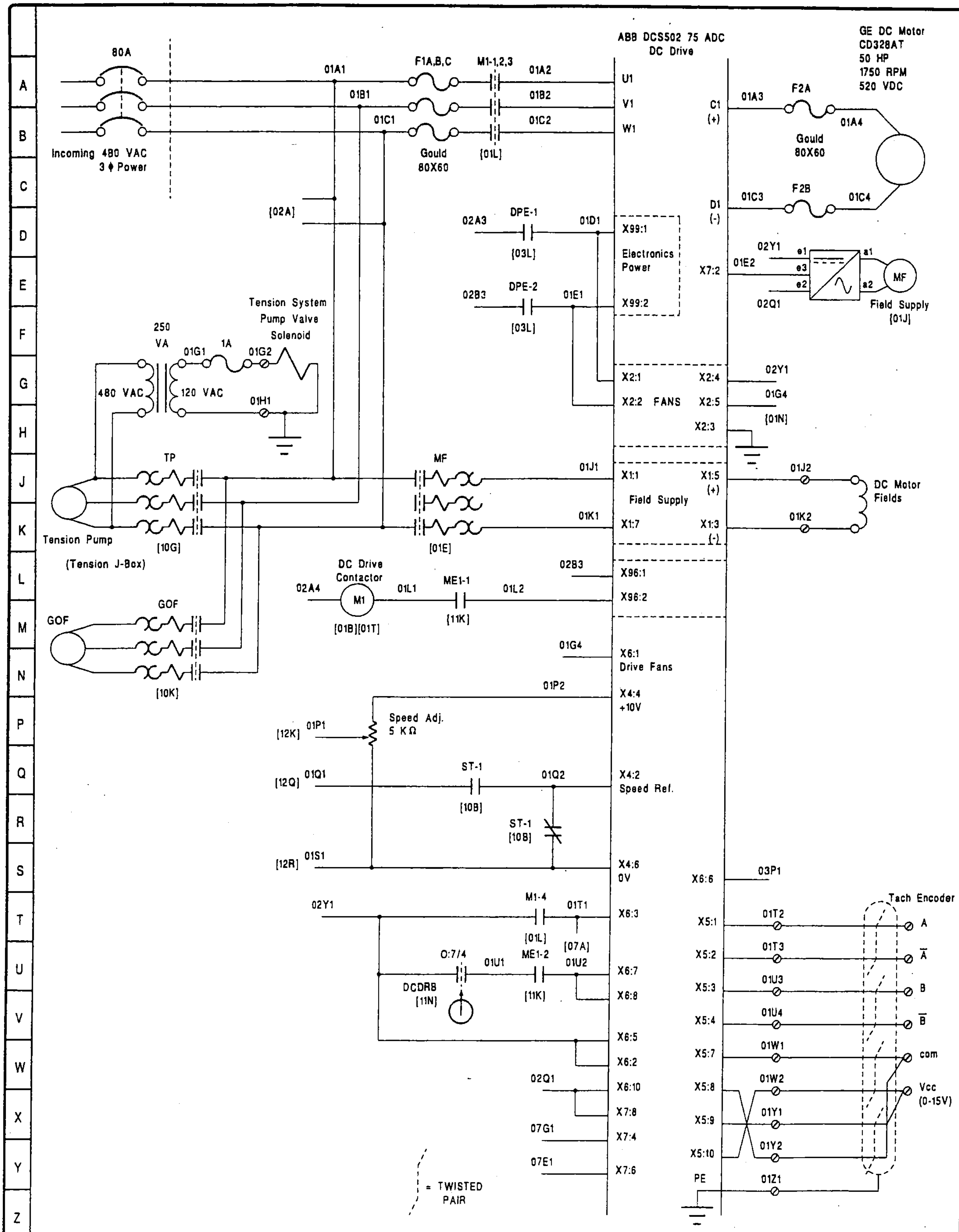
POMA of America, Inc. 2510 Foresight Circle Grand Junction, CO 81505	Pacoima Tram Los Angeles, CA.	Comm Line Wire Assignments	Dwg: 5.290.171	by: SLA	Date: 1/3/00
			file: pacoima.gcd	rev:	page IV of VI

Drive Station Electrical Power Oneline



POMA of America, Inc. 2510 Foresight Circle Grand Junction, CO. 81505	Pacoima Tram Los Angeles, CA.	Power Onelines	Dwg: 5.290.171 / file: pacoima.gcd	by: SLA / rev:	Date: 1/3/00 / page V of VI

	Description	Degree	Time
P1	Cooling ON	85°	
P2	Cooling OFF	70°	
P3	Heat OFF	50°	
P4	Heat ON	32°	
P9	Over Temperature Alarm	110°	
P10	Under Temperature Alarm	32°	
P11	Compressure Recycle Time Delay		60 sec
P12	Over Temperature Alarm Delay		05 sec
P13	Under Temperature Alarm Delay		05 sec



POMA of America, Inc. 2510 Foresight Circle Grand Junction, CO. 81505	Pacoima Tram Los Angeles, CA.	DC Drive Connections	Dwg: 5.290.171	by: SLA	Date: 1/3/00
			file: pacoima.gcd	rev:	page 01 of 18

Section 18

METRIC SYSTEM CONVERSION TABLE

Metric System Conversion Table

Our goal: to help make the metric system easy to understand for daily use.

DEGREES

Conversion °C to °F

- Subtract 2
- Multiply by 2
- Add 30

Example: 27°C
27-2 = 25
25x2 = 50
50+30 = 80°F

Conversion °F to °C

- Subtract 30
- Divide by 2
- Add 2

Example: 80°F
80-30 = 50
50÷2 = 25
25+2 = 27°C

DISTANCES

1 yard — 1 meter

3 feet — 1 meter (10 cm x 10)

4 inches — 10 cm

1 inch — 2.5 cm

1 hectare = 1000 square meters

1 mile — 1.6 kilometer (1600) meters

0.60 mile — 1 kilometer

Quick conversion miles to kilometers

- Take the figure of tens
- Multiply by 6
- Add to number of miles to convert

Example:

90 miles	9x6	= 54
	90+54	= 144 km
110 miles	11x6	= 66
	110+66	= 176 km

Quick conversion kilometer to miles

- Divide kilometers by 3
- Multiply by 2

Example:

96 kms	96÷3	= 32
	32x2	= 64 miles

FORCE UNITS

Kilograms as a force (weight unit - not exactly correct really a mass unit)
1 Tonne = 1000 kg
1 Kg = 2.205 lbs.

Deca Newtons as a force - this is the true metric force
1 DaN = 2.248 lbs
therefore 1 DaN = 1.0196 kg

PRESSURE UNITS

1 bar = 1 DaN / cm² = 14.5 lbs / in²

STRESS UNITS

lbs / in² 1422.58 = kg / mm²

WEIGHT

Quick conversion: lbs. to kilograms

- Divide by 2
- Subtract 10%

Example: 180 lbs.
180÷2 = 90 kg
90-10% = 90-9 = 81 kg

kilograms to lbs.

- Multiply by 2
- Add 10%

Example: 120 kilograms
120x2 = 240 kg
240 + 10 % = 240 + 24 = 264 lb

EXACT EQUIVALENCES

1 square inch	=	6.452 square centimeters
1 square foot	=	0.093 square meter
1 square yard	=	0.836 square meter
1 acre	=	0.405 hectare *
1 square mile	=	259.0 hectare
1 square mile	=	2.590 square kilometers
1 square centimeter	=	0.155 square inch
1 square meter	=	10.76 square feet
1 square meter	=	1.196 square yard
1 hectare	=	2.471 acres
1 square kilometer	=	0.386 square mile

EXACT EQUIVALENCES

IMPERIAL		METRIC
1 inch	=	2.540 centimeters
1 foot	=	0.3048 meter
1 yard	=	0.9144 meter
1 rod	=	5.029 meters
1 mile	=	1.609 kilometers

METRIC		IMPERIAL
1 centimeter	=	0.3937 inch
1 decimeter	=	0.3281 foot
1 meter	=	(3.281 feet)
1 meter	=	1.094 yard
1 decameter	=	10.94 yards
1 kilometer	=	0.6214 mile

IMPERIAL

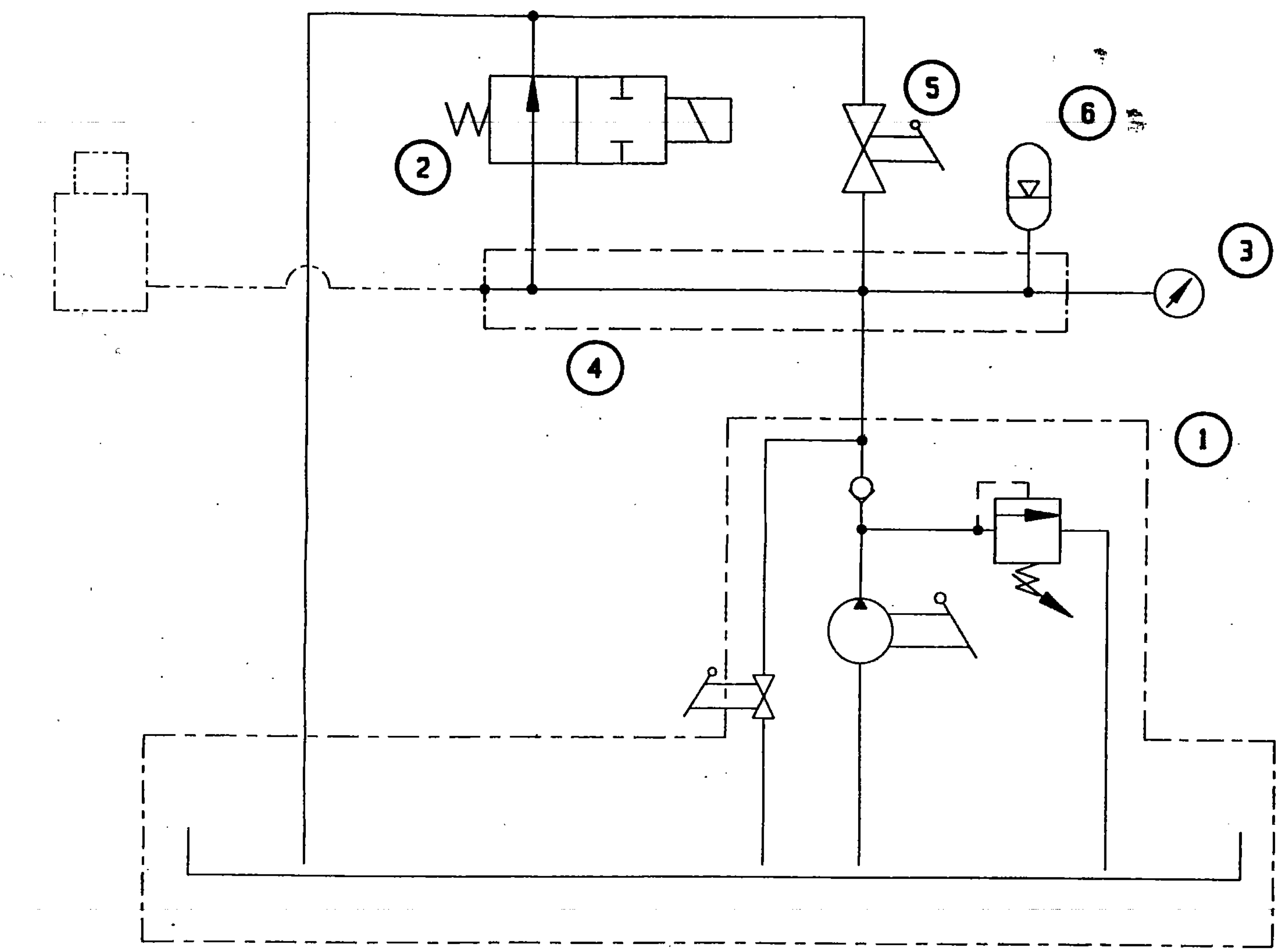
1 pint	=	0.568 liter
1 quart	=	1.137 liter
1 gallon	=	4.546 liters
1 bushel	=	36.369 liters
1 liter	=	0.880 quart
1 liter	=	0.220 gallons
1 liter	=	2.750 bushels

U.S.

1 pint (U.S.)	=	0.473 liter
1 quart (U.S.)	=	0.946 liter
1 gallon (U.S.)	=	3.785 liters
1 barrel (U.S.)	=	158.98 liters
1 ounce (avoir)	=	28.350 grams
1 pound (avoir)	=	453.592 grams
1 ton (short)	=	0.907 tonne*
1 ton (long)	=	1.016 tonne*
1 gram	=	0.035 ounce (avoir)
1 kilogram	=	2.205 pounds (avoir)
1 tonne	=	1.102
1 ton (short)	=	1
1 tonne	=	0.984 ton (long)

short ton or USA ton
long ton or U K ton

* 1 tonne = 1000 ilograms



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INDEX	REQ'D	DESCRIPTION	MANUF. PART NUMBER	POMA PART NUMBER
6	1	HYDRAULIC ACCUMULATOR, ENERPAC	WA-510	5300355
5	1	1/4" BALL VALVE, STAUFF	BBV20040001M	5300339
4	1	CUSTOM MANIFOLD	/	/
3	1	PRESSURE GUAGE, LENZ 0-6000 PSI	BAC-6M-25	5300232
2	1	SOLENOID VALVE, HAWE	GS 2-0	1100576
1	1	HAND PUMP, BRAND	HP-22 SA 50	5300356

V	DESCRIPTION OF REVISION	DATE	BY
\	ADDED 1/4" BALL VALVE	04.08.99	NT

QUANTITY:

USED FOR:

DUE DATE:

PRODUCTION USE ONLY

TOLERANCES * UNLESS INDICATED *

* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR .... ±1/2°

* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR .... ±.1°

ERIAL TRAM
2PL

MODEL YEAR 1998

HYDRAULIC PUMP SCHEMATIC

FOR TRACK ROPE BRAKE

TREATMENT: /

TOTAL WT./LBS.: / /

MARKING REQ'D.: /

QTY. REQ'D.: /

MARK LOCATION: /

OTHER REF.: /

ABLE
NSPORT
STEMS

SKILIFTS
CHAIRLIFTS
GONDOLAS
TRAMWAYS

POMA OF AMERICA

GRAND JUNCTION
COLORADO, USA

DRAWN BY: C. SPRAUER

DESIGNED BY: R.J. SMITH

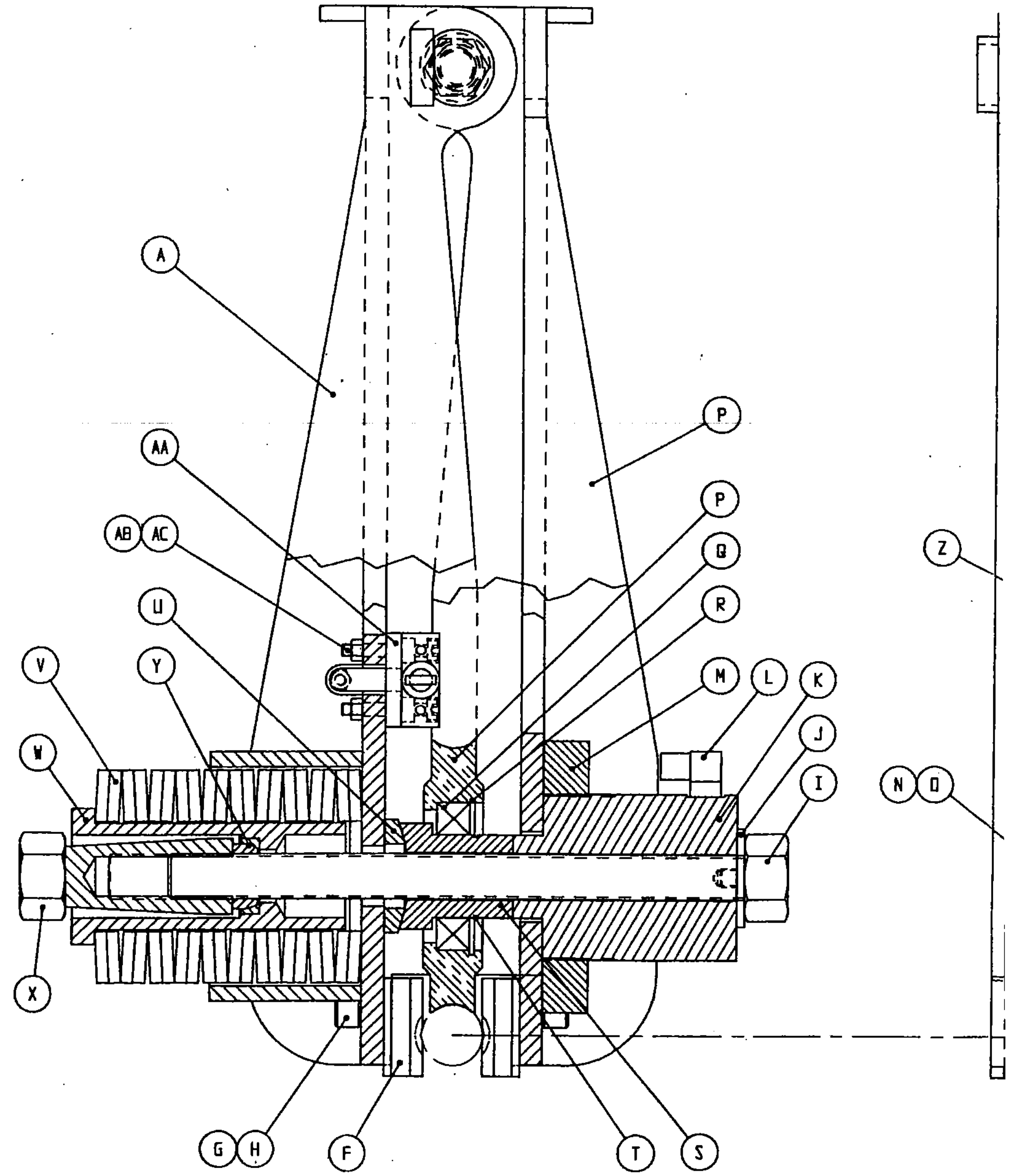
DATE: 4.16.98

SCALE(S): /

FORMAT: B

DRAWING NUMBER: 3038.768

REVISION: A


A
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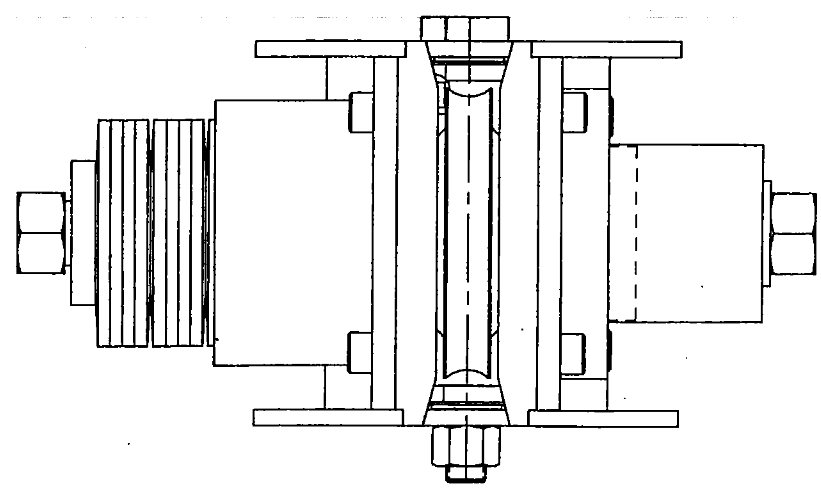
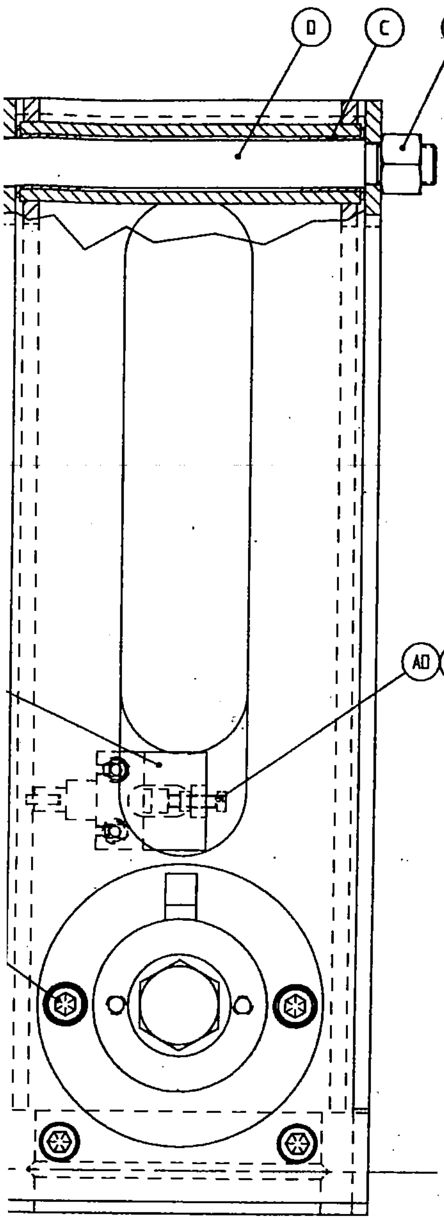




INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
AE	1	NUT HuM5 5.6 PLATED			058003	
AD	1	BOLT HM5x20/20 5.6 PLATED			057202	
AC	2	NYLOCK NUT M5 5.6 PLATED			058182	
AB	2	BOLT CHc M5x35/22 5.6 PLATED			5057306	
AA	1	MOUNT, BRAKE SWITCH			3225.577	A
Z	1	SWITCH, TM 9007-XMS13FS0600			5206250	
Y	1	BEARING, PLAIN SPHERICAL THRUST			5080112	
X	1	ADJUSTING NUT			3225.576	A
W	1	INNER GUIDE, SPRING PACK			3225.575	A
V	20	SPRING WASHER, 90/46/5			059068	
U	1	WASHER, SPHERICAL CONE, CL-7-SW PLATED			5059039	
T	1	EXT SNAP RING, ⌀1-3/8"			5070059	
S	1	SPINDLE, GUIDE WHEEL			3225.573	A
R	1	INT SNAP RING, ⌀2-7/16"			5070062	
Q	1	BEARING, SKF 6007 2RS			080027	
P	1	GUIDE WHEEL			3225.572	A
O	2	LOCKWASHER TYPE J INT M10 PLATED			5059052	
N	2	BOLT CHc M10x20/20 8.8 PLATED			057493	
M	1	COLLAR, ENERPAC AW-121			5300337	
L	1	ELBOW 90° 4MP-4MJ			5350277	
K	1	HYD CYLINDER, ENERPAC RWH-121			5300353	
J	1	WASHER 1" A325 PLATED			5059025	
I	1	BOLT 3/4"-10NC x 9 1/2 GR.8 PLATED			4075.688	A
H	4	LOCKWASHER JZC10 PLATED			059285	
G	4	BOLT HM10x25/25 8.8 PLATED			057212	
F	2	BRAKE PAD			3225.570	B
E	1	NYLOCK NUT M16 8.8 PLATED			058188	
D	1	AXLE, BRAKE PIVOT			3225.574	A
C	2	BEARING, IGLIDE GFI-1214-16			5080108	
B	1	PINCER, CYLINDER SIDE			4075.885	C
A	1	PINCER, SPRING SIDE			4075.884	C

REV | DESCRIPTION OF REVISION | DATE | BY

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

TOLERANCES UNLESS INDICATED

FABRICATION
FRACTIONAL ..... ±1/16
ANGULAR .... ±1/2°

MACHINING
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR .... ±.1°

AERIAL TRAM 1998

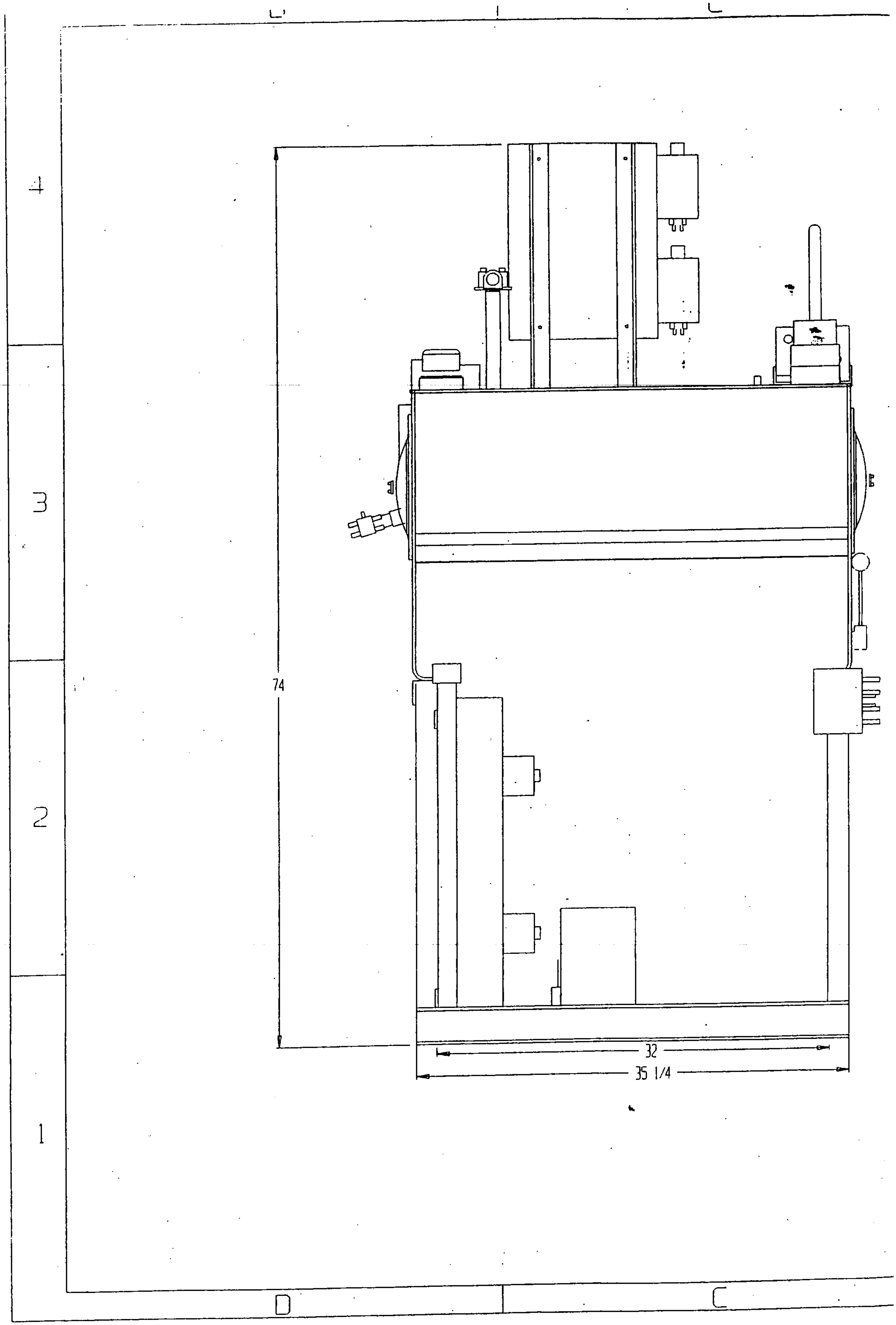
TRACK ROPE BRAKE ASSY

12pl CABIN, 26mm TRACK ROPE, 4 1/2 TON

CABLE TRANSPORT SYSTEMS — SKILIFTS CHAIRLIFTS GONDOLAS TRAMWAYS

DRAWN BY: N. TUSBERG
DESIGNED BY: N. TUSBERG

TREATMENT:
TOTAL WT./LBS.: FINISHED
MARKING REF'D.:
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.:
FORMAT | DRAWING NUMBER | REVISION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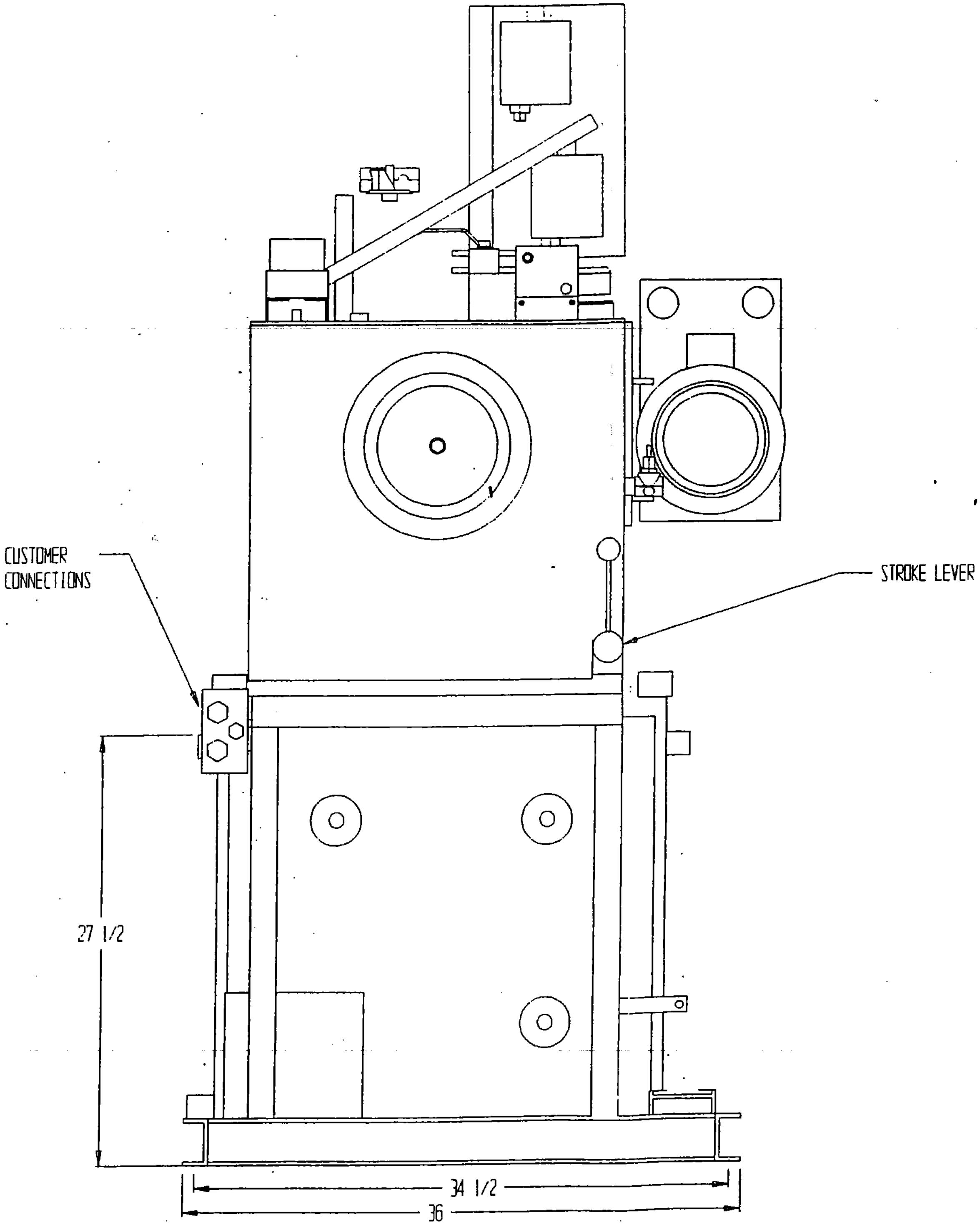
REV	DESCRIPTION	DATE	APPROVED

REVISIONS



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	REV

PARTS REQUIREMENTS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE.
FINISH 125 DECIMALS .X = ± .05 .XX = ± .02 .XXX = ± .005 .XXXX = ± .0005 ANGLES ± 1°

DO NOT SCALE DRAWING

FILE //MINIEVAC.PRT

ARCHIVE NO N/A

PROJECT NO. 13970

REF PART NO N/A

APPROVALS	DATE
DRAWN M DRAKE	4/6/98
CHECKED S. JONES	4/6/98
PROJECT ENG S JONES	4/6/98

TEI ENGINEERED PRODUCTS INCORPORATED
ENGLEWOOD, COLORADO USA

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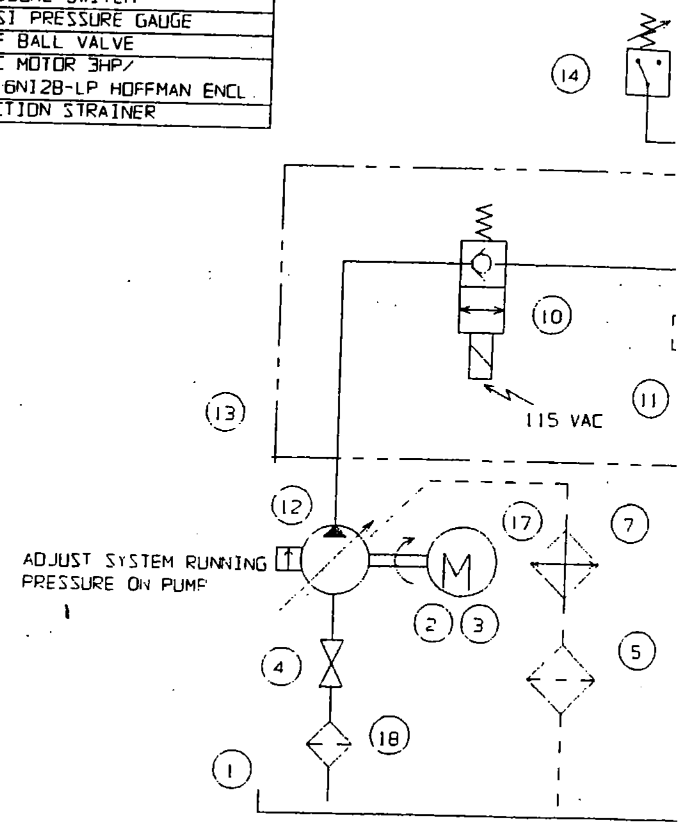
TEI ENGINEERED PRODUCTS, INC.
ENGLEWOOD, COLORADO 80112 U. S. A.

TITLE POMA
MINI-EVAC / COMP II

SIZE	DRAWN BY	DWG NO.	REV
B	MSD	13970-0101	0

DWG SCALE 1 : 1 | PLOT SCALE 1 : N/A | SHEET 1 OF 2

BILL OF MATERIAL COMP II POMA 1995		
ITEM	QTY	DESCRIPTION
1	1	30 OR 60 GALLON RESERVOIR
2	1	2AN-13-07 HAYES COUPLING
3	1	1960 VESCOR PUMP/MOTOR ADAPTOR
4	1	100-004 B&K GATE VALVE
5	1	MPS-501-RG2/CSG50-P10A/CI-20 MPS RETURN LINE FILTER W/INDICATOR
6	1	HP-61-DA-TL BRAND HAND PUMP
7	1	ADRM20S AMERICAN INDUSTRIAL HEAT EXCHANGER
8	1	D02B2-0.2N STERLING CHECK VALVE
9	1	BBV-200B-0001 STAUFF 1/2" BALL VALVE
10	1	GS020600N/CCS-115-D STERLING SOLENOID VALVE 115VAC SOLENOID & 5100-1090000 CONNECTOR
11	1	A5B020TN/TC1125 STERLING RELIEF VALVE
12	1	PV6-2L1C-CDD-SP1075 DENISON PUMP
13	1	TEI CUSTOM MANIFOLD
14	2	B1T-H32 BARKSDALE PRESSURE SWITCH
15	1	BAC-3M-25 LENZ 3000 PSI PRESSURE GAUGE
16	1	BBV-200B-0001M STAUFF BALL VALVE
17	1	130326 LEESON ELECTRIC MOTOR 3HP/ 230/460/3/182TC WITH 16N128-LP HOFFMAN ENCL.
18	1	TFS-100-3 STAUFF SUCTION STRAINER



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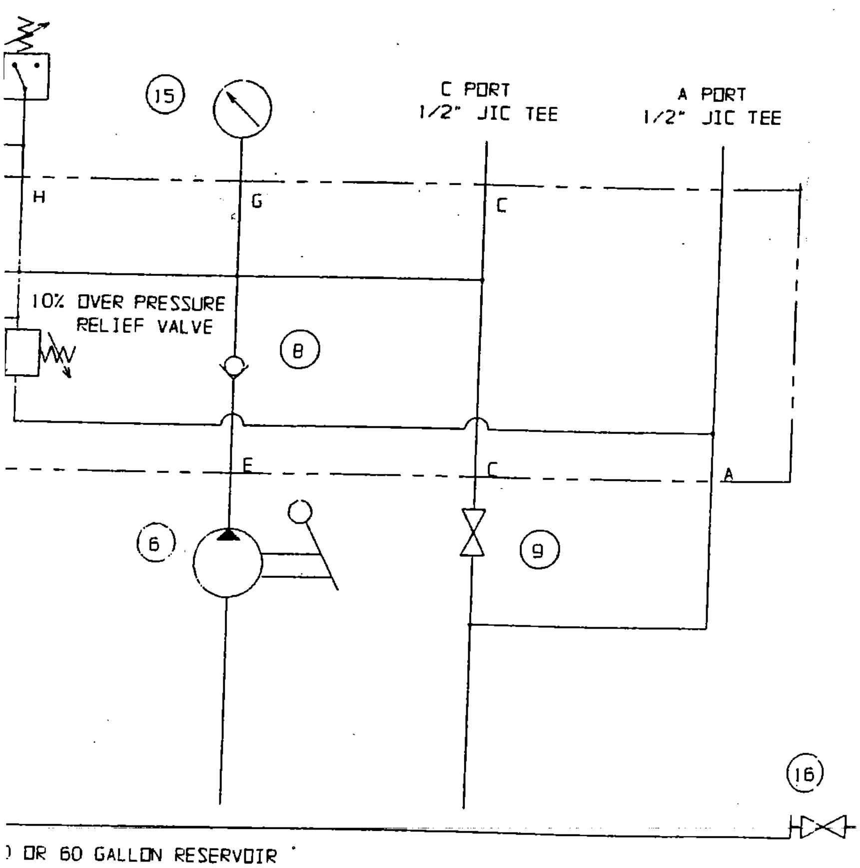
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

4



3

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1

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	REV

PARTS REQUIREMENTS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE
FINISH 125 DECIMALS .X = ± .05 .XX = ± .02 .XXX = ± .005 .XXXX = ± .0005 ANGLES ± 1°

DO NOT SCALE DRAWING

FILE: COMP2 HYD.PR1

ARCHIVE NO: N/A

PROJECT NO: 13791

REF PART NO: N/A

CALC WT: N/A

APPROVALS		DATE
DRAWN	S. JONES	4/6/98
CHECKED	S. JONES	4/6/98
PROJECT ENG	S. JONES	4/6/98

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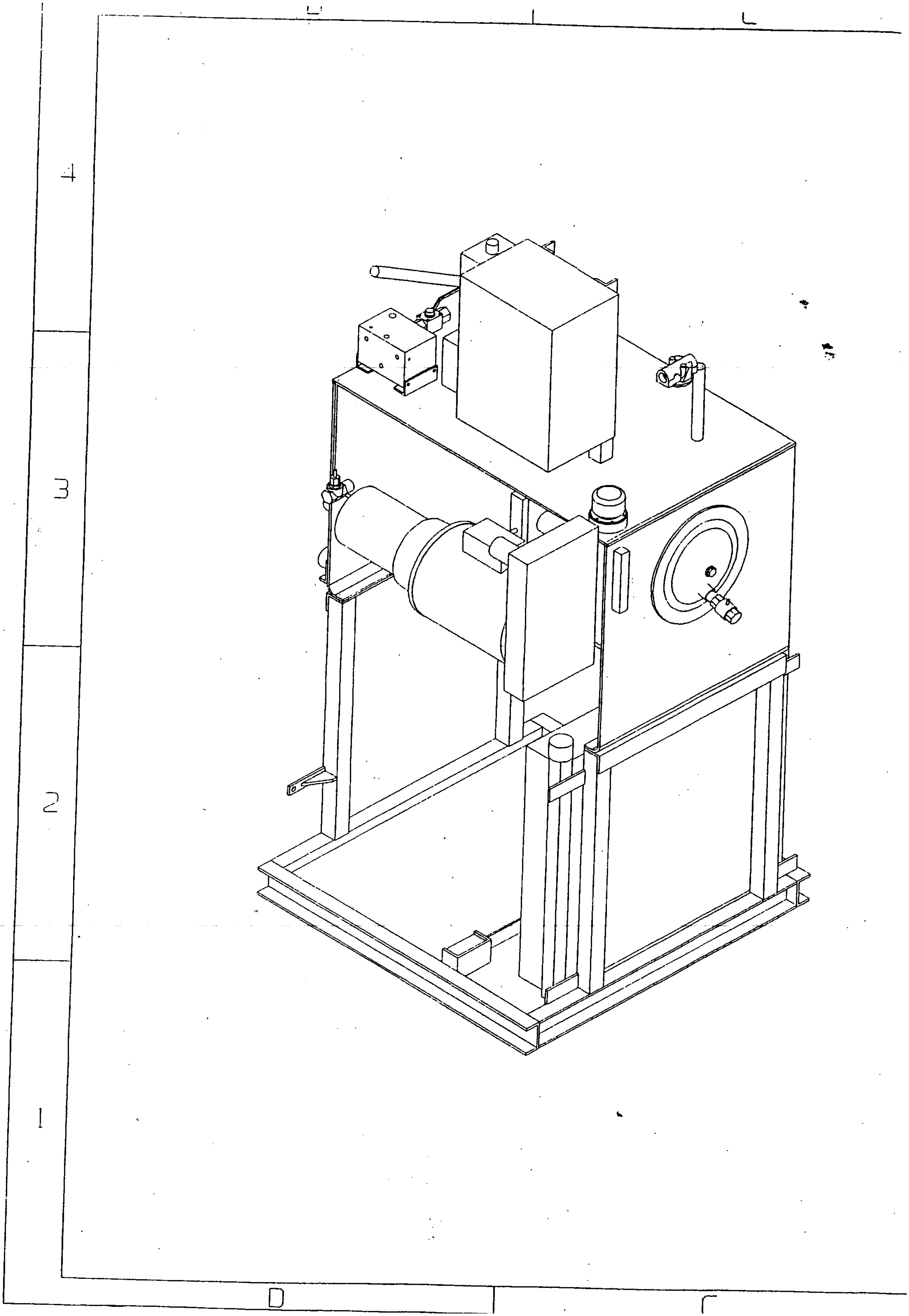
ENGLEWOOD, COLORADO 80112 U.S.A.

TITLE: COMPETETION II HYDRAULIC SCHEMATIC

SIZE: B | DRAWN BY: SAJ | DWG NO. 98COMP11-0100 | REV: 0

DWG SCALE 1 : N/A | PLOT SCALE 1 : N/A | SHEET 1 OF 1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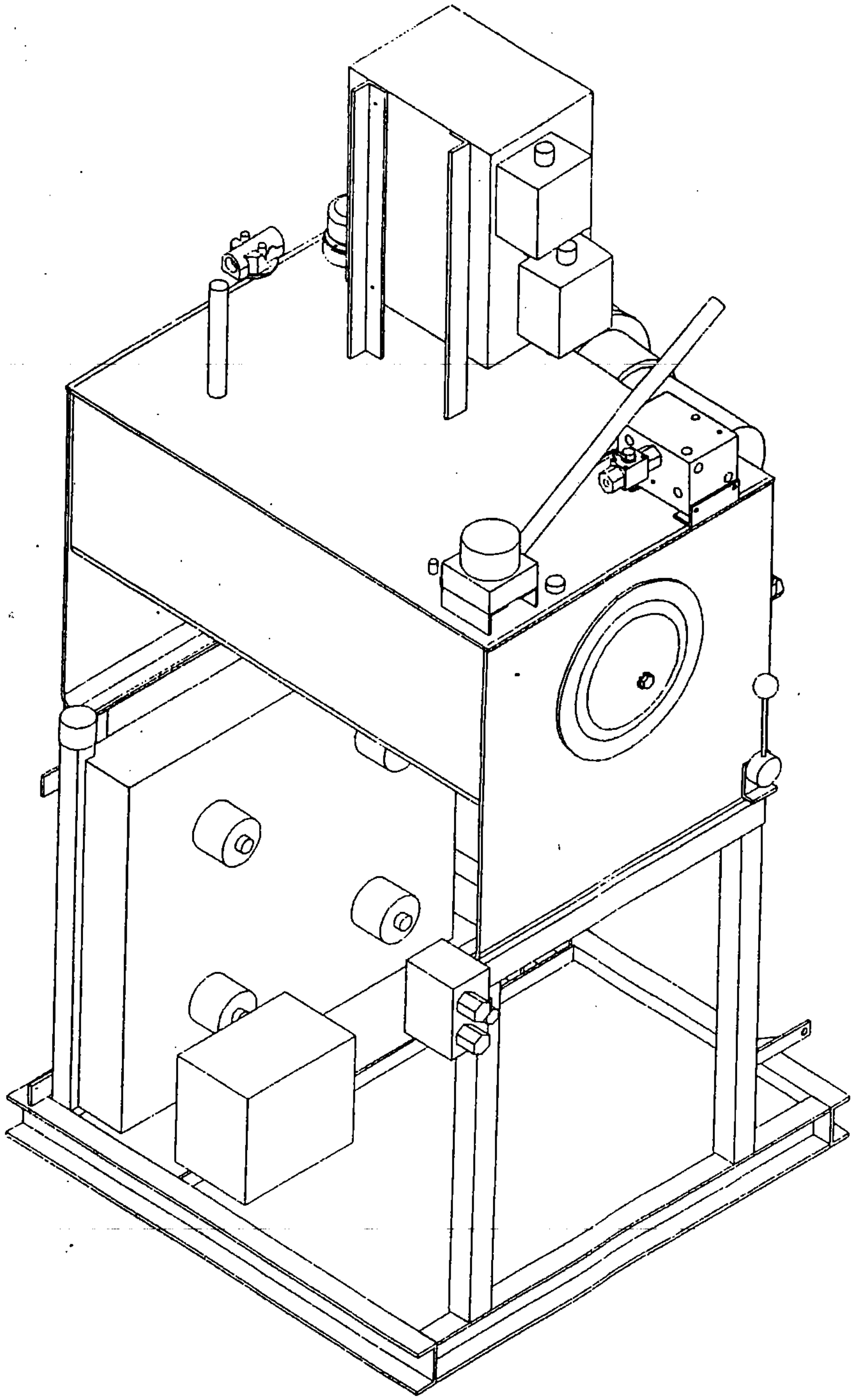
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	REV

PARTS REQUIREMENTS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE
FINISH 125 DECIMALS X = ± .05 XX = ± .02 XXX = ± .005 XXXX = ± .0005 ANGLES ± 1°

DO NOT SCALE DRAWING

FILE :/MINIEVAC.PRT

ARCHIVE NO

PROJECT NO. 13970

REF PART NO N/A

CALC WT

APPROVALS	DATE
DRAWN M. DRAKE	4/6/98
CHECKED S. JONES	4/6/98
PROJECT ENG. S. JONES	4/6/98

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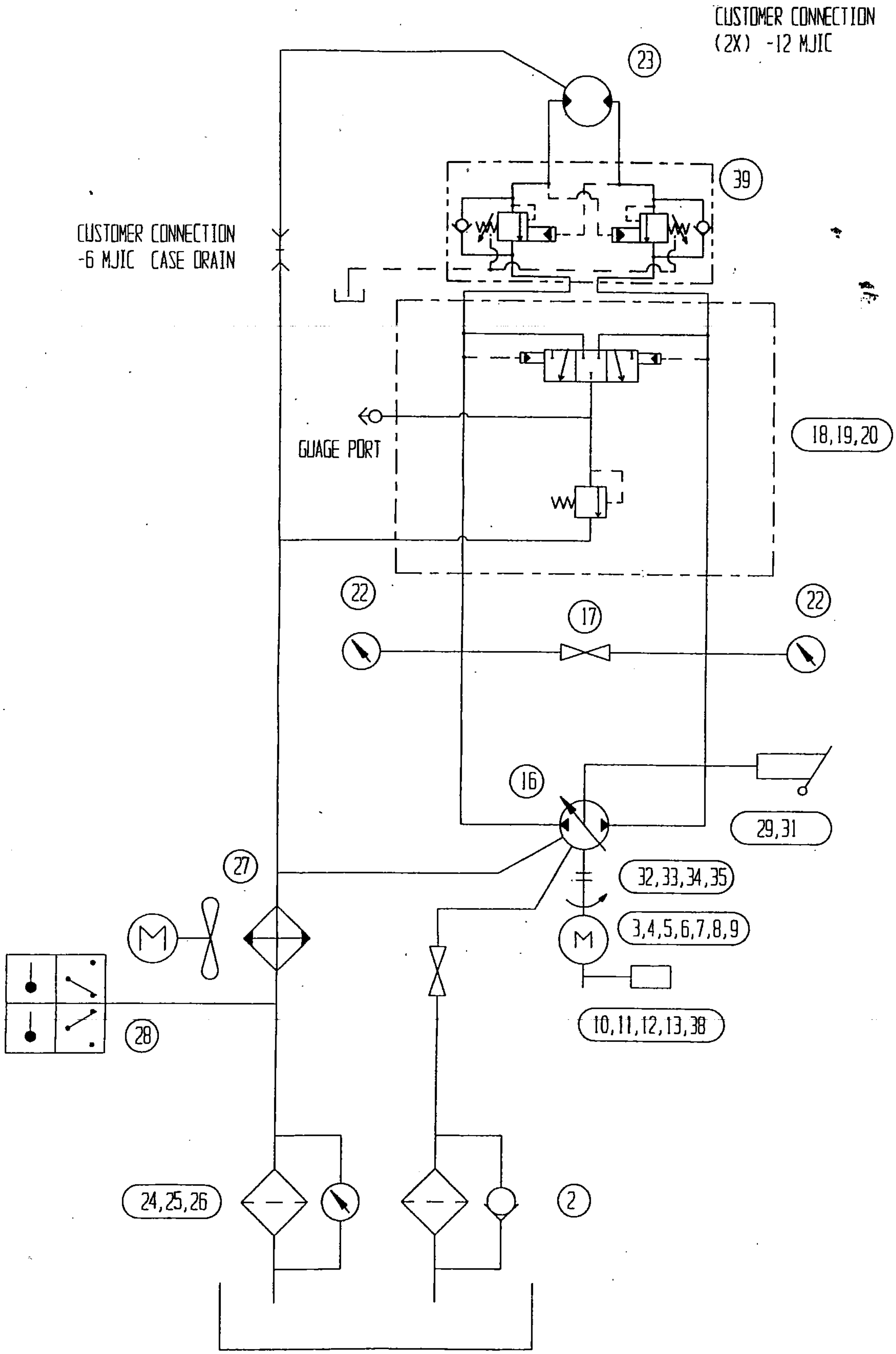
ENGLEWOOD, COLORADO 80112 U. S. A.

TITLE POMA
MINI-EVAC / COMP II

SIZE	DRAWN BY	DWG NO.	REV
B	MSD	13970-0101	0

DWG SCALE 1 : 1 | PLOT SCALE 1 : N/A | SHEET 2 OF 2



ITEM	QTY.	
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2	1	e
3	1	e
4	1	e
5	1	e
6	1	e
7	1	e
8	1	e
9	1	e
10	1	e
11	1	e
12	1	e
13	1	e
14	1	e
15	1	e
16	1	e
17	1	e
18	1	e
19	1	e
20	1	e
21		
22	2	ec
23	1	ec
24	1	ec
25	1	ec
26	1	ec
27	1	ec
28	1	ec
29	1	ec
30		
31	1	ec
32	1	ec
33	1	ec
34	1	ec
35	1	ea
36		
37	1	lot
38	1	ea
39	1	ea

B A

4

NUFACTURER	PART NUMBER	DESCRIPTION
	NA	Reservoir: Integral to Comp II
uff	SS-120-3-100	Suction Strainer: 1 1/4" NPT 23 GPM 100 Mesh
ler	CH256/SPEC 6B501	Engine: Gasoline, 25 hp, Extended Front Shaft
ler	24-189-01	Adapter: Spark Arresting
ler	24-786-11	Muffler: Exhaust
ler	52-755-79	Tank: Gasoline 6.6 Gallon
ler	24-584-11	Ignition Module: Engine
'er	52-704-01	Oil Sentry: Installed
er	24-755-08	Front Shaft: Generator Takeoff
Auto Elec	WAI24-1104	Pulley: Generator Takoff
Auto Elec	WAI24-1109	Pulley: Generator Takoff
Auto Elec	110-462	Alternater: 24 VDC, 35 A
	4L280	Belt: Alternater V Groove FHP Belt
	T-13790-01	Guard: Belt & Pulley
	T-13790-02	Framework: Custom Weldment
n	70142-RFCT/PPV124	Pump: Manual Stroke, Closed Loop, Integral Charge Pump
ff	BBV-2004-0001M	Valve: Bypass, Manual
ling	ABB060ZN	Valve: Hot Oil Shuttle Relief, Cartridge
ling	K3A125200N	Valve: Hot Oil Shuttle, Cartridge
ling	LB10-24BA	Line Body: Hot Oil Shuttle, Anodized Aluminum
	BAC-5M-25	Gauge: 0-5000 PSI Gauge - Motor Loop
Hydraulics	HB-05075410	Motor: Hydraulic 5.4 in3/rev, 1 1/16 - 12 ports, 1 1/4 Keyed Shaft
oducts	CSG70-P10A	Return Filter, 10 Micron Spin-on Filter, MP
oducts	MPS-050-RG2 / 5300251	3/4" NPT Filter Head, MP
oducts	CI-20	Indicator, MP
con Industri	ADMF-4-SAE-24	Heat Exchanger SAE 24 VDC
d Electric	B402-120	Temperature Switch
	150-0110	Hand Lever/Pump stroker control
	CAA174MTG3	Cable: Pump Stroking, 74.5" long
nd	RC3-0875-250	Reuland Coupling Half
nd	RC3-1437-375	Reuland Coupling Half
nd	RG3-H5	Reuland Insert Hytrel
	VEM-700-70-2A	Vescor Adapter
ip	TBD	Fittings
to Elec	WAI25-100	Fan
	CWCA-LHN-XPJ	Valve: Counter-Ballance

3

2

1

13790

N/A

N/A

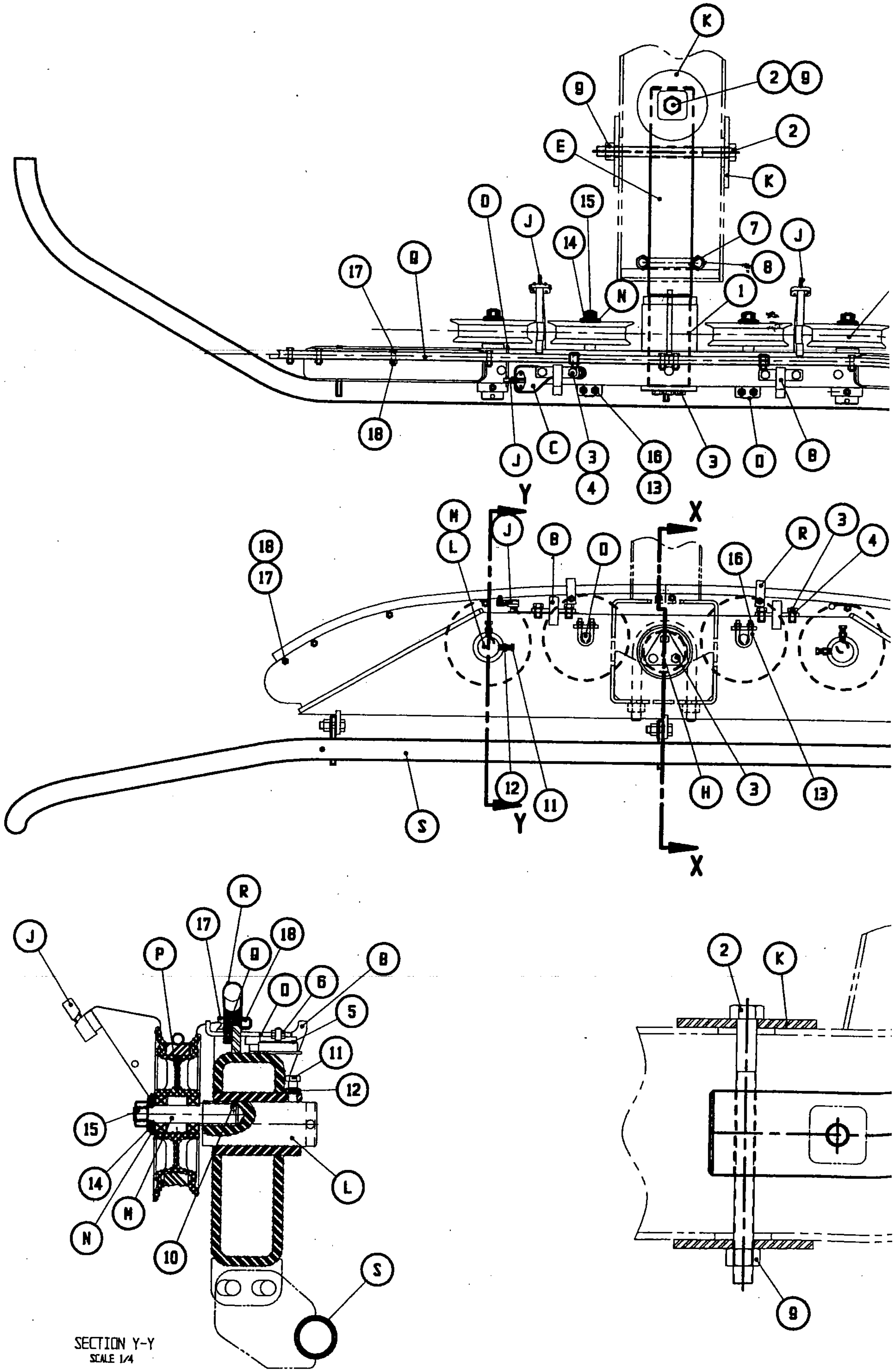
minievac hydro.prt

TEI ENGINEERED PRODUCTS, INC.

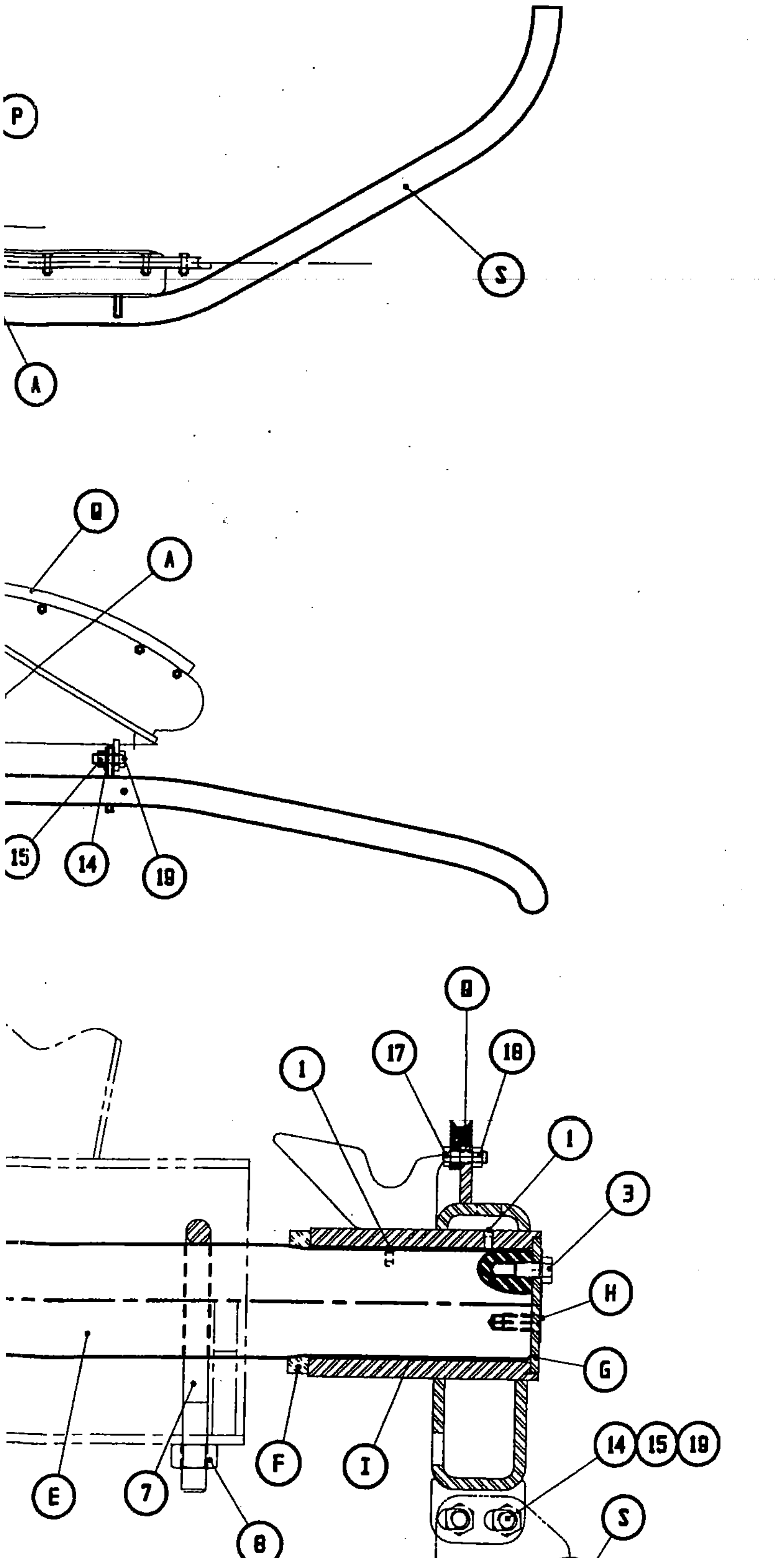
POMA
MINI-EVAC

B MSD 13790-1011 A

B A



SECTION Y-Y
SCALE 1/4



SECTION X-X
SCALE 1/4

19	6	BOLT HH 20x60/46 8.8 PLATED			087082	
18	12	NYLON LOCKNUT M12 8.8 PLATED			039065	
17	12	BOLT HH 12x40/40 8.8 PLATED			037080	
16	4	NYLON LOCKNUT M10 8.8 PLATED			039065	
15	10	NYLON LOCKNUT M20 8.8 PLATED			080192	
14	10	FLAT WASHER M20U PLATED			059110	
13	2	U-BOLT M10-15/30 x 2-3/4/1 PLATED		1.8	US 3110.[illegible]	A
12	4	NUT LOW HH 12 8.8 PLATED			039032	
11	4	BOLT HH 12 x 30/30 8.8 PLATED			037271	
10	2	ROLL PIN 6mm x 15mm			080300	
9	2	NYLON LOCKNUT 1 1/8-12NF A325 PLATED			305000	
8	2	NYLON LOCKNUT M27 8.8 PLATED			039204	
7	1	U-BOLT/HD M27, 9-1/8x10-3/16/3-3/4		8.4	US 3080.732	A
6	2	NUT HU M8 8.8 PLATED			080004	
5	2	WASHER M8U PLATED			039040	
4	4	LOCKWASHER JEC16 PLATED			039065	
3	7	BOLT HH 16x30/30 8.8 PLATED			037200	
2	2	BOLT 1 1/8-12NF-15 LG A325 PLATED		8.4	US 3020.882	A
1	2	GREASE ZERK 1/8" NPT			350004	

S	1	CABIN GUIDE 4 SHEAVE SADDLE		82.5	US 4075.000	B
R	2	TRACK ROPE DEROPEMENT STRAPS		0.15	US 3025.023	A
Q	2	480mm SADDLE, R10'		30	US 3025.404	B
P	4	STANDARD 8" ALUMINUM SHEAVE ASSEMBLY			2031 00	
O	2	480 mm SHEAVE AXLE		22.4	US 3025.403	B
N	4	NYLON DUST SEAL WASHER		0.25	US 3010.037	A
M	2	ECCENTRIC AXLE SHAFT		3	US 3025.402	B
L	2	ECCENTRIC AXLE BODY - 480mm SHEAVE		10.2	US 3025.401	B
K	4	CROSS ARM WASHER 40 x 1 3/16 x 1/2		20	US 3220.720	A
J	1	BRITTLE BAR			305120	
I	2	BUSHING SKF GLY.PG 115/120/70 A			082510	
H	1	LOCK PLATE		0.4	US 3080.734	A
G	1	STOP WASHER		2.5	US 3080.730	A
F	1	AXLE SPACER		0.4	US 3081.004	A
E	1	8 SUPPORT CENTRAL AXLE		180	US 3020.737	B
D	1	BRITTLE BAR EXTENSION 8mm ALLTHREAD		0.07	US 3080.024	A
C	1	TRACK ROPE BRITTLE BAR MOUNT		0.7	US 4075.720	A
B	2	TRACK ROPE CATCHER		3.4	US 4075.730	B
A	1	4 SHEAVE SADDLE		387.4	US 4075.047	B
INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./LBS.	REFERENCE	[illegible]

DESCRIPTION OF REVISION

AERIAL TRAM

1999

4 SHEAVE SADDLE ASSEMBLY

TOLERANCES
FABRICATION
FRACTIONAL ...... ±1/16
ANGULAR .... ±1/2°
MACHINING
DECIMAL W/.X ... ±.05
DECIMAL W/.XX ... ±.01
DECIMAL W/.XXX . ±.005
ANGULAR .... ±.5°

POMA OF AMERICA

DRAWN BY: [illegible]
CHECKED BY: J.[illegible]
DATE: 6.22.99
SCALE: 1/8

D 3038.783 /

12. Wiring Diagrams

GENERAL

This section consists of the schematic and connection wiring diagrams referenced in the text. The following drawings are included.

PCC Control

- Page 12-2 – Customer Connections Diagram (PCC)
- Page 12-3 – Accessory Interconnect Diagram (PCC)

Detector Control

- Page 12-4 – Customer Connections at the Engine Monitor Board (Detector Control)
- Page 12-5 – Customer Connections at the Auxiliary Relay Board (Detector Control)
- Page 12-6 – Accessory Interconnect Diagram (Detector Control)

Sentinel Control

- Page 12-7 – DC Wiring (Sentinel)

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

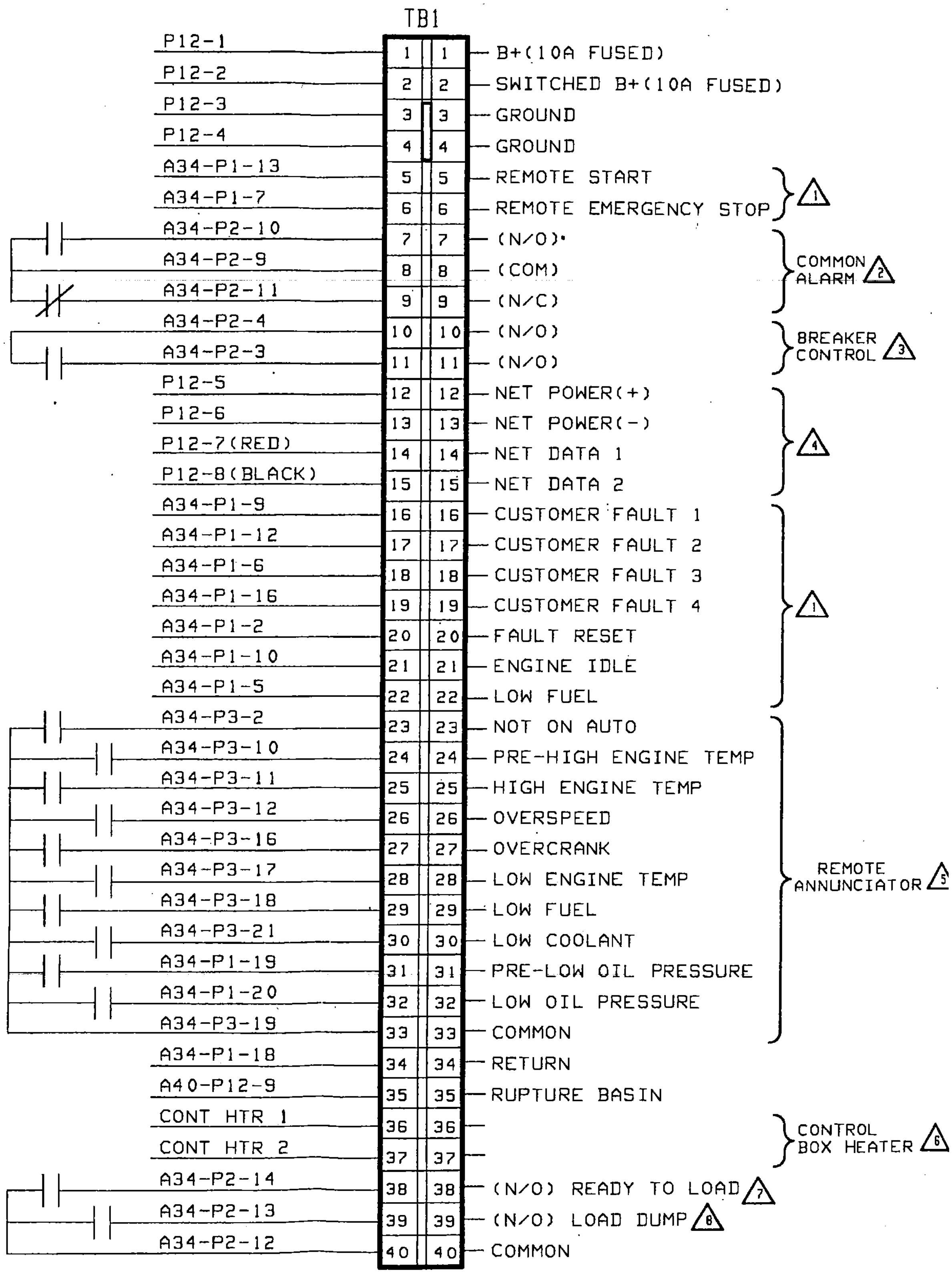
NOTES:

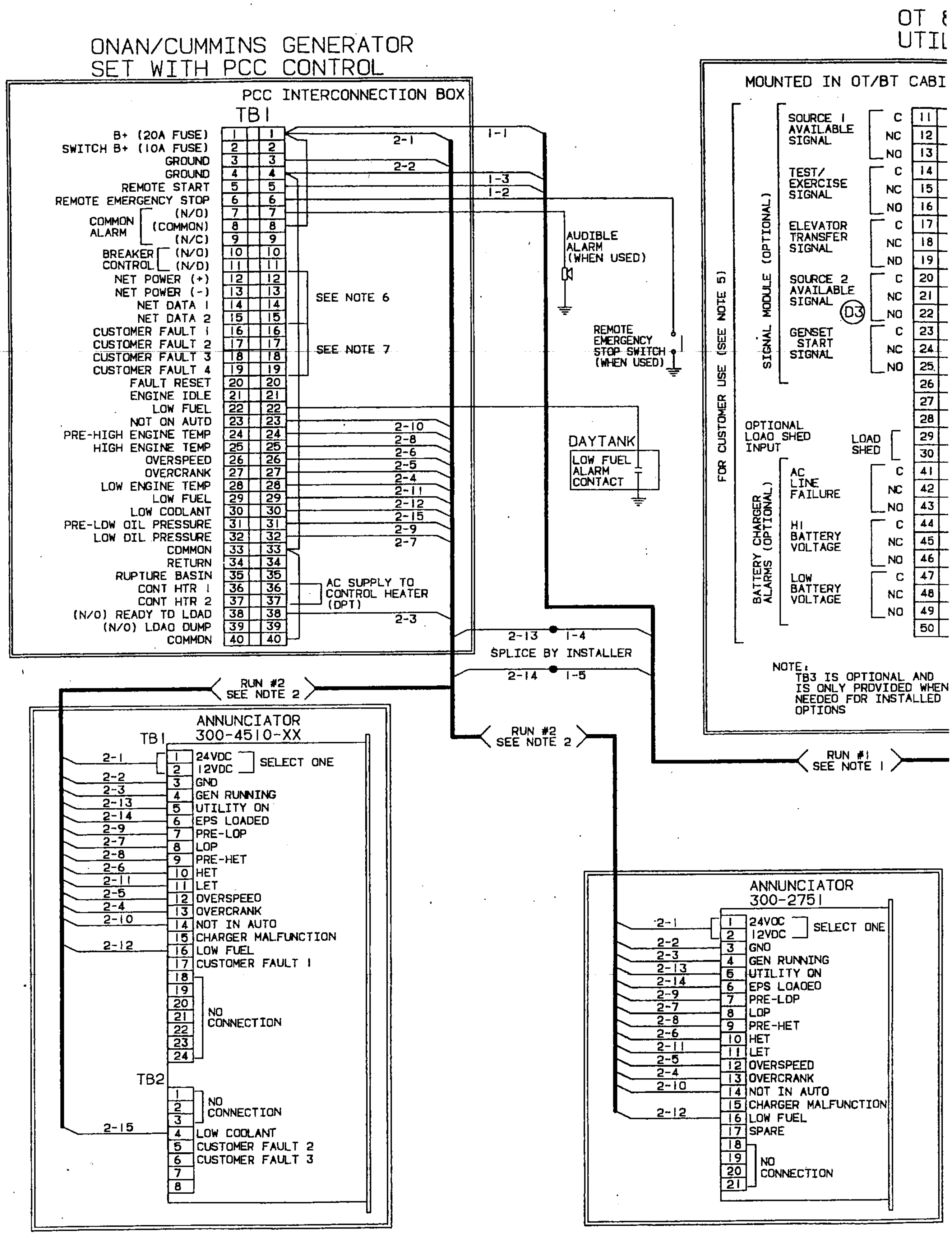
1. Apply a ground to activate input (less than 50mA).
2. 2A @ 30VDC relay contacts. This relay picks up with any warning or shutdown
3. 5A @ 30VDC relay contacts. This relay picks up to open breaker shunt trip in single mode.
4. Refer to Onan 900-0366 Power Command Network & Operation Manual.
5. 1A @ 30VDC relay contacts. These relays pick up on the given fault.
6. 120VAC or 240VAC @ 50 Watts.
7. 2A @ 30VDC relay contacts. This relay picks up when generator AC voltage and frequency exceed 90% of nominal.
8. 2A @ 30VDC relay contacts. This relay picks up if a overload or underfrequency condition continues for more than 5 seconds.

NO. 612-6658 sh 3
REV.
MODIFIED 4/20/94

CUSTOMER CONNECTIONS DIAGRAM (PCC)

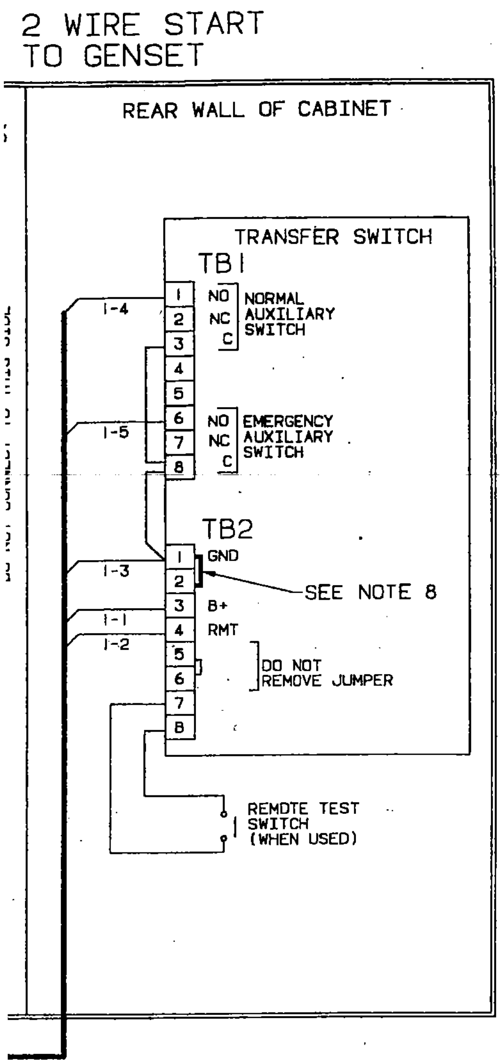
CUSTOMER TERMINAL BLOCK (SINGLE)





ACCESSORY INTERCONNECT DIAGRAM (PCC)

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

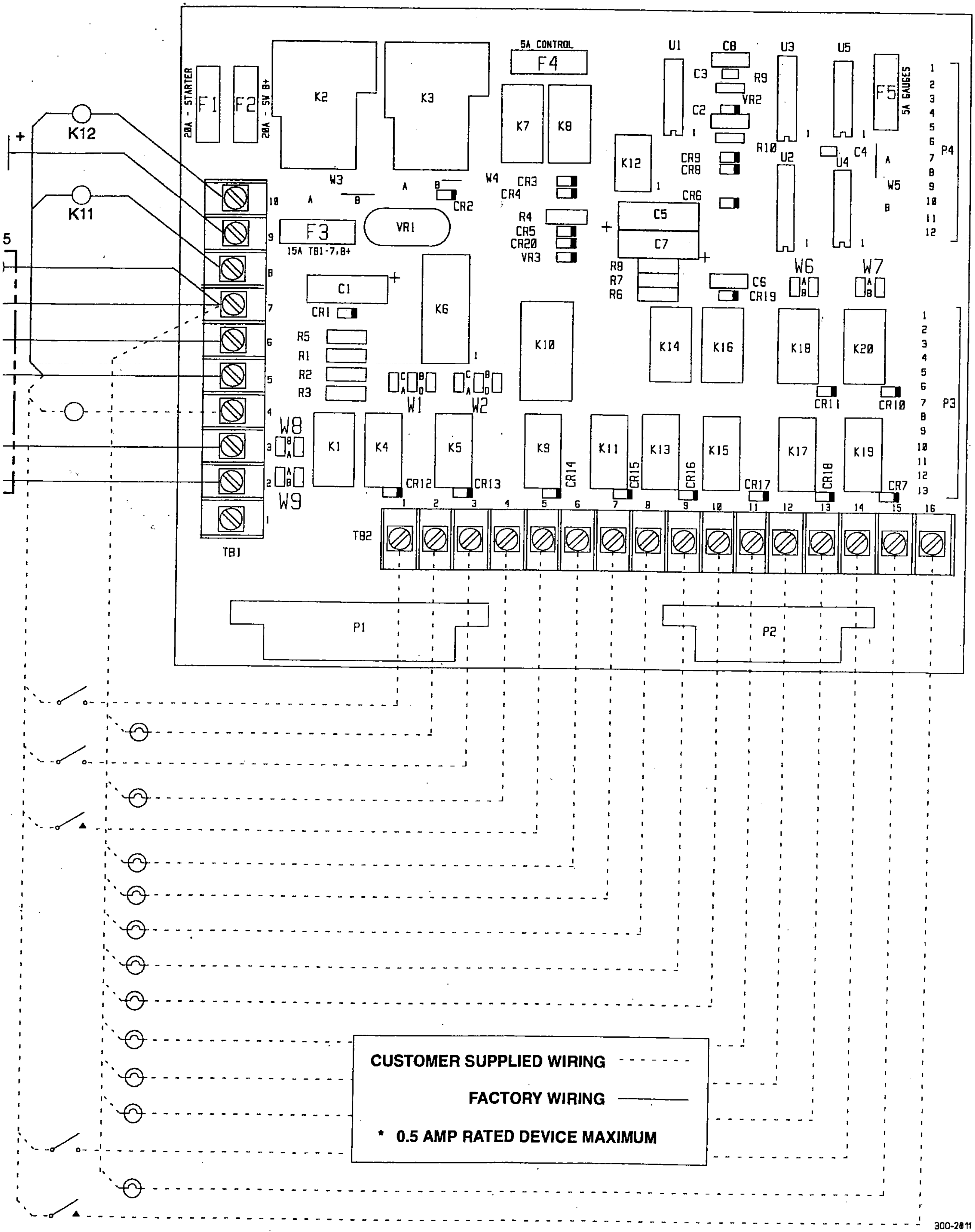


NOTES:

1. WIRE SIZES MUST BE AS FOLLOWS:
   RUN #1-GENSET TO TRANSFER SWITCH-LEAD SIZE MUST BE INCREASED IF A BATTERY CHARGER IS INSTALLED IN THE SWITCH.
   WITH NO BATT CHARGER-LEADS 1-1, -2, -3, -4, -5 USE COL A.
   WITH 2 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. B
   WITH 10 AMP CHARGER-LEADS 1-1 & 1-3, USE COL. C
2. RUN #2-GENSET TO ANNUNCIATOR-ALL LEADS, USE COL. A
3. FOR MULTIPLE TRANSFER SWITCHES, DUPLICATE RUN #1 FOR EACH SWITCH. DAISY CHAIN CONNECTION IS ACCEPTABLE PROVIDED WIRE SIZE & DISTANCE TO THE LAST SWITCH MEET THE SPECS IN NOTE 1.
4.
5. CONTACTS RATED: 4 AMPS AT 30 VDC OR 120V MAX.
6. REFER TO ONAN 900-0366 POWER COMMAND NETWORK & OPERATION MANUAL. FOR WIRING INSTRUCTIONS.
7. INPUTS FOR CUSTOMER FAULTS. GROUNDED SIGNAL REQUIRED TO ACTIVATE INPUT (MAX 50 MA.)
8. INSTALL JUMPER BETWEEN TB2-1 & TB2-2. FOR SETS WITH PCC CONTROL.

WIRE SIZE (AWG)	DISTANCE IN FEET, ONE WAY (MULTIPLY BY 0.3 FOR METERS)		
	A	B	C
16	1000	125	25
14	1600	200	40
12	2400	300	60
10	4000	500	100

NO.630-1345 sh1
REV. E
MODIFIED 6/29/94



CUSTOMER CONNECTIONS AT THE ENGINE MONITOR BOARD (DETECTOR CONTROL)

TB1-10 (SWITCHED B+ OUTPUT) FUSED AT 20 AMPS, ENERGIZED WHEN THE START SIGNAL IS APPLIED AND DE-ENERGIZED AT SHUTDOWN (NORMAL AND FAULT)

TB1-9 (B+ INPUT) BATTERY POSITIVE (+) CONNECTION

TB1-8 (START SOLENOID) FUSED AT 20 AMPS

TB1-7 (B+ OUTPUT) OUTPUT TO TIME DELAY START/STOP MODULE A15 (WHEN USED), FUSED AT 15 AMPS, AVAILABLE WHEN THE STARTING BATTERIES ARE CONNECTED

TB1-6 (REMOTE START) CONNECTED TO TIME DELAY START/STOP MODULE A15 (WHEN USED). CONNECT REMOTE START CONTACT OF THE AUTOMATIC TRANSFER SWITCH TO TERMINAL TB1-5 OF MODULE A15 (WHEN USED) OR TB1-6 OF EMB

TB1-5 (GROUND)

TB1-4 (COMMON ALARM B+ OUTPUT) 4 AMP RATED DEVICE MAXIMUM

TB1-3 (RUN) CONNECTED TO TIME DELAY START/STOP MODULE A15 (WHEN USED)

TB1-2 (DC DISCONNECT) CONNECTED TO TIME DELAY START/STOP MODULE A15 (WHEN USED)

TB2-1 (FAULT 2) GROUND INPUT FROM SENDER

TB2-2 (FAULT 2) GROUND OUTPUT TO LIGHT/RELAY*

TB2-3 (FAULT 1) GROUND INPUT FROM SENDER

TB2-4 (FAULT 1) GROUND OUTPUT TO LIGHT/RELAY*

TB2-5 (REMOTE RESET) MOMENTARY CONTACT TO GROUND

TB2-6 (OVERCRANK FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-7 (OVERSPEED FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-8 (HIGH ENGINE TEMPERATURE FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-9 (LOW OIL PRESSURE FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-10 (PRE-HIGH ENGINE TEMPERATURE WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-11 (PRE-LOW OIL PRESSURE WARNING) GROUND OUTPUT TO LIGHT/RELAY*

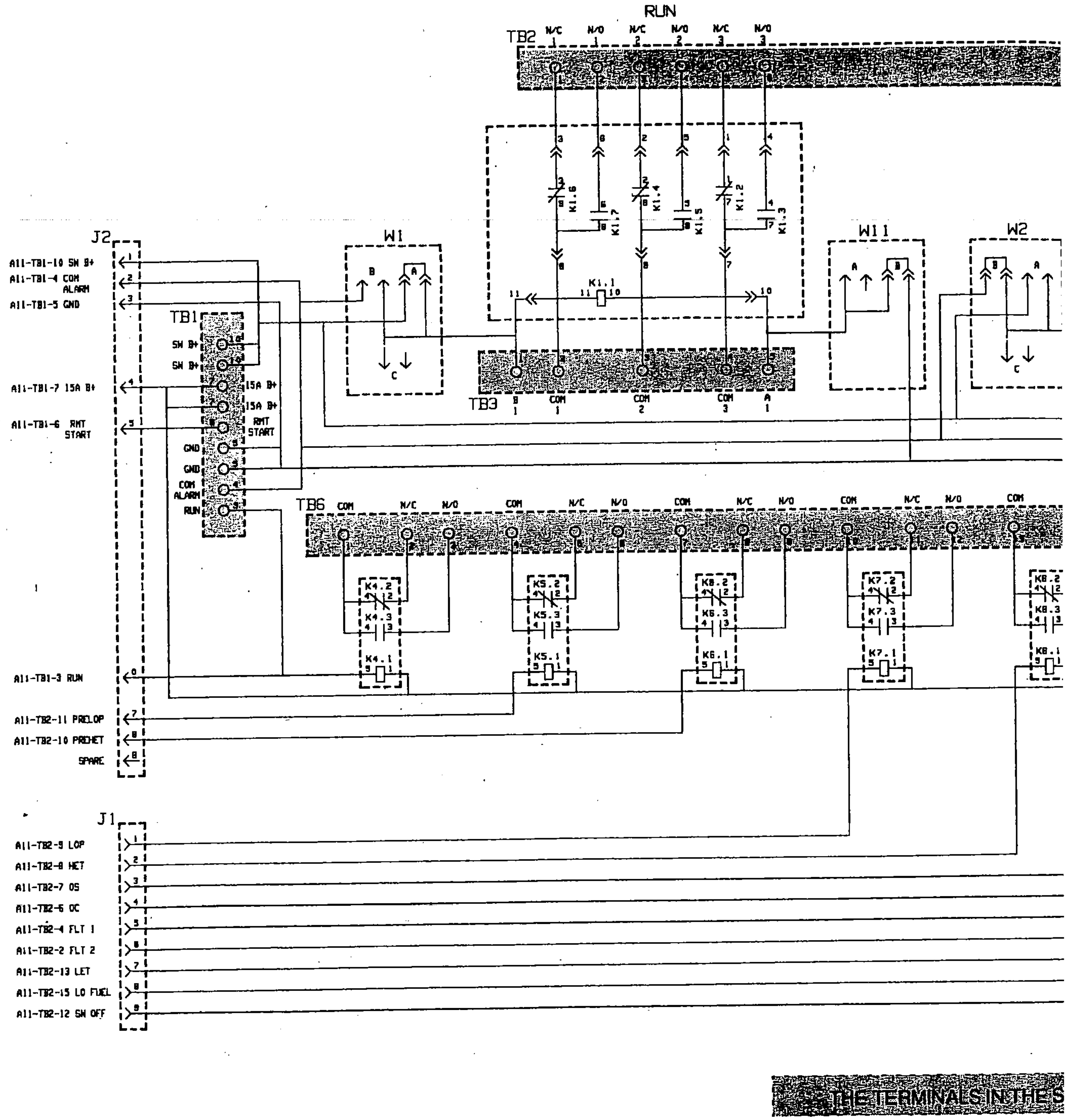
TB2-12 (SWITCH OFF WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-13 (LOW ENGINE TEMPERATURE WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-14 (LOW FUEL WARNING) GROUND INPUT FROM SENDER

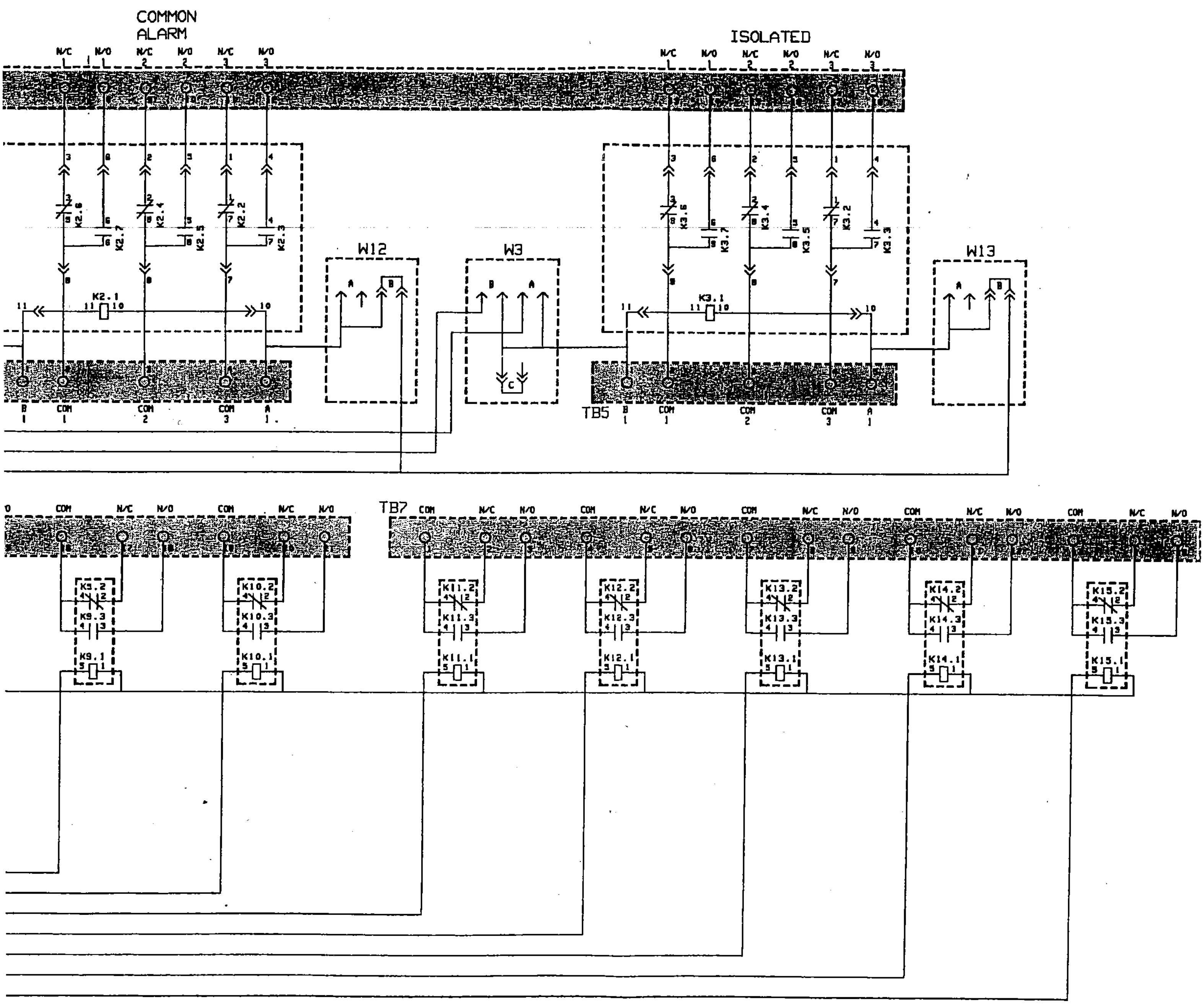
TB2-15 (LOW FUEL WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-16 (EMERGENCY SHUT DOWN) MOMENTARY CONTACT TO GROUND



CUSTOMER CONNECTIONS AT THE AUXILIARY RELAY BOARD (DETECTOR CONTROL)

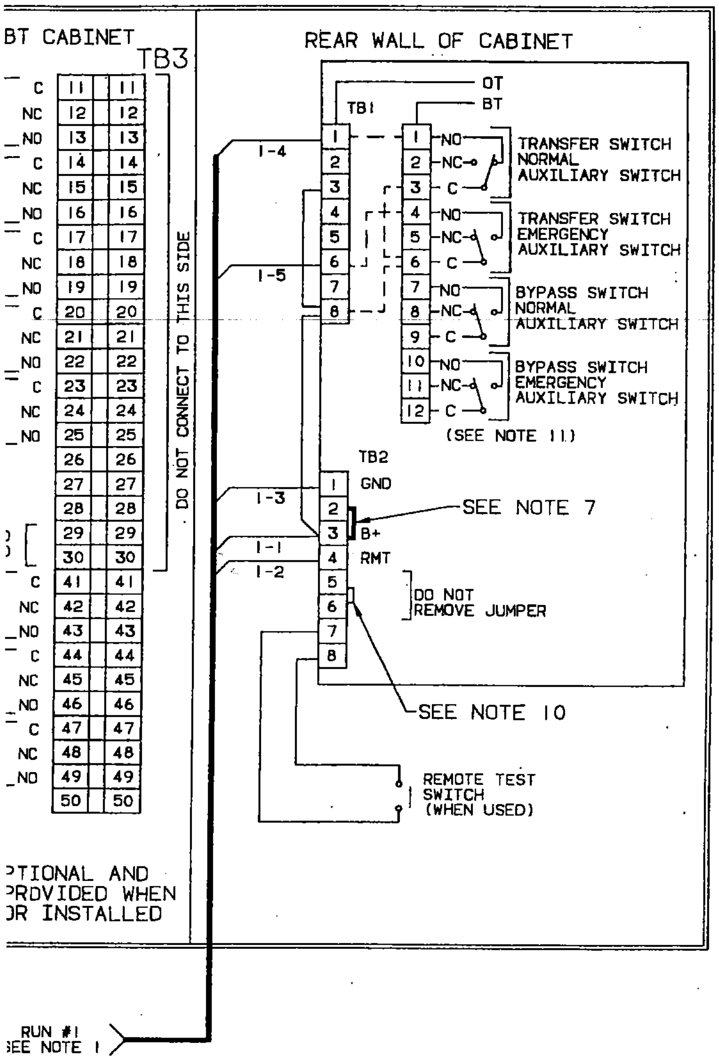
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



BOXES ARE FOR CUSTOMER CONNECTIONS

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

OT & BT 2 WIRE START
UTILITY TO GENSET



ɴ FEET, ONE WAY ƷY 0.3 FOR METERS)	
B	C
125	25
200	40
300	60
500	100

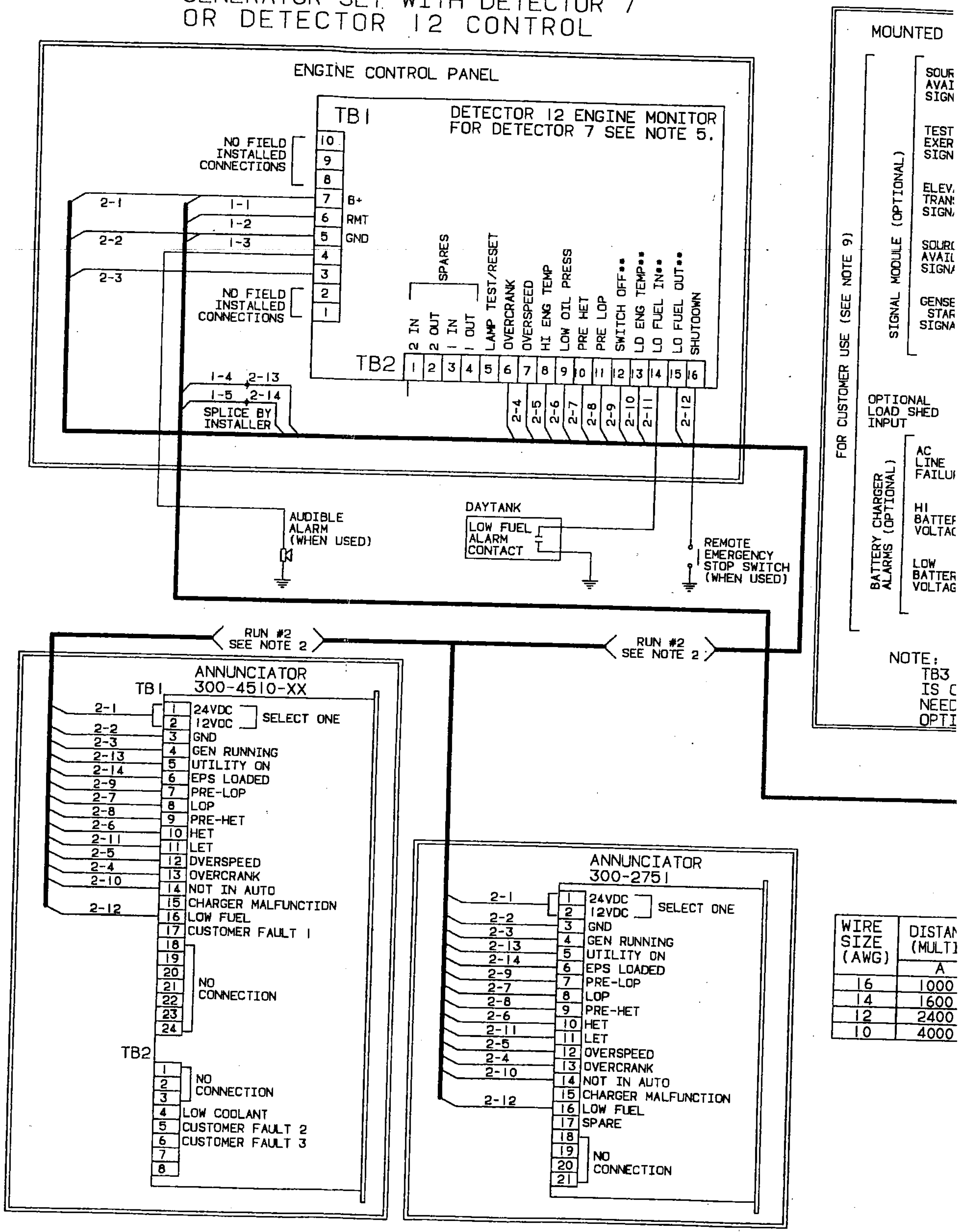
NOTES:

1. WIRE SIZES MUST BE AS FOLLOWS:
   RUN #1-GENSET TO TRANSFER SWITCH-LEAD SIZE MUST BE INCREASED IF A BATTERY CHARGER IS INSTALLED IN THE SWITCH.
   WITH NO BATT CHARGER-LEADS I-1, -2, -3, -4, -5 USE COL. A
   WITH 2 AMP CHARGER-LEADS I-1 & I-3, USE COL. B
   WITH 10 AMP CHARGER-LEADS I-1 & I-3, USE COL. C
2. RUN #2-GENSET TO ANNUNCIATOR-ALL LEADS, USE COL. A
3. FOR MULTIPLE TRANSFER SWITCHES, DUPLICATE RUN #1 FOR EACH SWITCH. DAISY CHAIN CONNECTION IS ACCEPTABLE PROVIDED WIRE SIZE & DISTANCE TO THE LAST SWITCH MEET THE SPECS IN NOTE 1.
4. INCLUDES EN AND ENTX. FOR ENT, SEE SHEET 4.
5. INCLUDES DL SERIES WITH 7 LIGHT OR 12 LIGHT MONITOR BOARD. FOR 9 LIGHT MONITOR BOARD, SEE SHEET 2. D6
6. FUNCTIONS INDICATED BY •• ARE NOT INCLUDED IN THE DETECTOR 7 CONTROL. JUMPER TB2-14 TO TB2-15 FOR LOW FUEL ALARM.
7. INSTALL JUMPER BETWEEN TB2-2 & TB2-3.
8. 300-4510-XX ANNUNCIATOR MAY BE USED ALSO. WIRE TB1 AS SHOWN.
9. CONTACTS RATED: 4 AMPS AT 30 VDC OR 120V MAX.
10. WHEN CONNECTING A REMOTE SIGNAL TO THE TRANSFER INHIBIT CIRCUIT, THE INSTALLER MUST USE A TWISTED PAIR OF WIRES WITH A SHIELDED GROUND.
11. TRANSFER SWITCH SHOWN CLOSED TO NORMAL BYPASS SWITCH SHOWN IN NEUTRAL POSITION.

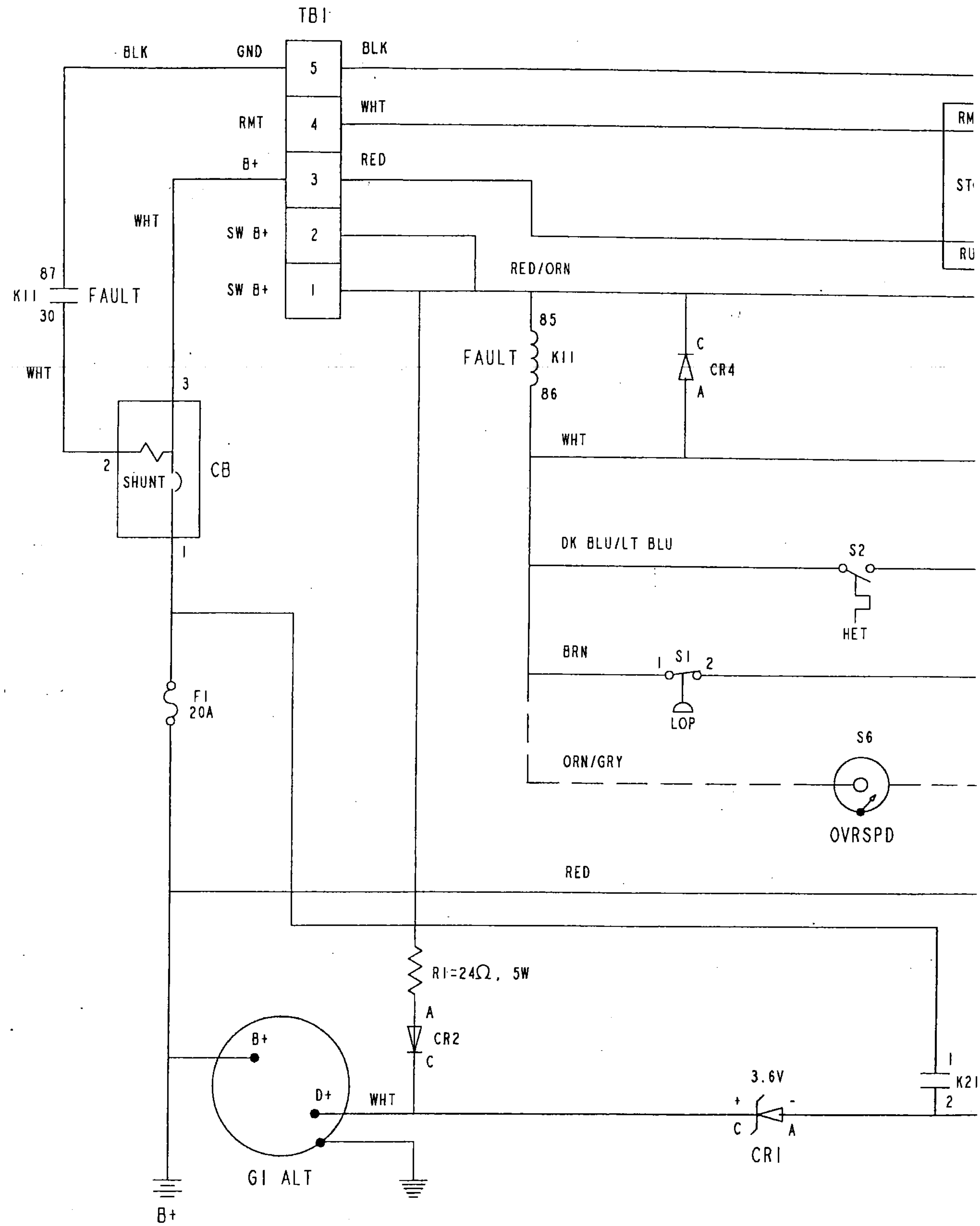
No. 630-1345 sh 3
Rev. H
Modified 02/28/96

ACCESSORY INTERCONNECT DIAGRAM (DETECTOR CONTROL)

GENERATOR SET WITH DETECTOR 7 OR DETECTOR 12 CONTROL

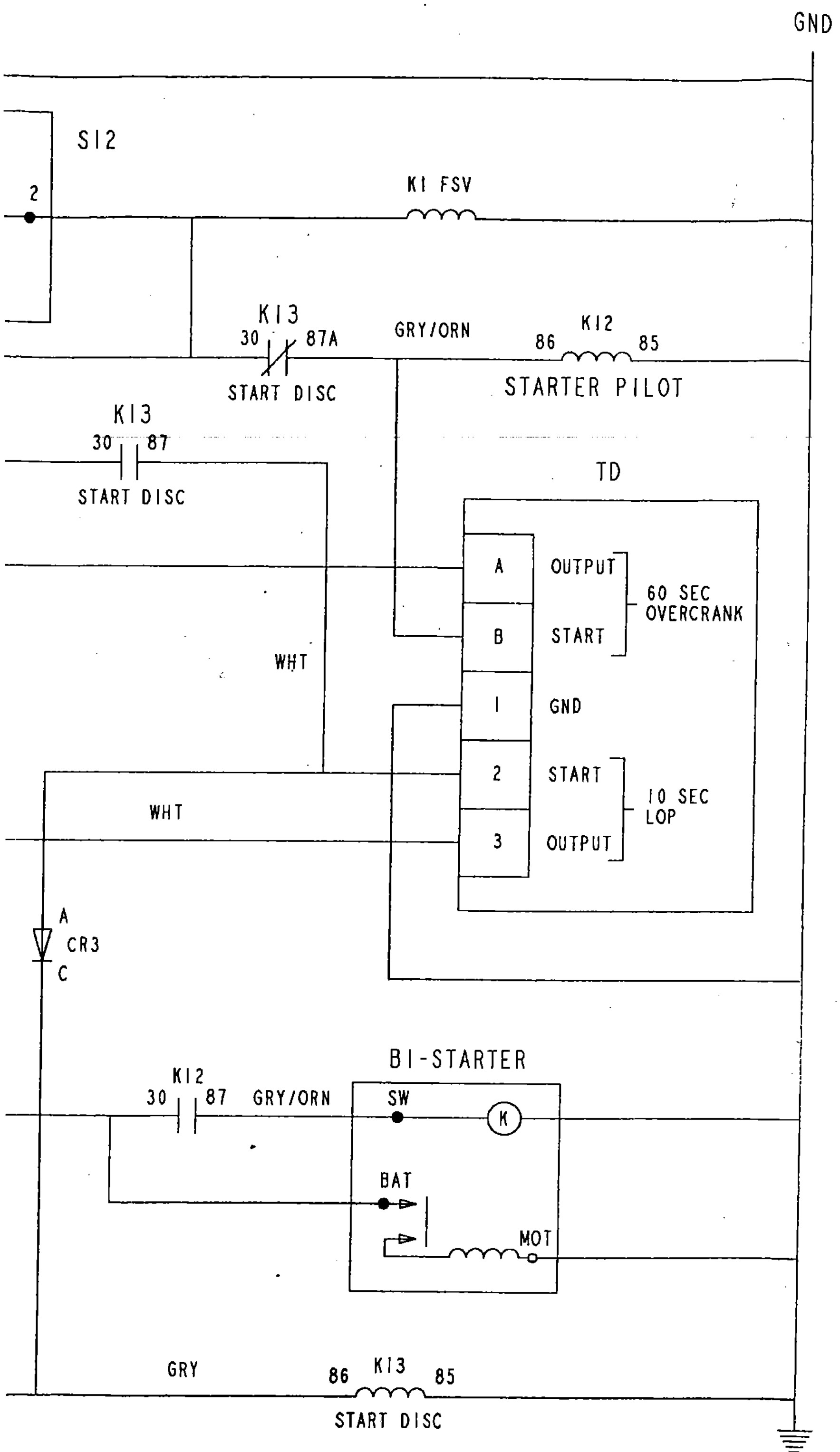


WIRE SIZE (AWG)	DISTAN (MULTI
	A
16	1000
14	1600
12	2400
10	4000

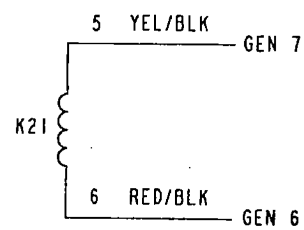


DC WIRING (SENTINEL)

THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.



ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION.

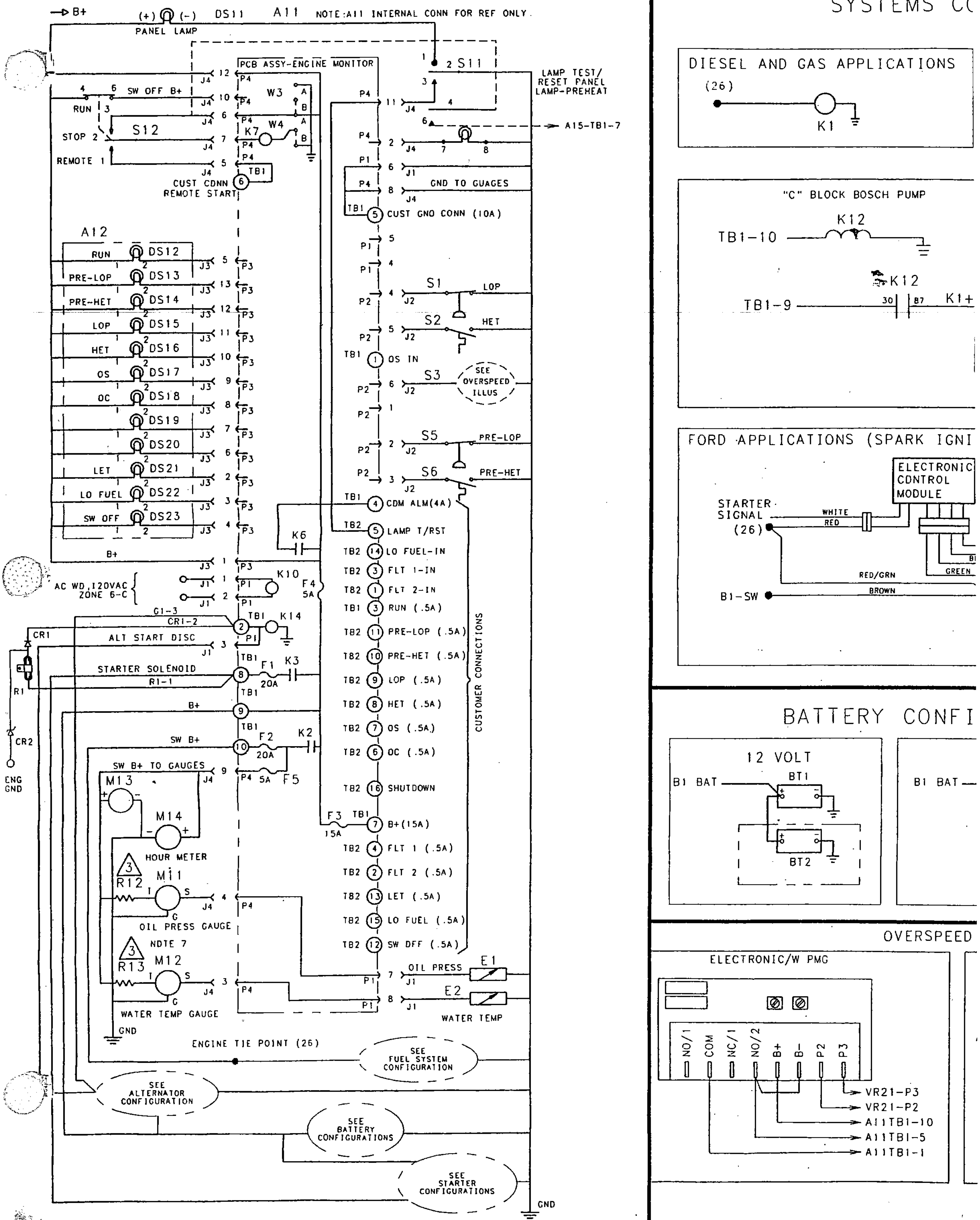


AC STARTER DISCONNECT

No. 612–6697 sh 2of 2
Rev. B Sys: ProE
Modified 4/11/96

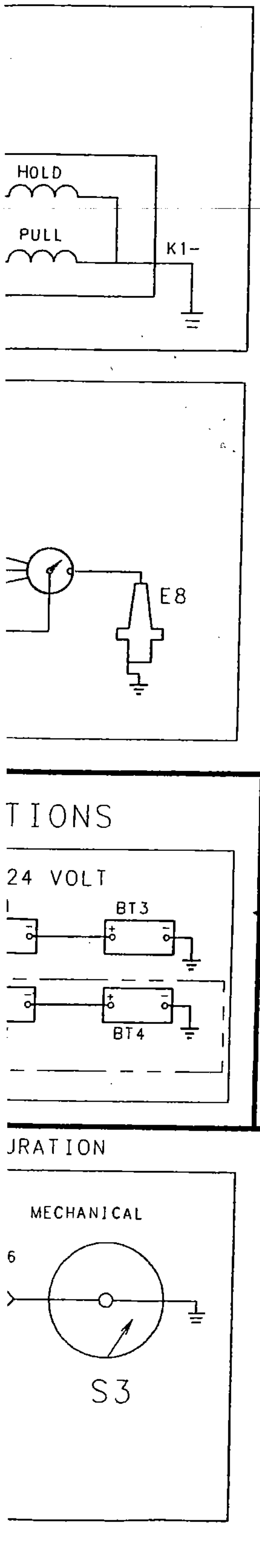
0612-6692 D

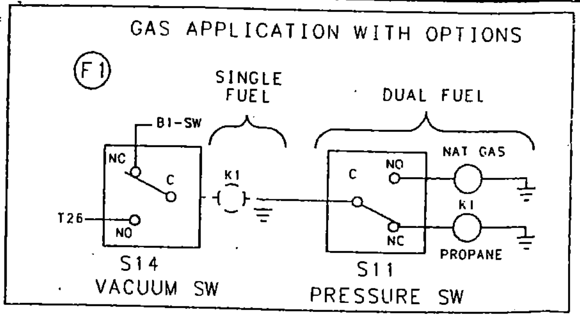
SCHEMATIC DIAGRAM



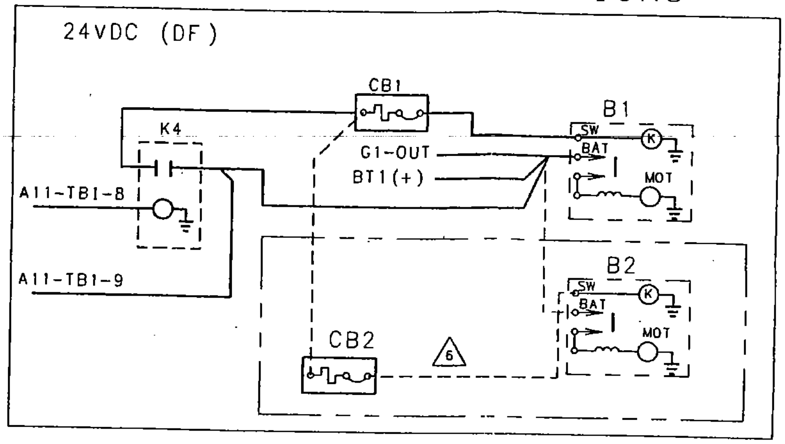
3 2 1

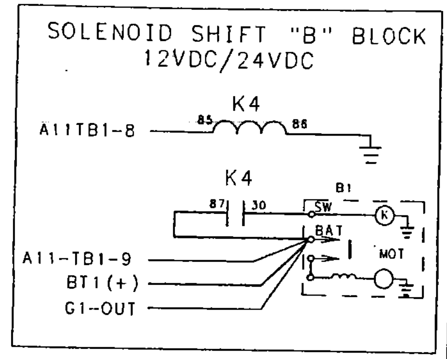
ER NO	LTR	NO	REVISION	ZONE	DR	CKHR	APPROVED	DATE
71067	A	1	PRODUCTION RELEASE	–	VB	VB	PRIEM	07-01-87
72472	B	1	ADD "B" BLOCK CONFIGURATION	1C	JC	JC	PRIEM	03-26-96
73216	C	1	ADD "C" BLOCK CONFIGURATION	3D	JC	JC	BAH	08-21-96
73957	D	1	REVISED PER ER	–	JC	JC	BAH	12-05-96
74774	E	–	--------------	–	--	--	------	------
74896	F	1	ADD GAS APPLICATION SCHEMATIC	2C	JC	JC	TAL	04-09-97
76286	G	–	--------------	–	--	--	-----	------





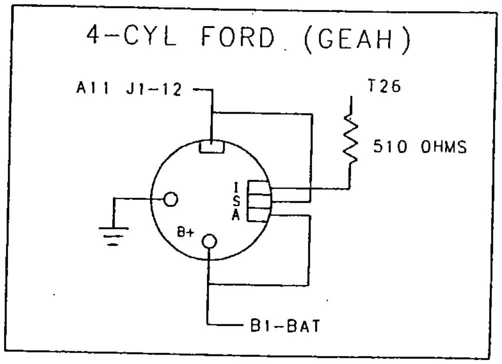
C1 STARTER CONFIGURATIONS

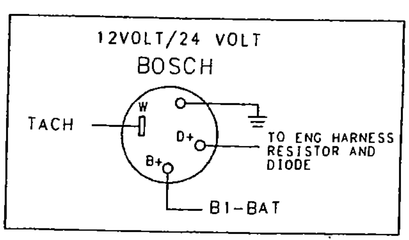


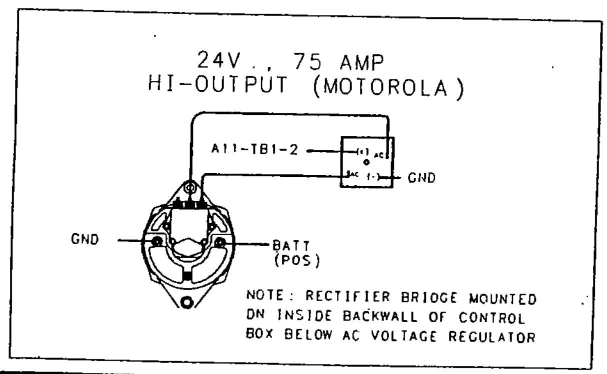


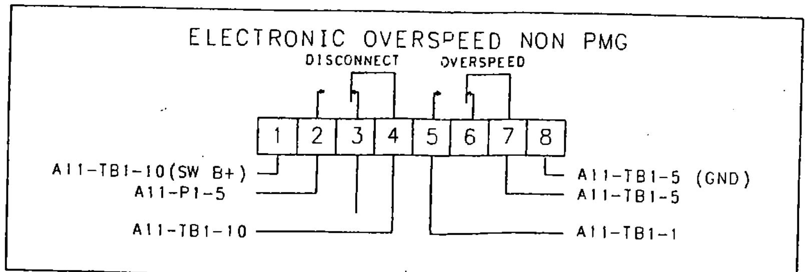
B1

ALTERNATOR CONFIGURATIONS









D C B A

REVISIO DWG

DO NOT SCALE PRINT

TOLERANCES UNLESS OTHERWISE SPECIFIED: MM / INCH; MACHINED HOLES ≤ 6 IN (13MM) +0.15 −0.05 / +.006 −.002; ANGLES ±; DRAWN TO SCALE OF

SIM TO / COPIED FROM / THIRD ANGLE PROJECTION

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0612-6692 D

REF DES	ITEM	PART NO	BULK	DWG SIZE	QTY	DESCRIPTION OR MATERIAL

	NAME	DATE
DR	V. BECKMAN	09-28-95
CHKR	D. YOUNG	09-28-95
APPROVED	D. PRIEM	09-28-95

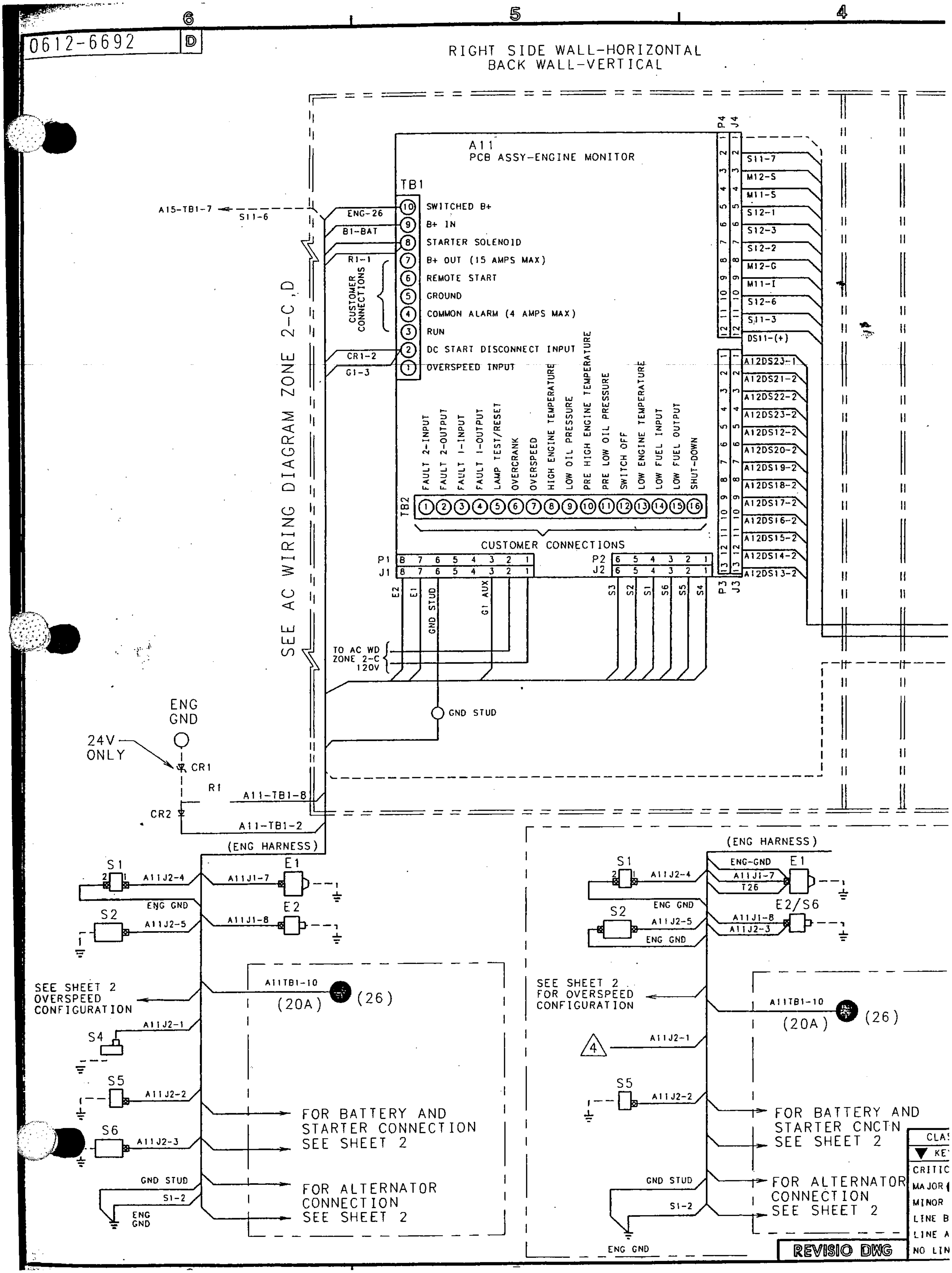
FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982

MODEL FIRST USED ON: DG

Onan — ONAN CORPORATION, MINNEAPOLIS, MINNESOTA

TITLE: WD-GEN SET DC CONT

DWG NO: 0612-6692 SHEET 2 OF 2 DWG SIZE D


0612-6692
D
RIGHT SIDE WALL-HORIZONTAL
BACK WALL-VERTICAL
A11
PCB ASSY-ENGINE MONITOR
TB1
SWITCHED B+
B+ IN
STARTER SOLENOID
B+ OUT (15 AMPS MAX)
REMOTE START
GROUND
COMMON ALARM (4 AMPS MAX)
RUN
DC START DISCONNECT INPUT
OVERSPEED INPUT
CUSTOMER CONNECTIONS
A15-TB1-7
S11-6
ENG-26
B1-BAT
R1-1
CR1-2
G1-3
SEE AC WIRING DIAGRAM ZONE 2-C,D
FAULT 2-INPUT
FAULT 2-OUTPUT
FAULT 1-INPUT
FAULT 1-OUTPUT
LAMP TEST/RESET
OVERCRANK
OVERSPEED
HIGH ENGINE TEMPERATURE
LOW OIL PRESSURE
PRE HIGH ENGINE TEMPERATURE
PRE LOW OIL PRESSURE
SWITCH OFF
LOW ENGINE TEMPERATURE
LOW FUEL INPUT
LOW FUEL OUTPUT
SHUT-DOWN
TB2
CUSTOMER CONNECTIONS
P1
J1
P2
J2
P3
J3
P4
J4
S11-7
M12-S
M11-S
S12-1
S12-3
S12-2
M12-G
M11-I
S12-6
S11-3
DS11-(+)
A12DS23-1
A12DS21-2
A12DS22-2
A12DS23-2
A12DS12-2
A12DS20-2
A12DS19-2
A12DS18-2
A12DS17-2
A12DS16-2
A12DS15-2
A12DS14-2
A12DS13-2
E2
E1
GND STUD
G1 AUX
S3
S2
S1
S6
S5
S4
TO AC WD ZONE 2-C 120V
GND STUD
ENG GND
24V ONLY
CR1
R1
CR2
A11-TB1-8
A11-TB1-2
(ENG HARNESS)
S1
A11J2-4
A11J1-7
E1
ENG GND
S2
A11J2-5
A11J1-8
E2
SEE SHEET 2 OVERSPEED CONFIGURATION
A11TB1-10
(20A)
(26)
A11J2-1
S4
S5
A11J2-2
S6
A11J2-3
FOR BATTERY AND STARTER CONNECTION SEE SHEET 2
GND STUD
S1-2
ENG GND
FOR ALTERNATOR CONNECTION SEE SHEET 2
(ENG HARNESS)
ENG-GND
E1
S1
A11J2-4
A11J1-7
T26
ENG GND
S2
A11J2-5
E2/S6
A11J1-8
A11J2-3
ENG GND
SEE SHEET 2 FOR OVERSPEED CONFIGURATION
A11TB1-10
(20A)
(26)
4
A11J2-1
S5
A11J2-2
FOR BATTERY AND STARTER CNCTN SEE SHEET 2
GND STUD
S1-2
FOR ALTERNATOR CONNECTION SEE SHEET 2
ENG GND
REVISIO DWG
CRITIC
MAJOR
MINOR
LINE B
LINE A
NO LIN

3 | 2 | 1

RIGHT SIDE DOOR
(REAR INSIDE VIEW)

ER NO.	LTR	NO.	REVISION	ZONE	DR	CHKR	APPROVED	DATE
71067	A	1	PRODUCTION RELEASE, -01 ONLY	-	VDB	DAY	D.PRIEM	09-28-9
72472	B	1	SEE SHEET 2	-	JC	JC	D.PRIEM	03-26-9
73216	C	1	SEE SHEET 2	-	JC	JC	HAMPEL	08-23-9
73957	D	1	REVISED PER ER	-	JC	JC	HAMPEL	12-03-9
		2	SEE SHEET 2	-	JC	JC	HAMPEL	12-03-9
74774	E	1	RELEASE -02	-	JC	JC	LOEHLEIN	03-20-9
74896	F	1	SEE SHEET 2	-	JC	JC	LOEHLEIN	04-09-9
76286	G	1	REVISED PER ER	-	CC	BG	LOEHLEIN	12-09-9

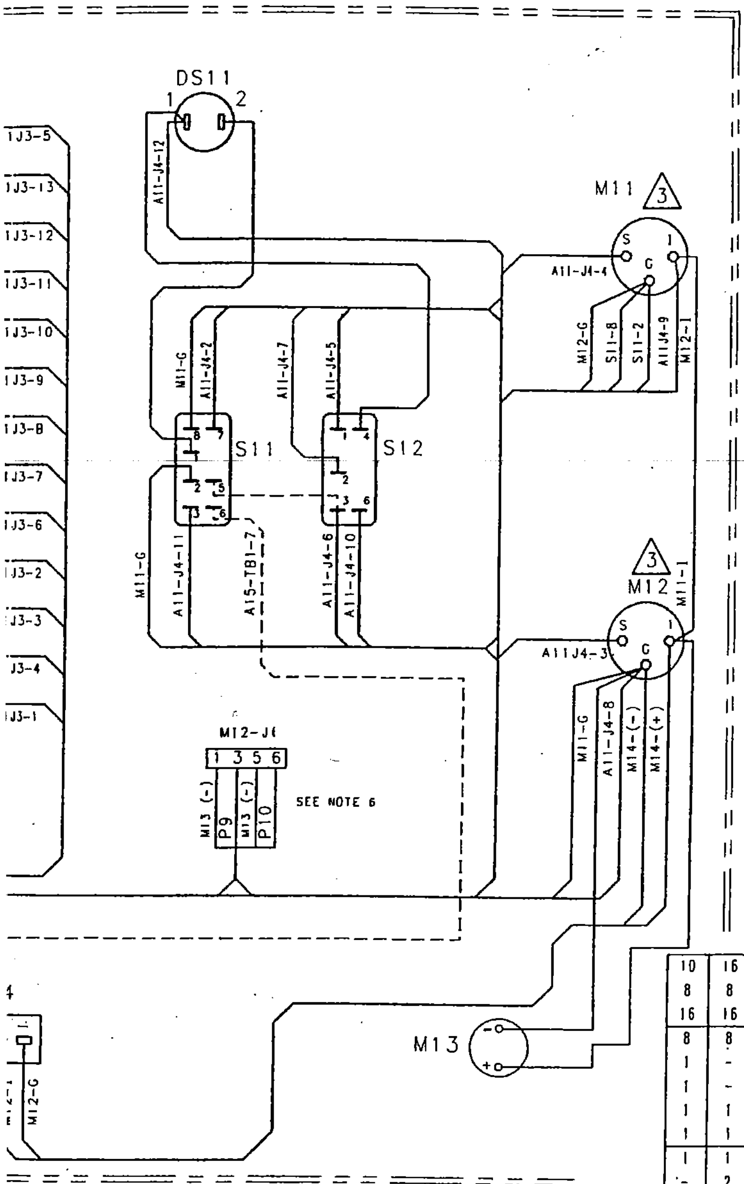


DIAGRAM FOR ALTERNATE SENDER PACKAGE

NOTES:

1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION.
2. ILLUSTRATION NUMBERS REFER TO DWG. NO. 539-0741.
3. GAUGE RESISTORS R12,13 (ILLUS #88) ARE USED ON 24V (-02) VERSION ONLY. MOUNT BEFORE ATTACHING HARNESS.
4. TIE ALL UNUSED LEADS INTO HARNESS
5. DASHED LEADS INDICATE WHEN USED.
6. M12-J1 USED FOR SPARK IGNITED PRODUCT.
7. WATER TEMPERATURE GAUGE IS WIRED TO F3 FOR CONTINUOUS OPERATION FOR SPARK IGNITED PRODUCT.

REF DES	PART NO	DWG SIZE	QTY.	DESCRIPTION
S6				THERMOSTAT (PRE-HET)
S5				SWITCH-PRESS (PRE-LOP)
S4				SWITCH LOW ENGINE TEMP
S3				SWITCH-OVERSPEED
S2				THERMOSTAT (HET)
S1				SWITCH-OIL PRESS (LOP)
K4				STARTER PILOT SOLENOID
K1				FUEL SOLENOID
G1				ALTERNATOR
E2				SENDER-WATER TEMP
E1				SENDER-OIL PRESSURE
BT1				BATTERY-STORAGE
B1				STARTER & SOLENOID

ENGINE PARTS LIST ABOVE (SHOWN FOR REFERENCE ONLY)

QTY -03	QTY -02	QTY -01	ITEM	PART NO.	DWG SIZE	DESCRIPTION OR MATERIAL	REF DES	ILLUS NO
10	16	16	33	871-0010	-	NUT-HBMS (#10-32)		
8	8	8	32	850-0030	-	WASHER-LK (#10)		
16	16	16	31	526-0049	-	WASHER-FLAT (#10)		
8	8	8	30	526-0409	A	WASHER-NYLON		
1	-	-	29	300-4323	D	PCB ASSY-GAUGE		
1	-	-	26	338-3326	D	HARNESS-DC (VERT)		
1	1	1	27	853-0008	-	WASHER-ET LK (#10)		12
1	1	1	26	308-1011	B	SWITCH (WO/L)	S12	90
1	1	1	25	308-1010	B	SWITCH-ROCKER (W/L)	S11	89
-	2	-	24	193-0250	P	RESISTOR (GAUGE,24V)	R12,13	88
1	1	1	23	517-0131	A	PLUG-HOLE		87
1	1	1	22	302-2002	A	METER-TIME TOTALIZING	M14	80
-	1	-	21	302-1642	P	VOLTMETER (16-36V)	M13	79
1	-	1	20	302-1641	P	VOLTMETER (8-18V)	M13	79
1	1	1	19	193-0351	A	GAUGE-WATER TEMP	M12	78
1	1	1	18	193-0466	A	GAUGE-OIL PRESSURE	M11	77
-	1	-	17	322-0017	-	LAMP-PANEL (24V)		71
1	-	1	16	322-0004	P	LAMP-PILOT (12V)		71
1	1	1	15	322-0361	P	LIGHT-PANEL	DS11	70
1	1	1	14	098-7477	D	SILKSCREEN-PNL FR (DC)		
-	-	-	13	REF	A	RECTIFIER	CR1	
-	1	-	12	322-0360-02	D	LAMP ASSY (12LT,24V)	A12	59
1	-	1	11	322-0360-01	D	LAMP ASSY (12LT,12V)	A12	59
-	1	-	10	300-4297	D	PCB ASSY-ENGINE MONITOR (12LT,24V)	A11	58
1	-	1	9	300-4296	D	PCB ASSY-ENGINE MONITOR (12LT,12V)	A11	58
-	1	1	8	338-3252	D	HARNESS-DC (VERT)		57
2	2	2	7	870-0183	-	NUT-H W/ET (#6-32)		56
2	2	2	6	815-0385	A	SCREW-RHM (#6-32 X 1/2)(BLK ZINC)		55
1	1	1	5	301-9055-01	C	DOOR WLDMT-CONTROL (RH) (VERT)		51
3	3	3	4	821-5000-05	C	SCREW-HH SEMS (#10-32 X .50)		
4	4	4	3	815-0388	-	SCREW-RHM XREC THD CUT (#6-32 X 1/2)		18
2	1	1	2	870-0131	-	NUT HEX W/ET (#10-32)		11
1	1	1	1	332-0052	P	CLIP-WIRE (5/8")		10

TABULATION		
DASH NO.	CONTROL	BAT. VOLTS
-01	VERT.	12V
-02	VERT.	24V
-D3	VERT. GAS	12V

12 LIGHT DETECTOR

F CHARACTERISTICS (NO TOLERANCE)

APPROVED D. PRIEM

DATE 09-28-95

APPLIES TO UPPER LIMIT
APPLIES TO LOWER LIMIT
APPLIES TO BOTH LIMITS

DO NOT SCALE PRINT

TOLERANCE UNLESS OTHERWISE SPECIFIED

	NAME	DATE
DR	V. BECKMAN	09-28-95
CHKD / MFG	D. YOUNG	09-28-95
APPROVED	D. PRIEM	09-28-95

COPIED FROM 612-6488 0

THIRD ANGLE PROJECTION

MODEL FIRST USED ON DG

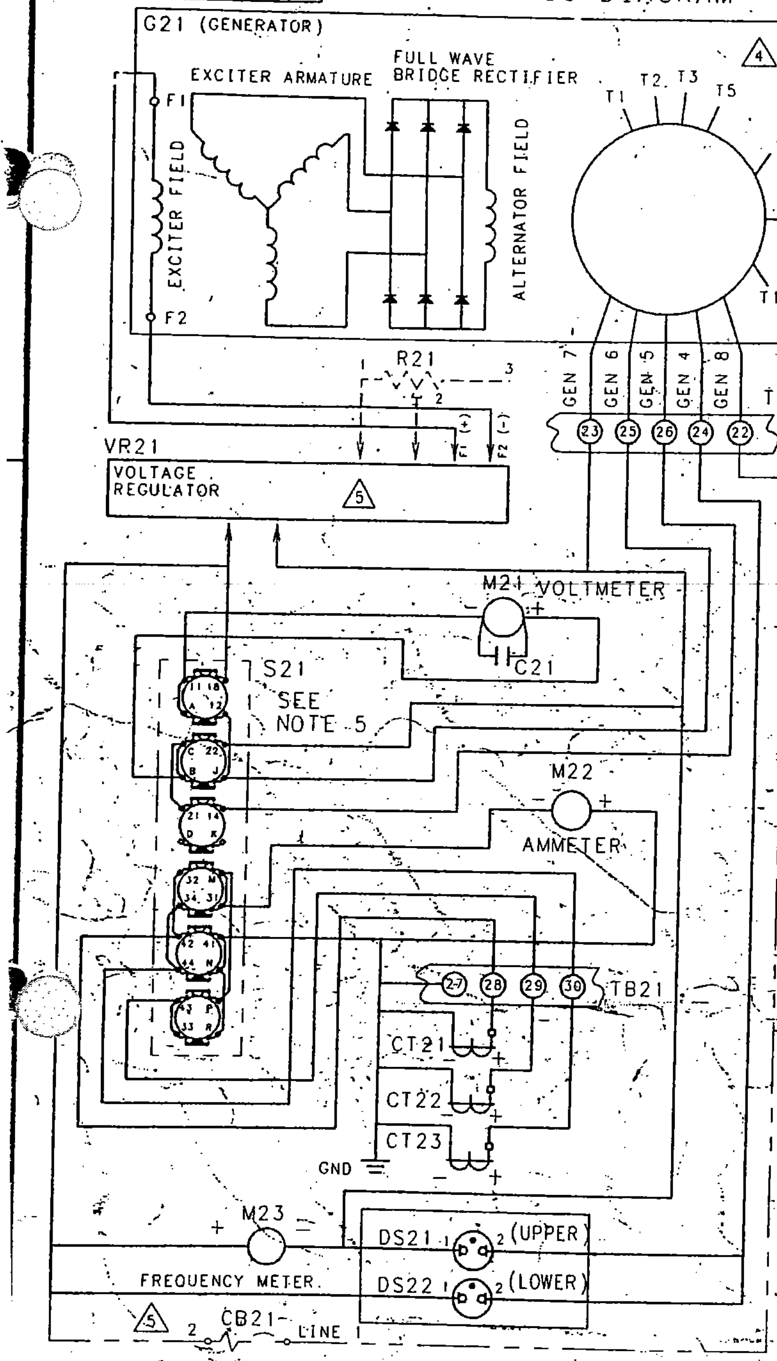
Cummins Onan

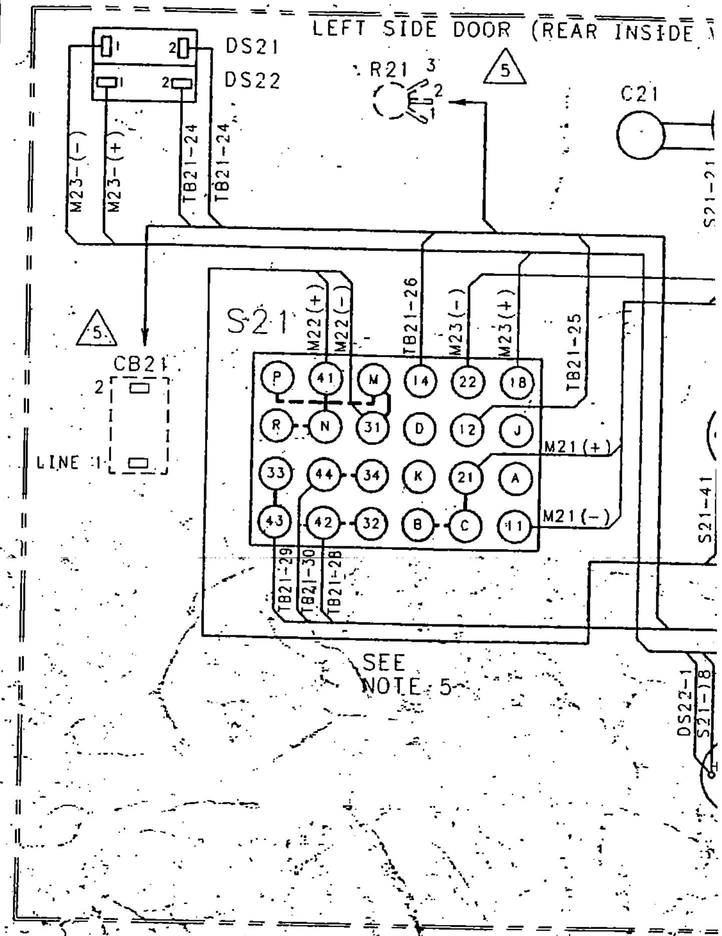
MINNEAPOLIS, MINNESOTA 55432

TITLE WD-GEN SET DC CONT

DWG NO 0612-6692 SHEET 1 of 2

SCHEMATIC DIAGRAM





C8

S21

POSITION	CONTACTS CLOSED				
L1-L2 3Ø	11-18	C-22	32-M	44-N	33-R
L2-L3 3Ø	A-12	C-22	44-N	42-41	43-P
L3-L1 3Ø	11-18	B-J	34-31	42-41	33-R
L1-L0 3Ø	11-18	21-14	44-N	42-41	33-R
OFF	—	—	44-N	42-41	33-R
L1-L2 1Ø	11-18	C-22	32-M	44-N	33-R
L1-L2 1Ø	11-18	C-22	44-N	42-41	43-P

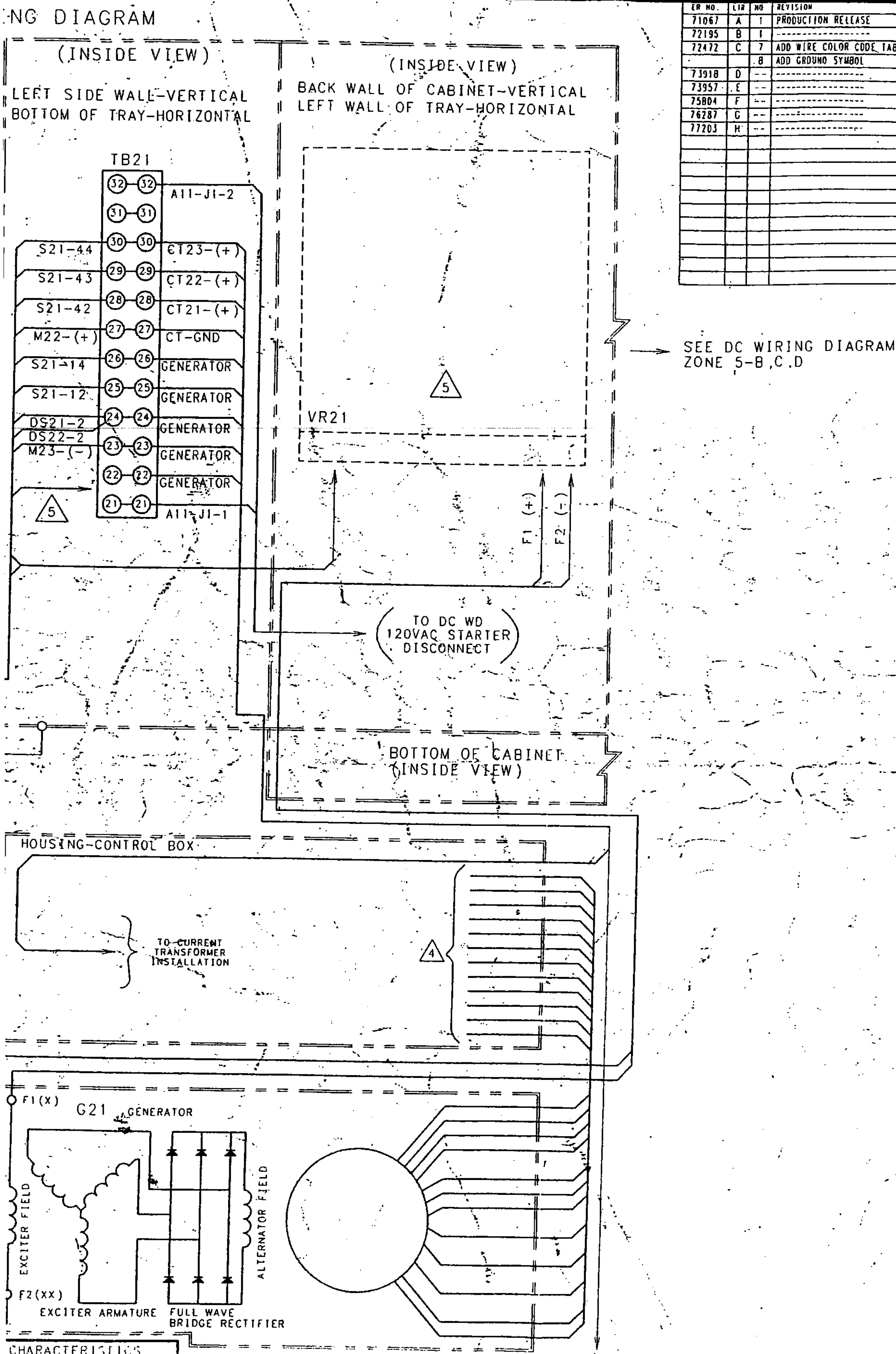
C7

TABULATION	
DESIGNATION	WIRE COLOR
CT21-1	PNK/BLK
CT22-1	PRP/BLK
CT23-1	ORN/BLK
CT COMMON	GRY/BLK
GEN 4	LT GRN/BLK
GEN 5	TAN/BLK
GEN 6	RED/BLK
GEN 7	YEL/BLK
GEN 8	DK BLU/BLK

CLASSIF
KEY INS
CRITICAL
MAJOR
MINOR (NONI
LINE BELOW
LINE ABOVE
ND LINE WI

REVISIO DWG

6 5 4



ER NO.	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
71067	A	1	PRODUCTION RELEASE	-	VDB	DAY	D.PRIEM	10-10-9
72195	B	I	-----------------	-	---	---	-------	-------
72472	C	7	ADD WIRE COLOR CODE TABULATION	5B	JC	DAY	D.PRIEM	03-19-9
		8	ADD GROUND SYMBOL	4B	JC	DAY	D.PRIEM	03-19-9
73918	D	--	-----------------	--	--	---	-------	-------
73957	E	--	-----------------	--	--	---	-------	-------
75804	F	--	-----------------	--	--	---	-------	-------
76287	G	--	-----------------	--	--	---	-------	-------
77203	H	--	-----------------	--	--	---	-------	-------

CHARACTERISTICS
O TOLERANCE)
APPROVED D. PRIEM
DATE 10-10-95
PPLIES TO UPPER LIMIT
PLIES TO LOWER LIMIT
PPLIES TO BOTH LIMITS

QTY | ITEM | PART NO. | DWG SIZE | DESCRIPTION OR MATERIAL | REF DES

DO NOT SCALE PRINT

ANG TOL ± ---
DRAWN TRUE SCALE OF ---

TOLERANCE UNLESS OTHERWISE SPECIFIED

	mm		Inch	
DIM	.X ±		.X ± ---	
	.X ±		.XX ± ---	
	.XX ±		.XXX ± ---	
HOLE	0.89- 4.99	+0.15/-0.08	.004-.700	+.006/-.003
	5.00- 9.99	+0.20/-0.10	.201-.421	+.008/-.004
	10.00-17.99	+0.25/-0.13	.422-.703	+.010/-.005
	17.50-24.99	+0.30/-0.13	.704-.999	+.012/-.005

SIM TO 612-6490 | D
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THIRD ANGLE PROJECTION

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FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982

MODEL FIRST USED ON DGCC

	NAME	DATE
DR	V. BECKMAN	10-10-95
CHKR / MFG	D. YOUNG	10-10-95
APPROVED	D. PRIEM	10-10-95

Cummins Onan

MINNEAPOLIS, MINNESOTA 55432

TITLE WD-GEN SET AC CONT

DOC NO 0612-6694

SHEET 2 of 2 | DWG SIZE D

6 5 4

0612-6694 D

TABULATION						
PART DASH NO.	VOLTS	ITEM 23 PART NO. (M21)	ITEM 24 PART NO. (M22)	AMMETER SCALE (M22)	CURRENT TRANSFORMER SECONDARY CONNECTION	ITEM 25 PART NO. (M23)
-01	<500V	302-1148	302-1975	(0-25,0-50)	0-25 (1-2),0-50 (1-3)	302-1968
-02	<500V	302-1148	302-1473	(0-50,0-100)	0-50 (1-2),0-100 (1-3)	302-1968
-03	<500V	302-1148	302-1147	(0-75,0-150)	0-75 (1-2),0-150 (1-3)	302-1968
-04	<500V	302-1148	302-1683	(0-100,0-200)	0-100 (1-2),0-200 (1-3)	302-1968
-05	<500V	302-1148	302-1684	(0-150,0-300)	0-150 (1-2),0-300 (1-3)	302-1968
-06	<500V	302-1148	302-1685	(0-200,0-400)	0-200 (1-2),0-400 (1-3)	302-1968
-07	<500V	302-1148	302-1724	(0-250,0-500)	0-250 (1-2),0-500 (1-3)	302-1968
-08	<500V	302-1148	302-1725	(0-375,0-750)	0-375 (1-2),0-750 (1-3)	302-1968
-09	<500V	302-1148	302-1726	(0-400,0-800)	0-400 (1-2),0-800 (1-3)	302-1968
-10	120V	302-1148	302-1685	(0-200,0-400)	0-400 (1-2),0-400 (1-3)	302-1992
-11	<500V	302-1148	302-1727	(0-500,0-1000)	0-500 (1-2),0-1000 (1-3)	302-1968
-12	<500V	302-1148	302-1728	(0-600,0-1200)	0-600 (1-2),0-1200 (1-3)	302-1968
-13	<500V	302-1148	302-1729	(0-750,0-1500)	0-750 (1-2),0-1500 (1-3)	302-1968
-14	<500V	302-1148	302-1798	(0-1000,0-2000)	0-1000 (1-2),0-2000 (1-3)	302-1968
-15	<500V	302-1148	302-1799	(0-1500,0-3000)	0-1500 (1-2),0-3000 (1-3)	302-1968
-16	<500V	302-1148	302-1800	(0-2000,0-4000)	0-2000 (1-2),0-4000 (1-3)	302-1968
-17	<500V	302-1148	302-1908	(0-3000,0-6000)	0-3000 (1-2),0-6000 (1-3)	302-1968
-18	<500V	302-1148	---	---	---	302-1968
-19						
-20						
-26	600V	302-1753	302-1975	(0-25,0-50)	0-25 (1-2),0-50 (1-3)	302-1968
-27	600V	302-1753	302-1473	(0-50,0-100)	0-50 (1-2),0-100 (1-3)	302-1968
-28	600V	302-1753	302-1147	(0-75,0-150)	0-75 (1-2),0-150 (1-3)	302-1968
-29	600V	302-1753	302-1683	(0-100,0-200)	0-100 (1-2),0-200 (1-3)	302-1968
-30	600V	302-1753	302-1684	(0-150,0-300)	0-150 (1-2),0-300 (1-3)	302-1968
-31	600V	302-1753	302-1685	(0-200,0-400)	0-200 (1-2),0-400 (1-3)	302-1968
-32	600V	302-1753	302-1724	(0-250,0-500)	0-250 (1-2),0-500 (1-3)	302-1968
-33	600V	302-1753	302-1725	(0-375,0-750)	0-375 (1-2),0-750 (1-3)	302-1968
-34	600V	302-1753	302-1726	(0-400,0-800)	0-400 (1-2),0-800 (1-3)	302-1968
-35	600V	302-1753	302-1727	(0-500,0-1000)	0-500 (1-2),0-1000 (1-3)	302-1968
-36	600V	302-1753	302-1728	(0-600,0-1200)	0-600 (1-2),0-1200 (1-3)	302-1968
-37	600V	302-1753	302-1729	(0-750,0-1500)	0-750 (1-2),0-1500 (1-3)	302-1968
-38	600V	302-1753	302-1798	(0-1000,0-2000)	0-1000 (1-2),0-2000 (1-3)	302-1968
-39	600V	302-1753	302-1799	(0-1500,0-3000)	0-1500 (1-2),0-3000 (1-3)	302-1968
-40	600V	302-1753	302-1800	(0-2000,0-4000)	0-2000 (1-2),0-4000 (1-3)	302-1968
-41	600V	302-1753	302-1908	(0-3000,0-6000)	0-3000 (1-2),0-6000 (1-3)	302-1968
-42						
-43						
-44						
-45						
-81	MV4160	302-1938	302-1975	(0-25,0-50)	0-25 (1-2),0-50 (1-3)	302-1968
-82	MV4160	302-1938	302-1473	(0-50,0-100)	0-50 (1-2),0-100 (1-3)	302-1968
-83	MV4160	302-1938	302-1147	(0-75,0-150)	0-75 (1-2),0-150 (1-3)	302-1968
-84	MV4160	302-1938	302-1683	(0-100,0-200)	0-100 (1-2),0-200 (1-3)	302-1968
-85	MV4160	302-1938	302-1684	(0-150,0-300)	0-150 (1-2),0-300 (1-3)	302-1968
-86	MV4160	302-1938	302-1685	(0-200,0-400)	0-200 (1-2),0-400 (1-3)	302-1968
-87	MV4160	302-1938	302-1724	(0-250,0-500)	0-250 (1-2),0-500 (1-3)	302-1968
-88	MV4160	302-1938	302-1725	(0-375,0-750)	0-375 (1-2),0-750 (1-3)	302-1968
-89	MV4160	302-1938	302-1726	(0-400,0-800)	0-400 (1-2),0-800 (1-3)	302-1968
-90	MV4160	302-1938	302-1727	(0-500,0-1000)	0-400 (1-2),0-400 (1-3)	302-1968
-91	MV4160	302-1938	302-1728	(0-600,0-1200)	0-600 (1-2),0-1200 (1-3)	302-1968
-92	MV4160	302-1938	302-1729	(0-750,0-1500)	0-750 (1-2),0-1500 (1-3)	302-1968
-93	MV4160	302-1938	302-1798	(0-1000,0-2000)	0-1000 (1-2),0-2000 (1-3)	302-1968
-94	MV4160	302-1938	302-1799	(0-1500,0-3000)	0-1500 (1-2),0-3000 (1-3)	302-1968
-95	MV4160	302-1938	302-1800	(0-2000,0-4000)	0-2000 (1-2),0-4000 (1-3)	302-1968
-96	MV4160	302-1938	302-1908	(0-3000,0-6000)	0-3000 (1-2),0-6000 (1-3)	302-1968
-97						
-98						
-99						

D1

F1

C6

NOTES:

1. ALL CO
2. ILLUST
3. LOCATE
   LEFT S
   LOCATE
   NEAR B
4. SEE GE
5. SEE VO
   TO VR2
6. TERMIN
   ON THE

CI

CRIT

MAJC

MINC

LINE

LINE

NO L

REVISIO DWG

3 2 1

ER NO.	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
71067	A	1	PRODUCTION RELEASE	-	VDB	DAY	D.PRIEM	10-10-95
72195	B	1	ITEM 15 WAS 0862-0015	2B	JC	DAY	D.PRIEM	02-14-96
72472	C	1	DELETE ITEM 4, WAS 0508-0001	2A	JC	DAY	D.PRIEM	03-19-96
		2	ITEM 14 QUANITY WAS 5	2A	JC	DAY	D.PRIEM	03-19-96
		3	CHANGE ITEM 15, WAS 0815-0905-07	2B	JC	DAY	D.PRIEM	03-19-96
		4	ITEM 18 WAS 0301-9054-04	2D	JC	DAY	D.PRIEM	03-19-96
		5	ADD ITEMS 40,41 & 42 TO PARTS LIST	2C	JC	DAY	D.PRIEM	03-19-96
		6	REVISED NOTE 3	4C	JC	DAY	D.PRIEM	03-19-96
		7	SEE SHEET 2	-	JC	DAY	D.PRIEM	03-19-96
73918	D	1	ADD -10 TO TABULATION	6B	JC	DAY	LOEHLEIN	11-22-96
		2	ADD "SEE TAB" TO ITEM 25	2B	JC	DAY	LOEHLEIN	11-22-96
		3	ADD ITEM 43 TO PARTS LIST	2C	JC	DAY	LOEHLEIN	11-22-96
73957	E	1	REVISED PER ER	--	JC	DAY	NAMPEL	12-17-96
75804	F	1	ADDED -18 TO TABULATION	6C	CC	BG	TAL	09-22-97
76287	G	1	REVISED PER ER	--	CC	BG	TAL	12-09-97
77203	H	1	RMV ITEM 3 (850-0045, QTY 4)	2A	CC	BG	TAL	04-22-98
		2	ITEM 14, 821-0014, WAS 800-0024	2A	CC	BG	TAL	04-22-98
		3	ITEM 16 (856-0008) QTY 2 WAS 1	2B	CC	BG	TAL	04-22-98

N IN DE-ENERGIZED POSITION.

S REFER TO DWG. NO. 539-0741.

(ITEM 42) ON INTERIOR OF
NY READILY VISIBLE AREA AVAILABLE.
32) ON EXTERIOR OF LEFT SIDE DOOR
ASP.

CTION DIAGRAM FOR INPUT CONNECTIONS.

OR INSTALLATION FOR CONNECTIONS
D TB21.

N THE TOP AND TERMINAL 11 TO BE

D3 C5 D2 C4 H3 C3 B1 H2 C2 C1 H1

QTY	ITEM	PART NO	DWG SIZE	DESCRIPTION OR MATERIAL	REF DES	
1	43	0821-5000-05	C	SCREW-HH SEMS (#10-32 X .50)		
1	42	0098-5387-01	B	LABEL-DANGER 3		
6	41	0870-1220	-	NUT- 4-40	M21,22,23	
	40					
1	39	0098-5298	D	SILKSCREEN-PNL FR (AC)		
1	38	0338-3429	C	HARNESS-TB21		
3	37	0815-0875-02	A	SCREW-RHM (M4 X .7 X 8C)		
	36					
1	35	0355-0189	A	CAPACITOR ASSY	C24	44
-	34	REF	-	TRANSFORMER ASSY-CUR	CT21-23	
-	33	REF	-	GENERATOR	G21	
1	32	0098-5387	B	LABEL-DANGER 3		
-	31	REF	-	INSTL-VOLTAGE REGULATOR	VR21	43
2	30	0815-0901-06	-	SCREW-XREC THD CUT (#6-32 X 5/8)		42
1	28	0332-2723	A	MARKER STRIP		41
1	28	0308-1052	C	SWITCH-ROTARY (VOLT & AMMETER)	S21	40
1	27	0853-0008	-	WASH-ET LK (#10)		39
-	26	REF	-	POTENTIOMETER (VOLTS ADJUST)	R21	38
1	25	SEE TAB	B	METER-FREQUENCY (45-65 HZ)	M23	33
1	24	SEE TAB	C	AMMETER-AC (SEE TAB)	M22	32
1	23	SEE TAB	B	VOLTMETER-AC (0-750)	M21	31
1	23	SEE TAB	B	VOLTMETER-AC (0-300,0-600)	M21	31
1	22	0322-0363	P	LAMP ASSY (UPPER/LOWER SCALE)	DS21-22	30
-	21	REF	-	CIRCUIT BREAKER-MAG (FIELD)	CB21	29
1	20	0338-2278	D	HARNESS-AC (VERT)		25
-	19	REF	-	PART OF AC HARNESS	TB21	25
1	18	0301-9054-01	D	DOOR WLDMT-CONTROL (LH) VERT		21
	17					
2	16	0856-0008	-	WASHER-EIT LK (5/16)		17
	15					
5	14	0821-0014	P	SCREW-LK HD (WHIZLOCK) (5/16-18 X .50)	K4	15
1	13	0337-0049	A	BOND-STRAP		14
1	12	0526-0018	-	WASHER-FLAT (1/4")		13
1	11	0871-0015	A	NUT-HEX (1/4-20)		12
1	10	0870-0131	-	NUT-H W/ET (#10-32)		11
1	9	0332-0052	P	CLIP-WIRE (5/8")		10
2	8	0406-0334	A	WASHER-STUD RTNR		9
2	7	0406-0333	A	STUD-FASTENER		8
2	6	0406-0332	A	RECEPTACLE-FASTENER		7
1	5	0508-0051	A	GROMMET (2")		6
4	4	0821-5000-05	C	SCREW-HH SEMS (#10-32 X .50)		
	3					1
4	2	0402-0527	B	ISOLATOR-VIBRATION		
1	1	0319-3030	C	BOX WLDMT-CONTROL (VERT)		1

OF CHARACTERISTICS
(NO TOLERANCE)

APPROVED D. PRIEM
DATE 10-10-95

APPLIES TO UPPER LIMIT
APPLIES TO LOWER LIMIT
APPLIES TO BOTH LIMITS

DO NOT SCALE PRINT

ANG ERL ± ---
DRAWN TO SCALE OF ---

TOLERANCE UNLESS OTHERWISE SPECIFIED

	mm		inch	
DIM	X ±		.X ± ---	
	.X ±		.XX ± ---	
	.XX ±		.XXX ± ----	
HOLE	0.09- 4.99	+0.15/-0.08	.004-.200	+.006/-.003
	5.00- 9.99	+0.20/-0.10	.201-.421	+.008/-.004
	10.00-17.49	+0.25/-0.15	.422-.703	+.010/-.005
	17.50-24.99	+0.30/-0.13	.704-.999	+.017/-.005

SIM TO 612-6490 D

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THIRD ANGLE PROJECTION

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FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982

MODEL FIRST USED ON DGCC

	NAME	DATE
DR	V. BECKMAN	10-10-95
CHKR MFG	D. YOUNG	10-10-95
APPROVED	D. PRIEM	10-10-95

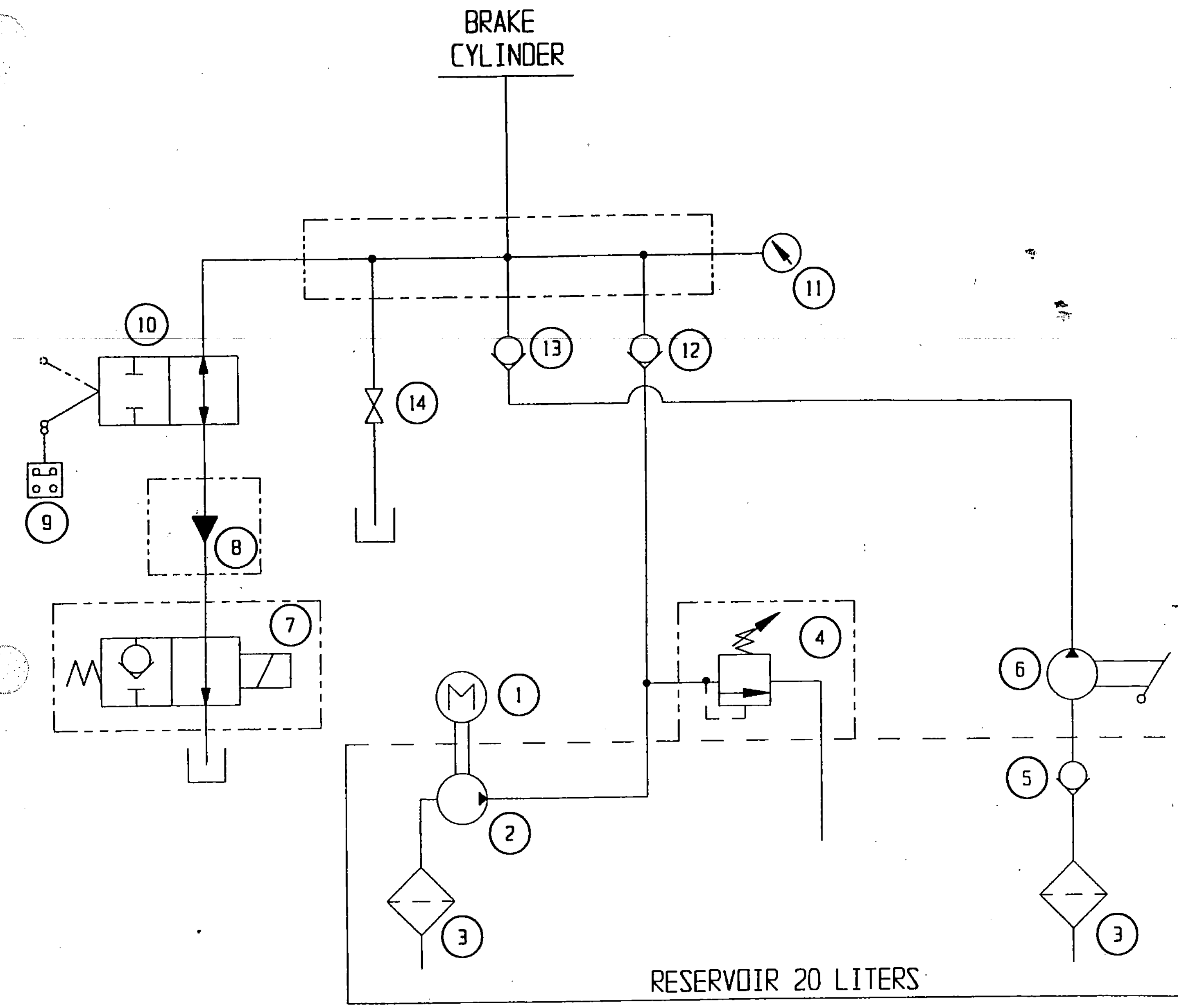
Cummins Onan

MINNEAPOLIS, MINNESOTA 55432

TITLE WD-GEN SET AC CONT

DWG NO 0612-6604

SHEET 1


BRAKE
CYLINDER
1
2
3
3
4
5
6
7
8
9
10
11
12
13
14
RESERVOIR 20 LITERS

INDEX	REQ'D	DESCRIPTION	MATERIAL	WT./ LBS.	REFERENCE	FORMAT
14	1	MANUAL DUMP VALVE			801 06 13	
13	1	CHECK VALVE			SRVVBLRWD	
12	1	CHECK VALVE			SRVVBLRWD	
11	1	PRESSURE GAUGE			0 A 400 BAR	
10	1	MANUAL STOP VALVE			801 06 13	
9	1	SWITCH			XCK M1 D10	
8	1	FLOW CONTROL VALVE			N10S	
7	1	SOLENOID VALVE			GS2-0 24 V	
6	1	HAND PUMP			PA 03-00/A	
5	1	CHECK VALVE			SRVZBLRWD 0.1 BAR	
4	1	PRESSURE RELIEF VALVE, 350 BAR			MVP 14H	
3	2	FILTER UCSE 1319			UCSE 1319	
2	1	PUMP			RM042	
1	1	ELECTRIC MOTOR 0.37 KW, 1800 RPM			LS71L2 480V/60HZ	

QUANTITY:
USED FOR:
DUE DATE:
PRODUCTION USE ONLY

REV	DESCRIPTION OF REVISION	DATE	BY

TOLERANCES • UNLESS INDICATED •

* FABRICATION *
FRACTIONAL ..... ±1/16
ANGULAR .... ±1/2°

* MACHINING *
DECIMAL W/.X ... ±.05
DECIMAL W/.XX .. ±.01
DECIMAL W/.XXX . ±.005
ANGULAR .... ±.1°

MODEL YEAR 1998

HYDRAULIC SCHEMATIC

ETHYWAG SINGLE BRAKE

TREATMENT:
TOTAL WT./LBS.: /
MARKING REQ'D.:
QTY. REQ'D.:
MARK LOCATION:
OTHER REF.:

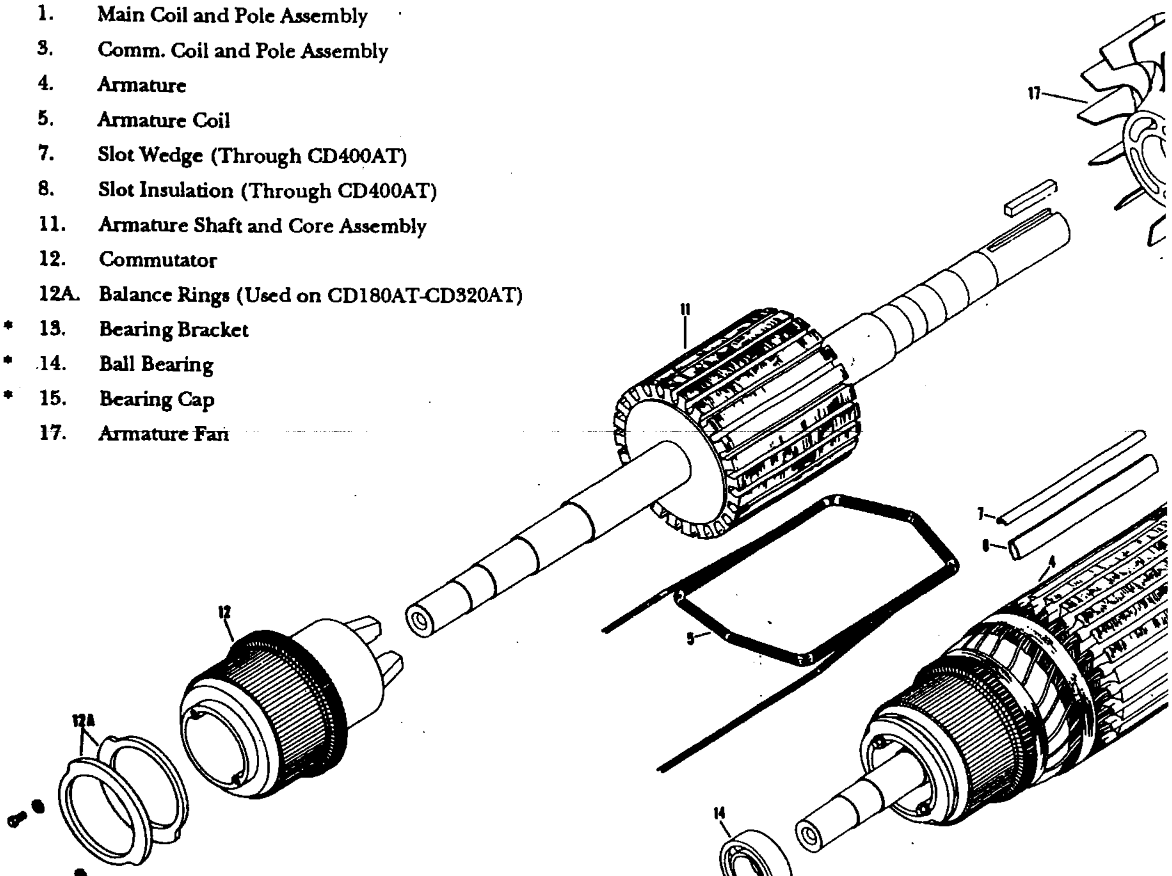
CABLE TRANSPORT SYSTEMS
SKILIFTS CHAIRLIFTS GONDOLAS TRAMWAYS
POMA OF AMERICA
GRAND JUNCTION COLORADO, USA

DRAWN BY: J.COPELAND
DESIGNED BY: J.COPELAND
DATE: 3/9/99
SCALE(S): NONE

FORMAT	DRAWING NUMBER	REVISION
B	3038.877	/

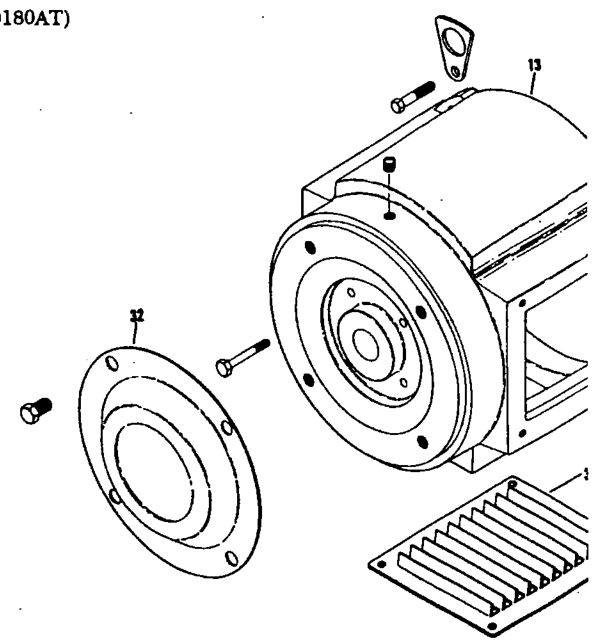
Ref. No. | **Description**

1. Main Coil and Pole Assembly
3. Comm. Coil and Pole Assembly
4. Armature
5. Armature Coil
7. Slot Wedge (Through CD400AT)
8. Slot Insulation (Through CD400AT)
11. Armature Shaft and Core Assembly
12. Commutator
12A. Balance Rings (Used on CD180AT-CD320AT)
* 13. Bearing Bracket
* 14. Ball Bearing
* 15. Bearing Cap
17. Armature Fan



Commutator End

18. Brush Rigging (Includes Complete Assembly for CD180AT)
    20. Brushholder Yoke
    21. Brushholder Stud
        (Includes Insulator on CD500AT)
    22. Brushholder
        (With Pressure Spring and Clip, if needed)
    23. Brushholder Spring
    24. Carbon Brush
26. Conduit Box
29. Conduit Box Adaptor
* 30. Bearing Bracket Covers
    (Specify side, bottom or top)
32. Shaft Cover
34. Conduit Box Gasket
38. Bearing Retaining Ring
    (Used on CD360AT-CD500AT Drive End Only)



* Specify whether for drive end or commutator end.

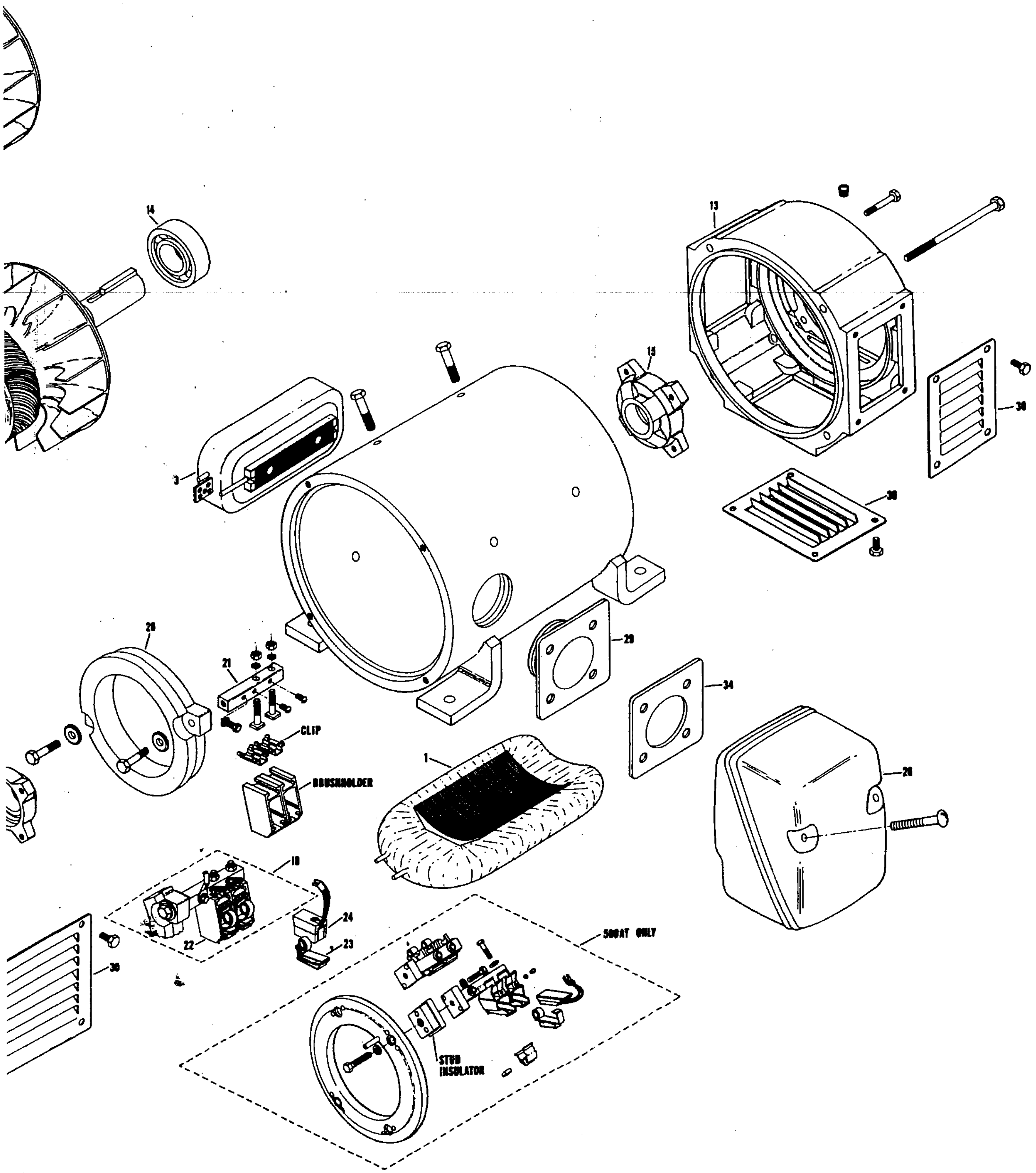


Fig. 11 CD210AT - CD500AT Frames, Exploded View