FOOD MAKERS BAKERY EQUIPMENT

AUTOMATIC PAN GREASER & EGG WASH SPRAYER

SPG - FA - E

OWNERS MANUAL

Food Makers Bakery Equipment
16019 Adelante Street
Irwindale, CA 91702

Phone: 626-358-1343
www.FMBE.COM

CERTIFICATION

Food Makers Bakery Equipment certifies that this machine was thoroughly tested and inspected and found to meet its design specifications when it was shipped from the factory.

WARRANTY

All FMBE products are warranted against defects in materials and workmanship. This warranty applies for one year warranty for defective parts replacement only.

FMBE will repair or replace parts which prove to be defective during the warranty period. This warranty does not include service or replacement parts necessitated by or in any way, directly or indirectly resulting from alteration, misuse, abuse, tampering, improper repairs, including but not limited to:

1. Use with defective or inadequate electrical circuits.
2. Loose or blown fuses or tripped circuit breakers.
3. Use with voltage and current other than that stated on motor nameplate.
4. Failure to follow instruction outlines in this manual.
5. Failure to comply with local electrical or building codes.
6. Use of products that must be heated in order to liquefy which may cause such product to solidify in the pump and lines.
7. Belts or chains which become bent or damaged due to abuse
8. Pump diaphragms which become damaged due to running unit with no product
9. FMBE will cover regular ground shipping costs for replacement or repair of parts covered by warranty. Expedited shipping costs will be the responsibility of the customer.

Such repair, replacement, or adjustment is not covered by this warranty and charges shall be made for the part(s) and for the service labor required.

The provisions herein contained express the sole and entire liability of the Food Makers Bakery Equipment, Inc. and provide the exclusive remedy against the company with respect to each of its products. FMBE neither assumes, nor authorizes any other person to assume for it, any obligation or liability in connection with their products.

Unpacking and inspection:

Inspect the machine for damage (scratches, dents, broken controls, etc.). If the machine is damaged, notify the freight carrier immediately. Retain the shipping carton and the packing material for the carrier's inspection.

Installation:

The FMBE SPG-FA Series Automatic Pan Greasing Machines require no assembly. However, it is necessary that you check the voltage and current rating before placing the machine into operation.

Voltage and Current Rating:

Unit is 120 VAC electric requirements. Before connecting your machine to the power source, check that the voltage and current rating of the power source matches the voltage and current rating of the electric motor on your machine.

BALDOR VARIABLE SPEED CONTROLLERS

- PLEASE SEE MANUFACTURERS MANUAL (ATTACHED BELOW) FOR OPERATION & MAINTENANCE.

HYDRACELL SPRAY PUMP

- PLEASE SEE MANUFACTURERS MANUAL (ATTACHED BELOW) FOR OPERATION & MAINTENANCE.

This pump is rated at 100 PSI @ 1750 RPM and 3 gallons per minute flow.

1. Do not block discharge from the pump.
    - Do not completely close pressure control valve as this can block discharge from the pump

2. Do not starve intake to the pump.
    - Pump must have some type of lubricant running through it at all times when in operation.

3. Blocking discharge and/or starving intake can damage the diaphragm inside the pump and result in no pressure being produced.
    - Damaged diaphragms are not warranted, be sure unit is not operated without oil or other product.

4. Periodically check if there is sufficient lubricant oil in the pump. The oil is food grade oil. In the event there is a leak in the diaphragm, there will be no contamination.

    PLEASE SEE MANUFACTURERS MANUAL (ATTACHED BELOW) FOR OPERATION & MAINTENANCE.

5. It is highly recommended that the oil in the pump be replaced after every 1000 hours, using Hydra-Cell food grade oil #AO1-114-3410

    More oil information at www.hydra-cell.com

OPERATING INSTRUCTIONS

1. Fill the tank with pan grease to minimum 1/3 full

2. Turn the sprayer pump on at control box located at the front of machine. (pictorial item #1)

3. Be sure grease is being pulled into the pump, if not, shut off immediately.

4. Set the control valve, at the top of the hood to the desired spray pattern.

5. **NOTE:** The grease application is also controlled by the speed at which pans are passed through the machine and the size of the nozzles. The machines are equipped with Part #3P1471 nozzle tips at the factory.

   Nozzle Tips with a lighter or heavier spray are available upon request.

6. Adjust the pressure valve (pictorial item #29) and pump speed controller (pictorial item #1) until the spray pattern extends the full width of side wall at conveyor height.

   For less pressure, turn **pressure control** (pictorial item #29) counter-clockwise

   For more pressure, turn **pressure control** (pictorial item #29) clockwise

7. IMPORTANT! Do not turn **PRESSURE VALVE** completely off (pictorial item #29) as this will damage the pump diaphragm.

8. Turn the **CONVEYOR** switch on (pictorial item#2), and adjust the speed control knob (pictorial item#2) to the desired speed. Only adjust the speed while the conveyor is in operation.

   - PLEASE SEE ENCLOSED MANUFACTURERS MANUAL FOR FURTHER OPERATION INSTRUCTIONS AND MAINTENANCE.

NOZZLE TIP OPTIONS

	SPRAY PATTERN	NOZZLE	BAKING PAN TYPE
	LIGHT	PART NUMBER: **3P1470** STAMP ON TIP: **8001** GALLONS PER MINUTE: **0.094 - 0.12 GPM**	Bun Pans Sheet Pans
	MEDIUM	PART NUMBER: **3P1471** STAMP ON TIP: **8002** GALLONS PER MINUTE: **0.19 - 0.24 GPM**	Strapped Pans Cake Pans Straight Wall Pans
	HEAVY	PART NUMBER: **3P1472** STAMP ON TIP: **8003** GALLONS PER MINUTE: **0.28 - 0.37 GPM**	Muffin Pans Multiple Cavity Pans Strapped Pans

* **GPM (Gallons Per Minute) -** Capacity Per Nozzle

Other applications:

The FMBE SPG - FA Series Spray Machine may be also used to:

- Glaze sweet goods.
- Apply egg wash to rolls.
- Spray special cake icing.
- Spray any liquid to semi-solid product.

These functions are performed in the same manner as pan greasing (see Operation) except that the appropriate fill is substituted for the pan grease.

There are many products in the marketplace compatible for use with automatic spray machines that do not require heating or melting. Be sure to **never use product** which requires heating or melting, as this will damage the pump and plug the spray lines.

Grease

The FMBE SPG - FA Series Sprayer will accommodate different grease formulas,
but these must be flowable.

Cleaning:

1. Sprayer is completely washdown construction and can be hosed down with low pressure hose.

   NOTE: Do not use high pressure wash as this may cause damage.

2. Remove the tank and thoroughly empty

3. Fill the tank with clean, hot water

4. Remove the spray nozzle tips

5. Turn sprayer on and run water through spray lines

6. Wash the tank, conveyor belt and frame with soap and warm water

7. Inspect spray nozzles and confirm these are clean and not blocked

   Remove and wash line strainer (pictorial item #21) Unscrew bottom of filter and wash screen, hand tighten, use no tools

8. Re-install nozzles and filters and tighten them by hand

   NOTE: While tightening the nozzles, check that the slots in the nozzles are parallel with the front and back of the machine.

9. The machine is now ready for re-use.

FOOD MAKERS BAKERY EQUIPMENT

AUTOMATIC PAN GREASER & EGG WASH SPRAYER

SPG - FA - E

PARTS BREAKDOWN

Food Makers Bakery Equipment
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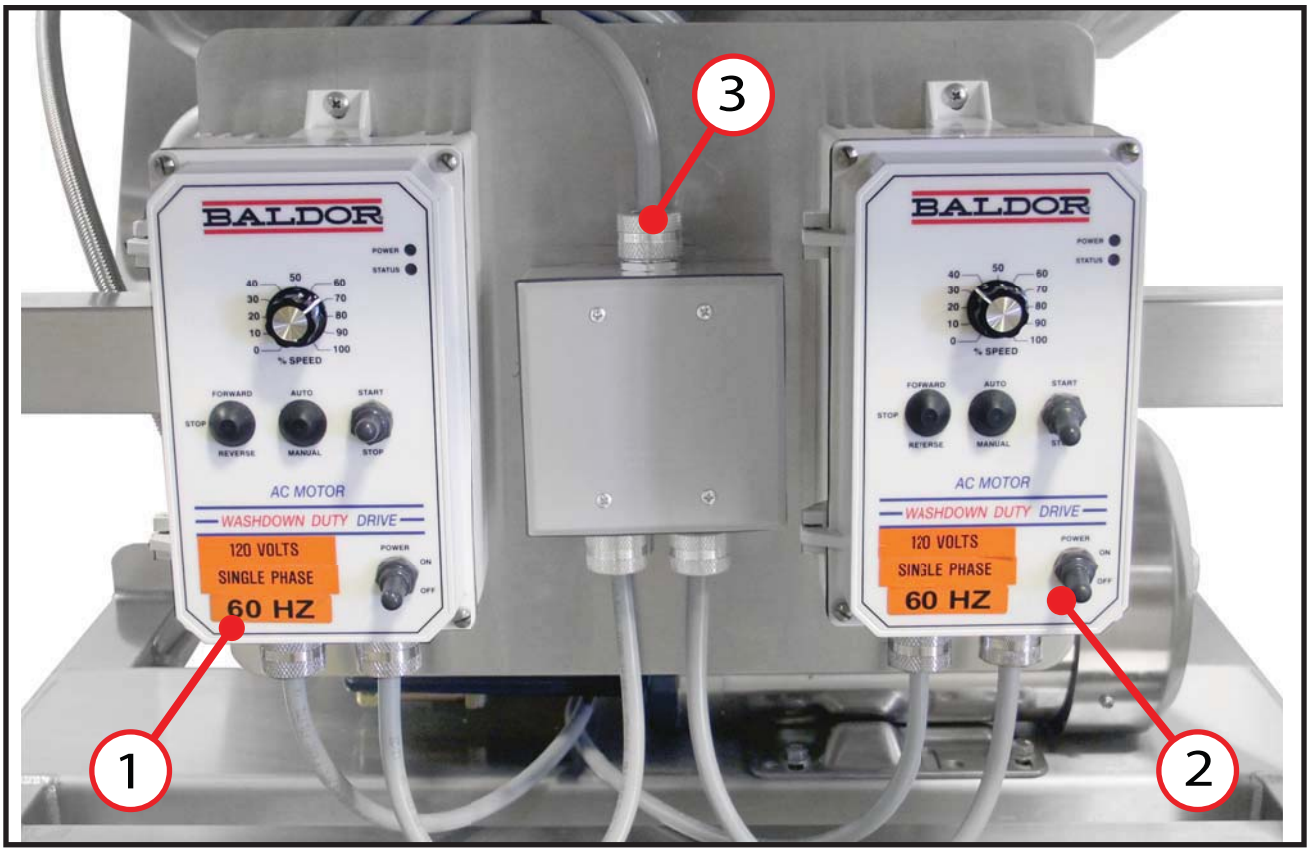
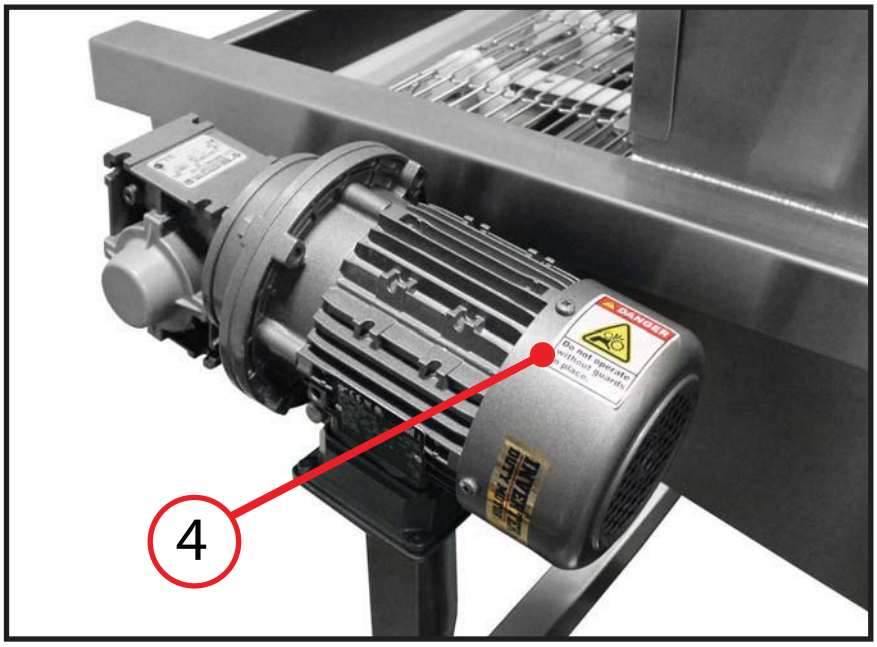
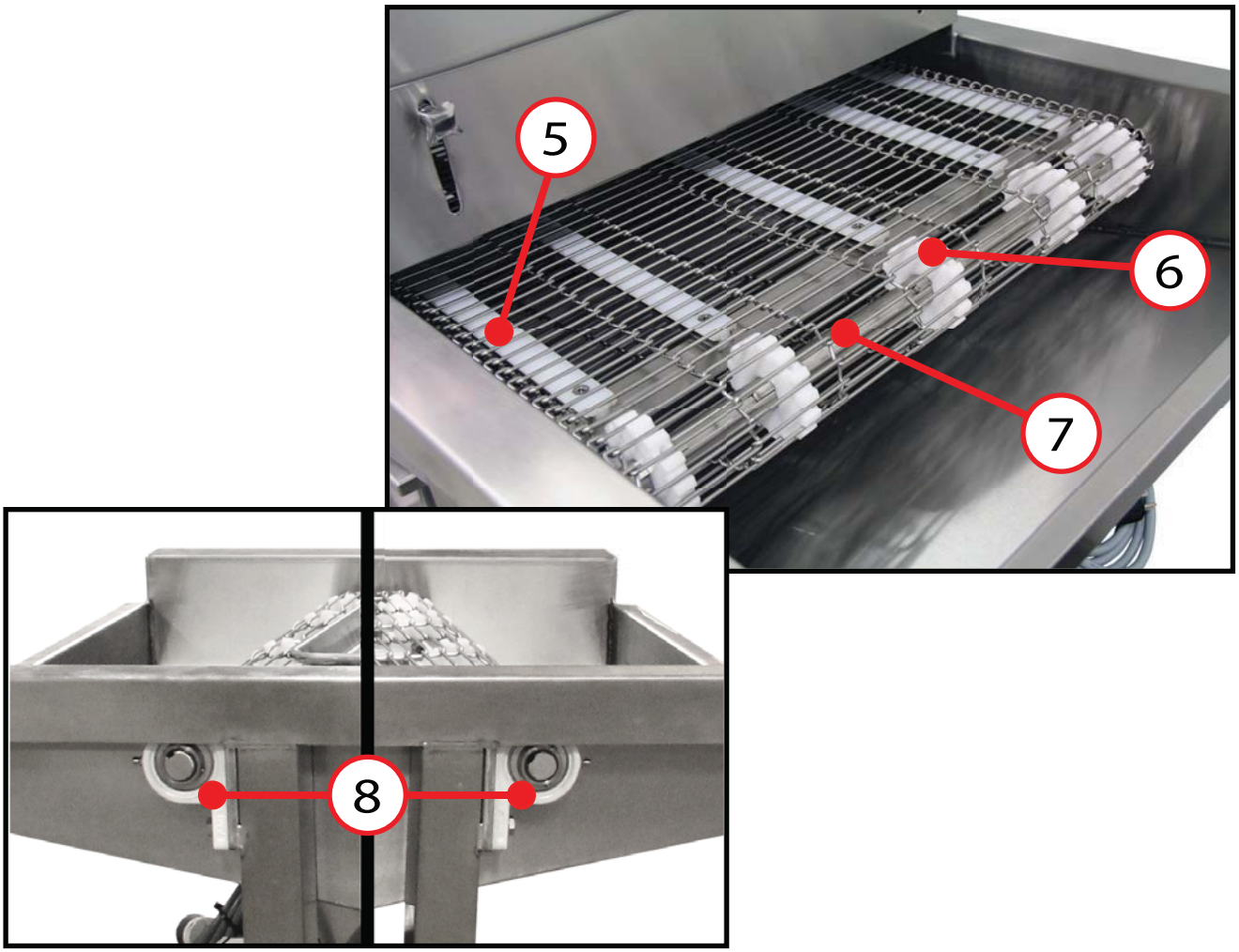
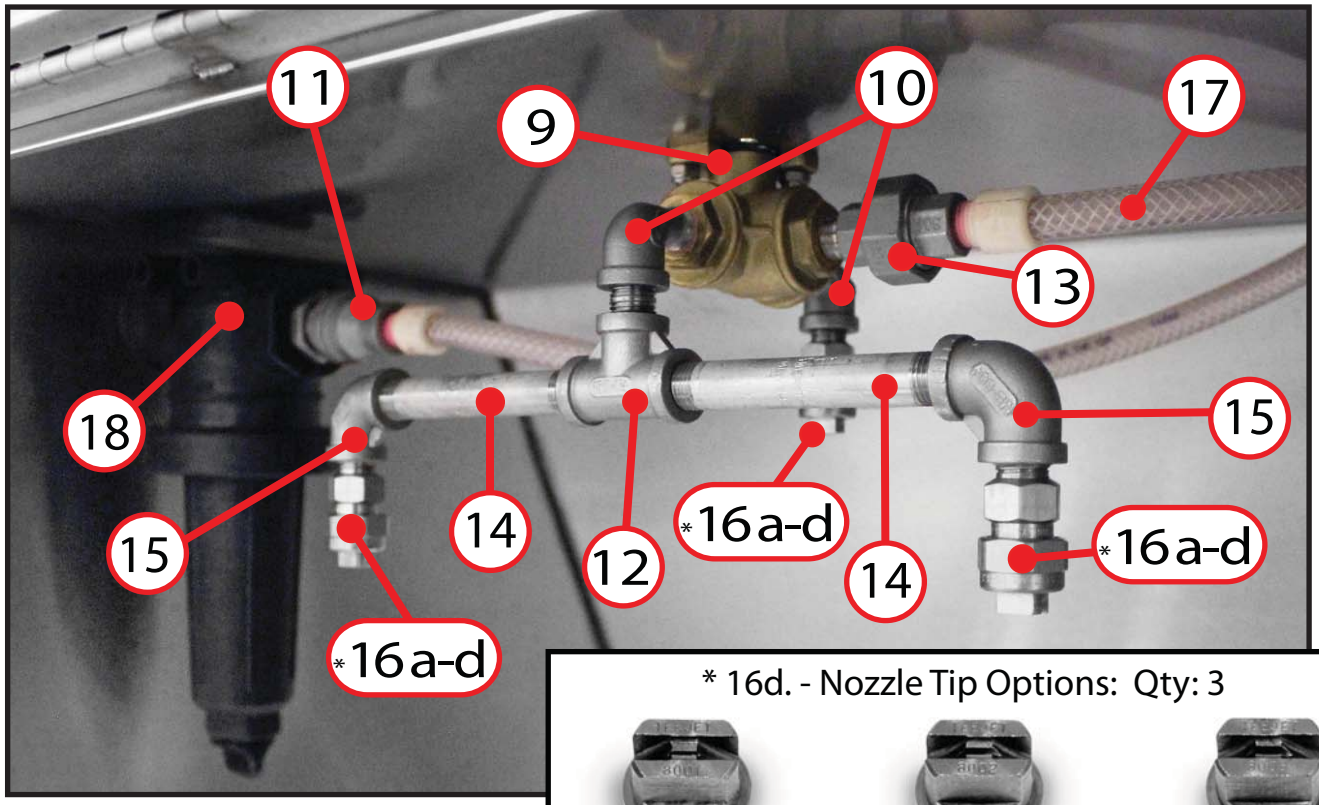


NO.	PART #	DESCRIPTION	QTY.
1.	4P2012	Baldor washdown inverter	1
2.	4P2012	Baldor washdown inverter	1
3.	6P1668	Cord connector 1/2”	8
4.	5P1574	Nord motor / Gearbox Combo w/NDS+	1





NO.	PART #	DESCRIPTION	QTY.
5.	1P1973	Conveyor guide rail -	5
6.	1P1974	Delrin Sprocket, 14-Tooth	10
7.	7P1474	Wire Belting 9' x 24"W 302 SS	
8.	4P2398	Pillow Block Thermoplastic 1" Bearing Unit	4

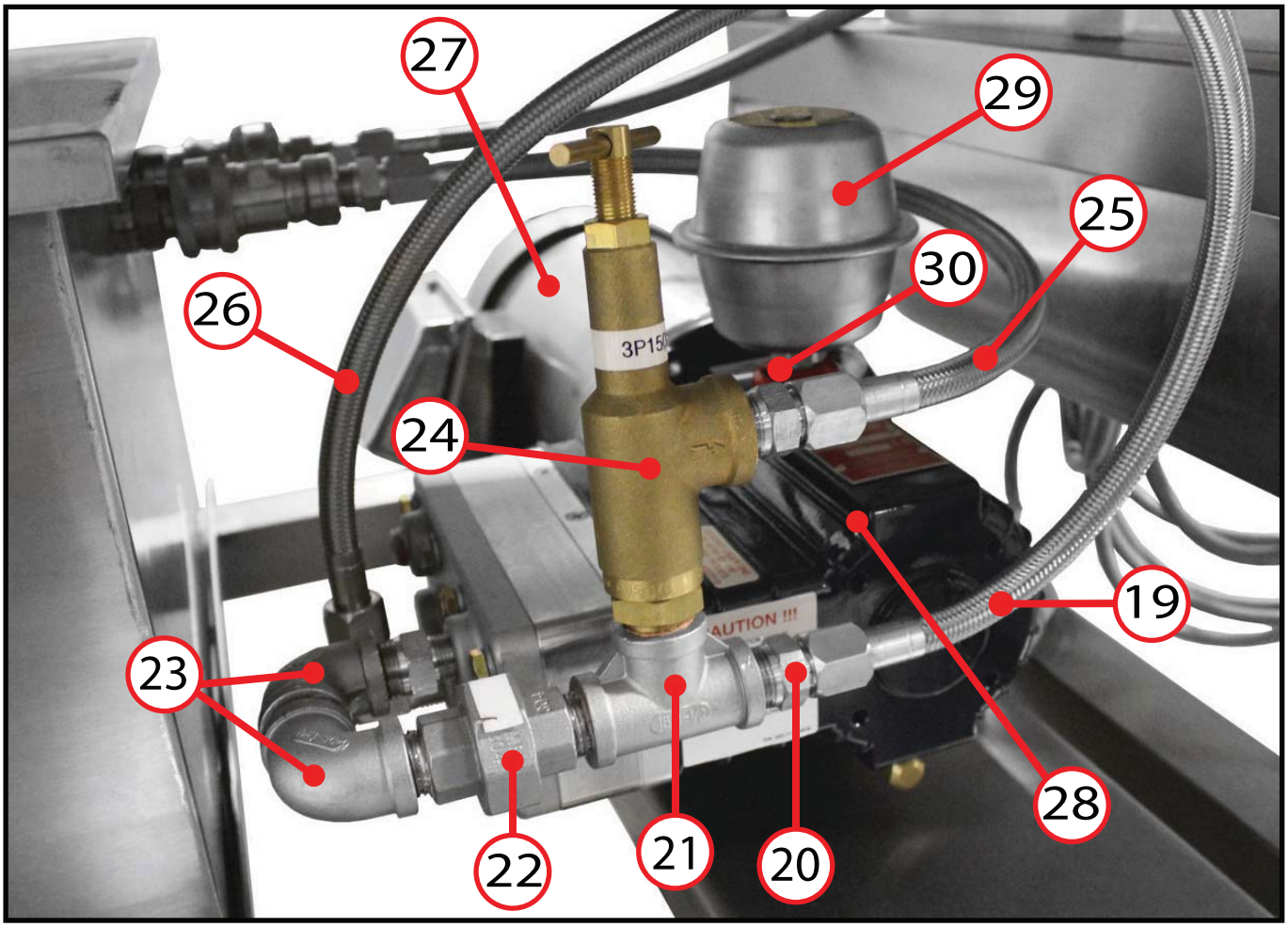


* 16d. Further information on nozzle tip can be found on page 4

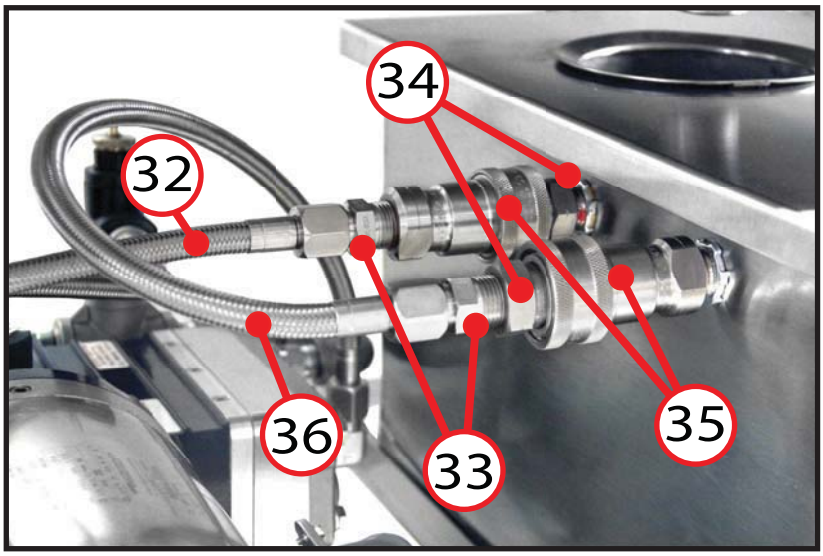
* 16d. - Nozzle Tip Options: Qty: 3

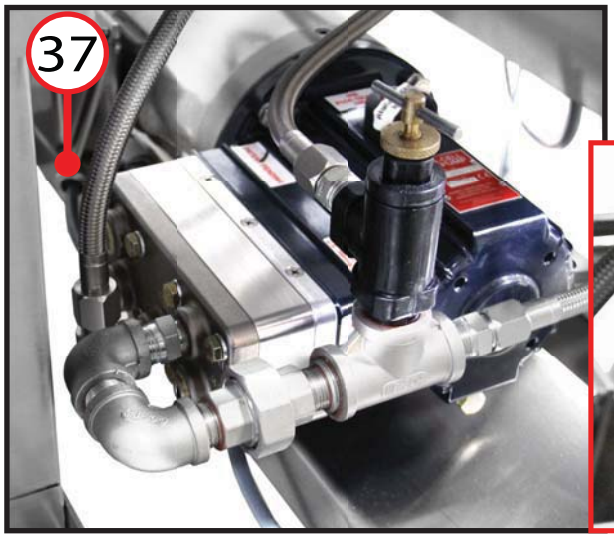
Light - 3P1470 Medium - 3P1471 Heavy - 3P1472

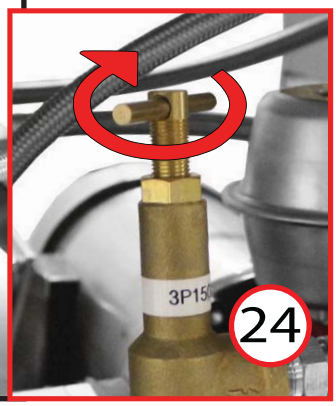
NO.	PART #	DESCRIPTION	QTY.
9.	3P1384	3 Port Brass Ball Valve	1
10.	2P2676	1/4" Pipe, 90 Degree Elbow	2
11.	3P1545	1/2 X 1/4" Reducing Coupling	2
12.	2P2489	Thrd pipe Fitting 1/2" pipe sz Tee	1
13.	2P2962	SS 1/4" pipe union, 1000PSI	1
14.	2P2678	Thrd Pipe Nipple 1/4" Pipe X 4" Length	2
15.	2P2490	Thrd pipe Fitting 1/4" pipe sz 90 deg.	2
16a.	3P1473	SS Cap	3
16b.	3P1474	SS Body 1/4TT	3
16c.	3P1475	SS Strainer	3
17.	3P1488	Hose w/ Fittings 24" Length 1/4 id 1/2" od	1
18.	3P1446	T-strainer W/drain Plug, 50 Mesh, 3/4 Npt Female	1



NO.	PART #	DESCRIPTION	QTY.
19.	1P2023	Hose teflon PTFE with stainless - 1/2", 55" length	1
20.	2P4392	Hex Reducer bushing 3/4m x 1/2f	5
21.	2P2492	SS 3/4" Pipe tee thrd pipe fit	1
22.	2P4334	SS 1/2" Pipe size, union, 150 P	1
23.	2P2495	Thrd pipe 1/2" sz 90 deg elbow	5
24.	3P1500	Pressure Relief Valve 1/2 - 300 psi	1
25.	1P1931	Hose teflon PTFE with stainles - 1/2" , 20" length	1
26.	1P1930	Hose teflon PTFE with stainles - 1/2" , 24" length	1
27.	5P1486	S.S. motor 1HP, 1800 rpm, 56c	1
28.	3P1439	Hydra-cell pump	1
29.	5P1934	Tirco Expansion Chamber 3/8" N	1
30.	2P6364	Wanner Red Cap	1







Turn Valve Clockwise
To Increase Pressure

NO.	PART #	DESCRIPTION	QTY.
9.	3P1384	3 Port Brass Ball Valve	1
19.	1P2023	Hose teflon PTFE with stainless - 1/2", 55" length	1
31.	1P1955	Stainless steel four-arm knob	5
32.	1P1931	Hose teflon PTFE with stainles - 1/2" , 20" length	1
33.	2P3267	MJ-MP Strt Fitting 1/2 x 1/2	6
34.	2P4044	S.S. Iso-b hose coupling, 303 SS, plug, 1/2	2
35.	2P4045	S.S. Iso-b hose coupling, 303 SS, sleve-lock Sckt, 1/2, 1/2	2
36.	1P1930	Hose teflon PTFE with stainles - 1/2" , 24" length	1
37.	6P4120	Cord connector 90 deg.	1

INSTALLATION & SERVICE

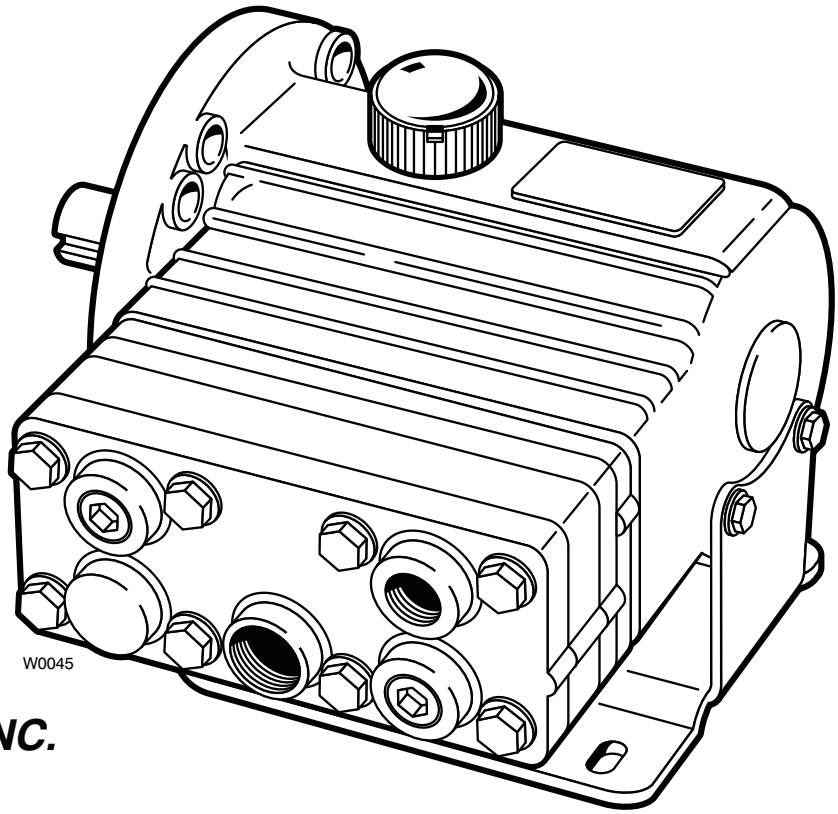
D03-991-2400A

Hydra-Cell®

INDUSTRIAL PUMPS

Models: D-03, G-03, G-13, M-03 and M-23

Kel-Cell and Standard Versions



W0045

WANNER ENGINEERING, INC.

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TOLL-FREE FAX [US only]: (800) 332-6812

www.hydra-cell.com
email: sales@wannereng.com

D/G-03 Maintenance

NOTE: The numbers in parentheses are the Ref. Nos. on the illustrations in the Parts Manual.

Daily

Check the oil level and the condition of the oil. The oil level should be 3/4 in. (20 mm) from the top of the fill port.

Use the appropriate Wanner Hydra-Oil brand motor oil for the application (contact Wanner Engineering if in doubt).

Caution: If you are losing oil but don't see any external leakage, or if the oil becomes discolored and contaminated, one of the diaphragms (17) may be damaged. Refer to the Service Section. Do not operate the pump with a damaged diaphragm.

Caution: Do not leave contaminated oil in the pump housing or leave the housing empty. Remove contaminated oil as soon as discovered, and replace it with clean oil.

Periodically

Change the oil after the first 100 hours of operation, then change according to the guidelines below. When changing, remove the drain plug (60). Allow all oil and contaminant to drain out.

Hours Between Oil Changes @ Various Process Fluid Temperatures

Pressure	RPM	<90°F (32°C)	<139°F (60°C)	<180°F (82°C)
Metallic Pump Head				
<800 psi (55 bar)	<1200	8,000	5,000	3,000
	<1800	4,000	3,000	2,000
<1200 psi (83 bar)	<1200	4,000	3,000	2,000
	<1800	2,000	1,500	1,000
Non-Metallic Pump Head				
<250 psi (17 bar)	<1200	4,000	3,000	—
	<1800	2,000	1,500	—

NOTE: Minimum oil viscosity for proper hydraulic end lubrication is 16-20 cST (80-100 SSU).

CAUTION: Do not turn the drive shaft while the oil reservoir is empty.

Use the appropriate Hydra-Oil for the application (contact Wanner Engineering if in doubt).

CAUTION: If you are losing oil but don't see any external leakage, or if the oil becomes discolored and contaminated, the diaphragm (17) may be damaged. Refer to the Fluid-End Service Section. Do not operate the pump with a damaged diaphragm.

CAUTION: Do not leave contaminated oil in the pump housing or leave the housing empty. Remove contaminated oil as soon as discovered, and replace it with clean oil.

Check the inlet pressure or vacuum periodically with a gauge.

CAUTION: Protect the pump from freezing. Refer also to the "Shutdown Procedure".

Shutdown Procedure During Freezing Temperatures

Take all safety precautions to assure safe handling of the fluid being pumped. Provide adequate catch basins for fluid drainage and use appropriate plumbing from drain ports, etc. when flushing the pump and system with a compatible antifreeze.

1. Adjust the discharge pressure regulating valve so the pump runs under minimum pressure. Stop the pump.
2. Drain supply tank; open any draincocks in system piping and collect drainage; remove plugs from manifold and collect drainage.
3. Close draincocks in system piping and replace manifold plugs.
4. Fill supply tank with enough antifreeze to fill system piping and pump.

   Note: disconnect the system return line from the supply tank and connect it to a separate reservoir.
5. Start the pump and allow it to run until the system is filled with antifreeze. Note: if the system has an air lock and the pump fails to prime, follow step 4 of the Initial Start-up Procedure to clear the air.
6. When mostly antifreeze is flowing from the system return line stop the pump. Connect the system return line back to the supply tank and circulate the antifreeze for a short period.
7. It is also good practice to change the oil in the Hydraulic End before storage for an extended period. This will remove any accumulated condensation and sediment from the oil reservoir. Drain and refill the Hydraulic End with the appropriate Hydra-Oil and operate the pump for a short period to assure smooth performance.

D/G-03 Troubleshooting

Cavitation

- Inadequate fluid supply because:
  - — Inlet line collapsed or clogged
  - — Clogged line strainer
  - — Inlet line too small or too long
  - — Air leak in inlet line
  - — Worn or damaged inlet hose
  - — Suction line too long
  - — Too many valves and elbows in inlet line
- Fluid too hot for inlet suction piping system.
- Air entrained in fluid piping system.
- Aeration and turbulence in supply tank.
- Inlet vacuum too high (refer to “Inlet Calculations”, page 3).

Symptoms of Cavitation

- Excessive pump valve noise
- Premature failure of spring or retainer
- Volume or pressure drop
- Rough-running pump
- Premature failure of diaphragms

Drop in Volume or Pressure

A drop in volume or pressure can be caused by one or more of the following:

- Air leak in suction piping
- Clogged suction line or suction strainer
- Suction line inlet above fluid level in tank
- Inadequate fluid supply
- Pump not operating at proper RPM
- Relief valve bypassing fluid
- Worn pump valve parts
- Foreign material in inlet or outlet valves
- Loss of oil prime in cells because of low oil level
- Ruptured diaphragm
- Cavitation
- Warped manifold from over pressurized system
- O-rings forced out of their grooves from over pressurization
- Air leak in suction line strainer or gasket
- Cracked suction hose.
- Empty supply tank
- Excessive aeration and turbulence in supply tank
- Cavitation
- Abrasives in the fluid
- Valve incompatible with corrosives in the fluid
- Pump running too fast
- Worn and slipping drive belt(s)
- Worn spray nozzle(s)

Pump Runs Rough

- Worn pump valves
- Air lock in outlet system
- Oil level low
- Wrong weight of oil for cold operating temperatures (change to lighter weight)
- Cavitation
- Air in suction line
- Restriction in inlet/suction line
- Hydraulic cells not primed after changing diaphragm
- Foreign material in inlet or outlet valve
- Damaged diaphragm
- Fatigued or broken valve spring

Premature Failure of Diaphragm

- Frozen pump
- Puncture by a foreign object
- Elastomer incompatible with fluid being pumped
- Pump running too fast
- Excess pressure
- Cavitation

Water (or Process Fluid) in Oil Reservoir

- Condensation
- Ruptured diaphragm
- Hydraulic cell not properly primed after diaphragm replacement
- Frozen pump

Strong Water (or Process Fluid) Pulsations

NOTE: Small pulsations are normal in single-acting pumps with multiple pumping chambers.

- Foreign object lodged in pump valve
- Loss of prime in hydraulic cell because of low oil level
- Air in suction line
- Valve spring (8) broken
- Cavitation
- Aeration or turbulence in supply tank

D/G-03 Troubleshooting

Valve Wear

- Normal wear from high-speed operation
- Cavitation
- Abrasives in the fluid
- Valve incompatible with corrosives in the fluid
- Pump running too fast

Loss of Oil

- External seepage
- Rupture of diaphragm
- Frozen pump
- Worn shaft seal
- Oil drain piping or fill cap loose.
- Valve plate and manifold bolts loose
- Pump housing porosity

Premature Failure of Valve Spring or Retainer

- Cavitation
- Foreign object in the pump
- Pump running too fast
- Spring/retainer material incompatible with fluid being pumped
- Excessive inlet pressure.

D/G-03 Installation

NOTE: The numbers in parentheses are the Reference Numbers on the illustrations in the Parts Manual.

Location

Locate the pump as close to the supply source as possible. Install it in a lighted clean space where it will be easy to inspect and maintain. Allow room for checking the oil level, changing the oil, and removing the pump head (manifold, valve plate and related items).

Mounting

The pump shaft can rotate in either direction. To prevent vibration, securely attach the pump (D-03, G-03) or motor (M-03, M-23, G-13) to a rigid base.

On a belt-drive system, align the sheaves accurately; poor alignment wastes horsepower and shortens the belt and bearing life. Make sure the belts are properly tightened, as specified by the belt manufacturer.

On a direct-drive system, align the shafts accurately. Unless otherwise specified by the coupling manufacturer, maximum parallel misalignment should not exceed .015" and angular misalignment should be held to 1 degree maximum. Careful alignment extends life of the coupling, pump, shafts, and support bearings. Consult coupling manufacturer for exact alignment tolerances.

On a close-coupled system, coat the motor shaft liberally with anti-seize.

Important Precautions

Adequate Fluid Supply. To avoid cavitation and premature pump failure, be sure that the pump will have an adequate fluid supply and that the inlet line will not be obstructed. See "Inlet Piping".

Positive Displacement. This is a positive-displacement pump. To avoid severe system damage if the discharge line ever becomes blocked, install a relief valve downstream from the pump. See "Discharge Piping".

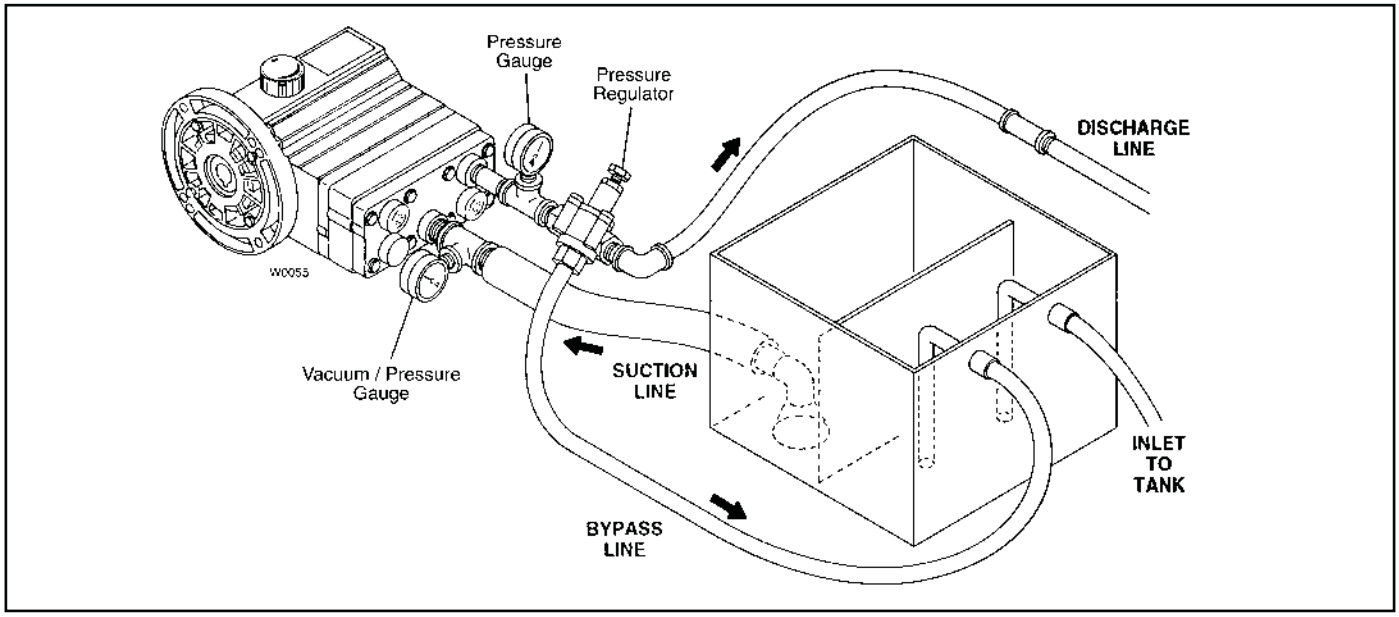
Safety Guards. Install adequate safety guards over all pulleys, belts, and couplings. Follow all codes and regulations regarding installation and operation of the pumping system.

Shut-Off Valves. Never install shut-off valves between the pump and discharge pressure regulator, or in the regulator bypass line.

Freezing Conditions. Protect the pump from freezing. See also the Maintenance Section.

Consult the Factory for the following situations:

- Extreme temperature applications (above 160° F or below 40° F)
- Pressure feeding of pumps
- Viscous or abrasive fluid applications
- Chemical compatibility problems
- Hot ambient temperatures (above 110° F)
- Conditions where pump oil may exceed 200° F because of a combination of hot ambient temperatures, hot fluid temperature, and full horsepower load — an oil cooler may be required



D/G-03 Installation

Inlet Piping (Suction Feed)

Caution: When pumping at temperatures above 160° F (71° C), use a pressure-feed system.

Install drain cocks at any low points of the suction line, to permit draining in freezing conditions.

Provide for permanent or temporary installation of a vacuum gauge to monitor the inlet suction. To maintain maximum flow, vacuum at the pump inlet should not exceed 7 in. Hg at 3 gpm and 70° F (180 mm Hg at 11.4 liters/min and 21° C). Do **not** supply more than one pump from the same inlet line. With Teflon diaphragms, the inlet must be flooded.

Supply Tank

Use a supply tank that is large enough to provide time for any trapped air in the fluid to escape. The tank size should be at least twice the maximum pump flow rate.

Isolate the pump and motor stand from the supply tank, and support them separately.

Install a separate inlet line from the supply tank to each pump.

Install the inlet and bypass lines so they empty into the supply tank below the lowest water level, on the opposite side of the baffle from the pump suction line.

If a line strainer is used in the system, install it in the inlet line to the supply tank.

To reduce aeration and turbulence, install a completely submerged baffle plate to separate the incoming and outgoing liquids.

Install a vortex breaker in the supply tank, over the outlet port to the pump.

Place a cover over the supply tank, to prevent foreign objects from falling into it.

Hose and Routing

Size the suction line at least one size larger than the pump inlet, and so that the velocity will not exceed 1-3 ft/sec (0.3 to 0.9 m/sec):

For pipe in inches: Velocity (ft/sec) = 0.408 x GPM/Pipe ID^2

For pipe in mm: Velocity (m/sec) = 21.2 x LPM/Pipe ID^2

Keep the suction line as short and direct as possible.

Use flexible hose and/or expansion joints to absorb vibration, expansion, or contraction.

If possible, keep the suction line level. Do not have any high points to collect vapor unless these high points are vented.

To reduce turbulence and resistance, do not use 90° elbows. If turns are necessary in the suction line, use 45° elbows or arrange sweeping curves in the flexible inlet hose.

If a block valve is used, be sure it is fully opened so that the flow to the pump is not restricted. The opening should be at least the same diameter as the inlet plumbing ID.

Do not use a line strainer or filter in the suction line unless regular maintenance is assured. If used, it should have a free-flow area of at least three times the free-flow area of the inlet.

Install piping supports where necessary to relieve strain on the inlet line and to minimize vibration.

Inlet Piping (Pressure Feed)

Provide for permanent or temporary installation of a vacuum/pressure gauge to monitor the inlet vacuum or pressure. Pressure at the pump inlet should not exceed 250 psi (17.3 bar); if it could get higher, install an inlet pressure regulator. Do **not** supply more than one pump from the same inlet line.

Inlet Calculations

Acceleration Head

Calculating the Acceleration Head

Use the following formula to calculate acceleration head losses. Subtract this figure from the NPSHa, and compare the result to the NPSHr of the Hydra-Cell pump.

$Ha = (L \times V \times N \times C) \div (K \times G)$

where:

Ha = Acceleration head (ft of liquid)

L= Actual length of suction line (ft) — not equivalent length

V= Velocity of liquid in suction line (ft/sec) [V = GPM x (0.408 ÷ pipe ID^2)]

N= RPM of crank shaft

C= Constant determined by type of pump — use 0.066 for the M-03, D-03, M-23, G-03 and G-13 Hydra-Cell pumps

K= Constant to compensate for compressibility of the fluid — use: 1.4 for de-aerated or hot water; 1.5 for most liquids; 2.5 for hydrocarbons with high compressibility

G= Gravitational constant (32.2 ft/sec^2)

Friction Losses

Calculating Friction Losses in Suction Piping

When following the above recommendations (under “inlet Piping”) for minimum hose/pipe I.D. and maximum length, frictional losses in the suction piping are negligible (i.e., Hf = 0) if you are pumping a water-like fluid.

When pumping more-viscous fluids such as lubricating oils, sealants, adhesives, syrups, varnishes, etc., frictional losses in the suction piping may become significant. As Hf increases, the available NPSH (NPSHa) will decrease, and cavitation will occur.

In general, frictional losses increase with increasing viscosity, increasing suction-line length, increasing pump flowrate, and decreasing suction-line diameter. Changes in suction-line diameter have the greatest impact on frictional losses: a 25% increase in suction-line diameter cuts losses by more than two times, and a 50% increase cuts losses by a factor of five times.

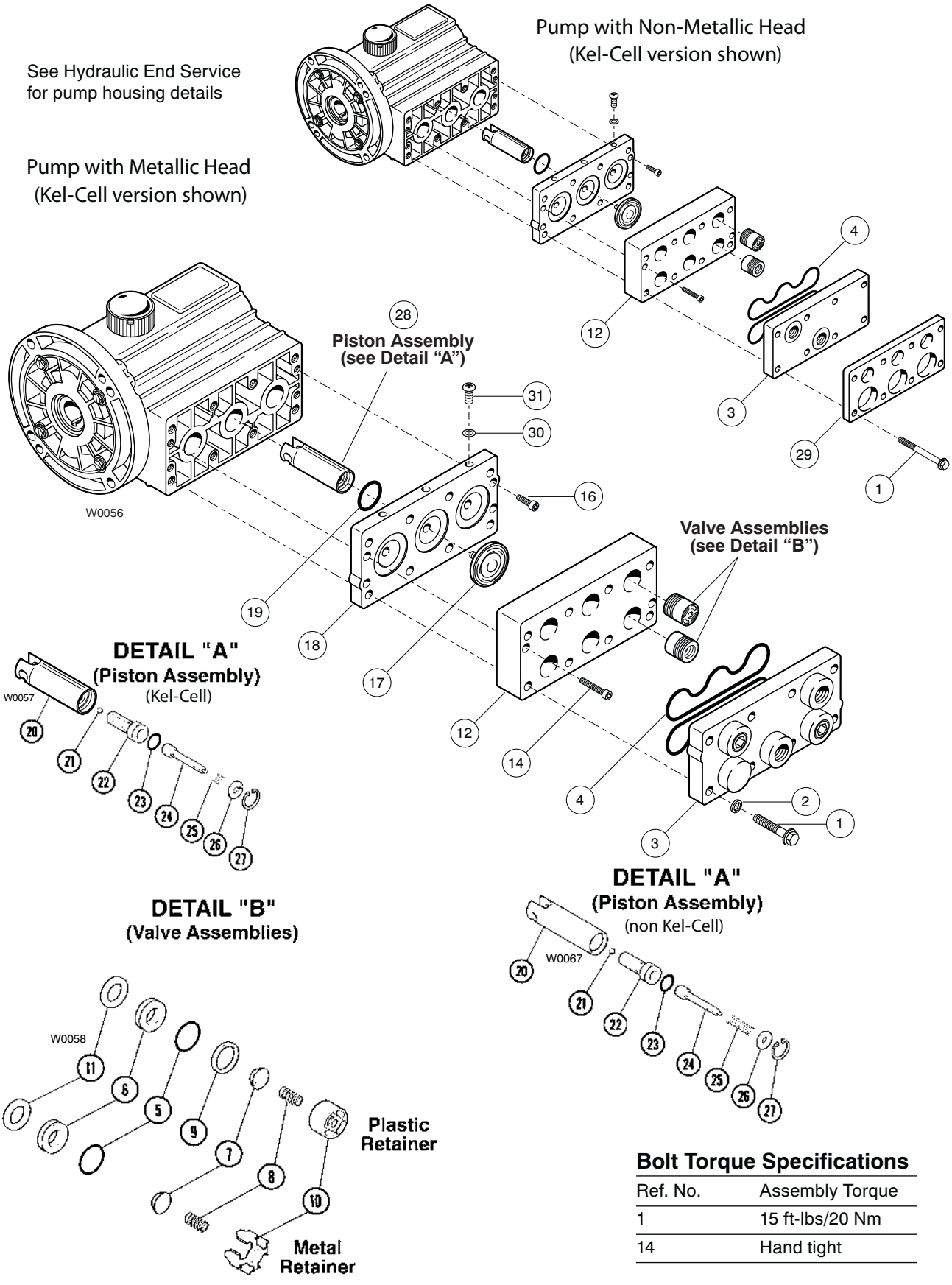
Consult the factory before pumping viscous fluids.

Minimizing Acceleration Head and Frictional Losses

To minimize the acceleration head and frictional losses:

- Keep inlet lines less than 3 ft (1 m) long
- Use at least 5/8 in. (16 mm) I.D. inlet hose
- Use soft hose (low-pressure hose, noncollapsing) for the inlet lines
- Minimize fittings (elbows, valves, tees, etc.)
- **Use a suction stabilizer on the inlet.**

D/G-03 Fluid End Service



Bolt Torque Specifications

Ref. No.	Assembly Torque
1	15 ft-lbs/20 Nm
14	Hand tight

D/G-03 Fluid End Service (All versions)

This section explains how to disassemble and inspect all easily-serviceable parts of the pump. Repair procedures for the hydraulic end (oil reservoir) of the pump are included in a later section of the manual.

Note: The numbers in parentheses are the Ref. Nos. on the illustrations in the Parts Manual.

Caution: Do not disassemble the Hydraulic End unless you are a skilled mechanic. For assistance, contact Wanner Engineering (Tel 612-332-5681 or Fax 612-332-6937) or the distributor in your area.

Important: Fluid End Service is different for Kel-Cell and non Kel-Cell versions. Before performing Fluid End Service, determine if the pump is a Kel-Cell or non Kel-Cell version as follows:

Kel-Cell versions are indicated by a "K" in digit 5 of the pump model number.

Non Kel-Cell versions are indicated by an "A" or "D" in digit 5 of the pump model number.

1. Remove Manifold (3), Valve Plate (12) (All versions)

a. Remove all eight bolts (1) around the manifold.

b. Remove the manifold (3).

c. Inspect the manifold for warping or wear around the inlet and outlet ports. If wear is excessive, replace the manifold.

To check if the manifold is warped, remove the O-rings (4) and place a straightedge across it. A warped manifold should be replaced.

d. Remove the two socket-head capscrews (14).

e. Inspect the valve plate in the same manner as the manifold.

2. Inspect Valves (5-11) (All versions)

The three inlet and three outlet valve assemblies are identical (but face in opposite directions). Inspect each valve as follows:

a. Check the spring retainer (10), and replace if worn.

b. Check the valve spring (8). If it is shorter than a new spring, replace it (don't just stretch the old spring).

c. Check the valve poppet (7). If worn excessively, replace it.

d. Remove the valve seat (6). A seat puller is included in the Wanner Tool Kit.

Inspect the valve seat for wear, and replace it if necessary. A new O-ring (5) should be installed.

e. Check the dampening washer (11), and replace if worn.

f. Reinstall the valve assemblies:

• Clean the valve ports and shoulders with emery cloth, and lubricate them with lubricating gel or petroleum jelly.

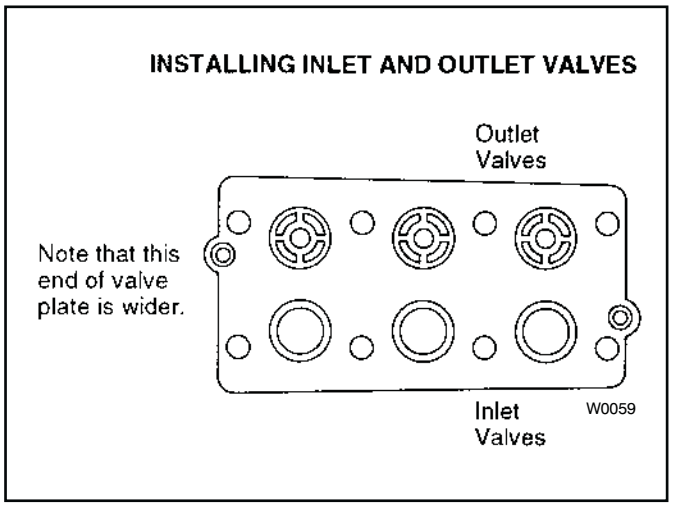
• Install the O-ring (5) on the valve seat (6).

• **Inlet (3 lower valves in the illustration below).** Insert the spring retainer (10) into the valve plate, then insert the spring, valve, tetra seal, valve seat with O-ring, and dampening washer (8,7,9,6,11). A flat O-ring [tetra seal] (5) goes between the plastic spring retainer and seat.

• **Outlet (3 upper valves in the illustration).** Install the 3 outlet valve assembly components in reverse order as inlet valves.

For Kel-Cell versions continue with Step 3 on page 13

For non Kel-Cell versions continue with Step 3 on page 14.



D/G-03 Fluid End Service (Kel-Cell only)

3. Inspect and Replace Diaphragms (17) (Kel-Cell only)

a. Lift a diaphragm by one edge, and turn the pump shaft until the diaphragm moves up to "top dead center". This will expose machined cross holes in the plunger shaft behind the diaphragm.

Note: If the pump has a hollow shaft, use the shaft rotator from the Wanner Tool Kit to turn the shaft.

b. Remove the three flat-head screws (31) and O-rings (30) from the edge access holes in the diaphragm plate (18). Insert a 3/32" hex wrench (A03-163-2200) into one of the holes in the diaphragm plate (18). Turn and pull the diaphragm (17) until the front cross hole in the valve plunger spool (24) lines up and allows the hex wrench to pass through. (Don't remove the hex wrench until the new diaphragm is installed in step "g" below.)

c. Unscrew the diaphragm. Use a 5/16 in. (8 mm) open-end wrench, and turn counterclockwise.

d. Inspect the diaphragm carefully. A ruptured diaphragm generally indicates a pumping system problem, and replacing only the diaphragm will not solve the larger problem. Inspect the diaphragm for the following:

• **Small puncture**. Usually caused by a sharp foreign object in the fluid, or by an ice particle.

• **Diaphragm pulled awa**y from the sides. Usually cause by fluid being frozen in the pump, or by over pressurization of the pump.

• **Diaphragm becoming stiff** and losing flexibility. Usually caused by pumping a fluid that is incompatible with the diaphragm material.

• **Diaphragm edge chewed away**. Usually caused by over pressurizing the system.

Caution: If a diaphragm has ruptured and foreign material or water has entered the oil reservoir, do not operate the pump. Check all diaphragms, then flush the reservoir completely (as outlined below) and refill it with fresh oil. Never let the pump stand with foreign material or water in the reservoir, or with the reservoir empty.

e. Clean away any spilled oil. Apply Loctite No. 242 Threadlocker to the screw of the new diaphragm (or the old one, as appropriate).

f. Install the diaphragm and tighten to 10 in-lbs (110 N-cm).

g. Repeat the above inspection procedure (and replacement, if necessary) with the other two diaphragms.

4. Flush Contaminant from Hydraulic End (Kel-Cell only)

(Only if a diaphragm has ruptured)

a. With the valve plate and manifold still removed (see above), remove the oil drain cap (60) and allow all oil and contaminant to drain out.

Caution: If you have EPDM diaphragms, or if food grade oil is in the reservoir, flush with the same lubricant that is in the reservoir. Pumps with EPDM diaphragms have an "E" as the 7th digit of the Model No.

b. Fill the reservoir with fresh oil, manually turn the pump shaft to circulate the oil, and drain once again.

c. Refill the reservoir. If the oil appears milky, there is still contaminant in the reservoir. Repeat the flushing procedure until the oil appears clean.

5. Reinstall Valve Plate (12), Manifold (3) (Kel-Cell only)

a. Reinstall the valve plate (12), with the valve assemblies installed as outlined above, onto the diaphragm plate (18).

b. Reinstall the O-rings (4) on the rear side of the manifold. Use petroleum jelly or lubricating gel to hold them in place.

c. Reinstall the manifold onto the valve plate.

d. Insert all bolts (1), with washers (2), around the edge of the manifold, and alternately tighten opposite bolts until all are secure. Torque to 15 ft-lbs (20 N-m).

e. Recheck all bolts for tightness.

6. Prime the Hydraulic Cells (Kel-Cell only)

a. With the pump **horizontal**, fill the reservoir with the appropriate Hydra oil for the application.

b. All air in the oil within the hydraulic cell (behind the diaphragms) must be forced out by turning the shaft (and thus pumping the piston). A shaft rotator is included in the Wanner Tool Kit.

Turn or jog the shaft until a **blubble-free** flow of oil comes out of each access hole in the diaphragm plate (18). Watch the oil level in the reservoir; if it gets too low during priming, air will be drawn into the pistons (inside the hydraulic end). This will cause the pump to run rough, and you will have to start over again with priming the hydraulic cells.

Reinstall the flat-head screw (31) and O-ring (30) for each access hole as they are primed.

D/G-03 Fluid End Service (non Kel-Cell only)

3. Inspect and Replace Diaphragms (17) (non Kel-Cell)

a. Lift a diaphragm by one edge, and turn the pump shaft until the diaphragm moves up to "top dead center". This will expose machined cross holes in the plunger shaft behind the diaphragm.

Note: If the pump has a hollow shaft, use the shaft rotator from the Wanner Tool Kit.

b. Insert a 3/32 in. hex wrench through one of the machined cross holes, to hold the diaphragm up. The proper size tool is included in the Wanner Tool Kit. (Don't remove the tool until the new diaphragm is installed in step "g" below.)

c. Unscrew the diaphragm. Use a 5/16 in. (8 mm) open-end wrench, and turn counterclockwise.

d. Inspect the diaphragm carefully. A ruptured diaphragm generally indicates a pumping system problem, and replacing only the diaphragm will not solve the larger problem. Inspect the diaphragm for the following:

• **Small puncture**. Usually caused by a sharp foreign object in the fluid, or by an ice particle.

• **Diaphragm pulled awa**y from the sides. Usually cause by fluid being frozen in the pump, or by overpressurization of the pump.

• **Diaphragm becoming stiff** and losing flexibility. Usually caused by pumping a fluid that is incompatible with the diaphragm material.

• **Diaphragm edge chewed away**. Usually caused by over pressurizing the system.

Caution: If a diaphragm has ruptured and foreign material or water has entered the oil reservoir, do not operate the pump. Check all diaphragms, then flush the reservoir completely (as outlined below) and refill it with fresh oil. Never let the pump stand with foreign material or water in the reservoir, or with the reservoir empty.

e. Clean away any spilled oil. Apply Loctite No. 242 Threadlocker to the screw of the new diaphragm (or the old one, as appropriate).

f. Install the diaphragm and tighten to 10 in.-lbs (110 N-cm).

g. Repeat the above inspection procedure (and replacement, if necessary) with the other two diaphragms.

4. Flush Contaminant from Hydraulic End (non Kel-Cell)

(Only if a diaphragm has ruptured)

a. With the valve plate and manifold still removed (see above), remove the oil drain cap (60) and allow all oil and contaminant to drain out.

Caution: If you have EPDM diaphragms, or if food grade oil is in the reservoir, flush with the same lubricant that is in the reservoir. Pumps with EPDM diaphragms have an "E" as the 7th digit of the Model No.

b. Fill the reservoir with fresh oil, manually turn the pump shaft to circulate the oil, and drain once again.

c. Refill the reservoir. If the oil appears milky, there is still contaminant in the reservoir. Repeat the flushing procedure until the oil appears clean.

5. Prime the Hydraulic Cells (non Kel-Cell)

a. With the pump **horizontal**, fill the reservoir with the appropriate Hydra oil for the application.

b. All air in the oil within the hydraulic cell (behind the diaphragms) must be forced out by turning the shaft (and thus pumping the piston). A shaft rotator is included in the Wanner Tool Kit.

Turn the shaft until a **bubble-free** flow of oil comes from behind all the diaphragms. Watch the oil level in the reservoir; if it gets too low during priming, air will be drawn into the pistons (inside the hydraulic end). This will cause the pump to run rough, and you will have to start over again with priming the hydraulic cells.

6. Reinstall Valve Plate (12), Manifold (3) (non Kel-Cell)

a. Reinstall the valve plate (12), with the valve assemblies installed as outlined above, onto the diaphragm plate (18).

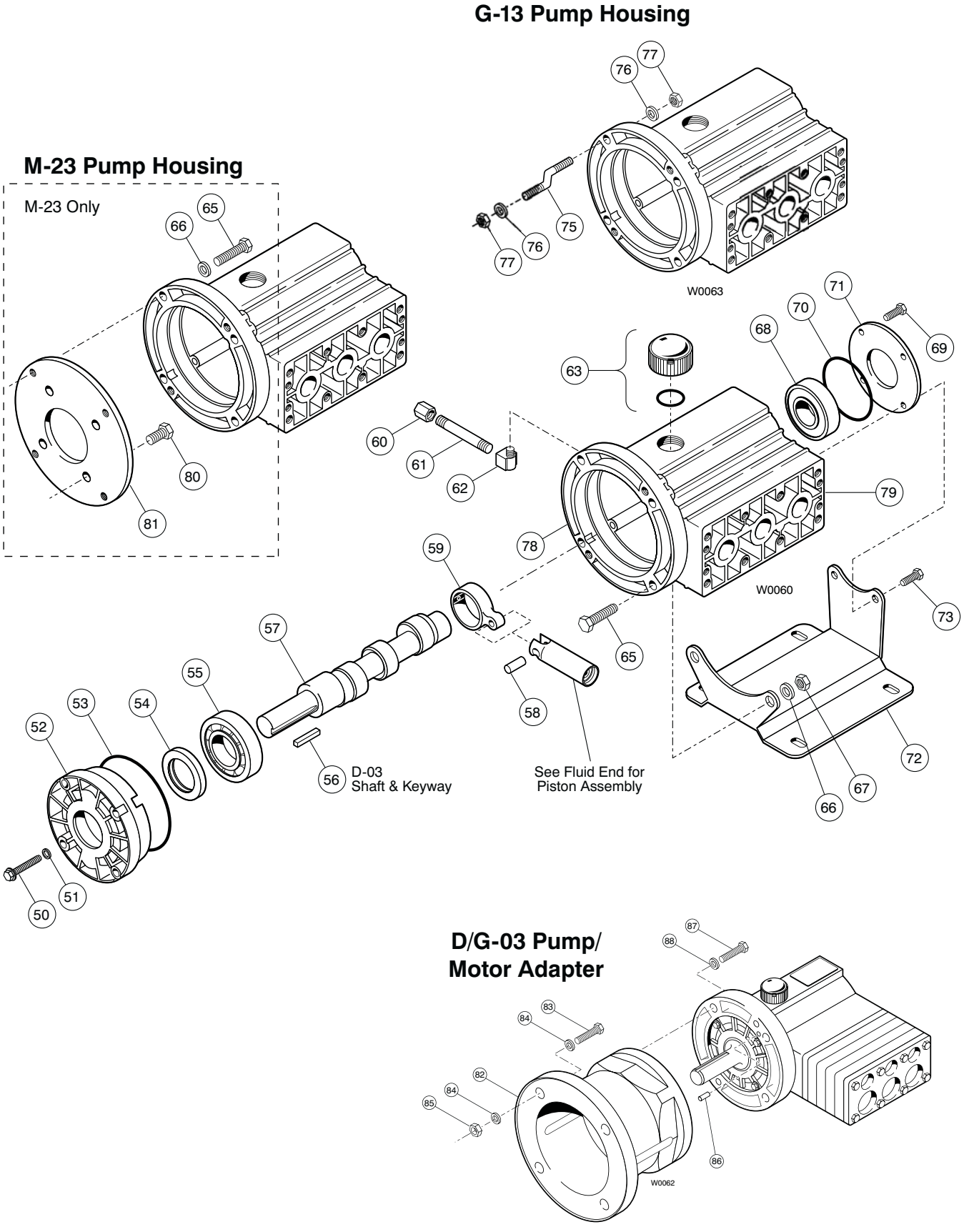
b. Reinstall the O-rings (4) on the rear side of the manifold. Use petroleum jelly or lubricating gel to hold them in place.

c. Reinstall the manifold onto the valve plate.

d. Insert all bolts (1), with washers (2), around the edge of the manifold, and alternately tighten opposite bolts until all are secure. Torque to 15 ft-lbs (20 N-m).

e. Recheck all bolts for tightness.

D/G-03 Hydraulic End Service



D/G-03 Hydraulic End Service

Note: The numbers in parentheses are the Ref. Nos. on the illustrations in the Parts Manual.

This section explains how to disassemble and inspect the hydraulic end (oil reservoir) of the pump.

Caution: Do not disassemble the hydraulic end unless you are a skilled mechanic. For assistance, contact Wanner Engineering (Tel 612-332-5681 or Fax 612-332-6937) or the distributor in your area.

Depending on the repair you are attempting, you may or may not have to remove the motor from a direct-drive pump/motor unit.

Internal piston components (21 - 27) can be serviced without removing the motor or crankshaft. The motor and crankshaft must be removed to service the connecting rod (59), piston housing (20), crankshaft (57), front bearing (68), back bearing (55), or seal (54).

To Service Pistons Without Removing Motor or Crankshaft

1. Disassemble Pistons

With the manifold, valve plate, diaphragm plate, and diaphragm removed, and the oil drained from the pump (see the Fluid End Service Section):

a. Remove the snap ring (27) from one of the pistons, using a standard snap-ring pliers.
b. Pull out the valve plunger (24). This also removes the washer (26) and spring (25).
c. Insert a hook through the center hole of the valve cylinder (22), and pull the cylinder out of the piston. Be careful not to damage the piston.
d. Inspect all parts, and replace the O-ring and any other parts that are worn or may be damaged.
e. Repeat steps “a” through “d” for the remaining pistons.

2. Reassemble Pistons

a. Tip the pump so the pistons are vertical.
b. Drop a ball (21) into the opening in the bottom of the piston.
c. Insert a valve plunger (24) into a valve cylinder (22). Slide a spring (25) over the plunger, inside the valve cylinder.
d. Slide the assembled valve cylinder, plunger, and spring (22 - 25) into the piston (20).
e. Insert a washer (26) over the plunger.
f. Insert a snap ring (27) into the piston. Use the snap-ring pliers.
g. Repeat the above procedure for the other two pistons.

To Remove Motor from Direct-Coupled Unit

1. Disassemble Motor from Pump

a. **M-03**. Remove the four bolts (65) and washers (66) that secure the pump and motor together.

   M-23. Remove the four bolts (65) and washers (66) that secure the pump and adapter plate (81) together.

   G-13. Remove the four nuts (77) and washers (76) from the motor side of the offset stud (75).
b. **M-03, M-23.** Install two of the bolts into the threaded holes in the rear of the pump housing.

   G-13. Install two M10 x 1.5 x 40 mm (65) or longer bolts into the threaded holes in the rear flange of the pump housing.
c. Alternately turn the bolts clockwise until the pump and motor separate.

2. Reassemble Motor to Pump

a. Thoroughly clean the motor shaft and the hollow pump shaft. Remove the tape from the key and keyway.
b. Apply a **liberal** amount of Loctite® Nickel Anti-Seize No. 77164 to the pump shaft.
c. Install the shaft key (56) into the keyway.
d. Slide the motor shaft into the hollow pump shaft.

   Caution: When assembling this pump to the direct-coupled motor, be careful that the shaft key remains in the motor shaft keyway and does not ride up the keyway and contact the shaft seals (which would cause premature seal failure). Incorrect key placement could also cause the hollow pump shaft to fail.

   Use a screwdriver to move the shaft key back in the motor shaft keyway as the motor and pump are drawn together.
e. **M-03, M-23**. Reinstall the four bolts (65) and washers (66).

   G-13. Reinstall the four washers (76) and nuts (77).

D/G-03 Hydraulic End Service

To Service the Remainder of the Hydraulic End

1. Remove Pump Housing

a. Remove the manifold, valve plate, and diaphragms, as outlined in the Fluid End Service Section.
b. Drain the oil from the pump housing by removing the drain plug (60).
c. Stand the pump on end, with the drive shaft up.
d. Remove the bolts (50) that secure the back cover (52) to the housing (78). Use a 3/8 in. socket wrench (10-mm on M-03/G-03 and G-13). Save the O-rings (51).
e. Remove the cover and the cover O-ring (53).
f. Remove the crankshaft (57) by pulling it through the connecting rods (59).

2. Remove and Replace Pistons

To remove the pistons (20), first remove the connecting rod (59) and pin (58) by pressing the pin through the connecting rod.

Reverse the process to reinstall the pistons.

Refer to Steps 5 and 6 below to replace the diaphragm and reassemble the pump.

3. Replace Shaft Seal

Note: Inspect the shaft seal (54) before continuing. If it looks damaged in any way, replace it.

a. Press the back bearing (55) and seal (54) out of the back cover (52). Discard the seal.
b. Apply a coating of Loctite® High-Performance Pipe Sealant With Teflon®, or a comparable product, to the outer surface of a new seal and the inside surface of the opening in the back cover (52) where the seal will rest.
c. Press the new seal into the back cover.
d. Inspect the bearing (55). If pitted or damaged, replace it.
e. Apply a coating of Loctite Rc/609 Retaining Compound or comparable product to the outer surface of the bearing. Press the bearing into the back cover until it rests on the shoulder. The shield on the bearing must face away from the back cover.

4. Reassemble Housing and Back Cover

a. Stand the pump on end.
b. With the pistons and connecting rods in place, reinstall the crankshaft by threading it through the connecting rods.
c. Reinstall the back cover (52), cover O-ring (53), and bolts (with their O-rings).

5. Reassemble Pump

Reassemble the pump as outlined in the Fluid-End Service Section.

Limited Warranty

Wanner Engineering, Inc. extends to the original purchaser of equipment manufactured by it and bearing its name, a limited one-year warranty from the date of purchase against defects in material or workmanship, provided that the equipment is installed and operated in accordance with the recommendations and instructions of Wanner Engineering, Inc. Wanner Engineering, Inc. will repair or replace, at its option, defective parts without charge if such parts are returned with transportation charges prepaid to Wanner Engineering, Inc., 1204 Chestnut Avenue, Minneapolis, Minnesota 55403.

This warranty does not cover:

1. The electric motors (if any), which are covered by the separate warranties of the manufacturers of these components.

2. Normal wear and/or damage caused by or related to abrasion, corrosion, abuse, negligence, accident, faulty installation or tampering in a manner which impairs normal operation.

3. Transportation costs.

This limited warranty is exclusive, and is in lieu of any other warranties (express or implied) including warranty of merchantability or warranty of fitness for a particular purpose and of any non contractual liabilities including product liabilities based on negligence or strict liability. Every form of liability for direct, special, incidental or consequential damages or loss is expressly excluded and denied.

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BALDOR®

A MEMBER OF THE ABB GROUP

Series 5 Inverter
NEMA 4X, IP65

03/12 **Installation & Operating Manual** MN781BW

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Chapter 1
Introduction

1.1 INTRODUCTION

CE This product complies with all CE directives pertinent at the time of manufacture. Contact your local Baldor District Office for Declaration of Conformity. Installation of a CE approved RFI filter is required. Additional shielded motor cable and/or AC line cables may be required along with a signal isolator.

This instruction manual, MN781BW, covers installation and operating instructions for the following NEMA 4X/IP65 control models:

Catalog No.	
Black	**White***
ID5601-B0	ID5601-W0
ID5602-B0	ID5602-W0
ID5203-B0	ID5203-W0
ID5403-B0	ID5403-W0
ID5405-B0	ID5405-W0

*White FDA approved finish.

The Baldor Series 5 Micro-Inverters are adjustable speed controls housed in a rugged NEMA 4X/IP65 washdown and watertight die-cast aluminum enclosure. Designed to operate at 3 phase 208 – 230 and 400/460VAC 50 & 60Hz to control AC induction motors from subfractional thru 5HP. The Pulse Width Modulated (PWM) output operates at a carrier frequency of 16kHz for high motor efficiency and low noise. Adjustable Linear Acceleration and Deceleration are provided, making the drive suitable for softstart applications.
For most applications no adjustments are necessary.

1.1.1 Standard Features
- Industrial Duty Die-Cast Aluminum Case with Hinged Cover – Available in black finish or FDA approved white finish.
- Simple to Operate – Does not require programming. Uses trimpots and jumpers, which are factory set for most applications.
- Motor HP Selection Jumper – Allows the drive to be used on a wide range of motors without recalibration.
- Diagnostic LEDs – Power on (POWER) and drive status (STATUS).
- Run/Fault Relay Output Contacts – Can be used to turn on or off equipment or to signal a warning if the drive is put into the Stop Mode or a fault has occurred.
- On/Off AC Line Switch – Disconnects the AC line.
- Start/Stop Switch – Provides electronic start and stop functions.
- Barrier Terminal Block – Facilitates wiring of motor, AC line, and Run/Fault Relay Output Contacts.
- Jumper Selection of Drive Output Frequency – Increases the motor speed up to two times the rated RPM.
- Ride-Through – Provides smooth recovery to the previous set speed during a momentary power loss (of less than 2 seconds).
- Holding Torque at Zero Speed – Resists motor shaft rotation when the drive is in Stop Mode.

1.1.2 Performance Features

- Power Start™ – More than 200% starting torque which ensures startup of high frictional loads.
- Slip Compensation with Static Auto-Tune and Boost – Excellent load regulation over a wide speed range.
- Speed Range – 60:1

1.1.3 Protection Features

- Motor Overload (I^2t) with RMS Current Limit* – Motor overload protection to prevent motor burnout and nuisance trips.*
- Electronic Inrush Current Limit (EICL™) – Eliminates harmful inrush current during startup.
- Short Circuit – Shuts down the drive if a short circuit occurs at the motor (phase-to-phase).
- Regeneration – Eliminates tripping due to high bus voltage caused by rapid deceleration of high inertial loads.
- Undervoltage and Overvoltage – Shuts down the drive if the AC line input voltage goes above or below the operating range.
- MOV Input Transient Suppression.
- Microcontroller Self Monitoring and Auto Reboot.

*UL approved as an electronic overload protector for motors.

Table 1-1 OPTIONAL ACCESSORIES

Description	Catalog No.				
	ID5601	ID5602	ID5203	ID5403	ID5405
Forward-Stop-Reverse Switch – Provides motor reversing and stop functions. Mounts on the enclosure cover and is supplied with a switch seal to maintain liquidtight integrity.	ID5FRS-1	ID5FRS-1	ID5FRS-1	ID5FRS-1	ID5FRS-1
Signal Isolator – Provides isolation between a non-isolated signal voltage source and the drive. Mounts on the drive's PC board with four snap-ins.	ID5SI-2*	ID5SI-2*	ID5SI-2*	ID5SI-2*	ID5SI-2*
Auto/Manual Switch – When used with the Signal Isolator, it selects remote process signal or the Main Speed Potentiometer. Mounts on the enclosure cover and is supplied with a switch seal to maintain liquidtight integrity.	ID5AMS-1	ID5AMS-1	ID5AMS-1	ID5AMS-1	ID5AMS-1

Notes: Complies with CE Council Directive 39/336/EEC Industrial Standard.

WARNING: It is highly recommended that the ID5S1-2 Signal Isolator be installed when using the drive with external control signals.

1.2 SAFETY NOTICES

WARNING: STATEMENT INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN INJURY OR DEATH.

Caution! Statement indicates a potentially hazardous situation which, if not avoided, could result in damage to property.

Note - Additional information that is not critical to the installation or operation.

WARNING: This product should be installed and serviced by a qualified technician, electrician, or electrical maintenance person familiar with its operation and the hazards involved. Proper installation, which includes wiring, fusing or other current protection, and grounding can reduce the chance of electrical shocks, and/or fires, in this product or products used with this product, such as electric motors, switches, coils, solenoids, and/or relays. Do not use this drive in an explosion-proof application. Eye protection must be worn and insulated adjustment tools must be used when working with drive under power. This product is constructed of materials (plastics, metals, carbon, silicon, etc.) which may be a potential hazard. Proper shielding, grounding, and filtering of this product can reduce the emission of radio frequency interference (RFI) which may adversely affect sensitive electronic equipment. It is the responsibility of the equipment manufacturer and individual installer to supply this Safety Warning to the ultimate end user of this product. Be sure to follow all instructions carefully. Fire and/or electrocution can result due to improper use of this product. (SW 1/2006)

WARNING: This equipment may contain voltages as high as 1000 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

WARNING: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.

WARNING: Electrical shock can cause serious or fatal injury. Be sure that all power is disconnected and there is no voltage present from this equipment or equipment to which it is or will be connected. Only qualified personnel should attempt the installation and start-up procedures.

WARNING: Electrical shock can cause serious or fatal injury. Verify there is no voltage phase-to-phase or phase-to-neutral at the AC Line Conductors before touching the AC Input wires. Do not touch live wires, all power must be disconnected before proceeding.

WARNING: Electrical shock can cause serious or fatal injury. Verify there is no voltage phase-to-phase or phase-to-neutral at the motor leads before connecting motor to this control. Motor may have high voltage present even when disconnected from this control.

WARNING: Do not use motor overload relays with an automatic reset feature. These are dangerous since the process may injure someone if a sudden or unexpected automatic restart occurs. If manual reset relays are not available, disable the automatic restart feature using external control wiring.

WARNING: This unit has an automatic restart feature that will start the motor whenever input power is applied and a RUN (FWD or REV) command is issued. If an automatic restart of the motor could cause injury to personnel, the automatic restart feature must be disabled.

WARNING: Using a jumper to eliminate the start/stop function will cause the motor to run at the Main Speed Potentiometer setting when the AC line is applied.

WARNING: If possible, do not adjust trimpots with the main power applied. Electrical shock can cause serious or fatal injury. If adjustments are made with the main power applied, an insulated adjustment tool must be used to prevent shock hazard and safety glasses must be worn.

Caution! Disconnect motor leads (U, V and W) from control before you perform a Dielectric Withstand test on the motor. Failure to disconnect motor from the control will result in extensive damage to the control. The control is tested at the factory for high voltage / leakage resistance as part of Underwriters Laboratories requirements.

Caution! Do not connect AC power to the Motor terminals U, V and W. Connecting AC power to these terminals may damage the control.

Chapter 2

Installation

These instructions are designed to help you get your new drive installed and operating quickly. Before you begin, be sure to read and follow all safety instructions listed in Chapter 1 of this manual. Be certain that all AC power is locked out and tagged out of service to avoid electrical shock hazard during installation. Do not proceed with this installation if you do not understand the safety instructions or if you have questions. Contact your local Baldor District Office for assistance.

2.1 IMPORTANT APPLICATION INFORMATION

2.1.1 Motor With External Fan Cooling

Most totally enclosed fan-cooled (TEFC) and open ventilated 3-phase AC induction motors will overheat if used beyond a limited speed range at full torque. Therefore, it is necessary to reduce motor load as speed is decreased.

Note: Some fan-cooled motors can be used over a wider speed range. Consult the motor manufacturer for details.

WARNING: Some motors have low speed characteristics which cause overheating and winding failure under light load or no load conditions. If the motor is operated in this manner for an extended period of time, it is recommended that the unloaded motor current be checked from 2 - 15 Hz (60 - 45- RPM) to ensure motor current does not exceed the nameplate rating. Do not use motor if the motor current exceeds the nameplate rating.

Caution! It is recommended that the drive be used with Inverter Duty or TENV motors.

Inverter duty and most totally enclosed non-ventilated (TENV) motors can provide full rated torque over an extended speed range without overheating. See Figure 2-1.

If external fan cooling is provided, open ventilated motors can also achieve an extended speed range at full rated torque. A box fan or blower with a minimum of 100 CFM per HP is recommended. Mount the fan or blower so the motor is surrounded by the airflow. See Figure 2-2.

Figure 2-1 Maximum Allowed Motor Torque vs. Speed

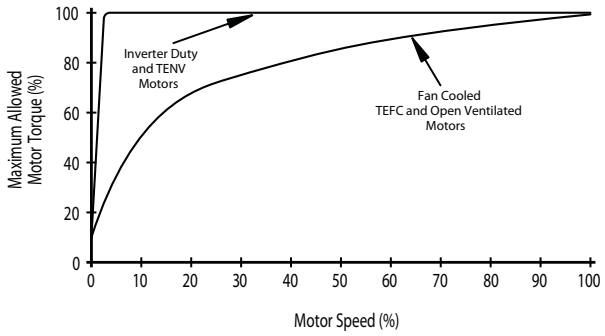
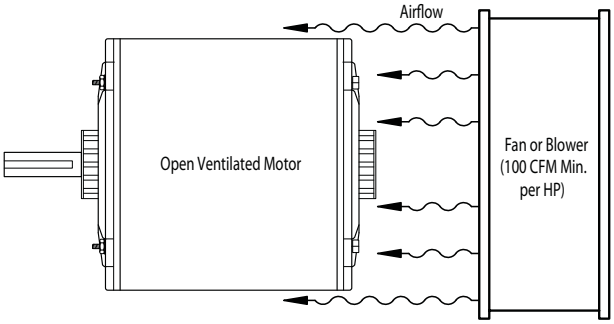


Figure 2-2 Open Ventilated Motor With External Fan Cooling



2.1.2 Electronic Motor Overload Protection

The drive contains Modified I²t Overload Protection.* Part of this function consists of a Current Limit (CL) circuit, which limits the drive current to a factory preset level of 160% of the rated drive current. The CL Trimpot is used to recalibrate the drive current from 60% thru 200%. The Power Start™ circuit provides an overshoot function that allows most motors to develop more than 200% of starting torque and breakdown torque.

Standard I²t is undesirable because it causes nuisance tripping. It allows a very high motor current to develop and will turn the drive off after a short period of time. The RMS Current Limit Circuit avoids this nuisance tripping while providing maximum motor protection.

If the motor is overloaded to 120% of full load (75% of the CL setting), the I²t Timer starts. If the motor continues to be overloaded at the 120% level, the timer will shut down the drive after 30 minutes. If the motor is overloaded to 160% of full load, the drive will trip in 6 seconds.

*UL approved as an overload protector for motors.

2.2 MOUNT THE DRIVE

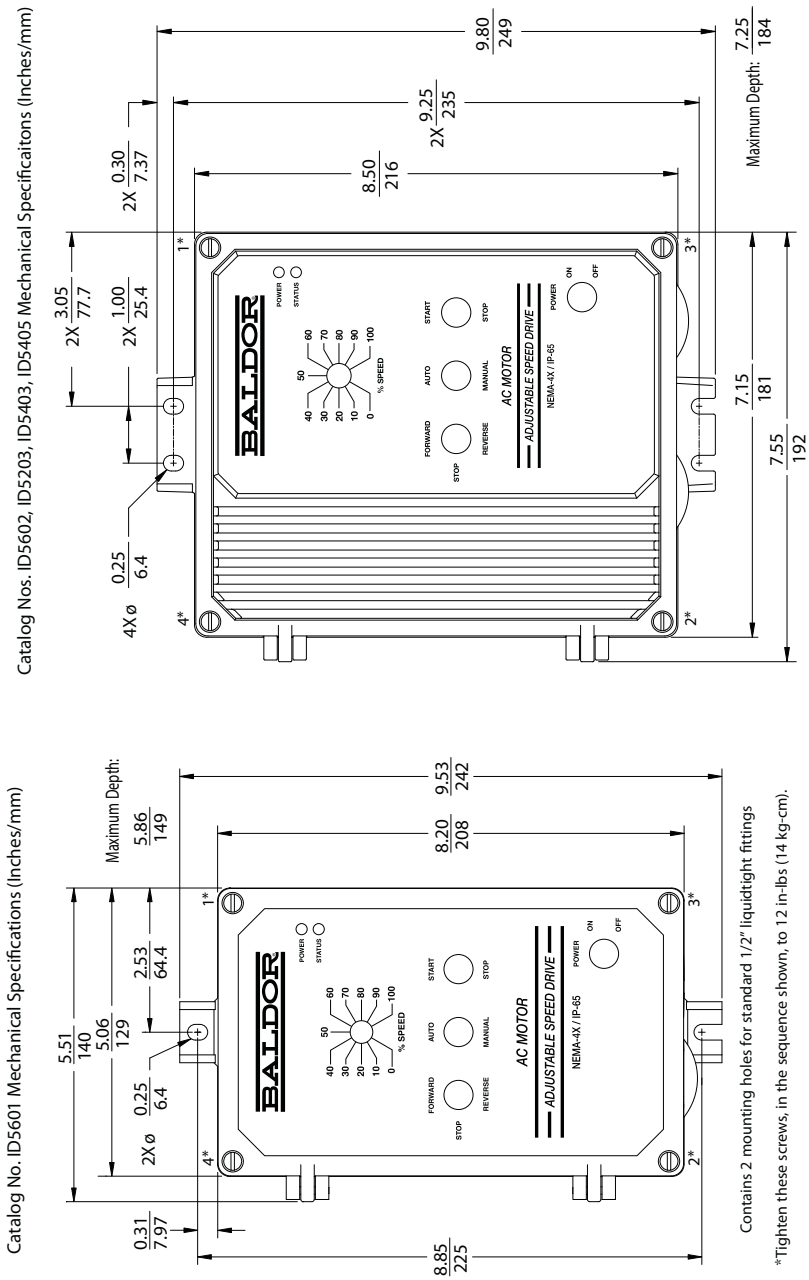
It is recommended that the drive be mounted vertically on a flat surface with adequate ventilation. Leave enough room below the drive to allow for AC line, motor connections, and any other wiring that is required. Although the drive is designed for outdoor and wash down use, care should be taken to avoid extreme hazardous locations where physical damage can occur. When mounting the drive in an enclosure, the enclosure should be large enough to allow for proper heat dissipation so that the ambient temperature does not exceed 45°C (113°F) at full rating.

The control should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. Exposure to these can reduce the operating life and degrade performance of the control.

Several other factors should be carefully evaluated when selecting a location for installation:

1. For effective cooling and maintenance, mount the drive vertically on a solid, flat, non-flammable, vertical surface. See Figures 2-1 for mounting dimensions.
2. Be sure to provide proper top, bottom and side clearance (2” minimum each side).
3. Securely fasten the control to the mounting surface at the mounting holes.
   Shock Mounting
   If the control will be subjected to levels of shock greater than 1G or vibration greater than 0.5G at 10 to 60Hz, the control should be shock mounted.
4. Operating Altitude 3300 feet (1000 meters) maximum.
5. Operating Temperature range 32° to 104°F (0°C to 40°C) ambient.

Figure 2-3 Mounting Dimensions



2.3 AC POWER CONNECTIONS

Input AC power connections must conform to NEC and local codes. Input disconnect and protection devices should be installed as required by these codes. Baldor recommends not using "Grounded Leg Delta" transformer power leads that may create ground loops. Instead, we recommend using a four wire Wye. Baldor Controls are designed to be powered from standard three phase lines that are electrically symmetrical with respect to ground. System grounding is an important step in the overall installation to prevent problems.

Ungrounded Distribution System

With an ungrounded power distribution system it is possible to have a continuous current path to ground through the MOV devices. To avoid equipment damage, an isolation transformer with a WYE grounded secondary is recommended. This provides three phase AC power that is symmetrical with respect to ground.

Input Power Conditioning

Baldor controls are designed for direct connection to standard three phase lines that are electrically symmetrical with respect to ground. An AC line reactor or an isolation transformer may be required for some power conditions.

- If the feeder or branch circuit that provides power to the control has permanently connected power factor correction capacitors, an input AC line reactor or an isolation transformer must be connected between the power factor correction capacitors and the control.
- If the feeder or branch circuit that provides power to the control has power factor correction capacitors that are switched on line and off line, the capacitors must not be switched while the control is connected to the AC power line. If the capacitors are switched on line while the control is still connected to the AC power line, additional protection is required. TVSS (Transient Voltage Surge Suppressor) of the proper rating must be installed between the AC line reactor or an isolation transformer and the AC input to the control.

2.3.1 Power Disconnect

A power disconnect should be installed between the input power service and the control for a fail safe method to disconnect power. The control will remain in a powered up condition until all input power is removed from the control and the internal bus voltage is depleted.

2.3.2 Protective Devices

A fuse or circuit breaker should be installed in the AC line. Fuse each conductor that is not at ground potential. Refer to Table 2-1 for fuse ratings.

Table 2-1 Electrical Ratings

Black	White[1]	AC Line Input			Fuse/ Brk Amps	Drive Output			Motor Horsepower Selection [2] (Jumper J2)					Net Wt.	
		VAC (50/ 60Hz)	Φ	Max Amp		Nominal VAC	Max Amp/ Phase	Max. HP(kW)						lb	kg
ID5601-BO	ID5601-WO	115	1	16	20	230	3.6	1 (0.75)	**1**	3/4	1/2	1/4	1/8	5.9	2.7
		208/ 230	1	10	15	230									
ID5602-BO	ID5602-WO	115	1	22	25	230	5.5	1.5 (1.13)	—	1.5[4]	1	3/4	1/2	10.3	4.7
		208/ 230	1	15	20	230	6.7	2 (1.5)	**2**[4]						
									A	**B**	**C**	**D**	**E**		
ID5203-BO	ID5203-WO	208/ 230	1	15	20	230	6.7	2 (1.5)	—	**2**[5]	1.5	1	3/4	10.3	4.7
			3	10.8	15	230	9.0	3 (2.25)	3[5]						
ID5403-BO[3]	ID5403-WO[3]	400/ 460	3	5.3	10	400/460	4.6	3 (2.25)	**3**	2	1.5	1	3/4	10.3	4.7
ID5405-BO[3]	ID5405-WO[3]	400/ 460	3	9.6	10	400/460	8.3	5 (3.75)	**5**	3	2	1.5	1	10.3	4.7

Notes:

1. White FDA approved finish.
2. Bold indicates factory setting. Jumper J2 on Catalog No. ID5601 is labeled “1”, “3/4”, “1/2”, “1/4”, “1/8” (factory set to the “1” position). Jumper J2 on Catalog No. ID5602 is labeled “2”, “1-1⁄2”, “1”, “3/4”, “1/2” (factory set to the “1-1⁄2” position). Jumper J2 on Catalog Nos. ID5203, ID5403, ID5405 is labeled “A”, “B”, “C”, “D”, “E” (factory set according to the table).
3. ID5403, ID5405 are rated 0 – 400 Volts AC for 50 Hz motor operation and 0 – 460 Volts AC for 60 Hz motor operation.
4. Catalog No. ID5602 is rated 1⁄2 HP maximum with 115 Volt AC line input and 2 HP maximum with 208/230 Volt AC line input.
5. Catalog No. ID5203 is rated 2 HP maximum with single-phase AC line input and 3 HP maximum with 3-phase AC line input.

Chapter 3
Wiring

3.1 WIRING

WARNING! Read Safety Warnings before using the drive. Disconnect main power before making connections to the drive. To avoid electric shock, be sure to properly ground the drive. It is highly recommended that the ID5SI-1 Signal Isolator be installed when using signal following.

Application Note - To avoid erratic operation, do not bundle the AC line and motor wires with each other or with control or signal wires. Also, do not bundle motor wires from multiple drives in the same conduit. Use shielded cables on all signal wiring over 12" (30 cm). The shield should be earth grounded on the drive side only. Wire the drive in accordance with the National Electrical Code requirements and other local codes that may apply.

Be sure to properly fuse each AC line conductor that is not at ground potential. Do not fuse neutral or grounded conductors. A separate AC line switch or contactor must be wired as a disconnect so that each ungrounded conductor is opened. For fuse or circuit breaker selection, see Table 2-1.

To maintain the watertight integrity of the drive, be sure to use suitable watertight connectors and wiring which are appropriate for the application. Catalog No. ID5601 contains two mounting holes for standard 1/2" liquidtight fittings (not supplied) (one watertight plug is provided, if only one knockout is used). Catalog Nos. ID5602, ID5203, ID5403, ID5405 contain two mounting holes for standard 1/2" liquidtight fittings (not supplied) and one mounting hole for standard 3/4" liquidtight fitting (not supplied) (two watertight plugs are provided, if only one knockout is used).

The drive is designed with a hinged case so that when the front cover is open all wiring stays intact. To open the cover, the four screws must be loosened so they are no longer engaged in the case bottom. After mounting and wiring, close the cover making sure that the wires do not get caught or crimped as the cover is closed. Tighten the four screws so that the gasket is slightly compressed. The recommended tightening torque is 12 in-lbs (14 kg-cm). See Figure 2-3 for the tightening sequence. Do not overtighten.

Table 3-1 Terminal Block Wiring Information

Terminal Block	Description	Catalog No.	Maximum Wire Size (Cμ)		Recommended Tightening Torque	
			AWG	mm^2	in-lbs	kg-cm
TB1	AC Line Input and Motor Wiring	ID5601	12	3.3	7	8
		ID5602, ID5203, ID5403, ID5405	12	3.3	12	14
TB2	Run/Fault Relay Output Contacts	All	16	1.3	3.5	3

3.1.1 AC Line Power Connection

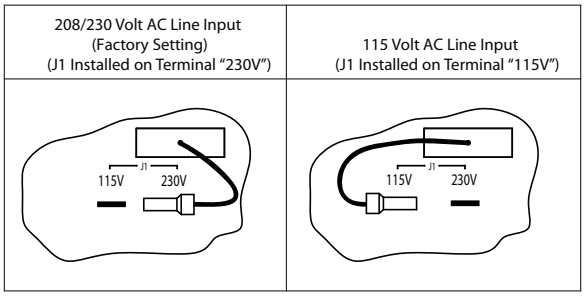
AC power and ground terminals are shown in Figure 3-2. Connect the incoming AC power as follows:

Note: Do not use a GFCI with this drive. If GFCI is required, contact your local Baldor District Office.

ID5601, ID5602 - 115/208/230VAC 1 Phase operation

Note: Catalog No. ID5602 is rated for 1-1/2 HP maximum with 115 Volt AC line input and 2 HP maximum with 208/230 Volt AC line input.

Figure 3-1 Voltage Selection Jumpers



1. Connect input power wires to L1 and L2 (115/208/230VAC).
2. Set J1 to the correct position 115V or 230V for the line voltage.

ID5203 208/230 VAC 1 or 3 Phase operation

Note: Catalog No. ID5203 is rated for 2 HP maximum 1 phase and 3 HP maximum with 3 phase line.

1. Single phase - connect input power wires to L1 and L2.
2. Three phase - connect input power wires to L1, L2 and L3.

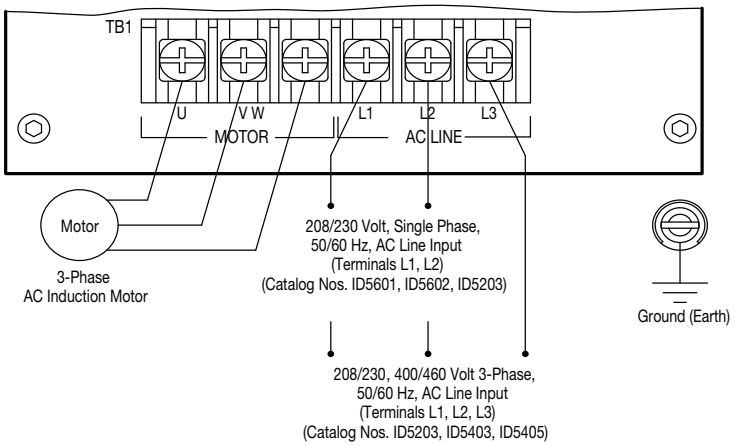
ID5403, ID5405 400/460 VAC 3 Phase operation

1. Connect input power wires to L1, L2 and L3.

3.1.2 Ground Connection

Connect the ground wire (earth) to the Ground (Earth) screw, Figure 3-2.

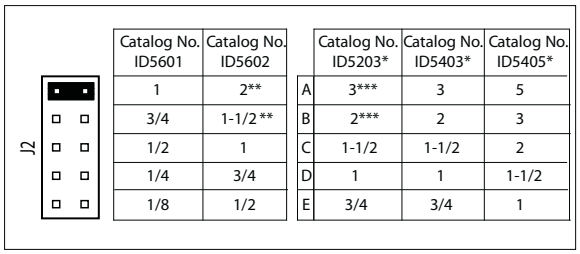
Figure 3-2 AC Line Input, Motor, and Ground Connection



3.2 MOTOR CONNECTION

1. Connect the motor wires to Terminal Block TB1 Terminals “U”, “V”, “W”. See Figure 3-2. Output reactors may be required for cable lengths over 100 ft. (30 m) (contact your local Baldor District Office.)
2. Motor Frequency Selection – Jumper J5 is factory set for 60 Hz 3-phase motor operation. For 50 Hz motor operation, set Jumper J5 to the “50Hz” position.
3. Rated Motor RPM Selection – Jumper J4 is factory set to “1X”.

Table 3-2 Motor HP Selection Jumper J2



	Catalog No. ID5601	Catalog No. ID5602		Catalog No. ID5203*	Catalog No. ID5403*	Catalog No. ID5405*
	1	2**	A	3***	3	5
	3/4	1-1/2**	B	2***	2	3
	1/2	1	C	1-1/2	1-1/2	2
	1/4	3/4	D	1	1	1-1/2
	1/8	1/2	E	3/4	3/4	1

The factory setting is shown in bold.
*Jumper J2 on Catalog Nos. ID5203, ID5403, ID5405 is labeled “A”, “B”, “C”, “D”, “E”.
**Catalog No. ID5602 is rated 1-1/2 HP maximum with 115 Volt AC line input and 2 HP maximum with 208/230 Volt AC line input.
***Catalog No. ID5203 is rated 2 HP maximum with single-phase AC line input and 3 HP maximum with 3-phase AC line input.

3.3 CONTROL CONNECTIONS

WARNING! Do not use START/STOP, or ENABLE functions as a safety disconnect. Only use an AC Line disconnect for that purpose.

3.3.1 Remote Start/Stop Switch

A factory installed prewired Start/Stop Switch is used to electronically “start” and “stop” the drive. This switch must be used to “start” the drive each time the AC line is applied to the drive or to “restart” the drive.

To operate the drive from a remote Start/Stop Switch (type ON-OFF-ON, SPDT), remove the white, black, and red wires from Terminals “RUN”, “COM”, and “STOP”. The wires may be taped and left inside the drive. The switch assembly may be removed from the drive cover if a liquidtight seal is installed to cover the hole. After applying power to the drive, momentarily set the Start/Stop switch to the “START” position.

For Start/Stop Switch with normally open stop contact, set Jumper J9 to the “NO” position (factory setting).

For Start/Stop Switch with normally closed stop contact, set Jumper J9 to the “NC” position. See Figures 3-3 and 3-4.

WARNING! Using a jumper to bypass the START/STOP function will allow the drive and motor to start and run when AC supply power is applied, when power is restored after a momentary power loss, or after a fault is reset. The user must ensure that automatic start up of the drive equipment will not cause injury to operating personnel or damage to the driven equipment. The user is responsible for providing suitable audible or visual alarms or other devices to indicate that the drive may start at any moment. Failure to observe this warning could result in severe bodily injury or loss of life.

Figure 3-3 Remote Start/Stop Switch Connection With Normally Open Stop Contact (J9 Installed in “NO” Position)

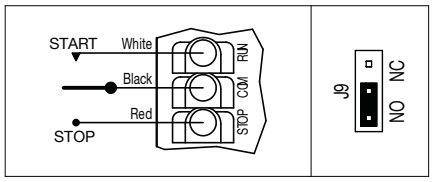
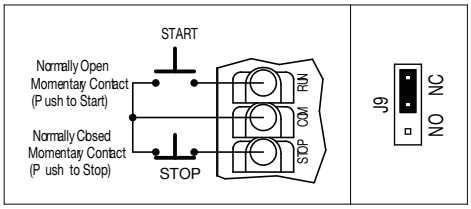


Figure 3-4 Remote Start/Stop Switch Connection With Normally Closed Stop Contact (J9 INSTALLED IN "NC" POSITION)

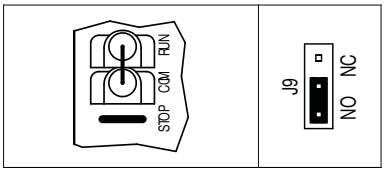


3.3.2 Automatic Restart

Automatic restart requires the removal of the Start/Stop Switch. Disconnect the white, black, and red wires from Terminals "RUN", "COM", and "STOP". The wires may be taped and left inside the drive. The switch assembly may be removed if a liquid tight seal is used to cover the hole in the front cover.

Connect the "RUN" and "COM" with the jumper that is provided. Be sure Jumper J9 is set to the "NO" position. See Figure 3-5.

Figure 3-5 START/STOP FUNCTION ELIMINATED



WARNING! Using a jumper to bypass the START/STOP function will allow the drive and motor to start and run when AC supply power is applied, when power is restored after a momentary power loss, or after a fault is reset. The user must ensure that automatic start up of the drive equipment will not cause injury to operating personnel or damage to the driven equipment. The user is responsible for providing suitable audible or visual alarms or other devices to indicate that the drive may start at any moment. Failure to observe this warning could result in severe bodily injury or loss of life.

3.3.3 Analog Input

Voltage Following Connection – An isolated 0 – 5 Volt DC analog signal input can control motor speed. The drive output will linearly follow the analog signal input.

Connect the signal input positive lead (+) to Terminal "P2" and the negative lead (-) to Terminal "P1", see Figure 3-6.

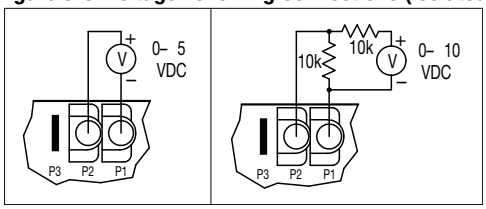
With external circuitry, a 0 – 10 Volt DC analog signal can also be used.

If a non-isolated signal is used, install the ID5SI-2 Signal Isolator.

The ID5SI-2 accepts voltage (±25 Volts DC) or current (4 – 20mA DC) signal inputs.

(Ref. MN781-S1)

Figure 3-6 Voltage Following Connections (Isolated)

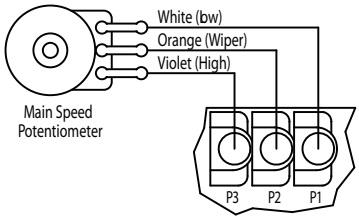


Note: For voltage following operation, the Minimum Speed Trimpot (MIN) must be set fully counterclockwise.

3.3.4 Remote Main Speed Potentiometer Connection

A Main Speed Potentiometer is mounted on the front cover. To operate the drive from a remote potentiometer (5 kohm), remove the white, orange, and violet potentiometer leads from Terminals “P1”, “P2”, and “P3”. The wires may be taped and left inside the drive. The potentiometer assembly may be removed if a watertight seal is used to cover the hole in the front cover. Connect the Main Speed Potentiometer to Terminals “P1” (low side), “P2” (wiper), and “P3” (high side). See Figure 3-7.

Figure 3-7 Remote Main Speed Potentiometer



Note: It is recommended to use an isolated speed pot with a plastic shaft, Baldor BC148, replacement potentiometer kit, or install the ID5S1-2 Signal Isolator option board.

3.3.5 Enable Circuit Connection

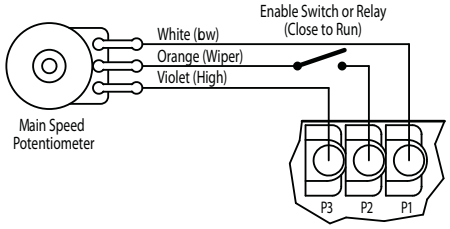
WARNING: Do not use START/STOP, or ENABLE functions as a safety disconnect. Only use an AC Line disconnect for that purpose.

The drive can also be started and stopped with an Enable circuit (close to run, open to stop), see Figure 3-8.

The Enable function is established by connecting a switch or contact in series with the orange Main Speed Potentiometer lead which connects to Terminal “P2”.

When the Enable Switch is closed, the motor will accelerate to the Main Speed Potentiometer setting. When the Enable Switch is opened, the motor will decelerate to stop.

Figure 3-8 Enable Circuit



3.3.6 Run/Fault Relay Connection

The Run/Fault Relay Output Contacts are located at TB2 and can be used to turn on or off equipment or to signal a warning if the drive is put into the Stop Mode or a fault has occurred. See Figure 3-9.

The Run/Fault Relay Contact status for various drive operating conditions is shown in Table 3-3.

Figure 3-9 Run/Fault Relay Output Contacts Connection

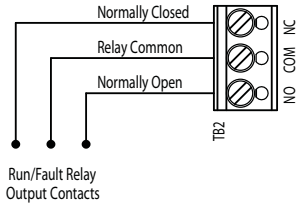


Table 3-3 Drive Operating Condition And Run/Fault Relay Contact Status

Drive Operating Condition	Description	Run Relay Operation (Jumper J8 Installed in "R" Position) (Factory Setting)		Fault Relay Operation (Jumper J8 Installed in "F" Position)	
		Normally Open Contact	Normally Closed Contact	Normally Open Contact	Normally Closed Contact
Power Off	Main Power Disconnected	Open	Closed	Open	Closed
Run Mode*	Normal Drive Operation	Closed	Open	Closed	Open
Stop Mode*	Selected by Operator	Open	Closed	Closed	Open
Fault**	Drive Tripped	Open	Closed	Open	Closed

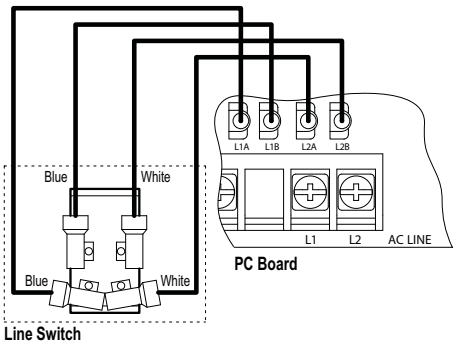
*Run Mode or Stop Mode is selected using the Start/Stop Switch.
**Overload, I^2t, Short Circuit, Undervoltage, Overvoltage.

3.3.7 ON/OFF AC Line Switch

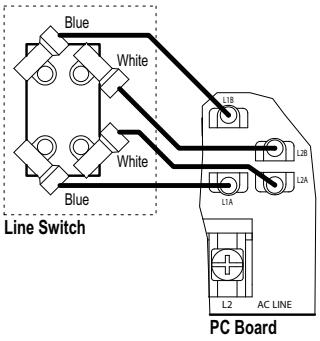
The drive is supplied with a prewired On/Off AC Line Switch to turn the drive On/Off. See Figure 3-10. This is not a Power Disconnect Device.

Figure 3-10 Wiring Diagram of Factory Installed AC Line Switch

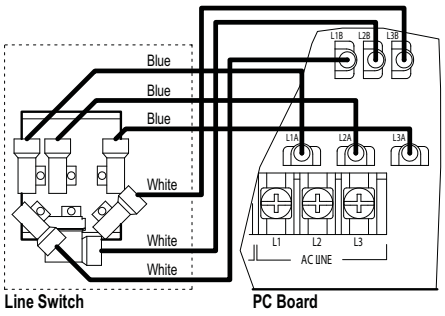
Catalog No. ID5601 ON/OFF AC Line Switch Connection



Catalog No. ID5602 ON/OFF AC Line Switch Connection



Catalog Nos. ID5203, ID5403, ID5405 ON/OFF AC Line Switch Connection



Chapter 4

Start-Up and Adjustment

4.1 JUMPER SETTINGS

4.1.1 Line Input Voltage Selection (J1)

(CATALOG NOS. ID5601, ID5602) – Jumper J1 is factory installed on Terminal "230V" for 208/230 Volt AC line input. For 115 Volt AC line input, the jumper must be removed and installed on Terminal "115V". See Figure 3-1.

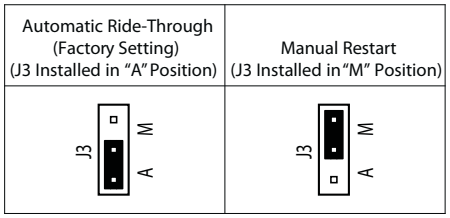
4.1.2 Motor Horsepower Selection (J2)

See paragraph 3.2 Motor Connection and Table 3-2 for Jumper J2 Position Selection.

4.1.3 Automatic Ride-Through or Manual Restart Selection (J3)

Jumper J3 is factory set to the "A" position for Automatic Ride-Through. If the power is interrupted for up to 2 seconds, the drive will shut down and then "ride-through" and automatically return to the set frequency. If Jumper J3 is set to the "M" position, the drive will have to be manually restarted for a momentary power loss using the Start/Stop Switch. See Figure 4-1.

Figure 4-1 Automatic Ride-Through or Manual Restart Selection (J3)



WARNING! The user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. The user is responsible for providing suitable audible or visual alarms or other devices to indicate that the drive may start at any moment. Failure to observe this warning could result in severe bodily injury or loss of life.

4.1.4 Setting The Drive For Two Times The Rated Motor RPM (J4)

The drive can also be used to operate the motor up to two times the rated RPM. However, constant horsepower will result when operating the drive in the "2X" mode above the motor rated frequency. See Figure 4-3.

For 120 Hz output with 60 Hz motor, set Jumper J4 to the "2X" position and be sure Jumper J5 is set to the "60Hz" position.

For 100 Hz output with 50 Hz motor, set Jumper J4 to the "2X" position and set Jumper J5 to the "50Hz" position.

Figure 4-2 Two Times Motor Rated RPM

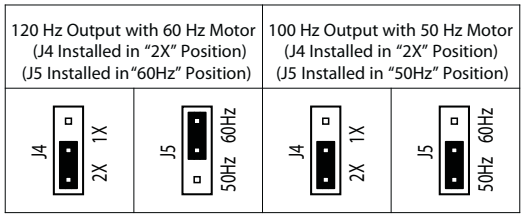
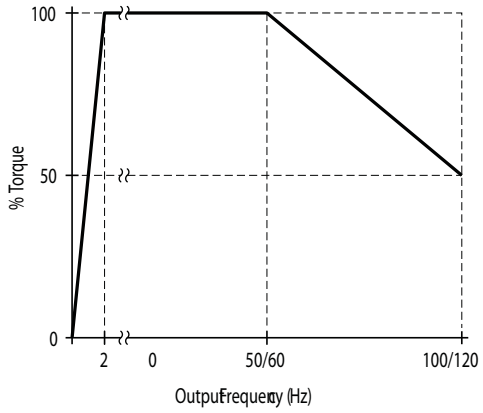


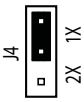
Figure 4-3 Available Torque Vs. Output Frequency



4.1.5 Setting The Drive For 60 Hz or 50 Hz Motor Operation (J5)

The drive is factory set to operate 60 Hz motors. Jumper J5 is factory set to the "60Hz" position. For 50 Hz motors, set Jumper J5 to the "50Hz" position. See Figure 4-2.

Figure 4-4 60 or 50 Hz Selection

60 Hz Motor Operation (Factory Setting) (J4 Installed in "1X" Position) (J5 Installed in "60Hz" Position)		50 Hz Motor Operation (J4 Installed in "1X" Position) (J5 Installed in "50Hz" Position)	
			

4.1.6 Boost Mode Selection (J6)

Jumper J6 is factory set to the "FIX" position for Fixed Boost. For Adjustable Boost using the BOOST Trimpot, set Jumper J6 to the "ADJ" position. See Figure 4-5. Also see Section 4.3.8 for the BOOST Trimpot range.

Figure 4-5 Boost Mode Selection

Fixed Boost (Factory Setting) (J6 Installed in "FIX" Position)	Adjustable Boost (J6 Installed in "ADJ" Position)
	

4.1.7 Braking Mode Selection (J7)

Jumper J7 is factory set to the “RG” position for Regenerative Braking when the Start/Stop Switch is set to the “STOP” position. For DC Injection Braking, set Jumper J7 to the “INJ” position. See Figure 4-6. Also see Section 4.3.5. When the Injection Brake Mode is selected, the DECEL Trimpot is used to adjust the brake time and intensity.

Figure 4-6 Braking Mode Selection

Regenerative Braking (Factory Setting) (J7 Installed in “RG” Position)	DC Injection Braking (J7 Installed in “INJ” Position)
	

4.1.8 Run/Fault Output Relay Operation Selection (J8)

Jumper J8 is factory set to the “R” position for “Run” operation of the Run/Fault Relay. For “Fault” operation of the Run/Fault Relay, set Jumper J8 to the “F” position. See Figure 4-7. For status of Run/Fault Relay output contacts, see Table 3-3.

Figure 4-7 Output Relay Operation

“Run” Output Relay Operation (Factory Setting) (J8 Installed in “R” Position)	“Fault” Output Relay Operation (J8 Installed in “F” Position)
	

4.1.9 Stop Contact Selection (J9)

Jumper J9 is factory set to the “NO” position for a normally open stop contact. For remote normally closed stop contact, set Jumper J9 to the “NC” position. See Figure 4-8.

Figure 4-8 Stop Contact Selection

Normally Open Stop Contact (Factory Setting) (J9 Installed in “NO” Position)	Normally Closed Stop Contact (J9 Installed in “NC” Position)
	

4.1.10 Torque Mode Selection (J10)

Jumper J10 is factory set to the "CT" position for Constant Torque Mode, which is desirable for most machine applications. For Variable Torque Mode, used for HVAC and fan applications, set Jumper J10 to the "VT" position. See Figure 4-9.

Figure 4-9 Torque Mode Selection

Constant Torque (Factory Setting) (J10 Installed in "CT" Position)	Variable Torque (J10 Installed in "VT" Position)
	

4.1.11 I^2t Overload Selection (J11)

Jumper J11 is factory set to the "1" position for Inverter Duty Motors.
For Non-Inverter Duty Rated Motors and HVAC applications, set Jumper J11 to the "2" position. See Figure 4-10.

Figure 4-10 I^2t Selection

Inverter Duty Rated Motor (Factory Setting) (J11 Installed in "1" Position)	Non Inverter Duty Rated Motor Operation (J11 Installed in "2" Position)
	

After the control is mounted, all wiring is connected and jumpers are correctly set, the control is ready for start-up and adjustment of trimpots to ensure correct performance.

WARNING! Verify the system is properly grounded before applying power. Do not apply AC power until you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.

WARNING! Electrical shock can cause serious or fatal injury. Verify there is no voltage phase-to-phase or phase-to-neutral at the AC Line Conductors before touching the AC Input wires. Do not touch live wires, all power must be disconnected before proceeding.

WARNING! Electrical shock can cause serious or fatal injury. Verify there is no voltage phase-to-phase or phase-to-neutral at the motor leads before connecting motor to this control. Motor may have high voltage present even when disconnected from this control.

4.2 START-UP PROCEDURE

WARNING! Using a jumper to bypass the START/STOP function will allow the drive and motor to start and run when AC supply power is applied, when power is restored after a momentary power loss, or after a fault is reset. The user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. The user is responsible for providing suitable audible or visual alarms or other devices to indicate that the drive may start at any moment. Failure to observe this warning could result in severe bodily injury or loss of life.

1. Set the On/Off AC Line Switch to the "ON" position. The power (POWER) LED will illuminate green. The status (STATUS) LED will indicate drive status.
2. To start the drive, momentarily set the Start/Stop Switch to the "START" position. The motor will begin to accelerate to the set speed.
3. Note the direction of motor rotation. If direction is incorrect, disconnect the AC power, and reverse any two motor leads (U, V and W), and repeat the start-up procedure.
4. Note the speed of motor rotation and note any noise or vibration.
5. Note any drive fault conditions indicated on the STATUS LED.
6. Stop the drive, momentarily set the Start/Stop Switch to the "STOP" position. The motor will begin to decelerate or coast to zero speed.
7. If operation is smooth and no faults were indicated, continue with Adjustments.
8. If problems were noted, refer to troubleshooting and STATUS LED descriptions.

4.3 ADJUSTMENTS

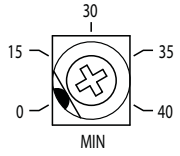
WARNING! If possible, do not adjust trimpots with the main power applied. Electrical shock can cause serious or fatal injury. If adjustments are made with the main power applied, an insulated adjustment tool must be used to prevent shock hazard and safety glasses must be worn.

Trimpots are factory set for most applications. Figure 4-1 shows the location of the trimpots and their approximate factory calibrated positions. Some applications may require readjustment of the trimpots in order to tailor the drive for a specific requirement.

4.3.1 Minimum Speed (MIN)

Sets the minimum speed of the motor. The MIN Trimpot is factory set to 0% of frequency setting. For a higher minimum speed setting, rotate the MIN Trimpot clockwise. See Figure 4-11.

Figure 4-11 Minimum Speed

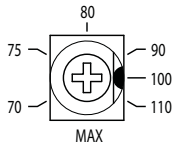


(Shown Factory Set to 0% Frequency Setting)

4.3.2 Maximum Speed (MAX)

Sets the maximum speed of the motor. The MAX Trimpot is factory set to 100% of frequency setting. For a lower maximum speed setting, rotate the MAX Trimpot counterclockwise. For a higher maximum speed setting, rotate the MAX Trimpot clockwise. See Figure 4-12.

Figure 4-12 Maximum Speed

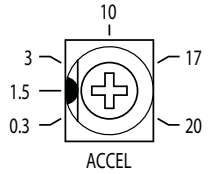


(Shown Factory Set to 100% Frequency Setting)

4.3.3 Acceleration (ACCEL)

Sets the amount of time for the motor to accelerate from zero speed to full speed. The ACCEL Trimpot is factory set to 1.5 seconds. For a longer acceleration time, rotate the ACCEL Trimpot clockwise. For more rapid acceleration, rotate the ACCEL Trimpot counterclockwise. See Figure 4-13.

Figure 4-13 Accel Trimpot

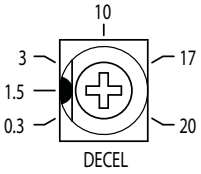


Note: Rapid acceleration settings may cause the current limit circuit to activate, which will extend the acceleration time.

4.3.4 Deceleration (DECEL)

Sets the amount of time for the motor to decelerate from full speed to zero speed. The DECEL Trimpot is factory set to 1.5 seconds. For longer deceleration time, rotate the DECEL Trimpot clockwise. For more rapid deceleration, rotate the DECEL Trimpot counterclockwise. See Figure 4-14.

Figure 4-14 Decel Trimpot

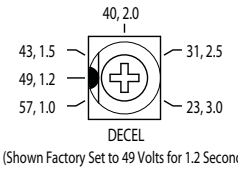
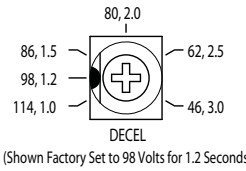


Note: On applications with high inertial loads, the deceleration may automatically increase in time. This will slow down the rate of speed of decrease to prevent the bus voltage from rising to the Overvoltage Trip point. This function is called Regeneration Protection. It is recommended that for very high inertial loads that both the ACCEL and DECEL Trimpots be set to greater than 10 seconds.

4.3.5 DC Injection Brake (DECEL)

The drive is factory set for Regenerative Braking (Jumper J7 set to the "RG" position). When the drive is set for DC Injection Brake (Jumper J7 set to the "INJ" position), the DECEL trimpot is used to set the DC Injection Brake voltage and time. The DC Injection Brake voltage and time range is 10% of full drive output voltage for 3 seconds with the trimpot fully clockwise and 25% of full drive output voltage for 1 second with the trimpot fully counterclockwise. Catalog Nos. ID5601, ID5602, ID5203 are factory set for 49 Volts for 1.2 seconds and Catalog Nos. ID5403, ID5405 are factory set for 98 Volts for 1.2 seconds. Adjust the trimpot so that the load stops within the required time. See Figure 4-15.

Figure 4-15 DC Injection Brake

Catalog Nos. ID5601, ID5602, ID5203	Catalog Nos. ID5403, ID5405
	
(Shown Factory Set to 49 Volts for 1.2 Seconds)	(Shown Factory Set to 98 Volts for 1.2 Seconds)

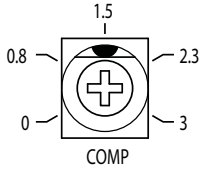
4.3.6 Slip Compensation (COMP)

Sets the amount of Volts/Hz to maintain set motor speed under varying loads. The COMP Trimpot is factory set to 1.5 Volts/Hz, which provides excellent speed regulation for most motors. To increase the slip compensation, rotate the COMP Trimpot clockwise. To decrease the slip compensation, rotate the COMP Trimpot counterclockwise. See Figure 4-16.

The slip compensation may be adjusted as follows:

1. Connect an AC RMS ammeter in series with one motor phase.
2. Run the motor and set the unloaded speed to approximately 50% (900 RPM on 4-pole 1500/1725 RPM motors).
3. Using a tachometer, record the unloaded speed.
4. Load the motor to the nameplate rated current (AC Amps).
5. Adjust the COMP Trimpot until the loaded RPM is equal to the unloaded RPM.
6. The motor is now compensated to provide constant speed under varying loads.

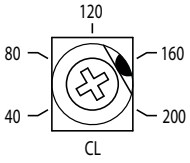
Figure 4-16 Slip Compensation



4.3.7 Motor Overload (I^2t) with RMS Current Limit (CL)*

Sets the current limit (overload), which limits the maximum motor current to prevent motor burnout and nuisance trips. The CL Trimpot is factory set to 160% of the drive rated current.
To increase the current limit, rotate the CL Trimpot clockwise.
To decrease the current limit, rotate the CL Trimpot counterclockwise. See Figure 4-17.
*UL approved as an electronic overload protector for motors.

Figure 4-17 Current Limit



(Shown Factory Set to 160% Full Load)

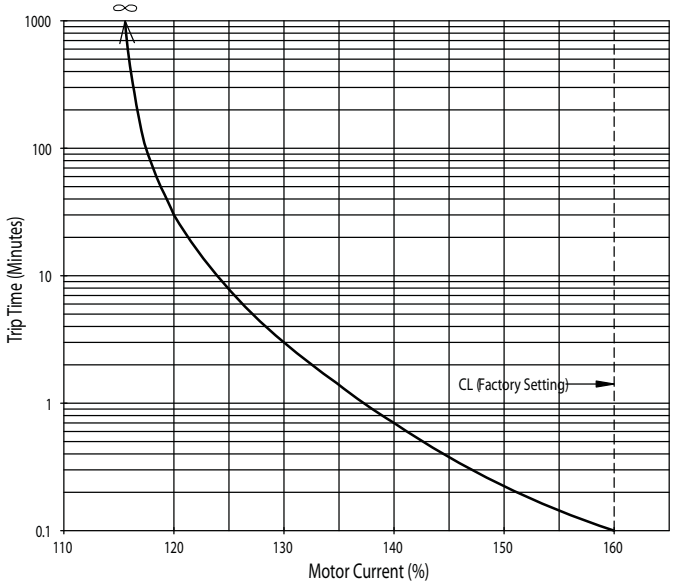
⚠ **CAUTION! Adjusting the current limit above 160% of the motor nameplate rating can cause overheating of the motor. Do not leave the motor in a locked rotor condition for more than a few seconds since motor damage may occur.**

To ensure the motor is properly protected, the CL Trimpot must be set for 160% of the motor nameplate rated current, as described below.
Note: This adjustment must be made within 6 seconds or the I^2t Trip will occur.

The current limit may be adjusted as follows:

1. Connect an AC RMS ammeter in series with one motor phase.
2. Set the CL Trimpot fully counterclockwise.
3. Adjust the speed setting to 30%.
4. Lock the motor shaft and start the motor. Adjust the CL Trimpot to 160% of the motor nameplate rated current. Stop the motor.

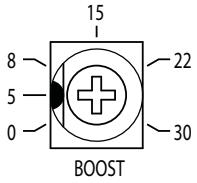
Figure 4-18 I²t Trip Time vs. Motor Current



4.3.8 Boost (BOOST)

The drive is factory set for Fixed Boost (Jumper J6 set to the "FIX" position). When the drive is set for Adjustable Boost (Jumper J6 set to the "ADJ" position), the BOOST Trimpot can be used to adjust the amount of boost voltage to the motor. See Figure 4-19.

Figure 4-19 Boost



Note: The Boost function operates over a frequency range of 0 – 15 Hz. If the frequency range required is above 15 Hz, Boost adjustment is not necessary.

WARNING! To avoid motor winding overheating and failure, do not over boost the motor.
Note: An unloaded motor with excessive boost will draw more current than a partially loaded motor.

The boost voltage may be adjusted as follows:

1. Connect an AC RMS ammeter in series with one motor phase.
2. Run the motor unloaded at approximately 4 Hz (or 120 RPM).
3. Increase the boost until the ammeter reading reaches the motor nameplate rated current (Amps AC).
4. Using the Main Speed Potentiometer, slowly adjust the motor speed over a 1 – 15 Hz (0 – 450 RPM) range. If the motor current exceeds the nameplate rating, decrease the boost setting.

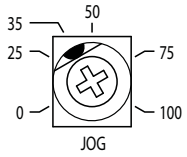
4.3.9 Jog (JOG)

The Jog feature requires the installation of a Run-Stop-Jog Switch. The switch must be connected as shown in Figure 4-21.

The orange Main Speed Potentiometer wire (wiper) which connects to Terminal “P2” on the drive must be removed and installed on Terminal “RUN” on the switch. The “JOG” Terminal on the drive connects to “JOG” on the switch. Terminal “P2” on the drive connects to the center (common) terminal on the switch.

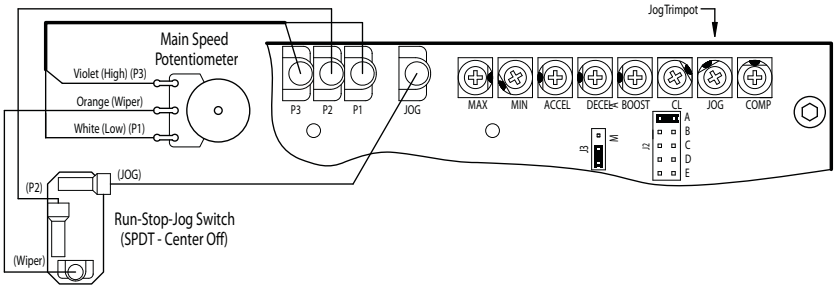
When the switch is in the “JOG” position, the JOG Trimpot is used to set the “jog” speed. See Figure 4-20. When the switch is in the “RUN” position, the Main Speed Potentiometer is used for speed setting.

Figure 4-20 Jog



(Shown Factory Set to 35% Frequency Setting)

Figure 4-21 Run-Stop-Jog Switch Connection (SPDT – CENTER OFF)



4.4 DIAGNOSTIC LEDS

Two diagnostic LEDs display the drive’s operational status.

4.4.1 POWER ON LED (POWER)

The “POWER” LED will illuminate green when the AC line is applied to the drive.

WARNING! Do not depend on the POWER LED as a guaranteed power off condition. Be sure the main power switch or circuit breaker is in the “OFF” position before servicing this drive.

4.4.2 STATUS LED (STATUS)

The “STATUS” LED is a tricolor LED which provides indication of a fault or abnormal condition. The information provided can be used to diagnose an installation problem such as incorrect input voltage, overload condition, and drive output miswiring. It also provides a signal which informs the user that all drive and microcontroller operating parameters are normal. Table 4-1 summarizes the “STATUS” LED functions.

Table 4-1 Drive Operating Condition And Status LED Indicator

Drive Operating Condition	Flash Rate[1] and LED Color
Normal Operation	Slow Flash Green
Overload (120% – 160% Full Load)	Steady Red[2]
I^2t (Drive Timed Out)	Quick Flash Red[2]
Short Circuit	Slow Flash Red
Undervoltage	Quick Flash Red / Yellow[3]
Overvoltage	Slow Flash Red / Yellow[3]
Stop	Steady Yellow
Stand-By[4]	Slow Flash Yellow

Notes: 1. Slow Flash = 1 second on and 1 second off.
Quick Flash = 0.25 second on and 0.25 second off.
2. When the Overload is removed, before the I^2t times out and trips the drive, the "STATUS" LED will flash green.
3. When the Undervoltage or Overvoltage condition is corrected, the "STATUS" LED will flash Red / Yellow / Green.
4. Only if the Forward-Stop-Reverse Switch is installed.

4.5 FAULT RECOVERY

The drive monitors four faults (Undervoltage, Overvoltage, Short Circuit at the motor (phase-to-phase), and I^2t. Table 4-2 describes how the drive will automatically start (factory setting) after the fault has cleared.

Note: In Manual Start Mode, the drive must be manually reset for any fault. Use the Manual Start Switch as described in Section 4.1.3.

Table 4-2 Fault Recovery & Resetting The Drive*

Fault	Automatic Start Mode (Factory Setting)
Undervoltage	Drive will automatically start after the bus voltage returns to the operational level or when the drive is first turned on (power up).
Overvoltage	Drive will automatically start after the bus voltage returns to the operational level.
Short Circuit	Drive will automatically start after the short circuit is removed.
I^2t	Drive must be manually restarted.

4.6 RESTARTING THE DRIVE AFTER AN I^2t FAULT HAS CLEARED

The drive can be restarted after an I^2t Fault has cleared by any of the following methods.

Note: If an I^2t Fault occurs, the motor may be overloaded. Check the motor current with an AC RMS ammeter. Also, the CL setting may be set too low.

1. Disconnect and reconnect the AC power (approximately 15 seconds). The "ST" LED must change from quick flashing red to flashing red/yellow.
2. Set the Main Speed Potentiometer to zero (fully counterclockwise).

Note: To reset the drive by setting the Main Speed Potentiometer to zero, it is necessary to have the MIN Trimpot set to zero (fully counterclockwise).

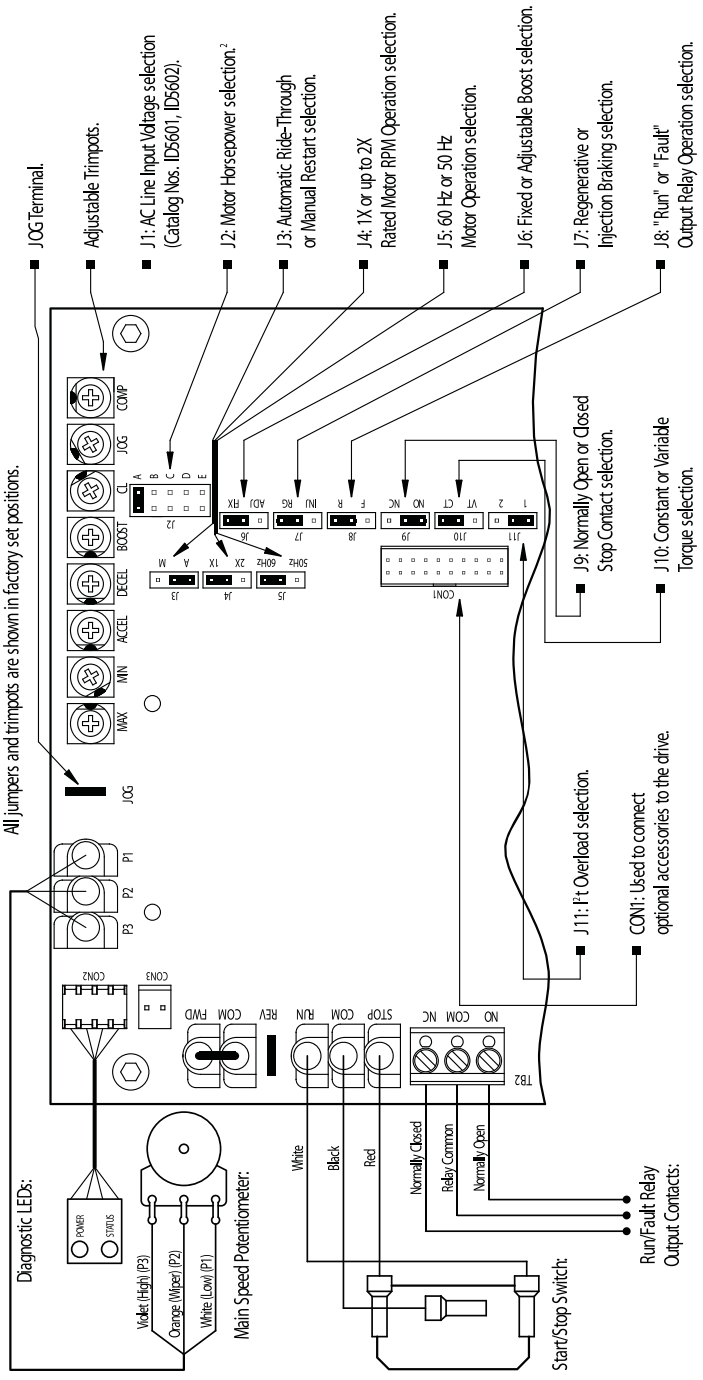
3. Open and close the Enable switch or contact.

4.7 PERFORMANCE SPECIFICATIONS

Description	Specification	Factory Setting
115 Volt AC Line Input Voltage Operating Range	115VAC (±15%)	—
208/230 Volt AC Line Input Voltage Operating Range	208VAC (-15%) / 230VAC (+15%)	—
400/460 Volt AC Line Input Voltage Operating Range	380VAC (-15%) – 460 VAC (+15%)	—
Maximum Load (% Current Overload for 2 Minutes)	150	—
Carrier, Switching Frequency	16kHz, 8kHz	—
Signal Following Input Voltage Range	0 – 5 VDC [1]	—
Output Frequency Resolution (Bits, Hz)	10, .06	—
Minimum Speed Trimpot (MIN) Range (% Frequency Setting)	0 – 40%	0
Maximum Speed Trimpot (MAX) Range (% Frequency Setting)	70 – 110%	100
Acceleration Trimpot (ACCEL) and Deceleration Trimpot (DECEL) Range	0.3 – 20 seconds	1.5
Boost Trimpot (BOOST) Range	0 – 30Volts/Hz	5
Slip Compensation Trimpot (COMP) Range at Drive Rating	0 – 3 Volts/Hz	1.5
Current Limit Trimpot (CL) Range (% Full Load)	40 – 200 %	160
Jog Trimpot (JOG) Range (% Frequency Setting)	0 – 100%	35
Motor Frequency Setting	50Hz, 60Hz	60
Output Frequency Multiplier	1X, 2X [2]	1
Minimum Operating Frequency at Motor	1Hz	—
Speed Range (Ratio)	60:1	—
Speed Regulation (30:1 Speed Range, 0 – Full Load) (% Base Speed)	2.5% [3]	—
Overload Protector Trip Time for Stalled Motor	6 seconds	—
Undervoltage/Overvoltage Trip Points for 115 Volt AC Line Input (± 5%)	76 – 141VAC [4]	—
Undervoltage/Overvoltage Trip Points for 208/230 Volt AC Line Input (± 5%)	151 – 282VAC [4]	—
Undervoltage/Overvoltage Trip Points for 400/460 Volt AC Line Input (± 5%)	302 – 567VAC [4]	—
Run/Fault Relay Output Contact Rating	1A@30VDC, 0.5A@125VAC, 0.25A@250VAC	—
Operating Temperature Range	0 – 40°C (32 – 104°F)	—
Operating Humidity Range (% Relative, Non-Condensing)	0-95	—
Storage Temperature (°C/°F)	-25 to +85 / -13 to +185	—

Notes: 1. Requires an isolated signal. If a non-isolated signal is used, or if using ±25 Volts DC, or 4 – 20mA DC signal input, install the ID5SI-2 Signal Isolator.
2. Allows the motor to operate up to two times the rated RPM. Constant horsepower will result when operating the drive in the "X2" mode above the motor rated frequency.
3. Dependent on motor performance.
4. Do not operate the drive outside the specified AC line input voltage operating range.

Figure 4-22 Adjustment Location[1]



Notes:
1. Layout of Catalog No. ID5601 varies slightly.
2. Jumper J2 on Catalog No. ID5601 is labeled "1", "3/4", "1/2", "1/4", "1/8" (factory set to the "1" position).
   Jumper J2 on Catalog No. ID5602 is labeled "2", "1-1/2", "1", "3/4", "1/2" (factory set to the "1 1/2" position).
   Jumper J2 on Catalog Nos. ID5203, ID5403, ID5405 is labeled "A", "B", "C", "D", "E" (factory set according to Table 2-1.