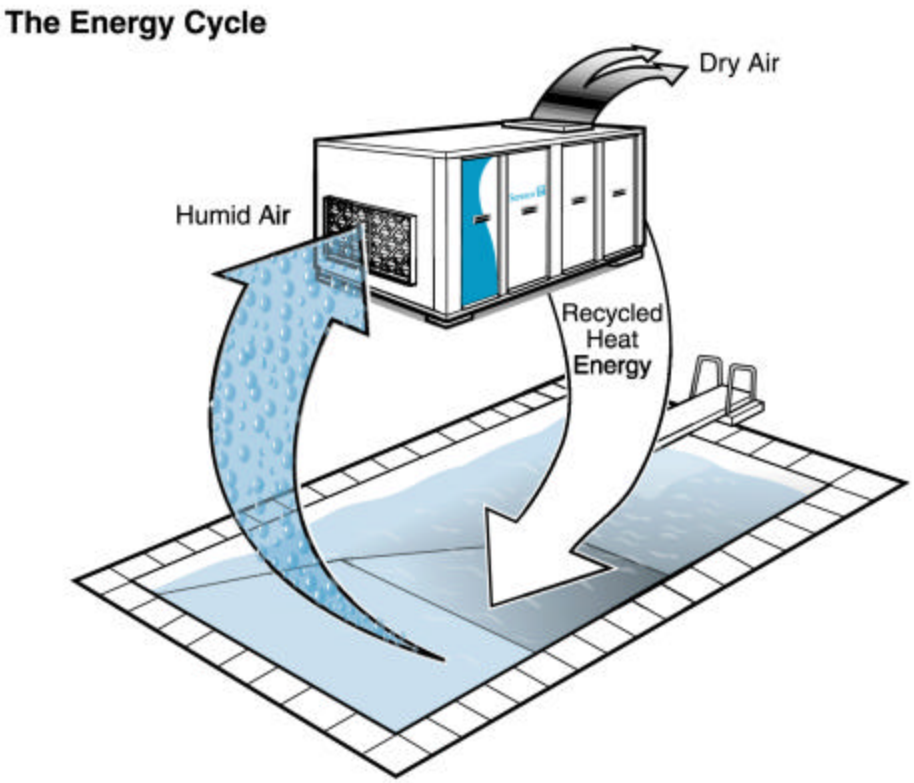
Seresco: (pronounced Sir-ES-co) Meaning, “to become dry”

Installation and Operation Manual

NE Series Dehumidifiers

For Models:
PV, NV, PH and NH Configuration Natatorium Dehumidifiers
NC Series Outdoor Air-cooled Condensers



CAUTION

ONLY TRAINED, QUALIFIED PERSONNEL SHOULD INSTALL AND/OR SERVICE SERESCO EQUIPMENT. SERIOUS INJURY AND PROPERTY DAMAGE CAN RESULT FROM IMPROPER INSTALLATION/SERVICE OF THIS EQUIPMENT. HIGH VOLTAGE ELECTRICAL COMPONENTS AND REFRIGERANT UNDER PRESSURE ARE PRESENT

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1. Preface

Natatorium: a facility that contains an indoor pool, whirlpool or spa ranging in size from a small residential installation to a large commercial indoor waterpark.

Seresco's Natatorium Dehumidifiers were developed by a team of industry experts with a lifetime of experience developed while working with many thousands of indoor pools. A natatorium has many critical design issues that must be fully understood and properly addressed to ensure years of comfortable and trouble free operation of the facility.

This booklet contains valuable design guidelines based on Seresco's extensive knowledge and experience in solving humidity control problems in many thousands of indoor pool installations. Seresco Technologies Inc., manufacturer of the NE Series of natatorium air quality control systems is dedicated to providing state-of-the-art features and design, quality engineering and the most reliable products in the market.

The environment in a natatorium should be the same as in any other room in a building: comfortable and healthy for the occupants and their activity, and provide good air quality. The space conditions in a natatorium need to be precisely maintained in order to maximize human comfort and health as well as preserve building integrity. Relative humidity, air temperature, water temperature and air quality are all key environmental aspects to control. High relative humidity levels are not only a problem to bather comfort and health, but can seriously damage the building structure possibly leading to building component failures. Revenues can also be affected in commercial facilities. Several hotel chains offer a full money-back guarantee should the hotel guest have any complaint regarding their stay.

A properly designed and maintained natatorium delivers years of pleasure. The first step is to become familiar with the design challenges and to understand how to address them. A Natatorium's overall performance is inversely proportional to the amount of compromises and shortcuts taken in the design and construction of the natatorium.

A Successful Facility. A natatorium is one of the most notoriously difficult facilities to design because there are so many critical considerations that if overlooked develop into problems with the building structure or complaints from the occupants. The designer must take a complete system approach, from basic engineering issues to the more subtle details in the air distribution. Experience and a complete understanding of the design issues help the designer satisfy:

- Comfort and Health
- Humidity Control
- Indoor Air Quality
- Condensation Control

Comfort and Health: Human comfort levels are very sensitive to temperature and relative humidity. It is essential that both are controlled and stable. While temperature control is generally well understood and mastered by designers, it is important to recognize what temperature levels natatorium patrons want. The space temperatures in a natatorium are unique to each project and assumptions must never be made. Fluctuation of relative humidity levels can be an even greater concern because it has a direct effect on human comfort and health. Figure 1 shows that relative humidity levels outside the 40%- 60% range can result in increased human susceptibility to disease from bacteria, viruses, fungi and other contaminants that reduce air quality and potentially lead to respiratory problems.

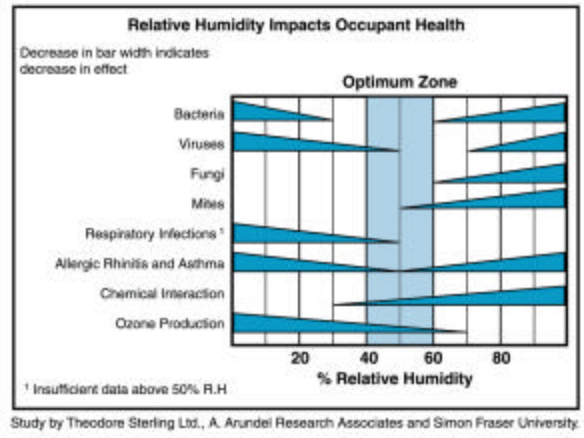


Figure 1- Relative Humidity Effect on Health Factors.

The type of facility being designed dictates the space temperature. Table 1 helps target some typical conditions. It is critical to understand who will be using the facility in order to deliver the conditions most likely to satisfy them.

Pool Type	Air Temperature, °F	Water Temperature, °F
Competition	78 to 85	76 to 82
Diving	80 to 85	84 to 88
Elderly Swimmers	84 to 85	85 to 90
Hotel	82 to 85	82 to 86
Physical Therapy	80 to 85	90 to 95
Recreational	82 to 85	80 to 85
Whirlpool/spa	80 to 85	102 to 104

Table 1 – Typical Natatorium Operating Conditions

Indoor pools are normally maintained between 50 and 60% RH for two reasons:

- Swimmers leaving the water feel chilly at lower relative humidity levels due to evaporation off the body and:
- It is considerably more expensive (and unnecessary) to maintain 40% RH instead of 50% RH.

General Notes:

- Facilities with warmer water temperatures tend to have warmer space temperatures.
- Physical Therapy facilities will cater to therapist comfort rather than the patient because they are generally not in the space for more than an hour, whereas the therapist is there all day. The designer should consult local codes. Some States require a full purge of the room air with 100% outdoor air for every hour of occupancy.
- Elderly swimmers tend to prefer much warmer air and water temperatures.

Humidity Control: High relative humidity levels inside a building are well known for their destructive effects on building structure and can pose serious health concerns. Buildings with high humidity levels are prone to condensation problems that can destroy the building structure. They also facilitate the growth of mold and mildew, which in addition to being unsightly, can adversely impact the air quality. Controlling humidity requires that a total moisture load be accurately calculated. This amount of moisture must be removed from the space at the same rate it is generated to maintain stable space conditions.

1.1 Packaged mechanical refrigeration system.

By far the most common and popular method of removing moisture from the space, these are packaged refrigeration units like those built by Seresco. The units are designed and developed specifically for dehumidifying indoor pools.
A major benefit of this approach is that both the sensible and latent heat is combined with the heat generated by the compressor's power consumption and can be directed to wherever heat may be required in the natatorium. This process is unique in the HVAC industry as is uses both the cooling and heat rejection sides of the refrigeration cycle. The system can be simultaneously dehumidifying (cooling) the air and then reheating it and/or the pool water to deliver dehumidified and reheated air to the space, and/or warm water to the pool.

How it works. Figure 2 illustrates schematically how warm humid air passes through the dehumidifying coil and is cooled to below its dew point. As a result moisture condenses out of the air. Depending on the space temperature requirements the hot gas from the compressor can be used to reheat the air or reject its heat to an outdoor condenser. Compressor hot gas can also be used to heat the pool water.

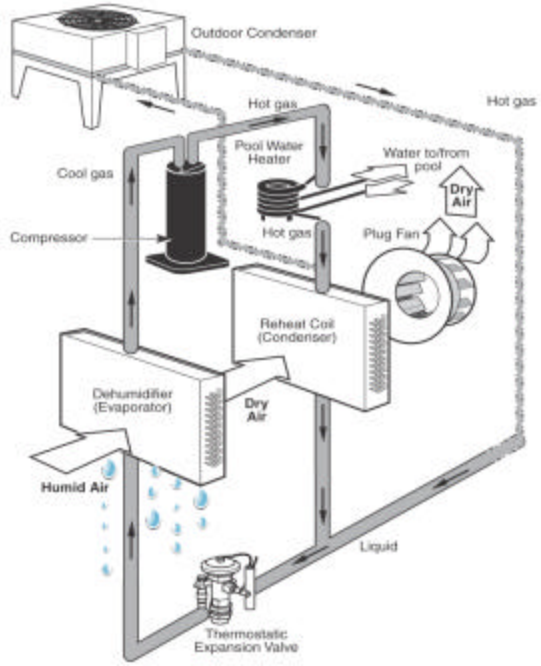


Figure 2 Mechanical Refrigeration System.

Typical Operating Conditions:
Air On Evaporator: 84°F, 50% RH
Air Off Evaporator: 50°F
Suction Pressure: 65 PSIG
High Pressure: 220 PSIG
Superheat: 12-15 °F
Pool Water Heat: in 84°F- out 92°F

1.2 NE Series Dehumidifier Features.

Major components are located within the NE Series unit.

1 - Air Filters. The standard filter is a 2" or 4" pleated 30% efficient filter. 4" 95% filters are available. Access to the filters is through a service access door.

2 - Evaporator. The 6 row deep coil is corrosion protected to ensure a long lifespan and premium dehumidification performance. It is also recessed into the cabinet allowing these units to perform even if the duct connection is less than perfect.

3 - Drain Pan. A stainless steel drain pan covers the unit's entire coil section. The drain pan is sloped to ensure minimal water retention.

4 - Reheat Coil. This corrosion protected condenser coil is capable of rejecting 100% of compressor heat to the air steam.

5 - Blower. Plenum fans are standard on all units. A plenum fan doesn't need extended runs of perfect ductwork to convert velocity to pressure: it's done inside the NE unit! This feature that helps ensure the NE unit will perform to specifications even if the installation is not prefect.

6 - Compressors: The NE Series is equipped with robust high-efficiency scroll compressors.

7 - Blower Motors: The NE Series uses Inverter Spike Resistant direct driven blower motors. This blower drive design simplifies unit maintenance and delivers the air more efficiently.

8 - Electrical Panel. All electrical components and connections are inside this panel.

9 - Receiver. The receivers have two sight glasses. This facilitates the system charging process

10 - Pool Water Heater. This coaxial heat exchanger is provided with the PH and PV models. The water circuit is corrosion resistant cupro nickel pipe.

11 - Command Center. The Keypad and Display panel has a backlit graphic Liquid Crystal Display (LCD) and 7 system status LEDs.

12 - Evaporator Bypass Damper. The motorized bypass damper is controlled by the Command Center and it is used to ensure the evaporator is always operating at optimum pressures.

13 - Outside Air Opening. Manual or motorized air balancing dampers are provided and two-inch air filters.

14 - Cabinet: Seresco has taken all possible commercially feasible precautions to protect the NE Series units against the corrosion. The sheet metal is galvanized automotive grade G-90 or aluminum with both sides painted.

15 - Refrigerant Pressure transducers. These allow the user or serviceman to access the vital information of refrigerant pressures through the operator panel of the microprocessor rather than having to connect a set of refrigerant manifold gauges. This is the most important operation and diagnostic data for any refrigeration system.

2. Installation

2.1 Uncrating and Inspecting

Seresco inspects and fully tests each dehumidifier in all operating modes before it ships from the factory. The unit can suffer damage in transit. Check the equipment thoroughly for both visible and concealed damage before you sign the receiving papers. Document any damage in writing on the carrier's bill of lading to ensure that damage claims are handled promptly. If the unit has been damaged, obtain a claim form from the carrier. Promptly fill out and return the form, and notify Seresco of any damage.

NOTE: Damage claims or missing parts must be filed with the freight carrier.

2.2 Mounting and Service Clearance

The NE Series dehumidifier continuously removes a significant amount of moisture from the room air. Some models have a pool water heating option. Condensate lines and pool water circuits can leak.

NOTE: Do not install the unit in a location where a water leak will cause damage.

- The mechanical room where the unit is installed should have a floor drain.
- If there is no floor drain, a secondary pan with a drain or condensate pump should be installed under the entire unit. (As is done with a residential washing machine)
- Do not store pool chemicals in the same room as the dehumidifier.

Install the unit on an appropriate mounting base or a platform. Install industry standard components that prevent vibration and sound transmission. Never install the dehumidifier on a wooden platform that can resonate. Do not install the unit near occupied rooms such as bedrooms. Never suspend from the floor joists of an occupied room above the mechanical room. Never locate the unit above a swimming pool or a spa water surface.

Allow a minimum of 36 inches of clearance on the sides of the NE series dehumidifier for piping, duct connections, and service access.

DO NOT install an indoor dehumidifier in an unconditioned space or where ambient temperatures can fall below 45°F or climb above 90°F. If such a space is being considered, Seresco offers outdoor-rated dehumidifiers with weatherproofing and thicker insulation.

2.3 High Voltage Electrical Connections

NOTE: The installing contractor must ensure that all electrical wiring satisfies all National, State and Local codes.

2.3.1. Wire and Fuse Sizing

The field-installed power supply wires and over current devices must be sized to handle the minimum ampacity of the dehumidifier without exceeding the maximum fuse size rating. Both the MCA and MOP are indicated on the unit nameplate.

NOTE: Improper wiring to the dehumidifier could create the possibility of shock and may lead to system failure.

2.3.2. Line Voltage Connections

Figure 7 shows typical power wiring connections. Single-phase units power supply must have 3 wires (2 power, 1 ground). On three phase units the power supply must have 4 wires (3 power, 1 ground). Connect the power supply wires to the main power block located inside the electrical panel.

Always check the nameplate voltage before connecting to the unit.

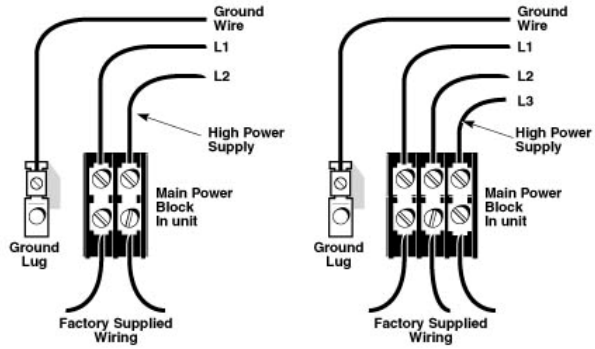


Figure 7 – Power Wire Connection

2.4 Control Wiring

The NE Series dehumidifiers have all necessary sensors unit mounted and set points pre-programmed at the factory. Remote duct heaters, outdoor air-cooled condensers, auxiliary pool water heaters and remote exhaust fans all require interfacing with the dehumidifier. Their connection terminals are identified in Table 2.

The microprocessor has been programmed to control their operation. Figure 8 illustrates how an Ethernet connection to the Internet allows all functions to be monitored by trained professionals with Seresco's Websentry. It is the final step to ensure the facility operates trouble free.

Table 2 - Control Terminals (dry contacts)

Dry Contact 24V 5A	Terminal Numbers
Outdoor Condenser	J10-1, J11-10
Outdoor Air Damper	J9-9, J9-10
Alarm	J10-5, J10-6
System On Light	J10-3, J10-4
Exhaust Fan/Damper	J9-7, J9-8
Stage 1 Heat	J9-3, J9-4
Stage 2 Heat	J9-1, J9-2
Aux. Pool Water Heater	J10-7, J10-8
Firestat Interlock	J7-7, J7-8
0 – 10 VDC	Terminal Numbers
Hot Water Control Valve	J8-7
SCR heater Control	J8-8

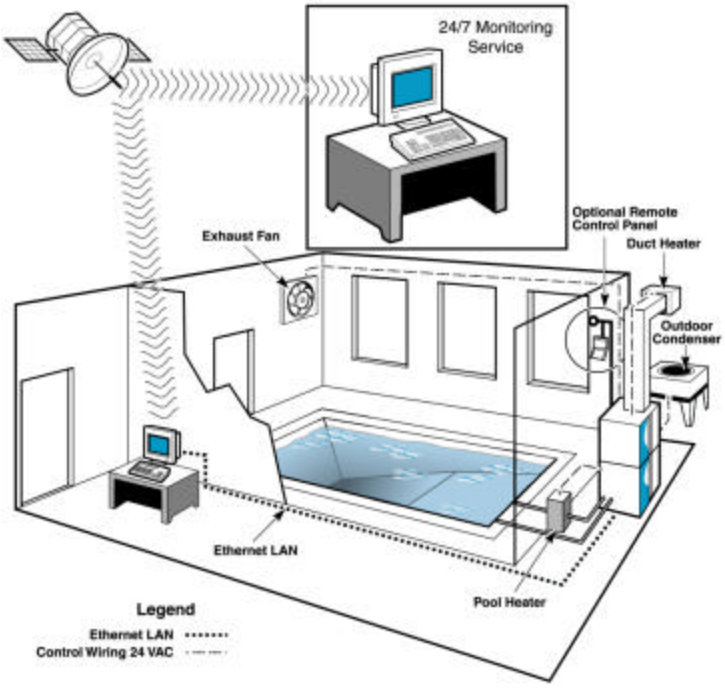


Figure 8 Web Monitoring Service.

2.5 Controller, Programming and Sensors

The NE Series Command Center (Figure 9) is the brains behind the NE Series Dehumidification System. The Command Center is composed of a microcontroller system, an LCD display and keypad, an Ethernet interface, and WebSentry – a web browser based remote interface tool for monitoring and controlling NE Series systems from anywhere in the world via the internet.

Figure 9 – Command Center

The keyboard/display panel is shown in Figure 9 and is located on the NE Series unit at the mechanical compartment access. The LCD display has a built-in backlight for easy reading in low light conditions. The keys have the following functions:

1, 2, 3 4, 5, 6	Correspond to selections numbered on the screen (e.g. 1-Menu, press 1 for the main menu)
Back	Allows you to return to the previous menu without making any changes.
↑↓	Used for viewing additional menus, alarms or operating data and for changing parameters on the screen such as setpoints.
Enter	Press to save changes to parameters and (optionally) press again to return to the main sensor screen.

There are 7 LEDs as shown and their function is as follows:

Alarm	Solid Red indicates an active alarm (that has not yet been cleared). A Flashing Red indicates an alarm that has not been acknowledged yet.
Dehum	Solid Green indicates system is in dehumidification mode. Compressor will run when anti-short cycle timer is satisfied.
A/C	Solid Green indicates system is in air-conditioning mode. Compressor will run when anti-short cycle timer is satisfied.
Pool	Solid Green indicates that pool heating is on. If Dehum or A/C is also on, then heating is by the NE Series unit. If Dehum and A/C are off, auxiliary heating is energized.
Heat	Solid Green indicates that the auxiliary air heating system is on.
Filter	Solid Yellow indicates that the air filters are dirty and need changing (optional only).
Service	Solid Yellow indicates that the NE Series unit is in Service Mode. Flashing Yellow indicates that the blower or compressor have been manually disabled (when not in Service Mode).

There are two main modes of operation for the NE Series Units: “Normal Mode” and “Service Mode”. In normal mode, the user can view sensor information, view unit operating status, change setpoints (password protected), adjust the occupied/unoccupied schedule (password protected), and view alarms and warnings. The system operates automatically.

In Service Mode, the trained technician has access to special features to aid in system commissioning and troubleshooting, including Ethernet network access test utilities.
The system operates under manual control.

From the main screen, which shows sensor readings, press 1 (-Menu) to open the main menu structure. From any menu level, the Back button will return to the previous menu level **without making any changes**. Menus and selections are accessed using the “1-6” numbered keys – each menu item and parameter is preceded by a number from 1 to 6. When the scroll keys can be used to access additional menu items they will appear on the screen. The same scroll keys are used to change values after a parameter has been selected.

A User Password is required to view/change setpoints and schedules. Passwords are 3 digits long, and entry is done using the scroll keys (? and ?) to change the 1st digit to the correct password value – then press Enter to accept that digit and move on to the 2nd digit, repeat for the 3rd digit. The User password is supplied to the customer under separate cover..

Only trained Service Technicians should use the Service mode, as damage to the equipment can result from misuse. To Exit Service mode, perform a manual reset and allow the system to start up on its own.

Logs
The CommandCenter logs alarm messages which can be accessed from the LCD/Keypad.

Alarm messages are as follows:

HP# -NN	High pressure trip (# indicates compressor, NN can be SW or TD indicating switch or transducer alarm)
LP# -NN	Low pressure trip (# indicates compressor, NN can be SW or TD indicating switch or transducer alarm)
Blower OL	Blower overload trip
No Air	Airflow alarm, air pressure switch (optional) reading too low air pressure differential
Fire	Firestat signal active
Waterflow	Low water flow, controls have detected pool water out temperature is too high
Filter	Dirty filter, filter switch (optional) reading a high pressure differential
Pumpdown	Compressor pumpdown timed out (no LP switch detected)
Freeze	Freezestat
Purge	Supply air too cold during purge, purge shut down
Volt Mon	Voltage monitor
Oil #	Oil failure (# indicates compressor)
No Config	System not configured at startup (only needs to be done once)
Restart	Manual Reset required to start normal operation
SW Error	System has detected an internal error – contact factory
CompPower	Indicates that compressor has been manually disabled through an external switch for an extended period of time
SensorNNN	Indicates sensor fault where NNN identifies the sensor

The operating log is easy to read as the messages clearly indicate what action has taken place.

The sensor log uses the following abbreviations in order to display the sensor values on two screens:

RH Return Air Humidity %
RA Return Air Temperature F
HP Refrigerant Discharge Pressure PSI
LP Refrigerant Suction Pressure PSI
EV Air Temperature Leaving Evaporator F
SA Supply Air Temperature F
SH Suction gas Temperature F
CC Auxiliary Temperature sensor F
OA Outdoor Air Temperature F
PO Pool Water Leaving Temperature F
PI Pool Water Entering Temperature F

System Status

The CommandCenter has a feature which will provide more detailed information about the internal operation of the system, which can assist an owner or service technician in understanding his NE Series unit is doing at any given moment.

This feature is accessed through the menu system at /Main Menu/System/System Status.

The various system elements are broken into three main groups:

Environment	Related to air relative humidity and temperature control, pool heating control
Compressor	Related to the operation of the compressors
Other	Related to miscellaneous system operations

Selecting the Compressor elements takes you to a screen showing the compressor status, and also which solenoid valves and contactors are energized. The solenoid valves and contactors are coded as follows:

PW Compressor contactor
PD Pumpdown valve
DH Dehumidification (reheat) valve
AC Air conditioning valve
PH Pool water heating valve
PB Pool water heating bypass valve

Menu Guide:

The following table summarizes the menu selections accessible from normal mode. From the main sensor screen, press 1-Menu to enter the menu structure. Pressing the BACK button returns to the previous menu without making any changes to the screen. ENTER is used to accept changes, and also to return to the sensor screens in lieu of pressing BACK several times. See Addendum For Factory Settings and Service Mode menus.

Setpoint	
Temperature	Room temperature setpoint
Humidity	Room relative humidity setpoint
Pool Temp	Pool water temperature setpoint
Economizer	Outdoor air temperature below which economizer not used
Freezestat	Supply air temperature below which Freezestat alarm trips
Purge	Supply air temperature below which Purge will stop
Heat Recovery	Outdoor air temperature below which heat recovery starts
Schedule	Sets occupied/unoccupied state for ventilation control
Time Slot 1-6	There are 6 available time slots that can be established
Weekday	None/All/Weekday/Weekend/Monday to Sunday selection
On	Time at which occupied status and ventilation begins
Off	Time at which unoccupied status begins, ventilation stops
System	
Blower/Compressor	Enabling/disabling blower and compressor operation
Purge	Starts/stops purge 100% ventilation operation
System Restart	Manual reset
Alarm Log	View Alarms
System Status	See Section 2.5.4
System Summary	Summary of system configurations
User Settings	
Display	
Backlight	Turn backlight on or off
Reset Display	Idle time before display reverts to the main sensor screen
Short Message	Time for which short information messages remain visible
Long Message	Time for which long information messages remain visible
System Clock	
Date	Set the date
Time	Set the time
Zone	Set the time zone
Daylight	Set daylight savings on or off manually
Date Format	Format the date on the screen
Time Format	Format the time on the screen
Synch	Synchronize with internet time server (when connected)
User Password	
Enabled	Enable/disable user password control
Password	Change user password
Retention	Set time for which password entry remains valid
Factory Settings	
Service Mode	

Figure 10 Command Center Quick Menu

2.6 System Design Checklist.

Ensuring that all critical system design aspects have been addressed is paramount to obtaining a safe and healthy pool environment. Seresco's name is a useful checklist.

System duct design and air pattern
Evaporation rate and latent loads
Required Access Space
Exhaust Air
Supply Air flow
Cooling and Heating loads
Outdoor Air

2.6.1. System Duct Design and Air Pattern

The overall duct design will determine whether or not the space will be comfortable and condensation free. Special care must be taken to ensure the entire room sees the required air changes per hour and that all exterior windows have air delivered to them. Stagnant areas, especially where occupants can access (the deck area for example) will suffer from poor air quality and lead to complaints.

Traditional problems in indoor pools are easily predictable and can be avoided by following two models provided here. Figures 12 & 13 illustrate good air distribution practices and layouts.

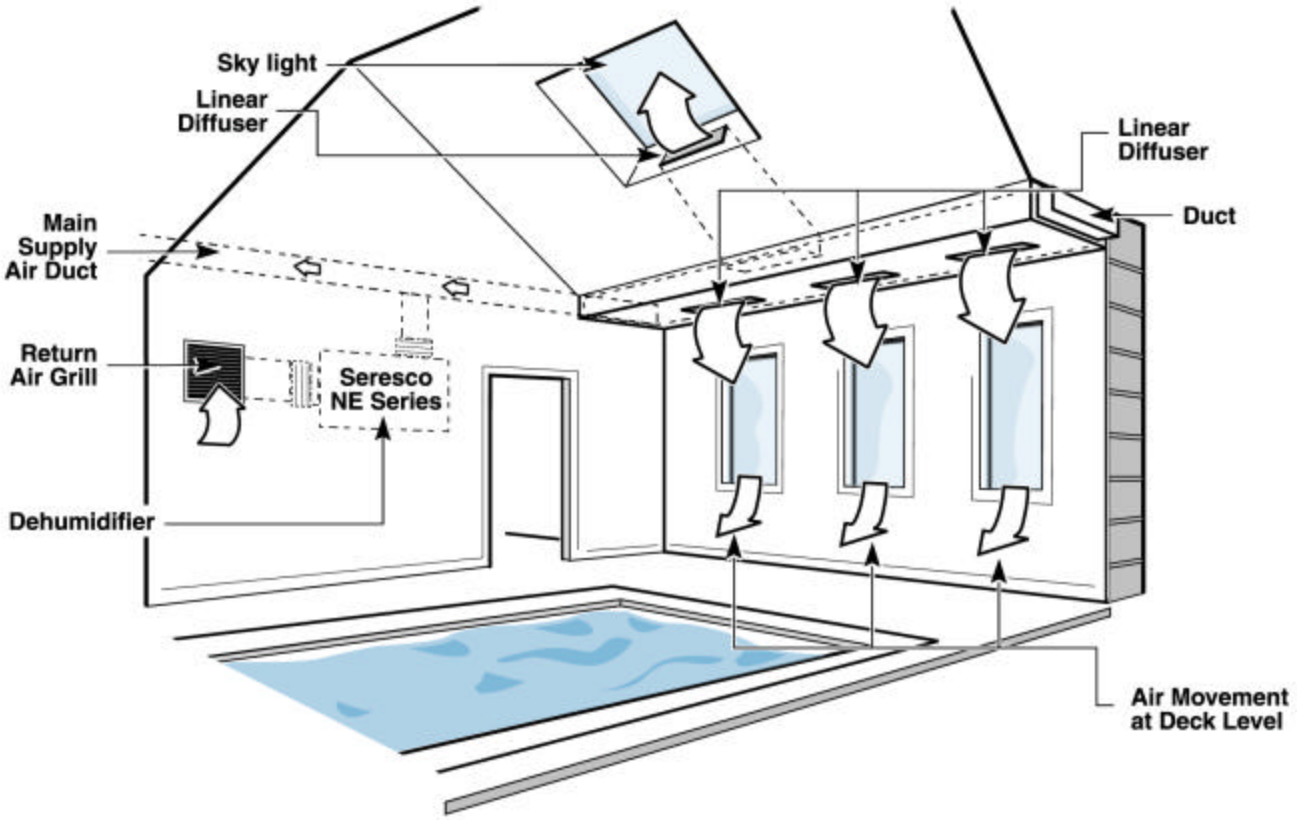


Figure 12 – Perimeter Duct Layout

All air distribution systems should:

- Supply 4-6 volumetric air changes per hour.
- Blanket exterior windows, exterior surfaces prone and other areas prone to condensation with supply air. A good rule of thumb is 3 - 5 CFM per ft² of exterior glass.
- Locate the return grille to enhance the overall air pattern within the room.
- Prevent air short-circuiting. Avoid installing the return air grille too close to a supply grille.
- Select grilles, registers and diffusers that deliver the required throw distance, and the specified CFM rating.
- Introduced outdoor air per local codes and/or ASHRAE Standard 1999
- Maintain a negative pressure in the space with an exhaust fan.

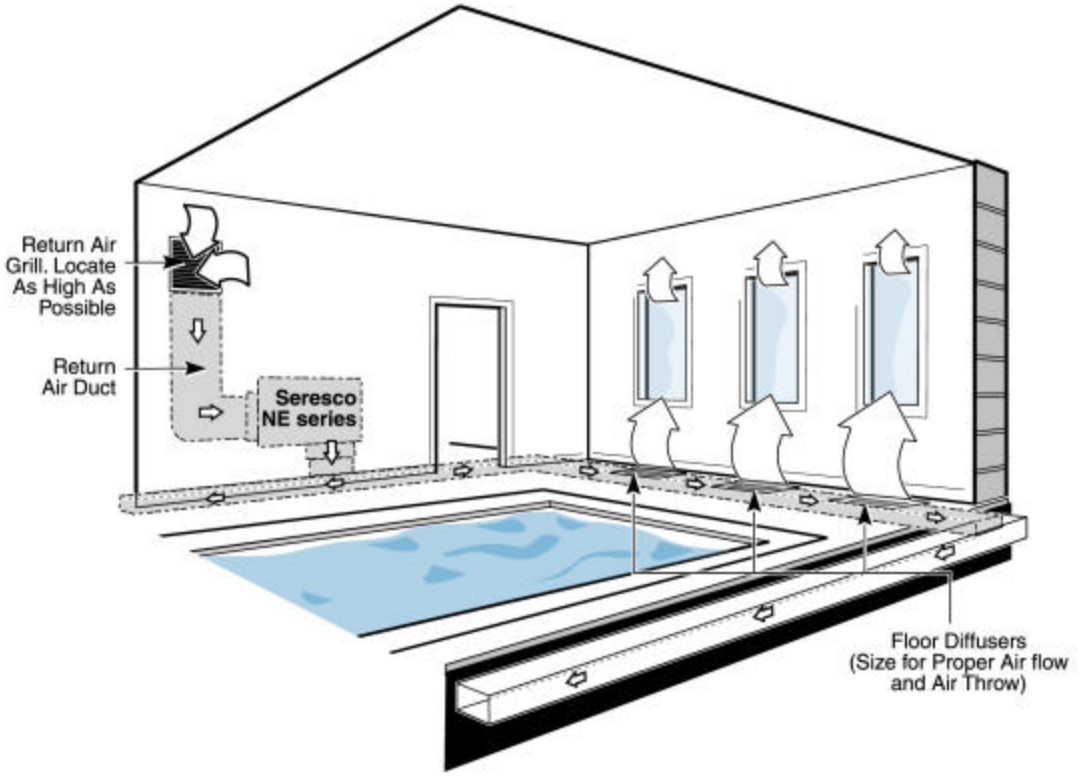


Figure 13 – Perimeter Below Grade Duct Layout

2.6.2. General Recommendations:

- Galvanized sheet metal ducts are acceptable in most installations. A below-grade duct system should use PVC or plastic-coated galvanized spiral pipe to avoid deterioration.
- Ductwork that passes through an unconditioned area should be insulated on the exterior.
- When applicable, locate exhaust fan air intakes as close to the whirlpool as possible.
- To prevent excessive vibration noise, install neoprene flex connectors when attaching ductwork to the dehumidifier.
- Skylights require significant airflow to avoid condensation on their surfaces.

2.6.3. Evaporation and Latent Loads

Every building's moisture (latent) load is calculated in the same way. There are generally three sources of moisture that are considered: Internal load: Evaporation rate, Occupants, and Outdoor air load

It is important to be aware of the design criteria used to calculate the total load and reconcile a unit selection. Seresco's Natatorium Design Manual has more information on this subject.

2.6.4. Required Access Space

No Access = no service or maintenance. All NE series dehumidifiers have been designed to require only two sides access. Allow a minimum of 36 inches of clearance on the sides indicated in Figure 14 for piping and service access. Mirror access units are also available.

2.6.5. Exhaust Air

ASHRAE recommends the room be maintained at 0.05-0.15" WC negative pressure relative to surrounding spaces.

NOTE: Ten percent more exhaust air than outdoor air is a good rule of thumb.

Figure 14 illustrates how the location of the exhaust fan can also significantly improve the air quality in the space. A spa or whirlpool should have the exhaust air intake grille located directly above it. This extracts the highest concentration of pollutants before it can diffuse into the space and negatively impact the room air quality.

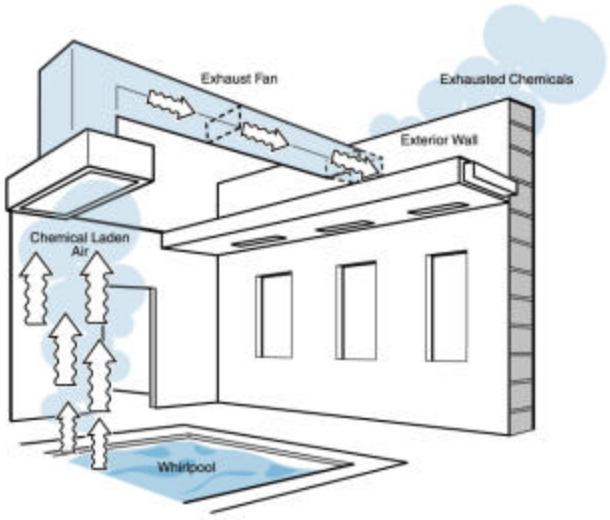


Figure 14 – Exhaust Air Intake recommendation

2.6.6. Supply Air.

ASHRAE recommendations for proper volumetric air changes per hour are important to ensuring that an entire room will see air movement. Stagnant areas must be avoided, as they will be prone to condensation and air quality problems.

Short-circuiting between supply and return air must also be avoided as it significantly reduces the actual air changes within the space.

ASHRAE recommends:
4-6 volumetric air changes per hour in a regular natatorium.
6-8 volumetric air changes per hour in facilities with spectators

Supply air required (CFM) = [room volume (ft^3) x desired air changes] / 60

2.6.7. Cooling and Heating Loads.

All buildings should have cooling and heating load calculations done to determine their specific requirements. The room air temperature of an indoor pool facility is generally 10-15 ºF warmer than a typical occupied space. Therefore, the heating requirement is larger than a traditional room and the cooling needs are less.
Rules of thumb do not apply. This is a unique space that requires accurate load calculations. Outdoor air must be included in load calculations as it often represents up to 50% of the heating load.
Space cooling is a free byproduct from packaged dehumidifiers. These systems dehumidify by cooling the air below its dew point. The compressor heat can be used to heat the pool water during this time or merely sent outdoors to a condenser as is done with traditional air conditioning systems. If the cooling load exceeds the standard output of a dehumidification unit, a larger unit with compressor staging is often specified.

2.6.8. Outdoor Air.

The introduction of outdoor air is essential to maintaining good air quality in any facility. The impact of outdoor air ventilation on a natatorium changes with the weather. Introducing outdoor air during the summer adds moisture to the space and in the winter removes moisture from the space. For maximum dehumidification load calculation the Summer Design conditions are considered.

Ventilation codes generally require that outdoor air be introduced into a commercial building during occupied hours. ASHRAE Standard 62-1999 recommends the introduction of outdoor air into a natatorium at the following rates:
0.5 CFM/ft^2 of pool and (wet) deck area
15 CFM per spectator.

NOTE: Most designers use the larger of the two values.

Seresco suggests that only the wet deck (a 5-6' perimeter) be considered in this calculation, as the purpose of this outdoor air is to help dilute chemicals off-gassed from water. A predictably dry portion of the deck will not factor into the IAQ issues.

The NE Series units have an outdoor air opening with a filter and manual balancing damper. Optional unit mounted motorized dampers and time clocks are available. Figure 16 illustrates a typical connection configuration.

Figure 16 – Outdoor Air Duct Detail

- Outdoor air requires considerable heating in the winter and can add significant moisture in the summer. Exceeding code requirements is not recommended as it will increase the operating expenses and may increase the size of the dehumidifier.

Locate the outdoor air intake away from any sources of airborne contamination such as exhaust fans or plumbing vents.

If more than 20% of the total airflow is outdoor air or if the winter design temperature is below 10ºF: The outdoor air must be preheated to 65ºF.

If outdoor air is introduced into the return duct: it must be preheated to the space temperature.

2.7 Condensate Drain.

The dehumidifier is a draw through configuration as a result the entire cabinet is under negative pressure. Without a trap, condensate will not drain and the unit will overflow into your mechanical room.

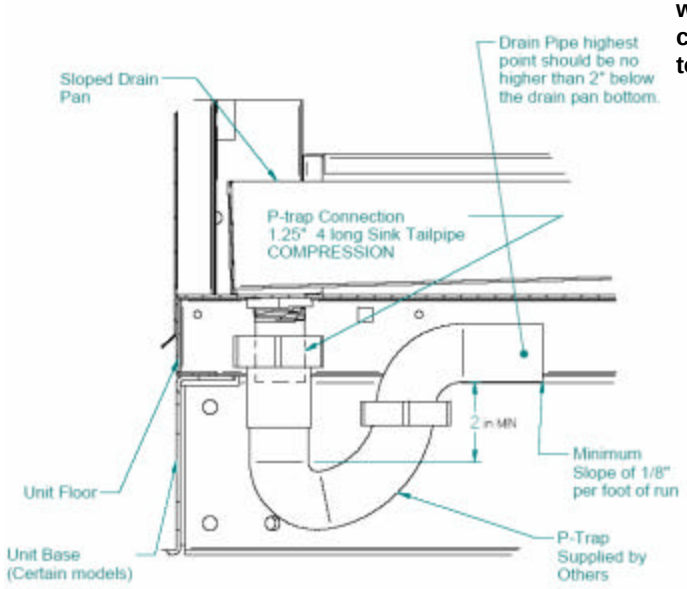


Figure 16 – P Trap

Per Figure 16 pitch the condensate drain line a minimum of 1/8" per linear foot, and support the pipe with code-approved hangers at least every 5 feet.

If the drain line passes through an unconditioned space, heat tracing is required to prevent the condensate in the drain from freezing.

When gravity disposal is not possible, a condensate pump can be used. Follow the pump manufacturer's installation instructions.

2.8 Pool Water Heating (PH and PV Models Only).

The energy a pool loses through evaporation represents approximately 90% of its annual water-heating requirement. The Seresco unit captures 100% of this heat as a by-product of the dehumidification process and can return this energy back to the pool, thereby greatly reducing pool water heating costs. During the cooling season the dehumidifier is capable of providing 100% of the pool's water-heating requirement. Refer to Figure 18 for proper pool water piping connections to the NE Series unit.

2.8.1. Water Piping Connections.

The NE unit requires only a fraction of the total water being circulated by the main filter system. Refer to Table 4 or the unit nameplate for nominal water flow rates.

- The water circuit should tap off the main pool water line downstream of the main filter and upstream of the auxiliary pool water heater and chemical feeder.
- An auxiliary water pump to deliver the unit's required water flow rate is recommended. It is an open system and the pool's main circulating pump can rarely accommodate additional system pressure.
- **NOTE: All systems require auxiliary pool water heaters. The Seresco unit will control their operation when it is not able to provide water heating.**

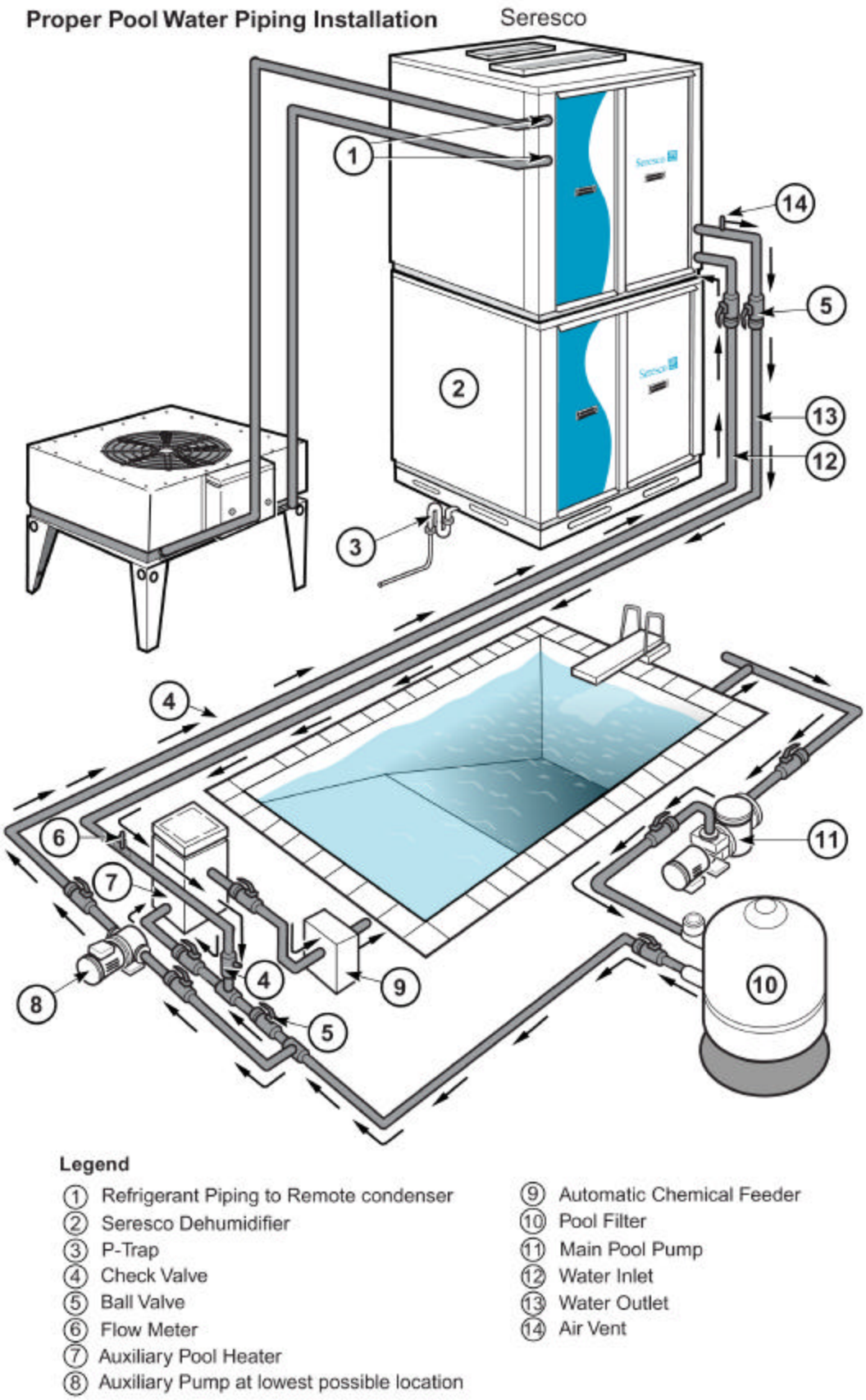


Figure 18 – Proper Pool Water Piping Installation

2.9 Outdoor Air Cooled Condenser Installation.

This condenser is used in air conditioning mode where it rejects unneeded heat from the space to outdoors. Proper installation is essential to ensure it can function as intended. Proper airflow and refrigerant piping are paramount.

- Ensure an appropriate maximum ambient air temperature has been specified.
- Ensure the unit has proper airflow per Figure 19. A perimeter of free area equal to its width must be provided.
- Use line sizes as specified by Seresco.
- To avoid potential seasonal system charge problems, ensure the installed line lengths are never longer than indicated on the plans and specifications.
- If the condenser is installed above the dehumidifier, ensure the hot gas line has proper oil traps.
- Contact Seresco if the condens er is installed more than eight (8) feet below the dehumidifier.
- The installer must endeavor to ensure that all industry standards for refrigeration component installation are met. This includes but is not limited to; proper line sizing, materials, nitrogen purging, brazing with Silfos 5 or better (NO SOFT SOLDER), evacuation, cleanliness, traps, long radius elbows and system charging.
- Install the remote condenser on a level, hard surface.

2.9.1. Refrigerant Piping of Remote Condensers

- NE series dehumidifiers are equipped with isolation valves and access valves located in the blower compartment. Do not open the isolation valves until all exterior piping is leak checked and evacuated. The last outdoor condenser vacuum can be broken with liquid REFRIGRANT. Monitor the exact amount of REFRIGRANT added, as the total system charge must be per the unit nameplate.
- NE series dehumidifiers have refrigerant pipe stubs for the line set connection inside the cabinet.
- Use standard commercial refrigeration piping practices when installing the refrigeration piping between the dehumidifier and the remote air-cooled condenser.
- Hot Gas and Liquid line sizes should be per unit nameplate. The stubs inside the NE unit will be the correct sizes for line lengths up to 50'.

Do not exceed 50' total line length or install the condenser more than 8' below the NE unit.
Per figure 20, install an oil trap at the start of and at every 15 feet of vertical lift in the hot gas discharge line as shown in Figure 18. Pitch horizontal lines a minimum of 1/2" every 5 feet *in the direction of flow*. All piping must be clean and de-burred. Keep copper chips and foreign materials out of the tubing. A nitrogen purge while brazing is paramount to reduce the chances of oxidation in the pipes.
Keep the Hot Gas and Liquid lines a minimum of 2" apart to prevent heat transfer. Insulate the hot gas line in all areas where a person may come in contact with the line and be in danger of a burn.
When all piping work is complete, check for leaks by pressurizing the remote condenser and line set with dry nitrogen. If no leaks are detected, the circuit is ready to be evacuated. Evacuate the condenser and piping to a minimum 250 microns. Isolate the piping for ONE HOUR to verify that the system is free from leaks, moisture, and non-condensables.

NOTE: Consult Seresco before installing the outdoor air-cooled condenser more then 8 feet below or more than 50 feet away from the dehumidifier.

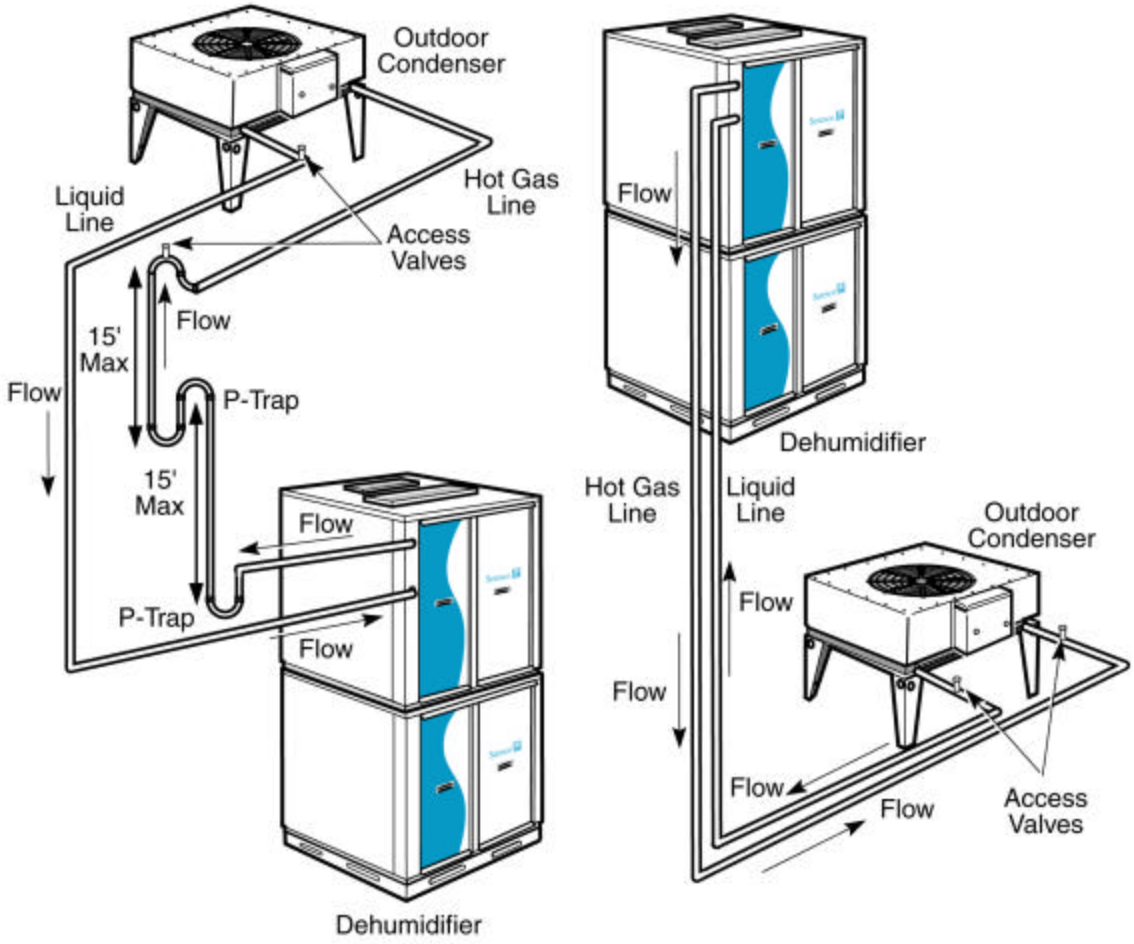


Figure 20 – Typical Outdoor Condenser Installation

2.9.2. Charging of Remote Condensers

Once a proper evacuation has been accomplished the system is ready for charging. The outdoor air-cooled condenser requires a field charge by the installing contractor. The field charge required depends on the size of the condenser and the length of the piping. The unit nameplate will show the exact field charge required.

The last vacuum can be broken with liquid refrigerant. Monitor the exact amount of refrigerant added, as the total system charge must be per the unit nameplate.
Connect the control wiring to the terminals provided inside the electrical compartment of the dehumidifier and outdoor condenser. Refer to the low voltage wiring schematic for details. The condenser fan(s) will not operate until this is complete.
Once you have charged and checked the condenser and line set for leaks, open the service valves located in the compressor compartment of the dehumidifier.
There is an access valve in the liquid line after the pump down valve. The pump down valve can be manually closed during start-up mode via the controller. Add only as much refrigerant as is needed to get to the total charge indicated on the nameplate. Never charge liquid into the suction line access valve!
The receiver has 2 sight glasses with float balls to help ensure the maximum and minimum refrigerant levels are easily met.

2.9.3. Power and control wiring.

The power supply and disconnect for the outdoor air-cooled condenser is provided by the installing contractor. The installing contractor must provide control wiring for the 24 volt – 5 Amp circuit between the NE unit and the outdoor air-cooled condenser to enable the condenser fan(s) while the system is in air conditioning mode. The control wire terminal numbers can be found in Table 2 on page 8.

3. Start-up Procedures

3.1 Pre Start-up

A complete start-up is required to ensure all systems have been setup and adjusted to ensure optimum and reliable unit operation. The final adjustment and balancing must be done when all space and water temperatures are at design conditions. The use of auxiliary or portable air heaters may be required to heat the room. Read this section thoroughly before attempting to commission the Seresco dehumidifier.

NOTE: Do not use the unit as a construction site heater. Construction dirt will invade the unit and can significantly deteriorate unit performance and lifespan.

1. Ensure the unit installation conforms to all recommendations made by Seresco in this manual.
2. Check to ensure all packing materials and shipping brackets have been removed from the unit.
3. Leak test (with halogen leak detector) all factory and field piping. Shipping and handling may have caused refrigerant leaks inside the dehumidifier.
4. Check the nameplate for power requirements and confirm that it matches the available power supply.
5. Voltage must be within ±10% of the voltage printed on the nameplate. Verify that all field wiring matches the Seresco wiring schematics. Inspect and tighten all field and factory wiring.
6. Leave power on and allow 24 hours of crankcase heater operation before attempting the start-up.
7. Check the drain pan and the condensate piping. Test the drain and prime the P-trap by pouring water into the drain pan.
8. Verify that any space heating coil is installed in the supply air duct (after the evaporator coil) and *not* in the return duct.
9. PV or PH models have a pool water heater. Energize the circulating pump and establish water flow. Inspect the piping and repair any water leaks. Ensure the control wiring has been installed between the unit and auxiliary pool water heater.
10. Ensure the control wiring has been installed to the outdoor air-cooled condenser.
11. Ensure all peripheral controls and sensors are connected and wired correctly.
12. Verify that all service valves in the refrigeration lines are fully open.
13. Inspect the air filters and coils to assure they are clean. If necessary, clean the coils and install new air filters.
14. Verify that the unit has appropriate vibration isolators and that the unit is level.
15. Complete the Pre Start-up checklist section of the Warranty Registration/Start-up Form (copy provided with the unit and on page 34 of this manual).

3.2 Start-up

All appropriate fields and sections of the Warranty Registration and Start-up report should be completed. A proper start-up requires that the unit be run and monitored in all modes of operation at design conditions with the operating data recorded on the forms provided in the annex of this manual. Seresco reviews every report to ensure all aspects of the system are functioning within normal operating parameters. Carefully follow the process detailed in the start-up report.

NOTE: If the space is not at design conditions at the time of the start-up, a follow up visit for final adjust and balance is required.

Mail or fax the completed start-up report back to Seresco to validate your unit's warranty. Seresco will archive it for future reference. If you do not have a start-up report, call the Seresco for a new copy or download a PDF version from www.seresco.net.

3.3 System Operation Modes

The standard sequence of operation for a Seresco dehumidifier is relatively simple. Whenever the compressor operates the evaporator coil is active where it absorbs heat from the warm, humid air stream. The cooling process at the evaporator coil drops the air well below its dew point and thereby dehumidifies the air.

Whenever the compressor operates the evaporator is always dehumidifying and cooling the return air.

The heat removed from the air at the evaporator (plus the heat of compression) must be rejected to one of three heat sinks; room air, pool water (PH AND PV models) or outdoors (remote condenser/Dry cooler/cooling tower). The microprocessor will direct the heat to where it is needed based on the room conditions.

In the case of PH AND PV models with remote condensers, if both the water *and* the air require heat, the dehumidifier heats the air first. If neither the water nor the air requires heat, then the dehumidifier rejects the heat to the Air conditioning condenser.

3.3.1. Power turned ON (or after power failure)

Blower begins to operate immediately and continuously.

Microprocessor self test and system diagnostics begins. If all systems are a go, the microprocessor will use sensor feedback to resume normal unit operation.

Microprocessor confirms with internal real time-clock and operation log that compressor has been off for 5 minutes.

3.3.2. Dehumidification Mode

This mode occurs when the space requires dehumidification. The air discharged from the unit is dehumidified and about 20°F (warmer than when it entered.
The return air Relative Humidity is above setpoint.
The compressor starts.
The evaporator sees nominal airflow.
The compressor hot gas condenses at the reheat coil.

3.3.3. Air Conditioning Mode.

When the room air requires cooling only the NE unit will direct 100% the refrigerant hot gas heat outdoors. The air discharged from the unit is dehumidified and about 15°F cooler than when it entered.

Air Conditioning Mode Stage 1

The return air temperature is above setpoint.
The compressor starts if not already operating in dehumidification mode.
The evaporator sees nominal airflow.
The compressor hot gas condenses at the outdoor air-cooled condenser.

Air Conditioning Mode Stage 2

The return air temperature is above setpoint 2.
The compressor starts if not already operating in Stage 1 AC or dehumidification mode.
The evaporator bypass damper closes for maximum airflow across the coil.
The compressor hot gas condenses at the outdoor air-cooled condenser.

3.3.4. Pool Water Heating Mode (PH AND PV Models Only)

If the unit is in dehumidification or air conditioning mode then there is free heat available from the dehumidifier.
The pool water temperature drops below setpoint.
Water heating demand alone will not start the compressor. There must be a pre-existing demand to operate. If the compressor is already operating:
The pool water control valve directs hot refrigerant flow through the heat exchanger.
The heat exchanger rejects heat to the pool water. It also acts as a refrigerant sub-cooler increasing system capacity and efficiency.
If there is no other demand for the compressor to operate the microprocessor sends an on/off signal to the external auxiliary pool water heater (by others). No additional controls are required to operate the auxiliary pool water heater.

3.3.5. Blower Operation

Units have been factory wired for continuous blower operation. This helps prevent air stagnation and stratification. Continuous blower operation is also required to ensure that the sensors read conditions representative of the entire Natatorium.

3.3.6. Compressor Start Sequence

All NE units have a pump down sequence and anti-short cycle timer. When a demand requires the compressor to operate the following sequence occurs:
Blower operation confirmed by microprocessor and ASCT sequence completed.
Pump down solenoid opens.
25 psig will close the low pressure safety switch contact.
Compressor starts.

3.3.7. Space Heat Demand (Unit Mounted or remote)

The Seresco unit's microprocessor is designed to control a space-heating coil (unit mounted or remote). When the room temperature drops below the set point the microprocessor will send a signal to the heating coil's control mechanism.

4. Service and Maintenance

The NE unit is a piece of mechanical equipment, which requires routine maintenance and service. The service required is nothing more than a traditional commercial air conditioner. If a problem is encountered, refer to the TROUBLESHOOTING GUIDE in Section 6.2.

If all suggestions in the "Trouble shooting guide" have been exhausted, call Seresco's service department. Be sure to have the Model and Serial number when you call.

1-888-SERESCO (737-3726)

If the unit has been ordered with the Internet connection capabilities, Seresco or the local factory representative can directly access the unit and diagnose the problem from their facility.

4.1 Routine Maintenance

Seresco dehumidifiers are designed for years of reliable service. In order to ensure this, they require periodic maintenance.

4.1.1. Monthly Service

Check the air filters and replace them if necessary.
Verify that all setpoints are programmed into the controller as desired by the facility.

4.1.2. Annual Service

Tighten all field and factory electrical connections.
Verify that the coils in the dehumidifier and the remote outdoor air-cooled condenser or dry cooler are clean. Use compressed air or a commercial coil cleanser if they are dirty.
Verify that the airflow around the remote condenser or dry cooler remains unobstructed.
Check drainpan and clean out any residue that may have accumulated.

Conduct a complete system check up. This requires the service technician to fill out page #2 of the Warranty Registration and Start-up Report. A copy of this worksheet is located on page 33. This form is a valuable maintenance tool, which can help to uncover problems before they get expensive.

4.2 Compressor Replacement

Compressor failures can be caused by:
Liquid slugging, air or moisture in the refrigerant circuit, solid contaminants, excessive heat or electrical service malfunctions. To avoid repeated failures, the cause of the failure must be determined and then corrected. If the compressor has failed because its' motor has burned out, the refrigerant, oil, and piping is contaminated. The procedure in section 4.2.1 should be followed to replace the compressor and clean the refrigerant system.

NOTE: All acid must be removed from the system to avoid future burnouts.

Use an oil test kit to determine the severity of the burnout. Be sure to follow directions provided by the test kit manufacturer for complete system cleansing and acid removal. Make sure you use rubber gloves and eye protection, as contaminated refrigerant and oil can cause severe burns!

4.2.1. Compressor Burnouts

If the compressor has failed due to a burnout, the entire refrigerant charge has been contaminated. In the service mode, all solenoid valves can be opened in order to evacuate the circuit completely. On systems equipped with an optional pool water condenser, take care to avoid freezing the condenser during evacuation.
Verify that the TX Valve and solenoid valves are free of debris. Clean or replace them as necessary.
Replace the suction filter with a suction line filter-drier designed specifically for cleaning system burnouts (Sporlan "HH" series or equivalent). Select filters that are equipped with a tap for measuring the pressure drop across the filter.
Remove the old liquid line filter-drier and replace it with a new filter one size larger than the original.
Remove the old compressor if you have not already done so. Install the new compressor.
Evacuate the system to 250 microns or lower.
Replace all compressor contactors, start capacitors, run capacitors, and starting relays.
Check the piping and joints for leaks, and recharge the system.
Operate the unit for an hour in all modes. (The duct heater may have to operate to maintain the space temperature while operating in air conditioning mode. Contact Seresco for instructions.)

NOTE: It is <u>critical</u> that the unit be run in AC mode for cleaning system burnouts. The entire system must clean and acid free.

Monitor the pressure drop across the suction filter. If the pressure drop is 3 psi or less after one hour, continue to run the system for 24 hours, then take an oil sample. If the oil sample is dirty or acidic, or if the one-hour pressure drop is greater than 3 psi, then recover the system charge and replace both the suction and liquid filter-dryers.
Repeat the previous step until your oil sample tests negative.

Seresco will require a copy of the acid test result if there is a warranty replacement request.

5. Pool Water Chemistry.

Pool water quality affects not only human health and comfort but also space air quality and performance of the mechanical equipment.

NOTE: Poor water chemistry is the single biggest cause of indoor air quality (IAQ) and corrosion problems in a Natatorium.

The owner/operator of the natatorium is responsible for maintaining proper pool water chemistry. Table 6 shows the National Spa and Pool Institute recommended levels for water quality.

Failure to maintain proper pool water chemistry will result in several problems:
- **Air Quality Complaints**
- **Corrosion**
- **Frequent and Costly Maintenance**
- **Reduced Equipment Life**

NOTE: Codes require a separate, ventilated space MUST be provided to store pool chemicals.

NOTE: DO NOT STORE POOL CHEMICALS IN THE MECHANICAL EQUIPMENT ROOM!

5.1 Foul Odors in the Pool Area.

The powerful chlorine smell that is often associated with indoor pools is not actually the smell of excess chlorine in the water but of Combined Chlorines. Combined Chlorines are a product of insufficient chlorine and can result in high levels of bacteria and algae in the pool water. Maintaining proper chlorine and constant pH levels will eliminate the foul odors. Airborne Combined Chlorines also have a strong affinity to pure water such as condensate. Consequently any condensation will become corrosive and further damage the structure.

The proper amount of outdoor air and exhaust air to and from the space is also crucial to ensuring chemical concentration levels are maintained within acceptable levels.

NOTE: The powerful chlorine smell that is often associated with indoor pools is NOT the result of too much free chlorine in the water; it is TOO LITTLE free chlorine that is the culprit!

5.2 pH Levels.

High pH levels (alkaline range) encourage scale formation, which reduces pool water heater efficiency. With low pH levels, the water is acidic and corrosive and may damage the metal parts in pumps, water heaters and piping. Maintaining pH levels between 7.2 and 7.6 will ensure the longest life for the pool equipment.

5.3 Water Exchange Rates.

Adequate water exchange rates are necessary to prevent the buildup of bio-wastes and their oxidation products. High concentrations of dissolved solids in water have been shown to directly contribute to high combined chlorine (chloramine) levels.

Pool water test kits must be able to accurately monitor:

- **pH Levels**
- **Alkalinity**
- **Free Chlorine**
- **Combined Chlorine**
- **Dissolved Solids**
- **Total Hardness**

Table 6 lists the NSPI recommended levels of each.

	Pools	**Whirlpools**
	Desirable Range	Desirable Range
PH	7.4 – 7.6	7.4 – 7.6
Alkalinity	80 – 100 PPM	80 – 100 PPM
Free Chlorine	2.0 – 3.0 PPM	3.0 – 4.0 PPM
Combined Chlorine	0 PPM	0 PPM
Dissolved Solids	100 – 300 PPM	100 – 300 PPM
Total Hardness	225 – 250 PPM	175 – 275 PPM

Table 6 - National Spa and Pool Institute Recommended Levels for Water Quality

5.4 Corrosion.

Unbalanced pool water chemistry leads to health problems and the deterioration of the pool building and equipment. Conversely, a balanced pool with proper water treatment and sufficient outdoor air/exhaust air dilution offers an environment that will not affect the health of the users or cause damage to mechanical equipment or the structure.

Although it stands to reason that every pool operator does their utmost to create and maintain an optimum environment for patrons and equipment, mishaps do occur. Both swimmers and equipment should expect exposure to occasionally elevated levels as a result of inaccurate pool chemical treatment or chemical spills. Seresco has taken all possible commercially feasible precautions to protect the NE Series units against the corrosion caused by accidentally high chemical levels. The equipment, materials and paints are all resistant to airborne chemicals for a short period of time.

6. Service

6.1 Nameplate

The unit nameplate and Outdoor air-cooled condenser nameplate is attached to the outside of the electrical box door. You will require the electrical rating plate information when you install and service the dehumidifier.

NOTE: The serial number will be required should you ever require information to a specific unit.

7. Recommended maintenance procedure for roof mounted units

Each Seresco Seasons-4 Roof Mounted Unit is designed and constructed for minimum maintenance and dependable operation. However, certain maintenance procedures are required to ensure maximum operating efficiency. Some suggested procedures are listed below with recommended intervals.

CAUTION: Before attempting to check or service unit, turn electrical power off and lock out to prevent accidental startup of unit.

7.1 Special maintenance

After each severe windstorm check unit panels for secureness and damage.
After each electrical storm check units for blown fuses or tripped overloads. Use new fuses equal in amperage with original fuses. Use dual element fuses in all motor circuits.
Frequently check supply diffusers and grilles for accumulation of dust and/or lint, etc.
Check unit insulation for secureness.

7.2 Monthly maintenance

Change filters (more frequently if dusty conditions exist)
Check tightness and condition of blower fan belts. Belt tension should be such that the belt may be depressed ¼" midway between pulleys with the fingers (actual belt tension is shown on the blower door). When replacing belts where (2) belts are used, replace both belts with a matched set of belts equal in quality to original belts.
Inspect pulleys for tightness.
Check for dirty or clogged condenser and evaporator coils.
Check damper linkage for tightness. Check barometric relief dampers for free movement.
Check motor mountings for tightness. Check compressor mounts.
Check evaporator blower wheel(s) for dust collection.
Check "Blower Bearings Lubrication Schedule" on inside of blower door. Lubricate as required.
Check all access doors for air leaks and adjust handles as required. Adjust handles by loosening the cam latch located on the inside of the door and sliding the cam toward the door. If excessive pressure is required to close the door, re-adjust the handle to reduce closing pressure. Excessive force applied to the handle may damage the door handle assembly!

7.3 Quarterly maintenance

Check motor bearings for dryness.
Clean condenser and evaporator coils with pressurized air or water. Caution should be used so that the coil fins are not damaged.

7.4 Mechanical System Troubleshooting

Issue	Possible Cause	Remedy
Supply blower will not start	Firestat contact closure	Check firestat switch
	Loss of main power	Check for tripped circuit breaker or blown fuses
	Manually shut down on controller	Restart
	Faulty control wiring	Check for loose or incorrect wires on system and controller
	Faulty wiring	Check for loose or faulty wiring on system and controller
	Motor windings have shorted	Replace motor
	Blower overload has tripped	reset overload
Compressor will not start	Manually shut down on controller	Restart
	Faulty control wiring	Check for loose or incorrect wires on system and controller
	No demands to run	Adjust setpoints to what is indicated on the unit Nameplate
	Loss of main power	Check for tripped circuit breaker or blown fuses
	Blower not operating	Refer to supply blower problem section
	Faulty wiring	Check for loose or faulty wiring on system and controller
	Compressor thermal; protector is open	Allow one hour for compressor to cool off.
	Compressor delay-timer	Wait 3 minutes for timer
	Compressor overload has tripped	Correct cause and reset overload
	Compressor draws locked rotor amps	Replace compressor (or check fuses on three-phase units)
	Motor windings have shorted	Replace compressor
	Compressor starts but does not pump	Replace compressor
Low Suction pressure **Normal: 60 – 75 PSIG**	Bubbles in sight glass	Lack of refrigerant. Check receiver sight glasses –level indicators. Is the bottom ball floating?
		Blocked filter drier.
	Return air is below 70°F	Is cold outdoor air mixing upstream of the coil?
		Too much cold outdoor air being introduced to the space.
		Duct heater not able to accommodate actual load. Review space heating requirement.

Low Suction pressure Normal: 60 – 75 PSIG	Return air % RH level too low	Check register locations for short-cycling of air.
		Check setpoints; unit should not be operating.
	Insufficient evaporator air flow	Evaluate system air flow
		Check for dirty filters or restricted ductwork
		Assure coils are not blocked or dirty.
		Close bypass damper to force additional air across the coil.
	Blocked filter drier	Evaluate filter pressure drop and replace if necessary
	Expansion valve not feeding properly	Evaluate expansion valve setting and performance. Replace if necessary.
	Restriction in refrigeration piping	Check piping for kinks
High Head pressure Normal: 200- 250 PSIG	Compressor discharge service valves closed or not fully open	Fully open service valves
	Excessive refrigerant charge	Check receiver sight glasses – level indicators. Is the top ball floating? Re-evaluate system charge
	Non-condensables in system	Evacuate or purge system
	Solenoid valve not opening	Check all solenoid valves operation
	Restriction in refrigeration piping	Check coil and tubing for kinks
	Refrigeration system is overloaded	Check operating conditions against the unit design conditions on the nameplate. It may be undersized.
	Too much airflow across evaporator	Verify the bypass damper is open.
		Balance the system airflow as directed in section 6.4
Outdoor Condenser and Dry Cooler related High Head Pressure	Air on condenser temperature above design condition.	If this is a chronic situation a larger condenser or dry cooler may be required.
	Excessive pressure drop in line sets	Re-evaluate remote condenser installation and line sizing
	Fan motor overload tripped.	Reduce fan speed and reset overload
	Contactor faulty	Replace contactor
	Outdoor condenser fan does not run.	Control wiring missing from dehumidifier
	ORI valve setting too high	Adjust ORI in water heating mode so unit delivers 10 degrees of water heating.

Unit operates but windows have condensation	Poor air distribution	Ensure all exterior windows see 3-5 CFM/ft² of air over their entire area
	Airflow across evaporator is too high. Coil only doing sensible cooling	Check bypass damper operation. Ensure fully open or recalibrate in Service mode.
	Unit is undersized	Re-evaluate unit sizing. Check for initially neglected sources of humidity
	Air and/or pool water temperature incorrect	Reset controller setpoints to original design specifications
Pool Water Heating (PH and PV Models)	Low water temperature rise	Solenoid valve not opening
		Excessive water flow. This erodes the water heater and must be rectified.
	High water temperature rise	Insufficient water flow.
Compressor runs for short periods and shuts off	Conditions are being satisfied quickly	Check register locations for short-circuiting of air
		Unit oversized
Low Supply Air Temperature rise in Dehumidification Mode	Too much airflow through unit.	Balance the system airflow as directed in section 6.4
High Supply Air Temperature rise in Dehumidification Mode	Too little airflow through unit.	Close bypass plugs until desired target range reached.
		Re-evaluate duct pressure losses to ensure they are within the parameters indicated on the unit nameplate.

7.5 Microprocessor Troubleshooting

Issue	Possible Cause	Remedy
Communication fault	Broken or loose wire between controller and IO board	Repair any damaged or loose wires.
	Corrosion on pins or terminals	Clean pins and terminals
	Defective IO board – LED is not on	Replace IO board
	Defective controller	Replace controller
Sensor fault	Sensor wires broken or shorted to ground	Connect sensor directly to IO board. If it functions replace wire.
	Sensor reading outside design parameters	Replace sensor
Setpoint out of range	Setpoint parameters are outside acceptable limits	Reenter setpoint. Replace sensor if problem persists

8. Airflow Adjustment Procedure

8.1 Supply Airflow adjustment.

All Seresco units have adjustable sheaves airflow balancing ports.

8.1.1. Internal Static Pressures (ISP).

The standard NE Series unit is configured for ¾" - 1" External Static Pressure (ESP) depending on options. Should the ESP change from what was initially specified contact the factory to help evaluate whether a motor or fan change may be required.

9. Basic Unit Operation

9.1 Controller Set Points

All NE units have been selected based on predetermined operating conditions for each facility. Most operating conditions fall within the parameters suggested in Table 1 on page 5. Changing setpoints can significantly increase the evaporation load from the pool. Before making significant changes (more than 2ºF) to the setpoints indicated on the unit nameplate, contact factory to verify that the resulting load does not exceed unit capacity.

RECOMMENDED SET POINTS:

- Humidity: 50% to 60% RH.
- Air temperature: 2º to 4º F above the pool water temperature.
- Refer to Table 1 on page 5 for guidelines.

WARNING: Never shut down a dehumidifier. Even when not in use, pool water continues to evaporate moisture to the air. It is also prudent to cover the pool if the facility is to be unattended for longer periods of time.

9.2 Typical Unit Operation Parameters.

There are several variables that impact unit performance. If the unit is operating within the parameters listed in Table 8, the systems are well balanced and the unit is performing well.

- These are "Rule of Thumb" guidelines only and do not include outdoor air. Outdoor air would need to be shut off fully during the time of the measurement or be factored into these values based on its exact conditions at the time of the test.
- The indicated refrigerant pressures are the most important to target as they directly impact all aspects of system performance.
- If any operating parameters are outside those listed in Table 8 on page 30, refer to the trouble-shooting guide in section 6.3 for possible solutions.

10. Factory Start-up Supervision

Seresco factory start-up supervision can be purchased with the equipment. A factory start-up includes several key services:

- The expertise of an accomplished, factory-trained technician who will supervise the commissioning of the equipment.
- This Seresco representative will assist the installing contractor with filling out the Start-Up Report.
- They will also inspect the installation to make sure that the dehumidifier has been properly integrated with the rest of the equipment on the jobsite.
- Finally, they can train the maintenance personnel to operate and service the equipment if necessary.

A factory start-up does *not* include installation assistance. The installing contractor is responsible for ensuring that the system is ready for start-up when the Seresco representative arrives. If the system is not ready, Seresco reserves the right to bill the contractor for a second visit.
When the installing contractor is confident the system will be ready, contact the Seresco Sales representative to schedule the start-up. Please call at least two weeks before the desired start-up date to prevent scheduling conflicts.

Items required for Start-Up

- A service technician and a fully stocked service vehicle.
- A set of refrigerant manifold gauges.
- Air balancing equipment (magnehelic differential pressure gauge).
- Volt/Amp/Ohm meters.
- A digital thermometer w/clamp on sensors.
- A halogen leak detector, REFRIGRANT and a scale.

Items to be Completed Before Start-up

- Refrigerant leak-check (with halogen leak detector) and inspect the unit for internal concealed damage.
- Level and support the dehumidifier properly.
- Install the outdoor air duct filters and damper (if applicable).
- Install the condensate P- trap and drain.
- Pipe the remote condenser fan pressure controls to the condenser hot gas lines (if applicable).
- Evacuate and leak-check the remote condenser line set (if applicable).
- Tighten all electrical connections and verify that the line voltage is correct for the unit.
- Install all controls and verify that all field wiring matches the schematic.

- Fill and heat the pool and room to design conditions.
- Install the pool water piping and a flow meter (if applicable). Purge all air from pool lines.
- A complete system air balancing.

Typical Unit Performance				
	Dehumidification	Air Conditioning	Water Heat & A C	Water Heat & Dehumidification
Supply Air Temperature change	+ (10 – 15)°F	- (10 – 15)°F	- (10 – 15)°F	+ (0 – 3)°F
Air off evaporator	47- 55°F	47- 55°F	47- 55°F	47- 55°F
Leaving Water Temperature change	0 °F	0 °F	+ (8 – 10)°F	+ (8 – 10)°F
Suction - PSIG	60-75	60-75	60-75	60-75
High - PSIG	200-250	200-250	200-250	200-250

11. Warranty

General Policy

This warranty applies to the original equipment owner and is not transferable. Seresco Inc. warrants as set forth and for the time periods shown below that it will furnish, through a Seresco Inc. authorized installing contractor or service organization, a new or rebuilt part for a part which has failed because of defect in workmanship or material. Seresco Inc. reserves the right to apply handling and inspection charges in the case of parts or equipment improperly returned as defective whether under warranty or not.

Warranty Registration and Start-up Report

Warranty void unless upon start-up of the unit the "Warranty Registration and Start-up Report " is completed and sent to the factory within one week of initial start-up. This report will also register the compressor warranty with the compressor manufacturer.

Labor Warranty

During the first 90 days from initial start-up and subject to prior approval from the factory Seresco Inc. will provide and/or reimburse the required labor, materials, and shipping costs incurred in the replacement or repairing of a defective part.

Parts Warranty

If any part supplied by Seresco Inc. fails because of a defect in workmanship or material until completion of the 24th month from date of shipment, Seresco Inc. will furnish a new or rebuilt part F.O.B. factory. No reimbursement will be made for expenses incurred in making field adjustments or replacements unless specifically approved in writing beforehand by Seresco Inc.

Applicability

This warranty is applicable only to products that are purchased and installed in the United States and Canada. This warranty is NOT applicable to:

1. Products that have become defective or damaged as a result of the use of a contaminated water circuit or operation at abnormal water temperatures and/or flow rates.
2. Parts that wear out due to normal usage, such as air filters, belts and fuses. Refrigerant lost during the parts warranty will be reimbursed in accordance to the current market price of refrigerant at the time of repair. Seresco Inc. will not be responsible for refrigerant lost from the system due to improperly installed contractor piping to the remote outdoor air cooled condenser.
3. Refrigerant coils that corrode due to improperly balanced pool chemistry or corrosive air quality.
4. Components that have been relocated from their original placement at the factory.
5. Any portion of the system not supplied by Seresco Inc.
6. Products on which the model and/or serial number plates have been removed or defaced.
7. Products which have become defective or damaged as a result of unauthorized opening of refrigeration circuit, improper wiring, electrical supply characteristics, poor maintenance, accidents, transportation, misuse, abuse, fire, flood, alteration and/or misapplication of the product.
8. Products not installed, operated and maintained as per Seresco Inc. Owner's Manual.
9. Products on which payment is in default.

Transportation Costs

After the initial 90-day warranty period has expired, charges covering transportation of the defective part to Seresco Inc. from the customer site and replacement part(s) from Seresco Inc. to the customer site are not covered by this warranty.

Limitations

This warranty is given in lieu of all other warranties. Anything in the warranty notwithstanding, any implied warranties of fitness for particular purpose and merchantability shall be limited to the duration of the express warranty. Manufacturer expressly disclaims and excludes any liability for consequential or incidental damage for breach of any express or implied warranty.

Where a jurisdiction does not allow limitations or exclusions in a warranty, the foregoing limitations and exclusions shall not apply to the extent of the legislation; however, in such case the balance of the above warranty shall remain in full force and effect.

This warranty gives specific legal rights. Other rights may vary according to local legislation.

Force Majeure
Seresco Inc. will not be liable for delay or failure to provide warranty service due to government restrictions or restraints, war, strikes, material shortages, acts of God or other causes beyond Seresco Inc. control.

Second to Fifth Year Compressor Warranty (optional) This extended warranty must be purchased before the shipment of the unit.

NOTE: Seresco Inc. will provide a replacement compressor for 60 months from the date of shipment provided the compressor fails as a result of manufacturing defect and is returned to the factory with transportation prepaid. This extended compressor warranty is subject to all the terms of the standard Seresco Inc. warranty but applied to the compressor only.

NOTE: No charges attributed to the replacement of a component, except as detailed in the above Labor Warranty, will be allowed unless specifically granted in writing beforehand by Seresco Inc.

Second to Fifth year Coil Warranty (optional)

This extended warranty must be purchased before the shipment of the unit.

Under this warranty a replacement coil will be supplied at Seresco Inc.'s expense, provided the failed coil is returned to the factory with transportation prepaid. This extended coil warranty is subject to all the terms of the standard NE Series warranty but applied to the coil only.

This warranty is contingent to the proper maintenance of pool water chemistry including a pH of between 7.2 and 7.6 free chlorine not exceeding 2.0 ppm and combined chlorine maintained at less than 0.3 ppm. These parameters are to be measured and recorded daily and are available for review upon request.

Second to Tenth year Coil Warranty (optional) This extended warranty must be purchased before the shipment of the unit.

Under this warranty a replacement coil will be supplied at Seresco Inc.'s expense, provided the failed coil is returned to the factory with transportation prepaid. This extended coil warranty is subject to all the terms of the standard NE Series warranty but applied to the coil only.

This warranty is contingent to the proper maintenance of pool water chemistry including a pH of between 7.2 and 7.6 free chlorine not exceeding 2.0 ppm and combined chlorine maintained at less than 0.3 ppm. These parameters are to be measured and recorded daily and be available for review upon request.

6.8 Refrigeration Diagrams

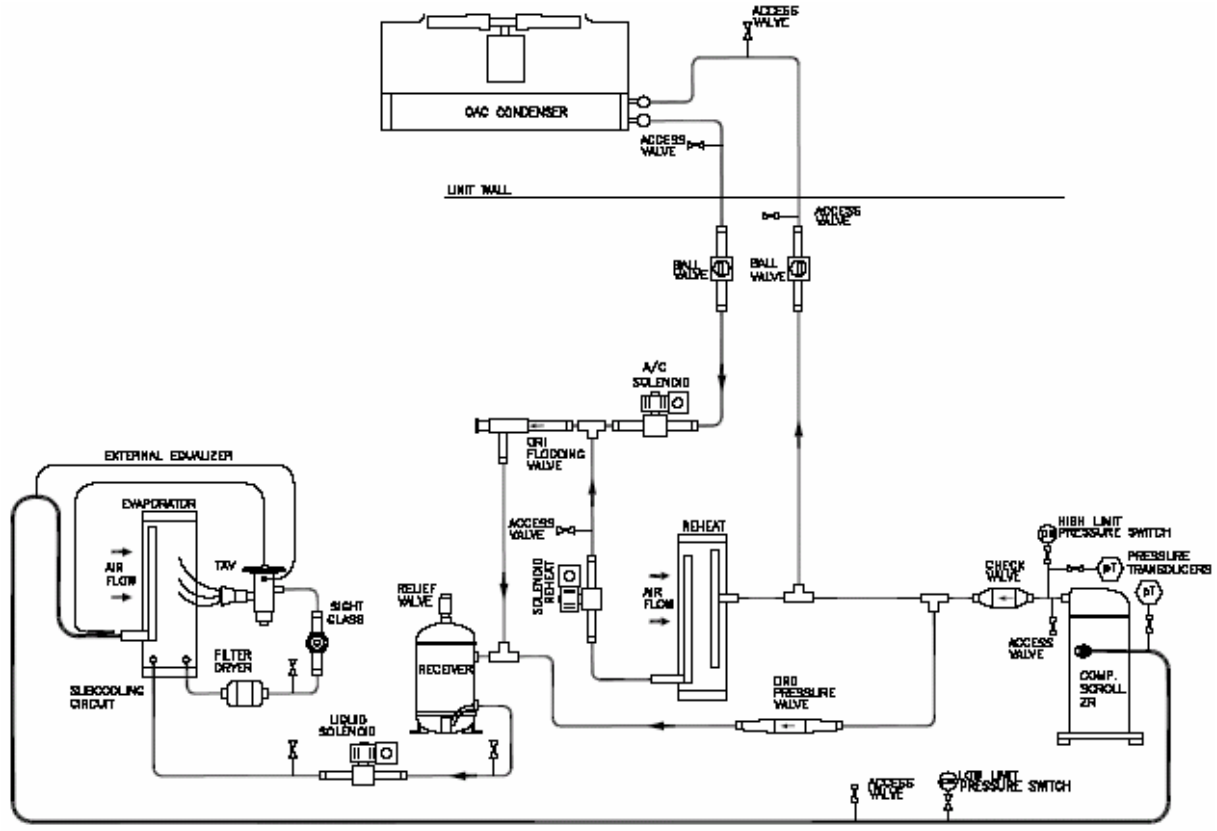


Figure 26 – Refrigeration Typical Circuit – c/w Outdoor Condenser

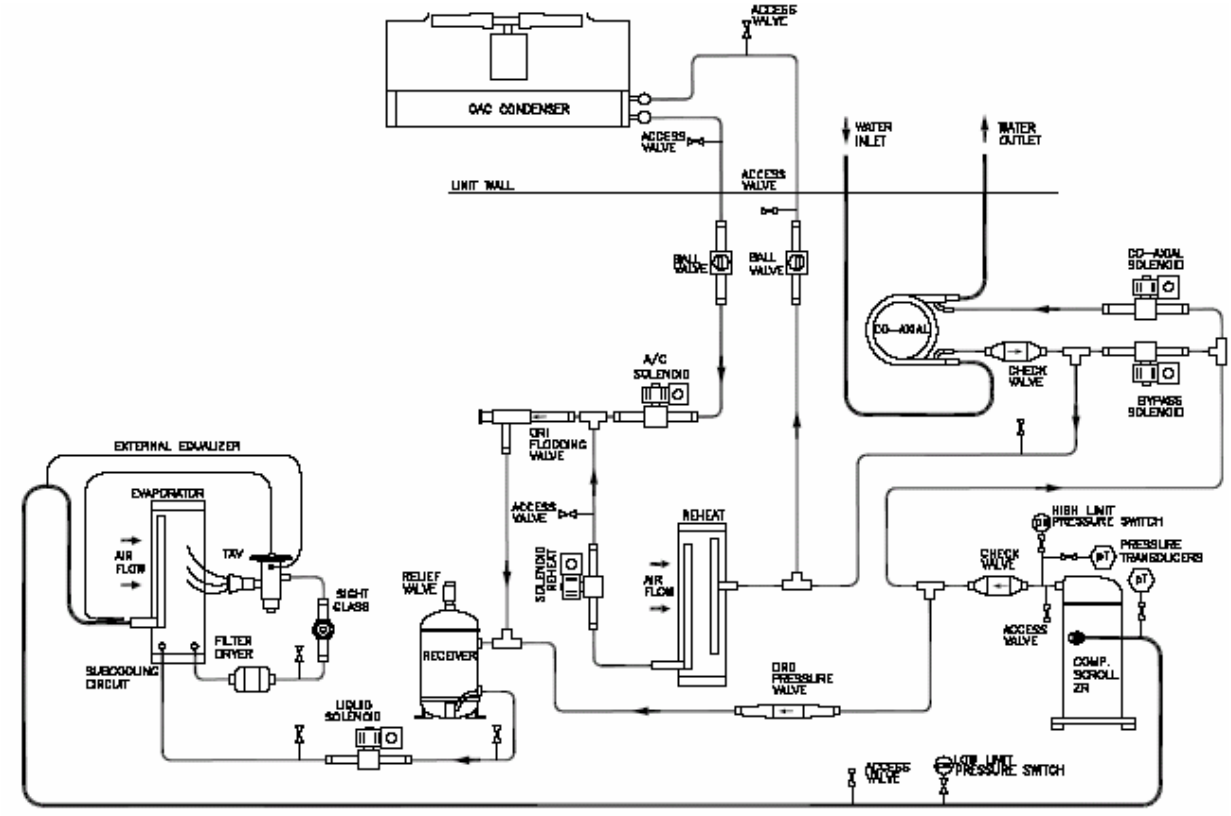


Figure 27 – Refrigeration Typical Circuit – c/w Pool Heating and Outdoor Condenser

STARTUP REPORT

Project Name _____

Location _____

Jobsite telephone number _____

Seresco Representative _____

NE Series Model _____

Serial Number _____

Compressor Serial # _____

Voltage on site _____

Electrical Data	L1 – L2	L2 – L3	L1 – L3	Nameplate
Compressor Amperage				
Compressor Voltage				
Blower Amperage				
Blower Voltage				

Installation Review and Checklist

- ❑ Supply air blowing on exterior doors and windows?
- ❑ No supply-return air short-circuiting?
- ❑ Outdoor air connected to Seresco unit?
- ❑ Exhaust fan installed and operating?
- ❑ Vapor Barrier installed?
- ❑ Adequate service access provided?
- ❑ Units level and vibration isolated?
- ❑ Flex-Connectors used at both unit duct connections?
- ❑ Condensate P-Trap installed and filled?
- ❑ Condensate line tested?
- ❑ Pool Water piping properly installed?
- ❑ Pool water circulating pump operating?
- ❑ Auxiliary circulating pump installed?
- ❑ Pool water flow per specifications?
- ❑ Floor Drain in mechanical room?
- ❑ Chemicals stored in separate ventilated room?
- ❑ Outdoor air cooled condenser or Dry Cooler properly installed?
- ❑ Unit nameplate voltage verified?
- ❑ Main disconnect installed?
- ❑ Wiring connections checked & tightened?
- ❑ Control wiring to outdoor condenser or Dry Cooler installed?
- ❑ Control wiring to auxiliary pool water heater installed?
- ❑ Ethernet cable connected to unit.
- ❑ Blower rotation correct?
- ❑ Air balance report on file?

Outdoor Air cooled condenser or Dry Cooler location:

- ❑ ……. ft [above / below] Seresco unit
- ❑ If above, oil traps installed: [yes / no]
- ❑ Same Level as Seresco Unit
- ❑ Condenser/Dry Cooler Model installed:……

- ☐ Total line length to OACC or Dry Cooler……
- ☐ Hot gas line size……..
- ☐ Liquid line size……..
- ☐ Total lbs of refrigerant added……
- ☐ Pipe size to Dry Cooler……

Water Cooled and Dry Cooler AC

- ☐ Fluid GPM……..
- ☐ Glycol %:……
- ☐ Glycol stabilizers added: [yes / no]
- ☐ Piping and valves installed per Specs?
- ☐ Water/fluid temperatures:
  Entering Seresco unit:……..
  Exiting Seresco unit:……

Operational Data				
	Dehum.	A C	Water Heat & A C	Water heat & Dehum
Return Air (°F)				
Supply Air (°F)				
Return Air %RH				
Entering Water (°F)				
Leaving Water (°F)				
Water – GPM				
Air off evaporator (°F)				
Suction - PSIG				
High - PSIG				
Compressor Discharge Temp (°F)				
Sight Glass Clear?				
Receiver sight glass ball floating? Top/Bottom				

Controller Programming	
Sensor	**Setpoint**
Space temperature	
Space relative humidity	
Water temperature	
Outdoor Air	
CFM	
DB/WB	
Intake minimum 6' from an exhaust outlet?	
Preheated prior to entering unit?	
Heat recovery device used?	

Comments:……
……
……
……
……
……
……
……
……
……

Telephone Number:…….. ……

Date:……

Technician…….
Company:……

Fax to 613 – 254 - 7405

Your local Seresco representative:

Design Checklist

System design and air flow pattern

Exhaust Air

Required Access Space

Evaporation rate and latent loads

Supply Air

Cooling and Heating loads

Outdoor Air

Project: _____

Reviewed by: _____

System design and air flow pattern
All exterior windows, doors and skylights are fully blanketed with supply air.
No stagnant areas including the water surface.
Vapor retarder is installed on the warm side of the dew point in the roof and walls.

Evaporation rate and latent loads
Pool load calculated.
Outdoor Air load calculated.
Water features reviewed with factory.
Spectators and swim meet mode calculated.

Required Access Space
Unit is accessible.
Unit has adequate service clearance.
Suspended unit has unobstructed access.

Exhaust Air
Exhaust fan identified on the plans.
Exhaust Air is minimum 110% the outdoor air CFM.
Exhaust air drawn from the whirlpool or any other warm or highly active water area.

Supply Air
System delivers 4 air changes per hour or greater.
Supply air is delivered to the deck area.
No short-circuiting of supply air to the return duct.

Cooling and Heating loads
Sensible cooling load has been calculated for the space design temperature.
Heating load has been calculated for the space design temperature.
Outdoor air has been included in all load calculations.

Outdoor Air
1.0 CFM/ft² of water and wet deck for pool with water features.
0.5 CFM/ft² of water and wet deck for regular pool.
15 CFM per spectator.

Comments:

_____
_____
_____
_____

1-888-Seresco (737-3726)
For more information visit www.seresco.net

Seresco

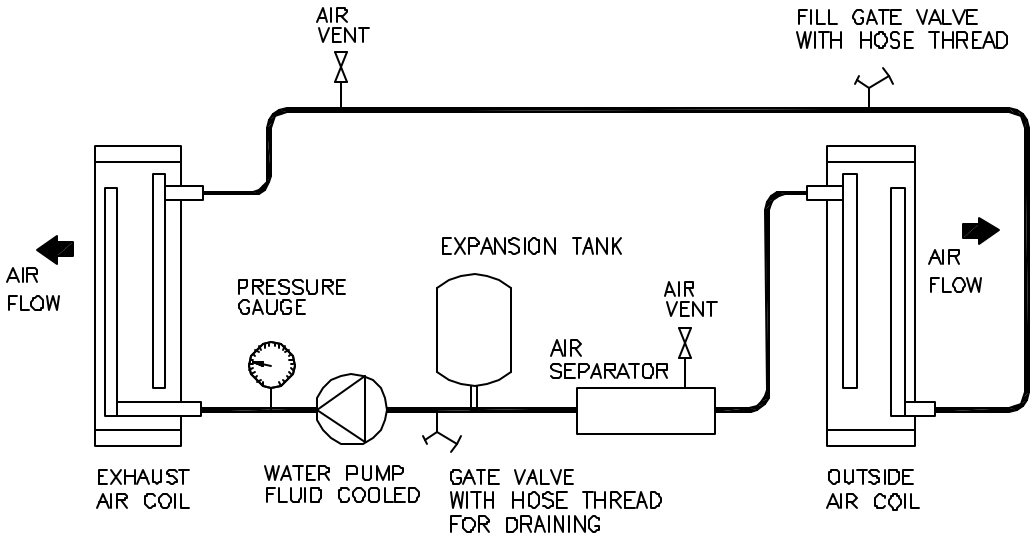
Appendices

Your local Seresco representative:

Heat Recover (Run Around Loop)

The energy a room loses from the exhaust air, as a result of the fresh air requirements, can represents approximately 50 % of the room heating requirements. The Seresco unit captures 50-60 % of this exhaust heat with its heat recovery loop. By doing so it supplies heat to warm the cold OA and can provide generous energy savings to the room and reduce heating costs. During freezing weather conditions the OA can provide much of the dehumidification required and minimizing the time the compressors run offsetting some of the running electrical costs.

Our typical energy recovery loop places two glycol coils one in the outside air intake and the other in the exhaust air-stream. The coils are connected in counter-flow closed loop piping system. The system comprises an inline fluid cooled pump, an air separator, and in some larger systems a pressure tank and pressure gauge. By circulating a glycol mixture, typical 30%, we can extract enough heat from exhaust air stream to preheat the outside air intake to about 50-60% of the room temperature. Extracting more heat from the exhaust air stream is possible but would also lead to possibly freezing of the exhaust air and would require a more complex and costly system of frost prevention. Keeping our effectiveness down to 50-60% reduces initial cost and keeps things simple.



Types of Solutions:

We recommend and typically use ethylene glycol in our systems but local codes or building requirements may specify propylene glycol mixtures. The higher viscosity of propylene means a stronger pump is required or a lower circulating water flow will occur. So it is best to contact the factory if a switch from one glycol to another is preferred.

It is important to use corrosion inhibitors and in the correct amount. When adding the corrosion inhibitor solution please followed the suggested instructions for the required quantity of fluid.
Seresco strongly recommended that if the glycol, if not already mixed, it be mixed with distilled water. The final toping up and pressurizing of the system can be done with clean tap water. In municipalities where local tap water has a high mineral content, Seresco strongly advises the use of distill water otherwise “sludging” and premature failure may occur.

Your local Seresco representative:

Annual testing should be made of the fluid solution to ensure the adequate glycol concentrations and corrosion inhibitor protection. Freeze point and PH test strips are available from your local plumbing supply house. It is important to insure the solution wont freeze in the case of a power failure or that it is not acidic and will prematurely corroding the system.
The glycol mix should be replaced after 5 years or when quality is deem unsatisfactory and cannot be restored.

Filling or Refilling the Glycol Loop:

When filling the system please insure all air has been removed. Air in the system will cause corrosion and improper functioning of the pump. Do not run the pump for any extent time with air in the system it will foam up the glycol and this will make it difficult to remove the air. If this happens pressurize the system with some water to about 15 PSI and let stand overnight. Before restarting vent as much air as possible running the pump for very short burst to move the water and any possible air bubbles around slowly to the vents.

For systems with a pressure tank keep the system under a 10-15 PSI positive pressure to ensure no air get into the system.

If the system is left dry for any period of time electrically disable the pump to avoid it possible coming on without fluid in the system.

Please keep record, near the unit, the type of glycol used; ethylene or propylene, the two types should not be mixed.
Keep careful track of what percentage by volume was used and when it was changed. And the last time it was check.

Fill in this page and keep it with the unit.

Type of Glycol:……..

Glycol Concentration:……%

Total Volume of Solution:……Gallons

Amount of inhibitor added:……..

Comments:…….
…….
…….

Technician…….. Company:……..

Telephone Number:…… Date:……..

I

Your local Seresco representative:

Addendums to the Manual

1-888-Seresco (737-3726)
For more information visit www.seresco.net

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Your local Seresco representative:

Wiring Diagrams

Unit Schematics

&

Specifications

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Your local Seresco representative:

Unit Component Specifications

&

Component Service Sheets

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For more information visit www.seresco.net

Seresco

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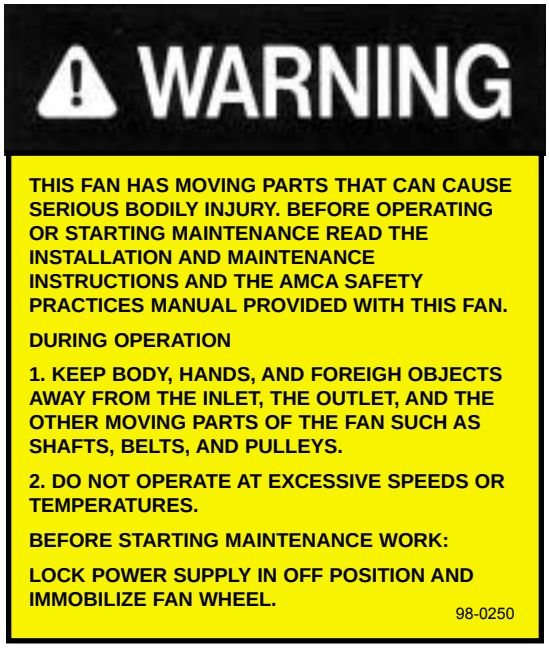
TEL: [630]794-5700•FAX:[630]794-5776•WEB: http://www.nyb.com•E-MAIL:nyb@nyb.com

INSTALLATION MAINTENANCE, OPERATING INSTRUCTIONS

IM-190

PLUG FANS
PLENUM FANS



A WORD ABOUT SAFETY

The above **WARNING** decal appears on all **nyb** fans. Air moving equipment involves electrical wiring, moving parts, sound, and air velocity or pressure which can create safety hazards if the equipment is not properly installed, operated and maintained. To minimize this danger, follow these instructions as well as the additional instructions and warnings on the equipment itself.

All installers, operators and maintenance personnel should study AMCA Publication 410, "Recommended Safety Practices for Air Moving Devices", which is included as part of every shipment. Additional copies can be obtained by writing to New York Blower Company, 7660 Quincy St., Willowbrook, IL 60527.

ELECTRICAL DISCONNECTS

Every motor driven fan should have an independent disconnect switch to isolate the unit from the electrical supply. It should be near the fan and must be capable of being locked by maintenance personnel while servicing the unit, in accordance with OSHA procedures.

MOVING PARTS

All moving parts must have guards to protect personnel. Safety requirements vary, so the number and type of guards needed to meet company, local and OSHA standards must be determined and specified by the user. Never start a fan without having all safety guards installed. Check regularly for damaged or missing guards and do not operate any fan with guards removed. Fans can also become dangerous because of potential “windmilling”, even though all electrical power is disconnected. Always block the rotating assembly before working on any moving parts.

SOUND

Some fans can generate sound that could be hazardous to exposed personnel. It is the responsibility of the system designer and user to determine sound levels of the system, the degree of personnel exposure, and to comply with applicable safety requirements to protect personnel from excessive noise. Consult **nyb** for fan sound power level ratings.

AIR PRESSURE AND SUCTION

In addition to the normal dangers of rotating machinery, fans present another hazard from the suction created at the fan inlet. This suction can draw materials into the fan where they become high velocity projectiles at the outlet. It can also be extremely dangerous to persons in close proximity to the inlet, as the forces involved can overcome the strength of most individuals. Inlets and outlets that are not ducted should be screened to prevent entry and discharge of solid objects.

ACCESS DOORS

The above DANGER decal is placed on all **nyb** cleanout doors. These doors, as well as access doors to the duct system, should never be opened while the fan is in operation. Serious injury could result from the effects of air pressure or suction.

Quick-opening doors must have the door handle bolts securely tightened to prevent accidental or unauthorized opening. Bolted doors must be tightened for the same reason.

RECEIVING AND INSPECTION

The fan and accessories should be inspected on receipt for any shipping damage. Turn the wheel by hand to see that it rotates freely and does not bind.

F.O.B. factory shipping terms require that the receiver be responsible for inspecting the equipment upon arrival. Note damage or shortages on the Bill of Lading and file any claims for damage or loss in transit. **nyb** will assist the customer as much as possible; however, claims must be originated at the point of delivery.

HANDLING AND STORAGE

Fans should be lifted by the base, mounting supports, or lifting eyes only. Never lift a fan by the wheel, shaft, motor, motor bracket, or any fan part not designed for lifting. A spreader should be used to avoid damage.

Whenever possible, fans and accessories should be stored in a clean, dry location to prevent rust and corrosion of steel components. If outdoor storage is necessary, protection should be provided. Cover the entire fan to prevent the accumulation of dirt and moisture in the housing. Cover motors with waterproof material. Refer to the bearing section for further storage instructions. Inspect the stored unit periodically. **Rotate the wheel by hand every two weeks to redistribute grease on internal bearing parts.**

FAN INSTALLATION

nyb wheels are dynamically balanced when fabricated. Fully assembled fans are test run at operating speeds to check the entire assembly for conformance to **nyb** vibration limits. Nevertheless, all units must be adequately supported for smooth operation. **Ductwork or stacks should be independently supported as excess weight may distort the fan housing and cause contact between moving parts.** Where vibration isolators are used, consult the **nyb** certified drawing for proper location and adjustment.

nyb fans are designed for smooth operation throughout the cataloged speed range. Vibration levels are dependent upon the rigidity of the support structure on which the fan is mounted. The optimum installation is one in which the Plug Fan mounting panel or Plenum Fan base is bolted directly to the main supporting structurals of the particular system (see Figure 1). By doing so, the entire machine provides the mass and rigidity necessary to insure smooth operation.

The Plug Fan mounting panel has a formed edge to add strength and the face of the panel is provided with prepunched holes. The Plenum Fan base is also provided with predrilled holes. These holes are large enough to allow alignment at the time of installation yet still accept a large enough mounting bolt or stud to ensure ample security. All of the mounting holes should be used.

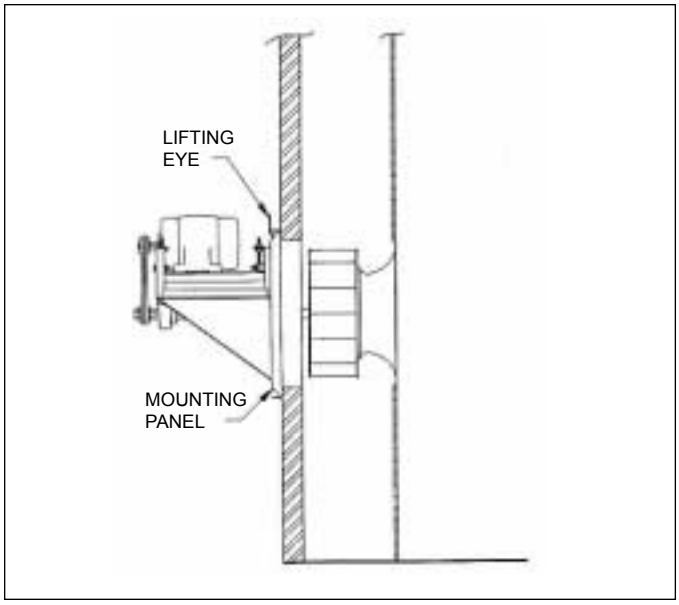


Figure 1

Typical Plug Fan Installation

For Plug Fans, the inlet cone support must be supplied by the user. In most cases, this is an internal baffle or plenum wall. The baffle or wall must be properly located and be straight to ensure optimum wheel-to-inlet cone clearance. It must also be sufficiently rigid to prevent movement of the cone during operation.

V-BELT DRIVE

Installation

1. Remove all foreign material from the fan and motor shafts. Coat shafts with machine oil for easier mounting. Mount all guards at this time if partial installation is required prior to sheave mounting.
2. Mount sheaves on shafts after checking sheave bores and bushings for nicks or burrs. Avoid using force. If resistance is encountered, lightly polish the shaft with emery cloth until the sheave slides on freely. Tighten tapered bushing bolts sequentially so that equal torque is applied to each.
3. Adjust the motor on its base to a position closest to the fan shaft. Install belts by working each one over the sheave grooves until all are in position. Never pry the belts into place. On **nyb** packaged fans, sufficient motor adjustment is provided for easy installation of the proper size belts.
4. Adjust sheaves and the motor shaft angle so that the sheave faces are in the same plane. Check this by placing a straightedge across the face of the sheave. Any gap between the edge and sheave faces indicates misalignment. Important: This method is only valid when the width of the surface between the belt edge and the sheave face is the same for both sheaves. When they are not equal, or when using adjustable-pitch sheaves, adjust so that all belts have approximately equal tension. Both shafts should be at the right angles to the center belt.

Belt Tensioning

1. Check belt tension with a tensioning gage and adjust using the motor slide base. Excess tension shortens bearing life while insufficient tension shortens belt life, can reduce fan performance and may cause vibration. The lowest allowable tension is that which prevents slippage under full load. Belts may slip during start-up, but slipping should stop as soon as the fan reaches full speed. For more precise tensioning methods, consult the drive manufacturer's literature.
2. Recheck setscrews, rotate the drive by hand and check for rubbing, then complete the installation of the belt guard.
3. Belts tend to stretch somewhat after installation. Recheck tension after several days of operation. Check sheave alignment as well as setscrew and/or bushing bolt tightness.

START-UP

Safe operation and maintenance includes the selection and use of appropriate safety accessories for the specific installation. This is the responsibility of the system designer and requires consideration of equipment location and accessibility as well as adjacent components. All safety accessories must be installed properly prior to start-up.

Safe operating speed is a function of system temperature and wheel design. Do not under any circumstances exceed the maximum safe fan speed published in the **nyb** bulletin, which is available from your **nyb** field sales representative.

Procedure

1. If the drive components are not supplied by **nyb**, verify with the manufacturer that the starting torque is adequate for the speed and inertia of the fan.
2. Inspect the installation prior to starting the fan. Check for any loose items or debris that could be drawn into the fan or dislodged by the fan discharge. Check the interior of the fan as well. Turn the wheel by hand to check for binding.

⚠ CAUTION

BEFORE INITIAL OPERATION:

1. **TIGHTEN ALL SET SCREWS IN FAN WHEEL.**
2. **TIGHTEN ALL SET SCREWS IN BEARINGS.**
3. **REPEAT AFTER 8 HOURS OF OPERATION.**
4. **REPEAT AGAIN AFTER TWO WEEKS OPERATION.**

98-0271

3. Check drive installation and belt tension.
4. Check the tightness of all setscrews, nuts and bolts. When furnished, tighten hub setscrews with the wheel oriented so that the setscrew is positioned underneath the shaft.
5. Install all remaining safety devices and guards. Verify that the supply voltage is correct and wire the motor. “Bump” the starter to check for proper wheel rotation.
6. Use extreme caution when testing the fan with plenum ducting disconnected. Apply power and check for unusual sounds or excessive vibration. If either exists, see the section on Common Fan Problems. To avoid motor overload, do not run the fan for more than a few seconds if plenum is not fully installed. Without plenum ductwork, normal operating speed may not be obtained without motor overload. Once plenum ductwork is complete, check for correct fan speed and complete installation. Plenum ductwork and guards must be fully installed for safety.
7. Setscrews should be rechecked after a few minutes, eight hours and two weeks of operation (see Tables 1 & 2 for correct tightening torques).

NOTE: Shut the fan down immediately if there is any sudden increase in fan vibration.

Table 1 - WHEEL SETSCREW TORQUES

Setscrew Size Diameter (in.)	Carbon Steel Setscrew Torque*	
	lb.-in.	lb.-ft.
1/4	75	6.2
5/16	144	12
3/8	252	21
7/16	396	33
1/2	600	50
5/8	1164	97
3/4	2016	168
7/8	3204	267
1	4800	400

*** Stainless Steel setscrews are not hardened and should not be tightened to more than 1/2 the values shown.**

Table 2 - BEARING SETSCREW TORQUE, lb.-in.

Setscrew Diameter	Manufacturer				
	Link-Belt	Sealmaster	SKF	McGill	Dodge
#10	40	--	35	35	--
1/4	90	65	50	85	--
5/16	185	125	165	165	160
3/8	325	230	290	290	275
7/16	460	350	350	--	--
1/2	680	500	620	--	600
5/8	1350	1100	1325	--	1200
3/4	2350	--	--	--	2000

FAN MAINTENANCE

nyb fans are manufactured to high standards with quality materials and components. Proper maintenance will ensure a long and trouble-free service life.

Do not attempt any maintenance on a fan unless the electrical supply has been completely disconnected and locked. In many cases, a fan can windmill despite removal of all electrical power. The rotating assembly should be blocked securely before attempting maintenance of any kind.

The key to good fan maintenance is regular and systematic inspection of all fan parts. Inspection frequency is determined by the severity of the application and local conditions. Strict adherence to an inspection schedule is essential.

Regular fan maintenance should include the following:

1. Check the fan wheel for any wear or corrosion, as either can cause catastrophic failures. Check also for the build-up of material which can cause unbalance resulting in vibration, bearing wear and serious safety hazards. Clean or replace the wheel as required.
2. Check the V-belt drive for proper alignment and tension (see section on V-belt drives). If belts are worn, replace them as a set, matched to within manufacturer’s tolerances. Lubricate the coupling of direct-drive units and check for alignment (see section on couplings).
3. Lubricate the bearings, but do not over lubricate (see the bearing section for detailed specifications).
4. Ceramic-felt shaft seals require no maintenance, although worn seals should be replaced.
5. During any routine maintenance, all setscrews and bolts should be checked for tightness. See tables for torques.
6. When installing a new wheel or cone, the proper wheel-to-inlet cone clearance must be maintained (see Figure 2).

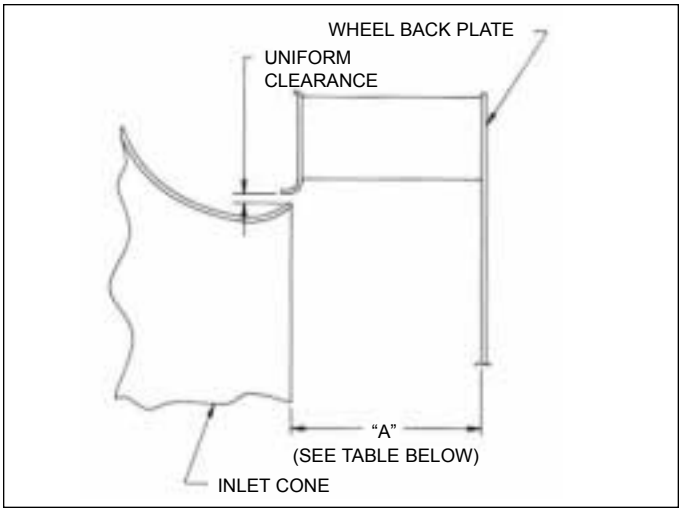
WHEEL BALANCE

Airstreams containing particulate or chemicals can cause abrasion or corrosion of the fan parts. This wear is often uneven and can lead to significant wheel unbalance over time. When such wear is discovered, a decision must be made as to whether to rebalance or replace the wheel.

The soundness of all parts should be determined if the original thickness of components is reduced. Be sure there is no hidden structural damage. The airstream components should also be cleaned to remove any build-up of foreign material. Specialized equipment can be used to rebalance a cleaned wheel that is considered structurally sound.

Balance weights should be rigidly attached at a point that will not interfere with the housing nor disrupt airflow. Remember that centrifugal forces can be extremely high at the outer radius of a fan wheel. Welding is the preferred method of balance weight attachment. Be sure to ground the welder directly to the fan wheel. Otherwise, the welding current could pass through the fan bearings and damage them.

WHEEL-CONE CLEARANCES



Fan Size	"A" Dimension	Fan Size	"A" Dimension
12	4 1/2	30	11 1/4
13	5	33	12 1/4
15	5 1/2	36	13 3/8
16	6 1/2	40	14 3/4
18	7	44	16 1/4
20	7 1/2	49	17 7/8
22	8 1/4	54	19 3/4
24	9 1/4	60	21 3/4
27	10 1/8	66	24
		73	26 1/2

Figure 2

BEARINGS

Storage

Any stored bearing can be damaged by condensation caused by temperature variations. Therefore, **nyb** fan bearings are filled with grease at the factory to exclude air and moisture. Such protection is adequate for shipment and subsequent immediate installation.

For long term or outdoor storage, mounted bearings should be regreased and wrapped with plastic for protection. **Rotate the fan wheel by hand at least every two weeks to redistribute grease on internal bearing parts.** Each month the bearings should be purged with new grease to remove condensation, since even a filled bearing can accumulate moisture. Use caution when purging, as excessive pressure can damage the seals. Rotate the shaft while slowly adding grease.

Operation

Check the setscrew torque before start-up (see Table 2 for correct values). Since bearings are completely filled with grease at the factory, they may run at an elevated temperature during initial operation. Surface temperatures may reach 180°F. and grease may bleed from the bearing seals. This is normal and no attempt should be made to replace lost grease. Bearing surface temperatures will decrease when the internal grease quantity reaches a normal operating level. Relubrication should follow the recommended schedule.

Lubrication

Use the table for relubrication scheduling according to operating speed and shaft diameter. Bearings should be lubricated with a premium quality lithium-based grease conforming to NLGI Grade 2. Examples are:

Mobil	-	Mobilith AW2
Texaco	-	Premium RB
Chevron	-	Amolith #2
Shell	-	Alvania #2

Do not use "high temperature" greases, as many are not formulated to be compatible with fan bearings.

Add grease to the bearing while running the fan or rotating the shaft by hand. Be sure all guards are in place if lubrication is performed while the fan is operating. Add just enough grease to cause a slight purging at the seals. Do not over lubricate.

COMMON FAN PROBLEMS

Excessive Vibration

A common complaint regarding industrial fans is "excessive vibration". **nyb** is careful to ensure that each unit is precisely balanced prior to shipment; however, there are many other causes of vibration including:

1. Loose mounting bolts, setscrews, bearings or couplings.
2. Misalignment or excessive wear of couplings or bearings.
3. Misaligned or unbalanced motor.
4. Bent shaft due to mishandling or material impact.
5. Accumulation of foreign material on the wheel.
6. Excessive wear or erosion of the wheel.
7. Excessive system pressure or restriction of airflow due to closed dampers.
8. Inadequate structural support, mounting procedures or materials.
9. Externally transmitted vibration.

Inadequate Performance

1. Incorrect testing procedures or calculations.
2. Fan running too slowly.
3. Fan wheel rotating in wrong direction.
4. Wheel not properly centered relative to inlet cone.
5. Poor system design, closed dampers, air leaks, clogged filters, or coils.
6. Obstructions or sharp elbows near inlets.
7. Sharp deflection of airstream at fan outlet.

Excessive Noise

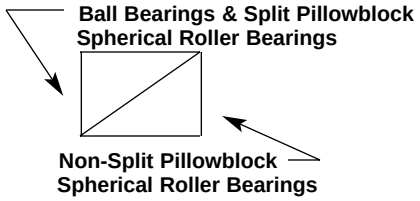
1. Fan operating near "stall" due to incorrect system design or installation.
2. Vibration originating elsewhere in the system.
3. System resonance or pulsation.
4. Improper location or orientation of fan intake and discharge.
5. Inadequate or faulty design of supporting structures.
6. Nearby sound reflecting surfaces.
7. Loose accessories or components.
8. Loose drive belts.
9. Worn bearings.

Premature Component Failure

1. Prolonged or major vibration.
2. Inadequate or improper maintenance.
3. Abrasive or corrosive elements in the airstream or surrounding environment.
4. Misalignment or physical damage to rotating components or bearings.
5. Bearing failure from incorrect or contaminated lubricant or grounding through the bearings while arc welding.
6. Excessive fan speed.
7. Extreme ambient or airstream temperatures.
8. Improper belt tension.
9. Improper tightening of wheel setscrews.

BEARING LUBRICATION INTERVAL
(months)

Shaft	RPM 1-500	501-1000	1001-1500	1501-2000	2001-2500	2501-3000	3001-3500	3501-4000	4001-4500	4501-5000
5/8 thru 1	6	6	5-6	5-6	4-6	4-6	3-4	3-4	2	2
1 3/16 thru 1 7/16	6 / 6	6 / 4	5-6 / 4	4-6 / 2	4-6 / 2	3-5 / 1	2-4 / 1	2-4 / 1	1-2 / 1	1 / 1/2
1 11/16 thru 1 15/16	6 / 6	6 / 4	4-6 / 2	4-6 / 1	2-4 / 1	2-4 / 1	2 / 1/2	1-2 / 1/2	1-2	1
2 3/16	6 / 6	5-6 / 4	4-6 / 2	3-4 / 1	2-4 / 1	1-2 / 1/2	1-2	1-2		
2 7/16	6 / 4	4-6 / 2	4-6 / 1	3-4 / 1	2 / 1/2	1-2 / 1/2	1-2	1		
2 11/16 & 2 15/16	5-6 / 4	4-6 / 2	2-4 / 1	2 / 1	1-2 / 1/2	1				
3 3/16	6	6	4	2	2					
3 7/16 thru 4 3/16	4-6 / 4	3-5 / 2	2-4 / 1	1-2 / 1/2	1					



NOTE:

1. **These are general recommendations only; specific manufacturer's recommendations may vary slightly.**
2. **Assumes clean environment, -20°F. to 120°F.**
   a. **Consult The New York Blower Company for operation below -20°F. ambient.**
   b. **Ambient temperatures greater than 120°F. will shorten bearing life.**
   c. **Under extremely dirty conditions, lubricate more frequently.**
3. **Assumes horizontal mounting configuration. For vertically mounted applications, lubricate twice as frequently.**

LIMITED PRODUCT WARRANTY

All products are warranted by **nyb** to be free from defects in materials and workmanship for a period of one (1) year after shipment from its plant, provided buyer demonstrates to satisfaction of **nyb** that the product was properly installed and maintained in accordance with **nyb**'s instructions and recommendations and that it was used under normal operating conditions.

This warranty is limited to the replacing and/or repairing by **nyb** of any part or parts which have been returned to **nyb** with **nyb**'s written authorization and which in **nyb**'s opinion are defective. Parts not manufactured by **nyb** but installed by **nyb** in equipment sold to the buyer shall carry the original manufacturer's warranty only. All transportation charges and any and all sales and use taxes, duties, imports or excises for such part or parts shall be paid for by the buyer. **nyb** shall have the sole right to determine whether defective parts shall be repaired or replaced.

This warranty does not cover any customer labor charges for replacement of parts, adjustments or repairs, or any other work unless such charges shall be assumed or authorized in advance, in writing, by **nyb**.

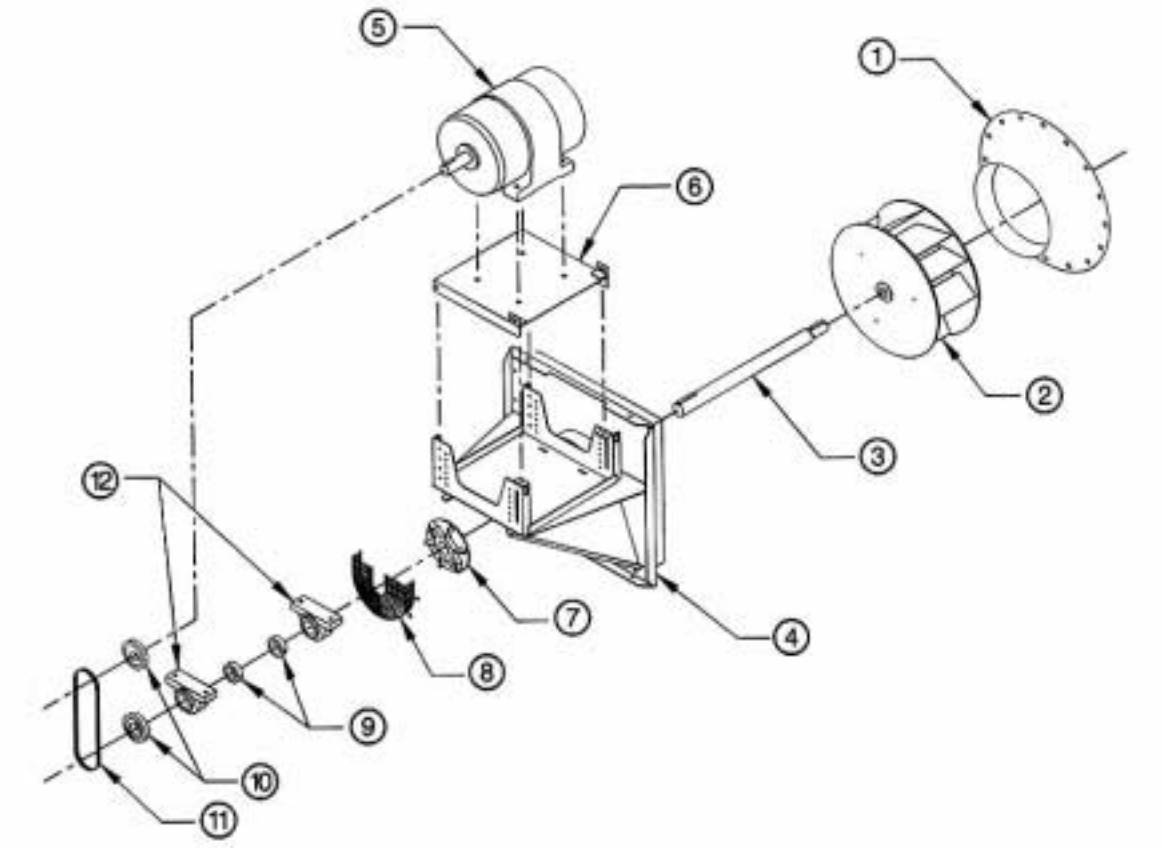
This warranty does not cover any product which, in the judgement of **nyb**, has been subject to misuse or neglect, or which has been repaired or altered outside **nyb**'s plant in any way which may have impaired its safety, operation or efficiency, or any product which has been subject to accident.

This warranty shall be null and void if any part not manufactured or supplied by **nyb** for use in any of its products shall have been substituted and used in place of a part manufactured or supplied by **nyb** for such use.

There are no warranties, other than those appearing on the acknowledgement form **INCLUDING NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE**, given in connection with the sale of the goods sold hereunder. The buyer agrees that his sole and exclusive remedy, and the limit of **nyb**'s liability for loss from any cause whatsoever, shall be the purchase price of the goods sold hereunder for which a claim is made.

SPECIFY ROTATION AS VIEWED FROM DRIVE SIDE

ARROW INDICATES COUNTERCLOCKWISE ROTATION



REPLACEMENT PARTS

It is recommended that only factory-supplied replacement parts be used. **nyb** fan parts are built to be fully compatible with the original fan, using specific alloys and tolerances. These parts carry a standard **nyb** warranty.

When ordering replacement parts, specify the part name, **nyb** shop control number, fan size, type, rotation (viewed from drive end), and bearing size or bore. Most of this information is on the metal nameplate attached to the fan base.

For assistance in selecting replacement parts, contact your local **nyb** representative or visit: http://www.nyb.com.

Example: Part required: Wheel
Shop/control number: B-10106-100
Fan description: Size 27 Plug Fan
Wheel: PLR
Rotation: Clockwise

Parts List

1.	Inlet Cone	7.	Shaft Cooler
2.	Wheel*	8.	Shaft Cooler Guard
3.	Shaft	9.	Shaft Set Collars
4.	Base and Mounting Panel	10.	Sheaves
5.	Motor	11.	V-Belts
6.	Motor Platform	12.	Bearings

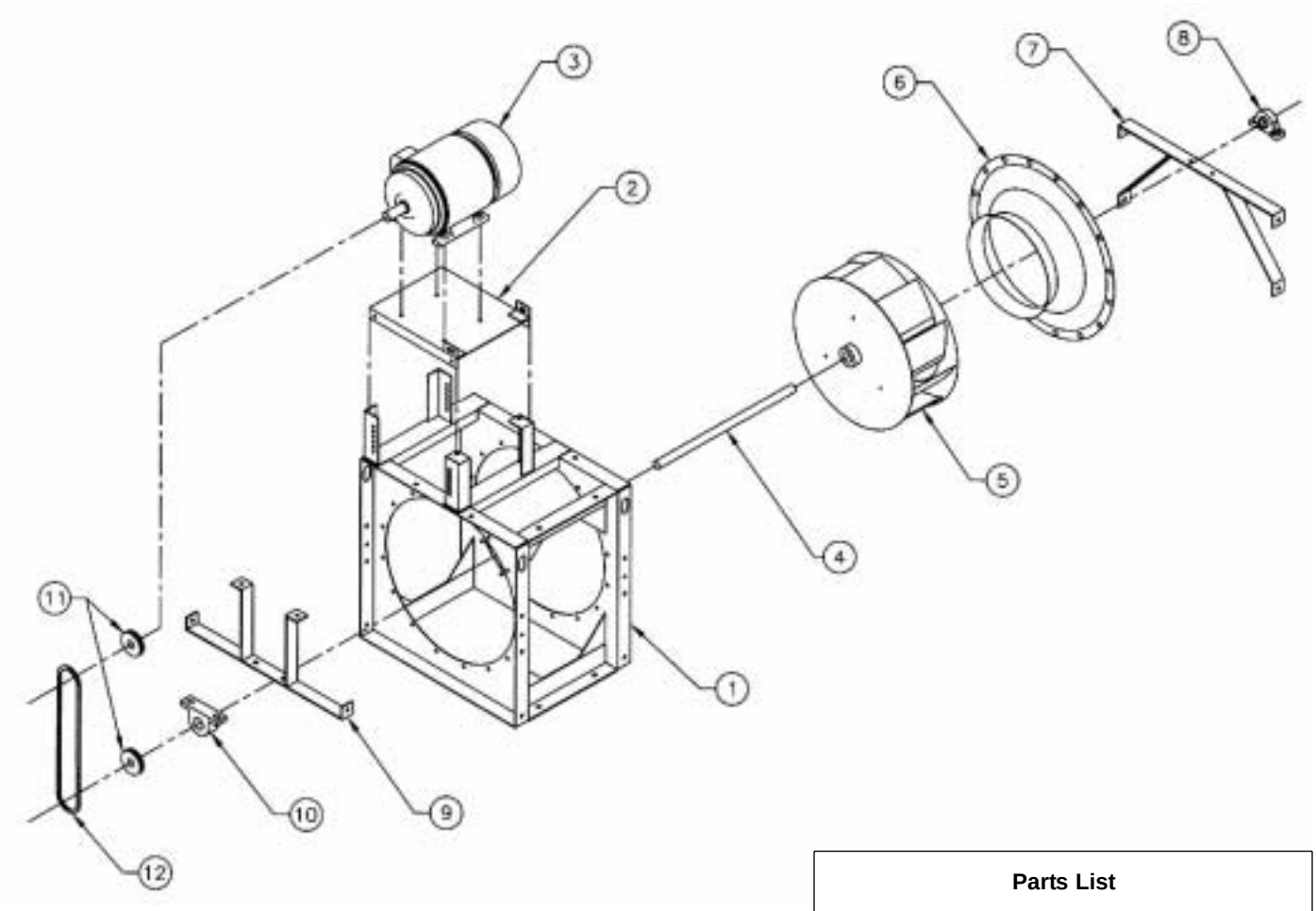
* Order for parts must specify rotation.

Suggested spare parts include:

Wheel
Shaft
Bearings
Shaft Seal
Shaft Cooler

Component Parts:
Motor
Sheaves
V-Belts

ARRANGEMENT 3P
PLENUM FAN

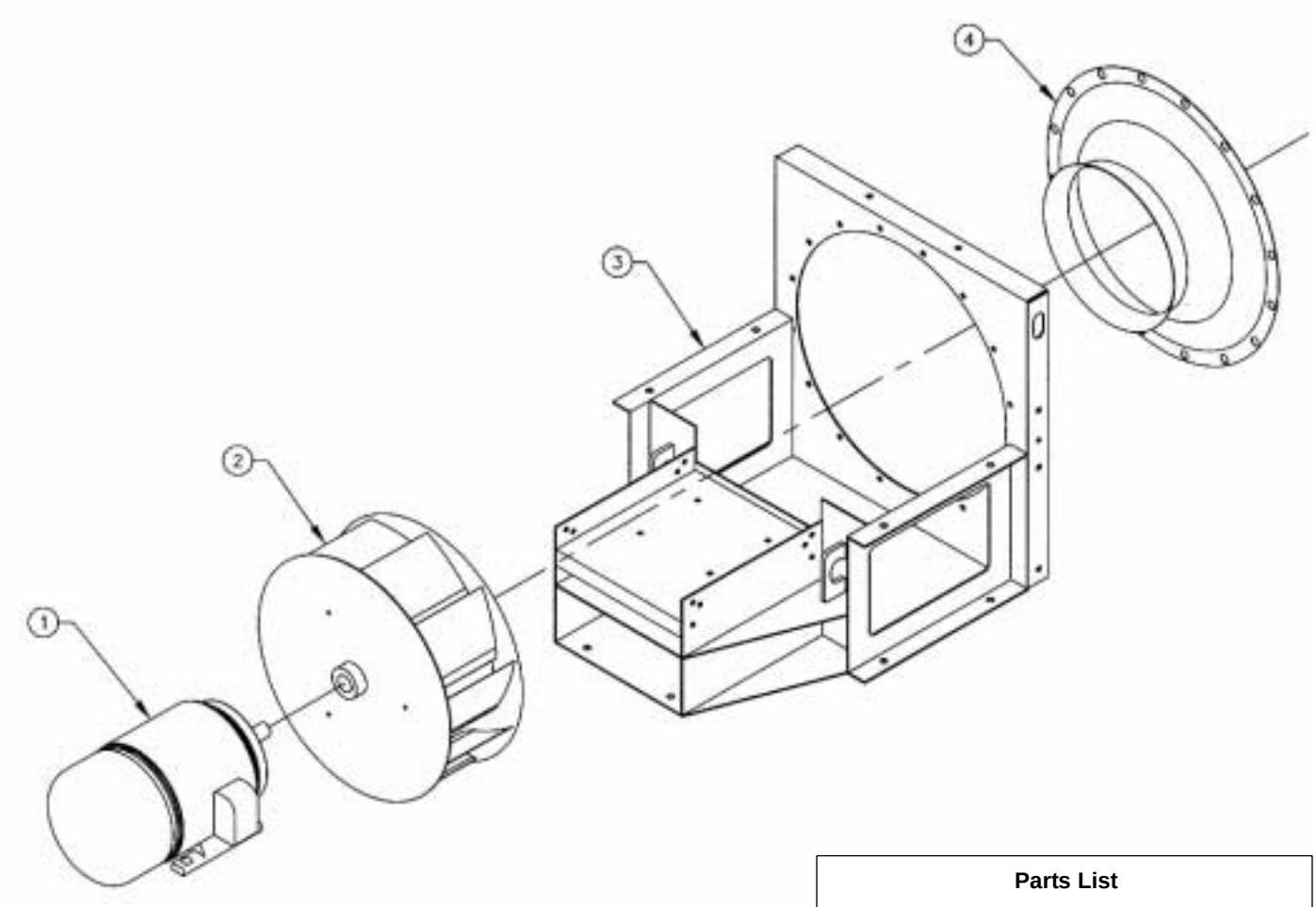


Parts List

1. Base Mounting Panel
2. Motor Platform
3. Motor
4. Shaft
5. Wheel
6. Inlet Cone
7. Inlet Side Bearing Support
8. Inlet Side Bearing
9. Drive Side Bearing Support
10. Drive Side Bearing
11. Sheaves
12. V-Belts

For assistance in selecting replacement parts, contact your local **nyb** representative or visit: http://www.nyb.com.

ARRANGEMENT 4
PLENUM FAN



Parts List

1. Motor
2. Wheel
3. Base Mounting Panel
4. Inlet Cone

Suggested spare parts include:

Wheel	Component Parts:
Shaft	Motor
Bearings	Sheaves
Shaft Seal	V-Belts
Shaft Cooler	

For assistance in selecting replacement parts, contact your local **nyb** representative or visit: http://www.nyb.com.

BALDOR®

Integral Horsepower
AC Induction Motors
ODP, WPI, WPII Enclosure
TEFC Enclosure
Explosion Proof

Installation & Operating Manual

8/05 **MN400**

Table of Contents

Section 1
General Information

Overview This manual contains general procedures that apply to Baldor Motor products. Be sure to read and understand the Safety Notice statements in this manual. For your protection, do not install, operate or attempt to perform maintenance procedures until you understand the Warning and Caution statements. A Warning statement indicates a possible unsafe condition that can cause harm to personnel. A Caution statement indicates a condition that can cause damage to equipment.

Important: **This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by Baldor. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your Baldor distributor for more information or clarification.**

Before you install, operate or perform maintenance, become familiar with the following:

- NEMA Publication MG-2, Safety Standard for Construction and guide for Selection, Installation and Use of Electric Motors and Generators.
- The National Electrical Code
- Local codes and Practices

Limited Warranty

1. Most Baldor products are warranted for 18 months from the date of shipment to Baldor's customer from Baldor's district warehouse or, if applicable, from Baldor's factory. Baldor Standard−E® standard efficient motors are warranted for 24 months. Standard−E is limited to three phase, general purpose, 1−200 HP ratings that fall under the Energy Policy Act (EPAct). Baldor Super−E® premium efficient motors are warranted for 36 months. Baldor IEEE841 motors are warranted for 60 months. All warranty claims must be submitted to a Baldor Service Center prior to the expiration of the warranty period.
2. Baldor will, at its option repair or replace a motor which fails due to defects in material or workmanship during the warranty period if:
   a. the purchaser presents the defective motor at or ships it prepaid to, the Baldor plant in Fort Smith, Arkansas or one of the Baldor Authorized Service Centers and
   b. the purchaser gives written notification concerning the motor and the claimed defect including the date purchased, the task performed by the Baldor motor and the problem encountered.
3. Baldor will not pay the cost of removal of any electric motor from any equipment, the cost of delivery to Fort Smith, Arkansas or a Baldor Authorized Service Center, or the cost of any incidental or consequential damages resulting from the claimed defects. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you.) Any implied warranty given by laws shall be limited to the duration of the warranty period hereunder. (Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.)
4. Baldor Authorized Service Centers, when convinced to their satisfaction that a Baldor motor developed defects in material or workmanship within the warranty period, are authorized to proceed with the required repairs to fulfill Baldor's warranty when the cost of such repairs to be paid by Baldor does not exceed Baldor's warranty repair allowance. Baldor will not pay overtime premium repair charges without prior written authorization.
5. The cost of warranty repairs made by centers other than Baldor Authorized Service Centers **WILL NOT** be paid unless first authorized in writing by Baldor.
6. Claims by a purchaser that a motor is defective even when a failure results within one hour after being placed into service are not always justified. Therefore, Baldor Authorized Service Centers must determine from the condition of the motor as delivered to the center whether or not the motor is defective. If in the opinion of a Baldor Authorized Service Center, a motor did not fail as a result of defects in material or workmanship, the center is to proceed with repairs only if the purchaser agrees to pay for such repairs. If the decision is in dispute, the purchaser should still pay for the repairs and submit the paid invoice and the Authorized Service Center's signed service report to Baldor for further consideration.
7. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Safety Notice:

This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment.

Be sure that you are completely familiar with NEMA publication MG-2, safety standards for construction and guide for selection, installation and use of electric motors and generators, the National Electrical Code and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of 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. National Electrical Code and Local codes must be carefully followed.

WARNING: Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices to reduce harmful effects to your hearing.

WARNING: This equipment may be connected to other machinery that has rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt to install operate or maintain this equipment.

WARNING: Do not by-pass or disable protective devices or safety guards. Safety features are designed to prevent damage to personnel or equipment. These devices can only provide protection if they remain operative.

WARNING: Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment.

WARNING: Be sure the load is properly coupled to the motor shaft before applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if the load decouples from the shaft during operation.

WARNING: Use proper care and procedures that are safe during handling, lifting, installing, operating and maintaining operations. Improper methods may cause muscle strain or other harm.

WARNING: Before performing any motor maintenance procedure, be sure that the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from the motor shaft before maintenance is performed. Unexpected mechanical rotation of the motor parts can cause injury or motor damage.

WARNING: Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.

WARNING: Do not use non UL/CSA listed explosion proof motors in the presence of flammable or combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof operation.

Safety Notice Continued

WARNING: **Motors that are to be used in flammable and/or explosive atmospheres must display the UL label on the nameplate along with CSA listed logo.**

Specific service conditions for these motors are defined in NFPA 70 (NEC) Article 500.

WARNING: **UL rated motors must only be serviced by authorized Baldor Service Centers if these motors are to be returned to a flammable and/or explosive atmosphere.**

Caution: **To prevent premature equipment failure or damage, only qualified maintenance personnel should perform maintenance.**

Caution: **Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load from the motor shaft before moving the motor.**

Caution: **If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.**

Caution: **To prevent equipment damage, be sure that the electrical service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.**

Caution: **If a HI POT test (High Potential Insulation test) must be performed, follow the precautions and procedure in NEMA MG-1 and MG-2 standards to avoid equipment damage.**

If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your Baldor distributor or an Authorized Baldor Service Center.

Receiving

Each Baldor Electric Motor is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.
2. Verify that the part number of the motor you received is the same as the part number listed on your purchase order.

Storage

If the motor is not put into service immediately, the motor must be stored in a clean, dry and warm location. Several precautionary steps must be performed to avoid motor damage during storage.

1. Use a “Megger” periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
2. Do not lubricate bearings during storage. Motor bearings are packed with grease at the factory. Excessive grease can damage insulation quality.
3. Rotate motor shaft at least 10 turns every two months during storage (more frequently if possible). This will prevent bearing damage due to storage.
4. If the storage location is damp or humid, the motor windings must be protected from moisture. This can be done by applying power to the motors’ space heater (if available) while the motor is in storage.

Unpacking

Each Baldor motor is packaged for ease of handling and to prevent entry of contaminants.

1. To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
2. When the motor has reached room temperature, remove all protective wrapping material from the motor.

Handling

The motor should be lifted using the lifting lugs or eye bolts provided.

1. Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft or the hood of a WPII motor.
2. When lifting a WPII (weatherproof Type 2) motor, do not lift the motor by inserting lifting lugs into holes on top of the cooling hood. These lugs are to be used for hood removal only. A spreader bar should be used to lift the motor by the cast lifting lugs located on the motor frame.
3. If the motor must be mounted to a plate with the driven equipment such as pump, compressor etc., it may not be possible to lift the motor alone. For this case, the assembly should be lifted by a sling around the mounting base. The entire assembly can be lifted as an assembly for installation. Do not lift using the motor lugs or eye bolts provided.

   If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting.

Section 2
Installation & Operation

Overview

Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent future accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.

Location

It is important that motors be installed in locations that are compatible with motor enclosure and ambient conditions. Improper selection of the motor enclosure and ambient conditions can lead to reduced operating life of the motor.

Proper ventilation for the motor must be provided. Obstructed airflow can lead to reduction of motor life.

1. **Open Drip−proof/WPI** motors are intended for use indoors where atmosphere is relatively clean, dry, well ventilated and non−corrosive.
2. **Totally Enclosed and WPII** motors may be installed where dirt, moisture or dust are present and in outdoor locations.

Chemical Duty enclosed motors are designed for installations with high corrosion or excessive moisture conditions. These motors should not be placed into an environment where there is the presence of flammable or combustible vapors, dust or any combustible material, unless specifically designed for this type of service.

Mounting

The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Foundation caps and sole plates are designed to act as spacers for the equipment they support. If these devices are used, be sure that they are evenly supported by the foundation or mounting surface.

After installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

The standard motor base is designed for horizontal or vertical mounting. Adjustable or sliding rails are designed for horizontal mounting only. Consult your Baldor distributor or authorized Baldor Service Center for further information.

Alignment

Accurate alignment of the motor with the driven equipment is extremely important.

1. **Direct Coupling**
   For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.
2. **End-Play Adjustment**
   The axial position of the motor frame with respect to its load is also extremely important. The motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.
3. **Pulley Ratio**
   The pulley ratio should not exceed 8:1.
4. **Belt Drive**
   Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting.

Caution: Do not over tension belts.

5. Sleeve bearing motors are only suitable for coupled loads.

Doweling & Bolting

After proper alignment is verified, dowel pins should be inserted through the motor feet into the foundation. This will maintain the correct motor position should motor removal be required. (Baldor motors are designed for doweling.)

1. Drill dowel holes in diagonally opposite motor feet in the locations provided.
2. Drill corresponding holes in the foundation.
3. Ream all holes.
4. Install proper fitting dowels.
5. Mounting bolts must be carefully tightened to prevent changes in alignment. Use a flat washer and lock washer under each nut or bolt head to hold the motor feet secure. Flanged nuts or bolts may be used as an alternative to washers.

Power Connection

Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices.

Conduit Box

For ease of making connections, an oversize conduit box is provided. The box can be rotated 360° in 90° increments. Auxiliary conduit boxes are provided on some motors for accessories such as space heaters, RTD's etc.

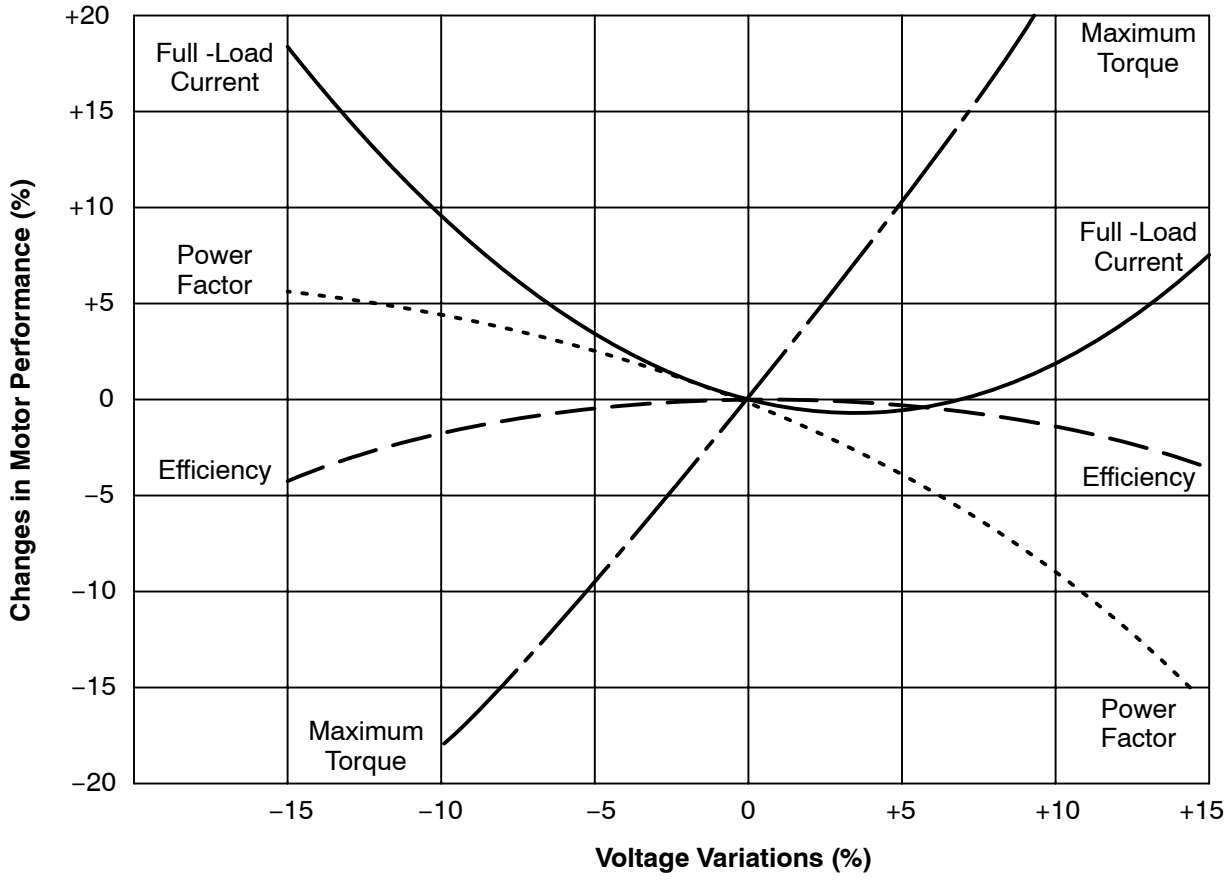
AC Power

Connect the motor leads as shown on the connection diagram located on the name plate or inside the cover on the conduit box. Be sure the following guidelines are met:

1. AC power is within ±10% of rated voltage with rated frequency. (See motor name plate for ratings).
   OR
2. AC power is within ±5% of rated frequency with rated voltage.
   OR
3. A combined variation in voltage and frequency of ±10% (sum of absolute values) of rated values, provided the frequency variation does not exceed ±5% of rated frequency.

Performance within these voltage and frequency variations are shown in Figure 2-1.

Figure 2-1 Typical Motor Performance VS Voltage Variations



First Time Start Up

Be sure that all power to motor and accessories is off. Be sure the motor shaft is disconnected from the load and will not cause mechanical rotation of the motor shaft.

1. Make sure that the mechanical installation is secure. All bolts and nuts are tightened etc.
2. If motor has been in storage or idle for some time, check winding insulation integrity with a Megger.
3. Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity.
4. Be sure all shipping materials and braces (if used) are removed from motor shaft.
5. Manually rotate the motor shaft to ensure that it rotates freely.
6. Replace all panels and covers that were removed during installation.
7. Momentarily apply power and check the direction of rotation of the motor shaft.
8. If motor rotation is wrong, be sure power is off and change the motor lead connections. Verify rotation direction before you continue.
9. Start the motor and ensure operation is smooth without excessive vibration or noise. If so, run the motor for 1 hour with no load connected.
10. After 1 hour of operation, disconnect power and connect the load to the motor shaft. Verify all coupling guards and protective devices are installed. Ensure motor is properly ventilated.

Coupled Start Up

This procedure assumes a coupled start up. Also, that the first time start up procedure was successful.

1. Check the coupling and ensure that all guards and protective devices are installed.
2. Check that the coupling is properly aligned and not binding.
3. The first coupled start up should be with no load. Apply power and verify that the load is not transmitting excessive vibration back to the motor though the coupling or the foundation. Vibration should be at an acceptable level.
4. Run for approximately 1 hour with the driven equipment in an unloaded condition.

The equipment can now be loaded and operated within specified limits. Do not exceed the name plate ratings for amperes for steady continuous loads.

Jogging and Repeated Starts

Repeated starts and/or jogs of induction motors generally reduce the life of the motor winding insulation. A much greater amount of heat is produced by each acceleration or jog than by the same motor under full load. If it is necessary to repeatedly start or jog the motor, it is advisable to check the application with your local Baldor distributor or Baldor Service Center.

Heating - Duty rating and maximum ambient temperature are stated on the motor name plate. Do not exceed these values. If there is any question regarding safe operation, contact your local Baldor distributor or Baldor Service Center.

Section 3
Maintenance & Troubleshooting

WARNING: UL rated motors must only be serviced by authorized Baldor Service Centers if these motors are to be returned to a flammable and/or explosive atmosphere.

General Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use a “Megger” periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Lubrication & Bearings

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

Type of Grease

A high grade ball or roller bearing grease should be used. Recommended grease for standard service conditions is Polyrex EM (Exxon Mobil).

Equivalent and compatible greases include:
Texaco Polystar, Rykon Premium #2, Pennzoil Pen 2 Lube and Chevron SRI.

– Maximum operating temperature for standard motors = 110° C.
– Shut–down temperature in case of a malfunction = 115° C.

Lubrication Intervals

Recommended lubrication intervals are shown in Table 3-1. It is important to realize that the recommended intervals of Table 3-1 are based on average use.

Refer to additional information contained in Tables 3-2 and 3-3.

Table 3-1 Lubrication Intervals *

NEMA / (IEC) Frame Size	Rated Speed - RPM					
	10000	6000	3600	1800	1200	900
Up to 210 incl. (132)	**	2700 Hrs.	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)		**	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)			* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 5800 incl. (300)			*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

* Lubrication intervals are for ball bearings. For vertically mounted motors and roller bearings, divide the lubrication interval by 2.

** For motors operating in this speed range, contact Baldor for lubrication recommendations based on specific motor and application.

Table 3-2 Service Conditions

Severity of Service	Hours per day of Operation	Ambient Temperature Maximum	Atmospheric Contamination
Standard	8	40° C	Clean, Little Corrosion
Severe	16 Plus	50° C	Moderate dirt, Corrosion
Extreme	16 Plus	>50° C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion, Heavy Shock or Vibration
Low Temperature		<–30° C **	

* Special high temperature grease is recommended (Dow Corning DC44). Note that Dow Corning DC44 grease does not mix with other grease types. Thoroughly clean bearing & cavity before adding grease.

** Special low temperature grease is recommended (Aeroshell 7).

Table 3-3 Lubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Table 3-4 Bearings Sizes and Types

Frame Size NEMA (IEC)	Bearing Description (These are the "Large" bearings (Shaft End) in each frame size)					
	Bearing	OD D mm	Width B mm	Weight of Grease to add * oz (Grams)	Volume of grease to be added	
					in^3	tea-spoon
56 to 180 incl. (63 to 112)	6206	62	16	0.19 (5.0)	0.3	1.0
210 incl. (132)	6307	80	21	0.30 (8.4)	0.6	2.0
Over 210 to 280 incl. (180)	6311	120	29	0.61 (17)	1.2	3.9
Over 280 to 360 incl. (225)	6313	140	33	0.81 (23)	1.5	5.2
Over 360 to 449 incl. (280)	6319	200	45	2.12 (60)	4.1	13.4
Over 5000 to 5800 incl. (355)	6328	300	62	4.70 (130)	9.2	30.0
Over 360 to 449 incl. (280)	NU319	200	45	2.12 (60)	4.1	13.4
Over 5000 to 5800 incl. (355)	NU328	300	62	4.70 (130)	9.2	30.0
Spindle Motors						
76 Frame	6207	72	17	0.22 (6.1)	0.44	1.4
77 Frame	6210	90	20	0.32 (9.0)	0.64	2.1
80 Frame	6213	120	23	0.49 (14.0)	0.99	3.3

* Weight in grams = .005 DB

Note: Not all bearing sizes are listed. For intermediate bearing sizes, use the grease volume for the next larger size bearing.

Lubrication Procedure

Be sure that the grease you are adding to the motor is compatible with the grease already in the motor. Consult your Baldor distributor or an authorized service center if a grease other than the recommended type is to be used.

Caution: To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact your Baldor distributor or an authorized Baldor Service Center for additional information.

With Grease Outlet Plug

1. With the motor stopped, clean all grease fittings.
2. Remove grease outlet plug.

Caution: Overgreasing can cause excessive bearing temperatures, premature lubrication breakdown and bearing failure.

3. Add the recommended amount of grease.
4. Operate the motor for 15 minutes with grease plug removed. This allows excess grease to purge.
5. Re-install grease outlet plug.

Without Grease Provisions

Note: Only a Baldor authorized and UL or CSA certified service center can disassemble a UL/CSA listed explosion proof motor to maintain it's UL/CSA listing.

1. Disassemble the motor.
2. Add recommended amount of grease to bearing and bearing cavity. (Bearing should be about 1/3 full of grease and outboard bearing cavity should be about 1/2 full of grease.)
3. Assemble the motor.

Sample Lubrication Determination

Assume - NEMA 286T (IEC 180), 1750 RPM motor driving an exhaust fan in an ambient temperature of 43° C and the atmosphere is moderately corrosive.

1. Table 3-1 list 9500 hours for standard conditions.
2. Table 3-2 classifies severity of service as "Severe".
3. Table 3-3 lists a multiplier value of 0.5 for Severe conditions.
4. Table 3-4 shows that 1.2 in^3 or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.

Accessories

The following is a partial list of accessories available from Baldor.
Contact your Baldor distributor for availability and pricing information.

Note: Space heaters and RTD's are standard on some motors.

Bearing RTD
RTD (Resistance Temperature Detector) devices are used to measure or monitor the temperature of the motor bearing during operation.

Bearing Thermocouples
Used to measure or monitor bearing temperatures.

Bearing Thermostat
Temperature device that activates when bearing temperatures are excessive. Used with an external circuit to warn of excessive bearing temperature or to shut down a motor.

Conduit Boxes
Optional conduit boxes are available in various sizes to accommodate accessory devices.

Cord & Plug Assembly
Adds a line cord and plug for portable applications.

Drains and Breathers
Stainless steel drains with separate breathers are available.

Drip Covers
Designed for use when motor is mounted in a vertical position. Contact your Baldor distributor to confirm that the motor is designed for vertical mounting.

Fan Cover & Lint Screen
To prevent build-up of debris on the cooling fan.

Nameplate
Additional stainless steel nameplates are available.

Roller Bearings
Recommended for belt drive applications with a speed of 1800 RPM or less.

Rotation Arrow Labels
Rotation arrows are supplied on motors designed to operate in one direction only. Additional rotation arrows are available.

Space Heater
Added to prevent condensation of moisture within the motor enclosure during periods of shut down or storage.

Stainless Hardware
Stainless steel hardware is available. Standard hardware is corrosion resistant zinc plated steel.

Winding RTD
RTD (Resistance Temperature Detector) devices are used to measure or monitor the temperature of the motor winding during operation.

Winding Thermocouples
Used to measure or monitor winding temperatures.

Winding Thermostat
Temperature device that activates when winding temperatures are excessive. Used with an external circuit to warn of excessive winding temperature or to shut down a motor.

Note: On some motors, leads for accessory devices are brought out to a separate conduit box located on the side of the motor housing (unless otherwise specified).

Table 3-5 Troubleshooting Chart

Symptom	Possible Causes	Possible Solutions
Motor will not start	Usually caused by line trouble, such as, single phasing at the starter.	Check source of power. Check overloads, fuses, controls, etc.
Excessive humming	High Voltage.	Check input line connections.
	Eccentric air gap.	Have motor serviced at local Baldor service center.
Motor Over Heating	Overload. Compare actual amps (measured) with nameplate rating.	Locate and remove source of excessive friction in motor or load. Reduce load or replace with motor of greater capacity.
	Single Phasing.	Check current at all phases (should be approximately equal) to isolate and correct the problem.
	Improper ventilation.	Check external cooling fan to be sure air is moving properly across cooling fins. Excessive dirt build-up on motor. Clean motor.
	Unbalanced voltage.	Check voltage at all phases (should be approximately equal) to isolate and correct the problem.
	Rotor rubbing on stator.	Check air gap clearance and bearings.
		Tighten “Thru Bolts”.
	Over voltage or under voltage.	Check input voltage at each phase to motor.
	Open stator winding.	Check stator resistance at all three phases for balance.
	Grounded winding.	Perform dielectric test and repair as required.
	Improper connections.	Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity. Refer to motor lead connection diagram.
Bearing Over Heating	Misalignment.	Check and align motor and driven equipment.
	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Reduce the end thrust from driven machine.
	Excessive grease in bearing.	Remove grease until cavity is approximately $^3/_4$ filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately $^3/_4$ filled.
	Dirt in bearing.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately $^3/_4$ filled.
Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Rotor out of balance.	Have rotor balance checked are repaired at your Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for assistance.
Noise	Foreign material in air gap or ventilation openings.	Remove rotor and foreign material. Reinstall rotor. Check insulation integrity. Clean ventilation openings.
Growling or whining	Bad bearing.	Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately $^3/_4$ filled.

Suggested bearing and winding RTD setting guidelines

Most large frame AC Baldor motors with a 1.15 service factor are designed to operate below a Class B (80°C) temperature rise at rated load and are built with a Class H winding insulation system. Based on this low temperature rise, RTD (Resistance Temperature Detectors) settings for Class B rise should be used as a starting point. Some motors with 1.0 service factor have Class F temperature rise.

The following tables show the suggested alarm and trip settings for RTDs. Proper bearing and winding RTD alarm and trip settings should be selected based on these tables unless otherwise specified for specific applications.

If the driven load is found to operate well below the initial temperature settings under normal conditions, the alarm and trip settings may be reduced so that an abnormal machine load will be identified.

The temperature limits are based on the installation of the winding RTDs imbedded in the winding as specified by NEMA. Bearing RTDs should be installed so they are in contact with the outer race on ball or roller bearings or in direct contact with the sleeve bearing shell.

Winding RTDs – Temperature Limit In °C (40°C Maximum Ambient)

Motor Load	Class B Temp Rise ≤ 80°C (Typical Design)		Class F Temp Rise ≤ 105°C		Class H Temp Rise ≤ 125°C	
	Alarm	Trip	Alarm	Trip	Alarm	Trip
≤ Rated Load	130	140	155	165	175	185
Rated Load to 1.15 S.F.	140	150	160	165	180	185

Note: • Winding RTDs are factory production installed, not from Mod–Express.
• When Class H temperatures are used, consider bearing temperatures and lubrication requirements.

Bearing RTDs – Temperature Limit In OC with 40°C Max Ambient

Bearing Type Oil or Grease	Anti–Friction		Sleeve	
	Alarm	Trip	Alarm	Trip
Standard*	95	100	85	95
High Temperature**	110	115	105	110

Note: * Bearing temperature limits are for standard design motors operating at Class B temperature rise.
** High temperature lubricants include some special synthetic oils and greases.

Greases that may be substituted that are compatible with Polyrex EM (but considered as “standard” lubricants) include the following:
– Texaco Polystar
– Rykon Premium #2
– Chevron SRI #2

See the motor nameplate for replacement grease or oil recommendation. Contact Baldor application engineering for special lubricants or further clarifications.

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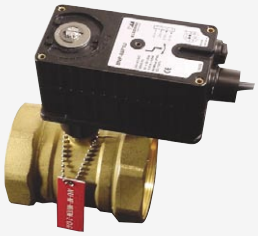
EloFlow™ Valve Selection and Technical Information



Overview

There are two main issues to consider before a valve can be set up correctly in the field. They are normal position with regard to the control signal, and fail-safe position. A fail-safe actuator will go to a safety or default position if power is removed at any time.

Normal Positioning

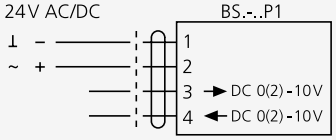
Normal Positioning is the position of a control valve, open or closed, with regard to ports A and AB, when its control signal is at the beginning of its capable range. This is to say the control valve is at its starting point and has not been called on to move by the controller. This position is always referred to as its normal position, commonly referred to as N.O. (normally open), and N.C. (normally closed). Often, normal position is mistaken for a control valve's fail-safe position. Control and fail-safe are actually two separate conditions used in setting up a valve. Below are three popular control methods used in valve applications.

Proportional Control Valve

A typical control valve signal range used in proportional control is 0–10 VDC. Depending on your controller output signal, the range can start with 0 VDC and increase to 10 VDC, or it can start at 10 VDC and decrease to 0 VDC. The starting position of a control valve can be either 0 VDC or 10 VDC, and its corresponding normal starting position can be N.O. or N.C. Our proportional actuators are equipped with a selectable switch that allows you to change the direction of the drive rotation as well as the control signal range. We offer 0–10 VDC and 2–10 VDC with a CW or CCW drive direction.

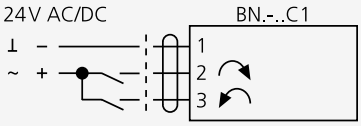
Direct Acting Control: You can have a direct acting control valve set up with a 0 –10 VDC control range which is N.C. (normally closed). Since the valve's normal control position is closed, the valve is fully closed at 0 VDC (its referenced starting point). The control valve will begin to open as the control signal increases, and will continue to open in direct proportion to the signal. The greater the signal voltage the more the valve will open. This is known as *direct acting control* with regard to the valve's position versus control signal.

Reverse Acting Control Valve: You can also have a reverse acting control valve set up with a 10–0 VDC control range which is N.C. (normally closed). Since the valve's normal control position is closed, it is fully closed at 10 VDC (its referenced starting point). The control valve will begin to open as the control signal decreases, and will continue to open in reverse proportion to the signal. The lower the control signal voltage, the more the valve will open. This is known as *reverse acting control* with regard to the valve's position versus control signal. Some other standard proportional control type signals are 2–10 VDC and 4–20mA. Please note that both of these examples can be found in Table 1 on page 17 of this document. You can set up either of the control valves in these examples as fail-safe open (F.O.) or fail-safe closed (F.C.).



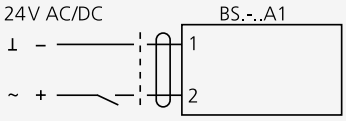
Floating Point Control Valve

Floating point control is also known as three-point control, and refers to using the same 24 VAC/DC to control the actuator that is used to power it. In floating-point control, the 24 volt signal is switched to either one of two terminals that drives the actuator CW or CCW, resulting in greater or lesser flow through the valve. The floating-point control signal is not an increasing or decreasing signal, but is a steady signal (24 VAC/DC) that is applied only long enough to achieve the desired flow position. Once the signal is removed, the actuator holds its position until it is called on to move again. A floating-point control valve can also be N.O. or N.C., and as before, refers to its starting, or normal position.



On/Off Control Valve

On/off control is also known as two-position control. Valves using this type of control can be either open or closed. There is no in-between or mid position as in proportional and floating-point control. On/off control valves can be set up as N.O. or N.C., which refers to its starting or normal position before power is applied.



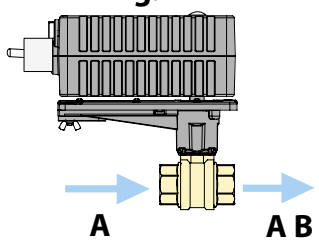
Please Note that all Elodrive USA control valve assemblies will be set up in the default positions shown in Table 2 below. We will be happy to set up your control valves to meet your specific requirements. Please use Table 1 on page 17 to review the available set up options.

Table 2

Default Factory Set Ups			
Fail Safe Valve Default Set-ups		**Non-Fail Safe Valve Default Set-ups**	
Proportional and Floating Valves	On / Off	Proportional and Floating Valves	On / Off
FO/ NCD	**FO / NOR**	**NC**	**NC**
(A to AB) Fail to Open/ Normally Closed / Increased signal gives an increase in flow	(A to AB) Fail to Open/ Normally Open / Applied signal gives a decrease in flow	(A to AB) Normally Closed / Increased signal gives an increase in flow	(A to AB) Normally Closed / Applied signal gives an increase in flow
All Elodrive USA valves will be shipped in the above default positions unless otherwise noted at the time your order is received. Optional valve set ups are available in table #1			

Fail-safe Set-up of a Control Valve

Fig. A



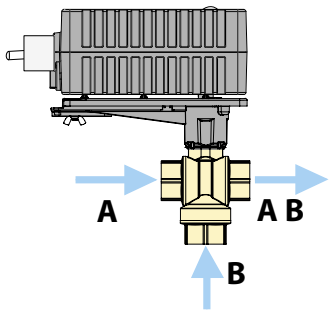
Please Note: The port designations A and AB are not marked on the valve body. They are used as a reference for flow direction only. With a 2-way valve, port A is the flow entrance port and port AB is the flow exit port.

Fail-safe Position, 2-way Valve

Which position do you want the valve to take when a power failure occurs? On a two-way valve, as shown in Fig. A, the valve can go to **fail open** (F.O. = flow A to AB) or it can go **fail closed** (F.C. = no flow A to AB).

Note: Fail-safe position is commonly set up by using port A to AB as the reference ports, and will be used as such in this document going forward.

Fig. B



Mixing valve ports A and B are entrance ports. AB is a common exit port.

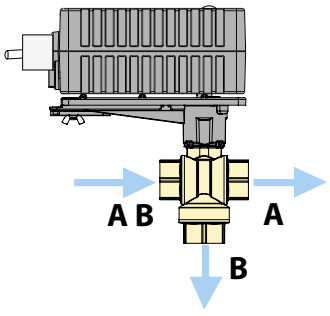
Mixing configuration = 2 inputs (A & B) and 1 common output (AB)

Fail-safe Position, 3-way Mixing Valve

Which position do you want the mixing valve to take when a power failure occurs? On a 3-way valve as shown in Fig. B, if power fails, the valve can go to **fail open**, (F.O. = flow A to AB) or it can go **fail closed** (F.C. = no flow A to AB). On a 3-way valve, however, this also affects flow from (B to AB) in a Mixing configuration.

Note: Please reference (A to AB) as fail-safe ports and your positioning preference when ordering 3-way mixing valves.

Fig. C



Diverting valve ports A and B are exit ports. AB is a common entrance port.

Diverting configuration = 1 common input (AB) and 2 common outputs (A & B)

Fail-safe Position, 3-way Diverting Valve

Which position do you want the diverting valve to take when a power failure occurs? On a 3-way valve as shown in Fig. C, if power fails, the valve can go to **fail open** (F.O.= flow AB to A) or it can go **fail closed** (F.C.= no flow AB to A). On a 3-way valve, however, this also affects flow from (AB to B) in a Diverting configuration.

Note: Please reference (AB to A) as fail-safe ports and your positioning preference when ordering 3-way **diverting** *valves.*

Setting Up the Proportional Actuator – What The Label Tells You

ELODRIVE

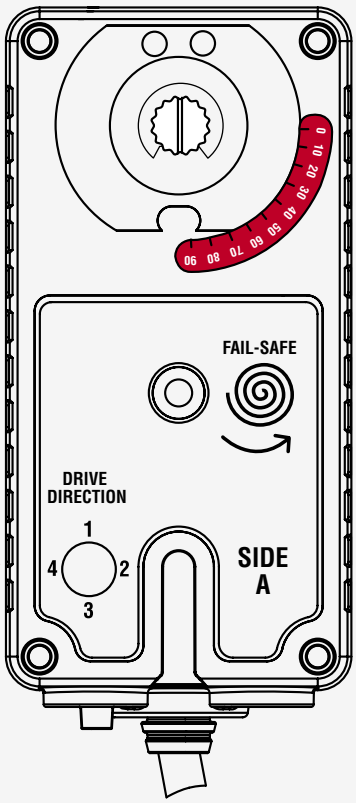
Drive direction selectable switch is used to set the control signal range as well as the actuator drive direction.

Drive Direction	Rotation
1 = CW 2-10VDC	0-90°
2 = CW 0-10VDC	0-90°
3 = CCW 2-10VDC	90-0°
4 = CCW 0-10VDC	90-0°

Control Range Options

Switch position 2 & 4 for 0-10VDC

Switch position 1 & 3 for 2-10VDC

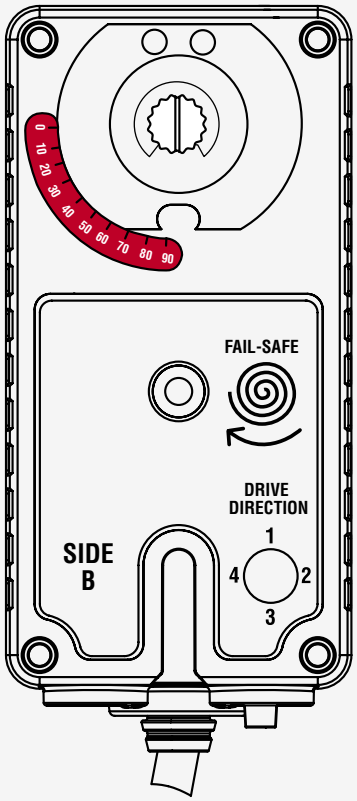


On the **A** side of the actuator the rotation scale is on the right (shown here in red).

Always mount actuator **A** side up when valve is F.O.

On the **B** side of the actuator the rotation scale is on the left (shown here in red).

Always mount actuator **B** side up when valve is F.C.



Drive direction selectable switch is used to set the control signal range as well as the actuator drive direction.

Drive Direction	Rotation
1 = CW 2-10VDC	90-0°
2 = CW 0-10VDC	90-0°
3 = CCW 2-10VDC	0-90°
4 = CCW 0-10VDC	0-90°

Control Range Options

Switch position 2 & 4 for 0-10VDC

Switch position 1 & 3 for 2-10VDC

3-Way Flow Rates

ELODRIVE

1 These valves are full port and do not have the linearizing insert.
2 Close-Off Pressures measured with 35 in-lb. actuator. The "Close Off Pressure" is the maximum allowable pressure drop across the valve body when the valve is fully closed.
3 C_v is defined as the quantity of water in GPM at 60°F that will flow through a given valve with a pressure drop of 1PSI. Hence the 1.0 PSI pressure differential column in the table below is equivalent to the C_v value.

LINE SIZE	MODEL NO.	FULL[1] PORT	CLOSE OFFΔP[2]	FLOWRATE (GPM) @ DIFFERENTIAL PRESSURE (PSI)											
				2-Position HVAC Apps		HVAC Modulating Apps									
				C_v[3]											
				0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	7.0	10.0
1/2"	BV3WBR .5-1		50 PSI	0.2	0.33	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.9	1.0
	BV3WBR .5-2			0.4	0.59	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.3	1.6	1.9
	BV3WBR .5-3			0.7	1.0	1.2	1.4	1.6	1.7	1.9	2.0	2.1	2.2	2.6	3.2
	BV3WBR .5-4			1.7	2.4	2.9	3.4	3.8	4.2	4.5	4.8	5.1	5.4	6.3	7.6
	BV3WBR .5-5			3.0	4.3	5.3	6.1	6.8	7.4	8.0	8.6	9.1	9.6	11.4	13.6
	BV3WBR .5-6			5.7	8.0	9.8	11.3	12.6	13.9	15.0	16.0	17.0	17.9	21.2	25.3
3/4"	BV3WBR .75-1		50 PSI	0.3	0.40	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.1	1.3
	BV3WBR .75-2			0.5	0.66	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.7	2.1
	BV3WBR .75-3			0.9	1.3	1.6	1.8	2.1	2.3	2.4	2.6	2.8	2.9	3.4	4.1
	BV3WBR .75-4			1.7	2.4	2.9	3.4	3.8	4.2	4.5	4.8	5.1	5.4	6.3	7.6
	BV3WBR .75-5			2.7	3.8	4.7	5.4	6.0	6.6	7.1	7.6	8.1	8.5	10.1	12.0
	BV3WBR .75-6	●		7.8	11.0	13.5	15.6	17.4	19.1	20.6	22.0	23.3	24.6	29.1	34.8
1"	BV3WBR 1-1		50 PSI	0.3	0.40	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.1	1.3
	BV3WBR 1-2			0.5	0.65	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.7	2.1
	BV3WBR 1-3			0.9	1.3	1.6	1.8	2.1	2.3	2.4	2.6	2.8	2.9	3.4	4.1
	BV3WBR 1-4			1.6	2.3	2.8	3.3	3.6	4.0	4.3	4.6	4.9	5.1	6.1	7.3
	BV3WBR 1-5			2.5	3.5	4.3	4.9	5.5	6.1	6.5	7.0	7.4	7.8	9.3	11.1
	BV3WBR 1-6			7.1	10.0	12.2	14.1	15.8	17.3	18.7	20.0	21.2	22.4	26.5	31.6
	BV3WBR 1-7			6.1	8.6	10.5	12.1	13.6	14.9	16.1	17.2	18.2	19.2	22.7	27.2
	BV3WBR 1-8			15.8	22.3	27.3	31.5	35.3	38.6	41.7	44.6	47.3	49.9	59.0	70.5
	BV3WBR 1-9			10.5	14.9	18.2	21.1	23.6	25.8	27.9	29.8	31.6	33.3	39.4	47.1
	BV3WBR 1-10			3.2	4.5	5.5	6.4	7.1	7.8	8.4	9.0	9.5	10.1	11.9	14.2
	BV3WBR 1-11			21.8	30.8	37.7	43.6	48.7	53.3	57.6	61.6	65.3	68.9	81.5	97.4
1-1/4"	BV3WBR 1.25-1	●	40 PSI	13.7	19.4	23.8	27.4	30.7	33.6	36.3	38.8	41.2	43.4	51.3	61.3
	BV3WBR 1.25-2			9.0	12.7	15.6	18.0	20.1	22.0	23.8	25.4	26.9	28.4	33.6	40.2
	BV3WBR 1.25-3			2.9	4.1	5.0	5.7	6.4	7.0	7.6	8.1	8.6	9.1	10.7	12.8
	BV3WBR 1.25-4			6.1	8.7	10.6	12.3	13.7	15.0	16.2	17.3	18.4	19.4	22.9	27.4
	BV3WBR 1.25-5	●		24.1	34.1	41.8	48.2	53.9	59.1	63.8	68.2	72.3	76.2	90.2	107.8
	BV3WBR 1.25-6			19.0	26.8	32.8	37.9	42.4	46.4	50.1	53.6	56.9	59.9	70.9	84.7
1-1/2"	BV3WBR 1.5-1		40 PSI	9.5	13.4	16.4	18.9	21.1	23.2	25.0	26.7	28.4	29.9	35.4	42.3
	BV3WBR 1.5-2			2.8	4.0	4.9	5.7	6.4	7.0	7.5	8.1	8.5	9.0	10.7	12.7
	BV3WBR 1.5-3			5.8	8.3	10.1	11.7	13.1	14.3	15.5	16.5	17.5	18.5	21.9	26.1
	BV3WBR 1.5-4	●		22.6	32.0	39.2	45.3	50.6	55.5	59.9	64.0	67.9	71.6	84.7	101.3
	BV3WBR 1.5-5			16.6	23.5	28.8	33.3	37.2	40.8	44.0	47.1	49.9	52.6	62.3	74.4
	BV3WBR 1.5-6			43.2	61.1	74.8	86.4	96.6	105.8	114.3	122.2	129.6	136.6	161.6	193.2
2"	BV3WBR 2-1		40 PSI	16.9	23.9	29.3	33.8	37.8	41.4	44.7	47.8	50.7	53.4	63.2	75.6
	BV3WBR 2-2			40.1	56.7	69.4	80.2	89.7	98.2	106.1	113.4	120.3	126.8	150.0	179.3
	BV3WBR 2-3			27.0	38.2	46.8	54.0	60.4	66.2	71.5	76.4	81.0	85.4	101.1	120.8
	BV3WBR 2-4			76.7	108.5	132.9	153.4	171.6	187.9	203	217	230	243	287	343
	BV3WBR 2-5			58.4	82.6	101.2	116.8	130.6	143.1	154.5	165.2	175.2	184.7	219	261
2-1/2"	BV3WBR 2.5-1		40 PSI	26.9	38.1	46.7	53.9	60.2	66.0	71.3	76.2	80.8	85.2	100.8	120.5
	BV3WBR 2.5-2			52.4	74.1	90.8	104.8	117.2	128.3	138.6	148.2	157.2	165.7	196.1	234
	BV3WBR 2.5-3	●		70.4	99.5	121.9	140.7	157.3	172.3	186.1	199.0	211	223	263	315

3-Way Valve Adjusted C_v Rating for Piping Geometry

ELODRIVE

Valve		Line Size								
Ends	Through C_v	0.5	0.75	1	1.25	1.5	2	2.5	3	4
1/2"	0.33	--	0.3	0.3						
	0.59	--	0.6	0.6						
	1.0	--	1.0	1.0						
	2.4	--	2.3	2.3						
	4.3	--	4.0	3.8	--					
	8.0	--	7.9	5.7	--					
3/4"	0.40	--	--	0.4	0.4	0.4				
	0.66		--	0.66	0.66	0.66				
	1.3		--	1.3	1.3	1.3				
	2.4		--	2.4	2.39	2.38				
	3.8		--	3.8	3.74	3.7				
	11.0		--	10.4	9.78	9.4				
1"	0.40			--	0.40	0.40	0.40	0.40	0.40	
	0.65			--	0.65	0.65	0.65	0.65	0.65	
	1.3			--	1.3	1.3	1.3	1.3	1.3	
	2.3			--	2.3	2.3	2.3	2.3	2.3	
	3.5			--	3.5	3.5	3.5	3.5	3.5	
	4.5			--	4.5	4.5	4.5	4.4	4.4	
	8.6			--	8.5	8.4	8.3	8.2	8.2	
	10.0			--	9.9	9.7	9.6	9.5	9.4	
	14.9			--	14.6	14.1	13.5	13.3	13.1	
	22.3			--	21.2	19.9	18.4	17.7	17.3	
	30.8			--	28.0	25.2	22.3	21.1	20.5	
1-1/4"	4.1				--	4.4	4.4	4.4	4.4	4.4
	7.7				--	8.3	8.2	8.2	8.2	8.1
	8.7				--	14.8	14.5	14.3	14.2	14.0
	12.7				--	35.0	31.5	29.6	28.6	27.6
	19.4				--	39.0	34.3	31.9	30.7	29.4
	34.1				--	79.1	53.3	45.5	42.0	39.0
1-1/2"	4.0					--	4.0	4.0	4.0	4.0
	8.3					--	8.2	8.2	8.2	8.2
	13.4					--	13.3	13.2	13.2	13.1
	23.5					--	23.1	22.7	22.4	22.1
	32.0						31.0	30.0	29.3	28.6
	61.1						54.9	49.7	46.9	44.1
2"	23.9						--	23.8	23.7	23.5
	38.2						--	37.8	37.3	36.62
	56.7						--	55.5	54.0	52.0
	108.5						--	100.7	92.3	83.3

How to Order

It is important for us to know what your project requirements are when ordering valves so they can be properly set up. **Call 866-356-3748 for assistance with your order.**

STEP 1 Choose Valve Model

From Selection Tables pg 8 thru 11

STEP 2 Choose Actuator

From Selection Tables pg 8 thru 11

EXAMPLE

BV 3W BR .5 -1 NPT + B S P- 35 P 1 U

Valve Type
BV = Ball Valve

Configuration
2W= Two-way
3W = Three-way

Trim Material*
BR= Brass
ST = Stainless

Size
.5 = 1/2"inch
1/2"[.5] to 3"[3] available

Indicates C_v rating (GPM at 1 psi ΔP)
(Example: The numbers -1 through -7 represent the seven available standard C_v values offered for 1/2" valves) See selection chart.

Fitting Style*
NPT = Threaded
SWT = Sweat

Actuator Series
B-Housing
A-Housing

Fail-safe Type
N= Non Fail-safe
S = Spring Return Fail-safe

Housing Protection
P = NEMA 4
Blank = NEMA 2
T = Terminals (NEMA 1)

Torque Ranges (in-lb)

Fail-safe	*Non Fail-safe*
35	35
	44

Control Signal
P = Proportional Control 0-10VDC / 2-10VDC
F = Floating Point
A= On/Off
C = Combination Floating Point and On/Off

Power Supply
1 = 24 VAC
2 = 120/230 VAC/DC

Market
U = USA

***Note:** Brass ball and trim and female NPT end connections are standard. For stainless steel ball and trim change BR to ST. For sweat end connections change NPT to SWT at same price.**

ELODRIVE

STEP 3 Configure Control Valve Before Ordering

Note: Add the info below as setup info to the end of the control valve model number

= Nomenclature Summary

Only used for fail-safe, 2-way and 3-way valves and should be omitted for all other set ups.

M F. O. NCD — **BV3WBR.5-1 + BSP-35P1U - MFONCD**

- **M**: D = Diverting, M= Mixing
- **F. O.**: **Fail-safe set-up** F.O.= Fail Open F.C.= Fail Closed
- **NCD**: **Control Set-up** see chart below
- **BV3WBR.5-1**: **Valve Model**
- **BSP-35P1U**: **Actuator**
- **MFONCD**: **Set-Up**

Note: Please specify D or M and F.O. or F.C. and Control Set Up Code from Table 1 below when ordering. This will insure your valves are set up correctly when they are shipped.

Job-Site TAG — Add job-site Product ID (optional) e.g. AHU 1, AHU 2

Table 1

Set up Code	Normal Valve Position	Control Signal vs Fluid Flow	Valve response to Control Signal
Normally Closed Valve with Direct Acting Control			
NCD	If you need a N.C. = Normally Closed (A to AB)[1] valve that reacts like this →	↑ Signal increase = Flow increase ↑	This is direct acting; as the signal increases the flow increases
Normally Open Valve with Direct Acting Control			
NOD	If you need a N.O. = Normally Open (A to AB)[1] valve that reacts like this →	↓ Signal increase = Flow decrease ↓	This is direct acting; as the signal decreases the flow decreases
Normally Closed Valve with Reverse Acting Control			
NCR	If you need a N.C. = Normally Closed (A to AB)[1] valve that reacts like this →	↓ Signal decrease = Flow increase ↑	This is reverse acting; as the signal decreases the flow increases
Normally Open Valve with Reverse Acting Control			
NOR	If you need a N.O. = Normally Open (A to AB)[1] valve that reacts like this →	↑ Signal increase = Flow decrease ↓	This is reverse acting; as the signal increases the flow decreases

[1] Note: This would be B to AB for Diverting Valves

Table 2

2-Way and 3-Way Default Factory Set Ups			
Fail Safe Valve Default Set-ups		**Non-Fail Safe Valve Default Set-ups**	
Proportional and Floating Valves	On / Off	Proportional and Floating Valves	On / Off
FO / NCD	**FO / NOR**	**NC**	**NC**
(A to AB) Fail to Open/ Normally Closed / Increased signal gives an increase in flow	(A to AB) Fail to Open/ Normally Open / Applied signal gives a decrease in flow	(A to AB) Normally Closed / Increased signal gives an increase in flow	(A to AB) Normally Closed / Applied signal gives an increase in flow
3-Way Default is Mixing. All Elodrive USA valves will be shipped in the above default positions unless otherwise noted at the time your order is received. Optional valve set ups are available in table #1			

Technical Data/Submittal

Electric Actuator Type BE(P)

Electronic Fail-Safe, 88/132 in-lb Minimum Torque,
BE NEMA 2 / BEP NEMA 4

Elodrive type BE(P) actuators are designed and produced for long lasting, reliable and quiet operation of air control dampers and temperature control valves. BE(P) type actuators feature **EloSafe**™ electronic fail-safe technology which uses goldcap capacitors to electronically position the actuator in the event of an interruption of power to the actuator. **EloSafe** capacitors store six times the energy required to drive the actuator to the fail-safe position under full torque load. Thermal compensation allows EloSafe actuators to deliver the full rated torque even at the lowest ambient temperature rating. A universal self-centering mounting clamp and anti-rotation strap are included with all models. All Elodrive models feature durable Elodrive brushless DC motor technology and easy manual positioning.

		✓	Model	Min. Torque in-lb (Nm)	Control Input	Power Supply 24 VAC/DC, 120VAC	Transformer Sizing Min VA	Power Consumption Watts Running/Holding
Fail-safe	NEMA 2		BE-88A1U	88 (10)	On/Off	24	20	6.0 / 2.0
			BE-88A2U	88 (10)	On/Off	120/230	20	12 / 2.0
			BE-88D1U	88 (10)	Directional**	24	20	6.0 / 2.0
			BE-88D2U	88 (10)	Directional**	120/230	20	12 / 2.0
			BE-132A1U	132 (15)	On/Off	24	20	6.0 / 2.0
			BE-132A2U	132 (15)	On/Off	120/230	20	12 / 2.0
			BE-132D1U	132 (15)	Directional**	24	20	6.0 / 2.0
			BE-132D2U	132 (15)	Directional**	120/230	20	12 / 2.0
			BE-88P1U	88(10)	0/2-10VDC	24	20	6.0 / 2.0
			BE-88F1U	88(10)	Floating	24	20	6.0 / 2.0
			BE-132P1U	132 (15)	0/2-10VDC	24	20	6.0 / 2.0
			BE-132F1U	132 (15)	Floating	24	20	6.0 / 2.0
	NEMA 4		BEP-88A1U	88 (10)	On/Off	24	20	6.0 / 2.0
			BEP-88A2U	88 (10)	On/Off	120/230	20	12 / 2.0
			BEP-88D1U	88 (10)	Directional**	24	20	6.0 / 2.0
			BEP-88D2U	88 (10)	Directional**	120/230	20	12 / 2.0
			BEP-132A1U	132 (15)	On/Off	24	20	6.0 / 2.0
			BEP-132A2U	132 (15)	On/Off	120/230	20	12 / 2.0
			BEP-132D1U	132 (15)	Directional**	24	20	6.0 / 2.0
			BEP-132D2U	132 (15)	Directional**	120/230	20	12 / 2.0
			BEP-88P1U	88 (10)	0/2-10VDC	24	20	6.0 / 2.0
			BEP-88F1U	88(10)	Floating	24	20	6.0 / 2.0
			BEP-132P1U	132 (15)	0/2-10VDC	24	20	6.0 / 2.0
			BEP-132F1U	132 (15)	Floating	24	20	6.0 / 2.0

Technical Data Electric Actuator Type BE(P)		
Characteristic	24 V	120 V
Nominal voltage	AC 24 V +/- 20%, 50/60 Hz, DC 24 to 36 V +/- 10%	AC 90-264 V, 50/60 Hz
Protection class	Class II (safety low voltage)	
Starting current	.5 A for approx. 40 Sec	
Synchronization	+/- 5%	
Rotation direction	Selectable via switch L/R (CCW/CW) or by L/R mounting	
Angle of rotation	Max. 95°	
Manual adjustment	Standard allen key positioning without disengaging gears	
Shaft mounting	Centered, Ø 0.3in [8mm]-0.8in [20mm]; ◊ 0.2in [6mm]-0.6in [14mm]	
Running time	90 sec (+/- 5%), during normal operation; independent of load; Fail-safe operation approx. 30 sec	
Position indicator	Mechanical	
Noise emission level	< 35 dB (A), Fail-safe operation < 60 dB (A)	
Ambient temperature	-22 to +122°F [-30 to +50°C]	
Storage temperature	-40 to +176°F [-40 to +80°C]	
Humidity	5 to 95% RH non-condensing (excludes NEMA 4 models)	
Quality Standard	ISO - 9001	
Agency listings	c UL us	
Weight	2.1 lb [950 g]	
Maintenance	Maintenance free	

U-03/05 - Ver. 1.0

ELODRIVE

Perfection is Our Drive

Highlights of the EloSafe series of actuators:

- 100% self-locking even without voltage.
- Full specified torque throughout the entire 90° fail-safe function
- Remains in a defined fail-safe position with 100% self-locking
- Fail-safe function also possible when control signal (2-10 V) is missing

Nomenclature

Actuator Series
B-Housing

Housing Protection
P = NEMA 4
Blank = NEMA 2

Control Signal
P = Proportional Control 0-10VDC / 2-10VDC
F = Floating Point
A = On/Off
D = Directional**

B E P - 88 A 1 U

Country Code
U = USA

Power Supply
1 = 24 VAC/DC
2 = 120/230 VAC

Torque Ranges (in-lb)
Fail-safe
88
132

Fail-safe Type
E = Electronic Fail-safe

**Elodrive now offers new and unique directional control actuator models where extremely quiet, two position, fail-safe control is needed. This is achieved by maintaining power to the actuator and simply switching direction as required with one set of dry contacts. The operation noise is dramatically reduced by eliminating the need for a mechanical spring. The Elodrive, EloSafe™ models BE(P)-88D1U and BE(P)-132D1U are used for 24 VAC/DC powered applications and the BE(P)-88D2U and BE(P)-132D2U are used for 120 VAC powered applications.

Available accessories:

See also separate data sheet.

Crank Arm

Foot Mounting Bracket

Mounting Bracket

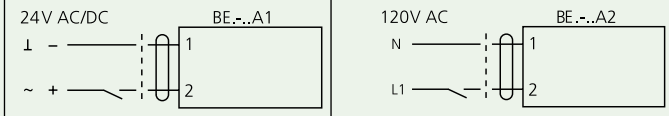
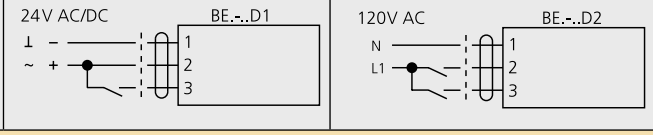
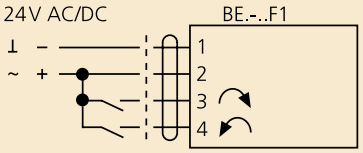
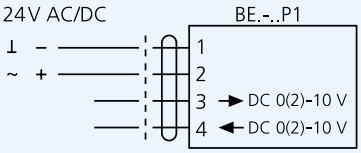
Crank Arm Sets

Form Fit Adapter

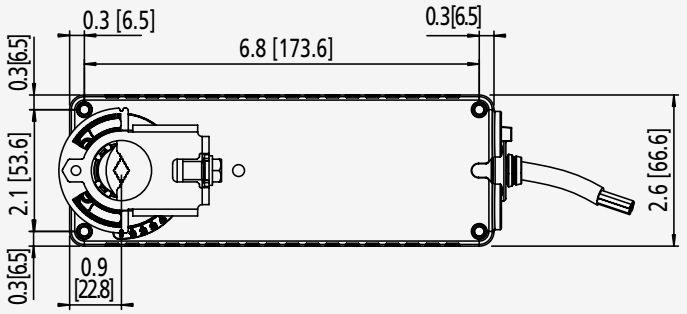
Anti-Rotation Strap

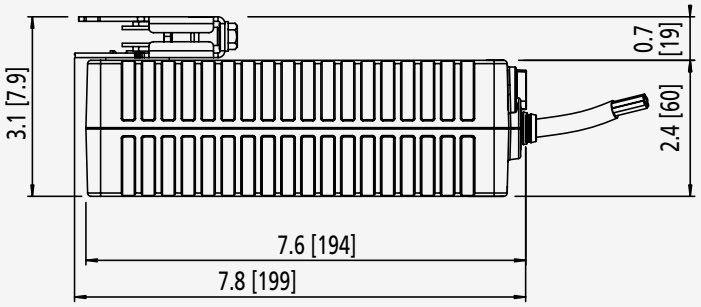
Ball Joint

External Switches and Potentiometers

Technical Data Electric Actuator Type BE(P)	
On/Off	
Connection Cable	2-wire, 3 ft [0.9], appliance, 1/2 in conduit fitting
Wiring schematics On/Off	
Directional	
Connection Cable	3-wire, 3 ft [0.9], appliance, 1/2 in conduit fitting
Wiring schematics Directional	
Floating Point	
Connection Cable	4-wire, 3 ft [0.9 m], plenum, 1/2 in conduit fitting
Wiring schematics Floating Point	
Proportional 0/2-10 V	
Input signal	0-10 V or 2-10 V selectable via switch
Input impedance	>100 kΩ
Output signal	DC 0/2-10 V for 0-100%
Connection Cable	4-wire, 3 ft [0.9 m], plenum, 1/2 in conduit fitting
Wiring schematics Proportional 0/2-10 V	

All Dimensions in inches and metric [mm]





VersaFlo® UPS

Wet Rotor, In-Line, Single Stage Circulator Pumps

Table of Contents:

SAFETY WARNING

Read This Booklet

This booklet is designed to help a certified installer install, begin operation of and troubleshoot the Grundfos VersaFlo UPS pumps. It should be left with the owner of the pump for future reference and information regarding its operation. Should the owner experience any problems with the pump, a certified professional should be contacted.

Electrical Work

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Shock Hazard

A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

Risque de choc électrique

Un moteur ou un câblage défectueux peuvent causer un choc électrique qui pourrait être fatal, soit par contact direct, soit par conduction à travers de l'eau stagnante. Il faut donc mettre la pompe à la terre sur la borne de mise à la terre de la source d'alimentation afin d'assurer une installation et un fonctionnement sécuritaires.

Pour tous les types d'installations, la plomberie en métal de surface devrait être raccordée à la mise à la terre de la source d'alimentation, tel qu'indiqué à l'Article 250-80 du Code national de l'électricité.

PRE-INSTALLATION CHECKLIST

1. Confirm You Have the Correct Pump

- Read the pump nameplate to make sure it is the one you ordered.
- Compare the pump's nameplate data and its performance curve (for head, GPM, etc.) with the application in which you plan to install it.
- Will the pump do what you expect it to do?

2. Check the Condition of the Pump

The shipping carton your pump came in is specially designed around your pump during production to prevent damage. As a precaution, it should remain in the carton until you are ready to install it. At that point, look at the pump and examine it for any damage that may have occurred during shipping. Examine any other parts of the shipment as well for any visible damage.

3. Verify Electrical Requirements

Verification of the electrical supply should be made to be certain the voltage, phase and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run on ±10% of the nameplate-rated voltage. Wiring connection diagrams can be found inside the terminal box cover and later in these Installation and Operating Instructions. If voltage variations are larger than ±10%, do not operate the pump.

4. Pumped Liquid Requirements

CAUTION: This pump is intended for use with water only.
Your VersaFlo UPS pump can be used to circulate:

- Potable hot water
- Water for hydronic heating
- Cooling water
- In domestic hot water systems it is advisable to use bronze pumps (VersaFlo UPS model) only for water with a degree of hardness lower than 14 grains per gallon of hardness. For water with a higher degree of hardness, a direct coupled VersaFlo TP pump is recommended.
- If the pump is installed in a heating system, the water should meet the requirements of accepted standards on water quality in heating systems.

The pump is lubricated and cooled by the liquid being pumped. Therefore, the pumped liquid must always be allowed to circulate through the pump. Extended periods without circulation will cause premature wear to the bearings and excessive motor heat. The pumped liquid must also meet the following requirements:

MINIMUM PUMP INLET PRESSURE (During Operation)

UPS Model	At These Liquid Temps: 167°F 75°C		194°F 90°C		230°F 110°C	
	[psi]	hf	[psi]	hf	[psi]	hf
32-40/4	0.7	1.6	2.2	5.1	21.0	48.5
32-80/2	0.7	1.6	5.1	11.8	23.9	55.2
32-160/2	11.6	26.8	16.0	37.0	34.1	78.8
40-40/4	0.7	1.6	4.4	10.2	23.2	53.6
40-80/4	0.7	1.6	1.5	3.5	18.1	41.8
40-80/2	6.5	15.0	10.9	25.2	29.0	67.0
40-160/2	5.1	11.8	9.4	21.7	27.6	63.8
40-240/2	11.6	26.8	16.0	37.0	34.1	78.8
50-40/4	0.7	1.6	2.9	6.7	21.8	50.4
50-80/4	0.7	1.6	4.4	10.2	23.2	53.6
50-80/2	4.4	10.2	8.7	20.1	26.8	61.9
50-160/2	11.6	26.8	16.0	37.0	34.1	78.8
50-240/2	10.2	23.6	14.5	33.5	32.6	75.3
80-40/4	11.6	26.8	16.0	37.0	34.1	78.8
80-80/4	14.5	33.5	18.9	43.7	37.0	85.5
80-160/2	21.8	50.4	26.1	60.3	43.5	100.5
100-40/4	27.6	63.8	31.9	73.7	50.0	115.5

LIQUID TEMPERATURE RANGE

Continuously: 14°F (-10°C) up to 230°F (110°C)
Intermittent: < 284°F (140°C) for short periods of time.
Domestic Hot Water: <140°F (60°C)

Installation Procedures

WARNING: Never make any connections in the pump terminal box unless the electrical supply has been switched off.

AVERTISSEMENT: Ne jamais établir de connexions dans la boîte de jonction de la pompe à moins que l'alimentation électrique n'ait été coupée.

1. Electrical Preparation

Terminal Box Position

At the bottom of the stator, closest to the pump housing, there are two drain holes to allow condensed water to escape. The drain holes must point downwards. As they are opposite the terminal box position, the terminal box must point upwards in one of the positions shown in Fig.1. The following terminal box positions apply whether the piping is mounted vertically or horizontally.

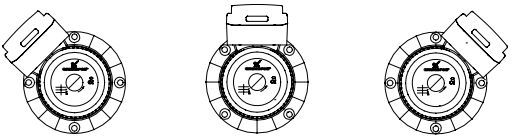


Fig.1

Rotating the Terminal Box

To rotate the terminal box, follow these steps:

WARNING: If the pump is already installed in the system, the system must be drained or the isolating valves on both sides of the pump must be closed before the allen head screws are removed as the pumped liquid may be scalding hot and/or under pressure. Do not start the pump until the system has been filled with liquid and vented.

AVERTISSEMENT: Si la pompe est déjà installée, il faut drainer le système ou fermer les deux robinets d'isolement latéraux de la pompe avant d'enlever les vis à tête hexagonale, car le liquide pompé pourrait être brûlant et/ou sous pression. Ne pas faire fonctionner la pompe jusqu'à ce que le système ait été rempli de liquide et purgé.

1. Remove the four allen screws holding the pump head onto the pump housing
2. Carefully lift the pump head and rotate it so the terminal box is in the desired position. DO NOT locate the terminal box beneath the pump. Make sure the O-ring is properly seated in the pump housing.
3. Replace the pump head onto the pump housing
4. Tighten the allen head screws evenly. Torque to: 8mm ..... 15 ft lbs
   10mm ..... 25 ft lbs
5. Check to make sure the rotor turns freely. Do this by removing the the vent plug in the middle of the pump nameplate. Insert a medium size flat-blade screwdriver into the slot at the exposed end of the shaft. Gently turn the shaft. If it does not turn easily, repeat steps 1-4 above.
6. The position of the nameplate can be changed by easing the outer edge of the plate at the cut out with a screwdriver. Turn the nameplate to the required position and push into place.
7. Refer to page 15 for additional instructions.

2. Piping Considerations

Thoroughly clean and flush all dirt and sediment from the system before attempting to install the pump.

Location in the Piping Line

The pump should never be located at the lowest point of the piping system, where dirt and sediment collect. Nor should it be located at the highest point of the piping sytem, where air accumulates.

Mounting Positions

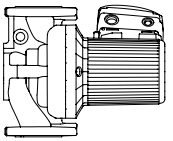


Fig.2

The arrows on the flanges of the pump indicate the direction of water flow. Although the VersaFlo UPS may be installed in either vertical or horizontal piping, **the motor shaft must always remain horizontal**, as shown in Fig. 1 of the Terminal Box Position instructions and as shown in Fig. 2 to the left.

Also remember: **Pumps installed outdoors** must be protected by a ventilated, watertight cover to keep out moisture and dirt.

WARNING: The pump must be positioned so that someone cannot accidentally come into contact with the hot surfaces of the pump.

AVERTISSEMENT: La pompe doit être placée de sorte que personne ne puisse accidentellement toucher ses surfaces chaudes.

3. Connect the Pump

Install the pump into the piping system. Grundfos recommends that pressure gauges be installed in the inlet and discharge flanges or pipes to check pump and system performance.

4. Electrical Connection

The electrical connection and protection should be carried out in accordance with the latest edition of the National Electrical Code, local codes and regulations by a qualified electrician.

WARNING: Never make any connections in the pump terminal box unless the electrical supply has been switched off.

- The pump must be grounded.
- The pump must be connected to an external main power switch.

AVERTISSEMENT: Ne jamais établir de connexions dans la boîte de jonction de la pompe à moins que l'alimentation électrique n'ait été coupée.

- La pompe doit être mise à la terre.
- La pompe doit être raccordée à un interrupteur d'alimentation principale externe.

The operating voltage and frequency are marked on the pump nameplate. Make sure that the motor is suitable for the electrical supply it is being installed to.

The pump should be grounded to protect against indirect contact and a ground fault interrupter can be used as extra protection.

Multi-Speed Pump (1 phase)

All single phase pumps are equipped with built-in, automatic resetting, thermal overload protection. The pump is protected at all three speeds.

Multi-Speed Pump (3 phase)

The pump must be connected to the electrical supply via an external contactor. The contactor must be connected to the built in thermal overload switch terminals T1 and T2 (3x208-230V) or P1 and P2 (3x460V & 575V) to protect the pump against overloading at all three speeds.

OR: If the pump is protected by means of a motor starter, the starter must be set to the current consumption of the pump at the selected speed. The motor starter setting must be changed every time the pump speed is changed. The current consumption at the individual speeds is stated on the pump nameplate.

Figures 4, 6, 7, 9, and 10 on the next page show the possible connections:

Installation Procedures

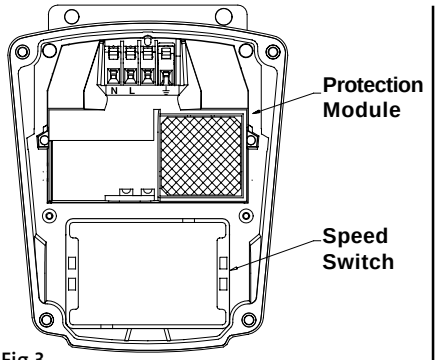


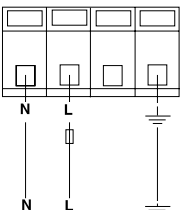
Fig.3

VersFlo UPS 1x115V & 230V Terminal Box:
All VersaFlo UPS single head pumps come with a protection module and a speed switch as shown in Fig.3. All are equipped with built-in, automatic resetting, thermal overload protection. The pump is protected at all three speeds.

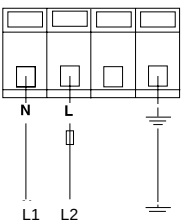
Wiring Diagrams

Fig.4 shows the electrical connections for a single phase pump with protection module.

Fig.4



1~ x115V supply



1~ x230V supply

Notes:
Provide electrical disconnect and current protection as per local electrical codes.
K = External contactor sized to FL & LR pump current. Auxilary contacts rated for supply voltage (figure 6 & 9 only).

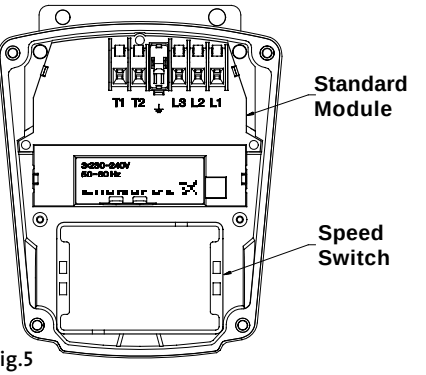


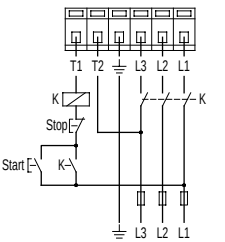
Fig.5

VersFlo UPS 3x208-230V Terminal Box:
All VersaFlo UPS single head pumps come with a standard module and a speed switch as shown in Fig.5. All are equipped with an internal thermal overload switch (terminals T1 & T2, to be connceted to an external contactor) to protect the pump at all three speeds.

Wiring Diagrams

Fig.6 shows the electrical connections when using external **impulse contacts** (momentary contacts) for start/stop push button station.

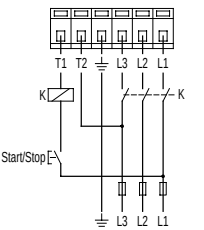
Fig.6



3~ x208-230 volt supply

Fig.7 shows the electrical connections when using an external **changeover contact** (maintained contacts) for start/stop push button station.

Fig.7



3~ x208-230 volt supply

Installation Procedures

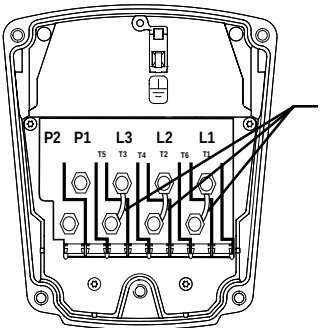


Fig.8

VersaFlo UPS 3x460V & 575V Terminal Box:
All VersaFlo UPS single head pumps with 3 phase x 460V & 575V terminal boxes (Fig.8) come with a special two speed terminal box. The speed is changed by the orientation of the jumpers as shown on page 9. All are equipped with an internal thermal overload switch (terminals P1 & P2) to be connected to external contactor.

Wiring Diagrams

Fig.9 shows the electrical connections when using external **impulse contacts** (momentary contacts) for start/stop push button station.

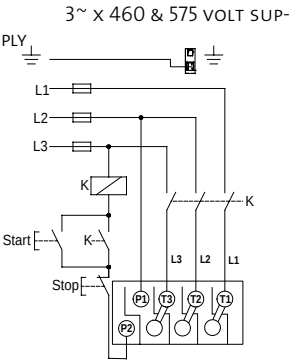


Fig.9

Fig.10 shows the electrical connections when using an external **changeover contact** (maintained contacts) for start/stop push button station.

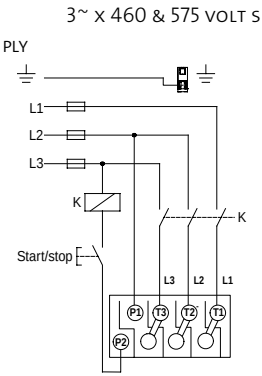


Fig.10

Starting the Pump

1. Vent the Piping System

After the pump has been installed and the electrical connections made, the piping system must be vented. Never operate the pump dry -- the system must first be filled with liquid and vented. Do not vent the piping system through the pump. Instead, follow these steps:

a. Fill and pressurize the system with liquid, and vent all trapped air from the piping by suitable means.

b. If any isolation valves are used, make sure they are OPEN.

WARNING: If the vent screw is to be loosened, care should be taken to ensure that the escaping scalding hot liquid does not cause personal injury or damage to components (see Fig. 12).

AVERTISSEMENT: S'il faut desserrer la vis de purge, prendre les mesures nécessaires pour que le liquide brûlant qui s'échappe ne cause pas de blessures ou de dommages aux composants (voir la figure 12).

2. Check the Direction of Shaft Rotation

APPLIES TO 460V & 575V 2-SPEED MODELS ONLY

(three speed pumps direction of rotation is checked by fault finding chart, page 10)

a. Make sure that the power is OFF.

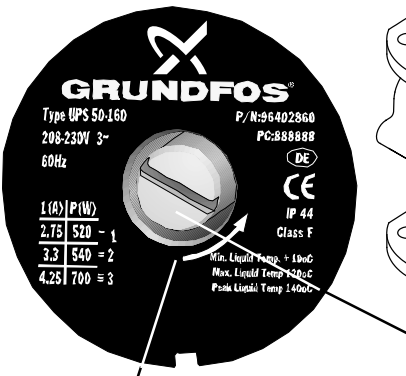
b. Unscrew and remove the vent plug located at the center of the nameplate.

c. Insert a small, flat-blade screwdriver into the slot in the end of the motor shaft (see Fig.12). Rotate the shaft with the screwdriver to make sure it does so freely.

d. Briefly start and stop the pump and watch to see which direction the shaft rotates. The shaft must rotate in the counterclockwise direction as shown on the nameplate (see Fig.11).

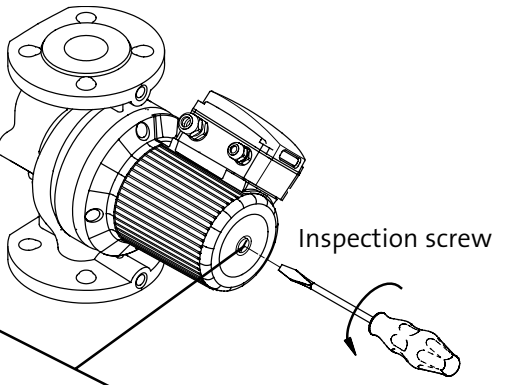
e. If the pump shaft is rotating incorrectly, disconnect the power and interchange any two power leads in the terminal box.

f. Check once again for proper counterclockwise rotation. When it is rotating correctly, replace the vent plug.



Direction of Rotation

Fig.11



Vent Plug

Fig.12

3a. Speed Selection

(three speed, all models except 3 x 460V & 575V)

The speed switch in the terminal box can be turned to three positions. The speed in the three positions appears in the table below (also see Fig.13).

Switch Position	Speed in % of Maximum Speed	
	Single-Phase Pumps	Three-Phase Pumps
1	approx. 60%	approx. 70%
2	approx. 80%	approx. 85%
3	100%	100%

Changing to lower speeds offers considerable reduction in energy consumption and less noise in the system.

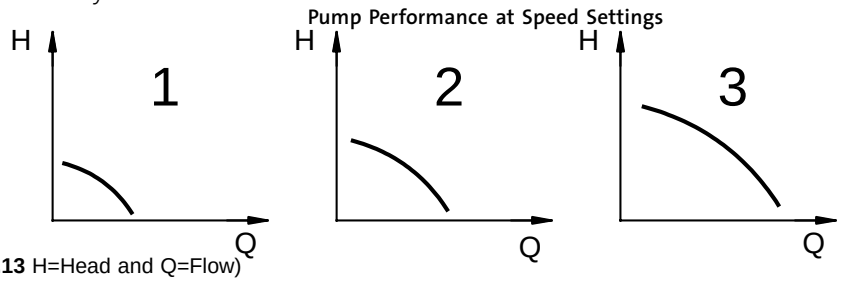


Fig.13 H=Head and Q=Flow)

WARNING: Never make any connections in the pump terminal box unless the electricity supply has been switched off.

AVERTISSEMENT: Ne jamais établir de connexions dans la boîte de jonction de la pompe à moins que l'alimentation électrique n'ait été coupée.

Change the pump performance as follows:

1. Switch off the electrical supply to the pump at the main circuit breaker. The green indicator light in the terminal box must be off.
2. Remove the terminal box cover by loosening the four screws in the cover.
3. Pull out the speed switch module and re-insert it so that the desired speed is visible through the window in the terminal box (see Fig.14)

NOTE: When changing to and from speed 1, the cover of the speed switch module must be removed and fitted on the other side of the switch.

Continued on next page

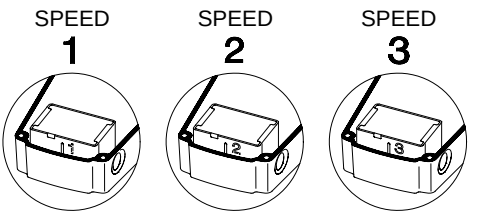


Fig.14

Starting the Pump

Change the pump performance as follows: (continued)

4. Fit the terminal box cover back onto the terminal box and tighten the four screws in the cover.

5. Switch on the electrical supply. Check that the green indicator light is permanently on or flashing.
NOTE: The speed switch module must never be used as an on/off switch.

3b. Speed Selection (two speed, 3 x 460V & 575V)

The speed setting in the terminal box (see Fig.13) can be changed to two positions. The speed in the two positions appears in the table below (also see Fig.13 on page 8).

Speed Step	Speed in % of Maximum Speed
1	approx. 75%
2	100%

WARNING: Never make any connections in the pump terminal box unless the electrical supply has been switched off.

AVERTISSEMENT: Ne jamais établir de connexions dans la boîte de jonction de la pompe à moins que l'alimentation électrique n'ait été coupée.

Change the pump performance as follows:

The speed is changed by the position of the bridges in the terminals. The bridges are fitted according to:

- Figure 15 for speed 1 - Low speed
- Figure 16 for speed 2 - High speed

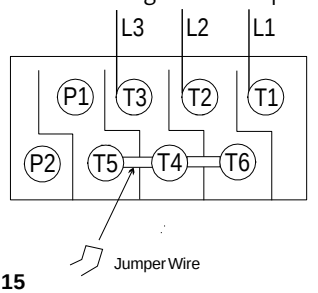


Fig.15

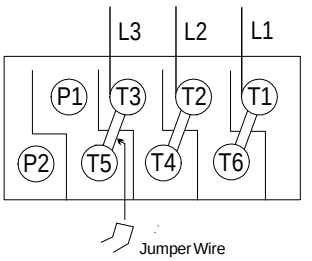


Fig.16

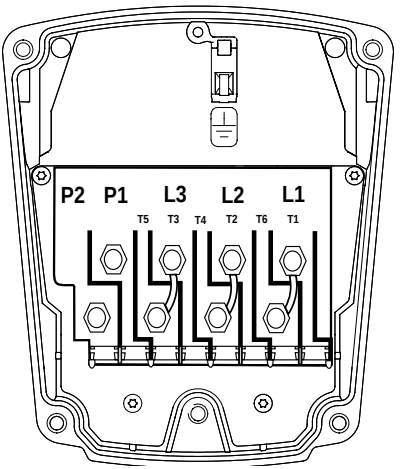


Fig.17

1. Fault Finding Chart

WARNING: Before removing the terminal box cover, make sure that the electrical supply has been switched off and that it cannot be accidentally switched on.

WARNING: The pumped liquid may be scalding hot and under high pressure. Before any removal or dismantling of the pump, the system must be drained or the isolating valves on both sides of the pump must be closed.

AVERTISSEMENT: Avant de retirer le couvercle de la boîte de jonction, s'assurer que l'alimentation électrique a été coupée et ne peut être rétablie accidentellement.

AVERTISSEMENT: Le liquide pompé peut être brûlant et sous haute pression. Avant de retirer ou de démonter la pompe, il faut drainer le système ou fermer les deux robinets d'isolement latéraux de la pompe.

Single-Head Pumps with Standard or Protection Module

Fault	Cause	Remedy
The pump does not run. None of the indicator lights are on.	One fuse in the installation is blown.	Replace the fuse.
	External circuit breaker is switched off.	Switch the circuit breaker on.
	Current/Voltage operated ground fault interrupter has tripped.	Repair the insulation defects and reset the circuit breaker.
	The pump's internal thermal overload switch has cut out (**Standard module only**).	Check that the liquid temperature falls within the specified range. With **external on/off changeover contact:** The pump will restart automatically when it has cooled to the normal temperature. With **external on/off impulse contacts:** The pump can be restarted when it has cooled to normal temperature.
The pump does not run. The green indicator light is on.	Rotor blocked, but the pump hasn't been cut out by the thermal overload switch.	Switch off the electricity supply and clean/repair the pump.
	The speed switch module has not been fitted.	Switch off the electricity supply at the external circuit breaker and fit the speed switch module into position.
Three-Phase Pumps Only: The pump is running. The red and green indicator lights are on.	The pump is running with the wrong direction of rotation.	Switch off the electricity supply at the external circuit breaker and interchange any two phases (leads) in the pump terminal box.
Noise in the system. The green indicator light is on.	Air in the system. The pump flow is too high. The pressure is too high.	Vent the system. Reduce the pump performance. Reduce the pump performance.
Noise in the pump. The green indicator light is on.	Air in the pump.	Vent the pump.
	The inlet pressure is too low.	Increase the inlet pressure and/or check the air volume in the expansion tank (if installed).
Insufficient heat in some places in the heating system.	The pump performance is too low.	Increase the pump performance, if possible, or replace the pump with a pump with higher flow.
Single phase pumps with protection module (only). The Pump does not run. The red indicator light is on.	The pump has been cut out by the thermal overload switch due to high liquid temperature or blocked rotor.	Check that the liquid temperature falls within the specied range.The pump will restart automatically when it has cooled to normal temperature. **Note:** If the thermal overload switch has cut out the pump three times within a short period, the pump must be restarted manually by switching off the electrical suply.
The green indicator light is off.	The speed switch module has not been fitted.	Switch off the electrical supply by means of the external mains switch and fit the speed switch module.

Preliminary Checks

Supply Voltage

To check the voltage being supplied to the motor, use a voltmeter. **Be careful, since power is still being supplied to the pump.** Do not touch the voltmeter leads together while they are in contact with the power lines.

Three Phase Motors

Touch a voltmeter lead to:

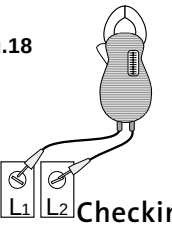
- Power leads L1 and L2
- Power leads L2 and L3
- Power leads L3 and L1

} *These tests should give a reading of full line voltage.*

Single Phase Motors

Touch one voltmeter lead to each of the lines supplying power to the pump L1 and L2 , (or L1 and N for 115V circuits).

Fig.18



Checking Single Phase Power

Evaluation

When the motor is under load, the voltage should be within 10% (+ or -) of the nameplate voltage. Any variation larger than this may indicate a poor electrical supply and can cause damage to the motor windings. The motor should not be operated under these conditions. Contact your power supplier to correct the problem or change the motor to one requiring the voltage you are receiving.

Current Measurement

To check the current, use an ammeter. To do so, follow these steps:

1. Make sure the pump is operating
2. Set the ammeter to the proper scale.
3. Place the tongs of the ammeter around the leg to be measured.
4. Compare the results with the amp draw information on the motor nameplate.
5. Repeat for the other legs.

Evaluation

If the current draw exceeds the listed nameplate amps, or if the current imbalance is greater than 5% between each leg on three phase units, then check the following:

- The voltage supplied to the pump maybe too high or too low.
- The contacts on the motor starter may be burned.
- The terminals in the starter or terminal box may be loose.
- There may be a winding defect. Check the winding and insulation resistance
- The motor windings may be shorted or grounded.

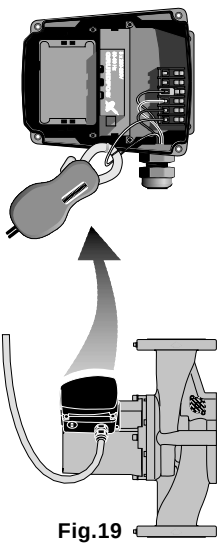


Fig.19

Insulation Resistance (lead-to-ground)

To check the insulation resistance (lead-to-ground) of the motor and leads, a megohmmeter is required.

1. Turn the **POWER OFF.**
2. Disconnect all electrical leads to the motor.
3. Set the scale selector on the megohmmeter to R x 100K, touch its leads together, and adjust the indicator to zero.
4. Touch the leads of the megohmmeter individually to each of the motor leads and to ground (i.e. L1 to ground; L2 to ground, etc.).

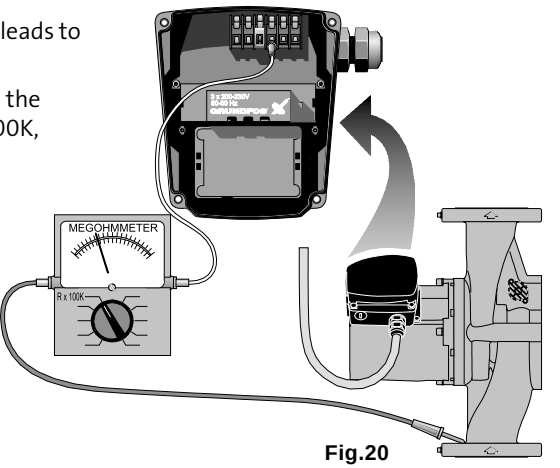


Fig.20

Evaluation: The resistance values for new motors must exceed 1,000,000 ohms. If they do not, replace the motor.

Winding Resistance (line to line)

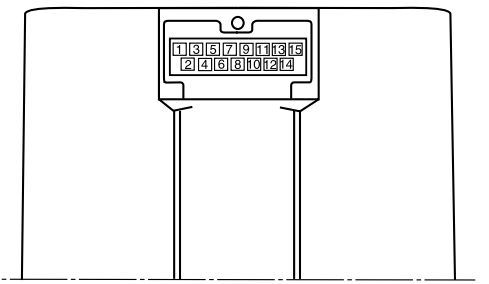
To check the winding resistance of the motor windings, a megohmmeter is required.

1. Turn the power off
2. Disconnect all electrical leads to the motor.
3. Set the scale on the megohmmeter to Rx1, touch its leads together and adjust the indicator to zero.
4. Using the charts below for reference, touch the leads of the megohmmeter to the appropriate pair of connectors. Check all pairs that are present and write down and label (R_A, R_{S1}, R_{S2}, R) all readings.
5. Compare your readings to the matching model, phase and voltage on the chart on page 15.

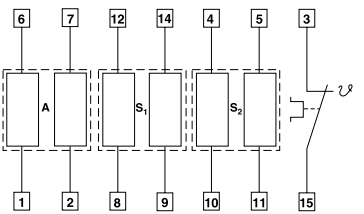
Evaluation : The resistance values must fall within the tolerances listed on the next page. If they do not, replace the motor.

Internal Wiring
UPS

Terminal plug in stator



Single Phase

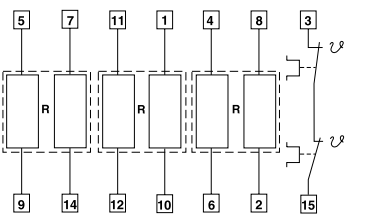


R_A:	6-1	or	6-1, 7-2
R_{S1}:	12-8	or	12-8, 14-9
R_{S2}:	4-10	or	4-10, 5-11

A: Main winding

S_2: Auxiliary winding
S_1: Auxiliary winding

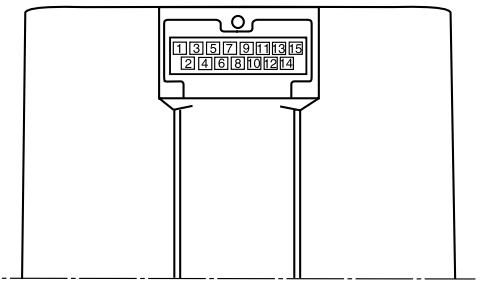
Three Phase 208-230V



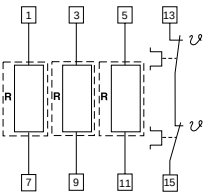
R:	5-9	or	5-9, 7-14
R:	11-12	or	11-12, 1-10
R:	4-6	or	4-6, 8-2

Internal Wiring
UPS

Terminal plug in stator



Three Phase 460/575V



Winding Resistance Chart

60 HZ					USA
UPS					
			[Ω] 20°C - 50°C		
Pump Type	Voltage	R	RA	RS1	RS2
	1 x 115 V		17.8 - 23.2	3.95 - 5.20	9.40 - 12.4
	1 x 230 V		70.0 - 91.5	17.0 - 22.2	39.5 - 52.0
UPS 32-40/4	3 x 208 - 230 V	180 - 236			
	3 x 460 V	360 - 470			
	3 x 575 V	575 - 750			
	1 x 115 V		9.55 - 12.6	3.05 - 4.00	6.70 - 8.80
	1 x 230 V		19.4 - 25.5	5.45 - 7.10	12.6 - 16.4
UPS 32-80/2	3 x 208 - 230 V	44.0 - 57.5			
	3 x 460 V	83.5 - 110			
	3 x 575 V	132 - 174			
	1 x 115 V		4.15 - 5.45	1.20 - 1.56	2.65 - 3.50
	1 x 230 V		8.30 - 10.8	2.20 - 2.90	5.05 - 6.65
UPS 32-160/2	3 x 208 - 230 V	26.0 - 34.0			
	3 x 460 V	53.5 - 70.0			
	3 x 575 V	84.5 - 110			
	1 x 115 V		11.4 - 15.0	2.95 - 3.85	5.60 - 7.35
	1 x 230 V		50.5 - 66.5	14.0 - 18.4	25.5 - 34.0
UPS 40-40/4	3 x 208 - 230 V	118 - 154			
	3 x 460 V	234 - 310			
	3 x 575 V	360 - 475			
	1 x 115 V		5.60 - 7.35	1.84 - 2.42	4.50 - 5.90
	1 x 230 V		11.0 - 14.4	3.95 - 5.20	8.55 - 11.2
UPS 40-80/2	3 x 208 - 230 V	32.0 - 42.0			
	3 x 460 V	64.0 - 84.0			
	3 x 575 V	102 - 132			
	1 x 115 V		4.15 - 5.45	1.94 - 2.55	3.30 - 4.35
	1 x 230 V		8.10 - 10.6	3.05 - 4.00	4.60 - 6.05
UPS 40-80/4	3 x 208 - 230 V	46.5 - 61.0			
	3 x 460 V	90.5 - 118			
	3 x 575 V	164 - 216			
	1 x 115 V		2.85 - 3.75	1.10 - 1.44	1.94 - 2.55
	1 x 230 V		5.60 - 7.35	2.02 - 2.66	3.75 - 4.95
UPS 40-160/2	3 x 208 - 230 V	22.8 - 30.0			
	3 x 460 V	45.5 - 59.5			
	3 x 575 V	72.0 - 95.0			
	1 x 230 V		6.80 - 8.95	2.02 - 2.65	3.70 - 4.85
UPS 40-240/2	3 x 208 - 230 V	11.0 - 14.4			
	3 x 460 V	22.0 - 29.0			
	3 x 575 V	35.0 - 45.5			
	1 x 115 V		6.55 - 8.55	2.12 - 2.80	4.30 - 5.65
	1 x 230 V		25.0 - 33.0	8.30 - 10.8	15.0 - 19.8
UPS 50-40/4	3 x 208 - 230 V	57.5 - 75.0			
	3 x 460 V	114 - 148			
	3 x 575 V	184 - 242			
	1 x 115 V		4.15 - 5.45	1.20 - 1.56	2.65 - 3.50
	1 x 230 V		8.30 - 10.80	2.20 - 2.90	5.05 - 6.65
UPS 50-80/2	3 x 208 - 230 V	26.0 - 34.0			
	3 x 460 V	33.5 - 70.0			
	3 x 575 V	84.5 - 110			
	1 x 115 V		2.75 - 3.60	1.74 - 2.30	2.85 - 3.75
	1 x 230 V		5.50 - 7.25	2.65 - 3.50	4.95 - 6.50
UPS 50-80/4	3 x 208 - 230 V	37.0 - 49.0			
	3 x 460 V	79.0 - 104			
	3 x 575 V	120 - 156			
	1 x 230 V		6.80 - 8.95	2.02 - 2.65	3.70 - 4.85
UPS 50-160/2	3 x 208 - 230 V	12.4 - 16.2			
	3 x 460 V	24.2 - 31.5			
	3 x 575 V	37.5 - 49.5			
	3 x 208 - 230 V	7.80 - 10.2			
UPS 50-240/2	3 x 460 V	15.6 - 20.6			
	3 x 575 V	25.0 - 33.0			
	3 x 208 - 230 V	46.5 - 61.0			
UPS 80-40/4	3 x 460 V	90.5 - 118			
	3 x 575 V	164 - 216			
UPS 80-80/4	3 x 208 - 230 V	23.6 - 31.0			
	3 x 208 - 230 V	7.80 - 10.2			
UPS 80 -160/2	3 x 460 V	15.6 - 20.6			
	3 x 575 V	25.0 - 33.0			
	3 x 208 - 230 V	27.5 - 36.0			
UPS 100-40/4	3 x 460 V	54.5 - 71.5			
	3 x 575 V	86.0 - 114			

Replacing the Pump Head Removal

1. Disconnect or TURN OFF the power supply.
2. Close any isolation valves on either side of the pump to avoid draining the system of liquid.
3. Disconnect the electrical leads from the terminal box.
4. Disconnect and remove the conduit from the terminal box.
5. Loosen and remove the four allen screws (8 or 10 mm) which connect the pump head housing to the pump housing.
6. Remove the pump head from the pump housing.
7. Clean the machined surfaces in the pump housing of any foreign material.

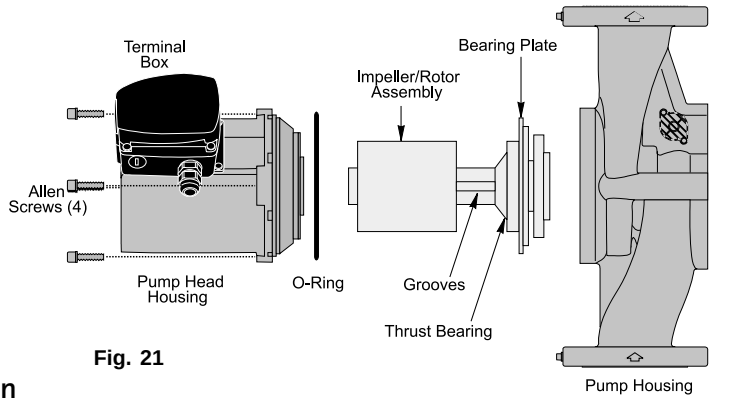


Fig. 21

Installation

1. Carefully remove the new pump head assembly from its packaging. Separate the impeller/rotor assembly from the new pump head.
2. While holding the thrust bearing, carefully place the impeller/rotor assembly into the pump housing. The bearing plate should fit snugly into the lowest machined surface in the pump housing.
3. Make sure that the impeller/rotor assembly can rotate freely.
4. Place the O-Ring over the rotor and locate it into the inner diameter of the pump housing.
5. Carefully place the pumphead housing over the rotor and rotate it so the terminal box is in the position you wish (see page 3 for positioning).
6. Make sure the pump head housing is properly seated on the pump housing. Do not force the two together -- if there is binding, disassemble them and repeat steps 2-6. Tighten the allen screws evenly to secure the pump head. Torque to:
   8mm ..... 15 ft lbs
   10mm ..... 25 ft lbs
7. Check to make sure the motor shaft turns freely, as explained in step 5 on page 3 (under "Rotating the Terminal Box").

Replacing Components

Replacing the Terminal Box or Capacitor

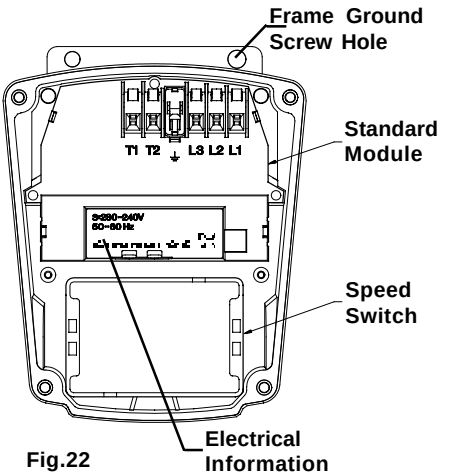


Fig.22

If the terminal box is replaced, make certain the electrical in-formation listed on the new box matches the information listed on the old box, and that it is compatible with the pump and incoming electrical supply.

For all terminal boxes, it is very important to tightly secure the frame ground-ing screw through the terminal box, so that a proper connection between the terminal box and motor is made.

All

1. Before replacing the terminal box or capacitor, make sure the power is OFF.
2. Remove the terminal box cover by completely loosening all four torx/standard screws.
3. Remove the speed switch (noting its position) by pulling firmly and evenly on both sides of it. (Not for 460/575 V)

Capacitor

a.4. (Capacitor replacement, single-phase only) Disconnect the two connector clips from the capacitor and unscrew the complete plastic strain relief nut. Remove capacitor wire and strain relief.

a.5. Screw in new complete strain relief nut and connect new clip connectors. Pull excess sheathed cable out of terminal box, being sure to leave at least $^{1}/_{8}$" of sheath inside of terminal box.

Terminal Box

b.4. (Terminal box replacement, single-phase and three-phase) Disconnect all wiring, remove the three phillips-head screws holding the terminal box in place and remove the terminal box by pulling firmly and evenly on both side.

b.5. Check that the clear rubber gasket is in place around the terminal box connector stem, carefully press the terminal box into the stator socket, replace the three phillips-head terminal box screws and replace wiring.

All

6. Replace the speed switch to its proper position, making sure to push it all the way in. (Not for 460/575V)
7. Replace the terminal box cover and tighten all four torx/standard screws.
8. Switch on electrical power supply. The pump is now ready for operation.

Notes

LIMITED WARRANTY

Products manufactured by (GRUNDFOS) GRUNDFOS PUMPS CORPORATION are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

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L-UPS-TL-001	Rev.10/01
PRINTED IN U.S.A.	

96459998

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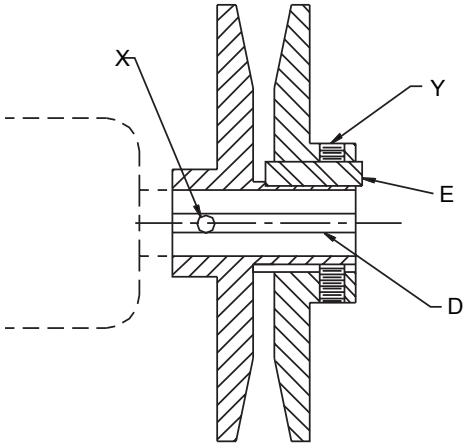
GRUNDFOS

INSTRUCTIONS FOR MOUNTING AND ADJUSTING BROWNING VARIABLE PITCH KEY TYPE SHEAVES

ISO 9001 CERTIFIED
EMERSON POWER TRANSMISSION
COMPONENTS OPERATIONS
MAYSVILLE, KY.



Key E Projects To Provide a Grip For Removing.

Do Not Operate Sheave With Flange Projecting Beyond The Hub End.

⚠WARNING

Disconnect power before installation and maintenance. Failure to do so can result in severe injury or death.

SINGLE GROOVE SHEAVES

MOUNTING:

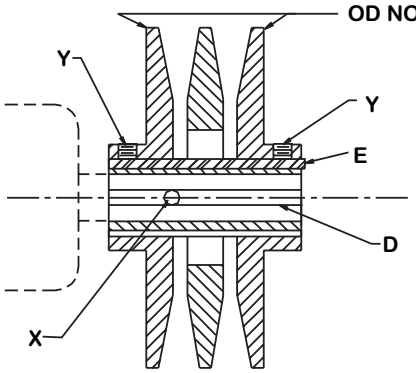
1. Make sure the shaft, sheave bore, keys and keyways are free of burrs, paint, etc.
2. All sheaves should be mounted on the motor or driving shaft with the end containing the setscrew “X” toward the motor. Be sure setscrew “X” is well over the shaft.
3. Fit shaft key “D” between sheave and shaft, and lock setscrew “X” in place. Wrench torque 110 in-lb min. - 130 in-lb max.
4. Be sure both driving and driven sheaves are in alignment and that shafts are parallel.
5. Total axial and parallel misalignment must not exceed 1/4°.

ADJUSTING:

1. Loosen setscrew “Y” in movable flange of sheave and pull out external key “E”. (This key projects a small amount to provide a grip for removing.)
2. Adjust sheave pitch diameter for desired speed by opening rotating parts by half or full turn increments from closed position. Do not open more than five full turns for “A” belts or six full turns for “B” belts.
3. Replace key “E” and tighten setscrew “Y” to 110 to 130 in-lb.
4. Put on belts and adjust belt tension. (Do not force belts over grooves.) A BROWNING® belt tension checker should be used to set tension.
5. Future adjustments should be made by loosening the belt tension and increasing or decreasing the pitch diameter of the sheave by half or full turns as required. Readjust belt tension before starting drive.
6. Be sure that all keys are in place and that all setscrews are torqued properly before starting drive. Check setscrews and belt tension after 24 hours service.

⚠WARNING

Operating drives without guards in place can result in severe injury or death.



Key E Projects To Provide a Grip For Removing.

Do Not Operate Sheave With Flange Projecting Beyond The Hub End.

⚠WARNING

Disconnect power before installation and maintenance. Failure to do so can result in severe injury or death.

TWO GROOVE SHEAVES

MOUNTING:

1. Make sure the shaft, sheave bore, keys and keyways are free of burrs, paint, etc.
2. Remove key “E” from sheave. Unscrew flanges until setscrew “X” is visible. If setscrew “X” is at an angle, flange may have to be removed in order to tighten it.
3. All sheaves should be mounted on the motor or driving shaft with the end containing the setscrew “X” toward the motor. If setscrew “X” is at an angle, mount away from motor.
4. Fit shaft key “D” between sheave and shaft, and lock setscrew “X” in place. Wrench torque 110 in-lb min. - 130 in-lb max. Replace outboard flange.
5. Be sure the center flange of both the driving and driven sheaves are in alignment and shafts are parallel.
6. Total axial and parallel misalignment must not exceed 1/4°.

ADJUSTING:

Each flange of the sheave has a small notch on the O.D. of the flange. This mark is located directly over the keyway on the two adjustable flanges and over one of the keyways on the non-adjustable (center) flange. To obtain proper adjustments:

1. Loosen setscrews “Y” in moving flanges and pull out key “E”. (This key projects a small amount to provide a grip for removing.)
2. Rotate both movable flanges inward until they touch the center flange.
3. Locate the notch over the keyway on the center flange.
4. Open each movable flange until its notch is adjacent to the notch on the center flange. Be certain that neither movable flange is opened more than one full turn.
5. From the position obtained in Step 4, open each movable flange the same number of full or half turns until the desired number of turns is obtained. Do not open more than five full turns for “A” belts or six full turns for “B” belts. (2VP36 5 turns).
6. Replace key “E” and tighten setscrews “Y”. Wrench torque 110 in-lb min. - 130 in-lb max.
7. Put on belts and adjust belt tension. (Do not force belts over flanges.) A BROWNING® belt tension checker should be used to set tension.
8. Future adjustments should be made by loosening the belt tension and increasing or decreasing the pitch diameter of the sheave by half or full turns as required. Readjust belt tension before starting drive.
9. Two groove sheaves must have both halves adjusted by the same number of turns from the position established in Step 4 to insure the same pitch diameter.
10. Be sure that all keys are in place and that all setscrews are torqued properly before starting drive. Check setscrews and belt tension after 24 hours service.

Have questions? Contact Technical Services at 1-800-626-2093.

⚠WARNING

Operating drives without guards in place can result in severe injury or death.

Form No. 3865-H 4/16/99
Printed in U.S.A.

BROWNING
Emerson Power Transmission
MAYSVILLE, KENTUCKY 41056

TB Wood's

JVS Variable Speed Sheave

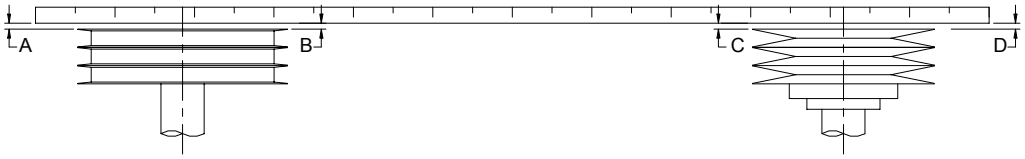
Installation, Maintenance and Adjustment Instructions

INSTALLATION INSTRUCTIONS

1. Loosen both clamping screws.
2. Slide the JVS sheave on the shaft. Note the central sleeve of this sheave is split at one end only. This end must be installed first as the split allows the sheave assembly to be secured to the shaft.
3. Adjust the JVS sheave to the approximate pitch diameter desired. One turn of the adjusting screw will vary the pitch diameter 0.2 inches. Seven turns are required to adjust the sheave from minimum to maximum pitch diameter. Refer to the note below.

NOTE:
Slight finger pressure on the face of the adjustable flanges near the split (180° from adjusting screw) may be required to permit free and equal movement of flanges during pitch adjustments. Tipping and binding may otherwise occur.

4. Align the JVS sheave with the companion sheave. This is most easily accomplished using the four-point method with a straight-edge as shown below. NOTE: Dimensions A, B, C and D must all be equal for correct alignment.



5. Torque the two clamp screws to the values shown below.

JVS-130	160 in-lb or 13 ft-lb
All others	325 in-lb or 27 ft-lb

NOTE: Be careful not to grasp flanges in such a manner as to cock them while tightening the clamp screws.

6. Install belts and properly tension.
7. Start drive and check speeds.
8. If a speed change is required, stop the drive, remove the belts and loosen the two clamp screws. Adjust the pitch diameter of the sheave as required. Follow steps 4 through 7 above.
9. When the correct speed is obtained, install all belt and sheave guards required.

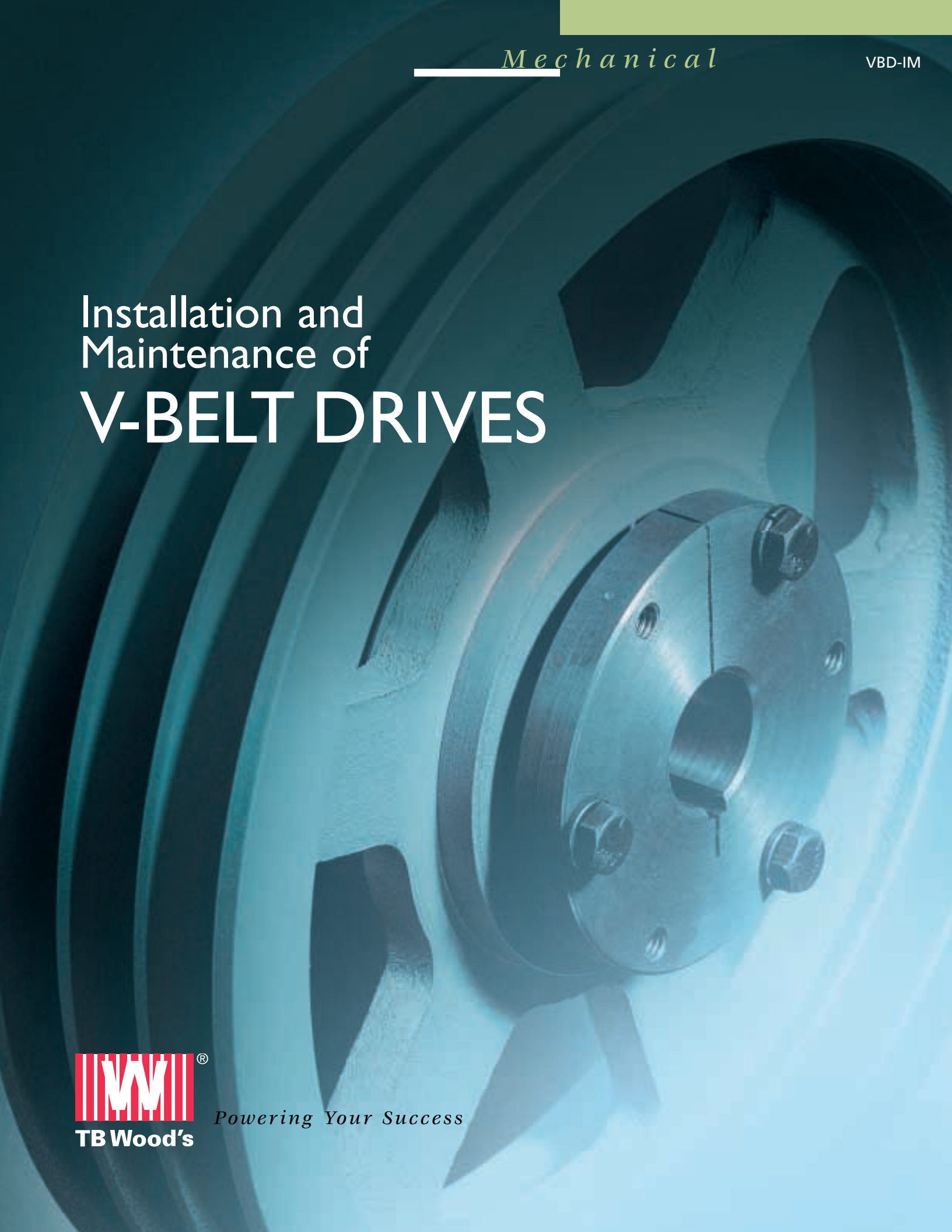
MAINTENANCE

No maintenance will be required if:

1. Clamp screws are properly torqued prior to operating sheave.
2. Clamp screws are loosened and belts removed when making speed adjustments.
3. Proper belt alignment and tension are maintained.

Should the JVS sheave require repairing, only the adjusting screw and clamp screw parts are available for field replacement. Should a rotating cast iron part need to be replaced, the sheave must be returned to the factory for repair. Please contact the factory and secure a Returned Goods Authorization tag to accompany your returned material.

Installation and Maintenance of V-BELT DRIVES



TB Wood's

Powering Your Success

TB Wood's

Quality Products and the Support to Back Them Up – Wood's

V-Belt sheaves of close grain, high-tensile cast iron are machined to provide safe, vibration-free operation at speeds up to 6500 FPM. Made to order sheaves of ductile iron material can be provided for speeds up to 10,000 FPM. V-Belt drives are only the beginning of what Wood's can do.

Wood's offers a complete line of high capacity synchronous drives. The RPP-Plus system offers a higher horsepower capacity drive at the cost of the competitions standard rated product. Wood's also offers the aramid fiber QT Powerchain drive in 8M and 14M pitch. The QT drive is capable of high horsepower capacity in a smaller package. Both QT and RPP sprockets offer metric/inch drilling for applications which require a totally metric drive system.

Wood's has many different ways of offering variable speed for customer applications. The most basic way is through the use of one of our many belted variable speed systems. Wood's also offers many different options in the line of electronic inverters and electronic speed controls. One of the most unique ways of varying speed, however, is our HSV/HSVA hydro-static systems. The HSV system is ideal for harsh, dirty, or explosive proof environments.

Wood's Elastomeric coupling line offers something for every application. Wood's Jaw couplings offer a full compliment of spider materials and bore option. Our Sure-Flex line offers the 4-way flexing action, and many different flange and sleeve options to meet your needs. The Dura-Flex coupling is designed and patented with improvements over other similar type coupling that provide for the maximum possible service life.

Wood's line of Steel couplings offers both gear and disc coupling options. Wood's Form-Flex disc couplings offer zero-backlash and eliminate the need for lubrication. Our gear couplings are available in all the standard, spacer, and special options common to the industry. In both disc and gear lines we welcome the challenge of the "special" coupling.

TB Wood's

Contents

The V-Belt Drive is industry's most popular means of power transmission. It is easy to select, simple to install, and will provide years of reliable performance.

Even when misapplied, improperly installed or completely ignored, the V-Belt Drive will usually deliver some kind of performance. However, with proper installation and maintenance, many years of operating efficiency can be added to the life span of the V-Belt Drive.

It is hoped that the information contained herein will help you receive the greatest possible value from your V-belts and sheaves, will help you receive a full measure of performance from industry's dominant drive.

TB Wood's

V-Drive Inspection and Maintenance Procedures

Well designed and properly installed V-belt drives are without question the most reliable, trouble-free means of power transmission available. In general, except for an occasional retensioning, they will run year in and year out without maintenance.

However, some do require periodic inspection and maintenance, both while the drive is running and while it is stationary.

Inspection while running

A noisy V-belt drive is like a person with a fever. Both need attention.

V-drive noise can be caused by the slapping of belts against the drive guard or other obstruction. Check for an improperly installed guard, loose belts or excessive vibration. Squealing of belts as a drive is started or while it is running is usually caused by a poorly tensioned drive and/or by a build-up of foreign material in the sheave grooves. But it can also be caused by oil or grease between the belt and the sheave groove.

If necessary, remove the belt guard and watch the drive while it is running under load. **(Caution: Observe only; stand clear of the running drive!)** Much can be learned by watching the action of the slack side of the drive. Each variation in the driven load causes a corresponding change in the tension of the slack side of the belt. During across-the-line starts or suddenly applied loads while running, the sag on the slack side of the drive will increase. If the sag under these conditions is excessive, tension should be increased.

Any vibration in a system will cause the slack side of the belts to dance up and down. Excessive vibration will also induce a vibration in the tight side of the drive. The cause of the vibration should be determined and corrected.

If a set of belts is perfectly matched, all belts will have the same amount of sag. However, perfection is a rare thing and there will usually exist some difference in sag from belt to belt. It is more important to look at the tight side of a drive to be sure that all of the belts are running tight. If one or more belts are running loose, the drive needs to be retensioned, or the belts replaced with a matched set.

The above conditions could also be caused by uneven wear of the grooves in the sheave. These should be checked with sheave groove gages.

Inspect sheaves often

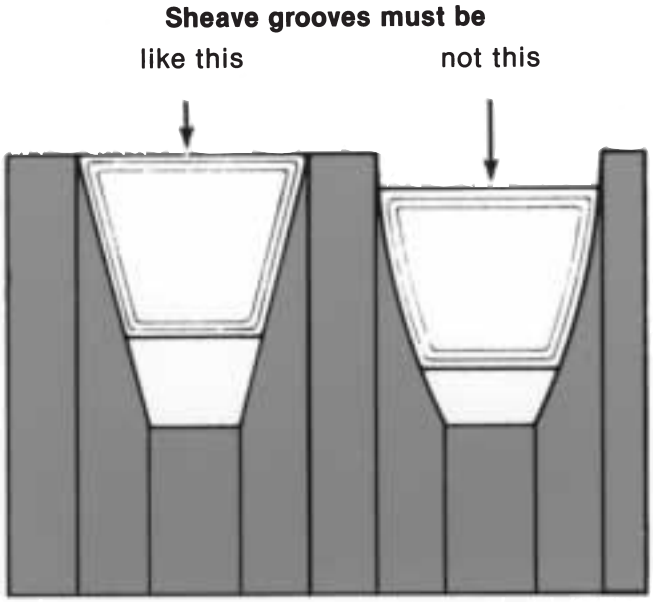
Keep all sheave grooves smooth and uniform. Burrs and rough spots along the sheave rim can damage belts. Dust, oil and other foreign matter can lead to pitting and rust and should be avoided as much as possible. If sheave sidewalls are permitted to "dish out," as shown in the picture on page 2, the bottom "shoulder" ruins belts quickly by chewing off their bottom corners. Also, the belt's wedging action is reduced and it loses its gripping power.

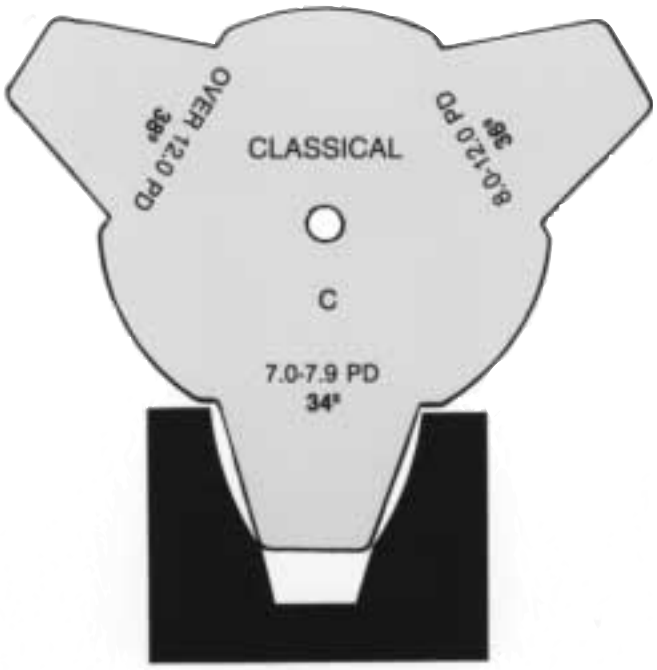
A shiny groove bottom indicates that either the sheave, the belt or both are badly worn and the belt is bottoming in the groove.

Badly worn grooves cause one or more belts to ride lower than the rest of the belts, and the effect is the same as with mismatched belts. This is called "differential driving." The belts riding high in the grooves travel faster than the belts riding low. In a drive under proper tension, a sure sign of differential driving is when one or several belts on the tight side are slack.

Check alignment of drive. Sheaves that are not aligned properly cause excessive belt and sheave wear. When the shafts are not parallel, belts on one side are drawn tighter and pull more than their share of the load. These overloaded belts wear out faster, reducing the service life of the entire set. If the misalignment is between the sheaves themselves, belts will enter and leave the

grooves at an angle, causing excessive cover and sheave wear and premature failure. See page 10 for complete information on drive alignment.



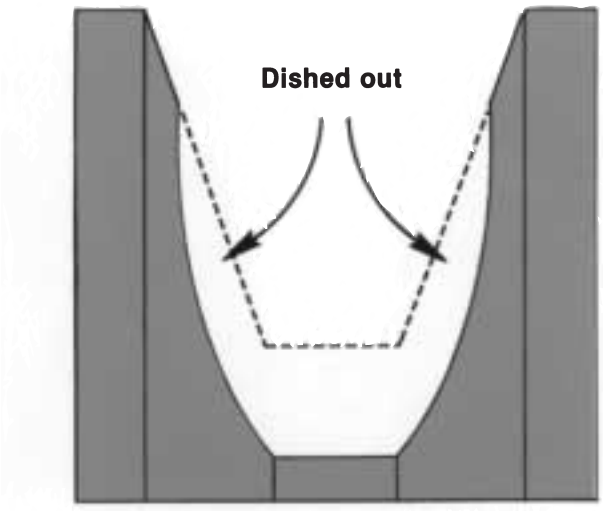


Groove gage.

Belt and sheave gages

Belt and sheave groove gage sets are available from your Wood's distributor.

You can use them to determine the proper belt section by trying the old belt in the various gages until a proper fit is obtained. The cross section of the Classical or Narrow belt can be read from the gage.



To check sheave grooves for wear, simply select the proper gage and template for the sheave diameter; then insert the gage in the groove until the rim of the gage butts against the outside diameter of the sheave flange. Worn grooves will show up as illustrated below. If more than $\frac{1}{32}$ inch of wear can be seen, poor V-belt life may be expected.

Check belt fit

Classical V-belts should ride in standard sheave grooves so that the top surface of the belt is just above the highest point of the sheave. In A-B combination grooves, an A section belt will ride slightly low in the groove, while a B belt will be in the normal position. In special deep groove sheaves, belts will ride below the top of the sheave.

Narrow belts are purposely designed so that the top of the belt will ride above the O.D. of the sheave. The tensile cords are located in the belt so that they ride almost at the O.D. of the sheave. This simplifies sheave identification and drive calculations.

No matter which V-belt section the sheave is grooved for, the belts should never be allowed to

bottom in the groove. This will cause the belt to lose its wedging action, to slip and/or burn. Sheaves worn to the point where they allow a belt to bottom should be replaced immediately.

Keep belts clean

Dirt and grease reduce belt life. Belts should be wiped with a dry cloth occasionally to remove any build-up of foreign material. If the belts have been splattered with grease and/or oil, clean them with methyl chloroform or soap and water. Inflammable cleaners such as gasoline are to be avoided as a matter of safety.

Although all Wood's V-belts are of oil resistant construction, an occasional cleaning will help to prolong their life.

Under no circumstances is the use of belt dressing recommended on a V-belt. The remedial effect is only temporary. It is much better to keep the belts and grooves of the drive clean.

Use belt guards

Belt guards protect personnel and the drive itself. They should be definitely used in abrasive atmospheres to protect the drive from sand, metal chips and other foreign matter. But they should be ventilated to avoid excessive heat.

Check them periodically for damage and for loose or missing mounting bolts. These could cause the belts to come in contact with the guard and cause failure.

Guards alone will generally protect belts from abrasion. But where abrasive materials are common — in rock processing machinery, grinders, foundries, etc. — drives should be inspected frequently for excessive belt and groove wear.

Check for hot bearings

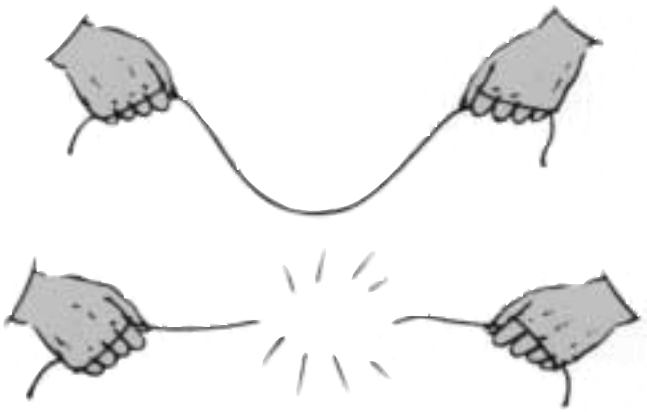
When the drive has been stopped for inspection, check the bearings to make sure they are not running hot. If they are, it could be due to improper lubrication or improper drive tension. Hot bearings can be caused by belts that are either too tight or too loose. Check the tension carefully using the instructions furnished.

If the belts are slipping on your drive, retension the drive. Never use belt dressing to correct slipping belts.

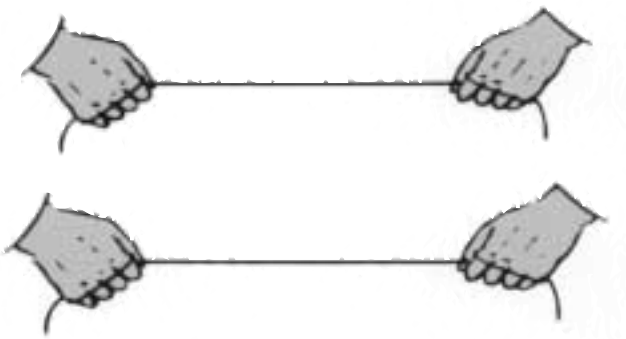
Maintain proper belt tension

Maintaining correct tension is the most important rule of V-belt care. It will give the belts 50% to 100% longer life.

Belts that are too loose will slip, causing excessive belt and sheave wear. V-belts that sag too much are snapped tight suddenly when the motor starts or when peak loads occur. That snapping action can actually break the belts, because the added stress is more than the belt was designed to take. This can be clearly demonstrated with a piece of string, as illustrated.



Loosely-held string snaps easily,
Taut string can stand strong pull.



TB Wood's

Belt Selection

Selecting the correct belts

All the work and experience that goes into designing a V-belt drive is wasted if the specified belts are not used or the number of belts is changed. Over-belting is wasteful. Under-belting is even more expensive in the long run, because overloaded belts wear out faster.

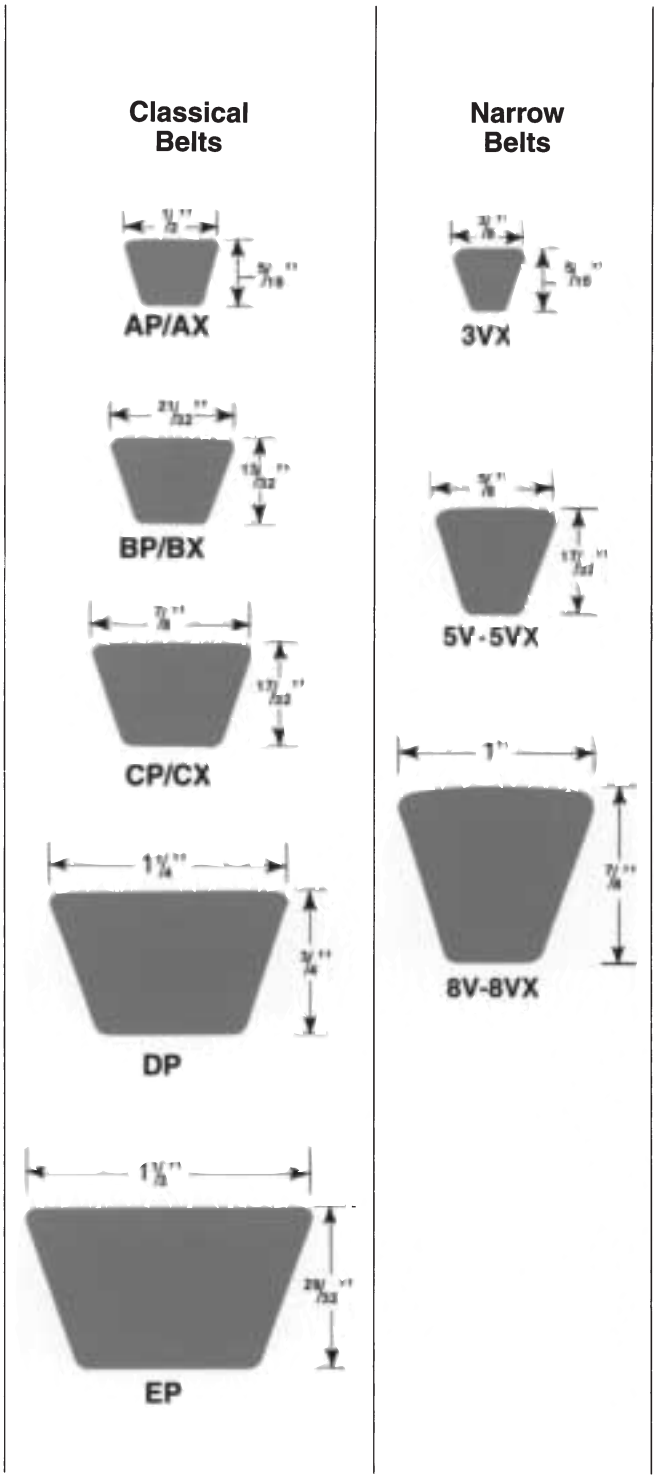
V-belts are identified for size according to industry standards. A combination of letters and numbers indicates the width across the top of the belt (often referred to as "cross section") and the belt length. Classical belts come in five widths: A, B, C, D, and E; while Narrow belts are made in three widths: 3V, 5V, and 8V. In addition, there are the Light Duty 2L, 3L, 4L, and 5L belts. If you are not sure which to use, measure the top width of the old belts carefully, or use Wood's gages described previously.

Be careful in measuring V-belts. The top widths of the B and 5V belts are very close; however, the 5V is considerably thicker, and the groove angles of the sheaves are different. Do not attempt to use these belts interchangeably. The 4L and 5L Light Duty belts are also very close in size to the A and B belts. But again, groove angles may be different. Light Duty belts should not be used on heavy-duty drives.

The belt number C270 indicates a belt with a nominal 7/8" top width and a nominal length of 270". Its pitch length is 270.9". These should be ordered as: CP270 Classical belts. (The "P" is for Wood's Premium construction.)

The number 5VX1250 indicates a narrow belt with a nominal 5/8" top width and an effective outside length of 125". These belts should be ordered as follows: 5VX1250 Narrow belts. (The "X" identifies cogged construction belts.)

The number 4L550 indicates a Light Duty fractional horsepower belt having a nominal top width of 1/2" and a nominal outside length of 55". Light Duty belts are available for general purpose applications; specify 4L550 Light Duty. It is designed to have little or no stretch and will require few take-ups during its life.



To assure maximum V-belt life, follow the minimum recommended pitch and sheave diameters for belts established by Mechanical Power Transmission Association and Rubber Manufacturers Association standards.

Classical Belt Section	Minimum* Pitch Diameter
A	3.0”
AX	2.2”
B	5.4”
BX	4.0”
C	9.0”
CX	6.8”
D	13.0”

**Not applicable to Light Duty Belts*

Narrow Belt Section	Minimum Sheave Diameter
3V	2.65”
3VX	2.2”
5V	7.1”
5VX	4.4”
8V	12.5”

All belts “ORS”

At one time it was necessary to order special belts for various types of environments. All Wood’s belts are of ‘‘ORS’’ construction, meaning they are heat resistant, oil resistant and static conducting.

By heat resistant, we mean these belts will operate well in ambient temperatures up to 140°F. They may be operated at higher temperatures, but there would be a reduction in service life. In general, short belts develop higher internal temperatures than long belts. They are usually subjected to more flexures per minute and are frequently found on totally-enclosed drives where there is little or no air circulation.

Oil resistance is a matter of degree. It varies with the amount of contact with oil, whether it is continuous or intermittent immersion, exposure to an atmospheric mist or an occasional spattering. A great many chemicals, particularly petroleum derivatives, can cause deterioration. All Narrow, Classical and Light Duty belts will withstand nominal exposure to oil and grease, but they are not 100% oilproof.

For maximum performance from belts in oily atmospheres, they should be guarded as much as practical against excessive amounts of oil and should be periodically cleaned with methyl chloroform. Oil and grease on belts and sheaves will tend to lubricate the drive and reduce the traction of the belt, even though they may not actually harm the belts themselves. However, since the friction factor is reduced, belts must be operated at abnormal tensions, and their life is shortened.

Belt failure caused by oil is obvious and easy to detect. The most apparent sign is the build-up of a black, soft substance that can be wiped off when the belt is rubbed. Another sign is a softening and swelling of the belt to the point where it no longer fits the sheave groove properly.

Like oil resistance, resistance to ozone is a matter of degree. Narrow, Classical and Light Duty belts are resistant to normal amounts of ozone in the atmosphere. However, high concentrations such as found around arc welding equipment can cause rubber to harden and crack. It is because of ozone that belts should never be stored in direct sunlight.

Belts intended for operation in potentially dangerous atmospheres are constructed with a relatively low electrical resistance characteristic and referred to as “static conducting.” All Narrow, Classical and Light Duty belts meet the following requirements.

In the standard method of measuring a belt’s electrical resistivity, two ⅝’’-diameter flat contacts are placed 8½’’ apart on centers, moistened with water and pressed against the belt with a force of 12½ lbs. The resistance ‘‘conductivity’’ between the contacts is measured with an ohmmeter operating at a potential of 500 volts and having an accuracy range from 0 to 10 megohms. Experience has demonstrated that the dissipation provided by belts having a resistance of 6 megohms or less ‘‘when new and measured as above’’ is satisfactory for operation in hazardous atmospheres.

Explosive atmospheres

Belts on drives in hazardous atmospheres should be kept reasonably free of encrusted accumula-

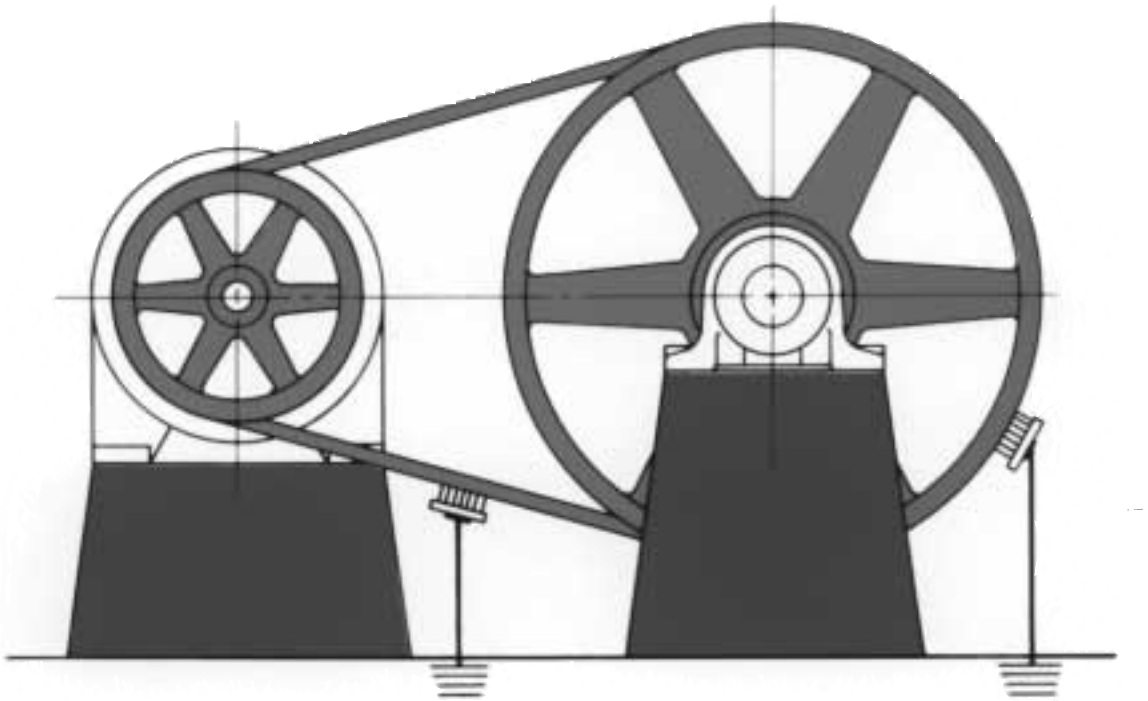
tions of non-conducting materials. In addition, all elements of the drive must be interconnected and grounded to earth as illustrated here.

Although we know of no explosion caused by static generated by a V-belt drive, we cannot accept responsibility beyond that of furnishing belts within the above described limits.

Store belts properly

V-belts should be stored in a cool, dry place out of direct sunlight. They should be kept away from ozone-producing equipment such as arc welders and high voltage apparatus. Temperature should be below 85°F, relative humidity below 70%. If belts are stored in piles, the piles should be kept small to avoid excessive weight which could distort the bottom belts. When belts are stored in boxes, the box size should be limited. Ideally, belts should be hung on saddle type pegs. With proper storage, belt quality will not change significantly within eight years.

Assuming good storage practices, a decrease in service life of approximately 10% per year of storage beyond eight years can be expected. From a norm of eight years storage life at 85˚, it is estimated that the storage limit should be reduced by half for each 15˚ increase in temperature. A significant increase in humidity may cause a fungus to form on belts, but any effect on the performance of the belt would be very slight.



Proper V-drive installation in explosive atmospheres

Safety Tips

No matter where rotating machines are located or by what means they are driven, there is always a chance of personal injury unless they are installed and operated under safe conditions. It is with this thought uppermost in our minds that this manual is written.

Guard all drives properly

All regulating agencies such as OSHA, State Departments of Labor and Industry, insurance firms and other safety authorities either recommend or insist on drive guards. We, also, strongly recommend that every V-belt drive be completely guarded. Do not be lulled into a sense of security by a temporary or makeshift guard.

Of course, provision can and should be made for proper ventilation and inspection by the use of grills, inspection doors and removable panels. But the guard should have no gap where workers can reach inside and become caught in the drive. Besides being a safety asset, a good guard helps make maintenance easier by protecting the drive from weather and foreign objects.

Check safe speed limits

Safe speed limits for sheaves manufactured by TB Wood's Incorporated have been established by a rigorous burst testing program. The limit for cast iron sheaves has been established at 6500 fpm; the maximum speed in rpm corresponding to 6500 fpm is either cast or stamped on each sheave.

Before installing the drive, this safe speed limit should be checked against the speed of the shaft on which it is being installed. Operating sheaves above recommended speeds could result in serious damage to equipment and/or serious personal injury.

Safe speed is cast into the arm of Wood's sheaves.

Burst testing. Results of centrifugal force are clearly shown in these broken "D"-groove sheaves. The pattern of breakage is typical. The rim breaks away from the arms, arms break from hub and the hub shatters through its bolt holes. With the force in several hundred thousand pounds, it all happens in a split second.

TB Wood's

Drive Installation

Sure-Grip® Sheave and Bushing Installation Instructions

Wood's Sure-Grip bushings are the most widely used, tapered, QD-type and have exceptional holding power that eliminates wobble. Standard and reverse mounting features provide greater adaptability. Sure-Grip bushings can be used interchangeably in many of Wood's products as well as those of other maufacturers.

To Install:

IMPORTANT:
DO NOT USE LUBRICANTS IN THIS INSTALLATION

Before beginning, make sure the correct size and quantity of parts are available for the installation. The bushing has been manufactured to accept a setscrew over the key and its use is optional. It is packaged with the hardware on sizes SH to M and loosely installed in the bushing on sizes N to S.

1. Inspect the tapered bore of the sheave and the tapered surface of the bushing. Any paint, dirt, oil, or grease MUST be removed.

2. Select the type of mounting (See Fig. 1 or 2) that best suits your application.

3. **STANDARD MOUNTING:** Install shaft key. (Note: If key was furnished with bushing, you must use that key.) Install bushing on clean shaft, flange end first. If bushing will not freely slide on the shaft, insert a screwdriver or similar object into the flange sawcut to act as a wedge to open the bushing's bore. **Caution: Excessive wedging will split the bushing.** If using the setscrew, tighten it just enough to prevent the bushing from sliding on the shaft. **Caution: Do not over tighten setscrew!** Slide sheave into position on bushing aligning the drilled holes in the sheave with the tapped holes in the bushing flange. (Note: Install M thru S bushings so that the two tapped holes in the sheave are located as far away as possible from the bushing's sawcut.) Loosely thread the capscrews with lockwashers into the assembly. **DO NOT USE LUBRICANT ON THE CAPSCREWS!**

4. **REVERSE MOUNTING:** With large end of the taper out, slide sheave onto shaft as far as possible. Install shaft key. (See shaft key note in #3 above.) Install bushing onto shaft so tapered end will mate with sheave. (See wedging note in #3 above.)If using the setscrew, tighten it enough to prevent the bushing from sliding on the shaft. **Caution: Do not over tighten setscrew!** Pull the sheave up on the bushing, aligning the drilled holes in the bushing flange with the tapped holes in the sheave. Loosely thread the capscrews with lockwashers into the assembly. **DO NOT USE LUBRICANT ON THE CAPSCREWS!**

5. Using a torque wrench, tighten all capscrews evenly and progressively in rotation to the torque value in Table. There must be a gap between the bushing flange and sheave hub when installation is complete. **DO NOT OVER TORQUE! DO NOT ATTEMPT TO CLOSE GAP BETWEEN BUSHING FLANGE AND SHEAVE HUB!**

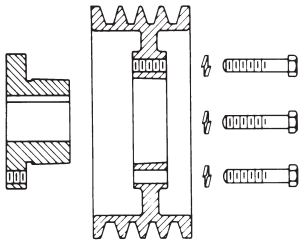


FIG. 1 **Standard Mounting**

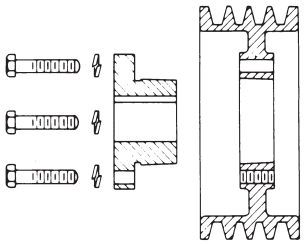


FIG. 2 **Reverse Mounting**

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To Remove:

1. Relieve drive tension by shortening the center distance between driver and driven sheaves.
2. Lift off belts.
3. Loosen and remove cap screws. If the bushings have keyway setscrews, loosen them.
4. As shown below, insert cap screws (three in JA through J bushings, two in QT and M thru W bushings and four in S bushing) in tapped removal holes and progressively tighten each one until mating part is loose on bushing. (Exception: If mating part is installed with cap screw heads next to motor, with insufficient room to insert screws in tapped holes, loosen cap screws and use wedge between bushing flange and mating part.)
5. Remove mating part from bushing, and if necessary, bushing from shaft.

Sure-Grip Bushing
Screw Tightening Information

Tapered Bushing	Size & Thread of Cap Screw	Ft.-Lbs. To Apply With Torque Wrench
QT	1/4—20	9
JA	No. 10—24	5
SH-SDS-SD	1/4—20	9
SK	5/16—18	15
SF	3/8—16	30
E	1/2—13	60
F	9/16—12	110
J	5/8—11	135
M	3/4—10	225
N	7/8—9	300
P	1 —8	450
W	1 1/8—7	600
S	1 1/4—7	750

CAUTION: The tightening force on the screws is multiplied many times by the wedging action of the tapered surface. If extreme tightening force is applied, or if a lubricant is used, bursting pressures will be created in the hub of the mating part.

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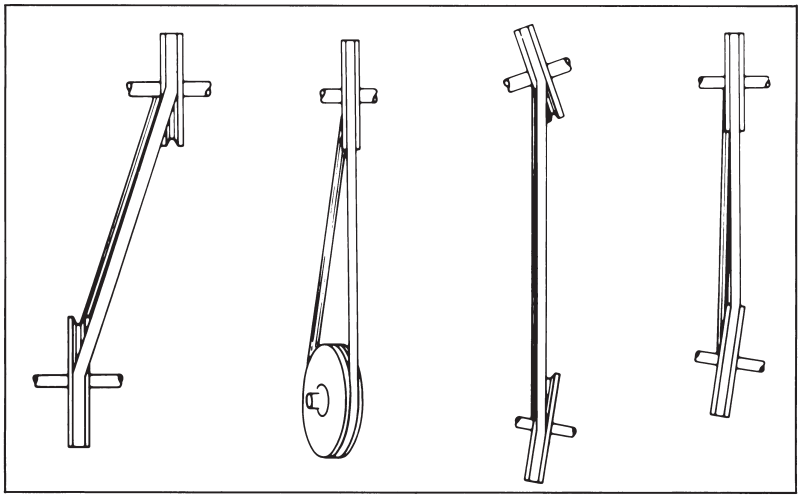
Check alignment

Although alignment is not as critical in V-belt drives as in others, proper alignment is essential to long belt and sheave life.

First, make sure that drive shafts are parallel. The most common causes of misalignment are non-parallel shafts and improperly located sheaves.

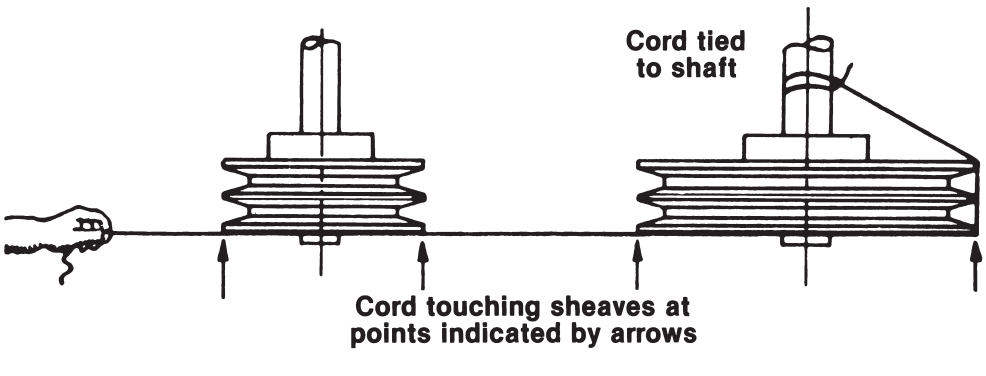
Where shafts are not parallel, belts on one side are drawn tighter and pull more than their share of the load. As a result, these belts wear out faster, requiring the entire set to be replaced before it has given maximum service. If misalignment is in the sheave, belts will enter and leave the grooves at an angle, causing excessive belt cover and sheave wear.



Shaft alignment can be checked by measuring the distance between the shafts at three or more locations. If the distances are equal, then the shafts will be parallel.

To check the location of the sheaves on the shafts, a straightedge or a piece of string can be used. If the sheaves are properly lined up, the string will touch them at the points indicated by the arrows in the accompanying sketch. Rotating each sheave a half revolution will determine whether the sheave is wobbly or the drive shaft is bent. Correct any misalignment.

With sheaves aligned, tighten cap screws evenly and progressively. Apply the recommended torque to cap screws as listed in table on page 9. NOTE: There should be ⅛'' to ¼'' gap between the mating part hub and the bushing flange. If gap is closed, the shaft is seriously undersize.



Install belts

Shorten the center distance between the driven and driver sheave so the belts can be put on without the use of force.

While the belts are still loose on the drive, rotate the drive until all the slack is on one side. Then increase the center distance until the belts are snug. The drive is now ready for tensioning.

NOTE: Never "roll" or "pry" the belts into the sheave grooves. This can damage the belt cords and lead to belt turnover, short life or actual breakage. Moreover, it is both difficult and unsafe to install belts this way.

Keep takeup rails, motor base or other means of center distance adjustment free of dirt, rust and grit. Lubricate adjusting screws and slide rails from time to time.

When belts are forced into the sheave with a screwdriver or other wedge, the outer fabric is often ruptured and cords broken.

It is well worth the time to move the driver unit forward so V-belts can be slipped easily into the sheave groove without damage.

Center Distance Allowance for Installation and Take-Up (Inches)

Narrow Belts

Belt Length	For Installation (Subtract)						For take-up (Add)
	3VX & 3V	3V Banded	5VX & 5V	5V Banded	8VX & 8V	8V Banded	All Cross Sections
250 thru 475	0.5	1.2	–	–	–	–	1.0
500 thru 710	0.8	1.4	1.0	2.1	–	–	1.2
750 thru 1060	0.8	1.4	1.0	2.1	1.5	3.4	1.5
1120 thru 1250	0.8	1.4	1.0	2.1	1.5	3.4	1.8
1320 thru 1700	0.8	1.4	1.0	2.1	1.5	3.4	2.2
1800 thru 2000	–	–	1.0	2.1	1.8	3.6	2.5
2120 thru 2360	–	–	1.2	2.4	1.8	3.6	3.0
2500 thru 2650	–	–	1.2	2.4	1.8	3.6	3.2
2800 thru 3000	–	–	1.2	2.4	1.8	3.6	3.5
3150 thru 3550	–	–	1.2	2.4	2.0	4.0	4.0
3750	–	–	–	–	2.0	4.0	4.5
4000 thru 5000	–	–	–	–	2.0	4.0	5.5

Classical Belts

Belt Length Designation	For Installation (Subtract)							For take-up (Add)
	AX & AP	BX & BP	BX & BP Banded	CX & CP	CX & CP Banded	DX & DP	DX & DP Banded	All Cross Sections
21 thru 35	0.8	1.0	1.5	–	–	–	–	1.0
36 thru 55	0.8	1.0	1.5	1.5	2.0	–	–	1.5
56 thru 85	0.8	1.2	1.6	1.5	2.0	–	–	2.0
86 thru 112	1.0	1.2	1.6	1.5	2.0	–	–	2.5
116 thru 144	1.0	1.3	1.8	1.5	2.1	2.0	2.9	3.0
148 thru 180	–	1.3	1.8	2.0	2.2	2.0	3.0	3.5
191 thru 210	–	1.5	1.9	2.0	2.3	2.0	3.2	4.0
225 thru 240	–	1.5	2.0	2.0	2.5	2.5	3.2	4.5
255 thru 300	–	1.5	2.2	2.0	2.5	2.5	3.5	5.0
315 thru 390	–	–	–	2.0	2.7	2.5	3.6	6.0
420 and Over	–	–	–	2.5	2.9	3.0	4.1	1.5% of belt length.

All dimensions in inches.

TB Wood's

Tensioning V-Belt Drives

Without exception, the most important factor in the successful operation of a V-belt drive is proper belt-tensioning. To achieve the long, trouble-free service associated with V-belt drives, belt tension must be sufficient to overcome slipping under maximum peak load. This could be either at start or during the work cycle. The amount of peak load will vary depending upon the character of the driven machine or drive system. To increase total tension, merely increase the center distance. Before attempting to tension any drive it is imperative that the sheaves be properly installed and aligned. If a V-belt slips it is too loose. Add to the tension by increasing the center distance. Never apply belt dressing as this will damage the belt and cause early failure.

General method

The general method for tensioning V-belts should satisfy most drive requirements.

Step 1: Reduce the center distance so that the belts may be placed over the sheaves and in the grooves without forcing them over the sides of the grooves. Arrange the belts so that both the top and bottom spans have about the same sag. Apply tension to the belts by increasing the center distance until the belts are snug. See figure 1.

Step 2: Operate the drive a few minutes to seat the belts in the sheave grooves. Observe the operation of the drive under its highest load condition (usually starting). A slight bowing of the slack side of the drive indicates proper tension. If the slack side remains taut during the peak load, the drive is too tight. Excessive bowing or slippage indicates insufficient tension. If the belts squeal as the motor comes on or at some subsequent peak load, they are not tight enough to deliver the torque demanded by the drive machine. The drive should be stopped and the belts tightened.

Step 3: Check the tension on a new drive frequently during the first day by observing the slack side span. After a few days' operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust so that the drive again shows a slight bow in the slack side.

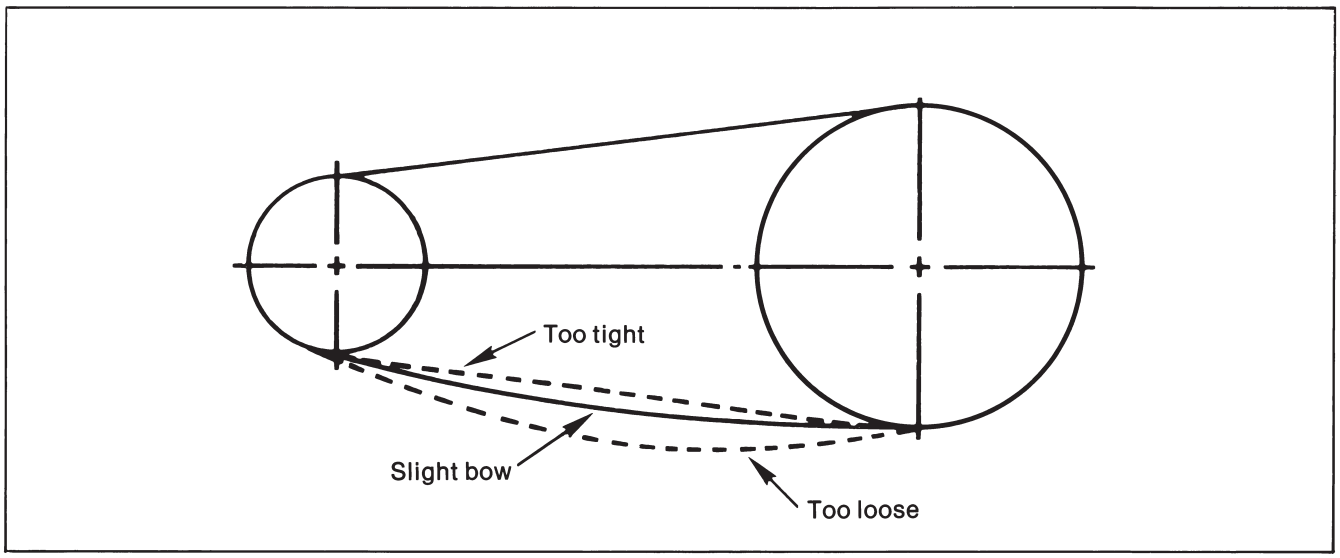


Figure 1

Force deflection method

This method should be used only for tensioning drives on which the grade of belt, rated belt capacity, service factor, design horsepower, etc. are known.

Step 1: Install belts per Step 1 of General Method. Measure span length (t) in inches as shown in figure 2, or calculate using formula.

Step 2: From figure 2 the deflection height (h) is always 1/64" per inch of span length (t). For example, a 32" span length would require a deflection of 32/64" or 1/2".

Step 3: Determine the minimum, maximum, and initial recommended pounds force using table 1 or calculate based on the required Static Strand Tension (T_S). Note: The initial recommended force is used only for installing new belts which have not seated themselves into the sheave grooves and where initial belt stretch has not taken place.

Step 4: Using a spring scale, apply a perpendicular force to any ONE of the belts at the mid point of the span as shown in figure 2. Compare this deflection force with the values found in Step 3.

a. If the deflection force is below the minimum, the belts are too loose and the tension should be increased by increasing the center distance.

b. If the deflection force is higher than the maximum, the belts are too tight and the tension should be decreased.

When new V-belts are installed on a drive the INITIAL tension will drop rapidly during the first few hours. Check tension frequently during the first 24 hours of operation. Subsequent retensioning should fall between the minimum and maximum force.

To determine the deflection distance from normal position, use a straightedge or stretch a cord from sheave to sheave to use as a reference line. On multiple-belt drives an adjacent undeflected belt can be used as a reference.

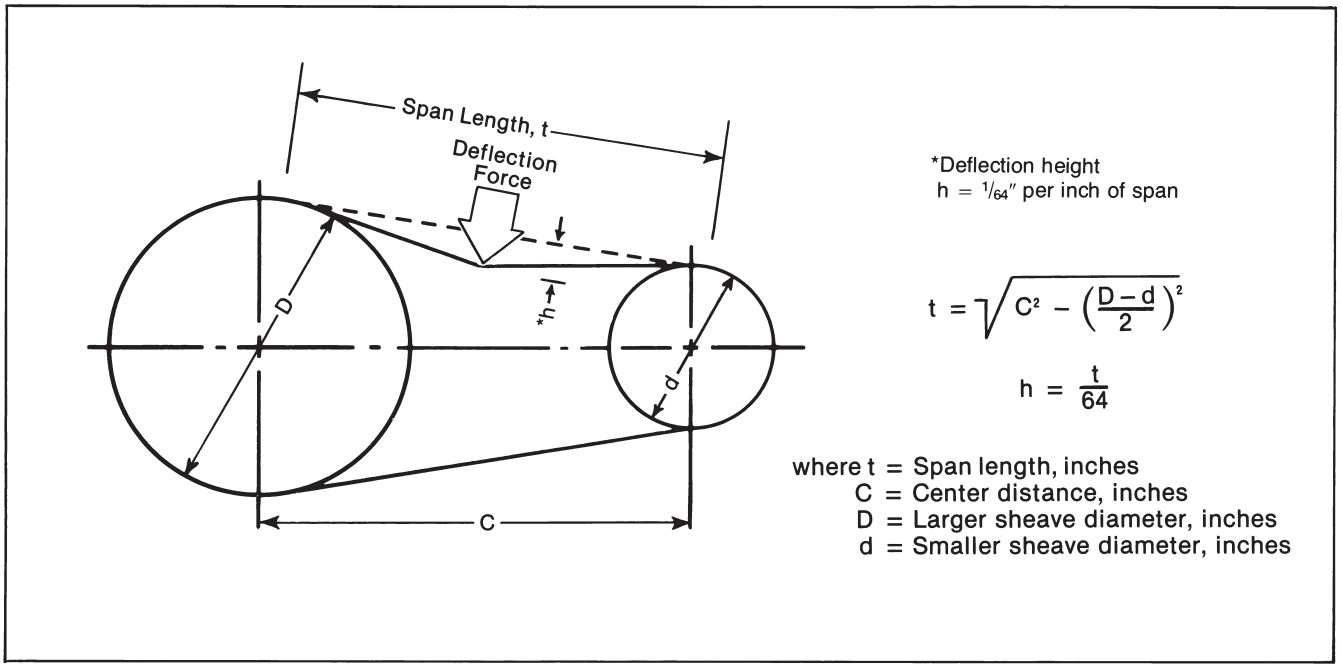


Figure 2

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Table 1
Recommended Minimum Force Per Belt

Belt Section	Small Sheave		Drive Ratio			
	Speed Range	Dia.	1.0	1.5	2.0	4.0 & over
3V	1200-3600	2.65	2.0	2.4	2.6	3.0
	1200-3600	3.65	2.8	3.6	3.8	4.2
	1200-3600	4.75	3.8	4.2	4.4	4.8
	1200-3600	5.60	4.2	4.6	4.8	5.4
	1200-3600	6.90	4.6	5.0	5.2	5.6
5V	900-1800	7.1	8.5	9.5	10	11
	900-1800	9.0	10	11	12	13
	900-1800	14.0	12	13	14	15
	700-1200	21.2	14	15	16	17
8V	900-1800	12.5	18	21	23	25
	900-1800	14.0	21	23	24	28
	700-1500	17.0	24	26	28	30
	700-1200	21.2	28	30	32	34
	400-1000	24.8	31	32	34	36
3VX	1200-3600	2.20	2.2	2.5	2.7	3.0
	1200-3600	2.50	2.6	2.9	3.1	3.6
	1200-3600	3.00	3.1	3.5	3.7	4.2
	1200-3600	4.12	3.9	4.3	4.5	5.1
	1200-3600	5.30	4.6	4.9	5.1	5.7
	1200-3600	6.9	5.0	5.4	5.6	6.2
5VX	1200-3600	4.4	6.5	7.6	8.0	9.0
	1200-3600	5.2	8.0	9.0	9.5	10
	1200-3600	6.3	9.5	10	11	12
	1200-3600	7.1	10	11	12	13
	900-1800	9.0	12	13	14	15
	900-1800	14.0	14	15	16	17
AP	1800-3600	3.0	2.0	2.3	2.4	2.6
	1800-3600	4.0	2.6	2.8	3.0	3.3
	1800-3600	5.0	3.0	3.3	3.4	3.7
	1800-3600	7.0	3.5	3.7	3.8	4.3
BP	1200-1800	4.6	3.7	4.3	4.5	5.0
	1200-1800	5.0	4.1	4.6	4.8	5.6
	1200-1800	6.0	4.8	5.3	5.5	6.3
	1200-1800	8.0	5.7	6.2	6.4	7.2
CP	900-1800	7.0	6.5	7.0	8.0	9.0
	900-1800	9.0	8.0	9.0	10	11
	900-1800	12.0	10	11	12	13
	700-1500	16.0	12	13	13	14
DP	900-1500	12.0	13	15	16	17
	900-1500	15.0	16	18	19	21
	700-1200	18.0	19	21	22	24
	700-1200	22.0	22	23	24	26
AX	1800-3600	3.0	2.5	2.8	3.0	3.3
	1800-3600	4.0	3.3	3.6	3.8	4.2
	1800-3600	5.0	3.7	4.1	4.3	4.6
	1800-3600	7.0	4.3	4.6	4.8	5.3
BX	1200-1800	4.6	5.2	5.8	6.0	6.9
	1200-1800	5.0	5.4	6.0	6.3	7.1
	1200-1800	6.0	6.0	6.4	6.7	7.7
	1200-1800	8.0	6.6	7.1	7.5	8.2
CX	900-1800	7.0	10	11	12	13
	900-1800	9.0	11	12	13	14
	900-1800	12.0	12	13	13	14
	700-1500	16.0	13	14	14	15
DX	900-1500	12.0	16	18	19	20
	900-1500	15.0	19	21	22	24
	700-1200	18.0	22	24	25	27
	700-1200	22.0	25	27	28	30

MAXIMUM Deflection Force = Minimum times 1.5

INITIAL Deflection Force = Minimum times 2.0

Minimum deflection force values shown in table 1 are based on assumed average static tensions for drives having multiple belts or more than one V-band, thus eliminating calculations. (For drives using only one belt or one V-band, deflection force must be determined by use of engineering formulas.)

Find the minimum recommended deflection force for the belt section and type based upon the small sheave diameter, speed and drive ratio. For intermediate sheave diameters and/or drive ratio combinations the minimum deflection force may be interpolated.

For Narrow Band, Classical Band and Classical Cog Band belts multiply the minimum deflection force from table 1 by the number of belts in the band. Where larger values make use of the Force Deflection Method impractical, use the Elongation Method to tension V-bands.

Table 2
K Factors and Arc of Contact

$\frac{D-d}{C}$	Arc Contact Degree	Factor Ac	Factor K	$\frac{D-d}{C}$	Arc Contact Degree	Factor Ac	Factor K
0.000	180	1.000	24.750	0.750	136	0.879	30.411
0.025	179	0.997	24.883	0.775	134	0.874	30.688
0.050	177	0.994	25.019	0.800	133	0.869	30.975
0.075	176	0.990	25.158	0.825	131	0.864	31.270
0.100	174	0.987	25.300	0.850	130	0.858	31.576
0.125	173	0.983	25.444	0.875	128	0.852	31.892
0.150	171	0.980	25.591	0.900	127	0.847	32.219
0.175	170	0.977	25.742	0.925	125	0.841	32.558
0.200	169	0.973	25.896	0.950	123	0.835	32.909
0.225	167	0.969	26.053	0.975	122	0.829	33.273
0.250	166	0.966	26.213	1.000	120	0.823	33.652
0.275	164	0.962	26.377	1.025	118	0.816	34.045
0.300	163	0.958	26.545	1.050	117	0.810	34.454
0.325	161	0.954	26.717	1.075	115	0.803	34.879
0.350	160	0.951	26.892	1.100	113	0.796	35.323
0.375	158	0.947	27.072	1.125	112	0.789	35.786
0.400	157	0.943	27.257	1.150	110	0.782	36.270
0.425	155	0.939	27.445	1.175	108	0.774	36.777
0.450	154	0.935	27.639	1.200	106	0.767	37.307
0.475	153	0.930	27.837	1.225	104	0.759	37.864
0.500	151	0.926	28.040	1.250	103	0.751	38.448
0.525	150	0.922	28.249	1.275	101	0.742	39.064
0.550	148	0.917	28.463	1.300	99	0.734	39.713
0.575	147	0.913	28.684	1.325	97	0.725	40.398
0.600	145	0.908	28.910	1.350	95	0.716	41.123
0.625	144	0.904	29.142	1.375	93	0.706	41.892
0.650	142	0.899	29.381	1.400	91	0.697	42.709
0.675	141	0.894	29.627	1.425	89	0.687	43.580
0.700	139	0.889	29.881				
0.725	137	0.884	30.142				

Force deflection engineering formulas

For a more precise method, or where a V-drive combination is not within specified limits, table 1, use the following engineering formulas to determine force deflection values.

Step 1: Determine Span Length (t) and Deflection Height (h). Reference figure 2.

Step 2: Calculate the Static Strand Tension (Ts).

$$Ts = \frac{K \times DHP}{N \times S} + \frac{MS^2}{2}$$

Step 3: Calculate the recommended Deflection Forces (P) for drives using multiple belts or more than one V-band.

$$P_{Minimum} = \frac{Ts + Y}{16}$$

$$P_{Maximum} = \frac{1.5(Ts) + Y}{16}$$

$$P_{Initial} = 1.33 \text{ times } P_{Maximum}$$

Explanation of Symbols

- A_c = Arc of contact - smaller sheave, degrees
- C = Center distance, inches
- D = Larger sheave pitch diameter, inches
- d = Smaller sheave pitch diameter, inches
- DHP = Design horsepower based upon the recommended application service factor
- h = Deflection height, inches (Refer. figure 2)
- K = Value from table 2 depending on $\frac{D-d}{C}$ or $K = 16.5 \frac{2.5-A_c}{A_c}$
- L = Belt length, inches
- M = Centrifugal constant table 3
- N = Number of belts or V-band ribs
- P = Deflection force, pounds
- S = Belt speed, FPM/1000
- t = Span length, inches (Refer. figure 2)
- Y = Belt constant table 3

Note: For drives using only one belt or one V-band, and at least one shaft free to rotate use the following to determine the recommended Deflection Forces (P).

$$P_{Minimum} = \frac{Ts + Y\left(\frac{t}{L}\right)}{16} \qquad P_{Maximum} = \frac{1.5(Ts) + Y\left(\frac{t}{L}\right)}{16} \qquad P_{Initial} = 1.33 \text{ times } P_{Maximum}$$

Table 3
Belt Constants M and Y

Factors	Narrow			Narrow Cog		Classical					Classical Cog			
	3V	4V	8V	3VX	5VX	AP	BP	CP	DP	EP	AX	BX	CX	DX
M Single Belts	.46	1.23	3.28	.39	1.08	.66	1.08	1.98	3.74	5.85	.61	1.00	1.78	3.97
M V-Band	.51	1.32	3.80	—	—	—	1.40	2.33	4.29	6.26	—	1.28	2.10	4.56
Y	4.0	12.00	22.00	7.0	20.0	6.0	9.0	16.0	30.00	45.00	7.0	10.00	28.00	82.00

Belt elongation method

This method is recommended for V-band drives where larger deflecting forces make the use of previously described methods impractical.

Elongation is related to the tension causing it; thus, tape measured V-band lengths, both slack and tight, can be used to obtain proper V-band tension.

Step 1: Decrease the center distance until the V-band(s) can be easily slipped into the sheave grooves. Forcing the belts on can damage the load-carrying cords and cause premature belt failure.

Step 2: With the V-band(s) still on the drive at NO tension, measure the outside circumference (slack O.C.) of the bands. Note: If retensioning a used drive, decrease the center distance until there is no tension on the band(s), then measure the outside circumference (slack O.C.) of the band(s).

Step 3: Determine the required Static Tension (Ts) per individual rib strand using the following formula.

$$Ts = \frac{K \times DHP}{N \times S} + \frac{MS^2}{2}$$

Step 4: Find a range of recommended tensions.

Lower Tension = Ts
Upper Tension = 1.5 times Ts

Step 5: Calculate minimum and maximum elongated band lengths for use in tensioning the drive.

a. From table 4, find length multipliers corresponding to the lower and upper Ts values in Step 4 above.

b. Multiply the slack O.C. found in Step 2 by the length multipliers to find the minimum and maximum elongated band lengths.

Step 6: Increase the drive center distance until a tape measurement of the band(s) O.C. is between the two values calculated for elongated band length Step 5b.

Step 7: Retension as required. New V-bands may lose tension rapidly during the run-in period and will probably require retensioning. V-bands that have been on a drive for some time may also require retensioning due to tension decay from normal use and wear.

TB Wood's

Table 4 Belt length multipliers for tensioning banded belts

Ts Per Strand (lbs.)	NARROW BAND					CLASSICAL BAND					CLASSICAL COG BAND		
	CROSS SECTION												
	3V	5V		8V		BP		CP		DP	BX All Sizes	CX All Sizes	DX All Sizes
		5V1700 & under	5V1800 & over	8V1700 & under	8V1800 & over	BP144 & under	Over BP144	CP144 & under	Over CP144				
10	1.00186	1.00056	1.00001	1.00013	1.00010	1.00113	1.00141	1.00029	1.00052	1.00013	1.00082	1.00027	1.00013
12	1.00220	1.00068	1.00097	1.00016	1.00012	1.00135	1.00168	1.00035	1.00062	1.00016	1.00098	1.00032	1.00016
14	1.00254	1.00079	1.00113	1.00019	1.00014	1.00157	1.00194	1.00041	1.00072	1.00019	1.00114	1.00038	1.00019
16	1.00288	1.00090	1.00129	1.00021	1.00016	1.00178	1.00220	1.00046	1.00082	1.00021	1.00129	1.00043	1.00021
18	1.00320	1.00101	1.00144	1.00024	1.00018	1.00199	1.00246	1.00052	1.00092	1.00024	1.00145	1.00048	1.00024
20	1.00352	1.00112	1.00159	1.00027	1.00020	1.00220	1.00271	1.00058	1.00102	1.00027	1.00160	1.00054	1.00027
24	1.00414	1.00133	1.00190	1.00032	1.00024	1.00261	1.00320	1.00069	1.00122	1.00033	1.00191	1.00065	1.00032
28	1.00472	1.00155	1.00219	1.00037	1.00029	1.00301	1.00368	1.00081	1.00141	1.00038	1.00220	1.00075	1.00038
32	1.00520	1.00176	1.00249	1.00043	1.00033	1.00339	1.00414	1.00092	1.00161	1.00044	1.00250	1.00086	1.00043
36	1.00556	1.00197	1.00277	1.00048	1.00037	1.00377	1.00458	1.00104	1.00180	1.00050	1.00278	1.00097	1.00049
40	1.00588	1.00217	1.00305	1.00054	1.00042	1.00413	1.00500	1.00115	1.00199	1.00056	1.00306	1.00107	1.00054
45	1.00625	1.00243	1.00340	1.00060	1.00047	1.00458	1.00529	1.00129	1.00222	1.00063	1.00341	1.00121	1.00061
50	1.00659	1.00268	1.00374	1.00067	1.00053	1.00500	1.00553	1.00144	1.00246	1.00071	1.00374	1.00134	1.00068
55	1.00691	1.00293	1.00406	1.00074	1.00058	1.00528	1.00574	1.00158	1.00268	1.00078	1.00407	1.00147	1.00075
60	1.00722	1.00317	1.00438	1.00081	1.00064	1.00553	1.00591	1.00172	1.00291	1.00086	1.00439	1.00161	1.00081
65	1.00754	1.00341	1.00470	1.00088	1.00070	1.00576	1.00606	1.00186	1.00313	1.00094	1.00470	1.00174	1.00088
70	1.00787	1.00365	1.00500	1.00095	1.00076	1.00596	1.00620	1.00200	1.00335	1.00102	1.00500	1.00187	1.00095
75	1.00822	1.00389	1.00523	1.00101	1.00082	1.00614	1.00632	1.00214	1.00357	1.00110	1.00522	1.00200	1.00102
80	1.00861	1.00412	1.00545	1.00108	1.00088	1.00631	1.00644	1.00228	1.00378	1.00118	1.00543	1.00213	1.00109
85	1.00903	1.00434	1.00566	1.00115	1.00094	1.00646	1.00656	1.00242	1.00399	1.00127	1.00563	1.00227	1.00116
90	1.00949	1.00456	1.00586	1.00122	1.00100	1.00659	1.00668	1.00256	1.00420	1.00135	1.00581	1.00240	1.00123
95	1.01000	1.00478	1.00606	1.00129	1.00106	1.00672	1.00682	1.00270	1.00441	1.00144	1.00599	1.00253	1.00130
100	1.01056	1.00500	1.00625	1.00136	1.00113	1.00684	1.00697	1.00284	1.00461	1.00152	1.00616	1.00266	1.00137
120	1.01333	1.00561	1.00696	1.00164	1.00139	1.00727	1.00780	1.00339	1.00528	1.00188	1.00679	1.00319	1.00166
140	1.01692	1.00617	1.00765	1.00192	1.00166	1.00771	1.00912	1.00393	1.00579	1.00226	1.00736	1.00371	1.00195
160	1.02081	1.00672	1.00836	1.00220	1.00194	1.00827	1.01104	1.00447	1.00627	1.00265	1.00793	1.00423	1.00224
180	1.02385	1.00728	1.00913	1.00249	1.00223	1.00902	1.01357	1.00500	1.00675	1.00306	1.00854	1.00474	1.00253
200	1.02655	1.00707	1.01000	1.00277	1.00254	1.01000	1.01718	1.00534	1.00724	1.00349	1.00922	1.00525	1.00283
240	1.03118	1.00921	1.01213	1.00335	1.00319	1.01279	1.02268	1.00607	1.00832	1.00440	1.01090	1.00625	1.00343
280	1.03579	1.01088	1.01524	1.00395	1.00389	1.01663	1.02737	1.00692	1.00963	1.00542	1.01313	1.00724	1.00405
320	1.04070	1.01292	1.01834	1.00454	1.00461	1.02088	1.03275	1.00797	1.01124	1.00656	1.01590	1.00824	1.00468
360	1.04671	1.01562	1.02162	1.00515	1.00543	1.02423	1.03853	1.00926	1.01317	1.00771	1.01925	1.00924	1.00532
400	1.05308	1.01826	1.02526	1.00575	1.00631	1.02708	1.04393	1.01081	1.01580	1.00886	1.02229	1.01026	1.00598
450		1.02179	1.03056	1.00652	1.00744	1.03072	1.05000	1.01311	1.01877	1.01028	1.02625	1.01156	1.00683
500		1.02558	1.03643	1.00732	1.00859	1.03425		1.01610	1.02186	1.01164	1.03000	1.01292	1.00768
550		1.02927	1.04200	1.00813	1.00976	1.03781		1.01888	1.02500	1.01293	1.03354	1.01435	1.00856
600		1.03286	1.04642	1.00896	1.01094	1.04158		1.02169	1.02813	1.01413	1.03685	1.01557	1.00946
650		1.03632	1.05000	1.00982	1.01213	1.04567		1.02449	1.03123	1.01524	1.04000	1.01729	1.01037
700		1.03967		1.01071	1.01331	1.05000		1.02718	1.03426	1.01625	1.04333	1.01919	1.01130
750		1.04310		1.01163	1.01449			1.03000	1.03719	1.01718	1.04667	1.02126	1.01224
800		1.04655		1.01257	1.01571			1.03282	1.04000	1.01802	1.05000	1.02372	1.01320
850		1.05000		1.01354	1.01689			1.03563	1.04268	1.01833		1.02607	1.01418
900				1.01454	1.01887			1.03838	1.04524	1.01936		1.02840	1.01518
950				1.01561	1.01927			1.04101	1.04768	1.02044		1.03068	1.01619
1000				1.01667	1.02049			1.04345	1.05000	1.02156		1.03209	1.01717

TB Wood's

Trouble Shooting V-Belts

How to spot V-belt trouble

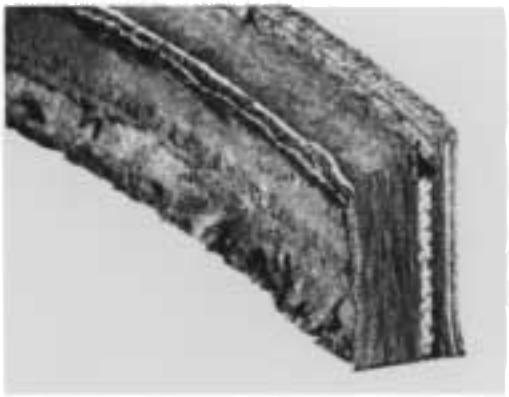
Trouble	Cause	To correct
Belt slip (sidewalls glazed)	Not enough tension.	Replace belts; apply proper tension.
Drive squeals	Shock load.	Apply proper tension.
	Not enough arc of contact.	Increase center distance.
	Heavy starting load.	Increase tension.
Belt turned over.	Broken cord caused by prying on sheave.	Replace set of belts correctly.
	Overloaded drive.	Redesign drive.
	Impulse loads.	Apply proper tension.
	Misalignment of sheave and shaft.	Realign drive.
	Worn sheave grooves.	Replace sheaves.
	Flat idler sheave.	Align idler. Re-position on slack side of drive close to drive sheave.
	Excessive belt vibration.	Check drive design. Check equipment for solid mounting. Consider use of banded belts.
Mismatched belts.	New belts installed with old belts.	Replace belts in matched set only.
	Sheave grooves worn unevenly; improper groove angle. Give appearance of mismatched belts.	Replace sheaves.
	Sheave shafts not parallel. Give appearance of mismatched belts.	Align drive.
Belt breaks.	Shock loads.	Apply proper tension; Recheck drive.
	Heavy starting loads.	Apply proper tension; Recheck drive. Use compensator starting.
	Belt pried over sheaves.	Replace set of belts correctly.
	Foreign objects in drive.	Provide drive shroud.
Belt wears rapidly.	Sheave grooves worn.	Replace sheaves.
	Sheave diameter too small.	Redesign drive.
	Mismatched belts.	Replace with matched belts.
	Drive overloaded.	Redesign drive.
	Belt slips.	Increase tension.
	Sheaves misaligned.	Align sheaves.
	Oil or heat condition.	Eliminate oil. Ventilate drive.

TB Wood's

How to diagnose V-belt failure

V-Belt Troubleshooting Checklist

BELT CONDITION



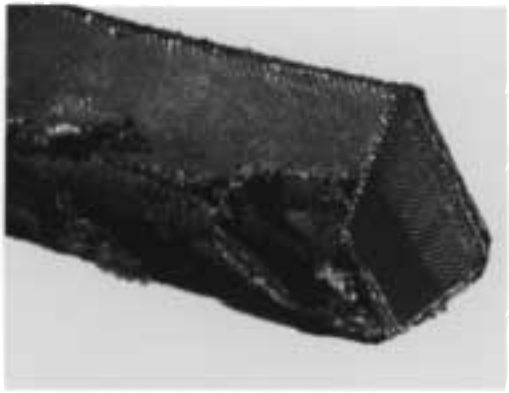
Oil Deterioration

CAUSE

Oil-softened rubber.

PREVENTION

Splash guards will protect drives against oil. Although Classical belts are oil resisting, excessive oil can cause some deterioration.



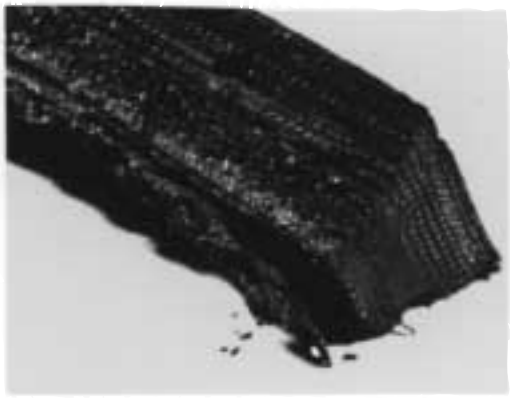
Cover Fabric Rupture

CAUSE

Cover fabric ruptured when belt was pried over sheave during installation.

PREVENTION

Proper installation of belts by moving motor so belts do not have to be pried into the grooves.



Slip Burn

CAUSE

Belt too loose. Belt didn't move, friction against sheave burned rubber. When belt finally grabbed, it snapped.

PREVENTION

Maintain proper tension on the drive.

TB Wood's

How to diagnose V-belt failure

V-Belt Troubleshooting Checklist

BELT CONDITION

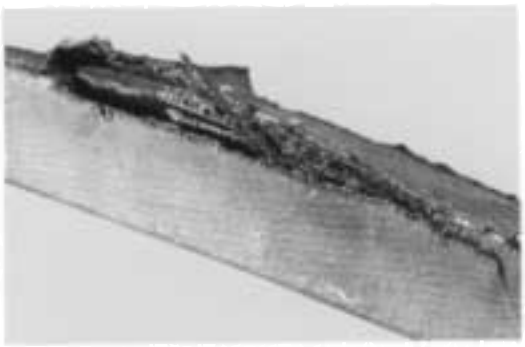
Base Cracking

CAUSE

Severe back-bend idlers. Improper storage. Excessive ambient operating temperature.

PREVENTION

Check storage conditions. If back-bend idler cannot be avoided, install idler of larger diameter. Avoid ambient temperature over 140°.



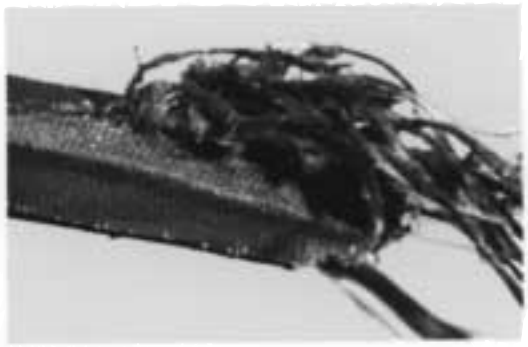
Ply Separation

CAUSE

Split along pitch line indicating belt ran over too small a sheave.

PREVENTION

Redesign drive using sheaves of proper size.



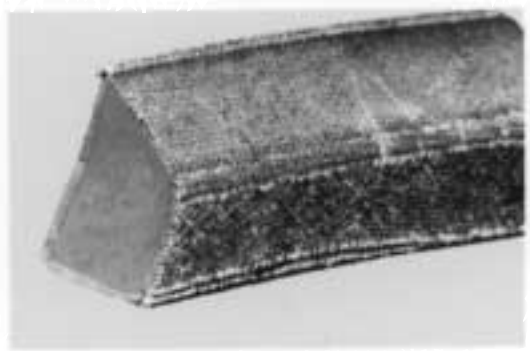
Ruptured

CAUSE

Ruptured cords in the plies.

PREVENTION

Check for rocks or tools falling into sheave grooves. Check tension. Belts loose enough to twist in groove can rupture cords.



Worn Belt Sides

CAUSE

Misalignment. Grit or dirt. Normal wear.

PREVENTION

Align sheaves. Replace belts as required.

TB Wood's

How to diagnose V-belt failure

V-Belt Troubleshooting Checklist

BELT CONDITION

Snub Break

CAUSE

Cover wear indicates slip. Clean break reveals sudden snap.

PREVENTION

Maintain proper tension on the drive.

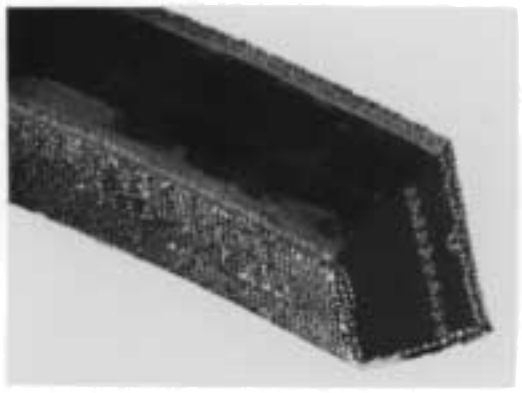
Distorted Belt

CAUSE

Breakdown of adhesion or broken cords.

PREVENTION

Do not pry belts on drives. Check sheaves for recommended diameters.



Abrasion

CAUSE

Foreign material and rust in sheaves wore away sidewalls, letting belt drop to bottom of groove.

PREVENTION

Dust guards help protect against abrasion. Tension must be maintained in dusty atmospheres.

TB Wood's

SURE-GRIP® SHEAVE FEATURES

Wood's sheaves are constructed of fine grain, high tensile cast iron, and have been carefully engineered to assure maximum performance over a long life span. Behind each sheave is one of the most extensive engineering design and testing programs in the industry.

DESIGN INTEGRITY

TB Wood's Incorporated has been a leading supplier of cast iron pulleys, v-belt sheaves, synchronous belt sprockets and Sure-Grip mounting bushings since the inception of these products. We are committed to the continual improvement of our standard products and special or MTO products through design, materials and quality enhancements. For example, new product designs are typically computer generated and then verified using finite element analysis before CAD drawings are made. This enables Wood's to quickly and accurately quote on any special needs, and to relay the tool paths for new designs quickly from engineering to the shop floor.

FOUNDRY PROCESSES

TB Wood's Incorporated has a modern state-of-the-art foundry in Chambersburg, PA where cast iron and ductile iron castings are produced. This captive foundry operation not only gives Wood's the control needed to obtain standard high quality castings as they are required, but also enables them to produce any special requirements in a minimal amount of time.

MACHINING

TB Wood's Incorporated has numerous machining facilities throughout North America. Each is equipped with modern CNC equipment and capable of doing high precision machining. Statistical process controls are in place in each location, and each has been ISO-9000 certified.

SPECIFICATIONS

TB Wood's products are manufactured to conform to or exceed recognized industry standard specifications. The following is a listing of some of these specs.

ANSI/RMA	IP-20	Classical V-Belt Sheaves
ANSI/RMA	IP-22	Narrow V-Belt Sheaves
ANSI/RMA	IP-24	Synchronous Sprockets
MPTA	QD-1	QD Bushing Guideline
MPTA	SPB	Pulley Balance
MPTA	SAS	V-Belt Sheave Arm Stress
MPTA	SF	Pulley Surface Finish

Powering Your Success

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