Yeomans submersible motors are furnished with a tandem mechanical seal arrangement consisting of two (2) independent Type-21 or approved equivalent mechanical seals running in an oil reservoir. The Type-21 mechanical seal is the industry standard for original equipment manufacturers. The seals are readily available from many commercial sources on a worldwide basis thereby providing the customer with easy access to repair or replacement seal parts. The modest cost of Type-21 seals helps reduce the customer’s spare parts expense. Non-standard, Non-U.S. manufactured seal designs supplied by some competitors can be very costly to replace and hard to find from local sources.

For sewage and wastewater applications, the standard Silicon Carbide vs. Silicon Carbide lower seal face combination is the ideal choice. This hard seal face combination is suitable for most applications including abrasion service with high grit content, standard water, wastewater, high temperature service (up to 90°C), and most chemicals. On the standard seals, the secondary sealing bellows (flexible elastomer bellows) and the stationary cup are Viton material for maximum performance. All metal seal parts, including the spring, are made of Stainless Steel. The standard upper seal is constructed using Silicon Carbide vs. Carbon because the environment of the upper seal is an oil bath and is normally not subjected to the pumped media.

Please refer to the following drawing and notations for detail of specific seal features and benefits:

1. The single coil-spring and flexible bellows design provides self-alignment which automatically adjusts to compensate for shaft endplay, run out, primary sealing ring wear, reverse pressure and equipment tolerances. This feature will help increase the seal life and prevent premature failure.

2. The drive band and retainer distribute drive loading evenly and eliminate over-stressing of the flexible elastomer bellows. The head design prevents solids from dislodging the seal face, allows the seal to withstand higher pressure and rotational speed and eliminates the metal shell from contacting the seal ring.

3. The primary and mating seal faces are lapped to 3-helium light bands (33 millionths of an inch) flatness to provide effective sealing and leakage protection. Both primary and mating ring are made of solid-block construction for greater reliability and longer service life compared to the soldered, welded or sprayed hard-face designs used by other manufacturers.
All Yeomans submersible motors are manufactured and tested in a controlled work cell environment in our Aurora, Illinois factory. Each rotor core is visually inspected for complete filling of the die-cast end rings and fan blades. Correct core length is verified by measurement. The rotor is then heated and press-fit onto a cooled precision-machined one-piece stainless steel shaft and the assembly is then machined and balanced as a unit.

The stator assembly receives a quick, high-voltage surge test (approximately 2500 volts peak) to each phase in sequence, and the decay of the surge through the windings is integrated by the tester and compared phase to phase. This test checks for proper connection, impedance balance between the phases and minor or impending short circuits in the windings. The D.C. resistance of each phase is also checked against the calculated resistance value for the stator and for balanced resistance between each phase.

The finished rotor and stator unit is then assembled into a central motor housing unit. The motor assembly is then subjected to a High-Potential (Hi-Pot) Test. An A.C. voltage of 2000 volts is applied between the winding and ground to test the integrity of the insulation between the winding and core iron. Any breakdown of the insulation causes the motor to be rejected.

Each Yeomans motor is designed, built and tested in strict accordance with the standards of the latest NEMA MG-1 design criteria for Design B motors. All nameplate ratings are based on a 40°C ambient, Class H insulated (Class F for 140 frame), totally enclosed non-ventilated motor of explosion-proof design. Other insulation systems are available upon request. Yeomans subscribes to a design and sales philosophy of providing the user with a recognizable and common nameplate rating system. Unlike the Pump Industry, which adheres to the Hydraulic Institute Standards or the Motor Industry, which adheres to NEMA and IEEE standards, today's wastewater industry is generally unregulated and not standardized with regard to submersible motor design and rating standards. At Yeomans we feel compelled to design our motors and pumps in accordance with NEMA and Hydraulic Institute Standards respectively. With this compliance, the user can be assured that the Yeomans equipment that is specified will meet or exceed the common, but specific, standards that they would expect from any other type of pump or motor supplier whether it be for a wastewater, process or clean liquid application.

NEMA standards require specific limits for these types of machines with regard to Locked Rotor Amps, Torque, Breakdown and Pull-Up Torque. Specifying and demanding 40°C ambient, NEMA MG-1 design limits on totally enclosed non-ventilated motors is common practice in the North American market. Yeomans strictly practices these limits and strongly suggests they also be the standard for motor ratings in the submersible wastewater pump market.
Proper design and operation of submersible pump systems necessitates consideration of minimum submergence requirements. The water level in the wet-well must normally be maintained at a minimum level for two primary reasons:

1- Prevention of motor overheating
2- Prevention of “vortexing” and associated problems

From experience, many customers recognize the concern about motor overheating but fail to understand the concern about prevention of vortexing and the associated pump damage that can occur. In this paper we will address both issues and offer recommendations to help prevent both problems.

1- Prevention of motor overheating

Conventional submersible non-clog pump motors are air-filled non-jacketed type designed to be cooled by convection heat transfer to the surrounding media. Typically, these motors are conservatively rated for continuous operation in a fully submerged condition or for at least 15 minutes in a non-submerged condition. The minimum recommended submergence to prevent overheating will normally be noted in the pump manufacturer’s product information.

A common question:
"But what if my pump occasionally runs non-submerged for longer than 15 minutes? Will it overheat and be damaged"?

Answer: No. Due to varying wet-well levels and inflow conditions, there may be occasions when the pump motor may be partially or fully non-submerged for periods longer than 15 minutes. To prevent any motor damage due to overheating, Yeomans pumps are equipped with three (3) normally-closed, automatic-reset thermostats connected in series and embedded in adjoining phases of the motor stator windings. Should the motor winding temperature rise excessively, the thermostats will open before the temperature can reach a level that can cause damage to the motor. When the thermostats open, power to the motor is interrupted. When the motor has cooled down, the thermostats automatically reset and the pump can resume normal operation.

Caution: This should not be understood to mean that a submersible pump can be run for extended periods of time without adequate suction conditions, as that is detrimental to the pump seals.

For applications requiring the motors to operate in a non-submerged condition for sustained periods longer than 15 minutes, four (4) primary methods have been developed for motor cooling:

A- Oversizing of conventional submersible motors

For low horsepower applications, it is normally cost effective to utilize conventional non-jacketed submersible motors that are de-rated for continuous-in-air service. For example, a typical 7-1/2 HP, 4-pole non-jacketed submersible motor may, in some cases, be de-rated and nameplated at 5HP for continuous-in-air service. (The pump motor manufacturer should be consulted for any specific application.) For medium and larger horsepower sizes, this method is generally not cost effective.
SECTION 9000
Solids-Handling Submersible Wastewater Pumps
Minimum Submergence Considerations

B- By-pass (pumpage-cooled) jacketed motor design

For medium and larger horsepower sizes, some manufacturers elect to offer by-pass (pumpage cooled) jacketed motor designs. These designs utilize an internal by-pass system to circulate the pumped liquid throughout the motor cooling jacket. For clean-water applications, this is an effective and reliable method for motor cooling. For dirty water or sanitary sewage applications, clogging of the cooling jacket passages can easily occur due to a build-up of solids, grease, corrosion and other matter. When this build-up and clogging occur, serious motor damage may result due to overheating and premature insulation failure. Periodic inspection and cleaning are required to prevent these problems.

C- External water cooled jacketed motor design

When a reliable external source of clean, cool water is available, this type of system has proven to be an effective means of motor cooling. In most cases however, a suitable external water supply is not available or the cost of the clean water is prohibitive. Thus, this type of system has very limited applicability for most customers.

D- Closed loop cooled (self-contained cooling system) motor design

The closed-loop cooled jacketed motor design offers practical solutions to problems found with other designs. Initial cost is comparable to that of by-pass cooled or external cooled jacketed motor. The self-contained cooling system eliminates the need for an external water supply. The clear, environmentally safe cooling fluid eliminates clogging, associated maintenance and premature failure commonly associated with “pumpage-cooled” motors and makes this system the most cost effective when considering overall operating costs.
2- **Prevention of surface "vortexing" and associated problems**

Inadequate submergence can result in pre-rotation of the water in the wet-well, resulting in the formation of strong free-surface air core vortices and the entrance of air into the pump suction inlet. This phenomenon is commonly called "vortexing".

"Vortexing" can cause unstable pump operation, vibration, pulsation and severe mechanical damage.

The U.S. based Hydraulic Institute has produced the following guidelines for recommended minimum submergence of the pump suction inlet to reduce the probability that strong free-surface air core vortices will occur:

\[
S = D + \left[ \frac{0.574 \times Q}{D^{1.5}} \right]
\]


In most cases, the recommended submergence for prevention of free-surface air vortices is more than adequate to prevent motor overheating. The following illustration provides a typical example:

Typical 4" Submersible Non-Clog Pump with Guiderail Installation

Rated Capacity: 400 USGPM
Suction Inlet Diameter: 4"

\[ A = 32.70" = \text{Recommended submergence per ANSI/HI standards for prevention of "vortexing"} \]

\[ B = 33.25" = \text{Distance from sump floor to top of motor stator housing} \]
SECTION 9000
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Minimum Submergence Considerations

A common question:
"What if I operate my pump at a very low level for sump cleanout purposes?

Answer:
It is normally acceptable to pump the wet-well completely down for purposes of cleaning, inspection or maintenance. This is a common practice and should not result in any damage to the unit. Sustained operation at extremely low levels should be avoided to prevent premature pump seal damage from "vortexing".

Conclusions

Pump system designers and end-users should consider both motor overheating and prevention of "vortexing" (inadequate suction conditions) when designing systems and specifying non-clog submersible pumps, regardless of the preferred pump manufacturer(s). Proper consideration of both items will help the customer determine suitable sump pit dimensions and level control elevations.

For wet-pit installations, it is recommended that the low water level elevation be specified to meet or exceed the minimum submergence to prevent vortexing. In many cases it will be found that the minimum recommended submergence to prevent vortexing will be equal to, or greater than, the minimum submergence required to prevent overheating. This is particularly true if it has been confirmed that the submersible motor has been rated in strict conformance with NEMA standards as is recommended by the Submersible Wastewater Pump Association (SWPA). Thus, once proper anti-vortexing submergence is established, the concern about motor overheating will frequently be eliminated.

For applications that require continuous non-submerged operation, such as dry-pit submersible installations, it is recommended that the design engineer specify the motor type best suited for the intended service. For sewage or similar water-based mixtures containing solids, grease or fat, the closed-loop-cooled motor design is the preferred choice whenever the horsepower size required exceeds the practical limit for de-rating of conventional submersible motors.

Since all applications have specific requirements, the pump manufacturer should be consulted for verification of the proper application of their products and for recommendations of specific equipment for the intended service.
Start-Up Instructions

Thank you for your purchasing Yeomans submersible pumps!

The pump Warranty requires that the pump be properly installed and that start-up be performed by qualified personnel. Completion of the Start-Up & Warranty Registration Report is required to register the pump start-up with the factory and to support any warranty claims. Copies of electrical schematics (wiring diagrams) for the pump control system may also be required.

1- Review the Installation, Operation & Maintenance instructions supplied with the pump(s).

2- Review the electrical wiring diagrams and related instructions supplied by the manufacturer of the control system.

3- For general start-up procedures and guidelines, please refer to the latest edition of the Start-up & Field Check-Out Procedures Manual published by SWPA (Submersible Wastewater Pump Association). To order copies of this document please contact:

   Submersible Wastewater Pump Association
   1866 Sheridan Road, Suite 201
   Highland Park IL 60035-2545
   PH: 847-681-1868
   FX: 847-681-1869
   www.swpa.org

4- Complete the Start-Up & Warranty Registration Report and mail to:

   Yeomans Pump
   P.O. Box 6620
   Aurora, IL 60598-0620
   Attn: Sales Department Administrator

The following additional publications may be useful for reference purposes:

- Submersible Sewage Pumping Systems (SWPA) Handbook
  (available from Submersible Wastewater Pump Association)

- Submersible Motor Megger Testing (technical paper)
  (available from Yeomans Pump)
## Start-Up & Warranty Registration Report

<table>
<thead>
<tr>
<th>Owner’s Name:</th>
<th>Address:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of Installation:</td>
<td>Person in Charge:</td>
</tr>
<tr>
<td>Phone #:</td>
<td>Fax #:</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Purchased From:</th>
<th>Series:</th>
<th>Model:</th>
<th>S/N:</th>
</tr>
</thead>
</table>

<table>
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<tr>
<th>Voltage:</th>
<th>Phase:</th>
<th>Hertz:</th>
<th>HP:</th>
<th>RPM:</th>
</tr>
</thead>
</table>

Rotation (viewed from bottom): _____ Clockwise ______ Counterclockwise

Does impeller turn freely by hand: _____ Yes _____ No

<table>
<thead>
<tr>
<th>Condition of Equipment:</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Condition of Cable Jacket:</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
</table>

Resistance of Cable and Pump Motor (measured at pump control panel)
- Red-Black _____ Ohms
- Red-White _____ Ohms
- White-Black _____ Ohms

Resistance of Ground Circuit Between Control Panel and Outside of Pump: _____ Ohms

Motor Thermal Sensors connected and circuit closed: _____ Yes _____ No

MEG Ohm Check of Insulation:
- Winding Temperature: _____ ºF _____ ºC
- Red to Ground _____ Ohms
- White to Ground _____ Ohms
- Black to Ground _____ Ohms

<table>
<thead>
<tr>
<th>Condition of Equipment at Start-Up:</th>
<th>Dry</th>
<th>Wet</th>
<th>Muddy</th>
</tr>
</thead>
</table>

Was Equipment Stored: _____ Yes _____ No

Describe Station Layout:

Liquid Being Pumped:

Debris in Bottom of Station? _____ Yes _____ No

Was Debris Removed in Your Presence? _____ Yes _____ No

Are Guide Rails Exactly Vertical (plumb)? _____ Yes _____ No

Is Base Elbow Installed Level? _____ Yes _____ No

Liquid Level Controls – Model:

Is Control Installed Away from Turbulence? _____ Yes _____ No

Operation Check:
- Tip lowest float (stop float), all pumps should remain off.
- Tip second float (and stop float), one pump comes on.
- Tip third float (and stop float), both pumps on (alarm on simplex).
- Tip fourth float (and stop float), high level alarm on (omit on simplex).

If not our level controls, describe type of controls:

Does liquid level ever drop below volute top? _____ Yes _____ No

(Continued on reverse side)
(Continued from reverse side)

Control Panel Mfr: _______  S/N: _______

Number of Pumps Operated by Control Panel _______

NOTE: At no time should hole be made in top of control panel, unless proper sealing devices are utilized.

Short Circuit Protection: _______  Type: _______

Number and Size of Short Circuit Device(s): _______  Amp Rating: _______

Overload Type: _______  Size: _______  Amp Rating: _______

Do Protective Devices Comply With Pump Motor Amp Rating? _______Yes _______No

Are All Connections Tight? _______Yes _______No

Is the Interior of the Panel Dry? _______Yes _______No  (If “No,” correct the moisture problem.)

Electrical Readings:

**Single Phase:**
- Voltage Supply at Panel Line Connection, Pump Off, LI, L2: _______
- Voltage Supply at Panel Line Connection, Pump On, LI, L2: _______
- Amperage: Load Connection, Pump On, LI _______ L2 _______

**Three Phase:**
- Voltage Supply at Panel Line Connection, Pump Off, LI-L2 _______ L2-L3 _______ L3-LI _______
- Voltage Supply at Panel Line Connection, Pump On, LI-L2 _______ L2-L3 _______ L3-LI _______
- Amperage, Load Connection, Pump On, LI _______ L2 _______ L3 _______

Final Check:
- Is Pump Seated on Discharge Properly? _______Yes _______No
- Was Pump Checked for Leaks? _______Yes _______No
- Do Check Valves Operate Properly? _______Yes _______No

Flow: Does Station Appear to Operate at Proper Rate? _______Yes _______No

Noise Level: _______Acceptable _______Unacceptable

Comments:

Describe any equipment difficulties during start-up:

Manuals:
- Has Operator Received Pump Instruction and Operations Manual? _______Yes _______No
- Has Operator Received Electrical Control Panel Diagram? _______Yes _______No
- Has Operator Been Briefed On Warranty? _______Yes _______No

Name/Address of Local Representative / Distributor:

I Certify This Report To Be Accurate.

Start-Up Person: _________________________________  (Print Name)  ________________________________  (Signature)

Employed By: ________________________________  Date: ________________________________

Date and Time of Start-Up:

Present at Start-Up:

( )Engineer's Name:  ( )Operator's Name:  ( )Contractor's Name:  ( )Others:

Please mail the completed form to: Yeomans Pump, P.O. Box 6620, Aurora, IL 60598-0620, Attn: Sales Administrator or FAX to: 630-236-5511

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