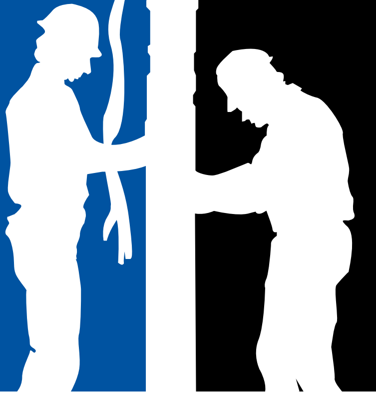
Franklin Electric



Europe edition

FRANKLIN AID

Franklin Electric

franklinwater.eu

Summary

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data ***Europe*** No. 1 January 2003

NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW

Franklin Electric Europa **A**pplication / **I**nstallation **D**ata / **AID**

Franklin Electric – market leader in submersible motors – wants to use this bulletin to throw light on technical details, application-related solutions as well as innovations for our customers and users of our products. This AID will be published quarterly and will inform you on submersible motors application related issues and all our products and their proper installation to ensure a trouble free operation.
Furthermore we would like to introduce our special trainings and seminars. Franklin Electric Europa GmbH offers service seminars, either here at our headquarters in Wittlich, but also in different places across Europe, the Middle East, North Africa and the Near East. We are also prepared to conduct these seminars at your premises, to show you the functioning, installation and maintenance of our products.

Please visit our web-site for further information at: **www.franklin-electric.de**

Our competent Field Service Team will be at your disposal also at your premises. Please find our address below.

Franklin Electric ist Marktführer auf dem Gebiet von Unterwassermotoren und möchte in dieser Unterlage seinen Kunden und Anwendern technische Details, anwendungsbezogene Problemlösungen aber auch Neuerungen näher bringen. Diese AID wird vierteljährlich erscheinen und Sie über alle wichtigen Dinge, die unsere Produkte und deren Einsatz betreffen, informieren.
Weiterhin möchten wir Ihnen unsere Schulungsangebote vorstellen. Franklin Electric Europa GmbH bietet Service-Seminare an, die hier im Stammwerk Wittlich, an verschiedenen Orten innerhalb Europas, sowie im Mittleren Osten, in Nord-Afrika und dem Nahen Osten stattfinden. Auf Wunsch besteht die Möglichkeit von Schulungen in Ihren Firmen. Bei diesen Seminaren wird die Funktionsweise, Installation und Wartung unserer Produkte behandelt.

Weitere Informationen finden Sie im Internet unter: **www.franklin-electric.de**

Bei Bedarf steht Ihnen gerne unser kompetentes Field Service Team auch vor Ort zur Verfügung. Adressen finden Sie auf der Rückseite.

QUALITY MADE BY

Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany

Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

e-mail: field-service@franklin-electric.de
www.franklin-electric.de

Franklin Electric Europa Field Service Team

Franklin Electric Europa Headquarter Team

Edwin Klein
Field Service Manager
Tel.: +49-(0)65 71 10 54 20

Ulrich Ehses
Technical Service Assistant
Tel.: +49-(0)65 71 10 54 22

Beate Röthel
Field Service Assistant
Tel.: +49-(0)65 71 10 54 21

South / West Europe

Jean Pierre Carminati
Field Service Engineer
57G, Avenue Foch
54000 Nancy, France
Tel.: +33-(0)3 83 28 37 37
Fax: +33-(0)3 83 28 37 38
Jeanpierre.carminati@wanadoo.fr

North Africa – Near East

Jean Ghazal
Field Service Engineer
Holiday Beach, Apt. 82
Zouk Mosbeh, Lebanon
Tel.: +9 61-9 23 21 15
Fax: +9 61-9 23 21 15
franklin@dm.net.lb

Seminartermine für Deutschland im Jahr 2003 / Seminar Schedule 2003 for Germany

Bremen	: 25 March 2003, Novotel Achim Uphusen
Mannheim	: 27 March 2003, Novotel Mannheim
Berlin	: 10 April 2003, Novotel Siemensstadt

Seminartermine für Europa im Jahr 2003 / Seminar Schedule 2003 for Europa

Toulon	: 18 March 2003, Novotel Toulon
Avignon	: 20 March 2003, Novotel Avignon
Bordeaux	: 28 April 2003, Novotel Bordeax Le Lac
Narbonne	: 29 April 2003, Novotel Quartier Plaisance

Bitte melden Sie sich, damit wir Ihnen weitere Informationen zukommen lassen können.
Please let us know, if you require more information.

FRANKLIN AID

Franklin Electric

No. 2 Mai 2003

NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW *** NEW

Let us continue with our successfully implemented Franklin A.I.D., focussing the most upcoming questions as:

Why do Submersible Motors fail – Part 1

To continuously improve the quality of our products, Franklin Electric has reviewed many motors returning from the field. Also we examined numerous applications looking for the reasons leading to premature motor failure. This and the next A.I.D. will help you avoid application related problems to improve lifetime for your motor.More than 80% of motor electrical failures are a result of stator winding burnout. Main reasons are: single phasing, extreme high or low voltage, phase unbalance on 3-phase motors, high voltage surges or direct strikes of lightning.

The good news: in most cases, these conditions are preventable.As a general rule, every motor must be protected by using properly sized time –delay fuses in conjunction with Class 10, EN 60947-4-7 (VDE 0660T-102), ambient-compensated overload protection, as well as a good quality surge arrestor.

Surge arrestor to be effective, it must be grounded to the water strata, which means, to the actual water underground. Any surge in the system is looking for the easiest path to true water ground. The faster this surge is directed to ground, the less damage it can cause. Connecting the ground wire from the arrestor directly to the ground wire of the motor would be the best. Other potential ground sources are : metal well casings and metal drop pipes in direct contact with the well water.

Lassen Sie uns fortfahren mit der erfolgreich eingeführten Franklin A.I.D. indem wir uns häufig gestellten Fragen zuwenden:

Warum fallen Unterwassermotoren aus –Teil 1

Um die Qualität unserer Produkte ständig zu verbessern, hat Franklin Electric viele Motoren aus dem Feld überprüft. Auch wurden eine große Anzahl von Anwendungen und Einsätzen besucht, um nach Ursachen für frühzeitige Motorausfälle zu suchen.

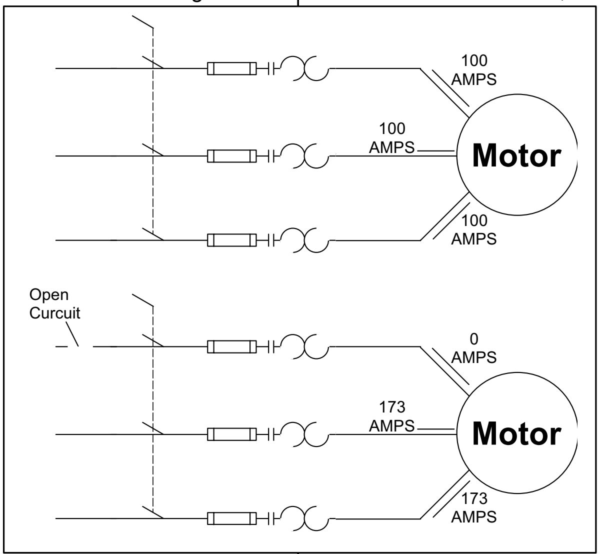
Diese und die nächsten Franklin A.I.D.'s sollen helfen, anwendungsbedingte Probleme zu verhindern um die Lebensdauer der Motoren zu erhöhen.

Mehr als 80% der elektrischen Fehler eines Motors entstehen wegen verbrannter Wicklungen. Hauptgründe sind: Phasenausfall, extrem hohe oder niedrige Spannung, Phasenunbalance (Unsymmetrie) an 3-Phasen Motoren, Hochspannungsspitzen oder auch direkte Blitzschläge.

Das Gute: den meisten dieser Fälle kann vorgebeugt werden.Grundsätzlich sollte jeder Motor mit einem richtig bemessenen Überlastschutz der Klasse 10 (Nominalstromstärke 500% max. 10 sec) abgesichert sein, mit einer eingebauten Umgebungstemperatur-Kompensation und Phasenausfallschutz, gemäß EN 60947-4-1 (VDE 0660 T. 102). Auch sollte ein Überspannungsableiter von guter Qualität nicht fehlen.Die höchste Effektivität eines Überspannungsschutzes wird erreicht beim Anschluss direkt an die wasserführende Schicht im Untergrund. Jede Überspannung sucht den leichtesten Weg zum direkten Wasser. Je leichter/schneller dieser Weg ist, desto weniger Zerstörung gibt es.

Das Beste ist, den Erdleiter des Überspannungsschutzes direkt mit dem Erdleiter des Motors zu verbinden. Andere potentielle Möglichkeiten sind: Anschluss an das metallene Brunnenrohr oder an das metallene Wasserförderrohr, welche direkt in Kontakt mit dem Untergrund-Wasser sind.

Single-phasing on a 3 Phase power distribution system can be disastrous to a 3-phase motor, unless it has excellent overload protection. Single phasing occurs when one line on the motor supply is opened. This can be caused by storm damage, loose connections, burnt switch/relay contacts or insulation problems in the wiring that blow fuses.
This causes the motor amperage on the remaining two lines to increase to 173% , while the third drops to zero.
Voltage Effects: Both too high and too low voltage affect the operating amperage of the motor. Franklin designs the motors to tolerate –10% of the lowest, and + 6 % of the highest nameplate voltage with minimal current increase. Working outside this range results in excessive heating of the windings. High voltage causes the motor winding to saturate, while low voltage starves the motor of power.
Unbalance: is a result of Unequal voltage presented to each winding. 1% voltage unbalance will result in 6 to 10% current unbalance. This causes extreme heat in the motor windings. Current unbalance greater than 5% must be avoided, since excessive heat build-up in the windings greatly affects the life of the motor. For every 10° C of increased (above normal)internal winding temperature the motor lifetime is cut in half.
Current unbalance and the resulting winding temperature must be avoided for normal motor life expectancy.



Phasenausfall in der 3 Phasen Spannungsversorgung kann für einen 3 Phasen Motor fatale Folgen haben, falls er nicht mit einem erstklassigen Überlastschutz geschützt wird. Der Phasenausfall geschieht, wenn eine Phase in der Spannungsversorgung unterbrochen wird. Sturmschäden, Kontaktabbrand, lose Verbindungen oder Isolations-bedingtes Auslösen einzelner Sicherungen sind einige Gründe für Phasenausfall.
Hierdurch wird die Stromstärke auf den anderen beiden Phasen auf 173% erhöht, während die Dritte auf 0 abfällt.
Spannungseffekte: Beides, zu hohe und zu niedere Spannungen beeinflussen die Stromaufnahme des Motors. Franklin Electric erlaubt eine Toleranz von –10% bezogen auf die niedrigste und + 6% bezogen auf die höchste im Motoraufdruck angegebenen Spannungen. In diesem Rahmen ändert sich die Stromstärke nur gering. Betrieb außerhalb dieses Rahmen führt zu übermäßigem Temperatur-anstieg in den Wicklungen. Zu hohe Spannungen führen zu einer Übersättigung der Motor-wicklungen, während zu geringe Spannungen zu einer Unterversorgung führen.
Phasenunbalance/Unsymmetrie:
Ist eine Folgeerscheinung von ungleichmäßiger Spannungsversorgung.1% Spannungsunterschied kann zu 6% bis 10%Stromunterschied führen.
Dieses bewirkt extreme Hitze in den Motorwicklungen. Stromunterschiede größer als 5% müssen vermieden werden, da Temperaturaufbau die Motor-Lebenserwartung erheblich beeinflusst. Man kann davon ausgehen, dass eine dauerhafte Temperaturerhöhung um z. B. 10° Celsius (über die zulässige Temperatur) eine 50%-ige Reduzierung der Lebenserwartung zur Folge hat.
Für eine normale Motor-Lebenserwartung muß eine Stromunsymmetrie und die daraus resultierende hohe Wicklungstemperatur vermieden werden.

Seminar Schedule 2003 / Seminarübersicht 2003

Germany:

Düsseldorf: 04. November 2003
Erfurt: 06. November 2003
Ingolstadt: 11. November 2003

Europa:

Bordeaux: 21. October 2003
Narbonne: 23. October 2003

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe*

No. 3 August 2003

This issue of our A.I.D will continue to give in sight on troubleshooting:

Why do Submersible Motors fail – Part 2

VOLTAGE SURGES AND SPIKES: High voltage surges and voltage spikes are the result of close proximity lightning strikes, opening of power line switch gear, fast current-limiting power line switch gear, or the removal of large inductive loads from the power lines. These spikes and surges can travel to the motor windings, where they attempt to break down the insulation resistance. While Franklin motors can handle voltage surges in the magnitude of 10.000 Volts, unfortunately, power surges do not limit themselves to this voltage. This is why a good surge arrestor, capable of multiple hits, is needed for submersible motors without internal arrestors (4” single phase motors may have built-in arrestors on request). Remember, there is little advantage to installing an arrestor unless it is grounded to the water strata. Surge arrestors over the years have also been known as lightning arrestors. While a direct lightning strike of millions of volts to the motor is almost impossible to protect against, voltage surge related motor failures can be prevented with good arrestors and proper grounding.

Diese Ausgabe unserer A.I.D. will weiterführen mit Erkenntnissen der Fehlersuche:

Warum fallen Unterwassermotoren aus – Teil 2

SPANNUNGSSTÖSSE UND SPANNUNGSSPITZEN: Hohe Überspannungen und Spannungsspitzen resultieren aus näheren Blitzschlägen, dem Öffnen von Leitungs-Lastschaltern, oder durch das Wegschalten großer induktiver Lasten aus dem Leitungsnetz. Diese Überspannungsspitzen können bis zu den Motorwicklungen wandern und versuchen den Isolationswiderstand zu brechen. Franklin Electric Motoren können Spannungsstöße bis ca. 10.000 Volt ertragen. Die Spannungsspitzen sind jedoch häufig höher und können den Motor zerstören wenn keine Schutzvorrichtung installiert ist. Deshalb wird ein guter Überspannungsschutz dringend für Unterwassermotoren empfohlen. 4“ Einphasenmotoren können optional mit eingebautem Blitzschutz ausgerüstet werden. Bitte beachten Sie, dass die Installation eines Überspannungsschutzes nur Sinn macht, wenn er an ausreichendes Massepotential angeschlossen ist. Überspannungsschutzeinrichtungen werden auch als Blitzschutz bezeichnet. Während Sie einen direkten Blitzschlag mit Millionen von Volt unmöglich schützen können, ist es möglich, die Mehrzahl Motorausfällen mit guten Überspannungsschutzgeräten und einwandfreier Erdung zu vermeiden.

1~ No. 150 814 902

3~ No. 155 440 901

QUALITY MADE BY

Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany

Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

e-mail: field-service@franklin-electric.de
www.franklin-electric.de

LETS NOW FOCUS ON HOW MECHANICAL PROBLEMS AFFECT MOTOR LIFE !

When reviewing mechanical failures, the typical problems are shaft spline damage, broken or twisted shafts, and radial bearing, thrust bearing, or upthrust bearing damage.

SHAFT DAMAGE: Spline wear can be attributed to sand deposits, lime deposits, misalignment between pump and motor, upthrusting, a loose fitting coupling, missing acid free silicon grease during assembly of pump to motor, bad powder metal coupling, pump vibrations, or any combination of these. Before assembling the spline coupling to shaft, the coupling should be filled with a non toxic FDA approved waterpoof grease (Mobil FM102, Texaco Cygnus 2661 or FDA approved equivalent or Vaseline). This inhibits the entrance of abrasive deposits into the spline area.

BROKEN or TWISTED SHAFTS: They are typically the result of a motor starting while backspinning, a "machine gunning" starter, a water logged pressure tank, or continuous shaft side load.
Backspinning is caused by a failed, by a leaking or a lack of check valves. If the motor is started while backspinning, this sudden reversal strains the pump and motor assembly and can cause shaft damage.
"Machine gunning", or a ultra-rapid starting and stopping the motor, places excessive stress loads on the motor shaft, coupling, and pump shaft. This is caused by a problem in the control circuit. Loose mechanical connections and partial shorts to ground are some of the conditions causing a "maschine gunning" starter.

A water logged pressure tank also causes rapid cycling that results in broken or twisted shafts. This condition shock loads the motor's thrust bearing and can contribute to thrust bearing failure, as well.
A fixed or continuous shaft side load can cause a broken or twisted shaft and/or radial bearing damage. Pump bolts working loose, misalignment between the pump and motor, or bent shafts can cause shaft side loads. Excessive side loading overloads the top motor bearing journal. This can cause the shaft to overheat and twist off in the journal area.

IN THE NEXT AID WE WILL CONTINUE TO EXPLAIN MECHANICAL DAMAGES OF SUBS.

Special Information: ***As of late summer this year our 8" cantype 316 motors will include an exchangeable "screw in" top endbell check valve instead of the glue fixed valve.***

LASSEN SIE UNS NUN BETRACHTEN, WIE MECHANISCHE POBLEME DAS MOTORLEBEN BEEINFLUSSEN !

Wenn wir mechanische Schäden betrachten, finden wir typische Probleme wie: Verzahnungsabnutzungen, gebrochene oder verdrehte Wellen, Radiallagerschäden, Drucklagerschäden oder Gegenlauflagerschäden.

WELLENSCHÄDEN: Verzahnungsabnutzungen können herbeigeführt werden durch Sand- oder Kalkeintritt, Nichtfluchten von Motor zur Pumpe, Gegenlauf, lose Kupplungsbefestigung, fehlendes säurefreies Silikonfett bei der Montage der Pumpe an den Motor, Kupplungen aus schlechtem Sintermetall, Pumpenvibrationen oder einer Kombinationen aus diesen Ursachen. Bevor die Pumpe an den Motor angebracht wird, sollte die Kupplung ausreichend befüllt werden mit einem ungiftigen, FDA geprüften wasserfesten Silikonfett (Mobil FM 102, Texaco Cygnus 2661 oder ähnlich) oder auch mit Vaseline. Dies verhindert den Eintritt von abrasiven Mitteln in die Verzahnung.

GEBROCHENE ODER VERDREHTE WELLEN:
Treten typischerweise auf durch:

- - Start des Motor bei rückwärts drehender Welle,
- - häufiges Schalten der Pumpe (durch defekten Drucktank oder flatternden Schalter),
- - oder stündige seitliche Belastung der Welle

Eine rückwärtsdrehende Motorwelle ensteht durch zurückströmendes Wasser, welches die Pumpe wie in einer Turbine antreibt. Dies kommt dann vor, wenn das Rückschlagventil defekt oder angebohrt ist oder aber fehlt. Wird der Motor gestartet während die Welle zurückdreht , kommt es zu extrem hohen Drehmomenten, welche einen Wellenschaden zur Folge haben können.
Häufges Schalten der Pumpe ensteht entweder durch einen Fehler in der Schaltanlage oder durch einen komplett gefüllten Drucktank. In der Schaltanlage können ein Flattern eines Schützes oder lose Kontakte die Ursache für das häufige Schalten sein. Bei jedem Schaltspiel wirkt das Anlaufdrehmoment auf die Motor- und Pumpenwelle , sowie auf die Kupplung. Wird diese Belastung sehr schnell wiederholt, kann dies zu Sch?den an den Wellen oder der Kupplung führen.
Eine Seitenlast auf die Wellen entsteht durch lose Pumpenverschraubungen, einen Versatz zwischen Motor und Pumpe, verzogene Wellen, oder eine ungleichmäßig aufgesetzte Pumpe. Diese Seitenlasten führen zu einer Abnutzung des oberen Radiallagers bzw. bei sehr hohen Belastungen zu einer Verbiegung oder dem Bruch der Welle.

DIE NÄCHSTE AID WIRD WEITERE ERKLÄRUNGEN ZU MECHANISCHEN SCHÄDEN AN UNTERWASSERMOTOREN ENTHALTEN.

Sonderinformation: ***Ab Spätsommer dieses Jahres werden unsere Spaltrohrmotoren 8"-316 mit einem austauschbaren „einschraubbaren" Ventil im oberen Lagerschild ausgerüstet anstelle des eingeklebten Ventils.***

Seminar Schedule 2003 / Seminarübersicht 2003 **(Booking / Reservation : field-service@franklin-electric.de)**

Germany:	**Düsseldorf Novotel:**	**04. November 2003**
	Erfurt Hotel Ibis:	**06. November 2003**
	Ingolstadt Ara Hotel:	**11. November 2003**
Europa:	**Bordeaux Novotel Bordeaux Lac:**	**21. October 2003**
	Narbonne Novotel Narbonne Sud:	**23. October 2003**

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe* No. 4 December 2003

This A.I.D. will focus the mechanical failures of submersible motors:

Radial Bearing Damage: Radial bearing failures are typically the result of sand or abrasive entry into the motor after the shaft seal has been worn.
For these types of "sandy applications" Franklin Electric recommends the use of our "Sandfighter" motors, which utilizes a silicon carbide seal and special sealing system to provide extended lifetime.
However, continuous side loading of the shaft, as mentioned in the broken shaft section, can also cause radial bearing failure prior to shaft breakage.
Once the radial bearing fails, the resulting debris can produce excessive wear on the thrust bearing and lead to eventual failure of the motor.

Thrust Bearing Damage: In addition to the water logged pressure tank mentioned earlier, water hammer, dead heading pump , insufficient water flow past the motor, and back spinning damages the thrust bearings.

The shock wave caused by water hammer shatters the thrust bearing. The shock wave travels down the water column to the pump shaft and onto the motor's thrust bearing. This shock wave is similar to a train engine coupling to a line of freight cars. When the engine hits the first car, it hits the second and so forth, all the way to the caboose. The thrust bearing is the caboose of a submersible motor and pump.

Dead heading (running the motor, but not moving any water) and insufficient water cooling past the motor causes extreme heating of the motor fill solution. These conditions are usually caused by running against a closed valve, a frozen water line, or blocked outlet. Top-feeding wells, motors installed in open bodies of water, or motors buried in mud or sand, do not allow enough water to move past the motor, unless a flow sleeve is used.
Once the fill solution heats up and turns to steam, all bearing lubrication is lost and the thrust system fails.

Diese Ausgabe der A.I.D. beleuchtet mögliche mechanische Fehler an Unterwassermotoren:

Radiallager-Schäden: Typischerweise entstehen Radiallager-Schäden durch das Eindringen von Sand oder abrasiven Materialien in den Motor, und zwar nachdem die Wellendichtung abgenützt ist. Des weiteren können kontinuierliche seitliche Lasten die Radiallagerschäden herbeiführen, was im brechen der Rotorwelle enden kann.
Falls die Radiallager ausfallen, kann das Lagermaterial zu einer übermäßigen Abnutzung des Drucklagers und zu einem Ausfall des ganzen Motors führen.
Zu Ihrer Information: Für sogenannte „ sandige Einsätze" empfiehlt Franklin Electric den Einsatz von den Sandfighter Motoren, die ein spezielles Dichtungssystem enthalten für eine erweiterte Lebensdauer unter diesen Bedingungen.

Drucklager-Schäden: Wasserhammer, Nullförderung der Pumpe, ungenügender Kühlwasserstrom am Motor entlang, und Rückdrehen der Pumpe führt zu Schäden an den Radiallagern.

Die durch eine Wasserhammer ausgelöste Druckwelle zerschmettert das Drucklager. Die Schockwelle wandert durch die Wassersäule über die Pumpenwelle bis in das Drucklager. Dies kann verglichen werden mit einer Lokomotive, die angekuppelt wird an eine Reihe von Waggons. Wenn die Lokomotive gegen den ersten Waggon stößt, geht dieser Stoß weiter über den zweiten bis zum letzten Waggon. Das Drucklager ist in unserem Falle dieser letzte Waggon.

Nullförderung der Pumpe (Motor läuft, jedoch keine Wasserförderung) und ungenügender Kühlwasserstrom am Motor entlang bewirken eine extreme Aufheizung der Motor-Füllflüssigkeit.

QUALITY MADE BY

Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13
e-mail: field-service@franklin-electric.de
www.franklin-electric.de

Back - spinning of the pump allows the water to flow back through the pump as the water column drops to static level. While the water is draining back, the pump spins the rotor at low RPM. The speed of the rotor is typically not high enough to properly lubricate the thrust bearing and so bearing failure results.

Upthrust failure: Upthrusting occurs when the pump is moving more water than it is designed to pump. On a pump curve, this typically means the pump is running on the "right side" of the curve, with less head or back pressure on the system than intended. With most pumps, this causes an uplifting or upthrusting on the impeller/shaft assembly in the pump. While Franklin submersibles have upthrust bearings which allow limited upthrust without motor damage, it should avoided to minimize wear in the pump and motor. Continuous upthrusting damages the motor's upthrust bearing, imparts debris into the motor, and eventually causes a thrust bearing failure.

The final system failure category is mechanical failures which progress into electrical failure. In the "which came first: chick or the egg" scenario, electrical failures will rarely cause mechanical failures. However, many failures progress into electrical failures once the radial bearings wear enough to allow the rotor to rub the stator liner. When the stator liner is breached, the motor is grounded.

During our motor review process and system analysis, we track stator winding failures and their direct relation to control circuit problems. Control circuit difficulties cause winding failures through the increased internal temperatures caused by repeated high inrush current. This destroys starter and pressure switch contacts, which can lead to low voltage or single-phasing.

In the last 2 issues of the Franklin A.I.D. we have reviewed how system problems contribute to motor failure. By understanding the cause and effect relationship, we hope our readers may recognize some of these and be able to take the necessary steps to get the longest life from their motor.

If you have any question or you need assistance, do not hesitate to contact us via Hotline:

Hotline: ++49-(0)6571-105420
Fax : ++49-(0)6571-105513
Email : field-service@franklin-electric.de

Franklin Electric International Training

10 th Feb. 2004 to 12 th Feb. 2004

Franklin Electric Service Seminars in Germany

Wolfsburg	17 February 2004
Cottbus	02 March 2004
Rostock	04 March 2004

For information please visit our website at

www.franklin-electric.de

or contact us under

field-service@franklin-electric.de

Diese Bedingungen werden normalerweise hervorgerufen durch Arbeiten gegen einen geschlossenen Schieber, eine gefrorene Förderleitung oder einen blockierten Auslass. Brunnen, bei denen das Förderwasser von oben an die Pumpe gelangt, in offenen Behältnissen installierte Pumpen, oder Motoren die in Sand oder Schlamm sitzen, verhindern die ausreichende Umströmung des Motors, es sei denn, ein Kühlmantelrohr wird verwendet. Falls nämlich die Füllflüssigkeit aufheizt und sogar Dampf bildet, ist die Schmierung verloren und das Drucklager fällt aus.

Rückdrehen der Pumpe wird herbeigeführt durch das Zurückfließen von wasser durch die Pumpe, bis die Wassersäule den statischen Stand erreicht. Hierbei dreht sich die Pumpe mit sehr niedrigen Umdrehungen. Diese Geschwindigkeit ist zu gering um das Drucklager ausreichend zu schmieren, so das es ausfallen kann.

Gegenlauflager-Schäden: Gegenlauf entsteht wenn die Pumpe mehr Wasser fördert, als diese nach Design fördern soll. Auf einer Pumpenkurve heißt das, die Pumpe läuft rechts außerhalb der Kurve, mit weniger Systemdruck als vorgesehen. Bei den meisten Pumpen bewirkt dies ein Emporheben oder Gegenlaufen der Impeller mit der Welle in der Pumpe. Franklin Electric Motoren erlauben aufgrund der eingebauten Gegenlauflager beschränkten Gegenlauf ohne Motorschaden. Dies sollte jedoch vermieden werden um Abnutzungen im Motor und in der Pumpe zu minimieren. Kontinuierlicher Gegenlauf zerstört das Gegenlauflager, abgeriebene Teile hiervon gelangen in den Motor und können eventuell das Drucklager und die Radiallager zerstören. Bei einer richtig ausgeführten Installation, speziell im Hinblick auf Rückschlagventile, ist der Gegenlauf beim Anlaufen auf ein Minimum oder sogar Auf null begrenzt.
Die abschließende Systemschaden-Kategorie besteht aus mechanischen Ausfällen, die elektrische Schäden bewirken können. In der Ordnung: was war erst, das Huhn oder das Ei ? es seltener, dass elektrische Fehler zu mechanischen Ausfällen führen. Jedoch führen viele mechanische Fehler zu elektrischen Ausfällen, wenn z. B. die Radiallager soweit verschlissen sind, dass der Rotor am Spaltrohr oder an der Wicklung schleift, was zu einem Kurzschluß führen kann.
Bei Motor – und Systemanalysen müssen wir auch Wicklungsausfälle und deren direkte Beziehung zur Motorstromversorgung betrachten. Schwierigkeiten in der Spannungsversorgung bewirken Wicklungsausfälle durch erhöhte interne Temperaturen, die hervorgerufen werden durch hohen Strom Zufluß. Dieses kann zu Zerstörungen des Startrelais und der Druckschalterkontakte führen, die enden können in geringer Versorgungsspannung oder Phasenausfall.

In den 2 letzten Ausgaben der Franklin A.I. D. haben wir erörtert, wie Systemprobleme zu Motorausfällen führen können. Wenn man die Ursachen- und Ausfalleffekte verstand, hoffen wir, das einige Erkenntnisse gewonnen wurden , die beim Einhalten der notwendigen Schritte dazu führen, längstmögliche Lebensdauer des Motors zu erreichen.

Wenn Sie Fragen haben oder unsere Hilfe in Anspruch nehmen möchten, so können Sie uns gerne erreichen unter:

Hotline: ++49-(0)6571-105420
Fax : ++49-(0)6571-105513
Email : field-service@franklin-electric.de

FRANKLIN AID

Franklin Electric

No. 1 March 2004

Many modern applications today require the use of submersible motors in combination with variable frequency d Below guidelines will give you necessary information on Franklin`s submersible motors.

This A.I.D. will focus the Variable Speed Submersible Pump Operation, Inverter Drives:

Franklin three-phase submersible motors are operable from variable frequency inverter drives when applied within guidelines shown below. These guidelines are based on present Franklin information for inverter drives, lab tests and actual installations, and must be followed for warranty to apply to inverter drive installations.

Franklin single-phase submersible motors are not recommend for variable speed operation.

Load Capability: Pump load should not exceed motor nameplate service factor amps at rated voltage and frequency.

Frequency Range: Continuous between 30 Hz and Rated frequency (50 or 60 Hz). Operations above rated frequency require special considerations, consult factory for details.

Volts/Hz: Use motor nameplate volts and frequency for the drive base settings. Many drives have means to increase efficiency at reduced pump speeds by lowering Motor voltage. This is the preferred operating mode.

Voltage Rise-time or dV/dt: Limit the peak voltage to the motor to 1000V and keep the rise-time greater than 2 µsec. Alternately stated: keep dV/dt<500V/µsec. See Filters or Reactors.

Motor Current Limits: Load no higher than motor nameplate service factor amps. For 50 Hz ratings, nameplate maximum amps are rated amps. See Overload Protection below.

Motor Overload Protection: Protection in the drive (or separately furnished) must be set to trip within 10

Viele moderne Applikationen verlangen heute den Einsatz von Unterwassermotoren in Verbindung mit Frequenzumrichtern. Um Ihnen notwendige Informationen bez. Franklins Unterwassermotoren zu geben, haben wir Ihnen nachfolgend einige wichtige Richtlinien zusammengestellt.

Diese AID beleuchtet den Frequenzumrichter-betrieb von Unterwassermotoren:

Franklin 3-Phasen Unterwassermotore können mit Frequenzumrichtern betrieben werden, solange nachfolgende Richtlinien eingehalten werden. Diese Richtlinien basieren auf aktuellen Franklin Informationen, Labortests und Installationen und müssen, um Gewährleistungsansprüche zu erhalten, befolgt werden. Franklins Einphasen-Motoren können nicht an Frequenzumrichtern betrieben werden.

Pumpenlast: Die Pumpenlast darf den Strom auf dem Motortypenschild bei Nennspannung und Nennfrequenz nicht überschreiten.

Frequenzbereich: Kontinuierlich zwischen 30 Hz und Motornennfrequenz(50 oder 60 Hz). Der Betrieb über Nennfrequenz setzt spezielle Betrachtungen voraus, treten Sie in diesem besonderen Fall mit dem Hersteller in Kontakt.

Volts/Hz: Benutzen Sie als Grundparameter des Umrichters die Spannungs- und Frequenzangaben auf dem Motortypenschild. Viele Umrichter besitzen Optimierungsparameter, um die Effektivität bei niedriger Drehzahl mit niedriger Motorspannung zu steigern. Dies ist als bevorzugter Betriebsmodus anzusehen.

Spannungsanstieg (dV/dt): Spannungsspitzen sollten unter 1000 Volt bei einer Anstiegszeit der Spannung höher als 2 µsec sein, alternativ <500V/µsec.

Beachten Sie das Einsetzen von Filtern und Drosseln.

Motor Strom Limit: Last nicht höher als die Angabe auf dem Motortypenschild. Bei 50 Hz Nennfrequenz ist die Stromangabe auf dem Typenschild der Nennstrom.

Überlastschutz: Der Schutz im Umrichter ,oder die externe Absicherung, muss innerhalb von 10 Sekunden bei 5 fachem

seconds at 5 times motor maximum nameplate amps in any line, and ultimately trip within 115% of nameplate maximum amps in any line.
Subtrol-Plus: Franklin`s Subtrol-Plus protection systems ARE NOT USABLE on VFD installations.
Start and Stop: ONE SECOND MAXIMUM RAMP-UP AND RAMP-DOWN TIMES BETWEEN STOPPED AND 30 HZ. STOPPING BY COAST-DOWN IS PREFERABLE.
Starts: Allow 60 seconds before restarting.
Filters or Reactors: Required if all three of the following conditions are met: (1) Voltage is 380V or greater and (2) Drive uses IGBT or BJT switches (rise-times<2 µsec) and (3) Cable from drive to motor is more than 15.2 m. A low-pass filter is preferable. FILTERS OR REACTORS SHOULD BE SELECTED IN CONJUNCTION WITH THE DRIVE MANUFACTURER AND MUST BE SPECIFICALLY DESIGNED FOR VFD OPERATION.
Cable Lenghts: Per Franklin`s cable table unless a reactor is used. If a long cable is used with a reactor, additional voltage drop will occur between the VFD and the motor. To compensate, set the VFD output voltage higher than the motor rating in proportion to the reactor impedance (102% voltage for 2% impedance,etc.)
Motor Cooling Flow: For installations that are variable-flow, variable-pressure, minimum flow rates must be maintained at nameplate frequency. In variable-flow, constant pressure installations, minimum flow rates must be maintained at the lowest flow condition. Franklin`s minimum flow requirements for 4" cantype motors: 8 cm/sec. and for 6" and 8 motors 16 cm/sec. Rewindable motors require different flow-speeds(refer to technical doc`s or motor nameplates).
Carrier Frequency: Applicable to PWM drives only. These Drives often allow selection of the carrier frequency. Use a carrier frequency at the low end of the available range.
Miscellaneous: Franklin three-phase motors are not declared "Inverter Duty" motors per NEMA MG1, Part 31 standards. However, Franklin`s submersible motors can be used with VFDs without problems and/or warranty concerns provided these guidelines are followed.

Explanations:

IGBT : Isolated Gate Bipolar Transistor
BJT : Bipolar Junction Transistor
PWM : Pulse wide modulation
VFD : Variable Frequency Drive

Motornennstrom allphasig auslösen bzw. bei 115% des Motornennstroms.
Subtrol-Plus: Franklin`s Subtrol-Plus Schutzsystem kann nicht in Frequenzumrichter- Installationen genutzt werden.
Ein-und Ausschalten: DIE RAMPENZEITEN ZWISCHEN START UND 30HZ BZW. 30 HZ UND STOP DÜRFEN MAX.1 SEKUNDE BETRAGEN.
DIE KONTINUIERLICHE DREHZAHLABSENKUNG BIS ZUM STILLSTAND IST ZU BEVORZUGEN.
Intervall-Betrieb: Zwischen den Startzyklen muss eine Wartezeit von 60 sek. eingehalten werden.
Filter oder Drosseln: Sie werden benötigt, wenn alle nachfolgenden Bedingungen gegeben sind.

(1) Die Spannung ist größer als 380V und
(2) Die Frequenzumrichter arbeiten mit IGBT oder BJT (Anstiegszeit<2 µsec.) und
(3) Die Leitungslänge zwischen Umrichter und Motor beträgt mehr als 15,2 m.

Ein Tiefpass-Filter ist vorzuziehen.
FILTER UND DROSSELN SOLLTEN NACH ABSPRACHE MIT DEM UMRICHTER-HERSTELLER AUSGEWÄHLT WERDEN UND MÜSSEN SPEZIELL FÜR UMRICHTERBETRIEB KONSTRUIERT SEIN.
Kabellänge: Die Kabellänge kann der Kabeltabelle entnommen werden, solange keine Drossel Verwendung findet. Wenn ein langes Motorkabel mit einer Drossel eingesetzt wird, kann ein zusätzlicher Spannungsfall auftreten, der kompensiert werden muss. Dies kann erfolgen, indem man die Ausgangsspannung des Umrichters in Abhängigkeit der Drossel erhöht(102% Spannung für 2% Drosselimpedanz,etc.).
Motor-Kühlfluss: In Installationen mit variabler Fließgeschwindigkeit und variablem Förderdruck muß die Mindestfließgeschwindigkeit bei Nennfrequenz laut Typenschild sichergestellt sein. In Installationen mit variabler Fließgeschwindigkeit und konstantem Förderdruck muß der Kühlfluß auch bei der geringsten Fördergeschwindigkeit eingehalten werden.
Franklin`s Mindestfließgeschwindigkeiten betragen bei 4" Spaltrohrmotoren 8 cm/sek. und bei 6" bzw. 8" Motoren 16 cm/sek. Wiederwickelbare Motoren benötigen verschiedene Kühlgeschwindigkeiten(ersichtlich aus den technischen Dokumentationen und den Motorbeschriftungen).
Trägerfrequenz: Nur bei PWM-Umrichtern anwendbar. Diese Umrichter erlauben die Auswahl der Trägerfrequenz. Nutzen Sie eine Trägerfrequenz am unteren Ende des Auswahlbereiches.
Sonstiges: Franklins 3-Phasen-Motore sind nicht nach NEMA MG1, Part 31 als Frequenzumrichter-tauglich deklariert. Franklins Unterwassermotore können jedoch

Seminar Schedule 2004 / Seminarübersicht 2004 (Booking / Reservation : field-service@franklin-electric.de)

Europe:

Mercure Lognes Marne la Vallée	4. Mai 2004
Novotel Lyon Bron	6. Mai 2004

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data Europe No.2/ 2004

In this new edition of the Franklin AID we want to shed some light onto the requirements of borehole pump installations. On the reverse you will find the explanation of the positions 1 to14 shown in the drawing.

Furthermore we would like to introduce our new member to the headquarter's service team:

Torsten Schulte-Loh

Mr. Schulte-Loh started his education in a pump company, working there for more than 12 years in the electrical-mechanical department. He then started his studies at the Balthasar-Neumann-Technikum, Trier/ Germany, where he graduated as Electrical Engineer.

His wide pump and motor related knowledge will be a great benefit for his future work in Franklin Electric.

Franklin Electric

“MINIMUM REQUIREMENTS FOR A SUCCESSFULL BOREHOLE PUMP INSTALLATION”

1 **CABLE SIZING**
Cable sizes MUST be based on the distance between the supply entry point and the motor. See Franklin’s cable selection charts or consult the cable manufacturer. Tie the cable to the riser pipe.

2 **EARTHING**
Use an insulated earth wire, cross section to be selected according to local regulations (in Germany VDE 0100, Part 540). Connect cable arrestors to the ground (earth) wire coming from the motor instead. Arrestors MUST be installed as close to the motor (top of the borehole) as possible.

3 PRESSURE GAUGE
Preferably with drag pointer to indicate the presence of waterhammer.

4 **NON-RETURN VALVE**
Surface non-return valves are optional.

5 **REGULATING VALVE**
A suitable control type valve is strongly recommended.

6 **WATERHAMMER**
If surface valves are installed, a vacuum breaker must be fitted.

7 **UP-THRUSTING**
For boreholes with high static water levels, up-thrusting should be minimized (i.e. smaller riser pipe, nozzle)

8 **LEVEL MEASUREMENT**
Dipper tube (open at the bottom) for measuring static and dynamic water levels. Tie the tube to the rising main.

9 CORROSION CONTROL*
Experience showed that 1/2 to 1 meter of srewed and socketed galvanized pipe could help to reduce corrosion.

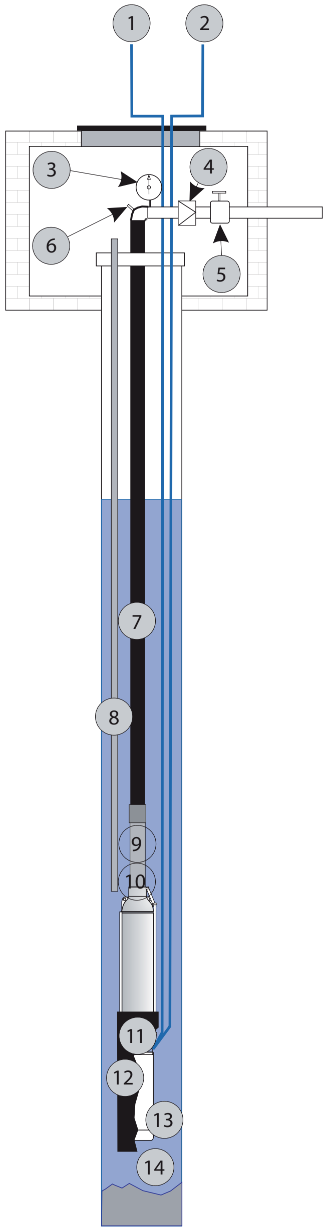
10 **NON RETURN VALVE**
A fully operational springloaded non return valve MUST be installed at the discharge of the pump.

11 **COUPLING AND SPLINE LUBRICATION**
The pump coupling must be filled with a good quality water resistant grease or vaseline. Rotate the coupling while joining the motor to the pump.

12 **INDUCER SLEEVE**
An inducer sleeve MUST be fitted if the pump is installed below the main inflow point, the diameter of the well is large, the inflow point is unknown or the minimum flow along the motor cannot be provided.

13 **MOTOR PROTECTION**
Motor protection must open the circuit within max. 10 seconds of a locked rotro. It shall include phase failure protection and temperature compensation.

14 **PREVENTING INGRESS OF SAND AND SILT**
Pump and motor must be installed above of sediment or borehole bottom.
Recommendation:
4 inch + 6 inch motors min. 5 m higher
8 inch + 10 inch motors min. 10 m higher



“MINDESTANFORDERUNGEN AN EINE ERFOLGREICHE BRUNNENPUMPEN-INSTALLATION”

1 **KABELQUERSCHNITT**
Der Kabelquerschnitt MUSS auf die Länge zwischen Versorgungseintrittspunkt (Trafo) und Motor abgestimmt werden. Beachten Sie die Franklin Kabeltabelle oder kontaktieren Sie den Kabelhersteller. Befestigen Sie das Motorkabel an der Steigrohrleitung.

2 **ERDUNG**
Benutzen Sie eine isolierte Erdleitung in Anlehnung an VDE 0100,Teil 540. Schließen Sie das Erdkabel am Erdleiter des Motorkabels und an den Spannungsableitern an. Diese müssen so nah wie möglich am Motor (am Brunnenkopf) installiert werden.

3 **DRUCKMANOMETER**
Bevorzugt mit Schleppzeiger zur Anzeige möglicher Druckschläge durch Wasserhammer o.ä.

4 **RÜCKSCHLAGVENTIL**
Die Installation eines Rückschlagventils außerhalb des Brunnens ist optional.

5 **DROSSELVENTIL**
Ein angepasster Absperrschieber sollte in jedem Fall in die Druckleitung am Brunnenkopf eingebaut werden.

6 **WASSERHAMMER**
Bei Installation eines Rückschlagventiles empfiehlt sich der Einsatz eines Belüftungsventils.

7 **GEGENLAUF**
In Brunnen mit hohem statischen Wasserspiegel sollte der Gegenlauf minimiert werden (durch z.B. Steigleitung mit geringerem Durchmesser, Düse, etc.).

8 **WASSERSTANDSMESSUNG**
Messrohr zur Überwachung des statischen und dynamischen Wasserstands.

9 **KORROSIONSSCHUTZ***
Franklin`s 4” Motoren können zum Korrosionsschutz mit Opferanoden bestückt werden.

10 **RÜCKSCHLAGVENTIL**
Ein voll funktionsfähiges, federbelastetes Rückschlagventil MUSS unmittelbar am Austrittsflansch der Pumpe eingebaut sein.

11 **KUPPLUNG UND VERZAHNUNG**
Die Kupplung muss mit wasserbeständigem, trinkwasserzugelassenem Fett oder Vaseline eingesetzt werden. Drehen Sie die Kupplung beim Anflanschen der Pumpe an den Motor.

12 **KÜHLMANTELROHR**
Ein Kühlmantelrohr MUSS eingesetzt werden wenn sich der Zulauf des Brunnens oberhalb des Motors befindet, der Brunnendurchmesser zu groß ist, der Mindestkühlfluss am Motor entlang nicht erreicht wird oder der Wassereintrittspunkt unbekannt ist.

13 **MOTORSCHUTZ**
Das Überlastrelais muss innerhalb von 10 Sekunden bei 5-fachem Motornennstrom auslösen. Phasenausfall und Temperaturkompensation sollten integriert sein.

14 **VERMEIDUNG VON SAND- UND SCHLAMMEINTRITT**
Pumpe und Motor müssen oberhalb des Brunnenbodens bzw. der Ablagergrenze für Schwerstoffe installiert werden.
Empfehlung:
4” + 6” Motoren min. 5 m höher
8” + 10” Motoren min. 10 m höher

Other Important Points:

1) Pump duty point must always fall within the middle third of the pump’s operating curve.
2) Pressure surges must be prevented using appropriate valves.
3) Do not exceed the maximum number of starts per hour as shown in Franklin Electric’s Installation Manual.
4) All electrical control apparatus must be in safe and good working condition. Regular checks should be made for loose connections and burnt contactor points.
5) Excessive operation against a closed or partially open valve must be avoided.
6) Protect all submersible motors with an optimized surge/overvoltage protector.
7)* Franklin’s 4 inch motors can be protected against corrosion by using sacrifying anodes.

Weitere wichtige Gesichtspunkte :

1) Der Betriebspunkt der Pumpe muss im mittleren Drittel der Pumpenkennlinie liegen.
2) Druckspitzen muss vorgebeugt werden durch geeignete Ventile.
3) Überschreiten Sie nicht die max. zulässige Anzahl der Sarts/Stops pro Stunde, die in der Franklin-Dokumentation angegeben ist.
4) Die Elektroinstallation muss regelmäßig auf Sicherheit und Funktionstüchtigkeit (Kontaktbrand, schlechte Kabelverbindungen, etc.) untersucht werden.
5) Lang anhaltender Betrieb gegen einen geschlossenen oder nur teilweise geöffneten Schieber muss vermieden werden.
6) Schützen Sie alle Unterwassermotoren mit einem optimierten Überspannungs-Blitzschutz.
7)* Franklin's 4”- Motoren können zum Korrosionsschutz mit Opferanoden bestückt werden.

Franklin Application/Installation Data ***Europe*** No. 3 / 2004

This 3rd edition will highlight: **"The Construction of Submersible Motors – Part 1: Electrical Design"**

When you install an electric submersible pump and motor in a well, you expect the motor to operate reliably for several years while delivering its rated horsepower for the required duty cycle.

However, as electric motors are not generally designed to operate under water, a special type of motor for this application had to be designed. Franklin Electric Company was the pioneer in developing and constructing durable submersible motors to operate effectively in deep well applications. The design features discussed in this article are t result of experience gained in the production and field usage of millions of motors for water well service over the past six decades. As it is generally known, water and electricity don't mix. So, the central question in the design of a submersible motor is how to protect the copper windings in the core of the motor (the stator) from contact with water, thus preventing an electrical short-circuit. A second important issue that will be addressed in our next FEE AID relates to the mechanical design requirements: in deep well situations, costs generated by pulling/reinstalling the pump together with the downtime costs generally are much higher than the costs of the replacement pump itself. Therefore, submersible motors must be designed to offer a long, maintenance-free life in their natural environment, the well water.

Today, the submersible motor market knows three different motor designs:

⇒ **Canned-type, Hermetically-sealed, or Encapsulated Motors**
The electrical active part, the stator core with winding, is surrounded by a hermetically sealed stainless steel housing (can). The wound stator core is pressed into a stainless steel outer cylinder (the shell) and another very thin inner stainless steel cylinder (liner) is placed into the stator bore. Both are welded to solid carbon steel discs (upper and lower end rings) forming an enclosed can. The air trapped in this can is evacuated and replaced by a patented resin filling to maintain rigidity in the windings and improve heat transfer. All canned type motors are equipped with a removable "water bloc" lead connector. When a canned motor is repaired, the entire stator may be replaced by a new factory produced encapsulated stator, thus ensuring the same high quality electrical performance found in a new motor.

⇒ **Rewindable or Wet-wound Motors**
As opposed to the canned design, "wet wound" submersible motors use special plastic coated magnet wires. As a result, these windings do not need to be encapsulated and are directly surrounded by the internal cooling and lubrifying liquid, generally a mixture of water and non-contaminating anti-freeze. The rest of the (mechanical) design is very similar to encapsulated motors, although in this design, the leads are usually directly connected to the motor windings. As the repair of a wet-wound submersible motor implies exchanging the magnet wire in the stator slots, the quality of the repair is highly dependant on the used material and the operator skills.

⇒ **Oilfilled- Motors**
Oil-filled submersible motors use standard, varnish-insulated and impregnated copper windings. However, the filling liquid in these motors is not water, but oil, which offers both cooling and insulation to the electrical parts. In addition, it acts as lubricant for the mechanical bearings, which in most cases are standard ball bearings. Because the electrically insulating as well as the lubricating properties of oil rapidly deteriorate with water contamination, particular care must be taken in choosing high quality sealing components paired with a very high quality standard during manufacturing.

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20 Tel.: +49 (0)65 71 10 54 20 e-mail: field-service@franklin-electric.de
D-54516 Wittlich/Germany Fax: +49 (0)65 71 10 55 13 **www.franklin-electric.de**

In dieser Ausgabe möchten wir Ihnen **„Das Design und die Konstruktion von Unterwassermotoren: Teil 1“** *vorstellen.*

Wenn Sie eine Unterwasserpumpe mit Motor installieren, erwarten Sie, dass der Motor jahrelang zuverlässig arbeitet und dabei seine Nennleistung für den gewünschten Einsatz abgibt. Elektromotoren sind normalerweise nicht für den Einsatz unter Wasser gebaut; sie müssen speziell für diese Anforderungen konstruiert werden. Franklin Electric ist Pioneer auf dem Gebiet von Design- und Konstruktionslösungen für leistungsfähige und standfeste Unterwassermotoren für den Brunneneinsatz. Die hier aufgezeigten Designmerkmale sind das Ergebnis von Erfahrungen, die bei der Herstellung und dem Einsatz von vielen Millionen Unterwassermotoren gewonnen wurden. Die zentrale Frage bei der Herstellung eines Unterwassermotors ist: Wie schütze ich die spannungsführenden Kupferwicklungen im Stator vor Wasser? (Da Wasser ein natürlicher Leiter für Elektrizität ist, würde dies zu einem Kurzschluss führen). Ein weiterer Gesichtspunkt wird in der nächsten AID thematisiert: Der mechanische Aufbau. In tiefen Brunneninstallationen betragen die Bergekosten ein Vielfaches des Preises des Ersatz-Aggregates. Aus diesem Grund müssen Unterwassermotoren so konstruiert sein, dass ein langer, wartungsfreier Betrieb in ihrem natürlichen Element, dem Wasser, möglich ist.

Zur Zeit gibt es 3 verschiedene Motorkonstruktionen am Markt:

⇒ **Spaltrohrmotor**
Die Lamination ist mit den Wicklungen in einen Edelstahlzylinder eingepresst und umlaufend wasserdicht verschweißt. Mit einem patentierten System wird ein dünnes Edelstahl-Spaltrohr innen im Stator eingebracht, welches es den eingeschlossenen Wicklungen erlaubt, elektrisch so zu agieren, als wären diese nicht innerhalb eines wasserdichten Gehäuses. Der vom Stator und den Motorendteilen eingeschlossene Innenraum ist komplett mit Wasser und Propylenglycol gefüllt, um einem Frostschaden vorzubeugen. In diesem niederviskosen Wassermedium dreht der Rotor mit Antriebsverzahnung mit sehr hoher Effizienz. Das Wassermedium erlaubt allen beweglichen Teilen im Motor uneingeschränkte Kühlung und Schmierung. Beim wassergefüllten Design würden geringfügige Mengen von Brunnenwasser, die in den Motor eintreten könnten, keinerlei Schaden anrichten.

⇒ **Wiederwickelbarer Motor – Nassläufer**
Bei diesem Design sind die Wicklungen durch eine Drahtumhüllung mit einer Schicht aus entweder PVC oder PE2PA abgedichtet. Diese Ausführung hat die gleichen Stärken wie die der hermetisch abgedichteten Spaltrohrmotoren, aber einige Punkte sind zu beachten: Auswahl des Isolationsmaterials bei der Fabrikation, sowie die größere Baulänge aufgrund geringerer Kupferfüllung der Laminationsnuten. Schmierung und Innenkühlung erfolgen ebenfalls durch eine Wasserfüllung.

⇒ **Ölgefüllte Motoren**
Bei ölgefüllten Motoren werden standardisierte, lackdrahtisolierte Kupferwicklungen verwendet. Die Füllflüssigkeit die Motoren ist nicht wasserbasierend sondern Öl, welches die Kühlung des Motors und die Isolation der elek-trischen Te übernimmt. Zusätzlich dient es auch der Lagerschmierung. Die Lager sind in den meisten Fällen als Kugellager ausgeführt. Wegen der Isolierung und der starken Verschlechterung der Schmiereigenschaften von Öl bei Eindringen von Wasser in den Motor, muss ein besonderes Augenmerk auf die Auswahl geeigneter, hochqualitativer Dichtungskomponenten gelegt werden, in Verbindung mit sehr hohem Qualitätsstandard während der Motorfertigung.

In der nächsten Ausgabe der AID werden wir mit Materialien und Komponenten von Unterwassermotoren fortfahren.

Franklin Electric Submersible Seminars 2005

Spring 2005: North of France
Portugal
Spain

Please visit our website at www.franklin-electric.de for more information and details on future trainings and seminars or contact us directly at field-service@franklin-electric.de.

Franklin Application/Installation Data ***Europe*** No. 4 / 2004

This edition will highlight: **"The Construction of Submersible Motors Part 2 : Mechanical Design"**

Technically speaking, the submersible motor is an asynchronous motor, featuring a stator, a rotor and bearings just like any other above ground motor. Its mechanical design however needs to account for the very specific environment and load that it has to carry: it lives its life under water, in narrow boreholes, with sometimes aggressive chemical behaviour or high dissolved solid contents. The motor drives a multistage submersible pump that by design exercises a certain downward oriented thrust load on the motor shaft. Thus, a submersible motor is of slim, long shape, with two or more radial bearings to center the rotor and an additional thrust bearing to carry the pump load. Its constituting materials in contact with the environment are of corrosion resistant materials. A shaft seal keeps the filling liquid inside and a pressure equalizing diaphragm allows for its heat expansion.

In more detail:

⇒ **Bearing System**

Especially the rotor bearing design in submersible motors is of particular interest: Normally, ball bearings would be used for radial purpose and angular contact bearings for combined radial/thrust loads. As in submersible motors it is desirable to have water-based cooling and lubrication fillings, ball bearings are not the first option, although they are used in the oil-filled design. Also, as already discussed, because of high pulling costs, lifetime without the need of maintenance is of major concern. Considering the above, slide bearings have been found to offer theoretically unlimited lifetime with best behaviour in water-based lubrication. For both Encapsulated and Rewindable submersible motors, Franklin Electric uses hydrodynamic slide bearings. Our radial bearings consist of stainless steel shaft sleeves and carbon journals as bearing partners. When the rotor comes to speed, a water cushion is built up between the stationary carbon journal and the rotating stainless steel sleeve, so there is virtually no mechanical contact between the two components and consequently no wear. The thrust bearing also makes use of the same materials: it consists of a rotating carbon disc and a number of stationary, tilting stainless steel pads. In normal operation, a very thin water film is drawn between the pads and the carbon disc, which makes the thrust disc to "float" over the pads. This is comparable with the "aquaplaning" phenomenon known to most automobile drivers, and again results in theoretically no wear and long, maintenance-free bearing life. Obviously, it has to be made sure that the original filling liquid does not get contaminated with solids, and here is where the shaft seal steps in.

⇒ **Sealing system**

The inner part of the motor is filled with liquid for the purpose of lubrication, cooling and pressure equalization. This filling operation is performed at the factory with a water-based, clean filling liquid. Ideally, this liquid will not be exchanged for the entire lifetime of the submersible motor. To guarantee this, all joints of the motor are equipped with sealing components such as O-rings, flat gaskets and a lip- or mechanical seal for the shaft. To protect the seal from excessive wear by solids in suspension which are normally observed in well water, a sand slinger is fitted on the shaft to cover the seal area. Submersible motors also need a volume compensating diaphragm that allows for the heat expansion of the filling liquid captured inside the motor. As a positive side effect, the diaphragm also equalizes the pressure inside and outside of the motor for the various submergence depths.

The next edition will continue with leads and lightning arrestors.

QUALITY MADE BY

Franklin Electric Europa GmbH

Rudolf Diesel Straße 20 Tel.: +49 (0)65 71 10 54 20 e-mail: field-service@franklin-electric.de
D-54516 Wittlich/Germany Fax: +49 (0)65 71 10 55 13 **www.franklin-electric.de**

Diese Ausgabe beschäftigt sich mit der **„Konstruktion von Unterwassermotoren, Teil 2: Mechanik“**

Aus technischer Sicht ist ein Unterwassermotor ein Asynchronmotor, bestehend aus Stator, Rotor und Lagern, ähnlich den normalen, trocken aufgestellten Elektromotoren. Der mechanische Aufbau ist jedoch an die speziellen Einsatzbedingungen im Bohrloch angepasst: engster Raum, permanente Wasserüberdeckung, Einsatz in aggressiven oder mit Feststoffen versetzten Medien. Der Motor treibt eine mehrstufige Pumpe an, welche konstruktionsbedingt eine zum Motor hin wirkende Drucklast auf die Motorwelle abgibt. Daher ist ein Unterwassermotor schmal und lang gebaut, mit 2 oder mehr Radiallagern zur Zentrierung des Rotors und zusätzlichem Axiallager, um die Drucklast der Pumpe aufnehmen zu können. Die mit dem Umgebungsmedium in Kontakt stehenden Komponenten des Motors sind aus korrosionsbeständigen Materialien ausgeführt. Eine Wellendichtung sorgt dafür, dass die Motor-Füllflüssigkeit nicht austritt und eine Membrane ermöglicht der Füllflüssigkeit, sich bei Volumenvergrößerung durch die beim Betrieb entstehende Wärme auszudehnen.

⇒ **Lagersystem**

Speziell die Rotorlagerung ist bei Unterwassermotoren von besonderem Interesse. Bei herkömmlichen Elektromotoren werden die auf den Rotor wirkenden Druck- und Seitenlasten normalerweise durch Kugellager aufgenommen. Für Unterwassermotoren ist es jedoch erstrebenswert, eine wasserbasierende Kühl- und Füllflüssigkeit im Motor-inneren zu verwenden, welche dann auch die Lagerstellen umgibt. Da diese Art von Flüssigkeit zur Schmierung normaler Kugellager ungeeignet ist, kommen diese nur in ölgefüllten Unterwassermotoren zum Einsatz. Außerdem ist aufgrund hoher Bergungskosten die Wartungsfreiheit dieser speziellen Motorenart von primärem Interesse. Unter Berücksichtigung der oben aufgeführten Gründe haben sich in wassergefüllten Bohrlochmotoren Gleitlager durchge-setzt, welche eine zumindest theoretisch unbegrenzte Standzeit bei gleichzeitig minimalem Wartungsaufwand versprechen. Demzufolge verwendet Franklin Electric sowohl bei Spaltrohr- als auch bei wiederwickelbaren Motoren hydrodynamische Gleitlager. Die Radiallager bestehen aus einer Edelstahl-Wellenhülse, die in einer
Kohlebuchse läuft. Ab einer bestimmten Rotordrehzahl baut sich ein Schmierfilm zwischen stationärer Kohlebuchse und rotierender Edelstahl-Wellenhülse auf, so dass praktisch kein mechanischer Kontakt zwischen den beiden Teilen besteht und demzufolge auch kein Verschleiß auftritt. Das Drucklager verwendet dieselben Materialien, besteht jedoch aus einer rotierenden Kohlescheibe und mehreren feststehenden, kippbaren Edelstahl-Segmenten. Ähnlich dem den meisten Autofahrern bekannten „Aquaplaning“-Phänomen baut sich im Betrieb des Motors ein dünner Wasserfilm zwischen der Kohlescheibe und den Segmenten auf, welcher der Kohlescheibe erlaubt, berührungslos über die Segmente zu gleiten. Dies resultiert in einer theoretisch unbegrenzten Standzeit und Wartungsfreiheit des Lagers, vorausgesetzt, die Original-Füllflüssigkeit wurde nicht durch Festkörper verschmutzt.

⇒ **Dichtsystem**

Das Motorinnere wird im Herstellerwerk zum Zweck der Schmierung, Kühlung und des Druckausgleichs mit einer wasserbasier-ten, sauberen Flüssigkeit gefüllt. Idealerweise wird diese Flüssigkeit über die gesamte Lebenszeit des Motors nicht ausgetauscht oder kontaminiert. Dies wird durch ein ausgeklügeltes Dichtsystem bestehend aus Wellendichtung, Membrane sowie diversen
O-Ringen bzw. Flachdichtungen erzielt. Die meisten Brunnengewässer beinhalten einen gewissen Anteil von Feststoffen in Suspension (Sand), welche zu erhöhtem Verschleiß an der Wellendichtung führen kann. Um dies zu verhindern, besitzen Unter-wassermotoren einen Sandschleuderring auf dem Wellenende. Da sich Elektromotoren während des Betriebes erwärmen, muss für die Volumenausdehnung der eingefüllten Flüssigkeit gesorgt werden. Diese Aufgabe übernimmt eine elastische Membrane, welche zugleich den Druckausgleich zwischen Motorinnerem und Umgebung sicherstellt, unabhängig von der Einsatztiefe.

Die nächste Ausgabe wird Kabel und Überspannungsableiter behandeln.

Franklin Electric Submersible Seminars 2005

Spring 2005: North of France
Portugal
Spain

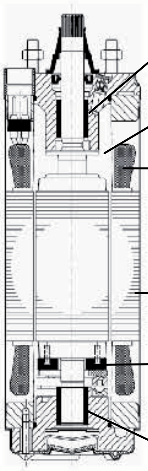
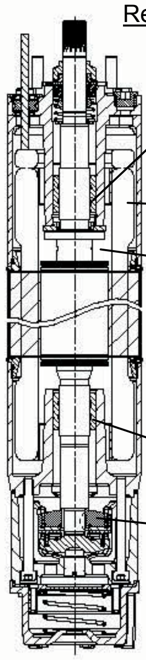
Please visit our website at www.franklin-electric.de for more information and details on future trainings and seminars or contact us directly at field-service@franklin-electric.de.

FRANKLIN AID

Franklin Electric

Franklin Application/ Installation Data Europe **AID 1/2005**

The previous editions of the Franklin AID dealt with different constructions and designs of motors. To finalize this subject you will find below drawings of the different designs in direct comparison.

Encapsulated	Oil filled	Rewindable
		

We are glad to introduce our new Field Service Engineer Mr. Alberto Fornasier. He took over responsibility for the areas Italy, Greece and the corresponding islands.
You can reach him under the following numbers:
Phone: +39 0422 761 713
Fax: +39 0422 761 711
email: afornasier@fele.com

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

In this and the next issue of our FE AID, we will discuss the leads and drop cables used with submersible motors.

The electrical power from the grid/power supply needs to be taken all the way down to the submersible motor, which is done by means of electrical power cables. Practically, in bore-hole pump installations one divides between “motor short leads” and “drop cables”.

Definitions: The leads directly connected to the submersible motor, generally a few meters long, are to be considered **“motor short leads**”. Because these leads need to be taken alongside the pump and underneath a cable guard, the main design feature for these leads is “flat and narrow”. So, for practical reasons, motor manufacturers choose the smallest possible lead suitable to carry the motor’s nameplate current **under water**. The cooling by the well water of the smaller gauge lead size is sufficient.

Also, even though this lead’s cross-section is low, because of its shortness there will be no noticeable voltage drop on this portion. Because of it’s shortness there will be no noticeable voltage drop on this portion, even though this lead’s cross-section is low.

These motor short leads are then spliced to a generally thicker (larger cross-section) cable called “**drop cable**”. Because the riser pipe is generally narrower than the pump, there are no space limitations to be observed for drop cables. Also, as opposed to the motor short lead, at least a portion of the drop cable will be taken out of the water and into the control panel of the pump. Thus, this cable needs to be able to carry the full line current of the motor in air at specified temperatures.

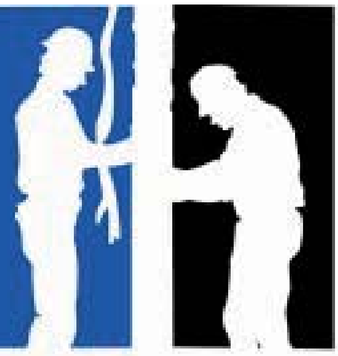
While the motor manufacturer chooses the appropriate gauge for the motor short lead, sizing the drop cable to be both cost-effective and technically correct can be a challenge. Two aspects need to be considered here: **ampacity** and **voltage drop**.

The next Franklin AID will go on with **ampacity**, **voltage drop** and crimping.

QUALITY MADE BY Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric



Franklin Application/ Installation Data Europe **AID 3/2005**

The last FE AID started with the motor leads. In this AID we will focus the ampacity and the voltage drop.

The **ampacity** represents the maximum current a cable is designed to permanently carry under specified mounting and environmental (liquid/gas, temperature, conduit) conditions. It is listed in the catalogues of the cable manufacturers. For long cable runs, the cable impedance represents a load that causes a voltage/power loss. In other words, the full voltage applied at the grid does not reach the motor service entrance. Franklin Electric requests that the **voltage drop** across the drop cable is not greater than 5% of the rated voltage. The first step is to determine the minimum (because most economic) lead crossection that can carry the full line current of the motor in air at specified temperature, using the cable manufacturers catalogues. Then, the voltage drop across the drop cable run needs to be calculated. If cables are long (50-300m), the previously determined minimum crossection will probably cause a voltage drop over 5% of the nominal voltage. In this case, the next larger cable needs to be verified, until the voltage drop results within limits.
The way of connecting the motor short leads to the drop cable is an important factor in achieving the desired lifetime of your borehole pump installation. Today, four different methods are widely in use: taping, splicing by resin casting, heat shrinking, a combination of any of these. These connections need to make good electrical contact, be mechanically reliable and properly sealed for required submergence. Another important aspect is the suitability of these leads/cables for use in drinking water.
As required by CE regulations, submersible motor leads are double insulated: they feature a core insulation and a sheath. The latter is in permanent contact with the pumped liquid; therefore most customers require certified leads that would not pollute the drinking water. Franklin Electric Europa GmbH motor leads meet all major drinking water standards and carry both the KTW and ACS drinking water approvals.

Technical News: New Generation of our 8”+10” Rewindable Motors

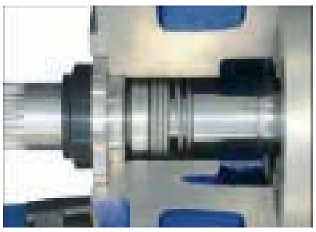
Internal Mechanical Seal with additional Sandslinger
Pressurized interior due to spring preloaded Diaphragm
Optional Material 904L, ensures:

- Enhanced Lifetime in abrasive applications, proven in a 12 month field trial
- Horizontal Application without additional Equipment (except 8“-93 Kw and 10“-185 Kw)

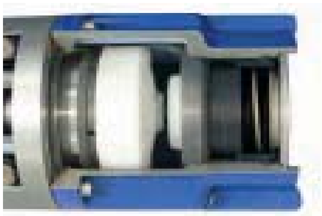
No changes to the physical dimensions and the electrical performance !

For further details, please contact your Franklin Electric Area Sales Manager or Field Service Engineer.

New seal parts



New seal parts assembled



New Spring

Spring mounting tool

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

Franklin Application/ Installation Data Europe AID 4/2005

Lightning/Voltage surges and their effects on submersible installations

Short duration voltage spikes are commonly generated by switching large inductive appliances under load or lightning that strikes overhead power lines. The two characteristic properties of such a spike are it's very short duration (tiny part of a second) and very high magnitude (tenthousands of volts).
These transient voltage spikes travel along the power lines looking for a path to earth (to ground themselves). By nature, the best electrical ground is supplied by the underground water strata (aquifer), and this is exactly where the submersible motors are situated. For this reason, the submersible borehole motor is more susceptible to be damaged by overvoltage than other, above ground mounted appliances.

How lightning/voltage surges do its damage.

Arriving through the motor supply cables (drop cables), the surge will leave the power lines at the motor, jump across the motor winding insulation to motor frame, and dissipate itself to ground (water).The surge will no longer exist on the power lines, except that a very small hole has been punctured through the motor winding insulation. If the motor is running at the time, the current of the normal voltage supply will follow through this hole in the motor winding insulation. It is this power follow current which causes the damage. This current will be high (in the nature of a short circuit) and severe burning of windings and insulation will result that will ruin the motor windings. Remember: This whole procedure takes only a tiny part of a second.

How to protect ?

The industry offers a large variety of surge protectors (commonly referred to as lightning arrestors) to the consumers. Basically, these arrestors create a lower insulation resistance point in the way of the transient overvoltage. When the voltage surge arrives at these devices, it will encounter them as a convenient, low resistance way to earth and will tend to ground itself through this device, thus protecting the downstream mounted electrical appliances. By construction, these lightning arrestors are capable of withstanding the very high transient discharge current as well as break the power follow current. The correct grounding of the surge arrester is of paramount importance for it's capability to provide protection. For efficient protection of submersible motors, the arrestor must be low resistance grounded to the same water strata the motor is installed.

4" Motors

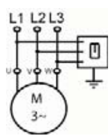
The best way to do that would be to put a lightning/surge arrestor right into the motor itself, one arrestor for each wire coming in. The arrestors are in contact with the casing of the motor, which is in contact with the underground water. When the power surge comes down the lead wires, the arrestors divert it to the casing, and then on into the water. And the arrestors keep on diverting all parts of the surge into the water so there's no double-power reflected voltage to damage a motor.
Franklin Electric offers optional built-in lightning arrestors for its 4" SS motors. (Exclusion: 2-wire BIAC motors are as a standard factory equipped with lightning arrestors)

6" and larger Motors

For the lightning protection of 6" motors and larger Franklin Electric recommends the use of commercially available 3-phase surge arrestors. To provide best protection for the submersible motor, above ground arrestors must be installed as close to the well head as possible. As described before, the suitability of the ground connection is all important: if the grounding of the arrestor is better than the ground afforded by the submersible motor, most of the high voltage surge will go through the lightning arrestor to ground and protection will be provided to the motor.

Single phase lightning arrestor
(in the motor installed)

Three phase lightning arrestor
(external)



Connection

Seminars:

To check out our latest seminar schedule, please visit our website www.franklin-electric.de or contact us at: field-service@franklin-electric.de

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

Franklin Application/ Installation Data Europe

AID 1/2006

*   *   * *NEWS*   *   *   *   *   *   * *NEWS*   *   *   *   *   *   * *NEWS*   *   *

FRANKLIN**TECH** -Training Center

Seminar-
Classroom

„Hand‘s on“ -
Training

We are excited to introduce the new Franklin Tech training center wich has been completed in Wittlich, Germany, as an extension of the various seminars offered in the past. Individual emphasis will be placed on languages, product groups and customer specific requirements. Please contact us for our seminar schedule by phone +049-6571-105421 or email: field-service@franklin-electric.de.

We gladly welcome a new addition to our Field Service Team:

Andrej Diel

After completion of his electrotechnical studies in Russia Andrej gained experience working for an international company in Germany. Stationed in Berlin, he will offer his support and service to our customers in Eastern Europe.
He can be reached at:+49-170-3330344 or email: adiel@fele.com

FRANKLIN AID

Franklin Electric

In this edition of the Franklin AID we want to answer a subject often inquired about:
"What conclusion can be drawn about the electrical condition of a motor from the measuring of the insulation resistance?"
In below table you will find the corresponding values. Please note that the insulation resistance may vary depending on the environmental temperature.

Conditions of motor and lead	Ohm	Megohm
New motor (without lead)	200.000.000	200 (and more)
Motor to reinstall in the well (without lead)	20.000.000	20 (and more)
Motor in the well with lead		
New motor	2.000.000	2 (and more)
Motor to reinstall in the well	500.000 - 2.000.000	0,5 - 2
Defective motor insulation	less 500.000	less 0,5

All these measurements must be done at 500 V DC !

Your assistance is required!

If you let us know your e-mail address, you will receive the Franklin AID much sooner as an electronic file.

QUALITY MADE BY Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de

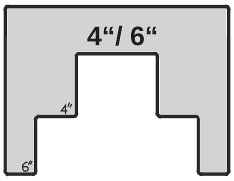
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

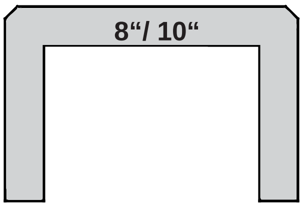
Franklin Electric

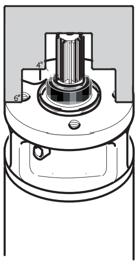
In this Franklin AID we would like to demonstrate the tools for the external service checks in the field. The tools can be ordered via franklin dealers.

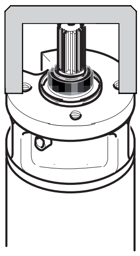
Gauge
156125101



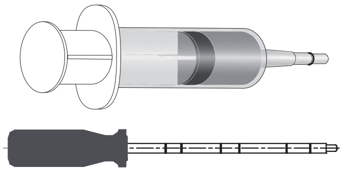
Gauge
308239103

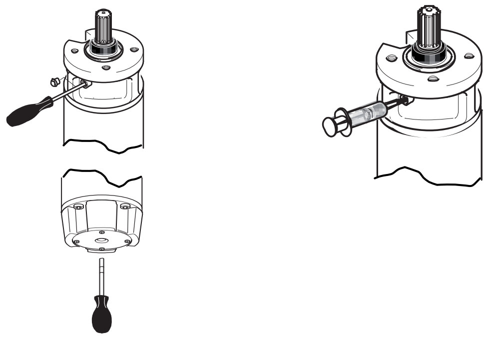






Filling kit
308726103





Shaft height:

4“ ENC. motor: 38,05 mm - 38,30 mm

6“ ENC. motor: 72,88 mm - 73,02 mm

8“ ENC. motor: 101,73 mm - 101,98 mm

6“ REW. motor: 72,77 mm - 73,03 mm

8“/10“ REW. motor: 101,4 mm - 101,6 mm

Diaphragm position:

4“ ENC. motor: 10 mm

6“ ENC. motor: 59 mm /316: 19 mm

8“ ENC. motor: 37 mm

6“/8“ REW. motor: 44 mm

10“ REW. motor: 64 mm

- Unfortunately there was an error in the last Franklin AID: In chapter 2 „Motor in the well with lead“ please ignore the addition in brackets („without lead“).
- Visit us at the EIMA/Bologna/Italy at 15. - 19. November 2006.
- To check out our latest seminar schedule, please visit our website www.franklin-electric.de or contact us at: field-service@franklin-electric.com

FRANKLIN AID

Franklin Electric

Franklin Application/ Installation Data (AID) Europe 4/2006

We need your help!

For more than 3 years we have been publishing our Franklin AID. Now we would like to ask for your help: According to statistics, every year 10% of a readership either change addresses or employment status. Thus, in order to formally update our mailing list, we kindly ask you to submit the latest names and addresses (postal or email) to where we shall direct our mailing. Please also inform us if you receive duplicate mailings or copies for someone no longer in your company.

Now, as we are facing the cold season, let us examine:

COLD WEATHER AND SUBMERSIBLES

Franklin Electric submersible motors for use in standard water well applications are filled with a water-based mixture, consisting of water and Propylene Glycol. This is to lubricate the motor's internal bearing system and to keep the motor from freezing during storage.
Polypropylene Glycol – not to be confused with the toxic car antifreeze Ethlene Glycol – is safe for consumption and being used in pharmaceuticals, ice cream, make-up and soft drinks.
With the factory-installed filling solution, our submersible motors are kept from freeze damage in temperatures as low as -40° Celsius. However, as the temperature drops down below -3° Celsius, the filling solution will begin to turn to slush and the shaft may no longer turn. But remember, no damage to the motor should occur with the factory-installed, undiluted filling solution.
The composition of filling solution varies for the different types of motors. Franklin Electric recommends using FES filling solution exclusively for refilling or exchanging in order to achieve maximum storage and operation conditions. To determine the proper filling solution for the respective motor please check the AIM (Application-Installation-Manual) or consult your Field Service Engineer.

Motor breathing and freezing conditions

During operation, the normal motor heating causes an expansion of the filling solution. Most of this is accepted by the diaphragm, although some of the filling solution may leak out of the motor around the seal. When the motor has cooled, Franklin Electric standard motors can pull well water through an installed filter into the motor by means of a check valve. How fast and often this exchange occurs depends on run times, frequency of starts and other factors surrounding the operation of the pumping system. This means that after years of operation the motor has exchanged its filling liquid with well water, making it sensitive to freezing. Please refill used motors with the FES filling solution or store them indoors.
Another option for winter storage of motors working in fountains or cascading wells is to sink the motor to the bottom of the pond and thus assure it is below freezing level.

Please note: The filter is replaced with a sealed pipe plug on 316 Stainless Steel motors to avoid entry of aggressive water into the motor.

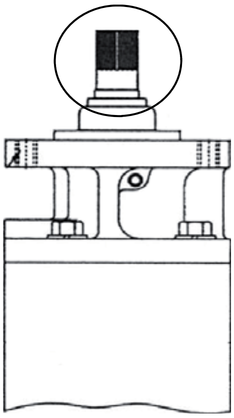
- To check out our latest seminar schedule, please visit our website www.franklin-electric.de or contact us at: field-service@franklin-electric.de

QUALITY MADE BY Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Fight against SPLINE WEAR

In this Franklin AID we would like to point out some facts about couplings and splines.

RECOMMENDATIONS:



1. Coupling:
   - Coupling material (powdered metal parts) needs to be compressed as high as possible (of high density).
   - Assure coupling splines are dimensionally correct to provide uniform tooth loading.
   - Assure quality of coupling material is matching material of the shafts (in order to avoid galvanic currents).
   - Couplings featuring a hardened washer between pump and motor shaft ends are the preferred option (avoids chips in the spline area).
2. Lubrication: The spline compartment of rotor and coupling must be filled properly with a water proof silicon grease, or if not available: Vaseline, to be found in any pharmacy.
3. Loose fitting coupling (coupling shall be tied fixed on pump shaft, but free on rotor splines).
4. Sealing: Make sure coupling is designed to touch the rotating sandslinger, in order to avoid entry of abrasive particles into the spline area.
5. Misalignment: When mounting pump to motor, it should be checked, if motor and pump are properly in one line.
   - Wet ends with plastic or very lean investment casting/sheet metal inlets are likely to cause misalignment.
6. Centering: Motor to pump must center properly each other to avoid any side–load.
7. Respect maximum recommended torques of the pump manufacturer when attaching the pump to the motor.
8. Handle long units (higher head pumps already attached to motors) with care to avoid permanent deformation.

Reduced spline lifetime due to:

- Upthrusting conditions, i.e. pump operation at the very right hand side of the pump curve (large quantity, small total head).
- Water hammering, high dynamic conditions in the pipe system.
- Frequent switching (on and off), such as with broken bladder in the pressure vessel.
  Recommendation: Max. 20 per hour.
  - Chattering relay contacts.
- Overpumping, possibly due to wrong pump selection, creating sudden changes in torque (pump discharge larger than well water supply).
- Motor back spin, resulting in increased shock loading on motor start-up (faulty pressure system, leaking check valve).
- Excessive or insufficient revolutions (as a result of backspinning due to a leaking or missing check valve).
- Pump cavitation will shock load the splines and/or induce vibrations which may cause stripped spline or accelerated spline/coupling wear (right selection of pump in accordance to suction conditions – NPSH).

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Temperature control of submersible motors

Attached we want to show our temperature control portfolio. This additional temperature control does not replace the thermal motor protection (according to EN60947-4-1).
Please address further questions to: field-service@franklin-electric.de.

Encapsulated Motor

PT100 Receiver

Must be provided on site

PT100 Sensor retrofitable

Submonitor

Subtrol Sensor

Rewindable Motor

PT100 Sensor retrofitable

PT100 Receiver

Must be provided on site

Modification of diaphragm cover screw by 4” motors

Starting Date Code 07A62 (January 2007) the formerly used slotted screw was gradually replaced by a combination drive & truss head screw. **Exception:** the 2 wire Motor (244…)!

TX 25

QUALITY MADE BY Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data (AID) Europe **3/2007**

In our last edition we gave an overview of the various motor protection options. Let's go into detail and inform you about the benefits of the FE SubMonitor.

The SubMonitor can be used for the protection of encapsulated Franklin Electric motors (3 phase from 2,2 kW to 150 kW). Current, voltage and motor temperature are monitored using three integrated current transformers. Motors from 37 kW to 150 kW are factory equipped with the Subtrol heat sensor. Motors below these ratings can be ordered optionally.

SubMonitor Premium 586 000 5100

incl. Lightning Arrestor

Monitors:

- Under- and Overload
- Current unbalance
- False Start (Chattering)
- Under- and Overvoltage
- Phase reversal
- Overheated motor (when motor is Subtrol equipped)
- No additional cable

FEATURES:

- Voltages from 190 V to 600 V
- AMPS range from 3-359 AMPS
- Password protection option
- DIN rail mounting Option
- Stores fault, setting changes, and pump run time. Can be accessed through the display
- Detachable display unit can be mounted

Important:

A 3-year warranty will be granted on new SubMonitor and new Subtrol equipped motor.

For further questions please ask our Sales & Service staff.

QUALITY MADE BY Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

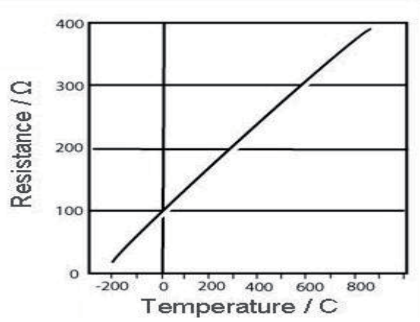
Franklin Electric

Franklin Application/Installation Data (AID) Europe **4/2007**

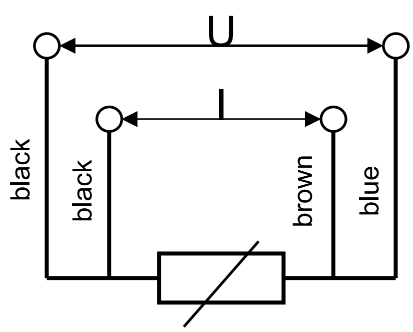
Today we will review the **PT100** Temperature Control System that we offer for both our Encapsulated and Re-windable motors.

General

What does PT100 mean? The answer: The resistance of a PT 100 probe at 0° Celsius is exactly 100 Ohms, and it rises proportional to the increasing temperature. This means, that a PT100 **monitors** the temperature inside the motor.
Each Franklin Electric supplied PT 100 probe includes a chart enabling the installer to adjust the right setting of the PT100 receiver. The well water temperature and coolant speed are the major parameters influencing the setting.



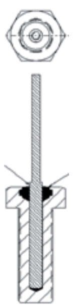
PT100 curve



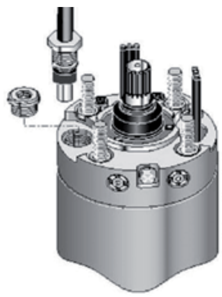
Wire diagram

Installation: Franklin Electric has developed a system, which allows easy retrofitting of a PT100 probe to our motors

Encapsulated motors 6" and 8": One of the 4 bolts tightening the upper endbell to the stator will be re-placed by a PT100 bolt. The length of the attached cable is 10 m and can be extended by cable of 1,5 mm^2.



Rewindable motors 6" up to 12": A plug in the upper endbell to be removed to install the PT100. Refilling and bleeding of filling liquid can be easily done with FEE's syringe and depth gauge.
Cable length: 10 m - 50 m.



We recommend our Filling Kit P/N 308 622 121 for proper filling and bleeding of our rewindable motors.

Please contact our Sales & Service staff for further information.

QUALITY MADE BY Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

In this edition of the Franklin AID we want to answer a subject often inquired about:

”What is the meaning of: Derating?”

Answer: De-Rating = Operating the motor at only partial load compensating higher ambient temperature by lower winding and motor temperature.

Attached we want to show the derating table for the 6/8 inch Encapsulated motors. (basically designed for 30°C at 16cm/s cooling speed)

Maximum motor load capacity in % of nominal load						
Temp. °C	Power 5,5 bis 22kW			Power >22kW		
	Flow in m/s			**Flow in m/s**		
	0,16	**0,3**	**1**	**0,16**	**0,3**	**1**
40	88	100	100	76	88	100
45	76	88	100	62	76	88
50	62	76	88	48	62	76

Example: If you want to run a 6“ 15 kW motor in ambient temperature of 45°C with a cooling flow of 16 cm/s, you can load the motor with maximum 76% of the nominal shaft power that means with 15 kW x 0,76= 11,4 kW.

Attention: **From Edition n° 3/2008 our Franklin Aid will be exclusively distributed per E-Mail as electronic file.**

NEW **NEW** **NEW**

We are glad to introduce our new Field Service Engineer Mr. Michele Polga. He took over responsibility for South/West Europe
His contact is:

Phone/Fax: +39 044555548
Mobil: +39 3316633062
email: mpolga@fele.com

FRANKLIN AID

Franklin Electric

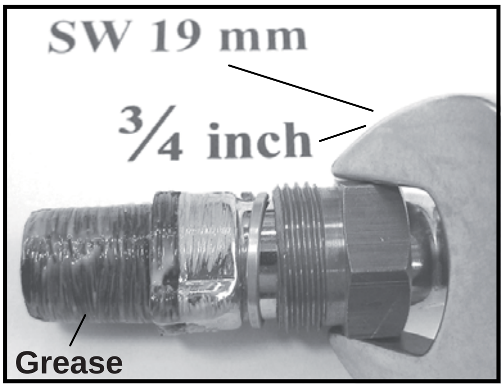
Today we will give some recommendations, to ensure a leaktight joint of the lead connectors to the 4“ Cantype motors.

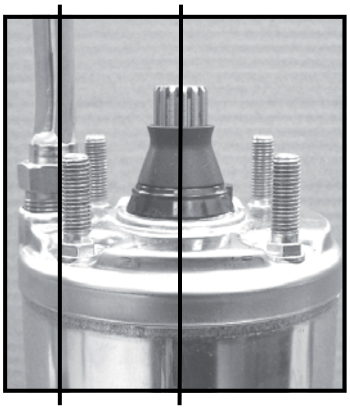
Procedure:

- make sure the connector hole in the motor is clean and dry.
- the cylindric rubber bushing of the connector shall be covered with a thin layer of water resistant silicone grease or Vaseline.
  - When inserting a stainless steel jam nut into a 316 stainless steel motor, also lubricate the thread of the jam nut.
  - No lubricant shall enter into the receptacles of the connector.
- Push the connector of the lead straight and as deep as possible into the connector hole.
- Turn the jam nut (by pressing toward the motor) counterclockwise until the start of the thread is reached.
- Now rotate the jam nut by hand force clockwise until the jam nut did fully cath with its thread.
- Continue to turn the jam nut clockwise by the help of a spanner 19mm (3/4”), until a higher torque is required.
- Another ½ to ¾ turn (at max. 20 – 27 Nm) will ensure the right fitting of the connector.

Notice:

The corner of the hexagon part of the jam nut must not necessarily touch the top of the upper endbell, a gap of 1 mm is permissible.





Your assistance is required!

Please let us know your e-mail address:

Next Franklin AID Edition will be only distributed per e-mail as an electronic file.

QUALITY MADE BY Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Franklin Application/Installation Data *Europe* No. 3/2008

In this issue of the Franklin AID we would like to inform you about:

Change of colours of connection cables according to the harmonization document 308 (HD 308)

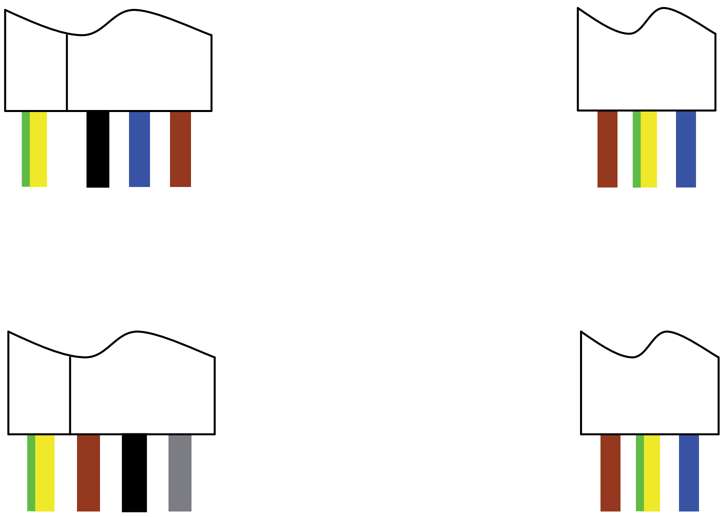
Franklin Electric has gradually changed the wire cables of short motor leads according to HD 308. Following you will find an update of the colours. In case of questions please contact the Franklin Electric Field Service Engineer responsible for your area or below address.

4 inch motor leads

3X1,5 + 1G1,5 | **3G1,5 (2-wire, PTC)**

Old

New



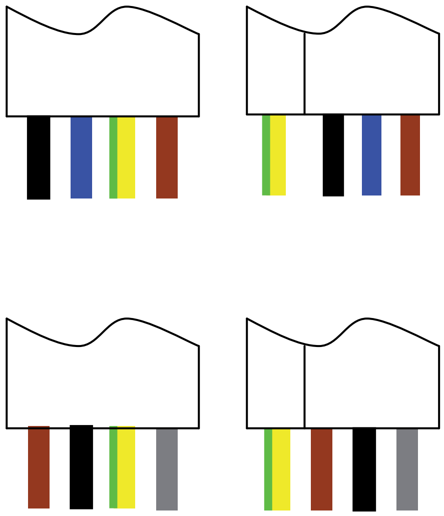
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

6, 8 inch Encapsulated motor leads

4G4 | 3X8,4+1G8,4

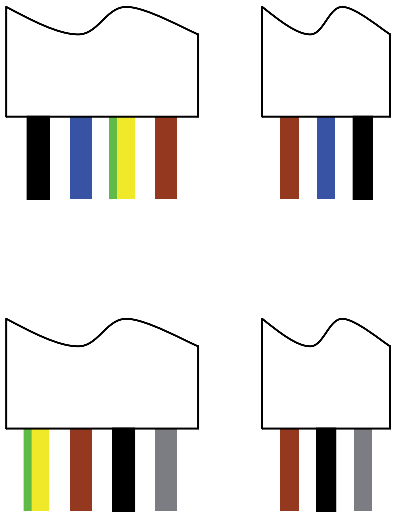
Old

New



6, 8, 10 inch Rewindable motor leads

4G2,5	3X2,5	4G4
3X4	4G6	3X6
4G10	3X10	4G16
3X16	4G25	3X25
4G35	3X35	3X50



Important to know:

- The grey colour replaces the blue colour.
- Positioning of the cores within the flat jacket has changed according to above (NEW) drawings.

Please refer to our current Operation & Installation Manuals.

Registrations to our free-of-charge seminars at the FRANKLINTECH Training Center in Wittlich/Germany are still possible:

Date:	Language:
4 – 5 November 2008	English
18 – 19 November 2008	Spanish
2 – 4 December 2008	Russian

Your Franklin Electric Field Service Team

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

Franklin Application/ Installation Data (AID) Europe **4/2008**

As the end of the year approaches we would like to highlight several subjects, but above all wish you a wonderful holiday season and all the best for the coming year. Your Franklin Electric Service Team

Ribbon-cutting ceremony for the practical training center

The Service Engineers Torsten Schulte-Loh and Michael Fuka as well as the Product Manager Lyon van der Merwe have already executed successful trainings in the now finished practical training center in Wittlich/Germany.

Training of Service Engineers

Internal Training

During a visit of Franklin Electric's CEO Scott Trumbull of Bluffton, Indiana – USA to Wittlich, he and Peter C. Maske officially carried out the ribbon-cutting ceremony.

Scott Trumbull, Peter C. Maske , Edwin Klein

Ribbon Cutting

After the Field Service Manager, Edwin Klein's opening speech about the significance of qualified trainings – Franklin Electric already plays a leading role! – the red ribbon was officially cut on September 4, 2008

General Information

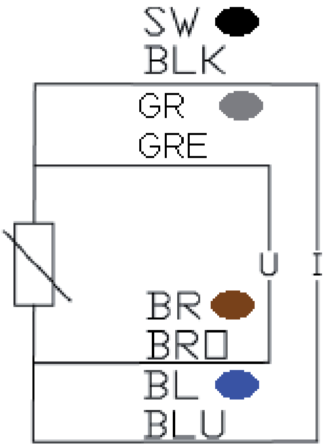
We train very different groups in our facilities:

- Partners of the international industry: pump manufacturers, distributors, installers, well drillers, and end users.
- Franklin employees of various departments: Sales, Engineering, Production, and Service.

We offer a participation in regular trainings or upon request execute individual trainings tailored to your needs.

PT 100 Cable colours

According to the new harmonization HD 308 the colours of connection cables of the PT 100 have changed. Please see drawing.



CONNECTION DIAGRAM
PT 100

Extended Date Code System

Starting January 2009 the **Motor Date Code** and **Sequence Number** will be changed into a 13 digit number replacing the old 11 digit number. It will be a running change.

The new format will be as shown below:

“**yymbpddsssssC**”:

yy = year, **m** = month, **bp** = branch plant, **dd** - day, **sssss** - 5 digit sequence number, **C** = Schedule code.

For example : 08F621500250A

Today:	08	F	62	15	0004	
New:	08	F	62	15	00004	A

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe* No. 1/2009

For years now, coastal regions are experiencing a decrease in well water quality. From a submersible motor manufacturer's perspective, this creates corrosion failures on motors built with standard AISI 304 stainless steel components. While motors of higher grade (AISI 316) materials are available, cost implications often prevent these solutions from being adopted.

In this issue of our FE Aid Bulletin we want to demonstrate how you can extend the service life of standard 304 SS motors by means of a couple of simple tricks, even when employed in adverse water conditions.

1. Sacrificial anodes for 4“ SS and HT motors, which can easily be assembled to the bottom part of the submersible motor:
   4“ SS → FE no. 308250912; 4“ HT → FE no. 308250913
2. Stainless steel fitting with galvanized pipe at the pump outlet:
   Length approx. 0,5- 0,75 m
3. Potential adjustment between upper end bell of motor and galvanized pipe.
4. A proper, low resistance connection of potential equalizing wires to motor and pipe.

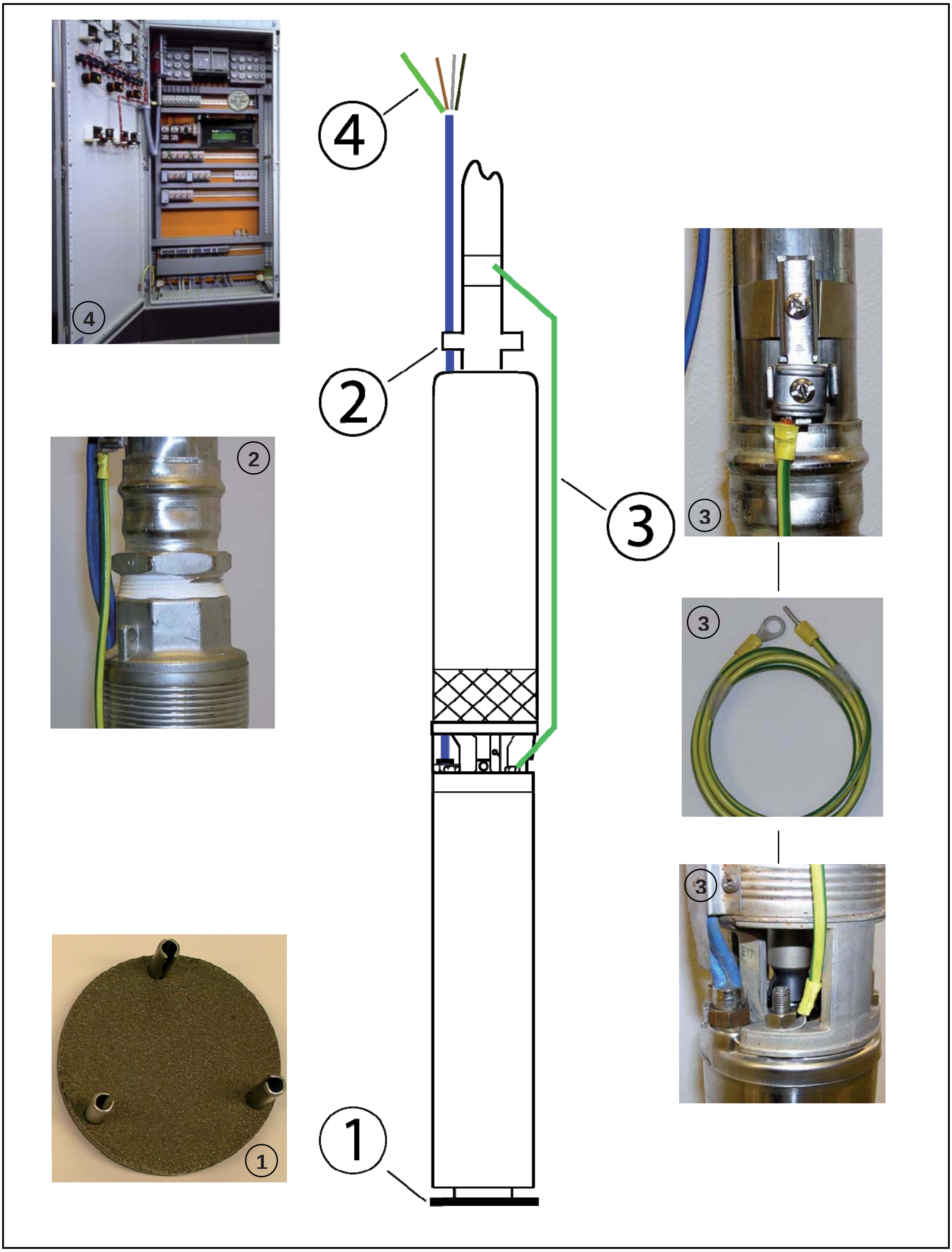
Information on our free-of-charge seminars at the FRANKLIN**TECH**

Training Center in Wittlich/Germany can be obtained by visiting following link:

http://www.franklin-electric.de/de/training.asp

Your
Franklin Electric Field Service Team

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13



Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Franklin Application/Installation Data *Europe* No. 2/2009

Upon numerous requests we would like to shed light on following topics in this edition:

1. – Cooling of submersible motors

2. – Repair instructions for PE2/PA motors

3. – Seminar overview

1. When operating, just like any other electrical motor, a submersible motor produces heat. Accumulated heat generally leads to increased thermal ageing of the motor’s insulating system, mechanical wear and ultimately to thermal destruction of the motor. This is why generated heat must be permanently dissipated into its environment.
Due to space limitations such as typically encountered in narrow boreholes and the absence of cooling fins or aerators, submersible motors are already designed to generate as little heat as possible.

Nevertheless, most submersible motors need a defined cooling flow of water around their shell to safely transfer the produced heat to the surroundings. Franklin Electric standard motors are designed for a maximum water temperature of 30°C, with the required cooling flow being specified on the motor nameplate as well as in the manual.

To determine whether cooling requirements are met, the following parameters need attention:

-motor diameter
-well casing diameter
-pump flow rate
-pump mounting (above or below screened portion of well casing)

In the majority of cases, installing the pump and motor above the well casing inlet screen already takes care of the motor cooling. For more difficult cases, you may find below sketches and formulas helpful:

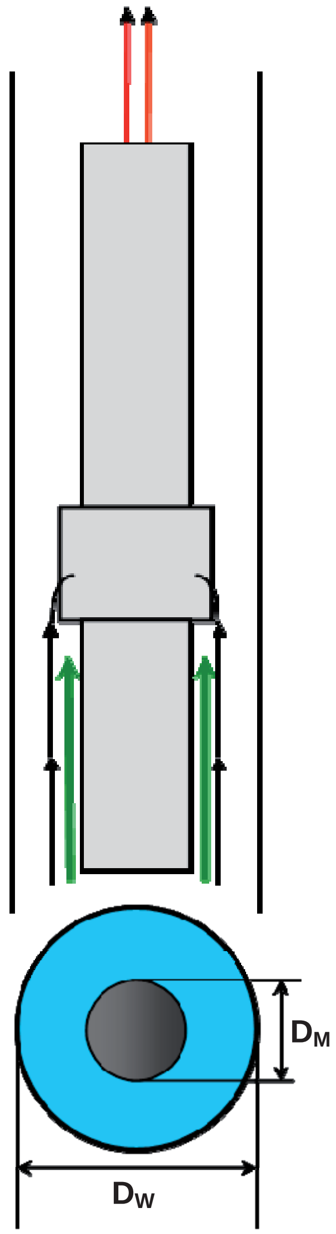
QUALITY MADE BY Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

$$\text{Cooling flow} = \frac{\text{Quantity discharge}}{\text{Ring space}}$$

$$V = \frac{Q \cdot 353{,}68}{(D_W^2 - D_M^2)}$$

$$D_W = \sqrt{\frac{Q \cdot 353{,}68}{V} + D_M^2}$$

$V_{[m/s]}$ = cooling flow
$Q_{[m^3/h]}$ = volumetric delivery of pump at operating point
$D_{W\,[mm]}$ = inner diameter of well pipe/cooling sleeve
$D_{M\,[mm]}$ = outer diameter of motor



Example:

- Flow: 50 m^3/h
- Motor: 6" Encapsulated (D_M = 0,137m)
- Well diameter: 0,3m
- Is the minimum cooling flow of 16 cm/s guaranted?

$$V = \frac{50\ m^3/h \cdot 353{,}68}{(300mm^2 - 137mm^2)}$$

The flow is 0,248 m/s or 24,8 cm/s

<u>The minimum cooling flow of 16 cm/s is guaranted; in fact it's even higher than needed!</u>

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

2. **Spare motor lead for PE2/PA motors:**

   It is essential to use a special Teflon tape to attach the short motor lead to the motor's winding. This tape is not automatically included in the kits, therefore, when placing requests or orders please indicate the type of winding insulation of the motor (PVC or PE2/PA), so that the special tape can be added as a separate item.

3.

<u>Seminar overview 2009:</u>

English seminar: week 39

Arabic seminar: week 42

German seminar: week 46

Russian seminar: week 49

Information on our free-of-charge seminars in the FRANKLINTECH Training Center in Wittlich/Germany can be found at:

http://www.franklin-electric.de/de/training.asp

We wish you a successful season with Franklin Electric products!

Your Franklin Electric Field Service Team

QUALITY MADE BY Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe* No. 3/2009

In this issue of our FE Aid Bulletin we would like to highlight the following topics:

1. **Seminar Overview 2009**
2. **Substart SC Control box**
3. **Motor Test Report**

1. Seminar Overview 2009

Seminar Overview 2009:

English seminar: week 39

Arabic seminar: week 42

German seminar: week 46

Russian seminar: week 49

Information on our free-of-charge seminars in the FRANKLINTECH Training Center in Wittlich/Germany can be found at: http://www.franklin-electric.de/de/training.asp

Please submit your registration no later than 3 weeks prior to the event.

For those who need a visa to attend, the visa has to have been issued prior to registration!

Your Franklin Electric Field Service Team

2. Substart SC Control Box

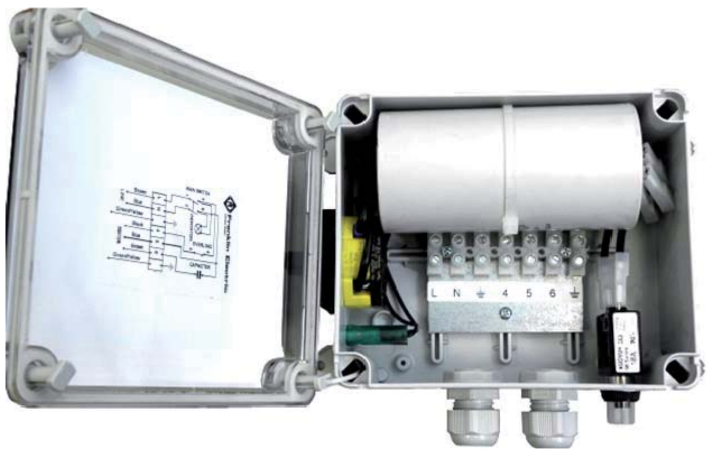
We would like to introduce the SubStartSC control box for our PSC motor line, first member of what will become a greater family of submersible motor control gear available from Franklin Electric Europa GmbH.

The SubStartSC motor starters have been designed to solve specific problems often encountered when using standard control boxes:

- True IP54 – even when mounted on a wall
- Safety – enclosure tested against all relevant standards, with third party certification
- Ergonomic design – large cable glands, wiring space accounted for – ease of installation
- Quality electrical components certified to international standards – long service life
- 100% factory performed functionality test with included test print-out
- TÜV approved

Some other special features worth mentioning:

- Attention to detail – every little aspect engineered for the application
- Detailed multilingual manual supplied with each box
- Complete package – insures 100% compatibility with motor characteristics
- Reliability backed by the leader in submersible motors



---

3. Motor Test Report

The Motor Test Report is a very helpful tool to analyse defective motors. It will guide you step by step through motor analysis.
After having completed all pre-defined fields, please add in any additional site information / observations to help our technicians get a “feel” for the particular application.
You may then send the report to our attention for processing.
The report shown below is attached as an electronic file to this bulletin.

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Franklin Electric

FEE – NO: ___

VISIT DATE: ___

Motor Test Report

Additional comments under „Remarks"

1. CUSTOMER / USER

Company: ___ **Country:** ___ **Town:** ___

Talked To: ___ **Tel.:** ___

2. MOTOR

Type: .... Modell: ___ KW: ___ Volts: .... Hz: ....

Date Code: ___ Sequenz-Nr: ___ Stator Nr: ___ Assembler: ___ Material ....

Equipped for: .... Worked with ....

Worked for: ☐ Months ___ ☐ Days ___ ☐ Hours ___ Date Inst.: ___ Date Failed: ___

3. INSTALLATION

☐ Vertical ___ ☐ Horizontal ___ Pump Make: ___ Type: ___

Well depth /[m]: ___ Well diameter /[cm]: ___ Pump at /[m]: ___ Water inlet at /[m]: ___

Cable length /[m]: ___ Cable square /[mm^2]: ___ Protection Make: ___ Type: ___

Water: ___ Temperature: ___ PH-Value: ___ Setting /[A]: ___

4. EXTERNAL

Shaft Height: .... Upper End Bell: .... Shaft Rotation: .... Slinger: ....

Stator Shell: .... Lower End Bell: .... Deposits: .... Valve: ....

Splines: .... Diaphragm Pos.: .... Cable / Lead Insu.: .... Connector ....

Nameplate: .... Leakage: .... Snap Ring: ....

5. ELECTRICAL MEASUREMENTS

Phase 1: ___ Ω Normal Value: ___ Ω Main Phase: ___ Ω

Phase2: ___ Ω Normal Value: ___ Ω Start Phase: ___ Ω

Phase3: ___ Ω Normal Value: ___ Ω Insulation Resistance: ___ MΩ

6. TEARDOWN

Thrust Bearing: .... Lower Radial Bearing: .... Diaphragm: ....

Segments: .... Upper Radial Bearing: .... Liner: ....

Filling Liquid: .... Sleeve Upper Shaft End .... Shaft Seal: ....

Water Entry: ___ cm^3 Sleeve Lower Shaft End .... Windings: ....

Up-thrust Washer .... Prong: ....

7. CONTROL BOX

Relay: .... Type: ___ Capacitor: .... Wiring: ....

Subtrol: .... CP-Water: ....

8. REMARKS

Tech. Warranty: .... **Com. Warranty:** .... ☐ Repair ☐ Scrap **Defect:** .... **Cause:** ....

Signature: ___ **Date:** ___ **Entered into EDP:** ___ **Date:** ___

Franklin Application/Installation Data *Europe* No. 4/2009

Submersible Motor Installation Check List

In this edition we will focus on the right and necessary procedures to be executed prior to an installation of a submersible motor and pump into the application. As an attachment you can find this also “ready to be printed “and to be used by your technicians as a checklist.

1. Motor Inspection

A. Verify that the model, kW or hp, voltage, number of phases and hertz on the motor nameplate match the installation requirements.
B. Check that the motor lead is not damaged.
C. Measure insulation resistance using preferably a 500 volt DC megohmmeter, from each lead wire to the motor/ground. Resistance shall be more than 400 Megohms at 20°C without drop cable for a new motor.
D. Keep a record of motor model number, kW or hp, voltage, date code and serial number, located above and in the motor nameplate. (Sample: D/C 09H62 S/N08-00019A Type: 234 724 1621)

2. Pump Inspection

A. Check that the pump rating matches the motor.
B. Check for pump damage and that shaft turns freely.

3. Motor/Pump Assembly

A. Lubricate the rotor shaft splines with a food grade, water resistant grease or Vaseline. (see AID 01/2007)
B. Also lubricate the cylindrical rubber part of the cable connector before screwing into the motor with similar lubricant. (see AID 02/2008)
C. Check that pump and motor mounting faces are free from dirt, debris and uneven spots
D. Pumps and motors above 3 kW (4hp) should be assembled in the vertical position to prevent stress on pump brackets and shafts. Assemble pump and motor together so their mounting faces are in contact, and then tighten assembly bolts or nuts **evenly** (crosswise) following manufacturer specifications in terms of torque.
E. If accessible, check that the pump shaft turns freely. (4” motors: check that motor sandslinger touches/seals the coupling)
F. Assemble the pump lead guard over the motor leads. Do not cut or pinch lead wires during assembly or installation.

QUALITY MADE BY Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

4. Power Supply and Controls (Ensure electric power in the installation is switched off)

A. Verify that the power supply voltage, Hertz, and kVA capacity match motor requirements.
B. Verify control box kW (hp) and voltage matches motor (4” PSC, 3-Wire)
C. Check that the electrical installation and controls meet all local safety regulations and match the motor requirements, including fuse or circuit breaker size and motor overload protection. Connect all metal plumbing and electrical enclosures to the power supply ground to prevent shock hazard.
Please observe local electrical safety legislation.
Electrical installations must be done by skilled technicians.

5. Lightning and Surge protection

A. Use properly rated surge (lightning) arrestors on all submersible pump installations. Smaller 4” motors can be factory equipped with “built in” surge arrestors. Check product leaflet. (see AID 4/2005)
B. Ground all above ground arrestors with copper wire directly to the motor frame, or to a metal drop pipe or casing, which reaches below the well pumping level.

6. Electrical Drop Cable

A. Use submersible cables sized in accordance with existing regulations and with the cable charts. Motor short lead must be buried in water. Drop cables must meet ampacity and temperature requirements. Ground motor per local codes. (see AID 2 and 3/2005)
B. If required by regulations, include a ground wire to the motor and surge protection, connected to the power supply ground. Also: always ground a pump set operated outside a drilled well.

7. Motor cooling

A . Ensure at all times that the installation provides adequate motor cooling ; min. cooling speed to be found in our product leaflets or in the motor nameplate. (see AID 2 – 2009)

8. Motor/Pump Installation

A. Splice motor leads to supply cable using electrical grade solder or compression connectors, and carefully insulate each splice with watertight tape or adhesive-lined shrink tubing
B. Support the cable to the delivery pipe every 3 meters (10 feet), with straps or tape, strong enough to prevent sagging. Allow cable to be a bit slack, when using a PP or plastic riser tube/pipe, in order to avoid stress on cable. Use padding between cable and any metal straps.
C. Verify pump is equipped with a spring loaded check valve. Otherwise an inline valve in the delivery pipe is recommended, within max.8m (25 feet) above the pump, but below the draw down level of the water supply (dynamic water level). (see AID 02/2004)
D. Assemble all pipe joints as tightly as practical, to prevent unscrewing from motor torque. As a thumb rule: torque should be 2mkg per kW (10 pound feed per hp) .
E. Set the pump far enough below the lowest pumping level to assure the pump inlet will always have at least the **N**et **P**ositive **S**uction **H**ead (NPSH), specified by the pump manufacturer. Pump set should be at least 3 meters (10 feet) from the bottom of the well to allow for sediment build up.
F. Check insulation resistance as motor/pump assembly is lowered into the well. Resistance may drop gradually as more cable enters the water. A sudden drop indicates possible cable, splice or motor lead damage.

9. After Installation

A. Check all electrical and water line connections and parts before starting the pump.
B. Switch on main electrical power switch. Start the pump and check the motor amps and pump delivery. If normal, continue to run the pump until delivery is clear. If three phase pump delivery is low, it may be running backward. Rotation can be reversed (with power off) by interchanging any two motor lead connections to the power supply.
C. Check three phase motors for current balance within 5% of average. Higher imbalance will cause higher motor temperatures and may cause overload trip, vibration and reduced life.
D. Verify that starting, running and stopping cause no significant vibration or hydraulic shocks.
E. After at least 15 minutes running time, verify that pump output, electrical input, pumping level and other characteristics are stable and as specified.
For best electrical protection: Set motor protection (Submonitor or overload relay) close to duty point operation amps.

The Franklin AID has been published since January 2003. In case you have not received all editions, please contact our Field Service Department at field-service@franklin-electric.de and we will send you the required edition. Attached you will find a listing of all subjects published up until today.

Seminars in 2010:

Please check our website http://www.franklin-electric.de/de/training.asp
and sign up for it.
Upon request we offer specific seminars tailored to your needs.

The Franklin Electric Service Team wishes "Merry Christmas" and good success with Franklin products in 2010

QUALITY MADE BY Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe* No. 1/2010

Single phase submersible motors – part I

To our knowledge, Franklin Electric is the only manufacturer of submersible electric motors worldwide to offer a complete range of 2-wire, 3-wire and PSC single phase motors. The aim of such endeavor is clear: enabling our customer to exactly match specific needs of different applications.
This is the first issue of a series of three AID bulletins to focus on the advantages of each electrical design respectively. At the end of the last article, AID no. 4/2010 will provide a “quick reference table” to serve as a conclusion and selection guide to our customer.

Please also refer to our latest seminar offering at the end of this bulletin.

Single Phase motors – general

All Franklin Electric submersible motors are of the squirrel cage asynchronous type. To be able to start, each single phase motor contains an auxiliary winding which is geometrically removed from the main winding by an angle of 90°. Additionally, the current flowing through this winding is phase-shifted by either the use of capacitors (PSC and 3-wire motors) or increased resistance winding (split-phase 2-wire motors).
This is why most single phase motors require additional controls start and operate.

Use of capacitors

Capacitors for motor operation can be divided into two categories: Start capacitors and run capacitors.

Run Capacitors need to permanently carry AC current flowing through the auxiliary winding of the motor. Additionally, depending on motor design, they are subjected to high voltages especially when the motor is operated under partial load conditions.

Start capacitors help the motor to start and/or boost available starting torque. They need to be switched off immediately after the motor has come to speed or they will be damaged.

QUALITY MADE BY Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Selecting a replacement capacitor

To ensure long lasting trouble free installations, Franklin Electric's control boxes only use high-quality and approved capacitors. Should original spare parts be unavailable, please refer to below points when choosing a replacement capacitor:

- Capacity [µF]: The rated capacity is defined during motor design and is important for high starting torque and smooth motor torque during operation.
- Rated voltage [V]: This parameter is also determined by the motor manufacturer and shall be respected for extended capacitor service life.
- Class of operation: There are several classes of operation defining expected/guaranteed service life of the capacitor under specified working conditions. They are coded capital letters A, B, C, D. Select higher classes (A/B) for longer life.

Seminars in 2010:

Please check our website http://www.franklin-electric.de/de/training.asp
and sign up for it.
Upon request we offer specific seminars tailored to your needs.

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe* No. 3/2010

The 2-wire Motor

Continuing our tour of the Franklin Electric single phase submersible motor designs, let's today have a look at a genuine Franklin invention, the so-called 2-wire motor.

As opposed to all other single phase motor designs, starting this motor does not involve a capacitor. The necessary phase angle shift between the main phase and auxiliary winding currents is obtained by an increased ohm resistance of the start winding. When the rotor has come up to speed, this start winding current is switched off by the BIAC, a patented electronic switch inside the motor itself.

In addition to starting the motor, this BIAC switch also generates something we call a "reverse impact torque": In a locked rotor condition, the switch will supply full start winding current for approximately 1 second. Then, the switch begins to open and close rapidly, which chops the start winding current switching it between leading and lagging the run winding current. This in turn
produces impact torque in both forward and reverse directions, which will literally shake and loosen many possible obstructions. Once cleared, the motor will run in predetermined rotation direction.

All Franklin Electric 2-wire single phase motors come with built-in overload and lighting arres-

tors, which obsoletes the need for external controls.

Benefits:

- Requires only a three-core supply lead
- No need for an external control box
- Reverse impact torque
- Built-in overload
- Built-in lightning arrestor

QUALITY MADE BY Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D- 54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0)6571 105 420
Fax: +49 (0)6571 105 513

Checking 2-wire motors:

Because of the built-in electronic switch, winding resistances cannot simply be measured externally. Accurate determination of winding condition implies opening the motor which should only be performed by authorized repair shops.

Insulation resistance can however be checked using a 500V megger instrument.

You will found a 2-wire function simulation under: **http://apps.franklin-electric.com/am/biac-switch/standard/index.html**

Seminars in 2010:

Please check our website **http://www.franklin-electric.de/de/training.asp** and sign up.
Upon request we offer specific seminars tailored to your needs.

Rudolf Diesel Straße 20
D- 54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0)6571 105 420
Fax: +49 (0)6571 105 513

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data ***Europe*** No. 4/2010

Closing the subject of single phase motors, we would like to give some information about the 3-wire motor.

At the end of this Franklin AID you will find a wiring diagram of all three Franklin Electric single phase motors

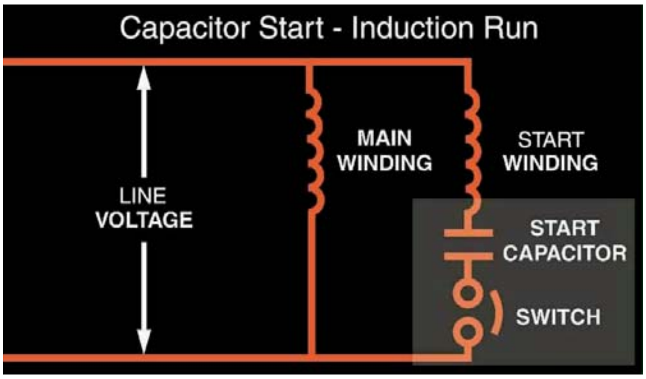
The 3-wire Motor

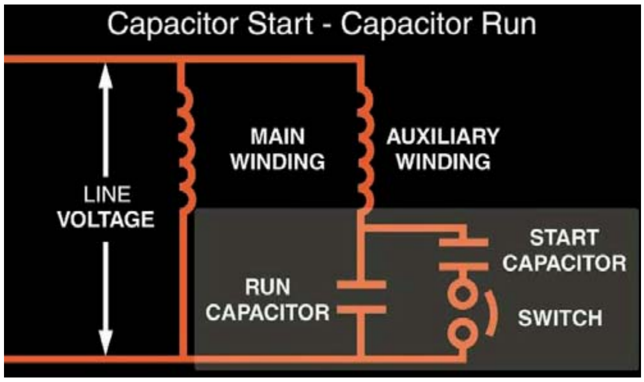
In applications that require a high starting torque and where the power supply is fluctuating the 3-wire motor is our solution. Due to its design the 3-wire motor needs a control box that switches off the start capacitor from supply after start up.

<u>We differentiate between 2 modes:</u>

Capacitor Start /Induction Run or Capacitor Start/Capacitor Run

Attached connection charts will show the difference.

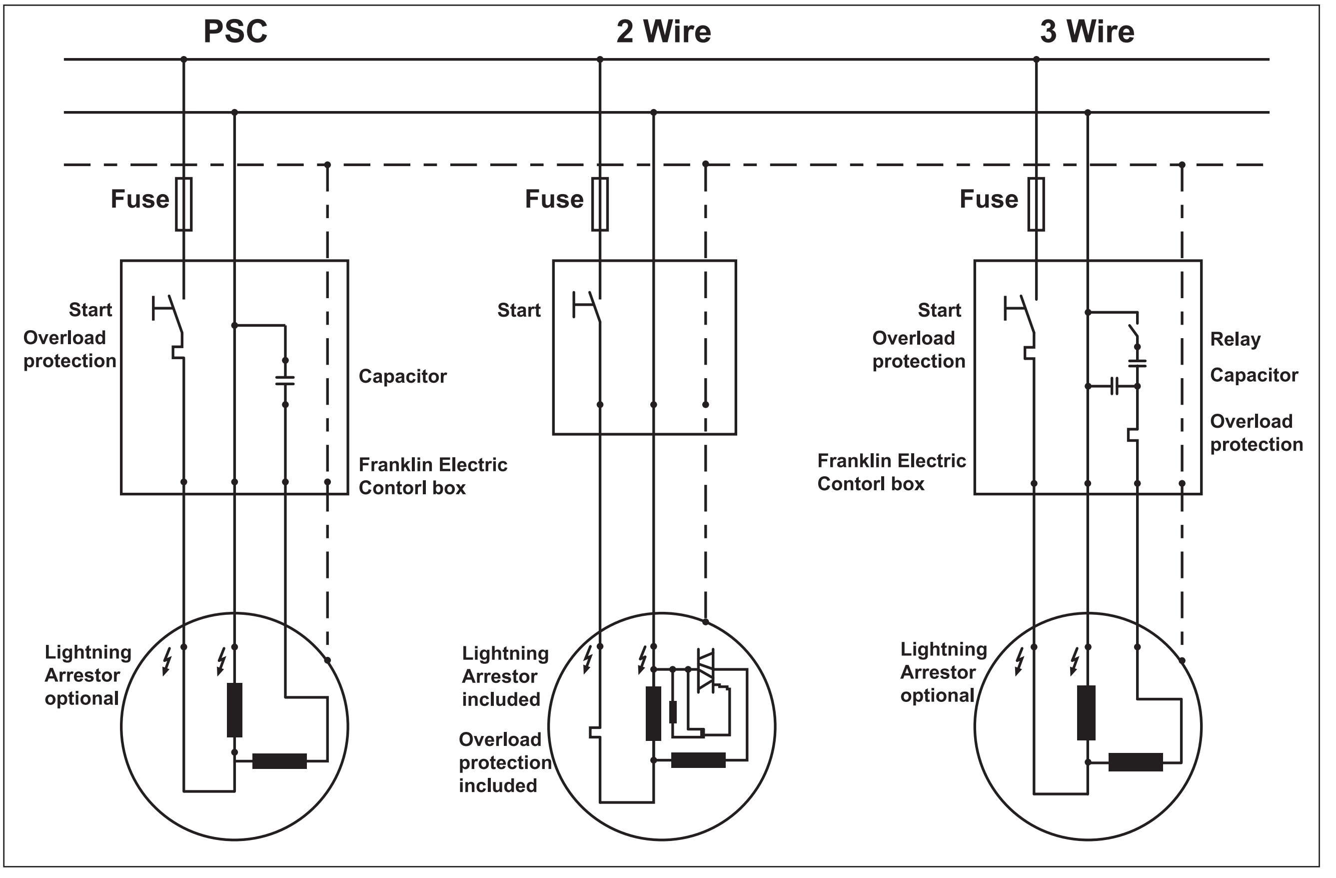




While in the first mode the start winding gets switched off from the power supply after start up, the start winding stays connected after start up in the second mode. Due to its permanent operation this winding is called auxiliary winding. In combination with the operating capacitor it generates a high torque at the shaft end.

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D- 54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu
Tel.: +49 (0)6571 105 420
Fax: +49 (0)6571 105 513

Wiring diagram of Franklin Electric Single Phase Motors



Seminars in 2010:

Please check our website **http://www.franklin-electric.de/de/training.asp** and sign up.
Upon request we offer specific seminars tailored to your needs.

The Franklin Electric Service Team thanks for the good cooperation and wishes "Merry Christmas" and good success with Franklin products in 2011.

QUALITY MADE BY Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D- 54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0)6571 105 420
Fax: +49 (0)6571 105 513

FRANKLIN AID

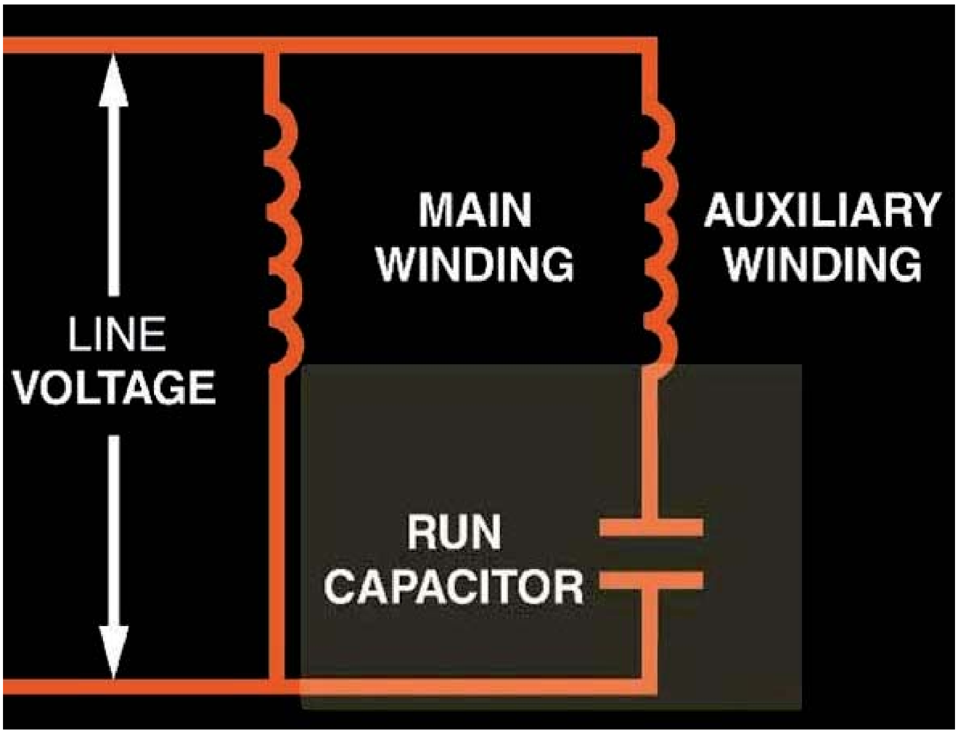
Franklin Electric

Franklin Application/Installation Data *Europe* No. 2/2010

Single phase motors, part 2

The PSC Motor

This motor permanently runs on both start and main phases. The chosen capacitor allows both an adequate starting torque and smooth motor operation. The design is especially suitable with unstable grid situations as it will reliable start the pump even under variable incoming voltage conditions.



Schematic diagram PSC-Motor

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Electrically checking PSC motorsDanger! Life threatening voltage! Switch off all power to equipment under test and make sure nobody can unexpectedly turn on power while work is being carried out.
In addition to the already known insulation resistance check, PSC motors also allow for DC resistance check on the start and main phases. This is particularly helpful to identify the windings when drop cable cores have not been appropriately marked. The ohmic resistance of the main phase is always lower than the start phase resistance. For accurate values please refer to our service literature.

Checking motor capacitors

Visually inspect the capacitor first. If no evident damage is found, the capacitor may be tested electrically. For conclusive capacitor tests, special apparatus and knowledge is necessary. A quick check in the field can however be performed with good success by the use of an analogic ohmmeter. Note: capacitors must not be connected to motor windings and must be completely discharged.

- Disconnect all wires from capacitor terminals
- Discharge capacitor by shorting out terminals
- Select meter setting: Rx1000 and connect to capacitor terminals
- Correct meter reading: pointer should swing toward zero, then back to infinity
- Repeat test with swapped terminals
- Do not touch meter tips while reading
- You can compare results with readings of similar capacitors in known good shape**.**

Seminars in 2010:

Please check our website http://www.franklin-electric.de/de/training.asp
and sign up for it.
Upon request we offer specific seminars tailored to your needs.

Franklin Application/Installation Data *Europe* No. 3/2010

The 2-wire Motor

Continuing our tour of the Franklin Electric single phase submersible motor designs, let's today have a look at a genuine Franklin invention, the so-called 2-wire motor.

As opposed to all other single phase motor designs, starting this motor does not involve a capacitor. The necessary phase angle shift between the main phase and auxiliary winding currents is obtained by an increased ohm resistance of the start winding. When the rotor has come up to speed, this start winding current is switched off by the BIAC, a patented electronic switch inside the motor itself.

In addition to starting the motor, this BIAC switch also generates something we call a "reverse impact torque": In a locked rotor condition, the switch will supply full start winding current for approximately 1 second. Then, the switch begins to open and close rapidly, which chops the start winding current switching it between leading and lagging the run winding current. This in turn produces impact torque in both forward and reverse directions, which will literally shake and loosen many possible obstructions. Once cleared, the motor will run in predetermined rotation direction.

All Franklin Electric 2-wire single phase motors come with built-in overload and lighting arrestors, which obsoletes the need for external controls.

Benefits:

- Requires only a three-core supply lead
- No need for an external control box
- Reverse impact torque
- Built-in overload
- Built-in lightning arrestor

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Checking 2-wire motors:

Because of the built-in electronic switch, winding resistances cannot simply be measured externally. Accurate determination of winding condition implies opening the motor which should only be performed by authorized repair shops.

Insulation resistance can however be checked using a 500V megger instrument.

Seminars in 2010:

Please check our website http://www.franklin-electric.de/de/training.asp and sign up.

Upon request we offer specific seminars tailored to your needs.

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Closing the subject of single phase motors, we would like to give some information about the 3-wire motor.

At the end of this Franklin AID you will find a wiring diagram of all three Franklin Electric single phase motors.

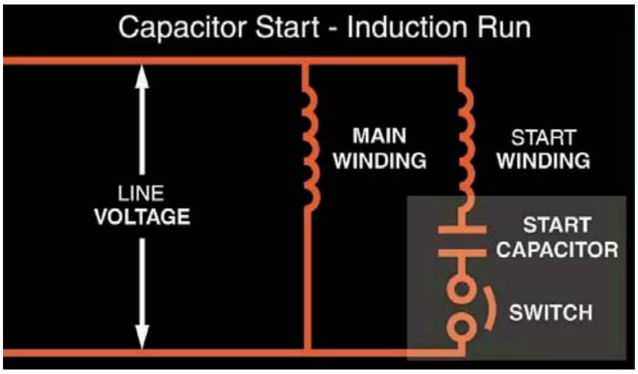
The 3-wire motor

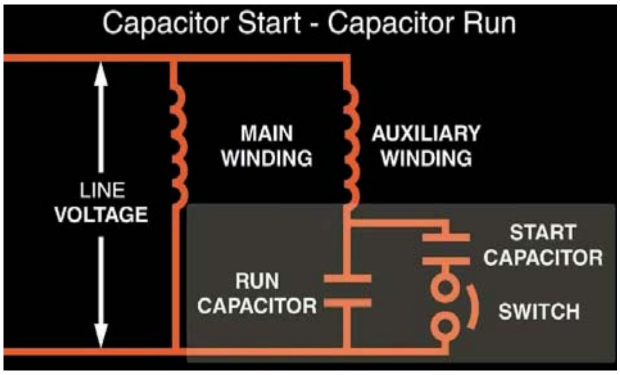
In applications that require a high starting torque and where the power supply is fluctuating the 3-wire motor is our solution. Due to its design the 3-wire motor needs a control box that switches off the start capacitor from supply after start up.

We differentiate between 2 modes:

Capacitor Start /Induction Run or Capacitor Start/Capacitor Run

Attached connection charts will show the difference:

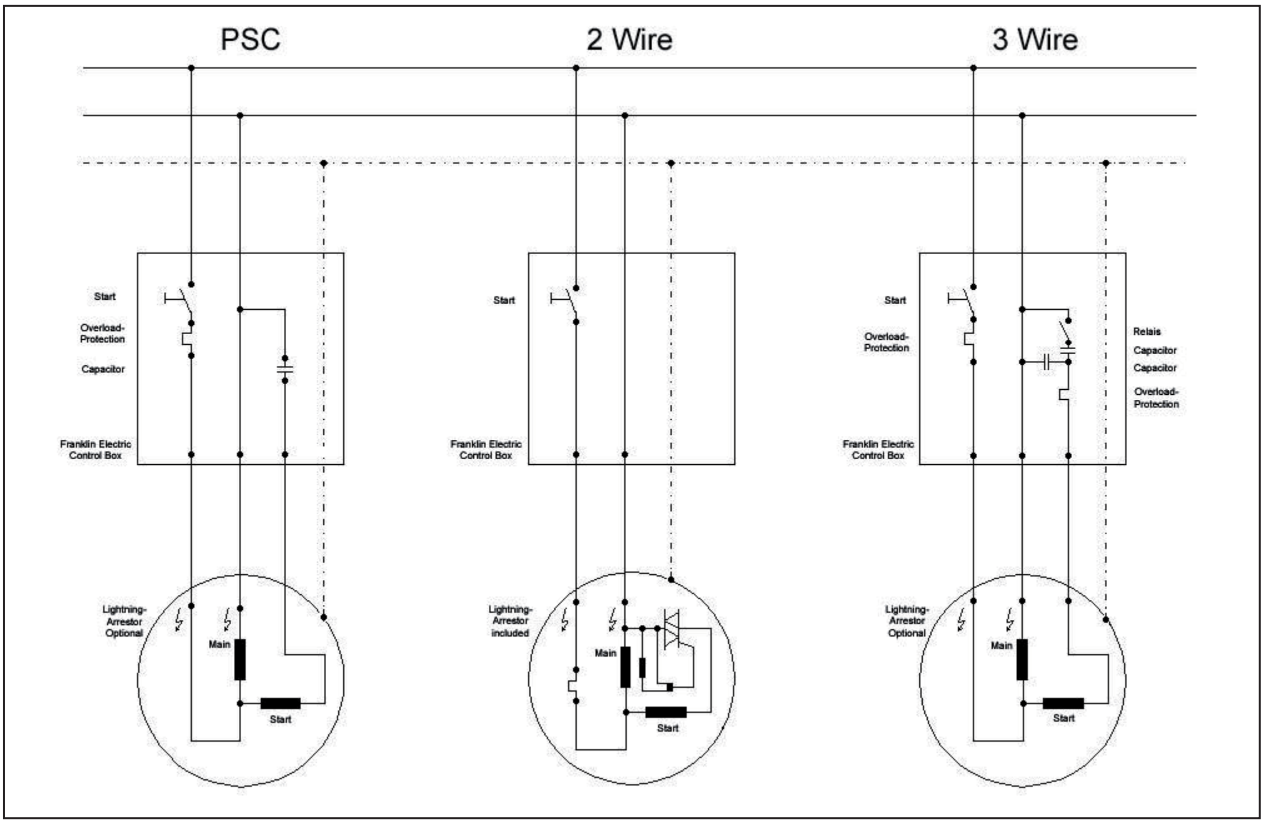




While in the first mode the start winding gets switched off from the power supply after start up, the start winding stays connected after start up in the second mode. Due to its permanent operation this winding is called auxiliary winding. In combination with the operating capacitor it generates a high torque at the shaft end.

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Wiring diagram of Franklin Electric Single Phase Motors



Seminars in 2010:

Please check our website http://www.franklin-electric.de/de/training.asp
and sign up.

Upon request we offer specific seminars tailored to your needs.

The Franklin Electric Service Team thanks for the good cooperation and wishes "Merry Christmas" and good success with Franklin products in 2011.

Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de

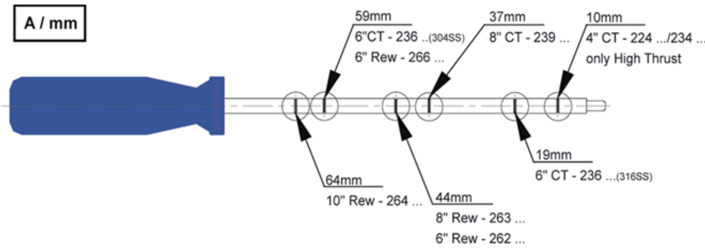
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

This Franklin AID bulletin will show in addition to our catalog once again the tools for measuring and filling of a Franklin Electric submersible motor. These tools can be ordered from Franklin Electric Wittlich.

At the end of this Franklin AID you will find a summary of our actual training sessions in our training center in Wittlich, Germany.

Filling kit

Part no. 308726103



4/6 inch gauge for day to day field use, not for motor assembly.

Part no. 156125101

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

4 inch precision shaft gauge

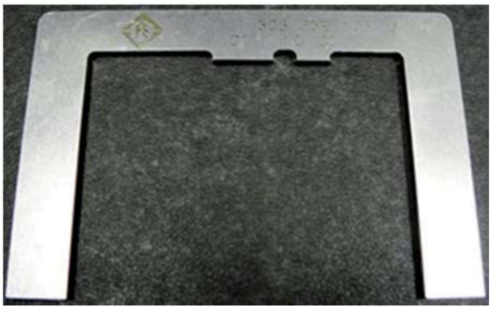
Part no. 308239104

6 inch precision shaft gauge

Part no. 308239106

8-10 inch precision shaft gauge

Part no. 308239108



FES 92 filling solution

Part no. 308353941

Seminar schedule:

Russian Seminar	week 13
German Seminar	week 14
Arabic Seminar	week 21
English Seminar	week 41

Please check our website http://www.franklin-electric.de/de/training.asp and sign up.
Upon request we offer specific seminars tailored to your needs

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Requests from the field have encouraged us to focus the right selection of FE control boxes for 4” single phase submersible motors. Information can also be found in our product catalog.

Below you will find a summary of the scheduled training sessions in our training center in Wittlich, Germany.

Franklin Electric Control Box and motor Overview

3 - wire motor

214…

Control box type	Power
2803554115	0,25 kW-0,37 kW
2803574115	0,55 kW
2803584115	0,75 kW

Motor type	Power
214753..	0,25 kW
214755..	0,37 kW
214757..	0,55 kW
214758..	0,75 kW

QUALITY MADE BY Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

3 - wire motor

224…

Control box type	Power
2823508114	1,1 kW
2823518114	1,5 kW

Motor type	Power
224750..	1,1 kW
224751..	1,5 kW

3 - wire motor

224…

Control box type	Power
2823528114	2,2 kW

Motor type	Power
224752..	2,2 kW

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

3 - wire motor

224…

Control box type	Power
2822534014	3,7 kW

Motor type	Power
224753..	3,7 kW

PSC - motor

254…

Control box type	Power
2846233510	0,25 kW
2846243510	0,35 kW
2846253510	0,55 kW
2846263510	0,75 kW
2846273510	1,1 kW
2846283510	1,5 kW
2846293510	2,2 kW

Motor type	Power
2548..	0,25 kW
2548..	0,35 kW
2548..	0,55 kW
2548..	0,75 kW
2548..	1,1 kW
2548..	1,5 kW
2548..	2,2 kW

QUALITY MADE BY
Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

PSC - motor

254…

Control box type	Power
2846233511	0,25 kW
2846243511	0,35 kW
2846253511	0,55 kW
2846263511	0,75 kW
2846273511	1,1 kW
2846283511	1,5 kW
2846293511	2,2 kW

Motor type	Power
2548..	0,25 kW
2548..	0,35 kW
2548..	0,55 kW
2548..	0,75 kW
2548..	1,1 kW
2548..	1,5 kW
2548..	2,2 kW

Seminar Overview:

English Seminar	week 41
Russian Seminar	week 43
French Seminar	week 45
German Seminar	week 48

Please check our website http://www.franklin-electric.de/de/training.asp and sign up.

Upon request we offer specific seminars tailored to your needs.

QUALITY MADE BY
Franklin Electric Europa GmbH

Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Franklin Application/Installation Data *Europe* No. 3/2011

Many questions regarding submersible motors in combination with a VFD reach our Franklin Electric Field Service team.

In this Franklin AID we want give you additional information on VFD drives and submersible motors. Our Franklin AID I/2004 already dealt with this subject.

Output filters:

Output filters should be chosen in accordance to Franklin AID 01-2004.

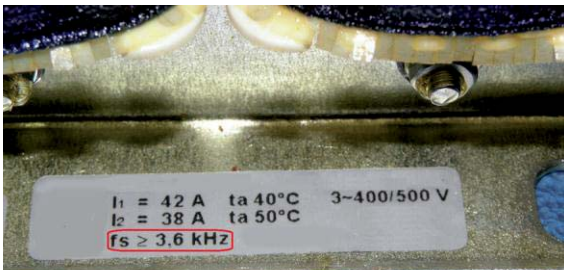
In addition, the frequency range of the filter must be taken in consideration.

It is important to select the filter covering the right “carrier frequency range”.

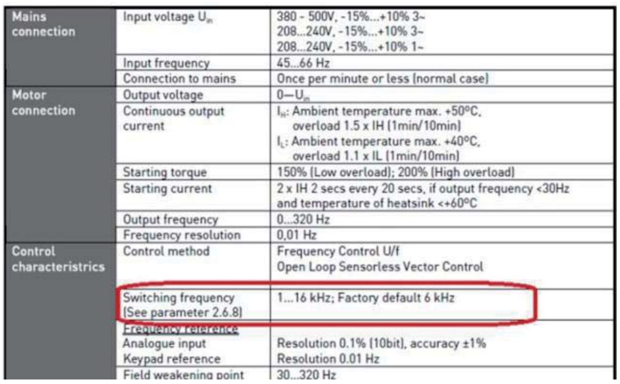
This means if for example the nameplate of the filter shows fs ≥ 3,6 kHz, the carrier frequency of the VFD has to be adjusted to a minimum of 3.6 kHz.

A wrongly selected output filter or a badly adjusted frequency range can lead to a premature failure of the installation. Thus possibly resulting in reduced performance, increased heating or non-smooth run of the submersible motor.

Output filter nameplate



VFD manual



Mains connection	Input voltage U_{in}	380 - 500V, -15%...+10% 3~ 208...240V, -15%...+10% 3~ 208...240V, -15%...+10% 1~
	Input frequency	45...66 Hz
	Connection to mains	Once per minute or less (normal case)
Motor connection	Output voltage	0—U_{in}
	Continuous output current	I_H: Ambient temperature max. +50°C, overload 1.5 x IH (1min/10min) I_L: Ambient temperature max. +40°C, overload 1.1 x IL (1min/10min)
	Starting torque	150% (Low overload); 200% (High overload)
	Starting current	2 x IH 2 secs every 20 secs, if output frequency <30Hz and temperature of heatsink <+60°C
	Output frequency	0...320 Hz
	Frequency resolution	0,01 Hz
Control characteristics	Control method	Frequency Control U/f Open Loop Sensorless Vector Control
	Switching frequency (See parameter 2.6.8)	1...16 kHz; Factory default 6 kHz
	Frequency reference Analogue input Keypad reference	 Resolution 0.1% (10bit), accuracy ±1% Resolution 0.01 Hz
	Field weakening point	30...320 Hz

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

Another important topic:

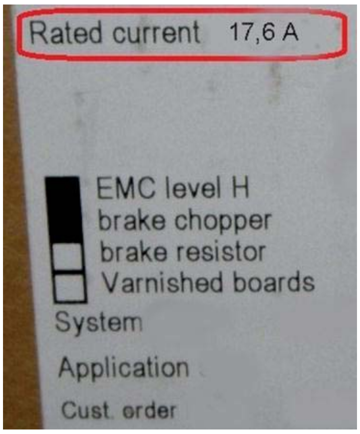
The majority of the VFD’s are designed for “above ground” motors, which means the selection/purchase is generally done according to the performance of the motors in kW.

Due to their construction features submersible motors usually take higher amps (Ampere) than comparable above ground motors at the same performance (P_2).

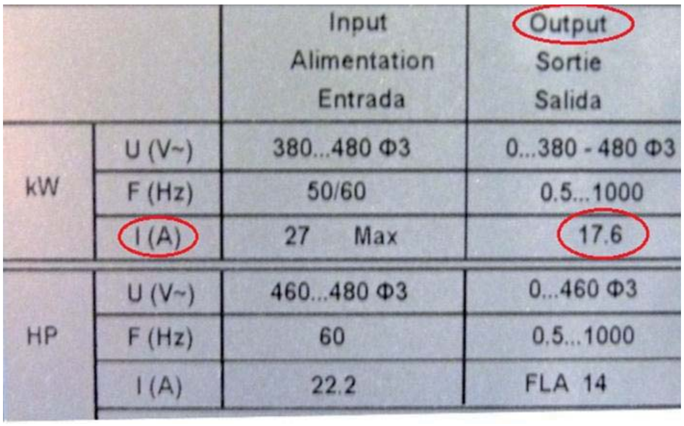
As a result, the VFD cannot supply the necessary current for Submersible motors and move into an “Overload” condition.

Therefore VFD’s for Submersible motors must be selected on the nominal Amps basis of the motor (Inominal) which can be found on the motor nameplate as well as in our documentation.

VFD label



VFD nameplate



Seminars in 2012:

Please check our website http://www.franklin-electric.de/de/training.asp and sign up.

Upon request we offer specific seminars tailored to your needs.

The Franklin Electric Service Team thanks for the good cooperation and wishes “Merry Christmas” and good success with Franklin products in 2012.

QUALITY MADE BY
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)65 71 10 54 20
Fax: +49 (0)65 71 10 55 13

FRANKLIN AID

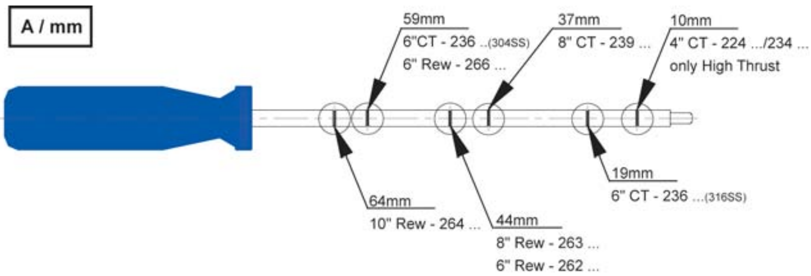
Franklin Electric

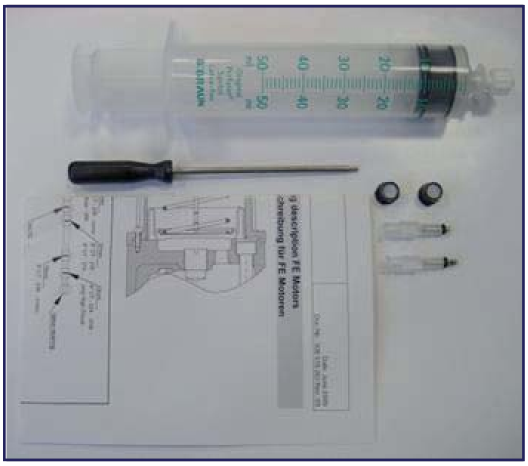
Franklin Electric Application/Installation Data **1/2012**

We want to keep you up to date. In this publication of the Franklin AID we show changes and modifications of our Franklin Electric Products.

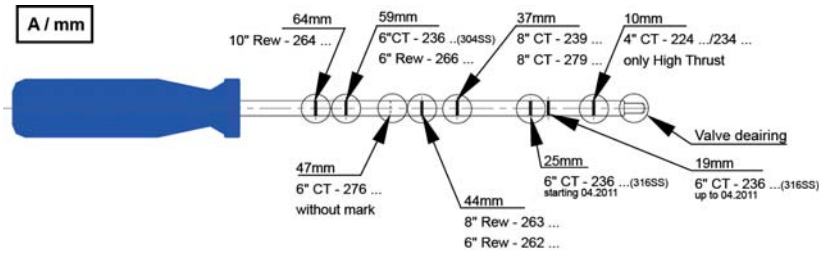
Changes to the FRANKLIN ELECTRIC FILLING-KIT

Current Filling Kit, Part.-No 308726103





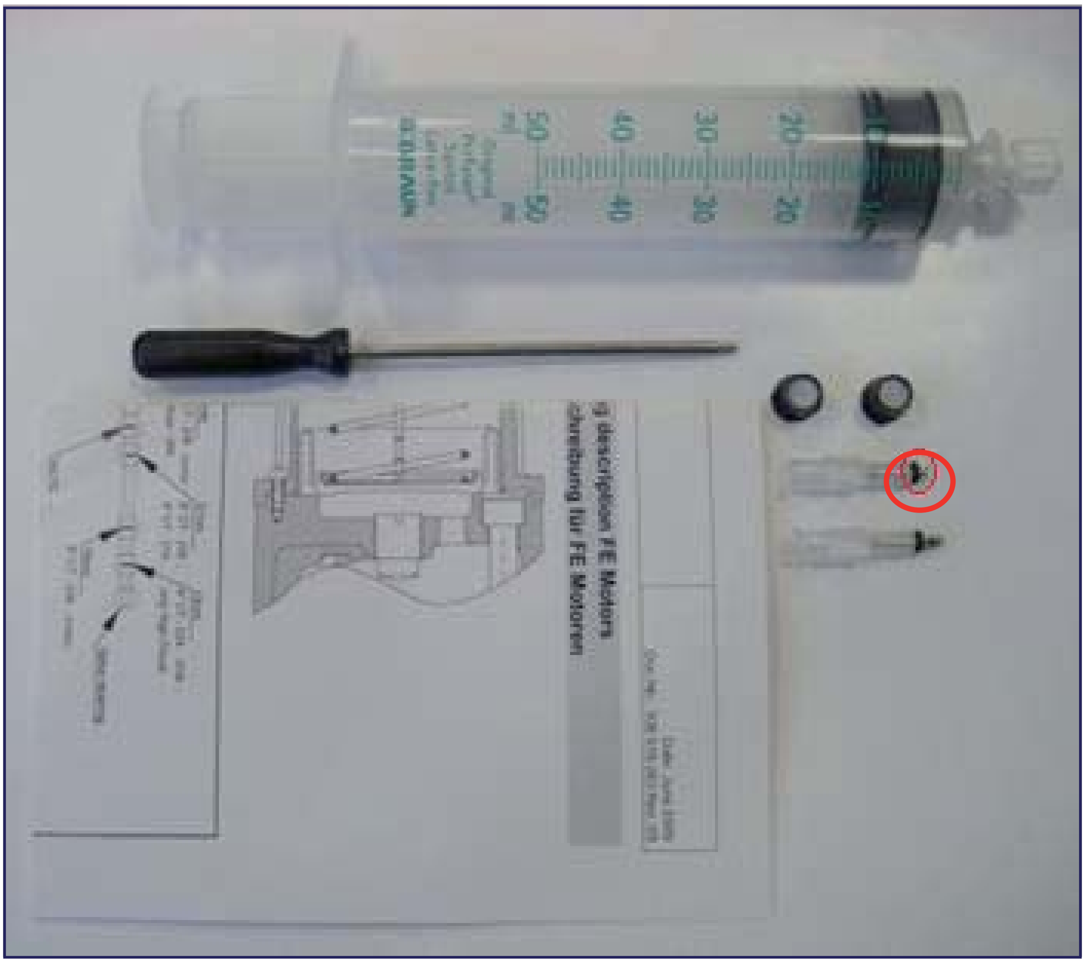
New Filling Kit, Part.-No. 308726103



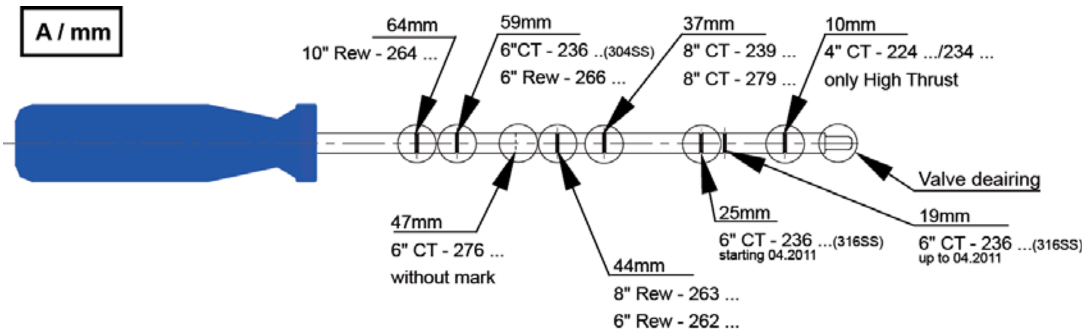
Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513



To fill the 6" Rewindable Motor of full 304 the standard filling pin can be exchanged by the shorter pin coming with the new filling kit.



We added a new mark at 25 mm to the blue gauge for the 6" Encapsulated Motors 316SS from 4kW bis 30 kW (236…).
This change effects motors starting at Date Code 11D.

The measurement of 47 mm for the 6" Encapsulated Motors 276 … ….
is shown in the instruction sheet as a dotted line, but not marked on the gauge. However due to the closeness to the next mark it is not grooved.

Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

NEW 6" REWINDABLE 304SS MOTORS

As a result of our continuous value improvement program, Franklin Electric is pleased to introduce the new 6" Rewindable Motors 304SS (4-37kW).

Product Features/Advantages:

- Fully 304SS
- Truly rewindable (removable winding covers)
- Higher operating safety (lower heat rise)
- Sand Fighter® sealing system as a standard
- Dual voltage labelled (50&60Hz)
- Motors are ~17mm shorter and ~5kg weight reduced versus current model
- Same electrical parameters (electrical active material)

Model numbers:

- 262 xxx 86xx - 304SS & PVC
- 262 xxx 87xx - 304SS & PE2/PA

Service:

Rotor and all individual wear & tear parts (bearings, sealings, …) except the diaphragm will stay the same.

Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

Franklin Electric 6" ENCAPSULATED MOTOR 316SS

In the case of our continuous product improvement some modifications were adapted in the 6" Encapsuladed Motors 316.

- New Diaphragm
- Additional diaphragm support ring

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

Changes to Franklin Electric Submersible Motor Date and Sequence Number Identification

In an effort to standardize motor markings across frame sizes, Franklin Electric Europe GmbH is moving the date and sequence number information on the 4" motor line to a new position:

Current

New

Currently, a.m. information can be found in a chain of characters engraved above the motor nameplate. On new motors, the same chain will be positioned alongside the nameplate to its left, the same position used with 6" Encapsulated Motors.
The information content and syntax/format of the marking remain unchanged.

Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

FRANKLIN AID

Franklin Electric

Franklin Electric Application/Installation Data — **No. 2/2012**

This issue of Franklin AID will improve the understanding about electrical power,in terms of calculating the electrical cost of operating a submersible pump. As part of this, we'll examine the phase relationship between voltage and current, known as power factor.

First, a quick review of voltage and current:

Voltage is simply electrical pressure, and is measured in volts (V).
The equivalent measure in a water system is water pressure or bar.

Current, which is measured in amperes (A), is electrical flow.
1 A is defined as 6.2×10^{18} electrons (that is 6.2 followed by 18 zeros) flowing past a given point each second.
This concept is very similar to flow in a water system, where the unit of measurement is liter per second (l/s) instead of electrons per second.

Electrical power is a combination of voltage and current.

To borrow the water systems analogy once again, a 1,1 kilowatt (kW) pump obviously delivers more power than a 0,55 kW pump.
Said another way, the 1,1 kW pump will deliver a higher combination of pressure and flow than the 0,55 kW unit.
Electrical power works the same, it is also expressed in watts (W) or kilowatts (kW).
What is very different about electrical power versus a water system is that electricity is supplied as alternating current, generally just called AC.
This means that the voltage and the current constantly change or "alternate". Hence, the familiar sine wave we've all seen many times.
The electrical power "alternates" at 50 Hertz or 60 Hertz, (50 or 60 cycles per second).

The waveforms of the voltage and current don't necessarily "line-up".
That is, the peaks and zero crossing points don't occur at the same time, and are "out-of-phase".

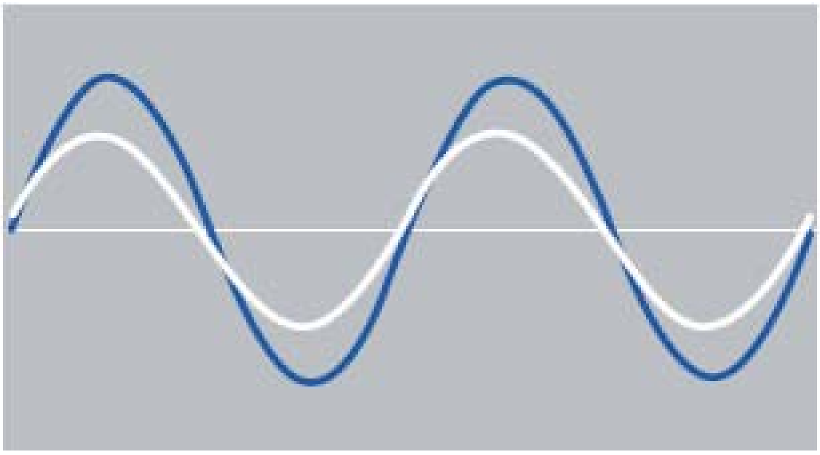
This phase relationship between voltage and current is called the **Power Factor**.
The lower the power factor, the higher the out-of-phase rate of voltage and current.

Franklin Electric

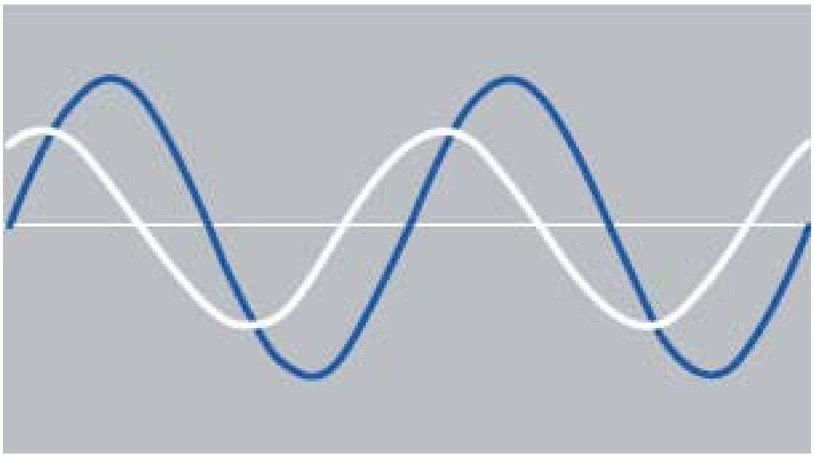
Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

In the first example below, the power factor is relatively high, and you can see that the voltage and current are almost completely "in-phase".
The second diagram shows the case of a relatively low power factor, and the voltage and current are significantly out of phase to each other.



High Power Factor



Low Power Factor

Power factor is always a number between 0 and 1, and is sometimes expressed as a percentage. It is also dimensionless. That means, it has no units.

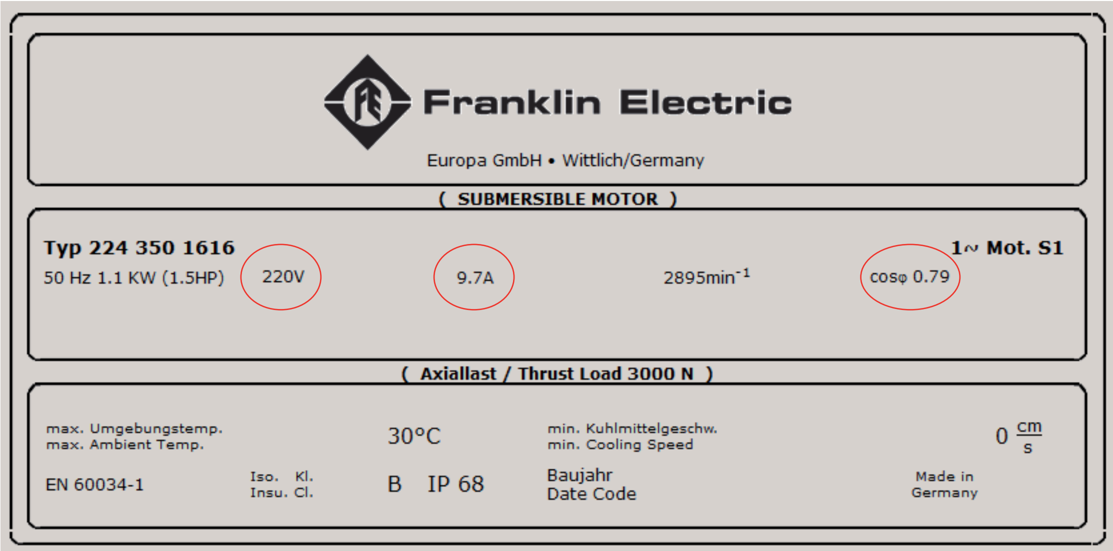
The reason for this discussion is that it turns out that power in an AC electric circuit depends not only on the voltage supplied and the current consumed, but on the power factor of that circuit as well.

Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

Let’s look at a real world example. From the motor name plate data a 220 volt, 1,1 kW mechanical power motor has the following characteristics:



<u>Single-phase electrical power</u>, in a AC circuit, is calculated as follows:

Electrical power = Voltage • Current • Power Factor $\quad P_{electrical} = U \cdot I \cdot \cos\varphi$

Voltage = 220V
Amps = 9.7A
Power Factor = 0.79

$$\mathbf{Power_{electrical} = 220V \cdot 9{,}7A \cdot 0{,}79 = 1685{,}86\ W = 1{,}69\ kW}$$

<u>3-phase electrical power</u> calculation in a circuit is slightly different:

Electrical power = 1,732 • Voltage • Current • Power Factor $\quad P_{electrical} = \sqrt{3} \cdot U \cdot I \cdot \cos\varphi$

<u>Calculating the costs:</u>

A key point here is that power is "what you pay for". You don't pay for voltage or current, but for the combination of the two.
So, how does this translate into money and costs?
We all pay for power in terms of kilowatt-hours. One kilowatt- hour is simply 1 kilowatt for 1 hour.

To calculate the monthly cost, we need to know three things:
1. Power consumption of the device in kilowatts
2. How many hours per day or month the device operates
3. Cost of power in kilowatt-hours

Monthly Cost = Power • hours of operation per month • cost per kilowatt-hour

Once again, let's look at an example:

1. Power consumption – Going back to our example above, a single phase 1.1 kW motor consumes 1,69 kilowatts.
2. Hours per month – In our example, let's assume that the motor/pump runs an average of 2 hours per day. That would mean it runs about 60 hours per month, in average.
3. Cost of power – According to the Power Supply Companies, the average residential cost of electricity in 2011 was 12 cents per kilowatt-hour (in Germany).

Monthly Cost = 1,69 kW • 60 hours per month • 0,12 €/kWh
= 12,17 €

This is a quick way to calculate how much it costs to operate a submersible pump.
So, if you want to know the operating costs of a water system, this show how to calculate.
Current and Power can easily be mixed: Although current is only one component of electrical power, much like flow (l/s) is only one component in the performance of a water system.

SEMINARS INSIDE THE FRANKLIN TECH TRAINING CENTER 2012

Please check our website http://www.franklin-electric.de/training and sign up.

Upon request we offer specific seminars tailored to your needs.

FRANKLIN AID

Franklin Electric

Franklin Electric Application/Installation Data No. 3/2012

Following many requests from the field this edition of the Franklin AID will deal with the correct assembly of the motor lead to the encapsulated Franklin Electric submersible motor.

Assembly of motor lead

1. Assemble the lead to the motor prior to mounting the pump.
2. Check for any apparent damage on the lead insulation, the connector as well as the motor socket. Do not use damaged parts such as defective insulation or bent contacts. The electrical connection parts of lead and motor have to be clean and dry.
3. Grease the rubber part of the connector with food-grade grease or Vaseline for easy assembly.

4. For 316 SS motors please use an anti-galling agent. This lubricant has to be applied to the thread of the stainless steel jam nut for easy assembly.
5. Align the lead connector to the motor socket. Make sure the weight of the lead does not apply any side force to the connector (risk of misalignment).

Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

6. Having positioned the bushing “nose” to the guiding groove in the motor end bell, gently insert the lead by moving it slightly from side to side.

7. In order to align the jam nut to the thread first turn it left giving it slight pressure until the beginning of the thread is found. Then turning it right, tighten hand tight.

8. Tighten the jam nut to the torque noted below:

Encapsulated motor	starting torque
4"	20 ... 27 Nm
6"	68 ... 81 Nm
8"	68 ... 81 Nm
8" fixing with 4 screws	9 ... 10,2 Nm tighten screws crosswise.

<u>Attention:</u> **Insufficient torque will lead to leaky connections. If the torque is too high, the rubber seal will be deformed –this can also result in a motor failure.**

9. Check the insulation resistance at 500 V after lead assembly as well as prior to operation with the motor submerged. The insulation resistance of a new motor with a lead should be at least 4 Mega Ohm.

<u>Attention:</u> **Incorrect lead assembly can lead to danger to life or material damage due to electric shock.**

<u>Seminars in the Franklin Tech Training Center 2013</u>

Please visit our website: http://www.franklin-electric.de/training and sign up.

Upon request we offer specific seminars tailored to your needs.

The Franklin Electric Service Team thanks you for the great co-operation and wishes happy holidays and much success in 2013 with Franklin Electric products.

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

FRANKLIN AID

Franklin Electric

Franklin Electric Application/Installation Data **No. 1/2013**

Franklin Electric submersible motors are offered in either DOL or Star-Delta version. Today's Franklin AID will show the differences between the two and characteristics of the Star-Delta connection.

Depending on the geographical location in which the submersible motor is to be installed, the local energy provider gives technical connection guidelines that have to be kept for the operation of electrical drives. One of these guidelines implements reduced start-up current for submersible motors for certain drive capacities which differ from region to region. The Star-Delta drive of submersible motors is a cost-efficient possibility to adhere to these guidelines.

<u>Risks and details of the Star – Delta start will be highlighted in our next FE-AID edition.</u>

Picture 1: **<u>DOL (Direct Online) Motor</u>**

Picture 2: **<u>Star-Delta Motor</u>**

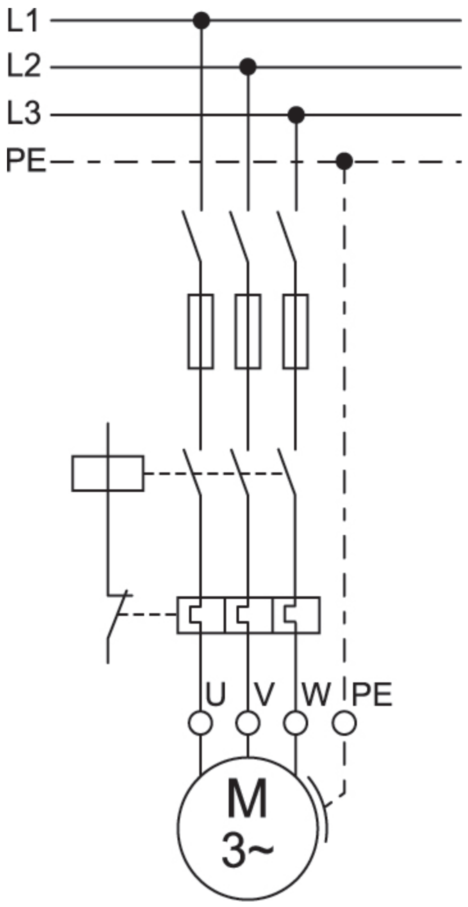
Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

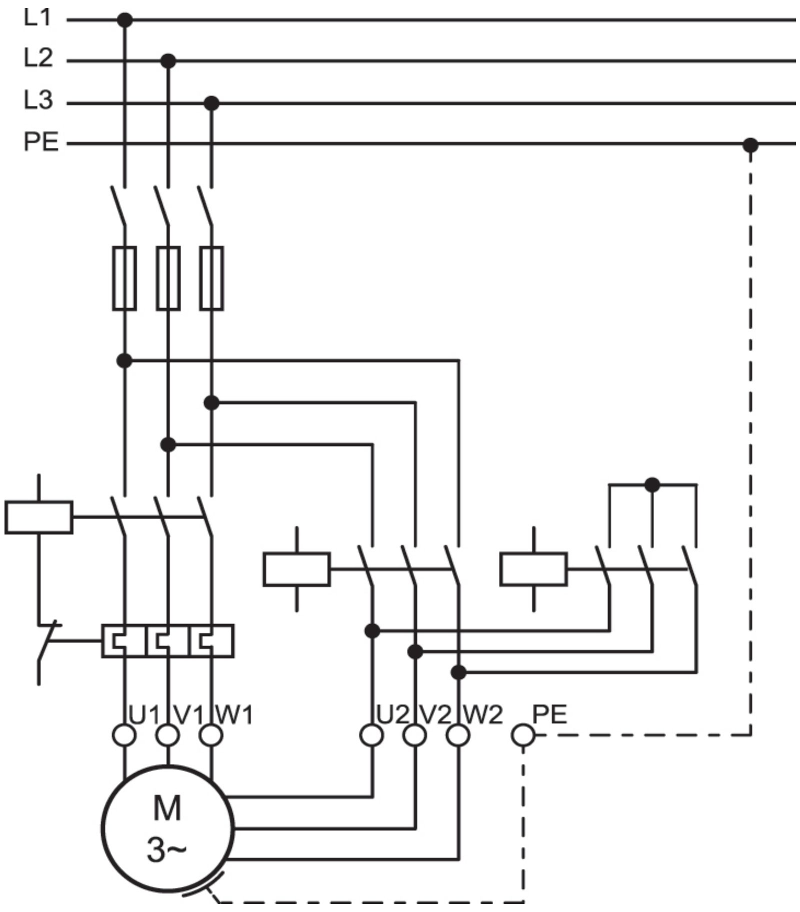
Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

Direct-on-line (DOL) starting motors only require adequate motor protection, whereas star-delta starting implies a more complex circuitry composed of several relays and contactors.

The following two images demonstrate the different possibilities for electrical connection:



Picture 3: **DOL**

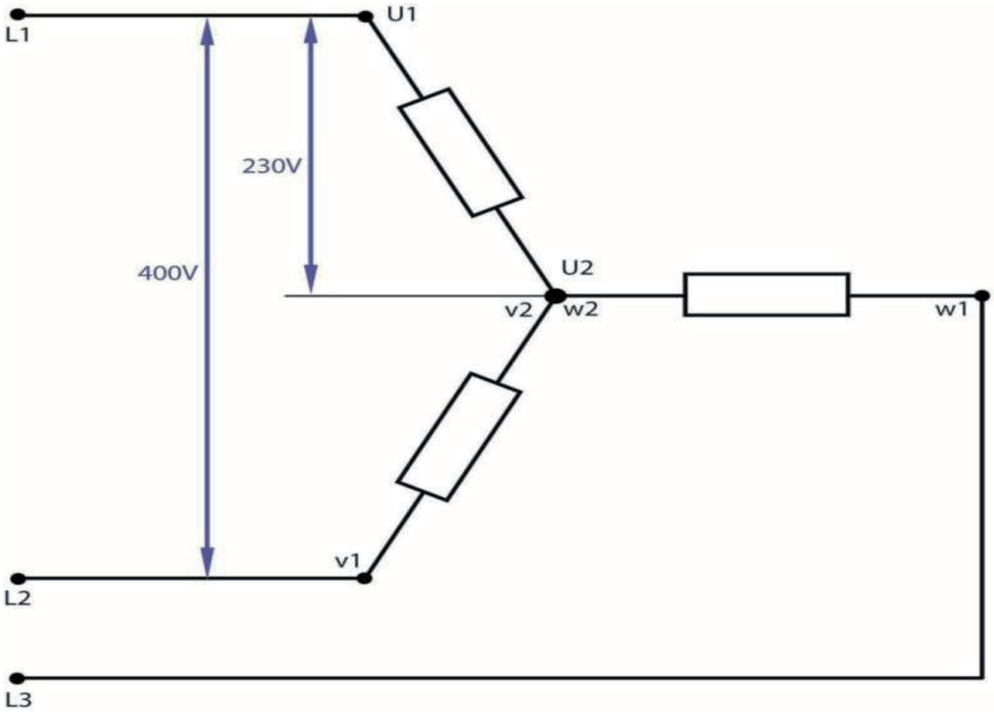


Picture 4: **Star-Delta**

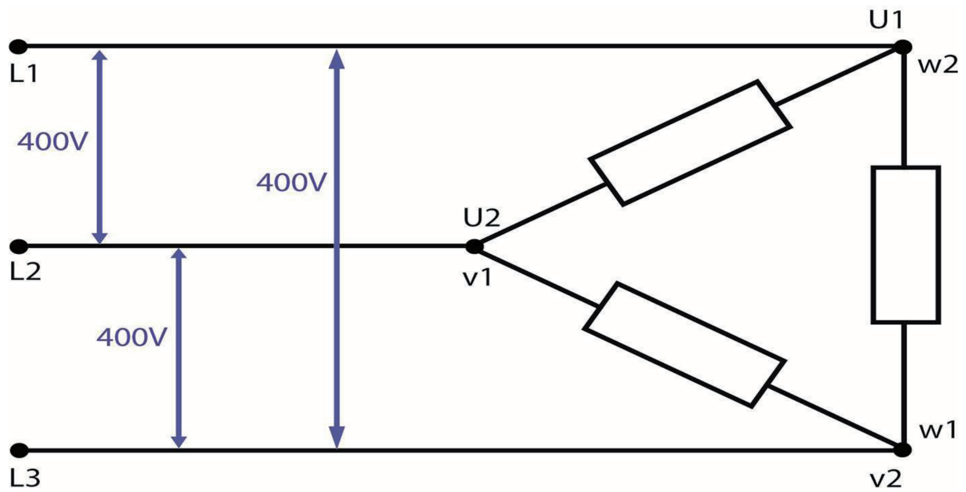
Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

The following images show the electrical circuitry of the three motor windings and their phase voltages:



Picture 5: **STAR connection of the motor windings**



Picture 6: **DELTA connection of the motor windings**

As shown in Pic. 5 and 6, the difference in connections is not just limited to the different circuitries, but also in the resulting voltages of the windings..Whereas in the DOL connection the windings are supplied by the voltage they are designed for permanently, the STAR connection is operated at a voltage reduced by the factor √3. Following principles result from this, which have to be respected by all means for a continuous operation of a STAR-DELTA motor:

$$I_Y = \frac{1}{\sqrt{3}} \cdot I_\Delta$$

The motor-current (Amps) of a STAR-DELTA motor during start (I_Y) is reduced roughly by factor 0,58; a motor with a nominal starting current of 400A will consume only 232 A in STAR – connection. This fullfills the requirement of a current reduced start.

$$P_Y = \frac{1}{3} \cdot P_\Delta$$

(P_Y), the available mechanical performance on the shaft to drive the pump, is also reduced to 1/3 of the nominal performance. To avoid an overloading of t he motor, it is necessary to observe the power demand of the pump during startup in comparison with the start current of the motor.

$$M_Y = \frac{1}{3} \cdot M_\Delta$$

The available shaft torque (M_Y) also reduces while start to 1/3 of the nominal torque. This also raises the necessity, to compare the demanded starting torque of the pump to the available torque of the motor, and – to do the right selection.

For deeper questions/explanations please consult your Field Service Engineer or the technical staff of FEE.

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

Seminars in FRANKLIN TECH TRAINING CENTER 2013

Please visit our website:http://www.franklin-electric.de and sign up.

Upon request we also offer in 2013 seminars tailored to your requirements.

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

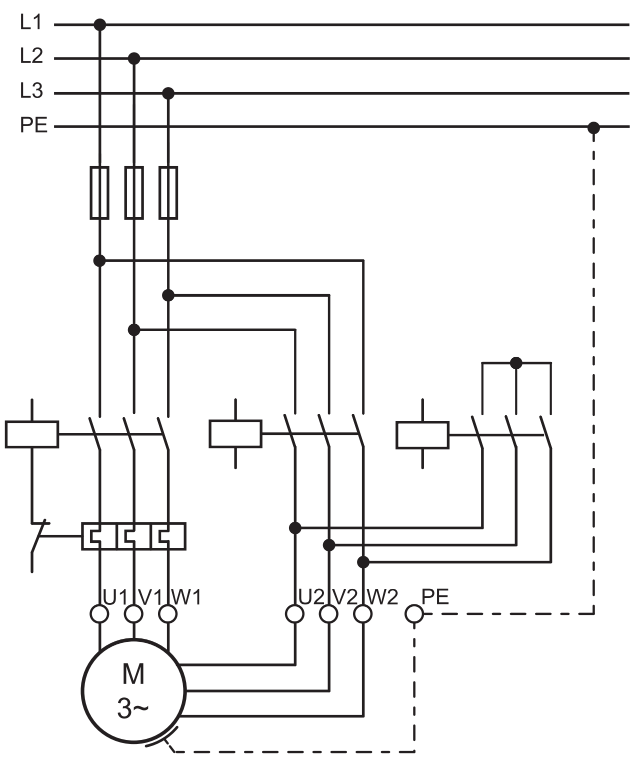
Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

Franklin AID 1/2013 focused on the Wye-Delta operation of submersible motors in general. Today's AID version 2/2013 offers final remarks and highlights possible pit falls when star-delta starting submersible borehole motors and pumps.

Adjusting of the overload/motor protection device:

Basically, the motor protection sensors can be connected to the line side of the star-delta starter or to one of the motor leads. Please refer to pictures 1 and 2 detailing these two possible connections.

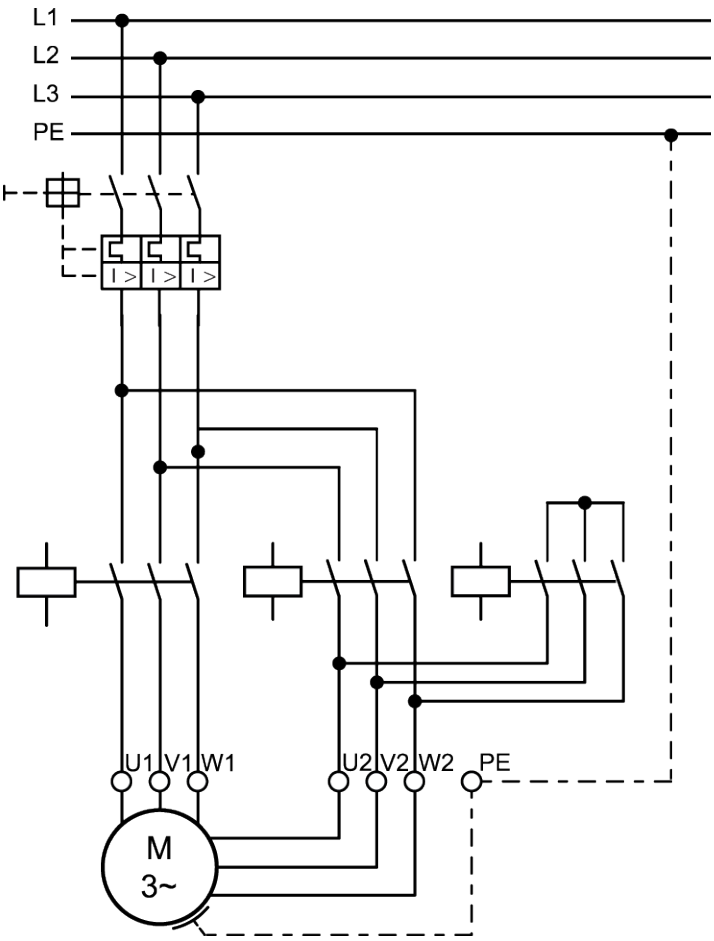
Picture 1: Overload relay behind Wye-Delta starting device



If this configuration is used, the overload relay has to be set to 58% of the measured duty point current of the motor (0,58 • Iduty).

Franklin Electric
Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu
Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

Picture 2: **Motor protection device on the line side of the Wye-Delta starting device**



For this hook-up, the overload trip point needs to be set to the full recorded duty point current (Iduty). The duty point current needs to be below or equal to the rated motor current in all operation modes.

Connection of the single wires:

Please refer to the connection examples laid out in the respective motor manuals for correct wiring of motor leads.

Should extension cables have been fitted, please make sure color coding has been respected before powering the motor up.

Adjusting of the Wye-Delta switching time:

Franklin Electric recommends a max. switching time of 3 Seconds.

Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

Possible risks of Wye-Delta starting of submersible motors:

With some pumps, the reduced starting torque in star connection may not be sufficient to overcome the break-loose torque required by the pump/rotor. Consequently, the motor will experience a "locked rotor" condition until the star-delta starter switches to delta connection. During this period, the motor generates an important amount of heat that cannot be dissipated and which may lead to permanent motor damage.

Conversely, due to the slim construction of submersible borehole equipment and the resulting low moments of inertia, the pump/rotor assembly will quickly lose speed during the switching time of the star-delta starter. With some starters, this will mean the pump basically will start again in a delta connection with full line voltage which eliminates the advantages of the reduced voltage starting.

Final remarks:

Make sure available motor torque is higher than the required break-loose torque of the pump.

Motor torque available must be higher than the required load torque over the entire startup process.

Make sure overload trip point setting has been matched to the application.

Motor current draw must be below or equal to its nominal value over the entire range of operation points.

Maximum recommended switching time for star-delta starter: 3 seconds.

Please refer to your responsible Franklin Electric Field Service Engineer for further details.

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

OPEN SEMINARS INSIDE
FRANKLIN TECH TRAINING CENTER 2013

week 47 technical Seminar in german language

Up on request we also offer in 2013 seminars tailored to your requirements.

Please sign up via telephone or email.

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

FRANKLIN AID

Franklin Electric

Franklin Electric Application/Installation Data No. 3/2013

In our today's edition, we want to highlight Franklin Electric's latest product development, the:

6" High Efficiency System

In consideration of environmental relief and energy saving Franklin Electric developed a High Efficiency 6" Submersible Borehole System, consisting of a synchronous submersible 304SS motor associated variable frequency drive and output filter, which can be connected with any brand of 6 inch (NEMA Standard) Submersible Pump.

For more in-depth information, or questions regarding the product, please contact your Franklin Electric representative. More details on back cover.

Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

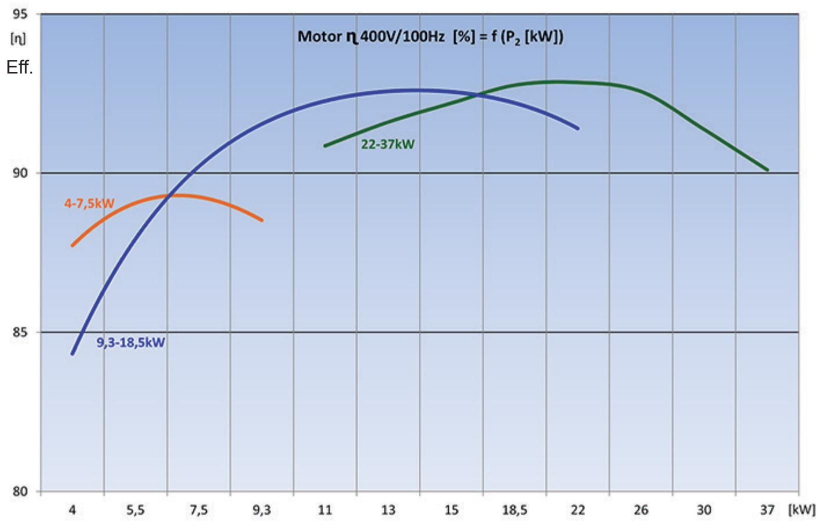
System Product advantages:

- One-stop shop – perfectly matching components guarantee first class performance
- Up to 20% energy saving*
  ⇨ *System payback < 2 years*
- Up to 13% improved motor efficiency (system up to 11%) with excellent partial load behaviour*
  ⇨ *SKU Reduction*
- Significant lower motor heat rise
  ⇨ *Increased lifetime*
- Higher power density*
  ⇨ *Lightweight*
- Easy installation/ set-up due to tailored pre-setting, user interface and software
- Speed control
  ⇨ *Optimum aggregate operation - pump matches system any time*
- Incorporated Soft start and protection features
  ⇨ *Increased lifetime*
  ⇨ *No additonal investment*
- Reduced amps
  ⇨ *Smaller drop lead cross size*
- Top class protection with Electronics in IP66/54**
  ⇨ *Easy retrofit - no additional cabinet cost*
- Power factor corrected input
  ⇨ *No power compensation needed*
- Communication Modbus (RS485 and Ethernet)

System Technical Specification:

- Power Supply: Voltage 400V +/- 10%
  Frequency 50Hz +/- 6%

*In comparison to current asynchronous technology
**Alternative Electronics in IP21/00 for cabinet assembly available



SEMINARS IN FRANKLIN TECH TRAINING CENTER 2014

Please check our website http://www.franklin-electric.de/de/training.asp and sign up.

Upon request we offer specific seminars tailored to your needs.

The Franklin Electric Service Team thanks you for the good cooperation and wishes you "Merry Christmas" and much success with Franklin Electric products for in 2014.

Franklin Electric

Europa GmbH
D-54516 Wittlich / Germany
e-mail: field-service@franklin-electric.de
www.franklin-electric.eu

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513

Based on frequently asked questions from the field, today's issue of Franklin AID will again cover the topic "upthrust operation".

Explanation:

If a pump delivers more water than specified (see curve below), the impellers (depending on type of pump) will not apply further pressure, instead they will move up together with the pump shaft (Figure 1).

In the curve below, the operating point of the pump is very far to the right (Figure 2).

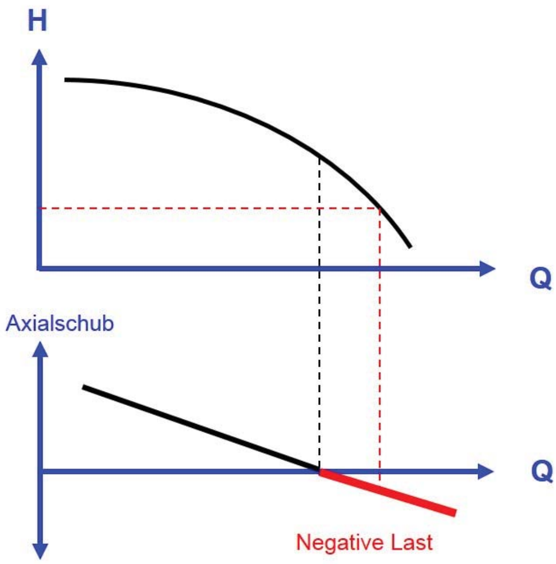


Figure 1:
Negative axial thrust load

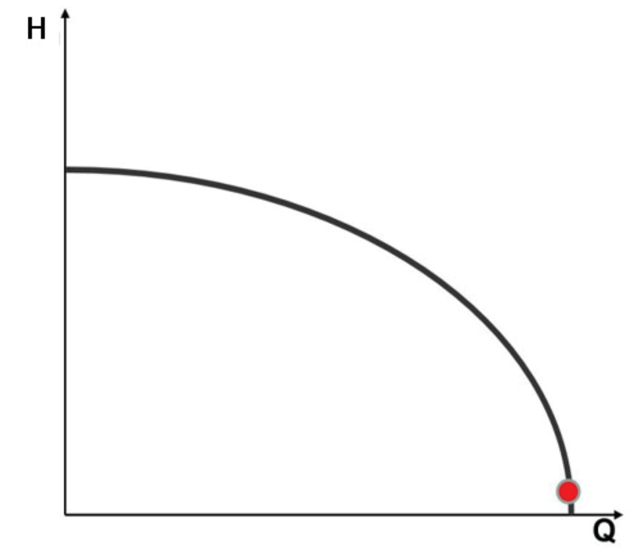


Figure 2:
Operating point of the pump at end of the curve

In a correctly installed application, this will only happen once when the pump is first taken into service and the riser pipe is filled. During further operation the pipe remains filled with water by properly installed check valves in the line or by the non-return valve in the pump.

Due to the friction-locked connection between pump coupling and motor shaft the upward movement of the pump shaft is also transferred to the rotor of the submersible motor. This may result in the rubbing of the upthrust washer.

Submersible motors can handle this upthrust for a limited time. Permanent upthrust operation will lead to the destruction of the upthrust washer as the constructional limits are exceeded.

Figure 3:
New upthrust washer

Figure 4:
Example of 6“ Motor CT

Figure 5:
Destroyed upthrust washer

This can cause damage on both, the motor and the pump. In the event of damage, both components, motor as well as the pump, should be checked.

The abrasion of the upthrust washer will impair the lubrication of the radial and thrust bearings and can lead to damage.

An upthrust damage always indicates a system related cause.

Experiences from the field show the following possible reasons:

- Leaking riser pipe
- Removed/drilled/leaking non-return valve of the pump
- Inappropriate pairing of pump to motor
- Over-pumping of the well (dry run)
- Other

In a properly carried out installation especially regarding non-return valves, an upthrust of the pump during start-up is limited to a minimum or even to zero.

SEMINARS IN THE FRANKLINTECH TRAINING CENTER 2014

In 2014 we also provide seminars specifically tailored to your needs. Please register by e-mail: field-service@franklin-electric.de or by telephone: +49 (0)6571 105 – 0.

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data ***Europe*** No. 2/2014

In this and coming editions of the Franklin AID we want to refreshen the knowledge of the correct motor protection.

<u>Overload Protection of 3 Phase Submersible Motors</u>

The characteristics of submersible motors are different from standard, above ground motors. Submersible motors require special overload protection.

In order to properly protect a three-phase submersible motor, ambient-compensated, quick trip overload protection must be used. Most common devices are adjustable overload protectors, as long as they are ambient-compensated and quick-trip.

Franklin Electric's Submonitor and VFD units provide a similar protection.

<u>Ambient compensated:</u>

Ambient-compensated overload protection must be used to maintain protection in both, high and low air temperature areas. Three-phase pump panels are typically suitable for indoor and outdoor applications within temperatures of -10°C to 50°C (+14°F to +122°F).

<u>IMPORTANT:</u> Pump panels should never be mounted in direct sunlight or high temperature locations, as this will cause unnecessary tripping of overload protectors.

A ventilated enclosure, preferably painted white to reflect heat, is recommended for outdoor high temperature locations. Additionally a sunroof should be installed.

<u>Quick-Trip:</u> If the motor is stalled or the rotor shaft cannot turn, the overload protector must trip quickly to protect the motor's windings. We specify that the overload must trip within max. 10 seconds with 500% normal current I_N (Class 10).

Since there are standard trip overload units in the market with different trip times (for example 20 seconds) it is important to verify that **Quick trip overload protection devices are being used.**

Devices shall comply with EN 60947-4-1 (VDE 0660 T. 102)

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

Recommendations for the overload setting:

1. Overload protection units must be selected to carry at least equal or higher Amps than the desired nominal Amps (I_N) of the submersible motor.
2. Before first start of the pump-set the tripping point must be set to nominal Amps (I_N) of the submersible motor. Values can be found in the motor name plate or in Franklin Electric's documentations.
3. The overload protection must be reset/adjusted (close to duty point), if the motor (pump-set) shows lower amps than I_N in operation. This helps to have a more sensitive protection.
4. Setting the overload trip point above nominal Amps (I_N) of the submersible motor may result in overloaded/overheated windings.

The next Franklin Electric AID will focus on different overload protection devices and the recommended wiring/placing of an overload protection in the electric wiring system.

SEMINARS IN THE FRANKLIN*TECH* TRAINING CENTER 2014

In 2014 we will also provide seminars specifically tailored to your needs. Please register by email: field-service@franklin-electric.de or by telephone: +49 (0)6571 105 – 0.

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data ***Europe*** No. 3/2014

In today’s edition of the AID we will inform about motor protection and its settings.

The functional principle of a bimetal release:

The bimetal release consists of two mechanically connected metal strips with different thermal expansion coefficients that conduct the motor current. Due to the current flowing through them, these metal strips will heat up. If the current reaches excessive values, the resulting deflection of the bi-metal strip will open the electrical circuit and protect the connected load.

Motor protection switch:

These switches are combined devices that protect the load against both overloads and short circuits. The overload function is usually done using the a.m. thermal effect of the electrical current (bi-metal), whereas the short-circuit protection is given by factory pre-set magnetic releases.
Additionally, these motor protection devices feature manual controls that can be used to switch the load under normal operating conditions. These controls are also used to re-arm the protection device after the fault condition has been cleared.

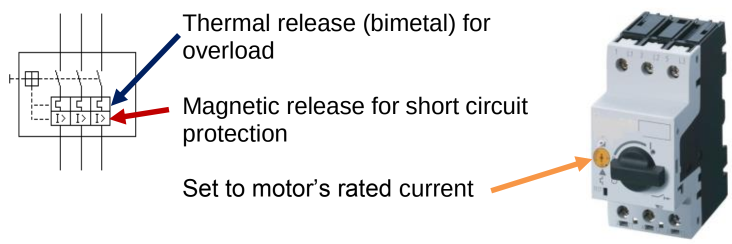


Figure 1: Motor protection switch

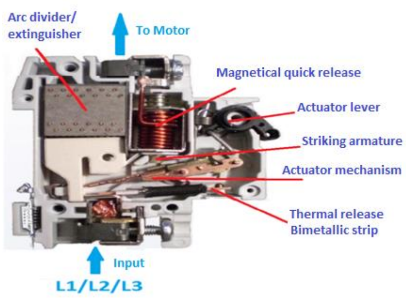


Figure 2: Sectional view of motor protection switch (thermal and magnetic release)

Motor protection relay:

The thermal overcurrent relay is designed to protect the consumers from excess heating due to overload or phase failure. Additionally, it usually features a trip-free mechanism to prevent re-arming as long as the heat has not dissipated. Motor protections relays generally trigger when 1.2 of the preset current has been reached, however, they do not protect from short circuits. Additional safety fuses or automatic circuit breakers are required for short circuit protection when protection relays are being used.

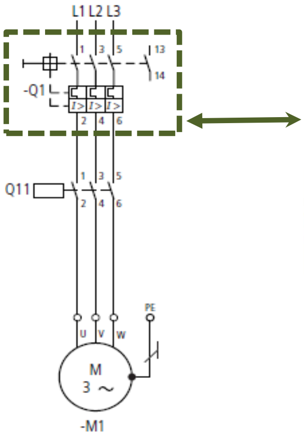
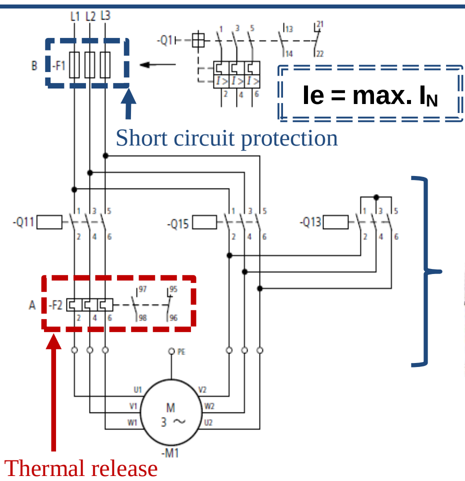
Figure 3: Motor protection relay

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

Motor protection switch – use and settings:

Direct motor start DOL	Star-delta-start up YΔ
 	 Motor protection in star-delta connection  **Ie = 0,58 X I_N**

The setting of the motor protection switch depends on the installation point in the electric circuit. For direct motor start the overload protection may be set at motor rated nameplate current $\mathbf{I_N}$. If the motor protection switch was installed in a star-delta start-up in the delta connected branch as in above picture, its setting has to be motor nominal current $\mathbf{I_N}$ times 0.58.

<u>We remind our customers that with submersible borehole installations, the switching time from star to delta connection is best chosen as short as practical (~3 seconds). This is due to the extremely low moments of inertia associated with borehole pumps.</u>

<u>Choosing the overload protection for submersible motors:</u>

Submersible motors should be protected by switchgear in conformity with EN 60947–4–1
(VDE 0660 T. 102), Class 10 (release within 10 seconds at 7,2xIn). Additionally, the overload protection should be phase failure sensitive and temperature compensated.

However, the optimum setting of the overload is taking into account the motor current at the duty point of the pump system.

FRANKLIN AID

Franklin Electric

***PRACTICE:**

The motor protection device has triggered and the motor and pump are disconnected from the circuit. What should be checked prior to restart:

1. Does the overload setting correspond to the normal current respectively maximum nominal current of the installed motor?

2. Was there a temporary voltage change in the feeder? (under voltage – overvoltage – phase asymmetry – voltage breakdown)?

3. Is the insulation resistance of the lead and motor within Franklin Electric's specifications?

4. Are the winding resistances within specification?

   3. and 4.: The measuring has to be carried out as close to the motor as possible.
   PLEASE NOTE: The voltage supply has to be reliably switched off and be protected against accidental restart!!!
   The measuring may only be carried out by authorized personnel!

5. Does the pump seem to have a mechanical damage, which might have shown in a changed amount of water or in pressure prior to the release of the overload?

The above is a short troubleshoot assistance. For a more detailed analysis, the pump and motor has to be pulled.

The Franklin Electric Service Team wishes a Merry Christmas, a Happy New Year and continued good success with Franklin Electric products in 2015

SEMINARS IN THE FRANKLIN TECH TRAINING CENTER 2015

Upon request we offer seminars in 2015 especially tailored to your needs.

Please register by email to field-service@franklin-electric.de or by phone +49 (0)6571 105 – 0.

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

Franklin Application/Installation Data ***Europe*** No. 1/2015

The 6” Franklin Electric High Efficiency System (HES)

As the world’s leading manufacturer of submersible electric motors, drives and controls for water well pumping systems, we want to introduce our latest product:

The 6” Franklin Electric High Efficiency System (HES)

In consideration of environmental relief and energy saving, Franklin Electric has developed a High Efficiency 6“ Submersible Borehole System, consisting of a synchronous submersible 304SS NEMA motor (3000 1/min) associated variable frequency drive and output filter.

A large number of these products is already working successfully in the field, but let us enlighten today <u>one</u> specific installation to recognize the benefits of this unit:

Test installation Water Authority

On December 10, 2012 in corporation with the local Water Authority Franklin Electric installed and put into operation a 6“-15 kW Franklin Electric High Efficiency System, consisting of a 304SS NEMA synchronous submersible motor (3000 1/min), IP66 variable frequency drive (VFD) and an IP54 du/dt output filter.

Picture 1

Picture 2

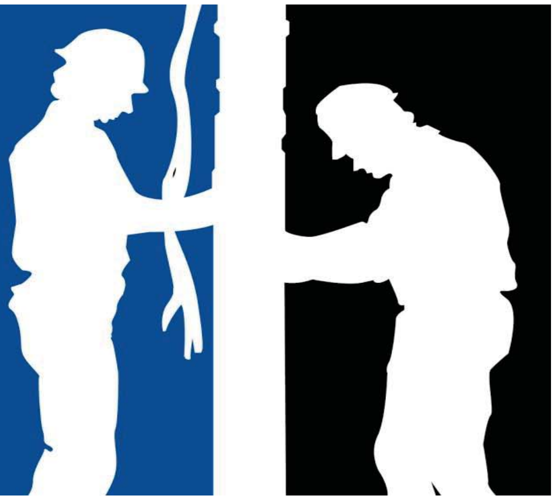
Picture 3

Picture 4

Franklin Electric
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.eu
Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

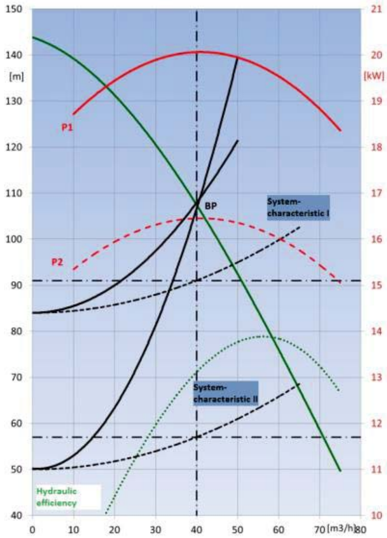
FRANKLIN AID

Franklin Electric



Initial situation:

The installation is operated from a central control room via SPS. In the past a 10 stage 60 m^3/h borehole pump with asynchronous submersible motor was installed at 31m below ground.
The well (Ø 400 mm and 50 m deep) is equipped with a continuous OBO filter. An additional cooling sleeve guarantees a minimum cooling flow alongside the motor.
Due to intake requirements as well as geological characteristics such as water quality and well yield, the pump has to constantly deliver 400 m^3/h into a collecting pipe. Depending on additional wells being connected the delivery head varies between 57 to 91 m. As these required duty points are not directly on the Q/H curve the volume has to be throttled mechanically.
In the years 2011 and 2012 the pump ran an average of approximately 200 hours per month with an input of P_1= ~20 kW.
> See graph 1.



Graph 1

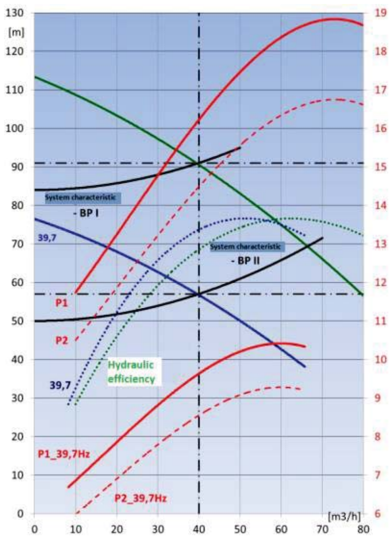
New installation December 12, 2012:

An existing 5 stage 60 m^3/h borehole pump including the existing cooling sleeve was installed with a Franklin Electric HES at 31m. Due to limited space the electronic parts (VFD in IP66 and du/dt filter in IP 54) were mounted outside the cabinet directly to the wall.
> See picture 4 above.

At a rotating speed of 48,2 Hz the newly chosen pump accurately meets the duty point I of 40 m^3/h at 91 m
> green solid curve.

The preset process reference 40 m^3/h (read by existing flow control unit) adjusts the rotational speed in case of changing operational conditions/pumping heads. Duty point II is at 39,7 Hz for 40 m^3/h at 57 m. *> blue solid curve.*

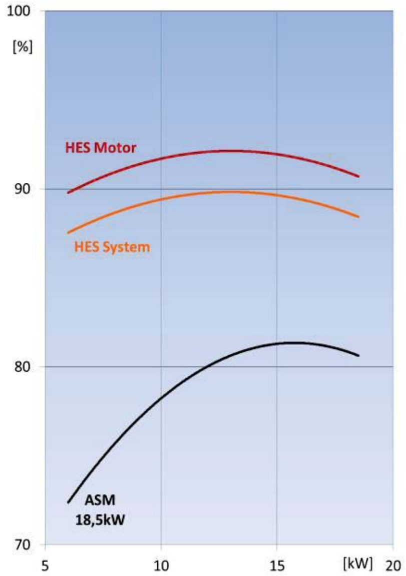
Due to the reduced rotation speed the efficiency curve “moves” left resulting in an improved hydraulic efficiency compared to nominal load *> blue dotted curve.*



Graph 2

Franklin Electric
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.eu
Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

These two duty points can now be achieved with an input of P_1= 9,5 and 16,2 kW respectively.
> See graph 2.



Graph 3

Conclusion:

Due to this new method of operation the pump now works at an average input of P_1= ~10,3 kW. Thus, the energy consumption is halved (~ 80 % reduction caused by the speed control and ~20 % due to new motor technology).
The reduction in motor technology is due to a constant excellent efficiency throughout the entire performance range as well as perfectly balanced electronic components. *> See graph 3.*

The start-up went quickly and smoothly because of the custom-designed VFD software specifically developed by Franklin Electric.

Franklin Electric HES Systems are available from 4 to 37 kW.

We hope we could give you a self explaining sample of our new system.

For further information please contact your correspondent Franklin Electric sales representative or visit our website at www.franklin-electric.eu .

SEMINARE IM FRANKLINTECH TRAINING CENTER 2015

Upon request we offer seminars in 2015 especially tailored to your needs.
Please register by email to field-service@franklin-electric.de or by phone +49 (0)6571 105 – 0.

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.eu

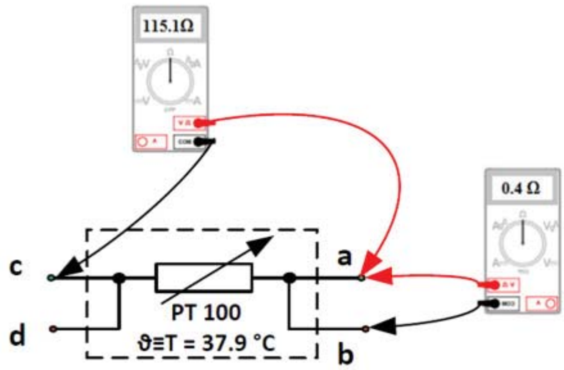
Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

PT 100 Read-Out with multimeter and usage with VFD

Based on the previous editions FE AID 4/2007 and FE AID 4/2008 we would now like to give practical tips on how to measure the temperature of the PT100 with the help of a standard ohmmeter.

PT100 read out by means of a multimeter:

The PT100 contains a platinum thermo element which changes its resistance depending on the temperature: at 0° C the nominal resistance of the PT100 equals 100 Ω, at 100° C the resistance becomes 138,5 Ω. Thus, one can determine the temperature of the device the PT100 is connected to by measuring its resistance with the help of a multimeter.



Pic. 1: PT100- Measuring connection with Ohmmeter

1. Measurement:
The measuring leads of the ohmmeter are connected to the cable ends a and b (see drawing). This measurement will render the resistance of the connecting leads, i.e. 0,4 Ω.

2. Measurement:
The measuring leads of the ohmmeter are connected to the cable ends a and c. This measurement represents the resistance values of the PT100 and the connecting lead, i.e. 115,1 Ω.

In order to determine the real PT100 resistance, we subtract measurement 1 from measurement 2, i.e. 115,1 – 0,4=114,7 Ω . In order to “translate” the resistance value to a temperature value, we now subtract the PT100 constant (100 Ω) and divide the result by 0,385 (a constant): 14.7 Ω/0,385 = **38.1° C**

Shielding

Can a PT100 be used together with a frequency converter?

Yes. However, good practice is required when wiring the installation, as currents and voltages of process signals (such as PT100/PT100, level/flow transducers…) are easily disturbed by electromagnetic fields such as generated by VFDs. These interferences can lead to false readings resulting in equipment malfunction. Since current signals (0/4-20mA) are less prone to interference than voltage signals (0/2-10V) these should be the preferred option.
In order to prevent/minimize interference the cables conducting process signals should be routed as far away as practical from power leads conducting motor currents and should cross these only in right angles.
Also, process signal cables have to be shielded and this shielding has to be carried out according to high frequency regulations.

Franklin Electric
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

A few words of our Head of Franklin Electric Europa Field Services, Edwin Klein, on the occasion of the generation change in the Field Service Department:

"Since 1997 I have been able to accept the numerous and always new challenges as the Field Service Manager of Franklin Electric. With the help of an excellent Service team internally and externally, it has always been our goal to help with prompt solutions and information.
Having reached my retirement age, I am ready to enter a new stage in my life. I thank you all for the good and pleasant coorporation in the past 18 years. It was an interesting and multifaceted time with many encounters and experiences, which have influenced my life.
Dieter Schuch will succeed me as the new Field Service Manager – I wish him all the best."

Sincerely,
Edwin Klein

Edwin Klein and Dieter Schuch

SEMINARS IN THE FRANKLINTECH TRAINING CENTER 2015

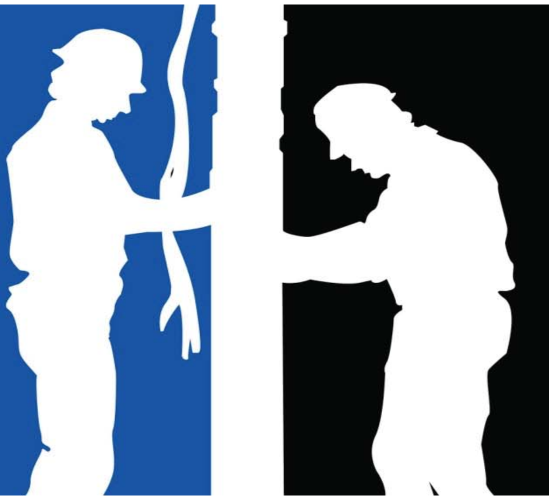
Upon request we offer seminars in 2015 especially tailored to your needs.

Please register by email to field-service@franklin-electric.de or by phone +49 (0)6571 105 – 0.

Franklin Electric
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.de
Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

FRANKLIN AID

Franklin Electric



Franklin Application/Installation Data *Europe* No. 3/2015

Presenting our new 4” submersible motor

As the population of our newly introduced standard 4” submersible motor is rapidly growing, we want to dedicate this AID bulletin to discuss some of the highlights and novelties this design proposes.

Full AISI 304/316 stainless steel construction
With this new motor, we have eliminated the mix of dissimilar materials that currently make up the top and bottom stator housing. We expect this to improve not only the look and feel, but also the motor performance when used in slightly aggressive environments.

Flat cable without separate earth lead
The novel plug sleeve design accommodates a jacketed, 4-cored flat lead. This significantly reduces the effort of water-tight splicing the motor short lead to the drop cable, reducing time, cost and risk of water ingress.

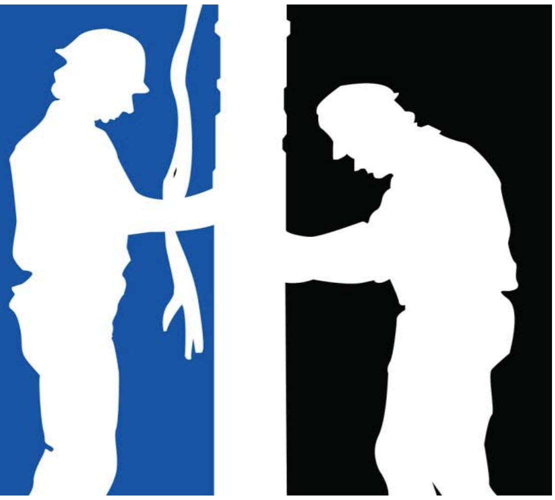
Clamped, positive stop cable mount
When replacing motor leads in the field, sometimes operators found it tricky to assemble and correctly tighten the jam nut of the 4” motor cable. With the new design, we are proposing a cable clamp solution that uses only one T25 hexalobular (Torx®) – slot combination head screw that will be torqued down to a positive stop with a well-defined torque of 3-4,5Nm.

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.eu
www.franklin-electric.eu

Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

FRANKLIN AID



Franklin Electric

Franklin Application/Installation Data ***Europe*** No. 3/2015

New Thrust Bearing
A consequence of modern, state-of-the art design capabilities and manufacturing technology, it uses fewer components but is capable of carrying more thrust than any of the previous designs. At the same time, it is easier to assemble and replace than the current design.

Replenishing valve accessible from outside for all motor ratings
All new 4” motors now feature a replenishing possibility via syringe from the outside of the motor by removing a plastic cap and filter.

The new design will apply to all “low thrust” standard motors in the following electrical executions:
• 3-phase
• 3-wire
• PSC

The “high thrust” motors, as well as the 2-wire motors will continue to come with the 3+1 lead configuration using a round plug and jam nut.

Please contact your Area Sales Manager or Field Service Representative with any questions you may have.

LOOK OUT for 2016...
While thanking you for the trust you have extended to us as we say goodbye to 2015, we are excited about a new year of challenges, sweat and great satisfaction ahead!

Your Franklin Electric Field Service Team - EMENA

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.eu
www.franklin-electric.eu

Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

FRANKLIN AID

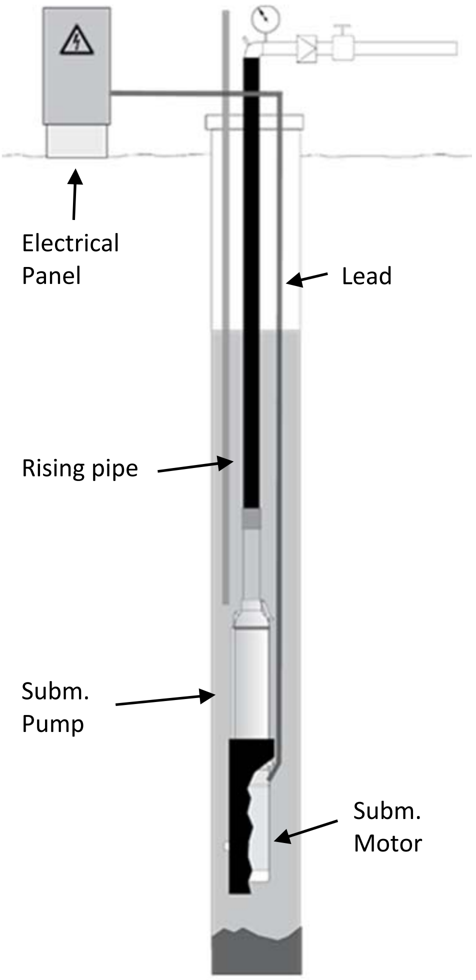
Franklin Electric

Franklin Application/Installation Data *Europe* No. 1/2016

Submersible motor cable selection

Special needs…

Submersible motors, specially designed for a life underwater, require supply cables equally special in form and function.



On the left, you will find a simple schematic of a typical borehole installation. From this, it is easy to deduct the challenges in selecting/sizing the right cable. Ideally, a cable that feeds a submersible borehole pump must:

- be sized to deliver adequate voltage to the motor
- work without overheating or burnout – both in the well/water and aboveground in air/conduct
- satisfy any local safety and/or drinking water/hygienic approvals
- mechanically withstand installation conditions and provide reliable life.

Because of the complexity of the subject, we will dedicate this and the next edition of our AID Bulletin to discuss above mentioned requirements and possible technical solutions in detail.

Voltage

When power flows through electrical cable, some input voltage is lost in the cable due to its electrical resistance/reactance. Essentially, it can be thought of as an electrical resistor that creates voltage and power loss. The longer the cable and the smaller its cross-sectional area, the larger these losses will be and the less voltage will arrive at the motor terminals. So, in order to maintain an efficient and reliable motor operation, the drop cable cross section should be matched to the expected motor amperage.

Temperature

Cables consist of the active part – in today's world almost always copper which conducts the electrical field and the current. The copper wire is insulated against neighboring conductors and the environment by different layers of electrically insulating materials, usually XLPE and/or rubber compounds (see figure 2).

When conducting electrical current, heat built up in the copper is transferred to and through these insulating compounds and dissipated to the environment (water or air).

Cable manufacturers specify the maximum temperature these insulating/sheathing materials can withstand, in function of the ambient conditions (water or air and temperature), the cable construction (single conductor or multicore) and the method of installation (laying on surface/free in air etc.).

Having understood the above, it now becomes clear why factory-fitted motor short leads can be much smaller than the ones they will be spliced to: these motor leads always operate under water (so their current carrying capability is high) and because of their shortness, the voltage drop across them is insignificant.

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

FRANKLIN AID

Franklin Electric

Safety and drinking water/hygienic requirements

The vast majority of submersible motors are used for extracting water from aquifers and so, are subjected to governmental, state or community laws/regulations concerning contamination. In Europe, there are several national agencies that are testing and approving cable materials for safe use in drinking water: ACS, KTW, WRAS are some of the acronyms encountered.

Also, the majority of national electrical codes require a jacketed construction for any cable intended to be permanently installed under water. In the absence of a dedicated cable standard for borehole applications, most manufacturers use the more generic cable standards to prove compliance to safety regulations.

Mechanical construction

Cables can be built using either stranded or solid conductors, and copper or aluminum as active material. For our application, it is the stranded copper variant that will be best suited to bear mechanical and electrical stresses typically encountered.

Special conditions

- Hydrocarbon resistance

Not all installations are for drinking water supply or irrigation; sometimes, borehole pumps are used for mine dewatering, process water pumping or desalination. In such cases, yet again special chemical or mechanical properties must be taken into consideration, which are not within the scope of this article. It should be considered, though, that factory supplied motor short leads are built for drinking water usage and their suitability for special applications must be checked prior to commissioning.

- VFD

Today, many submersible pumps are controlled by variable speed drives. The PWM voltage generated by these devices poses some very unique challenges to the motor/cable system that can lead to premature failure if not addressed: High electrical field generated by reflected voltage as well as high dV/dt rates shorten useful life of insulation material. The best way to diminish the negative effects of voltage overshoots and high dV/dt rates is using passive filtering at the drive output.

In EMC-sensitive applications, it may be desirable to use shielded motor cables with symmetrically disposed earth conductors. In the vast majority of cases, however, experience shows it is more practical and economical to shield adjacent low-power cables.

Conclusion

Submersible motor cables are different, and most large cable manufacturer's catalogues list a selection of drinking water approved leads for your convenience.

In the next edition of our AID bulletin, we will be taking you through the cable sizing process and explain how to use cable charts supplied by submersible motor manufacturers.

SAVE THE DATES

Keep yourself and your colleagues up-to-date with the latest developments in submersible borehole technology and trends. We're offering conveniently-timed, off season technical seminars for industry professionals at our Wittlich, Germany training facility.

Check into our website for the latest dates at: http://www.franklin-electric.de/training.aspx?lang=en

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.de

Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

FRANKLIN AID

Franklin Electric

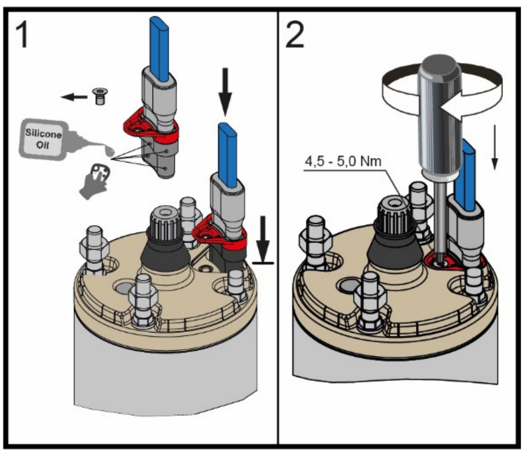
Franklin Application/Installation Data *Europe* No.2 /2016

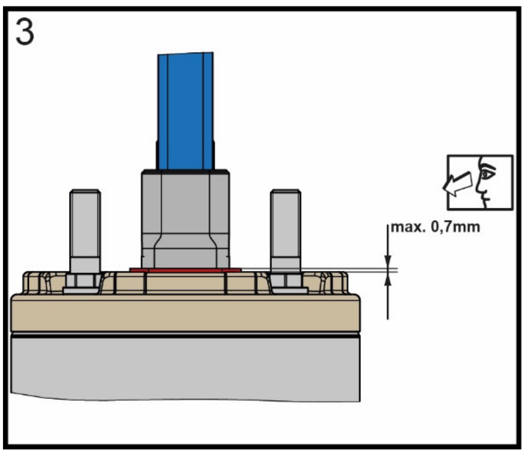
Following many requests from the field this edition of the Franklin AID will deal with the correct assembly of the motor lead to the encapsulated Franklin Electric submersible motor.

Assembly of motor lead

1. Assemble the lead to the motor prior to mounting the pump.
2. Check for any apparent damage on the lead insulation, the connector as well as the motor socket. Do not use damaged parts such as defective insulation or bent contacts. The electrical connection parts of lead, motor and sealing surface of the lead must be clean and dry.
3. Lubricate the rubber part of the connector with food-grade silicone oil for easy assembly.
4. Align the lead connector to the motor socket. Make sure the weight of the lead does not apply any side force to the connector (risk of misalignment).
5. Having positioned the bushing in the motor end bell, gently insert the lead by moving it slightly from side to side and push down to hard stop.
6. Make sure the connector has been pushed all the way down in the receptacle, before attempting to fix the securing clamp.
7. Insert the lead screw and then turning it right, tighten hand tight.
8. Tighten the screw to 4,5-5 Nm.
9. Measure cable clamp height position to upper end bell cover, height max. ≤ 0,7 mm.
10. See tutorial on Franklin Electric Europe YouTube Channel https://www.youtube.com/watch?v=tHFNfUByT3s
11. Check the insulation resistance according to installation manual.

Attention: Incorrect lead assembly can lead to danger to life or material damage due to electric shock.





YouTube Channel

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.eu

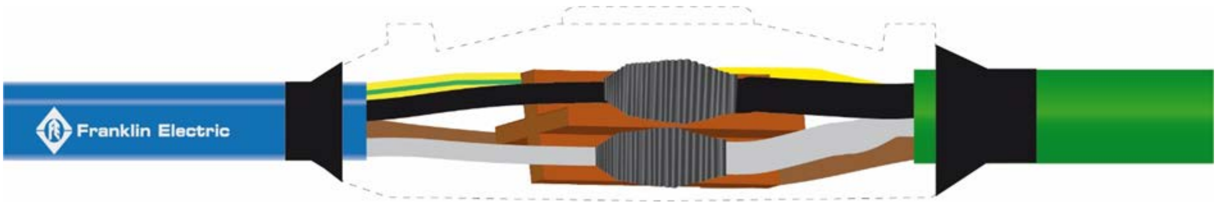
Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 513

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe* No.1 /2017

After having explained why submersible pump cables are different, let us have a look at how to correctly size a so-called “drop cable”.



In most cases, submersible motors will come supplied with a short electrical cable. For space constraints (it must be routed alongside the submersible pump in the narrow borehole space), it is usually selected by the manufacturer such that:

- It is a reduced cross section cable – just enough to carry the motor full load current in cold water (30°C)
- It is usually of the individual or flat jacketed construction
- It may require a separate earth cable to save space and add flexibility
- The outer sheath is usually selected in compliance with specified drinking water regulations

If you simply took the same cable type to cover the distance to the above ground electrical panel, the cable would most likely burn and so would your submersible motor. This is because

- the cable will overheat when it gets out of the cold well water and into hot air
- of its length, it will generate a large voltage drop so the motor will be under-supplied

For these reasons, borehole professionals will splice the motor short lead to a larger cross-size “drop cable” that will safely carry the required current and supply the motor with the desired voltage. So how to select the right cable type?

General Selection Algorithm

Input (data you need for sizing the cable):

- Chemical properties of the water
- Temperature of well water
- Temperature of air (in the well and along the entire cable run)
- Max. submergence (or max. pressure in booster applications)
- Agency requirements:
  - Related to hygienic/sanitary aspects (drinking water approved materials)
  - Related to local or industry electrical/mechanical codes (heavy duty cable construction, EMC compatibility etc.)
- Nominal operating voltage of load (when used with a VFD, make sure the cable insulation materials are suited for typical stresses of VFD operation)
- Nominal motor current
- Cos fi (power factor) of motor
- Total length (from submersible motor to pump panel)

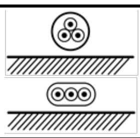
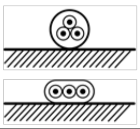
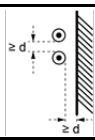
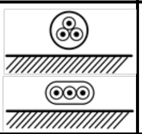
Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.eu
Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 511

CALCULATION

1. Select cable mechanical construction according to chemical properties and agency approvals. Most cable manufacturers will have several cable types in their catalogues to choose from.

2. Choose correct sizing (cross-section)
   - Determine the **minimum** cross section of the cable capable of carrying the motor current under the specified environmental conditions: temperature of water/air and method of installation. Most cable manufacturers will tabulate the data as in the example below:

	Max. conductor temperature 90 °C				Max. short circuit temperature	
					200 °C	250 °C
No. of loaded conductors	3	3	1	3	-	-
	In air	In air contacted by walls and floors	In water	In water	Tinned conductor	Plain Conductor
Nominal Cross Section					-	-
mm²	Current ratings in ampere for an ambient temperature of 30 °C				Max. short circuit current (1s)- kA	
1	19	18	-	23	0,12	0,14
1,5	24	23	42	29	0,18	0,21
2,5	32	30	54	38	0,31	0,36
4	43	41	74	52	0,49	0,57
6	56	53	96	67	0,73	0,86
10	78	74	133	94	1,22	1,43
16	104	99	179	125	1,95	2,29
25	138	131	236	166	3,05	3,58
35	171	162	293	205	4,27	5,01
50	213	202	365	256	6,1	7,15
70	263	250	451	316	8,54	10
95	317	301	544	380	11,6	13,6
120	370	352	635	444	14,6	17,2
150	425	404	730	510	18,3	21,5
185	485	461	832	582	22,6	26,5
240	576	547	988	691	29,3	34,3
300	666	633	1142	799	36,6	42,9

*) The current ratings for use in water are valid for the installation in water with the total length. The calculated value is 20 % higher than the value of the installation in air.

Correction factor for ambient air temperature other than 30 °C															
Ambient temp. °C	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
Conversion factor	1,18	1,14	1,10	1,05	1	0,95	0,89	0,84	0,77	0,71	0,63	0,55	0,45	0,41	0,29

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.eu
Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 511

This is the most economic cable size that can carry the current of your pump under the specified environmental conditions. HOWEVER, due to the inherent voltage drop along the cable, you must check for the maximum allowable cable length in a second calculation.

1. Calculate the maximum allowable cable length
   - Set the maximum allowable voltage drop your application will allow (usually between 3% and 5%)
   - Take the determined minimum cross-section determined under point 2. and use a voltage drop calculation formula (example given below for a 3 phase motor) to determine the maximum permissible lead length for the given cross-section:

$$L = dv / (\mathrm{sqrt}((v^* \cos(\varphi) + a^*r)^\wedge 2 + (v^*\sin(\varphi) + a^*x)^\wedge 2) - v)$$

where:

r = specific resistance, [Ω /m]
x = specific reactance, [Ω /m]
a = rated current of motor, [A]
cos(φ) = power factor of motor, [-]
v = rated voltage of motor, [V]
dv = allowable voltage drop, example: 0.05* v for a 5% voltage drop
L = maximum allowable cable length for specified voltage drop

Values for r & x must be specified by the cable manufacturer.

If the result of the calculation is matching or exceeding the required length for your application, this is the cable type you want to use. However, in most cases, the smallest cross-section (the most economical lead) will not be suitable for the length needed, so the calculus must be redone with the next higher available cross-section (check the manufacturer tables for available cross-sections). Redo the math in an iterative way until the result matches or exceeds the required total length of your application.
As the above is time-consuming and requires access to cable manufacturer data, most submersible pump manufacturers provide tabulated data for drop cable leads in function of the rated motor/pump power and voltage.
However, depending on the assumptions made, the type of cables chosen and safety factors applied, you will notice different recommended cable sizes for the same pump/motor rating coming from different manufacturers. Also, these tables are usually only available for standard supply voltages, ambient temperatures and cable construction materials.
With Franklin Electric submersible motors, these tables come with the motor manuals or can be conveniently downloaded from the internet.
In the next AID Bulletin, we will take you through a practical example of drop cable selection for a submersible pump application.

SAVE THE DATES

Keep yourself and your colleagues up-to-date with the latest developments in submersible borehole technology and trends. We're offering conveniently-timed, off season technical seminars for industry professionals at our Wittlich, Germany training facility.
For information on scheduled seminars please send us an email to field-service@franklin-electric.de.

Franklin Electric
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
field-service@franklin-electric.de
www.franklin-electric.eu
Tel.: +49 (0)6571 105 - 0
Fax: +49-(0)6571 105 - 511

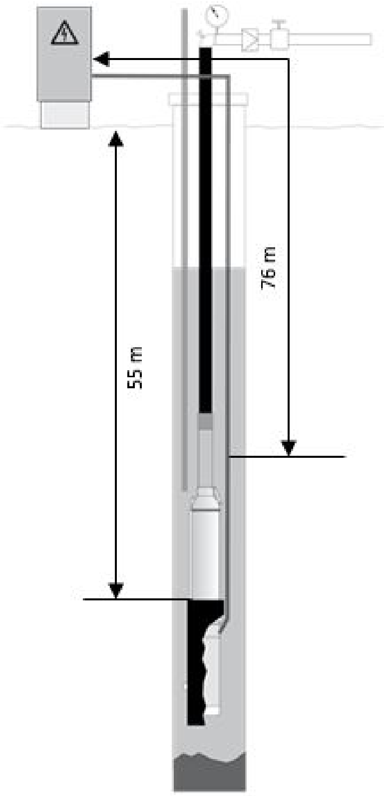
FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data ***Europe*** No.2 /2017

To close our AID series on **cable selection for borehole pumps**, let us walk you through a practical example.

Let us assume you need to find the correct cable for a submersible pump equipped with a 18,5 kW, 400V/50Hz direct on-line rated motor used for drinking water supply to a community water system. The pump is set at a depth of 55 m, the total cable length from the junction to the control panel is 76 m and the climatic conditions specify a max. air temperature of 50 °C in the summertime. The cable will be installed “lying on a surface” into a metal conduit.



Further, the owner of the facility has specified a max. voltage drop of 3 % from service panel to motor terminal.

You have a variety of drinking water approved cables to choose from and need to determine the correct cable cross-section.

The easiest approach to this will be to use the motor manufacturer’s data supplied with the product, Annex “D” of Franklin Electric’s Motor Assembly and Operating Instructions lists maximum allowable cable lengths per motor kW and rated cross-section.

A renewed version of this table, accounting for modern cable maximum allowable temperature at copper of 90 °C and energy efficiency requirements of max. 3 % voltage drop, is presented below:

6 - 12 Inch Motor Drop Cable Lengths

Maximum lengths in meters for 400vV / 50 Hz and 3 % voltage drop at 50 °C ambient temperature and 90 °C at copper wire

Jacketed Drop Cable Length

DOL - Start

Rating		**Cable size mm², copper wire - 90 °C rated insulation**																
KW	HP	2,5	4	6	10	16	25	35	50	70	95	120	150	185	240	300	**400**	**500**
4	5,5	95	155	230	385	605	915											
5,5	7,5	70	110	170	280	440	670	915										
7,5	10	50	80	126	205	325	500	685	935									
9,3	12,5	40	65	100	170	270	410	565	770	1030								
11	15		55	85	140	225	345	470	645	865	1110							
13	17,5		50	75	125	195	300	410	560	750	965							
15	20		40	65	105	170	265	360	495	665	855	1030						
18,5	25			50	85	140	210	290	400	530	680	810	950					
22	30				75	120	180	250	340	455	585	700	815	945				
26	35				60	100	150	210	290	385	500	600	705	815	970			
30	40					85	135	185	250	335	430	515	600	695	820	935		
37	50						105	150	205	270	350	420	485	565	665	760	875	980
45	60						90	125	175	235	310	375	445	520	630	730	860	980
52	70						80	110	155	210	270	325	385	450	540	625	735	840
55	75							105	145	195	255	305	360	420	505	580	685	770
60	80							95	135	185	240	290	345	400	485	560	660	750
67	90								120	160	210	255	300	350	415	480	565	640
75	100								105	145	185	225	270	315	375	435	510	580
83	111								95	130	170	210	250	290	350	405	480	540
85	114									125	160	195	230	265	315	365	425	480
93	125									115	150	185	215	255	300	350	410	460
110	150										120	145	170	200	235	270	310	350
130	175											130	155	180	215	250	290	330
150	200												145	170	205	235	275	280
185	250														140	160	185	210
220	300														130	150	175	200
250	335															125	145	160
300	400																	150
350	470																	120
400	540																	

Scrolling down the kW column to the 18,5 kW rated motor used in your application, then following the row to the right, you will find that the minimum cross-section that can be used with this motor is 6 mm². However, the total length for the required max. 3 % voltage drop along the cable is quoted with 50 m, which does not cover the 76 m the application requires.

Therefore, we will move to the right in the same row to find the next quoted cable cross-section of 10 mm², where the max. allowable cable length is 85 m, thus comfortably above the specified 76 m.

On a closing note:

- Determining the right type and size of the drop cable is important, as it greatly influences the useful service life of your borehole or booster installation
- Making the right choice is easy when you rely on specialist partners that provide the right instruments
- In addition to the classic paperback documentation, Franklin Electric's Application Installation Data is available for download at franklinwater.eu and soon will be interactively available via specialized IPhone and Android APPs.

FRANKLIN TECH Seminar schedule – upcoming events

We are delighted to announce another two dates for our well-appreciated "Submersible Motor and Pumps Workshop" to be held at our Wittlich/Germany Franklin Tech Training Center.

Don't miss the chance to get your complimentary technical update on the latest product trends and have a productive exchange of opinions with other industry specialists.

As always, these trainings are offered free of charge, but their value is priceless!

GERMAN language: 21 – 22 November 2017
ENGLISH language: 14 – 15 November 2017

For detailed seminar program and schedule, please contact us at field-service@franklin-electric.de

Franklin Application/Installation Data *Europe* No. 01/2018

THE IMPORTANCE OF GOOD DATA

When you purchase a product, you expect it to work - that's what you purchased it for.

In real life, products sometimes fail to perform as expected, and this is when things become interesting. Manufacturers, dealers, installers, customers – they are all part of the communication chain when a product fails to perform.

The number one priority for the user is restoring the functionality of the broken product. The faster and easier this process works, the more likely it is the customer will be satisfied with the performance of his supply chain.

Franklin Electric has long been known for being exactly this: a company you can trust - before AND after the sale. This AID bulletin is a plead for our cause – the cause of providing good service.

Product Failure Tracing

Aside from merely determining whether a claim for free product replacement (usually called "warranty replacement") is founded, the more important task is often to understand the reasons the product failed.

Why? Because today, most quality manufacturers have sourcing and manufacturing processes in place that guarantee a flawless and constant quality of their product.

Consequently, experience accumulated in our service department shows that in most cases, the root cause of failure lies in the application itself.

> *Not chasing down and eliminating this cause will lead to premature failure of the replacement product, leaving behind an even more unsatisfied customer.*

franklinwater.eu

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 511
Email: fieldservice-germany@fele.com

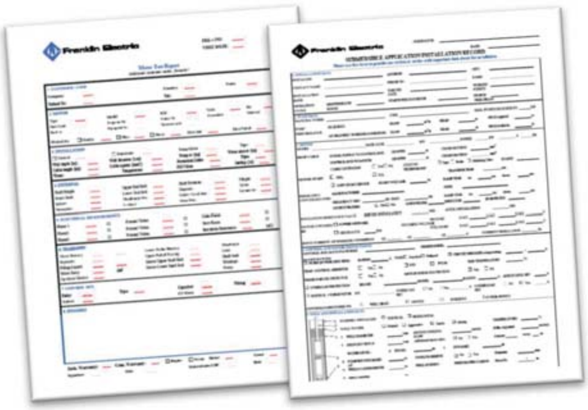
Franklin Electric

Help Franklin Electric Field Service to help you!

To make this work, Franklin Electric maintains a network of Field Service Engineers and Franklin Electric Service Partners that are there in case of trouble. Lines are open on “all channels” – including e-mail, telephone, world wide web to name the most common. After the first contact is made, it is important we are provided with data on:

- Product identification and motor details (date code, sequence no., etc.) and year of purchase
- Installation details and failure mode

Because the questions are always the same, we have designed standard forms for your convenience. These shall be primarily used to convey all needed information:



(Please see documents enclosed in this AID)

Sometimes, this data contained in these forms will already allow us to determine what went wrong and how it can be corrected. Our specialists will get back to the business partner with a failure report containing the probable root cause of failure, the commercial decision on product replacement and our recommendations for system improvement.

In other cases, we will have to get the product back for a deeper inspection or even have a Field Service Engineer visit the application site.

However, one thing to remember is:

> *The better the input data, the faster and more accurate the response.*

From experience, information received upfront is often incomplete, misleading or incorrect. This leads to callbacks, additional workload and unnecessary delays in resolving a claim.

Not surprisingly, the same applies to pre-sales service. When quoting equipment for an installation, the engineer must be provided with sufficient system details to properly fulfil his job. A lot of expensive commissioning and – afterwards – service calls can be avoided if the equipment ties in well and interfaces work.

Thank you for your business and we are looking forward to assisting you with whatever issues you may encounter using Franklin Electric products!

Be sure to observe your next training opportunities:

TRAINING SCHEDULE

Submersible Motor Workshop

English: 13 – 14 Nov. 2018

German: 20 – 21 Nov. 2018

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 511
Email: fieldservice-germany@fele.com

Franklin Electric

ORIGINATOR ____________________

DATE ____________________

SUBMERSIBLE APPLICATION INSTALLATION RECORD

Please use this form to provide our technical service with important data about the installation.

1. INSTALLATION DATA

INSTALLER ________ ADDRESS ________ CITY ________

CONTACT NAME ________ PHONE NO. ________ E-Mail ________

INSTALLATION DATE ________ FAILURE DATE ________ WORKED PERIOD ________

OPERATION CYCLE MONTHS/DAYS/ HOURS ________ STARTS PER DAY/HOUR ________ STARTS TIME DELAY ________

2. PUMP DATA

MANUFACTURER ________ TYPE ________ MAX. POWER REQUIRED P2 ________ kW

PUMP PERFORMANCE
REQUIRED FLOW ________ m^3/h HEAD ________ m NPSH required ________ m
AT DELIVERY WORKING CONDITION FLOW ________ m^3/h HEAD ________ m NPSH available ________ m

3. MOTOR

MODEL ________ DATE CODE ________ S/N ________ POWER ________ kW ________ V ________ Hz

DROP CABLE
POWER SUPPLY TO CONTROL BOX LENGTH ________ m CROSS SECTION ________ mm^2
CONTROL BOX TO MOTOR LENGTH ________ m CROSS SECTION ________ mm^2
CABLE EXTENSION ☐ Yes ☐ No SPLICING TECHNOLOGY ☐ Tape ☐ Resin ☐ Shrinking Tube BRAND ________

MOTOR START ☐ DOL ☐ Y/Δ TRANSFER TIME ________ sec
☐ SOFT START DEVICE START VOLTAGE ________ % RAMP TIME up ________ sec down ________ sec

FREQUENCY CONVERTER (VFD) MANUFACTURER ________ TYPE ________
FREQUENCY MIN ________ Hz /MAX ________ Hz RAMP TIME up ________ sec down ________ sec
OUTPUT FILTERS ☐ Yes ☐ No SINUS FILTER ________ INDUCTOR ________ dV/dt-FILTER ________

INSULATION RESISTANCE VALUE BEFORE INSTALLATION ________ MΩ AFTER INSTALLATION ________ MΩ

MOTOR POWERED BY ☐ POWER NETWORK
☐ GENERATOR ________ Kva
INCOMING VOLTAGE NO LOAD L1-L2 ________ L2-L3 ________ L3-L1 ________ V
FULL LOAD L1-L2 ________ L2-L3 ________ L3-L1 ________ V

INPUT CURRENT AT WORKING CONDITION L1 ________ L2 ________ L3 ________ A **CURRENT IMBALANCE** ________ %

4. CONTROL AND MOTOR PROTECTION(S)

CONTROL BOX MANUFACTURER ________ SERIES/MODEL ________

EQUIPPED WITH
☐ FUSES (POWER LINE SIDE) RATING ________ A TYPE ☐ Standard ☐ Delayed ☐ CIRCUIT BREAKER rating/setting ________ / ________ A

TEMP. CONTROL ARRESTOR ☐ Yes ☐ No ☐ PTC ☐ PT100 TRIP TEMPERATURE ________ °C

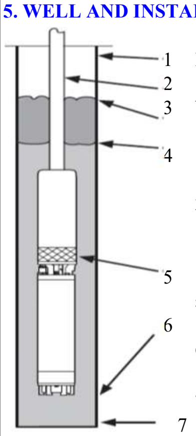
PHASE FAILURE DETECTOR ☐ Yes ☐ No MOTOR SURGE PROTECTION ☐ Yes ☐ No

☐ OVERLOAD PROTECTION BRAND ________ MODEL ________ RATING ________ A ADJUSTABLE SET ________ A

☐ SUBTROL +/SUBMONITOR S/N ________ OVERLOAD SET ☐ No ☐ Yes ________ A UNDERLOAD SET ☐ No ☐ Yes ________ A

CONTROLS GROUNDED TO ☐ WELL HEAD ☐ MOTOR ☐ BUILDING ☐ POWER SUPPLY

5. WELL AND INSTALLATION DATA



PUMPSET INSTALLED ☐ VERTICAL ☐ HORIZONTAL

WELL WATER ☐ Normal ☐ Aggressive ☐ Sandy ☐ Muddy TEMPERATURE ________ ºC

1 WELL DIAMETER ________ mm MOTOR COOLING FLOW ________ cm/sec (Min. requested ________ cm/sec)

2 DELIVERY PIPE Ø ________ mm Additional check valve ☐ No ☐ Yes Amount ________ every ____ m

WATER LEVEL: 3 STATIC ________ m 4 DYNAMIC ________ m

5 PUMPSET INSTALLED AT ________ m COOLING SLEEVE ☐ No ☐ Yes Diameter ________ mm

6 WELLS CASING DEPTH ________ m WELL SCREEN - PERFORATED CASING From/To ____ / ____ m

7 WELL DEPTH ________ m

Franklin Electric

FEE – NO: ____

VISIT DATE: ____

Motor Test Report

Additional comments under „Remarks“

1. CUSTOMER / USER

Company: ____ **Country:** ____ **Town:** ____

Talked To: ____ **Tel.:** ____

2. MOTOR

Type: .... Modell: ____ KW: ____ Volts: .... Hz: ....

Date Code: ____ Sequenz-Nr: ____ Stator Nr: ____ Assembler: ____ Material ....

Built in: .... Equipped for: .... Worked with ....

Worked for: ☐ Months ____ ☐ Days ____ ☐ Hours ____ Date Inst.: ____ Date Failed: ____

3. INSTALLATION

☐ Vertical ____ ☐ Horizontal ____ Pump Make: ____ Type: ____

Well depth /[m]: ____ Well diameter /[cm]: ____ Pump at /[m]: ____ Water inlet at /[m]: ____

Cable length /[m]: ____ Cable square /[mm^2]: ____ Protection Make: ____ Type: ____

Water: ____ Temperature: ____ PH-Value: ____ Setting /[A]: ____

4. EXTERNAL

Shaft Height: .... Upper End Bell: .... Shaft Rotation: .... Slinger: ....

Stator Shell: .... Lower End Bell: .... Deposits: .... Valve: ....

Splines: .... Diaphragm Pos.: .... Cable / Lead Insu.: .... Connector ....

Nameplate: .... Leakage: .... Snap Ring: ....

5. ELECTRICAL MEASUREMENTS

Phase 1: ____ Ω Normal Value: ____ Ω Main Phase: ____ Ω

Phase2: ____ Ω Normal Value: ____ Ω Start Phase: ____ Ω

Phase3: ____ Ω Normal Value: ____ Ω Insulation Resistance: ____ MΩ

6. TEARDOWN

Thrust Bearing: .... Lower Radial Bearing: .... Diaphragm: ....

Segments: .... Upper Radial Bearing: .... Liner: ....

Filling Liquid: .... Sleeve Upper Shaft End .... Shaft Seal: ....

Water Entry: ____ cm^3 Sleeve Lower Shaft End .... Windings: ....

Up-thrust Washer .... Prong: ....

7. CONTROL BOX

Relay: .... Type: ____ Capacitor: .... Wiring: ....

Subtrol: .... CP-Water: ....

8. REMARKS

Tech. Warranty: .... **Com. Warranty:** .... ☐ **Repair** ☐ **Scrap** **Defect:** .... **Cause:** ....

Signature: ____ **Date:** ____ **Entered into EDP:** ____ **Date:** ____

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe* No.02 /2018

SubStartSC and SubTronicSC More than meets the eye

Franklin Electric's control boxes for 4″ submersible motors – the underestimated champion

When it comes to submersible motor start and control, professionals in the water business have quite a variety of products to choose from. From the outside, control boxes all look pretty much the same, so often their features are also considered equal.

This bulletin will show you why Franklin Electric's range of 4″ motor control boxes are substantially different from the rest, and how this can actually make a difference to your business.

The primary function of a starter box is to allow connection of the submersible motor to the grid, offering motor and drop cable short circuit protection.

More sophisticated designs will protect against additional dangers such as motor overload, transient overvoltage and pump dry run and will offer a certain degree of automation.

However, it is important to understand just how exactly these functions are technically implemented.

> *"Why the Franklin Electric boxes are substantially different from the rest, and how this can actually make a difference to your business"*

SubStartSC

Basic version: *SubStartSC*

Let us first have a look at the "basic" version of the control box, the so-called *SubStartSC*. With attention to detail, this Franklin Electric design helps installers achieve true IP54 installations at the wink of an eye, while generous space around the terminal blocks results in effortless connection of motor and power wires. A choice of quality components from audited suppliers ensures years of trouble-free operation avoiding customer calls for warranty-period service.

Premium Control SubTronicSC

Our *SubTronicSC* line of premium controls takes this concept to the next level: in addition to all the features described above, we have developed a proprietary control and automation concept specifically adapted to the needs of the submersible borehole application. While most similar products on the market merely use power factor for motor load monitoring and dry run protection, the *SubTronicSC* electronic board allows real-time power measurement and monitoring.

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany

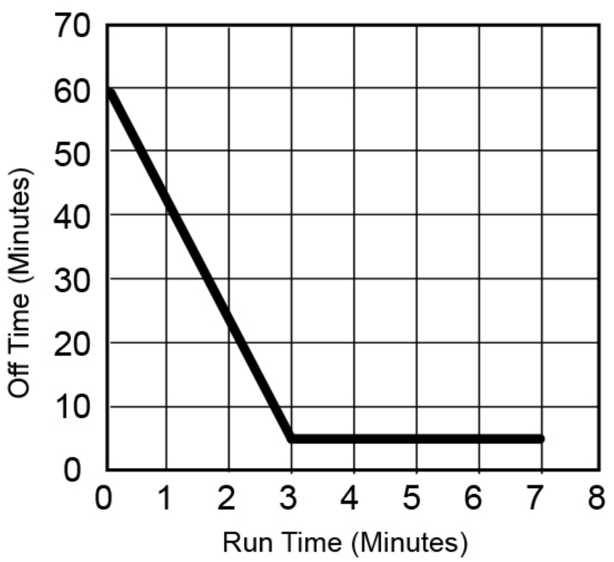
Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513
Email: fieldservice-germany @fele.com

Instantaneous voltage and current data are fed into the microprocessor where a complex algorithm is used to determine working conditions and take appropriate decisions.

Premium version: *SubTronicSC*

This approach actually allows Franklin Electric submersible pumps to be operated outside the nominal limits of incoming voltage, where other protection devices will cut out pumps and seize water delivery.

Following the same philosophy of maximizing water extraction from weak wells, an intelligent, self-resetting sliding rule dry run protection algorithm has also been invented. Using this, off-time between automatic restarts after a dry run-induced stop will automatically adjust to best match the well recovery time. In other words, customers will not be forced to wait on water if well recovery is fast.



Smart Reset Well Recovery Time

Overvoltage, undervoltage and rapid cycle protection complete the list of functions adding safety against virtually all imaginable mishaps.

So; be sure to understand why Franklin Electric Control Boxes are more than meets the eye! Well explained to the end-user, they will make the difference! Do not hesitate to ask your Area Sales Manager or Field Service Engineer for additional information on this great product range.

> ***Following the philosophy of maximizing water extraction from weak wells, an intelligent sliding rule dry run protection algorithm has been invented.***

As 2018 is coming to an end, we take the opportunity to thank all of our business partners for their continued support.

Best wishes for a healthy and prosperous 2019

Your Franklin Electric Field Service Team

franklinwater.eu

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513
Email: fieldservice-germany @fele.com

Franklin Electric

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe* No.01 /2019

Latest insights – Variable frequency drives and borehole pumps

One of the topics getting the most attention in Franklin Electric's "FranklinTECH" seminars is the chapter treating variable speed operation of borehole pumps.

After 'conquering" almost every other branch of the industry, variable frequency drives have gradually made their way into submersible pumping applications. Yet, when applying VFDs to this specific environment, it is critical system designers and operators understand the physics behind the method of controlling speed and take the necessary precautions to ensure satisfactory service life for both motor and pump.

> *So, what is a standard variable frequency drive and how does it control motor/pump speed?*

Today, virtually all industrial drives are of the "voltage-source" type which means they will convert incoming AC grid voltage to DC and "store" this battery-type voltage in an array of capacitors called DC link.
Then, an array of "valves" or "switches" will chop this DC voltage following a predetermined pattern to generate a high speed train of voltage impulses at the drive's output.

Simply put, each outgoing phase is alternately connected to the "+" and "-" terminal of the DC link or left "idle". How often in a second this switching takes place is given by the so-called "carrier frequency" that ranges between some kHz to some tens of kHz.

The figure 1 depicts the block diagram of a standard DC-link VFD with associated voltage graphs:

It is important to note the output signal of these drives is not the sinusoidal AC voltage that induction motors have been built to work with. As depicted, the voltage that can be measured at the drive's output is a train of impulses that mimic a sinewave.

Worse, because of the high switching frequency of today's drives, long cables at the VFD output generate transmission line effects **that effectively double up the DC link voltage** when it hits the motor terminal.

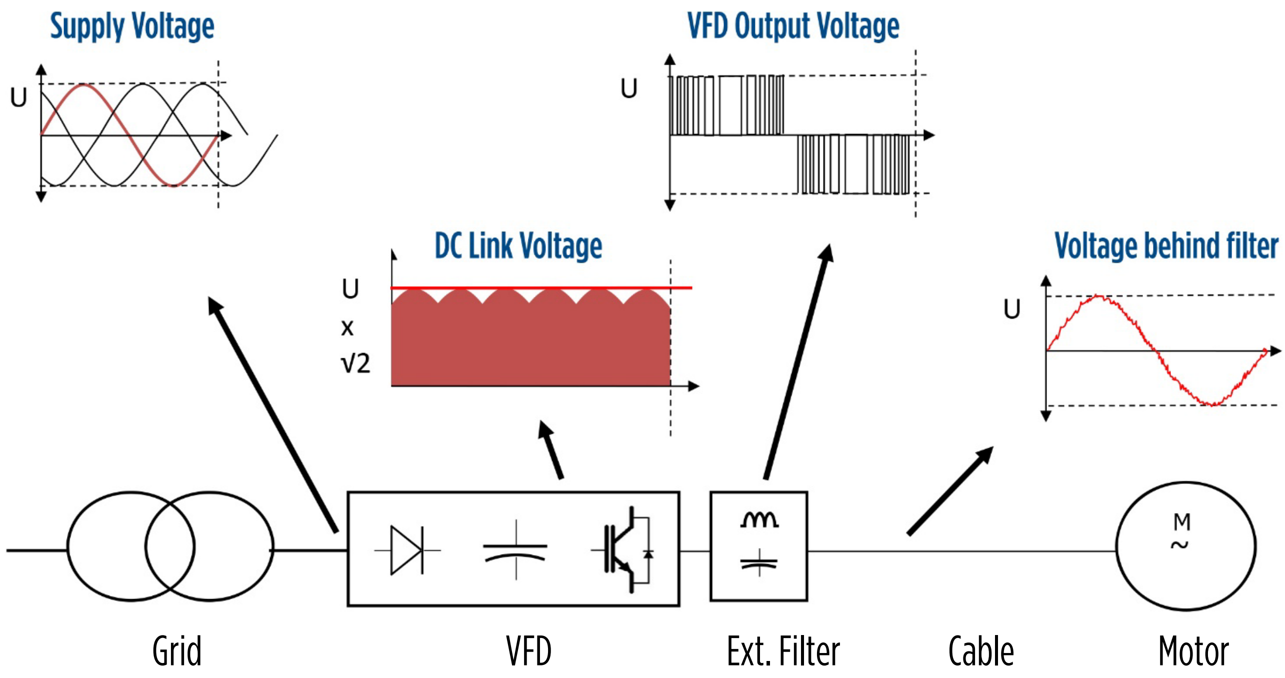
franklinwater.eu

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513
Email: field-service@franklin-electric.de

Franklin Electric

Fig. 1:



While the above is all pretty technical, what we have to walk away with is a good formula for calculating the voltage stress at the motor terminals starting from the VFD input (grid) voltage:

$$V_{SUPPLY} \times 1.4 \times 2 = V_{MOTOR}$$

For a standard 400 V grid, the motor terminals will see 2.8 x 400 V = **1120 V voltage peaks** between phases **and very similar voltages to ground potential.**

Standard induction motors have been designed to operate grid-fed at nameplate sinusoidal AC voltage. Their insulation systems will suffer from permanent high dv/dt and voltage peaks generated by VFDs.

There are several solutions available to increase service life of submersible motors when supplied by voltage-source VFDs:

> *Always install output filters!*

These should be sized in accordance with the VFD manufacturer indications and should limit voltage peaks at the motor terminals to 1000 Vpp both line-to-line and line-to-ground. Voltage rise time should be less than 500 V/µs.

Important facts about output filters

- Output filters can be ordered in a variety of configurations to match different applications. As a rule of thumb, output reactors and dv/dt filters are less expensive but also less effective and should be used up to ~120 m of total output lead length.

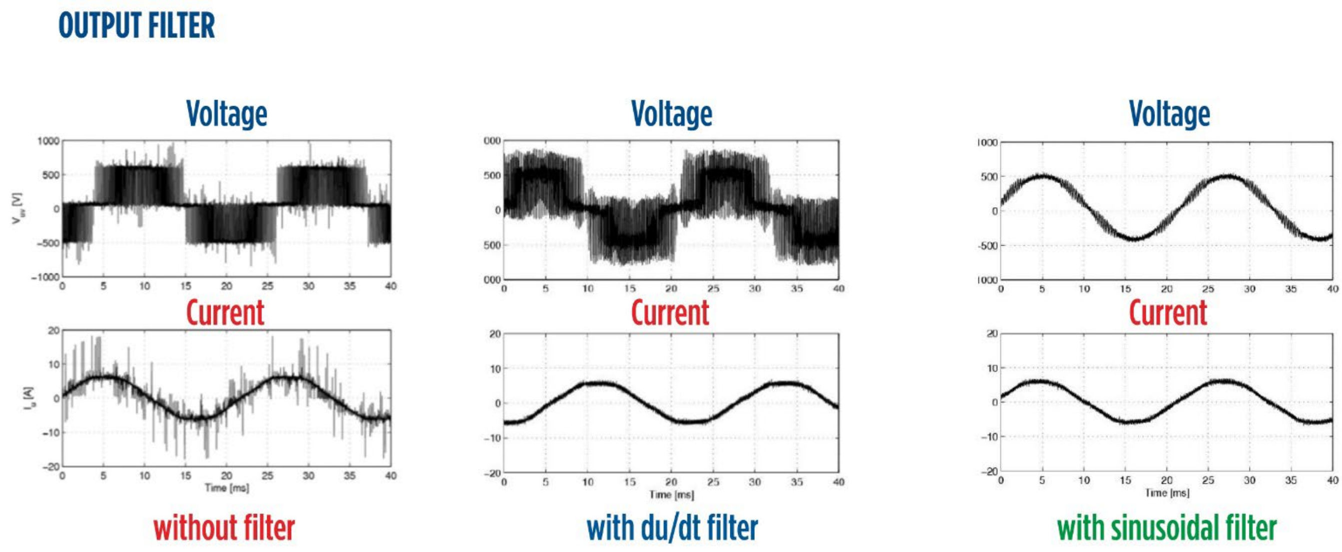
> *Sine wave filters are the best option*

  and are recommended whenever longer cables are needed.

- Output filters should be matched to the drive's carrier frequency to avoid resonance and overheating

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513
Email: field-service@franklin-electric.de

Fig. 2: Typical voltage outputs for different filter types:



- Last but not least, standard filters will only decrease line-to-line voltages and voltage rise times.

> ***For best protection, 4-pole filters acting also on the line-to-ground voltage peaks are recommended.***

Drive-Tech MINI

- Grid voltage is the base for calculating voltage peaks at motor terminals. Even is the VFD settings allow motor nameplate voltage setting, ***280 % of grid voltage*** will always hit the motor insulating system. Standard motors should therefore be used up to max. 460 V / 60 Hz VFD input voltage.

- For Franklin Electric Rewindable Submersible motors, we recommend ***choosing PE2/PA winding wire*** when operated by VFD.

- For higher drive input voltage, special motor designs with increased insulation material strength are available upon request.

TRAININGS

German: 12 – 13 November 2019
English: 19 - 20 November 2019

franklinwater.eu

Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany

Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513
Email: field-service@franklin-electric.de

Franklin Electric

FRANKLIN AID

Franklin Electric

Franklin Application/Installation Data *Europe* No.02 /2019

HOW TO USE A SELF PRIMING PUMP

When you need to extract water from a shallow well or a water storage tank and submersible / submerged pumps are not an option, a self-priming pump will be your instrument of choice. So, what is it you need to know when designing / installing such a pumping system?

As opposed to submersible pumps, with dry-mounted pumps there is no water pressure available to help evacuate the air inside. Since air is a compressible gas, the pump will not work.

> *With dry-mounted pumps there is no water pressure available to help evacuate the air.*

For this reason, aboveground mounted pumps that are intended to rise water from a level situated below their intake need to be primed. Even so, during operation, air can be trapped inside the pump creating noise and cavitation, both unwanted and leading to premature failure.

While there are several types of self-priming mechanisms, the one using an elastic valve inside the pump is the most commonly used.

Depending on the application, the pump itself can be single- or multistage, but the priming system will stay the same.

> *Some installation arrange-ments must be respected*

Things to remember when installing a self-priming pump:

- Place the pump as close as possible to the suction source.
- With suction pipes longer than 10 m, use an internal pipe diameter larger than the pump suction connection. For flow ratings over 4 m^3/h use a suction pipe G 1 1/4 (DN 32).
- The suction pipe must be perfectly airtight and be led upwards in order to avoid air pockets.
- With a pump located above the water level, fit a foot valve with strainer which must always remain immersed (or a check valve on the suction connection).
- If operating with flexible hoses use a reinforced spiral suction hose, in order to avoid the hose collapsing due to suction vacuum.
- For suction from a storage tank fit an anti-backflow valve.
- With a (geodetic) head at outlet over 15 m fit a check valve between the pump and the gate valve in order to protect the pump from water hammering and prevent foreign particles from entering the pump.

Conditions for self-priming:

- Suction pipe with connections perfectly airtight and immersed in the water to be lifted at all times
- Install a portion of vertical pipe at the discharge above discharge port
- Before a non-return valve pump casing completely filled with clean cold water before starting.

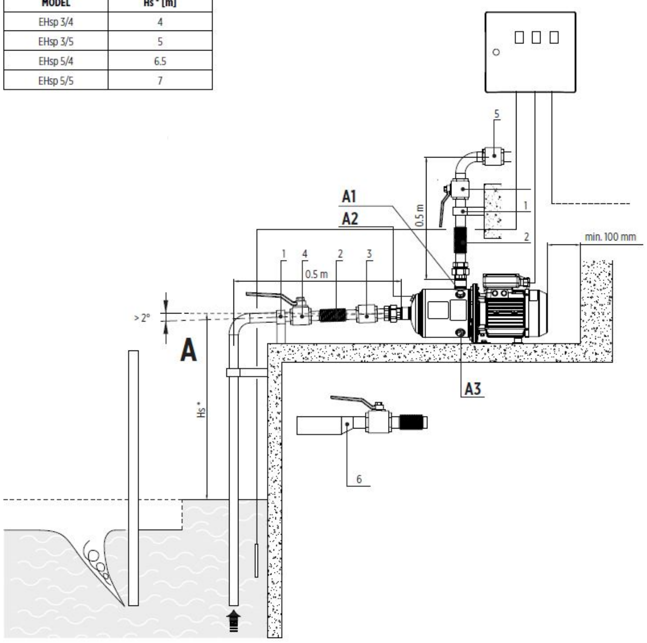
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany

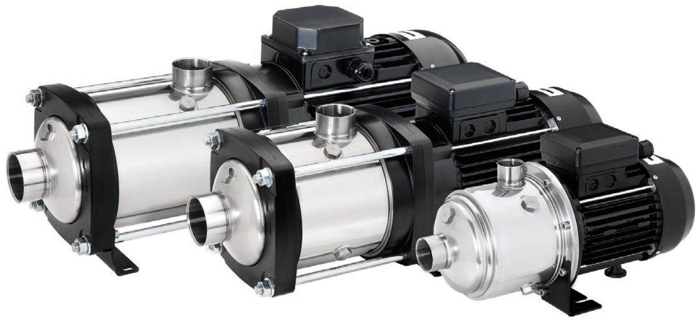
Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513
Email: field-service@franklin-electric.de

Below picture details a typical installation:

EHsp - Installation recommendations

SUCTION HEIGHT	
MODEL	Hs * [m]
EHsp 3/4	4
EHsp 3/5	5
EHsp 5/4	6.5
EHsp 5/5	7





System components:
A1, A2: Priming holes
A3: Drain hole
Hs: Suction height
1: Pipe support
2: Flexible coupling
3-5: Non return valve
4: Check valve

TRAININGS

In spring 2020
Please visit our website for dates

The Franklin Electric Field Service Team thanks you for the good corporation and wishes a Merry Christmas and all the best for 2020.

franklinwater.eu
Franklin Electric Europa GmbH
Rudolf Diesel Straße 20
D-54516 Wittlich/Germany
Tel.: +49 (0) 6571 105 - 0
Fax: +49 (0) 6571 105 - 513
Email: field-service@franklin-electric.de
Franklin Electric

Notes

Franklin Electric

Franklin Electric Europa GmbH
Rudolf Diesel Strasse 20
54516 Wittlich / Germany

franklinwater.eu