Why is electrical protection is necessary for electric motors and pumps?

1- First, safety standards around the world have established regulations to protect the lives of people who may be in contact with these devices in some way, and have set requirements for manufacturers, designers, and even installers, and consider them mandatory.

Secondly, in order to prevent fires that may occur due to electrical connections, it is mandatory to place control devices in the electrical path of these devices, and this is also an obligation.

2- International standards have required manufacturers of these devices to equip their devices with devices to protect against problems that may arise during use and cause damage to the electric motor of this device and User.

One of the most important protections that the standard has made mandatory is the control of the temperature inside all electrical appliances, especially in electric motors and electric pumps, that the heat inside their winding coils must be controlled as much as possible.

It should be noted that why do standard organizations pay special attention to the control of the temperature of these windings that it comes to electric motors and electric pumps?

All reputable manufacturers in the world design electric motors and electric pumps, considering the power they need, with advanced engineering calculations and attention to important items such as the definition and standard requirements regarding insulation class and thermal class, voltage and frequency of the input power, working conditions and cooling conditions of the electric motor, and its around shaft per minute, they will reach at the main items that must be observed in building the desired electric motor.

These items include the type of wire required, its type of insulation, its number of around the winding bobbin, and most importantly, its thickness and cross-section.

Choosing good insulation is extremely important for the quality and useful life of electric motors. (E1 , E2 , E3)

Here, since we are discussing the protection of the windings of electric motors, we will only discuss the insulation class of electric motors and electric pumps for now: Pay attention to the electric motor insulation class table below.

Class	Ambient Temp		Temp Rise		Hot Spot		Max Winding Temp		Application Notes
	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	
Y	104	40	113	45	41	5	194	**90**	Obsolete, rarely used today
A	104	40	140	60	41	5	221	**105**	Older/light-duty equipment
E	104	40	168	75	41	5	248	**120**	Transitional class between A and B
B	104	40	176	80	50	10	266	**130**	Common in general industrial use
F	104	40	221	105	50	10	311	**155**	Widely used, good balance of cost and durability
H	104	40	257	125	59	15	355	**180**	For high-temp or harsh environments
N	104	40	302	150	59	15	392	**200**	Aerospace and specialty applications
R	104	40	347	175	59	15	428	**220**	High-performance, rare
S	104	40	392	200	59	15	464	**240**	Military or extreme-duty systems

Note:1

• Every 10 degrees of temperature increase above the allowable limit can halve the life of the insulation.

• The selection of the appropriate class depends on the ambient temperature, ventilation, working load and installation conditions.

While the maximum insulation temperature of the classes above is specified, electric motors are usually designed to operate much lower than this temperature to ensure long life and reliability.

It should be stated that there is no need to talk about all these insulation classes at the moment

And only about Class F class H which is the most discussed, which most of all industries deal with.

There is a table for class F and class H in below to show what the winding temperature should be for normal operation and even at full load and even a specified overload of +15% so that the electric motor and electric pump can work well and for much longer.

Typical Winding Temp (°C) for Class F			
Condition	**Typical Winding Temp (°F)**	**Typical Winding Temp (°C)**	**Notes**
Light to moderate load	153-194	70–90	Common in well-ventilated environments
Normal full load (1.0 S.F.)	212-248	100–120	Within safe limits, allows thermal margin
Full load with 1.15 S.F.	239-257	115–125	Still below max, but closer to thermal ceiling
Surface temperature (outer case)	140-194	60–90	Depends on motor frame and cooling design

These are designed so that, first, in normal operation and even up to its maximum full load, the temperature inside the winding should not exceed about 75 degrees Celsius or 167 Fahrenheit.

• Class F is the most common class in the industry and offers a good balance between thermal tolerance and service life.

Class H insulation allows a temperature rise of up to 125°C (257 Fahrenheit), (at an ambient temperature of 40°C or 104 Fahrenheit, resulting in a maximum winding temperature of 180°C (356 Fahrenheit).

- Surface temperatures are typically 20 to 40°C (68-104 Fahrenheit)lower than the winding temperature, depending on the motor design and cooling.

Typical Operating Temperatures – Class H Insulation

Operating Condition	Winding Temp (°C)	Surface Temp (°C)	Note
Light to moderate load	90–110	70–85	Efficient cooling, low ambient temp
Normal full load (1.0 S.F.)	120–140	90–110	Within safe thermal margin
Full load with 1.15 S.F.	135–150	105–120	Approaching thermal ceiling
Maximum allowable winding temp	180	—	Per IEC 60085 / NEMA MG-1
Caution threshold	>160	>130	May reduce insulation life

- For long-term reliability, motors are ideally operated 20 to 30°C (68-86 Fahrenheit)below the maximum permissible limit. And most importantly, heating the coil even less than the standards may not burn the coil, but the heat generated, the body of the electric motor and the pump will become so hot that if you come into contact with it, it will cause severe skin injury. And most importantly, this continuous heat will destroy the life of the insulators and cause the possibility of the insulators drying out to the point where the body connection is created, which is very dangerous. And if the grounding system of this pump is worn out or does not work well, it will cause people who are near these pumps to get electrocuted.

So one of the best protections is controlling the temperature of these coils, which will both increase the efficiency of the alternators and not reduce their useful life.

The results of these studies and the standard indicate that quality manufacturers with international standards are required to consider a minimum protection system for their manufactured electric motors and electric pumps.

In this regard, due to the expansion of the use of digital and electronic systems in the industry, these electronic devices have become very useful in the manufacture and operation of electric motors and electric pumps. However, currently, up to %75 of these electric motors and electric pumps are supplied without electronic controllers. Therefore, the manufacturer is required to consider controlling the temperature of the coil by sensors for this minimum protection.

This protection is done in several common ways as follows.

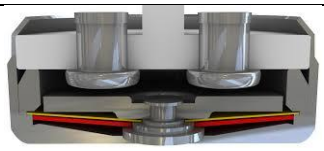
1- Method Built-in of controlling single-phase pumps with thermal protector

Single-phase pumps up to a maximum of 1.1 kW have a Thermo-guard placed inside the coil in the input power path (MTP) so that if the coil heats up for any reason, this thermo-guard creates an open contact in the power path and causes the input power to be cut off, however, it should be noted that when the coil cools down, the contact of this thermo-guard closes and the power flow is restored. If this problem still exists, the power will be cut off again and this operation may continue until the problem is fixed.

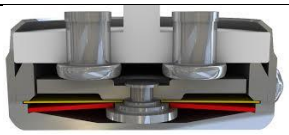
It is better to cut off the power and fix the existing problems in the first step by the consumer.

Wiring with overload

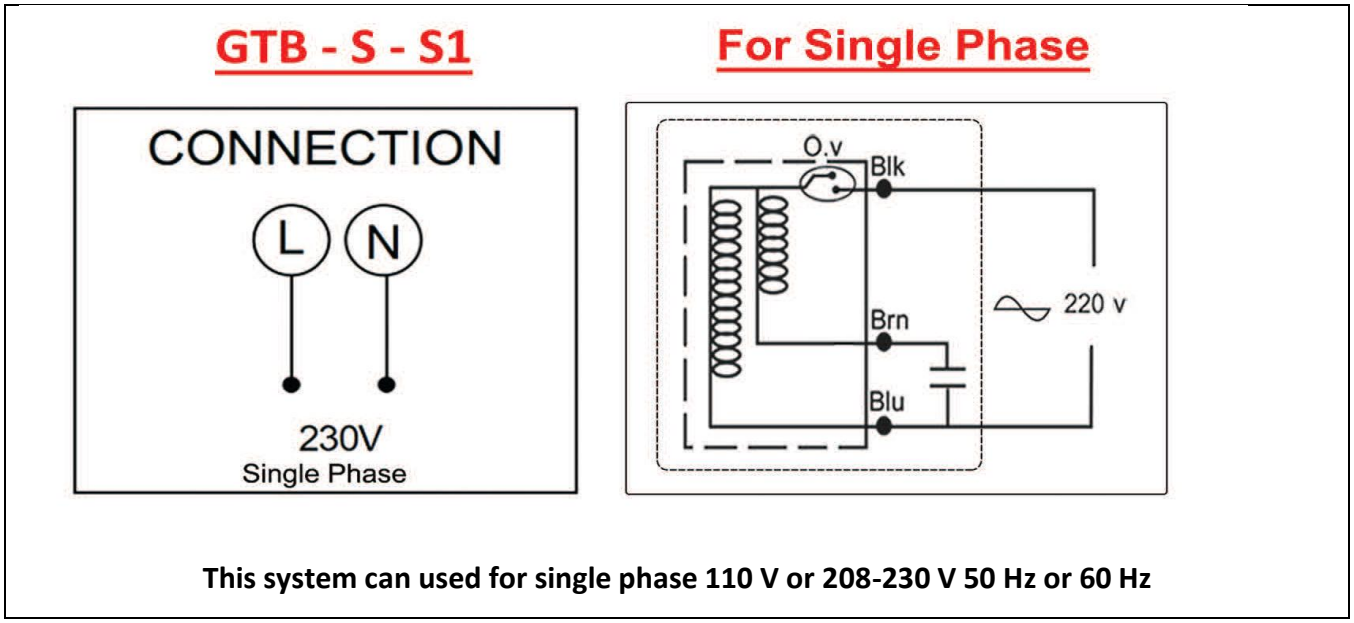
Thermal Protector (Overload)



overload in protected position is open



overload in normally Closed position



This system can used for single phase 110 V or 208-230 V 50 Hz or 60 Hz

For more information , you can click to below Link

The temperature to which these thermo-guards react is from 105 to 135 degrees Celsius (221 - 275 Fahrenheit) for class F and from 130 to 150 degrees Celsius (266- 302 Fahrenheit)for class H, which is selected at the discretion of the manufacturer.

So it is concluded that this protection system is only for a warning that gives the consumer to immediately fix the problem and if this is not fixed, with repeated switching on and off, the heat will increase and in the long run will cause the insulation to fail.

(A table of the number of switching on and off times per hour for each electric motor or electric pump depending on its power is in the attached link)

Note 1: The result is that this method is approved by the standard, but it should be stated that this method can provide 70% safety for the consumer and why it cannot provide 100% protection is that if the rotor of this electromotor is locked for any reason, when the power is connected to the pump, the coil heats up and the contact of thermal protector will be opens. If the mains power is still connected to the pump, the coil cools down and the contact closes and the thermal protector's platinum withstands a large current. With repeated disconnections and connections, due to the increase in temperature and the connection current, the platinum will be damaged and these platinum may fuse together and the contact will no longer be able to open due to high heat, and eventually the coil will burn.

Or if the consumer mistakenly connects his electric motor or Electric Pump to a higher voltage, the thermal protector will be severely damaged and, depending on the excess voltage, it may burst and both damage itself and cause significant damage to the winding.

Note 2: For 100% protection, an electronic current controller must be used so that if for any reason a problem occurs, the amperage consumption increases, or the coil temperature exceeds the set value, the electronic protection immediately cuts off the power and will not connect it again and announces the problem that has arisen. In this situation, having an overload inside the coil can act as a safety valve so that even if your digital controller breaks down, this thermo-guard will work.

2- Method of controlling single-phase pumps with CTP thermal sensors for more than of 1.5 Kw

In these single-phase electric motors and electric pumps that have a power of more than 1.5 kw, reputable manufacturers do not assignment the responsibility of protecting the electric motor and electric pump to the consumer and use a minimum protection in various system.

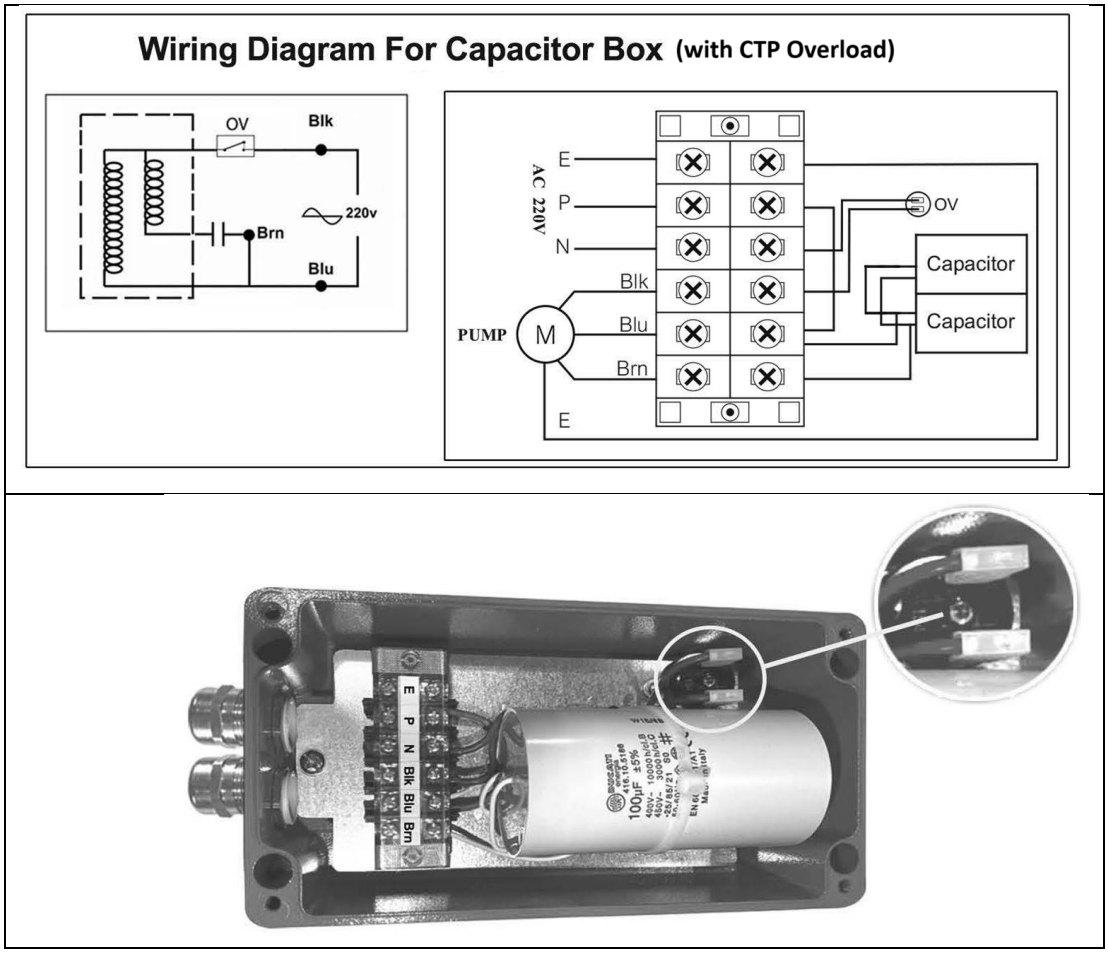
One of the methods is to place an external overload in the input power path in the terminal of the electric pump or electric motor, which controls the amount of consumed

amperage as the consumed current passes through the thermocouple, and if the consumed amperage exceeds the specified amount, it cuts off the power flow. This controller, like thermo-guards, reconnects the power after cooling down. This control method is a very good method for single-phase electric pumps that can insure up to 85% of the pump's health against problems that arise.

Note 3: The result is that this method is approved by the standard, but it should be stated that this method can provide 80% safety for the consumer and why it cannot provide 100% protection is that if the rotor of this electromotor is locked for any reason, when the power is connected to the pump, the current flow increases and the thermocouple of this overload heats up and the contact of this overload opens. If the mains power is still connected to the pump, when the thermocouple cools down, the contact closes and the platinum of this overload withstands a large current. With repeated disconnections and connections, due to the increase in the connection current, its platinum will be damaged and these platinum's may weld together and the contact will no longer be able to open against the high current and eventually the coil will burn.

Or if the consumer mistakenly connects his electric motor or pump to a higher voltage, the thermal protector will receive a severe shock and depending on the overvoltage reached, the thermocouple may melt, in which case control will no longer be possible and if the problem still exists, the winding will be severely damaged.

Note 4: For 100% protection, an electronic current controller must be used so that if for any reason a problem occurs, the amperage consumption increases, or the coil temperature exceeds the set value, the electronic protection immediately cuts off the power and will not connect it again and announces the problem that has arisen. In this situation, having an overload inside the coil can act as a safety valve so that even if your digital controller breaks down, this thermo-guard will work.

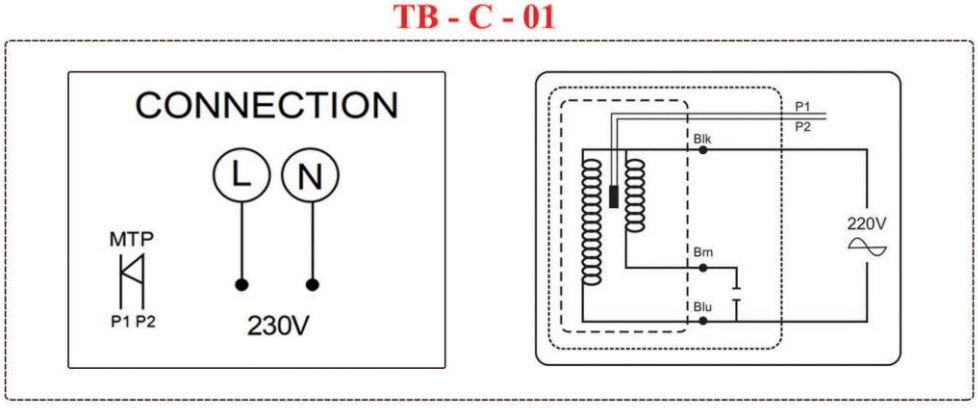


3 - Using an internal thermal protector without direct connection to power : MTP (Miniature Thermal Protector)

In this method, like method 1, a thermal protector is placed inside the coil but not in the power path and both wires are separately transferred to the main terminal. In this method, a type of thermal protector with a closed contact (NC) can also be used, which opens its contact when its contact is too hot, and when it is placed in the contactor coil path, it cuts off the main input power.

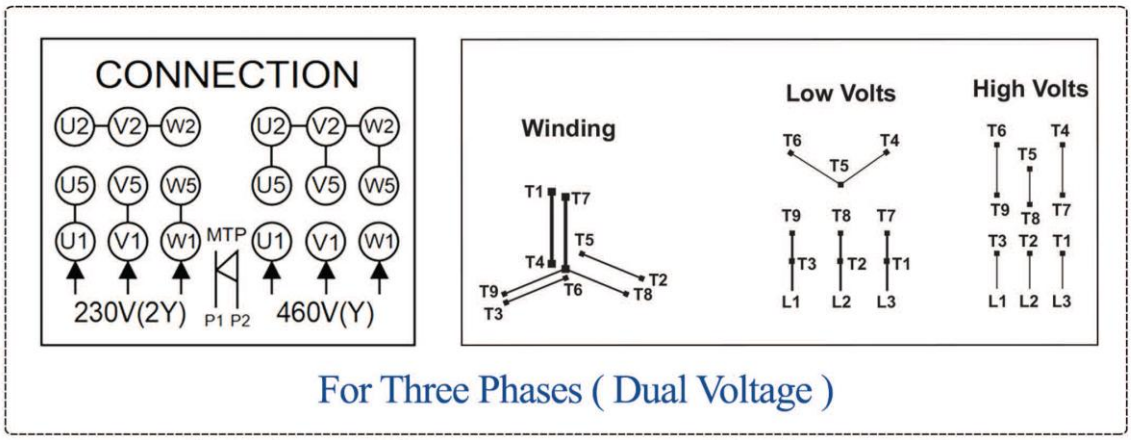
And some manufacturers use a resistance thermal protector called PTC, which increases its resistance due to heat, and this increase is measured by an electronic module and, in connection with the contactor coil, cuts off the main input power.

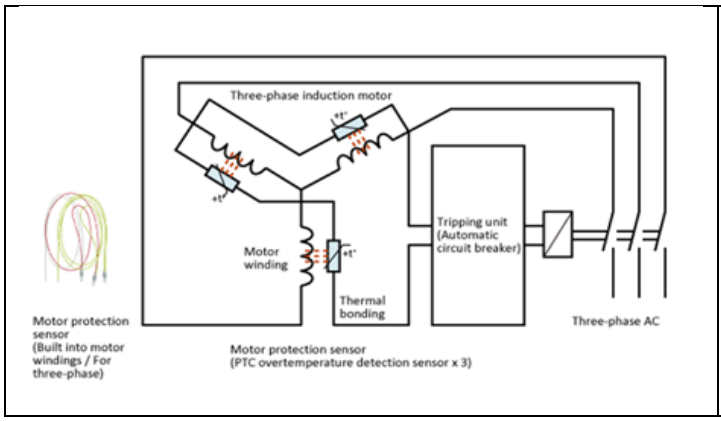
This method is one of the control methods that can provide protection of nearly 90%, and makes your electro pump and electromotor valuable insurance. However, this method requires a controller to place the two ends of the thermo-guard wire in the contactor coil path. If a digital controller specifically for this pump is used, the protection will increase to 99.5%.

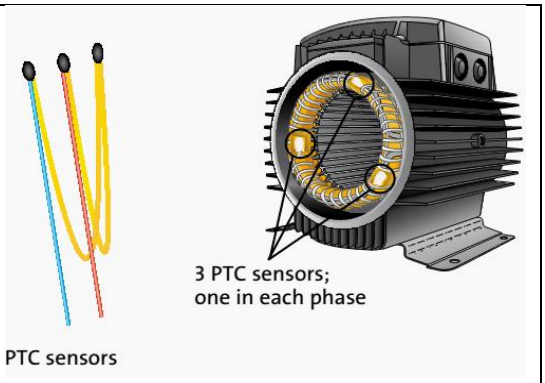


This method is used for both single-phase electric motors and electric pumps and for all three-phase electric pumps and electric motors.

GTB - C - 03

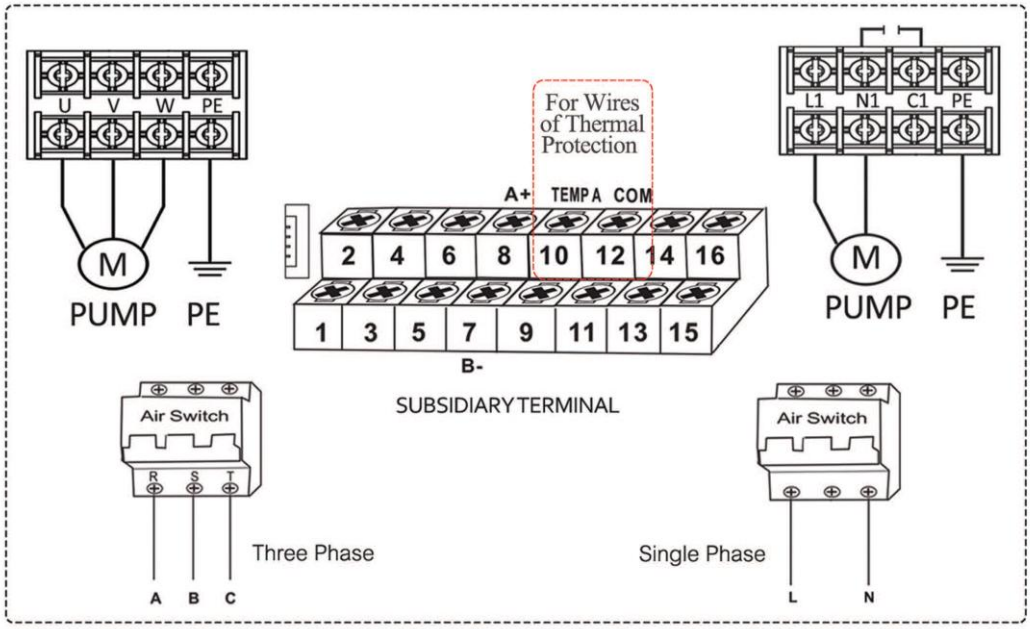


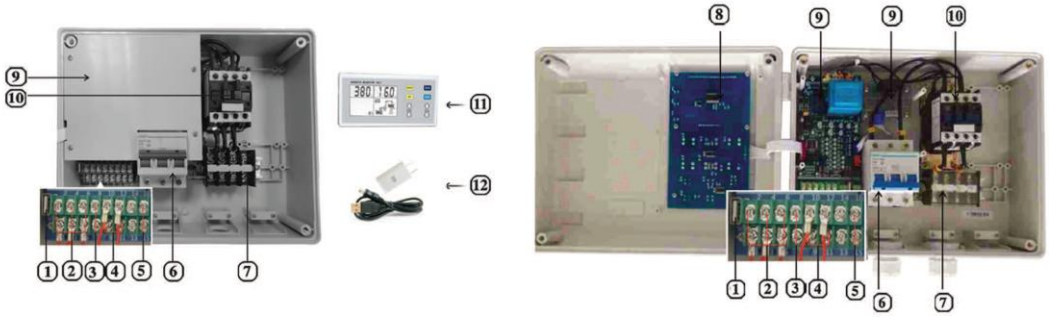




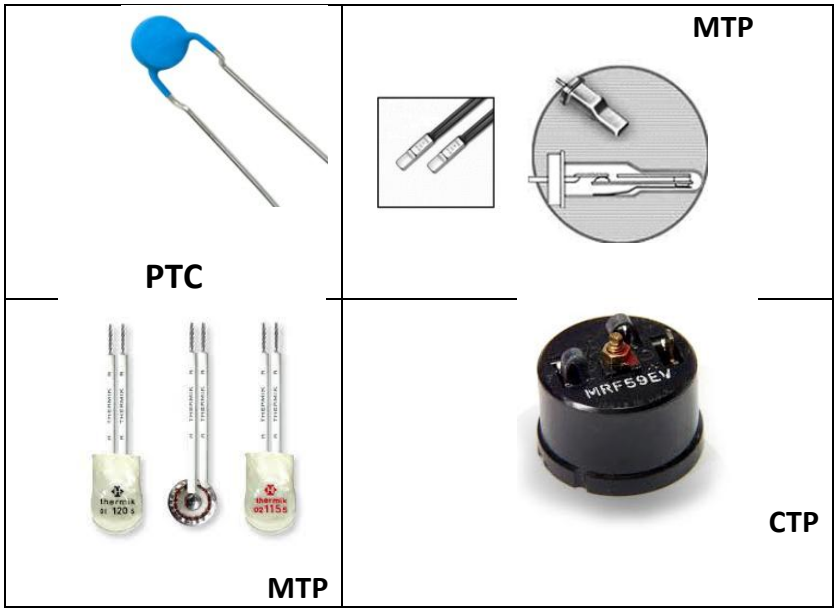
Gol Pump Company offers two series of control panels for this type of protection for single-phase and three-phase.

A- For single-phase pumps GPL911 and three-phase up to 18.5 kW, the GPL931 control panel





These controllers are suitable for both CTP-MTP closed-contact thermoregulators and PTC controllers.



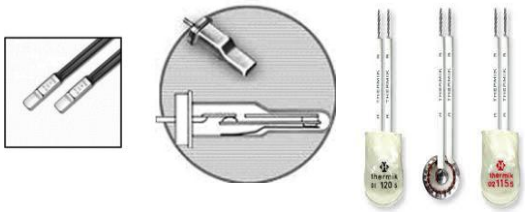
The capabilities of these digital panels are so important that they will control electric motors and electric pumps with extraordinary capabilities in all electrical matters and will provide a special service to the consumer.

For more information, click on the link below

B- For three-phase Electric motors or Pump with maximum power of 15 kW, which use CTP, MTP thermo-guards, for single-phase and three-phase, we make a suggestion ESWF control panels, and for three-phase Electric motors and pumps with PTC control system, we make a suggestion to use Soft Stater model SWSS900 that Equipped with PTC modules, for all sizes.

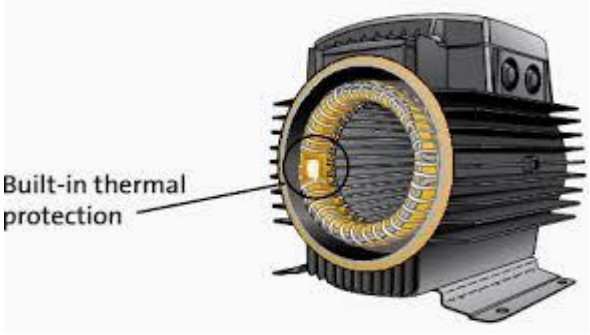
ESWF

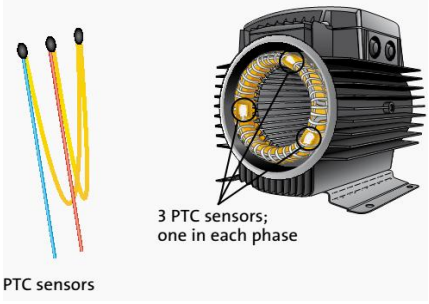
SSW07 Soft starter



MTP

PTC





Important: **If you use the recommendations given to set up your Electro pump, you may pay a little more to start, but be sure that in the long run you will save a lot on the next expense you will have to fix its problems. In essence, this extra cost is a safe investment and a good insurance to prevent expensive future expenses.**

For more information , please click to link

How to protect Submersible alternators from winding burnout

What are Submersible dynamos and how many models are there?

Submersible or submerged dynamos are the driving force of Submersible pumps that operate completely submerged in a fluid such as water and have a long, narrow body that ranges from 0.25 kW to 450 kW and is used for different heads and different water flows for agricultural, industrial, utility, water purification, oil and salt water applications, all of which have temperature classes H and F and protection class 68 (IP68) according to the standard.

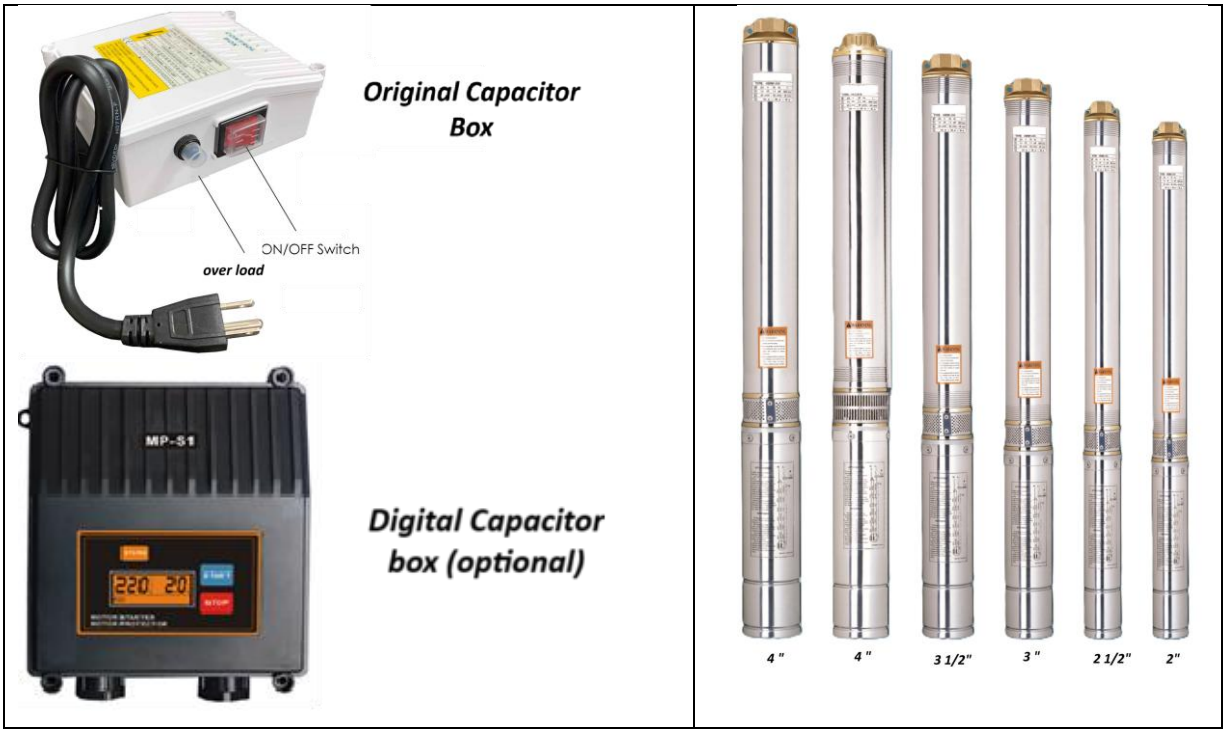
These Submersible Motors are manufactured in three types

1- Submersible dynamos Oil Field are made of lacquered copper wire and inside the dynamo, non-toxic oil is used to transfer heat from the coil. Gol Pump Company offers this type of Submersible Motor and its Pump with external diameter dimensions of 2 inches and 2 ½ inches and 3 inches and 3½ inches and 4 inches, with power of 0.25 kW to 7.5 kW, single phase and three phase.
(click this link for more information)

The protection of this type of dynamo is as follows:

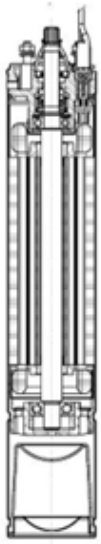
A- Single-phase dynamos oil field are made in different sizes from 0.25 kW to 2.2 kW and are used to protect external overloads that are located in their capacitor boxes.

And their protection conditions are about 85%.



SUBMERSIBLE MOTOR 4OL

- *Rewindable stator*
- *Oil filled*
- *Parts in contact with the water AISI 304*
- *Removable connector*
- *Fast and easy access to the stator*
- *PSC Technology*

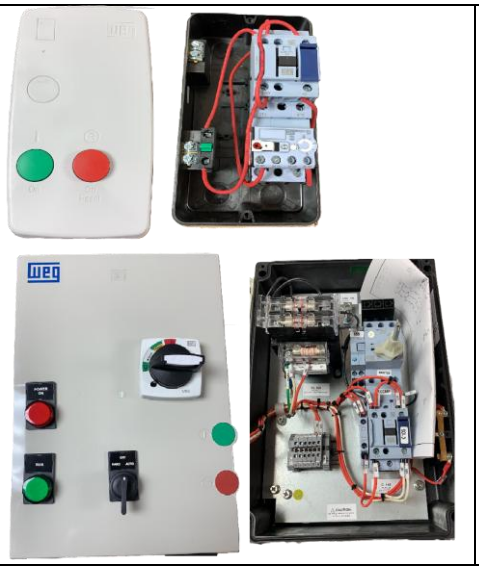


For more information , Please click to below Link

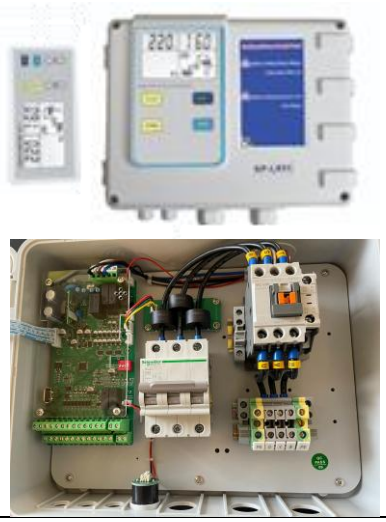
B- All three-phase Submersible motor Oil field of this family are offered without a protection system and the responsibility for its protection is assigned to the customer, but Gol Pump Company offers you a simple three-phase electronic controller in accordance with the submersible motor power to protect these three-phase alternators, which is offered at a low price with the model of your choice.

These electronic protection systems have many capabilities and protect your alternator up to 95%.

It is better to refer to the controller family (click the link below)



Analog Control panel



Digital Control Panel

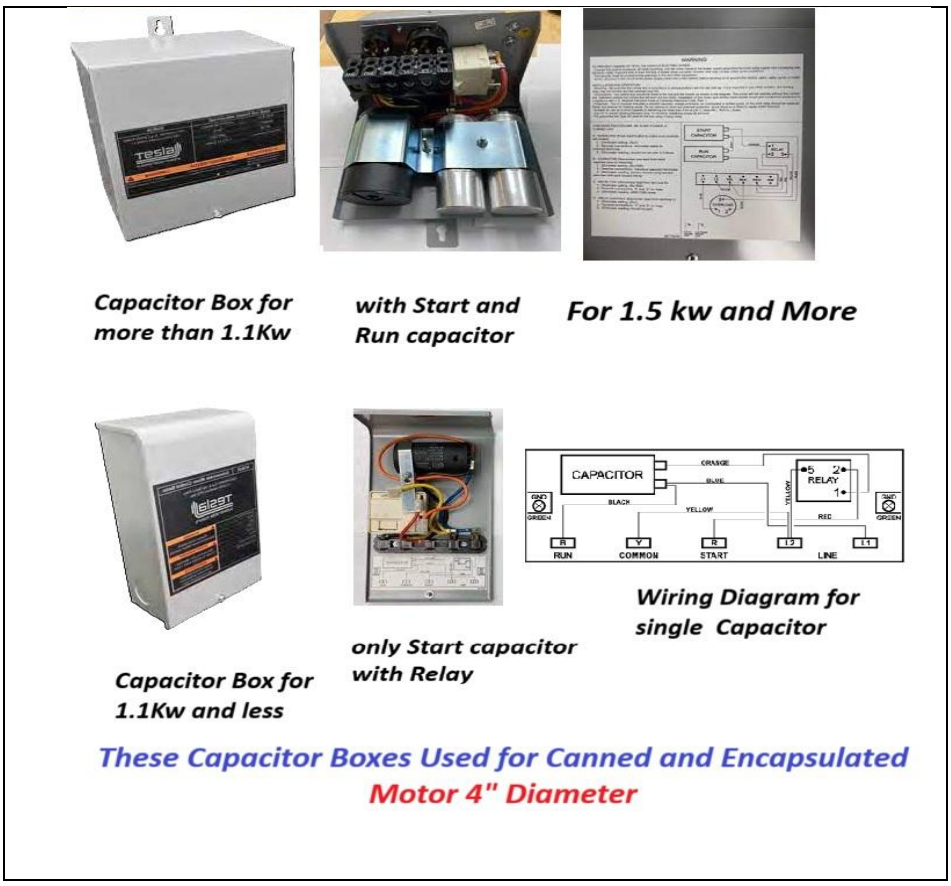
C- A number of manufacturing factories use encapsulated dynamos to produce electromotors and submersible Electro Pumps, in which the winding and stator are placed inside a capsule and are completely isolated and inside a special resin.

There is no oil in these dynamos, and a combination of water and glycol is used inside the dynamo to lubricate the bushes and transfer heat from inside to outside. There are no bearings in these dynamos, and a graphite bush is used for balance, and used Thrust Bearing for axial pressure control and a special tread is used for braking

This type of dynamo is produced in 3", 4" and 6" sizes and from 2 kW to 45 kW and is available in the Gol Pump warehouse.

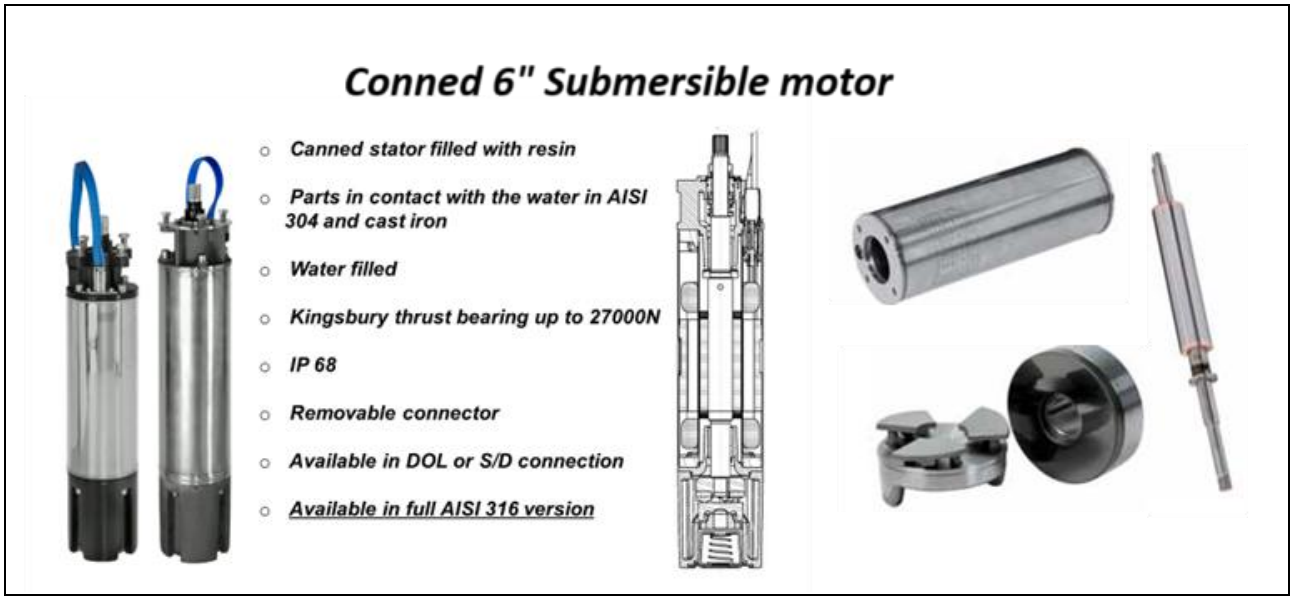
(for more information, refer to the family of submersible motor with the link below).

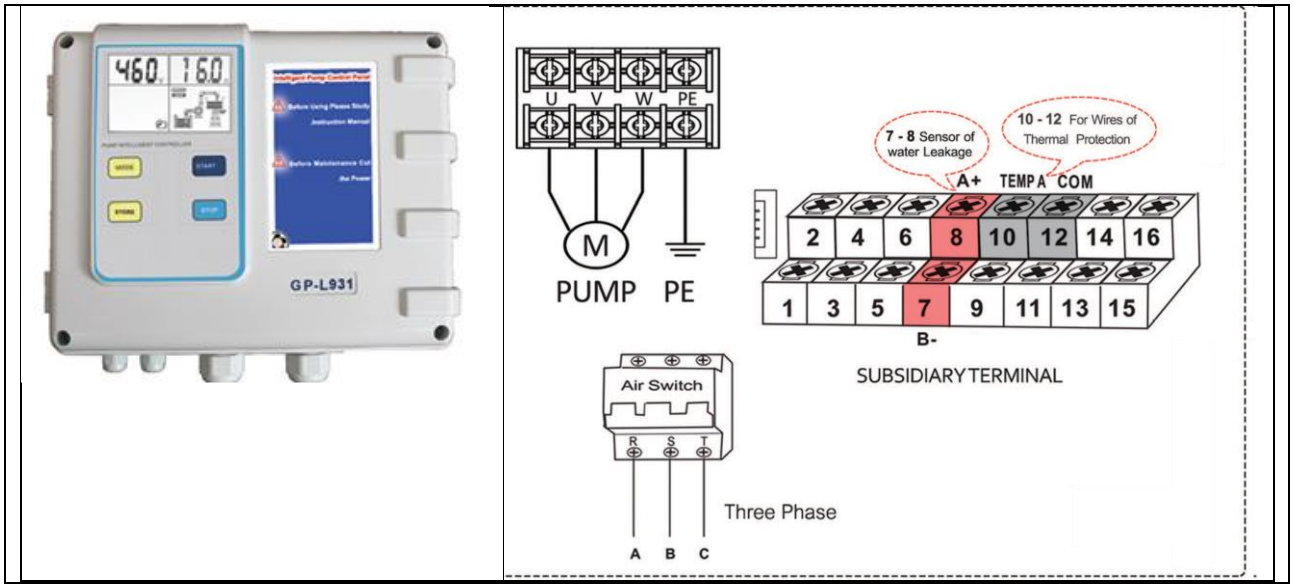
The protection of these Submersible motor is exactly the same as the A & B series dynamos, in that single-phase models are supplied with a capacitor box equipped with overload, and three-phase ones are completely recommended to use the control panel introduced by Gol Pump.



Three-phase Submersible motor of this family (encapsulated) are produced in 4-inch and 6-inch Out size Dia, and it is highly recommended to use the control Panels introduced by Gol Pump. These controller panels can be used up to 18.5 kW with the GP-931 series digital control panels, and from 10 kW to 45 kW with the

soft starters manufactured by WEG Factories. These controllers can protect your dynamo windings up to 85 percent.





Soft starter

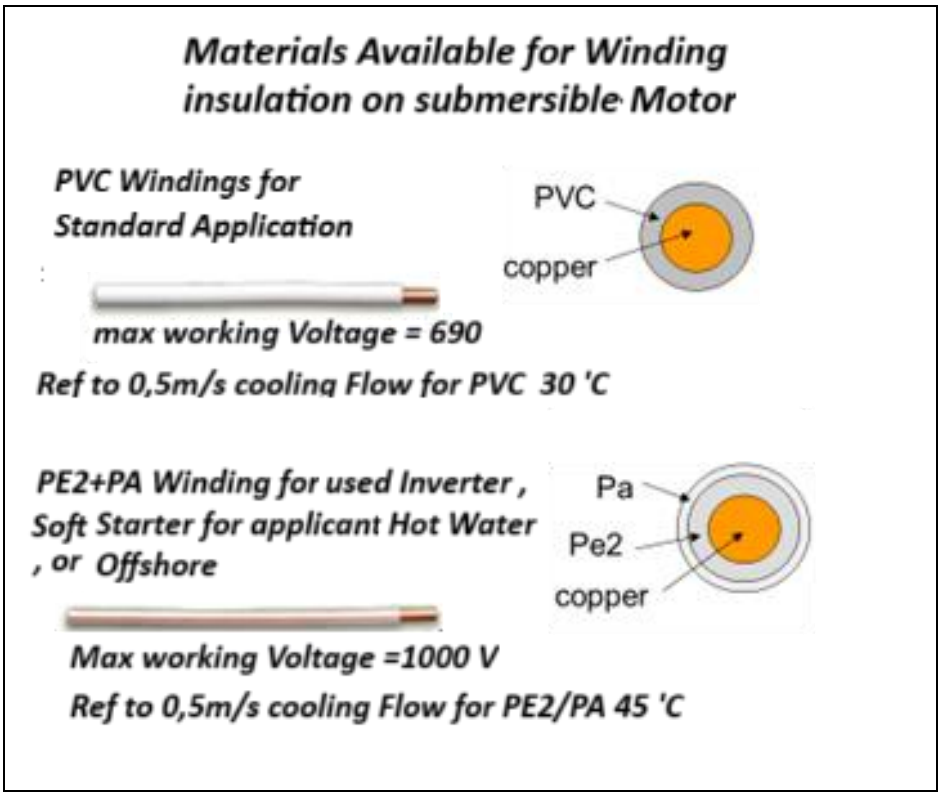
ESWF

For more information please click to

GF-931 **WEG Soft Starter** **WEG ESWF**

D- Submersible Motor water cold

The fourth group of submersible electromotors in Gol Pump Company are dynamos that made by PVC-coated copper wires with Class B or Class F or PA + PE2 coating with thermal Class H instead of lacquered copper wires.



Inside these dynamos, a mixture of water and glycol in a ratio of 1/5 is used for lubrication and heat transfer to the outside, and Thrust Bearing big size are used for balance and axial Pressure and braking.

(For more information on the characteristics of these types of dynamos, click on the link below)

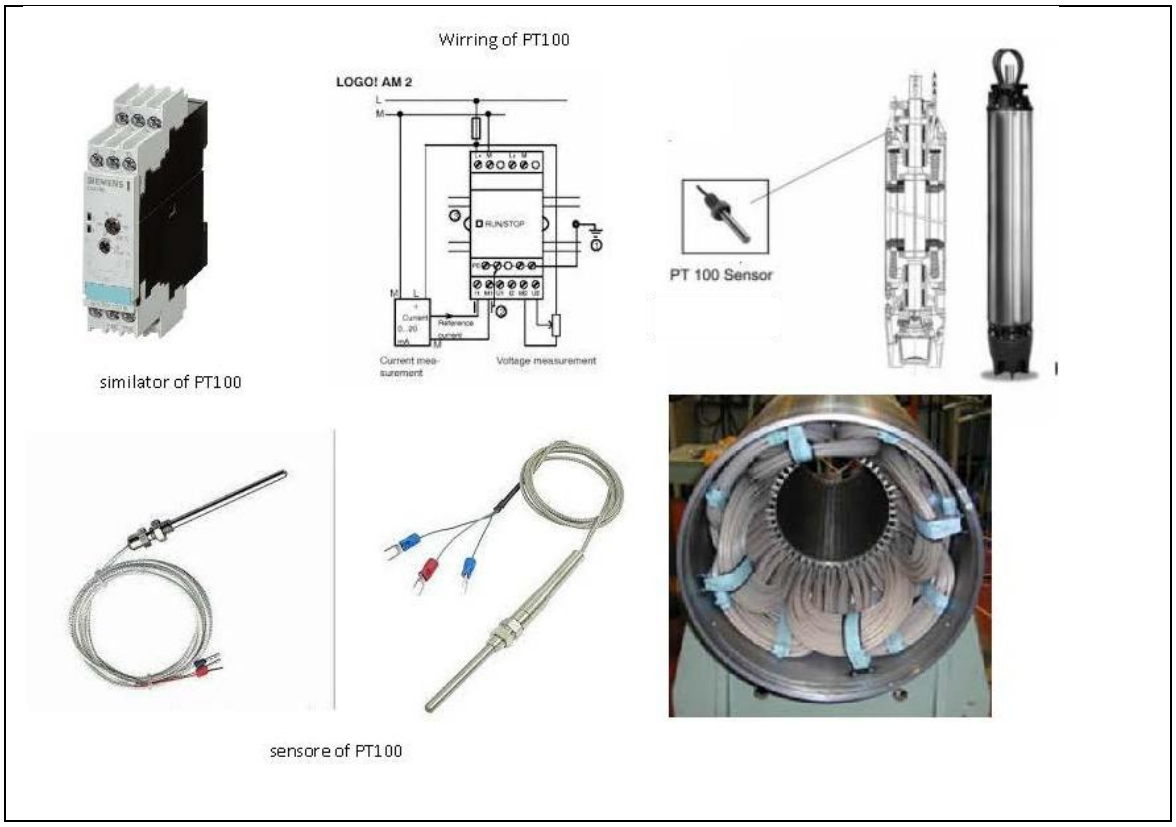
To protect these types of dynamos, all reputable manufacturers use a PT100 resistance sensor that monitors the changes in the heat of the liquid inside the motor shell.

The PT100 sensor has a resistance of 100 ohms at zero degrees, and for each degree of temperature increase, 0.385 ohms are added to its resistance. The goal of this project is to build a thermometer capable of measuring temperatures between 0 and 700 degrees.

Other types include PT 1000- PT500 - PT200 - PT 50. Resistance sensors are used in two forms, two-wire and three-wire, the floating dynamos in Gol Pump are PT100 type with three strands of wire.

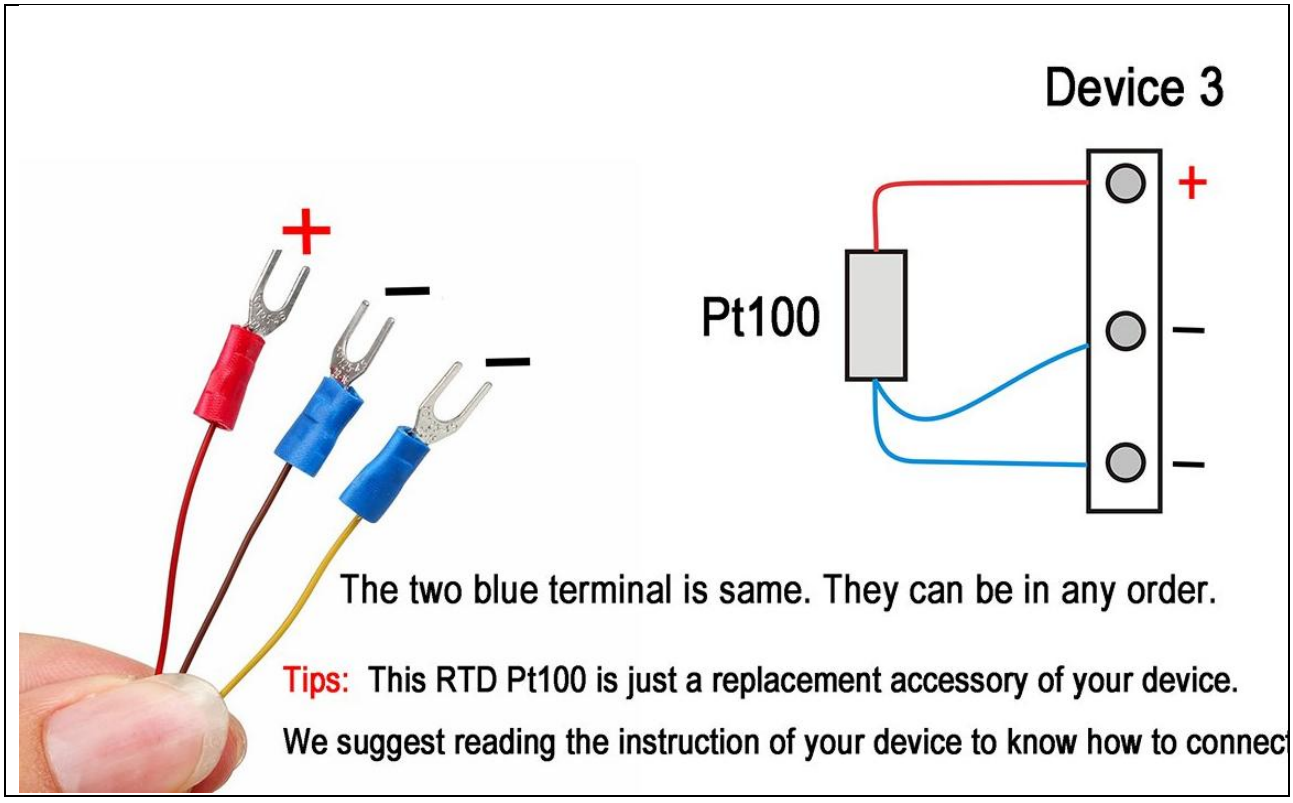
The engineers of Gol Pump Company recommend three methods for controlling the temperature inside the coil in this type of dynamo equipped with PT100.

1- **These dynamos can be controlled by a conventional control panel equipped with a simulator of this sensor (PT100), and if the consumer has own digital control panel, all he needs to do is install this simulator on own panel according to the instructions of this controller and adjust the temperature according to the type of fluid and its temperature and the type of coil selected for the winding between 70 and 90 degrees so that whenever the temperature of the water inside reaches this temperature, the power is immediately cut off through the control panel.**



For more Information link to PT100 installation

2- The best starter for floating dynamos with kW above 15 kW is to use a soft starter. Gol Pump Company suggests that if your floating dynamo has a PT100 controller, it is better to use the SW 900 soft starter because in this model, a PT100 simulator can be easily added to it and your valuable dynamo can be insured.



3-For thermal control of floating dynamos up to a maximum of 18.5 kW, the GCP 931 series digital control panels can be used. These controllers can not only use the PT100 sensor directly without adding anything to fully protect the dynamo, but also manage the analog and digital sensors and can manage all electrical problems that may damage the dynamo. For all the features of this type of updated control panel, refer to the following to understand the Potential of these panels.

0.5-4.5V Level transmitter / Pressure transmitter

4-20mA Level transmitter / Pressure transmitter

Float switch (ON/OFF signal)

Pressure switch (ON/OFF signal)

Liquid probe

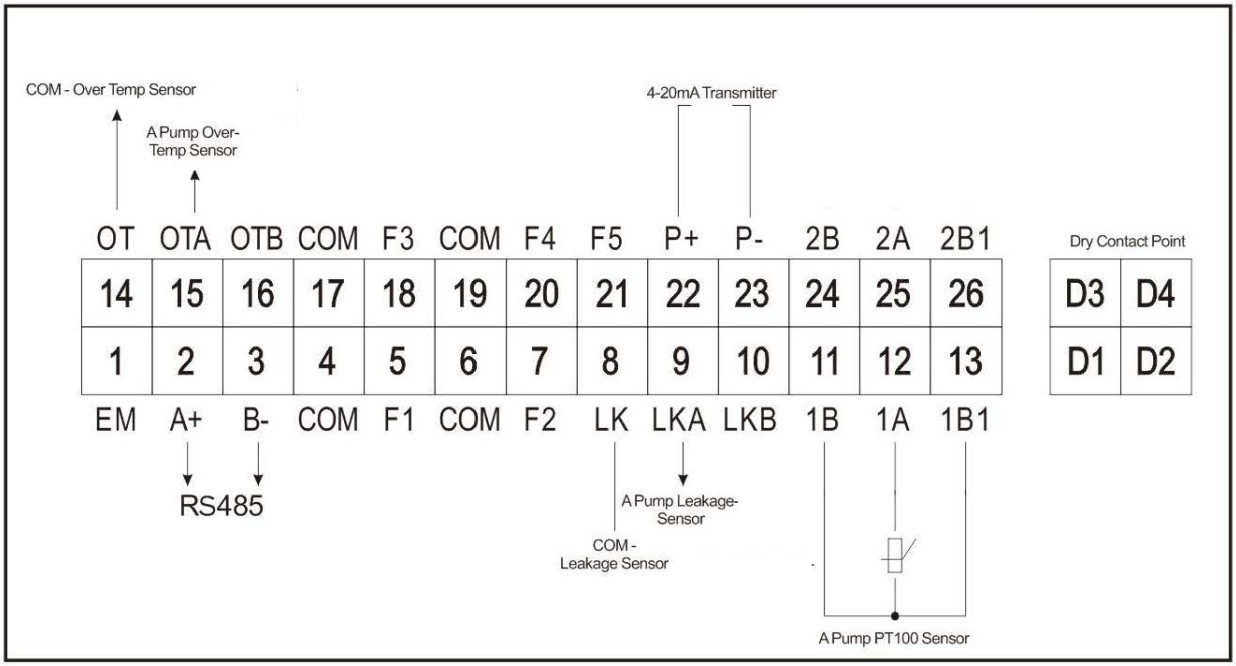
PT100 temperature sensor

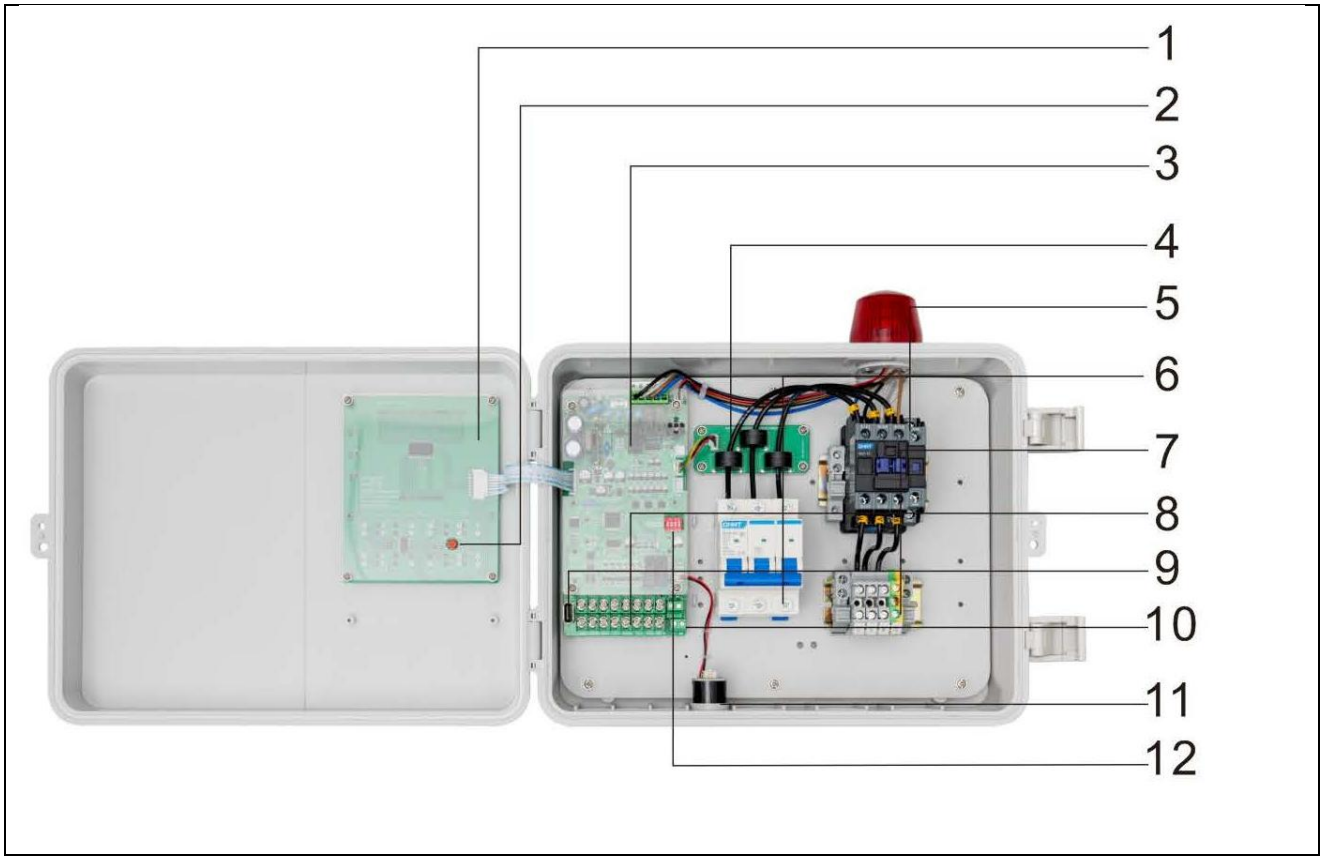
Thermal Protector or PTC sensor

MEMS air pressure transmitter

Sensor for Leakage of water in oil chamber

Some of the capabilities of this controller





1. LCD displaying board
2. Alarm test button
3. Main board
4. Current transformer board
5. AC contactor
6. Mini circuit breaker for electrical connection to the main input power supply
7. Terminals for electrical connection to the pumps
8. Terminals for electrical connection to probe, float switch, pressure switch, transmitter etc
9. USB interface
10. Passive dry contact point
11. Alarm buzzer
12. Function switch for different application setting

NOTE: controller structure will vary with different model and configuration.

To better understand the dynamos, Electro pumps, and systems available at Gol Pump Company, it is best to visit the category of electric motors, floating dynamos, and controllers. If you need more information or need appropriate answers to your questions, send them to us via Gol Pump Company's email and WhatsApp. It will be sent to you as soon as possible.

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