AMPHIBIOUS PUMPS TECHNICAL MANUAL

DS-EPO-01 REV22 – 21/Mar/2022 – This manual is subject to review without previous notice

HIGRA

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1 ABOUT US

HIGRA is a metal mechanics company, founded in late 2000, which directors are over 40 years experienced in the pumping segment. HIGRA brings to the market a new concept with pioneer and innovative products, focusing quality and reliability.

Responsible for design, manufacture and promotion of pumping and effluent treatment solutions for water and wastewater, irrigation, mining and general industry, HIGRA stands out in its segment for the high technology added to its products, innovative concepts and technical team qualification.

All HIGRA's activities follow Sustainability Management Integrated System's precepts. HIGRA's equipment are developed respecting demands of international standards, from creation to delivery.

State-of-the-art tools are applied to technically support development of new products. With interactivity of Autodesk INVENTOR and ANSYS CFX software HIGRA meets excellent hydro energetic efficiency and high efficiency motors, assuring a great performance pumping set. Every single equipment is submitted to a test bench before delivery to customer.

Under this concept, HIGRA assures high quality products developed under a sustainability system, respecting the nature and caring about safety and occupational health.

To know more about HIGRA and its products visit our web site www.higra.com.br or contact us through e-mail contato@higra.com.br or phone number ++ 55 51 3778 2929.

Figure 1 – Air View - HIGRA Industrial Ltd.

2 AMPHIBIOUS PUMPS

With a centrifugal pumping principle through closed impellers with mixed, radial or semi-axial fluxes, the amphibious pumps are capable of reaching high flows and pressures due to their centrifugal pumping principle through mixed or radial impellers and their single or multi stages. The amphibious principle is consequence of their design, being the water flux admitted by flanged axial suction, passing through a centrifugal impeller where all the pumped fluid passes alongside the motor and guarantees excellent thermal exchange.

These pumps have been designed to meet the new market needs in terms of fluid collection and movement. HIGRA pumps present very low noise level (less than 60Db) and are built with 100% recycled materials. They were created to be installed in the smallest space possible at collection units or industry and can also be installed as boosters in subterranean places, which eliminates the noise and visual or environmental pollution.

Motor internal cooling is also conducted with water. For that, motor is built with coated wire coils, what assures insulation and allows rewind process. Journal and thrust sliding bearings assure centralization and absorption of vibration and efforts resulting from rotary movement, push and hydraulic pressure over the centrifugal impeller. Amphibious pumps are completely hermetic. The moving parts are totally confined inside the set, preventing any type of leakage that might damage the environment.

The easy and simple way to install and operate both AMPHIBIOUS and SUBMERSIBLE pumps enable the equipment to be installed with minimum civil works and interventions reducing environmental impact and costs significantly.

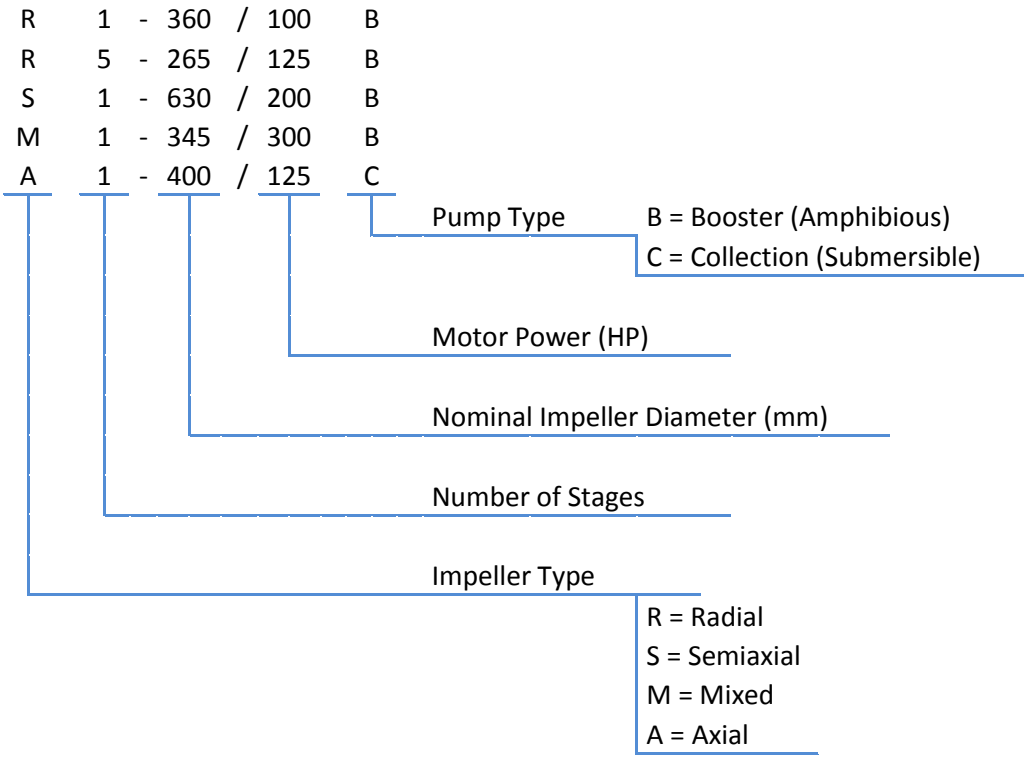
This manual presents details and technical features on HIGRA Amphibious Pumps, as well as how to safely install, operate, and provide basic maintenance.

Figure 2 – Amphibious Pump in a Tank

Figure 1 – Amphibious Pumps in Modular System

2.1 Models and Nomenclature

Regarding nomenclature, HIGRA pumps are identified according to impeller type, number of stages, impeller diameter, motor power and pump type, as per examples below:



Examples:

R1-360/100B = Radial pump, single stage, impeller nominal diameter: 360mm, power: 100HP, Booster type.
M1-345/300B = Mixed pump, single stage, impeller nominal diameter: 345mm, power: 300HP, Booster type.
S1-630/125B = Semiaxial pump, single stage, impeller nominal diameter: 630mm, power 125HP, Booster type.

Pump model refers to the nominal impeller diameter. Lowered impeller diameter, when applicable, is available on pump test report.

HIGRA pump line shares in two groups: Amphibious Pumps (booster style) and Submersible Pumps (collection style). This manual refers to Amphibious Pump Line, which is classified as follows.

Single Stage Radial Amphibious Pump

Figure 2 – R1-360/125B Amphibious Pump

Multi-Stage Radial Amphibious Pump

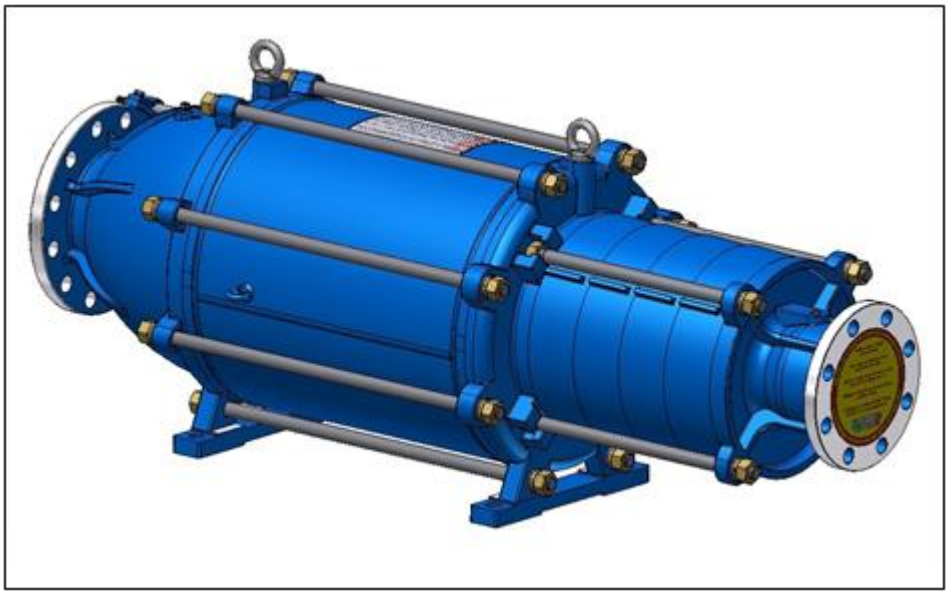


Figure 3 – R5-265/125B Amphibious Pump

Single Stage Mixed Amphibious Pump

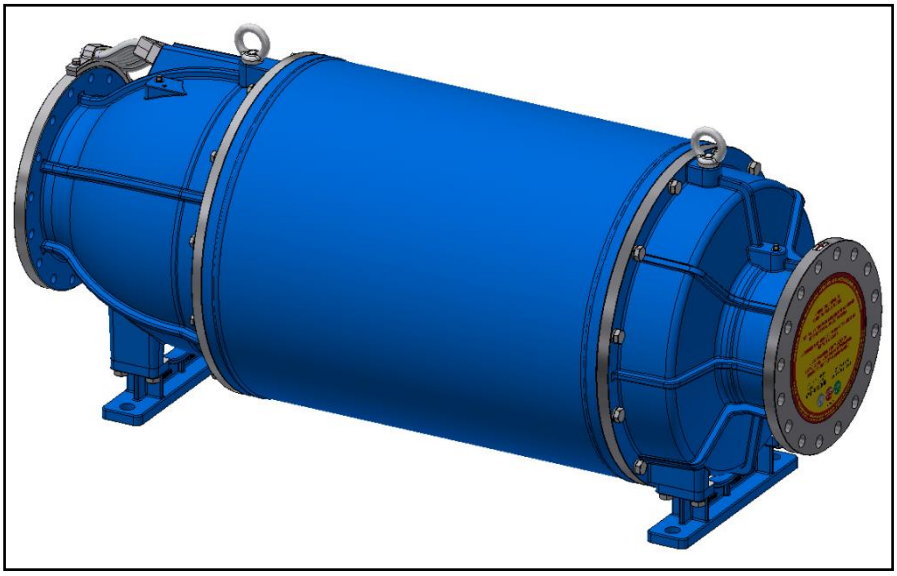


Figure 4 – M1-345/300B Amphibious Pump

Multi-Stage Mixed Amphibious Pump

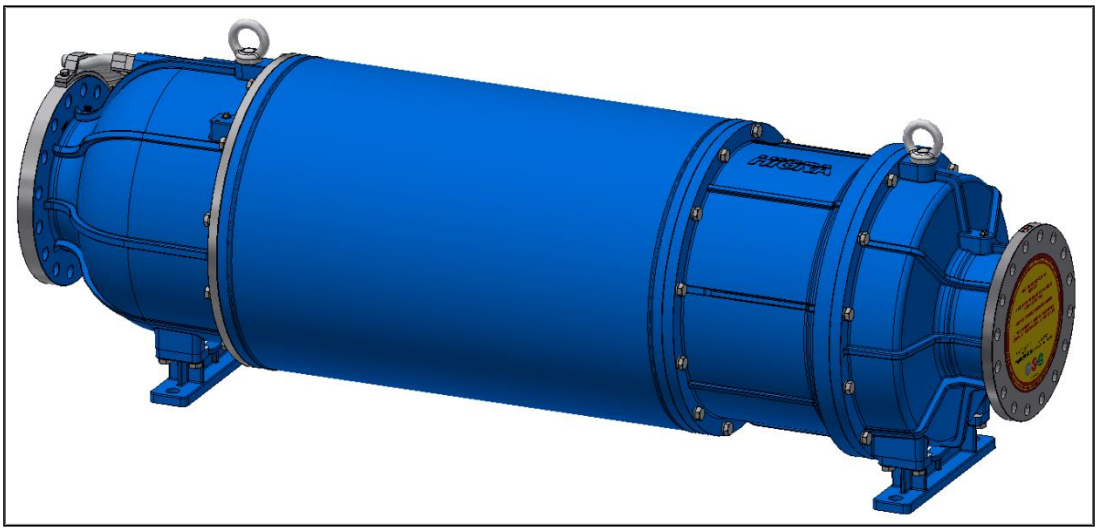


Figure 5 – M2-345/600B Amphibious Pump

Single Stage Semi-Axial Pump

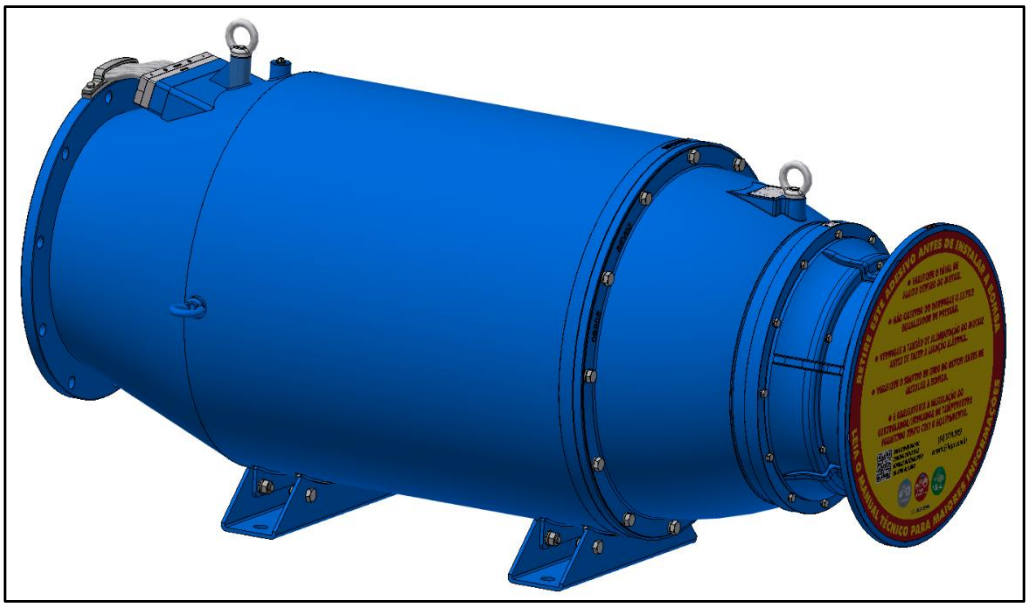


Figure 6 – S1-620/250B Amphibious Pump

Single Stage Radial Pump with Open Impeller

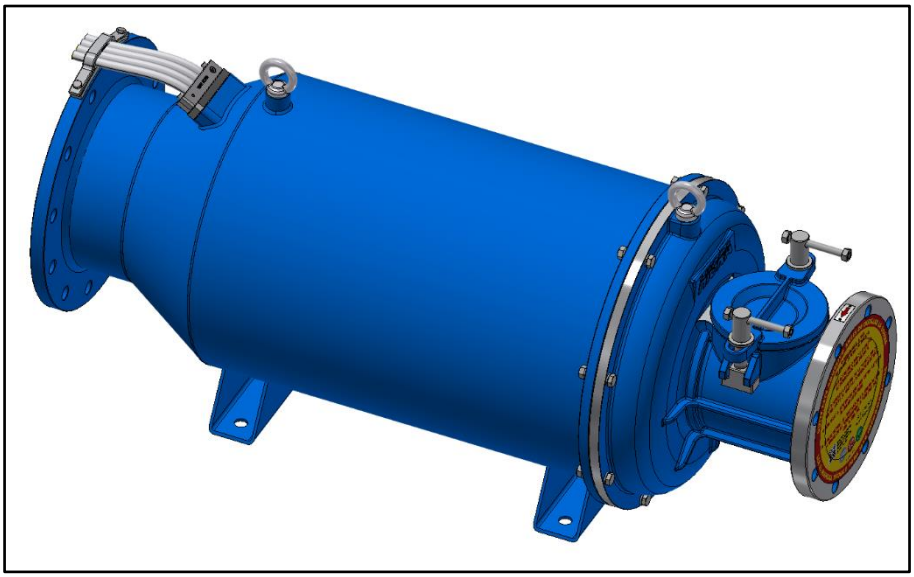


Figure 7 – Amphibious Pump Model E1-260/75B

2.2 Chart of Materials Per Application

On the following page are presented the manufacturing materials of the components of the amphibious pumps, possessing differentiations according to their application.

Suggested Application		Configuration # 1	Configuration # 2	Configuration # 3	Configuration # 4	Configuration # 5
		Raw Water (solids < 2%)	Raw Water (solids < 10%)	Salt Water	Light Chemical Contamination	Heavy Chemical Contamination
1	Impellers	Cast Iron	Chrome + Nickel Special Alloy	AISI 304	AISI 316L	CD4MCUN
2	Diffusers	Cast Iron	Chrome + Nickel Special Alloy	AISI 304	AISI 316L	CD4MCUN
3	Inlet Frame	Cast Iron	Cast Iron	AISI 304	AISI 316L	CD4MCUN
4	Shaft End	AISI 420C	AISI 420C	AISI 420C	AISI 420C + Chemical Nickel	AISI 420C + Chemical Nickel
5	Mechanical Seal	Body AISI 316L/Surfaces Silicon Carbide	Body AISI 316L/Surfaces Silicon Carbide	Body AISI 316L/Surfaces Silicon Carbide	Body AISI 316L/Surfaces Silicon Carbide	Body AISI 316L/Surfaces Silicon Carbide
6	Equalization System	Bronze (Filter)	Bronze (Filter) or AISI 316L (Piston)	AISI 316L (Piston)	AISI 316L (Piston)	AISI 316L (Piston)
7	Stage Frame	Cast Iron	Cast Iron	AISI 304	AISI 316L	CD4MCUN
8	Wear Rings	Bronze	Bronze	Bronze	AISI 420	AISI 420
9	Spacer Bushing	Tempered SAE 4140	Tempered SAE 4140	AISI 420C	AISI 420C + Chemical Nickel	AISI 420C + Chemical Nickel
10	Motor Set Frame	Cast Iron	Cast Iron	Cast Iron	Cast Iron	Cast Iron
11	Electrical Cables	Flexible HEPR 90°C	Flexible HEPR 90°C	Flexible HEPR 90°C	Flexible HEPR 90°C	Flexible HEPR 90°C
12	Shaft Nut	Bronze	Bronze	Bronze	AISI 420C	AISI 420C
13	Mechanical Seal Casing	Bronze	Bronze	Bronze	AISI 316	AISI 316
14	External Flow Casing	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel
15	Outlet Frame	Cast Iron	Cast Iron	Cast Iron	Cast Iron	Cast Iron
16	Sacrifice Anodes	Not Applicable	Not Applicable	Aluminum Alloy	Aluminum Alloy	Aluminum Alloy
17	Rubber Sealing	NBR O-Rings	NBR O-Rings	NBR O-Rings	NBR O-Rings	VITON® O-Rings
18	Fasteners[1]	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel
19	Fixation Elements[2]	Zinc Plated Carbon Steel	Zinc Plated Carbon Steel	AISI 304	AISI 304	AISI 316
20	Painting	Epoxy + Polyurethane[3]	Epoxy + Polyurethane[3]	Epoxy + Antifouling	Epoxy + Acrylic + Vinylic	Epoxy + Acrylic + Vinylic

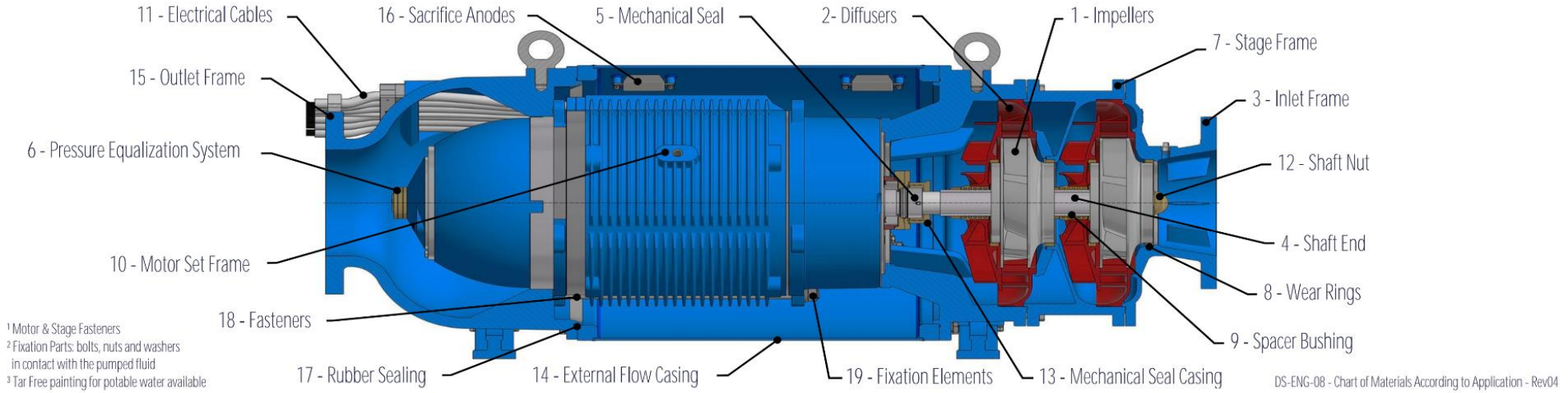


Table 1 – Materials per Application

2.3 Flow Direction

Drawing below indicates flow direction of pumped fluid inside Amphibious Pumps, presenting the equipment hydrodynamics, thermal exchange and acoustic chamber formed by fluid .

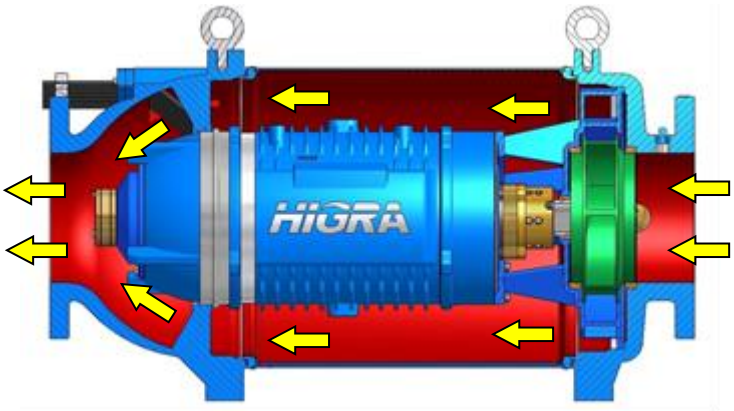


Figure 8 – Fluid flux inside the pump

2.4 Ways of Installation

Figure 9 – Amphibious pump working submerged

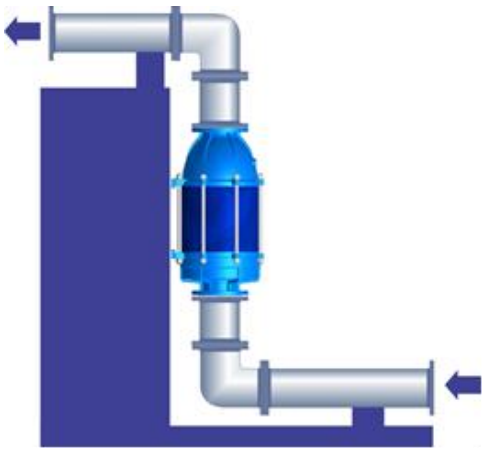


Figure 10 – Pump vertically installed in the pipeline, increasing the pipeline pressure

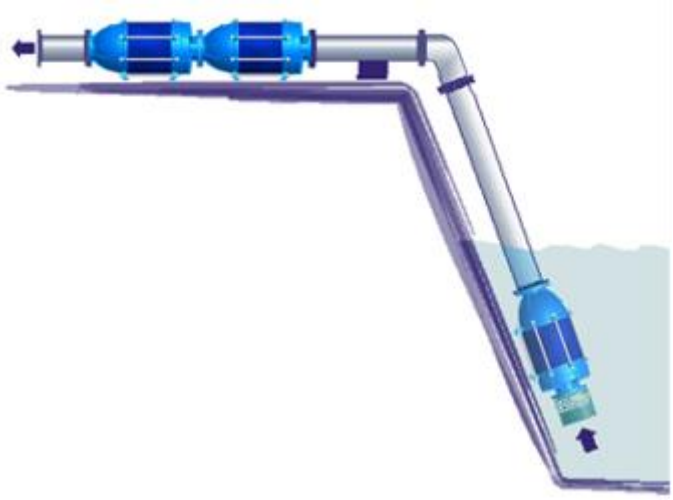


Figure 11 – Three modular pumps working in series increasing the pressure, where one is submersible

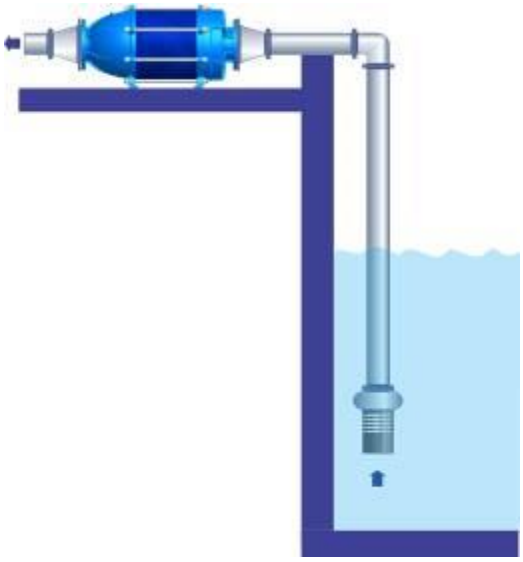


Figure 12 – Pump suctioning and using a foot valve

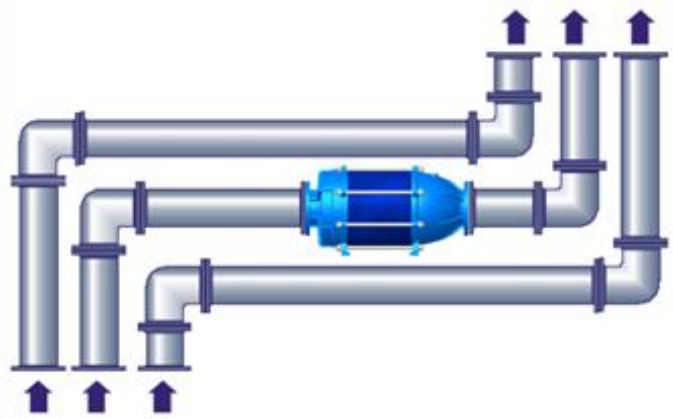


Figure 13 – Water system with a pump horizontally installed in the line, increasing the pressure

Figure 14 – Pump operating with suction submersed only

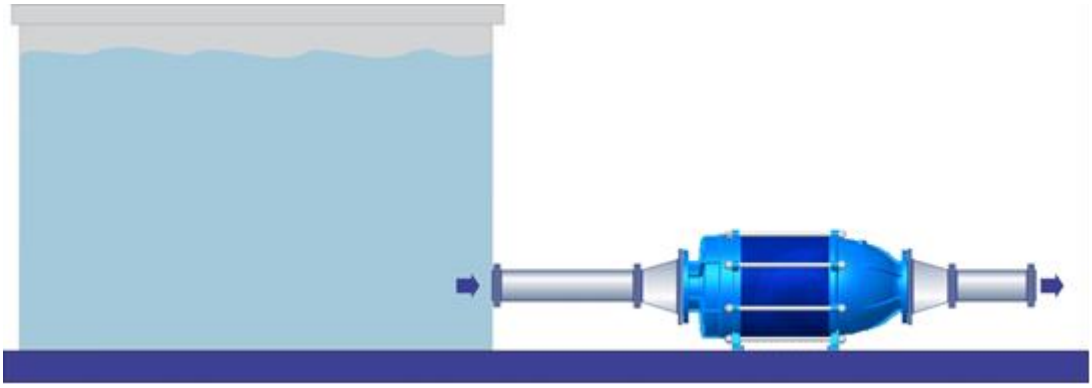


Figure 15 – Pump working out of the tank wit positive pressure

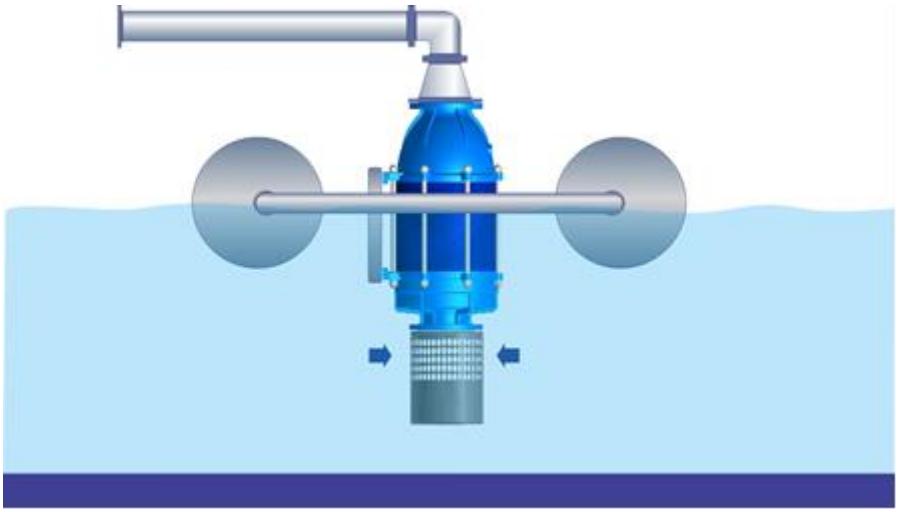


Figure 16 – Pump supported by floats

2.5 Installation Procedures

Installation procedures below must be followed for any of the ways of installation previously presented, otherwise there are risks of damages to the equipment. If it happens, the pump is no longer covered by warranty (see chapter 5).

WARNING: Applications in potable or raw water with solids contents lower than 2%, we suggest preventive maintenance after 24 months of operation. In both cases, the pumps must be inspected in case of reduced efficiency or partial wear.

2.5.1 Motor Internal Fluid

HIGRA equipment might present two different types of pressure equalization systems: Filter or Piston.

2.5.1.1 Pumps with Pressure Equalization Filter

After unpacking the equipment, place it in vertical position with the suction flange (where the impeller is located) facing down to make the pressure equalization system accessible. Such system is composed by internal brass filter and a rubber mask that avoids leakages and allows pressure equalization, through the exchange of water droplets between the motor and the external environment.

WARNING: Do not take off, block, perforate or damage the rubber mask of the filter, which has tiny orifices, since the mask is responsible for the pressure equalization .

To assure the pump is completely filled with fluid and the correct filter functioning it is necessary (as per figure below):

- Take off the Pressure Equalization Filter, located in the pump back;
- Check the internal fluid level and complete it with clean water, if necessary;
- Place the filter back (with the rubber O-ring) and fix it again by using the bolts.

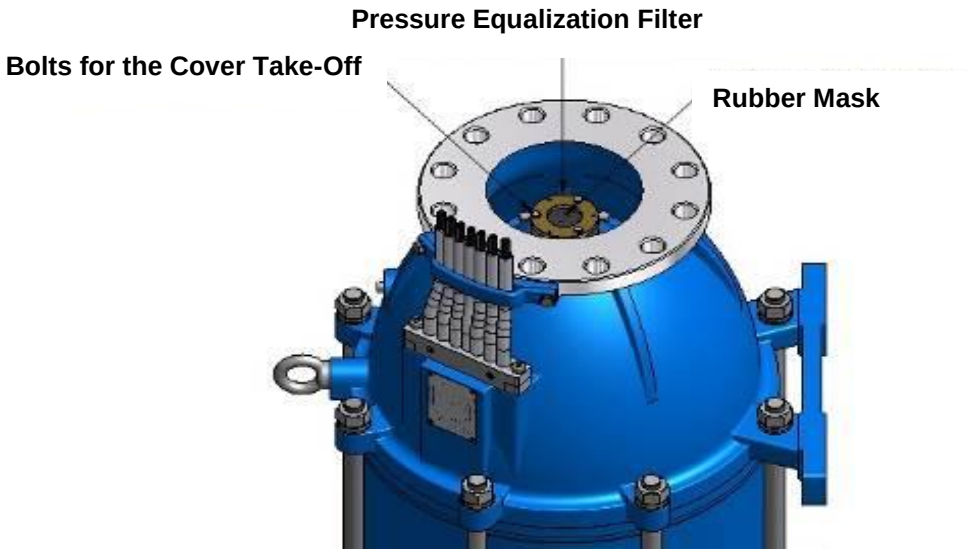


Figure 17 – Pressure Equalization Filter

NOTE: It is necessary to fill the motor thoroughly with the recommended fluid. The pressure equalization filter might not work properly in the case some air remains inside the motor.

IMPORTANT: It is normal some fluid exchange between environments inside and outside the pump, through the rubber mask, due to transportation and possible changes in the temperature the equipment is exposed to.

2.5.1.2 Pumps with Pressure Equalization Piston

After unpacking the equipment, place it in vertical position with the suction flange (where the impeller is located) down. This way, the Amphibious Pumps pressure equalization system will be accessible. Composed by a stainless-steel piston and rubbers that prevent leaks, its operation is based on the expansion or compression of the piston, according to the equipment dynamic need, equalizing the internal pressure of the engine to the pressure of the pumped fluid instantly.

To ensure total motor filling and the right Pressure Equalization Piston functioning, it is needed to (as per figure below):

- Take off the cover located in the piston, in the pump rear area;
- Pull out the piston until it reaches the end position;
- Check the internal fluid level and complete it with clear water;
- Place the cover back and fix it with the bolts.

Figure 18 – Pressure Equalization Piston Detail

HIGRA equipment are internally filled with clean water and it is responsible for lubricating and cooling the electromechanical system. Chart below shows the water volume for each motor size:

POWER (HP)	MOTOR FRAME	EQUIPMENT OPERATING AT TEMPERATURES ABOVE 0°C	EQUIPMENT OPERATING AT TEMPERATURES BELOW 0°C		Total Volume (liters)
		Water Volume (liters)	Propylene Glycol Volume (liters)	Water Volume (liters)	
10, 12, 15 e 20	132L	7,00	2,10	4,90	7,00
25, 30 e 40	160L	15,00	4,50	10,50	15,00
50, 60, 75 e 80	160T	15,00	4,50	10,50	15,00
200, 250, 300, 350 e 400	200T	55,00	16,50	38,50	55,00
75, 100, 125 e 150	225S	35,00	10,50	24,50	35,00
125, 150 e 175	225L	55,00	16,50	38,50	55,00
150, 175, 200, 250, 300, 350 e 400	315S	110,00	33,00	77,00	110,00
350, 400, 450, 500, 550 e 600	315L	110,00	33,00	77,00	110,00
600, 650, 700 e 750	315T	150,00	45,00	105,00	150,00
800, 900 e 1000	355T	300,00	90,00	210,00	300,00

Table 2 – Volume of fluid per motor

*This chart presents referential volumes. Higra equipment shall be filled with the indicated fluid.

Anti-Freezing Propylene Glycol

Color: Colorless

Example of Use: Automobile radiators
Freezing point: - 60°C

ATTENTION: Pumps working with salt water or fluids with presence of contaminants do not have pressure equalization filter, but a pressure equalization piston instead, which prevents salt water from having contact with the inner motor. For further details please contact the plant.

ATTENTION: Pumps working in regions where ambient temperature is below 0°C, shall have Propylene Glycol added to the motor emulsion in a 30% proportion, as indicated on chart 02. The Water/Propylene Glycol emulsion shall be prepared in a separate container before being poured into the motor, in order to get a homogeneous mixture. If it is made inside the motor or if it is not efficient, fluids tend to get a part and might cause the water to freeze.

2.5.2 Equipment Identification

HIGRA pumps are given an identification sticker that details the equipment specifications, as per the following items

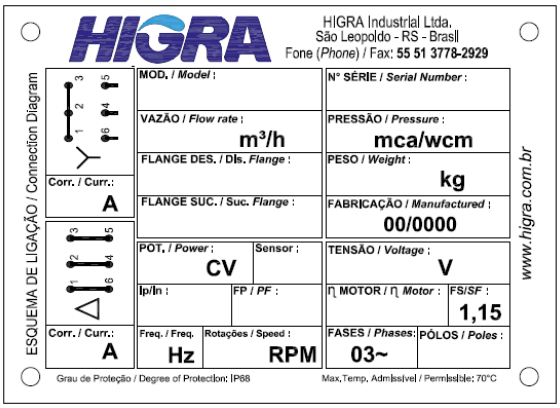


Figure 19 – Identification Sticker

MODEL: shows the pump model, according to examples on chapter 2.1.

SERIAL NUMBER: shows the equipment serial number.

FLOW RATE (m³/h): shows the pump flow rate required by customer.

PRESSURE (mwc – water column meter): shows the total pressure the pump can work with, as per previously agreed with customer.

DIS. FLANGE: shows the discharge flange manufacturing standard, as per ISO 2531 Standard and detailed on chapter 2.8.

SUC. FLANGE: shows the suction flange manufacturing standard, as per ISO 2531 Standard and detailed on chapter 2.8.

WEIGHT (kg): shows the monoblock equipment total weight (excluding the strainer weight).

POWER (CV): shows the electric motor power rating.

SENSOR: Displays the type of sensor contained in the equipment. Note: if you have more than one sensor, see item 2.5.3.4 of this manual.

MANUFACTURE: presents the equipment's month and year of manufacture.

Ip/In: Shows relation between start current and motor rated current.

VOLTAGE (V): tension connected in the electric motor of the equipment.
Motors up to 20 CV present an operation tension only: 220, 380 or 440V, for example.
Motors larger than 25 CV present two operation tensions: 220/380, 380/660, or 440/760V.

PF: Motor Power Factor is the relation between active power and apparent power absorbed by the motor.

η MOTOR (%): shows the electric motor efficiency, which is the motor efficiency when it transforms electrical energy in mechanical energy.

FREQ.: shows the frequency in which the motor was projected to work with. Frequency is how many times per second tension changes the direction and returns to the initial condition (cycles per second or hertz).

SPEED (RPM): shows the electric motor rated speed.

SF: shows the motor service factor, which is the multiplier that, when applied to the power rating, indicates the allowable overload that may be continuously applied under specific conditions without a heat that damages the motor, once tension and frequency are kept.

POLES: Shows the motor polarity. II pole motors work in 3500rpm, IV pole motor work in 1750rpm, IV pole motors work in 1160rpm and VIII pole motors work in 890 rpm.

CONNECTION DIAGRAM: shows the ways of closing the electric cables and their respective working currents .

Note: It is possible delivery the equipment with identification plate in stainless steel material, if necessary.

2.5.3 Electric Connection

As previously approached, HIGRA motors may present two different configurations of electric cables for electrical connection .

- Motors with one tripolar cable: one cable with three conductors leaves the motor, internally closed in the desired voltage. This configuration does not allow electric connection through star/delta starter, but with current compensator, direct start, soft starter or variable speed driver.

- Motors with 3 unipolar cables: three cables with a single conductor each. Similar to the option with one tripolar cable, the motor internal electric connection in the voltage required by customer.

- Motors with 6 unipolar cables: motor output with six single conductor cables that can be lead to the control panel to be connected through soft starter, star-delta switch or compensating switch. When started through compensating switch, the wires may be connected as follows:

Star Connection: this type of connection, connecting cables 1, 2 & 3, and connecting cables 4, 5 & 6 to the control panel, makes the motor work in higher tension. Example: a 220/380V motor, when star connected, works in 380V

Delta Connection: this type of connection, connecting cables 1-6, 2-4 & 3-5, makes the electric motor to work in the lower tension. Example: a 380/660V motor, when delta connected, works in 380V.

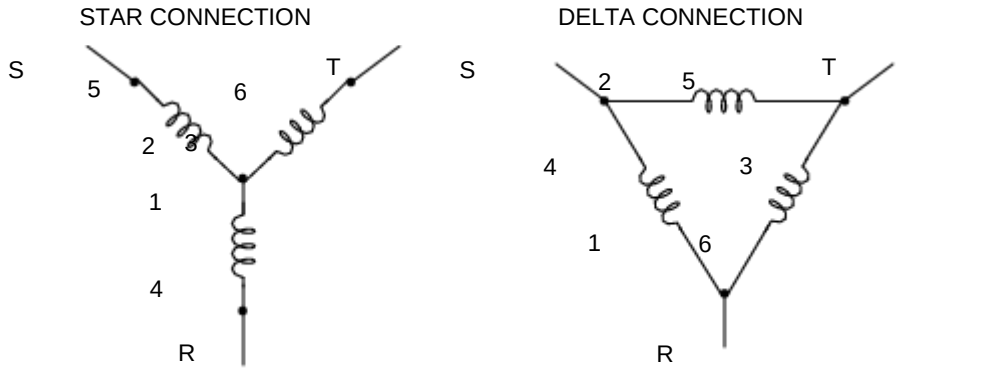


Figure 20 – Delta/Star connection

In the cases of special projects motor are fed through three vias cable only, and the electric connection is done for the operation voltage specified by the engineering according the customer's request, no matter the power.

2.5.3.1 Electric Cable Splice Procedure

Steps below are a guideline to splice and insulate electric cables of HIGRA equipment, for submersible operation. Pictures show a cable with three conductor wires, however procedure must be the same for equipment with three or six tripolar cables:

1 – Uncover the wire ends in irregular way, so that they will not be in the same position neither allow the splice to have a section wider than the cable diameter.

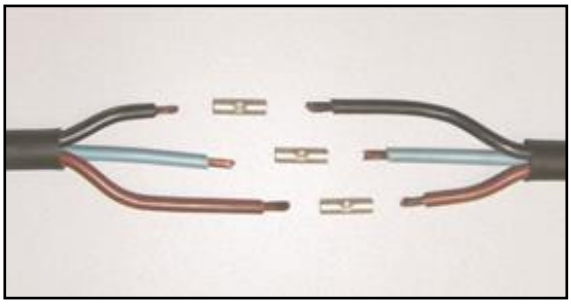


Figure 21 – Splicing step 1

2 – Use metallic tubular splices in the same diameter as the electric cable, pressing their ends with a plier.

Figure 22 – Splicing step 2

3 – Connect the electric cables and the tubular metallic splice by welding them with tin.

Figure 23 – Splicing step 3

4 – Use rubber friction tape (23BR brand 3M) alongside the whole splice and repeat the application twice more, making sure the tape is very well stretched.

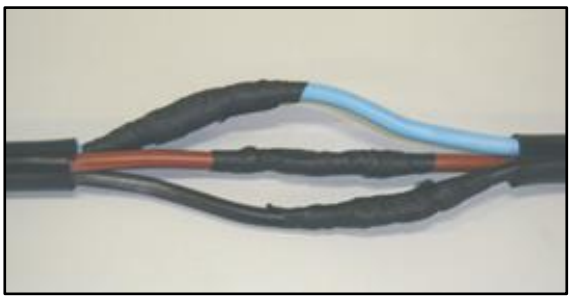


Figure 24 – Splicing step 4

5 – Apply plastic insulating tape (35+ brand 3M) over the friction tape. Repeat the application twice more, making sure the tape is very well stretched.

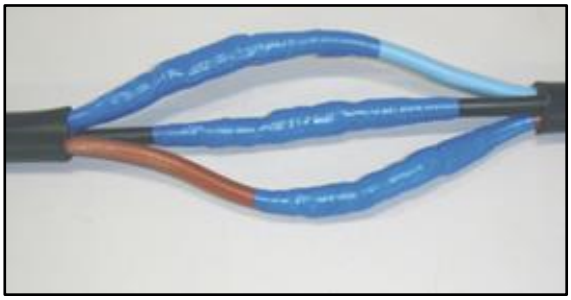


Figure 25 – Splicing step 5

6 – Put the cables together and apply rubber friction tape twice, alongside the whole cable, until it covers the splice thoroughly. After that, make two layers more with insulating tape over the whole splice, covering the friction tape.

Figure 26 – Splicing step 6

7 – As a finish, apply a retractable term with internal adhesive to fix the layers of self-melting and insulating tape, as shown in Figure 28.

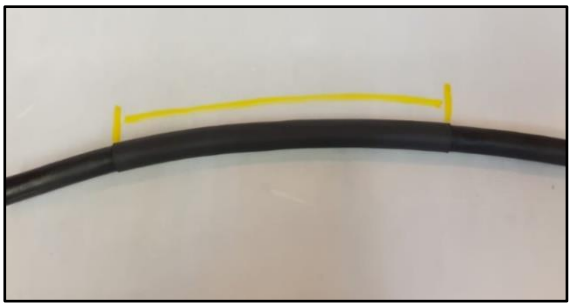


Figure 27 – Splicing step 7

NOTE: this method is used for splicing and insulation of low voltage electrical cables outside the equipment. Inside the submerged motor the cables also receive a mass layer for electrical insulation (Mastic) between operations 3 and 4.
There is specific procedure for splicing of medium voltage motors (above 1000V). Please check it with HIGRA, if necessary.

WARNING: splices exposed to the weather and made without respecting the above procedure may oxidize, provoke failure in some of the phases and/or generate short circuit, damaging the equipment.

2.5.3.2 Grounding

The purpose of grounding equipment is protecting it against electric current loss towards the motor frame, acting over the protection devices, besides protecting the operator against possible electric shock.

Pumps have a grounding spot located by the side of the hole that takes the pressure in the Rear External Frame, where the grounding cable is fixed through an eye terminal or bolt.

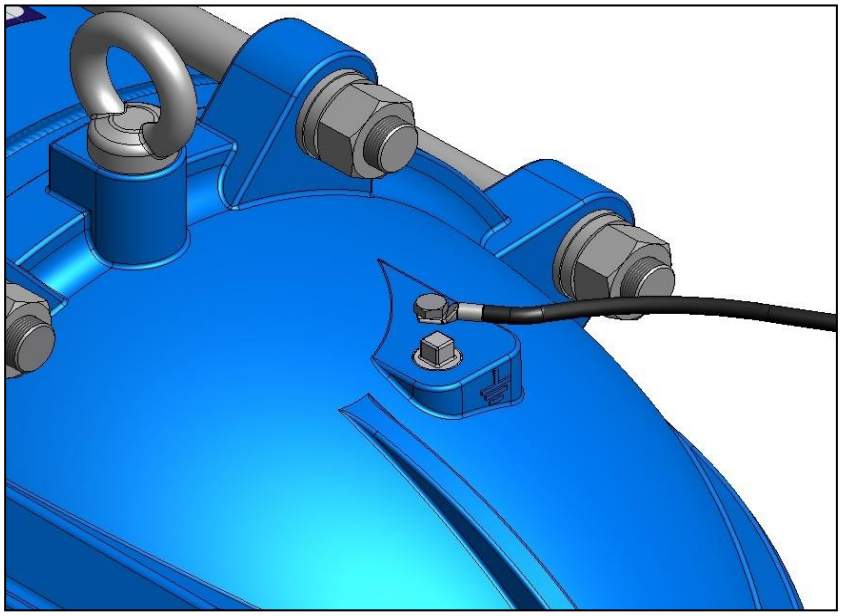


Figure 30 – Grounding system

NOTE: All amphibious pumps are designed in accordance with mechanical, electrical and hydraulic standards. They are submitted to tests that ensure the equipment's quality, performance and safety, meeting the Standards Regulatory of Occupational Safety in Machinery and Equipment (NR-12).

2.5.3.3 Chart of Electric Current

Below there is an amperage chart on 60 and 50Hz HIGRA motors. Rated and no load currents may vary 5%. If it varies out the tolerance, turn the equipment off and look for the plant or any local Representative/Authorized Service Shop.

NOTE: figures presented on Frame column are a reference to the nomenclature used by the motor manufacturers (Voges and Regal) used as a dimensional pattern by HIGRA.

II POLE MOTORS 60Hz – COATED WIRES – 90°C TEMPERATURE CLASS														
Mechanical Power (HP)	Mechanical Power (kW)	No of Poles	Frame	Package (mm)	Voltage (V)	Rated Current (A) (+-5%)	No Load Current (A) (+-20%)	Efficiency (%)	P.F. (cos Φ)	Ip/In	RPM	Starting Current (A)	Operation Torque (Kg.m)	Starting Torque (Kg.m)
15	11.033	II	132L	200	220	39,8	17,4	83,40	0,873	8,5	3532	338,01	3,043	8,344
					380	22,7	9,1	82,90	0,889	7,8	3526	177,41	3,047	7,300
					440	19,9	8,7	83,40	0,873	8,5	3532	169,00	3,043	8,363
20	14.710	II	132L	200	220	52,2	21,5	84,20	0,878	7,6	3518	396,86	4,072	10,104
					380	29,8	11,4	84,30	0,889	7,3	3514	217,70	4,077	9,628
					440	26,1	10,7	84,20	0,878	7,6	3518	198,43	4,072	10,127
25	18.388	II	132L	200	220	65,7	27,4	84,40	0,870	7,0	3508	460,02	5,104	12,162
					380	37,8	15,1	84,40	0,876	6,9	3506	260,72	5,107	11,840
					440	32,9	13,8	84,40	0,868	7,0	3509	230,54	5,104	12,276
30	22.065	II	132L	200	220	79,4	33,2	84,30	0,865	6,9	3503	547,93	6,133	15,027
					380	46,0	18,9	83,80	0,869	6,7	3502	308,44	6,135	14,210
					440	39,8	16,6	84,30	0,864	6,9	3503	274,28	6.133	15,062
300	220.650	II	200T	700	380	393,3	114,4	94,40	0,903	7,6	3558	2988,91	61,22	190,72
					660	226,4	66,0	94,40	0,903	7,6	3558	1720,89	61,22	190,72

Table 3 – II Pole Motors – 60Hz – Coated Wires

IV POLE MOTORS 60Hz – COATED WIRES – 90°C TEMPERATURE CLASS														
Mechanical Power (HP)	Mechanical Power (kW)	No of Poles	Frame	Package (mm)	Voltage (V)	Rated Current (A) (+-5%)	No Load Current (A) (+-20%)	Efficiency (%)	P.F. (cos Φ)	Ip/In	RPM	Starting Current (A)	Operation Torque (Kg.m)	Starting Torque (Kg.m)
3	2.207	IV	112M	130	220	9,5	5,9	76,30	0,797	6,7	1758	63,87	1,223	2,696
					380	5,5	3,4	76,30	0,797	6,7	1758	36,98	1,223	2,696
					440	4,9	3,1	74,90	0,789	6,4	1760	31,52	1,221	2,455
5	3.678	IV	112M	130	220	16,2	10,7	78,50	0,757	7,2	1757	116,23	2,039	5,690
					380	9,4	6,2	78,50	0,757	7,2	1757	67,29	2,039	5,690
					440	7,7	4,7	77,40	0,806	5,6	1746	43,70	2,051	3,784
10	7.355	IV	132L	200	220	27,2	13,1	82,70	0,859	8,5	1773	230,95	4,04	9,892
					380	15,7	7,6	82,70	0,859	8,5	1773	133,71	4,040	9,892
					440	13,6	6,5	82,80	0,859	8,5	1773	115,81	4,040	9,934
12,5	9.194	IV	132L	200	220	32,5	13,0	83,50	0,888	7,4	1765	241,87	5,075	10,917
					380	18,8	7,5	83,50	0,888	7,4	1765	140,03	5,075	10,917
					440	16,4	6,5	82,60	0,890	7,1	1765	115,89	5,076	9,934
15	11.033	IV	132L	200	220	40,3	18,9	84,30	0,853	8,2	1767	330,16	6,081	16,531
					380	23,3	10,9	84,30	0,853	8,2	1767	191,15	6,081	16,531
					440	20,2	9,5	84,30	0,851	8,3	1767	167,49	6,080	16,709
20	14.710	IV	132L	200	220	51,7	18,9	84,30	0,886	6,7	1754	344,46	8,170	17,776
					380	29,9	10,9	84,30	0,886	6,7	1754	199,43	8,170	17,776
					440	26,8	12,1	84,30	0,853	7,4	1760	198,63	8,136	21,078
25	18,388	IV	160L	200	220	64,1	24,9	86,40	0,871	7,6	1768	487,33	10,27	20,78
					380	37,1	14,4	86,40	0,871	7,6	1768	282,14	10,27	20,78
					380	36,9	13,6	86,30	0,877	7,6	1766	280,53	10,27	19,72
					660	21,3	7,9	86,30	0,877	7,6	1766	161,52	10,27	19,72
					440	32,0	12,4	86,50	0,871	7,6	1768	243,38	10,27	20,83
					760	18,5	7,2	86,50	0,871	7,6	1768	140,91	10,27	20,83
30	22.065	IV	160L	200	220	76,6	29,4	87,00	0,869	7,3	1766	559,12	12,33	24,74
					380	44,3	17,0	87,00	0,869	7,3	1766	323,70	12,33	24,74
					380	44,2	16,4	86,90	0,873	7,1	1765	313,75	12,34	23,81
					660	25,4	9,5	86,90	0,873	7,1	1765	180,64	12,34	23,81
					440	38,3	14,7	87,10	0,869	7,3	1766	279,24	12,33	24,80
					760	22,1	8,5	87,10	0,869	7,3	1766	161,66	12,33	24,80

Table 4 – IV Pole Motors – 60Hz – Coated Wires (3 – 30 HP)

IV POLE MOTORS 60Hz – COATED WIRES – 90°C TEMPERATURE CLASS														
Mechanical Power (HP)	Mechanical Power (kW)	No of Poles	Frame	Package (mm)	Voltage (V)	Rated Current (A) (+-5%)	No Load Current (A) (+-20%)	Efficiency (%)	P.F. (cos Φ)	Ip/In	RPM	Starting Current (A)	Operation Torque (Kg.m)	Starting Torque (Kg.m)
40	29.420	IV	160L	200	220	101,8	35,9	87,20	0,870	6,6	1760	671,69	16,09	29,62
					380	58,9	20,7	87,20	0,870	6,6	1760	388,87	16,09	29,62
					380	58,9	20,5	87,00	0,872	6,5	1760	382,98	16,10	29,00
					660	33,9	11,8	87,00	0,872	6,5	1760	220,50	16,10	29,00
					440	50,9	17,9	87,20	0,870	6,6	1760	335,84	16,09	29,70
					760	29,5	10,3	87,20	0,870	6,6	1760	194,44	16,09	29,70
40	29.420	IV	225S	270	220	103,3	40,9	87,20	0,857	8,6	1786	888,51	16,26	41,84
					380	59,8	23,6	87,20	0,857	8,6	1786	514,40	16,26	41,84
					380	59,2	21,5	87,10	0,867	7,8	1785	461,70	16,27	37,21
					660	34,1	12,4	87,10	0,867	7,8	1785	265,82	16,27	37,21
					440	51,7	20,4	87,20	0,857	8,6	1786	444,25	16,26	41,90
					760	29,9	11,8	87,20	0,857	8,6	1786	257,20	16,26	41,90
50	36.775	IV	160T	430	220	123,0	46,6	89,60	0,876	8,6	1770	1062,97	20,51	50,61
					380	71,2	26,9	89,60	0,876	8,6	1770	615,41	20,51	50,61
					380	70,9	25,6	89,50	0,881	8,3	1769	588,15	20,52	48,00
					660	40,8	14,8	89,50	0,881	8,3	1769	338,63	20,52	48,00
					440	61,4	23,3	89,70	0,876	8,7	1770	534,27	20,51	50,74
					760	35,6	13,5	89,70	0,876	8,7	1770	309,32	20,51	50,74
50	36.775	IV	225S	270	220	127,2	46,9	88,20	0,860	8,0	1784	1017,87	20,30	49,00
					380	73,7	27,1	88,20	0,860	8,0	1784	589,29	20,30	49,00
					380	73,0	25,0	88,20	0,868	7,5	1784	547,37	20,40	44,50
					660	42,0	14,4	88,20	0,868	7,5	1784	315,15	20,40	44,50
					440	63,6	23,1	88,25	0,860	8,0	1784	508,65	20,30	49,10
					760	36,8	13,5	88,25	0,860	8,0	1784	294,48	20,30	49,10
60	44.130	IV	160T	430	220	145,9	46,6	89,20	0,890	7,3	1763	1064,92	24,69	50,61
					380	84,5	26,9	89,20	0,890	7,3	1763	616,53	24,69	50,61
					380	84,4	25,6	89,00	0,893	7,0	1762	586,91	24,74	48,00
					660	48,6	14,8	89,00	0,893	7,0	1762	337,92	24,74	48,00
					440	72,9	23,3	89,30	0,890	7,3	1764	531,87	24,69	50,74
					760	42,2	13,5	89,30	0,890	7,3	1764	307,92	24,69	50,74
60	44.130	IV	225S	270	220	150,4	52,9	89,20	0,863	7,6	1784	1141,27	24,43	56,23
					380	87,1	30,5	89,20	0,863	7,6	1784	660,73	24,43	56,23
					380	86,5	28,5	89,20	0,869	7,1	1782	614,13	24,44	51,79
					660	49,8	16,5	89,20	0,869	7,1	1782	353,59	24,44	51,79
					440	75,1	26,5	89,30	0,863	7,6	1784	570,52	24,43	56,32
					760	43,5	15,3	89,30	0,863	7,6	1784	330,30	24,43	56,32
75	55.163	IV	160T	430	220	183,2	66,0	89,90	0,879	7,5	1763	1373,96	29,86	72,53
					380	106,1	38,1	89,90	0,879	7,5	1763	795,45	29,86	72,53
					380	106,2	37,8	89,70	0,880	7,4	1762	785,70	29,83	72,02
					660	61,1	21,8	89,70	0,880	7,4	1762	452,37	29,83	72,02
					440	91,7	33,0	89,90	0,878	7,5	1763	687,76	29,86	72,70
					760	53,1	19,1	89,90	0,878	7,5	1763	398,18	29,86	72,70
75	55.163	IV	225S	270	220	190,1	74,0	90,10	0,845	8,1	1784	1533,88	30,12	78,15
					380	110,1	42,7	90,10	0,845	8,1	1784	888,04	30,12	78,15
					380	109,4	41,2	90,20	0,849	7,9	1784	863,28	30,13	75,81
					660	63,0	23,8	90,20	0,849	7,9	1784	497,04	30,13	75,81
					440	95,1	37,0	90,10	0,845	8,1	1784	767,70	30,12	78,28
					760	55,0	21,4	90,10	0,845	8,1	1784	444,46	30,12	78,28
80	58.840	IV	160T	430	220	195,4	66,0	89,90	0,879	7,5	1763	1458,72	32,53	72,39
					380	113,1	38,1	89,90	0,879	7,5	1763	844,52	32,53	72,39
					380	113,3	37,8	89,70	0,880	7,4	1762	834,23	32,54	71,00
					660	65,2	21,8	89,70	0,880	7,4	1762	480,31	32,54	71,00
					440	97,8	33,0	89,90	0,878	7,5	1763	731,36	32,53	72,59
					760	56,6	19,1	89,90	0,878	7,5	1763	423,42	32,53	72,59
100	73.550	IV	225S	270	220	263,3	118,5	90,50	0,810	8,0	1784	2117,00	40,31	114,06
					380	152,4	68,4	90,50	0,810	8,0	1784	1225,63	40,31	114,06
					380	153,6	70,9	90,40	0,805	8,1	1784	1245,82	40,30	116,09
					660	88,4	40,9	90,40	0,805	8,1	1784	717,29	40,30	116,09
					440	131,7	59,3	90,50	0,810	8,0	1784	1059,69	40,31	114,29
					760	76,2	34,2	90,50	0,810	8,0	1784	613,50	40,31	114,29
125	91.938	IV	225S	270	220	319,4	118,6	90,90	0,831	6,7	1779	2130,8	50,18	114,06
					380	184,9	68,5	90,90	0,831	6,7	1779	1233,6	50,18	114,06
					380	186,0	70,9	90,80	0,827	6,7	1780	1255,1	50,17	116,09
					660	107,1	40,9	90,80	0,827	6,7	1780	722,6	50,17	116,09
					440	159,7	59,3	90,90	0,831	6,7	1779	1066,7	50,18	114,29
					760	92,5	34,2	90,90	0,831	6,7	1779	617,5	50,18	114,29

Table 4 – Cont. IV Pole Motors – 60Hz – Coated Wires (40 – 125 HP)

IV POLE MOTORS 60Hz – COATED WIRES – 90°C TEMPERATURE CLASS														
Mechanical Power (HP)	Mechanical Power (kW)	No of Poles	Frame	Package (mm)	Voltage (V)	Rated Current (A) (+-5%)	No Load Current (A) (+-20%)	Efficiency (%)	P.F. (cos Φ)	Ip/In	RPM	Starting Current (A)	Operation Torque (Kg.m)	Starting Torque (Kg.m)
150	110.325	IV	225S	300	220	389,4	162,9	91,80	0,810	7,0	1780	2723,26	60,36	151,74
					380	225,4	94,1	91,80	0,810	7,0	1780	1576,62	60,36	151,74
					380	216,5	73,0	92,30	0,839	6,3	1777	1370,16	60,47	129,94
					660	124,6	42,1	92,30	0,839	6,3	1777	788,88	60,47	129,94
					440	194,7	81,5	91,80	0,810	7,0	1780	1363,38	60,36	152,08
					760	112,7	47,1	91,80	0,810	7,0	1780	789,33	60,36	152,08
150	110.325	IV	315S	230	380	208,1	69,8	92,90	0,867	8,0	1790	1656,4	60,05	120,07
					660	119,8	40,3	92,90	0,867	8,0	1790	953,7	60,05	120,07
					440	183,9	71,1	92,70	0,849	8,6	1791	1576,0	60,03	134,05
					760	106,5	41,0	92,70	0,849	8,6	1791	912,4	60,03	134,05
175	128.713	IV	225L	400	380	245,1	80,7	92,90	0,859	7,4	1780	1809,7	70,40	186,60
					660	141,1	46,6	92,90	0,859	7,4	1780	1042,0	70,40	186,60
					440	215,4	81,2	92,90	0,844	8,0	1782	1732,91	70,51	211,91
					760	124,7	46,9	92,90	0,844	8,0	1782	1003,26	70,51	211,91
175	128.713	IV	315S	230	380	240,6	69,8	93,00	0,874	6,9	1788	1653,35	70,24	120,07
					660	138,5	40,3	93,00	0,874	6,9	1788	951,93	70,24	120,07
					440	211,1	71,1	92,90	0,861	7,4	1789	1572,85	70,22	134,05
					760	122,2	41,0	92,90	0,861	7,4	1789	910,60	70,22	134,05
200	147.100	IV	225L	400	380	279,4	80,7	92,70	0,863	6,5	1776	1812,27	80,54	186,60
					660	160,8	46,6	92,70	0,863	6,5	1776	1043,43	80,54	186,60
					440	243,8	81,2	92,80	0,853	7,1	1779	1739,54	80,40	211,91
					760	141,2	46,9	92,80	0,853	7,1	1779	1007,10	80,40	211,91
200	147.100	IV	315S	230	380	274,6	69,8	93,00	0,875	6,0	1786	1649,27	80,52	120,07
					660	158,1	40,3	93,00	0,875	6,0	1786	949,58	80,52	120,07
					440	239,9	71,1	92,90	0,866	6,6	1787	1572,43	80,41	134,05
					760	138,9	41,0	92,90	0,866	6,6	1787	910,36	80,41	134,05
250	183.875	IV	315S	300	380	337,7	86,5	93,70	0,883	6,9	1788	2333,22	100,29	185,73
					660	194,4	49,9	93,70	0,883	6,9	1788	1343,37	100,29	185,73
					440	292,3	78,5	93,80	0,880	7,1	1788	2083,49	100,28	193,29
					760	169,2	45,3	93,80	0,880	7,1	1788	1206,23	100,28	193,29
300	220.650	IV	315S	300	380	408,4	86,5	93,50	0,878	5,7	1784	2336,28	120,43	185,73
					660	235,1	49,9	93,50	0,878	5,7	1784	1345,13	120,43	185,73
					440	352,7	78,5	93,60	0,877	5,9	1785	2086,97	120,41	193,29
					760	204,2	45,3	93,60	0,877	5,9	1785	1208,25	120,41	193,29
350	257.425	IV	315S	300	380	486,8	86,5	93,10	0,863	4,7	1780	2304,00	142,71	185,73
					660	280,3	49,9	93,10	0,863	4,7	1780	1326,55	142,71	185,73
					440	419,0	78,5	93,20	0,865	4,9	1781	2057,67	142,67	193,29
					760	242,6	45,3	93,20	0,865	4,9	1781	1191,28	142,67	193,29
350	257.425	IV	315L	460	380	468,8	140,4	94,60	0,882	9,2	1790	4291,46	140,35	391,20
					660	269,9	81,1	94,60	0,882	9,2	1790	2470,84	140,35	391,20
					440	412,3	143,0	94,50	0,867	9,9	1791	4084,82	140,30	437,40
					760	238,7	82,6	94,50	0,867	9,9	1791	2364,89	140,30	437,40
400	294.200	IV	315S	350	440	473,5	113,8	93,60	0,871	6,1	1785	2866,67	162,72	286,50
					760	274,1	65,7	93,60	0,871	6,1	1785	1659,65	162,72	286,50
400	294.200	IV	315L	460	380	533,3	140,4	94,60	0,886	8,1	1789	4294,68	160,32	391,20
					660	307,1	81,1	94,60	0,886	8,1	1789	2472,70	160,32	391,20
					440	466,9	143,0	94,50	0,875	8,8	1790	4090,65	160,27	437,40
					760	270,3	82,6	94,50	0,875	8,8	1790	2368,27	160,27	437,40
450	330.975	IV	315L	460	380	601,3	140,4	94,50	0,885	7,1	1787	4269,08	182,90	391,20
					660	346,2	81,1	94,50	0,885	7,1	1787	2457,95	182,90	391,20
					440	523,4	143,0	94,50	0,878	7,7	1788	4030,38	182,68	437,40
					760	303,0	82,6	94,50	0,878	7,7	1788	2333,38	182,68	437,40
500	367.750	IV	315L	460	380	696,2	237,5	94,20	0,852	8,1	1789	5635,53	202,96	541,78
					660	400,8	137,1	94,20	0,852	8,1	1789	3244,70	202,96	541,78
					440	615,5	239,7	94,00	0,834	8,5	1789	5214,73	202,91	586,85
					760	356,4	138,4	94,00	0,834	8,5	1789	3019,05	202,91	586,85
550	404.525	IV	315L	460	380	762,2	237,5	94,20	0,856	7,4	1787	5632,76	223,34	541,78
					660	438,9	137,1	94,20	0,856	7,4	1787	3243,10	223,34	541,78
					440	672,2	239,7	94,00	0,840	7,8	1787	5243,48	223,53	517,92
					760	389,2	138,4	94,00	0,840	7,8	1787	3035,70	223,53	517,92
600	441.300	IV	315L	460	380	831,4	237,5	94,10	0,857	6,8	1786	5653,64	243,98	541,78
					660	478,7	137,1	94,10	0,857	6,8	1786	3255,13	243,98	541,78
					440	729,9	239,7	94,00	0,844	7,2	1787	5220,09	243,68	586,85
					760	422,6	138,4	94,00	0,844	7,2	1787	3022,16	243,68	586,85
650	478.075	IV	315T	660	440	744,3	132,8	94,70	0,890	6,2	1785	4614,60	264,44	519,04
					760	430,9	76,7	94,70	0,890	6,2	1785	2671,61	264,44	519,04
750	551.625	IV	315T	660	440	871,6	225,4	94,80	0,876	7,4	1787	6449,85	304,87	757,60
					760	504,6	130,1	94,80	0,876	7,4	1787	3734,13	304,87	757,60

Table 4 – Cont. IV Pole Motors – 60Hz – Coated Wires (150 – 750 HP)

VI POLE MOTORS 60Hz – COATED WIRES – 90°C TEMPERATURE CLASS														
Mechanical Power (HP)	Mechanical Power (kW)	No of Poles	Frame	Package (mm)	Voltage (V)	Rated Current (A) (+-5%)	No Load Current (A) (+-20%)	Efficiency (%)	P.F. (cos Φ)	Ip/In	RPM	Starting Current (A)	Operation Torque (Kg.m)	Starting Torque (Kg.m)
75	55.163	VI	225S	300	220	193,1	70,6	88,60	0,846	5,4	1180	1040,02	46,16	79,53
					380	111,8	40,8	88,60	0,846	5,4	1180	602,12	46,16	79,53
					380	112,6	42,6	88,80	0,838	5,4	1180	604,58	46,15	78,01
					660	64,8	24,6	88,80	0,838	5,4	1180	348,09	46,15	78,01
					440	96,5	35,3	88,70	0,846	5,4	1180	520,10	46,16	79,70
					760	55,8	20,4	88,70	0,846	5,4	1180	301,11	46,16	79,70
100	73.550	VI	225S	300	220	276,4	130,2	88,40	0,790	5,5	1180	1509,36	61,53	119,73
					380	160,0	75,2	88,40	0,790	5,5	1180	873,84	61,53	119,73
					380	157,8	70,8	88,50	0,800	5,4	1180	845,53	61,56	115,31
					660	90,9	40,9	88,50	0,800	5,4	1180	486,82	61,56	115,31
					440	138,2	65,1	88,40	0,790	5,5	1180	753,99	61,53	119,56
					760	80,0	37,6	88,40	0,790	5,5	1180	436,52	61,53	119,56
100	73.550	VI	225L	420	380	149,4	62,7	90,00	0,831	6,3	1183	939,97	61,37	129,75
					660	86,0	36,2	90,00	0,831	6,3	1183	541,20	61,37	129,75
125	91.938	VI	225L	420	220	327,4	146,0	91,10	0,809	6,0	1182	1952,78	76,77	157,76
					380	189,5	84,3	91,10	0,809	6,0	1182	1130,56	76,77	157,76
					380	187,0	80,1	91,30	0,818	6,0	1182	1122,21	76,79	157,29
					660	107,7	46,2	91,30	0,818	6,0	1182	646,12	76,79	157,29
					440	163,7	73,0	91,10	0,809	6,0	1182	982,12	76,77	158,13
					760	94,8	42,1	91,10	0,809	6,0	1182	568,59	76,77	158,13
150	110.325	VI	225L	420	220	399,3	184,8	91,10	0,796	6,0	1185	2382,00	90,66	203,82
					380	231,2	106,7	91,10	0,796	6,0	1185	1379,05	90,66	203,82
					380	229,7	102,1	91,00	0,802	5,7	1185	1316,96	90,68	190,02
					660	132,2	58,9	91,00	0,802	5,7	1185	758,25	90,68	190,02
					440	199,6	92,4	91,10	0,796	6,0	1185	1193,20	90,66	204,48
					760	115,6	53,4	91,10	0,796	6,0	1185	690,80	90,66	204,48
250	183.875	VI	315L	460	380	355,8	119,1	93,80	0,837	6,5	1191	2302,62	152,40	354,31
					660	204,9	68,8	93,80	0,837	6,5	1191	1325,75	152,40	354,31
600	441.300	VI	355T	650	440	750,6	265,6	94,20	0,819	5,9	1192	4428,31	365,42	748,13
					760	434,5	153,3	94,20	0,819	5,9	1192	2563,76	365,42	748,13

Table 5 – VI Pole Motors – 60Hz – Coated Wires

VIII POLE MOTORS 60Hz – COATED WIRES – 90°C TEMPERATURE CLASS														
Mechanical Power (HP)	Mechanical Power (kW)	No of Poles	Frame	Package (mm)	Voltage (V)	Rated Current (A) (+-5%)	No Load Current (A) (+-20%)	Efficiency (%)	P.F. (cos Φ)	Ip/In	RPM	Starting Current (A)	Operation Torque (Kg.m)	Starting Torque (Kg.m)
50	36.775	VIII	225S	300	440	71,8	38,8	91,30	0,736	4,7	888	340,46	40,88	67,42
					760	41,6	22,4	91,30	0,736	4,7	888	197,11	40,88	67,42
60	44.130	VIII	225L	360	220	172,1	93,3	91,30	0,737	4,8	889	824,42	49,05	82,20
					380	99,6	53,9	91,30	0,737	4,8	889	477,30	49,05	82,20
					380	107,7	68,4	90,90	0,685	5,4	890	577,70	48,93	102,75
					660	62,0	39,5	90,90	0,685	5,4	890	332,62	48,93	102,75
					440	86,1	46,6	91,30	0,737	4,8	889	412,64	49,05	82,35
					760	49,8	26,9	91,30	0,737	4,8	889	238,90	49,05	82,35
75	55.163	VIII	225S	300	440	108,6	50,5	88,60	0,752	3,9	883	418,91	61,67	86,15
					760	62,9	29,2	88,60	0,752	3,9	883	242,52	61,67	86,15
150	110.325	VIII	315L	400	380	244,9	119,9	92,00	0,744	5,6	893	1375,54	121,95	279,10
					660	141,0	69,2	92,00	0,744	5,6	893	791,98	121,95	279,10
					440	215,0	109,5	92,50	0,728	5,6	893	1209,23	121,92	278,52
					760	124,5	63,2	92,50	0,728	5,6	893	700,08	121,92	278,52
175	128.713	VIII	315L	460	380	285,1	138,4	92,70	0,740	5,6	893	1604,71	142,26	327,69
					660	164,1	79,9	92,70	0,740	5,6	893	923,92	142,26	327,69
					440	236,9	92,9	92,70	0,769	4,8	892	1137	142,50	262,28
					760	137,2	53,6	92,70	0,769	4,8	892	658	142,50	262,28
200	147.100	VIII	315L	460	380	321,7	138,4	92,50	0,751	5,0	892	1603,16	162,83	327,69
					660	185,2	79,9	92,50	0,751	5,0	892	923,03	162,83	327,69
					440	282,7	132,4	92,50	0,738	5,3	893	1491,50	162,67	357,60
					760	163,7	76,4	92,50	0,738	5,3	893	863,50	162,67	357,60
250	183.875	VIII	315L	460	380	423,1	192,3	91,70	0,720	4,6	891	1959,10	203,67	406,68
					660	243,6	111,0	91,70	0,720	4,6	891	1127,97	203,67	406,68
					440	369,4	175,9	91,60	0,713	4,7	892	1745,53	203,63	421,78
					760	213,9	101,6	91,60	0,713	4,7	892	1010,57	203,63	421,78
300	220.650	VIII	315T	660	440	430,6	208,6	93,00	0,723	5,2	892	2239,10	244,04	541,04
					760	249,3	120,4	93,00	0,723	5,2	892	1296,32	244,04	541,04
500	367.750	VIII	355T	840	440	729,2	383,6	93,60	0,707	5,1	894	3718,90	406,10	838,31
					760	422,2	221,5	93,60	0,707	5,1	894	2153,05	406,10	838,31

Table 6 – VIII Pole Motors – 60Hz – Coated Wires

II POLE MOTORS 50Hz – COATED WIRES – 90°C TEMPERATURE CLASS														
Mechanical Power (HP)	Mechanical Power (kW)	No of Poles	Frame	Package (mm)	Voltage (V)	Rated Current (A) (+-5%)	No Load Current (A) (+-20%)	Efficiency (%)	P.F. (cos Φ)	Ip/In	RPM	Starting Current (A)	Operation Torque (Kg.m)	Starting Torque (Kg.m)
20	14.710	II	132L	200	220	49,3	18,10	88,00	0,890	7,0	2910	345,03	4,91	12,94
					380	28,5	10,50	88,00	0,890	7,0	2910	199,75	4,91	12,94
					440	24,6	9,00	88,00	0,890	7,0	2910	172,51	4,91	12,94
30	22.065	II	132L	200	380	43,7	10,68	84,40	0,909	5,1	2856	221,72	7,524	14,070

Table 7 – II Pole Motors – 50Hz – Coated Wires

IV POLE MOTORS 50Hz – COATED WIRES – 90°C TEMPERATURE CLASS														
Mechanical Power (HP)	Mechanical Power (kW)	No of Poles	Frame	Package (mm)	Voltage (V)	Rated Current (A) (+-5%)	No Load Current (A) (+-20%)	Efficiency (%)	P.F. (cos Φ)	Ip/In	RPM	Starting Current (A)	Operation Torque (Kg.m)	Starting Torque (Kg.m)
3	2.207	IV	112M	130	220	11,3	8,8	73,70	0,695	6,1	1465	68,63	1,466	3,557
					380	6,5	5,1	73,70	0,695	6,1	1465	39,73	1,466	3,557
10	7.355	IV	132L	200	220	29,2	17,2	82,10	0,804	7,7	1475	224,22	4,855	11,249
					380	16,9	9,9	82,10	0,804	7,7	1475	129,81	4,855	11,249
15	11.033	IV	132L	200	220	39,6	14,6	82,00	0,891	6,1	1455	240,74	7,383	14,325
					380	22,9	8,5	82,00	0,891	6,1	1455	139,37	7,383	14,325
25	18.388	IV	160L	200	220	66,6	29,9	85,50	0,848	7,6	1470	507,54	12,35	28,08
					380	38,5	17,3	85,50	0,848	7,6	1470	293,84	12,35	28,08
					380	38,6	17,1	84,40	0,857	7,2	1471	279,79	12,35	23,78
					660	22,2	9,9	84,40	0,857	7,2	1471	161,09	12,35	23,78
30	22.065	IV	160L	200	220	80,1	36,3	85,90	0,842	7,3	1467	587,72	14,84	33,32
					380	46,4	21,0	85,90	0,842	7,3	1467	340,26	14,84	33,32
					380	46,7	21,6	85,20	0,842	7,2	1470	338,52	14,83	30,21
					660	26,9	12,5	85,20	0,842	7,2	1470	194,91	14,83	30,21
					440	40,1	18,1	85,90	0,841	7,3	1467	292,57	14,84	33,41
					760	23,2	10,5	85,90	0,841	7,3	1467	169,38	14,84	33,41
40	29.420	IV	225S	270	380	58,7	21,4	88,00	0,865	7,5	1485	439,12	19,56	44,34
					660	33,8	12,4	88,00	0,865	7,5	1485	252,83	19,56	44,34
50	36.775	IV	225S	270	220	126,5	42,3	87,90	0,868	6,8	1482	861,41	24,49	51,49
					380	73,2	24,4	87,90	0,868	6,8	1482	498,71	24,49	51,49
					380	74,2	28,2	88,00	0,856	7,6	1485	566,76	24,46	59,72
					660	42,7	16,3	88,00	0,856	7,6	1485	326,32	24,46	59,72
					440	63,2	21,1	87,90	0,868	6,8	1483	431,08	24,49	51,57
					760	36,6	12,2	87,90	0,868	6,8	1483	249,57	24,49	51,57
60	44.130	IV	225S	270	220	152,3	54,7	88,60	0,858	7,1	1483	1075,10	29,38	66,24
					380	88,2	31,6	88,60	0,858	7,1	1483	622,43	29,38	66,24
					380	87,3	28,2	88,60	0,867	6,5	1481	566,74	29,40	59,72
					660	50,3	16,3	88,60	0,867	6,5	1481	326,30	29,40	59,72
					440	76,2	27,3	88,60	0,858	7,1	1483	538,16	29,38	66,35
					760	44,1	15,8	88,60	0,858	7,1	1483	311,57	29,38	66,35
75	55.163	IV	225S	270	380	110,2	40,1	89,50	0,850	6,8	1481	744,74	36,75	81,24
					660	63,4	23,2	89,50	0,850	6,8	1481	428,79	36,75	81,24
100	73.550	IV	225S	270	220	267,2	122,2	90,30	0,800	7,0	1482	1865,79	48,51	123,76
					380	154,7	70,6	90,30	0,800	7,0	1482	1080,20	48,51	123,76
					380	152,8	66,7	90,40	0,809	6,9	1481	1048,97	48,52	119,71
					660	88,0	38,5	90,40	0,809	6,9	1481	603,95	48,52	119,71
					440	133,5	61,1	90,50	0,799	7,0	1482	938,27	48,51	125,23
					760	77,3	35,3	90,50	0,799	7,0	1482	543,21	48,51	125,23
125	91.938	IV	225S	300	380	195,5	93,3	91,00	0,785	6,8	1481	1338,67	60,78	158,36
					660	112,6	53,9	91,00	0,785	6,8	1481	770,75	60,78	158,36
150	110.325	IV	315S	230	220	363,5	118,5	92,20	0,864	6,8	1488	2469,65	73,16	139,13
					380	210,4	68,4	92,20	0,864	6,8	1488	1429,80	73,16	139,13
					380	214,9	80,2	92,00	0,848	7,2	1489	1555,55	73,14	152,82
					660	123,7	46,3	92,00	0,848	7,2	1489	895,62	73,14	152,82
					440	181,7	59,3	92,20	0,864	6,8	1488	1236,28	73,16	139,38
					760	105,2	34,2	92,20	0,864	6,8	1488	715,74	73,16	139,38
350	257.425	IV	315L	460	380	480,5	161,5	94,10	0,865	8,3	1490	3988,22	170,6	486,91
					660	276,7	93,2	94,10	0,865	8,3	1490	2296,25	170,6	486,91

Table 8 – IV Pole Motors – 50Hz – Coated Wires

VI POLE MOTORS 50Hz – COATED WIRES – 90°C TEMPERATURE CLASS														
Mechanical Power (HP)	Mechanical Power (kW)	No of Poles	Frame	Package (mm)	Voltage (V)	Rated Current (A) (+-5%)	No Load Current (A) (+-20%)	Efficiency (%)	P.F. (cos Φ)	Ip/In	RPM	Starting Current (A)	Operation Torque (Kg.m)	Starting Torque (Kg.m)
175	128.713	VI	315L	460	380	249,2	85,8	93,20	0,842	6,2	992	1553,51	128,12	288,70
					660	143,5	49,5	93,20	0,842	6,2	992	894,45	128,12	288,70
250	183.875	VI	315L	460	380	361,3	99,2	92,50	0,836	5,0	989	1797,31	181,36	344,02
					660	208,0	57,3	92,50	0,836	5,0	989	1034,82	181,36	344,02
					440	312,0	83,5	92,40	0,837	4,9	989	1522,41	181,39	336,55
					760	180,6	48,2	92,40	0,837	4,9	989	881,40	181,39	336,55

Table 9 – VIII Pole Motors – 50Hz – Coated Wires

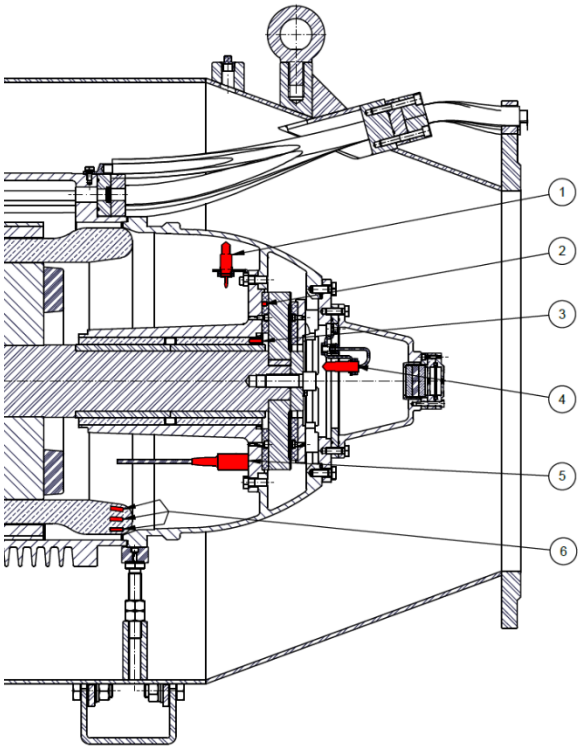
NOTE: For details on voltages different from the ones available on this chart, please contact HIGRA's local representative.

2.5.3.4 Sensing Devices

HIGRA pumps might be equipped with sensors that monitor their operation, enabling to detect abnormalities that might manifest in response to failures. There are three different categories of sensing:

- *Standard:* Installation of one RTD PT-100 temperature sensor on one of the winding's phases. It monitors the temperature and prevents excessive heating that might damage the equipment insulation. This is the only configuration available for HIGRA pumps with motors up to 125 HP.
- *Basic:* Available for motors from 150 HP on. Besides the RTD PT-100 temperature sensor installed at one of the winding's phases, this option also includes the following sensors:
    - (1x) RTD PT-100 temperature sensor at the Rear Bearing;
    - (1x) RTD PT-100 temperature sensor at the Graphite Sliding Ring (thrust bearing);
    - (2x) Photoelectric level sensors to monitor the level of fluid inside the motor in both horizontal and vertical installation positions.
- *Premium*: Includes all sensors of *Basic* category, plus:
    - (2x) RTD PT-100 temperature sensors on the other two phases of the winding;
    - (1x) Vibration Sensor.

Figure 28 shows installation spots for each sensing device.



1- Photoelectric Level Sensor for pump installed in horizontal position
2- Temperature Sensor for the Graphite Sliding Disc (thrust bearing)
3- Temperature Sensor for Rear Radial Bearing
4- Photoelectric Level Sensor for pump installed in vertical position
5- Vibration Sensor
6- Temperature sensor in one or three stages of the coil.

Figure 28 – Sensors installation spots

Used Sensors

Monitoring Variable	Sensor	Sensing Category
Temperature of the winding in one of the phases	PT-100, analog reading of temperature on the winding of one of the phases	*Standard*
Temperature of the Rear Radial Bearing	PT-100, analog reading of temperature on the Rear Radial Bearing	*Basic*
Temperature of the Graphite Sling Disc (thrust bearing)	PT-100, analog reading of temperature on the Graphite Sliding Disc	
Level of the fluid inside the motor	24 V NPN Photoelectric Sensor	
Temperature of the winding of phases 2 & 3	PT-100, analog reading of temperature on the winding of phases 2 & 3	*Premium*
Vibration	Sensor of analog output 4-20 mA proportional to the vibration level	

Table 10 – Categories of sensing and sensing devices

RTD PT-100 Temperature Sensor

Description	Measurement	Failure Figures
Resistor that varies resistance according to temperature	Resistance: • 100 ohm @ 0ºC (32ºF). • 107.79 ohm @ ambient temperature (20ºC / 68ºF). • 138.5 ohm @ 100ºC (212ºF). Force to resistance between 0 and 160 0ºC (32–212ºF) – please see PT100 force chart (Chart 15). PT100 should not be connected to voltages higher than 2.5 V.	> 200 ohms (approx.) might indicate the following situations: • Broken sensor • Bad contact < 70 ohms (approx.) might indicate: • Short circuit.

Table 11 – RTD PT-100 Temperature Sensor

Photoelectric Level Sensor

Description	Measurement	Failure Figures
The level sensor is a NPN photoelectric sensor installed in the rear part of the motor set.	+24V voltage signal, indicating when active or not.	If does not indicate the acting: • Broken sensor • Bad contact • Short circuit

Table 12 – Photoelectric Level Sensor

Vibration Sensor

Description	Measurement	Failure Figures
The vibration sensor is installed on the rear bearing. The output is a 4-20 mA signal proportional to the vibration level.	4 to 20mA electric current signal.	• >> 20 mA indicates short circuit • << 4 mA indicates failure • Zero might indicate damaged wire or bad contact.

Table 13 – Vibration Sensor

Sensors Installation

In a standard supply, one RTD-PT100 is embedded on the stator winding, which accommodates it uniformly alongside the its extension.

This sensor enables the continuous temperature monitoring, allowing evaluation of data obtained along a period of the time. This way, when temperature is higher than the limits established for HIGRA equipment, it is possible to take actions before the equipment is damaged.

The RTD-PT100 is connected through a cable with three 0.75 mm² conductors and protected against interferences, located between the motor connection electric cables. For protection purposes the sensor must be connected to the **NOVUS N1040 Indicator/Controller**, supplied with the equipment, which is set to turn the pump off when the winding internal temperature reaches 70°C (158 °F).

The National Electric Manufactures Association (NEMA) recognizes the RTD-PT100 for stators as a standard protection for motors.

IMPORTANT: For the standard supply, it is mandatory that the NOVUS N1040 indicator/controller is installed with the sensor cable mesh grounded, otherwise the equipment is not covered by warranty (as per chapter 5).

THERMAL PROTECTION RELAY TECHNICAL DATA:

Brand: NOVUS; Model: N1040;

Tension: 100 Vca or 240 Vca 50/60 Hz;

Sensors: Sensor type RTD-PT100;

Output 1 Pulse: Voltage pulse, 5 Vcc / 25 mA;

Output 2 Relay, Output 3 Relay: Relay SPST; 1,5 A / 240 Vca / 30 Vcc;

Output 4 Relay: Relay SPST; 3 A / 240 Vca / 30 Vcc;

Ambient temperature: 0 to 50 °C;

Maximum humidity: 80% @ 30°C;

Consumption: 5 VA

Dimensions: 48 x 48 x 80 mm; approximate weight: 60 g;

Protection grade: IP30, ABS+PC UL94 V-0

Communication: RS485.

Figura 29 – N1040 Thermal Relay

IMPORTANT: The NOVUS N1040 controller shall be connected to a driving contactor or device that activates the motor (as per figures 33 & 34) to automatically turn the pump off in an overheating situation. The Indicator/Controller shall not be connected to a device of sound alarm only, since this method demands manual intervention for the equipment turn off and cancels the product warranty.

RTD-PT100 sensors have an ohmic resistance characteristic curve in regards to temperature, for being a sensor based on high degree of purity. The Ohmic resistance figures per temperature variation are available on Table 14.

T (ºC)	R (Ω)	T (ºC)	R (Ω)	T (ºC)	R (Ω)	T (ºC)	R (Ω)	T (ºC)	R (Ω)
-9	96.48	25	109.73	59	122.85	93	135.84	127	148.70
-8	96.87	26	110.12	60	123.24	94	136.23	128	149.08
-7	97.26	27	110.51	61	123.62	95	136.61	129	149.45
-6	97.65	28	110.90	62	124.00	96	136.98	130	149.83
-5	98.04	29	111.28	63	124.39	97	137.37	131	150.21
-4	98.44	30	111.67	64	124.77	98	137.75	132	150.58
-3	98.83	31	112.06	65	125.16	99	138.13	133	150.95
-2	99.22	32	112.45	66	125.54	100	138.50	134	151.33
-1	99.61	33	112.83	67	125.92	101	138.88	135	151.71
0	100.00	34	113.22	68	126.31	102	139.26	136	152.08
1	100.39	35	113.61	69	126.69	103	139.64	137	152.46
2	100.78	36	113.99	70	127.07	104	140.02	138	152.83
3	101.17	37	114.38	71	127.45	105	140.40	139	153.21
4	101.56	38	114.77	72	127.84	106	140.78	140	153.58
5	101.95	39	115.15	73	128.22	107	141.16	141	153.96
6	102.34	40	115.54	74	128.60	108	141.53	142	154.33
7	102.73	41	115,92	75	128.98	109	141.91	143	154.71
8	103.12	42	116,31	76	129.37	110	142.29	144	155.08
9	103.51	43	116.69	77	129.75	111	142.67	145	155.46
10	103.90	44	117.08	78	130.13	112	143.05	146	155.83
11	104.29	45	117.47	79	130.51	113	143.42	147	156.20
12	104.68	46	117.85	80	130.89	114	143.80	148	156.58
13	105.07	47	118.24	81	131.28	115	144.18	149	156.95
14	105.46	48	118.62	82	131.66	116	144.56	150	157.32
15	105.85	49	119.01	83	132.04	117	144.93	151	157.69
16	106.24	50	119.39	84	132.42	118	145.31	152	158.07
17	106.63	51	119.78	85	132.80	119	145.69	153	158.44
18	107.02	52	120.17	86	133.18	120	146.07	154	158.81
19	107.40	53	120.55	87	133.56	121	146.44	155	159.19
20	107.79	54	120.93	88	133.94	122	146.82	156	159.56
21	108.18	55	121.32	89	134.32	123	147.19	157	159.93
22	108.57	56	121.70	90	134.70	124	147.57	158	160.31
23	108.96	57	122.09	91	135.08	125	147.85	159	160.68
24	109.35	58	122.47	92	135.46	126	148.33	160	161.05

Table 14 - RTD-PT100 Temperature x Resistance

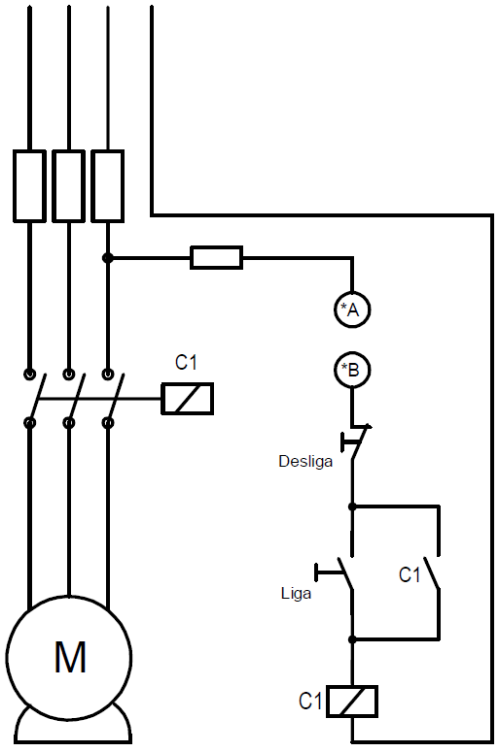


Figure 31 - Diagram of connection of indicator/controller to the start button

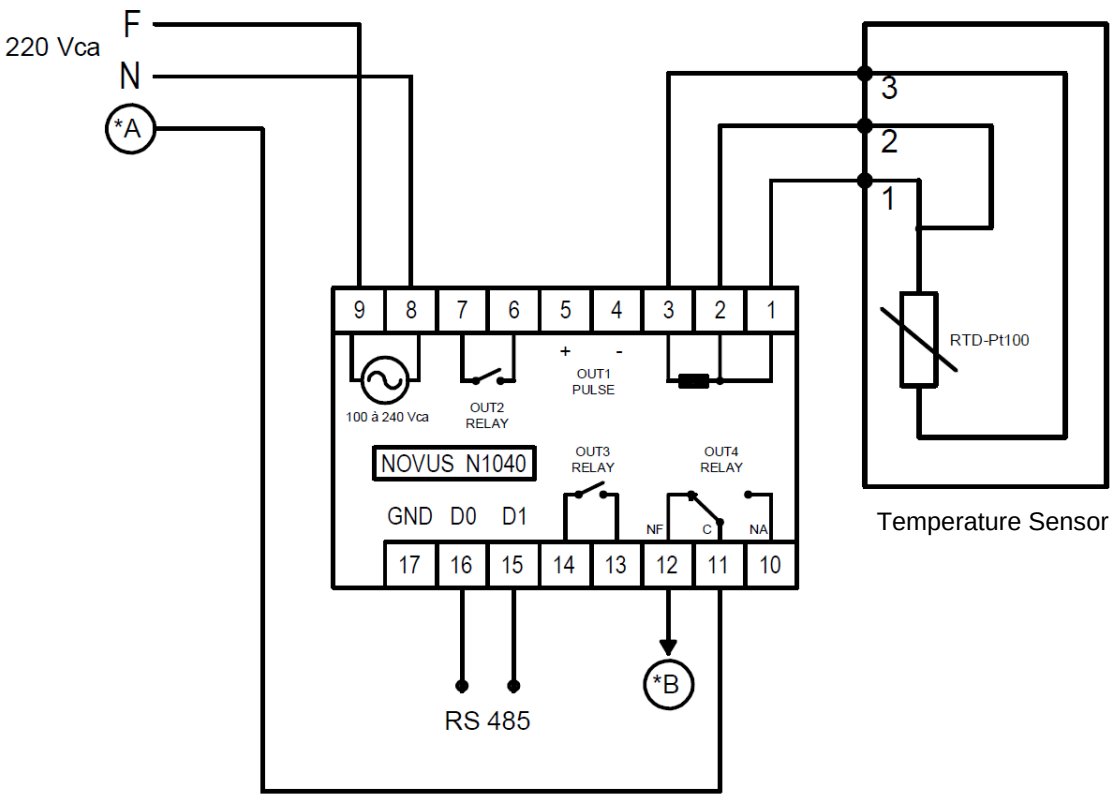


Figure 32 – Diagram of connection of RTD-PT100 sensor to the NOVUS N1040 controller

Standard and *Premium* sensing categories are supplied with the *Sensorcontroller,* that measures multiple sensors, registers the taken variables, commands via auxiliar relays and monitors via communication network. The *Sensorcontroller* is supplied with minimum measurement, trip and record program.

Figura 33 – *Sensor Controller*

SENSORCONTROLLER TECHNICL DATA:

- Tension: 24 Vcc/Vca 50/60 Hz
- 8 configurable analog inputs: PT100, 0 a 10V, 4 a 20 mA
- 8 configurable digital inputs/outputs
- 2 configurable reversible relays, 3 A / 250 Vca / 30 Vcc
- Ambient temperature: 0 a 50 °C
- Maximum humidity: 80% @ 30°C
- Consumption: 10 VA
- Dimensions: 164 x 117 x 70 mm
- Approximate weight: 400 g
- Protection grade: IP20
- Communication: RS485 and TCP/IP
- Internal memory: 512 thousand records
- Data collection: via network or USB
- Set up: via USB.

IMPORTANT: Pumps equipped with Basic and Premium sensing categories are covered by warranty only if the sensor cable is grounded and connected to the Sensorcontroller, as well as if the last one is connected to a contactor or start device that will turn the pump off automatically in the case of abnormal functioning conditions.

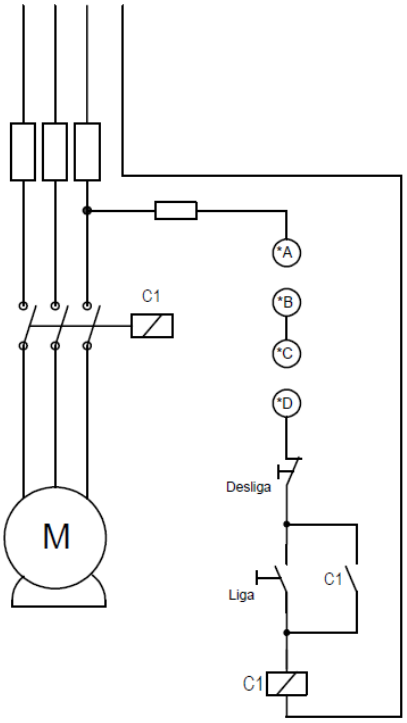


Figure 34 – Diagram of connection of the *Sensorcontroller* to the start command

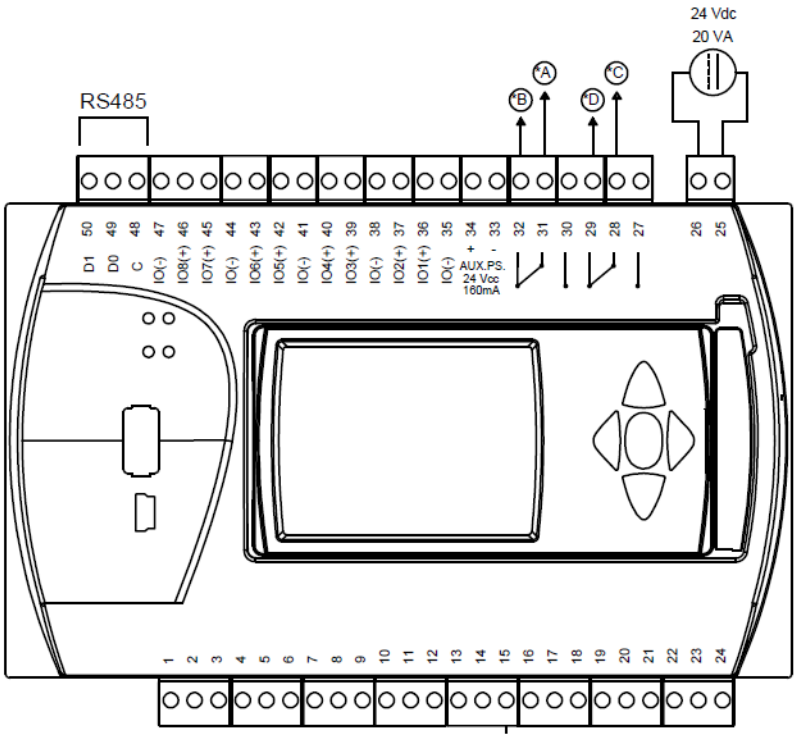


Figure 35 – Diagram of connection of sensors to the *Sensorcontroller*

Basic and Premium sensing demand a 36 via cable split in sets of three 0.5 mm² conductors. Such cable is shielded against interferences in any set and general shielding. The cable used for the sensors has different number and color for each via. Each set is used for a type of sensor, following the connection schemes below:

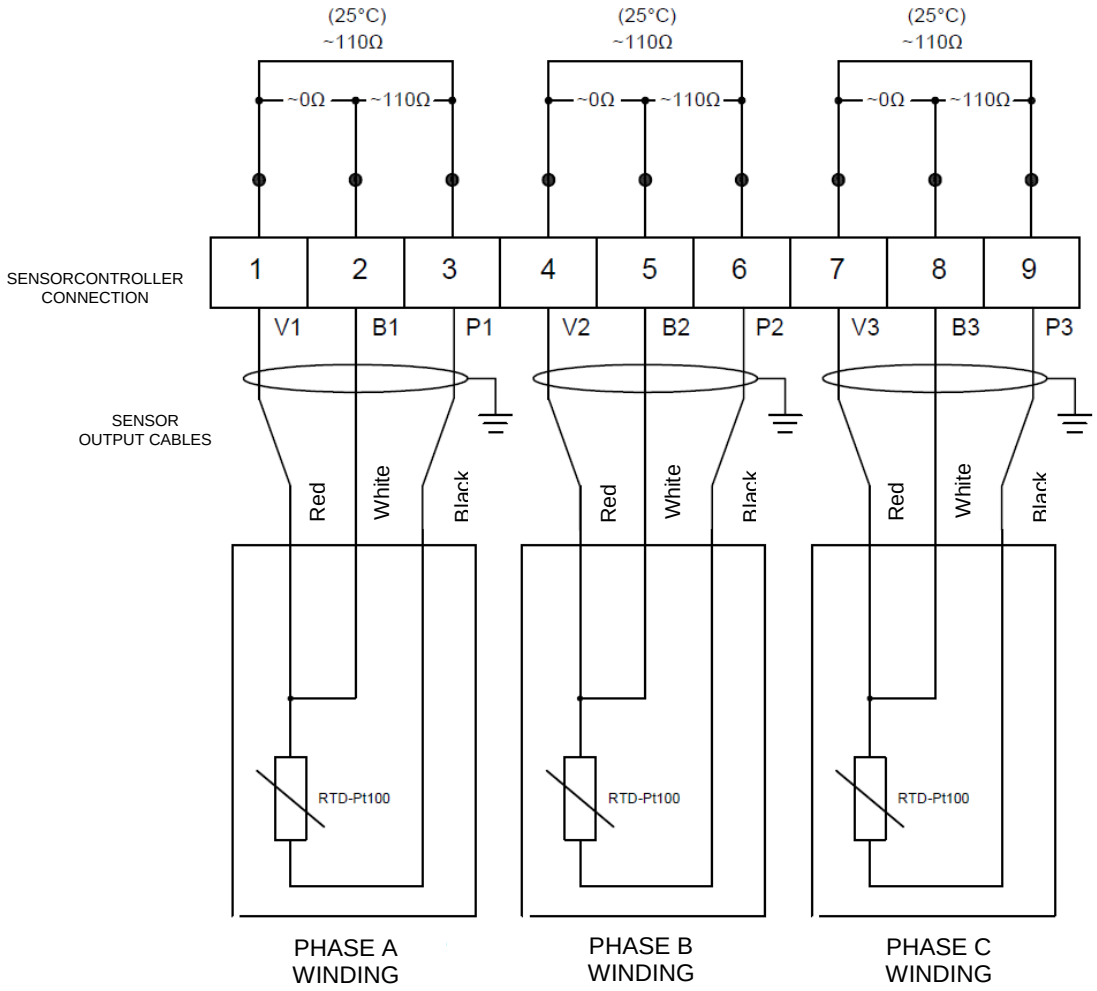


Figure 36 – Diagram of connection of RTD-PT100 sensors to the three phases of winding (*Premium* sensing)

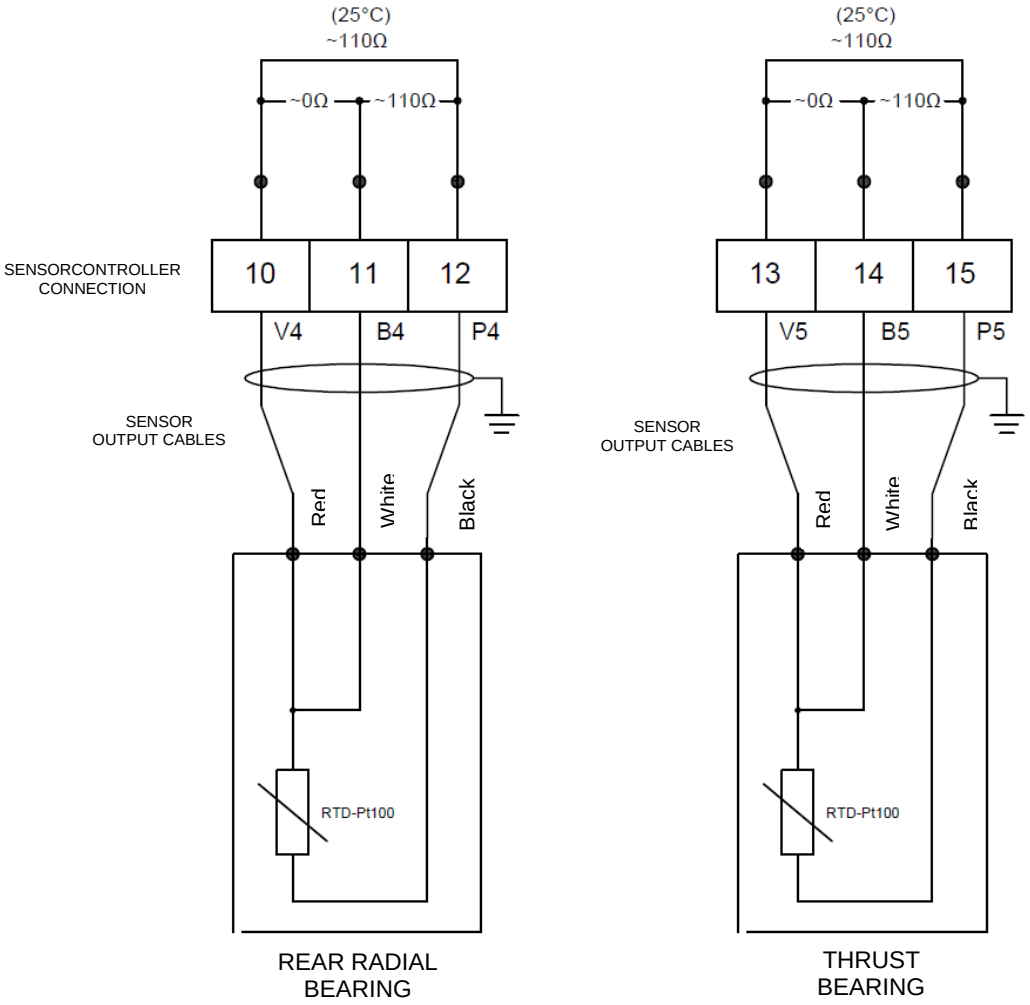


Figure 37 – Diagram of connection of RTD-PT100 sensors to the Rear Radial Bearing and Axial Bearing (*Basic* and *Premium* sensing)

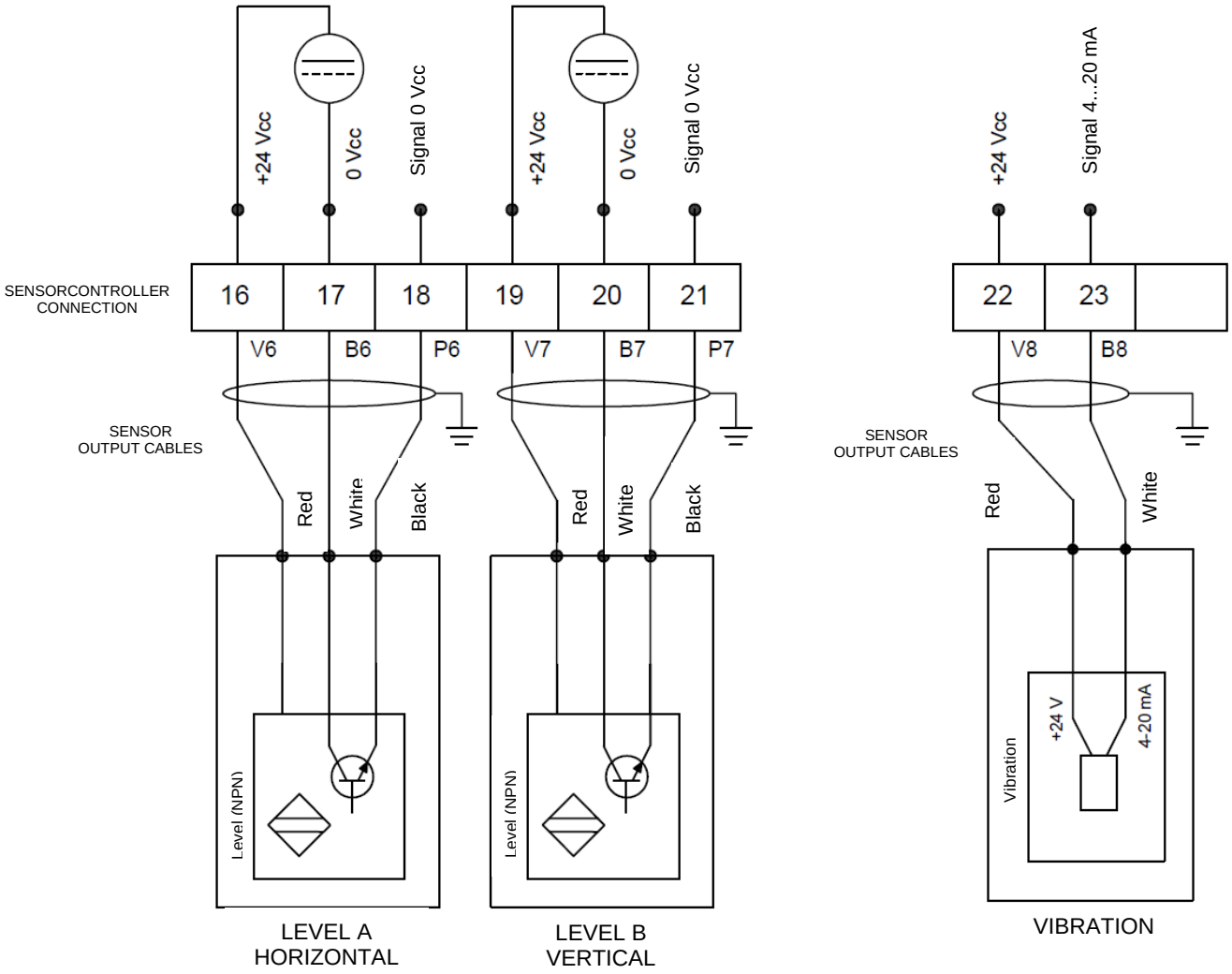


Figure 38 – Diagram of connection of Photoelectric Level Sensor (*Basic* and *Premium*) to the Vibration Sensor (*Premium* sensing)

IMPORTANT: the cable for sensors measurement must not be installed together with the equipment power cables, since electromagnetic field might cause interference and distortion to the measurement data.

IMPORTANT: There might occur variations to the numbers of the set of cable vias, as well as the quantity of vias, according to the sensors required by customer. In this case, please contact Higra or its local representative.

2.5.4 Spinning Direction

After connecting the pump to the control panel, through cable splice, it is necessary to check the impeller spinning direction with the pump on the ground (horizontal position).

WARNING: Spin direction verification must be conducted by turning the pump on and off quickly, without allowing the pump to hit its maximum working speed! In the case this procedure is not followed the pump may suffer some damages.

Compare the impeller spin direction with the identification plate (red arrow) fixed to the pump casing. If it spins in opposite direction, two phases must be inverted directly in the control panel, in order to correct the problem.

IMPORTANT: In the case the pump has been kept stopped for a long period before being installed, the wearing rings and the impellers might have oxidized leading to shaft to lock. In this case the impeller must be manually turned. If necessary, a lever should be used to help the impeller to be released. BE CAREFULL WHEN RELEASING THE IMPELLER WITH THE LEVER. WHEN MISCONDUCTED THIS PROCEDURE MIGHT BREAK THE IMPELLER SHOVEL.

2.5.5 Pump Placement and Fixation

All HIGRA pump models may be installed both fixed in the pump supports or over a base prepared to receive the pump (metallic skid, rail or concrete bases, etc.), when hung up by the flange(s) only. Check the flange nominal measure, standard and dimensions for each pump model on chapter of dimensions, in this manual. Such chapter also presents the pump support measures to build skids for pumps.

WARNING: Always use flanges compatible to the system pressures in the production pipes. The ends directly connected to the pump must use flanges identical to the pump flanges to avoid leakages.

For a perfect pump and system operation, the project must carefully foresee in your project the use of:

- Air vents;
- Eccentric reduction at suction;
- Strainers;
- Foot Valve (only when pump operates suctioning);
- Manometer (at discharge pipe);
- Vacuum Gage (at suction pipe);
- Check Valve;
- Flow Gage;
- Other necessary accessories.

Not necessarily, all above items are used in every pumping application. However, their applicability must be checked before pump installation. During pump installation and operation, the perfect functioning of all accessories of the system must be monitored.

CAUTION 1: In applications where pump works out of water, suction and collection pipe should not be supported in the pump flange because there is the risk of monoblock assembly misalignment and consequent damage to the equipment.

CAUTION 2: In the case of submersible installation in sandy place and/or in a place with natural ground (rivers, lakes, etc.), pump must be crucially operated with the protection strainer and away from the bottom, in order to avoid solid materials and/or fluids with higher density than water to be pumped.

Note: the strainer might, under Higra's criteria, be replaced the Sand Preventor Device for special applications.

CAUTION 3: For application in salty water, fluids with solids in suspension or with other corrosive and/or abrasive characteristics, parts in contact with fluid must be furnished in special materials like stainless steel, special steel alloys, etc. Contact the plant to get specifications on these materials as well as the maximum allowable levels for the fluid.

2.5.6 Suction

In applications where the pump will work suctioning, this step must be respected.

To operate satisfactorily, centrifugal pumps need liquids free from steam in the suction pipe, at impeller intake. If pressure inside the pump is lower than liquid steam pressure, steam bubbles will be created in this place.

Due to the fast increase of pressure inside the pump, bubbles join in a determined zone without presence of liquid. This phenomenon is called cavitation (from cavities) and is able to reduce the pump efficiency, causing noise, vibrations, impeller rupture, casing rupture, etc.

To avoid cavitation, pumps need a certain quantity of energy in the suction system, which is known as NPSH (Net Positive Suction Head). NPSH can be required (NPSHR) or available (NPSHA). NPSH value available in the application must be calculated taking into consideration all involved factors, such as load loss, pipe accessories resistance (foot valve, bends, etc.), suction height, temperature, density and altitude.

NOTE: Any discussion on NPSH or cavitation is taken into consideration at the pump intake only. Usually there is enough pressure to impede fluid vaporization at the pump discharge

After the available NPSH is calculated (as per chapter 4), it is necessary compare it with the NPSH required by the pump (according to the pump performance chart) for the desired pumping situation, where the following condition must be respected:

NPSHd > NPSHr + 1,0

IMPORTANT: NPSHd must be higher than NPSHr, preferably with a tolerance over 1 meter. Pump should not run if this condition is not met.

2.5.7 Priming

When the pump is installed in the production pipe (out of water), suctioning or as a booster, a priming must be conducted before starting the operation and installing the foot valve, in order to keep the pipe full of fluid in the pump shutdown.

In submersible installations or flooded applications, no priming nor check valve are necessary.

WARNING: pump priming is mandatory for all aforementioned situations. Otherwise, equipment can be damaged.

2.5.8 Pump Start

When starting the pump, control the electric indicators such as start current, voltage during the start ramp, working current and operating stress. Note that, if voltage drops down too much during the start or if it remains lower than the rated voltage during the operation, this fact will reflect an increase of working current. In this case, it is necessary to request the electric energy concessionaire to correct the voltage or transformer.

NOTE: Higra Amphibious Pumps have a S1 Service Regimen (ABNT NBR 17094-1:2018), allowing two successive starts (the first one with cold motor and the second one just after with unaccelerated motor – or even resting), or a start with the motor warmed up after operating under ordinary conditions.

During the beginning of the operation, until the pipe is completely filled and the work pressure is met, the pump working condition is different from that to which it was dimensioned (lower pressure). This results the work at a different point of the pump performance curve, usually higher in production and, consequently, higher power consumption. To control this condition, it is important to use a manometer installed near to the pump discharge.

NOTE: All Amphibious Pumps have in their back external casing (outlet) a rest for the manometer connection (1/2" BSP thread).

Through the manometer reading it is possible to determine if the pumping system is operating under pressure conditions according to projected. Sometimes, differences between the project and work pressures may occur due to incorrect estimative, mainly in the load loss calculation.

WARNING: In the case final pressure is too lower than required in the project, pay attention to the equipment working current, once it will increase and cannot surpass the limit for the service factor of 1.15. Contact HIGRA or its local agent/representative in the case there is any abnormality like this

In applications where the total manometric head (pressure) is over 15 mwc, it is recommendable the use of a valve after the pump. In this case, the valve must be totally closed at moment the pump starts, and then gradually opened until it is very open. This way the pump will fill the extensive pumping pipe little by little and the working current will be inside the curve it was projected for.

To startup pumps installed in series, it is recommendable to turn on the first suction pump and after the time necessary to fill the pipe until the next pump, start the second pump. This procedure must be repeated according to the quantity of pumps existing in the pipeline.

In the case customer wishes the pump start to be accompanied by an HIGRA's technician, a proposal on this service must be required to HIGRA or our local agent/representative.

NOTE: when the pump is started through variable speed driver and power cables longer than 50 meters, we recommend the use of an output filter indicated by the VSD manufacturer.

2.6 Detailed Drawing

The following table presents the list of the components of the amphibious pumps, and the drawing indicates their location. Description of the parts is common for all models of amphibious pumps with one or more stages.

Item	Description	Item	Description
01	Upper Cable Protector	21	Drive Shaft
02	Lower Cable Protector	22	Sliding Ring Key
03	Shared Stuffing Box Gland	23	Impeller Key
04	Linear Cables Cover	24	Mechanical Seal Inverted Box
05	Rear External Frame	25	Mechanical Seal Locking Plate
06	Pump Foot	26	Mechanical Seal
07	Pressure Equalizer Filter	27	Mechanical Seal Protector
08	Rear Cover	28	Front Radial Bearing
09	Graphite Sliding Ring	29	Rear Bearing Support
10	Rear Bearing Support	30	Centralizer Coupling
11	Allen Bolt	31	Front External Frame
12	Sliding Ring Washer	32	Spacer Bushing
13	Sliding Ring	33	Diffuser
14	Rear Radial Bearing	34	Wearing Ring
15	Cracked Stuffing Box Gland	35	Impeller
16	Cracked Cables Cover	36	Stage Pump Frame
17	Motor Frame	37	Stage Tie Beam
18	Inner Tie Beam	38	Impeller Nut
19	Flux Tube	39	Intake Bearing Bushing
20	External bolt	40	Intake Frame

Table 15 – Detailed Drawing List of Parts

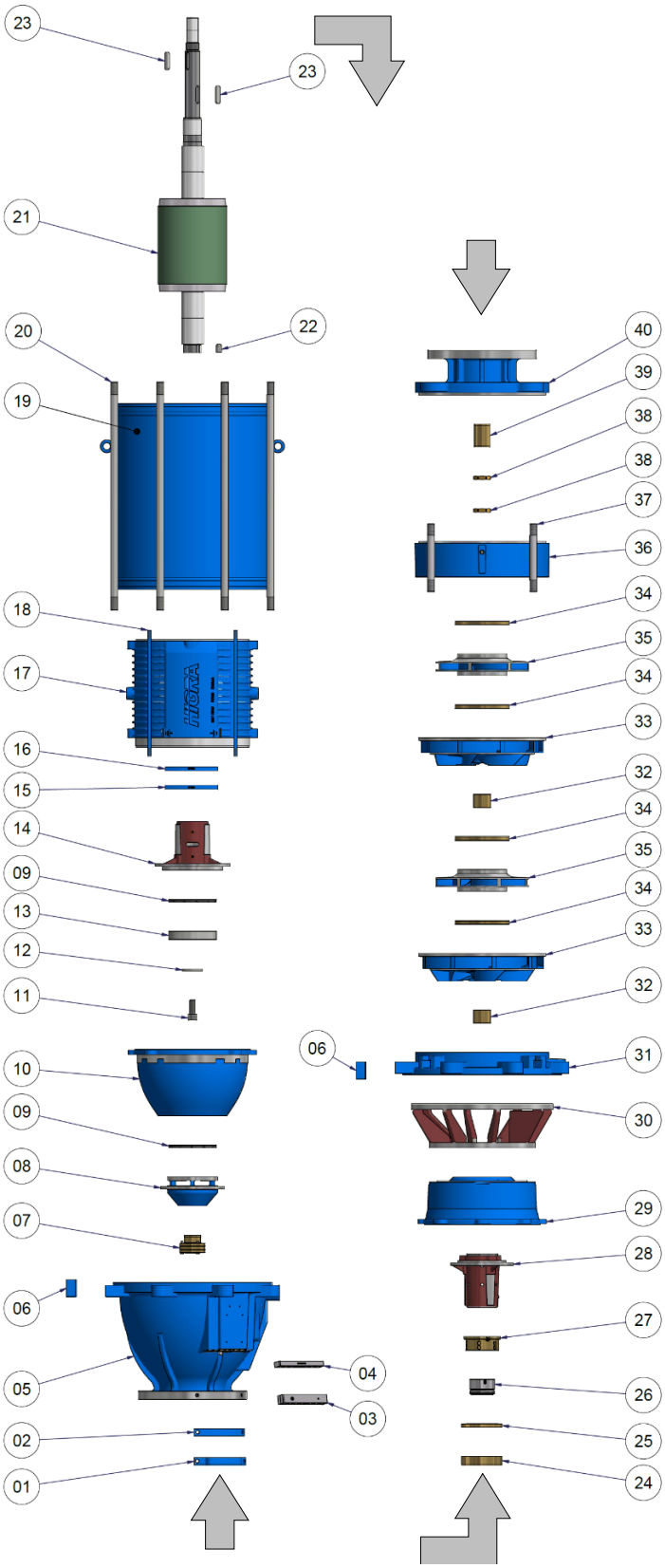


Figure 39 – Detailed Drawing of an Amphibious Pump Model R2-320/125B

To get any detailed drawing or list of parts relative any pump, please contact HIGRA or its local representative.

2.7 Dimensions

Below, dimension charts for Single and Multi-Stage Amphibious Pumps in 60 and 50 Hz, respectively.

Single Stage Amphibious Pump

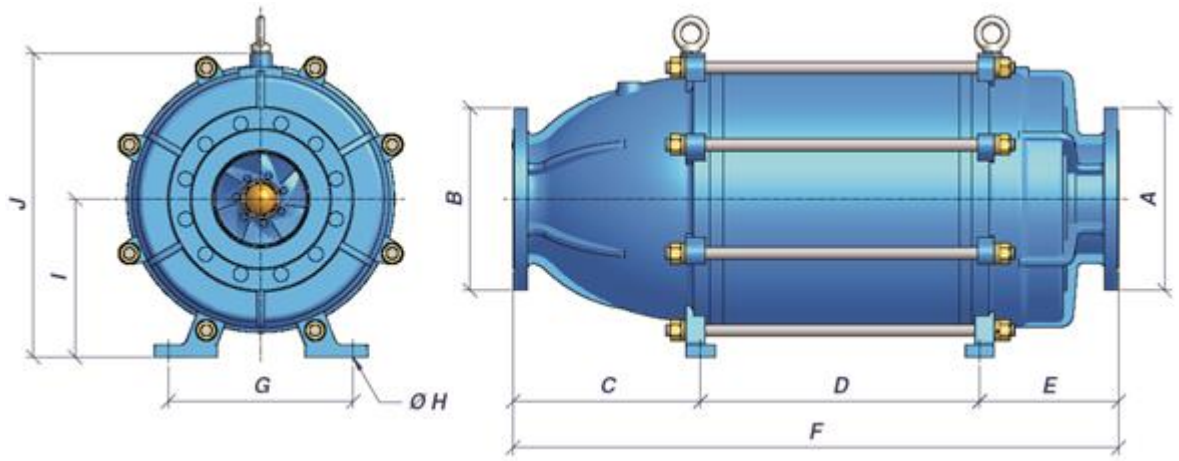


Figure 40 – Single Stage Amphibious Pump Dimensions

Multi-Stage Amphibious Pump

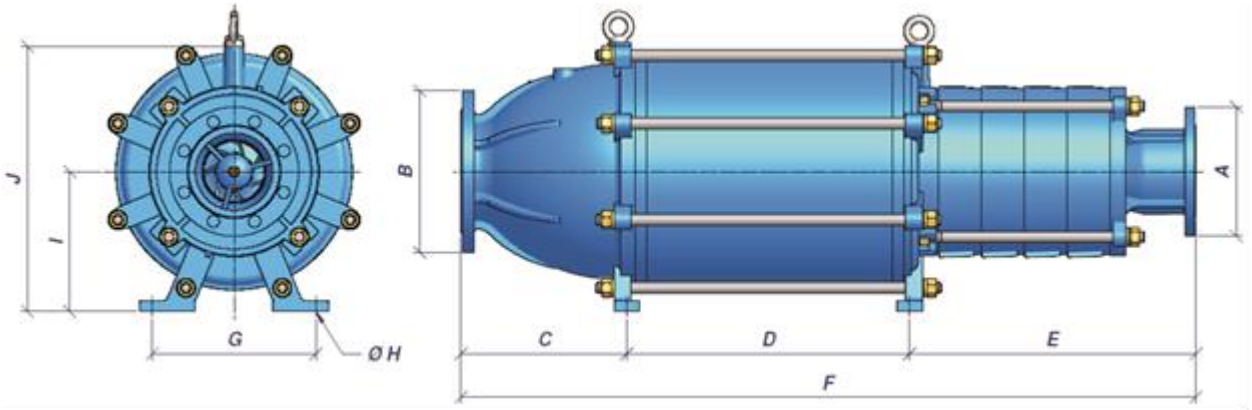


Figure 41 – Multi-Stage Amphibious Pump Dimensions

NOTE: Column GD²/4 presents the total inertia moment of rotary parts of the equipment, which is the resistance measurement that an equipment offers to any change in its rotary movement. This figure is used to calculate the time of acceleration and, consequently, the time the protection system equipment takes to startup.

NOTE: For dimension tables, consider +/- 5% variation equipment weight.

ATTENTION: Please consult Higra or its local representative for dimensional information on pumps with Equalizer Piston and/or sensing devices in both *Basic* or *Premium* configuration.

Model	Motor Frame	A Suction	B Discharge	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	ØH (mm)	I (mm)	J (mm)	Weight (Kg)	GD²/4 (Kg.m²)
R1-195/15B	132L	DN 80 PN 40	DN 80 PN 40	160	599	174	933	270	26,5	206	396	210	0,046
R1-195/20B													
R1-195/25B													
R1-195/30B													
R1-260/20B	160L	DN 200 PN 40	DN 200 PN 40	266	581	151	998	340	27	283	543	361	0,177
R1-260/25B													
R1-260/30B													
R1-260/40B													
R1-310/40B	160T	DN 200 PN 40	DN 200 PN 40	367	691	253	1381	280	27	314	648	550	0,36
R1-310/50B													
R1-310/60B													
R1-310/75B													
R1-320/40B	225S	DN 200 PN 40	DN 200 PN 40	385	658	211	1252	380	30	335	635	640	0,417
R1-320/50B													
R1-320/60B													
R1-360/50B	225S	DN 200 PN 40	DN 200 PN 40	385	573	286	1244	380	30	335	635	750	0,990
R1-360/60B													
R1-360/75B													
R1-360/100B													
R1-360/125B													
R1-360/150B													
R1-365/75B	225S	DN 300 PN 25	DN 300 PN 25	364	863	325	1377	430	30	362	700	880	1,19
R1-365/100B													
R1-365/125B													
R1-365/150B	225S	DN 300 PN 25	DN 300 PN 25	364	863	325	1377	430	30	362	700	1000	1,19
R1-365/175B	225L	DN 300 PN 25	DN 300 PN 25	364	863	325	1552	430	30	362	700	1100	1,44
R1-365/200B													
R1-390/150B	315S	DN 300 PN 25	DN 250 PN 40	355	1215	270	1840	450	35	435	815	2250	3,831
R1-390/175B													
R1-390/200B													
R1-390/250B	315S	DN 300 PN 25	DN 250 PN 40	355	1215	270	1840	450	35	435	815	2390	3,831
R1-390/300B													
R1-430/350B	315S	DN 400 PN 25	DN 400 PN 25	355	1215	299	1870	530	35	495	995	2240	4,162
R1-430/400B													
M1-240/25B	160T	DN 200 PN 10	DN 200 PN 10	392	350	364	1106	320	22	298	552	383	0,184
M1-240/30B													
M1-240/40B													
M1-240/50B	160T	DN 200 PN 10	DN 200 PN 10	392	580	364	1336	320	22	298	552	523	0,280
M1-240/60B													
M1-305/75B	225S	DN 300 PN 10	DN 300 PN 10	346	747	293	1386	376	30	327	647	753	0,940
M1-305/100B													
M1-305/125B													
M1-335/125B	225S	DN 300 PN 16	DN 300 PN 16	319	906	227	1452	520	30	376	731	1100	1,240
M1-335/150B													
M1-335/175B	225L	DN 300 PN 16	DN 300 PN 16	319	1081	227	1627	520	30	376	731	1200	1,490
M1-335/200B													
M1-345/150B	315S	DN 300 PN 25	DN 350 PN 10	269	1301	270	1840	450	35	435	815	1564	3,370
M1-345/175B													
M1-345/200B													
M1-345/250B													
M1-345/300B													
M1-400/350B	315L	DN 400 PN 25	DN 400 PN 25	726	960	576	2262	450	35	480	950	2750	5,236
M1-400/400B													
M1-400/450B													
M1-400/500B													
M1-550/450B	315T	DN 600 PN 10	DN 600 PN 10	799	1200	847	2846	700	35	568	1106	2650	1,290
M1-550/500B													
M1-550/550B													
S1-430/75B	225S	DN 500 PN 10	DN 500 PN 10	539	407	747	1693	480	35	433	974	940	1,380
S1-430/100B													
S1-430/125B	225L	DN 500 PN 10	DN 500 PN 10	539	582	747	1868	480	35	433	974	1120	1,730
S1-430/150B													
S1-630/150B	315L	DN 600 PN 10	DN 600 PN 10	620	787	854	2261	530	35	590	1097	2200	8,14
S1-630/175B													
S1-630/200B													
S1-630/250B													
E1-260/25B	160L	DN 200 PN 10	DN 300 PN 10	330	600	408	1340	280	28	314	584	550	0,160
E1-260/30B													
E1-260/40B													

Table 16 – Dimensional of Single Stage Amphibious Pumps in 60Hz

Model	Motor Frame	A Suction	B Discharge	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	ØH (mm)	I (mm)	J (mm)	Weight (Kg)	GD²/4 (Kg.m²)
R2-155/15B R2-155/20B	132L	DN 80 PN 40	DN 80 PN 40	160	599	193	951	270	24	206	396	215	0,038
R3-155/20B R3-155/25B	132L	DN 80 PN 40	DN 80 PN 40	160	599	242	1001	270	24	206	396	220	0,040
R4-155/25B R4-155/30B	132L	DN 80 PN 40	DN 80 PN 40	160	599	291	1050	270	24	206	396	230	0,042
R3-215/200B	200T	DN 150 PN 40	DN 200 PN 40	468	1200	712	2380	320	22	316	785	1550	0,898
R3-235/300B	200T	DN 150 PN 40	DN 200 PN 40	468	1200	712	2380	320	22	316	785	1565	0,893
R4-235/300B	200T	DN 150 PN 40	DN 200 PN 40	468	1200	813	2480	320	22	316	785	1580	0,928
R2-265/40B R2-265/50B R2-265/60B	225S	DN 150 PN 40	DN 200 PN 40	385	657	373	1406	380	30	335	635	805	0,416
R3-265/40B R3-265/50B R3-265/60B	225S	DN 150 PN 40	DN 200 PN 40	385	657	463	1506	380	30	335	635	690	0,81
R3-265/75B	225S	DN 150 PN 40	DN 200 PN 40	385	657	463	1506	380	30	335	635	830	0,899
R4-265/50B R4-265/60B R4-265/75B R4-265/100B R4-265/125B	225S	DN 150 PN 40	DN 200 PN 40	385	656	565	1606	380	30	325	615	900	0,951
R5-265/75B R5-265/100B R5-265/125B	225S	DN 150 PN 40	DN 200 PN 40	355	716	635	1704	380	30	335	633	950	1,003
R2-320/75B R2-320/100B R2-320/125B	225S	DN 200 PN 40	DN 200 PN 40	385	658	327	1370	380	30	325	613	694	0,949
R3-320/100B R3-320/125B R3-320/150B	225S	DN 200 PN 40	DN 200 PN 40	385	658	444	1487	380	30	325	613	940	1,055
R4-320/100B R4-320/125B R4-320/150B	225S	DN 200 PN 40	DN 200 PN 40	385	658	560	1603	380	30	335	628	897	1,161
R4-320/175B R4-320/200B R4-320/250B	315S	DN 200 PN 40	DN 250 PN 40	355	1080	616	2051	450	35	435	805	1700	3,303
R2-360/100B R2-360/125B	225S	DN 250 PN 40	DN 200 PN 40	385	658	327	1370	380	30	335	635	850	0,954
R2-360/150B R2-360/175B R2-360/200B R2-360/250B R2-360/300B	315S	DN 250 PN 40	DN 250 PN 40	355	1080	453	1891	450	35	435	818	1650	3,383
R3-360/150B R3-360/175B R3-360/200B R3-360/250B	315S	DN 250 PN 40	DN 250 PN 40	355	1078	598	2031	450	35	435	805	1990	3,851
R3-360/300B	315S	DN 250 PN 40	DN 250 PN 40	355	1280	598	2033	450	35	435	805	2100	3,634
R3-360/350B R3-360/400B	315S	DN 250 PN 40	DN 250 PN 40	355	1280	598	2033	450	35	435	805	2100	5,130
R4-360/350B R4-360/400B R4-360/450B R4-360/500B	315L	DN 250 PN 40	DN 250 PN 40	355	1280	741	2375	450	35	435	818	2360	5,381
R2-365/200B R2-365/250B R2-365/300B R2-365/350B	315S	DN 300 PN 25	DN 300 PN 40	395	1133	556	2085	450	35	440	828	1795	3,590
R3-365/250B R3-365/300B R3-365/350B R3-365/400B	315S	DN 300 PN 25	DN 300 PN 40	395	1133	789	2317	450	35	440	828	2160	4,394
R3-365/450B R3-365/500B R3-365/550B	315L	DN 300 PN 25	DN 300 PN 40	392	1333	787	2513	450	35	440	828	2400	5,45
R4-365/400B R4-365/450B R4-365/500B R4-365/550B R4-365/600B R4-365/650B	315L	DN 300 PN 25	DN 300 PN 40	394	1333	1024	2752	450	35	440	828	2700	5,815
R2-390/350B R2-390/400B R2-390/450B R2-390/500B R2-390/600B	315L	DN 300 PN 40	DN 300 PN 40	392	1433	439	2266	450	35	440	825	2500	6,281
M2-345/250B M2-345/300B M2-345/350B M2-345/400B	315S	DN 300 PN 25	DN 400 PN 25	355	1728	270	2353	450	35	440	857	2070	4,441
M2-345/450B M2-345/500B M2-345/550B M2-345/600B	315L	DN 300 PN 25	DN 400 PN 25	355	1928	270	2553	450	35	440	857	2500	5,377
M2-345/650B M2-345/700B M2-345/750B	315T	DN 300 PN 25	DN 400 PN 25	355	2128	270	2753	450	35	440	857	2970	6,882
M2-370/600B M2-370/650B M2-370/700B M2-370/750B	315T	DN 300 PN 25	DN 300 PN 40	397	2128	270	2795	450	35	440	826	2845	6,976

Table 17 – Dimensional of Multi-Stage Amphibious Pumps in 60Hz

Model	Motor Frame	A Suction	B Discharge	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	ØH (mm)	I	J (mm)	Weight (Kg)	GD²/4 (Kg.m²)
R1-195/12B	132L	DN 80 PN 40	DN 80 PN 40	160	599	174	933	270	25	206	396	210	0,046
R1-195/15B													
R1-195/20B													
R1-260/15B	160L	DN 200 PN 40	DN 200 PN 40	266	581	151	998	340	27	283	543	361	0,177
R1-260/20B													
R1-260/25B													
R1-260/30B													
R1-310/25B	160T	DN 200 PN 40	DN200 PN 40	367	691	253	1381	280	27	314	648	550	0,36
R1-310/30B													
R1-310/40B													
R1-320/25B	225S	DN 200 PN 40	DN 200 PN 40	385	658	211	1252	380	30	335	635	640	0,417
R1-320/30B													
R1-320/40B													
R1-360/50B	225S	DN 200 PN 40	DN 200 PN 40	385	573	286	1244	380	30	335	635	750	0,990
R1-360/60B													
R1-360/75B													
R1-360/100B													
R1-365/75B	225S	DN 300 PN 25	DN 300 PN 25	364	863	325	1552	430	300	362	700	880	1,190
R1-365/100B													
R1-390/150B	315S	DN 300 PN 25	DN 250 PN 40	355	1215	270	1840	450	35	435	815	2250	3,831
R1-390/175B													
R1-390/200B													
R1-430/175B	315S	DN 400 PN 25	DN 400 PN 25	355	1215	299	1870	530	35	495	995	2240	4,162
R1-430/200B													
R1-430/250B													
M1-240/15B	160T	DN 200 PN 10	DN 200 PN 10	392	350	364	1106	320	22	298	552	583	0,184
M1-240/20B													
M1-240/25B													
M1-240/30B													
M1-305/60B	225S	DN 300 PN 10	DN 300 PN 10	346	747	293	1386	376	30	327	647	753	0,940
M1-305/75B													
M1-335/100B	225S	DN 300 PN 16	DN 300 PN 16	319	906	227	1452	520	30	376	731	1100	1,240
M1-335/125B													
M1-345/150B	315S	DN 300 PN 40	DN 350 PN 10	269	1301	270	1840	450	35	435	815	1564	3,370
M1-345/175B													
M1-345/200B													
M1-400/200B	315S	DN 400 PN 25	DN 400 PN 25	728	762	575	2065	450	35	480	960	1942	3,909
M1-400/250B													
M1-400/300B													
S1-430/50B	225L	DN 500 PN 10	DN 500 PN 10	539	582	747	1868	480	35	433	974	1120	1,730
S1-430/60B													
S1-430/75B													
S1-430/100B													
S1-630/75B	315L	DN 600 PN 10	DN 600 PN 10	620	787	854	2261	530	35	590	1095	2200	8,14
S1-630/100B													
S1-630/125B													
S1-630/150B													
S1-630/175B													
E1-260/25B	160L	DN 200 PN 10	DN 300 PN 10	330	600	408	1340	280	28	314	584	550	0,160
E1-260/30B													

Table 18 – Dimensional of Single Stage Amphibious Pumps in 50Hz

Model	Motor Frame	A Suction	B Discharge	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	ØH (mm)	I (mm)	J (mm)	Weight (Kg)	GD²/4 (Kg.m²)
R4-155/15B	132L	DN 80 PN 40	DN 80 PN 40	160	599	193	1050	270	24	206	396	250	0,420
R4-155/20B													
R2-195/15B	160L	DN 80 PN 40	DN 80 PN 40	160	599	244	1003	270	26	206	450	220	0,057
R2-195/20B													
R2-195/25B													
R2-195/30B													
R3-265/30B	160T	DN 150 PN 40	DN 200 PN 40	385	656	465	1506	380	30	325	630	690	0,810
R3-265/40B													
R3-265/50B													
R4-265/40B	225S	DN 150 PN 40	DN 200 PN 40	385	656	565	1606	380	30	325	615	830	0,951
R4-265/50B													
R4-265/60B													
R4-265/75B													
R5-265/50B	225S	DN 150 PN 40	DN 200 PN 40	355	716	635	1704	380	30	335	633	950	1,003
R5-265/60B													
R5-265/75B													
R5-265/100B													
R2-320/50B	225S	DN 200 PN 40	DN 200 PN 40	385	658	327	1370	380	30	325	613	694	0,949
R2-320/60B													
R2-320/75B													
R3-320/60B	225S	DN 200 PN 40	DN 200 PN 40	385	658	444	1487	380	30	325	613	940	1,055
R3-320/75B													
R3-320/100B													
R4-320/100B	315S	DN 200 PN 40	DN 250 PN 40	355	1080	616	2051	450	35	435	805	1700	3,303
R4-320/125B													
R4-320/150B													
R2-360/100B	315S	DN 250 PN 40	DN 250 PN 40	355	1080	453	1891	450	35	435	818	1650	3,383
R2-360/125B													
R2-360/150B													
R2-360/175B													
R3-360/150B	315L	DN 250 PN 40	DN 250 PN 40	355	1280	598	2033	450	35	435	805	1600	5,130
R3-360/175B													
R3-360/200B													
R3-360/250B													
R4-360/150B	315L	DN 250 PN 40	DN 250 PN 40	355	1280	741	2376	450	35	435	818	2360	5,381
R4-360/175B													
R4-360/200B													
R4-360/250B													
R4-360/300B													
R4-360/350B													
R2-365/150B	315S	DN 300 PN 25	DN 300 PN 40	395	1133	556	2085	450	35	440	828	1795	3,590
R2-365/175B													
R2-365/200B													
R3-365/200B	315L	DN 300 PN 25	DN 300 PN 40	392	1333	787	2513	450	35	440	828	2400	5,450
R3-365/250B													
R3-365/200B													
R4-365/300B	315L	DN 300 PN 25	DN 300 PN 40	394	1333	1024	2752	450	35	440	828	2700	5,815
R4-365/350B													
R4-365/400B													
R2-390/250B	315L	DN 300 PN 40	DN 300 PN 40	392	1433	439	2266	450	35	440	825	2500	6,281
R2-390/300B													
R2-390/350B													
R2-390/400B													
M2-345/350B	315L	DN 300 PN 25	DN 300 PN 40	392	1848	370	2511	450	35	440	815	2500	5,377
M2-345/400B													
M2-345/450B													
M2-345/500B													
M2-345/550B													
M2-345/600B													

Table 19 – Dimensional of Multi-Stage Amphibious Pumps in 50Hz

2.8 Flange Dimensions

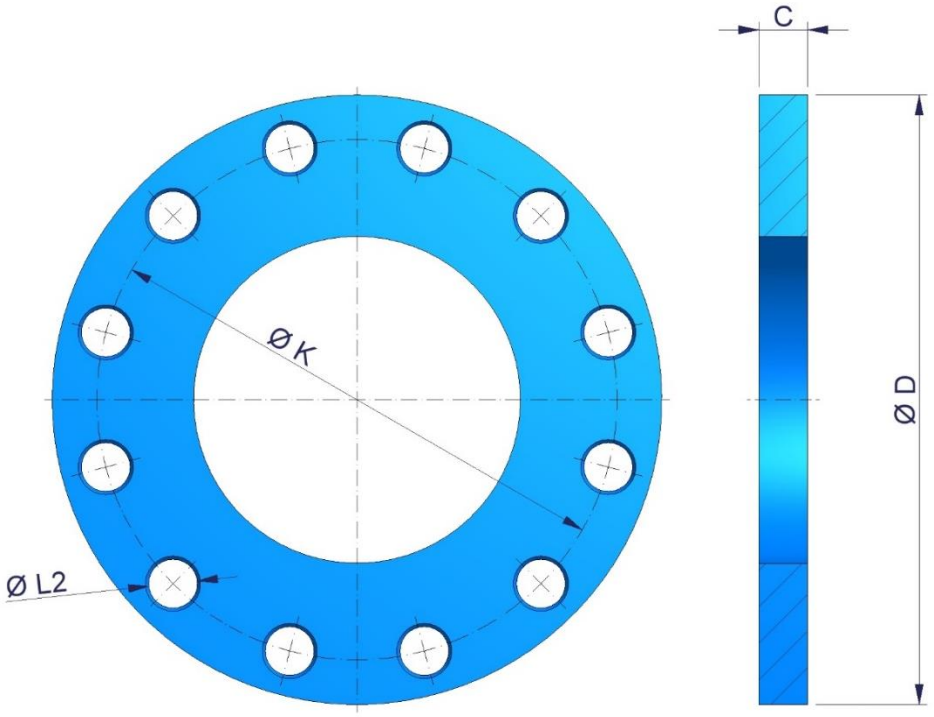


Figure 42 – Flange Dimensions

Nominal Diameter	Class	ØD (mm)	Tolerance ØD (mm)	C (mm)	Tolerance C (mm)	ØK (mm)	Tolerance ØK (mm)	ØL2 (mm)	Tolerance ØL2 (mm)	Qty. Holes
DN 300	PN 40	515	+5,5 / -2,5	39,5	±5,5	450	±2,8	34	±0,5	16
DN 250		450	+5,5 / -2,5	34,5	±5,5	385	±2,8	34		12
DN 200		375	±5,5	30	±5,5	320	±2,8	31		12
DN 150		300	±5,5	26	±5,5	250	±2	28		8
DN 80		200	±4,5	19	±4,5	160	±2	19		8
DN 400	PN 25	620	±6,5	32	±6,5	550	±2,8	37		16
DN 300		485	+5,5 / -2,5	27,5	±5,5	430	±2,8	31		16
DN 300	PN 16	455	+5,5 / -2,5	24,5	±5,5	410	±2	28		12
DN 600	PN 10	780	±6,5	30	±5,5	725	±2,8	31		20
DN 500		670	±6,5	26,5	±5,5	620	±2	28		20
DN 350		505	±6,5	24,5	±5,5	460	±2	23		16
DN 300		455	±5,5	24,5	±5,5	400	±2	23		12
DN 200		340	±5,5	20	±5,5	295	±2	23		8

Table 20 – Flange Dimensions

1) Measures in mm.
2) Some flanges class PN10 can have their thickness reinforced in relation to the ISO 2531 standard.
3) Some flanges class PN10 can have reduced quantity of perforations in relation to the ISO 2531 standard.
4) Flanges are manufactures with no ISO 2531 standard lowering for a higher reinforcement, but it could be machined if customer requires.

2.9 Chart of Maximum Admissible Solids

Chart below presents the maximum solid size the different models of impellers can pump, considering spherical shape and size of perforation of respective strainers. Elongated solids can lock the impeller or block the fluid passage in the pump. Elongated and malleable solids such as ropes, wires, fibers and fabric pieces can avoid the fluid to pass, wind on the shaft or accumulate at some points, damaging the equipment and its performance.

WARNING: The maximum solid sizes in Table 21 refer to the theoretical diameter of the sphere that can pass through the impeller from inlet to outlet without causing clogging and should not be considered as the size of solid allowed to be pumped.

Besides the aforementioned solids, water harvesting from rivers normally present leaves accumulation at the strainer perforations, what may cause impeller cavitation due to lack of fluid. To avoid this problem, it is necessary to handle the strainer retro washing, on a periodical basis. The retro washing is done through the regress of the fluid accumulated in the pipeline. It is not necessary to completely empty the pipeline. A small volume released is enough to offer a satisfactory strainer cleaning.

Pump				Strainer				
Type of Impeller	Number of Stages	Nominal Impeller Ø (mm)	Solids Maximum Size (Ømm)	Strainer Model	Perforated Plate Size (mm)	External Dimensions		Weight (kg)
						A (mm)	B (Ø mm)	
Radial	R2	155	14	**R1-180**	Ø10	373	280	17
	R3			**R1-180**	Ø10	373	280	17
	R4			**R1-180**	Ø10	373	280	17
	R1	195	14	**R1-180**	Ø10	373	280	17
	R3	215	17	**R2-215**	Ø10	473	475	43
	R3	235	17	**R2-215**	Ø10	473	475	43
	R4	235	17	**R2-215**	Ø10	473	475	43
	R1	260	24	**R1-260**	Ø22	623	423	40
	R1	265	19	**R4-265**	Ø22	523	300	23
	R2			**R4-265**	Ø22	523	300	23
	R3			**R4-265**	Ø22	523	300	23
	R4			**R4-265**	Ø22	523	300	23
	R5			**R4-265**	Ø22	523	300	23
	R1	310	24	**R1-260**	Ø22	623	423	40
	R1	320	22	**R1-260**	Ø22	623	425	40
	R2			**R1-260**	Ø22	623	425	40
	R3			**R1-260**	Ø22	623	425	40
	R4			**R1-260**	Ø22	623	425	40
	R1	360	24	**R1-260**	Ø22	623	425	40
	R2			**R1-260**	Ø22	623	425	40
	R3			**R1-260**	Ø22	623	425	40
	R4			**R1-260**	Ø22	623	425	40
	R1	365	34	**R1-365**	Ø22	575	673	71
	R2			**R1-365**	Ø22	575	673	71
	R3			**R1-365**	Ø22	575	673	71
	R4			**R1-365**	Ø22	575	673	71
	R1	390	24	**R1-400**	Ø22	869	729	120
	R2			**R1-400**	Ø22	869	729	120
	R1	430	35	**R1-430**	Ø22	950	804	141
Mixed	M1	305	25	**M1-290**	Ø22	673	575	71
	M1	335	50	**M1-335**	Ø22	800	680	106
	M1	345	32	**R1-400**	Ø22	869	729	120
	M2			**R1-400**	Ø22	869	729	120
	M2	370	32	**R1-400**	Ø22	869	729	120
	M1	400	34	**R1-430**	Ø22	950	804	141
	M1	550	55	**S1-630**	38 x 38	1057	923	160
Semi Axial	S1	430	60	**S1-430**	38 x 38	950	804	141
	S1	630		**S1-630**	38 x 38	1057	923	160

Table 21 – Maximum Admissible Solids

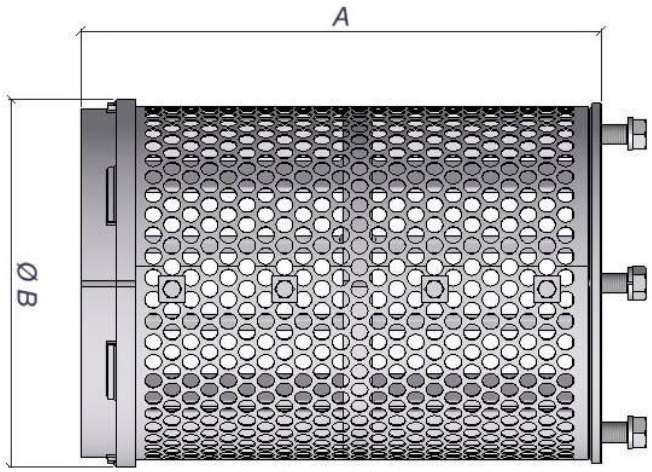


Figure 43 – Strainer with Perforated Plate

2.10 Sand Preventor Device

Sand protector is a device to slow down the fluid speed at the pump suction, preventing solids such as leaves, sand, wood and general debris are pumped towards the piping.

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Figure 44 – Sand Preventor Device

NOTE: Unlike the strainer, the sand preventor device is specifically developed for each application. That means its diameter, length, perforation and cone might change from case to case, making it a customized element.

2.11 Torque Table

Chart below presents values of torques applied to fixation elements on Higra equipment:

Type	Dimension	Torque (N.m)
Hexagonal (DIN 933)	M6	17.5
Hexagonal (DIN 931/DIN 933)	M8	50
Hexagonal (DIN 931/DIN 933)	M10	90
Hexagonal (DIN 931/DIN 933)	M12	115
Hexagonal (DIN 931/DIN 933)	M16	180
Hexagonal (DIN 931/DIN 933)	M20	210
Hexagonal (DIN 931/DIN 933)	M24	240
Hexagonal (DIN 931/DIN 933)	M30	260
Hexagonal (DIN 931/DIN 933)	W 1”	230
Cylinder Head Allen Bolt (DIN 912)	M5	9
Fairing Bolt (DIN 7984)	M6	4
Cylinder Head Allen Bolt (DIN 912)	M6	15
Cylinder Head Allen Bolt (DIN 912)	M8	35
Cylinder Head Allen Bolt (DIN 912)	M10	70
Cylinder Head Allen Bolt (DIN 912)	M16	145
Cylinder Head Allen Bolt (DIN 912)	M20	175
Carriage Bolt (DIN 603)	W 3/8”	10
Square Plug (ISO 49)	½” BSP	90
Square Plug (ISO 49)	1” BSP	210

Table 22 - Torque of Fixation Elements on Higra Equipment

NOTE: Torque figures on Table 22 are defined through calculations for equipment models according to the respective dimensions of nuts, tie beams, washers and others.

IMPORTANT: torque figures on Table 22 should be respected in order to prevent future damages to the equipment, for both excessive torque or the lack of it.

2.12 Performance Test

Previous to the shipment all HIGRA amphibious pumps are submitted to a performance evaluation conducted at the test bench. Approval criteria follows ANSI/HI 14.6-2016, grade 2B Standard, which stablishes the following limits for power, flow rate, electric current and pressure variation:

Variable	Tolerance
Power	±8%
Flow Rate	±8%
Electric Current	±5%
Pressure	±5%

Table 23 – Variables and respective tolerances

NOTE: Other approval criteria are possible, as long as previously agreed with HIGRA.

3 ELECTRIC MOTOR

HIGRA equipment is equipped with asynchronous induction motors, squirrel cage type, using special wires for submersible operation. The motor winding is built through technological process developed by HIGRA.

DATA	FEATURE
Type	II, IV, VI or VIII poles, asynchronous, rewindable and submersed
Frame	Built in Nodular Cast Steel, under ABNT NBR IEC 60034-6:2013 Standards. Denominated IC4W1W1.
Stator	Steel plates with low carbon content (thermally treated), ensuring low losses and elevated magnetic permeability
Impeller (shaft pack)	Steel plates with low carbon content (thermally treated), ensuring low losses and elevated magnetic permeability, with short circuit ring (cast in aluminum injected under pressure)
Wiring	Copper wire with Polypropylene cover
Protection Grade	IP68W, according to ABNT NBR IEC 60529:2005
Insulation Class	Y (90°C)
Service Factor	1,15
Frequency	50HZ or 60HZ

Table 24 – Technical Data on Higra Electric Motors

3.1 Power Cables

Higra motors use low tension (lower than 1000V) power cables, 0.6/1kV flexible type, class 5 stringing, with 90°C as maximum continuous working temperature, as per ABNT NBR 7286:2015 Standard and designed for each motor power according to ABNT NBR 5410:2004 Standard. Motor power cables might be, according to the equipment power: a) tripolar single cable, b) three unipolar cables or c) six unipolar cables.

For voltages equal or higher than 1000V, please consult HIGRA or its local representative.

ATTENTION: the use of power cables longer than the ones originally supplied with the equipment requires section sizing up.

3.2 Insulation Class

Insulation classes are defined according to the limit of temperature that the set of materials that make the insulation is able to support continuously, without affecting their life. Combination of two or more insulating materials used in an electric equipment is called insulating system. In an electric motor, this combination consists of the magnetic wire, the slot end insulation, the slot closure insulation, insulation between phases, varnish or wire insulation coat, connection cable insulation, etc. Any component in direct contact with the coil is considered part of insulation. Limits of temperature elevation for each insulation class, as per Brazilian standards, are the following:

Maximum Temperature	Temperature Class
90°C	Y
105°C	A
120°C	E
130°C	B
155°C	F
180°C	H

Table 25 – Motor Insulation Class according to IEC85

IMPORTANT: HIGRA motors are classified as Y Class, what means they can afford work temperatures up to 90°C.

Motor life depends fundamentally on the winding insulation. Many different factors might influence the motor life, however the insulating materials operating temperature is the critical point.

Insulating resistance test on motors of Higra Amphibious Pumps is conducted in accordance with ABNT NBR 17094-3:2008 Standard – section 6.3.4.2, by applying 500V continuous voltage for motors with nominal voltage inferior to 1000V. To assure a safe operation we recommend the use 1000MΩ as minimum value corrected for 40 °C temperature. To conduct the insulation resistance test in medium tension motors (higher than 1000V), consult HIGRA or its local representative.

3.3 Protection Degree

Frames of electrical machines are built according to the type of use it will have, in order to meet the protection specifications against liquids or solids damaging penetration. ABNT NBR IEC 60529: 2017 Brazilian Standard defines protection grades through letters IP followed by two numbers with the following meanings:

First number: indicates protection grade against accidental contact with people and the damaging penetration of solid bodies.

First Number	
Number	Indication
0	No Protection
1	Protected against solid objects larger than 50 mm
2	Protected against solid objects larger than 12 mm
3	Protected against solid objects larger than 2.5 mm
4	Protected against solid objects larger than 1.0 mm
5	Protected against dust that damages the motor
6	Totally protected against dust

Table 26 – First Number of Protection Degree

Second number: indicates protection grade against damaging penetration of water.

Second Number	
Numeral	**Indication**
0	Not Protected
1	Protected against drops of water falling vertically
2	Protected against drops of water falling with 15° maximum inclination
3	Protected against water sprinkled in 60° angle and vertical position (rain)
4	Protected against projection of water from any direction
5	Protected against water splash from any direction
6	Protected against sea waves or water projected in powerful splashes
7	Protected against immersion in water under defined weather and pressure conditions
8	Protected for continuous immersion in water under conditions specified for the manufacture

Table 27 – Second Number of Protection Degree

Electric motor standards deliver additional information through combination of letters and numbers that indicate special procedures during the testing or use under special atmospheric conditions. Letters S, M or W must be used the following meaning only:

W – Placed after the numbers, it indicates the equipment is designed for use under specific atmospheric conditions and foresees complementary protection steps or procedures previously agreed between customers and suppliers.

Letters S and M, coming after numbers, indicate special testing conditions:

S – Indicate that testing against water penetration must be affected with the equipment off.

M – Indicates the same test must be conducted with the equipment under operation

IMPORTANT: HIGRA motors are classified as IPW 68, as per ABNT NBR IEC 60529:2017.

3.4 Service Factor

Service factor is the multiplier that, when applied to the motor power rating, indicates allowable overload that should be applied continuously under specific conditions, without presenting damaging heating. In other words, it means the motor is able to deliver more power than that stamped on the identification plate, keeping the foreseen tension and frequency.

For example, a 10HP 60Hz 220V motor, with a service 1.15 factor (SF) could be used with a continuous overload up to 15%, keeping 60Hz, 220V, what means, 11.5 HP without damaging heating.

IMPORTANT: Although the motors of the HIGRA Amphibious Pump have a service factor of 1.15, we do not recommend continuous operation within this range, since the safety margin that can absorb the variations inherent in the pumping system is lost.
If you choose to operate inside the FS, the section of the power cable must be checked.

IMPORTANT: According to ABNT NBR 17094-1:2018 Standard, the use of the service factor results a life shorter than the one with motor in nominal load.

3.5 Electric Protections

Electric motor protection systems avoid dangerous operation conditions that might damage the equipment or injure users. Protection devices act based on the motor current and internal temperature.

ATTENTION: every HIGRA equipment must be connected to a control panel with electric protections compatible with the electric motor power, promoting the motor full protection. Motor burn is not covered by warranty.

4. NPSH AND CAVITATION

It is very important that manufacturers and users understand the NPSH variable behavior, in order to the pump present satisfactory performance, mainly in systems where there are both requirements: pump running at the beginning of the range, with low pressure and high production, and the existence of negative suction.

The higher the pump flow rate and the negative suction head are, the higher is the chance the pump presents cavitation due to NPSH. In technical terms, NPSH is defined as the total suction head referred at the local atmospheric pressure existing in the center of the suction connection, less the liquid steam pressure.

$$NPSH = (Ho - h - hs - R) – Hv$$

Where:
Ho = Local atmospheric pressure in mwc (chart 28);
h = Suction head in meters (installation datum);
hs = Load losses in the flow through the suction tubing, in meters;
R = Load losses in the flow inside the pump, in meters (provided by manufacturer);
Hv = Fluid steam pressure, in meters (chart 29).

For the NPSH offers the pump a satisfactory suction, it is necessary that the pressure at any line spot is never lower than the pumped fluid steam pressure. This condition is assured by taking the necessary steps at the suction installation for the pressure that is useful for the movement is always higher than the sum of the pipe friction losses, plus the suction head, plus the pump inner losses. Therefore:

$$Ho - Hv > hs + h + R$$

PUMP NPSH & INSTALLATION NPSH: For establishing, comparing and changing installation data, if necessary, it is usual to combine the previous formula terms in order to get the two characteristic figures (installation and pump), being:

Ho - Hv - h - hs = NPSHA (available), that is a characteristic of hydraulic installations. It is the energy that the fluid has at a point immediately before the pump suction flange above the steam pressure. This variable figure must be calculated by the one who dimensions the system, using determined coefficients and installation data.

R = NPSHR (required) is a pump characteristic determined in its design, through calculations and laboratorial tests. Technically, it is the energy necessary to win the load losses between the pump suction connection and the impeller helix, as well as create the desired speed in the fluid at the helix. The pump manufacturer furnishes this information on performance curves (NPSH curve). This way, for good pump performance it is necessary to always assure the following situation:

$$NPSHd > NPSHr + 1,0$$

Altitude (m)	0	150	300	450	600	750	1000	1250	1500	2000
Atmospheric Pressure (mwc)	10,33	10,16	9,98	9,79	9,58	9,35	9,12	8,83	8,64	8,08

Table 28 – Data on atmospheric pressure according to local altitudes.

Water Temperature (°C)	0	4	10	20	30	40	50	60	80	100
Water Steam Pressure (mwc)	0,06	0,08	0,12	0,23	0,43	0,75	1,25	2,03	4,83	10,33

Table 29 – Data on water steam pressure according to temperature.

EXAMPLE:

Supposing a pump runs with 35 mwc manometric head, 325 m3/h flow rate and that NPSHR informed in its curve is 4.5. Installation suction head will be 2 meters and the load loss at suction is 1.5 mwc (load loss in the tubing, valves, bends, etc.). Altitude is approximately 600 meters and the water temperature is 30ºC.

Knowing that:

NPSHd = Ho - Hv – h - hs

Where:
Ho = 9.58 (local atmospheric pressure – chart 28)
Hv = 0.433 (water steam pressure – chart 29)
h = 2.0 m (suction head)
hs = 1.50 m (load loss calculated for the suction friction)

We have:
NPSHA = 9.58 – 0.433 – 2.0 – 1.50
NPSHA = 5.64 mwc

If **NPSHA > NPSHR + 1.0**, so the pump can work suctioning normally.

Since this condition is satisfactory, once **5.64 > 4.5 + 1.0**, the pump can operate under the pre-determined conditions.

IMPORTANT: NPSHA must be higher than NPSHR, preferably with a tolerance superior to 1m. Do not run a pump if this condition is not met.

If these variables are changed, the NPSHA may become equal or inferior to NPSHR, resulting **CAVITATION**. When condition NPSHA > NPSHR + 1.0 is not guaranteed by the system, the phenomenon called cavitation occurs. This phenomenon happens when the fluid pressure in the pipe line is inferior to the fluid steam pressure, forming air bubbles, what means, fluid rarefaction (water column break) caused by the impeller helix displacement, flow nature and/or by the own fluid impulsion movement. These air bubbles are pulled by the flow and are condensed returning to the liquid state abruptly when pass inside the impeller and reach high-pressure zones. At the moment this state change happens, the fluid is already in high speed inside the impeller, what provokes pressure waves so intensive that surpasses the resistance to the impeller material traction and can extract particles from the pump body, blade and walls. It makes the pump to render useless in a short time of use for consequent lack of efficiency. The noise of a pump cavitating is different from its normal operation noise, since it sounds like it is pumping sand, stones or another material that causes impact. Actually, it is the sound of the air bubbles “imploding” inside the impeller. To prevent cavitation from happening, depending on the situation, the following steps must be adopted:

- - Reduce the suction head and the tubing length, installing the pump the nearest possible from collection point;

- Reduce load losses at suction, by increasing tubes and connections diameter;

- Re-do the system calculation and check the pump model;

    - When possible, without damaging flow rate and/or final pressure required by the system, cavitation can be eliminated adding a valve at the pump discharge ”throttling”, or modifying the pump(s) impeller(s) diameter(s). However, these steps must be adopted in last case only, since they can alter the assembly hydraulic efficiency significantly.

5. WARRANTY TERMS

We are thankful for your preference in acquiring a HIGRA equipment and sure you will be satisfied with this product. In the case equipment presents any damages or defects during the warranty period please contact the company that sold you the product or the plant. However, we suggest you to carefully read the instruction manual before contacting the plant, our agents or representatives, whose contact information are available on our catalogs, manuals or web site. However, we suggest you ready instruction on this manual carefully.

Through this Warranty Certificate, HIGRA guarantees the product functioning for TWELVE (12) months after shipment. If the product presents any problems due to manufacture defects during the warranty period, our local agent or representative will proceed with the product repair or replacement with no labor or part costs, as per conditions below.

Terms of This Warranty Certificate:

1. This warranty will be conceded only when the original invoice (indicating the acquisition date and product specifications) is presented with the defective product;

   1.1. HIGRA reserves the right to refuse free assistance if the above document is not presented or is unreadable.

2. This warranty does not reimburses neither covers damages resulting from adaptations or adjustments done to the product, without previous HIGRA's written consent, satisfying technical and safety standards for which product has originally produced;

3. This warranty is not applicable if the product serial number has been erased, removed or become unreadable;

4. As per article 18 from Brazilian Consumer Defense Code, HIGRA has 30 days from formal customer's communication, to solve the defect or change the product;

5. This warranty does not cover any situations below:

   5.1. Periodical maintenance, repair or parts replacement due to wear under normal operation conditions;

   5.2. Any adaptations or changes to update the product regarding its original characteristics, described on instruction manual, without HIGRA's previous written consent;

   5.3. Costs with transportation, displacement to the local where the equipment is installed and all transportation risks direct or indirectly related to the product warranty;

   5.4. Costs to uninstall and install the equipment;

   5.5. Damages resulting from:

   - Improper use, including, but not exclusively, using the product with a different purpose from that one it was specified or not following HIGRA's instructions for the correct use and maintenance;
   - Installation or use the product without accomplishing technical and safety standards approached in the product manual;
   - Incorrect or improper installation of equipment or accessories furnished by third parties;
   - Repairs effected by non-authorized personnel or by customer;
   - Accidents, flash lightning, fire, inefficient processes or any other causes out of HIGRA's control;
   - Fails in the electric power system energy, overload, energy peaks and other similar situations that result the electric motor burn

   5.6. Defects in the system where this product has been incorporated;

6. This warranty does affect the consumer' statuary rights, according to the current effective national lays, neither consumer's rights over the Company based on the sales agreement established between both parties;

7. This warranty is limited to the furnished product. HIGRA is not responsible for personal damages, neither damages to other third parties; equipment, facilities, lost profits or any emerging or consequent damages;

8. Events not explicit in this certificate will be analyzed case by case.

NOTE: before installing and starting up the equipment, read this manual carefully and follow all instructions.

IMPORTANT: for this warranty certificate to be effective, it is mandatory the receipt below to be filled, firmed and sent to HIGRA. Remittance may be sent by mail, e-mail, fax or through our local agent/representative.

✂ ----------

Herein, I acknowledge receipt of installation manual relative the acquired equipment.

CUSTOMER: _____ **INVOICE #:** _____

PRODUCT: _____ **DATE:** _____

RESPONSIBLE: _____ **SIGNATURE:** _____

LEARN MORE
ABOUT OUR PRODUCTS ON:

WWW.HIGRA.COM.BR

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