Technical & maintenance manual

FOR CIRCUIT “B” Electro pumps P1711,P1721

A	90/02	ISSUED FOR INFORMATION	CERPELLI	S.KEYVANI	DANESHFAR
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED

شرکت فولاد مبارکه M.S.C.

IRITEC IRAN INTERNATIONAL ENGINEERING COMPANY — ایریتک شرکت بین المللی مهندسی ایران

PROJECT TITLE:
5.4 mt/y REVAMPING & EXTENSION OF STEEL MAKING PLANT

CONTRACT AND PROJECT No.

	SIGNATURE	DATE
PREPARED	CERPELLI	90/02/15
CHECKED	S.KEYVANI	90/02/18
APPROVED	DANESHFAR	90/02/20

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http://www.cerpellipompe.com
Since 1904

Job	CP0900032
Pump	**HPEB 30X55**
Date	04/11/09

Data sheet, drawings and list of parts

Pump type HPEB 30x55	Client IRASCO
Serial number CP0900090.01 ÷ CP0900090.10	Order no 20080556BA
Cerpelli's Job CP0900032	Item / Plant P1711 A2/D2/S2 (Mod.1) P1721 A2-D2/S2 (Mod.2)

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Job	CP0900032
Pump	**HPEB 30X55**
Date	04/11/09

Pump Characteristics:

Pump type ....: Horizontal, single stage heavy duty centrifugal
Pump series..... .....: HPEB 30x55
Cerpelli reference ....: Job CP0900032,
serial no. CP0900090.01 ÷ CP0900090.10

Pump characteristics:
Service..... .....: Circuit "B" module 1&2 cold water pump, tower "B"
Pumped fluid: ....: Industrial water
Pumping temperature .....(°C) .....: 30,5
Specific gravity.....(kg/m³) .....: 1000
Head .....(m).....: 91,84
Pump capacity.....(m³/h).....: 900
Pump efficiency .....(%).....: 78
Pump speed .....(rpm).....: 1480
Pump rated power .....(kW).....: 288,7

Pump gross weight ....: 4285 kg
Pump rotation ....: CW
Type shaft seal ....: Packing
Type of coupling ....: Made by Rusteel, AD91 type
Type of lubrication ....: Oil

Electric motor
Type ....: Made by WEG, HGF 355C/D/E type

Annex documents
Outline drawing ....: 28641
Section drawing ....: 28537
Instruction manual ....: C493
Electric motor instruction manual .....: 9300.0009 I/10
Coupling instruction manual .....: ad_ita.ing_norm rev1
Certificates

Remarks

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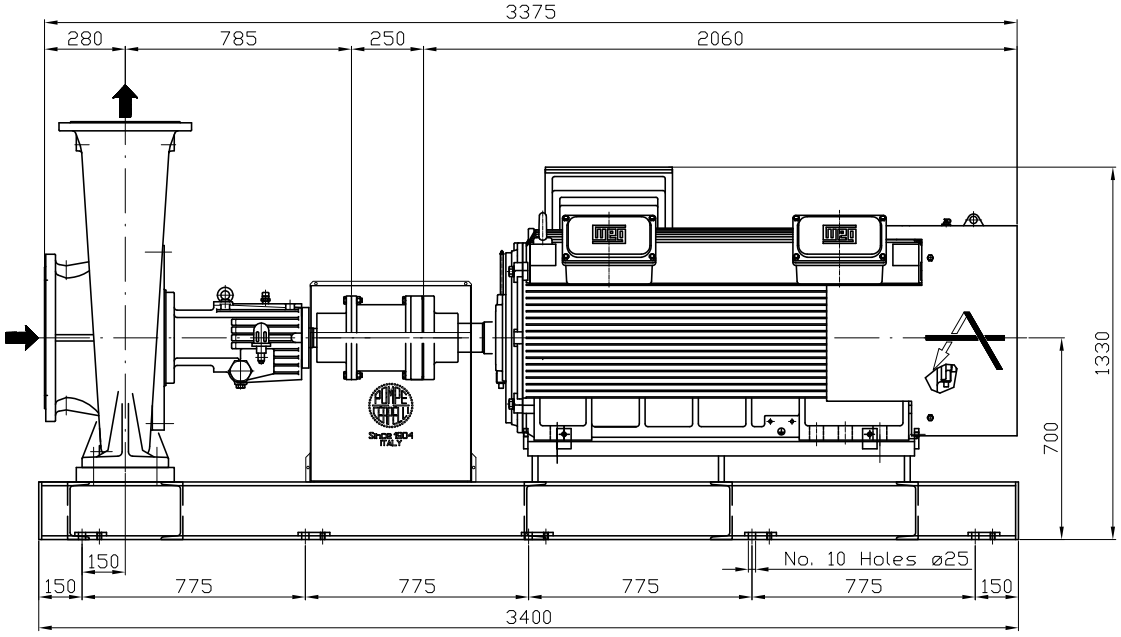
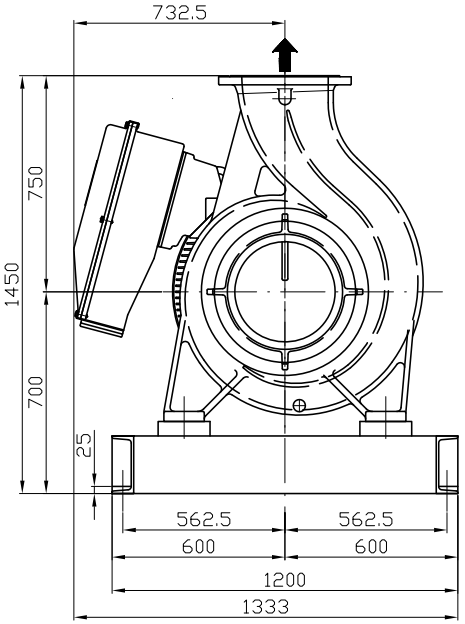
Job	CP0900032
Pump	**HPEB 30X55**
Date	04/11/09

Pump part list:

Section drawing no. 28537

Part. N.	Q.ty	Code	Description	Material
1100	1	CP05195	Pump casing	A 48 CL 35
1510	2	CP05196	Casing wear ring	A 48 GR.45
4100	1	CP05202	Stuffing box	A 48 CL 35
4590	1	CP05203	Gasket	Guarnital
6490	1	CP01824	Lifting device	Carbon steel
6573	24	CP01265	Stud bolt	A 193 GR. B7
6576,1	2	CP02622	Hexagon screw	A 193 GR. B7
6578,1	6	CP02418	Grub screw	A 193 GR. B8M
6580	24	CP01027	Nut	A 194 GR. 2H
6580,1	2	CP00918	Nut	A 194 GR. 2H
6576	4	CP02633	Hexagon socket screw	A 193 GR. B7
6513,1	7	CP04288	Plug	
2200	1	CP05198	Impeller	A 48 CL 35
2310	2	CP05200	Impeller wear ring	A 48 GR.45
6570,2	6	CP02418	Grub screw	A 193 GR. B8M
2100	1	CP05204	Shaft	A 276 TP.420
2912	1	CP05205	Impeller locknut	A 276 TP.420
3712	1	CP02004	Lock nuts	A 193 GR. B7
3713	1	CP01991	Lock washer	A 193 GR. B7
3862	1	CP05210	Lubrification disc	Carbon steel
6545	1	CP01625	Seeger ring	Carbon steel
6570	1	CP02362	Grub screw	A 193 GR. B8M
6710	1	CP05093	Key	A 276 TP.420
6742	1	CP05215	Key	A 276 TP.420
4551	1	CP05216	Gasket	Teflon
6570,3	3	CP02430	Grub screw	A 193 GR. B8M
3200	1	CP05206	Bearing housing	A 48 CL 35
3011	2	CP00162	Ball bearing	
3011,1	1	CP00228	Roller bearing	
3261	1	CP05207	Bearing cover	A 48 GR.45
3262	1	CP05209	Bearing cover	A 48 GR.45
3854	1	CP00029	Oil filling plug	
3855	1	CP00064	Constant level oiler	
2540	1	CP02252	Angus ring	NBR
2540,1	1	CP02264	Angus ring	NBR
2540,1	1	CP01822	Lifting device	Carbon steel
6515	2	CP01562	Plug	A 105
6515,1	1	CP01560	Plug	A 105
6515,2	1	CP01558	Plug	A 105
6546	1	CP01581	Seeger ring	R 150
6578	12	CP02661	Hexagon socket screw	A 193 GR. B7
4542	1	CP00527	Liquid gasket	
4134	1	CP05211	Lantern ring	Bronze
4120	1	CP05213	Gland	A 48 GR.45
2450	1	CP05214	Shaft sleeve	A 276 TP.420
6781	4	CP03111	Stud bolt	A 193 GR. B8M
6782	4	CP02772	Nut	A 194 GR. 8M
4130	5	CP05221	Packing	3075

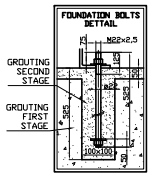




ANCHOR BOLTS DEATIL

(anchor bolts are not furnished by Cerpelli Pompe

Detail "A"



WEIGHTS

Pumps	850 kg
Electric motor	2650 kg
Baseplate	785 kg

PUMP NOZZLES – FLANGE POMPA	
Suction Aspirazione	DN 400 PN 16
Discharge Mandata	DN 300 PN 16

OPERATING CONDITIONS CONDIZIONI DI FUNZIONAMENTO		
Design pressure Pressione di progetto	(bar)	16
Operating temperature Temperatura di esercizio	(°C)	30,5
Specific gravity Peso specifico	(kg/m3)	1000
Operating pressure Pressione di esercizio	(bar)	9,2
Differential head Prevalenza	(m)	91,84
Flow Portata	(m3/h)	900
Pumped fluid Fluido pompato		INDUSTRIAL WATER
Service Servizio		CIRCUIT "B" MODULE 1&2 COLD WATER PUMP, TOWER "B"
Item Item		P-1711 A2/D2/S2 (MOD.1) P-1721 A2/D2/S2 (MOD.2)

MOTOR DATA – DATI MOTORE			
MFR Costruttore	WEG	Volts/Hz/Fasi Volts/Hz/Phases	6600/50/3
Type Tipo	MEC 355	Giri/min rpm	1480
Potenza Rated power	kW 360		

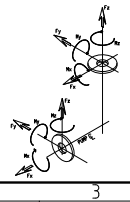
SEAL DATA – DATI TENUTA		COUPLING DATA – DATI GIUNTO		LUBRICATION – LUBRIFICAZIONE Pump – Pompa	
MFR Costruttore	-	MFR Costruttore	Ru-steel	Oil Type Tipo olio	ISO VG 68
Type Tipo	Packing	Type Tipo	Flexible AD9	Q.ty Q.tà	Lt. 2

WEIGHTS – PESI (kg)		DRAWINGS – DISEGNI	
Pump Pompa		Motor Motore	WEG 10000379467
Baseplate Basamento		Tank Serbatoio	-
Motor Motore		Pump Section Sezione Pompa	28537
Assembly Gruppo		Coupling Giunto	Rusteel- 22340

FORZE E MOMENTI MAX AMMISSIBILI SUI BOCCHELLI DELLA POMPA, IN ACCORDO CON API 610 10th EDIZIONE allowable forces and moments on pumps nozzles according to API 610 10th EDITION									
BOCCHELLI nozzles	FORZE - forces N				MOMENTI - moments N x m				
	Fx	Fy	Fz	Fr	Mx	My	Mz	Mr	
ASPIRAZIONE suction DIA.NOM. 400	10230	8450	6670	14850	7320	3660	5420	9820	
MANDATA discharge DIA.NOM. 300	6670	5340	8000	11700	6100	2980	4610	8210	

Il corpo pompa è in grado di sopportare il 150% dei valori di forze e momenti indicati in tabella applicati contemporaneamente sulle bocche, sovrapposti alla pressione interna, senza causare deformazioni che danneggino il funzionamento della pompa e della tenuta

The pump's pressure casing is capable of withstanding twice the forces and moments in table applied simultaneously to the pump through each nozzle, plus internal pressure, without distorsion that would impair operation of the pump or seal



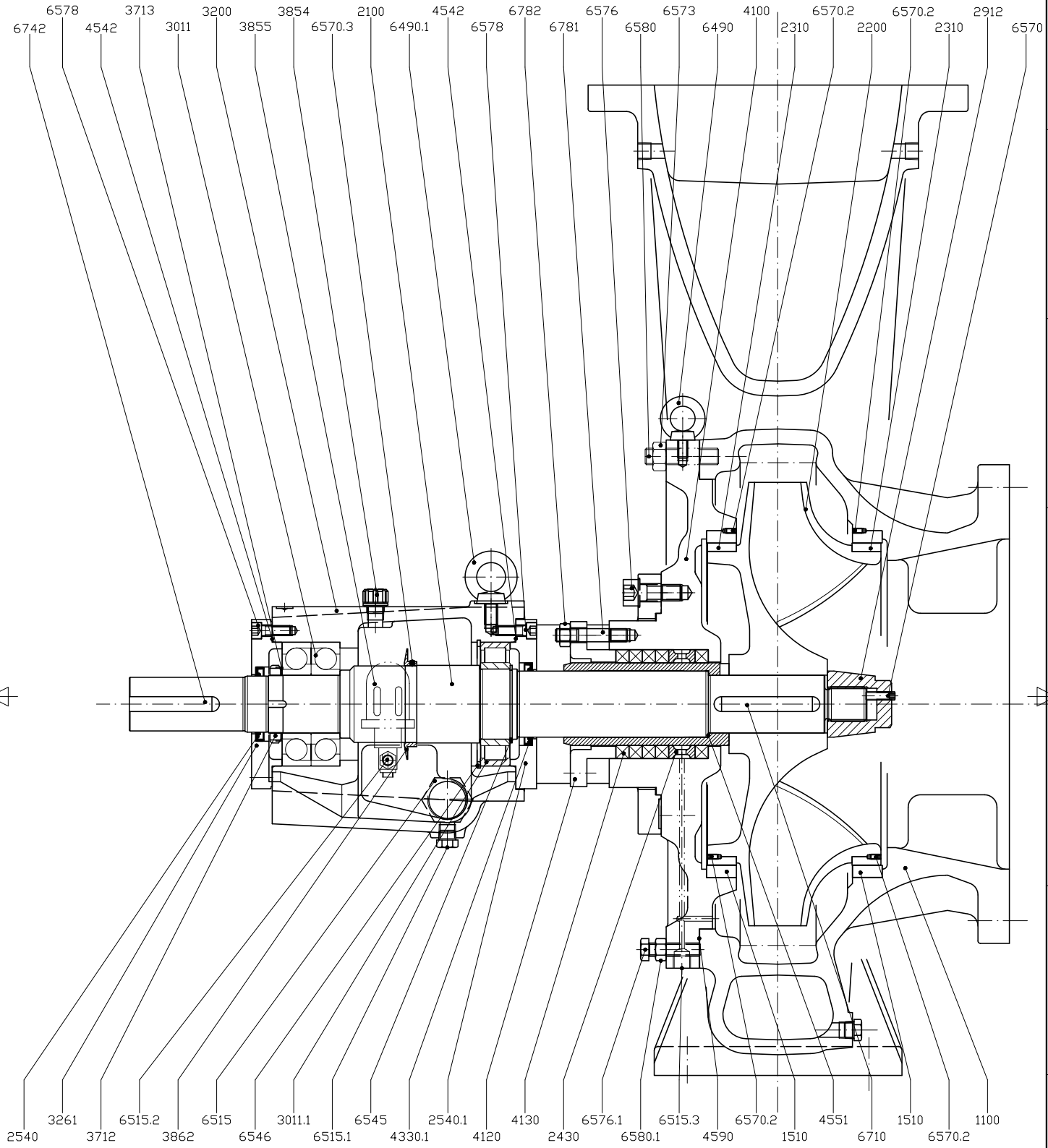
Serial number: CP0900090.01 ÷ CP0900090.10

REV.	MODIFICHE	VISTO	APPR.	DATA
2	Revised motor height	M.B.	CHESSA	22/07/09
1	Revised after your comments of 28/04/09	M.B.	CHESSA	10/06/09
0	PRIMA EMISSIONE	M.B.	CHESSA	21/04/09

Querceta Lucca

PUMP TYPE POMPA TIPO	JOB COMM.	CP0900032
HPEB 30x55	SERIAL NO. MATRICOLA	
DRAWING NR. DISEGNO N°	28461	

ISO A2



DISEGNO IN SEZIONE POMPA TIPO HPEB 30x55
SECTION DRAWING PUMP TYPE

POMPE CERPELLI
Querceta Lucca

28537

Foglio

Rev.					
0	Prima emissione	M.B.	Chessa	21/04/09	
Rev.	Modifiche	Visto	Appr.	Data	

ISO A3

Since 1904

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Edition	**00**
Date	01/07/2008

Operating and Maintenance Instructions with Dismounting and Mounting Procedures for Centrifugal pump type HPEB

This Operating and Maintenance instructions contains information from the pump manufacturer.They may need to be supplemented by instructions of the operator company for its personnel.

The instructions of this handbook do not consider the specific information concerning to operation and maintenance of the process plant into which the pump is integrated.

Such information can only be given by persons responsible for construction and planning of the plant

Some specific instructions concerning the operations or the installation maintenance where the pump is integrated have the priority on the pump builder instructions.

It is always necessary to refer also to the instructions concerning the installation builder operations and maintenance.

INDEX

1. GENERALITIES

1.1 Description of the pump

The HPEB pump is designed for heavy duty continuous service at medium temperatures and medium pressures in oil refinery , petrochemical and chemical industries.

Pump design is centerline mounted , horizontal single stage , single suction , double or single volute , radially split , back pull out according to American Petroleum Institute (API) 610 Standard type OH1.

Suction nozzle is in horizontal position (END) and discharge nozzle in vertical position (TOP).

The modular construction system , with identical dimension parts , allows minimum spare inventories , since only four sizes of bearing frames foreseen to cover the complete range of pumps sizes.

BEARING HOUSING is made in one piece and has machined pilot fit with stuffing box cover. Double row ball thrust and single row roller radial bearing are provided. Both radial and thrust bearing are sized to give 25.000 Hours minimum Lh-10 rating life with continuous operation at rated pump conditions. To allow oil mist lubrification , when required , an 1/4 " NPT connection on top pf the bearing housing is provided. Bearing are oil flood lubrificated. Oil level is maintained by a 4 once constant level oiler.

The Bearing housing is completely water jacketed. (Non-cooled bearing housing also available) The oil chamber is sealed with noncontact labyrinth deflectors as API 610 requirements.

WEAR RINGS are renevable to obtain the original running clearances and efficiency. They are insered in the casing , cover and impeller with a slight interference fit and are locked in position with stainless screws.

IMPELLER is closed type , single suction design so that head versus capacity curve is stable. A large eye area insures low NPSHR requirement and reduces cavitation possibilities. External surfaces are machined , internal or waterways are hand finished. All impellers are statically and dinamically balanced. The impeller has renevable wear rings on both suction and back side and balance holes to minimize axial load.

SHAFT SLEEVE is keyed and shouldred on the shaft near the impeller. Gasket between sleeve and shaft shoulder prevents leakage and avoid any shaft contact with the process fluid. The sleeve is free to expand and extend over the packing or mechanical seal gland.

SHAFT deflection is minimized by proper span between bearing, short impeller overhung and large shaft diameter with oversize bearings.

PUMP COVER is aligned by machined pilot fit. COVER has integral casted stuffing box cooling and heating jacket . Mechanical seal chamber is in according to API standard. Single , double , balanced or unbalanced mechanical seal , with all possible combination flash and quench glands are available. Tapped opening are foreseen in thecover for lantern ring sealing liquid or mechanical seal recirculation line.

SUCTION AND DISCHARGE FLANGES are ANSI rating 150. Upon request pumps can be furnished with different standards like UNI , DIN , BS and others.

The pump SUPPORT are located at foot.

CASING is radially split with suction and discharge nozzle integrally casted. In order to mimimize shaft deflection ,seal and bearing faliure , wear rings wear , the casing is of double volute design , which ensures radial balance.

1.2 Guarantee

All the details that compose the pump are strictly checked during the productive process, the pump meltings are subjected to the pressure test (hydrostatic test) and after the assembling, the whole equipment is subjected to a functional test in order to verify the contractual conditions.

1.2.1 Guarantee general conditions

The firm engages itself to provide systems conformable to the agreement and without vices that could compromise the use of the systems to which they are designed.
Our pumps are guaranteed for 12 months from the starting, or rather, within 18 months from the receiving the notice informing the goods is ready to be forwarded.
The guarantee does not cover damages due to adventitious chance, major forces, negligence, inexperience, want of maintenance, irrational use of the machines, not authorised changes and repairs.

The materials are not guaranteed against every kind of construction vice or defect, and for this reason, during the above mentioned period, we engage ourselves to substitute or to repair as soon as possible the failed or faulty pieces.
The delivery freights will be on our account and our guarantee does not cover the required manual labour for the possible substitution.
The guarantee does not cover the normal fretting parts or parts that can be fretted or corroded by the peculiar substance of the pumped liquid.
If the machine is not used within 18 months since its preparation, it could be required the intervention of a technician of ours for a supervision and a possible machinery restoration and the freight will be on the customer account.
After this intervention and our approval, the guarantee could have effect, again, for further 6 months.

2. GENERAL REGULATIONS OF THE HANDBOOK

This handbook has been realised in order to establish a reference for :

- the use safety
- the pumps installation and maintenance intervention
- starting, laying and pumps switching-off procedures,

and it has to be considered an integrating pump part and of all the engines that the Commercial Cerpelli Company Srl, here named Pumps Cerpelli, and has to be paired off to this for the life necessary till its breaking down.

It is necessary to retain carefully this handbook that has to be available for the skilled staff in charge of the pump use and maintenance, which is responsible for the operations executed on it and, for this reason, it must be CAREFULLY read before operating.

In the Directive 89/392/CEE and following up dates is defined that, with the term “Operator” means skilled staff whose experience, culture and the laws concerning the fire prevention knowledge, were authorised by the safety responsible to act if it is necessary to solve the problem efficaciously. It is also necessary that the operators have the first aid ability.

It is expressly FORBIDDEN the use of the pump to the staff that has not the required qualifications.
The pump must be used exclusively for the specified situation contained on the confirmation for which CERPELLI PUMPS has arranged the execution, the construction materials and the running tests which make the pump perfectly equivalent to the requests.
For this reason it CANNOT be used for situations different from the ones specified on the confirmation.
In case of working conditions change it is absolutely necessary to keep in touch with Pumps Cerpelli, which decline every kind of responsibility for uses different from those provided for by the contract.

If the pump constructive and working data are not available, they will be required to Pumps Cerpelli defining the serial number pressed on the plate fixed on the pump. It has to be always used the pump serial number to require the technical information and/or to order replacement pieces.
Besides, the user has to verify the right environmental conditions (for example frost or high temperature) where the pump will be set and could condition its performances and/or seriously damage it.

3. SECURITY REGULATIONS

In this chapter all the precautions that has to be carefully respected to avoid serious damages to persons and/or to the pump are listed:
damages to the installation vital parts
damages to the persons due to electrical, mechanical and chemical problems.

The security regulations contained in other chapters should have to be observed in addition to those listed in this page.

- Follow **ALWAYS** the regulations and the use provided for on the pump confirmation.
- The pump engine electrical connections must be **ALWAYS** executed by the authorised and skilled staff following the current regulations.
- The intervention on the pump must be **ALWAYS** executed by 2 persons at least.
- Get near the pump **ALWAYS** with the right wears (to avoid wide sleeve wears, ties, necklaces, etc.) and/or a protection equipment (helmet, glasses, gloves, shoes for the prevention of industrial accidents, etc.) fit for the operation to do.
- Disconnect **ALWAYS** the engine from the feeding installation, for example, taking away voltage to the line, when it is necessary to interfere on it.
- The pump must be **ALWAYS** stopped before touching it for every reason.
- The pump has **NEVER** to be warm when somebody is working on it.
- Reset **ALWAYS** the security regulations, that sometimes are kept away to intervene on the pump
- Do **NEVER** touch the pump and/or the pipings connected to it when there is the warm fluid transport more than 80°C.
- Be **ALWAYS** careful in touching a transporting pump or a pump that has transported toxic liquids and/or acids and/or dangerous substances.
- Arrange **ALWAYS** a fire-fighting equipment in the neighbourhood.
- **NEVER** use the pump in a sense opposed to the expected and rotation sense and it is showed on it.
- Do **NEVER** introduce the hands or the fingers into the holes and/or into the pump group openings.
- Do **NEVER** get on the pump and/or the pipings connected to it.
- The pump and the pipings connected to it do **NEVER** be in pressure when it is necessary to intervene on it.
- Maintain **ALWAYS** the surface of the pump cleaned by the powder and/or by greases to remove every possibility of self supporting combustion due to the surfaces overheating.
- Observe **ALWAYS** the regulations imposed by the local specifications.

Besides, in the pump there are some components that can cause some dangers to the persons who keep in touch with them even during the normal maintenance and/or use procedures:

Component	Use	Correlated dangers
Oil and/or grease	The bearing boxes lubrication	Skin and eyes inflammation.
Plastic and elastomer components	O-ring, V-ring	Smoke release in case of overheating.
Aramidic fibre	Packing rings	Emission of harmful powder, smoke release in case of heating.
Varnisch	External surface of the pump	Smoke and powder release in case of heating, flammability
Pump	*	Noise-exposure

4. EMERGENCY STOP

If the pump does not work well and/or there are some transported fluid loss, it is necessary to take off immediately the feeding voltage following the pump stop procedures and informing the installation responsible staff.

So, it is necessary to intervene as showed in chapter number 2.0 and, at least, two persons have to be particularly careful to the dangerous and/or harmful fluids for the health which are transported from the pump.

If somebody keep in touch and/or inhale some transported dangerous substances, it is necessary to take immediately the specific health precautions provided for by the installation internal safety plan and with the skilled and authorised physician staff.

5. UNPACKING MOVEMENT AND TRANSPORT

When the pump arrives to the installation where it is destined, it is always suitable to verify the right correspondence between the transport papers and the goods really received.
During the pump disassembly operations, it is necessary to follow these information:

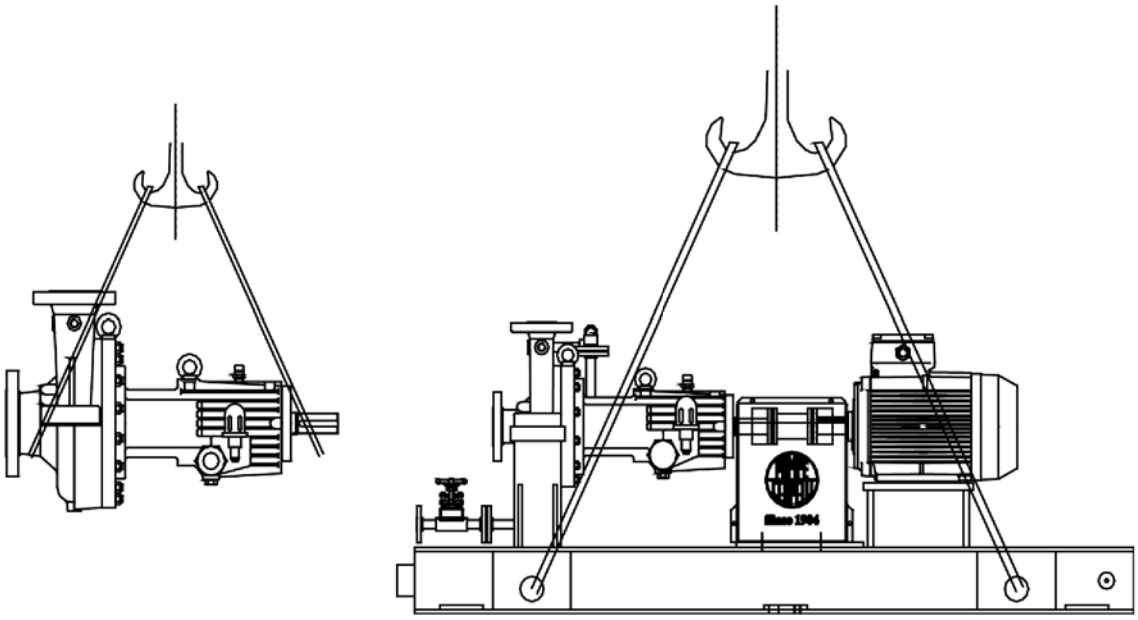
- check on the packing the lack of damages due to the transport
- remove with care the pump packing
- check that on the pump and on the equipment provided with it there is a lack of visible damages.

If there are damages on the pump and on the equipment provided with it, keep in touch immediately with Pumps Cerpelli to verify the pump function.
So, provide immediately to the packing elements waste disposal which can be dangerous, (such as rivets, splinters etc,) and to the materials checked and differentiated waste disposal (such as plastic, carton, polystyrene).

Before the pump transport, which has been already disassembled on the arranged installation base, check the technical papers furnished where there are the following data:
total weight
centre of gravity
overall dimensions
the points position arranged for the group lifting.

So, transport **ALWAYS** the pump (or the group pump-base-engine) in horizontal position on the arranged installation base.

Avoid always that the ropes do not damage the pump or the engine.



The pump transport has to be effected by skilled and experienced staff, informed about the risks connected to the movement operations following the current laws.
Make sure that the lifting and transport means discharge is suited to the engine weight.
Verify that the course to follow before the movement is free from obstacles and that dimensions are suitable for the group passage.
Verify the load solidity
Avoid the ropes or the slings used for the group lifting form a triangle with the vertex angle more than 90°.
DO NEVER USE the eyebolts arranged on every engine.

IT IS FORBIDDEN every pump movement or some parts of its different from what above described

5.1 The pump storage and preservation.

For all Pumps Cerpelli products, a preservation treatment is arranged in accordance with the peculiar customer demands (about 3/6 months), but if it is demanded more storage time, it is suitable to follow these information, preserving, if possible, the original pump and its fittings packing.

- Replace the pump in a closed, cleaned, dry place that is not exposed to solar rays and vibrationfree.
- Avoid that the temperature goes down below 5°C (in this case it is necessary to drain entirely the pump from every kind of liquid that is not antifreeze).
- Close every hole and/or communicating opening with the interior pump .
- Fill up entirely the pump with the suitable anti-corrosive product, compatible with the packing set up on the pump and then rotate the shaft pump for some turnings, impregnating the whole inner surface.
- Protect the worked area with antirust products.
- Cover the pump with an impermeable sheet.
- Fill up entirely the bearing boxes and the gear boxes with lubricant oil.
- Rotate the pump shaft, at least, every 3 months, and then let do some turnings to the pump.
- Periodically, check the liquid level in the pump and in the mountings.

If there is some rotary part shut-down, it is necessary to disassemble entirely the pump and then to substitute the damaged parts.
List of some products suitable for long preservation

ESSO	Rust-Ban 337
MOBIL	Mobilarma 247
CASTROL	Castrol Rustilio DW
SHELL	Shell Ensis fluids
IP	IP Idex fluid PM gr.II
VALVOLINE	Tectyl 511 M

Note: verify the use instructions of the suggested products through the producer cards

5.2 Starting after a long storage time.

Before starting the pump, it must entirely removed the anti-corrosive protection from the pump, using a solvent compatible both with the anti-corrosive product used with the pump constructive materials and, particularly, with the service to which the pump is destined.

Before starting the pump, verify the packing state such is O-ring, V-ring, checking their elasticity and, if that is the case, substituting them with new.

6. INSTALLATION

The pump installation in site is a very important operation and it has to be carefully attended because the good working depend on it.

Proceed to the group installation only after all the regulations imposed by the local Institution have been verified (for example safety, pollution laws etc.).

Do not remove the cover protection which are set up on the delivery and aspiration flanges or the closing caps belonging to possible connections before keeping in touch with the pipes, all this in order to protect the pump inside from the foreign bodies entry.

Before starting the delivery and aspiration pipes connection, it is always necessary to certify that these one are perfectly cleaned and then without slags, such as welding rests, sand, foreign bodies, etc.

If the pump is destined to the fluid pumping with a temperature more than 80°C some parts of it can be find during the working with the temperature higher than the threshold scald. In this case it is always suitable to foresee the right protective means, such as defining barriers or other.

The location has to be carefully done on the foundations trying to avoid crushes and using the right means for the lifting.

Set up the pump group in a place accessible from each side, cleaned and able to support a right and a viable installation foreseeing a 1500 mm area around the pump.

Guarantee a right group ventilation avoiding the location in narrow, dusty and hardly ventilated places

6.1 Foundations

The foundations must be projected and realised to take over both the group engine-pump vibrations, and sustain the pump weight, the auxiliary machines, the engine, so as to forestall vibrations and bad alignments during the working, making sure a stern mounting inside the same group.

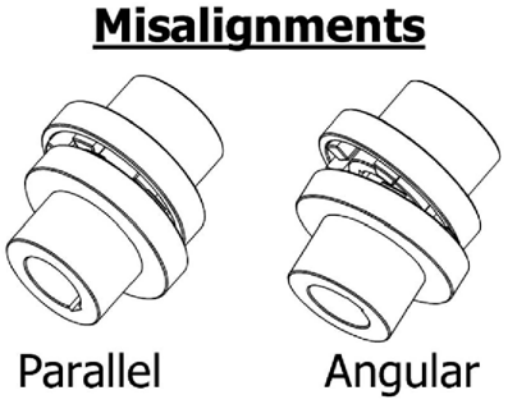
The foundation bolts should be setted as showed on the installation drawing.
Await that every preparation work necessary for the group starting, such as the wall work, finishes before going on with the installation.

6.2 Driver installation.

If the pump is supplied bare shaft, it is necessary to install a pump with a driver on appropriate basement.
If the furnished pump is not connected to an electric engine, but it has a base, it is necessary to do the connection with a right driver and a right coupling before going on with the installation.
Besides, install a coupling guard in according to the requests demanded by the safety laws (such as EN294 o DIN 24295).

6.3 Alignment

If the pump include coupling and driver, the whole group has been carefully aligned at the firm before the consignment.
The group alignment is critical for the good working of it.
Noises, shaft bending, vibrations, over wear or breaking of following parts, joint, compass bearing, wear rings, mechanic seal and engine seizing-up, can be the result of a faulty alignment.



Besides, the temperature can remarkably influence the group alignment and the pump and the engine expansion must be considered during the alignment.

If the temperature is high it is necessary to verify the alignment in all pump operation mode, at cold and hot conditions or counteract the shaft and the joint expansion increasing the distance among the same semi-joints.

Check always the alignment before the pump starting, to verify a possible changes due to casual reasons happened during the transport and the starting.
Check always the stopped pump after having made active the safety procedures to avoid the casual starting.
During the alignment operations it is always necessary to use protection for hands, such as gloves.
Execute the intervention at least with two persons.
For every operation use always the right engine such as tackles or other.

6.3.1 Alignment procedure

Stop the pump and remove the protection to the coupling.

Take away the protective varnish from the coupling and clean it carefully.

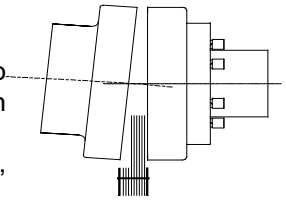
Disconnect the flexible elements of the coupling.

Check the bad alignment both angular and parallel.

Correct the driver position (or the pump position) including some depths or settling their position.

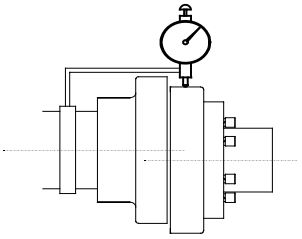
Check angular alignement:

Fit in a shim between the faces of the two semi-joints and check the distance between them.
Repeat the operation at least in other 4 point, making manually rotate a semi-joint



Check parallel alignement:

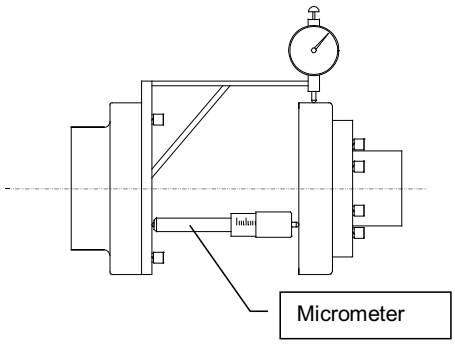
Fasten rigidly the comparator on the semi-joint pump side with a flask, in order to assure the comparator measure accuracy. Check the alignment putting the comparator lever on the other semi-joint, rotating a semi-joint and checking the measure quoted on the comparator.



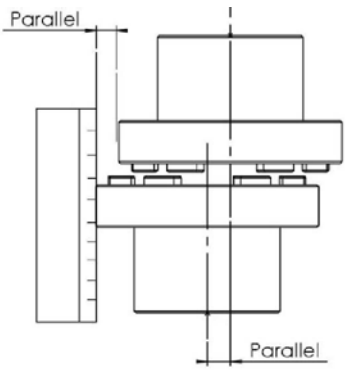
Repeat the control operation concerning the alignment until the noticed measures are part of the tolerances foreseen by the constructor. (See coupling tolerance table)
Block firmly the fastening bolts of the pump at the base.
Set out, bore and cut screws the engine plate bearing for the fastening bolts.
Tighten the engine fastening bolts and secure it firmly to the base.
Check again the alignment and execute the final regulations according to the necessities .
Reassemble the joint protection

WARNING	**Connect two semi-joints through elastic elements or the spacer only after having fastened the suction/discharge pipes and having checked that the pump freely turns acting manually on the pump shaft.**

Particular cases:



If the coupling have a spacer, check the parallel alignement, using an inner micrometer



If a sensible lever indicator is not available or the joint is too little, it is possible to execute the parallel alignement using a rule.

6.4 Pipes

The rated diameter of the suction and delivery piping not necessarily have to correspond to the pump flanges. But this diameter does not have to be smaller than the rated diameter of the suction/delivery pump.
Generally the fluid speed in the pipings has to be about of 2m/s, for the suction pipings and about 3m/s for the delivery.
With higher speed there will be higher pressure losses that could cause the cavitation arise, excessive pressure fall; in this way, the pump good working is compromised.

If the pump has to work with low values NPSHA (Net Pressure Suction Head Available) or in depression, the aspiration pipings and the whole aspiration system must be well sized and studied. It is unimaginable that the pump can pass the system project lacks, such as the long piping and aspiration ways, maybe subdimensioned and containing many curves, valves and first of all the aspiration piping has not to have bags or high points where the gas can tin.

Besides, this kind of machine, for its own peculiar working characteristics, has internal very strict games, and then every remaining or slag can cause serious damages to the pump. Examine carefully the pipings to assure that there is want of foreign bodies or incrustations and cleaning with care before connecting the pipings.

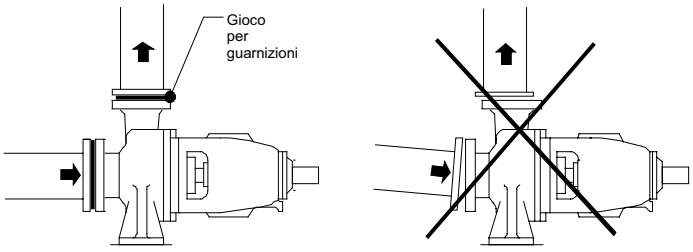
Avoid, where it is possible, the curves use and in particular the ones with narrow spoke, and connect different diameters pipings with reduction to tapered invitation and the eccentric type, and if possible with a connection way long about 10 times the diameter differences.

All the pipings must be set on their own mounting, independent from the pump, in order to sustain its own weight, the accessories weight with the isolation, the transported fluid weight and all the forces and the wringed moments due to the thermic expansions.

It is necessary to take every clever device not to discharge on the aspiration and the delivery flange of the pump forces and moments that can compromise the alignment and then prime vibrations, components and damages overwear.

Possible thermic shock and/or overvibrations should have to be prevented using, for example, some expansion joints.

The coupling between the different piping has to be executed through flanges interposing a dimension garnish and the suitable material, verifying that these are well centred between the tightening bolts so they do not provoke flux resistances or remaining tensions.



CORRECT **WRONG**

WARNING	After having blocked the pump to the base and after having connected all the pipings to the pump, check the shaft rotation acting on the coupling semi-joint without elastic elements, the pump must have the possibility to freely rotate. The mechanics resistance to win is due more to the friction between the faces in contact of the mechanics seal. **Check again the alignment after having blocked the pipings to the pump before connecting the joint to the engine**

A right aspiration and delivery piping connection is necessary to avoid the bad alignment and the following bearing overheating and the overwear of the rotary parts.
The faces of the pump and the pipings flanges must be parallel and to couple without compulsions.
Do not use levers to force the bolt holes alignment.

If the pipings are connected to the pump, do not weld them.

6.4.1 Suction pipe

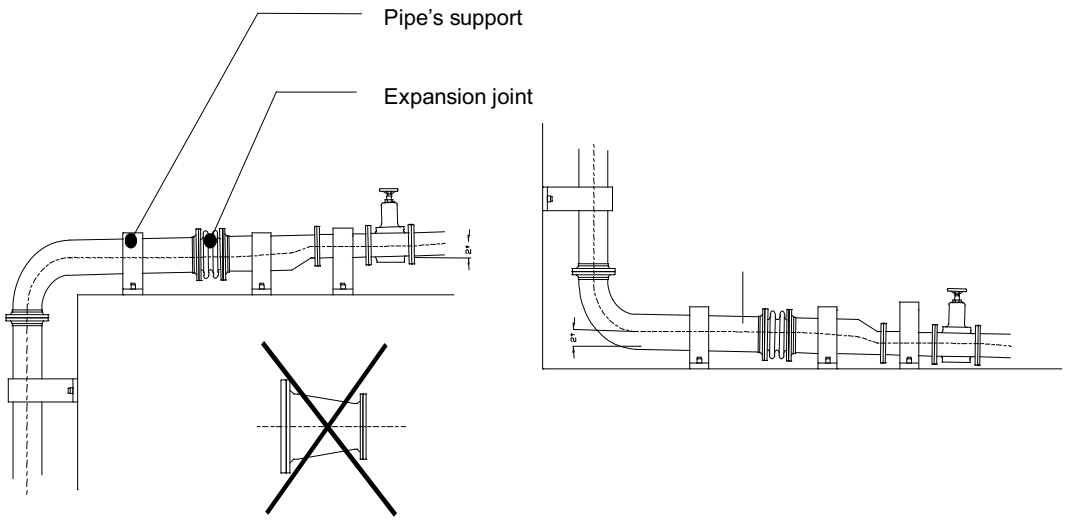
Install the suction pipes in order to avoid some air bags, that can cause vibrations and bad pump working. This piping should have to have a rising movement in case of low aspiration or descending in case of aspiration from a tank set on the pump. The possible valve set on the aspiration pump has to be used only with interception function and NOT the regulation one. Install, where it is necessary, a bottom valve to prevent the aspiration collector emptying during the stop.
If there is more pumps installation, every pump must have its own suction pipes connected to the main collector.

6.4.2 Discharge pipe

Immediately after the pump delivery flange, it is necessary to install a not return valve to prevent that, during the driver stop, the liquid column, reflowing toward to the tank, makes rotate the rotary axes in an opposed direction causing the shaft breaking if there are frequent starting.

Besides install an interception valve.

If is necessary a pump flow regulation act on the valve of interception placed on the pipes of delivery of pump



6.4.3 Auxiliaries pipes

The auxiliary piping can include those for breather, drainage, seal flange washing, seal circulation oil, seal fluxing, bearing mounting cooling, etc..
If the pipings are furnished by Pumps Cerpelli, look the enclosed installation drawing. When the auxiliary pipings have to be installed to the Customer, dimensions and all connection positions will be showed on the installation drawing.

6.5 Electrical connections

The electrical connections must be done only by skilled staff which should have to follow the engine constructor instructions, the electrical machines and the provided current regulations.
Verify the constructor specifications contained in the instruction journal enclosed to this handbook or furnished with the engine.

FOLLOW THE SAFETY SPECIFICATIONS LISTED IN CHAPTER 2.1
EVERY ACTION MUST BE ALWAYS EXECUTED WITHOUT ELECTRICAL VOLTAGE

It is recommended to protect the engine against the overweight with suitable switches and/or fuse-wires. Choose their protection degree verifying the full load current stamped on the engine plate.
Besides, it is suggested to install an emergency pushbutton.

Do the right electrical connections without neglecting the engine grounding.

Before doing the electrical connections, verify that pump and engine turn freely by hand.

Verify that the engine rotation direction agrees with the pump rotation direction stamped on it, if possible, before it is connected to the pump.

Foresee the suitable protection means in case of the rotation test of the engine got away from the pump in order to avoid possible incidents.

The opposite and/or dry rotation can cause serious damages to the pump.

7. PREPARING THE FIRST STARTING

Before going on with the starting operations verify that piping and pump are filled up with the fluid to pump and entirely escaped from possible air bags.

Verify that all the auxiliary services are available and ready to use and where it is necessary, properly started (such as, for example, the mechanical seals fluxing)

Check that the pump and the engine bearings are properly lubricated and the levels reflect the ones ordered. Possible refilling must be done through the suitable connections and using the suitable lubricants.

If the pumped liquid temperature represents a danger, it is necessary to protect both the pump and the pipings from the contact possibility, besides, it is necessary to avoid thermic shocks to the pump with suitable clever devices (such as insulation, pump body gradual preheat, etc.)

WARNING the pump must never work dry

During the first starting operations, it is necessary to be particularly careful in avoiding the contact and/or the inhalation of the possible pumped liquid.

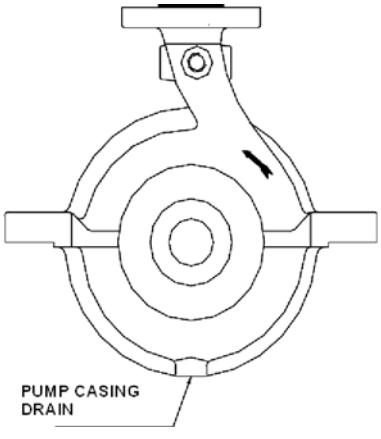
Check that the engine rotation agrees with the pump rotation direction as showed by the arrow set on the pump body.

Before starting the pump, check again the alignment and if necessary correct again as showed by the section “Alignment” verifying that it turns freely by hand.

7.1 Priming

The pump must be completely filled with liquid before starting. If the pump is above the level of the liquid to be pumped, close the discharge valve. If the pump is below the level of the liquid, open the discharge valve 1 1/2 to 2 turns. Prime the pump. All air and vapour must be removed.

Mechanical seal chambers must be vented and filled with liquid. This is particularly important when an external heat exchanger is used with the mechanical seal. When the priming operation has been completed and a continuous stream of liquid is flowing from the vent lines, close the vent valves.
The pump is ready for starting.



7.2 Checks before starting

Before pump starting procedures, it is necessary to verify the following:

1	Does this handbook have been read in its totality?	Yes ☐	No ☐
2	The whole piping system has been filtered and released by possible slags	Yes ☐	No ☐
3	Does every possible choking have been removed from pipings and pump?	Yes ☐	No ☐
4	Do all the auxiliary connections and the pump pipings have been properly installed as showed on the installation drawing/s?	Yes ☐	No ☐
5	Are all the auxiliary connections, such as the mechanics seal fluxing, ready for the working?	Yes ☐	No ☐
6	Are all the connections and pipings without losses and there are forces and wringed moments want?	Yes ☐	No ☐
7	Are all the bolts, the piping connections and taps properly tighten?	Yes ☐	No ☐
8	Do the pump and the engine have been properly lubricated? Are the lubricant levels right?	Yes ☐	No ☐
9	Does the coupling pump-engine have been verified?	Yes ☐	No ☐
10	Does the joint have been properly reassembled?	Yes ☐	No ☐
11	Are all the piping valves in the right position?	Yes ☐	No ☐
12	All the safety protections have been properly reassembled	Yes ☐	No ☐
13	Is the engine rotation direction right?	Yes ☐	No ☐
14	Is the pump stop pushbutton position clear and evident?	Yes ☐	No ☐

If there are one or more negative answers, do not start the pump but verify the point or the points till to obtain a positive answer.

7.3 The pump starting

Start the driver and bring the pump up to speed rapidly. As soon as the pump is up to full speed, open the discharge valve slowly. Do not let the pump run with the discharge valve closed.
Close the discharge valve up to the reaching of the pressure of contractual data.
Check that the pressure shown by the manometer is that correspondent to the contractual data of working of the pump.
Check that there are not losses and/or blow-by from the pipes.

Start the pump and check:

- the pressure of delivery
- the pump speed
- absorbed power

7.3.1 Starting Precautions For Hot Pumps

When the temperature of the liquid being pumped exceeds 180°C (350 °F) the pump must be gradually heated before starting. Any rapid change in temperature may cause thermal distortion, and the risk of misalignment of bearings and bushings internally, and of pump and driver externally. During the warm up procedure a small amount of hot liquid should be circulated through the pump. The warming up rate varies for each application and has to be individually analysed. In general we would recommend a warming up rate of 37°C (100°F) per hour up to 260°C (500°F) and 20°C (50°F) per hour above 260°C (500°F). This heating should be continued until the casing is not more than 20°C(50°F) below the eventual pumping temperature. Obviously these warm up rates are general and cover a wide range of materials and applications. Lesser warm up rates may be possible for special jobs and can only be determined by on site testing by user. During testing, alternative warm up rates may be tried and the pump alignment checked for any distortion and the pump turned over by hand to check the freeness of the rotor. An evenly heated pump case and piping will cause no excessive misalignment and an evenly heated pump rotor will turn without undue dragging.

7.4 regulation of the pressure and the flow of pump

The pump can be operated only momentarily at zero flow and never for longer periods at very low capacities (near shut-off).

Operating at low flows can be result in exceeding safe working temperature, and can cause severe pump damage.

If the process requires that the pump be operated near shut-off intermittently and/or for longer period, a by-pass line from pump discharge back to source of supply should be installed.

If the pump is connect to a constant speed driver, capacity can be reduced by throttling the discharge. If the pump is connect to a variable speed driver, reduction of both the head and the capacity can be accomplished either by reducing the speed or by throttling the discharge.

7.5 Stopping the pump

The centrifugal pumps must be stopped and then the delivery valve immediately CLOSE.
If on the piping there is not a no-return valve, it is necessary to avoid the pump reverse rotation, due to the fluid reflow from the aspiration tank.
Never start the pump if the shaft is running.
If there is an extended stop, empty completely the pump in order to avoid body breaking in case of freezing or corrosions due to the possible chemical alteration of stagnant fluid in the pump.

8. THE WORKING CHECK

Periodically, through the installation instrumentation, check the pump good working verifying that the pump is constantly able to do the service for which it has been arranged.

Check always with care:
- the suction pressure
- the delivery pressure
- the pump turnings
- engine operated absorption
- lubricant levels

The pump working must be free from vibrations or anomalous noises.
If there are anomalous vibrations or unknown noises stop immediately the pump, find the cause and eliminate the disadvantage.
Even if there is a lack of anomalies, it is necessary to check periodically the good pump working verifying also the alignment of it.
Check periodically the capacity system working and all the installed auxiliaries circuits.

If the pump performance, without conditions interventions different up or down it, are less it is necessary to stop it and then going on with possible substitution and repairing.

9. LUBRICATION PROCEDURE

To assure a good pump working, it is necessary to take care of the mounting and bearing housing lubrication.

The HPEB Pumps are always constructed with the bearing housings lubricated with oil.

Consult the data sheets of the pump, enclosed to the this handbook, to verify both the type and the quantity of the required lubricant

9.1 Lube interval

If the environment is cleaned enough and there are not peculiar lubricants pollution dangers from water or dust, and the mounting temperature is about less then 60°C, the lubricant must be substituted (or checked if with grease) every 4000/6000 working hours.

For mounting temperatures higher than 60° or for environments particularly dirty or damp, reduce the time between a change and another one.

The mounting and gears box working temperature must not pass 85°C during normal working. A possible overheating can be provoked by too much oil, the group bad alignment or over vibrations.

9.2 Bearing housing cleaning

Before the pump starting the bearing mounting must be carefully cleaned. Fill in with a solvent fit for the bearing housing. Drain the solvent and dry with care before the oil filling.

9.3 Lubrication procedure

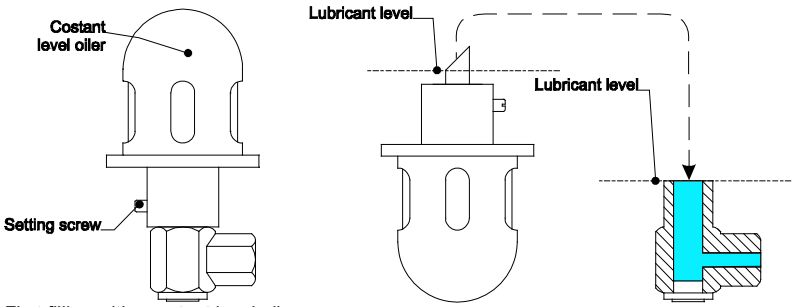
For the bearing housing lubrication, it is enough an oil for bearings with EP characteristics, having a viscosity ISO VG 68 and a viscosity index equal to 100 or better.

But, in peculiar cases they could need other values for a better lubrication, in these cases consult Pumps Cerpelli.

In case of first starting foresee a substitution of it after about 100/200 working hours.

Fill in the gears box with oil till the level showed on the case through the right packing tap, always set on the same case, till the minimum level reaching showed on the indicator set on the box side.

If required, the pump can be furnished complete of constant level oiler which yelds to maintain the oil level constant. This oil-feeder, when it is furnished, is put toward the firm in order to assure the right level.



First filling with constant level oiler:

- Remove the mounting breather cap.
- Loosen the fixing corn and then remove the oil-feeder.
- Put in the oil in the mounting through the filling cap hole till the oil leackage from the oil-feeder crank.
- Fill in the oil-feeder (without disassembling it)
- Put again the oil-feeder in its own crank
- Repeat the operation till the oil feeder level doesn't stop to decrease

Repeat next fillings pouring directly the oil in the oil feeder

9.4 Lubricants list

Type lubricant	Characteristics		Suggested brand / Typo	
Oils	Grading ISO VG Classification ISO Viscosity grade	68 L CC Min 90	SHELL	TURBO T 68
			AGIP	OTE 68
			CHEVRON	HYDRAULIC OIL 68
			ESSO	TERESSO 68
			MOBIL	D.T.E. OIL HEAVY MEDIUM

10. SHAFT SEAL

The Cerpelli HPEB series centrifugal pumps are provided in version with mechanical seal, mounted on pump cover.

The solution selected furthermore is always described in a detailed drawing for the mechanical seal enclosing in the present manual .

The stuffing box solutions are always realised in conformity to API 610 laws appendix C.

If the pump transports dangerous and/or toxic fluids it is necessary to take every precaution before starting every kind of operation.
On the mechanic seal have been installed packing which can release toxic and dangerous substances when there is overheat.
All the maintenance operations have to be done with the machine stopped and disconnected from the electrical line.
The mechanics seals must never work dry.

10.1 The seal installation and the maintenance to the shaft

10.1.1 The mechanical seals

If not specified with other terms, the mechanical seals are assembled on the pump toward the firm.
And other peculiar check and/or records during the disassembling and maintenance operations till they show some blow-by.
Use always original replacement pieces.

During the new seal and/or replacement pieces installation, and before arranging the assembling, it is always necessary to verify the shaft state and always substitute the old gaskets with the new ones.
Clean with care the shaft using an oil and lubricate it with a compatible grease with a pumped fluid.

Do not compress the seal during the assembling, the seal and its components must be freely installed.
If the assembling is forced, disassembling the components an install again the seal with particular care to the gaskets.
Check immediately every 4000 working hours the mechanical seals faces fretting state.

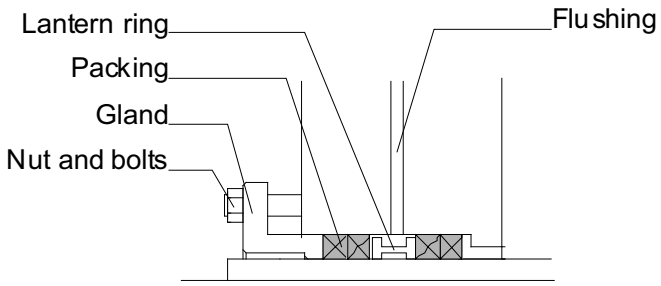
10.1.2 The packing seal

If the pump has got the packing seal, it will be necessary to do a right regulation to assure the regular working expanding the friction heat developed by the packings through a regular fluxing line lubrication.

Regulation
At the first starting loosen the gland nuts in order to consent a great liquid exit.
After tighten the nuts to reduce the loss entity till a unbroken dripping and without causing the stuffing box overheating.
Go on slowly and by degrees to the nuts tightening, usually can be necessary more than one working hour.
Be careful to the gland tightening because once tightened, the packings compact themselves and it is no longer possible, loosening the gland, to promote a greater loss.
If it is not possible to regulate a possible loss increase, it is necessary to substitute the packings with the new ones.

Installation
Before going on with the installation, remove entirely the old packings and clean the whole seal components.
Install the first packing ring and scotch it on the stuffing box bottom, applying if necessary a suitable lubricant substances every ring.
Fit in a metallic split socket-joint or an equivalent number of metallic rings and compress the packing ring tightening the gland.
Remove the gland, the socket-joint or the metallic rings and repeat the operation for every ring which compose the seal, taking care to stagger the 90°packing ring carvings.
Install the core iron ring as showed in the pump section drawing.

Rotate handly the shaft and assure that the core iron ring is rightly installed and its lubricant liquid arrives.
After regulate the packing.



11. MALFUNCTIONS, CAUSE AND REMEDY.

Before starting the failure research or bad working, check always the pump suction and/or delivery conditions, checking the installed instrumentation as suction and delivery gauges, the driver power absorption, etc. In case of bad workings or failures refer to the following table. If the failure persists, keep in touch with Cerpelli Pumps.

Failure	Possible cause	Remedy
INSUFFICIENT DELIVERY PRESSURE	Air from pumped fluid	Check possible air infiltrations from the aspiration piping. Check the flanges and packings bolt.
	Pump not run to rated speed	Check the driver, driver rotation
	Rotation opposed to the pump	Connect rightly the engine
	Mechanical defect	Wear rings worn, Impeller damaged, Internal leakage
	The obstructed aspiration filter	Disassembling the filter and clean or substitute the cartridge for it.
LOW PUMP CAPACITY	Rotation opposed to the pump	Connect rightly the engine
	The pump is not primed and not filled in with the fluid	Prime the pump as showed to priming section taking care to remove the air from the casing pump.
	Aspiration pipe not completely filled in the fluid.	Increase the pipe length or increase the swamping of it.
	Air from pumped fluid	Check possible air infiltrations from the aspiration piping. Check the flanges and packings bolt.
	Pipe in suction line without adequate submergence	Check the suction tank and suction pipe
	Filter partially obstructed or not enough	Clean the filter or reinstall a filter well dimensioned.
	NPSHA too low	Check suction pipe
	Pump not run to rated speed	Check the driver, driver rotation
	Delivery pressure too high	Check discharge valves
	Impeller clogged.	Check the pump impeller
THE PUMP LOSS THE VACUUM	Air in suction pipe	Check the piping
	Air from pumped fluid	Check possible air infiltrations from the aspiration piping. Check the flanges and packings bolt.
	Pipe in suction line without adequate submergence	Check the suction tank and suction pipe. Install or check suction gauge in suction tank
	The steam formation in the aspiration pipings.	Check suction line, excessive pressure drop in suction line
	Overheating of pumped fluid	
	Air from the aspiration pipings	Check possible air infiltrations from the aspiration piping.
	NPSHA too low	Check suction pipe
EXCESSIVE ENGINE ABSORPTION	Pump speed too high	Check driver and pump speed
	The fluid viscosity/Density is too high or higher than the contractual conditions.	Reduce the speed/capacity, check the fluid viscosity or preheat it.
	Density/viscosity of pumped fluid changes	Keep in touch with Cerpelli Pumps for new operatives conditions.
	Delivery pressure too low	Check discharge valves
	The packing/glands too tighten	Check the packing and glands
	Misalignment driver-pump	Check the alignment
	Misalignment driver-pump or piping-pump	Check misalignment between pump and driver and/or pump and piping
	Mechanical defect	Wear rings worn, Impeller damaged, Internal leakage
	Problems on driver	Check driver and pump speed
VIBRATIONS, EXCESSIVE NOISES OR EXCESSIVE OVERTEMPERATURE	The pump cavitation or steams in the aspiration pipings.	Check the aspiration piping and the aspiration pressure.
	The fluid viscosity/Density is too high or higher than the contractual conditions.	Reduce the speed/capacity, check the fluid viscosity or preheat it.
	Air from pumped fluid	Check possible air infiltrations from the aspiration piping. Check the flanges and packings bolt.
	Misalignment driver-pump	Check the alignment
	Not suitable foundations not suitable to slow foundation bolts.	Check the foundation and the foundation bolts.
	Bearings defect	Change the pump bearings
	Excessive rotor unbalanced	Check and balance the rotor
	Vibration on driver	Check the driver, driver rotation
	Impeller clogged.	Check the pump impeller
	Piping installed in wrong position, excessive misalignment of piping	Install pipe supports
	Pump operating below minimum recommended capacity.	Check pump contractual condition, install eventual by-pass line
	Overtemperature or rapid failure in bearings	Check bearing housing, lube oil and external lube system. Check pump/piping alignment
	Overheating of stuffing box	Check packing/mechanical seal flushing pipe
THE QUICK PUMP FRETTING	Solids in suspension in pumped fluid	Check suction filter mesh size and/or suction line
	Internal corrosion	Verify the pumped fluid or contact Cerpelli so to correct the pump materials
	Misalignment driver-pump	Check the alignment
	The pump turns dry or steam formation due to the fluid overheating	Check and verify that the feeding tank seal is 1.5 –2 times the pump rated seal.
	The pump bad lubrication	Check and verify the lubrication.
	Delivery pressure too high	Check with Cerpelli new pressure conditions

12. DISASSEMBLY AND REASSEMBLY

If it is necessary to repair the pump, it is required the knowledge of the operations to do.

Follow some regulations listed in chapter "SECURITY REGULATION"

Let the components transport be done by skilled staff, informed about the risks connected to the movement operations following current regulations.

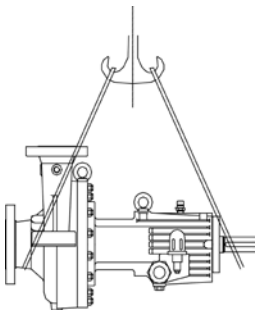
Assure that the lifting and transport means delivery is suited to the components weight to move.
wear a suitable protection wears, such as helmet, glasses, shoes, etc.
take away the engine feeding tension and if it is necessary, disconnect the pump, if there is a combustion engine, from the engine
close the aspiration valves and delivery pump and the accessories pipings valves such as cooling etc.
if the pump transports hot fluids, let make cold to room temperature.
If the pump transports dangerous and harmful fluids, adopt the necessary safety precautions.
discharge all the pumped liquid through the drainage holes and if necessary to reclaim the pump.

Before commencing dismantling make sure the pump to make sure it can not be switched on accidentally and close all shut-off valves in the suction and discharge lines and in the auxiliary lines. (flushing, cooling).
Pump casing and eventual jackets must be drained.

This pump is normal fitted with spacer coupling and dismantling bearing bracket and impeller can be done without removing the casing.
In case of coupling without spacer, disconnect suction and discharge flanges from pipelines. Disconnect eventual auxiliary pipes.

Reassembly is effected in reverse order to dismantling with same procedure. During reassembly following prescriptions are advisable:

- Use plastic or wooden hammers preferably; when using steel hammers, interpose always hardwood
- Bearings shall be shrinked on the shaft after an oil bath heating at 80-90° C .Do not hammer on the bearings.
- Extreme care should be observed when mounting the mechanical seal in order not to damage seal faces and o-rings.



To disconnect the pump from the installation, it is necessary to:

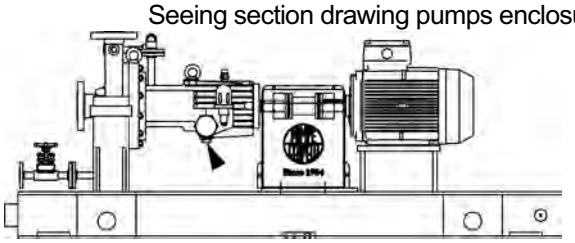
disconnect the aspiration and delivery flanges from the pipings
disconnect the possible accessories pipings
take away the butt strap
take off the joint spacer (if installed)
disassembling the pump loosing the clamping screws on the base
disconnect the pump from the installation taking care to not damage any component and raising it, if necessary, as showed on the drawing.

During the maintenance not accidentally dismantle the parts of the pump but follow the prescriptions shown below.

Always remount the particulars stopped work in the original positions.

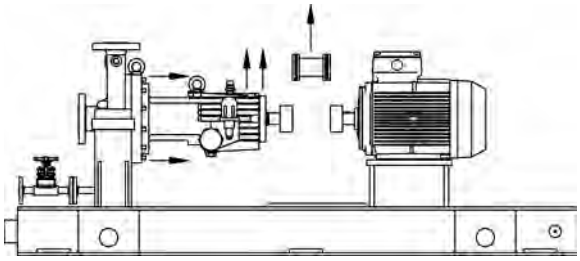
12.1 Disassembly

Seeing section drawing pumps enclosure to the technical specifications.

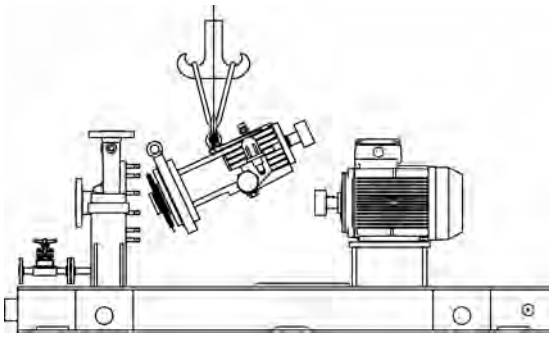


drain the oil contained in the support.

During the disassembly, always remove the particulars using suitable equipment and always in two people.

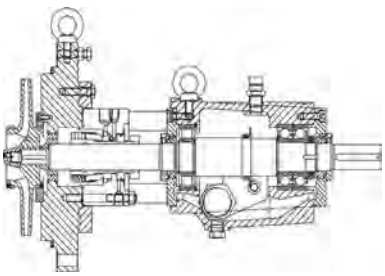


Remove the coupling spacer. Extracting from the body pumps the bearing housing, the cover (stuffing box) and the complete rotor, unscrewing stud bolts who fix the cover to the body.



Remove, using the suitable lifting device, the bearing housing and the complete rotor.

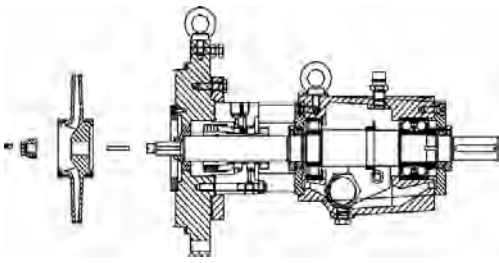
During the lifting pay attention not to damage the internal parts of the pump.
Raise with caution the rotating group and subsequently position it the easy zone for the maintenance.

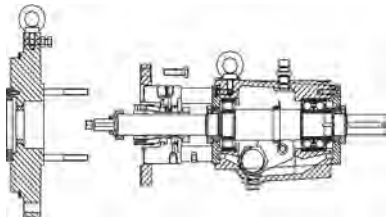


12.1.1 Disassembly of the rotating group

To remove the impeller one execute the following operations:

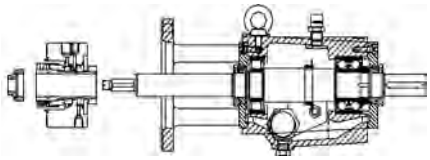
Unscrew the impeller screw nut. Extract the impeller, complete of the impeller wear rings.
The impeller wear rings are mounted forced on impeller. To dismantle them remove the fixing set screws before and use an extractor.
Remove the key which drags the impeller.





Unscrew the screws/stud bolts of the flange of the mechanical seal, up to disconnect the flange from stuffing box.
During this operation pay attention not to damage the mechanical seal.
Extract the screws which fix the stuffing box of the pump to the bearing support.
Extract the stuffing box.

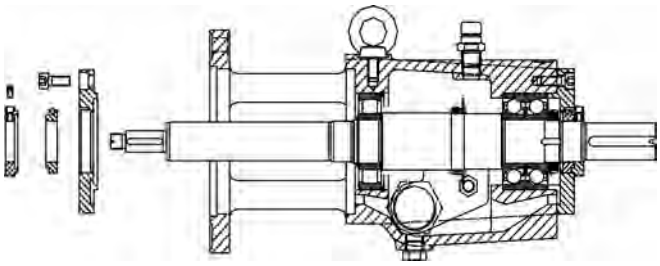
Extract the mechanical seal and the throttle bushing from the shaft.

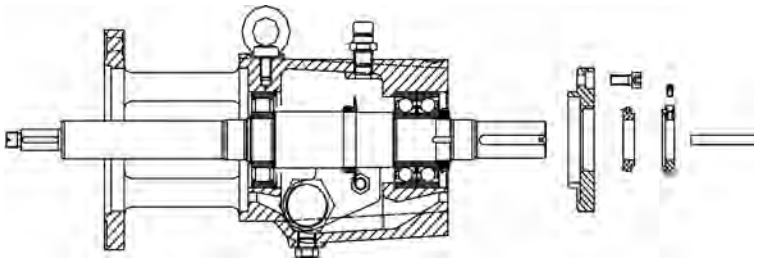


12.1.2 Disassembly of the bearing support.

After extracting the stuffing box of the pump proceed as afterwards described for the disassembly of the bearing housing:

Remove the half coupling of the pump.
Remove the key of the coupling.
Unscrew the set screws of the deflectors.
Extract the deflectors.

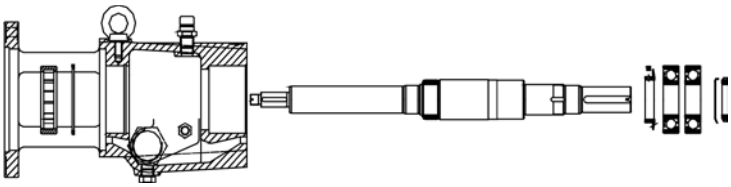




Remove the cover of bearing housing after freeing them from their fixing screws.
Remove the lock nut after freeing it from the safety washer.

Extract the shaft pump complete of the bearings and the internal ring of the radial bearing, extracting it from coupling side of the pump.

Remove the outside ring of the radial bearing, and the thrust bearings using a suitable extractor.



12.2 Reassembly Instructions

Before assembling, all parts to be connected must be cleaned. Old gaskets should never used.
Wear rings of the box and of the casing must be pressed into position, beating them slightly then fixed in the same ways of the original ones.
Mount all parts in the reverse order to that dismantling.
The mechanical seal is a precision product, therefore it should be handled with care, avoiding lapped sealing faces to be damaged.
In any way, refer to the drawing and assembly instructions herein annexed for correct installation.
Do not put the seal back into service until all non-metallic parts have been replaced and the sealing faces have been relapped or replaced.
Before completing the seal installation, wipe the lapped sealing faces perfectly clean.
Connect the pump and the driver coupling with spacer.
Recheck the alignment of the pump as outlined on general instructions.
At completed reassembly the pump should run freely acting by hand on the coupling.

13. INSTRUCTIONS TO PUT THE MACHINE OFF DUTY

Before doing th dismantling operations, go on with a careful machine cleaning.
For the disassembling and the movement way, refer to the chapter 6 ("Installation"), in particular for the safety specifications and the individual protection means.

Use the packing suitable to the machine dimension and weight.

Put on the packing neck a plate concerning the contents, the weight, and every information necessary to the safety transport.

Follow the current regulations dispositions toward the using country about the waste disposal. In particular, it is necessary to empty the lubricant liquids machine, for whose getting rid keep in touch with the authorised firm.

In case of contact with the lubricant substances, follow the information furnished by the " used substance Safety Card."

14. REMAINING RISKS

14.1 The machine or some parts of it movement

During the assembled machine movement operations (installation and put out duty) or some parts of it (maintenance phase and put out duty) there are remaining risks typical of the lifting and transport machine: crush for the use of a lifting and transport means, crush for the load fall or the transport means, impact, entrapping, lag, entangling.
To restrict the risk, the Buyer can ask the handling be done by a skilled staff, suitably informed about the risks concerning the load movement according to the current regulations (D. Lgs. 626/94).
The operators must respect this handbook dispositions.
Do not do handling different from the expected ones.

During the parts extraction operations from the pump case, the maintenance phases or put out duty, a residual ergonomic risk remaining. During this operations, it is possible that the operator use wrong posture in order of the movement or excessive stresses. The operations must exclusively done by a suitably informed staff about the load handle movement risks according to the current regulations (D. Lgs. 626/94) and formed in substance.

14.2 Manual operations with the tools use

There is a general mechanic risk due to the manual operations with the tools use during the installation, the maintenance and the put out duty, the drilling and the screw cutting operations during the installation phase, the operations for the alignment test. To limit the risk, the Buyer can ask the handling be done by a skilled staff, suitably informed about the typical of the treated activities, with the right tools and specific Protection Devices that they require.
The operator, before starting every kind of maintenance or cleaning operation, has to disconnect the electrical feeding. If this operation has not been done, there is a risk connected to the casual engines start during the phases in which the machine protections are temporarily removed.

14.3 Electrical remaining risks

If the machine has got the total electrical engine already mechanically installed, while the electrical part (feeding and electrical display) is due to the Buyer, the engine is conformable to the law EN 60204-1 dispositions, so as the law CEI 64-2. It is enclosed the Conformity Declaration furnished by the engine Constructor.

There are direct contact remaining risks with tension elements, or indirect contact with elements put in tension because of damages. These risks cannot be directly ascribed to the machine. At any rate, it reminds the following general rules:

- the electrical display must be realised in conformity with the current regulations dispositions, in particular with the CEI 64-8 and CEI 64-2, and all the electrical net connection must be done by an authorised installer following the law number 46 dated 1990. The installer is due to assure the derivation suitability from the electrical net and then doing all the connection respecting the current regulations.

- After any kind of impact on the machine from the movement means or the movemented material, even if with a light intensity, it is necessary to open the electrical isolator and then go on with an electrical isolation test before restarting the machine.

- Make all the maintenance operations only after having disconnected the electrical feeding. All the maintenance operations on the electrical installation must be made by the authorised staff following the law number 46 dated 1990

The operator, before starting every maintenance operation, has to disconnect the electrical feeding. If this operation has not been made, there is a risk connected to a casual engine starting during the phases in which the machine protections are temporarily removed.

14.4 The machine noise information.

The phonometric analysis executed on a machine-type endued of electrical engine has furnished a value maximum of 90 Decibel.

At any rate, it is necessary to make a phonometric inquiry on the installed machine following the current regulations (D.Lgs. 277/91).

It is recommended the use of suitable individual protection devices for the hearing protection.

14.5 Thermic risks

This pump can work at high temperature and some parts, like pump and bearing housing, during the working, can have temperatures higher than 80°C.
Marked these parts with the suitable signalling.
Do not touch these parts during the working.
Make any intervention on these components only after the machine cooling for, at least, 30 minutes.
Foresee always the suitable protective means, such as delimiter barriers or other.

14.6 Risks concerning the use of substances

There is a fire remaining risk connected to the fuel oil as pumped fluid. The machine has been realised with materials and geometries in order to eliminate or reduce the primer risk. Observe the safety dispositions relative to the fire risk contained in the current regulations.
During the maintenance operations, restarting after a maintenance or put out duty stop, it is possible that the operator keep in touch with the pumped fluid, with lubricant substances used in the machine or with products used for the cleaning. In this case, it is necessary to follow the warnings and the instructions showed by the Constructor and the products Supplier. In case of contact with substances, refer to the Safety Cards. At any rate, it is suggested the gloves use.

15. SPARE PARTS

Cerpelli recommends the original replacement pieces use.

The use of original replacements assure not only the perfect parts interchangeability, exactly worked as those already existing, but also the use of the same materials precisely selected for the required service, assuring to the pump a longer operative life.

15.1 Instructions to order replacement pieces.

To order the replacement pieces, it is necessary to supply:

- the serial number and the type of pump as showed on the identification plate.
- the quantity of required parts
- the replacement pieces description and its position as listed on the drawing in section enclosed in this handbook

For example:
replacement pieces for pump serial number…., number 1 couple rotor axes, position ... .

15.2 Parts of replacement pieces with operative characteristics changed.

If the pump operative conditions differs from that for which it has been acquired, add all the information concerning the new working conditions.
This is particularly important for the new rotors selections.
NOTE: If you are considering a service conditions change, consult the firm, to define the pump suitability.

15.3 Guide to the minimal replacement pieces advised.

Cerpelli Pumps suggests the replacement pieces supply for 2 years working as on the below table, as recommended by API 610 table 6-1.

The international regulations part the pump service into two categories, for the specific installation needs:
Vital Services (V), where the pump damage produce a production loss or a danger situation.
Essential Services(E), usually the pumpos are installed in couple, where a simultaneous damage of the main pump and the reserve one produce a production loss.

Particular		**Number of the identical pumps installed**						
		Start Up			**Normal Maintenance**			
Description	Service	**1-3**	**4-6**	**Over 7**	**1-3**	**4-6**	**7-9**	**Over 10**
Complete pump	V/E				1	1	1	1
Complete rotors ready to be installed	V				1	1	1	1
Impeller, shaft sleeve	E				1	1	1	2
Pump casing	V/E							1
Bearings pump	V/E	4	4	4	4	4	8	12
The shaft seals	V/E	4	4	8	4	4	8	12
Shaft sleeve	V/E	4	4	8	4	8	8	12
Gaskets, complete set	V/E	2	2	2	2	2	10	10

Remarks

Remarks

Since 1904

CERPELLI COMMERCIALE S.r.l

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NORME DI MONTAGGIO

GIUNTO ELASTICO – STEEL **TIPO "AD"**

E' di essenziale importanza che l'allineamento iniziale sia il più preciso possibile, sia assialmente che radialmente, in modo tale che si possano tollerare variazioni di condizioni durante l'esercizio ed assicurare al Giunto un'attività operativa più duratura e senza problemi.

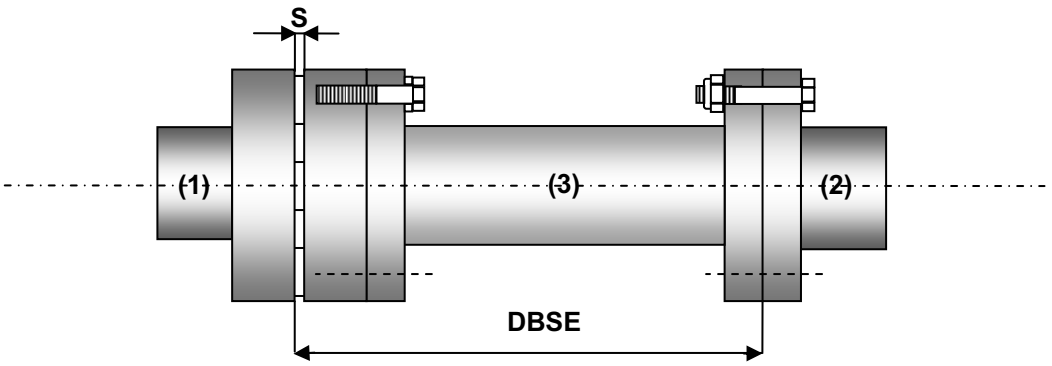
A) Il "Semigiunto" (1) e il Mozzo rigido (2) devono essere calettati in modo che la testa degli alberi venga a trovarsi allineata alla superficie interna dei mozzi.

B) Posizionare le macchine rispettando tra le teste d'albero la quota nominale "DBSE" (3)

ASSEMBLING RULES

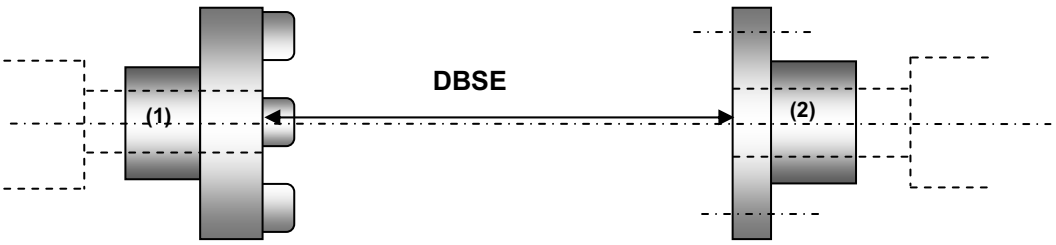
*ELASTIC COUPLING RU – STEEL **TYPE "AD"***

It is important that the starting alignment is as precise as possible in an axial as well as in a radial way, so that it is possible to endure changes of conditions during the application and assure to the Coupling a more durable operating activity without any problems.



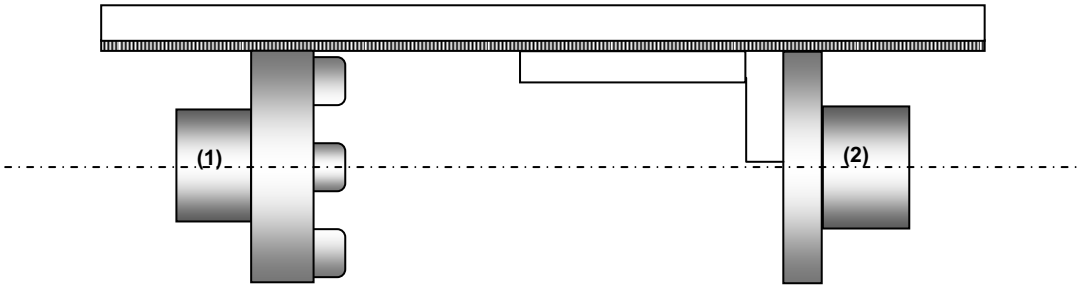
A) *The "Half-coupling" (1) and Rigid-Hub (2) must be connected so that the shafts' head is aligned with the inner surface of the hubs.*

B) *Place the machines, abiding by the "DBSE" (3) rated height between the shaft's heads.*



C) L'allineamento iniziale, con riga e squadra sulle flange dei mozzi ogni 90° dà un primo allineamento sia orizzontale che verticale, (verificare il Disallineamento parallelo ammissibile a pag. 24 del catalogo "Giunti Elastici").

C) *The starting alignment, with line and square , on hubs flanges every 90° carries out a first horizontal and vertical alignment. (check the parallel misalignment allowed on page 24 of the "Flexible Couplings" catalogue)*



D) Completare il montaggio del Giunto inserendo nell'ordine: Elementi Elastici, Flangia Dentata e Spaziatore. Procedere al fissaggio tramite gli appositi bulloni.

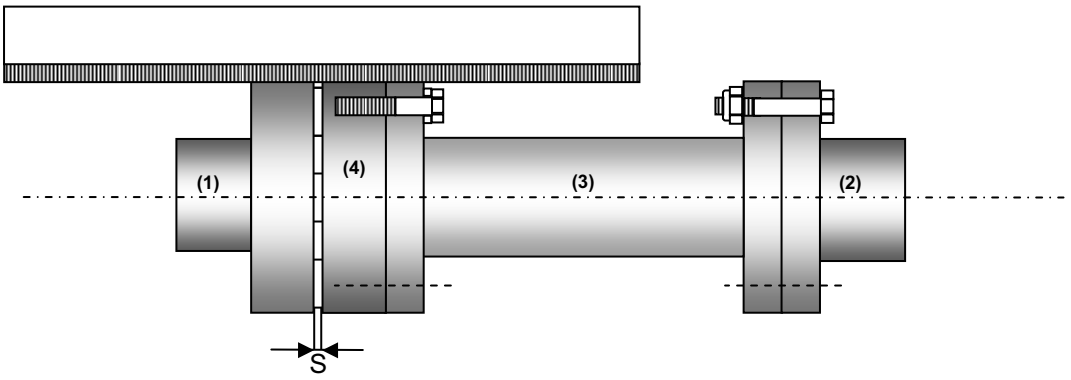
E) Si consiglia di ripetere il controllo del Disallineamento Parallelo tra la flangia del mozzo dentato (1) e la flangia dentata (4)

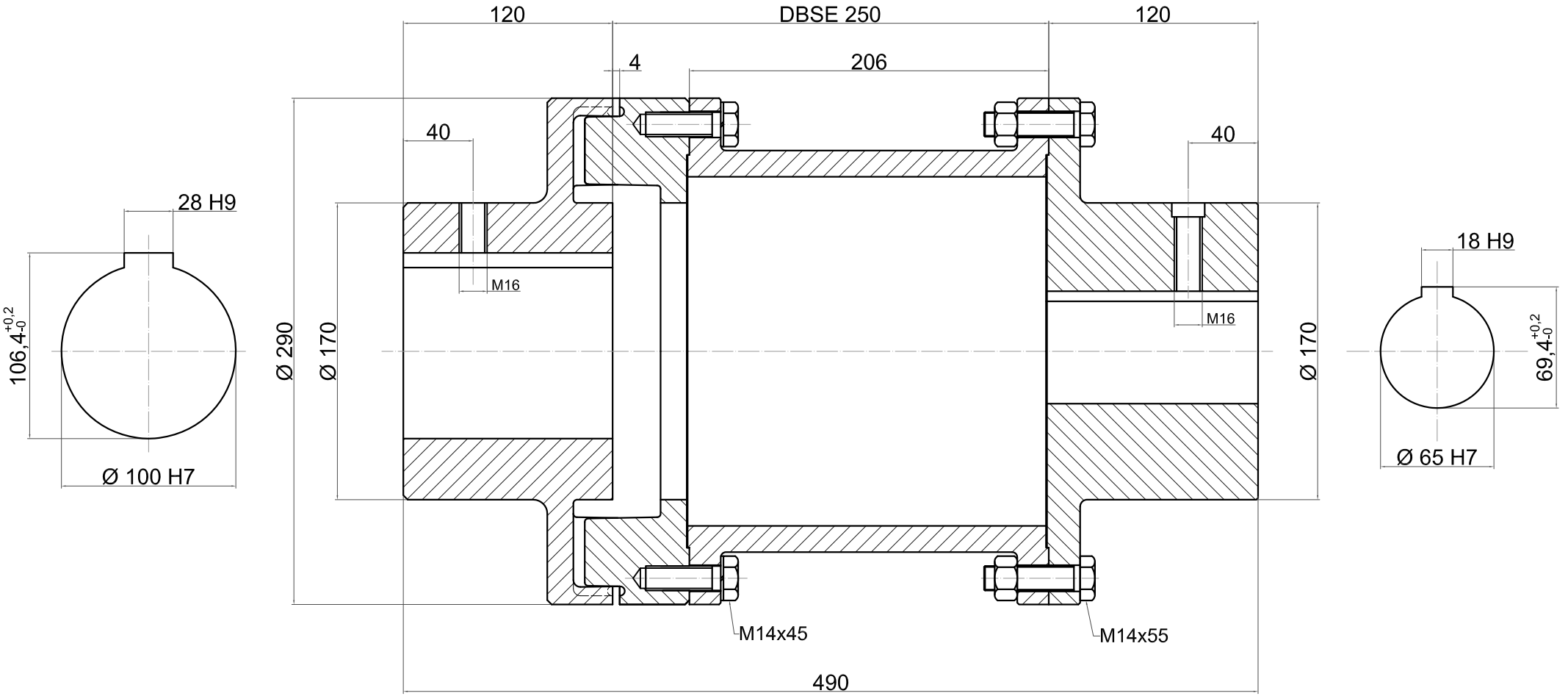
F) Verificare la quota "S" nei quattro punti, provvedendo ad eventuali correzioni fino ad ottenere valori entro limiti indicati (vedi tabelle a pag. 24 del catalogo "Giunti Elastici").

D) *Complete the Coupling's assembly by sequentially inserting: Flexible items, Toothed Flange and Spacer. Proceed to fasten the Coupling by tightening the appropriate bolts.*

E) *Checking again the Parallel Misalignment between the flange of the toothed hub (1) and the toothed flange (4) is strongly recommended.*

F) *Check the "S" height in its four points, carrying out corrections whenever required until reaching values within the indicated thresholds (see tables page 24 of the "Flexible Couplings" catalogue).*





Bilanciare Gr6,3 ISO1940 a 1500rpm

RIF. COMM : 20327.01/G

Data / *Date*	Ref	Modifiche / *Modifications*			Firma / *Signature*
Giunto Elastico *Elastic Coupling*		AD9 DBSE250		Materiale *Material*	Ghisa G25 / Acc. C45 / Gomma Cast Iron G25 / Steel C45 / Rubber
Particolare *Particular*		Assieme		Cliente *Customer*	*Cerpelli*
Data	23.02.09	Dis.: Lazzaroni	Ver.: Bedin	App.: Lazzaroni	Note:
RU-STEEL Italia srl TRASMISSION COUPLING				Dis. Num. *Drawing Num.*	*22340*

quote prive di tolleranze ISO 2768-M

INSTALLATION AND MAINTENANCE MANUAL

LOW AND HIGH VOLTAGE THREE PHASE INDUCTION MOTORS

Transforming energy into solutions

FOREWORD

The electric motor is the equipment widely used by man in the industrial development as most of the machines he has been inventing depend on it.

Taking into consideration the prominent role the electric motor plays on people's life, it must be regarded as a prime power unit embodying features that require special care including its installation and maintenance in order to ensure perfect operation and longer life to the unit.

Its installation and maintenance demand specific cares, to guarantee the perfect functioning and longer life to the motor.

The installation and maintenance manual for LOW AND HIGH VOLTAGE THREE-PHASE INDUCTION MOTORS intends to assist those who deal with electric machines facilitating their task to preserve the most important item of the unit:

The electric motor!

WEG EQUIPAMENTOS ELÉTRICOS S.A. - MÁQUINAS.

---- IMPORTANT ----
READ CAREFULLY THE INSTRUCTIONS INCLUDED IN THIS MANUAL IN ORDER TO ENSURE A SAFE AND CONTINUOUS OPERATION TO THE EQUIPMENT.

9300.0009 I/10
Material 10399277
February 2008

INDEX

1. INTRODUCTION

IMPORTANT:

This manual concerns all Weg three-phase asynchronous squirrel cage and slip ring motors. Motors with specialties can be supplied with specific documents (drawings, connection diagram, characteristic curves…). These documents must be carefully evaluated together with this manual, before proceeding the installation, operation or maintenance of the motor.

For motors built with high number of special features, contact WEG whenever an additional support is required.

All standard and procedures included in this manual must be followed accordingly to ensure a proper operation to the equipment as well as to ensure safety conditions to the personnel involved in the motor operation.

Following these procedures is also important for the warranty policy as explained at the end of this manual.

Therefore, we strongly recommend to any user of Weg motors to read carefully this manual before motor installation and operation. In case you still have further doubts, please contact WEG.

2. GENERAL INSTRUCTIONS

2.1. SAFETY INSTRUCTIONS

All personnel involved with electrical installations, either handling, lifting, operation and maintenance, should be well-informed and up-to-dated concerning the safety standard and principles that govern the work and furthermore, they should be advised to heed them.
Before work commences, it is the responsibility of the person in charge to ascertain that these have been duly complied with and to alert his personnel of the inherent hazards of the job in hand.
It is recommended that these tasks be undertaken by qualified personnel and they should be instructed to:

- Avoid contact with energized circuits or rotating parts;
- Avoid by-passing or rendering inoperative any safeguards or protective devices;
- Avoid extended exposure in close proximity to machinery with high noise levels;
- Use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment, and
- Follow consistently any instructions and product documentation supplied when they do such work.

Before initiating maintenance procedures, be sure that all power sources are disconnected from the motor and accessories to avoid electric shock.

2.2. UNPACKING

Prior to shipment motors are factory-tested and dynamically balanced.
The adjusting and sliding surfaces are protected with corrosion inhibitors.
Upon receipt, we recommend to check the boxes to see if any damage has occurred during transportation.
The motors are shipped with a shaft locking device to avoid any damage to the bearings. We recommended to keep this device in stock to be used on all further transportation.

If any damage, contact the carrier and Weg Máquinas. The lack of notice will void the warranty.

When lifting the boxes, it is important to observe the locals appropriate for this purpose as well as to check the weight of the box and the hoist capacity.

The motors shipped in wooden boxes must be always lifted by the eyebolts or by forklift machines and never by the shaft. The box never can be turned around. Lifting and lowering of such boxes must be done gently in order to avoid damage to the bearings.
Make a visual inspection after the unpacking has been effected. Do not remove the protecting grease from the shaft end neither the stoppers from the terminal boxes. These protecting devices should remain at their places until the installation is finished. For motors fitted with shaft locking device, this device must be removed. For motors fitted with ball bearings, rotate manually the rotor several times. If damages are noticed, contact the carrier and Weg Máquinas immediately.

2.3. STORAGE

2.3.1. INDOOR STORAGE

When motors are not immediately unpacked, boxes should be stored in their normal upright position in a dry temperature place, free of dust dirt, gases and corrosive atmosphere. Any other objects should not be stacked over or against the boxes.
Motors must be storaged in places free from vibrations in order to avoid damage to the bearings.

2.3.2. OUTDOOR STORAGE

If possible choose a dry storage location safe from flooding and free from vibrations. Repair any damage to the packing before putting the equipment in storage, in so far as this necessary to ensure proper storage conditions. Position machines, devices and crates on pallets, wooden beams or foundations that guarantee protection against ground dampness. Prevent the equipment from sinking into the ground and the circulation of air underneath the equipment from being impeded.
Covers or tarpaulins used to protect the equipment against the weather must not make contact with the surfaces of the equipment. Ensure adequate air circulation by positioning wooden spacer blocks between the equipment and such covers.

2.3.3. VERTICAL MOTORS STORAGE

Vertical motors with grease lubricated bearings can be stored so much in the vertical position as in the horizontal.
Vertical motors with oil lubricated bearings should be necessarily stored in vertical position and with the bearings lubricated.
The bearings oil of the vertical motors that are carried in the horizontal position is withdrawn to avoid leaks during it carries. When receiving, these motors must be put in the vertical position and their bearings should be lubricated.

2.3.4. OTHER CARES DURING STORAGE

For motors fitted with space heaters, these accessories must be kept switched-on.
If painting has suffered any damage, this must be repainted to avoid rusting. The same appliers to the machined surfaces when protecting grease has been wasted.
For slip ring motors, brushes must be lifted and removed from their pocket to avoid oxidation between contacts and rings when these motors are storage for more than 2 months.

NOTE: Before operating the motor, brushes must be reset in their pocket and the fitting must be checked.

2.3.5. INSULATION RESISTANCE

*** * WARNING! * ***

Before measuring insulation resistance, the machine must be at standstill and all windings being tested must be connected to the frame and to ground for a time to remove all residual electrostatic charge. Grounds surge capacitors, if furnished, before disconnecting and isolate from leads before meggering.
The non observation of these precautions may result in injury to personnel.

When a motor is not immediately put into operation, it should be protected against moisture, high temperatures and impurities in order to avoid damage to the insulation. The winding insulation resistance must be measured before operating the motor.
If the ambient contains high humidity, a periodical inspection is recommended during storage. It is difficult to determine rules for the actual insulation resistance value of a motor as the resistance varies according to type, size, rated voltage, condition of the insulating material used and method of construction of the motor. A lot of experience is required to decide when a motor is ready for operation. Periodical records will help to take such decision.
The isolation resistance should be measure using a Megohmmeter. The test voltage for the motors windings should be according the table below in accordance with the norm IEEE43.

Winding rated voltage (V)	Insulation resistance test direct voltage (V)
< 1000	500
1000 – 2500	500 – 1000
2501 – 5000	1000 – 2500
5001 - 12000	2500 – 5000
> 1000	5000 - 10000

The test voltage for space heaters should be 500Vcc and for other accessories 100Vcc. The insulation resistance measurement for thermal protectors is not recommended.

If the test is performed at a different temperature, it is necessary to correct the reading to 40ºC by using an insulation resistance variation curve in relation to temperature, given by the motor it self. If this curve is not available it is possible to use an approximate correction given by the curve of figure 2.3, as per NBR 5383 / IEEE43 Standards.

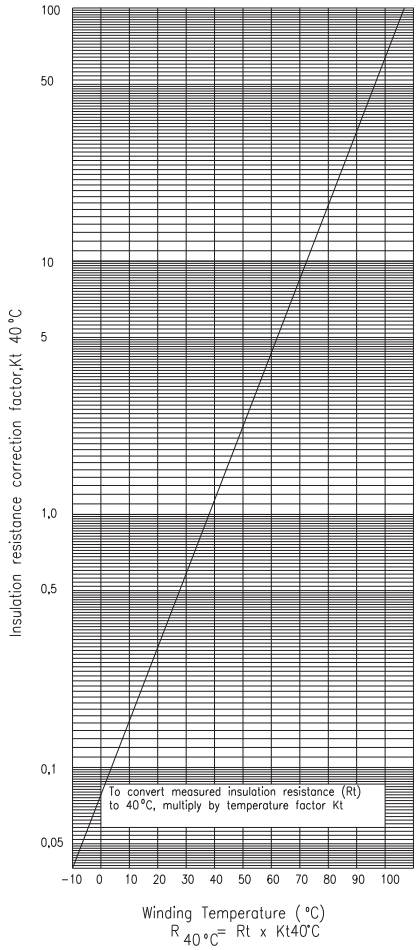


Figure 2.3.

On old motors, still in operation, higher values are normally obtained. The comparison with values obtained from previous tests on the same motor under identical load, temperature and humidity conditions will be a better indication of the insulation conditions in comparison to the value obtained from a single test. Any sudden or high reduction of the value requires careful attention.

Insulation Resistance Value	Insulation Level
2MΩ or smaller	Bad
< 50MΩ	Dangerous
50...100MΩ	Abnormal
100...500MΩ	Good
500...1000MΩ	Very good
> 1000MΩ	Excellent

Table 2.3a. - Reference limits for insulation resistant of electric motors.

Minimum Insulation Resistance:

- If the insulation resistance measured is smaller than **100 MΩ**, the winding must be dried according to the procedure below before starting the motor:
- Disassemble the motor removing the rotor and the bearings;
- Take the frame with stator winding to an oven and warms it to a temperature of 130°C, keeping this temperature for at least 8 hours. For great machines (above of the carcass 630 IEC or 104XX series NEMA, it can be necessary to the stay for at least 12 hours).

Use the same procedure for rotor windings of slip ring motors.

Double check the insulation resistance to verify if it has reached the acceptable values, according to table 2.3.a, otherwise, refers to WEG for instructions.

2.3.6. POLARIZATION INDEX

The polarization index (P.I.) is traditionally defined as ratio of the 10 min insulation resistance (IR_{10}) to the 1 min insulation resistance (IR_1), tested at a relatively constant temperature.

Through the polarization index, the user can be evaluated the motor isolation conditions, according to the table bellow:

Polarization Index	Insulation Level
1 or smaller	Bad
< 1,5	Dangerous
1,5 a 2,0	Abnormal
2,0 a 3,0	Good
3,0 a 4,0	Very Good
> 4,0	Excellent

Table 2.3b. - Polarization index (ratio between 10 and 1 minute).

Immediately after the measurement of the Isolation resistance, the windings must be grounded to prevent accident.

2.4. PROLONGED STORAGE

2.4.1. INTRODUCTION

The instructions for long term storage described as follow are valid for motors to be long term stored and/or long periods of standstill before the commissioning.

2.4.2. GENERALITIES

The existing tendency, especially during the construction of the plant, of storing the motors for several years before commissioning or to install immediately some units, results that the motors are exposed to influences that cannot be evaluated in advance for this time's period.
It is difficult to evaluate the different forms of stress (atmospheric, chemical, thermal, and mechanic) imposed to the motor, which might happen during storage maneuvers, assembly, initial tests and storage until the commissioning.
Other essential factor is the transportation, for example, the general contractor may transport the motor or the complete unit with motor as joint transportation to the installation location.
The motor internal gaps (air gap, bearings and interior of connection box) are exposed to the atmospheric air and temperature fluctuations. Due to the air humidity, it is possible the liquid condensation and, depending on the kind and air contamination degree, aggressive substances may penetrate into these spaces.
As a consequence after long periods, the internal components such as the bearings might get rust, the insulation resistance can decrease to under the admissible values and the grease lubricant capacity in the bearings is adversely affected. This influence increases the damage risk before commissioning of the plant.

To keep manufacturer's warranty, should be insured that the described preventive measures in this instructions, as: constructive aspects, preservation, packing, storage and inspections, be followed and registered.

2.4.3. STORAGE PLACE

In order to provide the best storage conditions to the motor during long standstill periods, the storage location should obey rigorously the criteria described as follow:

2.4.3.1. INTERNAL STORAGE

- Closed storage room with roof;
- The location must be protected against humidity, vapors, aggressive fumes discharge, fast heat changes, gnawing and insects.
- It must not present corrosive gases such as chlorine, sulfur dioxide or acid;
- It must not present continuous or intermittent severe vibrations.
- To have ventilation system with filter;
- It must not present quickly changes of temperature;
- Ambient temperature (5° C, > t < 60 °C) and must not present quickly changes of temperature;
- Relative air humidity < 50%;
- To have prevention against dirt and dust deposits;
- To have fire detection system.
- Electrical supply for space heater and illumination must be provided;

If some of these requisites do not be attended by the storage environment, WEG suggests that additional protections be incorporated in the motor packing during the storage period, like follows:

- Closed wooden or similar box with electrical installation, enable to the space heaters supply;
- Closed wooden box or similar with installation that allows the space heaters be energized;
- If there is a risk of fungus infestation and formation, the packing must be protected in the storage location by spraying or painting it with appropriated chemical agents.
- Preparation of packing must be done with greatest care by an experienced person. A reliable packing company must take over of the packing.

2.4.3.2. EXTERNAL STORAGE

The outdoor storage of the motor is not recommended.
If the external storage cannot be avoided, the motor should be packed in specific packing for this condition, as described bellow.

- For outdoor storage, besides the packing recommended above, we recommend to cover completely this packing with a protection against dust, humidity and other strange materials.
- Place the packing in pallets, wooden bunches or foundations that guarantee the protection against the soil humidity.
- Prevent the packing sink itself in the soil.
- After covering the machine, a shed should be build to protect it of rain, snow and excessive sun heat.

IMPORTANT
It is recommendable check the storage local conditions and the motors condition according to the maintenance plan for long term storage, described in this manual.

2.4.5. SPARE PARTS

- If parts have been supplied separately (connection boxes, heat exchanger, covers, etc...) these parts must be packed as described above.
- The air relative humidity inside the packing should not exceed 50% until unpacking the machine.

2.4.6. SPACE HEATER

- The space heater installed in the motor must be energized during the storage period to avoid the moisture condensation inside the motor and this way keeping the winding insulation resistance within acceptable levels.

THE SPACE HEATER OF THE MOTOR MUST BE MANDATORILY ENERGIZED WHEN THE MOTOR IS STORED IN LOCAL WITH TEMPERATURE < 5 °C AND RELATIVE AIR HUMIDITY > 50%.

2.4.7. INSULATION RESISTANCE

- During the storage period, the winding insulation resistance of the motor should be measured according to item 2.3.5 of this manual and registered every 3 months and before the motor installation.
- Eventual drops in the insulation resistance level must be investigated.

2.4.8. EXPOSED MACHINED SURFACES

- At factory, all exposed surfaces (for example, the shaft edge and flanges) are protected with a temporary protective agent (rust inhibiter).
- This protective coating should be reapplied every 6 months at least. When this coating is removed and/or damaged, the same preventive action must be done.

Recommended products:
Name: Dasco Guard 400 TX AZ, Manufacturer: D.A. Stuart Ltda.
Name: TARP, Manufacturer: Castrol.

2.4.9. BEARINGS

2.4.9.1. ANTIFRICTION BEARING LUBRICATED BY GREASE

The bearings are lubricated in the factory for make the motor tests.
During the storage period, every two months is necessary to remove the shaft brake device and turn the shaft manually to conserve the bearing in good conditions.
After 6 months of storage and before starting in operation, the bearings should be regreased, as item 4.2.1.5 of this manual.
If motor is kept in storage for approximately 2 years or more, the bearings must be inspected and regreased according to item 4.2 of this manual.

2.4.9.2. ANTIFRICTION BEARING LUBRICATED BY OIL

- Depending on the position, the motor can be transported with or without oil in your bearings.
- The motor must be stored in its original position of operation and with oil in the bearings;
- The oil level should be respected, remaining in the half the oil sight glass.

During the storage period, every two months is necessary to remove the shaft brake device and turn the shaft manually to conserve the bearing in good conditions.
After 6 months of storage and before starting in operation, the bearings should be relubricated, as item 4.2.3.1 of this manual.
If motor is kept in storage for approximately 2 years or more, the bearings must be inspected and relubricated according to item 4.2 of this manual.

2.4.9.3. SLEEVE BEARING

- Depending on the position, the motor can be transported with or without oil in your bearings;
- The motor must be stored in its original position of operation and with oil in the bearings;
- The oil level should be respected, remaining in the half the oil sight glass;
- During the storage period, every two months is necessary to remove the shaft brake device and rotate at about 30 rpm for the oil circulation and to conserve the bearing in good conditions.

If is not possible to rotate the shaft of the motor, the follow procedure should be used to protect internally the bearing and the contact surfaces against corrosion:
- Drain the whole bearing oil;
- Dismantle the bearing, following the procedure described in the item 4.2.4.2 of this manual;
- Clean the bearing;
- Apply the anti-corrosive (ex.: TECTIL 511, Valvoline or Dasco Guard 400TXAZ) in the bearing, bearing line (top and bottom half) and in the shaft contact surface of the motor;
- Assemble the bearing, following the procedure described in the item 4.2.4.3 of this manual;
- Close all tapped holes with screw plugs;
- Seal the gaps between the shaft and bearing seal and between bearing seal and bearing housing by using self-adhesive permanent tape;
- Connecting flanges (Ex.: Oil inlet and outlet) must be covered with blank plates.
- Remove the bearing top sight glass and spray the corrosion inhibitor on the bearing.
- Put some desiccant (silica gel) inside of the bearing. The desiccant absorbs the humidity and prevents the formation of moisture and water condensation inside the bearing.
- Close the bearing tightly with the top sight glass.

In case the standstill period is **longer then 6 months:**
- Repeat the procedures described above.
- Replace the desiccant (silica gel) into the bearing each six months.

In case the standstill period is **longer than 2 years:**
- Dismantle the bearing;
- Preserve and store the bearing parts.

2.4.10. BRUSHES

- The brushes of the slip rings motors should be lifted in the brush-holder, because should not remain in contact with the slip-rings during the storage period, avoiding thus the slip-rings oxidation.
- Before the motor installation and commissioning, the brushes should come back to the original position.

2.4.11. CONNECTION BOX:

When the winding insulation resistance of the motor is verified, the terminal box and accessories box must also be verified:

- The interior should be dry, cleaned and free of any dust deposit.
- The contacts should be free of rust (corrosion).
- The seals should be in good conditions.
- The cables inlet should be correctly sealed.

If any of these items is not correct, the parts must be cleaned or replaced.

2.4.12. PREPARATION FOR SERVICE AFTER LONG TERM STORAGE

2.4.12.1. CLEANING

- The machine interior and exterior should be free of oil, water, dust and dirt. The inside of the motor should be vacuum cleaned.
- Remove the corrosion inhibitor of the exposed surfaces with a cloth soaked in petroleum based solvent.
- Be sure that the bearings and cavities used to lubrication are free of dirt and the plugs on the holes are correctly sealed and tighten. Oxidations and marks on the bearings seats and shaft should be carefully removed.

2.4.12.2. BEARINGS LUBRICATION

Use grease or oil specified for bearings lubrication. This information is printed on the bearings nameplate and the lubrication should be made as described in the chapter 4 "Maintenance" of this Manual, according to the bearing type.
Note: Sleeve bearings, where was applied internally the protection product against corrosion and desiccant, these bearings should be dismounted as the procedure described in the item 4.2.4.2 of this manual, washes for remove the anti-corrosive and the desiccants must be removed.
Assemble again the bearings, as the procedure described in the item 4.2.4.3 of this manual and proceeds the re-lubrication.

2.4.12.3. ISOLATION RESISTANCE VERIFICATION

Before starting in operation the insulation resistance must be verified, according to the item 2.3.5 of this manual.

2.4.12.4. OTHER

Follow the further procedures described in the chapter 3.3 "Commissioning" of this manual, before putting the machine in operation.

2.4.13. MAINTENANCE PLAN FOR STORAGE

During the storage period, the motor maintenance must be executed and registered according to the plan described in the table below:

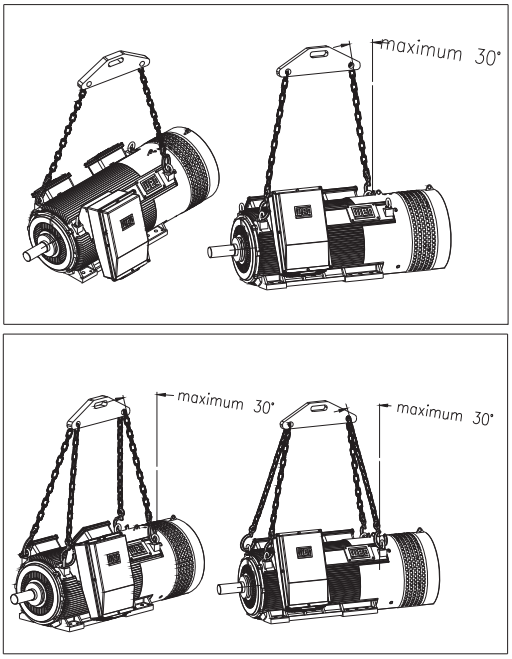
	Monthly	Each two months	Each six months	Each 2 years	Before operation	Note
Storage local						
Inspect the cleaning conditions		X			X	
Inspect the hu midity and temp erature conditions		X				
Verify signals insects infestations		X				
Measure the vibration level	X					
Packing						
Inspect physical damages			X			
Inspect the relative humid ity in the interior	X					
Change desiccant in the packing (if any)			X			When necessary
Space heater						
Verify the operation conditions	X					
Complete motor						
Make external cleaning			X		X	
Verify the painting conditions			X			
Verify the rust inhibitor in the exposed parts			X			
Replace the rust inhibitor			X			
Windings						
Measure the insulation resistance		X			X	
Measure the polarization index		X			X	
Connection box and grounding terminals						
Clean the inside of the box				X	X	
Inspect the seals and gaskets						
Antifriction bearing lubricated by grease or oil						
Turn the shaft		X				
Relubricate the bearing			X		X	
Dismount and clean the bearing				X		
Sleeve bearing						
Turn the shaft		X				
Apply rust inhibitor and desiccant			X			
Clean and relubricate the bearings					X	
Dismount and store the parts				X		
Brushes (slip-ring motors)						
Lift the brushes						During the storage
Lower the bru shes and verify the contact with the slip-rings					X	

2.5. HANDLING

Use only the existing eyebolts to lift the motor. Never lift the motor by the shaft. Check the motor weight. Lifting and lowering must be done gently in order to avoid damage to the bearings.

2.5.1. HANDLING – H LINE MOTORS

H LINE



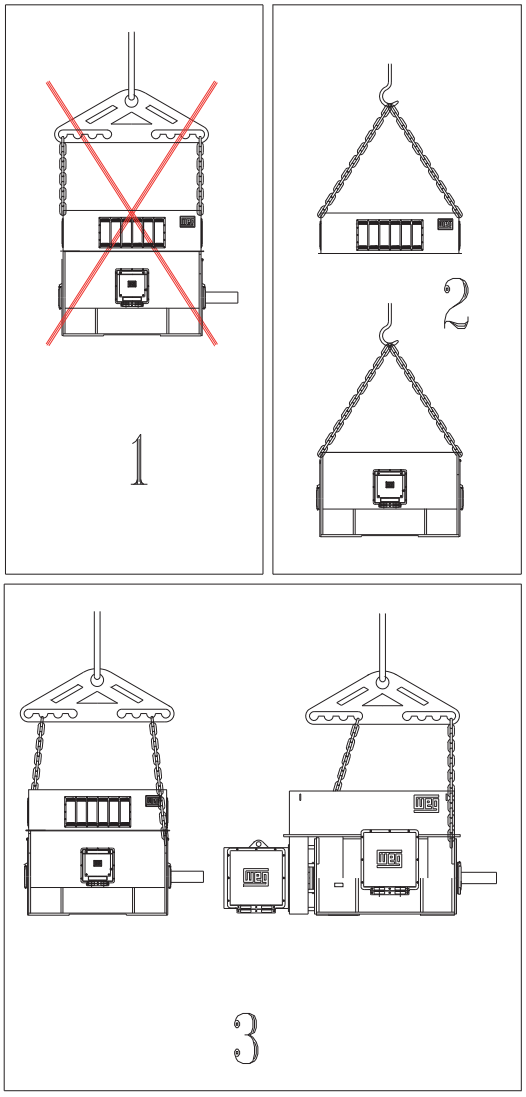
Notes:

1) Lifting lugs on the frame are designed for lifting machine only. Do not use for lifting coupled equipment such as pumps, compressors, gears or other equipment;
2) The chains or handles of hoisting must have on maximum angle of 30º with regard to vertical line:
3) Use all of eyebolts fixed in the frame, supplied together with the motor;
4) Failure to observe these precautions may result in damage to the equipment, injury to personnel or both.

The eyebolts attached to bearing housing, heat exchanger, end-bells, etc, should be used to handle these components only.

2.5.2. HANDLING – M LINE MOTORS

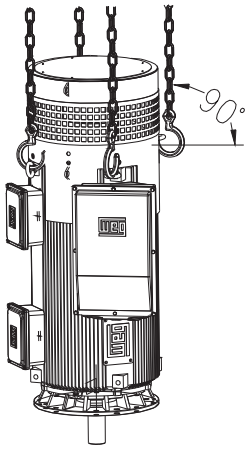
M LINE



Notes:

1) Do not the motor by the heat exchanger;
2) Lifting without heat exchanger;
3) If gravity center is not exactly in the middle of the lifting lugs, use one of the ways as per item 3.

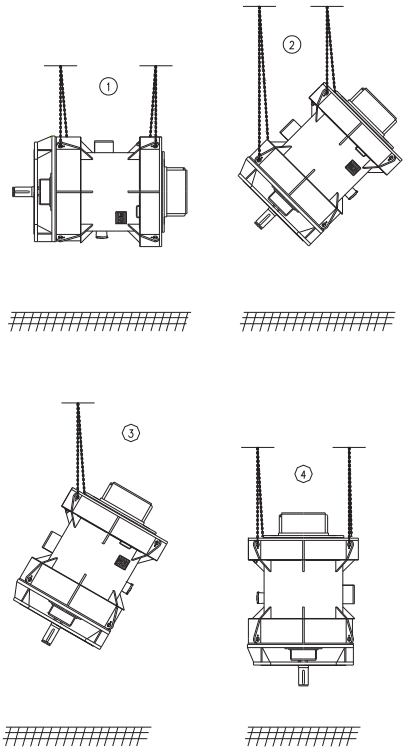
2.5.3. VERTICAL MOTORS HANDLING



The handling of the WEG vertical motors must be done as the illustration above.
Always use the 4 eyebolts for motors movement in vertical position, therefore the lifting chains or cables can also stay in the vertical position avoiding thus awful efforts to the eyebolts.

2.5.4. VERTICAL MOTORS POSITIONING

The WEG vertical motors are supplied with 8 eyebolts for lifting, being 4 at the front part and 4 at the back of the motors.
Some motors are carried in the horizontal position and need to be moved to the running position.
The procedure below should be followed when handling vertical mounting motors from the horizontal to vertical position and vice-versa, independent of the product model or line.



1) Lift the motor through the 4 lateral eyebolts using 2 cranes;

2) Lower the crane that is fixed in the motor drive end side and simultaneously lift the crane that is fixed in the motor non drive end side until the motor reaches the balance.

3) Loosen the crane that is fixed in the motor drive end and turn it 180º to allow the fixation of the crane previously loosen in the other 2 eyebolts located in the motor non drive end.

4) Fasten the loosen crane in the other 2 eyebolts on the motor non drive end and lift it until the motor gets the vertical position.

3. INSTALLATION

Electric motors should be installed in locations of easy access for inspection and maintenance. If the surrounding atmosphere contains humid, corrosive or flammable substances or particles, it is essential to ensure an adequate degree of protection. The installation of motors in ambient where there are vapours, gases or dusts, flammable or combustible materials, subject to fire or explosion, should be done in accordance with ABNT NBR, NEC Art. 500 (National Electrical Code) and UL-674 (Underwriters Laboratories, Inc.) Standard.
Under no circumstances, motors can be enclosed in boxes or covered with materials which may impede or reduce the free circulation of cooling air. Motors fitted with external cooling must be located at least 50mm from the ground to permit free air circulation. The air inlet and outlet should never be obstructed or reduced by conductors, pipes or other objects. The installation site should permit conditions of air renewal at a rate of 30m³ per minute for each 100kW motor output.

3.1. MECHANICAL ASPECTS

3.1.1. MOUNTING

In order to ensure the adequate operation, in additional to a stable foundation, the motor must be precisely aligned with the coupled equipment and the components mounted on the shaft end must be adequately balanced.

Notice:
With the machine mounted and coupled, the relation between the foundation natural frequency and:
- The motor speed frequency;
- The double speed frequency;
- The double line frequency.

Must be as specified according described bellow:

Foundation natural frequency of the 1st order:
- ≥ +25% or ≤ -20% in relation to the above frequencies.

Foundation natural frequency of higher order:
- ≥ +10% or ≤ -10% in relation to the above frequencies.

3.1.2. FOUNDATIONS

The motor base must be level and free from vibrations. For this reason, concrete foundation is recommended.
The type of base to be built will depend on the nature of the soil at the installation site or on the floor capacity.
When designing the motor foundation, it must be taken into consideration the fact that the motor might, occasionally, be submitted to a torque higher than the rated torque. If such designing is not correctly made, vibration problems can occur to the unit (foundation, motor and driven machine).

NOTE: On the concrete base, a metallic plate to support the leveling bolt must be provided.

Based on figure 3.1, the forces over the foundation can be calculated by the following formulas:

$$F_1 = +0.5.m.g. + \frac{(4C\max)}{(A)}$$

$$F_2 = +0.5.m.g. - \frac{(4C\max)}{(A)}$$

Where:
F1 and F2 - Forces on the base (N).
g - Gravity acceleration (9.81m/s²).
m - Motor mass (kg).
Cmax - Breakdown torque (Nm).
A - Taken from motor dimensional drawing (m).

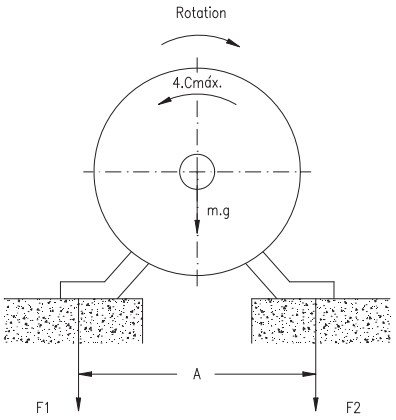


Figure 3.1.

NOTE: The drawing above shows the forces over the motor when running clockwise. For counter clockwise rotation, forces are reversed (F1, F2, 4.Cmax.).

Steel or iron blocks, plane surfaces blocks with anchorage devices can be fitted in the concrete foundation to fix the motor feet as suggested in figure 3.2. It is important that all the structure equipment are made in such a way that they can transmit any force or torque which may occur during the operation.

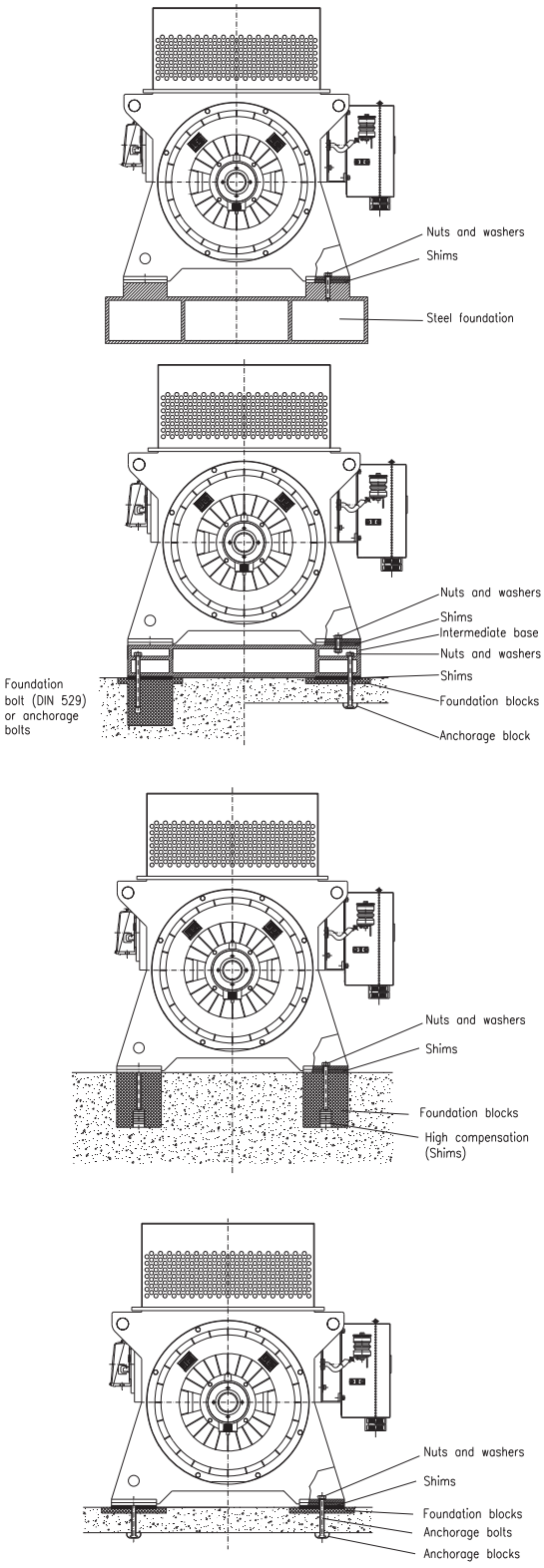


Figure 3.2. - Motor Fixation Types.

3.1.2.1. TYPES OF BASES

a) Concrete bases

As mentioned above, the concrete bases are the most commonly used for the fixation of these motors.

The type and size of the foundation - as well as other fixing devices for this purpose will depend on the type and size of the motor.

The motors can be mounted on a concrete base with four foundation blocks. See dimensions of the installation components in the table below.

Installation and examples:

Hole diameter in the motor feet	Foundation block		Fastening bolts (DIN 933)		Tapered pins (DIN 258)	
	Number	Dimension	Number	Dimension	Number	Dimension
28	4	M24	4	M24 x 60	2	14 x 100
36	4	M30	4	M30 x 70	2	14 x 100
42	4	M36	4	M36 x 80	2	14 x 100
48	4	M42	4	M42 x 90	2	14 x 100

Thread	Mounting dimensions				
	s	t	u	v	w
M26 and M30	50	450	220	265	315
M36	70	539	240	300	350
M42	70	600	270	355	400

Table 3.1. - Anchorage measurements (example of installation).

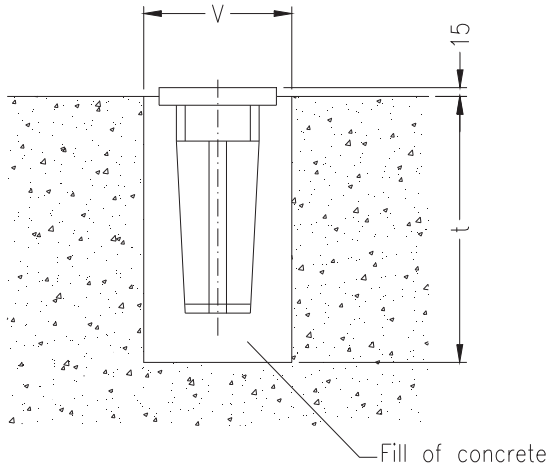


Figure 3.3 - Example 1.

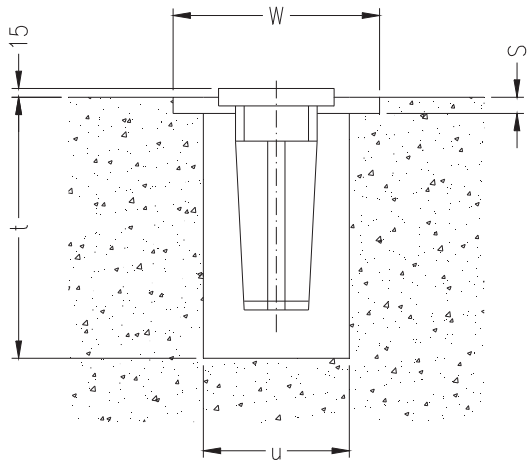


Figure 3.4 - Example 2.

Examples of preparation:

Remove all dirt from the foundation blocks in order to ensure a perfect anchorage between the foundation blocks and the motor. Fix the foundation blocks at the motor feet by means of bolts.

Provide shims of different thickness (total trickiness of about 2mm) between the motor feet and the foundation base to ensure a further accurate alignment vertically.

Inside the feet holes, the fastening bolts must be covered with a metal sheet or presspan in order to center the foundation blocks exactly to the feet holes and perform an accurate alignment horizontally.

Place shims or leveling bolts under the foundation blocks in order to obtain a perfect motor leveling and alignment between the motor and the driven machine. After introducing the concrete, make an accurate control of the alignment. Eventual small corrections can be done by washers or metal plates or by means of a new adjustment of the fastening bolt clearences. Tighten now firmly all fastening bolts.

Make sure all motor feet surfaces are supported uniformly without damaging motor frame. After completing the test, introduce two tapered pins for correct fastening. For this purpose, use the pre-drilled holes in the feet.

b) Slide rails

When drive system is done by pulleys, the motor should be mounted on slide rails and the lower part of the belt must be pulling.

The rail that stays near the drive pulley is positioned in such a manner that the adjusting bolt be between the motor and the driven machine. The other rail must be positioned with the bolt in the opposite position, as shown in figure 3.5. The motor is bolted to the rails and set on the base.

The drive pulley is then aligned in such a way that its center be in the same level of the driven pulley center.

Motor and driven machine shafts must be in a parallel position.

The belt should not be excessively stretched, see figure 3.12. After the alignment, rails are to be fixed.

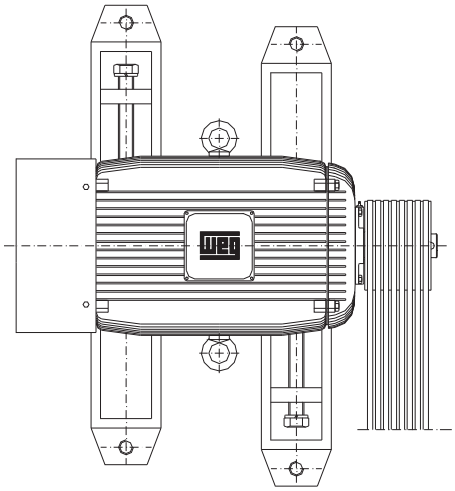


Figure 3.5.

c) Metallic bases

The metallic bases must have a flat surface under motor feet in order to avoid frame deformation. The bearing housing surface should be so determined that under the feet of the motor one can place shim plates of approximately 2mm thickness.

Motor should not be removed from their common metallic bases for alignment, the metallic bases should be leveled on the actual foundation.

When a metallic base is used to adjust the height of the motor shaft end with the machine shaft end, it should be leveled on the concrete base.

After the base has been leveled, foundation studs tightened, and the coupling checked, the metal base and the studs are then cemented.

3.1.3. ALIGNMENT/LEVELING

The electric motor must be accurately aligned with the driven machine, particularly in cases of direct coupling. An incorrect alignment can cause bearing defects, vibrations and even shaft breaking.

The best way to ensure correct alignment is to use dial indicator placed on each coupling half, one reading radially and the other axially.

In this way, simultaneous readings can be informed and one can check any parallel (figure 3.6a) or concentricity deviations (figure 3.6b) by rotating the shaft. The dial indicator should not exceed 0.05mm. If the operator is sufficiently skilled, he can obtain alignment with clearance gauge and a steel ruler, providing that the couplings be perfect and centered (figure 3.6c).

A measurement at 4 different points of the circumference should not give a reading difference larger than 0.03mm.

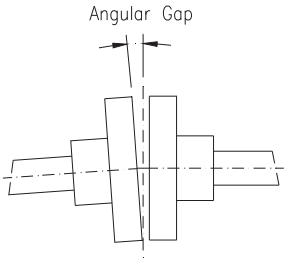


Figure 3.6a – Parallelism deflection.

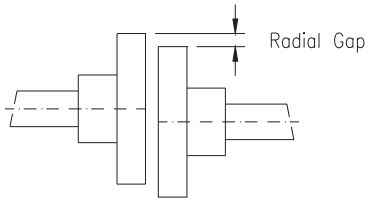


Figure 3.6b – Concentricity deflection.

On the alignment/leveling it is important to take into consideration the effect of the temperature over the motor and driven machine. The different expansion levels of the coupled machines can modify the alignment/leveling during motor operation.

After the set (motor and base) is perfectly aligned either at cold or at hot, motor must be bolted, as shown in figure 3.7. There are instruments which use visible laser ray added by specific computer programs that can perform and ensure high precision alignment.

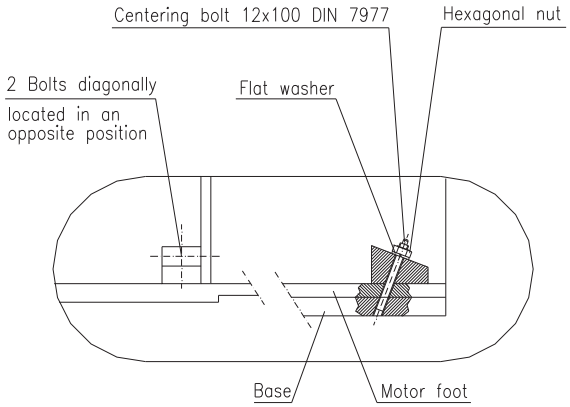


Figure 3.7.

NOTE: Bolts, nuts and washers can be supplied with the motor, if required.

3.1.4. COUPLINGS

a) Direct coupling
Whenever possible, it is recommended to use direct coupling due to lower cost, less space required, no belt slippage and lower accident risk. In case of speed ratio drives, it is also common to use direct coupling with a gearbox.

IMPORTANT: Align carefully the shaft ends using, whenever possible, flexible coupling, tolerating a minimum clearance of 3mm between the couples.

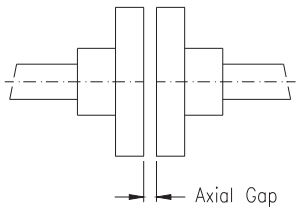


Figure 3.6b - Radial alignment (concentricity).

b) Gearbox coupling
Poorly aligned gearbox couplings normally cause jerking motions which provoke vibration to the coupling and to the motor. Therefore, due care must be given to correct shaft alignment, perfectly parallel in cases of straight gears, and at the correct angle for bevel or helical gears.
Perfect gear arrangements can be checked by inserting a strip of paper on which the teeth marks will be traced after a single rotation.

c) Belt and pulley coupling
Belt transmission is the most commonly used when a speed ratio is required.

ASSEMBLY OF PULLEYS: The assembly of pulleys on shafts featured with keyway and threaded hole must be done by inserting it halfway up to the keyway merely by manual pressure.
On shafts without threaded hole it is recommended to heat up the pulley to about 80ºC (figure 3.8).

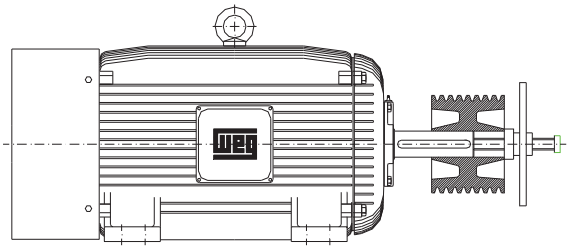


Figure 3.8. - Assembly or pulleys.

DISASSEMBLY OF PULLEYS: for disassembly of pulleys it is recommended to use the devices shown in figure 3.9 in order not to damage the key neither shaft surface.

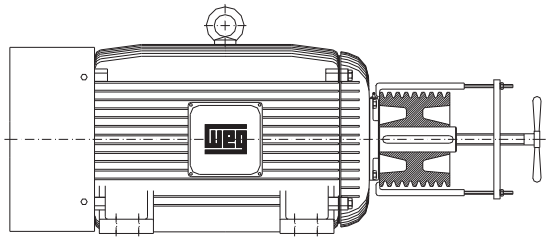


Figure 3.9. - Disassembly of pulleys.

Hammers should be avoided when fitting pulleys and bearings. The fitting of bearings with the aid of hammers causes spots in the bearing races. These initially small spots increase with usage and can develop to a stage that completely damage the bearing. The correct positioning of a pulley is shown in figure 3.10.

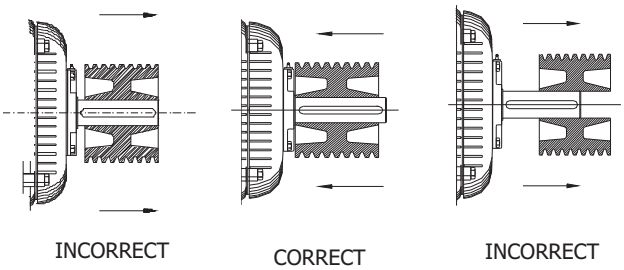


Figure 3.10.

RUNNING: Avoid unnecessary thrusts on the bearings by ensuring that the shafts are parallel and the pulleys perfectly aligned (figure 3.11).
Laterally misaligned pulleys, when running, transmit alternating knocks to the rotor and can damage the bearing housing. Belt slippage can be avoided by applying a resin type material such as rosin.

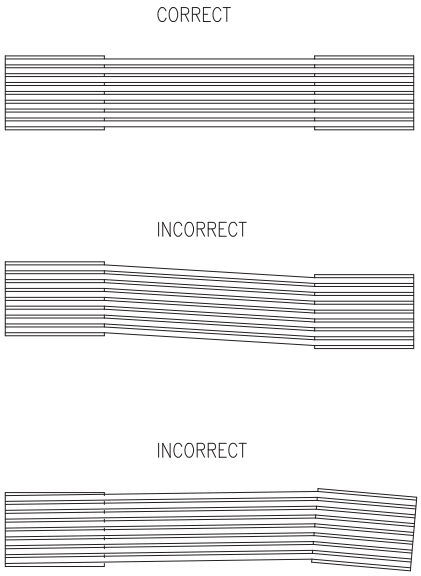


Figure 3.11. - Correct pulley alignment.

Belt tension is only required to avoid slippage during operation (figure 3.12).

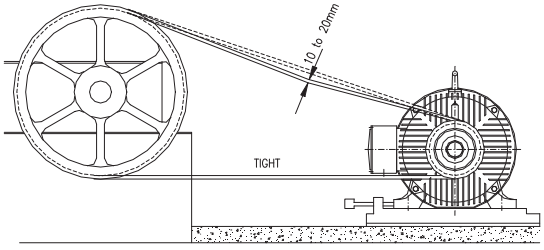


Figure 3.12 - Belt tension.

NOTE: A belt with excessive tension increases the force on the shaft end causing vibrations and fatigue leading to a possible shaft rupture.

Excessively small pulleys should be avoided; these cause shaft flexion as belt traction increases with the decrease of pulley size.

When specific pulleys are required, contact Weg Máquinas in order to insure a correct designing.

Due to the existing tensions on the belts, there is a reaction acting as radial load over the motor shaft end.
The data to calculate such reaction (radial force) are:
- Output transmitted [kW] (P);
- Motor speed [rpm] (RPM);
- Diameter of driven pulley [mm] (DPMV);
- Diameter of driven pulley [mm] (DPMT);
- Distance between centers [mm] (I);
- Friction coefficient [-] (MI) - (normally 0.5);
- Slip coefficient [-] (K);
- Belt contact angle on smaller pulley [RAD] (alfa);
- FR: Radial force acting over the shaft end [N] (FR).

$$ALFA = \pi - \left(\frac{DPMV - DPMT}{1} \right)$$

$$K = 1.1x \left[\frac{\varepsilon(MIxALFA) + 1}{\varepsilon(MIxALFA) - 1} \right]$$

$$FR = \frac{18836{,}25\chi N}{DPMTxRPM} x \frac{\sqrt{K^2 x[1 - COS(ALFA] + 1.21x[1 + COS(ALFA)]}}{2}$$

NOTE: Always use pulleys duly balanced. Avoid, in all cases, oversized keys as these can cause unbalancing. In case these instructions are not followed accordingly, vibration levels will occur.

3.1.4.1. COUPLING ARRANGEMENT FOR SLEEVE BEARING MOTORS - AXIAL CLEARANCE

Motors fitted with sleeve bearings should be directly coupled to the driven machine or even using a gearbox. Pulley/belt coupling is not recommended.
These sleeve bearing motors have three identification marks on the shaft end. The central mark (red painted) indicated the magnetic center; the other two indicate the limits for the rotor axial displacement.

When coupling the motor, the following aspects must be considered:
- Bearing axial clearance which is shown on the chart below for each bearing size.
- Axial displacement of the driven machine, if any.
- Maximum axial clearance allowed by the coupling.

Clearances applied to sleeve bearings for motor supplied by Weg Máquinas	
Bearing size	**Total axial clearance in mm**
9	3 + 3 = 6
11	4 + 4 = 8
14	5 + 5 = 10
18	7,5 + 7,5 = 15
22	12 + 12 = 24
28	12 + 12 = 24

Table 3.3.

The motor must be coupled in such a way that the arrow attached to the bearing frame be positioned exactly on the central mark (red painted) while motor is in operation.
During motor starting or even under operation, rotor should move freely between the two external lots if the driven machine creates any axial force on the motor shaft. Under no circumstance, motor can operate continuously with axial force on the bearing.
Sleeve bearings normally used by Weg Máquinas are not designed to withstand axial forces continuously.

The figure 3.14 shows part of the drive end bearing highlighting a basic configuration of the shaft/bearing set as well as axial clearances.

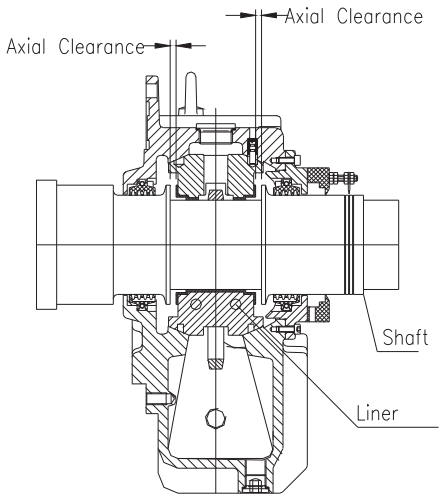


Figure 3.14.

The figure 3.15 shows part of the bearing frame where the arrow indicates the magnetic center and the three marks on the shaft.

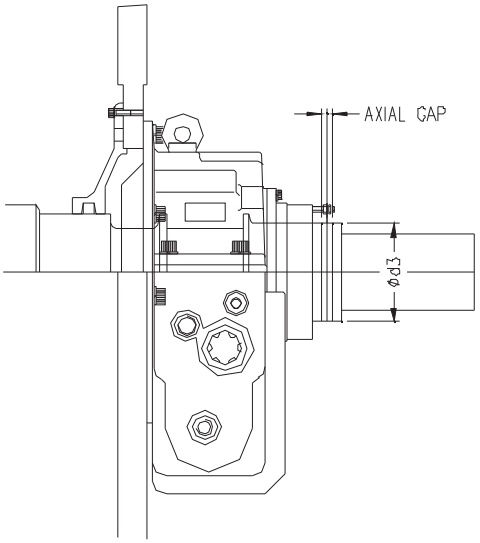


Figure 3.15.

3.2. ELECTRICAL ASPECTS

3.2.1. SUPPLY SYSTEM

Proper electric power supply is very important. All the wires and protection system must ensure an excellent quality of electric power supply on the motor terminals within the following parameters:
- Voltage: It can fluctuate within a range of more or less 10% in relation to rated value.
- Frequency: It can fluctuate within a range of -3 and +5% in relation to rated value.

3.2.2. CONNECTION

In order to connect the supply conductors, remove the covers of the rotor and stator terminal boxes (if any).
Cut the sealing rings (standard motors are not supplied with cable glands) according to the diameter to be used.
Insert the conductors into the rings. Cut the supply conductors to desired length, disbarkt the ends and assemble the terminals on them. Connect the metallic covering of the conductors (if any) to the common grounding.
Cut the grounding terminal to size and connect it to the existing connector in the terminal box and/or frame.
Fasten all connections firmly.

NOTE: Do not use, for terminal fastening, eel washers or other material which do not have excellent electric conductivity characteristics.

It is recommended to apply a grease protection on all connections before performing the connection. Insert all sealing rings into the respective grooves. Screw the terminal box cover carefully, ensuring that the sealing rings are correctly introduced.

3.2.3. GENERAL CONNECTION DIAGRAMS

We are presenting below orientative connection diagrams for squirrel cage and slip ring induction motors as well as motors supplied with lighting arrestors and surge capacitors.

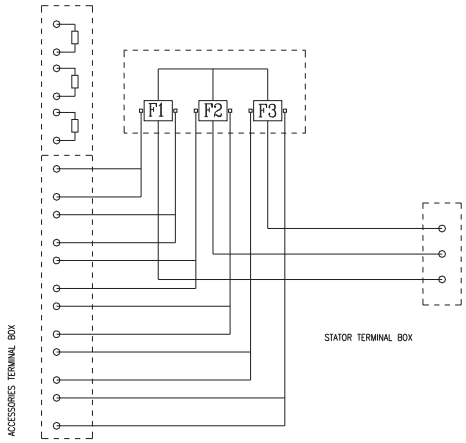


Figure 3.16. - General connection diagram for squirrel cage motors.

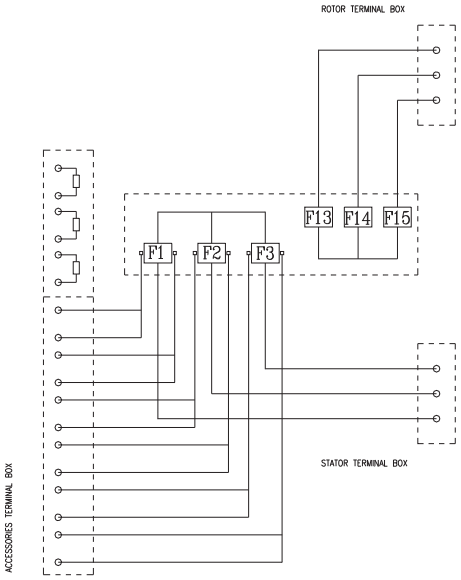


Figure 3.17. - General connection diagram for slip ring motors.

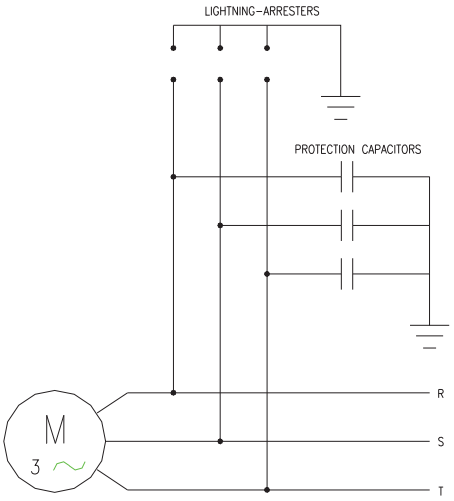


Figure 3.18. - General connection diagram for motors supplied with lightning arrestors and capacitors.

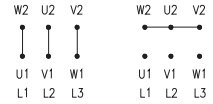
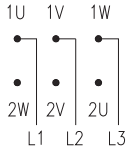
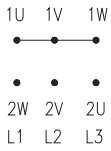
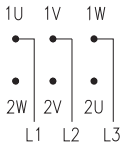
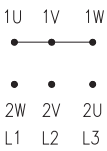
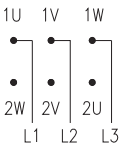
3.2.4. CONNECTION DIAGRAMS FOR STATORS AND ROTORS

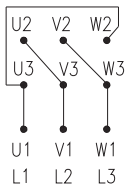
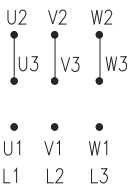
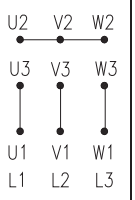
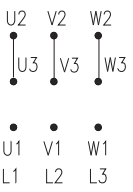
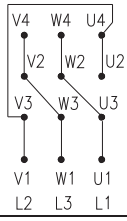
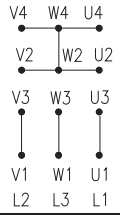
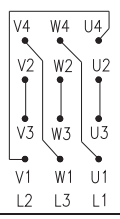
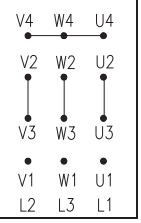
The following connection diagrams show terminals identification in the connection box and the possible connections for stator (phases) and rotor of the three-phase induction motors.
The described numbers in each diagram of the table below, serves for the user identify the correspondent motor connection diagram through the nameplate fixed on the motor, where are described the code numbers correspondent to the stator, rotor and accessories connection diagrams.

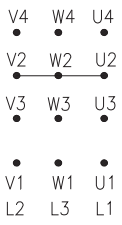
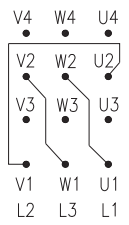
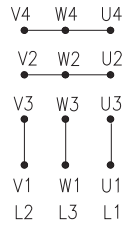
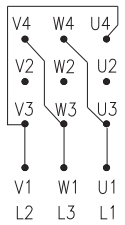
3.2.4.1. CONNECTION DIAGRAMS FOR STATORS AND ROTORS (Standard IEC 60034-8)

General terminals identification
U, V, W = Stator
K, L, M = Rotor

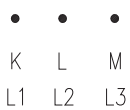
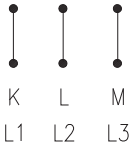
STATOR CONNECTION DIAGRAMS

3 TERMINALS	6 TERMINALS	6 TERMINALS - DAHLANDER				
9100  	**9101** **Δ** **Y**  	**9102** **Δ**  LOWER SPEED	**9103** **YY**  HIGHER SPEED	**9104** **Y**  LOWER SPEED	**9105** **YY**  LOWER SPEED	**9106** **Δ**  HIGHER SPEED
3 TERMINALS + NEUTRAL **9121**  						

9 TERMINALS				12 TERMINALS			
9107 **ΔΔ**  	**9108** **Δ**  	**9109** **YY**  	**9110** **Y**  	**9111** **ΔΔ**  	**9112** **YY**  	**9113** **Δ**  	**9114** **Y** 

12 TERMINALS - (part winding)			
9115  FOR STARTING IN Y	**9116**  FOR STARTING IN Δ	**9117**  Y ONLY FOR STARTING	**9118**  FOR RATED SPEED

ROTOR CONNECTION DIAGRAMS (WOUND ROTOR MOTOR)

ROTOR	
9120  	**9119** 

3.2.4.2. CONNECTION DIAGRAMS FOR STATORS AND ROTORS (Standard NEMA MG1)

General terminals identification
T1 to T12 = Stator
M1, M2, M3 = Rotor

STATOR CONNECTION DIAGRAMS

3 TERMINALS	6 TERMINALS	6 TERMINALS - DAHLANDER				
9200	**9201**	**9202**	**9203**	**9204**	**9205**	**9206**
T1 T2 T3 L1 L2 L3	Δ: T6 T4 T5 / T1 T2 T3 / L1 L2 L3 Y: T6 T4 T5 / T1 T2 T3 / L1 L2 L3	Δ T1 T2 T3 / T6 T5 T4 / L1 L2 L3 LOWER SPEED	YY T1 T2 T3 / T6 T5 T4 / L1 L2 L3 HIGHER SPEED	Y T1 T2 T3 / T6 T5 T4 / L1 L2 L3 LOWER SPEED	YY T1 T2 T3 / T6 T5 T4 / L1 L2 L3 LOWER SPEED	Δ T1 T2 T3 / T6 T5 T4 / L1 L2 L3 HIGHER SPEED
3 TERMINALS + NEUTRAL						
9221						
T1 T2 T3 N L1 L2 L3 N						

9 TERMINALS				12 TERMINALS			
9207	**9208**	**9209**	**9210**	**9211**	**9212**	**9213**	**9214**
ΔΔ T4 T5 T6 / T7 T8 T9 / T1 T2 T3 / L1 L2 L3	Δ T4 T5 T6 / T7 T8 T9 / T1 T2 T3 / L1 L2 L3	YY T4 T5 T6 / T7 T8 T9 / T1 T2 T3 / L1 L2 L3	Y T4 T5 T6 / T7 T8 T9 / T1 T2 T3 / L1 L2 L3	ΔΔ T11 T12 T10 / T5 T6 T4 / T8 T9 T7 / T2 T3 T1 / L2 L3 L1	YY T11 T12 T10 / T5 T6 T4 / T8 T9 T7 / T2 T3 T1 / L2 L3 L1	Δ T11 T12 T10 / T5 T6 T4 / T8 T9 T7 / T2 T3 T1 / L2 L3 L1	Y T11 T12 T10 / T5 T6 T4 / T8 T9 T7 / T2 T3 T1 / L2 L3 L1

12 TERMINALS - (part winding)			
9215	**9216**	**9217**	**9218**
T11 T12 T10 / T5 T6 T4 / T8 T9 T7 / T2 T3 T1 / L2 L3 L1 FOR STARTING IN Y	T11 T12 T10 / T5 T6 T4 / T8 T9 T7 / T2 T3 T1 / L2 L3 L1 FOR STARTING IN Δ	T11 T12 T10 / T5 T6 T4 / T8 T9 T7 / T2 T3 T1 / L2 L3 L1 Y ONLY FOR STARTING	T11 T12 T10 / T5 T6 T4 / T8 T9 T7 / T2 T3 T1 / L2 L3 L1 FOR RATED SPEED

ROTOR CONNECTION DIAGRAMS (WOUND ROTOR MOTOR)

ROTOR	
9220	**9219**
M1 M2 M3 L1 L2 L3	M1 M2 M3 L1 L2 L3

DIRECTION OF ROTATION

- The direction of rotation is described on the motor nameplate and shall be that of the shaft observed when facing the D-end.
- Machines with terminal markings according to the chapter 3.2.4.1 and 3.2.4.2 of this manual have a clockwise direction of rotation.

To invert the direction of the rotation must be inverted the connection of two phases. The motors with only one direction of rotation, shown by the motor nameplate and an arrow located on the frame possess unidirectional fan and must only operate in the specified direction. If is really necessary to invert the direction of the rotation, WEG must be consulted.

3.2.5. ACCESSORIES CONNECTION DIAGRAMS

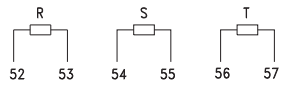
The following connection diagrams shown terminals identification in the connection box and the connection diagrams for accessories of the three-phase induction motors.
The described numbers in each diagram of the table below, serves for the user identify the accessories connection diagram through the nameplate fixed on the motor, where are described the code numbers correspondent to the stator, rotor and accessories connection diagrams.

General accessories terminals identification
16 to 19 = Space heater.
20 to 27 = RTD (PT100) in winding.
36 to 43 = Thermistors (PTC) in winding.
52 to 59 = Thermostats in winding (Klixon, Compela).
68 to 71 = RTD's in the bearings.
72 to 75 = Thermistors in the bearings.
76 to 79 = Thermostats in bearings.
80 to 82 = Thermometer.
92 to 93 = Brakes.
94 to 99 = Current transformers

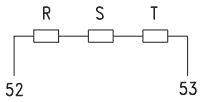
ACCESSORIES CONNECTION DIAGRAMS

THERMOSTATS

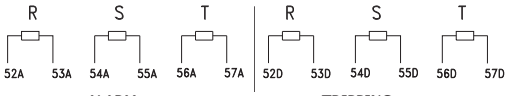
9029
IN WINDING
1 PER PHASE



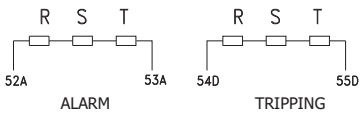
9030
IN WINDING
1 PER PHASE IN SERIES



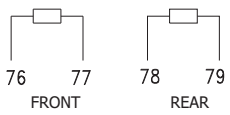
9031
IN WINDING
2 PER PHASE



9032
IN WINDING
2 PER PHASE IN SERIES

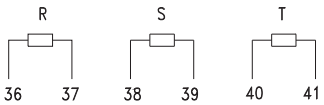


9036
IN THE BEARINGS
1 PER BEARING

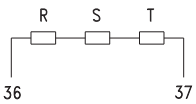


THERMISTORS

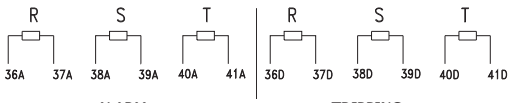
9025
IN WINDING
1 PER PHASE



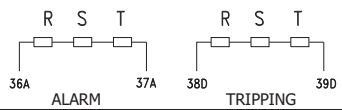
9026
IN WINDING
1 PER PHASE IN SERIES



9027
IN WINDING
2 PER PHASE



9028
IN WINDING
2 PER PHASE IN SERIES

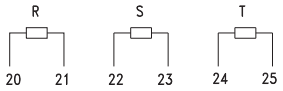


9035
IN THE BEARINGS
1 PER BEARING

TERMOSENSORS – RDT (PT-100)

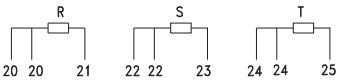
9021

IN WINDING
1 PER PHASE



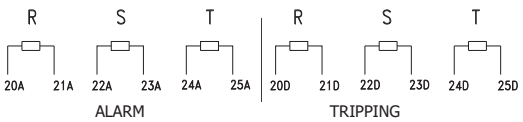
9022

IN WINDING
1 PER PHASE WITH 3 WIRES



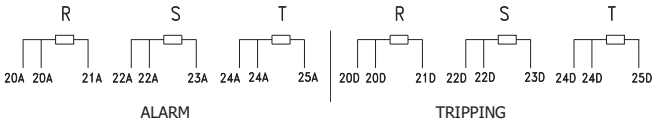
9023

IN WINDING
2 PER PHASE



9024

IN WINDING
2 PER PHASE WITH 3 WIRES



9033

IN THE BEARINGS
1 PER BEARING

9034

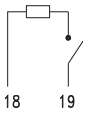
IN THE BEARINGS
1 PER BEARING WITH 3 WIRES

SPACE HEATER (single voltage)

9038

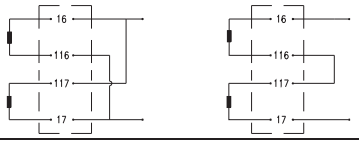
9039

WITH THERMOSTAT



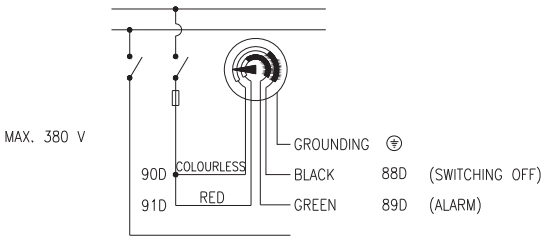
SPACE HEATER (double voltage)

9410



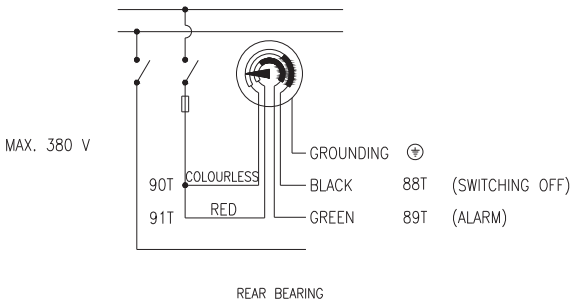
THERMOMETER (front bearing)

9037



THERMOMETER (rear bearing)

9037



SUPPLEMENTARY ACCESSORIES

In motors with more than 1 bearing for support, the sensor of temperature used in the extra bearing is identified with the corresponding number to the first bearing preceded of the number 1 (for 1 extra bearing) or 2 (for 2 extra bearings) Example: Motor with rear support composed of 2 bearings - 1 PT100 with 3 wires for bearing. The first bearing is identified with numeration 70 - 70 - 71 and the second bearing with numeration 170 - 170 - 171.
The same rule described above applies also for extra sensors in the stator or extra thermometers in the bearings.

3.2.6. ELECTRICAL MOTORS STARTING

3.2.6.1. STARTING – SQUIRREL-CAGE MOTOR

Whenever possible, three-phase squirrel cage motors should be started directly at full voltage through a contactor.
DOL is the easiest method of starting; only feasible, however, when the starting current does not affect the power supply.
Normally, the starting current of induction motors is six to seven times the rated current. Note that high starting current can cause supply disturbances to other consumers due to voltage drops in the main power supply.

This situation can be corrected with one of the following options:
a) The power supply rated current is so high that the starting current is not proportionally high;
b) Motor is started under no-load conditions with a short starting cycle and, as a consequence, a low starting current with a transient voltage drop tolerable to other consumers;
c) When duly authorized by the regional Energy Company (utility).

In the cases where the starting current of the motor is high, the following harmful consequences can occur:
a) High voltage droop in the grid of the feeding system. In function of this, it provokes interference in equipments installed in this system;
b) The protection system (lead, contactors) must be over specified, causing a high cost;
c) The imposition of the electrical energy companies who limit the voltage droop.

If direct starting is not feasible, either due to restrictions imposed by the utility or due to the installation itself, reduced voltage indirect starting methods can be used in order to reduce the starting current.

These indirect starting methods (reduced voltage) are:
- Wye-delta switch;
- Series-parallel switch;
- Compensating Switch or self-transformer;
- Static starting switch or soft-start;
- Frequency Inverter.

3.2.6.2. FREQUENCY OF DIRECT STARTINGS

Due to high starting current value on induction motor, the time required to accelerate high inertia loads results in sudden motor temperature rise. If interval between successive starts is significantly reduced, this will result in excessive winding temperature causing damage or reduce their life time. NBR 7094 establishes a minimum starting system electric motors must be suitable to withstand:
a) Two successive starts, where the first is made with motor still cold, that is, with winding at ambient temperature and the second right after that. However, only when motor has decelerated until rest;
b) One start with motor at hot, that is, with winding at service duty temperature.

The first condition simulates a case where the first start is affected. For example, due to protection switching-off, then allowing a second try right after that one. The second condition simulates a case of a motor accidental switching-off at normal operation. For example, due to lack of power supply, then allowing a second try as soon as the power supply returns.

3.2.6.3. LOCKED ROTOR CURRENT (Ip/In)

According to NBR7094 Standard, the value of Ip/In indicated on the motor nameplate is the relation between the locked rotor current and the motor rated current.

3.2.6.4. STARTING OF SLIP RING MOTORS WITH RHEOSTAT

For starting of slip ring motors an external rheostat is connected to the rotor by means of a set of brushes and slip rings.
The extra rotor resistance is held in the circuit during the starting to reduce the starting current and increase torque. Furthermore, it is possible to regulate the external resistance so as to have a starting torque equal to, or close to the motor breakdown torque.

NOTE: Every time customers intend to use other than **direct starting**, inform WEG Máquinas in advance so we can analyze the starting torques required by the load.

3.2.7. MOTOR PROTECTION

Motors have, in principle, two types of protection: protection against overload/locked rotor, and short circuits.
Motors in continuous use should be protected from overloading by means of a device incorporated into the motor, or by independent device, usually a fixed or adjustable thermal relay equal or inferior to the value derived from multiplying the rated power supply current at full load by:
- 1.25 for motors with a service factor equal or superior to 1.15 or;
- 1.15 for motors with service factor equal to 1.0.

Electric motors are fitted, under customer's request, with overheating protective devices (in case of overload, locked rotor, voltage drop, inadequate motor ventilation) such as a thermostat (thermal probe), thermistors, RTD s.

3.2.7.1. TEMPERATURE LIMITS FOR WINDINGS

The temperature of the winding hottest point must be kept below the thermal class limit.
The total temperature corresponds to the sum of ambient temperature plus temperature rise (T) plus the difference between average temperature of the winding and the hottest point.
By standard, maximum ambient temperature is 40°C. any temperature above this is considered special.
The temperature values and the permissible total temperature at the hottest point are given in the chart below:

Insulation class		B	F	H
Ambient temperature	°C	40	40	40
T = Temperature rise (resistance method)	°C	80	100	125
Difference between hottest point and average temperature	°C	10	15	15
Total: Hottest point temperature	°C	130	155	180

Table 3.4.

THERMOSTAT (THERMAL PROBE):
These are bimetallic thermal detectors with normally closed silver contacts and they trip at pre-determined temperatures. Thermostats are series-connected or independent according to the connection diagram.

THERMISTORS (PTC or NTC):
They are thermal detectors composed of semi-conductors PTC which sharply change their resistance when reaching a set temperature. They are series-connected or independent according to the connection diagram

NOTE: Thermostats and thermistors are connected to a control unit that cuts off the motor power supply or switches on an alarm system, in response to the thermistors reaction.

RESISTANCE TEMPERATURE DETECTORS (RTD's):
RTD's are resistance thermal detectors usually made of platinum.
Basically, RTD's operate on the principle that the electrical resistance of a metallic conductor varies linearly with the temperature. The detector terminals are connected to a control panel, usually fitted with a temperature gauge.
Normally Weg Motors are supplied with one RTD per phase and one per bearing where these protective devices are regulated for alarm and subsequent switch-off. For extra safety reasons, it is possible to fit two RTD's per phase.
Table 3.7 shows a comparison between the protection systems.

NOTE:
1) If required by the application, other protective devices must be used besides the ones indicated above.
2) Table 3.8 shows the temperature values in relation to the measured Ohmic resistance.
3) It is recommended to adjust the relays according to table 3, that is:

Class F:
Alarm: 130ºC.
Tripping: 155°C.
Class H:
Alarm: 155°C.
Tripping: 180°C.

The alarm and tripping values can be defined based on experience. However, they can not exceed the values given previously.

Causes of overheating	Current-based protection		Protection with thermal probe in the motor
	Fuse only	Fuse and thermal protector	
1. Overload with 1.2 times the rated current.	unprotected	totally protected	totally protected
2. Duty cycles S1 to S8, EB 120.	unprotected	partially protected	totally protected
3. Brakings, reversion and operation with frequent starts.	unprotected	partially protected	totally protected
4. Operation with more than 15 starts p/hour.	unprotected	partially protected	totally protected
5. Locked rotor.	partially protected	partially protected	totally protected
6. Fault on one phase.	unprotected	partially protected	totally protected
7. Excessive voltage fluctuation.	unprotected	totally protected	totally protected
8. Frequency fluctuation on power supply.	unprotected	totally protected	totally protected
9. Excessive ambient temperature.	unprotected	totally protected	totally protected
10. External heating caused by bearings, belts, pulleys etc.	unprotected	unprotected	totally protected
11. Obstructed ventilation.	unprotected	unprotected	totally protected

Table 3.7 - Comparison between Motor Protection Systems.

ºC	0	1	2	3	4	5	6	7	8	9
0	100.00	100.39	100.78	101.17	101.56	101.95	102.34	102.73	103.12	103.51
10	103.90	104.29	104.68	105.07	105.46	105.95	106.24	106.63	107.02	107.40
20	107.79	108.18	108.57	108.96	109.35	109.73	110.12	110.51	110.90	111.28
30	111.67	112.06	112.45	112.83	113.22	113.61	113.99	114.38	114.77	115.15
40	115.54	115.93	116.31	116.70	117.08	117.47	117.85	118.24	118.62	119.01
50	119.40	119.78	120.16	120.55	120.93	121.32	121.70	122.09	122.47	122.86
60	123.24	123.62	124.01	124.39	124.77	125.16	125.54	125.92	126.31	126.69
70	127.07	127.45	127.84	128.22	128.60	128.98	129.37	129.75	130.13	130.51
80	130.89	131.27	131.66	132.04	132.42	132.80	133.18	133.56	133.94	134.32
90	134.70	135.08	135.46	135.84	136.22	136.60	136.98	137.36	137.74	138.12
100	138.50	138.88	139.26	139.64	140.02	140.39	140.77	141.15	141.53	141.91
110	142.29	142.66	143.04	143.42	143.80	144.17	144.55	144.93	145.31	145.68
120	146.06	146.44	146.81	147.19	147.57	147.94	148.32	148.70	149.07	149.45
130	149.82	150.20	150.57	150.95	151.33	151.70	152.08	152.45	152.83	153.20
140	153.58	153.95	154.32	154.70	155.07	155.45	155.82	156.19	156.57	156.94
150	157.31	157.69	158.06	158.43	158.81	159.18	159.55	159.93	160.30	160.67

Table 3.8 - Variation of Platinum RTD's.

NOTE: When motors are supplied with accessories T-box, the connection terminals for thermal protectors and other accessories are fitted in this T-box.

3.2.7.2. SPACE HEATERS

When motors are fitted with space heaters to avoid water condensation during long periods o standstill, the space heaters must be connected so that they are energized immediately after the motor is switched-off and are de-energized immediately after the motor is switched-on. A dimensional drawing and a specific nameplate existing on the motor indicate the supply voltage and the characteristics of the space heaters installed.

3.2.7.3. VIBRATION LIMITS

WEG motors and generators Are factory balanced and comply with vibration limits established by IEC34-14, NEMA MG1 - Part 7 and NBR 11390 Standards (except when the purchasing agreement specifies different values).

Vibration measurements are performed on the non-drive and drive end bearings, vertically, horizontally and axially.

When a customer supplies the coupling half sleeve to WEG, the motor in question is balanced with this half sleeve mounted to the shaft. When this is not the case, based on the above standards motor is balanced with half key (that is, the key way is fulfilled with a piece of metal of identical width, thickness and height of the keyway).

The maximum allowable vibration levels recommended by WEG for motors in operation are given on the table below. These values are generic and serve as a guideline. Specific application conditions must be taken into consideration:

Rated speed (rpm)	Vibration Levels (mm/s RMS)			
	Frame	< 355	355 to 630	> 630
600 ≤ n ≤ 1800	Alarm	4.5	4.5	5.5
	Tripping	7.0	7.0	8.0
1800 < n ≤ 3600	Alarm	3.5	4.5	5.5
	Tripping	5.5	6.5	7.5

Table 3.5.

Vibration causes most frequently found on the field are:
- Misalignment between motor and driven machine;
- Incorrect motor fastening to the base, with "loose shims" underneath one or more motor feet and studs incorrectly fastened;
- Improper base, or not firmly built;
- External vibrations caused by other equipment.

Operate the motor with vibration values above those described above can damage its lifetime and/or its performance.

3.2.7.4. SHAFT VIBRATION LIMITS

In motors equipped or with forecast for installation of proximity sensor (normally used in sleeve bearing) the shaft surfaces are prepared with special finishing in the adjacent areas of the bearings, so as to ensure the correct shaft vibration measurement.
The shaft vibration in these motors is measured and must comply with IEC 34-14 and NEMA MG 1 Standards.
The alarm and tripping values of the table 3.6 represent values of permissible shaft vibration for coupled electric machines as norm ISO7919-3.
They are generic values and serve as a guideline, where specific application conditions must be taken into consideration, mainly diametric clearance between shaft and bearing.

Rated speed (rpm)	Shaft vibration (µm peak to peak)			
	Frame	280 and 315	355 to 450	> 450
1800	Alarm	110	130	150
	Tripping	140	160	190
3600	Alarm	85	100	120
	Tripping	100	120	150

Table 3.6.

Operate the motor with shaft vibration values close to alarm and tripping values can damage bearing liners.

The main reasons to cause increase of vibration are:
- Unbalance coupling problems and others that can affect the machine;
- Shaft manufacturing problems, which are minimized during the manufacturing;
- Residual voltage or magnetism on the shaft surface where measurement is made;
- Scratches, knocks or vibrations when finishing the shaft where measurement is made.

3.3. COMMISSIONING

3.3.1. PRELIMINARY INSPECTION

Before starting a motor for the first time, or after long period of standstill, check the following items:

1) Is the motor clean? Were all packing materials and cleaning materials removed?
2) Make sure the supply voltage and frequency correspond to those indicated on the nameplate.
3) Ascertain that the endbell and bearing-housing fastening bolts are firmly tightened.
4) Make sure the motor is correctly aligned (as per item 3.1.3).
5) Are the bearings correctly lubricated (as per item 4.2).
6) Are the rotor terminals connected? (Only for slip ring motors).
7) Are the thermal protector conductors, the rounding terminal and the space heaters connected?
8) Is the insulation resistance of the rotor and stator according to the prescribed value ? (as per item 2.3.5).
9) Were all objects such as tools, measuring instruments and alignment devices removed from the area of the motor?
10) Are the brush-holders in order? Are the brushes making contact? (see item 4.5 and 4.6).
11) Are all motor fixing bolts duly tightened?
12) When the motor is started at no load, does it rotate freely without abnormal noise? Is the direction of rotation correct? (To reverse the rotation, invert any of two terminal leads of the power supply).
13) Is the motor ventilation OK? Note the direction of rotation of unidirectional motors.

NOTES:

1) The gap between brush holder and Slip ring surfaces should be between 2mm to 4mm.
2) Brush pressure on the slip ring should be in accordance with the specified value, and the brush incidence to the contact surface should be perpendicular.
3) If the load (operation rated current) applied to the motor are not in accordance with the rated characteristics of such motor (above or below), the brushes specification must be analyzed in relation to the actual load requirements. Check data given in item 4.6.
4) Before changing rotation direction of two-pole motors, contact Weg Máquinas for analysis.
5) The "H" line motors with special noise level are built with unidirectional fan (all RPM´s). To reverse rotation direction, contact Weg Máquinas in order to analyze the fan.
6) The "Master" line motors are also built with unidirectional fans. So if rotation direction has to be reversed, contact Weg Máquinas in order to analyze the fan.

WARNING: The non observation of the items described above can lead to serious problems to motor performance, causing excessive wear to brushes and slip rings (for wound rotor motors), overheating and possible damage to motor windings. These problems are not covered under the warranty terms included in this manual.

3.3.2. START-UP

THREE-PHASE SQUIRREL CAGE ROTOR MOTOR

After careful examination on the motor, follow the normal sequence of starting operation listed above.

THREE-PHASE SLIP RING MOTORS

- The starting method must follow the manufacturer instructions for starting methods.
- On motors with permanent contact brushes, the starting rheostat remains in the "run" position while the motor is running.
- Special speed control rheostat designed for permanent connection to resistance contacts within a given range of settings are an exception to the above.
- Brushes must be correctly set against the slip ring.
- In motor with adjustable brush-holder system, after complete motor acceleration, make sure that the brush lifting system has worked.

3.3.3. OPERATION

Run the motor coupled to the load for a period of at least one hour to check if abnormal noises or sign of overheating occur. If there will be excessive vibrations in the unit between the initial operation condition and the condition after thermal stability, alignment and leveling must be rechecked. Compare the line current drawn with the value shown on the nameplate.
Under continuous duty without load fluctuation, this should not exceed the rated current times the service factor, also shown on the nameplate.
All measuring instruments and devices should be continuously checked in order to correct any abnormal operation, if required.
On slip-ring motors, the real load condition of the motor in duty, must be investigated, and if necessary, specify again the set of brushes. In case of doubt consult WEG Máquinas.

3.3.4. SHUTDOWN PROCEDURE

Before proceed any tasks on the motor, it is extremely important to observe the following: to touch any moving part on a running motor, even switched-off, is a danger to life.

a) THREE-PHASE SQUIRREL CAGE MOTORS: It suffices to open stator circuit switch, and with the motor stopped, reset the auto-transformer, if any, to the "start" position;

b) THREE-PHASE SLIP RING MOTORS: Open the stator circuit switch. When the motor is stopped, reset the rheostat to the "start" position.

***** WARNING *****
The motor connection boxes equipped capacitors do not have to be opened before the discharge time:
Time of discharge of the capacitors: 5 minutes after the disconnection of the motor.

3.4. ACOUSTICAL PROPERTIES

Day by day, electrical motors are increasingly used in offices and homes. Under these circumstances, it is essential that motors operate silently and safe without contributing to ambient discomfort. The solution lies in the ever closer collaboration of the user and the motor manufacturer.
The proper planning of home, office and factory acoustics requires knowledge of the sources of motor noises and how they affect the ambient noise level wherever motors are located.
The following parts of a motor can generate noise within the audio-frequency range:
1) Cooling system.
2) Brushes.
3) Bearings.
4) Magnetic circuit.

The part of the motor mainly responsible as noise source depends on its size, speed, degree of mechanical protection (casing) and of the driven machine design. Cooling system noise is airborne and usually affects only the noise level in the ambient where motor is installed. How ever, it is a different matter if the noise source is in the bearings or in the magnetic circuit. In this case, the noise is due to mechanical vibration of the part itself, or of the entire motor, and the sound is spreaded through the foundation, walls or ducts. This type of sound propagation, via structural components of an installation, can be reduced by installing the motor on suitable designed vibration dampers. It is important to note that improper dampers can even increase vibration.

3.5. MOTOR USED ON HAZARDOUS AREA EXPLOSIVE GAS ATMOSPHERES

Motors designed for hazardous areas are fitted with additional safety features which are defined in specific standards for each type of hazardous location, based on its classification.
The general requirements for electrical apparatus for hazardous locations are described in the following Brazilian and foreign standards, respectively:
NBR 9815 = Electrical apparatus for explosive gas atmospheres.
General requirements (specifications)
IEC 79-0 = Electrical apparatus for explosive gas atmospheres.
EN 50014 = Electrical apparatus for potentially explosive atmosphere.
General requirements

3.5.1. GENERAL CARE WITH HAZARDOUS LOCATION MOTORS

Before installing, operating or carrying out maintenance services on electric motors used on hazardous locations, care must be taken on the following:

- The standards listed below, applied to each case, must be studied and understood;
- All requirements included in the applicable standards must be understood accordingly.

Exe – Increased Safety: IEC 79-7 / NBR 9883 / EN 50019.
Exp – Pressurized: IEC 79-2 / NBR 5420.
Exn – Non sparking: IEC 7915.

3.5.2. ADDITIONAL CARE RECOMMENDED FOR HAZARDOUS LOCATION MOTORS

- Before carrying out maintenance services, inspections or repairs on the motor, make sure it is de-energized and completely stopped;
- All motor protections must be correctly installed and duly adjusted before starting the operation;
- Make sure motors are properly grounded;
- Connection terminals must be properly connected so as to avoid poor contacts which can result in overheating or sparking.

NOTE: All other recommendations referring to storage, handling, installation and maintenance included in this manual and applied to the motor in question must also be followed accordingly.

4. MAINTENANCE

A well-programmed maintenance of electric motors can be summed up as a periodical inspection of insulation levels, temperature rise (winding and bearings), wears, bearing lubrication and useful life, and occasional checking of fan air flow, vibration levels, brushes and slip rings wears.
In case one of the above items are not followed accordingly, you might have unexpected stops of the equipment. Inspection cycles depend on the type of the motor and conditions under which it operates.
Frame must be kept clean, free of dust, dirt or oil in order to make the cooling process easier.

Transportation care:
On any transportation, motors fitted with roller or ball bearings must have their shaft locked in order to avoid bearing damage.
To lock the shaft use the shaft locking device shipped together with the motor. See item 2.2.

4.1. CLEANLINESS

Motors should be kept clean, free of dust, dirt and oil. Soft brushes or clean cotton rags should be used to clean the motors. A jet of compressed air should be used to remove non-abrasive dust from the fan cover and any accumulated grime from the fan and cooling fins.
The heat exchanger tubes (if any) must be kept clean and free of any obstructing object to facilitate the air circulation. For the cleanliness of the tubes, a stick with a round brush at the ends can be used which, inserted in such tubes, removed all accumulated dirt.

NOTE: To perform such cleanliness, remove the ND end bell of the heat exchanger and insert the brush into the tubes.

In order to effect this cleanliness, a stick can be used which, inserted into the tubes, remove all the accumulated dust. If motor is fitted with air-water heat exchanger, a periodical cleanliness is inside the radiator tube is required to remove any dirt condensation.

On slip-rings motors, the brushes compartment must be cleaned with vacuum cleaner, withdrawing the brushes dust outside of the motor.
The slip-rings must be cleaned with a clean and dry cloth and that does not leave shreds residues.
The spaces between the rings should be cleaned with an air vacuum cleaner hose with a plastic wand on the end.
Do not use cleaning fluids because their vapor will have a detrimental effect on collector and brushes action.

Oil or damp impregnated impurities can be removed with rags soaked in a suitable solvent.
Terminal boxes of IP54 protection motors should also be cleaned; their terminals should be free of oxidation, in perfect mechanical condition, and all unused space dust-free. For aggressive environment, IP(W)55 protection motors are recommended.

4.1.1. PARTIAL CLEANING

- Drain the condensed water.
- Clean the inside of the terminal boxes.
- Make a visual inspection of the winding insulation.
- Clean the slip rings (see 4.4 and 4.5).
- Check the condition of the brushes.
- Clean the heat exchanger.

4.1.2. COMPLETE CLEANING

- Clean the dirty windings with a soft brush.
- Grease, oil and other impurities which adhered on the winding can be removed with a rag soaked in alcohol. Dry the windings with a jet of compressed air.
- A jet of compressed air should be used to clean the bearings and the air ducts in the stator and rotor cores.
- Drain the condensed water and clean the inside of the terminal boxes as well as the slip rings.
- Measure the insulation resistance (see table 2.3a).
- Clean the brushes/brush holders according to items 4.5.
- Clean the heat exchanger accordingly.

NOTE: When motor is fitted with air inlet and/or air outlet filters, these should be cleaned with a jet of compressed air.

If the dust is difficult to be removed with a jet of compressed air, then they should be washed in cold water with neutral detergent. After that, dry them in horizontal position.

4.2. LUBRICATION

4.2.1. GREASE LUBRICATED BEARINGS

The purpose of this maintenance is to lengthen bearing life.

Maintenance includes:
a) Attention to the overall status of the bearings;
b) Cleaning and lubrication;
c) Inspection in details of the bearings.

Motor noise should be measured at regular intervals of one to four months. A well-tuned ear is perfect capable of distinguishing unusual noises, even with rudimentary tools such as a screwdriver, etc. For a more reliable analysis of the bearings, sophisticated equipment is required.

Bearing temperature control is also part of routine maintenance. The temperature rise of grease lubricated bearings as recommended under item 4.2.1.2 should not exceed 60ºC (T = 60ºC/max. ambient = 40ºC, absolute temperature = T + ambient) measured at the external bearing cap.

Constant temperature control can be done by means of external thermometers or by embedded thermal elements.

*Alarm and tripping temperatures for ball and roller bearings can be set for **110°C** and **120°C** respectively.*

*The **alarm temperature** should be set at 10°C above the working temperature, not exceeding the limit of 110°C.*

Weg motors are normally supplied with grease lubricated ball or roller bearings.
Bearings should be lubricated to avoid metallic contact of the moving parts, and also for protection against corrosion and wear. Lubricant properties deteriorate in the course of time and due to mechanical operation and, furthermore, all lubricants are subject to contamination under working conditions. For this reason, lubricants must be renewed or replaced from time to time.

4.2.1.1. LUBRICATION INTERVALS

WEG motors are supplied with **POLYREX EM 103** grease (Supplier: Esso) up to frame 450 and **STABURAGS N12MF** grease (Supplier Klüber) for frame 500 and above, enough for the operating time period indicated on the data sheet and on the bearing identification nameplate.

Lubrication intervals depend on the size of the motor, speed, working conditions, type of grease used and working temperature.
The lubrication period and type of bearings are indicated on the motor nameplate.

Motors kept in stock should be relubricated every six months. Once each 2 months, shaft must be in order to have the grease homogenized.

Lubrication intervals, amount of grease and bearings used on the motors are indicated in Tables 4.2a and 4.2b, as reference values.

The bearings data, amount and type of grease and lubrication interval informed in the nameplate attached in the motor. Before the procedure of bearings lubrication, we recommend that these data are verified.

MAXIMUM LUBRICATION INTERVALS (IN HURS) FOR HORIZONTALLY MOUNTED MOTORS - 60Hz											
Frame	Poles	DE Bearing		DE Bearing (with pulley)		NDE Bearing (squirrel cage rotor)		NDE Bearing slip ring motor (Fixed brushes)		NDE Bearing slip ring rotor (Lifting brushes)	
		Bearing	Relubr.	Bearing	Relubr.	Bearing	Relubr.	Bearing	Relubr.	Bearing	Relubr.
315	2	6314	3.400			6314	3.400				
	4	6320	6.400	NU322	2.000	6316	8.900	6222	6.600	6222	6.600
	6		10.000		4.500		10.000		10.000		10.000
	8		10.000		6.400		10.000		10.000		10.000
355	2	6314	3.400			6314	3.400				
	4	6322	4.800	NU324	1.600	6320	6.400	6224	5.800	6224	5.800
	6		8.700		3.900		10.000		10.000		10.000
	8		10.000		5.800		10.000		10.000		10.000
400	4	NU224	2.200	NU228	1.400	6320	6.400	6226	5.100	6230	3.400
	6		4.900		3.700		10.000		9.300		6.900
	8		6.800		5.500		10.000		10.000		9.800
450	4	NU224	2.200			6322	4.800	6230	3.400	6234	2.500
	6		4.900				8.700		3.400		5.600
	8		6.800				10.000		3.400		8.400
500	4 1.80	NU226	0			6322	4.800	6230	3.400	6234	2.50
	6 4.30		0				8.700		6.900		5.60
	8		6.200				10.000		9.800		8.400
560	4	NU228				NU222		NU230		NU234	
	6 3.70		0				5.500		3.100		2.30
	8		5.500				7.500		4.900		3.90
	4	NU232									
	6 2.70		0				5.500		3.100		2.30
	8		4.400				7.500		4.900		3.900
630	4	23032				NU224		NU230		NU234	
	6 1.20		0				4.900		3.100		2.30
	8 2.20		0				6.800		4.900		3.90
	10 3.10		0				8.100		6.300		5.20
	12		3.800				9.000		7.300		6.20
	4	23036									
	6										
	8 1.60		0				6.800		4.900		3.90
	10 2.40		0				8.100		6.300		5.20
	12		3.100				9.000		7.300		6.200
710	6	23036				NU226		NU232		NU234	
	8 1.60		0				6.200		4.400		3.90
	10 2.40		0				7.500		5.700		5.20
	12		3.100				8.400		6.700		6.20
	6	23040									
	8 1.30		0				6.200		4.400		3.90
	10 2.00		0				7.500		5.700		5.20
	12		2.600				8.400		6.700		6.200

Grease: Polyrex EM 103 (Esso) Grease: Staburags N12MF (Klüber)

Table 4.2a.

NOTES:

- Normal relubrication interval for ambient temperature of 40ºC and types of grease specified above;
- For vertically mounted motors, reduce relubrication intervals by half;
- Bearing operating temperature = 70ºC;
- Apply correction factors given below for relubrication intervals of table above on the following cases:
  - Operating temperature below 60ºC: 1.59.
  - Operating temperature of 70ºC to 80ºC: 0.63.
  - Operating temperature of 80ºC to 90ºC: 0.40.
  - Operating temperature of 90ºC to 100ºC: 0.25
  - Operating temperature of 100ºC to 110ºC: 0.16.

MAXIMUM LUBRICATION INTERVALS (IN HURS) FOR HORIZONTALLY MOUNTED MOTORS - 50Hz											
Frame	Poles	DE Bearing		DE Bearing (with pulley)		NDE Bearing (squirrel cage rotor)		NDE Bearing slip ring motor (Fixed brushes)		NDE Bearing slip ring rotor (Liftable brushes)	
		Bearing	Relubr.	Bearing	Relubr.	Bearing	Relubr.	Bearing	Relubr.	Bearing	Relubr.
315	2	6314	4.900			6314	4.900				
	4	6320	8.300	NU322	3.000	6316	10.000	6222	8.500	6222	8.500
	6		10.000		5.700		10.000		10.000		10.000
	8		10.000		7.600		10.000		10.000		10.000
355	2	6314	4.900			6314	4.900				
	4	6322	6.500	NU324	2.500	6320	8.300	6224	7.700	6224	7.700
	6		10.000		5.100		10.000		10.000		10.000
	8		10.000		6.900		10.000		10.000		10.000
400	2	6317	3.400			6317	3.400				
	4	NU224	3.300	NU228	2.300	6320	8.300	6226	6.900	6230	4.800
	6		6.100		4.900		10.000		10.000		8.700
	8		7.900		6.700		10.000		10.000		10.000
450	4	NU224	3.300			6322	6.500	6230	4.800	6234	3.700
	6		6.100				10.000		8.700		7.300
	8		7.900				10.000		10.000		10.000
500	4 2.80	NU226	0			6322	6.500	6230	4.800	6234	3.70 0
	6 5.50		0				10.000		8.700		7.30 0
	8		7.300				10.000		10.000		10.000
560	4 2.30	NU228	0			NU222	3.900	NU230	1.900	NU234	1.30 0
	6 4.90		0				6.800		4.300		3.30 0
	8		6.700				8.600		6.100		5.00 0
	4	NU232									
	6 3.80		0				6.800		4.300		3.30 0
	8		5.500				8.600		6.100		5.000
630	4	23032				NU224		NU230		NU234	
	6 1.80		0				6.100		4.300		3.30 0
	8 2.90		0				7.900		6.100		5.00 0
	10 3.80		0				9.000		7.300		6.20 0
	12		4.400				9.600		8.000		7.10 0
	4	23036									
	6 1.30		0				6.100		4.300		3.30 0
	8 2.30		0				7.900		6.100		5.00 0
	10 3.10		0				9.000		7.300		6.20 0
	12		3.700				9.600		8.000		7.100
710	6 1.30	23036	0			NU226	5.500	NU232	3.800	NU234	3.30 0
	8 2.30		0				7.300		5.500		5.00 0
	10 3.10		0				8.400		6.700		6.20 0
	12		3.700				9.100		7.600		7.10 0
	6 1.00	23040	0				5.500		3.800		3.30 0
	8 1.80		0				7.300		5.500		5.00 0
	10 2.60		0				8.400		6.700		6.20 0
	12		3.200				9.100		7.600		7.100

Grease: Polyrex EM 103 (Esso) Grease: Staburags N12MF (Klüber)

Table 4.2b.

NOTES:

- Normal relubrication interval for ambient temperature of 40ºC and types of grease specified above;
- For vertically mounted motors, reduce relubrication intervals by half;
- Bearing operating temperature = 70ºC;
- Apply correction factors given below for relubrication intervals of table above on the following cases:
  - Operating temperature below 60ºC: 1.59.
  - Operating temperature of 70ºC to 80ºC: 0.63.
  - Operating temperature of 80ºC to 90ºC: 0.40.
  - Operating temperature of 90ºC to 100ºC: 0.25
  - Operating temperature of 100ºC to 110ºC: 0.16.

4.2.1.2. TYPE AND AMOUNT OF GREASE

Greases supplied with the motors

SUPPLIER GREASE		CONSTANT OPERATING TEMPERATURE (°C)	APPLICATION
ESSO	POLYREX EM 103 (POLIURÉIA BASED)	(-30 to +170)	NORMAL
KLÜBER	STABURAGS N12MF (SODIUM ANDE MoS^2 BASE)	(-20 to +140)	

Table 4.3a.

Grease options

SUPPLIER GREASE		CONSTANT OPEARATING TEMPERATURE(°C)	APPLICATION
ESSO	UNIREX N2 (LITHIUM BASE)	(-35 to +175)	NORMAL
PETROBRAS	LUBRAX GMA-2 (LITHIUM BASE)	(0 to +130)	
SHELL	ALVÂNIA R3 (LITHIUM BASE)	(-35 to +130)	
	AEROSHELL 7 (MICROGEL)	(-55 to +100)	LOW TEMPERATURE
ESSO	BEACON 325 (LITHIUM BASED)	(-50 to +120)	

Table 4.3b.

Amount of grease (g)

Ball bearings	
Bearing	Grease (g)
6222	40
6224	45
6226	50
6230	65
6234	85
6314	30
6316	35
6320	50
6322	60

Table 4.4a

Roller bearings	
Bearing	Grease (g)
NU222	40
NU224	45
NU226	50
NU228	55
NU230	65
NU232	70
NU234	85

Table 4.4b

Roller bearings Self-compensating	
Bearing	Grease (g)
23032	75
23036	105
23040	130

Table 4.4c

4.2.1.3. QUALITY AND QUANTITY OF GREASE

Correct lubrication is important for proper bearing operation. It means to say the grease must be applied correctly and in sufficient amount. On the other hand, insufficient or excessive greasing are prejudicial.

Excessive greasing causes overheating due to high resistance encountered by the rotating parts and, in particular, by the compacting of the lubricant and its eventual loss of lubricating qualities.

This can cause leakage with the grease penetrating into the motor winding, commutator rings or brushes.

Never mix greases with different base components.
Example: A calcium based grease must not be mixed with a polyurea based grease.

4.2.1.4. COMPATIBILITY

The compatibility of different types of grease can create occasional problems. When the properties of the mixture remain within the individual property range of the greases, we can say the greases are compatible.

To avoid any possible incompatibility grease problem we recommend performing an appropriate lubrication which can be summarized as follows: after removing the old grease and caring out a complete cleanliness of the grease cavity, new grease must be pumped in. When this procedure is not allowed, pump in new grease by pressure. This must be repeated until new grease is drained out through the grease relief.
As a general rule, greases with same soap type are compatible. However depending on the mixture rate, they can then be recommended to mix different types of grease before contacting a service agent and/or WEG.
Same and basic oils can not be mixed as they will not produce a homogeneous mixture. In this case, either a hardening or a softening (or drop of the resulting mixture melting point) can occur.

4.2.1.5. LUBRICATING INSTRUCTIONS

The lubrication system was designed to allow, when regreasing, the removal of all grease from the bearings races through a grease relief which at the same time impedes the entry of dust or other contaminants harmful to the bearing.
This grease relief also avoids injury to the bearings from the already known problem of over-greasing. It is advisable to relublicated while the motor is running so as to allow the renewal of grease in the bearings housing.
If this procedure is not possible due to existing parts near to the nipple (pulleys, etc), which can be harmful to the operator, the following procedure should be followed:

- Inject about half the estimated amount of grease and run the motor at full speed for approximately one minute;
- Switch off the motor and inject the remaining grease.

The injection of all the grease with the motor stopped can cause penetration of a portion of the lubricant into the motor through the internal seal of the bearing housing.

NOTE: Grease fittings must be clean before greasing the motor in order to avoid entry of any foreign bodies into the bearing.

For lubrication, use only a manual grease gun.

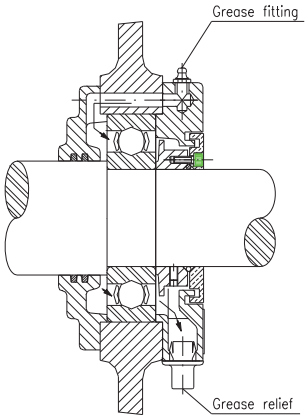


Figure 4.2. - Bearings and lubrication system.

4.2.1.6. BEARING LUBRICATION STEPS

1. Remove the grease relief cover.
2. Clean the area around the grease fitting with a clean cotton fabric.
3. With the motor running, add grease with a manual grease gun until the lubricant commences to expel from the grease relief, or insert the amount of grease recommended in Tables herewith indicated.
4. Leave the motor running enough time to drain all excess of grease.
5. Check bearing temperature to make sure there has not been any major variation.

4.2.1.7. SPRING DEVICE FOR GREASE REMOVAL

When grease outlet is not accessible to the operator, some motors are fitted with a spring device for grease removal during bearing relubrication.
Lubrication steps:

1. Before starting bearing lubrication procedure, clean the grease fitting with a piece of coth;
2. Remove the spring through bolt, clean the spring and place it back;
3. With the rotor in operation, add the amount of grease specified on the bearing identification nameplate with the application of a manual grease gun.
4. The excess of grease will be drain it through the bottom grease relief and is dropped on the spring.
5. Keep the motor running for a time period enough to drain out all excess of grease.

6. This grease must be removed by pulling the spring through bolt and then cleaning the spring. This procedure must be carried out as many times as it is required up to the point no grease is on the spring.
7. Check bearing temperature to make sure there has not been any major modification.

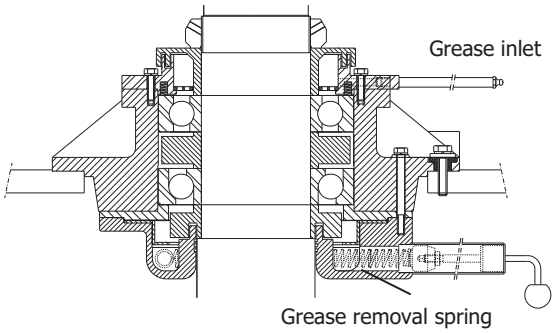


Figure 4.3. – Example of a vertically mounted NDE bearing with grease outlet fitted with spring device.

4.2.1.8. REPLACEMENT OF BEARINGS

After removing the bearing cap, avoid demage to the cores by filling the air gap between the rotor and the stator with stiff paper of a proper thickness. Providing suitable tooling is employed, disassembly of bearings is not difficult. (See bearing extractor with 3 grips in figure 4.4).

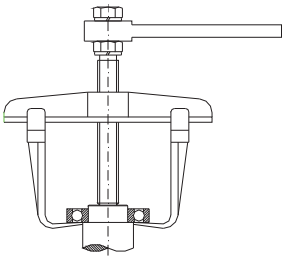


Figure 4.4. - Bearing Extractor.

The extractor grips must be applied to the sidewall of the inner ring to be stripped, or to an adjacent part.
To ensure perfect functioning and no injury to the bearing parts, it is essential that the assembly be done under conditions of complete cleanliness and by skilled personnel.
New bearings should not be removed from their packages until they are assembled.
Prior to fitting a new bearing, ascertain that the shaft has no rough edges or signs of hammering.
During assembly, bearings cannot be subjected to direct blows. To make the assembly easier, it is recommended to heat up (inductive heater) the bearing.
The aid used to press or strike the bearings should be applied to the inner ring.

4.2.2. ANTIFRICTION BEARIGS LUBRICATED BY GREASE – VERTICAL MOTORS

4.2.2.1. CHARACTERISTICS

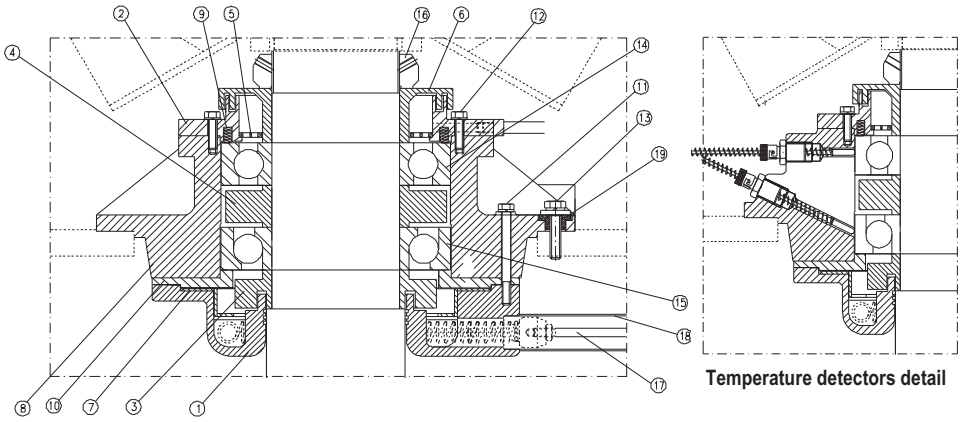
The bearings characteristics data, amount and type and quantity of grease and lubrication interval are informed in the nameplate attached in the motor.

4.2.2.2. RELUBRICATION STEPS

1) Before lubricating the bearing, clean the grease fitting nipples with cotton fabric;
2) Remove the spring bolt at the grease outlet (17), clean the spring and replace it.
3) With the motor in operation, add amount of grease indicated on the bearing nameplate with the application of a manual grease gun.
4) Excess of grease will drain out through the bearing bottom drain and dropped in the spring.
5) Leave the motor running for a time period enough to drain out all excess of grease.
6) This grease must be removed by pulling the through bolt and cleaning the spring as many times it is required until completely drained out.
7) Check bearing temperature to make sure there has not been a significant variation.

Bearing repair and replacement
If is necessary cleaning the bearing or remove it for maintenance, follows the instructions below:

4.2.2.3. DISASSEMBLY / ASSEMBLY – OPPOSITE DRIVE-END BEARING



1- Internal bearing cap
2- External bearing cap
3- Grease valve
4- Separator ring
5- Cover grease
6- Closed external ring
7- Spring cover protection
8- Rear cover
9- Pre-loading spring
10- Internal bearing cap
11- Fixation screw
12- Fixation screw
13- Fixation screw
14- External bearing
15- Internal bearing
16- Fixation nut
17- Grease relief
18- Grease relief
19- Press washer

Before disassembly

- Remove the prolongation tubes of the grease inlet and outlet;
- Remove the sun shade, cover, fan and other components that are in the rear side as sun as the shaft end becomes free for bearing removing.
- Clean completely the outside of bearings.
- Remove the temperature detectors from the bearings and provide a prop for support the shaft and avoid damages.

Opposite drive-end bearing disassembly

Care must be taken to avoid damage on the ball or roller and shaft surface.

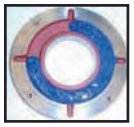
For disassemble the bearing, follows carefully the instructions below:

Keeps all the parts disassembled in an insurance local.

1) Remove the fixation nut (16)
2) Remove the grease relief (17);
3) Remove the closed external ring (6);
4) Remove the screws (12) which fasten the external bearing cap;
5) Remove the external bearing cap (2);
6) Remove the screws (11 and 13);
7) Remove the rear cover (8);
8) Remove the external bearing (14), separator ring (4) and internal bearing (15);
9) Remove the screw which fasten the grease valve (3) and remove it;
10) Remove the internal bearing cap (1) if necessary.

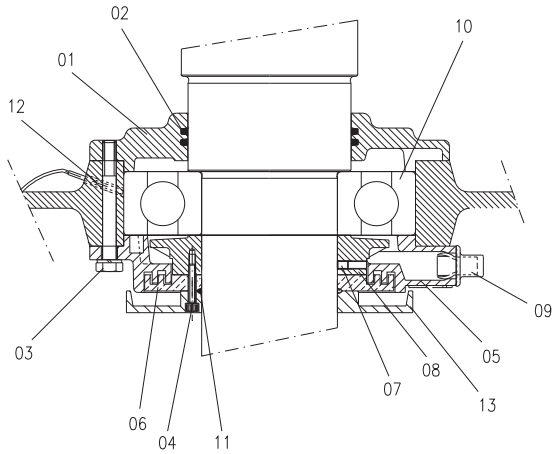
Opposite drive-end bearing reassembly

- Clean the bearings completely and inspects the removed parts and the interior of the caps.
- Certify that the bearing, shaft and bearing caps surfaces be smooth.



- Put the recommended grease on ¾ of the external and internal bearing cap deposit and lubricate the bearing with sufficient quantity of grease before reassemble it.
- Before place the bearing on the shaft, heat the bearing to a temperature between 50ºC and 100ºC. For reassembling the bearings, follow the instructions of disassembly in the inverse order.

4.2.2.4. DISASSEMBLY / ASSEMBLY – DRIVE-END BEARING



1- Internal bearing cap
2- White felt
3- Screw that fixes the bearing caps
4- Screw that fixes the seal disc
5- External bearing cap
6- Ring with labyrinth
7- Screw which fasten the grease valve
8- Grease valve
9- Drawer for waste grease
10- Bearing
11- Grease nipple
12- Thermal protective
13- Seal disc

Before disassembly

- Remove the prolongation tubes of the grease inlet and outlet (if any);
- Clean completely the outside of bearings;
- Remove the temperature detectors from the bearings;
- Remove the grounding brush (if any);
- Provide a prop for support the shaft and avoid damages.

Drive-end bearing disassembly

Care must be taken to avoid damage on the ball or roller and shaft surface.

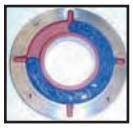
For disassemble the bearing, follows carefully the instructions below:

Keeps all the parts disassembled in an insurance local.

1) Remove the screws (4) which fasten the seal disc (13).
2) Remove the ring with labyrinth (6);
3) Remove the screws (3) which fasten the bearings cap (1 and 5);
4) Remove the external bearing cap (5);
5) Remove the screw (7) which fasten the grease valve (8);
6) Remove the grease valve (8);
7) Remove the front cover;
8) Remove the bearing (10);
9) Remove the internal bearing cap (1), if necessary.

Drive-end bearing reassembly

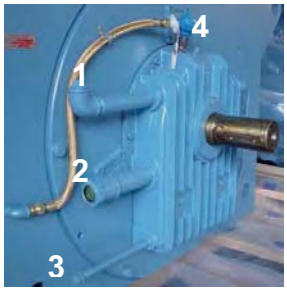
- Clean the bearings completely and inspects the removed parts and the interior of the caps.
- Certify that the bearing, shaft and bearing caps surfaces be smooth.



- Put the recommended grease on ¾ of external and internal bearing cap deposit and lubricate the bearing with sufficient quantity of grease before reassemble it.
- Before places the bearing on the shaft, heat the bearing to a temperature between 50ºC and 100ºC.

For reassembling the bearings, follow the instructions for disassembly in inverse order.

4.2.3. ANTIFRICTION BEARING LUBRICATED BY OIL



1- Oil inlet

2- Oil sight glass

3- Oil outlet

4- Temperature sensor

4.2.3.1. LUBRICATION INSTRUCTIONS

Oil removal

When re-lubrication is necessary, please remove the oil outlet (3) and oil inlet (1) plugs and quit the oil completely.

For oil insertion in the bearing:

- Close the oil outlet (3) with the drain plug;
- Remove the filter in the oil inlet (1), if any.
- Add the type and amount of oil up to the level indicated in the oil sight glass.

NOTES:

1) Make sure that all the openings are closed and that there is no indication of oil leakage in the oil reservoir or seals.
2) The proper oil level is obtained when the lubricant can be seen in the middle of the oil sight glass.
3) Excessive amount of oil will not damage the bearings, but it can cause the oil to leak through the seals.

Oil characteristics

The type of lubricant, lubrication interval and type of bearings are indicated on the motor nameplate like to the bearing.

Oil change - The change of the oil in the bearings should be made according to the table below, referring the bearing working temperature:

Below of 75ºC	=	20,000 hours
Between 75 and 80ºC	=	16,000 hours
Between 80 and 85ºC	=	12,000 hours
Between 85 and 90ºC	=	8,000 hours
Between 90 and 95ºC	=	6,000 hours
Between 95 and 100ºC	=	4,000 hours

IMPORTANT:

The bearings lifetime, their operating conditions and motor operating conditions will depend on the procedures followed by the maintenance personnel. The following recommendations must be observed.

- The oil selected for the application must have the adequate viscosity for the bearing operating temperature. The type of oil recommended by WEG already considers these criteria.
- Insufficient amount of oil can damage the bearings.
- The minimum recommended oil level is reached when the lubricant can be seen touching the bottom part of the oil sight glass, with the motor in the idle condition.

The oil level must be checked daily, being kept approximately in the middle of the oil sight glass.

4.2.3.2. BEARING OPERATION

The operation of motors equipped with oil-lubricated bearings is similar to the operation of motors equipped with grease-lubricated bearings.

The bearings performance during start up must be carefully checked as well as their performance during the first running hours.

Before running the motor, check:

- If the oil being used is the same as the oil recommended on the bearings nameplate.
- The oil characteristics;
- The oil level;
- The alarm and trip point for bearings temperatures;

During the first starting, pay special attention for excessive vibration or noise when the motor is running uncoupled. The motor and bearings should operate quietly and under low vibration. Have a copy of the factory vibration test report so you can compare the results obtained during the test with the results obtained after the installation. The motor must run for several hours until the temperature of the bearings stabilize.

If abnormal bearing operating temperature is noticed, the motor must be shut down and the installation, bearings and sensors must be re-checked. Check the whole bearing system (oil reservoir, seals) to make sure there is no oil leakage.

4.2.3.3. THERMAL PROTECTIONS SETTING

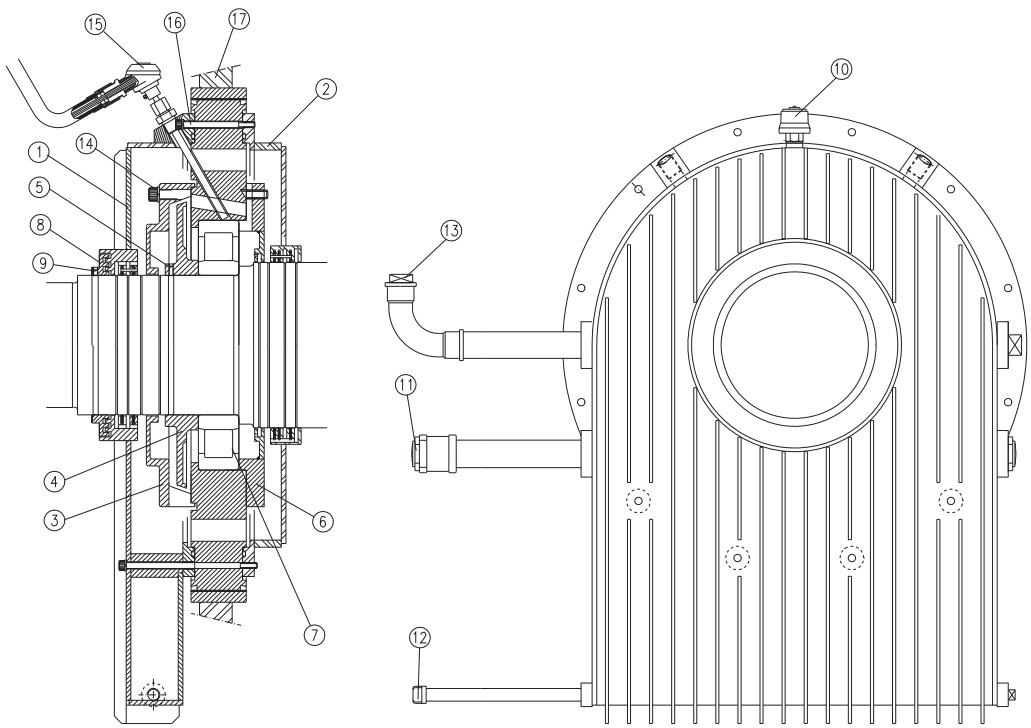
Each bearing is fitted with a Pt100 temperature detector installed directly in the bearing liner near the point where the load is applied. This device must be connected to a controlling panel with the purpose of detecting overheating and protect the bearing when operating under high temperature.

IMPORTANT: The following temperature must be set on the bearing protecting system:

ALARM 110ºC / TRIPPING OFF 120ºC

The

4.2.3.4. BEARING MAINTENANCE



1- External oil reservoir
2- Internal oil reservoir
3- External bearing cap
4- Oil valve
5- Screw which fasten the oil valve
6- Internal bearing cap
7- Roller bearing
8- Ring with labyrinth
9- Screw which fasten the ring with labyrinth
10- Filter
11- Oil level viewfinder
12- Drain plug (oil outlet)
13- Cover (oil inlet)
14- Screw which fasten the bearing caps
15- Thermal protector
16- Screw which fasten the external oil reservoir
17- Cover

To disassemble the drive-end bearing, please follow carefully the instructions given below.

Before disassembling
- Clean completely the outside of bearing;
- Remove the drain plug (12);
- Remove all of the oil from the bearings;
- Remove the temperature detectors (15) from the bearing;
- Remove the grounding brush (if any);
- Provide a support to the shaft so it can rest during disassembly.

Opposite drive-end bearing disassembly:
- Use extra caution to avoid any damage to the balls, rollers and shaft surface.
- To disassemble the bearing, carefully follow the instructions below:
- Keep all the parts disassembled in a safe and dust free environment.

1) Remove the screw (9) that fixes the ring to the labyrinth seal (8);
2) Remove the ring with the labyrinth seal (8);
3) Remove the screws (16) that fixes the external oil reservoir (1);
4) Remove the external oil reservoir (1);
5) Remove the screw (14) that fixes the external bearing cap (3);
6) Remove the external bearing cap (3);
7) Remove the screws (5) that fix the oil retaining ring (4) and remove it;
8) Remove the rear cover (17);
9) Remove the spherical roller bearing (7);
10) If it is necessary to completely disassemble the bearing, remove the internal bearing cap (6) and the internal oil reservoir (2).

Opposite drive-end bearing reassembly
- Clean the bearings completely and inspect the parts and the bearing cap.
- Certify that the bearing, shaft and bearing cap surfaces are smooth, with no sign of pitting or scratches.
- Before inserting the bearing to the shaft, heat the bearing to a temperature between 50ºC and 100ºC.
- To reassemble the bearing, follow the instructions of disassembling in the reverse order.

Attention
When reassembling, apply **Curril T** to seal the surfaces of the oil reservoir.

NOTE: The motors can be supplied with filter (10) in the location indicated on the drawing above or in the oil inlet.

4.2.4. SLEEVE BEARINGS

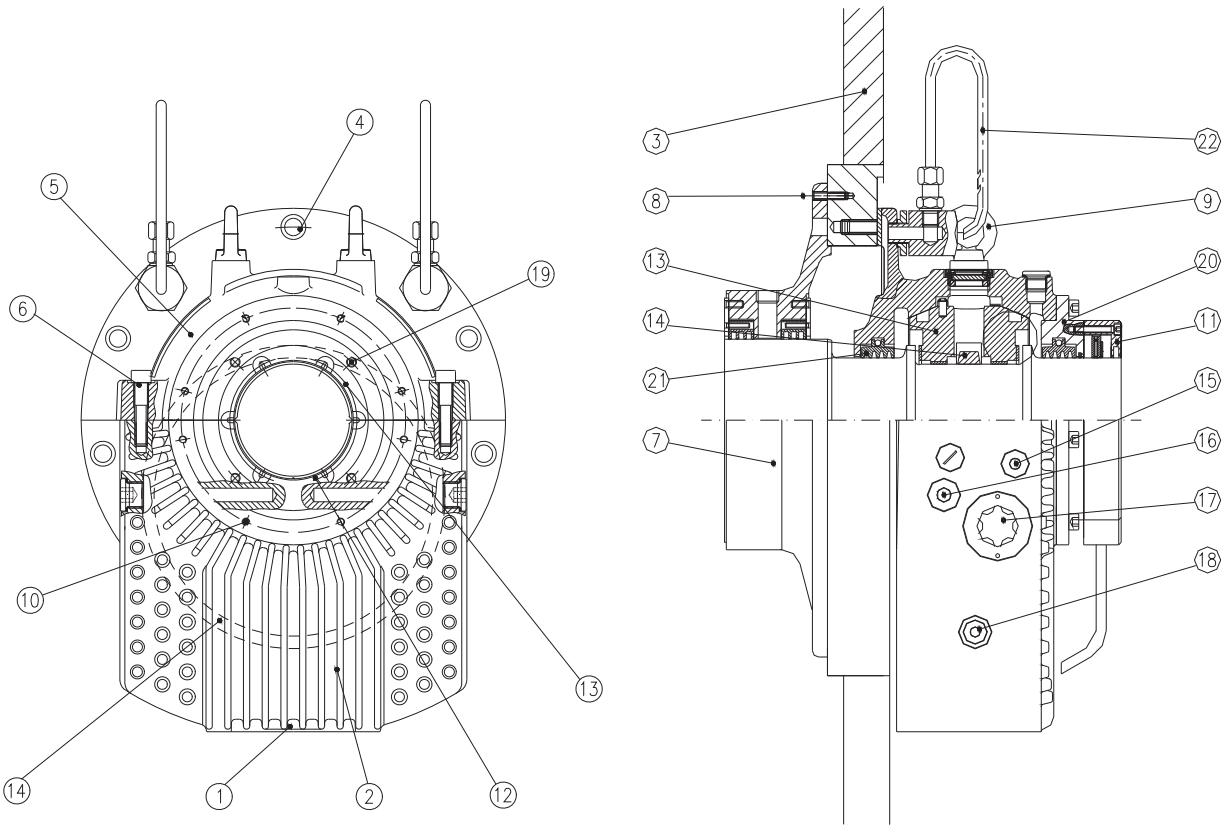


Figure 4.5.

1) Drain plug;
2) Bottom half of the bearing housing;
3) Motor frame cover;
4) Fixing bolts;
5) Top half of the bearing housing;
6) Bearing housing cap split line bolt;
7) Machine seal;
8) Machine seal bolt;
9) Lifting eyebolt;
10) External cover bolts;
11) External cover;
12) Bearing liner - bottom half;
13) Bearing liner - top half;
14) Oil ring;
15) Oil inlet;
16) Connection for temperature sensor;
17) Oil sight glass or oil outlet for lubrication
18) Tapped hole for oil sump temperature measurement;
19) Stationary baffle bolt;
20) Labyrinth seal carrier (outboard);
21) Labyrinth seal carrier (inboard) – bearing-housing.
22) Breathing pipe

4.2.4.1. GENERAL INSTRUCTIONS

Sleeve bearing performance is dependent on proper installation, lubrication and maintenance. Before assembling the bearing carefully read all instructions contained herein to become familiar with the complete bearing assembly procedure.
A proper maintenance of sleeve bearings include periodical checking of the level and actual condition of the lubricating oil, checking of noise level and vibration of the bearings, follow-up of the operating temperature, and fastening of the fixing and assembly bolts. The frame must be kept clean, free from dust, oil and dirt to facilitate cooling system.
Threaded holes for connecting the thermometer, oil sight glass, oil inlet, and immersion heater, or cooling coil (for oil sump thermometer or circulating pump with adapter) are provided on either side, so that all connections can be made on the right or left side of the bearing housing as required.
The oil drain plug is located centrally on the underside of the bearing housing.
In case of circulating oil lubrication, the outlet connection should be screwed into the threaded hole of an oil sight glass.
If the bearing is electrically insulated, the spherical liner seat surfaces in the housing are lined with a non-conducting material.
Do not remove this lining.
The antirotation pin is also insulated and the shaft seals are manufactured from a special non-conducting material.
Temperature monitoring instruments with contact to the bearing liner should be insulated appropriately (i.e., insulated protection tubes, synthetic fittings, etc.)
Water-cooled bearings are provided with the cooling coil installed. Care must be taken to protect the connections from damage when handling the housing prior to installation.

4.2.4.2. DISASSEMBLY OF THE SLEEVE BEARING SYSTEM (TYPE "EF")

To disassemble the bearing liner and all associated parts from the bearing housing, carry out the following instructions. Carefully store all disassembled parts in a safe location (see figure 4.5).

Drive end side:

- Throughly clean the exterior of the bearing housing. Loosen and remove the oil drain plug (1) at the bottom of the bearing housing. Drain the oil from the bearing housing.
- Loosen and remove the bolts (4) that connect the top half of the bearing housing (5) to the motor frame cover(3).
- Loosen and remove the bolts (6) that join the top and bottom half of the bearing housing (2 and 5).
- Use the lifting eyebolts (9) to lift (by hand or hoist) the top half of bearing housing(5) straight up, so that the cap is completely disengaged from the lower halves of the stationary baffle (11) labyrinth seals, labyrinth seal carrier (20) , and the bearing liner (12).
- Pull the top bearing housing forward out of and away from the bearing area. Loosen and remove the bolts (19) securing the top half of the stationary baffle. Loosen and remove the bolts (10) securing the upper half of the seal carrier (20).
- Lift (by hand or hoist) the upper half of the bearing liner (13) and remove it.
- Loosen and remove the bolts at the split line of the oil ring (14). Carefully disengage the dowels holding the oil ring halves together and remove the oil ring.
- Remove the garter springs that encircle the labyrinth seals and remove the top half of each seal. Rotate the bottom half of each seal out of the grooves in the seal carrier and bearing housing and remove them.
- Disconnect and remove RTD's, thermocouples, or any other temperature detecting instruments that enter the lower half of the bearing liner.
- Using a hoist or jack, raise the shaft slightly so that the lower half of the bearing liner can be rolled out of the bearing housing.

IMPORTANT: To make that feasible it is necessary that bolts 4 and 6 of the other bearing half be loose.

- Roll out (be careful not to use excessive force) the lower half of the bearing liner and remove it.
- Loosen and remove the bolts (19) securing the bottom half of the stationary baffle (11) to the seal carrier. Loosen and remove the bolts (10) securing the bottom half of the seal carrier (20) to the bearing housing. Remove the seal carrier.
- Loosen and remove the bolts (4). Remove the bottom bearing housing (2).
- Remove the frame cover (3).
- Loosen and remove the bolts (8) securing the machine seal (7) to the frame cover. Remove the machine seal.
- Thoroughly clean and inspect all individual parts which have been removed. Clean the interior of the bearing housing.
- To reassemble the bearing system, follow the preceding instructions in the reverse order.

NOTE: Festening torque of the bearing fixing bolts to the motor = 10 Kgfm.

Non drive end side:

- Thoroughly clean the exterior of the bearing housing. Loosen and remove the oil drain plug (1) at the bottom of the bearing housing. Drain the oil from the bearing housing.

- Loosen and remove the bolts (19) and remove the external cover (11).
- Loosen and remove the bolts (4) that fix the top bearing housing (5) to the motor frame cover(3).
- Loosen and remove the bolts (6) that join the top and bottom half of the bearing housing (2 and 5).
- Use the lifting eyebolts (9) to lift (by hand or hoist) the top half of the bearing housing (5) straight up, that the cap is completely disengaged from the lower halves of the bottom bearing housing (2) and the bearing liner (12).
- Lift (by hand or hoist) the top half of the bearing liner (13) and remove it.
- Loosen and remove the bolts at the split line of the oil ring (14). Carefully disengage the dowels holding the oil ring halves together and remove the oil ring.
- Remove the garter spring that encircles the labyrinth seal. Remove the top half of the seal, then rotate the bottom half of the seal out the groove in the bearing housing and remove it.
- Disconnect and remove RTD's, thermocouples, or any other temperature detecting instruments that enter the lower half of the bearing liner.
- Using a hoist or jack, raise the shaft slightly so that the lower half of the bearing liner (12) can be rolled out of the bearing housing.
- Roll out (be careful not to use excessive force) the bottom half of the bearing liner (12) and remove it.
- Loosen and remove the bolts (4) and remove the bottom bearing housing (2).
- Remove the motor frame cover (3).
- Loosen and remove the bolts (8) and remove the machine seal (7).
- Thoroughly clean and inspect all individual parts which have been removed. Clean the interior of the bearing housing.

To reassemble the Bearing System, follow he preceding instructions in the reverse order.

NOTE: Fastening torque of the bearing fixing bolts to the motor = 10 Kgfm.

4.2.4.3. SLEEVE BEARING ASSEMBLY

Check contact face and mounting recess of the bracket making sure it is clean and properly machined. Inspect shaft to ensure it is smooth (R_a 0.4, equivalent to 32 micro-inch finish, or better), within the dimensions and tolerances given by RENK and free of burr or any rough spots.
After removing the upper part of the housing (2) and the bearing liner (12 and 13) the interior of the housing and the running surfaces of the liner are to be cleaned thoroughly and checked for any damage caused in transit.
With the shaft slightly, locate the bearing base into the mounting recess of the machine end shield and bolt into position.
Apply oil to spherical seats in the housing base and the shaft and rotate the bottom liner half (12) into position. Special care must be taken so that the axial surfaces of the locating bearing are not damaged.
After the split faces of the bottom liner half and the housing base are aligned, lower the shaft into place. With a slight hammer blow against the housing base settle the liner into its seating so that the liner axis and shaft axis are parallel. The slight hammer blow produces a high frequency vibration which reduces the static friction between the liner and the housing and allows the correct adjustment of the liner. The self-alignment feature of the bearing is to compensate for normal shaft deflection during the assembling procedure only.
The loose oil ring is installed next. The ring must be handled with special care as safe operation of the bearing is also dependent on the effective and safe functioning of the oil ring. The bolts must be tightly fastened. Split misalignment must be avoided and any burrs or edges carefully removed in order to ensure smooth running of the ring. In any maintenance care must be taken that the ring is not distorted and its geometrical shape is maintained.
The outside of the two liner halves is stamped with identification numbers or marks near the split line. Make sure that these marks align and the split faces are clean when placing the top liner half into position. Incorrect fitting may lead to heavy damage to the bearing liners.
Check to ensure that the loose oil ring can still rotate freely on the shaft. With the top liner half in place, install the seal on the flange side (see paragraph "Shaft Seals").
After coating the split faces with a non-hardening sealing compound, place the housing cap into position. Care must be taken that the seal fits properly into the groove. Ensure also that the anti-rotation pin is seated without any contact with the corresponding hole in the liner.

NOTE: Housing or liner may be interchanged as complete assemblies only. Individual halves are not interchangeable.

4.2.4.4. SETTING OF THERMAL PROTECTIONS (PT100)

Each bearing is fitted with a Pt100 temperature detector installed directly in the bearing liner near the point where the load is applied. This device must be connected to a controlling panel with the purpose of detecting overheating and protect the bearing when operating under high temperature.

IMPORTANT: The following temperature must be set on the bearing protecting system:

ALARM 110ºC
TRIPPING OFF 120ºC

*The **alarm temperature** should be set at 10ºC above the working temperature, not exceeding the limit of 110ºC.*

4.2.4.5. WATER COOLING SYSTEM

When using water cooling system, the oil reservoir at the bearing is equipped with cooling coils through which the water circulates. This circulating water must present at the bearing inlet a temperature smaller or equal to the ambient one in order to make the cooling possible.
The water pressure must be 0.1 bars and the water flow must be 0.7 L/s. The pH must be neutral.

NOTE: When connecting the cooling coils, leaks in or on the bearings housing and oil reservoir must be avoided so that lubricating oil is not contaminated.

4.2.4.6. LUBRICATION

Bearings self lubricated
Oil change - The change of the oil in the bearings should be made according to the table below, referring the bearing working temperature:

Below of 75ºC	= 20,000 hours
Between 75 and 80ºC	= 16,000 hours
Between 80 and 85ºC	= 12,000 hours
Between 85 and 90ºC	= 8,000 hours
Between 90 and 95ºC	= 6,000 hours
Between 95 and 100ºC	= 4,000 hours

Bearings with forced lubrication (external)
The change of the oil in the bearings should be made every **20,000 working hours**, or whenever the lubricant present alterations in her characteristics. The viscosity and pH of the oil should be verified periodically.

Oil level must be checked daily which must be kept approximately at the center of the oil level sight glass.

The bearing must be filled with the prescribed type of oil through the oil port after removing the pipe plug.
All holes and threads not used are to be closed by pipe plugs. Also check all connections for oil leaks.
Filling the bearing with lubricant beyond the middle of the oil sight glass (II) does not impair the function of the bearing, but there is a possibility that excess oil may leak out through the shaft seals.

IMPORTANT:
The cares taken with bearing lubrication will determine the life for such bearings as well as the assurance of motor operation. For this reason, it is essential to follow these recommendations:

- The oil selected must have a viscosity suitable for the bearing operating temperature. This must be checked during eventual oil change or during periodical maintenances.
- If the bearing is filled with oil bellow the required oil level, or if the oil level is not checked periodically, insufficient lubrication may lead to damage to the bearing liner. The minimum oil level is reached when the oil can just be seen in the oil sight glass when the machine is not in operation.

4.2.4.7. SHAFT SEALS

The two halves of the floating labyrinth seal are held together by a garter spring. They must be inserted into the groove of the carrier ring in such a way that the stop pin is always in the corresponding recess in the upper half of the housing or carrier ring. Incorrect installation destroys the seal.
The seal is to be carefully cleaned and coated with a non-hardening seating compound on the faces in contact with the grooves. The drain holes in the lower part of the seal must be clean and remove obstruction. When installing the bottom half of the seal, press it lightly against the underside of the shaft.
An additional sealing is installed inside the motor to prevent sucking of oil due to low pressure generated by the motor cooling system.

4.2.4.8. OPERATION

The operation of motors fitted with sleeve bearings is similar to motors fitted with roller bearings.
It is recommended that the oil circulating system be accompanied carefully and also the first hours of operation.
Before the start-up, check the following:
- If the oil used has been prescribed accordingly.
- Characteristics of the lubricating oil.
- Oil level.
- Alarm and tripping off temperatures set for the bearings.

During the first start-up, check for vibrations or noises. In case bearing operation is not quiet and not uniform, motor is to be stopped at once.
Motor must operate for several hours until the bearing temperature is fixed within the limits previously indicated. If a temperature overheating occurs, motor must be stopped immediately and the temperatures detectors checked.
When bearing operating temperature is reached check for any oil leakage by the plugs joints or by the shaft end.

4.3. AIR GAP CHECKING (Large ODP motors)

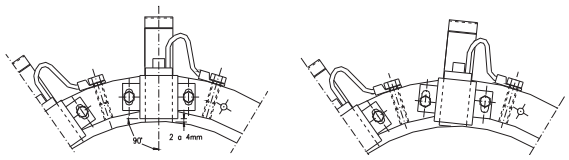
After disassembly and assembly of the motor it is necessary to check the air gap measurement between the stator and the rotor by using appropriate gauges. The gap variation at any two vertically opposite points must be less than 10% of the average air gap measurement.

4.4. SLIP RINGS (For slip ring motors)

Rings must be accurately centered as at high speed the mechanical vibrations cause contact faults, which in turn cause sparking. Rings must also be kept clean and polished.
As a general rule, cleaning should be done monthly in order to remove the dust accumulated between the rings (see item 4.10). Stained or slightly rough ring surfaces can be polished with fine sandpaper. Oval or rough surfaced rings will require machining and repolishing to avoid wear problems to brushes and brush-holders.

4.5. BRUSH-HOLDERS AND BRUSHES (for wound rotor motors)

Brush holders must be set radially to the slip ring and adjusted approximately 4mm away from the contact surface to avoid brush rupture or injury (figure 4.6).



CORRECT INCORRECT

Figure 4.6 – Brush-holder assembly.

OBS.: Brushes must be checked weekly to ensure free sliding inside the brush-holder.

Brushes
There is a factory-specified brush type for each electric motor fitted with slip rings.

NOTA: *In case motor is operating below its rated output (low load) or intermittent load, the set of brushes (brush type and quantity) must be adjusted to the actual operating conditions, avoiding in this way motor damage. This adjustment must be done with the help of Weg Máquinas.*

Never use assorted brushes of different types on the same rings. Any change of brush type must be authotized by WEG Máquinas, as different brushes cause performance alterations to the machine in operation.
Brushes should be constantly checked during operation. Any brush presenting signs of wear should be exceeding the mark indicated figure 4.7, immediately replaced.

At the time of replacement and whenever feasible, all brushes should be replaced. Having replaced the first one, the second brush should be replaced after a suitable running-in-period.
Replacement brushes should be sanded to set perfectly on the ring surface curvature (min. 75%).

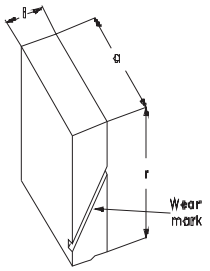


Figure 4.7 – Brush wear mark.

On machines that always rotate in the same direction, the brushes should be set in a single direction only. During the backward movement of the shaft the brushes must be lifted (figure 4.8).

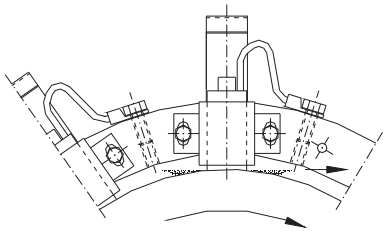


Figure 4.8 – Brush contact face.

Brushes must be fitted with identical pressure on the contact surface so as to ensure regular current balance and low brush wear.
It is important that all brushes have the same pressure with a tolerance of approximately 10%. Higher deviations lead to irregular current balance with consequent irregular wear.
Brush pressure control is done with the application of a dynamometer.
"Tired" springs must be replaced.

4.5.1. SHAFT GROUNDING DEVICE

On some induction motors, specially those requiring speed control due to frequency inverter application, a set of brush holder and brushes for shaft grounding is used.
This devices avoids electric current going through the bearings, which are highly harmful to their operation. The brush is put in contact with the shaft and connected to the machine frame through a cable, which must be also grounded.

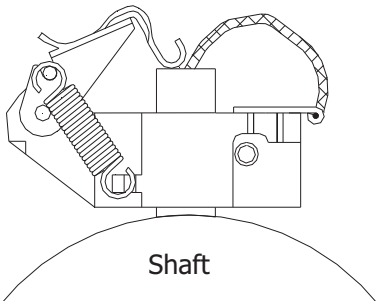


Fig. 4.9 – Shaft grounding brush.

To avoid shaft damage on WEG motors during transportation, shaft ends are protected with protective oil. For a correct Grounding Brush operation, this protective oil must be removed from the shaft surface before motor operation as well as any foreign materials that may be present between shaft and the brush.
Brush must be checked on permanent basis while in operation and, when getting to the end of its life time, must be replaced by another of same quality (granulation).

4.6. LIFTABLE BRUSH HOLDERS

4.6.1. CONNECTION DIAGRAM

AUTOMATIC OPERATION:
Operating condition with brushes at lower position and slip ring not short-circuited.
To ensure brushes are kept lowered, the switches:
- CCA1 - contacts 34 and 35,
- CCA2 - contacts 22 and 23,
- CCD - contacts 13 and 14, must be simultaneously close (logic "AND").
With this logic, motor is suitable to start.

Description of components:
A - Electromechanical Actuator ATIS
Type: MAI-25.B3.d9-25.10-F10-2CC-2CT-IP65
B - Three-phase induction motor FS 71
6 pole, 0.25kW, Mounting B3L, IPW55
Flange C105-DIN 42948
Voltage and frequency as per client request.
C - End-of-course
Type XCK-P121 – Telemecanique

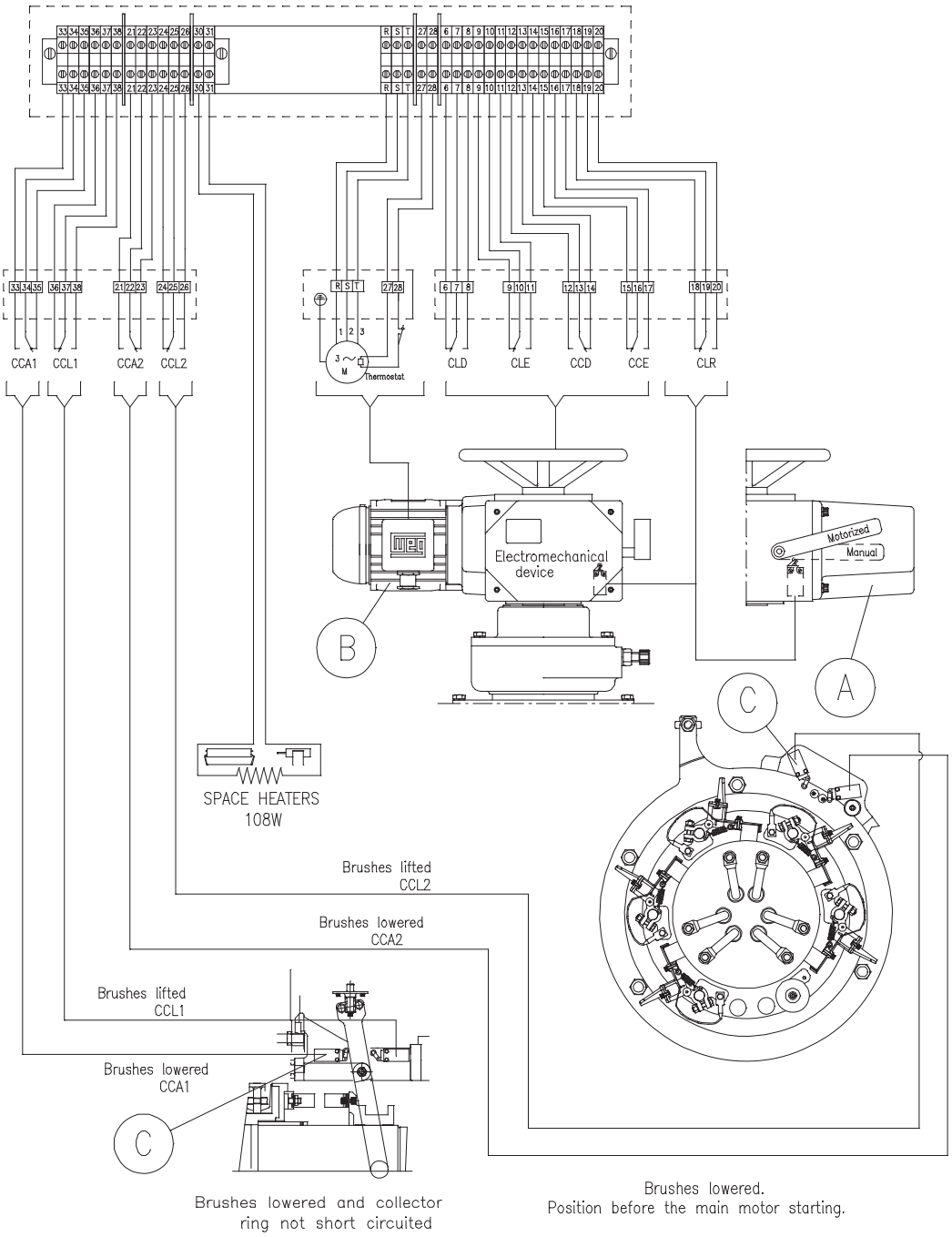


Figure 4.10.

Condition: Lifted brushes and short circuited collector ring.

In order to assure the brushes are lifted, the switches:

- CCL1 - contacts 37 and 38,
- CCL2 - contacts 25 and 26,
- CCE - contacts 16 and 17, must have the contacts simultaneously closed (logic "AND").

At this condition the motor is in continuous operation.

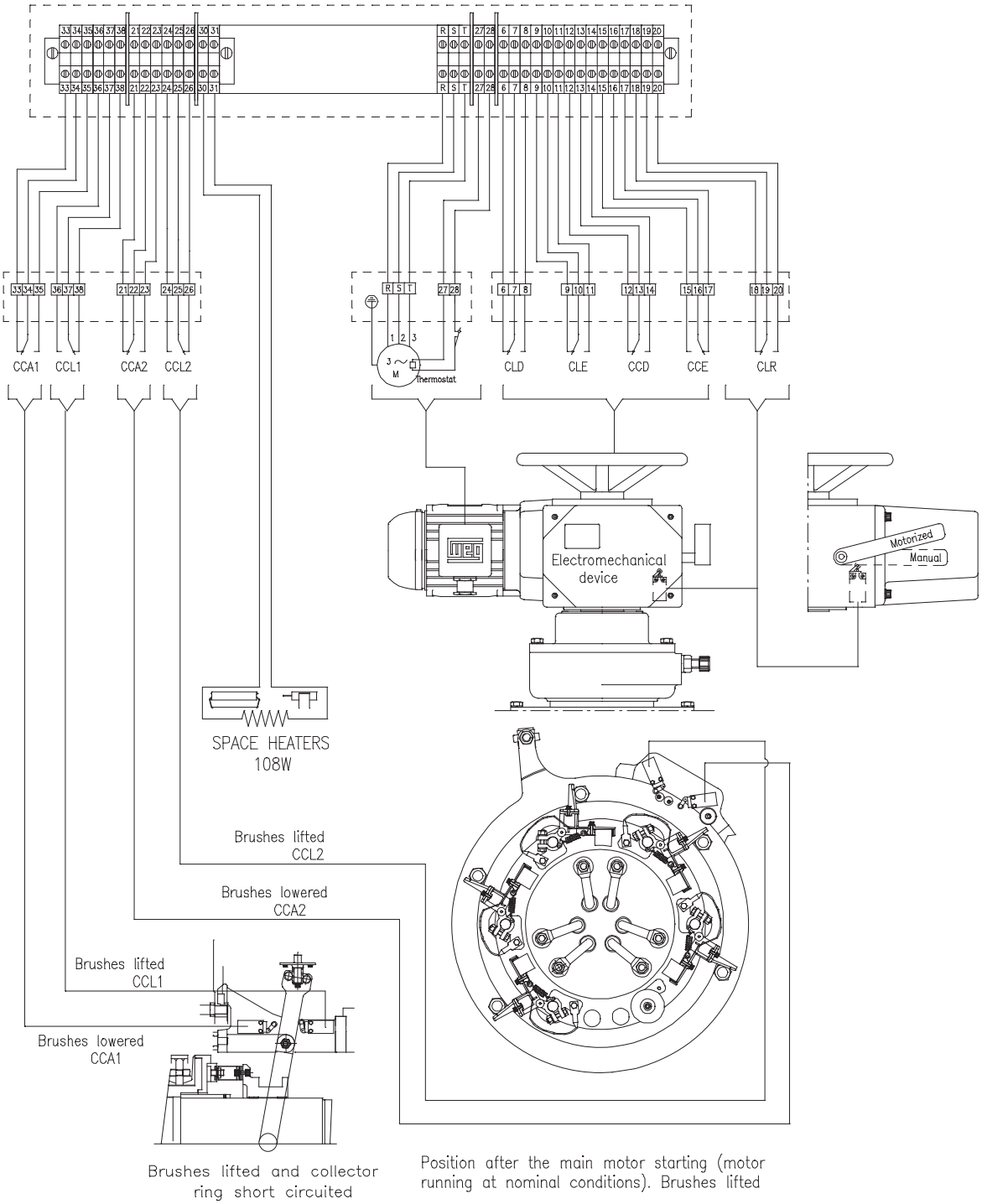


Figure 4.11.

MANUAL OPERATION:

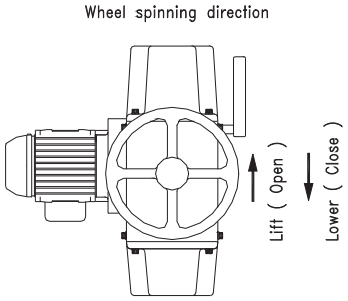


Figure 4.12.

Simbology:
CLD = Torque switch for overload switching off during lowering of the brushes (or phase reversion).

In case of fault on the CCD.

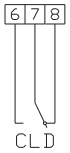


Figure 4.13.

CLE = Torque switch for overload switching off during lifting of the brushes (or phase reversion).

In cause the fault on the CCE.

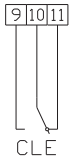
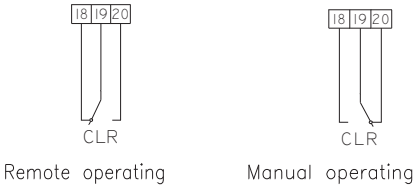


Figure 4.14.

CCD = End-of-course switch for switching off when brushes are totally lowered.

CCE = End-of-course switch for switching off when brushes are totally lifted.

CLR = Selecting switch indicating manual or motorized position.



Figures 4.15.

ADDITIONAL END-OF-COURSE SWITCHES FOR SIGNALIZATION.
CCL1 and CCL2 = End-of-course to indicate when the brushes are totally lifted.
CCA1 and CCA2 = End-of-course to indicate when the brushes are totally lowered.

4.6.2. PROCEDURE FOR MOTOR STARTING

Brush position or through a signal coming from the CCE switch which indicates the brush position, totally lowered.
In case the signal is not indicating the brush position totally lowered, motor can not be started before adjusting the commanding switch to the position of brushes totally lowered.
This can be done manually through the flywheel (7), operating the lever (8) or automatically operating the brake motor (9). If the manual system (7) is used, the lever (8) returns automatically to the previous position operating the brake motor (9). Under this condition (brushes totally lowered), the rings (5) are not short-circuited, allowing in this way a series connection of the external resistances (rheostat) with the rotor winding through the brushes (6).

NOTE: Perform the commanding tests with the complete liftable brush holder system before running the motor under load.

4.6.3. PROCEDURE AFTER MOTOR STARTING

At the moment motor has reached its rated speed, the short-circuit procedure of the collector rings must be started, operating the lifting and short-circuit device (1), on the reserve way, through the brake motor (9), or manually through the flywheel (7).
The short-circuit is done through the slide brushing (2) which holds the silver contacts (3). Furtherly, the brush lifting mechanism (4) is operated.
When brushes are totally lifted, the device is automatically switched-off through the CCE switch.

OBS.:
1) The automatic brush lifting system is provided with an overload protection system for the operation brake motor (9), through the torque switches for overload switching off during lowering (CLD) or lifting of brushes (CLE).

2) Before motor start up, make sure CLD, CLE, CCD and CCE switches are correctly connected to the panel.

3) When one of the CLE or CLD switches operate, the system must to be reconnected before checking the reason they have operated.

4) The end user is supposed to install proper signal indicating how the logical system operates on the control panel of the automatic brush lifting system.

5) The control and signaling system of the brush lifting system is not supplied by WEG.

6) After motor starting, brushes can not remain in contact with collector rings, which can lead to excessive brush and collector ring wear as well cause problems to the brush lifting system.

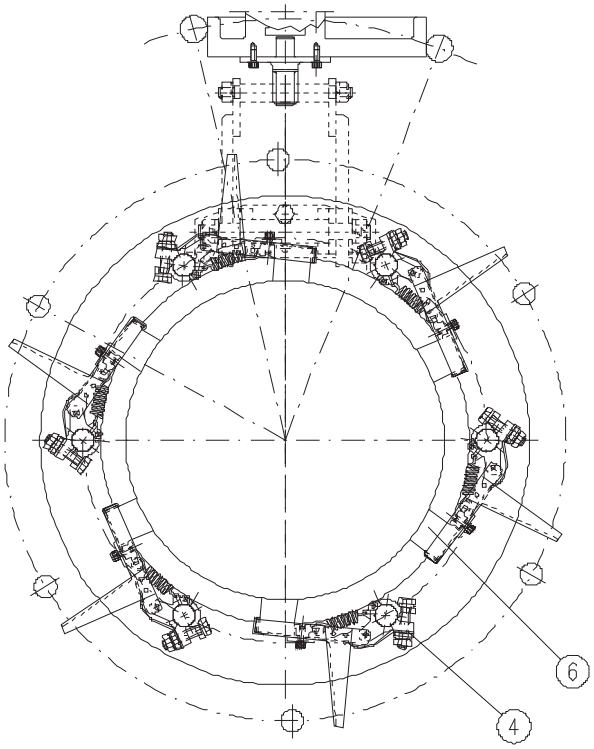


Figure 4.16.

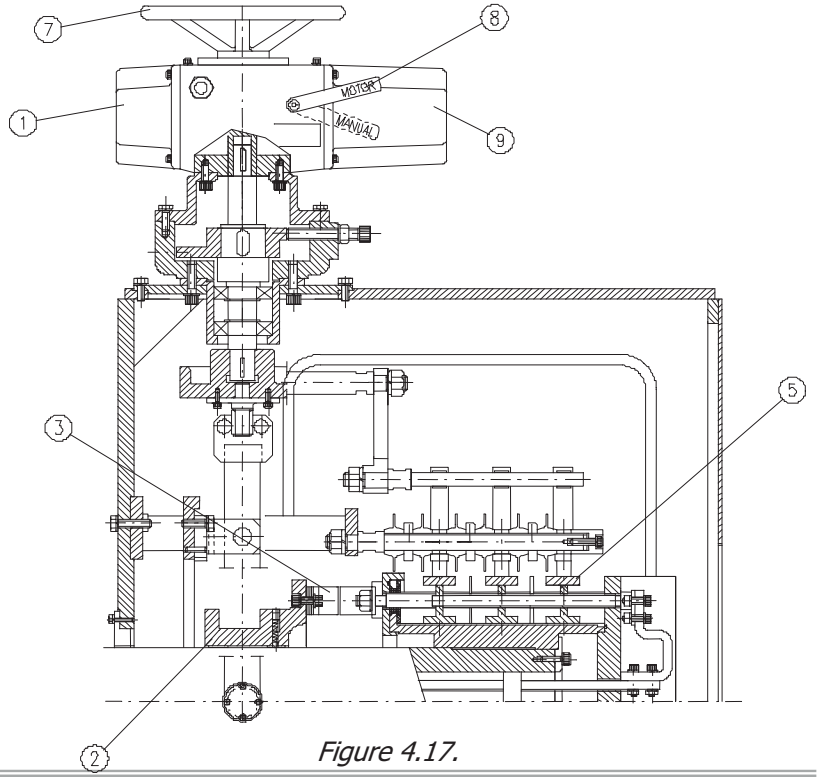


Figure 4.17.

4.6.4. ASSEMBLY

4.6.4.1. BRUSH HOLDER LIFTING DEVICE

1. Fix the pin support disc with the lifting set fixer on the protection box of the brush holder set.
2. Mount the bearing in the support pin and fix with a fixing pin which must be fixed with a retaining ring.
3. Fix the bearing support pin on the support disc.

NOTE: Bearing of the support pin: 6305 2ZRS1.

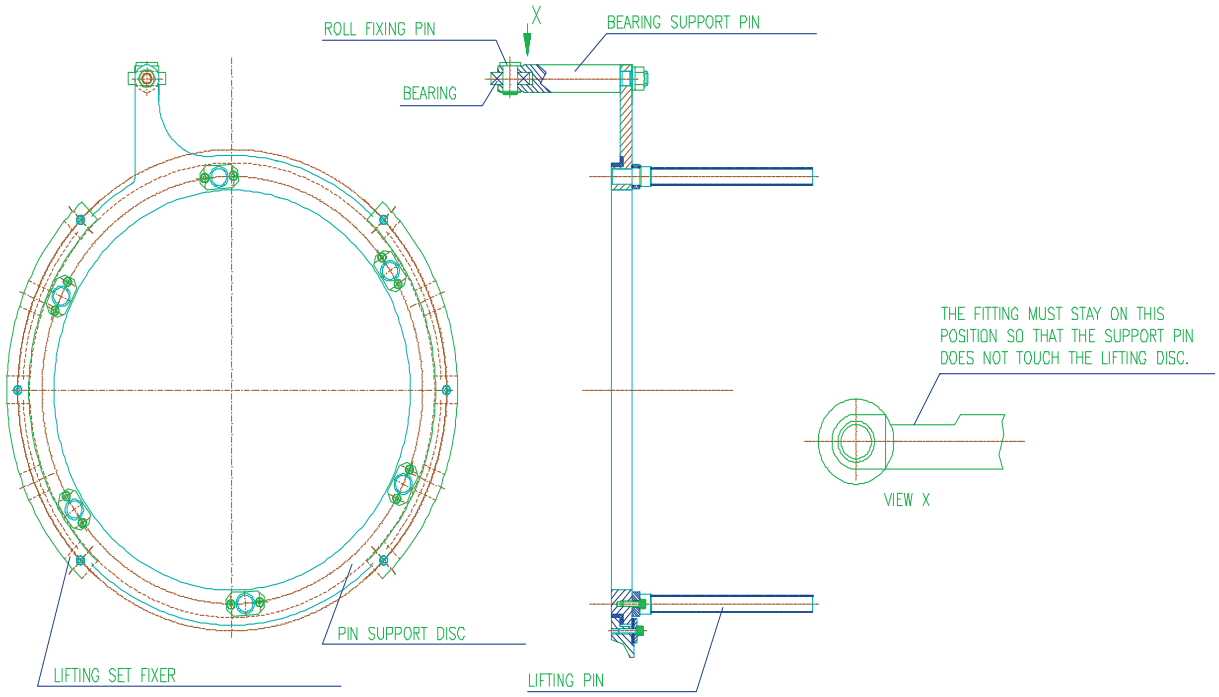


Figure 4.18.

4.6.4.2. SHORT-CIRCUIT BUSHING MOVEMENT SET

1. Mount the roll on the roll bearing on short bushing movement lever, and then the bearings, the spacing bushing and fix the bearing cover.

2. Fix the upper pins on one of the movement levers.

3. Mount the support pin on the movement lever.

4. Fix the guide support on the support base and the movement lever on the support. The rolls must be aligved with the short circuit bushing in such way that both touch the bushing simultaneously.

NOTE: Bearing of the movement levers: 6003Z.

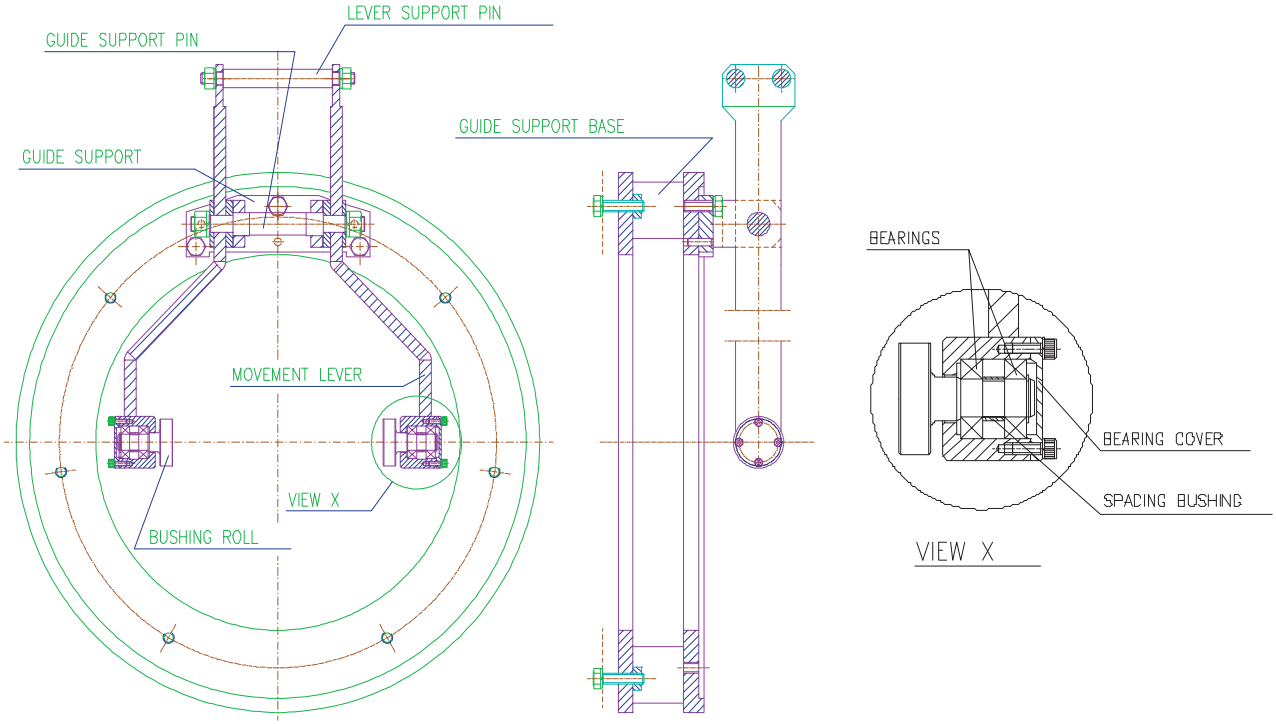


Figure 4.19.

4.6.4.3. BRUSH HOLDER OPERATION SET

1. Mount the bearing on the shaft and fix it with retaining rings. Then put a retaining ring to hold the second bearing. After that, mount it with retaining ring.

2. Mount and fix the disc on the operation shaft.

3. Insert the operation shaft in the set flange.

4. Fix the lifting disc on the operation shaft.

5. Mount the bushing on the lever operation shaft and fix it with a retaining ring. Fix the shaft on the operation disc.

6. Fix the locking device cover on the electromechanical device and then fix it to the device frame.

7. Fix the operation set on the brush holder protection box.

NOTE:
1) The operation shaft must be fitted between the upper pins of the lifting lever.

2) All the parts touching mechanically must be lubricated. After 6 months of use, check the lubrication of such parts.

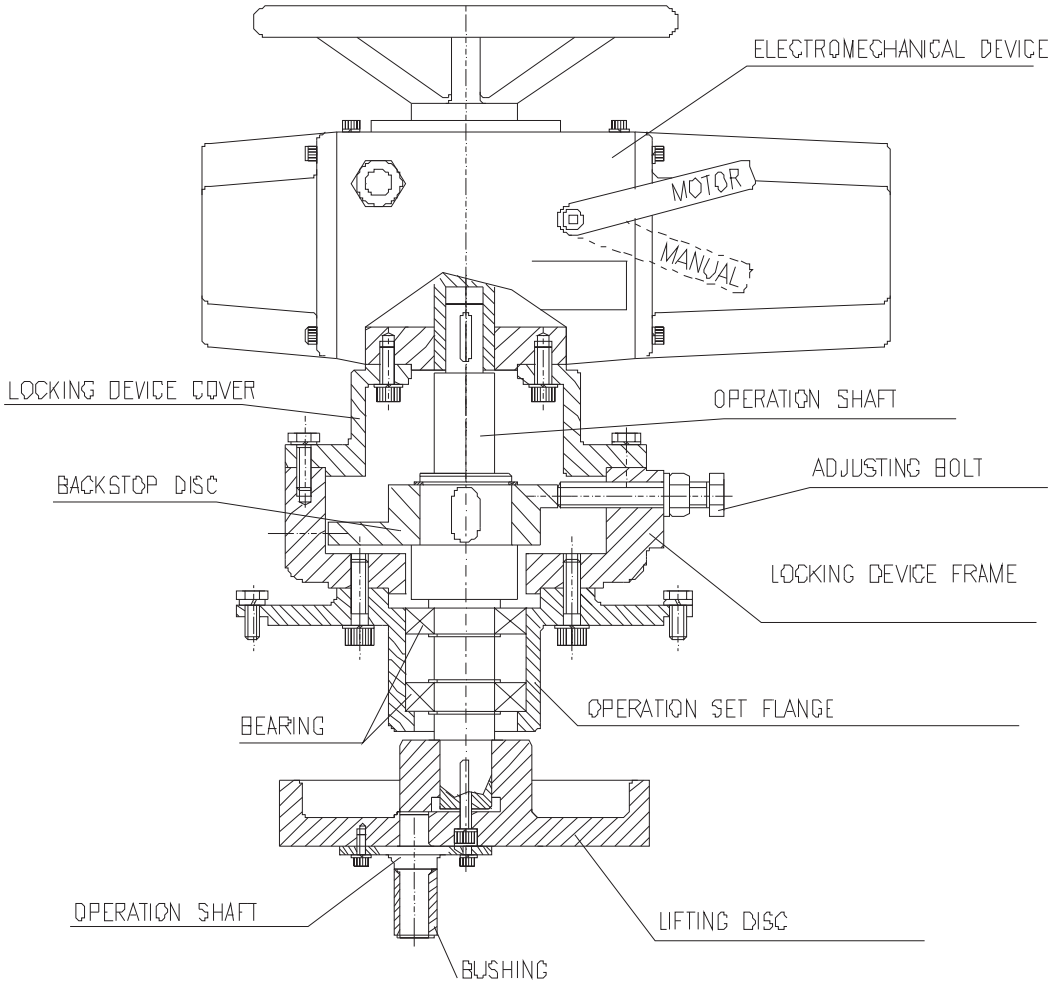


Figure 4.20.

4.6.4.4. RETURN PIN SET

1. Mount the spring shaft on the shaft support. Mount the shaft guide washer; fit it on the shaft and lock it on the shaft and lock it with a nut.
2. Close the set with an external fixing ring and fix on the brush holder protection box.

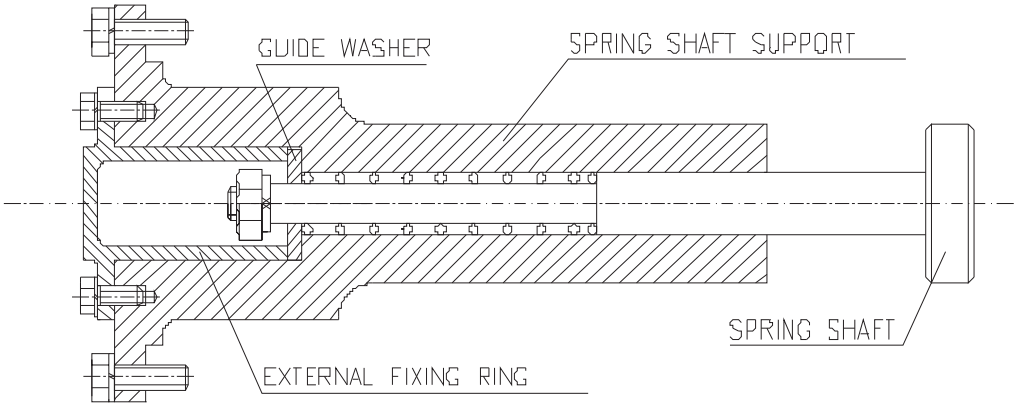


Figure 4.21.

4.6.4.5. BRUSH HOLDER SET

1. Fix the brushes on the brush holder. Fix the isolated pins on the support; mount the isolated discs, brush holders and contact rings on the pins.

2. Adjust the curvature ray existing on the brushes with the collector rings and put a sandpaper between brush and ring. The sandpaper must be moved back and forth in order to make a better fitting of the brush ray with the ring ray. Unfasten the brush holder fixing bolt and turn the brush holder clockwise until the brush ray matches perfectly the ring.

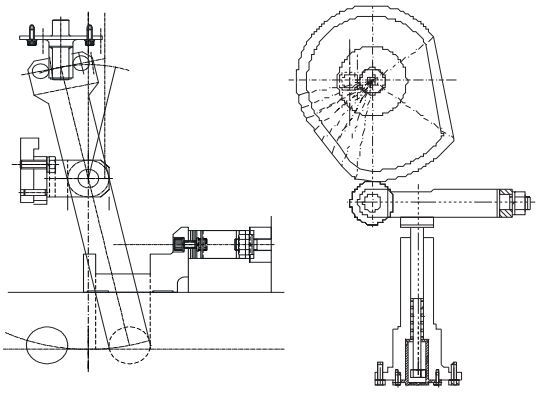


Figure 4.22. – Brushes lifted.

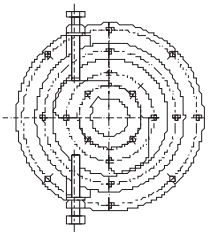


Figure 4.23. – Position Non Short-circuited.

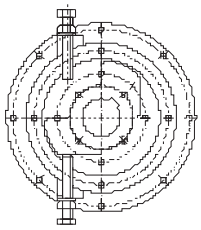


Figure 4.24. – Position Short-circuited.

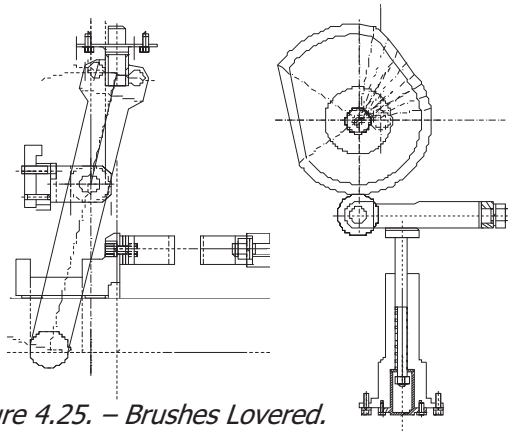


Figure 4.25. – Brushes Lovered.

4.6.5. DISASSEMBLY

For the disassembly of the liftable brush holder, proceed in the reserve way in relation to assembly procedures.

4.6.6. BRUSHES LIFTING SYSTEM ADJUSTMENT

1. Turn the lifting disc up to the short-circuit position and then turn it a bit more to release the rolls to avoid unnecessary thrusts on the roller bearings.

2. Fasten the adjusting bolt up to the backstop disc and then lock the adjusting bolt.

3. Turn the lifting disc up to the position of non short-circuit (brushes lowered) and repeat the same procedure carried out for the short circuit position.

4.7. DRYING OF THE WINDINGS

It is recommended that this task be undertaken carefully and by qualified personnel. The rate of temperature rise should not exceed 5ºC per hour and the winding should not be heated up to more than 150ºC.
Excessive temperature as well as too quick temperature rise can generate steams which damage the windings. During the drying process, the temperature should be controlled carefully and the insulation resistance should be measured at regular intervals.
In the beginning, the insulation resistance will decrease due to the temperature increase, but it will increase during the drying process.
The drying process should be continued until successive measurements of the insulation resistance show a constant insulation resistance which should be higher than the minimum value specified, as indicated in item 2.3.5.
It is important to provide a good ventilation inside the motor during the drying process assuring that the moisture is removed effectively.

4.8. DESMANTLING AND REASSEMBLY

4.8.1. " MASTER" LINE

A) SQUIRREL-CAGE ROTOR

Drive-End:
1. Remove the heat exchanger (if any).
2. Remove the temperature detectors from the bearing (if any).
3. Unscrew the bolts which fasten the bearing assembly.
4. Remove the external bearing caps (for roller bearing motors).
   4.1. For ball bearing motors, follow the procedures described in item 4.2.4.2.
5. Unscrew the bolts of the endshield. After being removed, the bolts should be screwed endshields in order to force its removing. To prevent the rotor falling onto the rotor, provide a support for it.
6. Remove the bearing(s) (for roller bearing motors).
7. Remove the internal bearing cap (for roller bearing motors).

Non Drive-End:
1. Unscrew the protecting screen of the fan (enclosed motors).
2. Remove the fan by unscrewing the bolts which fasten it on the shaft.
3. Loosen the four nuts which fasten the fan cover and remove it.
4. Repeat the procedures 2 to 7 of previous paragraph.

B) SLIP RING MOTORS

Drive-End:
The procedures are the same as for squirrel cage rotor motors.

Non Drive-End:
1. Remove the back protecting cover of the brush holders.
2. Disconnect the cables from the collector ring. Dismantle the brush holders.
3. Unscrew the brush holder protecting box from the cooling box.
4. Remove the collector rings and the ventilating.
5. Repeat the procedures 2 to 4 of the "Non drive-end" for squirrel cage rotor motors.

4.8.1.1. ROTOR REMOVING

Remove the rotor from the inside of the stator by means of hoisting ropes or other devices. The device must avoid that the rotor rubs on the stator or on the coil heads.

4.8.2. A LINE

Drive-End:

1. Disconnect the space heater leads from the terminal boxes.
2. Remove the bearing temperature detectors (if any).
3. Unscrew the bolts of the bearing assembly.
4. Remove the external bearing caps (for roller bearing motors).
   4.1. For ball bearing motors, follow the procedures described in item 4.2.2.2.
5. Unscrew the end-shield. By using an appropriate tool, force the end-shield to release and at the same time turn it to help the removal. Make sure that the shaft is held on a plate and so an eventual fall of the rotor on the stator is avoided.
6. Remove the bearing(s) (for roller bearing motors).
7. Remove the internal bearing cap.

Non Drive-End:

1. Remove the fan cover.
2. Release the fan retaining ring.
3. Repeat the procedures from 2 to 7 of item 4.8.2 (A).

NOTE:

1. For removing of rotor, observe section 4.8.1.1.
2. It is not necessary to remove the stator from the frame to perform an eventual rewinding.

4.8.3. F LINE

Drive-End:

Equal as A and H lines.

Non Drive-End:

1. Repeat the procedures 1 to 3 of item 4.8.2 (B).
2. Remove back protecting cover of the brush holder.
3. Disconnect the cables from the collector ring.
4. Remove the brushes and dismantle the brush-holder.

4.8.4. H LINE

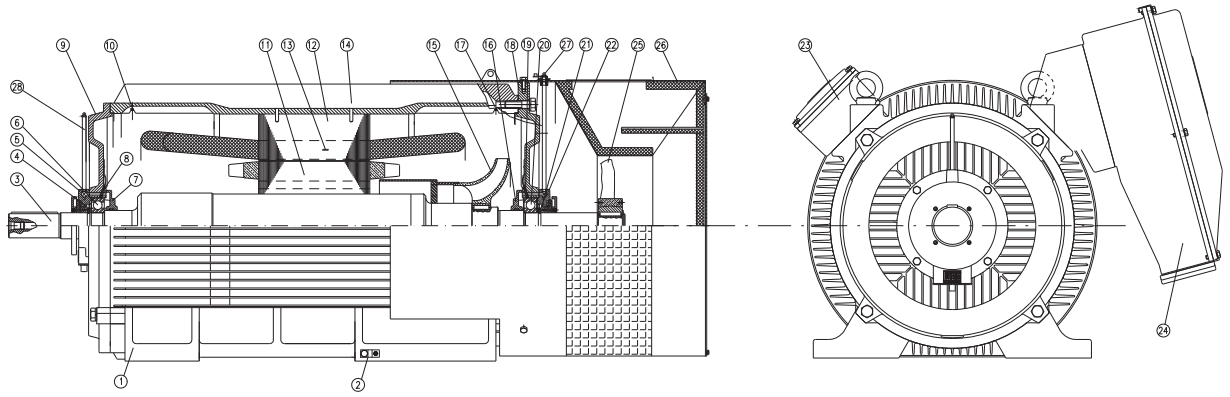


Figure 4.26.

Pos.	Description
1	Frame
2	Grounding lug
3	Shaft
4	Drive-end grease valve
5	External drive end bearing cap
6	Drive end bearing
7	Internal drive end bearing cap
8	Drive end bearing temperature sensor
9	Drive end cover
10	Drive-end space heater
11	Complete rotor assembly
12	Stator lamination core
13	Stator temperature sensor
14	Stator fixing pin

Pos.	Description
15	Internal fan
16	Internal non drive end bearing cap
17	Non drive-end space heater
18	Non drive cover
19	Non drive end bearing temperature sensor
20	Non drive end bearing
21	Non drive-end grease valve
22	External non drive end bearing cap
23	Accessory connection box
24	Stator connection box
25	External fan
26	Fan cover
27	Non drive end bearing grease fitting
28	Drive end bearing grease fitting

Tables 4.5.

Safety!
Ensure that the power cables have been switched-off.

DISASSEMBLY

1) Disconnect the temperature sensor cables (pos. 8 and 19) of the accessory connection box terminals;
2) Remove the non drive end fan cover (pos. 26);
3) Unfasten the fixing ring of the external non drive end bearing cap and remove the fan (pos.25);
4) Unfasten the bolts that fix the external non drive end bearing caps;
5) Remove the external drive end and non drive end bearing caps (pos. 5 and 22);
6) Remove the drive end and non drive end grease valve (pos. 4 and 21), unfastening the bolts that fix them to the shaft;
7) Place supports underneath the shaft to avoid that the rotor falls on the stator;
8) Unfasten and remove the drive end and non drive end covers (pos.9 and 18);
9) Remove drive end and non drive end bearings (pos.6 and 20) with the application of proper device;
10) Remove the internal drive end and non drive end bearing caps (pos. 7 and 16);
11) Applying proper device, remove the rotor (pos. 11) from the stator through the non drive end side of the motor, and pay attention to avoid that the rotor rubs the stator or on coil heads.

ASSEMBLY

1) Applying proper device, fit the rotor (pos. 11) into the stator, from the non drive end side of the motor, and pay attention to avoid that the rotor rubs on the stator or on the coil heads;
2) Place the internal bearing caps;
3) Fill out with grease ¾ the compartment of the internal bearing caps and bearings (check type of grease on the bearing identification nameplate attached to motor covers);
4) Check carefully shaft and cover surfaces where bearings will be fitted so as to avoid scratches or knocks. Also check for correct mechanical dimension tolerances;
5) Heat up and mount the drive end and non drive end bearings (pos. 6 and 20);
6) Lift the rotor, place supports underneath the shaft and mount drive end and non drive end covers (pos.9 and 18);
7) Mount the drive end and non drive end grease valve (pos. 4 and 21) and fix them to the shaft;
8) Mount the external drive end and non drive end bearing caps (pos. 5 and 22), fixing them t the internal bearing caps (pos. 7 and 16);
9) Mount the external non drive end fan (pos. 25) fixing it with a retaining ring;
10) Mount the non drive end fan cover (pos. 26);
11) Connect the temperature sensor cables (pos. 8 and 19) to the accessory connection box terminals;
12) Fill in remaining grease through the drive end and non drive end grease fitting (pos. 27 and 28).

4.8.5. TIGHTENING TORQUES FOR SCREWS

The table below presents the tightening torques of the screws recommended for assembly of the motor or its parts:

Resistance Class	4.6 5.8	8.8		12.9
Diameter	Tightening torque (Nm) tolerance ±10%			
M6	1.9 3.2	5.1		8.7
M8	4.6 7.7		12.5	21
M10	9.1 15		25	41
M12	16 27	42		70
M16	40 65		100	175
M20	75 125		200	340
M24	130 220	350		590

Notes:
- The resistance class normally is marked in the head of the hexagonal screws.
- When do not have marking at screws, indicates that the resistance class is 4.6.
- The internal hexagonal screws (type Allen) possess resistance class 12.9.

4.9. GENERAL ADVICES

- Any damaged part (cracked, or distorted machined parts, damaged threads) should be replaced and never recovered.
- All services herewith described should be undertaken by qualified personnel in order not to damage the equipment. In case of further doubts, contact WEG Máquinas.

4.10. MAINTENANCE SCHEDULE

COMPONENT	DAILY	WEEKLY	EVERY 3 MONTHS	YEARLY (PARTIAL MAINTEN.)	EVERY 3 YEARS (COMPLETE MAINTEN.)
- Complete motor.	- Check the noise and the vibration levels.		- Drain condensed water (it any).	- Retighten the bolts.	- Dismantle the motor. Check spare parts.
- Winding of the stator and rotor.				- Visual inspection. Measure insulation resistance.	- Cleanliness: check the fastenings and the slot wedges; measure the insulation resistance.
- Bearings.	- Check the noise level.	- Regrease; for intervals see the greasing plate. - Vibration control.			- Clean the bearings. Replace them, if required, check bearing liner and replace it, if required (sleeve bearing) check sleeve race (shaft) and rebuild, if required.
- Terminal boxes and grounding lugs.				- Clean the inside area retighten the bolts.	- Clean the inside area retighten the bolts.
- Coupling: follow the maintenance instructions contained in the manual of the coupling manufacturer.		- After the first week of operation: check the alignment and fastening.		- Check alignment and fastening.	- Check alignment and fastening.
- Monitoring devices.		- Record the measurement values.			- If possible, disassemble and check its operating condition.
- Filter.			- Clean it, if required.	- Clean it, if required.	- Clean it (see section 4.1.2).
- Slip rings area.		- Inspect the cleanliness and clean it, if required.		- Check the cleanliness and clean it, if required.	
- Slip rings.		- Check surface and contact area.			
- Brushes (slip ring motors); - Shaft grounding brushes (if any).		- Check and replace them when 2/3 of their height is worn (check wear mark in fig. 4.5).			
- Air/air heat exchanger.					- Clean the pipes of the heat exchanger.

Table 4.6.

5. SPARE PARTS

5.1. HOW TO ORDER

When ordering spare parts, motor type and serial number must be always given as indicated on the nameplate or on the frame.

5.2. KEEPING STOCK

It is recommended to keep in stock the spare parts that, under normal use, can have some kind of wear such as:

- Set of bearings;
- Brushes (type and quantity according to the specification);
- Felts for filter (if any).

The spare parts must be stored in clean, dry environments and aired well, if possible, with constant temperature. The bearing liners also are spare parts, however, due to the high cost, we suggest to analyze the real necessity to keep these parts in stock.

6. ABNORMAL SITUATIONS DURING OPERATION

The majority of the abnormal situations during operation that affect the running of electric motors can be avoided by a predictive maintenance.
Sufficient ventilation, cleanliness and careful maintenance are the main factors. A further essential factor is the prompt attention to any abnormal situation such as vibrations, shaft knocks, declining insulation resistance, smoke or fire, sparking or unusual slip ring or brush wear, sudden changes of bearing temperature.
When failures of an electric or mechanical nature arise, the first step to be taken is to stop the motor and perform a subsequent examination of all mechanical and electrical parts of the installation.
In the event of having a fire, the motor should be disconnected from the power supply, which is normally done by turning off the respective switches.
In case of starting of fire inside the motor itself, steps should be taken to retrain and suffocate it by covering the ventilation openings. To extinguish a fire, dry chemical or CO^2 extinguishers should be used. Never use water.

6.1. COMMON FAILURES ON INDUCTION MOTORS

Motors built by WEG Máquinas are normally designed for Class F insulation (155ºC) and for ambient temperatures up to 40ºC(as indicated on the motor nameplate). Most winding failures occur when temperature limits, due to current overload, are surpassed throughout the winding or even in only portions thereof. These failures are identified by the darkening or carbonizing of the wire insulation.

6.1.1. SHORT-CIRCUIT BETWEEN TURNS

A short-circuit between turns can be a consequence of two coincident insulation defects, or the result of defects arising simultaneously on two adjacent wires.
In some cases, the three-phase current imbalance can be so insignificant that the motor protective device fails to react. A short circuit between turns, and phases to ground due to insulation failure is rare, and even so, it normally occurs during the early stages of operation.

6.1.2. WINDING FAILURES

a) ONE WINDING PHASE BURNT
This failure occurs when a motor runs wired in delta and current fails in one power supply conductor. Current rises from 2 to 2.5 times in the remaining winding with a simultaneous drop of speed. If the motor stops, the current will increase from 3.5 to 4 times its rated value. In most cases, this defect is due to lack of a protective switch, or because this switch has been set too high.

b) TWO WINDING PHASES BURNT
This failure occurs when current fails in one power supply conductor and the motor winding is star-connected. One of the winding phases remains current less while the other absorb the voltage and carries an excessive current. The slip almost doubles.

c) THREE WINDING PHASES BURNT
Probable cause 1:
Motor protected only by fuses. An overload on the motor will be the cause of the trouble.
As a consequence, progressive carbonizing of the wires and insulation will generate a short between turns, or a short against the frame.
A protective switch placed before the motor would easily solve this problem.

Probable cause 2:
Motor incorrectly connected.
For example: a motor with windings designed for 220/380V is connected through a stat-delta switch of 380V.
The drawn current will be so high that the winding will burn out in a few seconds if the fuses or a protective switch incorrectly set fail to react promptly.

Probable cause 3:
The star-delta switch is not commutated and the motor continues to run for a certain time connected to the star under overload conditions.
As it only develops 1/3 of its torque, the motor cannot reach rated speed. The increase of slip results in higher ohmic losses arising from the Joule effect.
As the stator current, consistent with the load, may not exceed the rated value for delta connection, the protective switch will not react. Consequent to increased winding and motor losses the motor will overheat and the winding will burn out.

Probable cause 4:
Failures from this cause are caused by thermal overload, due to excessive starts under intermittent operation or to an overly long starting cycle.
The perfect functioning of motors operating under these conditions is only assured when the following values are taken into account.
a) Number of starts per hour;
b) starting with or without load;
c) Mechanical brake or current inversion;
d) Acceleration of load connected to motor shaft;
e) Load torque related to speed during acceleration and braking.

The continuous effort withstood by the higher rotor during intermittent starting brings about losses which provoke overheating. Under certain circumstances, there is a possibility that the stator winding be subject to damage with the motor stopped as a result of the heating on the motor.

6.1.3. ROTOR FAILURES (SQUIRREL CAGE)

If a motor running under load conditions produces a noises of varied intensity and decreasing frequency while the load is increased, the reason, in most cases, will be an unsymmetrical rotor winding.
In squirrel-cage motors the cause will nearly always be a break in one or more of the rotor bars; simultaneously, periodical stator current fluctuations may be recorded.
As a rule, this defect appears only in molded or die cast aluminum cages.
Failures due to spot heating in one or another of the bars in the rotor care are identified by blue coloration at the affected points.
If there are failures in various contiguous bars, vibrations and shuddering can occur. When the rotor core gets a blue or violet coloration, it is a sign of overloading.
This can be caused by overly high slip, by too many starts or overlong starting cycles. This failure can also come from insufficient power supply voltage.

6.1.4. SLIP RING ROTOR FAILURES

A break in one phase of the rotor winding is noticed by a strong noise that varies according to the slip and, in addition, stronger periodical stator current fluctuations occur.
It is possible, but rarely so, that a rupture could have occurred in the connection between the winding and the slip ring. However, it is advisable to first check if there is a break in the rheostat starter connection, or even in the part itself.

6.1.5. SHORT BETWEEN TURNS ON SLIP RING MOTORS

This abnormal situation occurs only under extremely rare circumstances. Depending on the magnitude of the short circuit, the start can be violent even if the rheostat is at the first tap of its starting position. In this case, heavy starting currents are not carried through the rings and so no burn marks will be noticed on them.

6.1.6. BEARING FAILURES

Bearing failure are the most frequent causes for delayed breakdowns.
The most common reasons for this failure are identified as excessive vibration, incorrect operation, bad alignment, unbalanced couplings and excessive radial and/or axial loads.
Check item 4.2 for bearing maintenance.

6.1.7. SHAFT BREAKING

Although bearings traditionally constitute the weakest part and the shafts are designed with wide safety margins, it is possible that a shaft may break by fatigue from bending stress caused by excessive belt tension. In most cases, breaking occurs right behind the drive end bearing.
As a consequence of alternating bending stress induced by a rotating shaft, breaking travel inwards from the outside of the shaft until the point of rupture is reached when resistance of the remaining shaft cross-section no longer suffices. At this point, avoid additional drilling on the shaft (fastening screw holes) as such operations tend to cause stress concentration.
The replacement of only one or two belts of a belt drive system is frequently a cause of shaft breaking, besides being an incorrect practice.
Any used and consequently stretched belts on a drive system, especially those closer to the motor, while new and unstretched belts are placed on the same drive but farther from the bearing, can cause shaft stress.

6.1.8. DAMAGE ARISING FROM POORLY FITTED TRANSMISSION PARTS OR IMPROPER MOTOR ALIGNMENT

Damaged to bearing and breaking of shafts are often resulted from inadequate fitting of pulley, couplings or pinions on the shaft.
These parts "knock" when rotating. The defect can be recognized by the scratches that appear on the shaft or the eventual scale like flaking of the shaft end. Keyways with edges pitted by loosely fitted keys can also cause shaft failures.
Poorly aligned couplings cause knocks and radial and axial shaking to shaft and bearings. Within a short while, these bad practices cause the deterioration of the bearings and the enlargement of the bearing on the drive end side. In other cases, motor shaft can break.

6.2. ABNORMAL SITUATIONS DURING OPERATION

NOTE: The following chart presents a list of abnormal situations during motor operation, the probable cause for such abnormal situations, and the corrective measures. In case of further doubts, contact Weg Máquinas.

ABNORMAL SITUATION	PROBABLE CAUSE(S)	CORRECTIVE MEASURE(S)
- Motor fails to start, neither coupled, nor uncoupled.	- At least two feeding conductors are broken, no voltage supply. - The rotor is locked. - Brushes problem. - Bearing is damaged.	- Check commanding board, switch, fuses, power supply conductors, terminals and setting of brushes. - The brushes might be worn or set incorrectly. - Replace the bearing.
- Motor starts very slowly with load and does not reach rated speed. - Motor starts under no load, but is fails when the load is applied .	- Too high load during start. - Supply voltage too low. - Too high voltage drop on the feeding conductors. - Rotor bars damaged or interrupted. - One supply conductor remained interrupted after the starting.	- Do not apply load on the machine during start. - Measure supply voltage, set the correct value. - Check the cross section of the feeding conductors. - Check and repair the rotor winding (squirrel cage), test the short circuit device (slip ring). - Check the supply conductors.
- Stator current changes with double frequency of the slip; during start humming can be heard.	- Rotor winding is interrupted. - Brushes problem.	- Check and repair rotor winding and short-circuit device. - Clean, set correctly or replace the brushes.
- No load current too high.	- Supply current too high.	- Measure the supply voltage and set it to the correct value.
- Rapid overheating of the stator, there is a humming during the operation.	- Parallel or in phase connected wires of the stator winding are broken.	- Measure the resistance of all winding phases. Replace the stator core with the winding.
- Areas of heating on the stator winding	- Short between turns. - Interruption of conductors connected in parallel or in phase of the stator winding - Poor connection.	- Rewind the motor. - Remake the connections.
- Areas of heating on the rotor.	- Interruption in the rotor winding.	- Repair the rotor winding, or replace it
- Abnormal noise with motor connected to load.	- Mechanical problems. - Electric problems.	- Noise decreases generally with the speed drop; see also "Noisy operation when uncoupled" - Noise disappears when motor is switched on. Contact the manufacturer
- Noise occurs when coupled and disappears when not coupled.	- Failure in the drive components, or on the driven machine. - Failure on the gearing. - Coupling problem. - Foundation is sunk. - Poor balancing of the parts or of the driven machine. - Supply voltage too high. - Direction of rotation is not correct.	- Check the power transmission, coupling and alignment. - Align the driving, check the position (coupling) of the gearing. - Align the motor and the driven machine. - Repair the foundation. - Test the supply voltage and the noload current. - Reverse the connections of two phases. - Rebalance the unit.

ABNORMAL SITUATION	PROBABLE CAUSE(S)	CORRECTIVE MEASURE(S)
- Overheating of the stator winding with load.	- Poor cooling due to dirty air tubes. - Load too high. - Excessive number of starts, or the inertia is too high. - Voltage too high and consequently also the iron losses are too high. - The voltage is too low and consequently the current is too high. - One feeding conductor is interrupted, or one phase of the winding is interrupted. - Rotor is rubbing on the stator. - The operation mode does not correspond to the data on the nameplate. - Electrical load unbalanced (blown fuse, incorrect control). - Dirty windings. - Obstructed cooling system. - Dirty filter. - Rotation direction not compatible with the fan used.	- Clean the air tubes of the cooling system. - Measure the stator voltage, decrease the load, use a larger motor. - Reduce the number of starts. - Do not exceed more than 110% the rated voltage, unless specifications on the nameplate are different. - Check the voltage supply and the voltage drop. - Check the current in all phases and make correction. - Check air gap, operation conditions, bearings, vibrations. - Maintain the operation mode as specified on the nameplate, or reduce the load. - Verify if there are unbalanced voltages, or if the two phases are operating. - Clean. - Clean the felt of the filter. - Analyze the fan in relation to motor rotation direction.
- Noisy operation when uncoupled.	- Unbalancing. - One phase of the stator winding is interrupted. - Dirt in the air gap. - Fastening bolts are loose. - Unbalancing of the rotor increase after the assembling of the driving components. Unbalanced rotor. - Foundation resonance. - Motor frame is deformed. - Bent shaft. - Uneven air gap.	- Noisy operation continues during rundown time after switching off the voltage; rebalance the motor. - Test current input of all feeding conductors. - Remove the dirt and clean the air gap. - Tighten and block bolts. - Check balancing. - Level the foundation. - Check the alignment. - The shaft can be bent, check the balancing and the eccentricity of the rotor. - Check if the shaft is bent or if the bearings are damaged.
- Slip ring motor operating at low speed with external resistance disconnected.	- Control circuit conductors too light. - Open circuit on rotor circuits. - Dirt between brush and slip ring. - Brushes gripe on brush holders. - Incorrect pressure on brushes. - Rough surfaces on slip rings. - Eccentric rings. - High current density on brushes. - Brushes incorrectly set.	- Install heavier conductors on control circuit. - Bring control closer to motor. - Test circuit with a magneto, or other means, and undertake necessary repairs. - Clean slip rings and insulation assembly. - Select brushes of correct size. - Check pressure on each brush and adjust it accordingly. - Clean, sand and polish. - Machine on lathe or with portable tool without removing from machine. - Reduce load or replace brushes. - Reset brushes correctly.
- Brush sparking.	- Poorly set brushes with insufficient pressure. - Overload. - Slip rings in poor condition. - Oval slip rings. - Excess of vibration. Rough surfaces and scored rings. - Low load causing damage to slip rings.	- Check brush setting, adjust for correct pressure. - Reduce load or install motor with higher capacity. - Clean rings and reset brushes. - Polish the slip rings and machine the same on lathe. - Balance the rotor, check the brushes for free movement within holders. - Check origin of vibration and correct it. - Adjust the brushes to the actual load requirement and machine the slip rings.

Table 6.2.

6.3. ABNORMAL BEARING SITUATIONS AND FAILURES DURING OPERATION

NOTE: The following chart presents abnormal bearing situations and failures during motor operation, the probable cause for such abnormal situation and the corrective measures. In certain cases, bearing manufacturer must be contacted to find out the cause of the failure.

ABNORMAL SITUATION	POSSIBLE CAUSE(S)	CORRECTIVE MEASURE(S)
- The motor "snores" during operation.	- Damaged bearings.	- Replace the bearing.
- Bearing noisy, dull spots, grooves in the ball races.	- Bearing was slanting mounted.	- Align the bearing and machine the bearing seat.
- High bearing noise and a high overheating of the bearing.	- Cage corrosion, small chips in the grease, race failure due to insufficient grease, or inadequate clearance.	- Clean and replace the grease according to the specifications. Replace the bearing.
- Overheating of bearings.	- Excessive grease. - Excessive axial or radial strain on belt. - Bent shaft. - Lack of grease. - Hardened grease cause locking on balls. - Foreign material in the grease.	- Remove the grease relief and run the motor until excess grease is expelled. - Reduce belt tension. - Have shaft straightened and check rotor balance. - Add grease to bearing. - Replace bearing. - Flush out housing and lubricant; regress.
- Dark spots on one side of the ball races subsequently the formation of grooves.	- Excessive axial strength.	- Check the condition between coupling and driving.
- Dark lines on the ball races or very close transversal grooves.	- Current on the bearings.	- Clean and replace the bearing insulation. Install an insulation if there was not any. - Branch the current avoiding that it circulates through the bearing.
- Grooves in the races and depressions in the division of the cylindrical elements.	- External vibration, mainly when the motor stopped for a long period of time. - Lack of maintenance during storage.	- If the motor is stopped during a long period, turn the shaft to an other position from time to time. This is mainly required for spare motors.

Table 6.3.

IMPORTANT:
The motors listed in this manual are constantly updated. For this reason, the information here with included may change without prior notice.

7. WARRANTY TERMS FOR ENGINEERING PRODUCTS

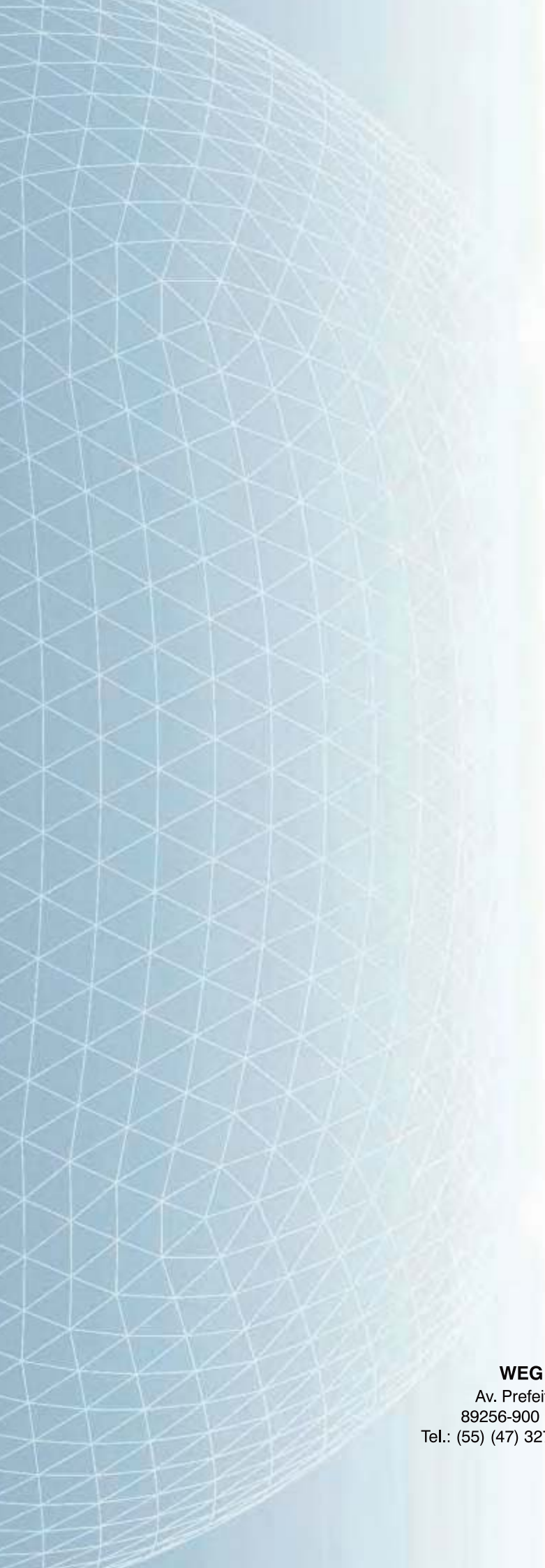
These products, when operated under the conditions stipulated by WEG in the operating manual for such product, are warranted against defects in workmanship and materials for twelve (12) months from startup date or eighteen (18) months from manufacturer shipment date, whichever occurs first.
However, this warranty does not apply to any product which has been subject to misuse, misapplication, neglect (including without limitation, inadequate maintenance, accident, improper installation, modification, adjustment, repair or any other cases originated from inadequate applications).
The company will neither be responsible for any expenses incurred in installation, removal from service, consequential expenses such as financial losses nor transportation costs as well as tickets and accommodation expenses of a technician when this is requested by the customer.
The repair and/or replacement of parts or components, when effectuated by WEG within the Warranty period do not give Warranty extension, unless otherwise expressed in writing by Weg.
This constitutes WEG's only warranty in connection with this sale and is in lieu of all other warranties, expressed or implied, written or oral.
There are no implied warranties of merchantability or fitness for a particular purpose that apply to this sale.
No employee, agent, dealer, repair shop or other person is authorized to give any warranties on behalf of WEG nor to assume for WEG any other liability in connection with any of its products.
In case this happens without Weg's authorization, Warranty is automatically cancelled.

LIABILITY

Except as specified in the foregoing paragraph entitled "Warranty Terms for Engineering Products", the company shall have no obligation or liability whatsoever to the purchaser, including, without limitation, any claims for consequential damages or labor costs, by reason of any breach of the express warranty described therein.
The purchaser further hereby agrees to indemnify and hold the company harmless from any causes of action (other than cost of replacing or repairing the defective product as specified in the foregoing paragraph entitled "Warranty Terms for Engineering Products"), arising directly or indirectly from the acts, omissions or negligence of the purchaser in connection with or arising out of the testing, use, operation, replacement or repair of any product described in this quotation and sold or furnished by the company to the purchaser.

WEG EQUIPAMENTOS ELÉTRICOS S.A. - MÁQUINAS
Av. Pref. Waldemar Grubba, 3000 89256900 Jaraguá do Sul/SC BRAZIL
Phone: (55) 047 372 4000 Fax: (55) 047 372 4030
www.weg.net

1013.02/0295

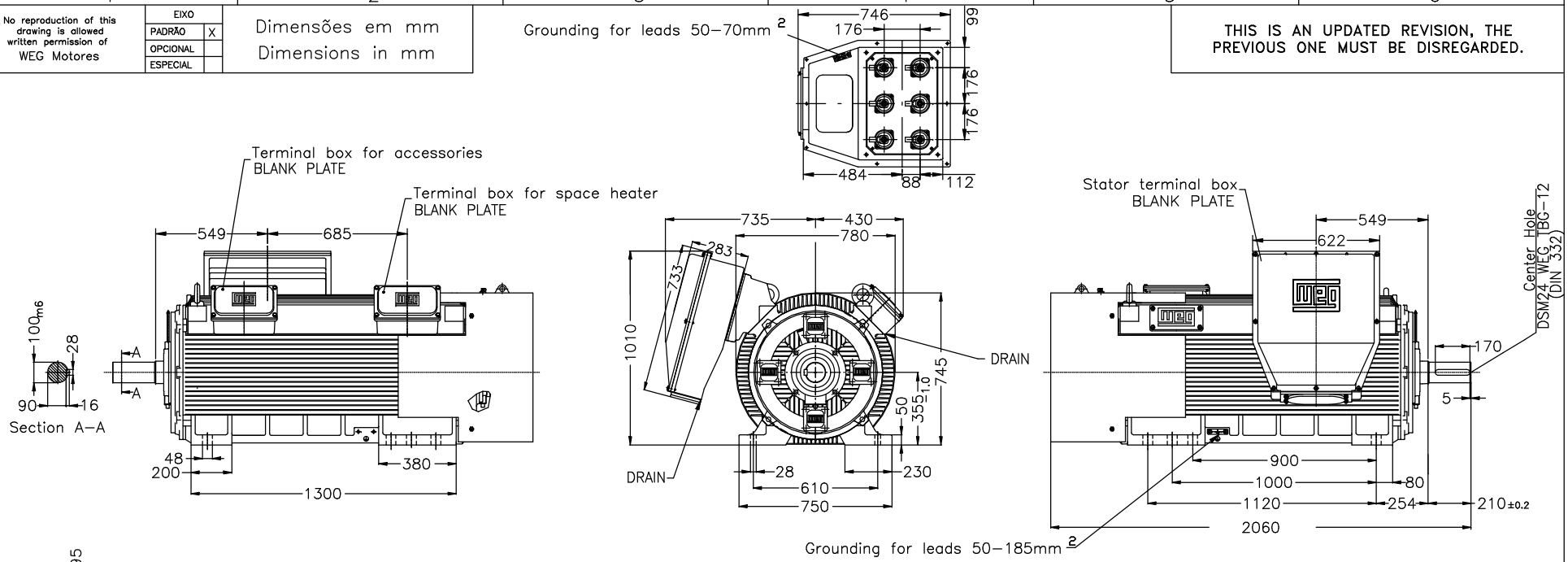


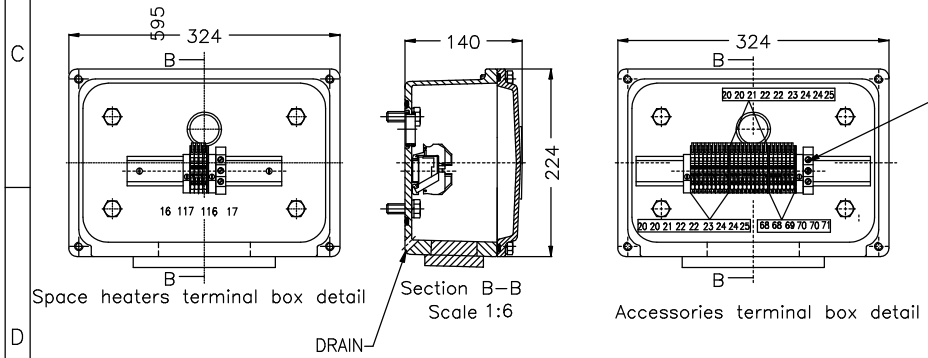
WEG EXPORTADORA S.A.
Av. Prefeito Waldemar Grubba, 3000
89256-900 - Jaraguá do Sul - SC - Brasil
Tel.: (55) (47) 3276-4000 - Fax: (55) (47) 3276-4030
www.weg.net

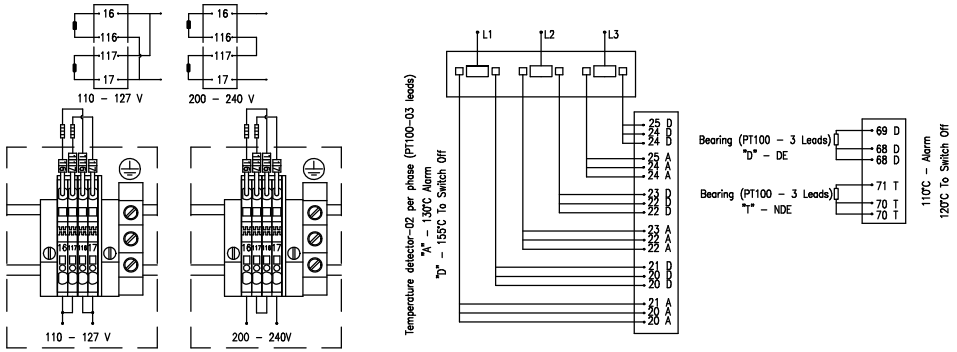
EIXO	
PADRÃO	X
OPCIONAL	
ESPECIAL	

Dimensões em mm
Dimensions in mm

THIS IS AN UPDATED REVISION, THE PREVIOUS ONE MUST BE DISREGARDED.







Kit porta escova de aterramento na dianteira / DE Brush holder kit	
Temperatura ambiente máxima 45°C / Max. ambient temperature 45°C	
Tampa traseira com mancal eletricamente isolado / N.D.E bearing hub electrically insulated	
Plano de pintura 212P / Painting plan 212P	
Forma construtiva B3D / Mounting B3L(D)	

WEG ITALIA S.R.L

GROSS WEIGHT		kg	NET WEIGHT		kg	SCALE	1:20	
500000170508	B–3	DIMENSION 1010 WAS 950		CLEBERP				06
500000155529		ALT. CONFORME CLAIM 400395034		DARRIMON		GEOVANEC	09.02.2009	05
MODIF. NUMBER	LOC	SUMMARY OF MODIFICATIONS		EXECUTED	CHECKED	RELEASED	DATE	VER

EXECUTED	ANASL	THREE PHASE HGF MOTOR	10000379467	
CHECKED		FRAME 355C/D/E IP55	000 | 06	
RELEASED	LISBOA			
REL. DATE	06.01.2009	WMO–JGS JARAGUÁ DO SUL ENG. MOTORES INDUSTRIAIS	SHEET 1 / 1	

ZME– A3

WEG Indústrias S.A.

Nr.: 02946/2009

Date: 15-JAN-2009

DATA SHEET

Three-phase Induction Motor - Squirrel Cage

Customer	: WEG ITALIA S.R.L
Product code	:
Product line	: Special Motor

Frame	: HGF 355C/D/E
Output	: 360 kW
Frequency	: 50 Hz
Poles	: 4
Rated speed	: 1490 rpm
Slip	: 0,67 %
Rated voltage	: 6600V
Rated current	: 39,9 A
L. R. Amperes	: 279 A
Il/In	: 7,0
No load current	: 16,1 A
Rated torque	: 2310 Nm
Locked rotor torque	: 150 %
Breakdown torque	: 280 %
Insulation class	: F
Temperature rise	: 75 K
Locked rotor time	: 18 s (hot)
Service factor	: 1,00
Duty cycle	: S1
Ambient temperature	: -20°C to +45°C
Altitude	: 1790 m.a.s.l
Enclosure	: IP55 (TEFC)
Mounting	: B3L(D)
Rotation	: Both
Aprox. weight*	: 2740 kg
Moment of inertia	: 12,471 kgm²
Sound Pressure Level	: 85,0 dB(A)

	Front	Rear
Bearing	6322-C3	6320-C3
Regreasing int.	4500 h	4500 h
Grease amount	60 g	51 g

Grease - Polyrex EM - ESSO

Load	Power factor	Efficiency (%)**
100%	0,83	95,0
75%	0,78	95,0
50%	0,68	94,3

Notes:

This is an updated revision. The previous one must be disregarded. The figures given herewith are regarded as average values based on actual tests and applied to sinusoidal power supplied motors, within permissible tolerances under IEC 60034-1. Noise level with tolerance of +3 dB(A).

Performed	Checked	Revision	Approved
faguiar	mamorim	Nr.: 1 Date: 14-FEB-2009	

*Weight value can be changed without previous notification.

**Determining losses and efficiency according to IEC 34-2 A.

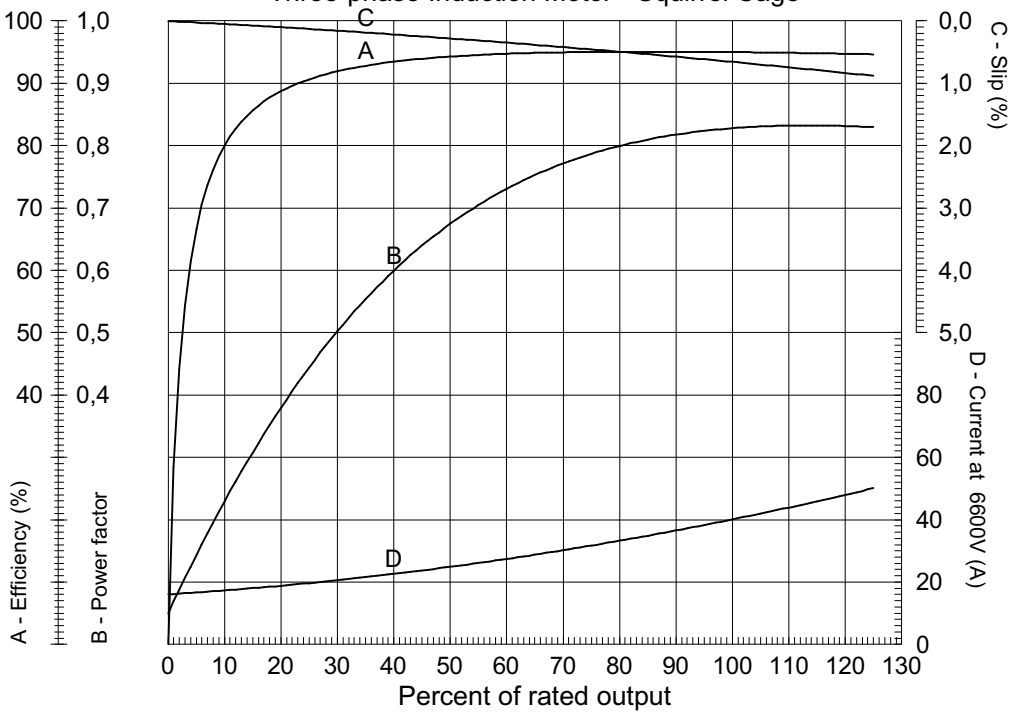
WEG Indústrias S.A.

Nr.: 02946/2009

Date: 15-JAN-2009

PERFORMANCE UNDER LOAD

Three-phase Induction Motor - Squirrel Cage



Customer	: WEG ITALIA S.R.L
Product code	:
Product line	: Special Motor

Output	: 360 kW	Duty cycle	: S1
Frame	: HGF 355C/D/E	Service factor	: 1,00
Rated speed	: 1490 rpm	Enclosure	: IP55 (TEFC)
Frequency	: 50 Hz	Locked rotor torque	: 150 %
Rated voltage	: 6600 V	Pull up torque	: 125 %
Insulation class	: F	Breakdown torque	: 280 %
Rated current	: 39,9 A		
Il/In	: 7,0		

Notes:

This is an updated revision. The previous one must be disregarded.The figures given herewith are regarded as average values based on actual tests and applied to sinusoidal power supplied motors, within permissible tolerances under IEC 60034-1.

Performed	Checked	Revision	Approved
faguiar	mamorim	Nr.: 1 Date: 14-FEB-2009	

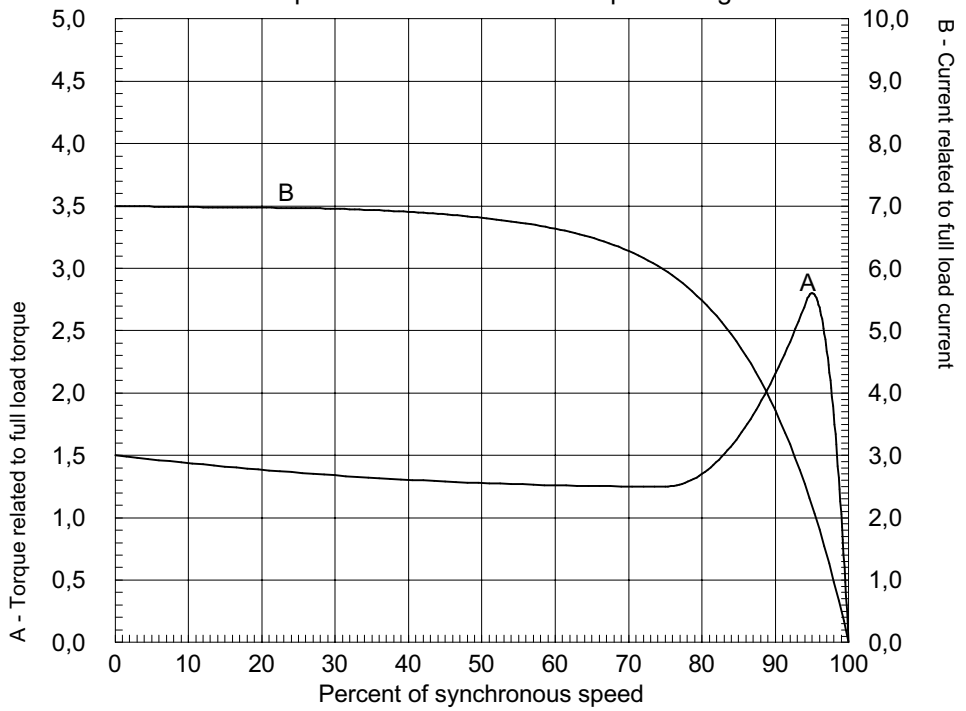
WEG Indústrias S.A.

Nr.: 02946/2009

Date: 15-JAN-2009

PERFORMANCE CURVES RELATED TO SPEED

Three-phase Induction Motor - Squirrel Cage



Customer	: WEG ITALIA S.R.L
Product code	:
Product line	: Special Motor

Output	: 360 kW	Duty cycle	: S1
Frame	: HGF 355C/D/E	Service factor	: 1,00
Rated speed	: 1490 rpm	Enclosure	: IP55 (TEFC)
Frequency	: 50 Hz	Locked rotor torque	: 150 %
Rated voltage	: 6600 V	Pull up torque	: 125 %
Insulation class	: F	Breakdown torque	: 280 %
Rated current	: 39,9 A		
Il/In	: 7,0		

Notes:

This is an updated revision. The previous one must be disregarded.The figures given herewith are regarded as average values based on actual tests and applied to sinusoidal power supplied motors, within permissible tolerances under IEC 60034-1.

Performed	Checked	Revision	Approved
faguiar	mamorim	Nr.: 1 Date: 14-FEB-2009	

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004219085

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

03/23/2009

Customer: WEG ITALIA S.R.L

Order: 0000304154

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 032009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2807 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.2409 Ohms | Ambient Temp.: 29.30 °C | Connection: Star

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 308.04 A | Power: 1164.53 kW

Tl/Tn: 2.31 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 14.72 A | Losses: 9745.50 W

4. High Voltage Test

Voltage: 14200 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 10500 MOhms | Ambient Temp.: 29.3 °C

NOTES

Thermistor Resistance type PT100 : 111.3 , 111.4 , 111.3 , 111.1 , 111.3 , 111.3 , 111.0 , 111.3 Ohms.
Space Heater : 280.5 Ohms.
10000379467

ACCEPT

Leandro Corrêa
Laboratory WEG
Tested on 03/18/2009

Witness:

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004219088

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

03/23/2009

Customer: WEG ITALIA S.R.L

Order: 0000304154

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 032009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2807 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.2426 Ohms | Ambient Temp.: 29.40 °C | Connection: Star

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 301.94 A | Power: 1141.47 kW

Tl/Tn: 2.27 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 14.61 A | Losses: 10384.50 W

4. High Voltage Test

Voltage: 14200 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 11700 MOhms | Ambient Temp.: 29.4 °C

NOTES

Thermistor Resistance type PT100 : 111.3 , 111.2 , 111.3 , 111.5 , 111.4 , 111.3 , 111.2 , 111.3 Ohms.
Space Heater : 271.6 Ohms.
10000379467

ACCEPT

Leandro Corrêa
Laboratory WEG
Tested on 03/18/2009

Witness:

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004219090

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

03/23/2009

Customer: WEG ITALIA S.R.L

Order: 0000304154

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 032009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2807 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.2524 Ohms | Ambient Temp.: 28.00 °C | Connection: Star

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 306.50 A | Power: 11587.65 kW

Tl/Tn: 2.30 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 15.13 A | Losses: 11768.00 W

4. High Voltage Test

Voltage: 14200 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 7500 MOhms | Ambient Temp.: 28 °C

NOTES

Thermistor Resistance type PT100 : 110.8 , 110.8 , 110.8 , 110.9 , 110.9 , 110.9 , 110.9 , 110.8 Ohms.
Space Heater : 288 Ohms.
10000379467

ACCEPT

Leandro Corrêa
Laboratory WEG
Tested on 03/18/2009

Witness:

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004219092

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

03/23/2009

Customer: WEG ITALIA S.R.L

Order: 0000304154

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 032009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2807 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.2611 Ohms | Ambient Temp.: 30.20 °C | Connection: Star

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 303.50 A | Power: 1147.24 kW

Tl/Tn: 2.28 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 14.80 A | Losses: 10005.50 W

4. High Voltage Test

Voltage: 14200 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 9830 MOhms | Ambient Temp.: 30.2 °C

NOTES

Thermistor Resistance type PT100 : 111.5 , 111.6 , 111.6 , 111.7 , 111.7 , 111.6 , 111.4 , 111.3 Ohms.
Space Heater : 279.2 Ohms.
10000379467

ACCEPT

Leandro Corrêa
Laboratory WEG
Tested on 03/18/2009

Witness:

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004219093

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

03/23/2009

Customer: WEG ITALIA S.R.L

Order: 0000304154

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 032009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2807 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.2397 Ohms | Ambient Temp.: 29.10 °C | Connection: Star

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 304.99 A | Power: 1153.00 kW

Tl/Tn: 2.29 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 14.50 A | Losses: 10145.00 W

4. High Voltage Test

Voltage: 14200 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 2300 MOhms | Ambient Temp.: 29.1 °C

NOTES

Thermistor Resistance type PT100 : 111.1 , 111.3 , 111.1 , 111.2 , 111.3 , 111.2 , 111.1 , 111.3 Ohms.
Space Heater : 274.9 Ohms.
10000379467

ACCEPT

Leandro Corrêa
Laboratory WEG
Tested on 03/16/2009

Witness:

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004763590

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

06/25/2009

Customer: WEG ITALIA S.R.L

Order: 0000304157

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 062009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2800 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.3412 Ohms | Ambient Temp.: 17.20 °C | Connection: Star

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 304.66 A | Power: 1132.05 kW

Tl/Tn: 2.32 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 14.75 A | Losses: 10683.00 W

4. High Voltage Test

Voltage: 14200 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 12900 MOhms | Ambient Temp.: 17.7 °C

NOTES

Thermistor Resistance type PT100: 108.8, 108.8, 108.8, 108.7, 108.7, 108.87, 108.4, 108.5 Ohms
Space Heater: 273.2 Ohms
10000379467

ACCEPT

Evaldo Hencke
Laboratory WEG
Tested on 06/25/2009

HENCKE

Witness:

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004763643

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

06/25/2009

Customer: WEG ITALIA S.R.L

Order: 0000304157

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 062009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2800 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.3456 Ohms | Ambient Temp.: 17.30 °C | Connection: Star

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 299.72 A | Power: 1160.55 kW

Tl/Tn: 2.69 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 14.23 A | Losses: 9768.00 W

4. High Voltage Test

Voltage: 1400 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 10000 MOhms | Ambient Temp.: 25 °C

NOTES

Thermistor Resistance type PT100: 108.7, 108.6, 108.7, 108.6, 108.8, 108.7, 108.0, 108.9 Ohms
Space Heater: 269.3 Ohms
10000379467

ACCEPT

Evaldo Hencke
Laboratory WEG
Tested on 06/25/2009

HENCKE

Witness:

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004763644

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

06/25/2009

Customer: WEG ITALIA S.R.L

Order: 0000304157

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 062009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2800 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.3448 Ohms | Ambient Temp.: 17.40 °C | Connection: Star

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 301.44 A | Power: 1136.91 kW

Tl/Tn: 2.44 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 14.31 A | Losses: 10792.00 W

4. High Voltage Test

Voltage: 14200 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 12800 MOhms | Ambient Temp.: 25 °C

NOTES

Thermistor Resistance type PT100: 108.6, 108.6, 108.7, 108.9, 108.7, 108.6, 108.2, 108.7 Ohms
Space Heater: 269.5 Ohms
10000379467

ACCEPT

Evaldo Hencke
Laboratory WEG
Tested on 06/25/2009

HENCKE

Witness:

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004763645

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

06/25/2009

Customer: WEG ITALIA S.R.L

Order: 0000304157

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 062009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2800 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.3381 Ohms | Ambient Temp.: 16.60 °C | Connection: Star

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 308.01 A | Power: 1088.59 kW

Tl/Tn: 2.18 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 14.24 A | Losses: 11204.50 W

4. High Voltage Test

Voltage: 14200 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 11550 MOhms | Ambient Temp.: 16.6 °C

NOTES

Thermistor Resistance type PT100: 108.3, 108.3, 108.3, 108.2, 108.2, 108.3, 108.0, 108.2 Ohms
Space Heater: 268.7 Ohms
10000379467

ACCEPT

Evaldo Hencke
Laboratory WEG
Tested on 06/25/2009

HENCKE

Witness:

Routine Test Report
Three-Phase Induction Motors

Serial Number
1004763646

WEG Indústrias S.A. - Motores
Departamento de Controle da Qualidade

06/26/2009

Customer: WEG ITALIA S.R.L

Order: 0000304157

IDENTIFICATION

Item: 11057097	Voltage: 6600 V	Service Factor: 1.00
Model: 355C/D/E 062009	Current: 39.9 A	Enclosure: IP55
Assembly: B3L	Power: 360 kW	Power factor:0.83
Approximate weight: 2800 kg	Frequency: 50 Hz	Eff. - 75%: -
Design: -	Full load Speed: 1490 rpm	Eff. - 100%: -
Ins. Class: F (75K)	Time Rating: S1	Il/In: -

TESTS - IEC 34-2 / IEC 34.1

1. Resistance Measurement

Resistance: 1.3361 Ohms | Ambient Temp.: 19.00 °C | Connection: U1-V1-W1

2. Locked Rotor Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 298.24 A | Power: 1145.87 kW

Tl/Tn: 2.26 | Full load torque (Tn): 235.05 mkgf | (1 mkgf or mkp = 9.813 Nm)

3. No Load Test

Voltage: 6600 V | Frequency: 50 Hz | Current: 14.19 A | Losses: 10303.50 W

4. High Voltage Test

Voltage: 14200 V | Time : 60 seconds

5. Insulation Resistance Test

Resistance: 6290 MOhms | Ambient Temp.: 20 °C

NOTES

Thermistor Resistance type PT100: 108.2, 108.3, 108.0, 108.4, 108.2, 108.3, 107.8, 108.0 Ohms
Space Heater: 274.5 Ohms
10000379467

ACCEPT

Evaldo Hencke
Laboratory WEG
Tested on 06/26/2009

HENCKE

Witness:

DECLARATION OF CONFORMITY

Manufacturer's name and Address:
WEG EQUIPAMENTOS ELÉTRICOS S.A. - MOTORES
Av. Prefeito Waldemar Grubba, 3000
89256-900 Jaraguá do Sul –SC - Brazil

We declare under sole responsibility that the products:

* Single- or three-phase induction motors
  IEC frame 63 up to 630
* Single- or three-phase induction motors
  NEMA frames 143 up to 10412

to which this declaration relates are in conformity with the following standards:

* IEC 60034-1/2 / 2A/5/6/7/8/9/11/12/14
* IEC 60072 - 1/2

European Standard	German Standard	VDE-Classification
EN 55014-1:1993+A1:1997+A2:1999	DIN EN 55014-1:1999-10	VDE 0875 Part 14-1:1999-10
EN 61000-6-2:1999	DIN EN 61000-6-2:2000-03	VDE 0839 Part 6-2:2000-03
EN 61000-3-2:1995+Corr.:1997+A1:1998 + A2:1998	DIN EN 61000-3-2:1998-10	VDE 0838 Part 2:1998-10
EN 61000-3-2:1995/A14:2000	DIN EN 61000-3-2/A14:2001-01	VDE 0838 Part 2/A14:2001-01

Designation:
The motors are provided with a CE mark, since January 1st, 1996.

By design, the motors, considered as components, comply with the requirements of following European Directives:

Low Voltage Directive 2006/95/EC of December 12th, 2006 that supersede the 73/23/EEC from February 19th,1973, amended by Directive 93/68/EEC of July 22nd 1993;

EMC Directive 2004/108/EC of December 15th 2004 that replace the Directive 89/336/EEC from May 3rd, 1989, regarding to the intrinsic characteristics to emission and immunity levels of Electromagnetic Compatibility (EMC);

Machinery Directive 89/392/EEC from June 14th, 1989, amended by 91/368/EEC, 93/44/EEC and 93/68/EEC, in accordance with article 4(2) and annex IIB, Paragraph B, provided the motors are installed according to our Installation and Maintenance Instructions. The above-mentioned directives were combined, without deviation, in one document as Directive 98/37/EC from June 22nd, 1998. The Directive 98/37/EC cancels and replaces these old Directives.

Certificate of Incorporation:
The above products cannot be put into service until the machinery into which they are incorporated has been declared to be in conformity with the Machinery Directive (89/392/EEC).

The Safety Notices in the product documents and the applicable installation specification (for instance EN 60204) must be followed.

Jaraguá do Sul, March 17th, 2008.

Siegfried Kreutzfeld
Engineering Director