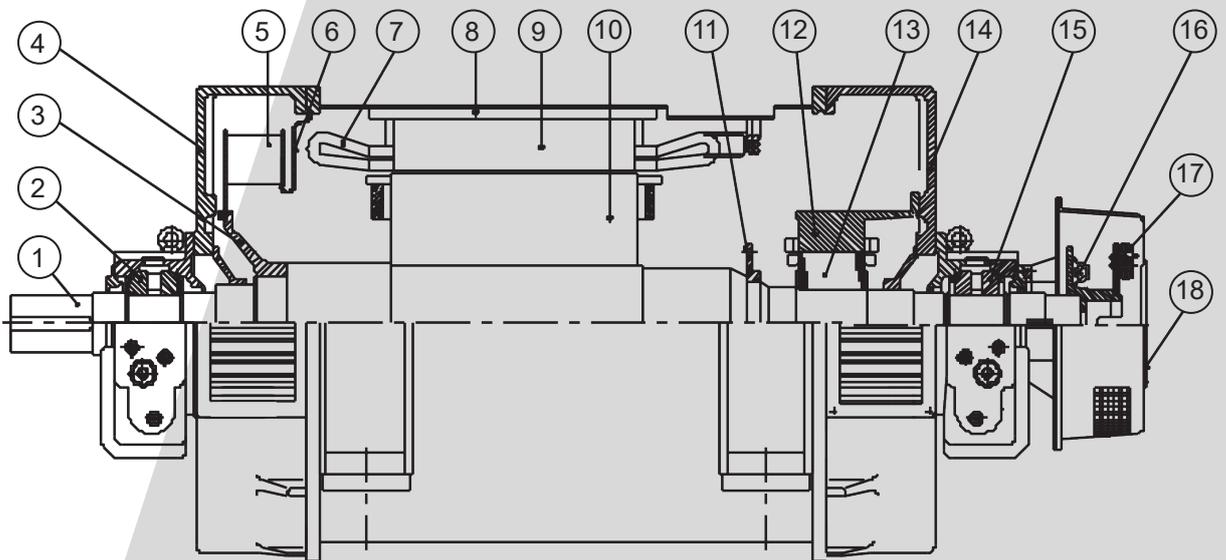




Power



# LSA 52.3 / LSA 53.2 / LSA 54.2

Industrial Range Alternators  
4 poles

**LEROY-SOMER**<sup>™</sup>

Installation and maintenance

# LSA 52.3 / LSA 53.2 / LSA 54.2

## Industrial Range Alternators – 4 poles

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## Industrial Range Alternators – 4 poles

### 1. GENERAL INFORMATION

#### 1.1 INTRODUCTION

##### 1.1.0 General information

This manual provides installation, operation and maintenance instructions for synchronous machines. It also describes the basic construction of these machines. This manual is general; it applies to an entire group of synchronous generators. Additionally, in order to make information-finding easier, Section 1, "Characteristics and Performance", has been included, describing the machine completely (type of construction, type of bearing, IP Code, etc.); this will enable you to identify directly the chapters which apply to your machine.

This synchronous machine has been designed for a maximum length of service. To achieve this, it is necessary to pay special attention to the chapter concerning the periodic maintenance schedule for the machines.

##### 1.1.1 Safety Notes

The warnings "DANGER, CAUTION, NOTE" are used to draw the user's attention to different points:

 **DANGER:**  
THIS WARNING IS USED WHEN AN OPERATION, PROCEDURE, OR USE MAY CAUSE PERSONAL INJURY OR LOSS OF LIFE.

 **CAUTION:**  
THIS WARNING IS USED WHEN AN OPERATION, PROCEDURE, OR USE MAY CAUSE DAMAGE TO OR DESTRUCTION OF EQUIPMENT.

**NOTE:**  
This warning is used when a delicate operation, procedure, or installation requires clarification.

##### 1.1.2 Conditions of use

###### 1.1.2.1 Generalities

A machine must only be installed and operated, by qualified and trained persons.

Any technician using or maintaining this machine must be authorised to do so by the local labour laws (e.g. holder of a certification for working on high voltage systems).

Operation which require handling must be done by qualified persons (Slings techniques; use of lifting devices, etc.). Local procedures must be strictly complied with Any product (sealing paste, cleaning product, etc.) used during maintenance or servicing must comply with local regulations and environmental standards.

The disposal of waste coming from servicing the machine must be managed in compliance with the local regulations and environmental standards in force.

The main characteristics of this machine are summarized in "Section 1" of this manual.

Any operating condition other than those specified by the original tender must receive a Nidec Power agreement.

Any modification of the machine structure must receive approval from Nidec Power.

##### 1.1.2.2 Vibration analysis

It is the responsibility of the generator set manufacturer to ensure that the different assembled system will be vibratory compatible in terms of vibration. (ISO 8528-9 and BS5000-3).

It is the responsibility of the generator set manufacturer to ensure that the shaft line torsional analysis has been done and accepted by the different parties (ISO 3046).

 **CAUTION:**  
**EXCEEDING THE LEVEL OF VIBRATIONS ALLOWED BY THE STANDARD ISO 8528-9 & BS5000-3 MAY CREATE SERIOUS DAMAGE (BEARING DAMAGE, STRUCTURAL CRACKS, ETC.).**  
**EXCEEDING THE LEVEL OF TORSIONAL VIBRATION OF THE SHAFT LINE (e.g.ABS, LLOYD, ETC.) MAY CAUSE SERIOUS DAMAGE (CRANKSHAFT FAILURE, GENERATOR SHAFT FAILURE, ETC.).**

Refer to chapter 2.1.3.4 for further information about the accepted vibration level of the standard ISO 8528-9 and BS5000-3, consult chapter 2.1.3.4.

##### 1.1.2.3 Short-circuit capacity

In the event of a fault, the terminal box is designed to support the maximum current level generated by the alternator.

If the current is higher than these levels, as may be the case with a fault coming from the electricity grid, the protection of the alternator must be ensured by the protective device of the installation.

 **CAUTION:**  
**THE ALTERNATOR IS A SUB-ASSEMBLY SUPPLIED WITHOUT A SHORT-CIRCUIT PROTECTION DEVICE.**

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### 1.1.2.4 Object projection risk

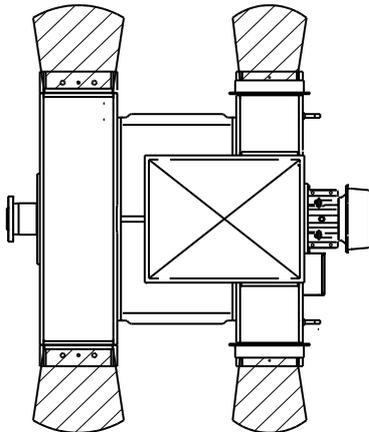
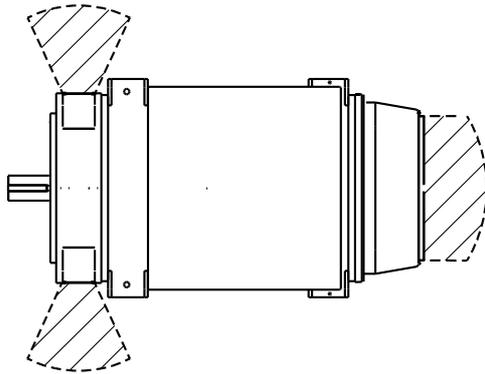


#### DANGER:

**IN THE EVENT OF A MAJOR ACCIDENT, DEBRIS CAN BE EJECTED FROM THE MACHINE THROUGH THE AIR INLET OR OUTLET OPENINGS. THESE DEBRIS CAN CAUSE A FATAL ACCIDENT. DO NOT ENTER HAZARDOUS AREAS DURING MACHINE OPERATION.**

#### NOTE:

**This risk must be considered in the risk analysis of the site concerned.**



## 1.2 GENERAL DESCRIPTION

### 1.2.1 Generator (arep)

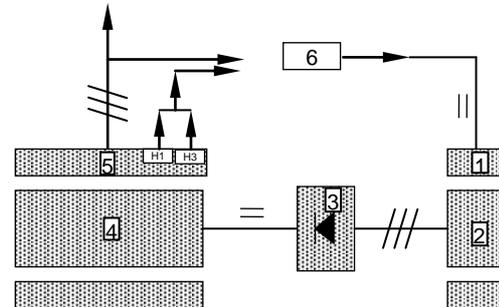
The synchronous generator is an alternating-current machine, without ring or brush. The machine is cooled by the flow of air through the machine.

Use the drawings of chapter 10 in order to better understand the machine.

The Automatic Voltage Regulator (item 6) supplies the inductor exciter field (static part; item 1) with DC current. The Exciter (item "1" & "2") works as an inverse alternator. The Exciter armature (rotating part; item 2) generates a three-phase current which supplies the rotating diode bridge (rotating part; item 3).

The Rotating diode bridge (rotating part; item 3) rectifies the three-phase current into DC current which supplies the Pole wheel (rotating part; item 4).

The pole wheel (rotating part; item 4) excites the alternator armature (static part; item 5) which generates a three-phase current.



- 1- Excitation field winding
- 2- Excitation armature
- 3- Rotating diodes bridge
- 4- Revolving field
- 5- Alternator armature
- 6- Automatic Voltage Regulator
- H1- AREP winding harmonic detection 1
- H3- AREP winding harmonic detection 3

### 1.2.2 Excitation system

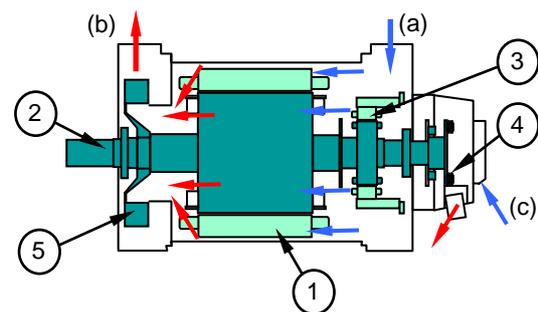
The excitation system is mounted at the rear of the machine.

## 2. DESCRIPTION OF SUB-ASSEMBLIES

### 2.1 - STATOR

#### 2.1.1 Stator of the electric machine

The alternator stator is a stack of low loss steel magnetic laminations assembled under pressure. The stator coils are inserted and blocked in the slots, then impregnated with varnish and polymerised (VPI system).



- 1 - Stator
- 2 - Rotor
- 3 - Exciter
- 4 - Rotating diodes
- 5 - Fan
- a - Stator Air inlet (cold air)

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- b - Stator air exhaust (warmed air)  
c – Rotating diodes air cooling

### 2.1.2 Excitation field winding

The excitation field winding comprises a wound solid element.

The excitation is equipped with a flange at the rear bearing of the machine.

### 2.1.3 Stator protection

#### 2.1.3.1 Heating resistance

The heating element avoids internal condensation during the shutdown periods. It is connected to the terminals of the main terminal box. The resistance heater is switched on as soon as the machine is shut down.

The electrical characteristics are provided in Section 1 "Technical Characteristics".

#### 2.1.3.2 Stator winding temperature sensor

The temperature sensors are located in the zone assumed to be the hottest part of the machine. The sensors are connected to a terminal box.

Depending on the insulation class of the machine, the temperature of the sensors must not exceed a maximum of:

INSULATION CLASS	ALARM	TRIPPING
H	180 °C	185 °C

To improve the protection of the machine, we recommend setting the alarm set-point according to the actual conditions of the site obtained after a representative operating time:

**Alarm temperature (\*) = Highest recorded temp + 10°K**

**Trip temperature (\*) = Alarm temperature + 5 °K**

(\*) do not exceed the values of the previous table.

(\*) Max. recommended temp: Maximum temperature measured at the stator after a representative operating time under severe operating conditions.

E.g. a class H insulation machine of 3000 kVA reached a maximum of 110°C at the stator after a representative time of operation at the site. Set the alarm temperature to 120°C instead of 180°C indicated in the previous chart. Set the trip setting to 125°C instead of the 185°C shown in the previous table.

#### 2.1.3.3 Stator air temperature probe

As an option an RTD or thermostat can measure the stator air inlet temperature (cold air).

Stator air inlet temperature; Alarm points and shutdown:

- alarm                      Nominal air inlet stator + 5 K
- shutdown                80°C

Stator air outlet temperature; Alarm points and shutdown:

- alarm                      Nominal air inlet stator + 35K
- shutdown                Nominal air inlet stator + 40K

#### NOTE:

For an open machine the nominal air temperature entering the stator corresponds to the ambient temperature.

#### NOTE:

If quickly restarting after a shut-down, inhibit the stator air sensor safety "alarm" for a few seconds (no more than 30 s) during the machine start up.

#### NOTE:

For a water cooled machine (CACW) the nominal air entering the stator may be approximated as following:  
T<sub>air entering stator</sub> = T<sub>water entering cooler</sub> + 15°K.

#### 2.1.3.4 Bearing vibration sensor

This chapter concerns the adjustment of seismic sensors. For more information on adjusting proximity sensors, see Chapter 2.2.6.1.

The level of vibration of the machines depends directly on the use made of them and on the characteristics of the site.

We propose the following adjustment:

**Vibration Alarm (\*) = Site Highest Vibration level + 50%**

**Vibration Trip = Vibration Alarm + 50%**

(\*) do not exceed the values of the following chart.

The machines are engineered to be able to withstand the vibration level specified by the standard ISO8528-9 and BS5000-3.

Maximum levels for: Internal combustion engines alternating current motors

Nominal speed (rpm)	kVA	Generator vibration level (nominal conditions)	
		Overall (mm/s rms) (2-1000 Hz)	Any harmonics
1300 to 2199	> 250	< 20	< 0.5 mm; pp (5 – 8 Hz)  < 9 mm/s; rm (8 – 200 Hz)
721 to 1299	≥ 250	< 20	
	> 1250	< 18	
≤ 720	> 1250	< 15	< 10 (*)

(\*) generator on concrete base

Maximum levels for: Turbines

Turbines (hydraulics; gas; steam)	Max. recommended value: 4.5 (global; mm/s (rms))
-----------------------------------	--

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### 2.2 ROTOR

#### 2.2.1 Pole wheel (laminated)

The pole wheel is produced by stacking cut laminations to reproduce the profile of the pole (item 1).

Stacking of steel laminations is completed at each end by high electrical conductivity laminations (item 2).

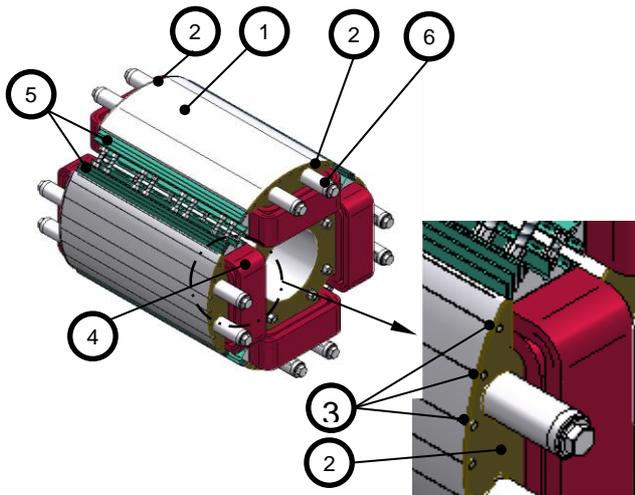
In order to allow the alternators to run in parallel, and so as to ensure stability, bars with high electrical conductivity are inserted in holes passing through the poles from one end to the other. These bars are welded together with the end plates so as to obtain a complete cage (or LEBLANC damper cage).

The winding (item 4) is wound on the pole and then impregnated.

The winding is made of insulated copper wire of rectangular cross-section and high electrical conductivity. Aluminium plates (item 5) are pressed against the winding acting as dissipating radiators and ensuring excellent wedging of the coils.

Retaining bars (item 6) on each pole protect the heads of the coils from centrifugal forces.

The wound pole wheel is heated and shrink fitted onto the shaft.



#### 2.2.2 Excitation armature

The excitation armature is made by stacking magnetic steel laminations. These steel laminations are held in place by rivets.

The excitation armature is keyed and heat-shrunk onto the shaft.

The windings are enamelled copper wires, class "F" insulation (or "H", depending on the customer's request or size of the machine).

#### 2.2.3 Fan (machines: IC 0 A1)

The synchronous machine is characterized by a self-ventilation system. A centrifugal fan is mounted between the revolving field coil and the front bearing.

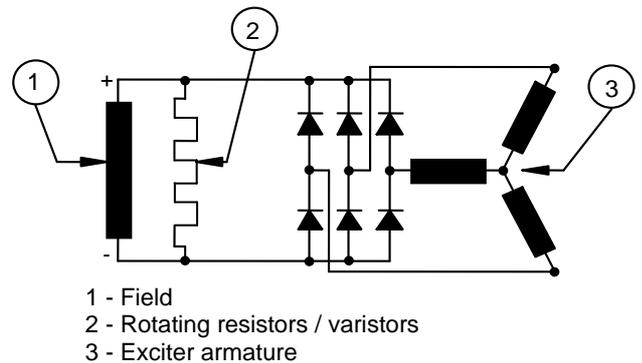
Air intake is at the rear of the machine and the exhaust at the front.

The fan consists of a hub, which is keyed and heat-shrunk onto the shaft. The fan is made of welded steel sheet,

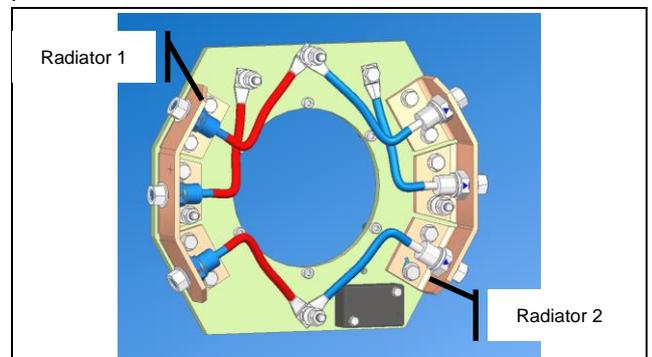
attached to the hub by screws. Ventilation is obtained by means of inclined blades. The air is exhausted by centrifugation. The air inlet and outlet must remain free during operation.

#### 2.2.4 Rotating diode bridge

The rectifier bridge, comprising six diodes, is placed at the rear of the machine. The rotating bridge is made of fibreglass with a printed circuit to connect the diodes together. This bridge is supplied with alternating current by the excitation armature and supplies direct current to the pole wheel. The diodes are protected against over voltage by rotating resistors, or by varistors. These resistors (or varistors) are mounted in parallel with the pole wheel.



The 2 radiators of the diode bridge are connected to the pole wheel.



- 1 - Radiator 1  
2 - Radiator 2

The diode fastening screws must be tightened to the correct torque.

**⚠ CAUTION:**  
**THE ROTATING DIODE FASTENING SCREWS MUST BE TIGHTENED USING A TORQUE WRENCH CALIBRATED TO THE RECOMMENDED TORQUE.**

#### 2.2.5 Balancing (single fan machine)

The complete rotor was balanced as per the ISO8221 standard to achieve a residual imbalance of less than:

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Generator set: Class G2.5

Turbine: Class G1

The shaft end is cold-stamped to indicate the type of balancing (as per ISO8221)

H: balancing with **Half-key carried out as standard**

F: balancing with Full key (upon request)

N: balancing without key (upon request)

The balancing is carried out in two planes.

The first is on the fan. It is recommended, when the fan is refitted (after servicing) to follow the initial indexing.

The second is at the rear of the machine.

The coupling must be balanced to adapt to the generator rotor balancing.

## 2.3 TERMINAL BOX

### 2.3.0 Description (on damper buffers)

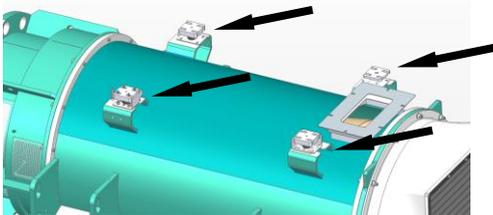
Use the attached Terminal box drawing.

The openings provide access to the terminals.

The gland plates are made of non-magnetic materials in order to avoid circulating currents.

If accessories not supplied by Nidec Power have to be installed in the terminal box (CT's, VT's, Shunt, etc.) refer to chapter.3.4.3.

In order to limit the level of vibration of the accessories contained in the terminal box, the terminal box is mounted on rubber damper pads.



**⚠ CAUTION:**  
**RUBBER DAMPERS MUST BE CHECKED PERIODICALLY AND REPLACED EVERY FIVE YEARS.**

### 2.3.1 Automatic voltage regulator (AVR)

When the automatic voltage regulator is located in the terminal box, it is fitted on a separate plate, insulated from vibration by means of dampers. The operation of the regulator is explained in Section 3.

## 2.4 NAMEPLATES

### 2.4.1. Main nameplate

The main nameplate is fitted to the stator. It gives the manufacturer's electrical characteristics, the type of machine and its serial number. The serial number is necessary for any contact with the factory.

For machines with anti-friction bearings lubrication parameters are indicated.

### 2.4.2. Lubrication nameplate

The machines with anti-friction bearings have the lubrication parameters indicated on the main nameplate fixed on the stator, indicating:

- Type of bearing
- Grease change frequency
- Amount of grease
- Grease type

### 2.4.3. Rotation direction nameplate

Located on the stator an arrow indicates the direction of rotation.

## 2.5 ROLLER-BEARING

### 2.5.0 Description of roller-bearings

The bearings ensure the guiding of rotor rotation and its axial positioning.

The bearings are protected from ambient dust by baffles. They can be replaced.

The bearings must be lubricated regularly. The old grease is forced out at the lower part of the bearings by the force of the new grease being injected.

### 2.5.1 Bearing protection devices

Optionally, the bearing can be equipped with RTD sensors to detect possible heating.

For special use in warm surroundings where the temperature of the bearings exceeds the authorised limit (for a bearing known to be in good condition), contact us.

Bearing; Alarm points and shutdown:

- alarm 90°C (194°F)
- shutdown 95°C (203°F)

To improve the machine protection we recommend to set the alarm point following effective site conditions:

**Alarm temperature (\*) = Highest recorded temp + 15°K**  
 (\*) do not exceed the values of the previous table.

E.g. On-site, the normal temperature of the bearing is 60°C. Set the alarm temperature to 75°C instead of the 90°C shown in the previous table.

#### NOTE:

Specific dedicated devices based on the analysis of the vibration signal are able to monitor bearings behaviour.

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### 2.10 AIR FILTERS

Only use approved filters. Any filter not correctly engineered may conduce to air flow restriction and then to abnormal generator cooling or to dust entering the generator.

### 2.12 TRANSPORT LOCKING SYSTEM

#### 2.12.0 General information

With certain types of machines, the alternator comes with a rotor locking system for transport.

The locking systems must be removed just before the final installation of the alternator and reinstalled if the alternator is later re-transported. It is recommended to lock the rotor during transport.

#### NOTE:

The locking systems are painted red or yellow.



**CAUTION:**  
THE ROTOR LOCKING SYSTEM MUST REMAIN IN PLACE IF THE ALTERNATOR IS GOING TO BE TRANSPORTED.

#### NOTE:

Maritime and rail transport are particularly demanding for the alternator.

#### 2.12.1 Machines with bearings

##### 2.12.1.0 General information

In case of re-use of the locking system for transport, the system must be reinstalled taking care not to touch any parts other than the shaft. If necessary, rotate the shaft so that the locking system does not touch the rotor cables.



**CAUTION:**  
THE ROTOR LOCKING FASTENING SCREW MUST BE TIGHTENED TO THE NOMINAL RECOMMENDED TORQUE (see chapter 5.6).

#### NOTE:

PMGs have very low air gaps, and may be damaged during the installation of the transport locking system.

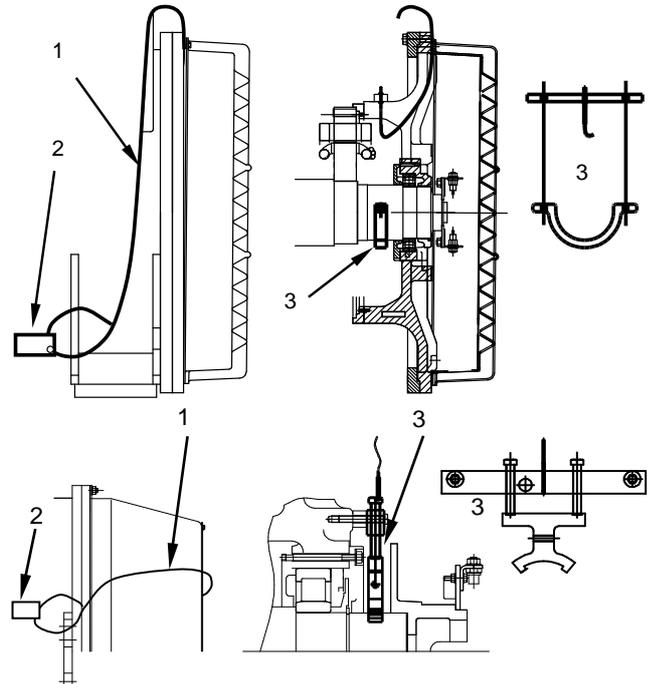


**CAUTION:**  
FOR SINGLE-BEARING PMG MACHINES, THE PMG ROTOR MUST BE DISASSEMBLED BEFORE INSTALLING ANY LOCKING SYSTEM FOR TRANSPORT.

#### NOTE:

Nidec Power only provides the transport system specific to the alternator transported alone. Upon request Nidec Power can provide a locking system for the transported alternator coupled to its "prime mover".

Rear bearing; Locking system examples:



1 - Cable  
2 - Red label out of the alternator indicating a Locking system  
3 - Rotor locking system

##### 2.12.1.1 Double roller bearing machine

A locking system is installed on the opposite side to the shaft end in order to load the roller bearing sufficiently and eliminate any possible movement of the rollers on their tracks.

##### 2.12.1.2 Single roller bearing machine

Machine transported alone:

On the front bearing, a threaded rod lifts the rotor and brings it into contact with the stator. The rotor is locked axially and radially.

Transported machine coupled to its prime mover

(single roller bearing machine only):

A locking system is installed on the opposite side to the shaft end in order to load the roller bearing sufficiently and eliminate any possible movement of the rollers on their tracks.

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## Industrial Range Alternators – 4 poles

### 3. INSTALLATION

#### 3.1 TRANSPORT AND STORAGE

##### 3.1.1 Transportation

During transport the level of intermittent shocks suffered by the machines must remain below 30 m/s<sup>2</sup>.

Machines equipped with roller bearing(s) must have their rotor locked during the transport to avoid any "false brineling" problem.

The temperature of the machine must remain between -20°C and +70°C. However, it is possible to go down to -40°C if not for more than a few hours.

The machine must be protected against the weather and condensation.

##### 3.1.2 Warehouse Storage

This chapter applies to machinery not protected by a sealed package (for machinery with a sealed package, see Chapter 3.1.3).

The machinery must be stored in a clean and dry place which is not subject to sudden temperature changes or high humidity (75 % maximum).

Storage at an ambient temperature of +5 to +45°C is recommended.

The machine must not be subject to vibrations greater than 1mm/s rms.

 **CAUTION:**  
**THE RESISTANCE HEATER MUST BE CONTINUOUSLY SWITCHED ON.**

##### 3.1.3 Storage in maritime packaging

The synchronous machine was hermetically sealed in the factory and then packed in a wooden box (SEI class 4c standard).

Storage in a hermetically sealed package and wooden box made by Nidec Power is guaranteed 2 years. In this case, there is no special weatherproof precaution to be taken.

In this case, the precautionary measures in Chapter 3.1.5; 3.1.6; 3.1.7; 3.1.8 do not apply.

The machine must not be subject to vibrations greater than 1mm/s rms.

 **CAUTION:**  
**BREAKING THE HERMETIC PROTECTIVE FILM DISCHARGES NIDEC POWER OF ITS LONG STORAGE GUARANTEE.**

##### 3.1.4 Unpacking and Installation

 **DANGER:**  
**THE DEDICATED LIFTING HOOKS MUST BE USED TO LIFT THE MACHINE WITH SLINGS (ONE HOOK AT EACH CORNER OF THE MACHINE).**

Rotors of machines with Sleeve bearings and single-bearing machines, are blocked during transportation so as to avoid any movement. Withdraw the retaining bars. The retaining bar is screwed to the end of the shaft and to the front support.

 **CAUTION:**  
**TRANSPORT LOCKING DEVICES PAINTED RED OR WITH RED STICKER MUST BE REMOVED.**

The end of the shaft is protected from corrosion. Clean it before coupling.

The resistance heater must be switched on at all times.

Before starting the machine up again, it will be necessary to carry out a start-up inspection.

##### 3.1.5 Roller bearing storage measures

This chapter must be followed if a machine remains stationary for more than 6 months.

After 6 months of stop; lubricate by injecting two times the grease volume used for a standard maintenance.

Then, every 3 months turn the machine shaft line by a few turns while injecting a standard grease volume.

##### 3.1.6 Uncovered machinery storage measures

For an uncovered machine, it is recommended to close the air inlet and outlet.

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## Industrial Range Alternators – 4 poles

### 3.2 INSTALLATION OF THE MACHINE

#### 3.2.1 Coupling Assembly (double-bearing machine only)

The coupling must be balanced separately before being assembled on the machine shaft. Refer to the balancing instructions in chapter 2.2.5.

The shrinking of the half coupling onto the electrical machine shaft end must be chosen, by the generator set manufacturer, in such way as it should be removable for maintenance (e.g. bearing change).

#### 3.2.2 Stator attaching

Four plates on the chassis allow the unit to be attached onto a pallet.

The fixing bolts must support the forces created by the static and dynamic loads.

The machine may be positioned by means of 4 dowel pins. The dowel pins make later realignment easier. (The use of pins is optional).

The machine may be aligned through the use of 4 jacking-screws. These jacking-screws allow the machine to be positioned along the various axes.

### 3.3 MACHINE ALIGNMENT

#### 3.3.1 General information concerning the alignment

##### 3.3.1.1 General information

Alignment is intended to achieve coaxiality of the driving and driven shafts under nominal operating conditions (machine running; at its operating temperature).

The machine must be aligned according to the Nidec Power standard and adhere to the manufacturer's alignment standard for the drive machine.

When heating the machine has its shaft line which grow up. Between stop and rotation the shaft axis location inside its bearing is different. The total axis height elevation is composed of the thermal elevation and of the bearing elevation.

**CAUTION:**  
**THE ALIGNMENT MUST BE DONE TAKING INTO ACCOUNT, THE CORRECTION FOR THE THERMAL EXPANSION OF THE SHAFT.**

The correct locating of the parts must be obtained by inserting shims under the machine feet.

The double-bearing machines are mounted with bearings (ball or roller) or Sleeve bearings. The axial clearance of the bearings (if the machine has Sleeve bearings) must be distributed as uniformly as possible, taking into account the axial thermal expansion. The roller bearing machines with a positioning bearing (standard machine) do not have axial play.

The machines are delivered with the rotor mechanically centred (axially and radially) in relation to the stator.

**CAUTION:**  
**THE ALIGNMENT STANDARDS OF MOTOR MANUFACTURERS ARE FREQUENTLY MORE ACCURATE THAN THOSE OF NIDEC POWER.**

#### 3.3.1.2 Shaft elevation caused by heat rise

$$\Delta H (\text{mm}) = \lambda (\text{K}^{-1}) \cdot H_{(m)} \cdot \Delta T (\text{K})$$

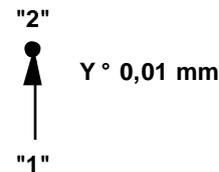
$H_{(m)}$  = Height of the machine axis

$\Delta T$  = frame temperature rise = 30°C

$\lambda$  = Coefficient of steel elongation = 0.012 °K-1

#### 3.3.1.3 Elevation of the shaft of a roller bearing machine

Caused by heat rise in the anti-friction bearing itself.



1 - cold, in rotation, or stopped

2 - hot, in rotation, or stopped

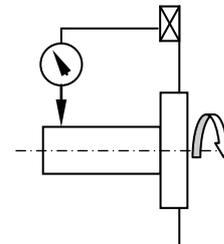
#### 3.3.1.4 Inspection of the generator before alignment

Check the out-of-round of the generator shaft tip.

The total reading must be within a tolerance of 0.04 mm.

#### NOTE:

**RUN OUT CHECK CAN BE INFEASIBLE ON SLEEVE BEARING MACHINE BECAUSE OF THE TOO HIGH NECESSARY TURNING TORQUE NEEDED TO TURN THE ROTOR.**



#### 3.3.1.5 Alignment procedure with the "double concentricity" method

#### NOTE:

**LASER DEVICES CAN MAKE THE JOB EASIER THAN WITH THE PROCEDURE INDICATED.**

This method is not sensitive to axial movements. (Alignment methods using axial measurement are often disrupted by a small axial movement of the rotor). It is possible to check the alignment with the coupling installed.

Equipment required:

Two rigid supports. The rigidity of the two supports is very important.

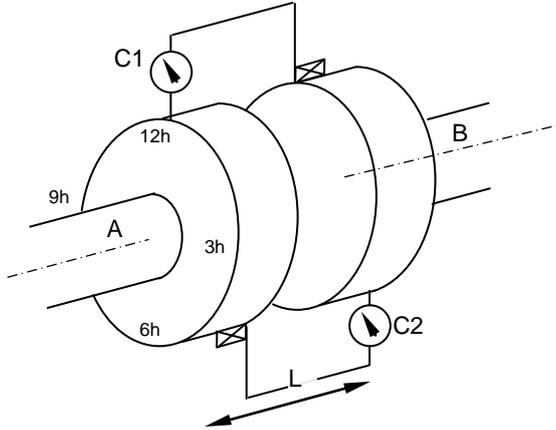
Two micrometers

# LSA 52.3 / LSA 53.2 / LSA 54.2

## Industrial Range Alternators – 4 poles

### Implementation:

During the measurements, both shafts must turn simultaneously in the same direction. (For example: the coupling installed with its screws loosened). By turning both shafts simultaneously, the measurement is not affected by the error resulting from run out of the two shaft ends.



The "C1" and "C2" micrometers are located at an angular difference of 180°.

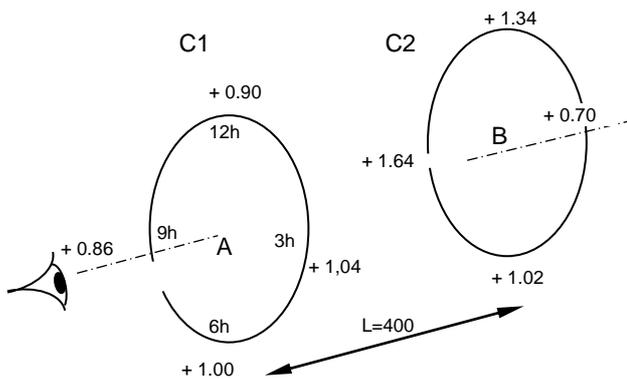
The longer the distance "L" the higher the sensitivity for detecting angular errors.

The reading should be performed 4 times for the "C1" and "C2" micrometers: at 12h, 3h, 6h, 9h.

It is recommended to record the results and draw the axes for better evaluation, as explained below. Interpretation of measurements by means of an example.

Values given in millimetres. The reading is considered positive (+) when the micrometer stylus is pushed inwards.

### MEASUREMENTS



#### Measurements referring to the vertical plane:

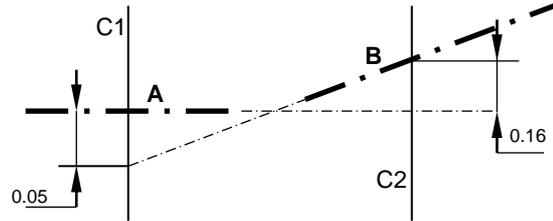
Considering the vertical plane "C1": The vertical action towards the top of shaft "A" on the micrometer is dominant.

In the plane "C1" the axis "A" is higher than axis "B"  
 $(0.9 - 1) / 2 = -0.05 \text{ mm}$

In the vertical plane "C2", the vertical action towards the top of shaft "B" on the micrometer is greater.

In the plane "C2" the axis "B" is higher than axis "A"  
 $(1.34 - 1.02) / 2 = 0.16 \text{ mm}$

The respective position of the axes is as follows:



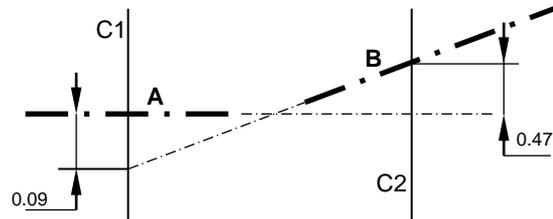
Regarding the vertical plane, the angular alignment error is:  
 $(0.16 + 0.05) * 100 / 400 = 0.0525 \text{ mm}/100\text{mm}$  (not acceptable).

#### Measurements referring to the horizontal axis:

In the plane "C1" the axis "B" is further to the right than "A"  
 $(1.04 - 0.86) / 2 = 0.09 \text{ mm}$

In the plane "C2" the axis "B" is further to the left than "A"  
 $(0.70 - 1.64) / 2 = -0.47 \text{ mm}$

The representation of the shafts is as follows:



Regarding the horizontal plane the angular error is:  
 $(0.47 + 0.09) * 100 / 400 = 0.14 \text{ mm}/100\text{mm}$   
 (not acceptable)

In the both planes the parallelism error is:

$\sqrt{5^2 + 9^2} = 0.103 \text{ mm}$  or  $\sqrt{16^2 + 47^2} = 0.496 \text{ mm}$  (not acceptable)

### 3.3.2 Alignment of a double-flanged bearing machine

#### 3.3.2.1 Machines without axial play (standard)

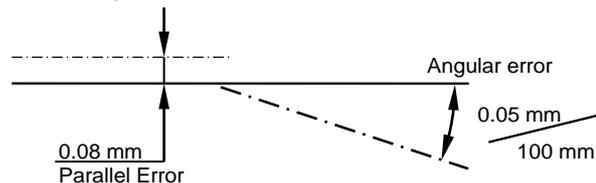
Alignment must take into account, coupling tolerances.



#### CAUTION:

**A MISALIGNMENT EVEN IF ACCEPTABLE BY THE COUPLING MUST NOT CREATE UNACCEPTABLE STRESS LEVELS FOR THE BEARING.**

Shafts alignment limits to comply with:



To check the alignment, there are different methods: the "double concentricity" method is described in the "alignment procedure" chapter 3.3.1.6.

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## Industrial Range Alternators – 4 poles

### 3.4 ELECTRICAL CONNECTIONS

#### 3.4.0. General information

The installation must comply with the electrical schematics attached in Section 5.

Check that all the protection devices are correctly connected and in good working order.

The assembler has the responsibility to mechanically and electrically protect the generator within the best practice rules and to secure any operation over the defined tender (respect of capability curve; overspeed, etc.).

For low-voltage machines, power supply cables must be connected directly to the machine terminals (without adding washers, etc).

For high-voltage machines, power supply cables should be connected to separate terminals or to current transformer terminals.

#### NOTE:

The gland plate is made of non-magnetic material.



#### CAUTION:

**DO NOT ADD WASHERS TO THE POWER SUPPLY CABLE TERMINALS OTHER THAN THOSE USED BY THE MANUFACTURER OF THE ELECTRIC MACHINE.**

Make sure the lugs are tight. Refer to chapter 5.8.



#### CAUTION:

**ALL CURRENT TRANSFORMERS MUST BE CONNECTED OR SHUNTED.**



#### CAUTION:

**THE VOLTAGE TRANSFORMER MUST NEVER BE SHUNTED.**



#### CAUTION:

**THE INSTALLED POWER CABLES MUST BE FASTENED AND SUPPORTED IN SUCH A WAY AS TO BE ABLE TO WITHSTAND THE VIBRATION LEVEL REACHED BY THE GENERATOR IN OPERATION (refer to chapter 2.1.3.4).**

The power cables must not stress (push, pull, flex, etc.) the generator terminals.

#### 3.4.1 Phase Order

##### 3.4.1.1 Standard units; IEC 34-8

Except by special request of the customer, the phase-sequence is chosen as per the IEC 34-8 standard.

An arrow located on the front bearing indicates the direction of rotation.

In the terminal box a specific marking plate indicates the specific generator phase sequence.

Clockwise rotation viewed from the shaft drive end	Counter clockwise rotation viewed from the shaft drive end
The phases are identified: U1, V1, W1.	The phases are identified: U1, V1, W1.
The installer connects the following: L1 --> U1 L2 --> V1 L3 --> W1	The installer connects the following: L3 --> U1 L2 --> V1 L1 --> W1

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## Industrial Range Alternators – 4 poles

### 3.4.1.2 Upon request; NEMA

An arrow located on the front bearing indicates the direction of rotation.

In the terminal box a specific marking plate indicates the specific generator phase sequence.

Counter clockwise rotation viewed from the stator connection (NEMA) (Clockwise rotation viewed from the shaft drive end following IEC)	Clockwise rotation viewed from the stator connection (NEMA) (Counter clockwise rotation viewed from the shaft drive end following IEC)
The cables are marked: U1, V1, W1. The terminals are marked: T3, T2, T1	The cables are marked: U1, V1, W1. The terminals are marked: T3, T2, T1
The installer connects the following: L1 --> (U1) T3 L2 --> (V1) T2 L3 --> (W1) T1	The installer connects the following: L3 --> (U1) T3 L2 --> (V1) T2 L1 --> (W1) T1

### 3.4.2 Insulation distances

Products not delivered by Nidec Power and then installed in the terminal box must meet the electrical insulating distances.

This applies to power cables and lugs, and to added transformers, etc.

Nominal Voltage	500 V	1 KV	2 KV	3 KV
Phase-Phase in the air (mm)	25	30	40	60
Phase-Earth in the air (mm)	25	30	40	60
Phase-Phase Creeping (mm)	25	30	40	70
Phase-Earth Creeping (mm)	25	30	40	70

Nominal Voltage	5 KV	7.5KV	12.5KV	15 KV
Phase-Phase in the air (mm)	120	180	190	190
Phase-Earth in the air (mm)	90	120	125	125
Phase-Phase Creeping (mm)	120	180	190	190
Phase-Earth Creeping (mm)	120	180	190	190

### 3.4.3 Added products in the terminal box

This may apply to site added customer CTs; VTs etc.

Nidec Power must be informed if some appliances have to be installed in the generator terminal box.

The products not delivered by Nidec Power and then installed in the terminal box must meet the electrical insulating distances. Refer to chapter 3.4.2.

The installed appliances must be able to withstand vibration.

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## Industrial Range Alternators – 4 poles

### 4. START-UP

#### 4.1 ELECTRICAL START-UP INSPECTION

##### 4.1.0 General information

Electrical connections (auxiliaries, safety and power lines) must comply with the drawings provided.

Refer to Section 5 to get the concerned schematics.



#### **DANGER:**

**Check that all safety equipment operates correctly.**

##### 4.1.1 Insulation of the winding

Isolation and polarisation index must be measured at start-up and then as recommended in Chapter 5.1.0.

To measure the insulation (refer to chapter 5.10).

##### 4.1.2 Electrical connections

The phases must be connected directly to the bars of the machine (without spacers or washers, etc.).

Make sure that the lugs are sufficiently tightened.



#### **CAUTION:**

**ALL CURRENT TRANSFORMERS MUST BE CONNECTED BEFORE STARTING. IF A CURRENT TRANSFORMER IS NOT USED, ITS OUTPUT MUST BE SHORTED.**

##### 4.1.3 Parallel operation

###### 4.1.3.1 Definition of parallel operation

###### • Between machines

Operation mode named by Nidec Power "1F".

At least two alternators are connected in parallel to supply a load.

The automatic voltage regulator is in voltage regulation mode.

A droop current transformer is necessary to share the reactive load.

###### • With the mains

Operation mode named by Nidec Power "3F".

At least one alternator is connected in parallel with the mains (Public electricity network).

The Automatic Voltage Regulator is in Power Factor regulation mode.

###### 4.1.3.2 Possibility of parallel operation



#### **CAUTION:**

**PARALLEL OPERATION CAN ONLY BE USED FOR ALTERNATOR ENGINEERED FOR SUCH OPERATION.**

###### 4.1.3.3 Parallel coupling



#### **CAUTION:**

**A WRONG SYNCHRONIZATION CAN LEAD TO SERIOUS DAMAGE(HIGH MECHANICAL OVERTORQUE AND OVER CURRENT).**

During synchronization the following values must not be exceeded:

Max frequency shift:	0.1 Hz
Max phase offset:	10° (electrical angle)
Max voltage (phase - neutral) between machines: (at phase offset =0)	5 % of the nominal voltage

Nidec Power will not be considered as liable for any damage in case of incorrect synchronisation, or mains micro-interruption inducing a fault over the indicated limits.

#### 4.2 MECHANICAL START-UP INSPECTION

##### 4.2.0 General information

###### 4.2.0.1 Alignment; attachment; drive motor

The installation must comply with the drive motor manufacturer's installation requirements (alignment, mounting).

An arrow at the drive end, end shield, indicates the direction of rotation.

###### 4.2.0.2 Cooling

The air inlet and outlet must not be obstructed.

The cooling auxiliaries (water circulation in the cooler, etc) must be operating.

###### 4.2.0.3 Lubrication

Lubrication must be carried out in accordance with Chapter 5. Lubricant quantity and periodicity as per Section 1.

###### 4.2.1 Starting roller-bearing machines

The bearings are pre-lubricated in the factory, but it is necessary to re-lubricate them before they are put into service in order to fill any gaps in the lubrication circuit and to remove the storage grease.



#### **CAUTION:**

**WHEN STARTING UP, LUBRICATE THE MACHINE WITH THE AMOUNT OF GREASE INDICATED ON THE NAMEPLATE WHILE IT IS IN OPERATION.**

Record the temperature of the bearings during the initial operating hours. Poor lubrication can cause abnormal heating.

If the bearing hisses, lubricate it immediately. Some bearings may make a clattering noise if they do not operate at normal temperature. This may occur if the weather is very cold or when the machine is operating under abnormal temperature conditions (start-up phase, for example). The bearings will become quieter after having reached their normal operating temperature.

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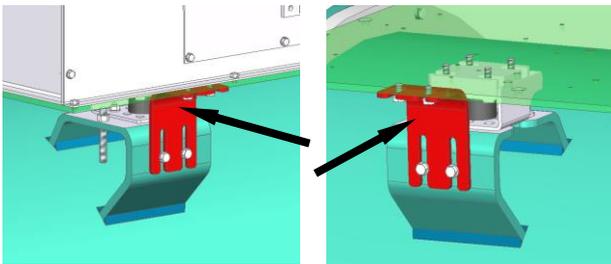
## Industrial Range Alternators – 4 poles

### 4.2.2 Terminal Box start-up

The terminal box is mounted on damper pads.

**⚠ CAUTION:**  
**BEFORE THE ALTERNATOR STARTS, ALL FOUR BLOCKING SYSTEMS FOR TRANSPORT MUST BE DISASSEMBLED.**

**⚠ CAUTION:**  
**THE BLOCKING SYSTEMS FOR THE TRANSPORT OF THE TERMINAL BOX MUST BE INSTALLED EACH TIME THE ALTERNATOR IS TRANSPORTED (ALONE OR WITH ITS MOTOR).**



The four locking brackets (each fastened by 4 M10 screws; red parts in the diagram above) must be removed and kept.

### 4.2.3 Vibrations

The vibration measurement must be taken on each bearing in all three directions. The measured levels must be lower than the specified values indicated in the chapter 2.1.3.4.

Adjust the sensor as per chapter 2.1.3.4.

## 4.3 START-UP SEQUENCES

Start-up (commissioning) of the generator must follow the following sequences:

### 4.3.1 Machine stopped checks

Mounting of the machine as per chapter 4.2.

Alignment as per chapter 3.3.

Cooling as per Chapter 4.2.0.2 & 4.2.3.

Lubrication of bearings as per Chapter 4.2.2.

Electrical connections as per chapter 4.1.2.

Winding insulation as per chapter 5.10.

### 4.3.2. Machine running checks

#### 4.3.2.0 Rotor speed ramp-up (Standard Machine)

There are no restrictions on the rate of rotor speed increase between stop and rated speed.

There is no restriction regarding the rate of load application.

#### 4.3.2.1 Checks of machine running without excitation

Run the generator without excitation by steps to verify the bearings temperature as per chapter 2.5.1 or 2.6.2.

At the nominal speed (not excited) measure the vibrations. Check that the vibration level is in accordance with the use of the generator (as per chapter 2.1.3.4).

#### 4.3.2.2 Checks of excited machine running with no load

In manual AVR voltage regulation mode, check the excitation current value (refer to Section 4 for more information on manual AVR mode and to Section 2 for the generator test report).

In AVR automatic mode; Voltage adjustments; Voltage range; check the excitation current value (refer to Section 4 for the AVR manual and to Section 2 for the generator test report).

At the nominal speed (excited) measure the vibrations.

Check that the vibration level is in accordance with the use of the generator (as per chapter 2.1.3.4).

#### 4.3.2.3 Generator and site safety parameter

Adjust the site safety systems (surge voltage relay, surge current relay, residual current protection, negative sequence relay, etc.) The setting points are not in the Nidec Power scope of supply.

The settings must comply with the generator data sheet (e.g. capacity curve; thermal damage curve, etc.).

Check the synchronizer setting as per chapter 4.1.3.3.

For any operation at a speed exceeding the nominal range (generally the main frequency +3%) the generator excitation must be shut off (refer to the electrical schematics).

#### 4.3.2.4 Checks of machine running under full load checks

Grid-coupled operation.

Adjust the Power Factor.

Progressively apply load to the generator:

Check the excitation current at 25% of the rated load.

Check the excitation current at 100% of the rated load.

At the nominal speed (full load) measure the vibrations.

Check that the vibration level is in accordance with the use of the generator (as per chapter 2.1.3.4).

**4.3.3 Generator start-up checklist**

TYPE		SERIAL No.						
Voltage		V	Frequency		Hz	Speed		rpm
Output Power		kVA	Power Factor					

**STATIC CHECKS**

**Mechanical checks**

- Direction of Rotation (refer to Section1) Clockwise  or Anti-clockwise
- Mechanical fastening of the generator (see Chapter 4.2) \_\_\_\_\_
- Coupling - Alignment with the motor (refer to chapter 3.3) \_\_\_\_\_
- **Cooling:** Coolant flow rate (see section 1; Chapters 4.2.0.2 & 4.2.3) \_\_\_\_\_
- Open air inlet and outlet \_\_\_\_\_
- **Bearing lubrication:** Lubrication of plain bearings (flow rate; level; oil) (Section 1 & Chapter 4.2.2) \_\_\_\_\_
- Or Roller bearings lubrication (refer to Section1 & chapter 4.2.1)
- Temperature sensors (correct readings) (Section 1& Chapters 2.5.1 & 2.6.2) \_\_\_\_\_
- Heating by additional resistance heaters (see section 1) \_\_\_\_\_

Type of AVR :       1F       3F

**Electrical connections between alternator, AVR and main panel:** (refer to Section 4 & drawing Section 5)

- Output power cable connections in phase order (see Chapter 3.4.1) \_\_\_\_\_
- Terminal box connections \_\_\_\_\_
- AVR detection voltage \_\_\_\_\_
- Supply power and excitation terminals \_\_\_\_\_
- Network detection (3F only) \_\_\_\_\_
- Command signals (equalisation and synchronisation for 3F) \_\_\_\_\_
- Excitation polarity and booster \_\_\_\_\_
- Protective devices: (Bearing oil level fault detectors; Temperature sensors, etc) \_\_\_\_\_
- External accessories (e.g. remote potentiometer) \_\_\_\_\_

**ALL CURRENT TRANSFORMERS MUST BE CONNECTED.**

**Windings insulation**

	Winding temp.:.....°C	Voltage	1 minute (MΩ)	10 minutes (MΩ)	Polarisation index
Static parts	3 Phases / Ground				
	"U" /Ground				
	"V" /Ground				
	"W" /Ground				
	"U" / "V"				
	"U" / "W"				
	"V" / "W"				
	Exciter field / Ground				
If the 3 phases/earth IR measurement is compliant then the rest of the measurements are not required for a Commissioning					
Rotating parts	Rotor / Ground	≤ 500 V			
	Exciter armature / Ground	≤ 500 V			
	Rotating resistances	≤ 500 V			
	Rotating diodes	≤ 500 V			

**All works must be carried out by a qualified and authorised person.**

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## Industrial Range Alternators – 4 poles

### RUNNING CHECKS

#### WITH EXCITATION - AT NO LOAD CONDITIONS

- Verification of the temperature of the bearings (refer to chapter 2.5.1 or 2.6.2)  °C
- In manual mode:
  - Voltage setting
  - Excitation current check
- In automatic mode:
  - Voltage Setting (referring to nominal voltage)
  - Excitation current check
- Parallel coupling: Adjustment for parallel operation (3F)

#### FAULTY SYNCHRONISATION CAN LEAD TO DAMAGE (HIGH MECHANICAL OVER-TORQUE)

- Maximum acceptable values for synchronisation with the mains:
  - Maximum frequency shift 0.1 Hz
  - Maximum Phase offset 10 °
  - Maximum voltage (P.N.) difference 5% of Un

#### Control / Adjustment of the site safety parameters

- Over-voltage
- Over-current (by short-circuit on stator in separate excitation mode)
- Negative sequence relay
- Over-speed
- Differential protection (in static conditions)
- Other protective device

#### CHECK THAT ALL SAFETY EQUIPMENT OPERATES CORRECTLY.

#### WITH EXCITATION - LOADED

Take the load gradually from 0 to 100% in steps of 25%.

Record for each step (refer to Section 1):

- Electrical output (KW)
- POWER FACTOR
- Voltage (V)
- Current (A)
- Excitation Current / voltage
- Winding temperature

Time	KW	pf	Volts	I (A)	I (ex)	U1 (°C)	V1 (°C)	W1 (°C)

- Temperature of the bearings (if thrust sensor available, please record its value)

Time	DE Thrust (°C)	DE Radial (°C)	NDE Radial (°C)

- Oil inlet temperature (if applicable; refer to Section 1)
- Oil flows (if applicable; refer to Section 1)
- Vibrations of the bearings (mm/s) (refer to chapter 2.1.3.4)

DE-V	DE-H	DE-A	DE-V	DE-H	DE-A

All maintenance must be carried out by a qualified and authorised person.

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## Industrial Range Alternators – 4 poles

### **5. MAINTENANCE AND SERVICING**

#### **5.0 GENERAL INFORMATION**

**DANGER:**

**BEFORE ANY WORK ON THE GENERATOR, MAKE SURE THAT THE START-UP CANNOT BE ACTIVATED BY ANY MANUAL OR AUTOMATIC SIGNAL. CHECK THAT ALL LOCKS ARE ENGAGED AND FOLLOW THE SITE SAFETY PROCEDURES.**

**DANGER:**

**Before working on the machine, make sure that you have understood the operating principles of the system. If necessary, refer to the appropriate chapters in this manual.**

To obtain additional information on the maintenance of sub-assemblies, refer to the chapters dealing with the sub-assemblies concerned.

When a defective part is replaced with a spare part, make sure that it is in good condition.

For any electrical work use electrical schematics for assistance.

The whole machine must be kept clean.

**CAUTION:**

**ANY OF THE CLEANING PERIODS INDICATED IN THIS MANUAL MAY BE CHANGED (INCREASED OR DECREASED) DEPENDING ON SITE CONDITIONS.**

The air inlet and air outlet surfaces must be kept clean (louvers can be cleaned like for the filters). Refer to chapter 5.5.1.

**CAUTION:**

**DIRT ENTERING THE MACHINE MAY POLLUTE AND THUS REDUCE THE ELECTRICAL INSULATION.**

**CAUTION:**

**ANY PRODUCT (SEALANT, CLEANING PRODUCT, ETC.) USED DURING MAINTENANCE OR CLEANING MUST COMPLY WITH LOCAL REGULATIONS AND ENVIRONMENTAL STANDARDS.**

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## Industrial Range Alternators – 4 poles

### 5.1 PREVENTIVE MAINTENANCE PROGRAMME

#### 5.1.0 General information

The purpose of the general preventive maintenance programme below is to assist in establishing the installation-specific maintenance programme. Suggestions and recommendations should be followed as closely as possible to keep the machine efficient so as not reduce its service-life.

The maintenance operations are detailed in the chapters dedicated to the topics concerned.

The time required for the operations is indicated for information purposes only.

	Hours	Comments	Task duration
Major overhaul	40000	Or 5-7 years depending on on-site conditions	4 weeks

#### 5.1.1 Stator

	Hours	Comments	Task duration
Winding temperature	24	Daily operation, (without generator set). Refer to chapter 2.1.3.2	
Insulation	8000	(*1) Refer to 5.8	4 hrs
Polarisation index	8000	(*1) Refer to chapter 5.8.2	
Bolt tightening	8000	(*1) Refer to chapter 5.6	2 hrs
Winding visual inspection	8000	(*1) Refer to 5.8	1 hr
Stator RTD function	8000	(*1) Refer to 2.1.3.2	
Cleaning air inlet and outlet	1000	(*1) Refer to chapter 5.5	

(\*1): or once a year, whichever comes first

#### 5.1.2 Rotor

Insulation	8000	(*1) Refer to 5.8	0.5 hr
Polarisation index	8000	(*1) Refer to chapter 5.8.2	
Winding visual inspection	8000	(*1) Refer to 5.8	
Cleaning diodes	8000	(*1) Refer to chapter 5.9	0.5 hr
Diodes and varistor check	8000	(*1) Refer to chapter 5.9	
Diode tightening	8000	(*1) Refer to chapter 5.6.4	

(\*1): or once a year, whichever comes first

#### 5.1.3 Terminal box

Cleaning	8000	(*1)	0.5 hr
Regulator assembly & supports	8000	(*1) Applicable if mounted in the terminal box	
Bolt tightening	8000	(*1) Refer to chapter 5.6.3	1.5 hrs

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### Industrial Range Alternators – 4 poles

#### 5.1.4 Roller bearing

According to the technical characteristics indicated in Section 1.

The bearings can be re-lubricated as standard	With regard to the type of grease, the lubricating intervals and the quantity to be supplied to each bearing: refer to nameplate directions	Minimum every 6 months
Standard grease	MOBIL POLYREX™ EM: NLGI grade 2	
Factory lubrication	MOBIL POLYREX™ EM: NLGI grade 2	
Special grease	Refer to nameplate directions	



**Following the requirements of the nameplate is essential. Other priority information may be mentioned.**



**Lubricating the alternator in operation and during the first commissioning is essential.**

**Before using any other grease, check its compatibility with the original grease.**



**On some 52.3, 3 lubricators are available on the bearings so that the maintenance operator can choose the most accessible. Lubrication is effectively ensured regardless of the lubricator used.**

Bearing temperature	24	Daily operation, (without generator set). Refer to chapter 2.5.1	
---------------------	----	--	--

#### 5.1.5 Rubber dampers

Rubber dampers	8000	Refer to chapter 2.3.1 Refer to chapter 5.13	
----------------	------	---	--

#### 5.1.6 Filters

According to the technical characteristics indicated in Section 1

Cleaning	1000	Cleaning following site conditions; Refer to chapter 5.5.1	4 hrs
----------	------	--	-------

#### 5.1.7 Protection devices

Protection devices	8000	(*1)	
--------------------	------	------	--

(\*1): or once a year, whichever comes first

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## Industrial Range Alternators – 4 poles

### 5.2 AIR GAP CHECK

#### 5.2.1 General information

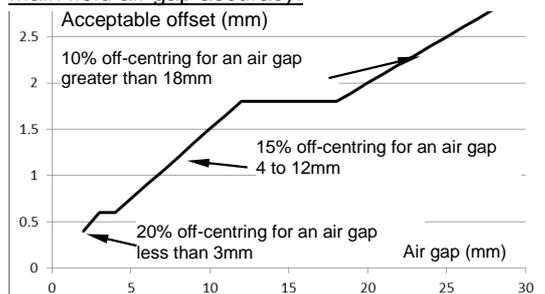
Measuring air gap is not always possible due to lack of access. When the air gap can be reached the measure can be distorted because of paint and resin coating on the checked surfaces.

Measure the air gap at different points (minimum four different points spaced by 90°).

Calculate an averaged value (sum of the measures divided by the number of measurements).

Compare the averaged value to the measured values.

#### Main field air gap accuracy:



E.g.: for a nominal air gap of 3 mm a measured air gap value of 2.4 mm is acceptable.

E.g.: for a nominal air gap of 10 mm an air gap measured value of 8.5 mm is acceptable.

#### Exciter air gap accuracy:

50% of the nominal value (e.g.: for a nominal air gap of 3 mm a reading of 1.5 mm is acceptable).

#### Permanent Magnet Generator (optional) air gap tolerance:

50% of the nominal value (e.g.: for a nominal air gap of 1 mm a reading of 0.5 mm is acceptable).

#### 5.2.2 Double-bearing machine

It is not necessary to check the air gap. The rotor is mechanically centred by its construction. Even after dismantling and reassembling the machine, the rotor will return to its position without verification of the air gap. The exciter air gap of generators type A60 and A62 can be adjusted on site by 2 jacking screws.

### 5.3 BEARINGS

#### 5.3.1 General information

##### NOTE:

Some international studies indicate that over 80% of roller bearings installed worldwide, regardless of the context, are damaged prematurely due to a lubrication problem.

To preserve your machine we recommend closely fulfilling the recommendations of this manual.

They must be lubricated regularly with the same type of grease as used in the factory. For information concerning the lubrication quantity and interval, refer to Section 1: "Characteristics and Performance".



##### CAUTION:

LUBRICATION MUST BE CARRIED OUT AS PER SECTION 1 OR AT LEAST EVERY 6 MONTHS WHICHEVER COME FIRST.

##### NOTE:

After a relubricating, the bearing temperature may increase by 10 to 20°C.

This temporary temperature increase may persist for a few tens of hours.

##### NOTE:

In case of a "stand by" duty or generator with short operation cycles, it is recommended to run the machine for at least 3 hours after each regreasing.

##### NOTE:

For regreasing period less than 2,000 hours we recommend installing a continuous lubrication system to limit the maintenance operator interventions.

This type of system must be deactivated during machine shut-down.

The grease contained in these systems must not remain there over a period of more than 1 year.

#### 5.3.2 Cleaning of old bearing grease

This chapter applies in the event of a change in the type of grease.

Dismantle the machine in order to have access to the bearing.

Remove the old grease with a palette knife.

Clean the lubricator and the grease removal tube.

For greater cleaning efficiency, use a brush with solvent.

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**NOTE:**

The solvent used must be in accordance with local regulations and environmental standards.

**DANGER:**

**THE PROHIBITED SOLVENTS ARE:**

**CHLORINATED SOLVENT**

**(TRICHOETHYLENE, TRICHLOROETHANE) WHICH BECOMES ACID.**

**FUEL-OIL (EVAPORATES TOO SLOWLY).**

**GASOLINE CONTAINING LEAD**

**BENZENE (TOXIC).**

After cleaning ensure that the bearing becomes perfectly dry.

Fill the bearing with the new grease.

Re-assemble the cage and the parts, which have been dismantled, filling them with grease (2/3 of the empty spaces must be filled with new grease).

Use a grease pump to complete the bearing lubrication (while machine running).

**5.3.3 Cleaning of the bearing assembly area**

The bearing service-life depends directly on the cleanliness of the lubricant. Dirt must not enter or pollute the bearings.

Excess grease must be removed before operation in order to avoid pollution of the environment as well as the alternator.

Periodically:

clean the labyrinth seals outside face. Remove any excess grease which may appear on the shaft.

Remove the excess of dry old grease from the bearing exhaust channel (use a clean blade).

After removing the old grease, check that a small fresh volume of grease will plug the exhaust channel (to avoid pollution coming back to the bearing).

**5.3.4 Bearing disassembly**

The bearing inner ring is shrink fitted onto the shaft.

The outer bearing race is free, or slightly tightened, on the hub (depending on the type of bearing). To remove the bearing from the shaft, it is necessary to use a dedicated hub-puller to avoid damaging the surface of the shaft.

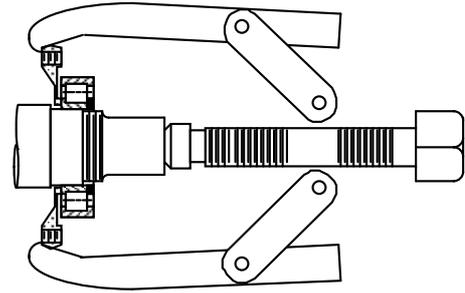
Typical bearing drawing assembly is given in chapter 10.

**CAUTION:**

**CLEANLINESS IS IMPERATIVE.**

**NOTE:**

**Heating the bearing during the pulling operation is recommended to prevent the shaft from being scored.**

**5.3.5 Bearing reassembly**

A bearing can be reused if it is found to be in perfect condition. As far as possible, we recommend to use a brand new bearing.

Before refitting a bearing, carefully clean the surface of the bearing and the other parts of the bearing.

Measure the shaft diameter to check it is within the recommended tolerances.

To install the bearing on the shaft, it is necessary to heat the bearing. The heat source may be an oven or a space heater (the use of oil baths is not recommended). The use of an induction bearing heater is recommended.

**CAUTION:**

**NEVER HEAT A BEARING TO MORE THAN 125°C (257°F).**

Push the bearing up to the shaft shoulder, and check after cooling that the inner ring is still in contact with the shoulder. Lubricate using the recommended grease. Fill the bearing covers with new grease.

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### 5.4 LUBRICANTS

#### 5.4.1 Greases

Recommended lubricant:

MOBIL POLYREX EM (polyurea base).

Recommendation for a substitution grease choice:

Mineral oil or PAO (SHC)

Base (soap) grade NLGI 2

Lithium complex base (Lithium base accepted)

Basic viscosity of oil at 40°C: from 100 to 200 mm<sup>2</sup>/s

Dye penetration test (DIN 51817): 2% minimum

Greases recognised as possible substitution grease:

SKF LGWA2 (lithium complex base). Recommended lubricant):

CASTROL LMX NLGI2

TOTAL Multis complex EP2



**CAUTION:**

**THE USE OF A SUBSTITUTION GREASE REDUCES THE RE-LUBRICATING PERIOD BY 40%.**

**NOTE:**

Lithium soap and lithium complex can be mixed.  
Lithium complex and calcium lithium soap can be mixed.

If the brand of grease is changed, it is recommended to do intense lubrication to eliminate the old grease.

**NOTE:**

Mixing different types of grease never improves the positive properties of greases! Mixing of different types of grease must be done only after obtaining agreement from the grease supplier or after cleaning off the old grease from the bearing.

### 5.5 AIR FILTER

#### 5.5.1 Cleaning

##### 5.5.1.1 Air Filter Cleaning Frequency

The frequency of cleaning depends on the on-site conditions and may vary.

Cleaning of the filter becomes necessary if the temperature of the stator winding (measured by probes) indicates an abnormal increase.

##### 5.5.1.2 Air filter cleaning procedure

The filter element (flat or cylindrical) is immersed in a tank of cold or warm water (temperature less than 50°C). Use water with detergent added.

Shake the filter gently to ensure that the water flows through the filter in both directions.

When the filter is clean, rinse it with clear water.

Drain the filter properly (there must be no more formation of droplets).

Refit the filter on the machine.



**CAUTION:**

**DO NOT USE WATER WITH A TEMPERATURE HIGHER THAN 50°C, DO NOT USE SOLVENTS.**

**NOTE:**

Do not clean the filter using compressed air. This procedure would reduce filter efficiency.

### 5.6 SCREW TIGHTENING

#### 5.6.0 General information

It is recommended to use a thread-locking compound on all fastening screws, or plugs (except for electrical contacts) that have been loosened or disassembled during any operation.

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A medium strength thread locking compound such as or similar to "Loctite 242"; or "Omnifit 100M" (from Henkel).

### 5.6.1 Steel screws in steel tapping

If no torque value is specified in the relevant chapter, apply the following values to secure the metal parts together.

Fasteners: Steel / Steel (with medium strength thread locking compound)			
Ø nominal (mm)	Torque (N.m)	Ø nominal (mm)	Torque (N.m)
3	1.0	18	222
4	2.3	20	313
5	4.6	22	430
6	7.9	24	540
8	19.2	27	798
10	37.7	30	1083
12	64.9	33	1467
14	103	36	1890
16	160		

### 5.6.2 Plugs

If no torque value is specified in the relevant chapter, apply the following values to tighten the plugs.

Steel and copper alloy Plugs (with medium strength thread locking compound)			
Ø nominal (inches)	Torque (N.m)	Ø nominal (inches)	Torque (N.m)
G3/8	30	G1 ¼	160
G1/2	40	G1 ½	230
G3/4	60	G2	320
G1	110	G2 ½	500

### 5.6.3 Electrical contact

If no torque value is specified in the relevant chapter, apply the following values for clean and dry brass (or copper alloy) threads.

**⚠ CAUTION:**  
**THE USE OF THREAD LOCKING COMPOUND ON ELECTRICAL FASTENERS IS PROHIBITED.**

Thread	M5	M6	M8	M10	M12	M14	M16
Torque [N.m]	3.3	5.7	14	28	48	76	118

### 5.6.4 Rotating diodes

**⚠ CAUTION:**  
**THE ROTATING DIODE FASTENING SCREWS MUST BE TIGHTENED USING A TORQUE WRENCH CALIBRATED TO THE RECOMMENDED TORQUE.**

Diode	Tightening torque
SKR 100/..	10 N.m
SKR 130/..	10 N.m
SKN 240/..	30 N.m

### 5.6.5 Synthetic parts

This applies to lightweight parts made of synthetic materials (plastic covers, fiberglass covers; fiberglass fan air deflector, etc.).

**⚠ CAUTION:**  
**THE USE OF A THREAD LOCKING COMPOUND IS IMPERATIVE.**

Thread	M8	M10	M12	M14	M16
Torque [N.m]	15	15	15	15	15

## 5.7 ELECTRICAL MEASURING INSTRUMENTS

### 5.7.1 Instruments used

- AC voltmeter 0-600 Volts
- DC voltmeter 0-150 Volts
- Ohmmeter 10E-3 to 10 ohms
- Megohmmeter 1 to 100 MOhms / 500 Volts
- AC Ammeter 0- 4500 A
- DC Ammeter 0-150 A
- Frequency meter 0-80 Hz

Low resistance can be measured by means of an appropriate ohmmeter or by using a Kelvin or Wheatstone bridge.

**NOTE:**  
The identification of the equipment polarity may differ from one ammeter to another.

## 5.8 INSULATION CHECK OF WINDINGS

### 5.8.0 General information

The insulation resistance is used to check the insulation status of the machine.

The following measurements can be taken at any time without any damage to the machine insulating material.

The insulation check must be done:

- Before the start up
- After a long shut-down

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- As soon as an abnormal operation occurs
  - At maintenance intervals (refer to chapter 5.1)
- If the measurement indicates a poor result, we advise contacting our Service department.

The generator must be stopped to perform the measurement.

If the insulation resistance is less than that required, it is necessary, to clean and dry the machine (refer to chapter 5.11).

**⚠ DANGER:**  
**BEFORE ANY WORK, THE RULES CONCERNING THE SAFETY OF MATERIALS AND PERSONS MUST BE APPLIED (TOTAL LOCKING OF THE GENERATOR FUNCTIONS, GROUNDING OF THE PHASES , ETC.).**

### 5.8.1 Insulation measurement

Disconnect the three phases at the generator terminals.

**⚠ CAUTION:**  
**ALL ACCESSORIES MUST BE DISCONNECTED (AVR, EMC FILTER, ETC.).**  
**REFER TO THE ELECTRICAL SCHEMATICS TO IDENTIFY THE ACCESSORIES TO DISCONNECT.**

The measurement has to be taken between one phase and the earth. The reading is taken after 1 minute of test.

	Test voltage (VDC)	Criteria (MΩ; 40°C)
Stator: $U \leq 1$ kV	500	5
Stator: $1 \text{ kV} < U \leq 6.6$ kV	2500	100
Stator: $U > 6.6$ kV	5000	100
Rotor	500	5
Exciter (Stator & Rotor)	500	5
Excitation auxiliary windings (AREP)	250	5
PMG (stator)	100	5
Heating element	500	5
Temperature sensors	500	5

IEEE 43 recommendations

If the insulation resistance is not measured with a tested element à 40°C, a corrective factor has to be used.

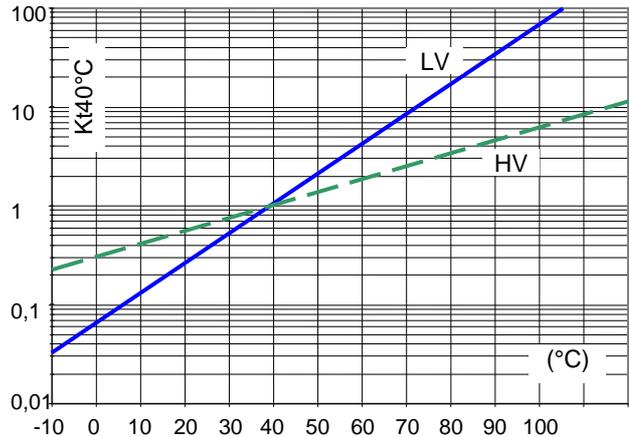
$$R_{m\ 40^{\circ}\text{C}} = R_t \times K_{t40}$$

$R_t$  Measured insulation resistance

$K_{t40}$  Corrective factor

LV curve for generator voltage  $\leq 1$  kV

HV curve or generator voltage  $> 1$  kV



If the minimum insulation level is not reached, dry the windings (see Chapter 5.11) and measure after drying. Start-up can only be allowed if the insulation value has increased and is above the recommended minimum value.

### 5.8.2 Polarisation Index

The polarisation index is used to check the insulation status of the machine and gives an indication of the pollution of the winding.

A poor polarisation index may be corrected by a cleaning and drying of the winding.

The following measurements can be taken at any time without any damage to the machine insulating material.

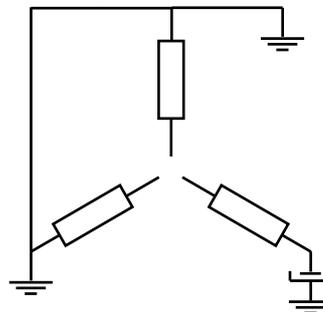
**⚠ CAUTION:**  
**ALL ACCESSORIES MUST BE DISCONNECTED (AVR, EMC FILTER, ETC.).**  
**REFER TO THE ELECTRICAL SCHEMATICS TO IDENTIFY THE ACCESSORIES TO DISCONNECT.**

### NOTE:

**It must be done using a stable DC source.**  
**Use a specific polarisation index appliance (refer to chapter 5.8.1 for the correct applied voltage).**

Proceed for each phase.

Open the winding star point.



Apply the requested voltage.

After 1 minute record the Insulating resistance " $R_{1\ \text{min}}$ ".

After 10 minutes record the Insulating resistance " $R_{10\ \text{min}}$ ".

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$$i_p = \frac{R_{(t=10\text{minutes})}}{R_{(t=1\text{minute})}}$$

Polarisation index	Diagnostic	Action
$i_p < 1$	Poor	Intervene
$1 < i_p < 2$	Fair	Monitor
$2 < i_p < 4$	Good	Nothing to report
$i_p > 4$	Very good	Nothing to report

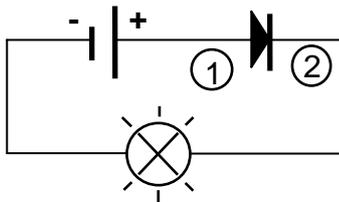
### 5.9 ROTARY DIODE BRIDGE TEST

Carry out the test using a D.C. source as indicated below.

A diode in good condition should allow the current to flow **only** in the anode-to-cathode direction.

Disconnect the diodes before the test.

3 ... 48 volts



- 1 - Anode  
2 - Cathode

Diode type	Positive	Negative
SKR	diode housing	diode wire
SKN	diode wire	diode housing

When reassembling, ensure that the diodes are tightened to the correct torque.

### 5.10 COIL CLEANING

#### 5.10.0 General information

The cleaning of the winding is a very demanding operation which must be carried out only if necessary.

The cleaning of the windings become necessary as soon as the insulation resistance and/or the polarisation index are not satisfactory (refer to chapter 5.8.2).

#### 5.10.1 Coil cleaning products

Effective long-term cleaning can only be performed in a workshop with specialised equipment.

A site cleaning, because less efficient, can be considered only for a transient period.

**⚠ CAUTION:**  
**USED CLEANING AGENT MUST BE IN ACCORDANCE WITH LOCAL REGULATION AND ENVIRONMENTAL STANDARDS.**

**⚠ CAUTION:**  
**SOLVENTS, WHICH ARE HIGHLY CHLORINATED AND SUBJECT TO HYDROLYSIS IN DAMP ATMOSPHERES ARE PROHIBITED. They quickly become acidified, producing corrosive and conducting hydrochloric acid.**

**⚠ CAUTION:**  
**DO NOT USE TRICHLOROETHYLENE, PERCHLOROETHYLENE, OR TRICHLOROETHANE.**

Avoid mixtures sold under various trademarks which often contain white spirit (which evaporates too slowly) or chlorinated products (which are likely to become acidified).

**⚠ CAUTION:**  
**DO NOT USE TOO STRONG ALKALINE PRODUCTS. THEY ARE DIFFICULT TO RINSE AND CAUSE REDUCTION OF INSULATION RESISTANCE BY ATTRACTING MOISTURE.**

#### 5.10.2 Cleaning Operation

Use a mild alkaline product or a dedicated cleaning product.

We recommend the use of the cleaning agent "ASOREL CN" from "Rhône Chimie Industrie"; 07300 Tournon; France. This cleaning agent Does not require any rinsing operation.

It is essential to avoid entry of cleaning agents and dirt into the notches. Apply the product with a brush, sponging frequently in order to avoid accumulation in the housing.

After cleaning, a rinsing operation must be performed. Hot soft water (less than 80°C) used under pressure (less than 20 bars) can be used.

**⚠ CAUTION:**  
**AFTER CLEANING THE GENERATOR, DRYING IS ESSENTIAL FOR RECOVERING THE CORRECT WINDING INSULATION.**

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### 5.11 WINDING DRYING

#### 5.11.0 General information

All electrical machines must be stored dry. If a machine is placed in a damp environment, it should be dried prior to start-up. Units operating intermittently or placed in areas with high temperature variations, are exposed to dampness and must be dried very thoroughly if necessary.

#### 5.11.1 Drying Method

##### 5.11.1.1 General information

During the drying operation, measure the coil insulation and polarisation index every 12 hours.

To survey the insulation progress, record the measured values and plot the obtained progress function of the time. When the insulation value becomes constant, the machine can be considered as dry.

When the resistance is constant, it may be assumed that the machine is dry. This operation may take up to 72 hours, depending on the size of the machine and on the degree of dampness.

#### **⚠ CAUTION:**

**TAKE FIRE-PREVENTION MEASURES DURING THE DRYING OF THE MACHINE.  
ALL THE CONNECTIONS MUST BE TIGHTENED.**

##### 5.11.1.2 Drying generator in a stopped position

The procedure "Drying generator in rotation" should be preferred to the following one if it is possible to run the generator at its nominal speed.

Several thermometers must be positioned on the winding and the temperature must not exceed 75°C (167°F). If one of the thermometers exceeds this value, immediately reduce the heating.

Dry by using an external source of heat, for example, heaters, lamps, or hot air blowers.

Leave openings to exhaust the damp air.

##### 5.11.1.3 Drying generator in rotation

**⚠ CAUTION:**  
**THIS OPERATION MUST BE DONE BY A QUALIFIED OPERATOR.**

Disconnect the machine from the mains.

Short circuit the machine stator at the machine terminals.

Disconnect the voltage regulator. If a booster current transformer used, short-circuit the booster.

Run the machine at its nominal speed (to air cool the machine) with the cooling system in operation.

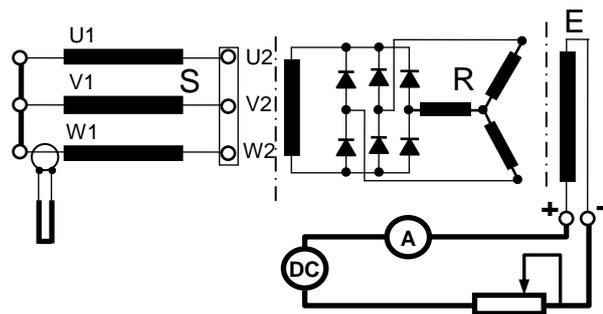
Energise the machine (exciter field) using a separate excitation source. Use a DC source (batteries, etc.).

Install an ammeter on excitation supply line.

Adjust the excitation current to get 2/3 of the nominal excitation current (refer to name plate data or alternator test report).

Warm up during 4 hours, stop and leave it to cool down (winding temperature < 50°C).

Check the winding insulation and the polarisation index. If necessary, repeat the drying.



S - Stator  
R - Rotor  
E - Exciter

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### 5.12 NEW VARNISH APPLICATION



**CAUTION:**  
A NEW VARNISH APPLICATION SHOULD ONLY BE CONSIDERED IF IT IS ABSOLUTELY NECESSARY. A NEW APPLICATION OF VARNISH MADE ON A COIL WHICH IS STILL DIRTY OR NOT PERFECTLY DRY CAN RESULT IN A DEFINITIVE LOSS OF INSULATION.

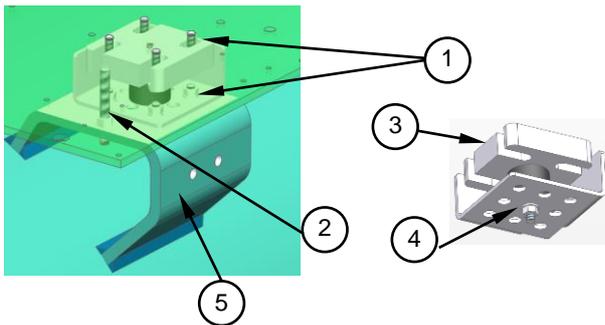
### 5.13 TERMINAL BOX



**CAUTION:**  
DAMPER PADS SHOULD BE CHECKED PERIODICALLY AND REPLACED EVERY FIVE YEARS.



**CAUTION:**  
BEFORE ANY INTERVENTION ON THE ALTERNATOR, MAKE SURE THAT STARTING CAN NOT BE ACTIVATED BY ANY MANUAL OR AUTOMATIC SYSTEM.  
CHECK THAT ALL LOCKS ARE ACTIVE AND FOLLOW SITE SAFETY PROCEDURES.



Damper pads must not show any cracks. If a crack is detected, or if the replacement period has come to term, change the pads for new ones.

Change of pads:

Lift the terminal box using the jack screw (item "2").

Loosen the 8 M10 screws (item "1").

Remove the block from the pad assembly (item "3").

Remove the M10 nut from the damper pad (item "4") to remove the lower plate.

Unscrew the damper pad from the top plate.

Mount a new damper pad (part ref: 13 160 700 015) on the upper plate and rest the lower plate with its nut M10 (item "4").

Place the damper block between the terminal box and the stator bracket (item "5") and fit the screws (item "1"). Do not tighten to torque at this stage.

Loosen the jack screw (item "2") so as to obtain a clearance at the end of the screw on the order of 5 mm.

Tighten all fastening screws (8 screws on each damper block; item '1') to their nominal torque (according to Chapter 5.6.1).

The four damper pads (one at each corner of the terminal box) must be changed at the same time.

### 5.14 SPARE PARTS

	LSA 52.3	LSA 53.2	LSA 54.2
Emergency kit AREP/PMG	5178320	5084565	5084580
Single bearing kit	5084681		
Two-bearing kit	5084674		

## LSA 52.3 / LSA 53.2 / LSA 54.2

### Industrial Range Alternators – 4 poles

#### 5.15 MECHANICAL DEFECTS

Fault		Action/Cause
Bearing	Excessive overheating of one or both bearings (bearing temperature 80°C above the ambient temperature)	<ul style="list-style-type: none"> <li>- If the bearing has turned blue or if the grease has turned black, change the bearing.</li> <li>- Bearing not fully locked (abnormal play in the bearing cage)</li> <li>- End shields incorrectly aligned</li> </ul>
Abnormal temperature	Excessive overheating of alternator frame (more than 40° C above the ambient temperature)	<ul style="list-style-type: none"> <li>- Air flow (inlet-outlet) partially clogged or hot air is being recycled from the alternator or engine</li> <li>- Alternator operating at too high a voltage (&gt;105% of Un on load)</li> <li>- Alternator overloaded</li> </ul>
Vibrations	Too much vibration	<ul style="list-style-type: none"> <li>- Misalignment (coupling)</li> <li>- Defective mounting or play in coupling</li> <li>- Rotor balancing fault (Engine - Alternator)</li> </ul>
	Excessive vibration and humming noise coming from the machine	<ul style="list-style-type: none"> <li>- Phase imbalance</li> <li>- Stator short-circuit</li> </ul>
Abnormal noise	Alternator damaged by a significant impact, followed by humming and vibration	<ul style="list-style-type: none"> <li>- System short-circuit</li> <li>- Misparalleling</li> </ul> Possible consequences <ul style="list-style-type: none"> <li>- Broken or damaged coupling</li> <li>- Broken or bent shaft end</li> <li>- Shifting and short-circuit of main field</li> <li>- Fan fractured or coming loose on shaft</li> <li>- Irreparable damage to rotating diodes/AVR, surge suppressor</li> </ul>

## LSA 52.3 / LSA 53.2 / LSA 54.2

### Industrial Range Alternators – 4 poles

#### 5.16 ELECTRICAL FAULTS

Fault	Action	Effect	Check/Cause
No voltage at no load on start-up	Connect a new battery of 4 to 12 volts to terminals E- and E+, respecting the polarity, for 2 to 3 seconds	The alternator builds up and its voltage is still correct when the battery is removed	- Lack of residual magnetism
		The alternator builds up but its voltage does not reach the rated value when the battery is removed	- Check the connection of the voltage reference to the AVR - Faulty diodes - Armature short-circuit
		The alternator builds up but its voltage disappears when the battery is removed	- Faulty AVR - Field windings open circuit (check winding) - Revolving field coil open circuit (check the resistance)
Voltage too low	Check the drive speed	Correct speed	Check the AVR connections (AVR may be faulty) - Field windings short-circuited - Rotating diodes burn out - Revolving field coil short-circuited (check the resistance)
		Speed too low	Increase the drive speed (do not touch the AVR voltage setting before running at the correct speed)
Voltage too high	Adjust AVR voltage potentiometer	Adjustment ineffective	- Faulty AVR - 1 faulty diode
Voltage oscillations	Adjust the AVR stability potentiometer		- Check the speed: possibility of cyclic irregularity - Loose connections - Faulty AVR - Speed too low when on load (or AVR LAM set too high)
Voltage correct at no load and too low when on load	Run at no load and check the voltage between E+ and E- on the AVR	Voltage between E+ and E- AREP / PMG < 10V	- Check the speed (or AVR LAM set too high)
		Voltage between E+ and E- AREP / PMG > 15V	- Faulty rotating diodes - Short-circuit in the revolving field coil (check the resistance) - Faulty exciter armature (check the resistance)
Voltage disappears during operation	Check the AVR, the surge suppressor, the rotating diodes, and replace any defective components	The voltage does not return to the rated value	- Exciter winding open circuit - Faulty exciter armature - Faulty AVR - Revolving field coil open circuit or short-circuited

# LSA 52.3 / LSA 53.2 / LSA 54.2

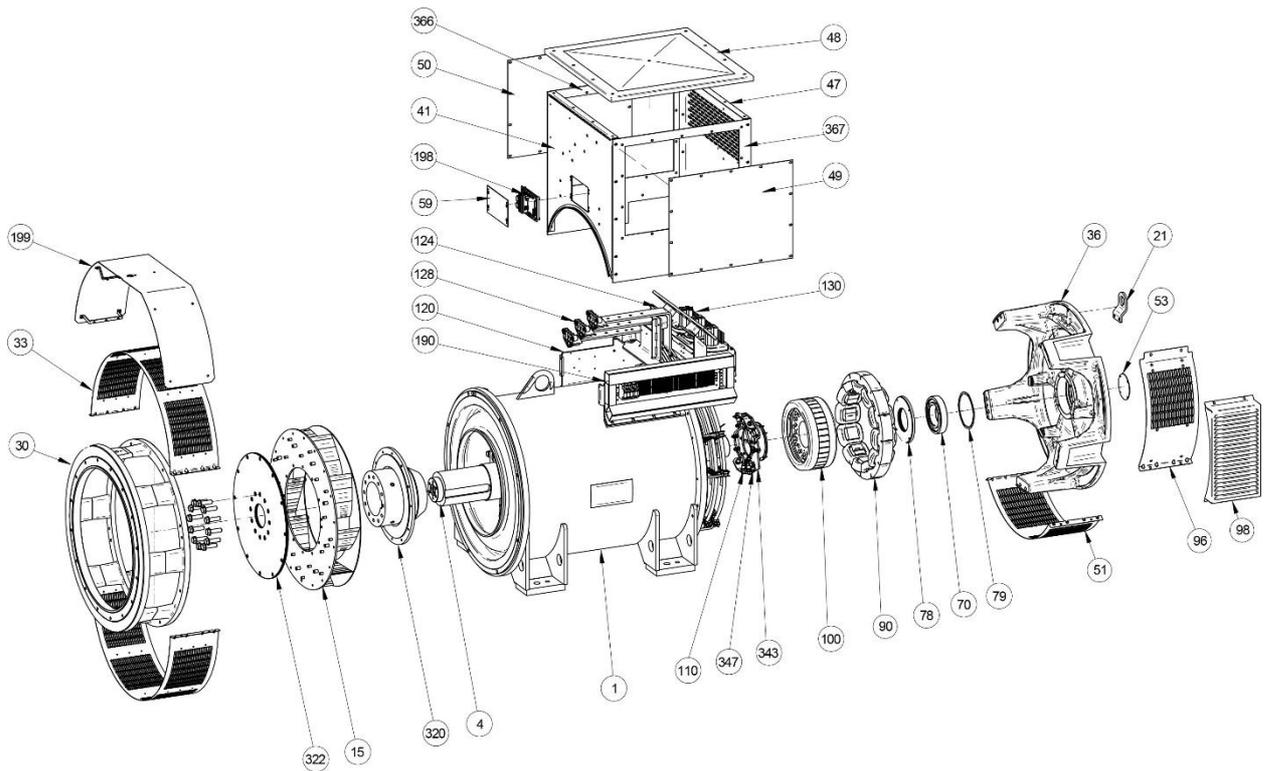
## Industrial Range Alternators – 4 poles

### 6. TYPICAL ASSEMBLIES AND DRAWINGS

#### 6.1 MACHINE SECTION VIEWS

##### 6.1.1 Machine type A52.3

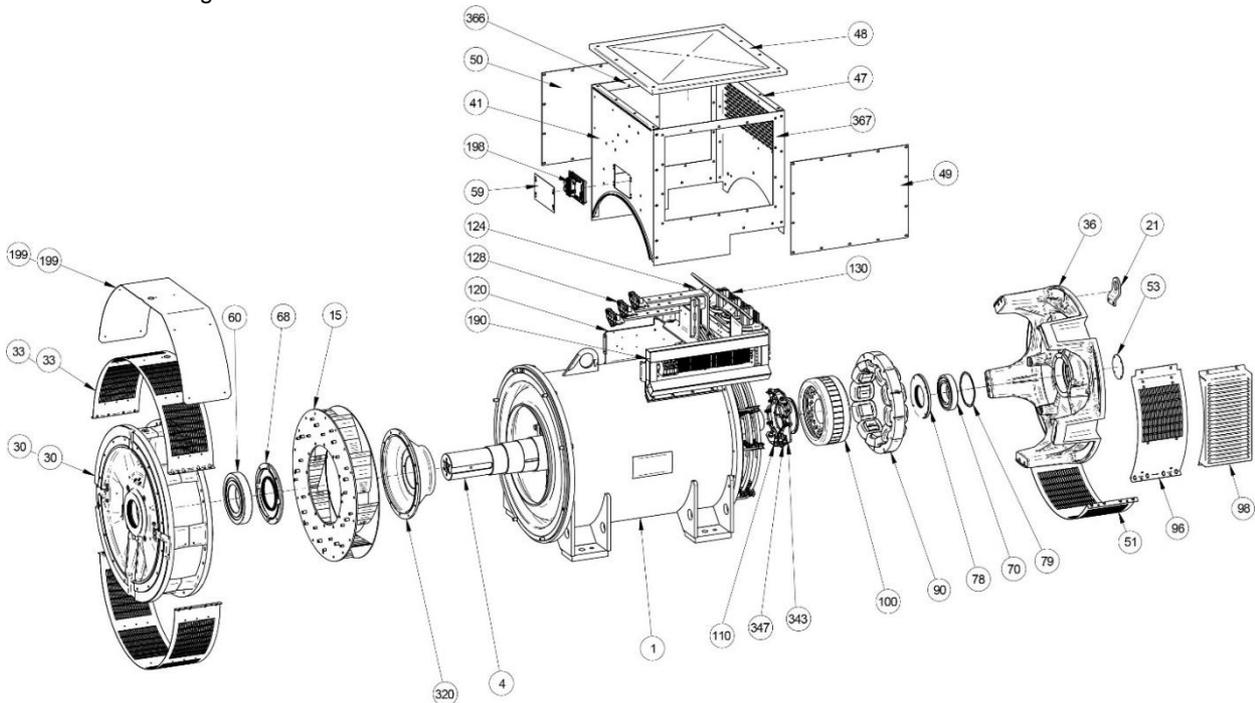
- Single-bearing



# LSA 52.3 / LSA 53.2 / LSA 54.2

## Industrial Range Alternators – 4 poles

- Two-bearing



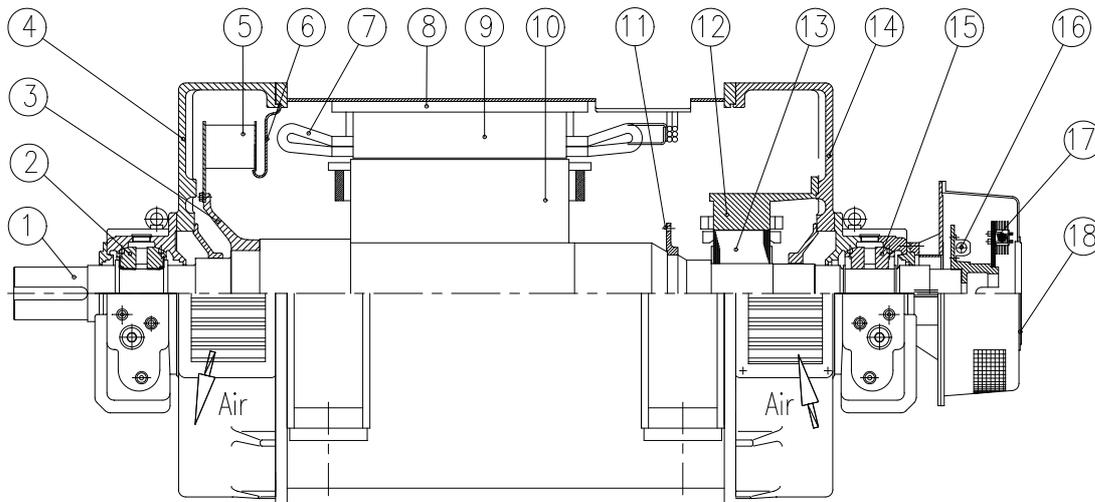
Ref.	Qty	Description	Screw Ø	Torque N.m	Ref.	Qty	Description	Screw Ø	Torque N.m
1	1	Stator assembly	-	-	90	1	Exciter field (stator)	M8	20
4	1	Rotor assembly	-	-	96	2	Air inlet cover IP21	-	-
15	1	Fan	-	-	98	2	Air inlet cover IP23	-	-
21	1	Lifting eye	-	-	100	1	Exciter armature (rotor)	-	-
30	1	Drive end (DE) flange (single bearing) or drive end (DE) bracket (two-bearing)	M12	69	110	6	Diode	-	-
33	2	Air outlet grille	M6	8.3	120	1	Terminal support	-	-
36	1	Non drive end (NDE) bracket	M12	69	124	5	Terminals	-	-
41	1	Terminal box front panel	M6	8.3	128	3	Phase busbar	M12	35
47	1	Terminal box rear panel	M6	8.3	130	1	Neutral busbar	M12	35
48	1	Terminal box top panel	M6	8.3	190	1	Terminal block	-	-
49-50	1	Terminal box access door	M6	8.3	198	1	Voltage regulator (AVR)	-	-
51	1	Air intake grille	M6	8.3	199	1	Protective cover IP23	-	-
53	1	Sealing cap	-	-	320	1	Coupling sleeve	-	-
59	1	AVR inspection door	M6	8.3	322	6	Coupling disc	M20	340
60	1	Drive end (DE) bearing	-	-	343	1	Diode bridge assembly	M6	4
68	1	Inner bearing retainer	-	-	347	1	Surge suppressor (+ PCB)	-	-
70	1	Non drive end (NDE) bearing	-	-	366	1	Terminal box side panel	M6	8.3
78	1	Inner bearing retainer	M8	20	367	1	Terminal box side panel for inspection door	M6	8.3
79	1	Preloading (wavy) washer	-	-					

# LSA 52.3 / LSA 53.2 / LSA 54.2

## Industrial Range Alternators – 4 poles

### 6.1.2 Machine type A53; A54

1	Rotor	10	Polar wheel
2	Bearing (front)	11	Balancing disc
3	Fan hub	12	Exciter field
4	Front spacer	13	Exciter armature
5	Fan	14	Rear spacer
6	Fan screen	15	Bearing (rear)
7	Stator winding	16	Rotating resistances
8	Stator ribs	17	Rotating diodes
9	Stator lamination	18	Diode bridge cover

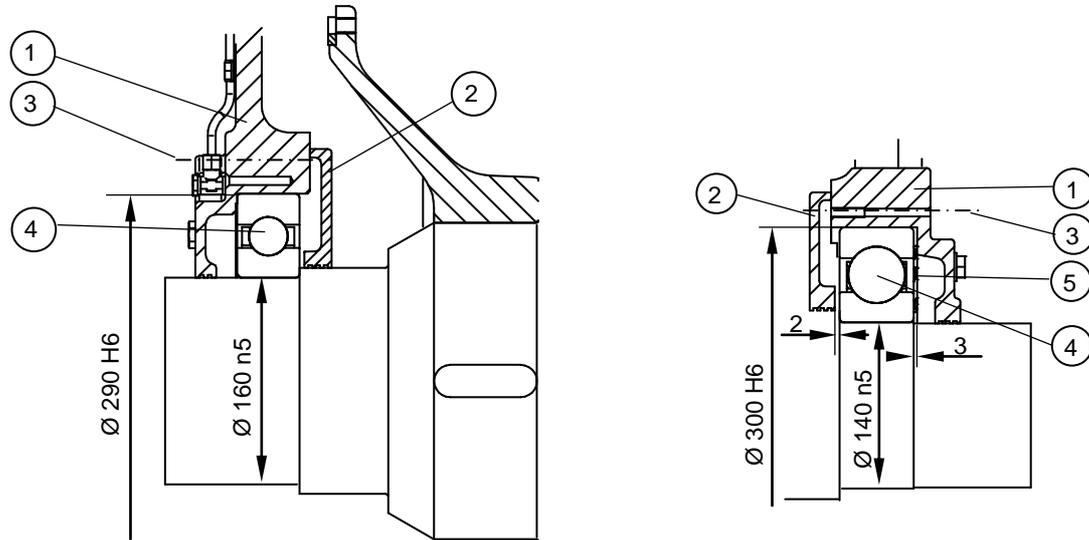


# LSA 52.3 / LSA 53.2 / LSA 54.2

## Industrial Range Alternators – 4 poles

### 6.2 ROLLER BEARING MOUNTING

#### 6.2.1 Machines A52, A53 and A54; standard



**Bearing assembly "Standard "**

Drive end		Non drive end	
1	End shield	1	End shield
2	End cover	2	End cover
3	End cover stud	3	End cover stud
4	Ball bearing	4	Ball bearing
		5	Bearing preload spring

# LSA 52.3 / LSA 53.2 / LSA 54.2

## Industrial Range Alternators – 4 poles

### 7. STANDARD SAFETY REGULATIONS

#### 7.1 EUROPEAN REGULATIONS AND DIRECTIVES

##### 7.1.1 Low Voltage Machines

Angoulême, 16<sup>th</sup> June 2024

### EC Declaration

Moteurs Leroy-Somer declares hereby that the electric generators of the types:

LSA 40 – LSA 42.3 – LSA 44.3 – LSA 46.3 – LSA 47.2 – LSA 47.3 – LSA 49.1 – LSA 49.3 – LSA 50.1 – LSA 50.2 – LSA 51.2 – LSA 52.2 – LSA 52.3 – LSA 53 – LSA 53.1 – LSA 53.2 – LSA 54 – LSA 54.2 – LSA 55.3 – TAL040 – TAL 042 – TAL 044 – TAL 046 – TAL 047 – TAL 0473 – TAL 049 – LSAH 42.3 – LSAH 44.3

as well as their derivatives, manufactured by Leroy-Somer or on Leroy-Somer's behalf.

#### MOTEURS LEROY-SOMER

Boulevard Marcellin Leroy  
16015 Angoulême  
France

#### MLS HOLICE STLO.SRO

Sladkovskeho 43  
772 04 Olomouc  
Czech Republic

#### MOTEURS LEROY-SOMER

1, rue de la Burelle  
Boite Postale 1517  
45800 St Jean de Braye France

#### LEROY-SOMER ELECTRO-TECHNIQUE Co., Ltd

No1 Aimosheng Road, Galshan Town,  
Cangshan District,  
Fuzhou, Fujian 350026  
China

#### NIDEC INDUSTRIAL AUTOMATION INDIA PRIVATE Ltd - BANGALORE

#45, Nagarur, Huskur Road  
Off Tumkur Road,  
Bengaluru-562 162  
India

#### NIDEC INDUSTRIAL AUTOMATION INDIA PRIVATE Ltd - HUBLI

#64/A, Main Road,  
Tarihal Industrial Area,  
Tarihal, Hubli-580 026  
India

meet the requirements of the following standards and directives:

#### Declaration of compliance:

- Low Voltage Directive Nr 2014/35/EU dated 26<sup>th</sup> February 2014.
- EN and IEC 60034-1, 60034-5 and 60034-22.
- ISO 8528-3 "Reciprocating internal combustion engine driven alternating current generating sets. Part3.Alternating current generators for generating sets".

These generators also comply with the ROHS Directive Nr 2011/65/EU dated 8<sup>th</sup> June 2011 and its Annex II Nr 2015/863 dated 31<sup>st</sup> March 2015, as well as the EMC Directive Nr 2014/30/EU dated 26<sup>th</sup> February 2014.

#### Declaration of incorporation:

These generators are designed to meet the essential requirements Annex I, chapters 1.1.2, 1.1.3, 1.1.5, 1.3.1 to 1.3.3, 1.3.6 to 1.3.8.1, 1.4.1, 1.4.2.1, 1.5.2 to 1.5.11, 1.5.13, 1.6.1, 1.6.4, 1.7 (except 1.7.1.2) of Machinery Directive Nr 2006/42/EC, as well as Annex VII, part B of this directive and the aforementioned standards.

As a result, these "Partly completed machinery" are designed to be incorporated into Electrical Gen-Sets complying with the Machinery Directive Nr 2006/42/EC dated 17<sup>th</sup> May 2006.

#### WARNING:

The here mentioned generators should not be commissioned until the corresponding Gen-Sets have been declared in compliance with the Directives Nr 2006/42/EC, 2014/30/EU, 2011/65/EU and 2015/863, as well as with other relevant Directives.

Moteurs Leroy-Somer undertakes to transmit, in response to a reasoned request by the national authorities, relevant information on the generator.

Those responsible for compiling the technical files and this declaration are:

Yannick MESSIN, Technical Manager LS Orléans, 1 rue de la Burelle, 45800 Saint Jean de Braye  
Jean-Pierre CHARPENTIER, Technical Manager LS Sillac, Bld Marcellin Leroy, 16015 Angoulême

J.P. CHARPENTIER – Y. MESSIN

#### Moteurs Leroy-Somer

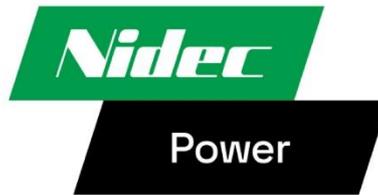
Headquarters: Boulevard Marcellin Leroy CS 10015 - 16915 Angoulême cedex 9 - France  
T: +33 (0)5 45 64 45 64 / www.nidecpower.com  
SAS with share capital of 32,239,235 € - RCS Angoulême 338 567 258.

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# LSA 52.3 / LSA 53.2 / LSA 54.2

## Industrial Range Alternators – 4 poles

### 7.1.2 Medium and High Voltage Machines



Orléans, 11<sup>th</sup> July 2024

### EC Declaration

Moteurs Leroy Somer declares hereby that the following medium voltage synchronous electric generators (more than 1000 V) of the types

**A50.1, A50.2, A51.2, A 52.2, A 52.3, A 53.1, A 53.2, A 54, A 54.2, A55.3, A56, A56.2, A58, A60, A62**

as well as their derived series manufactured by the company or on its behalf in the following manufacturing facilities:

**MOTEURS LEROY-SOMER**  
1, rue de la Burelle  
Boite Postale 1517  
45800 St Jean de Braye  
France

**MLS HOLICE STLO.SRO**  
Sladkovskeho 43  
772 04 Olomouc  
Czech Republic

meet the requirement of the following International Standards and Directive:

#### Declaration of compliance:

- EN and IEC 60034-1
- EN and IEC 60034-5
- EN and IEC 60034-22
- ISO 8528-3 "Reciprocating internal combustion engine driven alternating current generating sets. Part 3. Alternating current generators for generating sets".

These electrical generators also comply with the ROHS Directive Nr 2011/65/EU dated 8<sup>th</sup> June 2011 and its Annex II Nr 2015/863 date 31<sup>st</sup> March 2015, as well as the EMC Directive Nr 2014/30/UE dated 26<sup>th</sup> February 2014.

#### Declaration of incorporation:

These generators are designed to meet the essential requirements Annex I, chapter 1.1.2, 1.1.3, 1.1.5, 1.3.1, 1.3.2, 1.3.3, 1.3.6, 1.3.7, 1.3.8.1, 1.4.1, 1.5.1 to 1.5.11, 1.5.13, 1.6.1, 1.6.4, 1.7 (except 1.7.1.2) of Machinery Directive Nr 2006/42/EC dated 17<sup>th</sup> May 2006, as well as Annex VII, part B of this directive and the aforementioned standards.

Furthermore, these PARTLY COMPLETED MACHINERY, are designed to be incorporated into Electrical Gen-Sets complying with the Machine Directive Nr 2006/42 dated 17 may 2006 providing that the installation will be correctly performed by the manufacturer of the machinery (for instance: in compliance with our incorporation and installation instructions, and EN 60204-1 (2018-09) and NF EN IEC 60204-11 (2019-01) "Electrical Equipment of Industrial Machines").

#### WARNING:

The here mentioned generators should not be commissioned until the corresponding Gen-Sets have been declared in compliance with the Directives Nr 2006/42/EC, 2014/30/EU, 2011/65/EU and 2015/863 as well as with other relevant Directives.

Moteurs Leroy-Somer undertakes to transmit, in response to a reasoned request by the national authorities, relevant information on the generator.

The name and address of authorised representative, authorised to compile the relevant technical documentation is: Yannick MESSIN, Technical Manager LS Orléans, 1 rue de la burelle 45800 Saint Jean de Braye

LS Orléans Technical Manager  
Y. MESSIN

LS Orléans Quality Manager  
J. LOPEZ

Moteurs Leroy-Somer  
Headquarters: Boulevard Marcellin Leroy CS 10015 - 16915 Angoulême cedex 9 - France  
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SAS with share capital of 32,239,235 € - RCS Angoulême 338 567 258.

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# LSA 52.3 / LSA 53.2 / LSA 54.2

## Industrial Range Alternators – 4 poles

### 7.1.3 Short circuit capacity of the terminal box



Saint Jean de Braye, July the 16<sup>th</sup>, 2024

Ref : CAL-20220221-01-YM-RevB

### DECLARATION OF COMPLIANCE

This declaration applies to the following range of generators:

- Model : LSA 52.X, LSA 53.X, LSA 54.X and LSA 55.X.
- Voltage : 380 V up to 13 800 V
- IP Protection: IP 20 – IP 21 – IP 23 according to IEC 60034-5
- Frequency : 50 Hz & 60 Hz

We confirm that the design of terminal boxes of the above generators can withstand the following short-circuit current without risk to health and life in the immediate vicinity:

- For low voltage machines below 1000 V:..... **80 000 Amps – 1s**
- For medium and High voltage machines above 1000 V:..... **25 000 Amps – 1s**

Engineering Manager EPG Orléans

Yannick MESSIN

A handwritten signature in black ink, appearing to read "Yannick Messin".

Moteurs Leroy-Somer

Headquarters: Boulevard Marcellin Leroy CS 10015 - 16915 Angoulême cedex 9 - France

T: +33 (0)5 45 64 45 64 / [www.nidecpower.com](http://www.nidecpower.com)

SAS with share capital of 32,239,235 € - RCS Angoulême 338 567 258.

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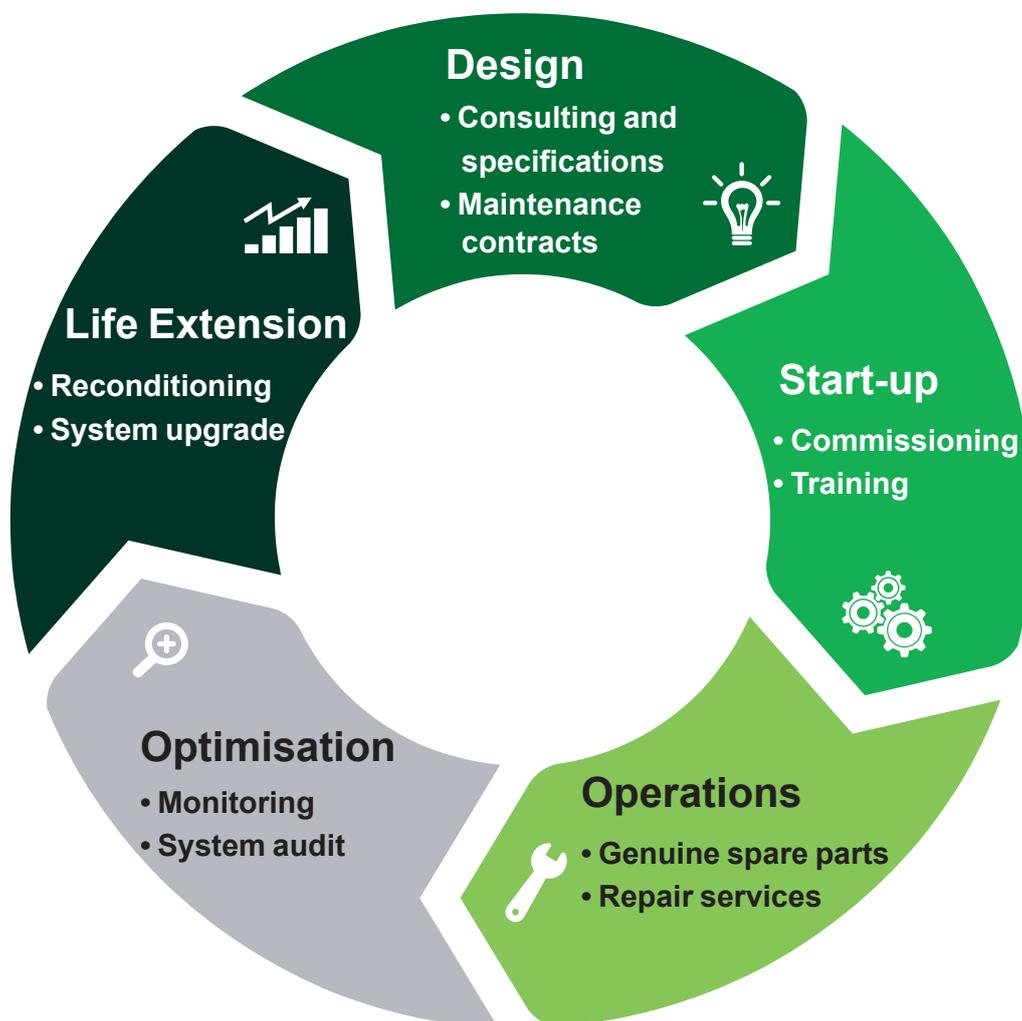
# Service & Support

Our worldwide service network of over 80 facilities is at your service. Our local presence is your guarantee for fast and efficient repair, support and maintenance services.

Trust your alternator maintenance and support to electric power generation experts. Our field personnel are 100% qualified and fully trained to operate in all environments and on all machine types.

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