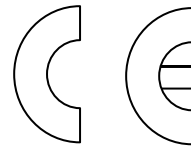


COELMO[®]

Generating Set Maintenance and Use Manual

FAC SIMILE



CONFORMITY DECLARATION FOR GENERATING SET

DECLARATION N°

Macchina tipo

Type of machine – Type de machine – Màquina modelo

Numero di matricola

Serial number – N° de série - Numero de matriculà

Data di costruzione

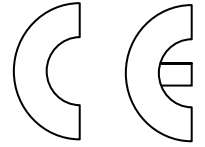
Data of manufacture – Data de fabrication – Fecha de construcció

Tabella direttive

directives – directives - directiva

98/37 CEE 91/368 CEE 93/68 CEE 73/23 CEE 89/336 CEE

.....
Direttore Tecnico / Technical Manager

FAC SIMILE**CONFORMITY DECLARATION FOR GENERATING SET****DECLARATION N°****Quadro tipo***Type of machine – Type de machine – Màquina modelò***Numero di matricola***Serial number – N° de série - Numero de matriculà***Data di costruzione***Data of manufacture – Data de fabrication – Fecha de construcció***Tabella direttive***directives – directives - directiva**98/37 CEE 91/368 CEE 93/68 CEE 73/23 CEE 89/336 CEE*

.....
Direttore Tecnico / Technical Manager

SUMMARY

1. INTRODUCTION	80
1.1 MANUAL AIM AND FIELD OF APPLICATION	80
1.2 ISTRUCTIONS TO THE MANUAL USE	81
1.3 REFERENCE DOCUMENTS	82
1.4 RELEVANT LEGISLATIONAL	83
1.5 GENERATING SET IDENTIFICATION NAMEPLATE	84
1.6 GUARANTEE	84
1.7 SPARE PARTS	84
2. LIMITS AND CONDITIONS OF USE	85
2.1 ENVIROMENTAL LIMITS	85
2.2 ELECTRICAL FACTORS OF THE SUPPLIED POWER	86
2.3 WRONG USE	89
2.4 MODIFICATION OF THE OPERATION DATA	90
3. SAFETY REGULATIONS	91
3.1 PARTICULARS	91
3.2 ACCESS TO THE INSTALLATION	91
3.3 SAFETY REGULATION DURING THE INSTALLATION AND FIRST SETTING UP	91
3.4 SAFETY REGULATION DURING THE MAINTENANCE GENERAL PRECAUTIONS	93
4. DESCRIPTION OF MACHINE	95
5. TRANSPORT AND MOVING	95
6. INSTALLATION	98
6.1 GENERAL CRITERIA OF INSTALLATION	98
6.2 PRELIMINARIES OF AUTOMATIC GENERATING SETS	98
6.3 OUTDOOR INSTALLATIONS	98
6.4 INDOOR INSTALLATIONS	98
6.5 BED	99
6.6 EXHAUST AND VENTILATION SYSTEM	100
6.7 MEASURING OF THE EXHAUST GAS TURBINES	101
6.8 VENTILATION	102
6.9 FUEL SYSTEM	103
6.9.1 STORAGE TANK SUPPLY THROUGH AUTOMATIC EXTRAVASION SYSTEM	104
6.10 ELECTRICAL CONNECTION	104
6.11 MANUAL GENERATING SET	105
6.12 AUTOMATIC GENERATING SET	105
6.13 CABLE DIMENSIONS	105
6.14 CABLE SETTING	105
6.15 GROUNDING	105

7. STARTING AND MAINTENANCE	106
7.1 CONTROLS AT THE FIRST STARTING	106
7.2 OUTPUT	107
7.3 ENGINE PROTECTION	107
7.4 PROTECTIONS	107
7.5 GENERATING SET BLOCK DURING AUTOMATIC FUNCTIONING	107
8. MAINTANCE	108
8.1 MANUALLY CONTROLLED GENERATING SETS	108
8.2 AUTOMATICALLY CONTROLLED GENERATING SET	108
8.3 IDLE TEST RULES	109
8.4 CLEANING	111
8.5 STORAGE	111
8.6 TROUBLE RESEARCH	111
9. DISMANTLING	111

I. INTRODUCTION

I.1 MANUAL AIM AND FIELD OF APPLICATION

The manual gives information and instructions to carry out properly and safely the activities relevant to the operative part of the Generating Sets life, from the delivery to the dismantlement: transport, installation, use and maintenance.

For any information about the various models of engine and Generating Sets' features, please go to the specific issues released by the respective builders. This manual and the other reference documents that you got with the Generating Set are addressed to everyone who is involved in the of life of a Generating Set and it is necessary to inform the ones who shall actually carry out the various activities as well as the ones who shall coordinate them, prepare the logistics and regulate the access to the room where the Generating Set will be installed.

WARNING: *the Generating Set CANNOT be operated by unprofessional users.*

All the activities relevant to the operative part of its life must be carried out by skilled and purposely trained workers, with experience in the diesel engines and the mechanical and electrical installations. This manual and the other documents are essential to accomplish the training of the said skilled workers.

I.2 INSTRUCTIONS TO THE MANUAL USE

• IMPORTANCE OF THE MANUAL

The manual and the other documents are an integral part of the Generating Set and must be kept with care, dry, and kept from anything that could damage them, for the whole life of the Generating Set. They must follow the Generating Set if it is transferred to another user or owner. We suggest you to read their content carefully and to comply with the instructions and the suggestions indicated in this manual and in the reference documents; doing like this you will assure the right installation of the Generating Set, its reliability and the protection from damage for objects and people.

COELMO refuses all responsibility for any damage deriving from a wrong installation, use and maintenance of the Generating Set.











If you are in doubt, in trouble or if you have any inconvenience, do not hesitate to call the COELMO Customer Service, which will give you all information.

Note: All information contained in this issue is corrected at printing time, but may be modified without warning or obligation of notice, if necessary, in accordance with the politics of perpetual improvement of COELMO.

They are addressed to the Generating Set which this manual was with, except for more particular information and/or integrations put in the supply specific documents.

• SYMBOLOGY

This symbology, in compliance with the international technical rules, was put in the manual

DANGER SIGNS		COMPULSORY SIGNS	
	Danger		General obligation
	Danger of electrical discharge		Protective headgear required (protective headgear must be worn)
	Danger: Flammable material		Feet protection required (safety shoes must be worn)
	Danger: Noise		Ear protection required (ear protectors or plugs must be worn)
	Danger of burning: Hot surfaces		Eye protection must be worn (wear goggles)

DANGER SIGNS



Danger: self-starting machine ADD



Grounding Obligation ADD

COMPULSORY SIGNS



**Hand protection required
(protective gloves must be worn)**



**Protective clothing required
(overalls must be worn)**

PROIBITION SIGNS



Prohibited



No water for burning out the fire



No access to unauthorised



**Do not use
(Sign placed on switching mechanisms
during maintenance)**



No smoking or naked flames



**Do not clean, lubricate, repair or manually
adjust moving parts**



No access to persons with pace-makers

I.3 REFERENCE DOCUMENTS

- a) *EC declaration of conformity.*
- b) *Generating Set and main parts' standard technical data sheet (Data Sheet).*
- c) *COELMO Generating Sets User Manual – General Part (this Manual).*
- d) *Electrical diagram and use and maintenance manual of switchboard and power panel.*
- e) *Engine user and Maintenance Manual.*
- f) *Generating Set user and Maintenance Manual*

I.4 REFERENCE LAW PROVISIONS

All the COELMO Generating Sets are designed and produced in compliance with the law provisions and they can be type-tested, on demand, by the main Control and Classification Bodies.

a) The Generating Set and its parts are made in compliance with the following Rules and Directives:

73/23/EEC Low Tension.

89/336/EEC Electromagnetic Compatibility.

97/68 EEC- 2002/88 Emission for off-road engines

98/37/EEC Machines Directive and EEC Mark

2000/14/EEC Acoustic Emission.

ISO 8528 Alternating Current Generating Sets set by an alternating internal combustion engine..

b) The Alternating Internal Combustion Engines are made in compliance with ISO 3046 Alternating Internal Combustion Engines.

c) The Synchronous Generators used on the COELMO Generating Sets are in compliance with the following rules:

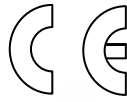
IEC 34-1 / CEI 2-3 / VDE 0530 / BS 4999-5000 / NF 51-100.

d) Possible installations set by the user shall comply with the Rules in force in the installation Country, which may regulate every single aspects in different ways, and in particular:

- noise;*
- emissions;*
- installation in dangerous places;*
- constraints on the installed power;*
- electric installations and safety devices;*
- quality of the fuel in the premises meant for the installation.*
- Condition Management of neutral wire and its distribution*

1.5 GENERATING SET IDENTIFICATION NAMEPLATE

The Generating Set identification nameplate shows all the identification data in compliance with the ISO 8528 Law and according to what is requested for the EC Mark. Here is a facsimile used for our Generating Sets.



Generating Set

SN: _____

Version:		
Model:	Year:	RPM:
kVA:(*)	cosφ :	
V:	In A:	Hz :
Engine:		SN:
Alternator:		SN:
Protection device		
neutral status		

1.6 GUARANTEE

The non-compliance with the instructions of installation or use and maintenance laws provided for the Generating Set and its parts, stops the guarantee. The Generating Sets' guarantee period is specified in the contract. Moreover, the general guarantee conditions provided for the industrial products shall be applied.

1.7 SPARE PARTS

You can only apply to our authorized spare parts dealers or the COELMO assistance mains. For a right identification of the spare parts, always specify the Generating Set's license data, the engine and/or the synchronous generator type and the relevant license numbers. In order to identify the right spare parts, it is important to apply only to the official spare parts papers provided by COELMO (Spare Parts Catalogues, Service Information, etc.). Any other source of information may be wrong or misleading, since it is not approved by COELMO for its installations.

2. LIMITS AND CONDITIONS OF USE

2.1 ENVIRONMENTAL LIMITS

• GENERATING SETS

Important: the Generating Sets' powers, for stationary installations, are referred to the following environmental conditions in compliance with ISO 3046/I Law:

- ambient temperature 25 °C;
- ambient pressure 1000 mbar (750 mm/Hg) (100 above sea level);
- relative humidity 30%;
- the license performances have a +/- 3% tolerance and they can be obtainable after 50 hours of operation.
- If the environmental conditions were not specified during the negotiation, the Generating Sets power can be referred to the standard conditions of 25°C, 100m above sea level, relative humidity 30%.

Example of the derating calculation:

A 100 KW (125 kVA) Generating Set at the standard conditions for the 25 °C engine, 100 m. Above sea level and the 30% of relative humidity.

Notes: Apart from what is differently arranged, the step load plug is of 50%, the distorting load must not exceed 20÷25% of the nominal power; the biggest electric engine with direct starting must not exceed ¼ of the Generating Set nominal power.

• DERATING FOR ENVIRONMENTAL CONDITIONS

For environmental installation conditions and operation that are different from the ones described before, it is necessary to provide proper degradings or "derating" for the engine, for the generator and for the electric power supplied by the unit. The environmental conditions in which the Generating Set shall operate must be defined at the time of the demand. Derating and degradings, in fact, must be already fixed during the negotiation so that engine and generator are meant to operate properly in the installation room.

In particular the following environmental conditions must be communicated:

1. *the high and the low limits of the ambient temperature;*
2. *the altitude above sea level or, preferably, the minimum and the maximum values of the barometric pressure in the installation room; in case of mobile generators the minimum and the maximum altitude values above sea level;*
3. *the humidity values concerning temperature and pressure of the installation place, with particular attention to the value of the relative humidity at the highest temperature;*
4. *any other peculiar environmental condition which may require special precautions or close maintenance cycles, such as:*
 - *dusty and/or sandy places;*
 - *marine places;*
 - *places with possibility of chemical pollution;*
 - *places with radiations;*
 - *operative conditions in the presence of strong stress or vibrations (i.e. earthquakes or outside vibrations caused by other adjoining machines);*

If the environmental conditions were not specified during the negotiation, the Generating Set power can be referred to the standard conditions of 25°C, 100m above sea level and 30% relative humidity.

Example of the derating calculation:

A 100KW (125kVA) standard Generating Set consists of: an 110 KW supercharged engine; an alternator with P = 125 kVA

up to 40 °C and 1.000 m. above sea level; it is supposed that this alternator's efficiency is 89%.

We want to verify the highest power suppliable by a generator at 1500 mt above sea level and a temperature of 45°C. The engine derating ratio is supposed to be 0,75. Therefore the engine power at the described conditions will be $0,75 \times 110 = 82,5$ KW. Taking into account the alternator performance the generator's power will be $82,5 \times 0,89 = 73$ KW.

Let's verify that the alternator is suitable. The derating for the alternator is given by the two ratios K1 and K2 which are deduced from IEC 34 – 1, ISO 8528 – 3 and CEI 2 – 3. The apparent power will be given by $K1 \times K2 \times P$ and that is: $K1 = 0,96$ $K2 = 0,97$ the highest apparent power will be $0,96 \times 0,97 \times 125 = 116,4$ kVA and the active power $\cos(\varnothing) = 0,8$ will be $116,4 \times 0,8 = 93,12$ KW. Therefore, the alternator is extremely well measured as to the power suppliable by the generator (73 KW).

5. Other factors that limit the machine use conditions are:

5.1. The load plug, if the Generating Set starting requires a step load plug more than 50% of the nominal power, you need to call the COELMO technical department which will give each machine the specific value of the proper load plug;

5.2. The presence of highly distorting loads (UPS, INVERTER) on the installation;

5.3 The presence of huge electrical engines on the installation;

(in cases 5.2-5.3 if not preventively validated by the technical department, COELMO refuses all responsibility about the Generating Set right operation on the installation.

2.2 ELECTRICAL FACTORS OF THE SUPPLIED POWER

• VOLTAGE

The Generating Set voltage regulator is normally adjusted so that, at a stabilized running, the voltage at the terminals has a value of $\pm 1,5\%$ of the nominal value, for all the load values between 0 and 100% and $\cos(\varnothing)$ from 0,8 to 1.

• POWER FACTOR

The Generating Sets license data are meant to operate at $\cos(\varnothing)=0,8$. To operate at a value different than $\cos(\varnothing)$ you need to remember what follows:

• LOAD WITH $\cos(\varnothing)$ BETWEEN 0,8 and 1.

For a nominal license value the synchronous generator operates at all loads between 0,8 and 1 while the Diesel engine is overloaded as much as $\cos(\varnothing)$ gets closer to 1. To obtain a right Generating Set operation you need to keep fixed the active power in KW, calculated at $\cos(\varnothing)=0,8$, for any $\cos(\varnothing)$ value between 0,8 to 1 of the load. The value of the apparent power in kVA supplied by the generator will decrease as much as the $\cos(\varnothing)$ increases).

• LOAD WITH $\cos(\varnothing)$ BELOW 0,8. The synchronous generator for a determined license value, referred to $\cos(\varnothing) = 0,8$, is overloaded in the excitation system as much as $\cos(\varnothing)$ tends to 0 and so the generator must be degraded according to the manufacturer's instructions. In these conditions, the diesel engine has an excess power.

WARNING!! Never connect the power factor correction system to the application but always and only to the system line.

The table below is carried just as an indication, to show the determination of these degradings. For more clarity it is necessary to see the manufacturer's documents.

Power Factor - $\cos \varnothing$	1	0,8	0,7	0,6	0,5	0,3	0
Reduction coefficients	1,00	1,00	0,93	0,88	0,84	0,82	0,80

Approximate ratios of reduction of a Generating Set power in cosine function (\varnothing).

• MONOPHASE LOAD

The Generating Sets can be also used with unbalanced loads till they reach, at the end, the nominal current in each phase. This means that between two phases (i.e. between R and S) you cannot put more than the nominal three-phase power of the unit; similarly, between a phase and a neutral wire (i.e. between T and the neutral wire) you cannot put more than 1/3 (that is 33%) of the license three-phase power. You need to remember that the monophasic operation with unbalanced loads the voltage tolerance shown in the word "Voltage" can no longer be kept by the voltage regulator. We suggest you to look up in the booklet "alternator use and maintenance", to find out in which phase it is allowed to collect the monophasic load. For a right running of the machine, it is always appropriate to assure a correct distribution of the loads.

• MEASURING OF THE GENERATING SET

The basic function of a Generating Set is to supply the energy that is necessary to satisfy the users' demands. You need to analyze the type of loads to cover, their electrical input, the variation of the power factor $\cos(\varnothing)$, the degree of contemporariness during the operation, etc. Some types of users, such as the asynchronous electric engines, cause a very high electric input during the starting; so you need to limit the contemporary starting of all engines, and notice and that the energy absorbed at full capacity is less than the energy absorbed in transient condition. This can be true for other types of users, too, (electric ovens, neon lamps), for which, giving for granted the active power demanded, the current absorbed increases as much to the phase difference. You need to notice that the addition of the license powers of the installed users in an industrial or civil settlement is generally more than the really absorbed power, because not all the users operate at the same time and at the worst conditions. That is why you need to verify the operation degree of contemporariness to the data values of the various users of an installation, to consent to choose the right size of the Generating Set.

It may occur that the load peak demanded by the users is more than the power available at the Generating Set terminals. Overload specially takes place if the asynchronous engines starting coincides with the maximum absorption by other users of the system. You need to delay the normal users' load peak as to the electric engines' transient conditions starting; the daily diagram analysis of the power consumption may make this choice easier, though it is not always feasible since it is impossible to prevent the overload from the engine start. In that case, you need to overmeasure the Generating Set to provide the necessary energy requirements to cover these demands in transient conditions. We dealt with "energy" and not with "power", because the transient conditions are short and the flywheel effect of the rotating grounds can provide, at least partially, to the most of the energy supply demanded. In that case you need a complex calculus which, besides what has already been said, reckons with voltage and pressure drops provided by the diesel engine, by the kind of excitation of the synchronous generator; COELMO can provide the necessary technical support, on the basis of its large experience, to obtain a correct measuring.

• TEMPORARY BEHAVIOUR

All the Generating Sets have their own temporary behaviour during the load appliance. This means that when a step load is applied, there is a frequency fall due to the drop of the engine turns and to the alternator's voltage fall, it depends on the kind of excitement of the electric machine and it is also influenced by the variation of the main engine revs. The higher the step load the more accentuated is the variation of said parameters and the recovery time to bring them back to the nominal conditions. Specially for the Generating Sets equipped with supercharged engines, the maximum step load which can be applied, keeping the revolution variation within acceptable values, is usually about 10% and 60%. The load appliance is regulated by the ISO 3046/IV law and fixed according to the engine average pressure.

• EXAMPLE OF GENERATING SET POWER CALCULATION FOR THE STARTING OF AN ASYNCHRONOUS ENGINE

As said above, the power of a Generating Set is selected according to the choice of the type of load to charge. You often need special Generating Sets to provide for the need to contain the voltage drop if the load requires powers at low $\cos(\varnothing)$ as in the example:

Let's suppose that, for example, you need to measure a Generating Set which must start up an asynchronous engine having the following features:

$N_p = 100 \text{ KW}$ (nominal power)

$\mu = 92\%$ (performance)

$\text{Cosfn} = 0,9$ (nominal power factor)

$\text{Cosfcc} = 0,4$ (short circuit power factor)

$I_{cc} = 6,8 \text{ In}$ (short circuit current)

$V_n = 380 \text{ V}$ (nominal voltage)

You can notice that, from the engine license data, the short circuit absorbs an apparent power 6,8 times higher than the nominal power, because the current at the starting I_{cc} is 6,8 the N_v . To limit the power at the acceleration you start up the engine at a reduced voltage. One of the classical methods is the star-triangle starter. The Motor-generator's power will be identified according to the following calculations.

From the nominal power N_p performed by the asynchronous engine, through the performance you can deduct the electric power really absorbed by the machine:

$P_e = P_n / \mu = 100 / 0,92 = 109 \text{ KW}$ The apparent power in kVA is $A = P_e / \text{Cosfi} = 109 / 0,9 = 121 \text{ kVA}$ Now you can deduce the absorbed power at the asynchronous engine acceleration by supposing to make a direct starting:

$A_s = 121 \times 6,8 = 830 \text{ kVA}$

Deciding to start up the engine at a reduced voltage, with the star-triangle system, the acceleration power will be reduced, too. The latter decreases as much to $(V_a / V_n)^2$ since the acceleration couple changes with the voltage square root. In said ratio « V_a » is the starting voltage and « V_n » is the nominal voltage. That is why:

so the power required to the asynchronous engine acceleration at the said conditions are:

$A_s = 830 \times 0,335 = 280 \text{ kVA}$

Now you need to verify what is the active power required to the Motor-generator, good to the right measuring of the diesel engine. Since the starting power factor (Cosfcc) is 0,4 the active power required to the diesel is:

$P = 280 \times 0,4 = 112 \text{ KW}$

Supposing that you can apply to Generating Set a step load equal to the 100% of the nominal load, we should choose a Generating Set whose nominal power is: $kVA = 112 \text{ KW} / 0,8 = 140 \text{ kVA}$

Now you can find out what would happen to a Generating Set of this size if you used it to start up the said asynchronous engine. Supposing that you can do it, you apply to the diesel engine a step load which is 100% of the available power, with consequent voltage drop of about 10%. You then apply to the electric machine a 280 kVA load of 280, equal to the double of the nominal power. There is a temporary voltage drop of about 35%. In most cases these variations are not acceptable. Therefore you need a special Generating Set where the electric machine is overmeasured as to the main engine. In this case the alternator shall have a minimum power of 300 kVA in order to keep the voltage drop within 20%. We suggest you to report the peculiar cases to the technical COELMO departments.

- MEASURING OF THE GENERATING SET IN CASE OF DISTORTING LOADS

When a Generating Set is installed to charge the lines where distorting loads such as stationary sets of continuity, starters for controlled rectifiers asynchronous engines, gas-discharge lamps are in the majority, you must pay attention to measure the Generating Set power since, contrarily, there may be some irregularities with the voltage and pressure regulation. Since the treatment of this problem is rather manual, we suggest you to ask COELMO technical department for the measuring.

2.3 WRONG USE

COELMO srl refuses all responsibility for the non-compliance with the safety and accident prevention regulations. It also refuses all responsibility for troubles caused by a wrong use of the machine or by modifications carried out without permission.

The Generating Set is meant to be used for the production of electric energy at the conditions and with the environmental and operative limits preventively showed and fixed by contract. Any modification must be immediately advised to COELMO, to get the necessary approval and if necessary carry out the modifications and/or the new setting to the Generating Set. The Generating Set is a machine which transforms the potential thermic energy contained in the fuel in electric energy and it is meant to charge electric systems that must be well-done. Though the powers are inferior than the public system ones, the danger is the same. The Generating Set an installation which adds the electric dangers to the dangers belonging to the presence of fuel (the real fuel and the motor oils), of rotating parts and of waste by-products (exhaust gas and heat of cooling and irradiation). Although it is impossible to exploit the heat contained in the exhaust gas and in the cooling circuit to raise the thermal efficiency of the process, this appliance must be done by a qualified staff, in order to obtain a reliable and safe installation for objects and people and to avoid the loss of the guarantee. Any other use, which is not preventively fixed with COELMO, must be considered as a wrong use and cannot be made.

2.4 MODIFICATION OF THE OPERATION DATA

• FREQUENCY CHANGE

COELMO Generating Sets generally have a speed controller on the engine provided to operate at 50 Hz (1500 g/min) or at 60 Hz (1800 g/min).

Possible variations must be agreed with COELMO during the supply, because in these conditions you need to adjust the injection pump again or regulate the speed. For the generator, you need to adjust the output voltage at the operative chosen value. You must remember that keeping it all unchanged, the voltage generated by the frequency increases as much as the latter.

For example, from 50 Hz to 60 Hz the voltage 400 V gets to 480 V.

To supply at 60 Hz the voltage of 400 V you need to ask for the authorization to COELMO customer service, which will verify the possibility of such a transformation.

When you change the frequency you must remember:

- the change from 50 to 60 Hz implies a slight increase of the supplied power, which can be noticeable on the table "Data Sheet" COELMO.
- the change from 50 to 60 Hz implies instead a slight power decrease.
- with an equal nominal voltage you need to adjust it operating on the regulating rheostat.
- to verify that frequency meter is right or adjusted to operate at the new frequency.

• MODIFICATION OF OPERATION TYPE

COELMO Generating Sets are designed to be used as manually controlled generators as well as automatically controlled ones. To change from one type to the other, you only have to replace the control board. The engine wiring is already preset for these connections, in order to use one of the two versions.

3. SAFETY REGULATIONS

- 3.1 PARTICULARS

Before beginning any starting up, oiling or maintenance, the workers must read and understand all the WARNING AND REFERENCE.

These are the precautions which shall be carefully followed to assure a safe operation:

- 3.2 ACCESS TO THE INSTALLATION

The place or area where the installation is must be run only by skilled and trained workers. They have to keep the keys.



Authorized personnel only.



No admittance to people with pacemaker, because of possible electromagnetic interferences.

In case of automatic Generating Sets it is necessary to:

- put a red light into a visible position and turn it on when the generator is operating;
- affix a danger sign to warn of the possibility of automatic starting up of the machine;
- affix an obligation sign: "All the maintenance must be carried out when the generator is STOPPED".

For the generator emergency stop press the button "emergency stop", placed in the board or the emergency button which shall be installed in the machine room.

In case of openwork Generating Sets, they shall be installed in a specific technical place and you need to insulate all the tracts of the exhaust pipe up to 2.5 m, signal this danger to the workers with warning signs and give individual safety devices.

- 3.3 SAFETY REGULATION DURING THE INSTALLATION AND FIRST SETTING UP



Only the personnel authorized by the sign Works in Progress are allowed to the yard where the Generating Set will be installed.



Always wear the protective helmet.



Always wear accident prevention shoes.



Danger hot parts (the exhaust manifold and the turbines are hot parts and so they stay even when the machine is switched off, pay attention and wear DPI gloves.



Danger self-starting machine (do not start any maintenance without stopping the Generating Set). 3.1.



Wear accident prevention gloves.



Immediately replace wet overalls.



Do not leave dismantled parts on the engine or round there, or tools or other which is not part of the installation, in the place near the Generating Set.



Do not move the original protections from all the exposed rotating parts, hot surfaces, air intakes, belts, voltage parts.



Never leave flammable liquids or rags soaked in flammable liquids near the Generating Set, near electric equipment (lamps included) or parts of the installation.



Take all precautions to avoid electrocutions; make sure that the ground installation is present and made in compliance with the Laws.



Affix the sign "PROHIBITION OF MANOEUVRES" on all the dissection members which insulate the parts of the installation where operating. When it is possible, use the key blocks to prevent dangerous or non-desired manoeuvring.

- Set up the necessary safety devices on the completing parts of the installation.
- Insulate all the disconnected links and wires. Do not leave the Generating Set power terminal board uncovered.
- Verify and control that the power and of the auxiliary services the electrical connections are made correctly.
- Make sure that the Generating Set cyclic phase direction is concordant with the system one.
- Verify the perfect functionality of the devices preset in the generator. In particular: the overspeed stop device (if installed); oil low pressure; high temperature water engine; emergency stop button installed by the user, generally outside the place.
- Control: the right ventilation of the place of the Generating set. Verify that engine exhaust is free and that the pipes allow the gas scavenging. Also verify that the pipes and the converters are properly supported, equipped with expansion joints and protected against accidental contacts, up to 2.5 m.
- Control that the exhaust gas are scavenged in the atmosphere in safe position, at least 1.5 m away from doors, windows and air intakes.
- Control the oil and the fuel (diesel) pipes and make sure that there are not leakages.
- Always make sure to clamp the machine cables and their mooring.

• PRELIMINARY SAFETY CONTROL FOR START-UP

Before starting, it is important to "know" the Generating Set and the installation very well.

Moreover, you need to control any source of real or potential danger, so:

1. Locate where the emergency stop buttons, the fuel shut-off valves, the switches and the possible other emergency devices are.
2. Learn about the particular emergency procedures relevant to this installation.

3. Locate where the extinguishers and the other prevention and emergency devices are and learn how to use them.
 4. Detect the sources of danger, for example fuel leakages, acid solutions, condensation drips, high voltages, high pressures, high temperature and other dangers.
 5. Make sure that the generator is clean, the surrounding area and the ways out are clean and free from obstacles.
- Verify that there are no impediments in the openings and in the entrance pipe and in the ventiduct.
6. Verify if some personnel are working on other machineries in the area and if this operation is dangerous and prevent the installation functioning.

WARNING!

The Generating set must be started in safe conditions only.

• 3.4 SAFETY REGULATION DURING THE MAINTENANCE GENERAL PRECAUTIONS



No admittance to the maintenance area, only authorized personnel showing the Work in Progress sign.



Affix the sign "PROHIBITION OF MANOEUVRES" on all the dissection members which insulate the parts of the installation where operating. When it is possible, use the key blocks to prevent dangerous or non-desired manoeuvring.



Never wear fluttering clothes, rings and/or necklaces when you are working near engines or moving parts.



Wear the protective gloves and glasses:



- during the batteries maintenance
- during the supply with inhibitors or antifreeze
- during the lubricating oil supply or replacement (the hot motor oil may cause burning when it is discharged. Let it get colder under 60° C.)
- or, if you are using pressured air (in this case max. air pressure used to clean, must be under 2 Atm (30 psi, 2kg/cm2).



Wear the protective helmet if you are working in an area with hanging loads or installations off your head.



Always wear accident prevention shoes.

During the operation on parts which may be in tension always make sure to have dry hands and feet. If necessary, make use of insulated platforms; if you have no experience with this kind of operation, call for skilled workers.



Always wear the overall /Immediately replace the wet overalls.



Use protective hands creams.



Put the oily rags in fire-proof cases.
Do not leave rags on the engine.

Get safe containers for the used fuel.

Do not try to make repairs which you don't know how to do. Always follow the instructions and, in their absence, call the supplier or some skilled workers. When you start the engine after a repair take precautions and stop the air suction if there is a gear indicator at the starting.

Always keep the engine clean, by removing fuel, oil and/or cooling liquids stains.

Never start the engine with the speed regulator disconnected.

Do not carry out by yourself operations requiring more than one person, especially if you must carry out operations on manoeuvre devices such as: switches, disconnecting switches, fuses and/or other voltage equipments.



Never add refrigerant to a superheated engine, allow the engine to cool first.

- Periodically control the level of the cooling liquids and fill up, if necessary, with a right liquid, according to the user and maintenance manual to the engine.
- Slowly remove the radiator cap. The cooling circuits are normally in pressure and hot liquid could come out violently while the pressure could be discharged too quickly.
- Periodically control voltage and the wear and tear of the pump/fan control belts.



Periodically control the level of the oil in the sump when the engine is cold and filling up, following the instructions written in the engine user and maintenance manual.



No smoking or light the fire during the oil supply.

- No smoking or light the fire during the fuel supply.

• Visually control the exhaust circuit to notice possible leakage and immediately provide to the necessary repair, since it would be a possible source of danger and fire.

• The parts of the installation preassembled in factory will be protected against the accidental contacts.

The completing parts, the gas scavenging pipes, the silencer, etc, must be insulated and/or protected by the installer.



- To make sure that the engine self-starting system does not start the engine while you are working on it, disconnect the battery negative pole, put on the emergency stop before working on the engine, in order to avoid accidental startings.



- Keep the connections tight and make sure that the cables are well insulated.



- No smoking, no naked lights near the batteries.



- To avoid electric arches it is good to connect the positive terminal to the battery first and then the negative one (generally grounded).



- Do not operate on the working Generating set. Before operating stop the generator, to make sure that it cannot start.



- You need to clean the air intakes for the motor-generator sets' ventilation and, in some models, the lubrication of the bearings. Verify the right clamping and the electric connections position.
- Before operating on the switchboard, disconnect mains supply and stop the Generating set.
- The switchboard, as well as all the electric equipment, cannot stand humidity and dust. Make sure of the right functioning of the anti-condensation heaters, if installed, and the cleaning of the ventilation air intakes.



- Periodically make sure that the clamping bolts of the electric connections are well fixed.

• DURING THE OPERATION



- Only the personnel authorized by the sign Works in Progress and equipped with keys are allowed to the yard where the Generating Set will be installed.



- Never wear fluttering clothes, rings and/or necklaces when you are working near engines or moving parts.



- Always wear, in order to avoid hearing damage, the anti-noise headphones if you have to stay where the Generating set is working.



- Do not touch the working Generating Set and in particular: cables, alternator connections, exhaust manifold and turbine.

Periodically control all the connections, for the clamping as well as for the insulation.



- Never leave flammable liquids or rags soaked in flammable liquids near the Generating Set near electric equipment (lamps included) or parts of the installation.

4. DESCRIPTION OF THE MACHINE

• COMPOSITION OF THE STANDARD COELMO GENERATORS

A Generating Set usually consists in:

- engine;
- synchronous generator;
- base metal frame with antivibrating supports, batteries and auxiliary services;
- fuel tank within the base and/or outer • switchboard • exhaust gas converter.

5. TRANSPORT AND MOVING

All the activities of transport and moving must be carried out by companies with experience in the transport and moving of industrial machines and equipment. These companies must have skilled workers and proper equipment, according to the dimensions, the weight of the items and to the logistic conditions of the sites (read the data sheet concerning the machine to move).



Do not stop near the Generating set when it is lifted or moved.



You must protect your head, hands and feet, during exhaust and moving operations.

It is not allowed to:

- carry out oblique pulls;
- tear constrained parts;
- leave pulling loads even for a short time;
- lift or transport people with the lifting means meant for the materials.

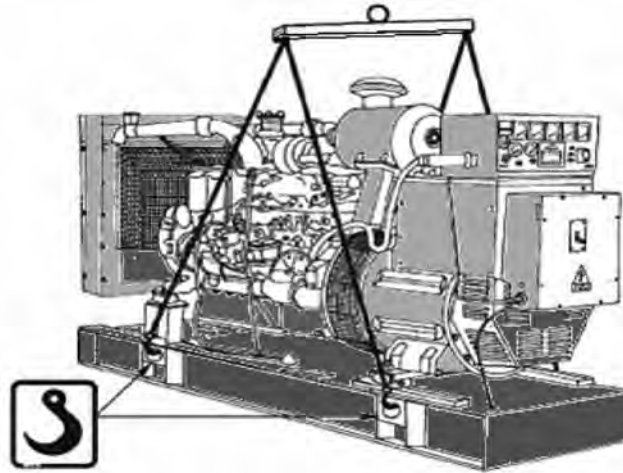
During moving operations, loads must be kept as near as possible to the ground and they must not be moved above workplaces and transit places, unless there are no people who stop along the transport.

Verify the right efficiency of the means and their safety devices (limit switches, brakes, signallers, etc.).

Verify that the load harness is made by skilled workers.

• **MOVING WITH STATIONARY CRANE, TRAVELLING BRIDGE-CRANE OR MOBILE CRANE**

To lift the Generating set you shall make use of the eyebolts or grommets provided by COELMO. These eyebolts are generally placed on the metal bed, as shown by the symbol in the illustration.



Instructions to sling a Generating set to lift it.

Always make use of a compensator or a rigid harness not to damage the Generating Set. It is not allowed to make use of any possible hooking placed on the engine, the alternator and/or other components.

In you are making use of a mobile crane, you must verify that the areas you are supposed to cross are able to support the total weight of the Generating Set and the crane.

• **MOVING WITH TRACKED UNDERCARRIAGE**

Verify that the areas you are supposed to cross are able to support the total weight of the Generating Set and the undercarriage. Place the forklifts under the base and open the arms as much as possible according to the load width to increase its stability.

• **REMOVAL OF POSSIBLE PACKING**

The opening of any possible packing must be done carefully, not to damage the materials.



The materials belonging to a possible packing must be collected, recovered and/or taken away in compliance with the laws in force in the Country, in particular the ones from the directive 94/62/CE about packing and waste material.



Do not leave packing and any other waste material into the environment.

6. INSTALLATION

• 6.1 GENERAL CRITERIA OF INSTALLATION

The Generating set installation must be carried out by a company with skilled workers and proper equipment.

The installations must be well-done and the company, at the end of the work, must issue a Declaration of Conformity of the Installation in compliance with the laws in force.

Before starting the installation, verify what follows:

- a) The Generating Set was chosen according to the requirements of the electric loads and the working environmental conditions (temperature, altitude, humidity) which it is used for.
- b) Generating Set (or Sets) place. In case of installation in a small place, the place itself must allow a good accessibility to the engine and the generator in order to carry out the normal maintenance as well as any possible repairs.
- c) In case of installation in a small place, you need to assure a proper air adduction, necessary to the engine combustion and to the cooling (radiator and generator) of the Generating Set, as well as to the place ventilation.
- d) The right use of fuels and lubricants.
- e) The compliance with the law about the sound emission.

• 6.2 PRELIMINARIES OF AUTOMATIC GENERATING SETS

During the preliminaries of installation of Automatic Generating Sets, during the making of the electric connections, in order to avoid inopportune startings etc., follow the following instructions:

- disconnect the starting batteries from the Generating Set;
- press the button “Stop” on the switchboard.

• 6.3 OUTDOOR INSTALLATIONS

The Outside Generating Set (excluding the canopy Generating sets or the ones in containers which are designed for them) must be located in an enclosed area sheltered from the atmospheric agents, dust, etc. Avoid the direct exposition to the sun which may cause an overheating of the complex; avoid rain, too. We suggest you to shelter the Generating Set with a roofing.

For temporary and short installations, it is good to place the Generating Set on a level ground; for long-lasting installations, we suggest you to build a concrete bed.



No admittance to the enclosed area. Authorized personnel only
Affix the danger and prohibition signs, as provided for the installations within the premises.

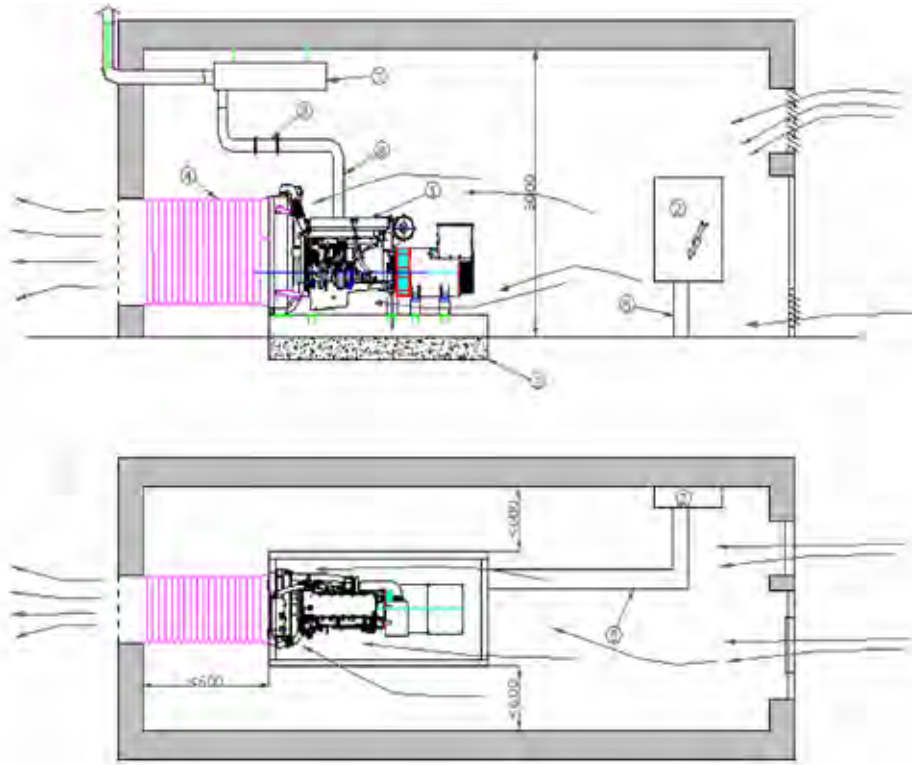
• 6.4 INDOOR INSTALLATIONS

The installation of a Generating set in a closed place implies the observance of the rules which follow:

- The place shall be dimensioned in order to let the Generating set operate and it must allow a good accessibility to its parts to carry out the normal maintenance as well as any possible repairs.
- The access room to the place must show the Generating set in by the normal transport and moving means available in-place.
- There shall be openings as big as to assure a good air exchange and conveyors to prevent from recycling the same air.
- You shall install a not very long exhaust pipe equipped with the minimum number of elbows.
- The Generating Set shall be located with enough space on the three sides at least, to assure accessibility and to comply with the safety regulation (as shown in the illustration).
- The switchboard II (in the case of Automatic Generating Sets) shall be placed so that an operator near the Generating Set can see the tools.

To summarize, control the:

- foundations;
- exhaust and ventilation system;
- fuel system;
- electrical connections;
- grounding;



- 1** Generating Set.
- 2** Switchboard (The manual one installed on the Generating Set – the Automatic one separate).
- 3** Foundation.
- 4** Air expulsion conveyor.
- 5** Cable drift.
- 6** Access door, partially grid for ventilation.
- 7** Exhaust Gas Silencer.
- 8** Exhaust Gas System.
- 9** Expansion joint.

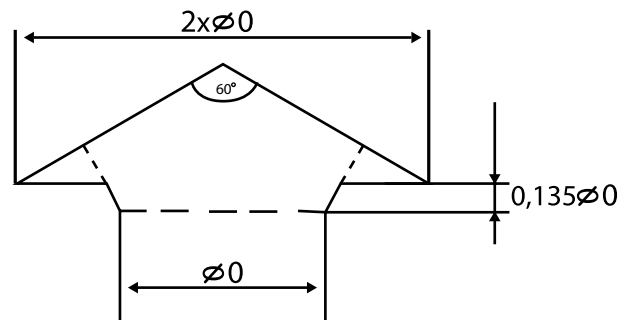
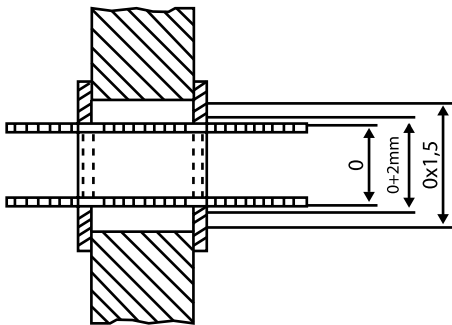
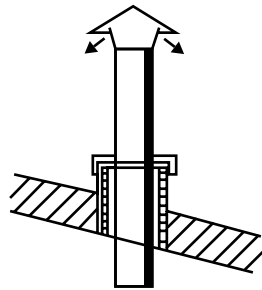
- 6.5 BED

Reckoning with the machine weight, the foundation shall be dimensioned and calculated by a specialist in civil engineering, to avoid the transmission of vibrations and noise to the other rooms of the building.

- 6.6 EXHAUST AND VENTILATION SYSTEM

The pipes for the exhaust gas normally consist in steel smooth pipes with no welding (UNI 1293) or, in special cases, in stainless steel pipes.

The pipes shall exhaust the gas where it does not damage anything, away from doors, windows or air intakes and they shall finish with a fixed rain shelter system. You need to provide to thermal insulation of the pipes to prevent heat from propagating into the walls.

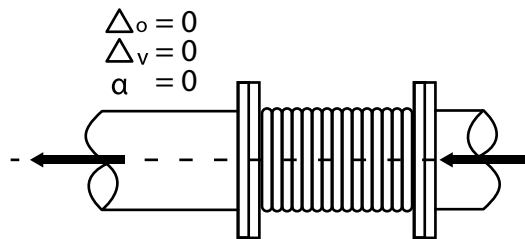


You can see details of what mentioned in the illustrations.

The pipe connection must be very tight in order to avoid leaks: the flange-connections with a gasket are the best. The structure of the vertical pipes must be such as to create a condensate well, to drain through proper plug, in the lowest part. Between the exhaust manifold outlet (or the turbosteam exhaust for the overcharged models) and for the downstream flow piping you need to install a flexible pipe so that the actions induced by the engine and the thermal expansion of the pipe itself are absorbed with no mutual damage.

By using the flexible pipe, you also need to clamp the exhaust pipe apart from the Generating Set itself; the pipes will then be fixed to the walls or the ceiling of the Generating Set room with proper supporting clamps which support the exhaust pipe without weighing on the engine.

Note well: The expansion joint possibly given with the Generating Set must be installed with concentric and parallel flanges, without pre-stress (as shown in the example).



To connect the exhaust manifold to the rigid pipe of the expulsion system, you can use a stainless double seaming flexible pipe. For very long pipes you need to insert expansion joints, always made with flexible tight elements.

When you decide where the exhaust pipe must be installed, you had better not put it near the engine air filters to avoid heated air suction. Anyway, you must insulate the pipe, not to overheat the room and to avoid accidental contacts with parts at dangerous temperature.

If there is more than one generator, the exhaust must not flow into one only pipe: there may be troubles if the exhaust gas joins the stationary one.

• 6.7 MEASURING OF THE EXHAUST GAS TURBINES

The exhaust back pressure influences its own power and its thermal exhaust.

The back pressure excessive values (measured at the exhaust manifold outlet for the normally aspirated engines and at the turbine outlet for the overfed ones) cause a power decrease, a rise in the exhaust gas temperature, smokiness, high power consumption, cooling water overheating with lubricant decrease and relative consequences on the engine parts.

The recommended not-to-exceed limits (in conditions of maximum power supply at full capacity) on the COELMO Generating Sets are:

- 150 mbar (1500 mm H2O) for normally aspirated engines.
- 50 mbar (500 mm H2O) for overfed engines.

These limits can be respected with a proper measuring of the exhaust system: pipe and silencer.

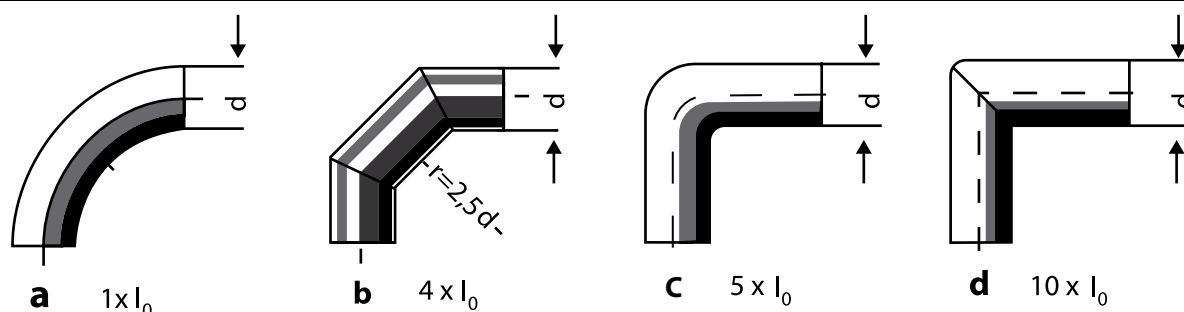
Just as an indication, here is an example of calculation of an exhaust gas pipe diameter.

With it, starting from the pipe length and deducing by the number of curves (90° with $r = 2,5 d$) and the exhaust gas capacity (in m^3/h)*, you can determine the pipe diameter (insulated and not insulated), once prefixed the admissible back pressure. Of course, this back pressure only has to do with a piece of pipe and not with the one due to the silencer. So you must try to keep the total back pressure (pipe and silencer) within the above-mentioned limits.

The pipes should be as short as possible and with few elbows.

When they are necessary, they shall have a large radius of curvature (on average 2,5-3 times the pipe diameter). In order to calculate the total pipe length, indispensable for the exhaust back pressure, the elbows shall be calculated by their rectified length value (l_0), deducible, for various pipe diameters, as shown in the table.

Internal diameter mm.	40	50	65	80	100	125	150	200	250	300
Equivalent length 10 m.	0,5	0,7	0,9	1,2	1,7	2,2	2,8	4,0	5,4	6,7



Here are various types of elbows, each with its rectified length shown in comparative terms.

The solutions different from the ones with a large radius of curvature ($2,5 \times d$) are more damaging, so they must be avoided and directly calculated.

Anyway, the exhaust pipe shall not have a diameter smaller than the exhaust manifold one. When the pipe diameter is larger, the connection to the engine shall be equipped with a 30° conical screw connection, to avoid load loss. Moreover you should verify, at the end of the installation, the total back pressure generated by the pipe and the silencer. This must be done near the engine turbine, possibly on a long and straight tract. You can use a normal U-bent transparent plastic pipe partially filled with water. One end must be in contact with the exhaust gas pipe and the other end must be free in the air. The water level difference between the two ends of the U-pipe gives the back pressure value, obviously in mmH₂O.

• 6.8 VENTILATION

For a good operation, the Generating Set shall be installed in a room with a very good ventilation and it is extremely important to:

- let the heat emanated during the Generating Set operation dispel;
- assure the right air supply flux necessary to the engine combustion;
- let the radiator engine get cooler; keeping the temperature in acceptable safety conditions.

Note that the best solution for most cases is the one shown in the typical illustration of installation.

The engine sucks the cooling air from the room and the warm air is ejected through the radiator and conveyed outside.

It is necessary not to allow the warm air going out of the radiator to enter the room again, taking care after the evacuation conveyor.

So you assure a continuous air exchange for the room.

The access openings measuring must be calculated according to the amount of the air capacity for cooling and combustion.

Pay attention to dusty rooms with particles floating in the air, which may block the radiator filters.

If necessary, install pre-cleaning systems.

To get a right air flux, the fresh air shall generally be put in through openings in the lower part of the room and, if possible, in the wall opposite the radiator's one, so that the air flux laps on the whole generator before coming out of the fan. In the Generating Set room must not be air stagnation, which may happen more frequently if several Generating Sets are operating the same room.

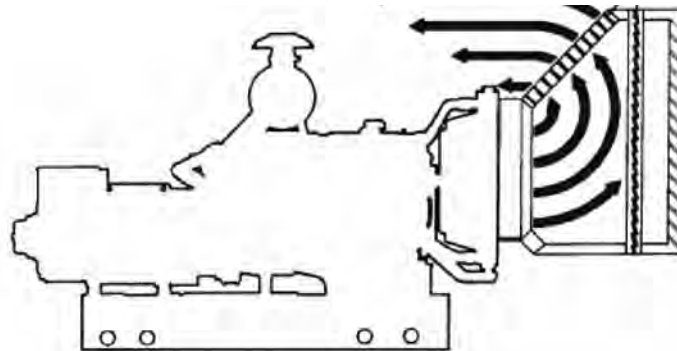
We suggest you to make sure that the cooling air is fresh enough in rooms where are generators which operate continually, or installations in resorts with high temperatures. If it is necessary to drop the temperature of the air coming out of the radiator, we suggest you to get yourself an auxiliary extractor fan.

The fan must eliminate the depression caused by the radiator fan; the position of this extractor in the room must be in the upper part, possibly on the same wall which the radiator discharges through.

Other way, you need to reckon with a part of the heat irradiated by the engine (i.e. by the turbine), relevant to the position of the intake filter. If the temperature of the comburent air entering the filter is too high and it damages the engine performances, you shall provide to a proper canalization for the comburent air which leads the outside air to the filter. This canalization shall be measured so that it could reduce to a minimum the additional load losses: the total maximum depression is of 250 mmH₂O.

VENTILATION IN COLD WEATHER RESORTS

In very cold weather resorts, a particularly low temperature in the generator room (lower than 10 °C), due to the excessive cool ventilation air may cause some problems. So you shall install choking systems with thermostatic control mobile shutters (see illustration) to keep an acceptable room temperature for the generators operation, without compromising the engines need for supply air. The thermostatic control must be designed one by one and may be verified by the room temperature and/or the water engine temperature.



Installation in cold climates.

• 6.9 FUEL SYSTEM

The basic COELMO Generating Set is equipped with a fuel system incorporated in the base supports. If to grant specific requirements or particular rules, it is necessary to make use of a separate tank, you shall connect the engine to the new tank, subject to interposition of flexible connections and proper pipes purposely clamped.

The tank capacity must be in proportion to diesel engine power and must consider the possible limitations provided by the laws in force in the installation Country.

The connections from the Generating Set tank generally are:

- to the engine injection pump fuel delivery;
- to the engine injection pump back excess;
- to the back drainage injectors;

As for the materials, it is necessary that said pipes are weldless and may be of steel, iron or annealed, in order not to damage the engine with the loss of the Guarantee, never make use of zinc steel pipes.

To insulate the fixed parts of the installation from the possible vibrations induced by the engine, there are different flexible connections:

- pieces of rubber pipe of a right length, reinforced with textile materials, diesel and fireproof, in compliance with the laws in force in the specific countries, for the connections with hose nozzles terminals and screw hose clamps;
- low pressure flexible hoses, diesel and fireproof in compliance with the laws in force in the specific countries, protected by metallic sleeve, fixed with hose fittings.

Synthetic resin connections must be avoided.

To complete the installation, pay attention to the following points:

- well-spaced pipe clamping in order to avoid vibration resonance and weight inflexion, especially with copper pipes;
- few joints to prevent the air from infiltrating, especially for the parts in depression (intake combustible delivery), this may cause difficult starting;
- inlet intake pipes under the fuel level up to 20 – 30 mm., in order to avoid the possible defusing of the inlet air circuit. These extensions must also be well-spaced (~30 cm.) so that the back fuel afflux does not directly affect the delivery with diesel impurities or mixed air.
- scrupulous cleaning of the used pipes;
- absence of abrupt variations of pipe sections and adoption of large connection radius in the pipe bending. Generally, the service tank must be supplied through a pump system and pipes fixed by a storage tank, specially if the tank is incorporated in the generator.

6.9.1 STORAGE TANK SUPPLY THROUGH AUTOMATIC EXTRAVASION SYSTEM

The manufacturing and the installation of storage tanks must comply with the laws in force in the installation Country dealing with fire and pollution prevention.

Anyway, these are the ends to achieve:

- minimum difference of level between tank and intake pump;
- minimum pipe length;
- distance from sources of heat;
- easy access to the filling machine.

The automatic extravasion pump system shall consist in an electropump and a manual filling pump in case of emergency. The electropump shall be automatically controlled by level switches put in the storage tank to fill. The measuring of the pump system shall be in proportion with the hour capacity to make, with the topographical features of the installation and with the load loss in the pipes.

The pipes and the connections shall be measured in proportion with the capacity and with the length to cover. They could be of copper or drawn black pipe.

Do not use zinned pipe.

You better provide a straight ball valve that can be operated from the outside, aimed to block the flux in case of emergency.

Always put bottom valves and filter on the intake delivery pipe.

Do not put any valves or back pipes from the engine to the service tank and from this to that storage tank. The tanks ventiduct pipes must go outside at least at 2,5 m. from the practicable floor and far from doors, windows and air intakes. The vent pipe end must be protected by fire net.

Underground storage tank

The tank must be double chamber with load sensing system and the dip point must be 2-3m deep from the Generating Set laying top, the distance from the dip point must not go beyond 10-15 m.

Above ground storage tank

The tank shall consist in a loss collection vat placed under the tank itself, which must be watertight.

If you are making use of one only storage tank to supply different Generating Sets, the delivery pipe must be separate, and each Generating Set must be provided with a dip point with its own valve and filter.

WARNING: we suggest you to ask COELMO technical department to define the precautions to consider for a right operation.

• 6.10 ELECTRICAL CONNECTIONS

The Generating Sets are already preset to be connected to the line. The Generating Set replaces the public system so it must

be considered as an outward source of electric energy. That's why the users' safety devices are not included in the supply and must be installed by Set installer considering the type of installation where the Generating Set is installed. Carrying out the connections, you must comply with the connections shown in the plans given with the Generating set. 6.10.

- 6.11 MANUAL GENERATING SET

The users cable will be connected to the terminals of the system which are in the lower part of the switchboard.

- 6.12 AUTOMATIC GENERATING SET

The cables belonging to the Generating Set, to the outward system and to the users will be connected to the switchboard terminals. The power cables of the Generating Set will be connected on it directly in the generator terminal board or to the machine switch.

The auxiliary services connection between Generator Set and switchboard will be carried out with a multiple cable and by making use of a multiple connector given with the Generating set. Its connection electric plan is given with the Generating Set.

- 6.13 CABLE DIMENSIONS

The choice and the dimensions of the cables is a responsibility of the installer. If you are using reduced sections, you need to know that they cause excessive voltage drop and damaging heating for the cable.

- 6.14 CABLE SETTING

The Generating Set connection cables – users for the manual Generating Sets – switchboard – system for the automatic ones, must be properly set in suitable pipe or drift.

All the cables belonging to the Generating Set or to the switchboard must be properly moored.

- 6.15 GROUNDING

The metal parts of the installations subject to people contact, which because of an insulation fault or other causes could be under voltage, must be connected to a ground electrode. The Generating Set (on its bed) and the switchboards are provided with grounding terminal. The dimensions of the cable connected to the ground electrode and the relative contact resistance, must be in compliance with the Laws in force.

Note: the ground installations must be as far as possible from railways/ tramways, in order to avoid the electrocorrosion of inside engine parts in contact with water.

7. STARTING AND MAINTENANCE

Starting and maintenance must be carried out by skilled workers and not by the operator, who is actually responsible for the good maintenance of the Generating Set. An inaccurate maintenance could cause deterioration or rapid wear and tear on the Generating set. That is why the maintenance must be as proper as possible to avoid failure. Therefore, the operator must treat the machine with care and immediately report any troubles and inconveniences, so that the Generating Set could have a high efficiency. Useful suggestions:

1) Get to know about the Generating Set in order to be able to report any possible trouble which, if disregarded, could cause very serious damage.

2) Constantly check if there is clamp release.

3) Verify the source of possible anomalous noises or vibrations which, if disregarded, could cause very serious damage.

At the first fill of cooling water, you shall open the deaeration points of the engine, until they pour water. After a short operation time you shall verify if the water level in the radiator is lower, since airpockets could have remained in the circuit during the first fill. The possible lacking water shall be added. In order to avoid electrocorrosion you must add the 30% of cooling water with

the common protective liquids. If the Generating Set must operate at room temperature below 0°C, add antifreeze to the water. The Generating Set has already an engine provided with first supply oil. We recommend to verify the right oil level in the sump before starting. The level must be verified again after a short operation time and changed 50 hours later. Fill the fuel tank with fuel for diesel engine. There are many products which prevent the forming of paraffin crystals in the fuel, on the market: so you can improve the fuel filterability and the lubricant power with positive effects for all the supply members. Use these products at ambient temperatures below 0°C. The mixture percentage vary from 0,2 to 0,4 % according to the outside temperature.

The lead batteries used for the COELMO Generating Sets are of the reduced maintenance type. We suggest you to charge them for some hours with current load equal to 1/10 of the batteries capacity, before starting.

- NEVER DISCONNECT THE BATTERIES without switching off the Generating Set and disconnecting the battery charger;
- DO NOT CHARGE THE BATTERY CHARGER, if the batteries are not connected or not correctly connected; the electronic equipment could irreparably get damaged;
- DO NOT GET ON the batteries, they could explode;
- DO NOT CAUSE SHORT CIRCUIT by leaving keys or tools on the batteries or on the cables connections, during the maintenance;
- USE protective gloves and glasses during the filling up, since the batteries acid is really aggressive;

The batteries only need a periodical control of the electrolyte level and a possible filling by using distilled water only.

In case of manual Generating Set, take out the key of the starting reverser during the Generating Set stops, in order to avoid to discharge the batteries.

Before starting, verify the electric connections extractitude, the terminals clamping, the fuses, the signal lamps and turn on the switches.

To start and manage the Generating Sets refer to the instructions in the electronic plan manual relative to the Generating Set to manage. (LEXYS AMF, LEXYS M, LEXYS SYNC).

• 7.1 CONTROLS AT THE FIRST STARTING

- Generating set manual starting
- Verify the correspondence between the voltage and frequency values within the +/- 3% of the license values.
- Check the cyclic phase direction since you need to know if the generator cyclic phase direction coincides with the outside manufacturing one, in order to avoid engine reversal of rotation and other troubles.
- Verify the right sense of rotation of the air extractors possibly installed in the Generating Set room;
- Measure the back pressure on the exhaust circuit;
- Make sure that the depression generated by the ventilation system makes easier the opening of the access doors to the room.;
- Manually close the remote control switch. So the users will be supplied by the Generating Set;
- Verify with the specific equipment that the load conditions are not bigger than the ones provided by the license data;
- Open the remote switch control and verify its actual operation;
- Close the remote switch control and verify its actual operation;
- Make sure that the functioning of the battery charge device and of the water preheating system;
- Press the STOP button until the engine stops;
- Automatic operation;
- Open the outside system general switch (outside the switchboard, if it exists) to simulate a lack of power.
- After the expected delay, the Generating Set must start up and when it supplies its nominal voltage, you must close the remote switch control;
- Close the outside system general switch again. After the delay, you must open the Generating Set remote switch control and close the system one.

The Generating set will stop after a delay with an idling for engine cooling.;

On trial. The Generating set must start regularly up but you must not close its remote switch control (unless there is a system

voltage drop). Put the presetting device on “automatic”. The Generating set stops presetting itself on stand-by and it is ready to operate in case of lack of outside power.

• 7.2 OUTPUT

Once the Generating Set is heated and lubricated enough (about 5-10 minutes), (for Generating Set with engine instruments this is set when the water thermometer shows a temperature above 60° C), it is then possible to pass onto the line output. After making sure there is no danger on the utilization lines, you have to switch off the general protection and/or output switch. Check through the ammeters that the loading conditions do not exceed the ones allowed: they are indicated on the plate data. During the output check, desultorily control the engine working conditions, verifying the good functioning, checking possible leakages and arranging the recurrent fuel supply.

For Generating Sets with engine instruments, make sure the working conditions are within normal limits. When the diesel oil level goes below the minimum, the light fuel minimum is switched on (when provided).

• 7.3 ENGINE PROTECTION

In the electrical board a specific electrical card is inserted to automatically protect the engine in case of anomaly on the pressure of the lubricating oil or an excessive buildup of the engine temperature, during normal functioning.

In the case of a low oil pressure or excessive temperature of the engine water, the engine automatically stops and the related message is displayed.

The light signal is stored until the operator intervenes. When the above mentioned anomalies take place, proceed as follows:

a) low engine oil pressure

Check oil level in the sump. Check any leakages in the lubricating circuit. Also follow instructions in the papers (Use and maintenance of the specific engine)

b) high engine temperature

- Check water level in the radiator and its outside cleanliness conditions (for water-cooled engines).

- Check there are no impediments to cooling air flow and that there is a chance for hot air to recirculate between fan out/ inflow.

- Also check engine cleanliness conditions, by following the instructions contained in the papers concerning “use and maintenance” of the specific engine.

- Check fan belt state.

• 7.4 PROTECTIONS

If during normal engine functioning an anomaly should take place (low oil pressure, high water temperature and so on) causing automatic Generating Set stop, you will have to operate as follows:

Blocking the presetting device;

Eliminate inconvenience which has caused the block.

Bring back the presetting device to the “manual” or “automatic” desired functioning position.

• 7.5 GENERATING SET BLOCK DURING AUTOMATIC FUNCTIONING

By pressing the stop button during the “Automatic” Generating Set functioning, an emergency block is caused. To go back to a normal functioning you have to stop acoustic alarm and reset the system by pressing the same button.

NOTE: for further information about the board, read the specific operative manual.

8. MAINTENANCE

To let the Generating Set keeps going, with a good performance, it is necessary to carefully follow the manufacturer's maintenance prescriptions. It is furthermore advisable to prepare a service card with the various operations to fulfil. On this card you will have to mark, day by day, functioning hours, interventions, supplies, maintenance and repair operations. Maintenance must be done by specialized technicians with suitable equipment.

• 8.1 MANUALLY CONTROLLED GENERATING SETS.

For continuously functioning Generating Sets, daily check:

- Water level
- Oil level
- Battery voltage

I. ENGINE – follow the specific engine paper prescriptions, carry out recurrent maintenance, change filtering cartridges (oil and diesel oil) and clean air filter.

II. GENERATING SET- follow paper prescriptions concerning the specific generator.

III. BATTERY – Check level and battery charging; if necessary, restore acid solution level with distilled water.

IV. CONTROL BOARD – weekly check fuse efficiency

V. Monthly check connections, contact wear and tear and clean properly.

Be careful in rooms with air suspended particles, in order to avoid filtering and cooling system obstruction.

NOTE: when working in dusty or desert areas or with air suspended particles, particularly with outdoor-installed Generating Sets, they must be properly cleaned since dust or particles, hindering produced heat transmission, may cause an anomalous heating on Generating Set components.

You must be particularly careful when dealing:

Radiator;

Air filters and pre-cleaners to be kept particularly clean:

Generating Set to be periodically cleaned inside with dry compressed air to avoid obstructions and isolation leakages; DO

NOT use compressed air for voltage electronic controller; use a vacuum cleaner;

The electric board will have to be cleaned only using a vacuum cleaner. Do not use compressed air in the electric board.

To carry out these operations you may be required to remove protection carters.

• 8.2 AUTOMATICALLY CONTROLLED GENERATING SET

For automatically operated Generating Sets, apart from following what has been already indicated about manual control Generating Sets, considering its specific employment type, that is to be disposed to function at any moment even if it has been not working for long periods, you have to carry out the following recurrent operations, i.e. check:

I. BATTERY: weekly check charge state and solution level. The battery charger for charge keeping must always stay inserted. Every 45 days check electrolyte density.

II. SUPPLIES: weekly check oil, water and fuel levels

III. LUBRICANT: even if the number of hours required to change engine oil has not been reached yet, it is advisable to change it at least once a year.

IV. GENERATING SET CHECK-UP: every week an idle functioning test must be carried out and possibly each month a charge test.

V. ELECTRIC CONNECTIONS: monthly check electric engine device connections on panel making sure they have a perfect clamping.

VI. CONTROL BOARD: yearly check the whole plant, verify all connecting terminal clamping. Clean by only using a vacuum cleaner. Check relay and remote control switch wear and tear and their cleanliness.

VII. WATER PRE-HEATING: in winter, check at least every 2 days engine pre-heating perfect functioning.

FURTHER INFORMATION:

- Regularly examine intake circuit filter state. Maintenance intervals vary according to season and working conditions. In particularly dusty ambients, it is necessary to carry out maintenance more frequently.

- Periodically check electrolyte level in the battery and carry out topping up only using distilled water.

- Keep battery clean.

- Try to keep fuel tank full at nearly any time to avoid any condensed steam.

- Periodically discharge water and sediments from tanks.

- Periodically replace fuel filter when there is pressure drop or Generating Set performance failure.

- Periodically check voltage and state of alternator control belts.

- 8.3 IDLE TEST RULES

- Put functioning selector switch on "Test" position.

- Check starting operation regular sequence, except mains set switching.

- Check plate data regularity (voltage, frequency and so on).

- Nominal speed functioning duration for 10-15 minutes.

- Put selector switch back to "Automatic" position.

- Verify that the stop operations are regularly carried out and that the generator is set for a new intervention.

NOTE: Should the mains fall down during idle test, the functioning Generating Set takes the load in a split second, carrying out the automatic opening operation of the mains remote control switch and the set remote control switch closing.

Troubles												Failure Research		
It doesn't start	It tries to start but stops	It doesn't reach the speed or slopes	Low or no voltage and or frequency	Aux. service failed running	Generator does not supply	Low oil pressure	High water temp.	Over speed	Fuel low level	Failed battery charger	Black fumes	Noisy engine	Possible cause	Solutions
●													The set is blocked for failure.	Find the cause and if necessary, contact the assistance service.
●	●												Run- down battery.	Check and recharge batteries. If necessary, replace them
●	●												Corroded or loosened battery connections.	Check cables and terminals. Replace cable lugs and nuts, if corroded. Lock well.
●										●			Inefficient connections, battery charger or battery failure.	Check connections on battery charger and batteries.
●													Defective starter.	Ask for assistance intervention.
●									●				No fuel.	Check tank. If they are no leakage, fill it.
	●												Air in the fuel circuit.	Deairate fuel circuit.
	●	●	●										Blocked air filter.	Replace the filter.
	●	●	●								●	●	Fuel circuit failure.	Ask for assistance intervention.
	●												Low ambient temperature.	Check SAE specific lubrication and fuel feature viscosity.
	●	●	●					●					Speed changer failure.	Ask for assistance intervention
	●	●	●										Board start control circuit failure.	Check start and stop control circuits. Of the set on the automatic board.
			●										Low ambient temperature, the set is not pre-heated.	Wait until the engine reaches a suitable temperature. Check the pre-heating plant.
		●	●		●								Voltage regulator failure.	Ask for assistance intervention.
		●	●										Too low speed.	Check speed controller.
			●										Instrument failure.	Check. If necessary, replace it.
			●										Instrument interconnections.	Check instrument connections.
					●			●					Switch opening due to overload.	Reduce load.
						●					●		Overload.	Check the set is not working in overload conditions, also concerning a higher than normal ambient temperature.
				●	●								Switch release. Short circuit or ground failure.	Check downstream circuits for failure research in the connected equipments and cables.
				●									Auxiliary service failure.	Ask for assistance intervention.
				●									No power.	Check power circuits.
											●		High oil level	Eliminate excess oil.
						●							No oil	Restore oil level into sump. Check there are no leakages.
						●							Blocked air filter	Replace filter.
						●							Oil circulating pump failure	Ask for assistance intervention
							●						No water	Wait for engine cooling and check water level into radiator. If necessary, feed. Check there are no leakages.
							●						Water circulating pump failure	Ask for assistance intervention.
					●	●	●	●	●				Alarm failure: sensor, board or interconnection breakdown	Check interconnections between sensor and board. Make sure sensor electrical connection are not of an earthing type. Check sensor and if necessary, replace it.
							●						Dirty or blocked radiator/intercooler	Check radiator/intercooler cleanliness. Check there are no hindrance to air flow and no possibility to air recirculation between output and fan aspiration.
●	●	●	●	●	●	●	●	●	●	●	●	●	Other possible causes	Ask for assistance intervention.

• 8.4 CLEANING

Terminals and connections must be always kept dry and clean; to avoid oxidation, clean and spread terminals with a light Vaseline coat. Be careful about acid spread to avoid erosion on the iron frame.

• 8.5 STORAGE

During long stops and storage, sets are to be possibly put in a closed and dry room and covered by a tarp. Storage prescriptions concerning Diesel engine indicated in the engine manual are to be particularly taken into account. When the sets are put into service, generator bearings (if necessary) are to be checked again. If the grease hardens, bearings must be cleaned and greased again. In the event of long period of inactive state, an isolation test on the generator and the control board should be carried out before setting it at work.

• 8.6 TROUBLE RESEARCH

Here below, a table containing the guidelines concerning any troubles which may take place during the Generating Set service.

In any case we recommend you to follow all the prescriptions contained in the manufacturers' manuals concerning the main subsets which make up the Generating Set, such as the engine, the alternator as regards trouble research and problem solving. Interventions to solve the various troubles must be carried out by qualified staff or an authorized repair shop.



Before any check or intervention read carefully Chapter 3” Safety Prescriptions” and specific papers.

9. DISMANTLING

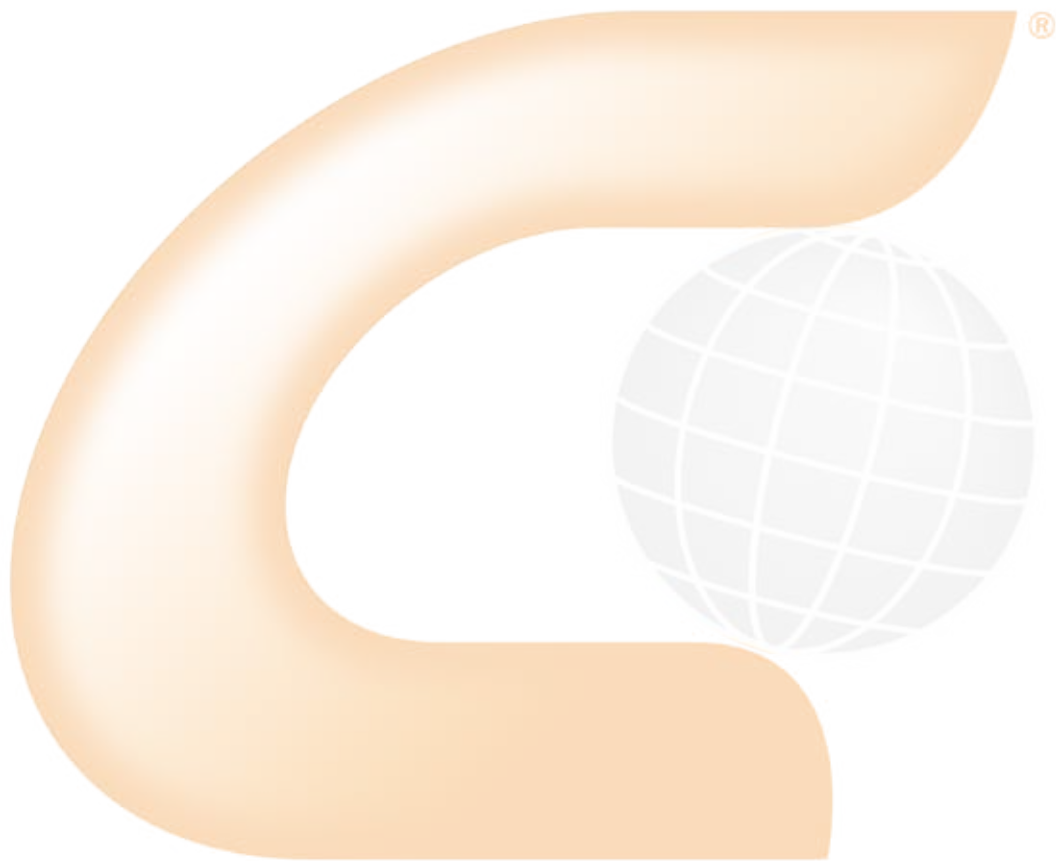
Inside the Generating Set and its components there are materials which may cause important ecological damages when dispersed in the environment.

The following materials must be handed to specific centre to be disposed of:

- starting batteries;
- exhaust lubricating oils;
- water and anti-freeze mixtures;
- filters;
- auxiliary cleaning material (i.e. greasy or soaked mops in fuel and/or chemical products for cleaning).

The Generating Set that is no more usable must be handed to an authorized organization for industrial machine demolition. All compound materials must be collected, differentiated, recovered and/or disposed of according to the rules in force in the installation country, particularly all those deriving from 91/156/EEC and 91/689/EEC regulations, regarding respectively waste and toxic waste.

It is strictly forbidden to disperse waste in the environment. All waste is potentially dangerous and environment-polluting.



COELMO spa

Sede Legale

Via F. Caracciolo, 17
80122 Napoli (Na) - Italy

Sede Operativa

Agglomerato Industriale ASI
80011 Acerra (NA) - Italy

Tel + 39 081 8039731

Fax + 39 081 8039724

E-Mail info@coelmo.it