DRESTER 120

ENGLISH

ORDERS AND PROCEDURES FOR THE INSTALLATION AND USE OF THE DISTILLATION UNITS

&

DIRECTIONS AND MAINTENANCE FOR THE SOLVENT RECYCLER DR-120

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SOLVENT RECOVERY SYSTEMS

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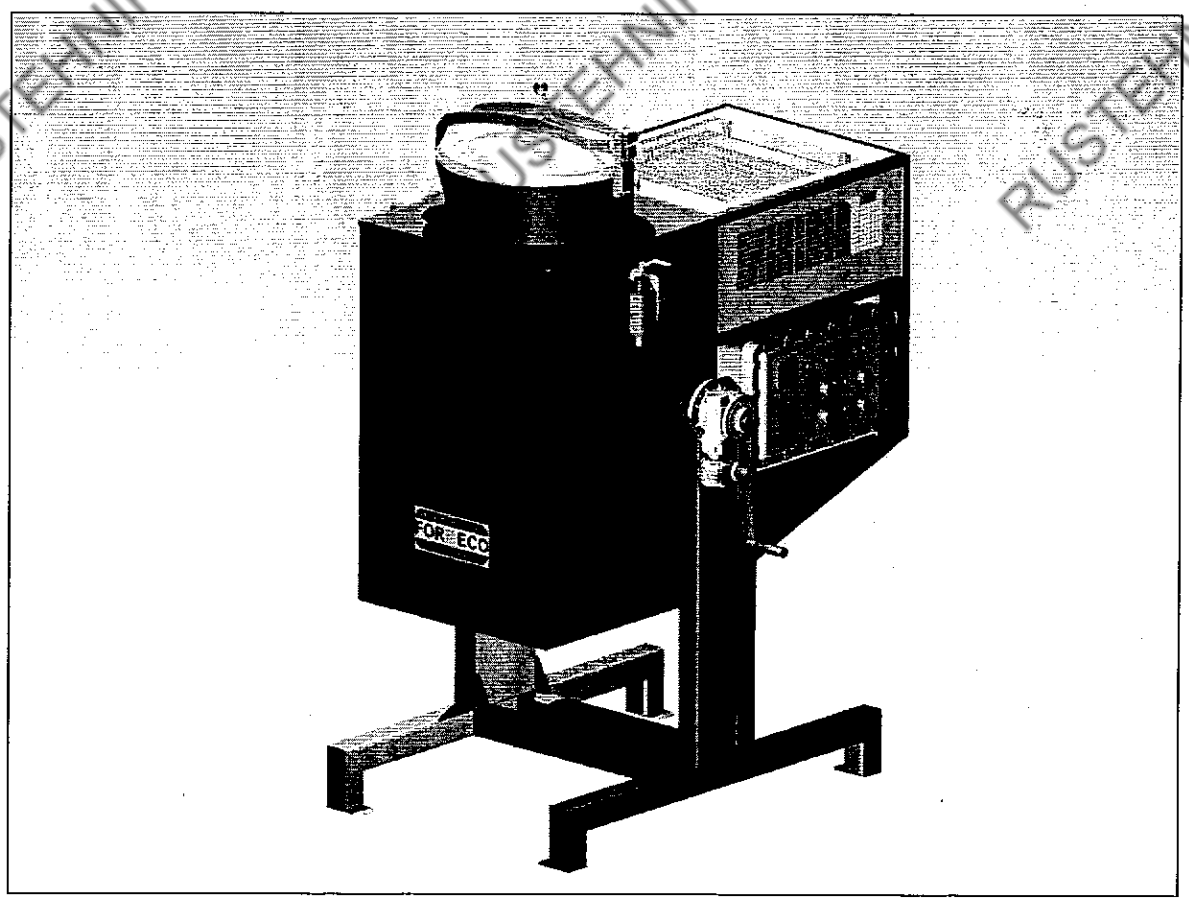
DISTILLATION GUIDE



Rev. 2.10.0

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1. PREFACE

1.1. Safety

In order to safely use the **FORMECO** distillation machine, consultation of the present guide is obligatory.

The guide to the **FORMECO** distiller allows qualified users to install, start functioning and to operate the distiller in safe conditions.

FORMECO declines every responsibility for injury and/or damages caused by misuse or unauthorised modifications to the machine. Eventual emergency intervention has to be carried out after considering the characteristics of the products in process.

1.2. Safety symbols

Information symbol: it indicates information for normal use.

Advised procedures symbol: it indicates the procedures to be observed to avoid damage to the equipment.

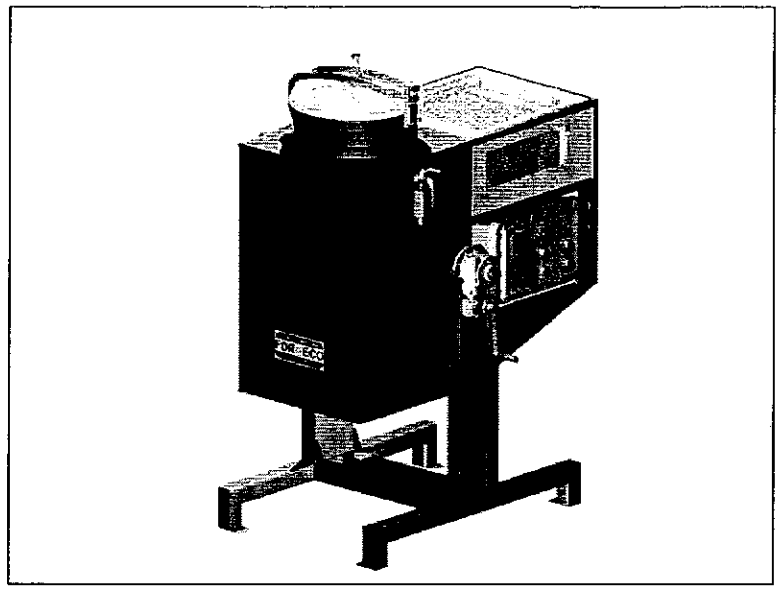
Attention symbol: it indicates a possible dangerous situation for the user or the equipment.

Electric danger symbol: it indicates a possible electrical danger, ignoring this could cause death or serious injury.

General danger symbol: it indicates a general danger, ignoring this could cause death or serious injury.

2. DISTILLERS

FORMECO DIstatic and **DYnamic** distillers exploit the principle of simple distillation, volatile substances (solvents and diluents) can be separated from non volatile (resins, paints, glue, etc.) or barely volatile substances (oils, ink, etc.).

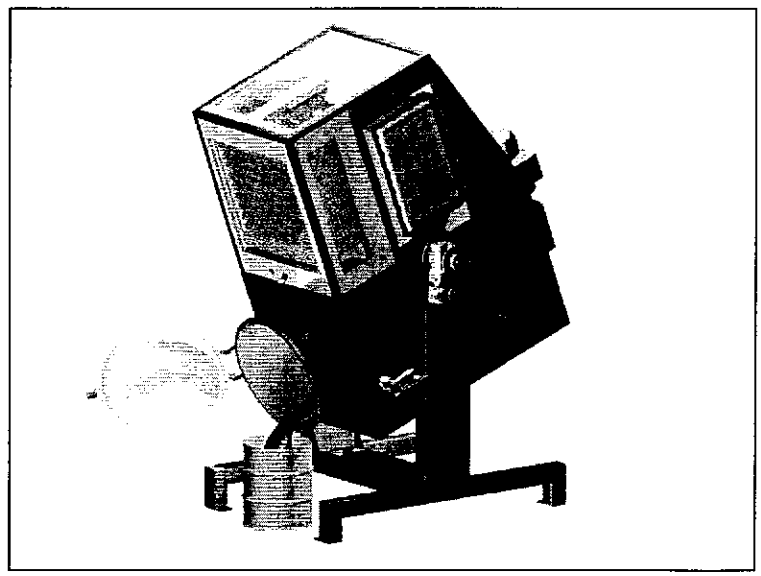


The mixture of solvents with contaminants is brought to boiling temperature inside a boiler equipped with a heating jacket with diathermic oil heated by electric elements. The vapour phase, consisting of solvents, is ducted towards an air cooled or water cooled heat exchanger and condensed; after that the condensed solvent is stored in suitable tanks.

The contaminants remain on the bottom of the boiler and in the case of liquid residues (oil, ink, etc.) can easily be removed by tilting the boiler.

If the contaminants are paints or glues, removable plastic bags Rec-Bag are used in the machines of the series **FORMECO DIstatic**, facilitating a quick and hygienic cleaning.

The cleaning of the machines of the series **FORMECO DYnamic** is very simple due to the presence of rotating scraper blades inside the boiler, that prevent the material sticking to the walls of the boiler. Again, the machine is then easy to empty by rotating it.



ⓘ The use is not recommended for the fractional distillation of solvents, since the result would be partial and industrially unacceptable.

3. RISK FACTORS

The choice of distillation unit, its placement and its operation, depend on the properties of the substances to be treated.

> ⓘ A distillation unit that can treat any type of solvent does not exist!
>
> ⚠ It is therefore absolutely necessary to know in advance the chemical and physical properties of the products to be treated.

Relative risk factors depending on the chemical and physical properties of each single component have to be taken into account.

3.1. Non-flammable solvents

During distillation of **non-flammable solvents** there is no danger of explosion or fire, the electrical input and electrical components therefore can be of water splash proof construction. Special attention has to be paid to the handling of the products, preventing inhalation and always following the guidelines as described in the safety data sheets provided by the manufacturer.

Prevent atmospheric and soil pollution due to accidents like overflow or tipping over of the vessel while loading the machine.

> ⓘ Some non-flammable solvents (halogenated hydrocarbons) can be thermally unstable. Maximum attention has to be paid to the distillation temperature to prevent acidification of the products.

Prevent atmospheric and soil pollution due to accidents like overflow or tipping over of the vessel while loading the machine.

3.2. Flammable solvents

Distillation of **flammable solvents** can lead to fire-hazards and can create potentially explosive atmospheres. Therefore, security measures have to be taken against fire and explosions. Special attention has to be paid to the following chapter that deals with the determination of the danger zone, the positioning of the machine and the electrical components of the machine.

Ask your supplier for the safety data sheets of each single product and distil them taking into account the data by paying special attention to the auto-ignition temperature. Furthermore attention has to be paid to the chemical and physical properties and safety data of the contaminants, especially in cases of paints with **nitrocellulose**.

3.3. Safety requirements

> ⓘ According to the legislation, the requirements for the installation and the placement of the machine are under the user's responsibility.

FORMECO distillation units with an identification code starting with the letter S (i.e. S25A), are equipped with a water splash proof electric installation (IP44) and hence are only suitable for the distillation of **non flammable solvents**; the distillation units with an identification code starting with the letter D (i.e. D25 A), are equipped with an explosion-proof electric installation **ATEX** ⟨Ex⟩, can work in ZONE 1 and hence can be used for the distillation of both **flammable** and **non flammable solvents**.

> ⓘ **ZONE 2:** place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.
>
> ⓘ **ZONE 1:** place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.
>
> ⓘ **ZONE 0:** place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continously or for long periods or frequently.

3.4. Identification

Every machine has to have its own identification code so that the user will know the protection of the electrical system and the chemical products that can be treated.

Interpretation of the identification code of the **FORMECO** machines, suitable for the distillation of **flammable** and **non-flammable solvents**:

CE Ex II 2 G IIA T2 .....

CE	Certificate of conformity of the producer for the European Union
Ex	European Union Symbol that indicates the apparatus conforms with the 94/9/EC norm, known also as ATEX regulations
II	Identifies the group of apparatus according ATEX regulations; in this case group II, that cannot operate in mining
2	Identifies the category of apparatus according ATEX regulations; in this case category 2, that can operate in zones with probable presence of flammable gas, vapours, mist or dust
G	Indicates that the protection is for flammable gas, vapours and mist
IIA	Indicates the explosion group
T2	Indicates the temperature class of the machine, in this case up to 300°C
.....	Eventual certification number

Special machines can be equipped with different electrical protections; in these cases the identification code can differ from the one shown above.

ⓘ It is recommended to protect the plate, for example with transparent tape, to keep it clean.

3.5. Installation place

ⓘ The listed guidelines are only indicative and can differ from the effective laws in every single country. Therefore it is advised to consult the official bodies for verification and/or additions to the listed guidelines.

The equipment must be installed in a way that prevents the generation of dangerous mixtures of gas or flammable vapours. The danger zone generated by the equipment must be indicated in the right way.

The installation of the equipment must comply with the fire prevention legislation and should have adequate ventilation, natural or artificial. If the equipment is installed in the open air, protect it from atmospheric conditions with a roof. If the ventilation is performed in an artificial way, the ventilation of the premises must be complete. The outlets of the air channels have to be ducted to the outside so that the escape of vapours does not constitute danger. Also the fans for the ventilation and their motors, when they are situated in zones with explosion risk, must comply with the ATEX protection criteria.

In order to avoid that possible spillage of liquids on the land might flow to adjacent premises in drainage systems etc, the machine has to be positioned within a bund with suitable dimensions, encircled with a wall with the correct height, able to contain eventual accidental solvent spillage. The pavement and the containment bund must be resistant to mechanical wear and chemical agents. It is useful to have a collection reservoir connected to the bund, where subsequently the liquid can be recovered.

Access to a suitable escape route should be available at all times. The escape route has to be located and constructed so that it can be found quickly and safely at all times. Escape routes must lead to the open air directly or through anti-flame corridors or scales. A door should at least be open from the premises in the escape direction.

It is necessary to install fire extinguishers, in correct places and in adequate number. The extinguishers must be for fires of **class B** (**fires of inflammable liquids**) and **class C** (**inflammable gas fires**). Warning signs have to be installed bringing attention to the possible dangers.

3.6. Operator instruction

ⓘ The customer has to know the chemical – physical characteristics of the products in use: ask the supplier for the Material Safety Data Sheets of every product and to proceed with the distillation taking into account all the available data, with particular regards to the flash points, boiling point and ignition point.

The operator must be instructed on the use and the operation of the still, on the correct use of the protection devices, on the possible fire risks. The instruction must be repeated at regular intervals.

The operator must wear anti-static clothing. There has to be no smoking, avoiding in every way the presence of possible ignition sources, for instance free flames, sparks of electrical, mechanical or electrostatic origin.

Depending on the nature of the products to be distilled, safety measures have to be adopted for personal protection. For the removal of the residue, the use of personal protection devices is obligatory, in particular gloves and a protection mask.

The operators must undergo preventive and periodic medical visits in relation to the composition of the used solvents.

The safety instructions and the emergency measures have to be exposed close to the apparatus or kept in an easily accessible place for the operating personnel.

3.7. Maintenance

The machine has to be regularly overhauled and controlled, depending on the use, always following closely the indications of the manufacturer as written in this manual. The maintenance has to be performed by qualified personnel.

The working of the safety devices has to be tested periodically.

Special attention has to be paid to the checking of safety devices like: thermostats, flow meters, thermometers, level controllers, aspirators, etc.

Before using a distillation unit that has been out of use for a long time, it is necessary to check the working of the unit and, if necessary, to do maintenance in order to guarantee a correct functioning at all times.

3.8. Environmental protection

The user has to ensure that according to the laws concerning the protection of the environment, the machine is not the cause of inadmissible emissions of vapours or gases and that the residue of the distillation is processed in a correct way.

3.9. Other risk factors

Particular attention will have to be paid to the handling of the products avoiding inhalation and paying close attention to the date of the Material Safety Data Sheets supplied by the manufacturer.

Some non-flammable solvents (e.g. halogenated) are thermally unstable. Maximum attention has to be paid to the process temperatures, otherwise the product may acidify.

Avoid atmospheric pollution and ground pollution due to accidental spillage during loading and discharging of the machine.

4. INSTALLATION

The equipment must be installed following the instructions of the handbook and of the present guide. The positioning on the ground, the electrical, hydraulic and other connections must be made by specialised personnel in accordance with the latest laws and technical regulations.

Before installation, verify that the still has not suffered obvious damage during transport or storage, check visually that the electrical circuits are not damaged.

The electrical power supply and ground connection necessary for the installation of the still must be designed and built in accordance with the current legislation.

For perform any maintenance and to be able to reach all parts of the machine, it is necessary to allow an adequate free space around the machine.

4.1. Placement

The machine has to be positioned horizontally in a walled or metallic bund.

4.2. Electric connections

Close to the machine and easily accessible and outside risk areas, a general interrupter has to be installed for maintenance and emergency command.

> All equipment that is installed in areas with explosion risk must meet protection criteria according ATEX regulations.

The connection of the equipment to the electrical power will have to be performed in accordance with the regulations.

Verify that the voltage and the mains net frequency correspond to the identification plate of the machine. For the values of installed power and absorbed current make reference to the identification plate of the equipment or to the use and maintenance handbook.

4.3. Grounding

The protection against indirect contact has to be effected by automatic power disconnection and grounding. The grounding has to be connected to the yellow-green connector inside the control panel.

The whole mass of the plant has to be connected to an efficient grounding net with an insulated cable of a section minimum 25 mm^2.

The distiller has to be connected to all metal containers (e.g. distillate container, dirty solvent tank, etc.) with an equipotential cable.

> During testing the insulation between the ground and the various active components of the machine are verified. The measured resistance should be higher than 1 MΩ (at 500 V DC). During the test it is also tested that there is no difference in potential between the earth and the metal parts of the distiller: this value should be less than 100 mΩ (at 25A). This measurement has to be repeated annually.

4.4. Feeding of the cooling water

only for machines equipped with water cooled condenser (Wx)

The entrance and the exit for the water are indicated with two plates (**IN** and **OUT**): use these connections as indicated! For the feed lines of the water ½" or 1" G tubes have to be used. The last part of the tube that is connected to the distillation unit has to be flexible to make sure that the boiler can be tilted.

Make sure that there is a valve and a manual tap on the water feed line to empty the condenser in winter time. The tubes have to be insulated to prevent them from freezing in the winter.

To ensure a correct working of the condenser, the water pressure should not be lower than 2 bar and the temperature of the water not higher than 20 °C.

The exit of the cooling water is to be connected to a small drainage well or can be recycled.

a. Recycling of the cooling water

To recycle the cooling water it's possible to use one of the following two methods:

A. **Storage vessel and circulation pump** of at least 30 litres/minute and a NPSH (head) of 50 meters.

Connect the control circuit of the storage vessel parallel with the electric valve of the cooling water. The dimension of the storage vessel has to be calculated according to the size of the machine installed. When the cooling is insufficient, the distillation cycle of the machine will be stopped automatically by the safety thermostat.

B. Cooling with a **CHILLER**: with a closed cooling circuit is the optimal solution in lowering the costs of the distillation as well as having the following advantages, a better condensation with a liquid cooled surface, the possibility to control the temperature of the distillate depending on the use, less loss of solvent due to natural evaporation, no danger for freezing in winter time.

For further details on how to dimension the cooling installation, the user is asked to contact his distributor.

4.5. Connections to distillate vessel

A vessel of sufficient volume has to be connected to the condenser exit. If the vessel is made of metal it has to be grounded. If the vessel is of plastic, a metal cord has to be connected to the metal part of the distillate outlet, going into the vessel down to the bottom. The collecting vessel should not be closed airtight to guarantee a free air circulation.

A solvent resistant rubber hose has to be used to connect condenser exit and vessel to prevent evaporation and smells. Also avoid the presence of curves and bends in the connecting hose between condenser exit and collecting vessel; an over-pressure could be formed inside the boiler and could result in vapours escaping from between the boiler and the cover. The hose should not extend itself for more than a few centimetres into the collecting vessel and the hose end should never be submerged in the fluid.

⚠ The hose should be in non-insulating material, with a superficial resistance under 1 GΩm (normal plastic or rubber hose has a resistance in the order of 10^4 GΩm), and electrical continuity has to be secured between distiller and hose. Therefore it is necessary to use non-insulating materials.

During the distillation of **flammable solvents** especially in closed areas (poorly ventilated), there has to be an anti-flame filter on the air vent of the distillate vessel, made with a pressed wire netting or the discharge pipe has to lead directly to the outside.

Before starting the distillation, check the correct installation of the hose between distiller and vessel.

5. SOLVENT TO BE DISTILLED

ⓘ The customer has to know the chemical – physical characteristics of the products in use: ask the supplier for the Material Safety Data Sheets of every product and to proceed with the distillation after taking into account all the available data with particular regards to the flash point, boiling point and ignition point.

To be able to work safely with the distillation unit it is necessary to know in advance the physical and chemical properties of the products to be treated. **Negligence of this can cause dangerous fire and explosion situations.**

5.1. Definitions

SOLVENT: Liquid that, without reacting chemically dissolves other substances (solutes), forming a solution.

DILUENT: Mixture of solvents.

5.2. Safety data sheet

Deliveries of solvents or diluents have to be accompanied by safety data sheets on which is found: name, physical and chemical properties, classification, labelling, toxicity, legislation, explosion limits, rules for storage, transport and treatment and the safety measures to be taken.

⚠ In case the Material Safety Data Sheets (MSDS) are not present, ask for them immediately from the supplier.

5.3. Physical characteristics

For the distillation special attention has to be paid to the physical and chemical properties, particularly about:

a. Flash point

This is the minimum temperature at which, above a free liquid surface of solvent, a gas or vapour phase is formed that burns spontaneously in contact with a flame. It is clear that, the lower the flash point, the higher the risk when handling the solvent.

b. Auto-ignition temperature

All flammable solvents have a specific auto-ignition temperature. The auto-ignition temperature is the minimum temperature at which the solvent, in contact with air, burns spontaneously and where the burning process proceeds without input of energy from the outside.

To prevent auto-ignition, the maximum surface temperature when the machine is functioning should never be higher than the auto-ignition temperature of the treated solvent.

c. Temperature class

Depending on the maximum surface temperature, machines are divided into six groups or **TEMPERATURE CLASSES**:

TEMPERATURE CLASS	MAXIMUM SURFACE TEMPERATURE
T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C
T6	85°C

Machines in T1 class can have a maximum surface temperature of 450°C. Therefore only solvents with an auto-ignition temperature higher than 450°C can be distilled with these machines; if the machine belongs to T2 class only solvents belonging to class T1 and T2, with an auto-ignition temperature higher than 300°C, can be distilled; if however the machine belongs to class T3, it can be used to distil solvents belonging to T1, T2 and T3 with an auto-ignition temperature higher than 200 °C.

The machines of **FORMECO** are normally constructed in T2 or T3 class.

Check the temperature class on the identification plate.

Examples

Acetone	
Auto-ignition temperature	535°C
Temperature class	T1
can be distilled with a distillation unit belonging to class T2 or T3.	

Methylcellosolve	
Auto-ignition temperature	235°C
Temperature class	T3
can be distilled with a distillation unit belonging to class T3.	

When a mixture of solvents has to be distilled refer to the lowest auto-ignition temperature.

⚠ Not adhering to the above mentioned guidelines can lead to a high risk of fire and explosion.

d. Heat of vaporisation

The heat of vaporisation is the amount of energy per mass unit needed for the transition from the liquid phase into the gas phase.

Examples

Solvent	Heat of vaporisation	
	kJ/kg	kcal/kg
TRICHLOROETHANE	238	57
ACETONE	536	128
WATER	2260	540

The heat of vaporisation gives an indication about the speed of the evaporation process and hence of the hourly production of the machine; the distillation rate of a certain solvent is not a function of the temperature but of the heat of vaporisation: the higher the heat of vaporisation, the lower the rate of distillation.

e. Density

The density of a liquid is the weight in kilograms of one litre of material expressed in kg/m^3.

This is a useful quantity when two immiscible liquids have to be separated mechanically. The bigger the difference in density the faster the separation.

f. Vapours density

Depending on the relative density in respect to air, vapours of inflammable solvents can be divided into **heavy**, when their relative density is higher than 1.1 kg/m^3; **light**, when their relative density is lower than 0.9 kg/m^3; for vapours with a relative density between 0.9 and 1.1 kg/m^3 (including the extremes) both safety measures for heavy as for light vapours are effective.

ⓘ This parameter is important for knowing the extent of the danger area and for the positioning of the ventilation vents.

g. Solubility in water

For separating a solvent mechanically from water, it is necessary to know the solubility of the solvent in water. Keep in mind that normally only halogenated solvents are not miscible with water and therefore mechanically separable from water.

h. Boiling point

The boiling point of a liquid is the temperature at which the liquid is transformed into gas at a given pressure. A solvent normally has one specific and constant boiling point. A mixture of solvents has a temperature range in which it boils. A dirty solvent normally boils at a higher temperature, depending on the type and amount of pollution.

The boiling point is independent of the heating source; but the bigger the temperature difference between heating source and boiling point, the faster the evaporation process will take place. During the distillation process it is common practice to take the heating temperature 30 ÷ 40°C higher than the boiling point of the

solvent. Although the production can be augmented by using a bigger temperature difference, this can lead to foaming, that can lead to fouling of the condenser and of the distillate produced; eventually this can even lead to blocking of the condenser.

ⓘ The most important physical properties of the common solvents are summarized in tables in appendix of this manual.

i. Acidity

ⓘ📖

The acidity (pH) of the product to be treated is important when choosing the machine.

The standard **FORMECO** machines are made with a boiler of stainless steel AISI 304. Condensers are made in copper, suitable for the distillation of neutral solvents and in stainless steel AISI 304 for the distillation of neutral and slightly acid solvents. In the case of relevant acid levels, every case has to be looked upon separately.

j. Flammable solvents

Inflammable solvents (ketones, alcohols, glycols, esters, aromatics) are neutral when they are purchased new; they can become acid for the following reasons:

- through oxidation due to long and/or wrong storage: before performing a distillation, especially when the solvents have been stored for a long time the acidity (pH) should be checked;
- during the distillation process of **thermally unstable solvents**: the acidification occurs above a certain temperature: ask your supplier about the acidification dependant on temperature;
- acidification due to **changes of the polluting residue**, especially during the drying phase of the distillation: check the pH of the distillate.

k. Halogenated solvents

Halogenated solvents, even when they are stabilized, can acidify during normal use as cleaning liquid and also during distillation. A stainless steel AISI 304 condenser has to be used for the distillation of these solvents (see table "non flammable solvents"). If possible the distillation has to be performed under vacuum and one has to pay attention to the reported temperatures. Check the pH, and neutralize the solvent if necessary.

⚠ The warranty on the distillation unit is no longer valid when it is used for the distillation of acid solvents. These solvents have to be neutralized immediately.

ⓘ The **Rec-Bag** will dissolve when used for the distillation of acid solvents.

ⓘ To be able to work correctly, tests should be performed first. Pay attention to the distillation behaviour of different products and catalogue the products. Prevent mixing of products with different boiling and distillation behaviour.

6. CONTAMINANTS

To know which kind of contaminations are in the solvents to be distilled is equally important as knowing which solvents are to be treated. This is both important when distilling the product when safety is concerned. For safety aspects, see the chapters 7.1 and 7.2; concerning the operation of the machine we have to distinguish between liquid and solid contaminants.

6.1. Liquid contaminant

The most common liquid contaminants are oil, ink and water.

The presence of liquid contaminants during distillation may lead to contamination of the distillate.

For different types of oil and ink with a particularly high boiling temperature this problem normally does not occur and the process of separation may be performed with a simple distillation; in the presence of water pay attention to the distillation behaviour (formation of azeotropes). If necessary work with a fractionated distillation.

The emptying of the boiler in the case of a liquid residue is very easy and can be done by simply tilting the unit.

6.2. Solid contaminant

The most common solid contaminants are resins, pigments, paints, polymers, glue, powder and grease. The advantage of solid contaminants is that, when they are not already classified as toxic and noxious they can simply be transported to a controlled waste dump on the condition that the percentage of solvent does not exceed that of the maximum limit posed legally in each country.

To empty the machines **FORMECO DIstatic** use the **Rec-Bag**, made of a special resistant type of plastic.

For machines **FORMECO DYnamic**, tests have to be performed first to check the behaviour of the residue. If the residue tends to stick to the scraper blades, add inert material to the product or explain the problem to the manufacturer.

It is emphasized here that paint residues often give a light colouring to the distillate in the drying phase; in most cases however this light colouring does not give any problems for the reuse of the distillate.

6.3. Use of Rec-Bag

For the cleaning and the easy removal of the residue from the boiler, the use of the **Rec-Bag** is recommended.

Before emptying the machine make sure that the temperature of the machine is lower than 50°C. To shorten the waiting time it is possible for units with a capacity of over 60 litres to perform a quick cooling down (optional).

⚠ The Rec-Bags can only be used for solvents belonging to group IIA; they cannot be used for solvents belonging to group IIB and IIC.

6.4. Boiler cleaning

Before emptying the machine make sure that the temperature of the machine is lower than 50°C and that the ventilation is correct, then open the cover tilt the machine and remove the residue.

⚠ Never use tools that may create sparks.

To shorten the waiting time it is possible for units with a capacity of over 60 litres to perform a quick cooling down (optional).

7. RISKS AND DANGERS

7.1. Dangerous chemical reactions

The chemical substances that are normally treated (hydrocarbons, chlorinated hydrocarbons, esters, glycols, ketones, alcohols) and most of the common contaminants (pigments, glue, ink and oil) can be heated up to the maximum working temperature of the distillation unit without any problem.

Pay close attention to the presence of other substances that can undergo dangerous chemical reactions or that can cause fire or explosion.

Dangerous situations can occur because of:

- reactions due to the presence of peroxides that can be formed in the presence of oxygen and in absence of stabilisers during the storage of certain solvents like for example tetrahydrofuran, ethyl ether and ketones;
- explosions by heating of nitro-substances (nitromethane, nitroaromats) or nitrate containing substances (nitric acid esters);
- explosions due to the presence of nitrocellulose in certain paints;
- presence of metal complexes that can be explosive in dry form;
- fire and explosion danger due to the presence of strongly oxidising substances (nitric acid, chromates, perchlorates) in presence of oxidisable substances;
- possibility of catalytic reactions in the solvent due to the presence of rust, azo-substances, colour pigments;
- possibility for decay of certain substances (carcinogenic aromatic amines from azo-substances).

Pay attention to the presence of substances that can lead to fire or explosion by chemical reactions.

In the presence of above mentioned substances, each case has to be looked upon separately to design an appropriate machine.

7.2. Nitrocellulose

Nitrocellulose is a combination of cellulose and a mixture of nitric and sulphuric used during production of paints, varnishes and inks: nitrocellulose is mainly present in wood paints, leather treating liquids and in printing inks. The percentage of nitrocellulose present on dry basis is usually between 2 and 30%.

In dry form, heated up to 100°C it decomposes forming nitric fumes generating an explosion at 170° – 180°C. In case of decomposition or ignition of nitrocellulose only fire extinguishers with water can be used: foam, carbon dioxide and chemical extinguishers can not be used.

When nitrocellulose containing material has to be distilled, the following rules have to be adhered to:

- the machine must never work above a maximum temperature of 150°C;
- working between 100°C and 150°C the distillation has to stopped when the residue is still liquid; to obtain dry residue it will be necessary to operate with temperature under 100°C finally under vacuum.

Upon request the distillation unit can be equipped with a special program to perform the distillation and the concentration of the residue automatically also in the presence of nitrocellulose.

a. AFN safety system

Optional ATEX device to detect the beginning of the decomposition of nitrocellulose and to automatically activate a safety system inside the boiler consisting of a sprinkler installation.

7.3. Ink

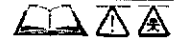
Particular attention must be paid to the drying of residue containing inks, normally used in wood painting. In a dry state, when reaching temperatures of 110÷120°C, these can decompose with emissions of toxic smoke. When operating at high temperatures the distillation cycle has to be stopped when the residue is still liquid to avoid the drying of the residue.

7.4. Temporary residue storage

Distillation residues that also contain only small percentages of nitrocellulose and/or ink that are in a dry state can cause fire even after 48 hours removal from the boiler.

In order to avoid such events from taking place, it is necessary to place the residues in the open air far away from other equipment, wetting them with water in order to reduce the fire risk.

7.5. Classification and waste disposal



Generally speaking, the distillation residues consist of concentrated mixtures of solvents and contaminants. They are considered as waste and have to be processed according to the laws of the country.

During the classification always pay attention to the percentage of organic solvents; special attention also has to be paid to the presence of heavy metals like lead, chrome, cadmium, etc. For the official classification of the waste contact an authorised laboratory for analyses.

The machines **FORMECO DIstatic**, when the solvent to be distilled does not contain more than 5÷6 % of residue and using a Rec-Bag will produce a residue that contains generally between 4÷7 % of residual solvent. The machines **FORMECO DYnamic** when also treating solvent with a high percentage of contaminants can produce a residue that contains less than 5% of residual solvent.

The presence of solvents is the only parameter that is used to classify waste. Also presence of heavy metals can determine the end-classification of the waste. For classifying distillation residues it is necessary to contact an approved laboratory.

8. THE DISTILLATION PROCESS

The working cycle of the **FORMECO** machines are divided into two or more phases. In this way it is possible to be flexible towards the different problems and criteria that every user has.

8.1. Simple distillation

With a simple distillation it is possible to separate volatile substances (solvents and diluents) from non-volatile (resins, pigments, glues, etc.) or hardly volatile (oil, ink, etc.) substances. The process consists of the boiling of the mixture of solvents with contaminants; only the volatile fraction evaporates and is condensed while the contaminants remain on the bottom as residue.

Determining parameters are: pressure, temperature and time.

a. Atmospheric distillation

The distillation process is normally performed at atmospheric pressure. The boiling points as mentioned in the tables are all at atmospheric pressure(101325 Pa).

When to use atmospheric distillation:

a. if a low boiling solvent has to be distilled and a vacuum distillation were to be used, it would be impossible to condense the distillate;
b. when the product foams too much during vacuum distillation;
c. it is advised for distillation temperatures between 70°÷140°C.

b. Vacuum distillation

The boiling temperature is lowered by lowering the pressure: by creating a vacuum inside the boiler and reaching a pressure of about 20000÷26500 Pa, the boiling temperature is lowered about 30÷40 %. In certain cases it is necessary to make use of this physical phenomenon.

> The **FORMECO** machines with the letter **V** in the identification code are suitable to work under atmospheric pressure as well as under vacuum.

When to use vacuum distillation:

a. it is advised for solvents with a boiling temperature above 170 °C;
b. it is necessary for distilling solvents with a boiling point higher than 200 °C because **FORMECO** machines have a maximum working temperature of 200 °C;
c. it is necessary for distilling solvents with a boiling point close to the auto-ignition temperature. The most common case is white spirit, having a boiling temperature of 150÷190°C and an auto-ignition temperature of 254°C;
d. when distilling halogenated solvents to work under the acidification temperature;
e. when the residues decompose or carbonize at the atmospheric distillation temperature.

The use of vacuum can also lead to unwanted side effects like the increased foaming during distillation and the maintenance of the vacuum group.

If the machine is equipped with an air-cooled heat exchanger, only solvents with a boiling point over 100°C can be distilled under vacuum. If for some reason it is necessary to distil low boiling solvents under vacuum, a water-cooled machine can be used if necessary with a chiller in closed circuit.

8.2. Distillation of mixtures

With mixtures of solvents with different boiling temperature it's possible to separate the components using different phases varying the process parameters (pressure, temperature, time). It's possible to distil different components working close to the distillation temperature of each.

a. Atmospheric distillation

In case a solvent mixture is composed of 2 solvents with very different distillation temperatures, for instance 60°C and 180°C, the temperature to be set (when operating with a single phase) would be 200°C. It is very likely that this would result in foaming and/or entrainment of the product due to the high temperature difference of the heating medium and the boiling point of the low boiling substance.

In these cases, the first phase of the distillation is performed under atmospheric pressure while the second phase is performed under vacuum.

The problem can be resolved by adopting 2 phases: one at 80°C (phase 1) and a second phase at 200°C (phase 2).

b. Vacuum distillation

In some cases it might be necessary to perform first a distillation at atmospheric pressure and afterwards a distillation under vacuum, for instance:

a. when distilling a mixture consisting of both solvents with a low boiling point (40 to 70°C) and solvents with a very high boiling point (higher than 200°C)

b. when the mixture produces too much foam during vacuum distillation.

During the change from atmospheric to vacuum conditions it might be necessary to first cool down the machine to the desired distillation temperature to prevent boiling over.

8.3. Concentration of the contaminants

A concentration phase after the distillation is useful for optimizing the yield of the process. After the distillation phase the time can be prolonged for another 15÷30 minutes at the same temperature. In this way the residue is stripped from remaining solvent.

The end result in the case of paint residues is a thick liquid product when it is still warm that will harden when it cools down.

The percentage of solvent in the residue will be about 10%.

8.4. Drying of the contaminants

The complete drying of the residue is used to obtain a residue that can easily be brought to a waste processor. A dry residue can be obtained with the right combination of temperature, vacuum, time and mixing.

Lowering of one of the parameters can be corrected by increasing another although it is not possible to guarantee by what amount.

The working temperature is higher than the distillation temperature and normally not lower than 160÷180°C; the vacuum influences the drying process in a dramatic way: usually it is necessary to work under vacuum in the drying phase. The length of time will depend on the concentration of the contaminants.

ⓘ Certainty about the solvent concentration in the residue can only be obtained by chemical analyses

8.5. Repeating the distillation

The distillation process consists of two phases: evaporation followed by condensation. During evaporation the distance between the molecules is enlarged by the energy given in the form of heat. During condensation this energy is removed and the intermolecular distance is restored.

It is clear that this process will not alter the physical-chemical properties of the solvent involved and therefore it is theoretically possible to repeat the distillation process an indefinite number of times.

In case of solvent mixtures a fraction of the low boiling substances is lost during use due to natural evaporation during distillation and a fraction of the high boiling solvents can get lost because they remain in the residue. In practice the low and high boiling fractions of the mixture will decrease in percentage.

It is therefore good practice to dilute the distillate regularly with fresh product.

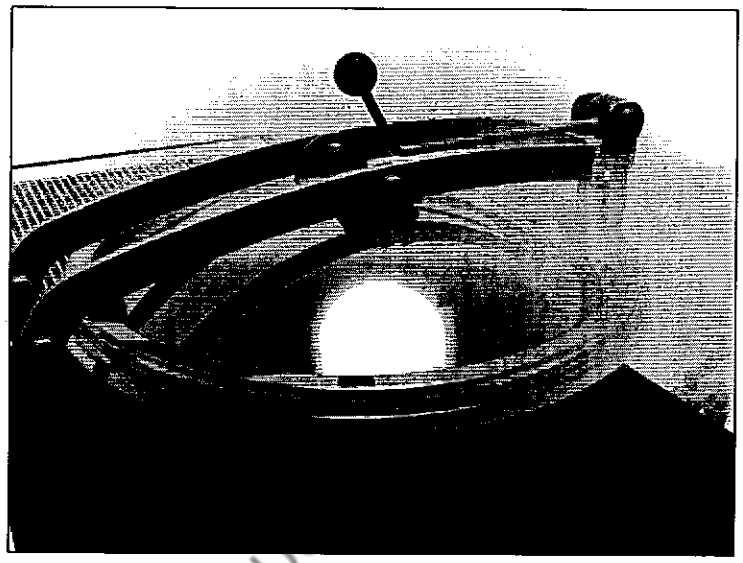
9. PROCESS RISKS

9.1. Over-pressure

The distillation process normally occurs at an over-pressure of not more than 0.1 bar. This over-pressure can increase because of a blockage in the tube leading from the boiler to the condenser due to over-filling of the boiler, boiling over of the solvent or because of foaming. Special attention has to be paid to the cleaning of the connecting tube during maintenance; this is indicated in the corresponding chapter.

Due to lack of maintenance, the overpressure can be increased. The cover of the boiler works as a safety valve and just as with a normal safety valve, during overpressure gases escape between boiler and cover. If gases escape between boiler and cover the machine has to be stopped and the cause of the over-pressure has to be investigated and fixed.

⚠ Do not in any way change the spring that closes the cover and do not block in any way the cover to prevent the evacuation of gasses.



⚠ The opening of the boiler due to over-pressure as described above has to be taken into account in the zone classification of explosion risk areas. This opening should be considered an anomaly that happens rarely and for a short period of time. The causes of over-pressure formation will have to be removed immediately as described in the instruction manual.

9.2. Foam

Each product produces foam during boiling; to insure a clean distillate the foam level should never reach the level of the condenser; for this reason the maximum loading capacity of the boiler is, depending on the model, 40÷60% of the geometrical volume: the difference between filling capacity and geometrical volume is in most cases big enough to be able to work satisfactory.

The most important factors for the formation of foam are:

- physical and chemical properties of the solvent;
- physical and chemical properties of the contaminants;
- pressure at which the distillation is performed;
- temperature of the heating jacket.

Working under vacuum increases the formation of foam: the deeper the vacuum, the bigger the formation of foam; the bigger the difference between boiling point of the solvent and the temperature of the heating oil in the jacket, the bigger the formation of foam.

Depending on the solvent and the process parameters, foam formation can depend strongly on the nature of the contaminants. In a lot of cases paint residues of the same type but of different colour can have different foaming characteristics.

To be able to work correctly, tests should be performed first. Pay attention to the distillation behaviour of different products and catalogue the products. Prevent mixing of products with different boiling and distillation behaviour.

ⓘ To be able to work correctly, tests should be performed first. Pay attention to the distillation behaviour of different products and catalogue the products. Prevent mixing of products with different boiling and distillation behaviour.

In case of exceptional foam formation it is possible to reduce it in the following ways:

- let the dirty solvent rest for 48 hours before distilling it;
- load the boiler with less solvent than usual; in this way the formation of foam will be less and there is more free space above the liquid in the boiler;
- if possible, try to do the first phase of the distillation at atmospheric pressure and the last phase under vacuum;
- depending on the boiling point of the solvent, lower the temperature of the oil in the heating jacket;
- use the **anti-foam disks** for machines where they are available;
- ask the manufacturer to install a special electronic program for modulated heating.

ⓘ Above mentioned measures can of course influence dramatically the maximum load (even up to 80% less) and therefore influence the hourly production of the distillation unit; values of maximum charge and hourly production in the tables are therefore indicative.

9.3. Drying

During the drying phase the temperature is normally increased to facilitate the removal of the remaining solvent from the residue.

Attention has to be paid in this phase to the possible decomposition of the **solvent**: always consult the safety data sheets and check for maximum safety the acidity of the distillate after the first distillation cycles.

In the drying phase there are increased risks connected with **nitrocellulose** and **dangerous chemical reactions**. See the appropriate chapters.

Make sure that the distillation and drying process does not lead to **acidification** of the contaminants and thereby of the distillate produced.

a. Phenomena connected to drying

The final phase of the process of drying of contaminants It is emphasized here that paint residues often give a light colouring to the distillate in the drying phase; in most cases however this light colouring does not give any problems for the reuse of the distillate.

If for a particular reason it is necessary to have a perfectly clear distillate, it is possible reduce the duration of the cycle or the temperature but you will however have to check the classification of the residues.

It is possible to overcome the problem with a valve that separates the solvent distillate from drying and the solvent from distilling into separate containers. It is possible for the valve to be combined with a special program for the washing of the condenser circuit to completely resolve the problem of this phenomenon.

9.4. Vacuum distillation

During the vacuum distillation all units remove the air from the inside of the machine and expel it outside; this air therefore can contain toxic vapours. If the unit is installed in a closed room it is good practice to lead the extracted air from the vacuum pump outside with a length of tube that should be kept as short as possible. When installing this tube it is important not to have bends and the air exit should be lower than the air exit out of the vacuum pump.

10. APPENDIX

Boiling point at atmospheric pressure (101325 Pa) for standard solvents; please refer to the producer for other details. If distillation is under vacuum or in case of foam the temperature could be reduced.

10.1. Flammable solvents

SOLVENT	DISTILLATION TEMPERATURE °C	TEMPERATURE CLASS	SAFETY TEMPERATURE °C
ETHYL ACETATE	79	T2	427
ISOAMYL ACETATE	125 ÷ 155	T2	375
ISOBUTYL ACETATE	104 ÷ 119	T2	420
ISOPROPYL ACETATE	89	T2	460
METHYL ACETATE	58	T2	475
METHYLGLYCOL ACETATE	137 ÷ 152	T2	380
ACETONE	56	T2	535
ISOBUTANOL	111	T2	430
ISOPROPANOL	83	T2	400
sec. BUTANOL	101	T2	390
ALCOOL n-PROPANOL	98	T2	371
AMYL ACETATE	126 ÷ 155	T2	375
BENZENE	80	T1	560
BUTANOL n	118	T2	366
2-BUTANONE	80	T1	530
BUTYL CARBITOL	234 •	T3	228
BUTYL CELLOSOLVE	173 •	T3	239
BUTYL CELLOSOLVE ACETATE	192 •	T3	280
BUTYL DIGLYCOL	234 •	T3	228
BUTYL GLYCOL	173 •	T3	239
CARBINOL	65	T2	385
CELLOSOLVE	143	T3	235
CELLOSOLVE ACETATE	156	T2	377
CYCLOHEXANE	81	T3	260
CYCLOHEXANOL	162	T3	300
CYCLOHEXANONE	155	T2	419
DICHLOROETANO	84	T2	412
1,2, DICHLOROPROPANE	56	T1	555
DIMETHYLFORMAMMIDE (DMF)	153	T2	445
ESAMETHYLENE	81	T3	260
n-HEXANE	70	T3	240
ETHYL BENZENE	136	T1	466
ETHYL GLYCOL ACETATE	156	T2	377
sim-ETHYLENE CLORIDE	84	T2	412
ISOBUTYL ACETATE	119	T2	420
ISOPROPANOL	83	T2	400
ISOPROPYL ACETATE	58	T1	475
ISOPROPYL GLYCOL	143	T2	345
METHYL CELLOSOLVE	124	T3	285
METHYL CELLOSOLVE ACETATE	156	T2	377
MEK (METHYL ETHYL KETONE)	80	T1	530
MIBK (METHYL ISOBUTYL KETONE)	117	T1	459
n-OCTANE	126	T3	220
PENTANOL n.	138	T2	327
n-PROPANOL	98	T2	371
RAGIA MINERALE	150 ÷ 190 •	T3	254
RAGIA VEGETALE (TREMENTINA)	152 ÷ 170 •	T3	250
SOLVENT NAFTA A – LIGHT	130 ÷ 165 •	T3	245
SOLVENT NAFTA B – HEAVY	150 ÷ 220 •	T3	250
STYRENE	146	T2	490
TOLUENE	111	T1	535
XYLENE	140	T1	525

• can only be distilled under vacuum.

10.2. Non-flammable solvents ⓘ

SOLVENT	DISTILLATION TEMPERATURE °C	SETTING WORKING TEMPERATURE °C	SAFETY TEMPERATURE °C
CHLOROFORM	61	110	160
METHYLENE CHLORIDE DICHLOROMETHANE	40 •	80 ÷ 100	120
FREON 113	46 •	80 ÷ 100	105
CARBON TETRACHLORIDE	78	120 ÷ 130	150
1,1,2,2, TETRACHLORO ETHANE	147	160	-
TETRACHLORO ETHYLENE PERCHLORO ETHYLENE VORS PERSTABIL PER	121	140	140
1,1,1, TRICHLORO ETHANE 3x1 METHYLCHLOROFORM CHLOROTHENE BALTANE SOLVETANE GENKLENE	74	120 ÷ 130	140
TRICHLOROETHYILENE TRI VORCLIN ALTHENE TRIKLONE	87	120	120
• can only be distilled at atmospheric pressure.			

ⓘ It is necessary to analyse periodically the product before and after the distillation process to verify the degree of acidity (pH). If the product becomes acid it must be neutralized with particular additives and stabilizers. It is common practice to add periodically new solvent to keep the concentration of stabilizers constant.

NOTES

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SOLVENT RECOVERY SYSTEMS

Via Cellini,33 – 35027 – NOVENTA PADOVANA (PD) – ITALY
Tel +39 049 8084 811 – Fax +39 049 8084 888
Technical Assistance +39 049 8084 816

OPERATING AND MAINTENANCE MANUAL

BEFORE READING THIS MANUAL IT IS OBLIGATORY TO CONSULT THE GENERAL MANUAL

DIRECTIONS

and

MAINTENANCE

FOR THE SOLVENT RECYCLER

MODEL RS120 A

FORMECO ®

THE SOLVENT RECYCLER

Via Cellini 33 - 35027 NOVENTA PADOVANA (PD) - ITALY
Central 49 - 8084 811 - Fax 49 - 8084 888

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INDEX

GB DECLARATION OF CONFORMITY
D KONFORMITÄTSERKLÄRUNG
F DECLARATION DE CONFORMITE
E DECLARACION DE CONFORMIDAD
NL CONFORMITEITSVERKLARING
I DICHIARAZIONE DI CONFORMITÀ

CE

FORMECO S.r.l., Via Cellini 33, 35027 Noventa Padovana (PD), Italy

GB Declares in keeping with its responsibility that the distillation unit:
D Erklärt in alleiniger Verantwortung, daß die Anlage:
F Déclare sous sa propre responsabilité que le Distillateur:
E Declara bajo su propia responsabilidad que el Destilador:
NL Verklaart onder haar eigen verantwoordelijkheid, dat het destillatie-apparaat:
I Dichiara sotto la propria responsabilità che il Distillatore:

GB	D	F	E	NL	I	
TYPE	TYP	TYPE	TIPO	TYPE	TIPO	**RS120 AX**
SERIAL NUMBER	SERIEN-NUMMER	N° DE SERIE	N° DE MATRICULA	SERIE-NUMMER	MATRICOLA	**34115**
PRODUCTION YEAR	BAUJAHR	ANNEE DE PRODUCTION	AÑO DE PRODUCCION	BOUWJAAR	ANNO DI PRODUZIONE	**2008**

GB Is in compliance with European directives concerning safety:
D In Übereinstimmung mit den europäischen Sicherheits-Richtlinien:
F Il est conforme aux normes de sécurité prévue de les directives Européens:
E Está conforme a lo que prevén las normas Europeas de seguridad:
NL In overeenstemming is met de Europese veiligheids-richtlijnen:
I Risponde alle requisiti essenziali di sicurezza previsti dalle Direttive Europee:

98/37/EC - 89/336/EC - 73/23/EC - 94/9/EC

GB And in compliance with the following regulations:
D Und konform mit folgenden Normen ist:
F Et conforme aux suivantes normes harmonisées:
E Y está conforme con las siguientes normas:
NL En conform de volgende normen is:
I Ed è conforme alle seguenti Norme armonizzate:

EN ISO 12100-1/2 - EN 294 - EN 13463-1 - EN 13463-5

EN 60204-1 - EN 50014 - EN 50018

GB Unauthorised changes to the machine or use that does not comply with its purpose, make this declaration of conformity loose its validity
D Unzulässige Änderungen an der Anlage, oder eine Verwendung die mit dem bestimmungsgemäßen Gebrauch nicht übereinstimmt, führen dazu dass diese Konformitätserklärung ihre Gültigkeit verliert.
F Les changements non autorisés à la machine ou à l'utilisation qui ne sont pas conformes à sa utilisation prévue, rendent cette déclaration de conformité lâche sa validité
E Modificaciones del aparato no autorizadas, así como su utilización impropia, invalidan esta declaración de conformidad.
NL Niet toegestane veranderingen aan de machine of een aanwending die niet overeenkomt met voorzien gebruik, leiden ertoe dat deze conformiteitsverklaring zijn geldigheid verliest.
I Modifiche dell'impianto non autorizzate, così come un utilizzo non conforme dello stesso, invalidano la presente dichiarazione di conformità.

GB Machine marking
D Kennzeichnung der Anlage
F Marquage du distillateur
E Marcado del Destilador
NL Machinemarkering
I Marcatura del distillatore

Ex **II 2G IIA T2**

GB The General Manager — Signature
D Der Präsident — Unterschrift
F Le President-Directeur général — Signature
E El Presidente — Firma
NL De algemeen directeur — Handtekening
I Il Presidente — Firma

A. Nicolè

WARRANTY CERTIFICATE

A. Company FORMECO Srl declares to provide its distillation apparatus with **Legal Warranty**, at the conditions and clauses specified here below:

1) Apparatus are warranted for a **twelve** months period from buying date certified by a delivery document issued by Reseller. The warranty covers component parts that are recognised as origin faulty ones for faulty workmanship.
2) The units are constructed according to the technical details and specifications as established during the sales phase and/or as established by the sales contract and details in the manual.
3) The manufacturer grants exclusively the technical and functional characteristics of the plant, but cannot assure the result or the constancy of the process results, even if the customer's samples have been tested preventively at the manufacturer's laboratory. In fact, the chemical composition variability of the product to be treated can determine different results from the ones obtained during the preliminary analysis.
4) All serial production apparatus are made with a boiler and condenser of stainless steel AISI 304 and a copper vapour condenser. The buyer has to verify the compatibility of these materials according to solvents to be treated, relieving the manufacturer from any responsibility or warranty in case of corrosion phenomena during the use of the apparatus.

B. Company FORMECO Srl declares to provide its distillation apparatus with **Functional Warranty**, at the conditions and clauses specified here below:

1) Machine parts are warranted to be free of any malfunction for a period of **six** months.
2) Warranty covers the free of charges replacement or repair of the apparatus, and with no labour charge, of the parts being recognised as origin faulty ones.
3) Under warranty interventions are carried out at manufacturer's works or at authorised Service Centres where apparatus must be delivered carriage paid and it will be returned at user's charge and risk.
4) For under warranty technical interventions at user's address, cost concerning move time, kilometric refund and all board and lodging expenses will be charged as per effective fares in Service personnel's possession. Nothing is due for repair time and for materials replacement.
5) This warranty does not entail any indemnity for direct and indirect damages due to the time of the possible apparatus inefficiency.
6) After-sales service is subject to the regularity of the current payments.
7) Technical interventions for setting of process-parameters or for the fine-tuning of the apparatus are not considered under-warranty interventions and are therefore charged as per effective fares, when these interventions are not explicitly described in the purchasing contract.
8) Furthermore warranty does not cover:
   - I. Boiler cover gasket;
   - II. Possible Teflon coating of the boiler;
   - III. As concerns item A4;
   - IV. All parts that should be faulty due to a wrong installation, negligence and carelessness in use, lack of maintenance, interventions carried out by non-authorised personnel, damages caused by transport and anyway by any other cause that cannot be imputed to apparatus faulty workmanship.

C. Manufacturer declines all responsibility for possible damages that, directly or indirectly, may be caused to persons or property as a consequence of the non-compliance with all the rules stated in the workbook and concerning, in particular, directions for apparatus placing, installation, use and maintenance.
This warranty does not entail any indemnity for direct and indirect damages due to the time of the possible apparatus inefficiency.

1. DISTILLATION UNITS FOR SOLVENT RECOVERY

GENERAL	U.M.	Model RS120 A
PROCESS		Single distillation
OPERATING CYCLE		Discontinuous
DISTILLABLE SOLVENTS		Inflammable and Non-flammable
MAXIMUM SUPERFICIAL TEMPERATURE	°C	240
BOILER		
GEOMETRIC CAPACITY	litres	19
LOADING CAPACITY	litres	8 - 12
ROTATION BOILER		Manual
MATERIAL: Standard		Stainless steel AISI 304
HEATING		
HEATING OF SOLVENT		Indirect with diathermic oil
DIATHERMIC OIL CIRCULATION		Natural
DIATHERMIC OIL INCLUDED		Yes
HEATING DIATHERMIC OIL		Electrical resistance
VAPOUR CONDENSATION		
CONDENSER		Air cooled
MATERIAL: Standard		Rame
Optional		Acciaio inossidabile Aisi 304
ELECTRICAL INSTALLATION		
ELECTRICAL CONSTRUCTION		Explosion-proof "EEx od IIB T2"
INSTALLED ELECTRICAL POWER	W	1010
NOMINAL CURRENT	A	4,5
NOMINAL VOLTAGE	V	220
POWER SUPPLY		Monofase
PERFORMANCES		
WORKING TEMPERATURE	°C	50 - 180
TIMER CYCLE	Hours	0 - 5
PREHEATING TIME	min.	45
AVERAGE DISTILLATION TIME	Hours	2,30 - 3,30
AVERAGE PRODUCTION	l/h	3 - 5
SERVICE OPERATIONS		
SOLVENT LOADING		Manual
SOLID RESIDUE UNLOADING		With "Rec Bag"
LIQUID RESIDUE UNLOADING		By rotation of the boiler
MAXIMUM DIMENSIONS		
LENGTH x DEPTH x HEIGHT	cm	60 x 53 x 162
WEIGHT	kg	65
VARIOUS		
AMBIENT WORKING TEMPERATURE	°C	-10 +30
NOISE LEVEL	dB A	64

2. GENERAL

The FORMECO 'RS120 A' unit allows the recovery and re-use of flammable and non-flammable solvents with a boiling point between 50 and 180 °C. Using a vacuum unit (optional) solvents with a boiling point up to 220 °C can be recycled. Exploiting the principle of simple distillation, the unit separates the contaminations (such as resins, paints, pigments, ink, oil, grease, etc.) from the original solvent, which, once recycled directly into a tank, can then immediately be used again.
The contaminations remain on the bottom of the boiler and can easily be unloaded at the end of the cycle. The characteristics of the solvents will in no way be altered by the process if the instructions are followed carefully. The number of distillations can hence be repeated indefinitely.

OPERATING PRINCIPLE

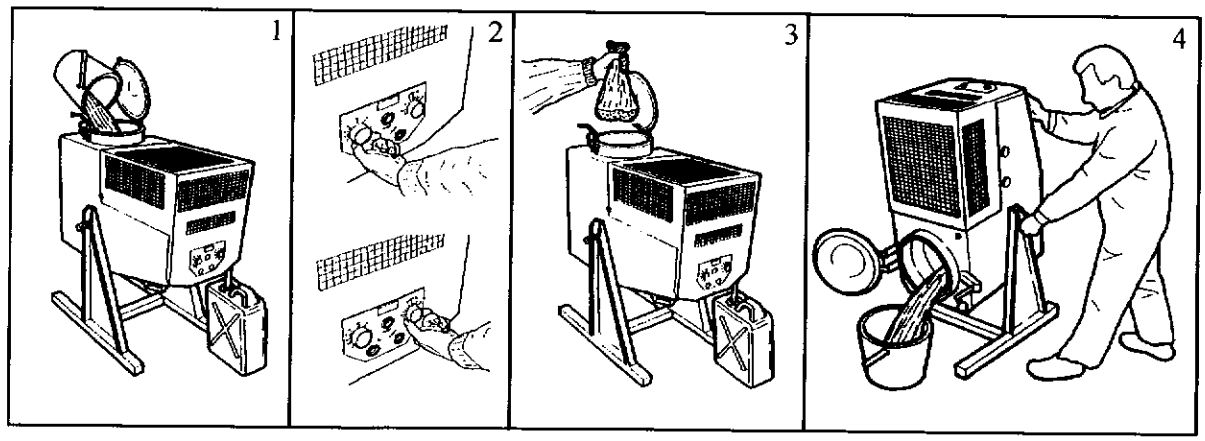
The boiling of the polluted solvent takes place in a boiler surrounded by a cavity space containing diathermic oil heated by an electric resistance. The vapour is conveyed to an air cooled condenser and transformed back into a liquid state; the so condensed solvent is collected in a tank.

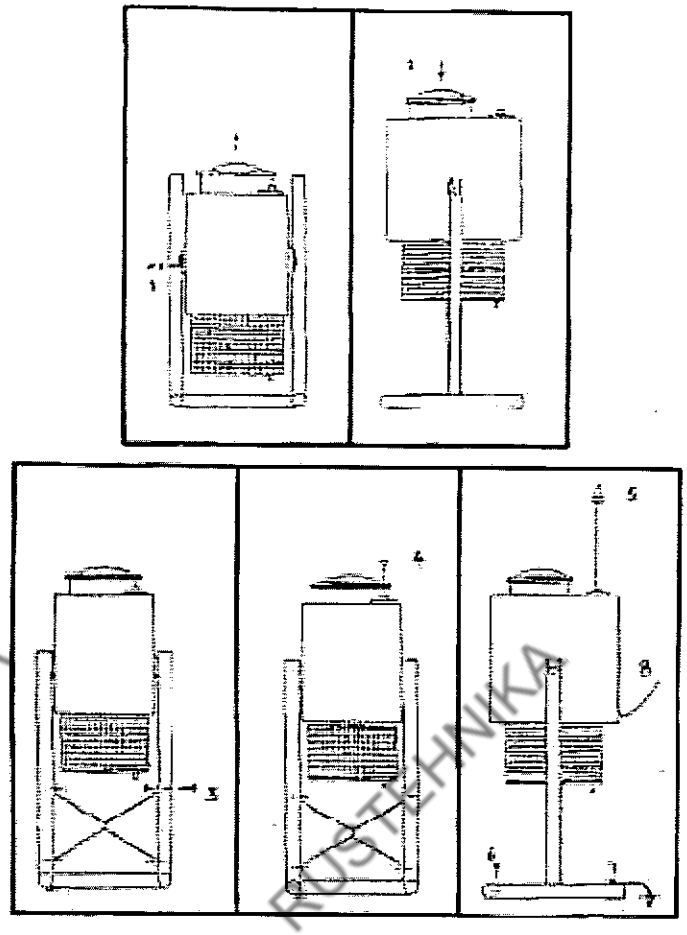
SAFETY DEVICES

- The distillation unit operates at atmospheric pressure.
- Cases of abnormal high temperature increases or faulty operation of the condenser are signalled and the machine stops automatically.

OPERATION

- The operation cycle is fully automatic
- The intervention of the operator is only necessary for loading the solvent to be distilled (1), setting temperature and distillation time (2) and unloading of the residues (3-4).





ASSEMBLING AND INSTALLATION OF THE UNIT

1) Remove the blocking nut
2) Fit the unit on the support
3) Fix the support hloding cross by means of the 4 screws.
4) Remove the plastic cap from the oil expansion vessel.
5) Screw on the oil bleeding valve in place of the cap.
6) In case the floor is not flat, fix the support with screws through the prearranged holes.
7) Earth the unit support and the containment basin.
8) Connect the electric feed by means of a switch equipped with fuses, as described on the General Manual, chapter 9.2.

Note **References to drawings / schemes are intended in the following way: (S15): Drawing / Scheme S, detail 15**

3.1 COVER GASKET VERIFICATION

According to the type of solvent to be distilled, it must be utilized the suitable rubber cover gasket (E3).

Code 359001 - Standard gasket (colour black):
For general use and for solvent mixtures.
Unless specified, it is mounted standard on the unit.

Code 359002 - Gasket for acetone (colour grey):
For pure acetone or for diluents with a high percentage of acetone.

Code 359003 - Gasket in viton (colour green):
For chlorinated solvents (methylene chloride, freon, chlorothene, trichloroethylene, perchloroethylene, etc.).

Code 239004 - Universal gasket (colour white):
Suitable for all solvents.

4. IMPORTANT ADVICES

1) Do not rotate or shake the unit once loaded or when operating.

2) Clean the oil expansion vessel (S21) only with a 'wet' rag to avoid generating sparks.

3) Opening the cover sooner than one hour after the distillation cycle has finished will cause the cover gasket to swell.

4) Some solvents during the ebollution phase create such a quantity of foam that a correct separation of the solvent from the polluting product is not possible. In these cases the distillate will be dirty. This inconvenience can be dealt with by using the optional antifoam kit.

ANTIFOAM KIT Code 301900

5. STARTING OPERATIONS

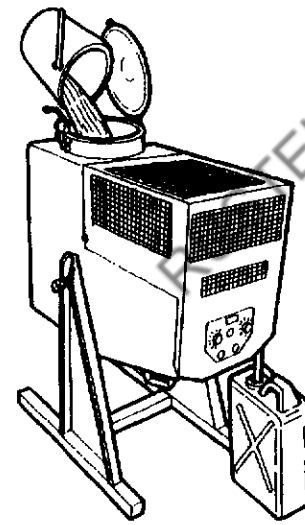
5.1 Put a container of at least 15 litres (S4) in line with the distillate discharge nozzle (S8). To connect the nozzle with the container, it is advisable to use an solvent-resistant rubber pipe (S7) in order to avoid evaporation and possible odours.
The tube must enter the container only for a few centimetres in order that it is never submerged in the distillate.
The container must not be sealed in order to allow a free air circulation. Provide a flame block (S5) on the air bleed when distilling flammable solvents. If the container is made of metal it is necessary to earth it (S1).

5.2 Verify that the diathermic oil level in the expansion vessel (S21) is in line with the minimum level.

Note: the unit already contains diathermic oil and is ready to operate.

5.3 SOLVENT LOADING

5.3.1 Always use earthed conductive tubes, funnels, or loading devices. These devices has to be always immered into the liquid



5.3.2 WITH LIQUID CONTAMINANTS (oil, ink, etc.)

Pour the solvent to be distilled into the boiler, up to the welded plates which indicate the maximum level.

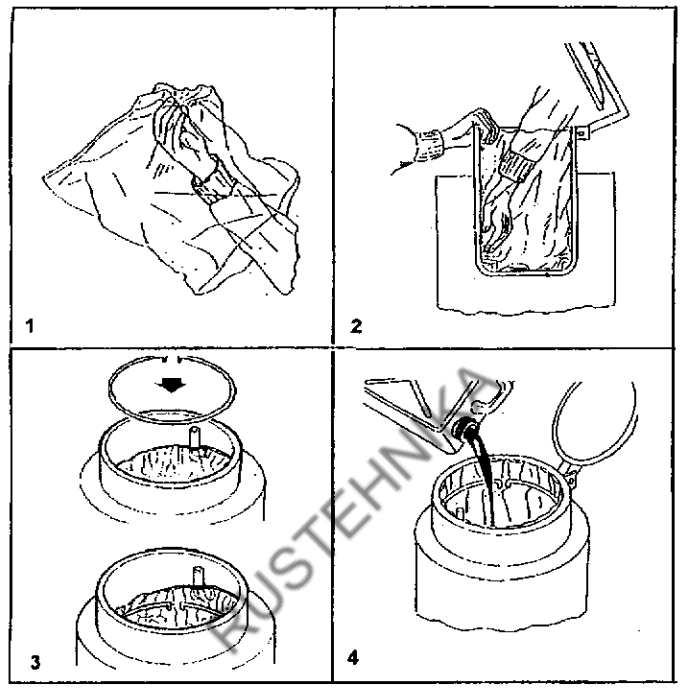
5.3.3 WITH SOLID CONTAMINANTS
(paints, polyester resins, etc.)

Always use the non re-usable 'Recbag' !
In this way the unit will always work with the maximum efficiency, the cleaning will be facilitated and the operator will not have to breathe in noxious vapours.

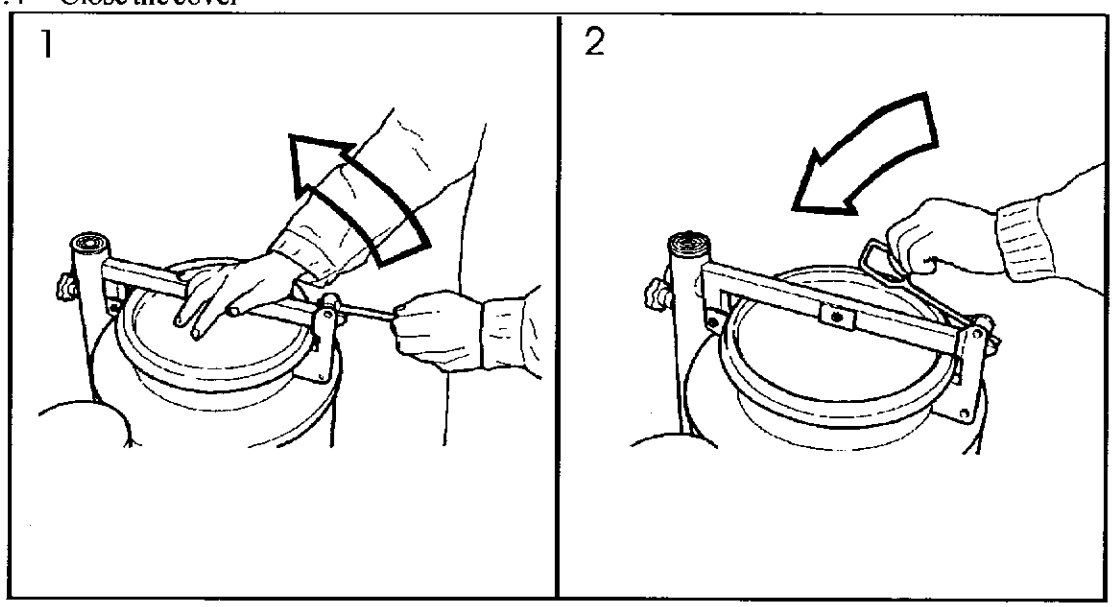
The RecBags are made to work with neutral solvents up to a temperature of 160/170 °C and can be used for only one distillation/drying cycle.
For working temperatures up to 180 °C, ask for the 'RecBag T'.
In cases where it is not possible to use the RecBag, we advice to use some Formeco detaching product to enable the easy removal of the residue.

1) Avoid any action which can cause electrstatic discharges
2) Pull the bottom corners inward.
3) Place the RecBag in the boiler, making sure that the bag adheres perfectly to the boiler wall. Air bubbles between the bag and the boiler surface have to be avoided.
4) Block the RecBag using the stop ring 'Ring Bag'.
5) Pour the solvent to be distilled into the bag up to the welded plates on the boiler wall which indicate the maximum level (S15).

ATTENTION: During loading, make sure not to pour solvent into the vapour manifold (S19): the first distillate would come out dirty.



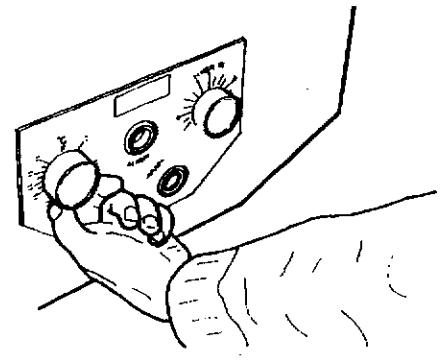
5.4 Close the cover



5.5 WORKING TEMPERATURE SETTING

A) SOLVENTS AND DILUENTS IN GENERAL

Set on the working thermostat (S11) a temperature of 10-20 °C higher than the boiling temperature of the solvent to be distilled (see Table of Solvents). In case of Nitro diluents or Synthetic set the working temperature at 160 °C. If the residue has to be dried, the working thermostat has to be set to 170-180 °C.

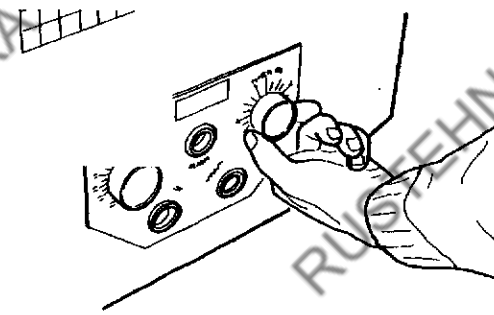


B) CHLORINATED SOLVENTS

Set the thermostat (S11) on the working temperature as reported in Table of Non-flammable Solvents.
If this temperature is exceeded the solvent will acidify !

5.6 TIME SETTING

The first time, set the distillation timer (S14) at the stroke end (5 hours); the time between the beginning of the cycle and the moment in which no more distillate comes out of the unit will be considered the optimal time. This time is to be set for successive distillation cycles. Normally a cycle lasts for 3-4 hours. For drying the residue this time can be prolonged with 15-30 minutes.
The cycle time depends both on the type of solvent and on the amount of contamination.



Indicated times are to be regarded as purely indicative and they refer to a distillation cycle with cold machine start up. In case of more consecutive distillation cycles, the time of the cycles after the first can be reduced with about 30 minutes.

5.7 Connect the electric power by means of the main switch (S22).
Mains green indicator light (S12) and operation white indicator light (S13) switch on: thus the cycle begins.
The distillate will start to flow out after about 40-50 minutes.

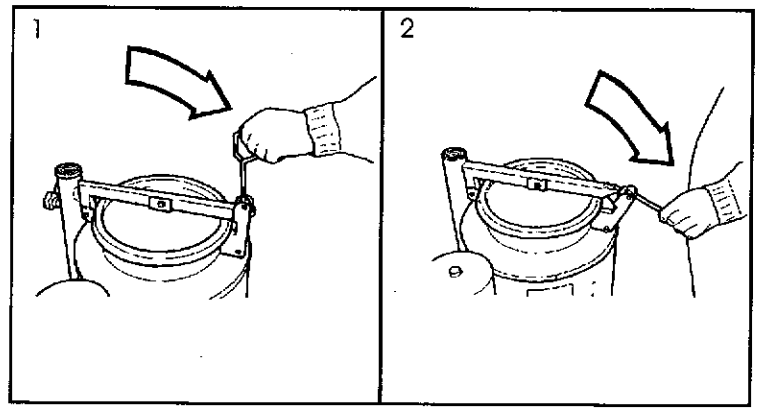
5.8 At the end of the preset time the unit will stop automatically.
The condenser air-fan will operate for another 30 minutes.

TO STOP THE UNIT MANUALLY, TURN THE TIMER (S22) TO ZERO

6. RESIDUE UNLOADING

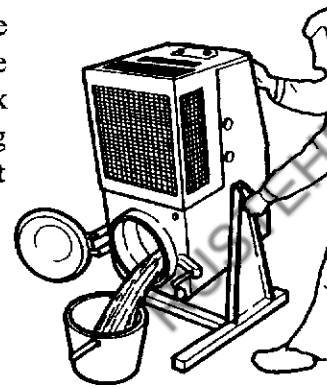
Wait until the diathermic oil temperature is below 50 °C.

- Turn of the power by turning the main switch (S22).
- Place a container for the residue and open the cover (S17).



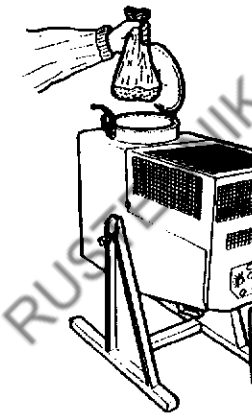
6.1. LIQUID CONTAMINANTS

Rotate the unit using the handle (S6) and at the same time pulling the click pawl (S21), and releasing it in order to block the unit in an oblique position.



6.2 SOLID CONTAMINANTS

Remove the stop ring 'RingBag' and slip off the RecBag paying attention not to break it.
To remove the small quantity of solvent remaining in the boiler, rotate the unit as explained in the previous point.



7. ALARM - RED INDICATOR LIGHT (S15)

The unit is equipped with three thermostats:

T1 (E31) **Working thermostat 50 - 180 °C (122 °F - 356 °F)**
(S11) The temperature set by the operator is the one operating during the cycle.

T2 (E39) **Safety thermostat with a fixed calibration at 225 °C (437 °F)**
Intervienes in case of the rupture of the working thermostat T1

T3 (E35) - **Safety thermostat set at 40 °C. (104 °F)**
Should the distillate come out at a temperature higher than 40 °C (104 °F) the resistances are turned off

The red indicator light signals the intervention of the safety thermostat **T2** or **T3**.
Provide at once to remove the anomaly.

8. MAINTENANCE

The maintenance has to be performed by specialised personnel that is adequately informed. For the annual maintenance and for the changing of the diathermic oil it is advised to turn to an authorised centre of assistance or to the manufacturer

8.1 DAILY MAINTENANCE

1) Clean daily the inside of the boiler of crusts and deposits that might have been formed. In that way the heat exchange between diathermic oil and solvent is favoured.

8.2 WEEKLY MAINTENANCE

1) Check the diathermic oil.
   - Check the diathermic oil level in the oil expansion vessel (S16) when the unit is cold. If necessary fill up the level.
2) Cleaning of the condensation circuit.
   - Blow with compressed air into the vapour manifold (S19) to remove deposits that might have been formed by entrainment or boiling over.
   - Always clean with compressed air the outside of the condensation section (S9)

8.3 YEARLY MAINTENANCE OR EVERY 2000 WORKING HOURS

CHANGING THE DIATHERMIC OIL AND CLEANING THE ELECTRICAL RESISTANCE
N.B.: Every oil changing, the oil breather valve on the expansion vessel must be changed.
This operation must be carried out when the unit is cold.

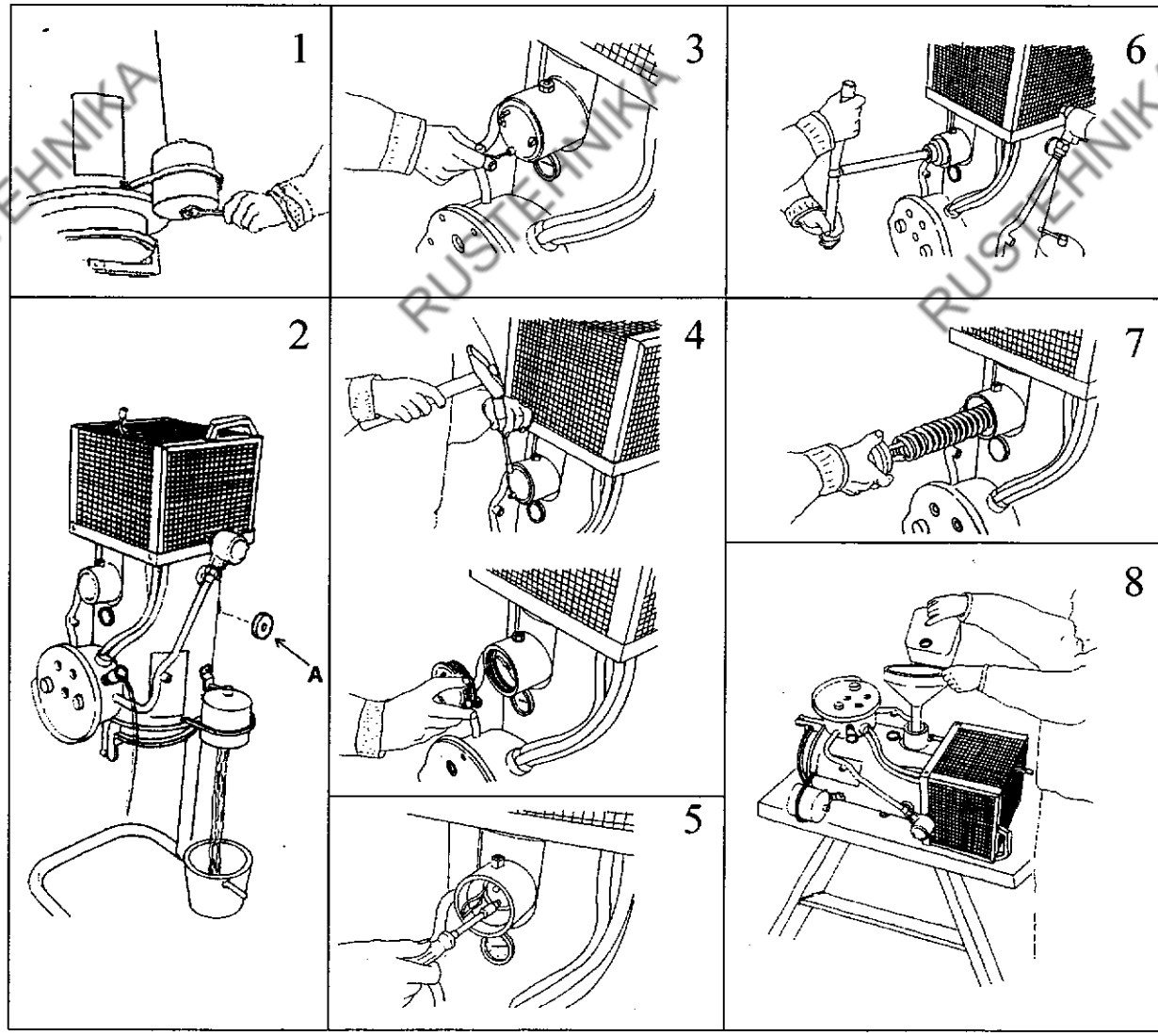
Quantity of diathermic oil: **6.5 litres**

Type: Formeco LT 200-Mobiltherm 605-Essotherm 500-Shell ThermiaB-Total Seriola 2100
For different brands, use diathermic oil with a cracking temperature higher than 320 ° C and a viscosity of about 31 cSt at 40 °C and 5,3 cSt at 100 °C.

Disconnect the unit from the electrical power.

1) Rotate the unit upside down (180 °) and loosen the oil bleeding valve.
2) Set up a collecting container with a capacity of at least 7 litres, remove the cap of the oil expansion vessel and remove tap 'A', hereby effectuating the outflow of oil.

3) Unscrew the security dowel of the lid of the resistance using a hexagonal key of 3 mm.
4) With the help of a screwdriver, loosen and remove the lid.
5) Disconnect the electrical wires using a box spanner.
6) Unscrew the resistance using a box spanner of 55 mm, paying attention not to damage the connecting cables of the resistance.
7) Clean the electrical resistance.
   Re-insert tap 'A' which was removed at point 2.
8) Remove the unit from its support and place it on a horizontal support like indicated and pour in 6 litres of diathermic oil..
   Reinstall the electrical resistance using a teflon ribbon for the sealing.
   Connect the electrical wires.
   Turn the unit on at maximum temperature without loading solvent and without mounting the oil bleeding valve. After one hour, having reached the maximum temperature, add through the hole on the lid of the oil expansion vessel about 0,5 litre of oil: enough to fill up the oil expansion vessel completely. Let the machine cool down and reset the oil bleeding valve.

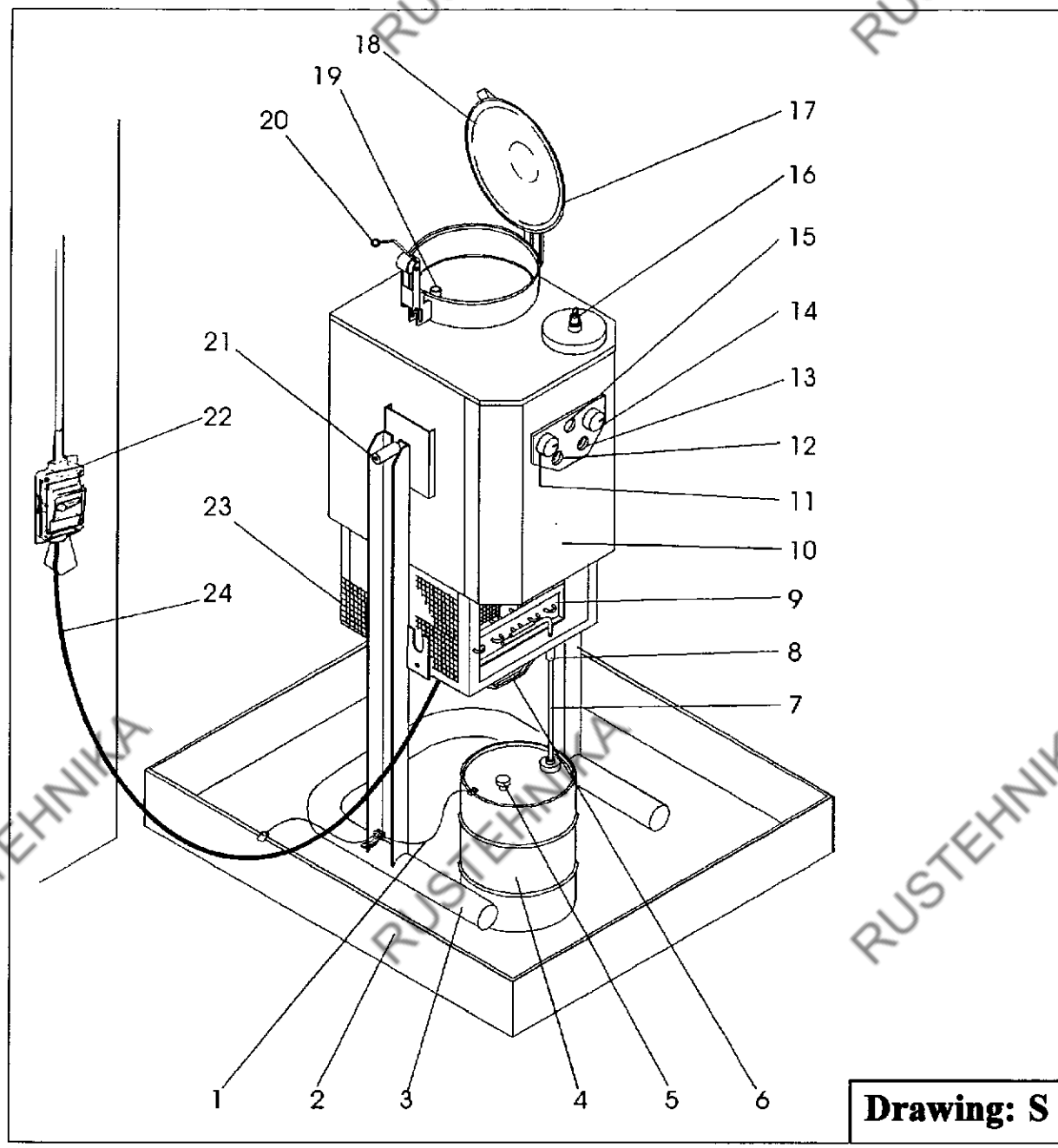


9.1 DISTILLATION UNIT MODEL RS120 A

DEFECTS	CAUSES	REMEDIES
The unit distills only part of the dirty solvent	Insufficient operating time	Increase the operating time
	The undistilled fraction has a boiling temperature higher than the set temperature on the working thermostat	Set a higher temperature on the working thermostat (S11)
	Solvent boiling point is higher than distiller maximum working temperature	Change the solvent with one that has a lower boiling point or distill under vacuum with suitable kit (optional)
	The working thermostat (S11- E35) is defect	Change the working thermostat (S11 - E35)
The distillate comes out dirty	Unit has been loaded with a quantity higher than the maximum	Load the exact quantity
	Solvent foams	Load with a lower quantity
		Use the anti-foam kit
		Wait at least 48 hours after utilizing the solvent before starting the distillation
	Temperature set on working thermostat too high	Reduce working temperature
	Vapour manifold (S19) or vapour condenser (S6) dirty	Wash manifold and condenser by pouring in clean solvent with a funnel or by blowing in compressed air
Distillate takes on a greenish colour: (condenser is becoming corroded	Distilling solvents or diluents in general: The solvent is acid	Replace the copper condenser (E15) with stainless steel one (E49)
	Distilling a chlorinated solvent: - Temperature set on thermostat is higher than the critical one and the solvent is acidified	Set the correct working temperature (see the table of Non-flammable solvents)
	- If the temperature set on the working thermostat is correct, acidification has occured before the distillation	Replace the solvent immediately
Distillation time much longer than 4 hours	There is a considerable percentage of water in the dirty solvent	Replace the solvent
	Lack of diathermic oil	Top up the diathermic oil till the minimum level when the machine is cooled down
	Diathermic oil is worn out	Change the diathermic oil
	The electrical resistance (E21) is scaled	Take out the diathermic oil and clean the electrical resistance
The cycle does not stop at the time set on the working timer	Cycle timer (S12) is defect	Replace cycle timer (E33)
The 'RecBag' is damaged	Working temperature too high	Reduce the working temperature or use 'RecBag T'
	The solvent is acid	Distill only neutral solvents

9.2 DISTILLATION UNIT MODEL RS120 A

DEFECTS	CAUSES	REMEDIES
The distiller heats but does not distill	Boiler (S23) is dirty	Clean the boiler
	Solvent boiling temperature is higher than the one set on working thermostat (S11)	Set a higher temperature on the working thermostat
	Solvent boiling point is higher than distiller maximum working temperature	Change the solvent with one that has a lower boiling point or distill under vacuum with suitable kit (optional)
	Diathermic oil is worn out	Change the diathermic oil
	Lack of diathermic oil	Top up the diathemic oil till the minimum level when the machine is cooled down
Smoke comes out from under the cover (S18)	Overheating of the poluting products or presence of nitrocellulose (see General Manual chapter 12)	Reduce the working time and/or temperature. Possibly distill under vacuum with the suitable kit (optional)
Cover gasket (E3) swells	The boiler cover (S18) is opened when the machine is still hot	Wait until the oil temperature has sunk under 50 °C, before opening the cover (S18)
	The cover gasket is not suitable for the type of solvent treated	Mount the suitable gasket (see Paragraf 4)
The solvent bleeds out of the cover (S18)	Worn out gasket	Replace the gasket (E3)
	Vapour manifold (S19) is clogged	Wash manifold and condenser by pouring in clean solvent with a funnel or by blowing in compressed air
	Vapour condenser (S6) is clogged	Replace the condenser (E15)
Unit 'ON' but does not heat	Working thermostat (S11) at zero	Set working temperature
	Electrical resistance (S7) burned out	Change the electrical resistance (E21)
	One of the thermostats is faulty	Change the faulty thermostat
The red indicator light (S13) switches on "ALARM"	Diathermic oil temperature is higher than the maximum allowed one: thermostat of maximum temperature (E42) intervenes	Replace the working thermostat T1 (E35) and reset the maximum thermostat T2 (E42) by pushing the button of the thermostat
	Distillate temperature is over 40 °C possible causes:	
	- Ambient temperature is too high	Ventilate the room or do not work at very warm days
	- Ventilator motor (S26) burnt out	Replace ventilator motor (E10)
	- Vapour condenser (S6) dirty on the outside	Clean with a compressed air jet
	- The security thermostat of the condenser T3 (E36) is defected	Call the producer for the setting or replacement of the thermostat



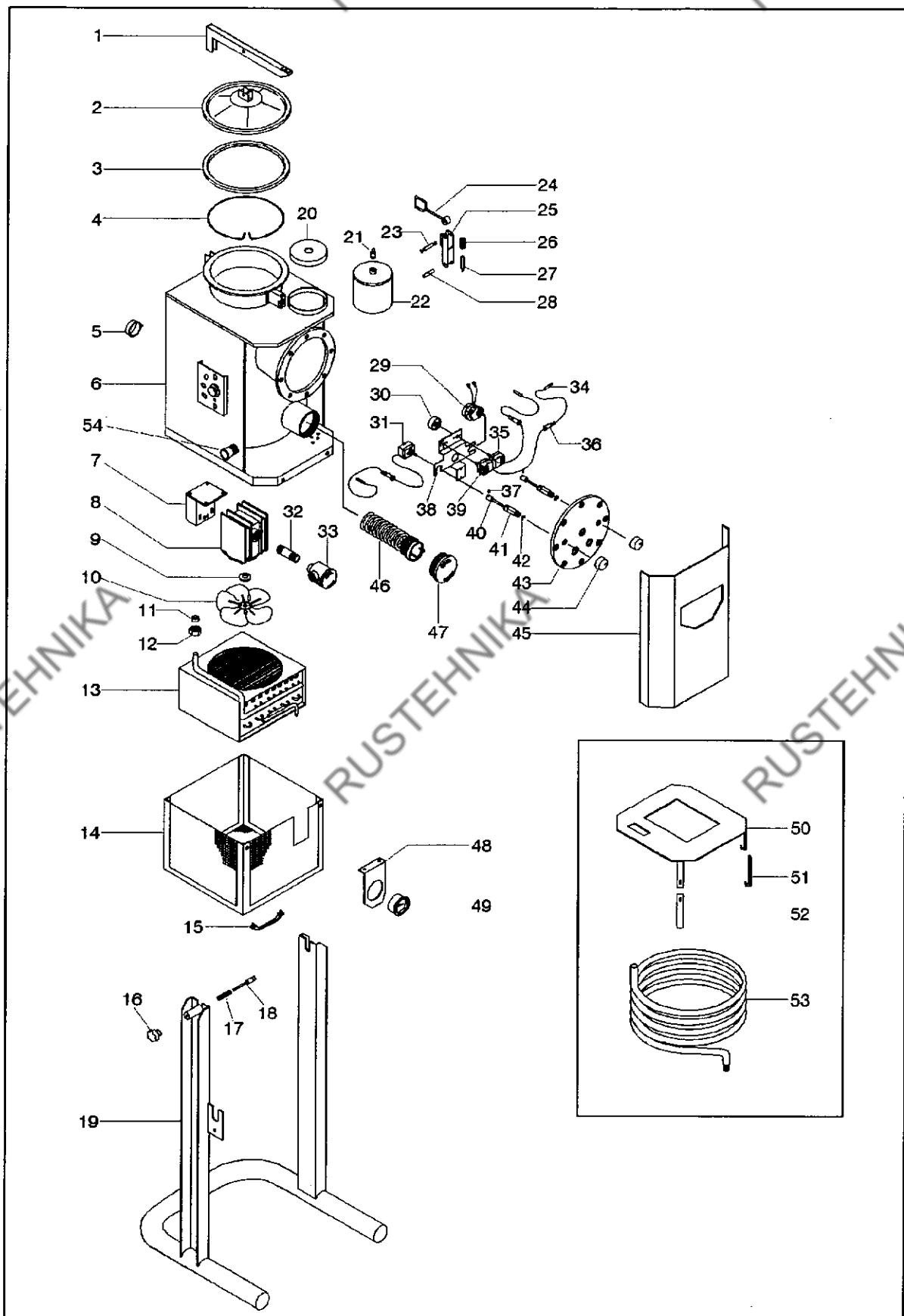
Drawing: S

10. DISTILLER RS120

N°	PARTICOLARE	N°	PARTICOLARE
1	Grounding	13	White indicator light ( ), 'Resistance on'
2	Containing basin	14	Timer (0 - 5 hours)
3	Support	15	Alarm indicator light (red)
4	Distillate collection vessel	16	Oil bleeding valve
5	Breather pipe with flame trap	17	Boiler cover
6	Unit rotation handle	18	Boiler cover gasket
7	Tube in solvent resistant rubber	19	Vapour manifold
8	Distillate outlet nozzle	20	Cover closing handle
9	Air cooled condenser	21	Unit rotation and locking system
10	Mantel	22	Mains connection with switch
11	Working thermostat 50 - 210°C	23	Condenser protection grid
12	Green indicator light ( ), 'Mains on'	24	Electrical feeding cable

11. SPARE PARTS

DRAWING	CODE	DETAIL
1	359023	Cover bar
2	359022	Boiler cover
3	359001	Boiler cover gasket : standard
3	359002	Boiler cover gasket : for acetone
3	359003	Boiler cover gasket : for chlorinated solvents
3	239004	Boiler cover gasket : universal
4	429004	Ring - Bag / ring for placement of RecBag
5	429001	Fixing ring oil expansion vessel
6	384000	Oil bleeding valve
7	380021	Expansion vessel diathermic oil
7A	38Z2062	Supporting tube foe expansion vessel
8	---------	Boiler
9	351401	Cover of oil drain
10	475000	Fan motor
10a	38Z7003	Support fan motor
11	357612	Tube electrical connection fan motor
12	472000	Ex shunt box
13	430300	Ogive for condenser
14	430150	Fastening nut for condenser
15	384022	Copper aircooled condenser
16	427000	Knob for blocking the rotation of the boiler
17	353701	Spring
17a	---------	Seeger washer
18	384711	Support structure
19	466149	Fan ring
20	466101	Fan (for copper condenser)
20	466102	Fan (for Stainless steel condenser)
21	466403	Electrical resistance
22	472100	Cover of the electrical resistance box
23	354000	Pin for blocking the rotation of the unit
24	302203	Protecting grid of condenser
25	429000	Unit rotation handle
26	354639	Upper pin of cover handle
27	429002	Cover handle
28	357403	Forked brace
29	353702	Spring for boiler cover
30	354641	Guide pin for spring
31	354640	Lower pin of cover handle
26/31	384002	Cover closing kit
32	433600	Diathermic oil thermometer
33	385007	Timer (0-5 hours)
34	425002	Knob
35	384018	Working thermostat 50-180°C (T1)
36	384008	Condenser safety thermostat (T3)
37	---------	Capillary of thermostat
38	---------	Gland to electrical control box
39	---------	Front panel of the electrical control box
40	425002	Knob
41	302005	Support for electrical components
42	384020	Maximum thermostat - 225°C (T2)
43	350000	Little shaft
44	350903	Bush for shaft
45	400012	Seeger washer
46	---------	Screw
47	302024	Fixing plate for stainless steel condenser
48	302123	Fastening rod for condenser
49	383022	Aircooled stainless steel AISI 304 condenser
50	V00093	Collecting basin in stainles steel AISI 304
	384051/6	Diathermic oil "Fomeco LT" Pack 6 litres
	384312Y	"REC BAG" (Pack 50 pcs)
	384306	"REC BAG T" (Pack 50 pcs)



RS120 **DISEGNO DRAWING - DESSIN - DIBUJO - ZEICHNUNG** **E**

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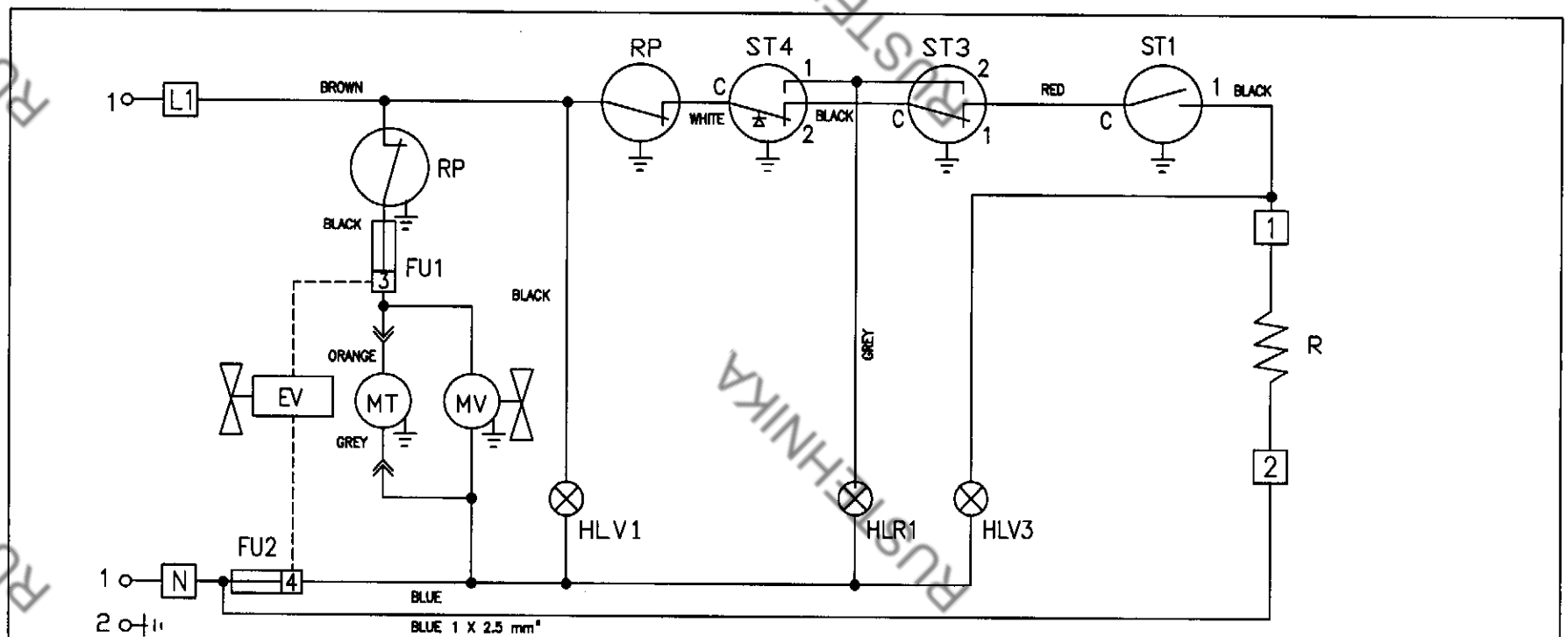

ITALIANO

1	ALIMENTAZIONE ELETTRICA
2	LINEA DI TERRA
RP	TIMER
MT	MOTORE DEL TIMER
MV	MOTOVENTILATORE O ELETTROVALVOLA ACQUA
ST1	TERMOSTATO DI LAVORO
ST4	TERMOSTATO DI SICUREZZA OLIO DIATERMICO
ST3	TERMOSTATO DI SICUREZZA CONDENSATORE
R	RESISTENZA ELETTRICA 1x800W
R	RESISTENZA ELETTRICA 1x800W
FU1	FUSIBILE X VENTILATORE E AUX.(1A)
FU2	FUSIBILE X VENTILATORE E AUX.(1A)
HLV1	SPIA VERDE (RETE INSERITA)
HLV3	SPIA VERDE (RESISTENZA INSERITA)
HLR1	SPIA ROSSA (INTERVENTO TERMOST. ST3/ST4)
EV	ELETTROVALVOLA VUOTO

ENGLISH

1	POWER
2	GROUNDING LINE
RP	TIMER
MT	TIMERMOTOR
MV	MOTOVENTILATOR OR WATER ELECTROVALVE
ST1	WORKING THERMOSTAT T1
ST4	DIATHERMIC OIL SAFETY THERMOSTAT
ST3	CONDENSER SAFETY THERMOSTAT T3
R	ELECTRIC RESISTANCE 1x800W
R	ELECTRIC RESISTANCE 1x800W
FU1	MOTOVENTILATOR AND AUX. FUSE(1A)
FU2	MOTOVENTILATOR AND AUX. FUSE(1A)
HLV1	GREEN INDICATOR LIGHT (MAINS ON)
HLV3	GREEN INDICATOR LIGHT (RESISTANCE ON)
HLR1	RED INDICATOR LIGHT (THERMOSTATS ST3/ST4 ON)
EV	VACUUM SOLENOID VALVE

DEUTSCH

1	ELEKTRISCHE SPEISUNG
2	ERDKABEL
RP	SCHALTUHR
MT	MOTOR DER SCHALTUHR
MV	VENTILATOR ODER ELEKTROVENTIL/WASSER
ST1	ARBEITSTHERMOSTAT
ST4	SICHERHEITSTHERMOSTAT
ST3	SICHERHEITSTHERMOSTAT KUEHLER
R	ELEKTRISCHER HEIZSTAB 1x800W
R	ELEKTRISCHER HEIZSTAB 1x800W
FU1	VENTILATOR UND AUX. SICHERUNGEN(1A)
FU2	VENTILATOR UND AUX. SICHERUNGEN(1A)
HLV1	GRUENE KONTROLLAMPE (NETZ EINGESCHALTET)
HLV3	GRUENE KONTROLLAMPE (HEIZUNG EIN)
HLR1	ROTE KONTROLLAMPE (THERMOSTAT ST3/ST4)
EV	ELEKTROVENTIL VAKUUM

FRANCAIS

1	RESEAU
2	LIGNE DE TERRE
RP	TIMER
MT	MOTEUR DU TIMER
MV	VENTILATEUR OU SOUPAPE ELECTRIQUE EAU
ST1	THERMOSTAT DE TRAVAIL
ST4	THERMOSTAT DE MAXIMUN
ST3	THERMOSTAT DE SECURITE CONDENSEUR
R	RESISTANCE ELECTRIQUE 1x800W
R	RESISTANCE ELECTRIQUE 1x800W
FU1	FUSIBLE POUR VENTILATEUR ET AUX.(1A)
FU2	FUSIBLE POUR VENTILATEUR ET AUX.(1A)
HLV1	VOYANT VERT (RESEAU BRANCHE)
HLV3	VOYANT VERT (RESISTANCE BRANCHE)
HLR1	VOYANT ROUGE (THERMOSTAT ST3 OU ST4 BRANCHE)
EV	SOUPAPE ELECTRIQUE DE VIDE

SCHEMA ELETTRICO / ELEKTRISCHES SCHEMA
WIRING DIAGRAM / SCHEMA ELECTRIQUE

01/11/97

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