

# STALAM

Radio Frequency Equipment

*Textile Dryers*

## COMPANY PROFILE

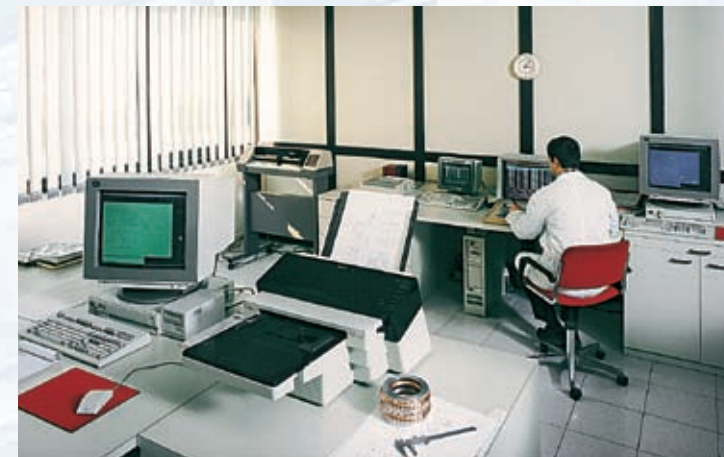
Established in 1978, STALAM is a world leader in the development, design and manufacture of equipment where capacitive electromagnetic fields at I.S.M. metric frequencies (RF fields) are exploited for a variety of heating and drying applications on raw materials, intermediate and finished industrial products.

As a member of AEI (Italian Electronic and Electro-technical Association) and of ACIMIT (Association of Italian Manufacturers of Machinery for the Textile Industry) STALAM co-operates actively with prestigious universities and research institutes for the development of the RF technology both as to generation techniques and to technological applications.

STALAM also co-operates with other leading European machinery manufacturers for the development of innovative drying technologies and for the supply of "turn key" automated and integrated processing lines.

Presently, more than 1000 STALAM radio frequency dryers are in operation in the textile sector, with rated power values ranging from 3 to 250 kW; from the simple, manually operated machine, to the fully automated line complete with computerised control and supervision systems.

Exporting about two thirds of its production to the five continents, STALAM provides professional and prompt commercial and technical assistance in all the relevant textile areas throughout the world.



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# STALAM

## RF DRYING TECHNOLOGY

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A wet product submitted to a radio frequency field absorbs the electromagnetic energy, so that its internal temperature increases. If a sufficient amount of energy is supplied, the water is converted into steam, which leaves the product; that is to say, the wet product is dried.

The heating/evaporation process carried out by means of a radio frequency field is:

**endogenous:** the thermal energy is not supplied to the wet product by an external heat source, but rather it is generated directly throughout its mass;

**selective:** the electromagnetic energy is absorbed mainly by the moisture and not by the product itself;

**controlled:** the heating/evaporation rate is directly proportional to the amount of electromagnetic energy supplied, and this energy can be controlled precisely.

Thanks to these features, the radio frequency drying of textiles, after dyeing or any other wet treatment, has the following advantages:

**high energetic efficiency:** the electromagnetic energy is transferred directly to the whole of the wet product, without losses to the surroundings, instantaneously, and is entirely exploited for the drying process; furthermore, the energy transfer is not negatively affected by variable parameters such as the dimensions or the density of the product;

**outstanding quality of the dried product:** all problems normally caused by the heat transmission phenomena are totally eliminated, so that the product dries quickly and uniformly down to the desired residual moisture level, with a beneficial steaming and bulking effect of the fibres which greatly improves the physical properties like elasticity, softness, hand and colour effect.

## STALAM RADIO FREQUENCY DRYERS

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STALAM radio frequency dryers have some specific design and construction features which allow their users to obtain the maximum benefits from the RF technology in terms of quality of the dried products, reduced operating costs, flexibility and reliability.

**The RF generators** are entirely designed and manufactured by STALAM; they are of the “lumped components” type, having high efficiency (Q factor) and outstanding reliability; all components and circuits are easily and quickly accessible.

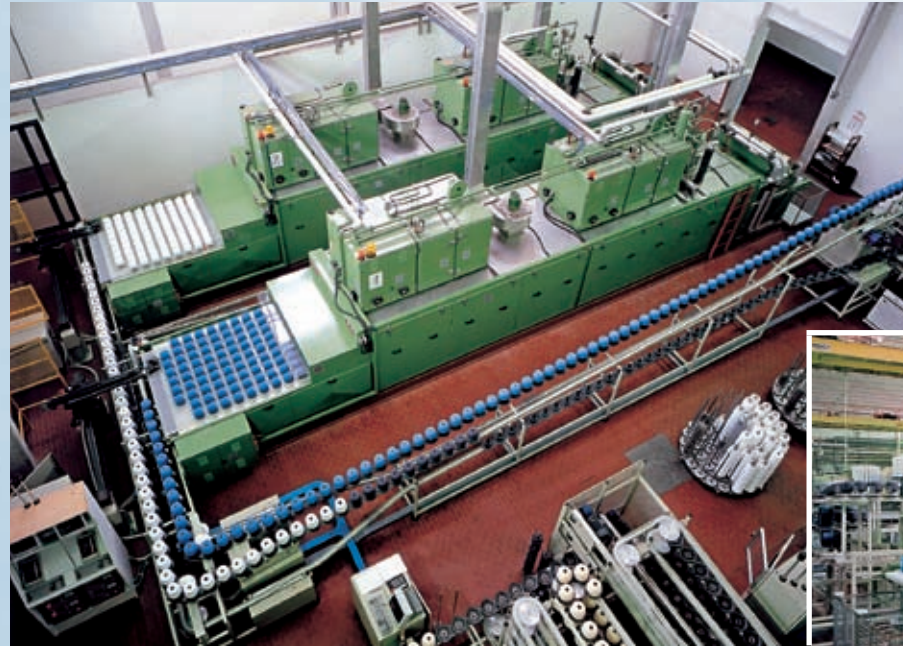
**The cooling system of the triodes** is made up of a double water circuit; it is designed to allow the longest possible life of the triodes and does not require periodic maintenance operations. Upon request, and as standard in some specific applications, STALAM also supplies generators fitted with a forced-air cooling system.

**The RF power adjustment** is accomplished by means of a semi-automatic circuit which controls the power supplied to the product being dried through a variable capacitor, located in the generator. No continuous raising or lowering of the upper electrode for RF power adjustment is required in STALAM dryers: the electrode is fixed or automatically positioned at pre-set heights.

**The power density** is as low as 5 to 14 kW(RF)/sqm of electrode surface. Therefore the heating/evaporation process is extremely gentle and the quality of the dried product is greatly enhanced.

**The construction is modular**, in the sense that high capacity dryers are made up of two or more drying modules, connected in series; this construction principle allows STALAM dryers to work with reduced RF power densities in all circumstances. Further modules can be added to the first at any time, so that considerable investment and floor space savings are possible.

# Dryers for yarn packages and tops



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*fig. 1 & 2 - "RF 2x40 kW" dryers for cotton and linen yarn packages, bleached and dyed on stainless steel cones, after pre-drying in a pressure dryer, with robotised loading system and supervision by an industrial PC. Unloading by free fall into baskets.*

## "RF" AND "RFA" SERIES DRYERS

More than 800 "RF" (Radio Frequency) model dryers, the well known conveyerised STALAM dryers sold all over the world since 1981, are presently in operation for the drying, to a conditioned weight, of yarns in packages and cakes, and of worsted fibres (tops) in bobbin and bump form.

Almost all combinations of natural, artificial and synthetic fibres, as filament fibres or worsted and spun, pure or blended, in every count and form (worsted slivers in bobbins and bumps, weighing from 3 to 25 kg; yarns wound on plastic cones or stainless steel springs, either compressed or not, and cakes wrapped in polyester hose) can be dried

perfectly, down to the desired residual moisture level, with outstanding efficiency and quality results. Such outstanding results cannot be achieved with any conventional hot air drying system.

Tops can be dyed and centrifugally hydroextracted using movable stainless steel basket-type carriers or directly on centrifugable spindles.

Yarn packages, after dyeing, can be hydroextracted one by one after removal from the dyeing carrier, or directly on centrifugable spindles, or may be simply pre-dried in a pressure (rapid) dryer. All handling operations can be carried out manually, assisted by partial automation or with fully automated systems.



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*fig. 3 - “RFA 60 kW” dryer for pastel shaded wool yarn packages, hydroextracted and loaded manually.*

*fig. 4 - “RF 2x40 kW” and “RF 85 kW” dryers for filament rayon and silk yarn packages, wrapped in polyester hose.*

*fig. 5 - Detail of the control panel fitted with a micro-controller (PLC).*



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In the “RFA” (Radio Frequency Assisted) series dryers, the RF treatment, duly controlled in the different phases of the drying process thanks to a special design of the RF application electrodes, is combined with a conventional warm air circulation system.

This technology allows savings in drying costs up to 5-10% compared to the standard “RF” technology.

## Dryers for yarn packages and tops



**6** *fig. 6 - Drying of yarn packages wound on stainless steel springs.*

*fig. 7 - "RF 2x75 kW" dryer for fine wool tops in 10 Kg bump form, dyed and hydroextracted on stainless steel spindles and loaded manually to the dryer.*



**8** *fig. 8 - Detail of the automation for loading and unloading tops.*



**9** *fig. 9 - "RF 5x40 kW" dryer for the drying of 16 ton/day of fine wool tops, 25 Kg each, hydroextracted one by one, with automated loading and unloading operations.*

## “RF 105 kW” and “RF 150 kW” DRYERS

Recently some interesting innovations have been introduced in the “RF” and “RFA” series dryers, such as the extensive use of stainless steel inside the drying tunnel, a new conveyor belt tracking and tensioning system, the modular polypropylene conveyor belt (Intralox), the multi-position upper electrode system and a micro-controller (PLC) with related software for fully automated operation. Moreover many studies have been dedicated to the development, in exclusive co-operation with the world’s leading supplier of vacuum RF tubes, of new, more powerful and even more reliable generators, which have enabled STALAM to present - on the occasion of ITMA '99 - the first textile dryer equipped with a 105 kW output power RF generator, either with water cooling or air cooling system and - on the occasion of ITMA '07 - the dryer with a single 150 kW output power RF generator.

This dryer represents, once again, a world record as to output power rated by a single RF generator in the textile industry, having the most convenient productivity/space and productivity/cost ratios - as to both capital investment and operating costs.



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*fig. 11 - “RF 150 kW” dryer, water cooled, equipped with modular PP conveyor belt, multi-position upper electrode system and PLC.*



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*fig. 10 - “RF 105 kW” dryer, water cooled, equipped with modular PP conveyor belt, multi-position upper electrode system and PLC.*

# Dryers for yarn packages and tops

## “TCRF” SERIES DRYERS

The “TCRF” (Thermo-Controlled Radio Frequency) model dryers represent the outcome of the researches carried out by STALAM in co-operation with Messrs. LORIS BELLINI as to the RF drying at a controlled temperature of yarn packages and tops in bobbin or bump form. These equipment can surely be considered as the most sophisticated textile dryers available worldwide.

In the “TCRF” dryers a suitable air flow, forced through the product while submitted to the RF field, makes it possible to control the product’s internal temperature: in more detail, the RF energy supplied endogenously causes the evaporation of the water within the product, and the air flow passing through quickly evacuates the water vapour, thus avoiding a temperature increase above a certain value, duly pre-set by the operator. An automatic weighing system stops the drying cycle automatically when the desired final weight has been reached. All working parameters and dryer operations are set and automatically controlled through a PLC or, since ITMA '99, through a PC.

“TCRF” dryers with 1 or 2 trolleys specifically designed for yarn packages, and a dryer model with 2 trolleys suitable for both tops and packages, are available.

Thanks to the accurate drying temperature control, the “TCRF” dryers are particularly suitable for: bleached and optical whitened fibres (such as chlorite bleached wool tops - also after anti-shrinking treatment - and cotton/acrylic blended yarns in light and pastel shades), cotton and viscose yarns dyed with direct dye-stuffs, both fixed and unfixed, and, generally speaking, for all products whose quality parameters are negatively affected by prolonged thermal treatments or by temperatures above a certain limit.



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*fig. 12 - “TCRF 1C” dryer for compressed viscose and cotton yarn packages, dyed with unfixed direct dye-stuffs, after centrifugal hydroextraction.*

# “TCRF”

“TCRF” dryers allow a remarkable reduction of overall drying costs: average electricity savings are of 10-25% compared to the standard radio frequency technology, depending on the product being dried; moreover, the ease of loading and unloading of the trolleys contributes to reduced labour costs. The “TCRF” dryers are also predisposed to be integrated into fully automated dyeing plants with robotised handling systems for dye-columns.



fig. 13 - “TCRF 2C/RT” dryer for fine wool tops for underwear, both in bump and bobbin form, after bleaching and anti-shrinking treatment.

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fig. 14 & 15 - “TCRF 2C/R” dryer for filament rayon yarn packages, integrated into a fully robotised dye-house.

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# Dryers for loose stock, tow/top slivers and yarns in hanks

fig. 16 & 17 - "LTRF 60 kW" dryer for cotton loose stock for "mélange", with volumetric hopper feeder and unloading with pneumatic transport to storage.

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## "RF" SERIES DRYERS

Dryers of the "RF" series, similar to those used for the drying of packages and tops, are widely utilised for the drying of yarns in hank form, unwound tow/top slivers, loose stock and other "loose" textile products.

Hanks, after dyeing and centrifugal hydroextraction or in-line squeezing, can be perfectly dried without any movement or passing air flow, thus avoiding yarn entanglement and making the winding operation more efficient.

Tow and top slivers can be dried folded up on the conveyor belt of the RF dryer: a perfect residual moisture distribution is obtained within the slivers,

resulting in an increased efficiency of the tow stretch-breaking or top intersecting / re-combing operations.

The RF drying of loose stock after carbonising or dyeing has many advantages as well: the fibres can be loaded directly onto the conveyor belt of the dryer or even inside permeable bags used for the dyeing and hydroextraction operations; the reduced losses of product, the uniformity of drying, the improved physical-mechanical characteristics of the fibres, and consequently the more efficient carding - combing - spinning operations, result in a higher yarn metric yield of up to 2%.



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fig. 18 - “LTRF 2x60 kW” dryer for cotton and rayon knitting yarns in hank form.

fig. 19 - “LTRF 75 kW” dryer for wool top slivers and related feeding system.

fig. 20 - “RFA/S 2x50 kW” dryer for wool and acrylic top slivers, dyed and hydroextracted in “big forms”. Slivers, at the outlet, are fed directly to the gill-box.

## “LTRF” AND “RFA/S” SERIES DRYERS

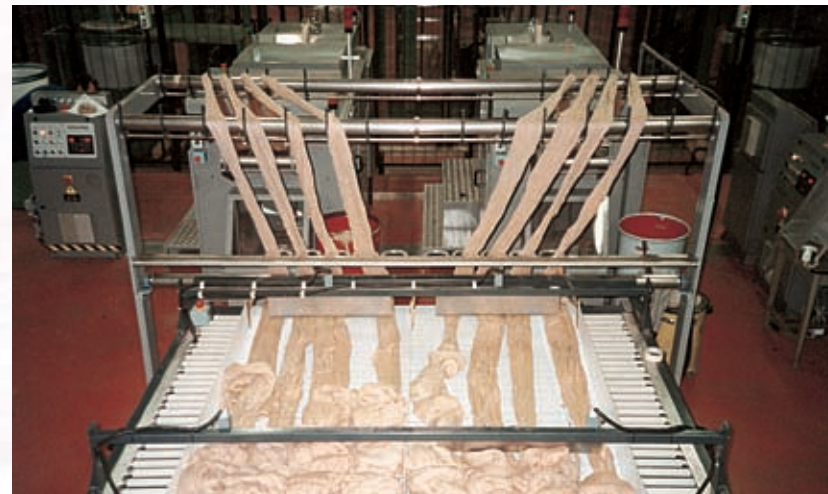
The “LTRF” (Low Temperature Radio Frequency) series dryers are especially designed for the low temperature drying of these products.

As far as the radio frequency generation and application sections are concerned, these dryers derive directly from the “RF” series equipment. The innovation consists in the additional air suction and blowing compartments, placed just beneath the conveyor belt, which are fitted with medium-head centrifugal fans. These compartments force a controlled amount of air through the product being submitted to the RF field, so that the drying process takes place at temperatures which normally do not exceed 60-70° C. The air passing through the product improves the energetic efficiency as well, so that drying costs are reduced by 15-30% when compared to the standard “RF” technology.

An original version of these dryers is the “RFA/S” series, presented for the first time at ITMA ‘95. Here, the principles of both the “RFA” and of the “LTRF” technologies are combined; the forced air flowing through the product and the accurate temperature control inside the drying tunnel allow us to set all parameters of the evaporative process. Both the product quality and the energetic efficiency are improved, and savings in drying costs up to 35% in comparison with the standard “RF” technology are obtained.



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## “RF/T” dryers for fabrics



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fig. 21 & 22 - “RF/T 60 kW” dryers for the drying and conditioning of high-quality woollen fabrics.



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The outstanding efforts spent by STALAM in researching innovative drying technologies led to the development, in co-operation with Messrs. BISIO, of a revolutionary radio frequency dryer for fabrics. Presented for the first time at ITMA '95, the “RF/T” series dryer can be considered the only industrial radio frequency drying equipment specifically designed for the tensionless drying - partial or complete - of knitted and woven fabrics.

Some of its most important characteristics are:

- the ability to transfer high radio frequency power values on small surfaces, thus obtaining great productivity within a small space;
- the drying process takes a few seconds and occurs at a low temperature (40-60°C);

- the residual moisture in the fabric is perfectly uniform and controlled by an in-line computerised system;

- the construction is modular, to fit any production requirement.

Widespread uses of these dryers are foreseen not only as independent drying units, but also in conjunction with existing (old or new) equipment such as conventional tensionless dryers, relaxation dryers, stenters, thermosetting equipment, and many other finishing machines, especially in the woollen industry: the “RF/T” will increase the efficiency and throughput of existing equipment, in addition to improving the quality of the finished product in terms of dimensional stability, formability, shear rigidity, etc.

# Dryers for stockings and tights



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fig. 23, 24 & 25 - "RF 30 kW" and "RF 40 kW" dryers for stockings and tights after dyeing and hydroextraction, unboarded inside bags or as boarded/ironed dozens.



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In comparison with traditional methods, the radio frequency drying of ladies stockings and tights after dyeing and hydroextraction, other than resulting in better product quality, offers various technical advantages, paving the way to innovative finishing procedures and, finally, leading to a corresponding increase in overall profitability.

Thanks to the RF dryers specifically designed for stockings and tights, which include some auxiliary devices addressing the specific problems of drying hosiery, STALAM gained the world leadership also in this particular sector.

Stockings and tights, prior to - or after boarding and/or ironing, can be efficiently and uniformly dried when laid on the conveyor belt of the RF dryer as loose dozens or inside the dye-bags. The quality thus obtained allows immediate packing without any further finishing treatment.

# Dryers for non-wovens and other textile applications



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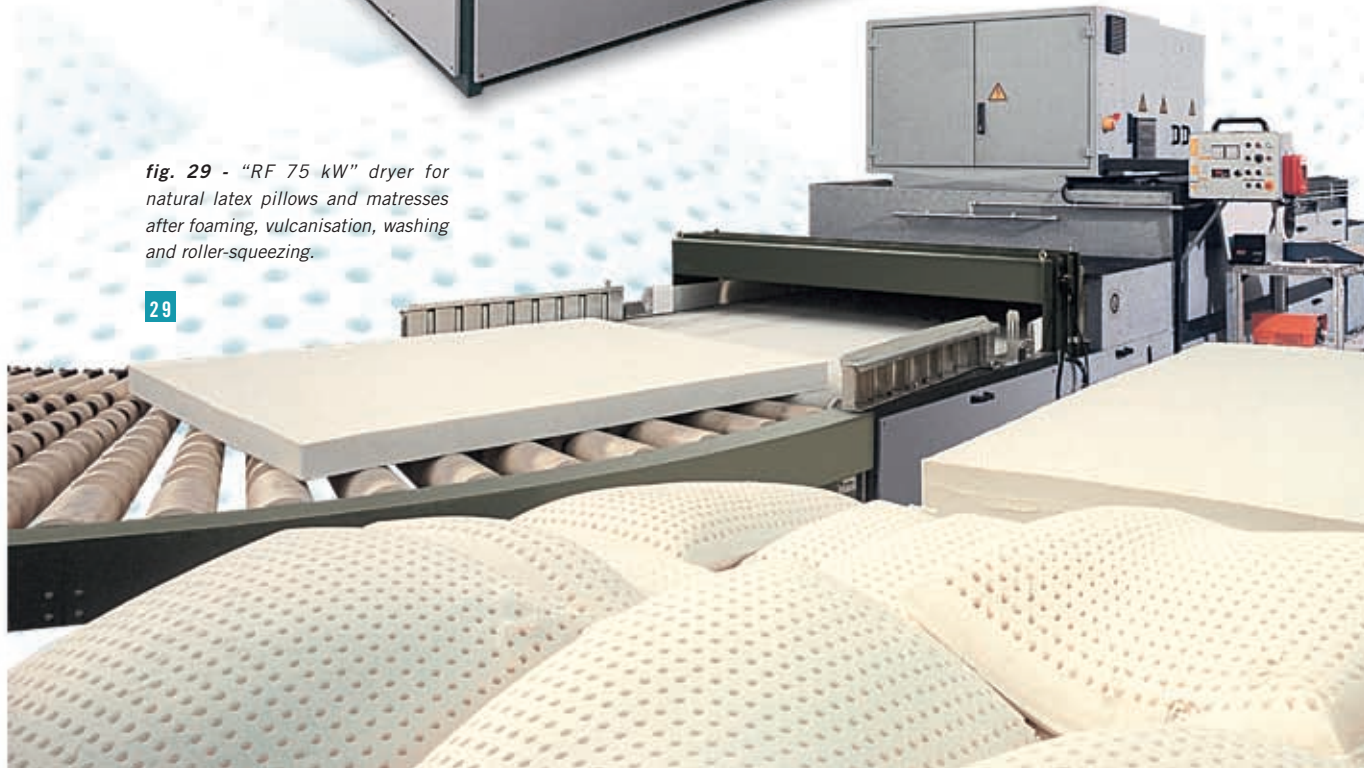
*fig. 26 - "RF 60 kW" dryer for "direct roving" glass-fibres.*

*fig. 27 - "RF 2x15 kW" equipment for glueing and drying narrow fabrics, stripes, coated bands, etc.*

*fig. 28 - "RF 15 kW" dryer for wet-spun linen spools, in-line with the spinning frame.*

*fig. 29 - "RF 75 kW" dryer for natural latex pillows and mattresses after foaming, vulcanisation, washing and roller-squeezing.*

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Bearing in mind that any drying process carried out by means of a radio frequency field shows outstanding energetic efficiency and leads to a better quality of the dried product, during the past decade STALAM has developed specific drying equipment suitable to process a variety of materials. Some of the most important applications within the textile industry are:

- the post-vulcanisation drying of foamed latex products;
- the drying of felt for clothing and for industrial uses, after impregnation, in the form of sheets and disks;
- the drying of dyed elastic bands and narrow fabrics;
- the drying of silk cocoons and silk wastes after carbonising;
- the drying and pre-heating of defective synthetic fibres to be recycled in pellet form, in-line with the extrusion equipment;
- the drying of glass-fibres.

## WORK FREQUENCY OF RF GENERATORS

Work frequency of RF generators: (I.S.M.) 27.12 MHz +/-0.6%

## AVAILABLE RF OUTPUT POWER VALUES

Single-unit "RF" dryers:	10 kW - 20 kW - 30 kW - 40 kW
"RF", "RFA", "LTRF", "RFA/S" modular dryers:	40 kW - 50 kW - 60 kW - 75 kW - 85 kW - 105 kW - 150 kW
"TCRF" batch dryers:	50 kW - 75 kW
"RF/T" dryers:	60 kW - 85 kW

## COOLING SYSTEM OF RF GENERATORS

Single-unit "RF" dryers:	water or air
"RF", "RFA", "LTRF", "RFA/S" modular dryers:	water or air
"TCRF" batch dryers:	air
"RF/T" dryers:	air

## EVAPORATIVE CAPACITY OF DRYERS

"RF", "RF/T" dryers:	1.2 - 1.3 kg(H <sub>2</sub> O)/kW(RF)h
"RFA", "RFA/S" dryers:	1.3 - 1.9 kg(H <sub>2</sub> O)/kW(RF)h
"LTRF" dryers:	1.4 - 1.7 kg(H <sub>2</sub> O)/kW(RF)h
"TCRF" dryers:	1.4 - 1.8 kg(H <sub>2</sub> O)/kW(RF)h

## MAIN OPTIONAL DEVICES

Prolonged inlet and outlet tables
Indicators of "empty" inlet and outlet tables
Metal detector on the inlet table
Lateral protection teflon guards
Internal air blowers
Suction - cooling device in the outlet
Automatic multi-position upper electrode
Manual or automatic fire extinguishing system (UV or smoke-detector)
Micro-controller (PLC) for fully automated operation

## DIMENSIONS OF DRYERS

(control panel excluded)

### Single-unit "RF" dryers:

10 kW:	6.0 m (L) x 1.4 m (W) x 2.8 m (H)
20 kW:	7.5 m (L) x 1.8 m (W) x 3.3 m (H)
30 kW:	7.5 m (L) x 1.8 m (W) x 3.3 m (H)
40 kW:	7.5 m (L) x 1.8 m (W) x 3.3 m (H)

### "RF", "RFA", "LTRF", "RFA/S" modular dryers:

40 kW:	9.0 m (L) x 2.4 m (W) x 3.3 m (H)
50 kW:	9.0 m (L) x 2.4 m (W) x 3.3 m (H)
60 kW:	9.0 m (L) x 2.4 m (W) x 3.3 m (H)
75 kW:	9.0 m (L) x 2.4 m (W) x 3.3 m (H)
85 kW:	9.0 m (L) x 2.4 m (W) x 3.3 m (H)
105 kW:	9.5 m (L) x 2.4 m (W) x 3.4 m (H)
150 kW:	10.5 m (L) x 2.4 m (W) x 3.6 m (H)

### Each additional module:

40 kW - 85 kW:	4.0 m (L)
105 kW:	4.5 m (L)
150 kW:	5.5 m (L)

### "TCRF" batch dryers:

1C:	4.0 m (L) x 1.5 m (W) x 3.6 m (H)
2C/R:	4.0 m (L) x 2.2 m (W) x 3.6 m (H)
2C/RT:	4.0 m (L) x 1.8 m (W) x 3.6 m (H)

### "RF/T" dryers:

4.2 m (L) x 4.2 m (W) x 4.2 m (H)

### Each additional module:

2.0 m (L)



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