TIBTECH *innovations*

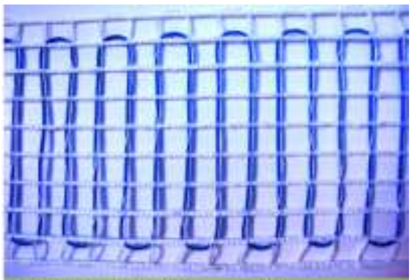
Electro-conductive or metal-fiber textiles

ELECTRO HEATING TIBGRID® for Composite Process or Functionalization

Technical Composite parts functionalization or energy efficient furnace-free production molds require easy to lay and fatigue withstanding heating grids that does not interfere with the composite structure itself nor creates delamination, even after many heating-cooling cycles. In additions special shapes or small radius curves of some mold or composite parts requires even thermal gradient, easy width adjustments and very high flexibility of the heating grid in 3 directions.

Most of heating fabrics available on the market are suited for rectangular size, or need to be pre-tailored designed to fit special shapes and avoid excessive connection costs.

TIBGRID® concept of very open and flexible heating grid engineered by TIBTECH is giving more flexibility in design and fulfilling most of theses challenges in addition to light weight or several other optional advantages as double safety circuit or even deformation monitoring.



TIBGRID® ISO 120mm width, pitch 15mm

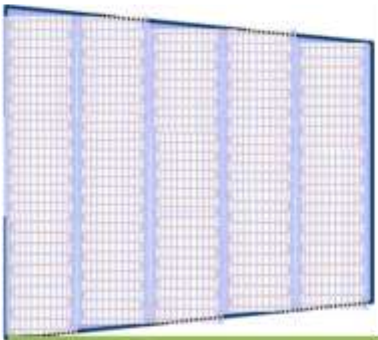
TIBTECH produces and sells a large range of fine and flexible THERMOTECH electro-heating yarns, eventually insulated with PTFE, that have a very good fatigue withstanding, and that can be used in heating molds or for composites functionalization.
Manual lay out of these THERMOTECH yarns is nevertheless a time consuming and expensive process and we have therefore developed specifically the TIBGRID® heating grid concept to improve the lay out efficiency.

. Its very open structure is designed to minimize the introduction of other support material, as it could be the case with a plain weave of glass felt, and to avoid delamination problems by allowing very good impregnation of the resin in its standard based material.

THERMOTECH heating yarns		Reference identification	Resist./m	color	count	outerwall	insualtion	max. temp.	max. volts	flexibility	water tight	fatigue withstanding
Insulated yarns	I type	**C-I-0,2** Vi -XE0 - T2,6 -1,0 MF	0,2	violet	2,6 g/m	1,0 mm	PTFE	230°C	250V	++	yes	++
		C-I-0,35 Bl-XP0 -T1,0 -0,8 HF	0,35Ω	white or blac	1,0 g/m	0,8 mm	PER	120°C	48V	+++	yes	++
		T-I-1,8 Rd-XE0 -T3,0 -1,25LF	1,85Ω	red	3,0 g/m	1,25mm	PTFE	230°C	380V	+	yes	++
		T-I-3,6 Wh-XE0 -T3,4 -1,35HF	3,60Ω	brown	3,4 g/m	1,35mm	PTFE	230°C	250V	+++	yes	+++
		T-I-4,6 Tr- XE0 -T2,6 -1,35HF	4,60Ω	ranslucent	2,6 g/m	1,35mm	PTFE	230°C	250V	+++	yes	+++
		T-I-7,0 Bu- XE0 -T2,3 -1,10HF	7,00Ω	blue	2,3 g/m	1,1 mm	PTFE	230°C	250V	+++	yes	+++
		T-I-13 Gy- XE0 -T1,1 -0,80HF	13,0Ω	grey	1,1 g/m	0,8 mm	PTFE	230°C	250V	+++	yes	+++
		T-I-14 Bl- XE0 -T1,6 -0,90HF	14,0Ω	black	1,6 g/m	0,9 mm	PTFE	230°C	250V	+++	yes	+++
		T-I-30 Wh- XP0 -T0,8 -0,90HF	30,0Ω	white	0,8 g/m	0,9 mm	PER	120°C	48CV	+++	yes	+++
	W type	**T-W-1,3** Wh-WGG-N7,9-3,2MF	1,32Ω	white	7,9 g/m	3,20 mm	glass/gl.	400°C	?	++	no	++
		T-W-30 Wh-WP0-N0,26-0,4HF	30,0Ω	white	0,26 g/m	0,40 mm	PAM	120°C	48 V	++++	no	+++
		T-W-30 Wh-WP0-N0,28-0,4HF	30,0Ω	white	0,28 g/m	0,42 mm	PAM	120°C	48V	++++	no	+++
		T-W-60 Wh-WP0-N0,15-0,2HF	60,0Ω	white	0,15 g/m	0,20 mm	PAM	120°C	48V	++++	no	+++
Non-Insulated yarns	hybrid	**C-N-0,2** Gy -000-N0,86 -0,45MF	0,2Ω	light grey	0,86 g/m	0,45 mm	no	280°C	n insul	+++	no	++
		H-N-0,7 Ye-000 -N0,36 -0,55 HF	0,7Ω	yellow 4c	0,36 g/m	0,55 mm	no	280°C	n insul	+++	no	+
		H-N-1,2 Ye-000 -N0,20 -0,35 HF	1,2Ω	yellow 2c	0,20 g/m	0,35 mm	no	280°C	n insul	+++	no	+
		H-N-11 Gy-000 -N0,04 -0,11 HF	11,0 Ω	copernic	0,04 g/m	0,11 mm	no	450°C	n insul	++	no	+
	N type	**T-N-1,8 Gy**-000 -N1,7 -0,70 LF	1,85Ω	grey	1,70 g/m	0,70 mm	no	600°C	n insul	+	no	+
		T-N-3,6 Gy-000 -N1,9 -0,70 HF	3,60Ω	grey	1,90 g/m	0,70 mm	no	600°C	n insul	+++	no	+++
		T-N-4,6 Gy-000 -N1,5 -0,55 HF	4,60Ω	grey	1,48 g/m	0,55 mm	no	600°C	n insul	+++	no	+++
		T-N-7,0 Gy-000 -N1,0 -0,50 HF	7,00Ω	grey	1,02 g/m	0,50 mm	no	600°C	n insul	+++	no	+++
		T-N-9,0 Gy-000 -N0,75-0,40 HF	9,00Ω	grey	0,75 g/m	0,40 mm	no	600°C	n insul	+++	no	+++
		T-N-14 Gy-000 -N0,51 -0,25 HF	14,0Ω	grey	0,51 g/m	0,25 mm	no	600°C	n insul	+++	no	+++
		T-N-30 Gy-000 -N0,24 -0,10 HF	30,0Ω	grey	0,24 g/m	0,10 mm	no	600°C	n insul	+++	no	+++
		T-N-60 Gy-000 -N0,11 -0,07 HF	60,0Ω	grey	0,11 g/m	0,07 mm	no	600°C	n insul	+++	no	+++

The heating circuit is linked by a very fine and open sacrificial polyester structure that has only the objective to keep it in place during the composite production process. It is on purpose designed to

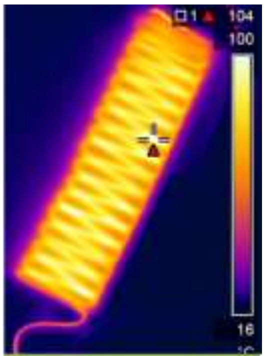
be very weak not to interfere with the other reinforcing materials of composite, nor with the resin, or for thermoplastic impregnation.
This very open structure facilitates also the use of injection foam or other hollow sphere fillers for light weight structure applications.


TIBGRID® continuous positioning

Connections costs saving in irregular shapes

Probably one of the most interesting property of TIBGRID® is to facilitate standard laying on non rectangular shapes : as you can see on the picture hereby, one can easily cut the holding structure in between one "finger" of the heating circuit to follow the variable width of the piece .

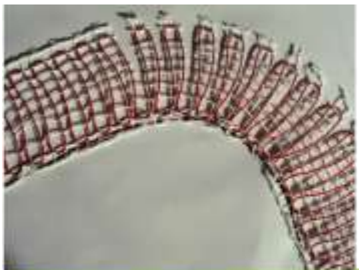
With this very interesting possibility, you can cover a complex surface with only two connections , … the input and output! (under reserve of course of having the suitable electrical circuit resistivity!)



TIBGRID® ISO in IR

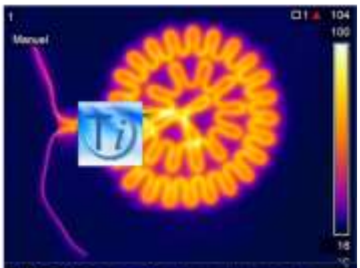
The Pitch between each heating wire can be adjusted to you needs . In fact , the pitch has to be closer when you wish to reduce the thermal gradient , but can be bigger if you work under several layers or thicker coating for large pieces as wind blade by example.
The pitch can vary from 2 to 40mm , but most common pitch are 15 or 20mm in composite.

Possibility to follow circular shapes


TIBGRID cut edge to follow curves

Another interesting use, by example to insert a de-icing device in the structure of large telecommunication antennas , is to cut the external holding warp yarns as on the picture joint.
You can also see the possibility to adjust to the center of the circle, as it has been done for the carbon composite - heating disk shown in IR camera.

Thermal gradient


TIBGRID® in IR :shaped in circle : follow curves of short radius (carbon disk or hollow sphere)

The picture joint of the carbon disk has been taken at the beginning of the heating process to have a clearer picture, but we have noticed that the gradient rapidly decreases as the temperature is getting more even within the resin and in between the fingers. After one minute, the camera gives an full orange disk where temperature is not much affected.

It is possible to work with larger pitch, but it may be useful to add a thermal conductive grid (as a stainless steel mesh by example) that will spread the heat more rapidly in between each heating wire. One can also use this conductive mesh to connect the composite to the ground. This would be a good safety issue , especially in case of heating molds that may accidentally get damaged; by example by a falling tool.

Temperature control and nominal Power calculation

The potential of power per surface unit is adaptable to a very large extent. The limiting factor are as follow :

Maximal temperature withstanding of the PTFE insulating material : 250°C this means that the maximum temperature in between the heating core of the yarn and its insulation cover must remain under this figure. It is difficult to talk of maximum power per surface unit as all will depend of the exchange ratio between the yarn and the composite itself, taking in account the outside environment. Generally , as a guidance only, we can give an indication of the maximum nominal power of one TIBGRID® structure in outside air at standard room temperature. (20°C)

Practically composite surface temperature up to180°C are often acceptable.

Dielectric is also an important issue, moreover in carbon composite : THERMOTECH is not designed to withstand over 380 volts , except specific case where the composite is not conductive (glass by example) . Under special request an extra layer of insulation can eventually be added on the THERMOTECH yarn for major issues.

In addition to these extreme temperature possibilities, it is relatively easy to monitor, control and adjust the exact temperature by inserting a temperature gage just under the surface, or one of the last layer. The easiest power adjustment method is to adjust the input tension, but other power management control are also possible. Heat cycles can be controlled very precisely up to nominal limit temperature.

Our team is ready to help you for the power calculation of your optimal circuit!

TIBGRID® DUO: double safety circuit concept

TIBGRID® Duo : double circuit for safety appl.

TIBTECH has developed, for some aerospace applications where safety is a major issue, a double circuit where each of the circuits are exactly covering the same heating zone. (see fig.) They can be switched on independently practically immediately in case of damage or electrical malfunction.

In certain applications, where heavy electronic power control is not possible, one can use this second circuit as power return or to bring double power load, for faster pre-heating by example.

THERMOSTRETCH Concept

To fit even better on variable shapes TIBTECH has developed an elastic version of its TIBGRID .
The elasticity has for purpose to facilitate an even and regular lay up of the heating grid while keeping a regular thermal pitch. Once inserted within the composite part, its role is over and it can be fixed.

THERMOSRETCH grid: Elastic version of TIBGRID®