Laboratorio
ELETTRA 80 EMC
Laboratorio
Prove e Misure EN 17025

ELETTRA 80 S.r.l.
Via Colonna, 14
31020 S.Maria del Piave (TV)

Tel.0438.27566
Fax.0438.759162

Web site:
www.elettra80emc.com

general mail:
elettra80emc@elettra80emc.com

P.I.: I.T.01180970269
C.F. e R.I. 01180970269
R.E.A. TV n. 146471
Capitale Sociale € 10.400
i.v.

S. Maria del Piave, 17/05/2013

Spett.le

Thermal Technology s.r.l.
Via Montello, 67
31031 Caerano di San Marco (TV) - ITALY

COMPARATIVE TABLE

*THERMAL TECHNOLOGY HEATING CABLE **VS** REGULAR HEATING CABLE*

	Thermal Technology heating cable (Carbon Fiber cable)	**Regular heating cable**
Voltage	230Va.c. 50Hz	230Va.c. 50Hz
Current	670mA	660mA
Power	154,1VA	151,8VA
Initial environmental temperature in test room (maintained during the test)	20°C	20°C
Maximum temperature for heating cable without insulation	**90°C**	**76,5°C**
Maximum temperature for tube without insulation	**81°C**	**70°C**
Time needed for cable without insulation to achieve the maximum temperature (from 20ºC to Tmax)	1:14':22"	1:15':22"
Time needed for cable without insulation to achieve 40°C temperature (from 20°C to 40°C)	**0:02':36"**	**0:07':52"**
Time needed for cable without insulation to achieve 50°C temperature (from 20°C to 50°C)	**0:05':38"**	**0:12':23"**
Time needed for cable without insulation to achieve 60°C temperature (from 20°C to 60°C)	**0:10':08"**	**0:19':08"**
Time needed for cable without insulation to achieve 70°C temperature (from 20°C to 70°C)	**0:15':45"**	**0:34':54"**
Time needed for cable without insulation to achieve 80°C temperature (from 20°C to 80°C)	**0:27':01"**	**Not accessible (1:15':22" at 76.5°C)**
Time needed for tube without insulation to achieve the maximum temperature (from 20ºC to Tmax)	**0:57':15 Tmax- 81ºC**	**1:14':36" Tmax-70ºC**
Time needed for tube without insulation to achieve 40°C temperature (from 20°C to 40°C)	**0:07':53"**	**0:10':08"**

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	Thermal Technology heating cable (Carbon Fiber cable)	Regular heating cable
Time needed for tube without insulation to achieve 50°C temperature (from 20°C to 50°C)	**0:10':23"**	**0:15':46"**
Time needed for tube without insulation to achieve 60°C temperature (from 20°C to 60°C)	**0:18':01"**	**0:25':54"**
Time needed for tube without insulation to achieve 70°C temperature (from 20°C to 70°C)	**0:28':09"**	**1:14':15"**
Time needed to decrease at minimum the temperature of the cable without insulation (from Tmax to 20ºC)	1:28:57	1:28:57
Time needed to decrease at minimum the temperature of the tube without insulation (from Tmax to 20ºC)	1:29:10	1:31:20
Maximum temperature reached in regime by the cable with insulation	**135°C**	**125,5°C**
Maximum temperature reached in regime by the tube with insulation	**132°C**	**121,5°C**
Time needed to achieve the maximum temperature of cable with insulation (from 20ºC to Tmax)	**2:11:41 Tmax- 135ºC**	**2:04:56 Tmax- 125,5ºC**
Time needed for cable with insulation to achieve 40°C temperature (from 20°C to 40°C)	**0:03':23"**	**0:06':46"**
Time needed for cable with insulation to achieve 60°C temperature (from 20°C to 60°C)	**0:10':07"**	**0:14':38"**
Time needed for cable with insulation to achieve 80°C temperature (from 20°C to 80°C)	**0:19':07"**	**0:24':45"**
Time needed for cable with insulation to achieve 100°C temperature (from 20°C to 100°C)	**0:30':22"**	**0:40':30"**
Time needed for cable with insulation to achieve 120° C temperature (from 20°C to 120°C)	**0:51':45"**	**1:22':09"**
Time needed for insulated tube to achieve the maximum temperature (from 20°C to Tmax)	**2:10':33" Tmax- 132ºC**	**2:11':26" Tmax- 121,5ºC**
Time needed for insulated tube to achieve 40°C temperature (from 20°C to 40°C)	**0:06':45"**	**0:9':00"**
Time needed for insulated tube to achieve 60°C temperature (from 20°C to 60°C)	**0:13':30"**	**0:16':52"**
Time needed for insulated tube to achieve 80°C temperature (from 20°C to 80°C)	**0:21':22"**	**0:28':07"**
Time needed for insulated tube to achieve 100° temperature (from 20°C to 100°C)	**0:34':42"**	**0:46':07"**
Time needed for insulated tube to achieve 120°C temperature (from 20°C to 120°C)	**0:58':30"**	**1:46':55"**
Time needed to decrease at minimum the temperature of the cable with insulation (from Tmax to 20ºC)	2:06':08"	2:09':32"
Time needed to decrease at minimum the temperature of the tube with insulation (from Tmax to 20ºC)	2:06:09	2:08:16

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The comparising tests are performed inside a test room with following dimensions: 3m x 2m x 2,1m, resulting a total volume of 13,8m^3 maintened at 20°C constant temperature.

Analysis of the results obtained

The results reported in the above table, obtained from the comparison of the two heating cables show that at equal powers, equal environmental and test conditions Thermal Technology heating cable in carbon reaches temperatures of about 10 ° C higher than a normal resistive cable. Furthermore it is shown that the time of reaching the temperature for Thermal Technology heating cable in carbon are lower in all the cases examined (40 ° C, 50 ° C, 60 ° C, 80 ° C, 100 ° C and 120 ° C) compared to those obtained with a normal resistive heating cable Furthermore, in tests without insulation, after 19 minutes of operation the temperature of the tube heated by Thermal Technology cable in carbon reaches 63 ° C surpassing the temperature reached by the normal heating cable (60 ° C). In tests with insulation after 12 minutes of operation, the temperature of the tube heated by Thermal Technology carbon fiber cable reaches 59 ° C, exceeding the temperature of the normal heating cable (56 ° C).

Annex A shows the measuring set-up and the temperature graphs of temperatures obtained during the tests.

Elettra 80s.r.l.
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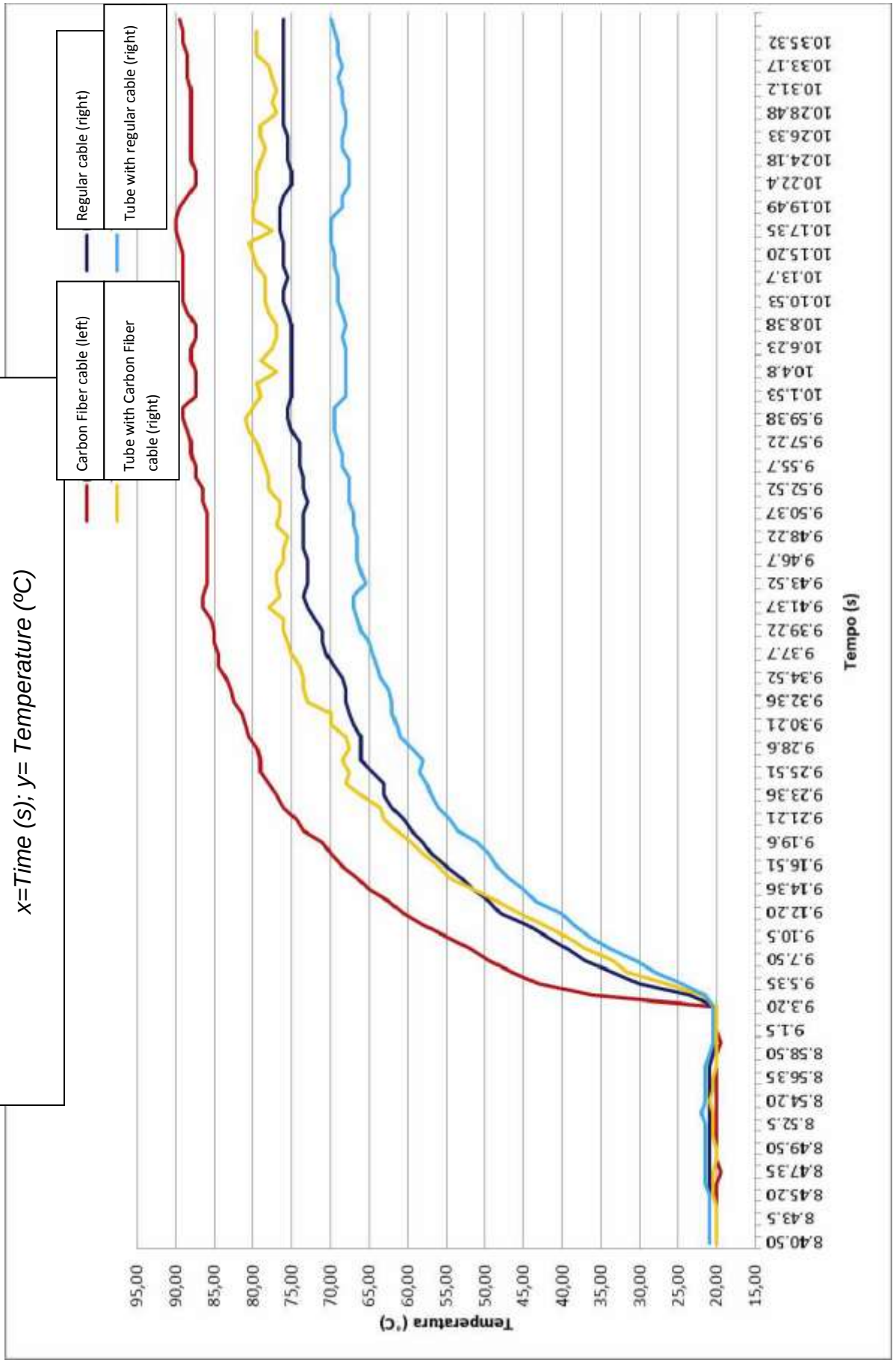
ANNEX A

Test Sensors Position

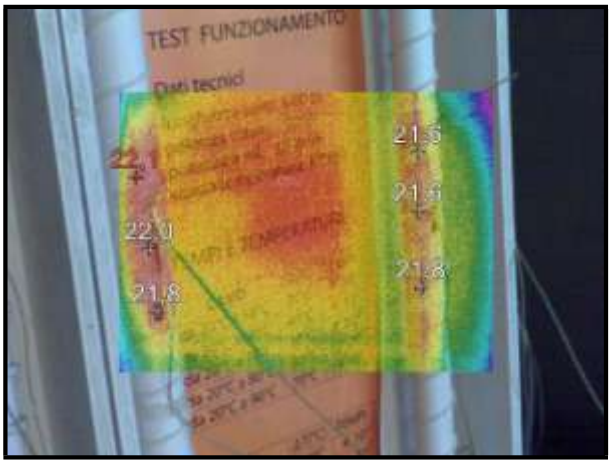
Heating without insulation

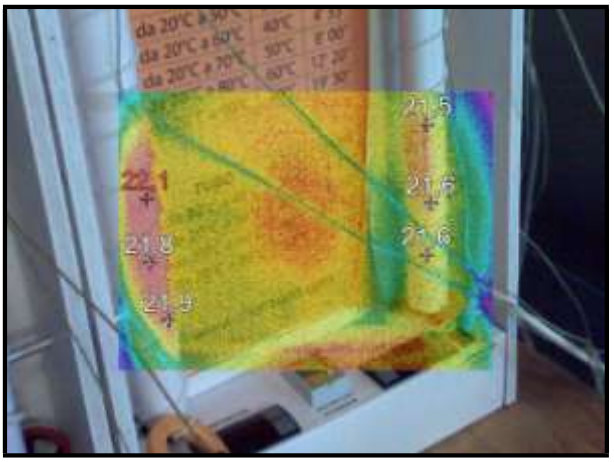


Thermographic camera pictures

Thermal Technology Carbon Fiber heating cable

Initial Conditions

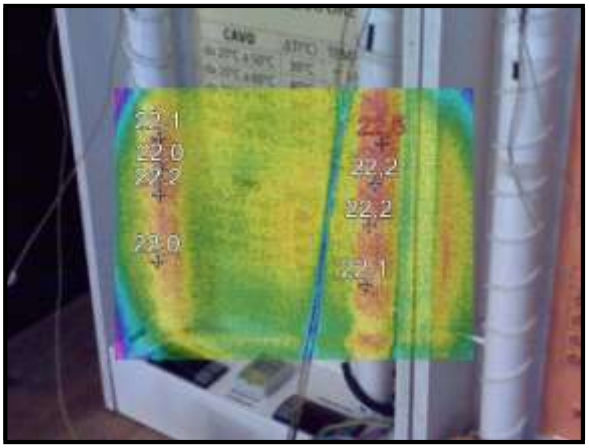




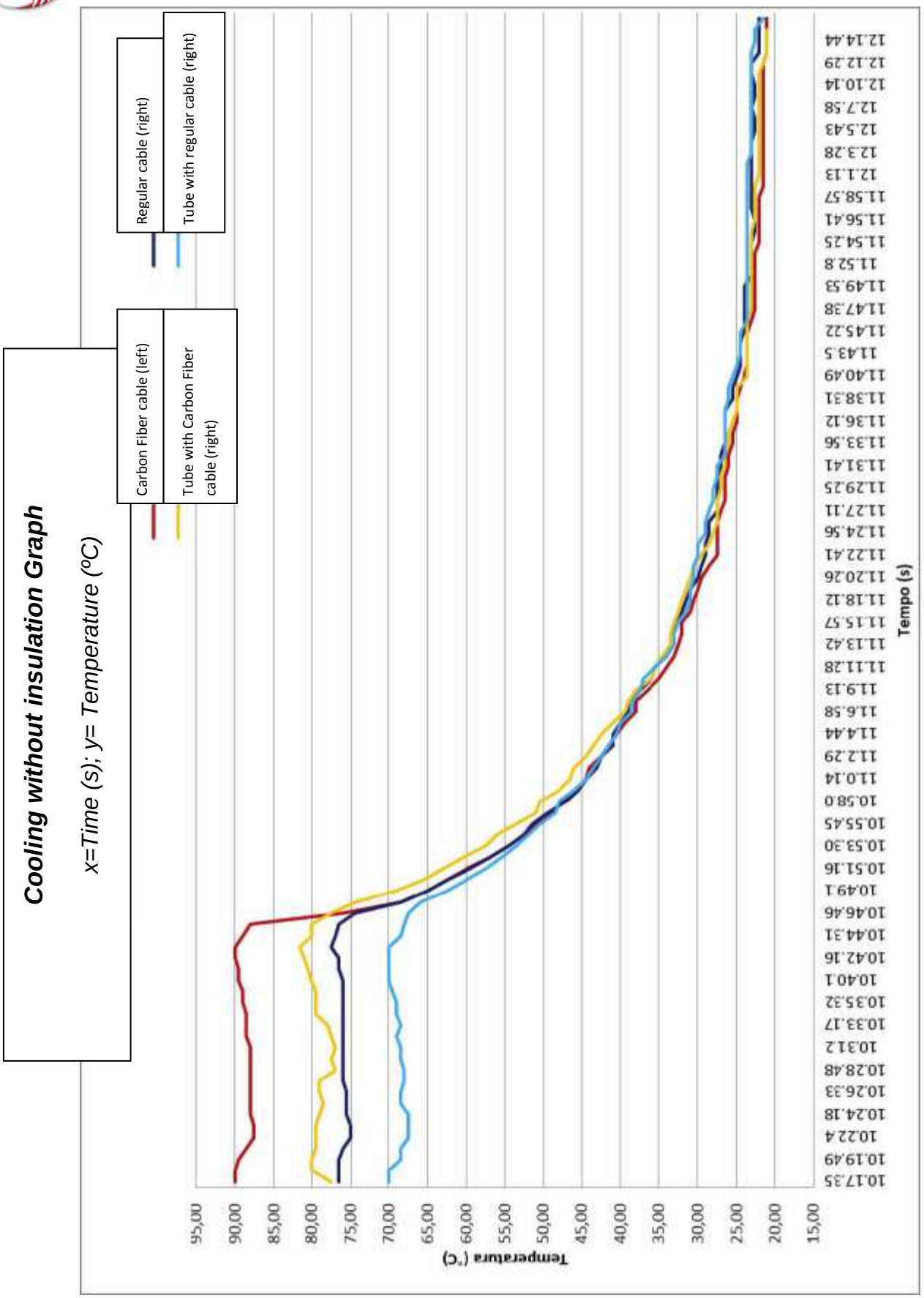
Regime Conditions

Regular heating Cable

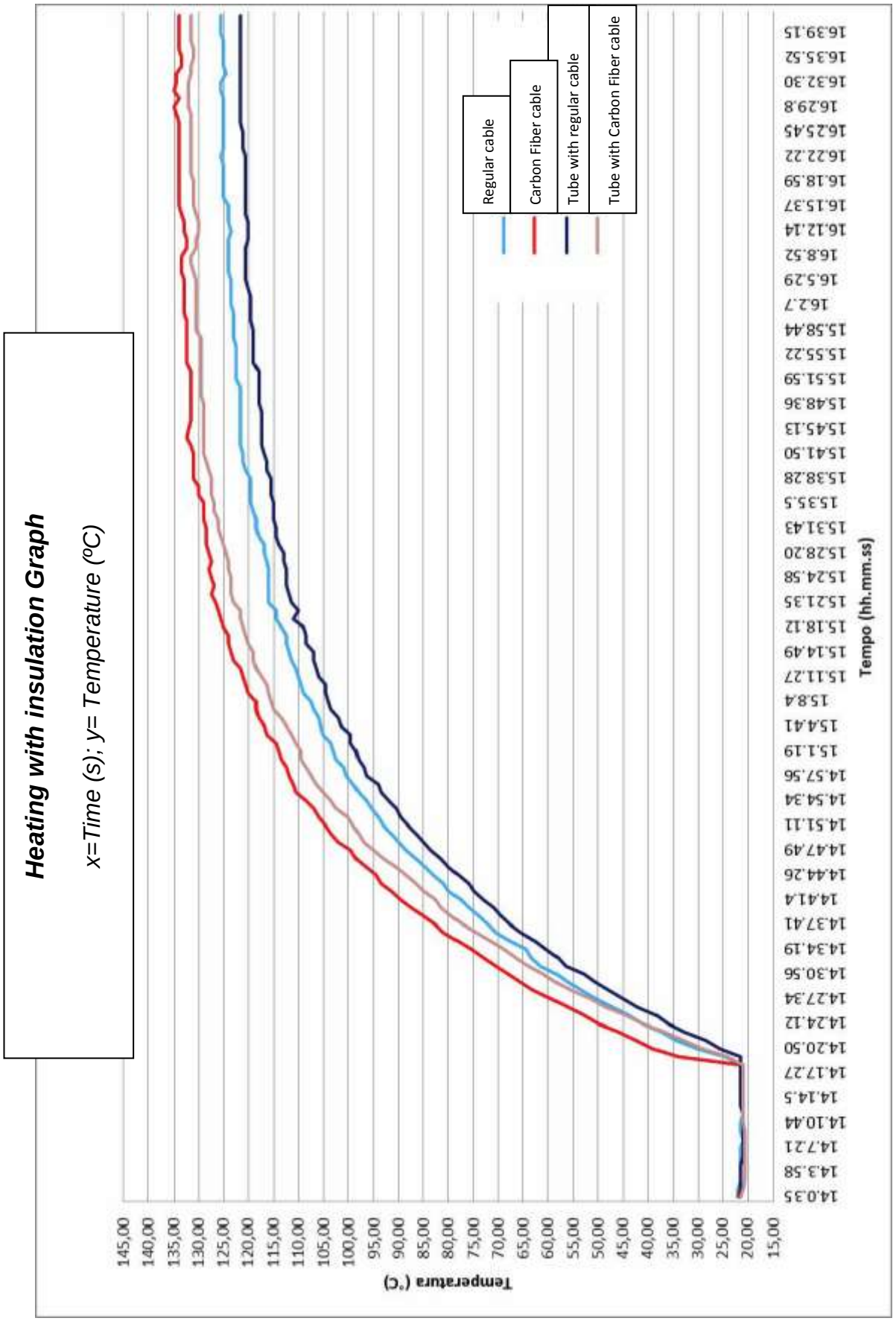
Initial Conditions



Regime Conditions



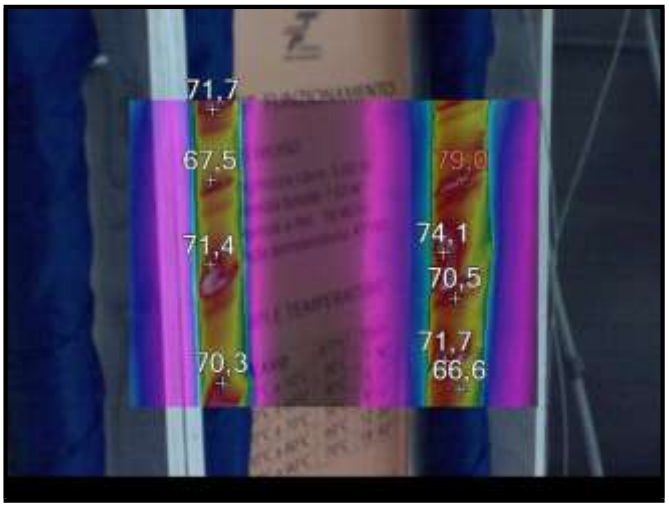
Heating with insulation

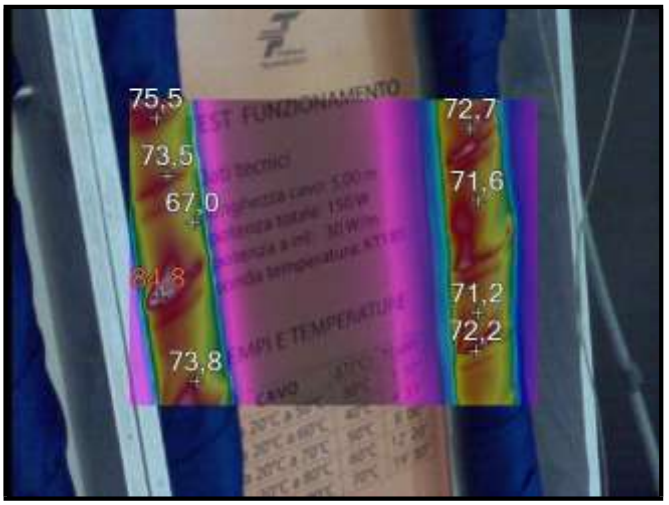


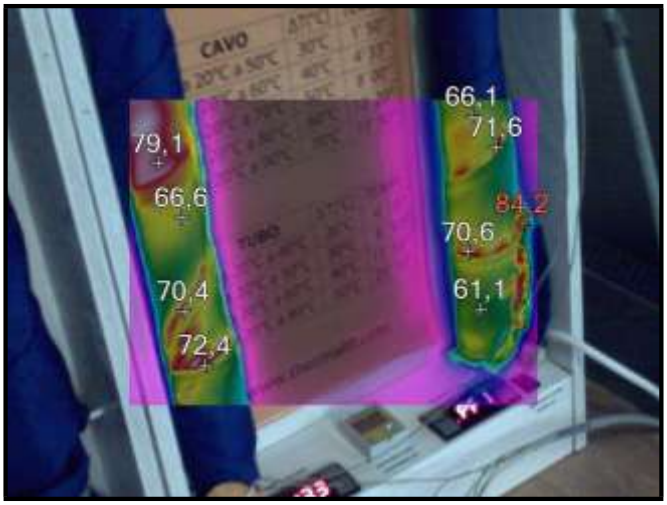
Thermographic camera pictures

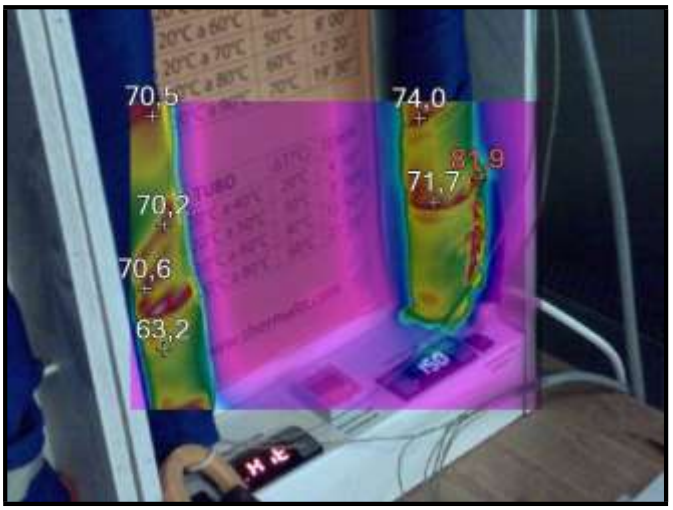
Thermal Technology Carbon Fiber heating cable

Regime Conditions



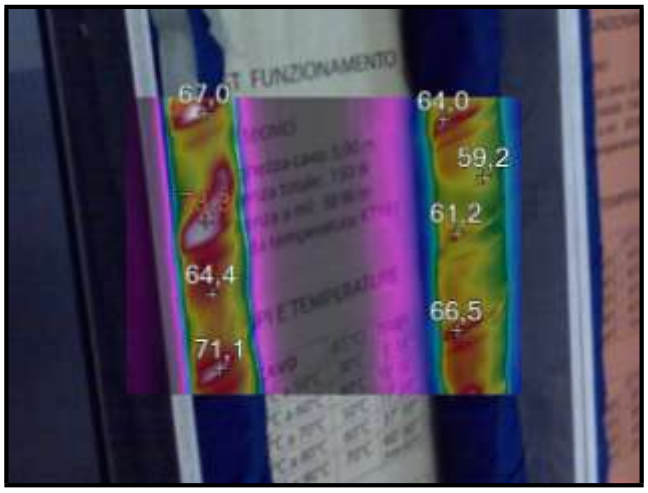


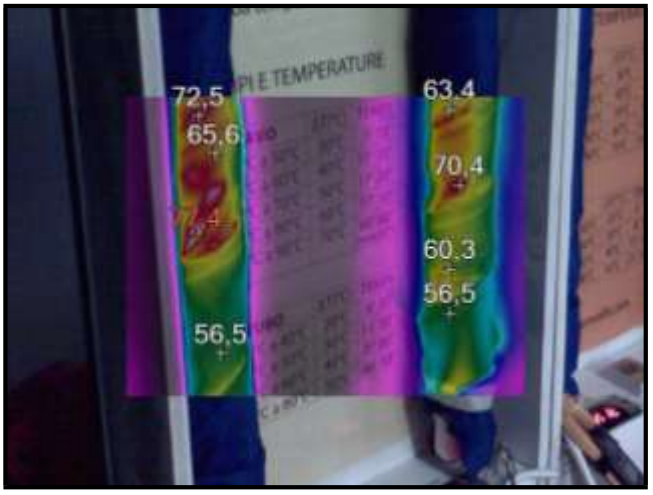


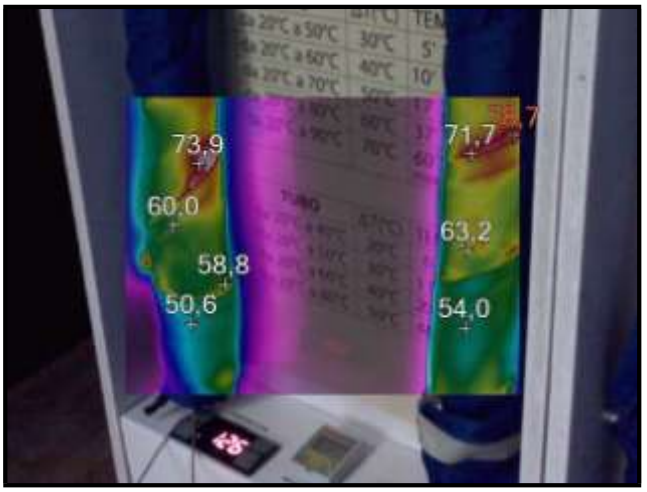


Regular heating cable

Regime conditions







ANNEX B

Measuring instruments

Measuring instruments	Using Range	Calibration date/ Calibration
Signal generator for power amplifier – Spitzenberger + Spies – SYCORE;	+5% / -10%	10/09/2012
Power amplifier – Spitzenberger + Spies – PAS5000	+5% / -10%	10/09/2012
Power amplifier supply – Spitzenberger + Spies – NT 5000/PAS	+5% / -10%	10/09/2012
climatic chamber – Elettra80	-15°/+ 60°C RH: 45-99%	19/12/2012
Thermocouples Type K system – Elettra80	–	13/12/2012
FLUKE Ti32 10010489	0°C to 600°C	27/08/2012
Multimeter – Fluke – 89 IV	–	27/08/2012
Wattmeter – Nonovip – 1176	–	28/08/2012
Current probe – HIOKI – 3287	–	12/10/2012