# MASTER CLIMATE SOLUTIONS


## KILLING VIRUS & BACTERIA
WITH HEAT

www.mcsworld.com

MASTER 1954

# HEAT EFFICIENTLY KILLS BACTERIA AND VIRUSES

The best way to disinfect a room is HEAT. In fact, heat can penetrate deeply into the area, efficiently killing bacteria and deactivating viruses. The effect of heat disinfection in a room can be measured and documented by using Master IMCS.

Heat comes with numerous other benefits:

- Environmentally friendly
- Simple setup procedure
- No subsequently cleaning required
- No risk of chemical pollution and/or allergic reactions
- Much more efficient than any other known alternative

Founded in 1954, Master Climate Solutions is an experienced manufacturer of portable heating solutions for a vast number of industries. Our EKO heaters have been specifically designed to exterminate living organisms quickly and with the highest possible success rate. Experienced industry experts stand ready to ensure efficient and correct usage.

This quick guide provides an overview of typical application areas, a list of temperature and duration requirements along with a short description of our EKO solutions.

## FOCUS:
## VIRUS & BACTERIA HEAT DISINFECTION FOR VEHICLES

Being frequently used by or in contact with different people, vehicles such as trains, buses, ambulances, trucks and cars are greatly exposed to bacteria and virus contamination. Using chemicals or household cleaning agents for disinfection procedures is risky as it will only do the job where it is applied. In contrast, heating eliminates viruses and bacteria everywhere.

Give your customers a safe travel experience without risk. Use HEAT.

## DISINFECTING BY HEAT IS PROVEN BY SCIENCE

Heat has been known to kill pathogens for centuries. In the course of history, scientists have been able to demonstrate how temperature exposure kills or disactivates a wide variety of bacteria and viruses. This is substantiated by the below table:

| Species | Temperature | Duration | Author/Scientist |
|---|---|---|---|
| Bacillus coli (E. coli) | 60°C | 10 minutes | Loeffler (1886) |
| Bacillus typhosus | 56°C | 10 minutes | Sternburg (1887) |
| Dysentery bacilli | 60°C | 10 minutes | Runge & O'brien (1924) |
| Vibrio cholerae | 55°C | 15 minutes | Kitasato (1889) |
| Mycobacterium tuberculosis | 63°C | 3 minutes | North & Park (1925) |
| Bacillus pestis (Yersinia) | 60°C | 2 minutes | Gladin (1898) |
| Staphylococci | 62°C | 10 minutes | Sternburg (1887) |
| Streptococci | 60°C | 30 minutes | Ayers & Johnson (1918) |

*Source: Hampil, B. (1932): "The Influence of Temperature on the Life Processes and Death of Bacteria", The Quarterly Review of Biology, 7(2):172-196*

In relation to modern day viruses such as the SARS-CoV Coronavirus, recent studies have found it to be quite stable at low and room temperatures. According to WHO, only a minimal reduction in virus concentration can be detected after 21 days at 4°C and -80°C respectively. At room temperature, even after two days, the virus concentration is reduced by one log only. This strong resistance makes Coronavirus extremely infectous.

However, studies conducted by the Chinese Institute for Viral Disease Control and Prevention (supported by Gerba, 1997; Laude, 1981) demonstrate that the family of Coronaviruses in general is quickly disactivated at higher temperatures. This is illustrated in the below table.

## CORONAVIRUS CAN BE DEACTIVATED WITH HEAT

**THIS TABLE SHOWS THAT CORONAVIRUS IS VERY STABLE AT LOW TEMPERATURES, BUT CAN BE QUICKLY DEACTIVATED AT TEMPERATURES ABOVE 56°C.**

| | 4°C | | 20°C | | 37°C | | 56°C | | 67°C | | 75°C | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 min | +++ | +++ | +++ | +++ | +++ | +++ | +++ | +++ | + + | + + | + | + |
| 30 min | +++ | +++ | +++ | +++ | +++ | +++ | +++ | +++ | + | + | - | - |
| 60 min | +++ | +++ | +++ | +++ | +++ | +++ | ++ | ++ | - | - | - | - |
| 90 min | +++ | +++ | +++ | +++ | +++ | +++ | - | - | - | - | - | - |
| 120 min | +++ | +++ | +++ | +++ | +++ | +++ | - | - | - | - | - | - |
| Cell control | - | - | - | - | - | - | - | - | - | - | - | - |
| Virus control | +++ | +++ | +++ | +++ | +++ | +++ | +++ | +++ | +++ | +++ | +++ | +++ |

*Note: CPE of infected cells was determined 48 h postinfection.*
*+: less than 25% cells with CPE, ++: 26%-50% cells with CPE, +++: 75% cells with CPE, ±: only few cells with CPE, -: without detectable CPE.*
*Source: "Stability of SARS Coronavirus in Human Specimens and Environment and Its Sensitivity to Heating and UV Irradiation", Biomedical and environmental sciences 16, 246-255 (October 2003)*

# APPLICATIONS

Heat treatments can eliminate bacteria and viruses in a variety of applications, a selection of which have been depicted here.

Common to all is the fact that heat needs to be applied long enough to penetrate the entire application structure for full efficiency. That requires a source of heat (heater) combined with a device capable of accurately measuring the temperature (digital thermostat) in the coldest area of the application.

*Please contact us for assistance in how to heat treat your application correctly.*

## AIRPLANES

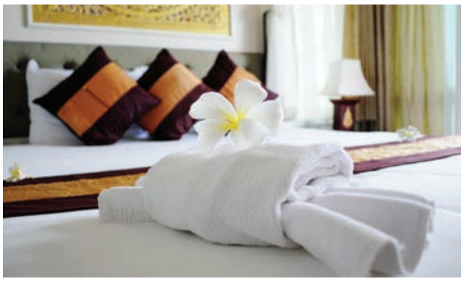
## AMBULANCES

## EMERGENCY TENTS & ARMY BARRACKS

## SPECIAL CLOTHING & TECHNICAL EQUIPMENT

## HOSPITALS


## HOTELS & HOSTELS



## POLICE CARS


## PRISON CELLS

## PUBLIC TRANSPORT

## RENTAL CARS


## TRAIN CARRIAGES

## FOOD CONTAINERS

# TEMPERATURES AND DURATION

The following table contains a number of examples from the literature demonstrating how temperature exposure affects different bacteria and viruses.

Please note that the table is for guidance only. Many factors can influence the time required to deactivate bacteria and viruses in different applications. Therefore, all stated figures are indicative and provided as is for guidance only.

## BACTERIA *– indicative temperature and time requirements*

BACTERIA

| Pathogen/Organism | Death Point | Time req. | Reference/Source* |
|---|---|---|---|
| Acinetobacter baumannii | 63°C | 15 minutes | Dumalisile, et al., 2005 |
| Aeronomas hydrophila | 50°C | 3 minutes | Gerba, 1997; Gordon et al., 1992 |
| Bacillus anthracis | 140°C | 3 hours | Hampil, 1932; Koch, 1881 |
| Bacillus coli (E. coli) | 60°C | 10 minutes | Hampil, 1932; Loeffler, 1886 |
| Bacillus pestis (Yersinia) | 60°C | 2 minutes | Hampil, 1932; Gladin, 1898 |
| Bacillus typhosus (Salmonella) | 56°C<br>63°C | 10 minutes<br>4 minutes | Hampil, 1932; Sternburg, 1887<br>Hampil, 1932; Orskov, 1926 |
| Bacterium tularense | 56°C | 10 minutes | Hampil, 1932; McCoy, 1912 |
| Brucella abortus | 61°C | 3 minutes | Jones & Martin, 2003; Golueke, 1982 |
| Brucella abortus | 55°C<br>65°C | 60 minutes<br>3 minutes | Jones & Martin, 2003; Stern, 1974 |
| Brucella abortus or suis | 55°C<br>60°C | 60 minutes<br>3 minutes | Jones & Martin, 2003; Day & Shaw, 2000 |
| Brucella melitensis | 55°C<br>60°C | 30 minutes<br>15 minutes | Hampil, 1932; Zwick & Wedeman, 1913 |
| Burkholderia mallei | 55°C | 10 minutes | Health Canada, 2007 |
| Campylobacter spp. | 75°C | 1 minute | Gerba, 1997; Bandres et al., 1988 |
| Chlamydia psittaci | 56°C | 5 minutes | TIP, 2000; Anderson et al., 1997 |
| Chryseobacterium meningosepticum | 63°C | 15 minutes | Dumalisile, et al., 2005 |
| Corynebacterium diphtheriae | 55°C<br>70°C | 45 minutes<br>4 minutes | Jones & Martin, 2003; Stern, 1974 |
| Dysentery bacilli (Shigella) | 58-60°C | 10 minutes | Hampil, 1932; Runge & O'Brien, 1924 |
| Enterococcus faecium | 60°C<br>62.5°C<br>65°C | <45 minutes<br><20 minutes<br><10 minutes | Spelina et al., 2007 |
| Escherichia coli | 45°C<br>60°C<br>65°C<br>70°C<br>75°C | 24 hours<br>105 minutes<br>45 minutes<br>45 minutes<br>15 minutes | Abbott, 2011 |
| Escherichia coli | 60°C | 45 minutes | Padhye & Doyle, 1992 |
| Escherichia coli | 65°C | 1 minute | Gerba, 1997; Bandres et al., 1988 |
| Escherichia coli | 60°C<br>70°C | 60 minutes<br>5 minutes | Jones & Martin, 2003; Stern, 1974 |
| Escherichia coli | 55°C<br>60°C | 60 minutes<br>20 minutes | Jones & Martin, 2003; Day & Shaw, 2000 |

BACTERIA

| Pathogen/Organism | Death Point | Time req. | Reference/Source* |
|---|---|---|---|
| Escherichia coli | 55°C<br>60°C | 60 minutes<br>20 minutes | Jones & Martin, 2003; Golueke, 1982 |
| Escherichia coli | 63°C | 25 minutes | Dumalisile, et al., 2005 |
| Hemophilus influenzae | 62°C | 2 minutes | Hampil, 1932; Onorato, 1902 |
| Klebsiella pneumoniae | 45°C<br>60°C<br>65°C<br>70°C | 24 hour<br>105 minutes<br>45 minutes<br>45 minutes | Abbott, 2011 |
| Legionella | 66°C | .45 minutes | Gerba, 1997; Sarden et al., 1989 |
| Legionella pneumophila | 60°C | 30 minutes | Stout, et al., 1986 |
| Listeria monocytogenes | 63°C | 30+ minutes | Rowan and Anderson 1998 |
| Listeria monocytogenes | 63°C | 20 minutes | Dumalisile, et al., 2005 |
| Meningococci | 60°C | 1 minute | Hampil, 1932; Bettencourt and Franca, 1904 |
| Mycobacterium avium<br>sub. paratuberculosis | 62°C<br>71°C | 23 minutes<br>73 seconds | Sung & Collins, 1998 |
| Mycobacterium diphtheriae | 55°C<br>70°C | 45 minutes<br>4 minutes | Jones & Martin, 2003; Stern, 1974 |
| Mycobacterium spp.<br>M. avium | 70°C | 2 minutes<br>2.3 minutes | Gerba, 1997; Robbecke and Buchhottz, 1992 |
| Mycobacterium avium<br>sub .paratuberculosis | 72°C | 15 seconds | Pearce, 2001 |
| Mycobacterium tuberculosis | 63°C | 3 minutes | Hampil, 1932; North & Park, 1925 |
| Mycobacterium tuberculosis | 70°C | 20 minutes | Jones & Martin, 2003; Stern, 1974 |
| Mycobacterium tuberculosis | 63°C<br>72°C | 30 minutes<br>15 seconds | Connor, 2007 |
| Paratyphoid bacilli | 60°C<br>63°C | 20 minutes<br>3 minutes | Hampil, 1932; Krumwiede & Noble, 1921<br>Hampil, 1932; Orskov, 1926 |
| Pasteurella multocida | 56°C<br>60°C | 15 minutes<br>10 minutes | TIP, 2000; Rimler and Glisson, 1998 |
| Pasteurella spp. | 55°C | 15 minutes | Health Canada, 2007 |
| Pneumococci | 60°C | 30 minutes | Hampil, 1932; Baggar, 1926 |
| Pseudomonas aeruginosa | 45°C<br>60°C<br>65°C<br>70°C | 4 hours<br>75 minutes<br>45 minutes<br>45 minutes | Abbott, 2011 |
| Pseudomonas aeruginosa | 60°C | <10 minutes | Spinks, et al., 2003 |
| Pseudomonas putida | 63°C | 20 minutes | Dumalisile, et al., 2005 |
| Salmonella | 60°C | 1 hour | Feachem, 1983 |
| Salmonella sp. | 65°C | 1 minute | Gerba, 1997; Bandres et al., 1988 |
| Salmonella newport | 60°C<br>65°C | 40 minutes<br>30 minutes | Wiley & Westerberg (1969) |
| Salmonella typhi | 60°C<br>70°C | 30 minutes<br>4 minutes | Jones & Martin, 2003; Stern, 1974 |
| Shigella sp. | 50°C | 1 hour | Jones & Martin, 2003; Stern, 1974 |
| Shigella sp. | 55°C | 1 hour | Feachem, 1983 |
| Shigella spp. | 65°C | 1 minute | Gerba, 1997; Bandres et al., 1988 |
| Staphylococci | 62°C | 10 minutes | Hampil, 1932; Sternburg, 1887 |
| Staphylococcus aureus | 45°C<br>50°C<br>60°C<br>65°C<br>70°C | 96 hours<br>48 hours<br>105 minutes<br>45 minutes<br>45 minutes | Abbott, 2011 |
| Methicillin Resistant<br>Staphylococcus aureus (MRSA) | 50°C<br>65°C<br>70°C | 24 hours<br>45 minutes<br>45 minutes | Abbott, 2011 |
| Staphylococcus aureus | 50°C | 10 minutes | Jones & Martin, 2003; Golueke, 1982 |
| Staphylococcus aureus | 63°C | 20 minutes | Dumalisile, et al., 2005 |
| Streptococci | 60°C | 30 minutes | Hampil, 1932; Ayers & Johnson, 1918 |
| Streptococcus pyogenes | 54°C | 10 minutes | Jones & Martin, 2003; Golueke, 1982 |
| Streptococcus pyogenes | 55°C | 10 minutes | Jones & Martin, 2003; Day & Shaw, 2000 |
| Vibrio cholera | 55°C | 1 minute | Gerba, 1997; Roberts & Gilbert, 1979 |
| Vibrio cholerae | 55°C | 15 minutes | Hampil, 1932; Kitasato, 1889 |
| Yersinia enterocolitica | 60°C | 30 minutes | Gerba, 1997; Frazier and Westhoff, 1988 |
| Coxiella burnetii | 63°C | 30 minutes | Connor, 2007 |
| Coxiella burnetii | 63°C | 30 minutes | Health Canada, 2007 |

## VIRUSES – *indicative temperature and time requirements*

VIRUSES

| Pathogen/Organism | Death Point | Time req. | Reference/Source* |
|---|---|---|---|
| Adenovirus | 60°C | 20 minutes | Gerba, 1997; Mahnel, 1977 |
| Avian pneumovirus | 56°C | 30 minutes | TIP, 2000; Collins, 1986 |
| Cercopithecine Herpes Virus 1 | 60°C | 30 minutes | Health Canada, 2007 |
| Coronovirus | 55°C | 2 minutes | Gerba, 1997; Laude, 1981 |
| Coxsackievirus | 60°C | 30 minutes | Health Canada, 2007 |
| Cytomegalovirus | 60°C | 30 minutes | Health Canada, 2007 |
| Ebola virus | 60°C | 60 minutes | Health Canada, 2007 |
| Echovirus | 50°C | 2 hours | Health Canada, 2007 |
| Enterovirus 70 | 60°C | 30 minutes | Health Canada, 2007 |
| Enteroviruses, Reoviruses and Adenoviruses (All) | 60°C | 2 hours | Feachem, 1983 |
| Epstein-Barr Virus | 60°C | 30 minutes | Health Canada, 2007 |
| Hantavirus Pulmonary Syndrome (HPS) | 60°C | 30 minutes | Health Canada, 2007 |
| Hepatitis A | 70°C | 10 minutes | Gerba, 1997; Siegl et al., 1984 |
| Hepatitis A | 70°C | 4 minutes | Health Canada, 2007 |
| Highly Pathogenic Avian Influenza (HPAI) | 56°C | 15 minutes | TIP, 2000; Blaha, 1989 |
| Infectious bronchitis | 56°C | 15 minutes | Otsaki, 1979 |
| Newcastle Disease Virus (NDV) | 60°C<br>70°C | 1 hour<br>50 seconds | TIP, 2000; Foster & Thompson, 1957 |
| Norwalk virus | >60°C | >30 minutes | Health Canada, 2007 |
| Parvoviruses | 60°C | 30 minutes | TIP, 2000; Gough et al., 1981 |
| Poliovirus | 60°C | 25 minutes | Gerba, 1997; Larkin and Fasolitis, 1979 |
| Poliovirus 1 | 55°C<br>60°C | 30 minutes<br>5 minutes | Feachem, 1983, p163; Wiley & Westerberg, 1969 |
| Poxviruses | 60°C | 8 minutes | TIP, 2000; Tripathy, 1993 |
| Reovirus | 60°C | 20 minutes | Gerba, 1997; Mahnel, 1977 |
| Rotavirus | 63°C | 30 minutes | Feachem, 1983, p188; G.N. Woode |
| Rotavirus | 50°C | 30 minutes | Gerba, 1997 ; Estes, et al., 1979 |
| Viruses (Most) | 70°C | 20 minutes | Jones & Martin, 2003; Day & Shaw, 2000 |
| Viruses (Most) | 70°C | 25 minutes | Jones & Martin, 2003; Stern, 1974 |

**MOST VIRUSES CAN BE EASILY DEACTIVATED IN LESS THAN 1 HOUR WHEN TREATED WITH TEMPERATURES BETWEEN 55°C AND 70°C.**

# MASTER EKO 3KW ELECTRIC HEATER

*An effective disinfection requires high temperatures. But to avoid thermal shock to the room and the objects in it, the temperature needs to be increased smoothly. Master's purpose-built EKO heaters do just that.*

*Most other heaters on the market are incapable of reaching these high temperatures smoothly and are therefore unfit for thermal disinfection.*


## FEATURES

- Compact and lightweight
- EKO 3 delivers 800 m³/h of hot air using only 2.8 kW at 240 V (single phase)
- Connection to the external digital remote thermostat THK, specific for this application, included in the package
- Overheat thermostat
- Motor with thermal protection and intervention
- The Master EKO is placed inside the room and recirculates the air increasing the temperature by 15°C at a time
- Compatible with Master IMCS remote monitoring and documentation device

**Included in the box**

**Remote thermostat THK with probe 4150.137**

**Compatible with Master IMCS**

| Specifications | Units | EKO 3 |
|---|---|---|
| Heating power | kW | 2.8 |
| | Btu/h | 11260 |
| | kcal/h | 2866 |
| Air flow | m³/h | 800 |
| Power supply | V/Hz | 230/1ph/50 |
| Rated current | A | 12.4 |
| Remote thermostat | | Digital |
| Product size (l x w x h) | mm | 455 x 440 x 600 |
| Weight | kg | 19 |

**Note:**

EKO 3 has a power limited to 2.8 kW.
EKO 3 alone will not be able to heat a standard room.
EKO 3 is designed to be used in very small spaces or as a support to an EKO 9

## SMOOTH TEMPERATURE INCREASE

The temperature of the air flowing through is increased in amounts of 15°C each time. 20°C->35°C ->50°C- 70°C. The big air flow allows a fast increase and an even temperature distribution. This solution avoids temperature shocks.

## HIGH AIR FLOW

The high air flow quickly mixes the air in the room allowing to heat everywhere.

# MASTER EKO 9KW ELECTRIC HEATER

*An effective disinfection requires high temperatures. But to avoid thermal shock to the room and the objects in it, the temperature needs to be increased smoothly. Master's purpose-built EKO heaters do just that.*

*Most other heaters on the market are incapable of reaching these high temperatures smoothly and are therefore unfit for thermal disinfection.*


## FEATURES

- EKO 9 delivers 1400 m³/h of hot air using only 9 kW at 380 V (three phase)
- Connection to an external digital remote thermostat THK, specific for this application, included in the package
- Overheat thermostat
- Motor with thermal protection and intervention
- The Master EKO is placed inside the room and recirculates the air increasing the temperature by 15°C at a time
- Compatible with Master IMCS remote monitoring and documentation device

### Included in the box

**Remote thermostat THK with probe 4150.137**

### Optional accessories

**Extension cord**
16A, 5m
16A, 10m

**Compatible with Master IMCS**

| Specifications | Units | EKO 9 |
|---|---|---|
| Heating power | kW | 9 |
| | Btu/h | 30709 |
| | kcal/h | 7740 |
| Air flow | m³/h | 1400 |
| Power supply | V/Hz | 400/3ph/50 |
| Rated current | A | 13.8 |
| Remote thermostat | | Digital |
| Product size (l x w x h) | mm | 550 x 606 x 921 |
| Weight | kg | 35 |

## SMOOTH TEMPERATURE INCREASE

The temperature of the air flowing through is increased in amounts of 15°C each time. 20°C->35°C ->50°C- 70°C. The big air flow allows a fast increase and an even temperature distribution. This solution avoids temperature shocks.

## HIGH AIR FLOW

The high air flow quickly mixes the air in the room allowing to heat everywhere.

# MASTER EKO 150
# DIESEL HEATER 150KW

*An effective disinfection requires high temperatures. But to avoid thermal shock to the room and the objects in it, the temperature needs to be increased smoothly. Master's purpose-built EKO heaters do just that.*

*Most other heaters on the market are incapable of reaching these high temperatures smoothly and are therefore unfit for thermal disinfection.*


BIG POWER FOR BIG ROOMS!

## FEATURES

- The MASTER EKO 150 is an extremely powerful heater which is able to treat large spaces, ie. chicken farms, pig farms
- It delivers 12,800 $m^3$/h of hot air
- It uses only 2.8kW of electric power at 220-240V
- Connection to an external digital remote thermostat THK, specific for this application, included in the package
- Connection to flexible tubes to disperse heat in critical points
- High air pressure, allowing the use of long flex tubes
- Air recirculation, allowing the heater to be placed outside the room being treated
- Compatible with Master IMCS remote monitoring and documentation device

### Included in the box

**Remote thermostat THK with probe 4150.137**

**Compatible with Master IMCS**

| Specifications | Units | EKO 150 |
|---|---|---|
| Heating power | kW | 150 |
| | Btu/h | 512,000 |
| | kcal/h | 129,000 |
| Total air pressure | Pa | 250 |
| Air flow | $m^3$/h | 12,800 |
| Flex tube | cm | 1 tube Ø 70cm, 2 tubes Ø 51cm or 4 tubes Ø 34cm |
| Power supply | V/Hz | 220-240/1ph/50 |
| Rated current | A | 12.6 |
| Remote thermostat | | Digital |
| Summer ventilation | | Yes |
| Fan | | Axial |
| Flue tube | mm | 200 |
| Electronic box protection | | IP 55 |
| Product size (l x w x h) | mm | 2200 x 985 x 1620 |
| Weight | kg | 380 |

## SMOOTH TEMPERATURE INCREASE

The temperature of the air flowing through is increased in amounts of 15°C each time. 20°C->35°C ->55°C- 70°C. The big air flow allows a fast increase and an even temperature distribution. This solution avoids temperature shocks.

## HIGH AIR FLOW

The high air flow quickly mixes the air in the room allowing to heat everywhere.

MASTER CLIMATE SOLUTIONS


**Dantherm A/S**
Marienlystvej 65
DK-7800 Skive
Denmark
t. +45 96 14 37 00

**Dantherm Ltd.**
Unit 12, Galliford Road
Maldon CM9 4XD
United Kingdom
t. +44 (0)1621 856611

**Dantherm GmbH**
Oststraße 148
22844 Norderstedt
Germany
t. +49 40 526 8790

**Dantherm S.p.A.**
Via Gardesana 11
37010 Pastrengo (VR)
Italy
t. +39 045 6770533

**Dantherm Sp. z o.o.**
ul. Magazynowa 5a
62-023 Gądki
Poland
t. +48 61 65 44 000

**Dantherm AS**
Løkkeåsveien 26
3138 Skallestad
Norway
t. +47 33 35 16 00

**Dantherm AB**
Fridhemsvägen 3
602 13 Norrköping
Sweden
t. +46 (0)11 19 30 40

**Dantherm AG**
Im Vorderasp 4
8154 Oberglatt ZH
Switzerland
t. +41 44 851 51 51

**Dantherm SP S.A.**
C/Calabozos
6 (Polígono Industrial)
28108 Alcobendas, Madrid
Spain
t. +34 91 661 45 00

**Dantherm LLC**
Transportnaya 22/2
142800, Stupino
Moscow
Russia
t. +7 (495) 642 444 8

**Dantherm SAS**
23 rue Eugène Henaff
69694 Vénissieux Cedex
France
t. +33 4 78 47 11 11


*Dealer:*

KEEP UPDATED
**FOLLOW US ON:**


**Contact us**
eko@dantherm.com

mcsworld.com