THERMASOLV™

Dielectric Cooling Fluids

for electronic & electric devices

INVENTEC
PERFORMANCE CHEMICALS

HIGH PERFORMANCE

EXCELLENT COMPATIBILITY

OPTIMAL PROCESS

ENVIRONMENTAL FRIENDLY

INVENTEC, A DEHON GROUP COMPANY

A family company created in 1874, first specialized in the filling and distribution of refrigerants.

Dehon group companies:

SMBAUTO
Car care solutions & services

climalife
Refrigeration, air conditioning & heating

matelex connected refrigeration
Leak detection & energy for refrigeration

SODEREC INTERNATIONAL
High-risk chemicals

INVENTEC PERFORMANCE CHEMICALS
Soldering, Cleaning, Coating & Cooling solutions

PUS Pure Ultrasonic Systems
Powder, atomizer & sieving activities

ealis
Custom filling & packing

750 collaborators worldwide: 13 subsidiaries in 3 continents

INVENTEC PERFORMANCE CHEMICALS

WORLDWIDE PROVIDER OF SOLDERING, CLEANING, COATING & COOLING SOLUTIONS FOR ELECTRONIC, SEMICONDUCTOR AND INDUSTRIAL APPLICATIONS

For nearly **60 years** we have shown leadership in innovation by putting High Reliability applications and minimizing **environmental & health impact** at the core of our product development. **10% of our turnover is invested in R&D**.

With **ISO 9001 & 14001 production sites** in France, Switzerland, USA, Mexico, Malaysia and China we can guarantee a smooth and cost-effective supply chain.

With more than **1500 satisfied customers** & more than **300 products,** we are armed to find the right solution based on your requirements, process and sustainable targets.

OUR GUIDELINES

PROXIMITY
a worldwide presence to support our customers

PERFORMANCE
specialized teams and effective technical solutions to serve our customers

PROTECTION
friendly solutions for health & environment

A COOLING SOLUTION
FOR NEW & FUTURE INNOVATIONS

INNOVATION IS TURNING THE HEAT UP

Many innovations to improve performance of electronic & electrical devices result in a higher power consumption and hence generate more heat.

- The number of cores within a CPU is constantly increasing
- More use of overclocking to improve compute performance
- Increasing use of high power GPU's
- Lower latency requirements demands components to be put closer together
- Miniaturization and weight reduction of devices
- Faster EV charging
- Fast acceleration or more powerful electric engines
- Batteries perform best when maintained cooled and need security from fire

GLOBAL WARMING IS DEMANDING A MORE SUSTAINABLE APPROACH

The high energy use for air-cooled datacenters is a big concern and putting legislation in place to limit the PUE of new datacenters build. Besides, there is the restriction of excessive water use and concerns towards health & safety issues with some current available solutions.

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THERMASOLV™

PRODUCTS MADE FOR HIGH RELIABILITY

Electronic or electrical devices in use, create heat and **need to be cooled to avoid malfunction**. Based on our 60 years of experience in solvent based cleaning fluids and processes, Inventec has developed a cooling fluid range to cater today's and future **technical requirements.**

Key paramaters taken into account:

- Heat transfer effectiveness
- Electrical Insulating Properties
- Safety & environmental consideration
- Compatiblity with materials

PERFORMANCE

- Outstanding thermodynamic properties
- Dielectric fluid
- Low viscosity
- Low surface tension
- High thermal stability

SAFE

- Non-flammable & no flash point
- No CMR or hazardous compounds
- Fire extinguishing properties (depending on product)

SUSTAINABLE

- Recyclable
- Non-corrosive
- Compatible with most materials
- Mild odor
- Medium low to No GWP (Except Thermasolv CF1)
- No ODP

COOLING FLUIDS

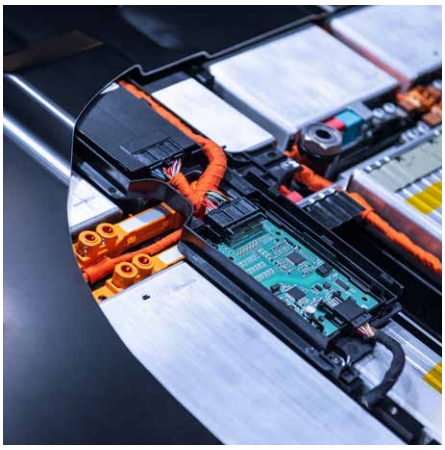
APPLICATION FIELDS

COMPUTING

- DATACENTERS
- CRYPTO & BLOCKCHAIN
- SUPERCOMPUTERS
- STOCK EXCHANGE SYSTEMS

INDUSTRIAL PROCESSES

- DIELECTRIC TESTING
- FREEZE-DRYING
- SEMICON ETCHING



MOBILITY

- CHARGING STATIONS
- BATTERY SYSTEMS
- ELECTRIC MOTORS
- CONTROLLERS
- BRAKING SYSTEMS

HIGH POWER MANAGEMENT

- CONVERTERS & INVERTERS
- LASERS & POWER LEDS
- MEDICAL SCANNERS
- MILITARY INSTALLATIONS

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THERMASOLV™

RECOMMENDED PRODUCTS

Each product has specific parameters in order to suit best your application and process.
Our team is ready to help you to select the right product.

THERMASOLV™ IM1
Dielectric heat transfer fluid

GREENWAY

- Hydrofluoroether based (HFE)
- Dedicated for 2-phase systems (boiling point: 61°C / 142°F)
- Medium low GWP

THERMASOLV™ IM2
Dielectric heat transfer fluid

GREENWAY

- FluoroKetone based (FK)
- Dedicated for 2-phase systems (boiling point: 49°C / 120°F)
- No GWP

THERMASOLV™ CF1
Dielectric heat transfer fluid

- Polyfluorene polymer based
- Dedicated for 1-phase systems (boiling point: 170°C / 338°F)
- High GWP

THERMASOLV™ CF2
Dielectric heat transfer fluid

GREENWAY

- Polyfluorene Alcene based
- Dedicated for 1-phase systems (boiling point: 110°C / 230°F)
- Low GWP

THERMASOLV™ CF3
Dielectric heat transfer fluid

GREENWAY NEW

- Perfluoroepoxyde based
- Dedicated for 1-phase systems (boiling point: 120°C / 248°F)
- Low GWP

Non-exhaustive list of products. Let INVENTEC assists you to customize the best product adapted to your need.

3 MAIN PROCESSES

1

IMMERSION COOLING (1-PHASE / 2-PHASE)

Electronic boards, components or devices are immersed in a dielectric fluid where heat from the components is transferred to the fluid. Pumps are used to flow the heated fluid to a heat exchanger.

In 2-Phase immersion cooling, fluid is boiled and condensed, increasing substantially heat transfer efficiency.

2

DIRECT COOLING

The fluid is pumped through cold plates attached to electronic components or through cooling tubes to take away the heat. The electronics are never in contact with the fluids. The heated fluid can be cooled in a 1 or 2-phase system.

3

DIELECTRIC TESTING & MANUFACTURING

The cooling fluid is used for dielectric testing or to cool critical manufacturing processes in the semicon and pharma industry.

Cooling fluids

OVERVIEW TABLE

APPLICATIONS	IM1	IM2	CF1	CF2	CF3
Chemical nature	HFE	FCO	PF POLYMER	PF ALCENE	PERFLUORO-EPOXYDE
ODP	0	0	0	0	0
GWP	320	<1	7800	120	<200
Flash Point	No	No	No	No	No
Boiling Point (°C/°F)	61 / 142	49 / 120	170 / 338	110 / 230	120 / 248
Pour Point (°C/°F)	-135 / -211	-108 / -162	-100 / -148	-110 / -166	-82/ 116-
Critical Temperature (°C/°F)	195 / 383	169 / 336	300 / 572	550 / 1022	
Critical Pressure (Mpa)	2,23	1,88			
Vapor Pressure (kPa)	27	40	0,1	3	1,516
Heat of vaporization (KJ/Kg)	112	88		82,5	82,8
Liquid density (Kg/m^3)	1520	1600	1770	1815	1836
Kinematic viscosity (cSt)	0,38	0,4	1,81	1,35	1,274
Specific Heat (J/Kg-K)	1138	1103	1143	1177	1162
Surface tension (dynes/cm^2)	13,6	10,8	17	15	13
Dielectric strenght (KV)	28	>40	>40	39	>35,7
Dielectric constant @ 1 kHz	7,4	1,84	1,93	1,79	2,09
Resistivity (Ohm-cm)	1,00E+09	1,00E+13	1,00E+11	2,50E+14	1,00E+14

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Greenway™

THE WAY WE THINK, THE WAY WE ACT

In 2012, Inventec launched Greenway™ in order to steer new development to more green products.

10 years later, Greenway™ evolved to **classify each product related to their HSE impact**.

GREENWAY™ SCORE

GUIDES YOU TOWARDS THE MOST SUSTAINABLE SOLUTION

To evaluate the impact, the following product indicators are taken into account:

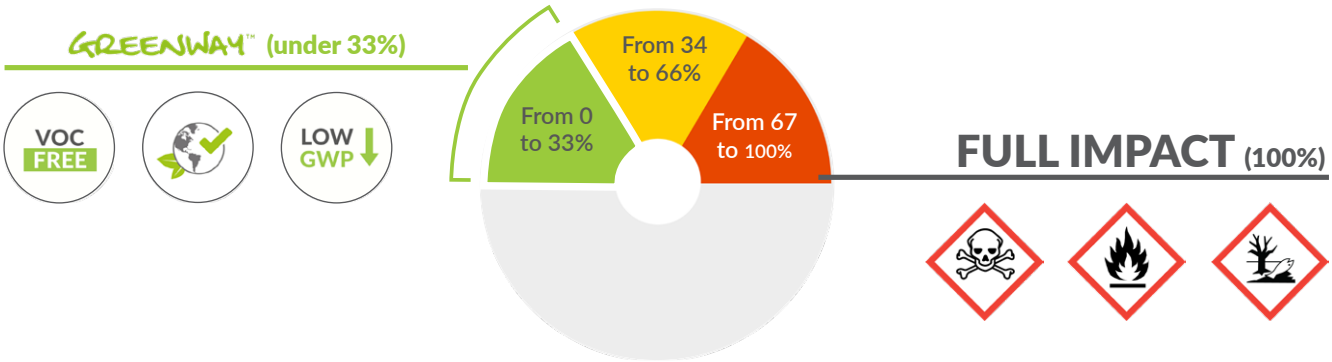
INDICATORS ON HUMAN HEALTH

- flammability
- toxicity
- corrosivity
- risks of raw materials

INDICATORS ON ENVIRONMENT PROTECTION & RESSOURCES MANAGEMENT

- water consumption
- energy consumption
- source / origin of raw materials
- waste management
- emissions reduction (VOC, GWP)
- recyclability of the product & packaging
- circular economy possibilities: with the ECOPROGRAM
- consumption of other consumables
- comparison of processes

Indicators are translated in percentage with crossed reference data. The data taken into account to calculate the impact score are based on the product MSDS, industrial expertise & European legislations.



A GREENWAY™ PRODUCT HAS LESS THAN 33% OF IMPACT

Ecoprogram™

RECYCLING OF COOLING FLUIDS

ECOPROGRAM

*Service for **SOLVENT RECYCLING, SOLVENT REGENERATION & ECO-CONSULTANCY***

Benefits:

- to reduce the amount of waste in the environment
- to avoid cost & administration for the destruction
- to buy recycled but still high-quality product at lower cost
- to improve your company's environmental image

Most Thermasolv cooling fluids don't end up as waste when you don't need them anymore.

You may also want to purify the fluid over time to avoid the risk of any build up impurities in your system.

REDUCE

- ENVIRONMENTAL IMPACT
- COST

Our ECOPROGRAM service availability may differ from one to another country as recycling and waste-treatment is strictly regulated.

OUR COOLING FLUIDS DON'T END UP AS WASTE

INVENTEC PERFORMANCE CHEMICALS

Application focus

DATACENTERS

Innovation pushes the performance of a single server unit to new heights but this comes also with a higher power output and hence increase of generated heat. Cooling with air is at its technical limits.

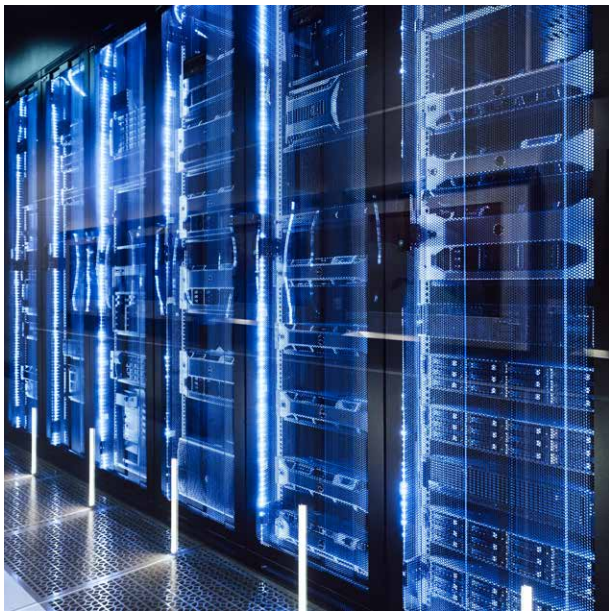
Energy consumption for cooling is a major cost for datacenters and from a global warming perspective, some countries already put regulation in place to cap the PUE of newly to build facilities.

Power density per rack is limited to around 40 kW for air cooled datacenters. With current server specification, a lot more physical space is needed to meet up with demand.

RE-THINK
COOLING
FROM THE GROUND UP

ADVANTAGES OF IMMERSION COOLING

- 95% reduction in energy consumption
- Increase power density to > 250kW per rack
- Greater & uniform thermal efficiency
- Reduce physical space to 100 kW/m2
- Less design complexity, more design freedom
- Reduce water consumption

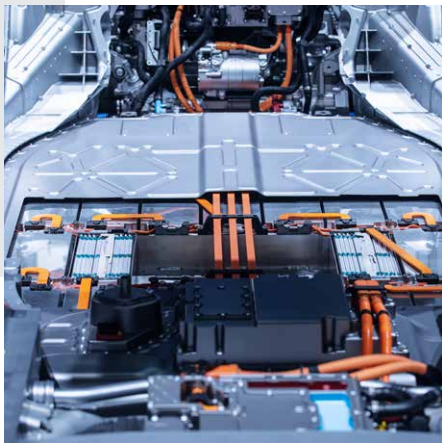


ADDITIONAL BENEFITS

- Some Thermasolv™ fluids have fire extinguishing properties providing an extra fail-safe in case of fire.
- In case of a leakage, the clean-up is not as messy compared with oil-based cooling fluids.
- The very low surface tension allows the fluid to penetrate under low stand-off components.
- Easy extraction and recovery of heat for further use.
- Higher hardware reliability as moving parts, like fans, are not needed and electronics are shielded from dust and humidity.
- Less depending on geographical conditions
- Some of our fluids evaporate quickly, making it easy to perform maintenance.
- Reduction in noise level

Application focus

ELECTRICAL VEHICLE BATTERIES & CHARGING STATIONS



ELECTRICAL VEHICLE BATTERIES

KEY ISSUES

Keeping EV batteries cool is critical for the performance and to optimize driving range and battery lifetime. Besides, there is the need for shorter charging times and the safety issue of run-away fires with lithium battery technology.

Direct cooling by liquid cooling of cold plates or tubes does provide better results as air cooling but does not provide a uniform cooling. Cells positioned farther from the inlet of cooled fluid receive less cooling, leaving so called hot spots.

ADVANTAGES USING THERMASOLV™

- Uniform temperature across the whole battery pack
- Possible to increase the battery density
- Less weight
- Higher charging & discharging possible
- Eliminate the risk of short circuits
- Prevention of run-away fires

CHARGING STATIONS

KEY ISSUES

While 150 kW DC fast charging is becoming the standard for public charging facilities, solutions of up to 350 kW are entering the market. Profound heat management becomes critical with these solutions.

These charging stations also need to be able to operate in environments as low as -35 and up to 50 degrees Celcius.

ADVANTAGES USING THERMASOLV™

- Non-flammable
- Outstanding thermodynamic properties compared to glycol & oils
- Space & weight saving compared to air cooling
- Easy & ergonomic integration
- Non-corrosive

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Technical support & product trials

FINDING THE BEST SOLUTIONS WITH OUR EXPERTS

Inventec has a worldwide dedicated Technical Support team to help you along the different stages of our partnership.

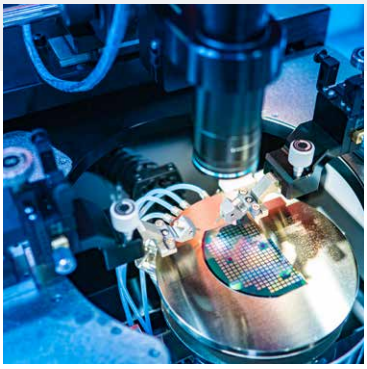
Depending on you request, we provide online or onsite support:

- to select the right product **based on your specific needs**,
- to assist you in your **product qualification process**,
- to guide you with the initial **set up of you process** at all your worldwide manufacturing facilities,
- to provide **fast response on technical issues** which could occur at any time during mass production.

Talking to our Technical Team, who are experts in all materials we offer, will help you greatly to **overcome technical challenges within your overall process.**

Customers looking for a cleaning solution are also welcome in our CLEANING CENTERS to **see the process in action and to get convinced by our solutions**. We cover water and solvent-based processes.

OUR MEMBERSHIPS TO STRENGTHEN OUR KNOWLEDGE IN VARIOUS INDUSTRIES



They support us

Inventec is one of the **110 laureates of the France Relance automotive & aeronautical modernization funds** in 2020.

By being part of laureates, Inventec developed its **FLUSHING NET** project:

- set up of a **flushing cleaning line** at Inventec France,
- creation of a **laboratory dedicated to particle counting** in order to validate cleaning effectiveness,
- optimization of the **recycling process** in order to minimize flushing fluid consumption and improve the sustainability of the process.

The project has been put in place in 2022.

INVENTEC WORLDWIDE

6 PRODUCTION SITES | **10** SUBSIDIARIES | WORLDWIDE DISTRIBUTOR NETWORK

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