

SOLVAY

Solvay Solexis & VPS

Fluids overview

Syntheses and commercial products

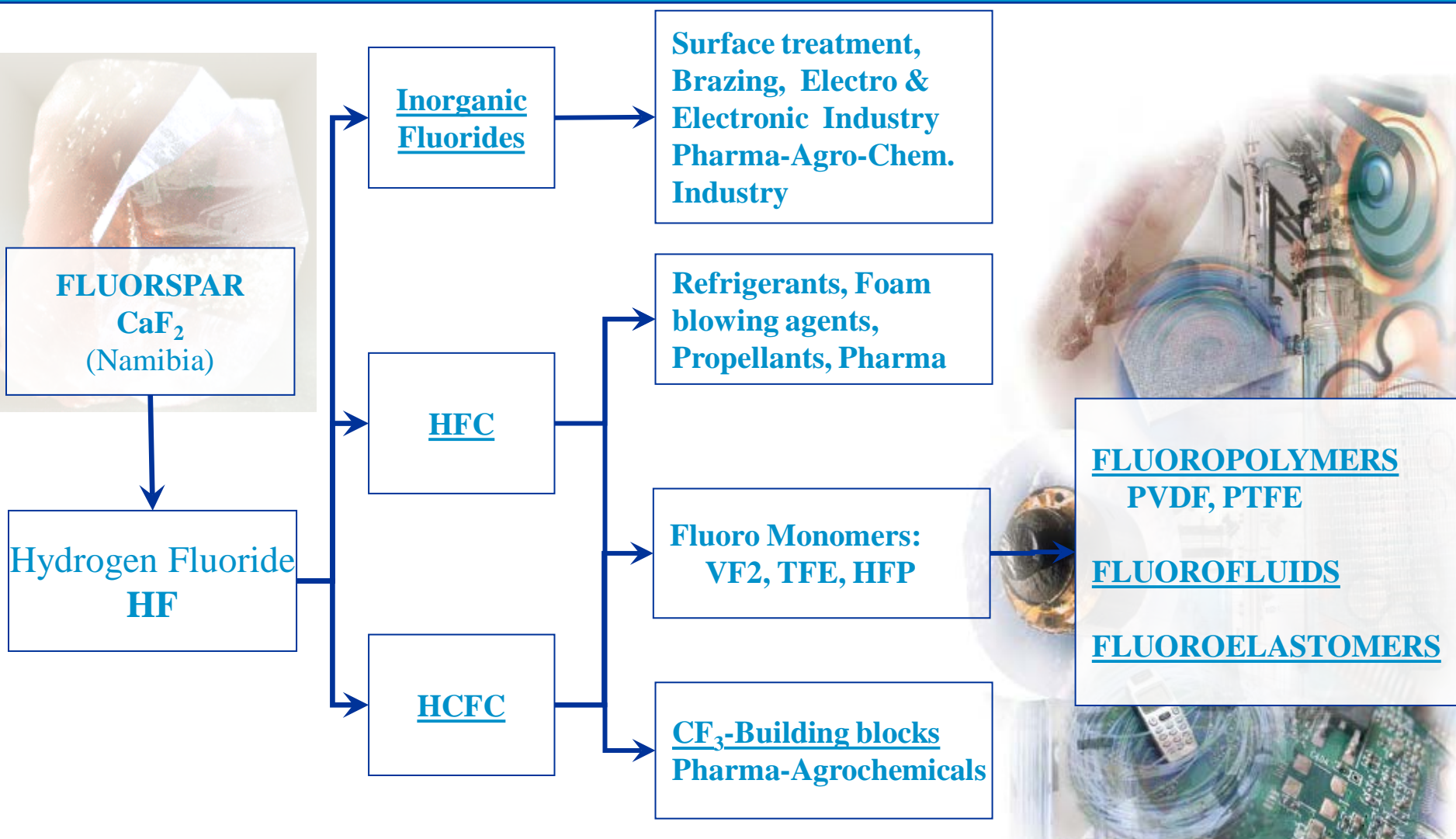
Solvay
Solexis



Presentation Preview

- Technological Platform
- Products and Applications
- Galden VPS Fluids
- Environmental Issues

The Technology Platform



Highlights

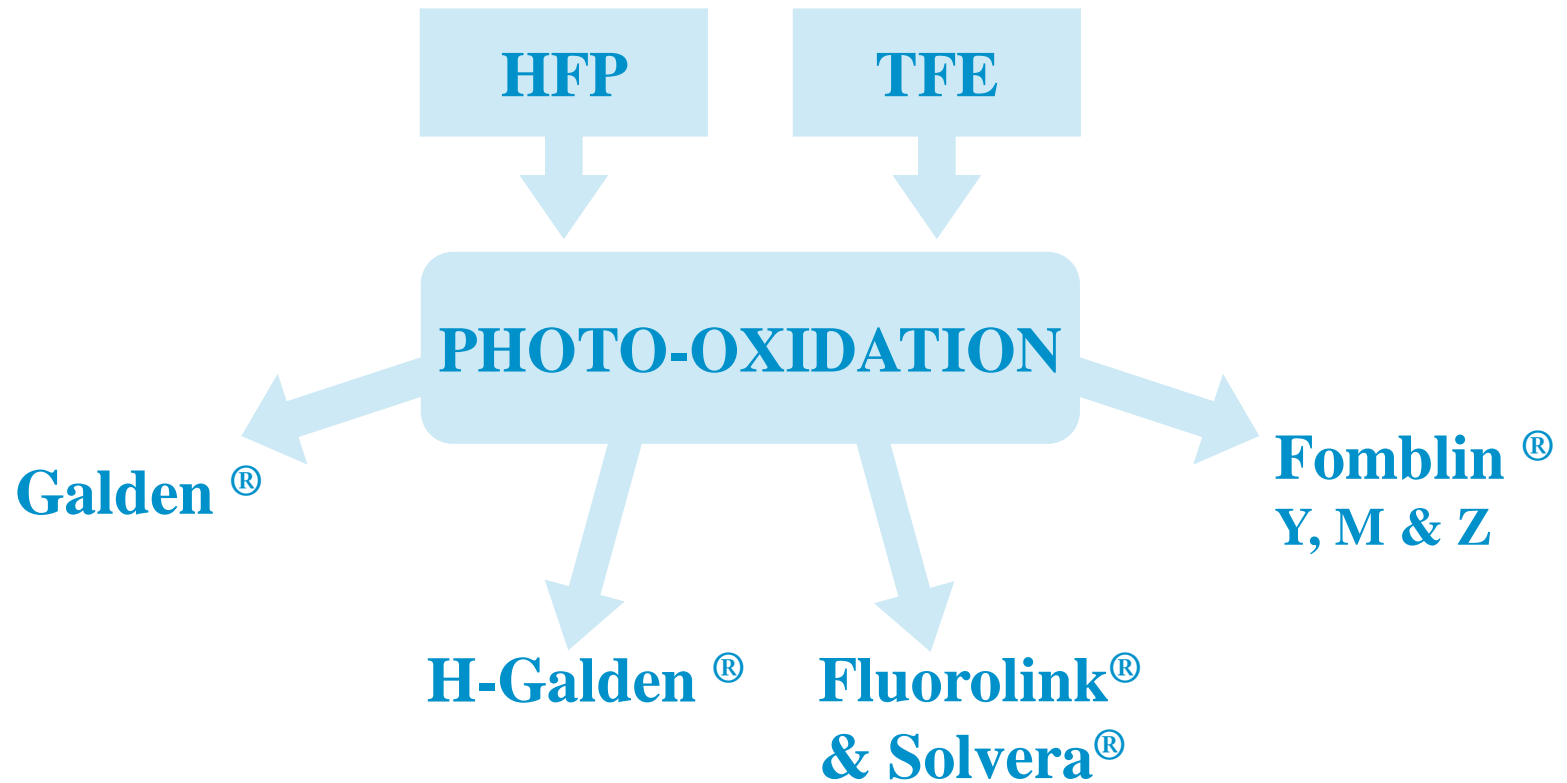
Produced with unique and proprietary technology

- Flexible and tunable
- Highly integrated process

Based on two key monomers

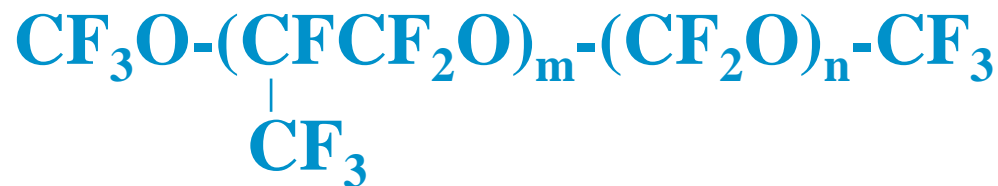
- Hexafluoropropene (HFP)
- Tetrafluoroethylene (TFE)

PFPE Preparation



Solvay Solexis Fluids

Fomblin®, Galden®:



Fluorolink®:

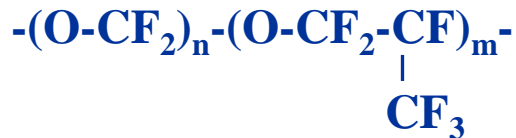



Physical-Chemical Features of PFPEs

Linear



Branched



- 
- Thermally Stable
 - Chemically Inert
 - Non Flammable
 - Non Toxic
 - UV Transparent
 - Good Dielectric Properties
 - Highly Apolar (hydro- and oleophobic)
 - Extremely Low Tg Temperatures
 - High Viscosity Index

Physical-Chemical Features of Fluorolink



- Reactive functional groups
- Chemical resistance
- Low surface Tension
- Water-Oil repellence
- Low Coefficient of Friction
- Release properties
- Low Tg Temperatures
- Low viscosity
- Low Refractive index
- High gas permeability

Fluids Applications

GALDEN® PFPE & HFPE

Special fluids for heat transfer and various high technology applications in electronics and semiconductors

- **Galden HT and H-Galden ZT:** Heat Transfer Fluids, Recirculating Chillers, Etcher PVD, CVD
- **Galden D:** Reliability Testing Fluids for Thermal Shock & Hermetic Seal Testing
- **Galden LS/HS:** Vapor Phase Soldering/ Leadfree Soldering



FOMBLIN® PFPE

Special lubricating oils and greases for various high technology applications such as extreme vacuum, aerospace, automotive and magnetic media

- **Fomblin Y VAC**
- **Fomblin Lubricant Oils**
- **Fomblin Specialty Greases**



FLUOROLINK & SOLVERA

Functional polymer derivates for surface treatments on paper, ceramic materials, textiles, and surface protection



PFPE's for cosmetics

- **FOMBLIN® HC Classic**
- **FOMBLIN® HC Light**
- **FOMBLIN® HC Functional**



Galden

Wide Range of Boiling Points from:

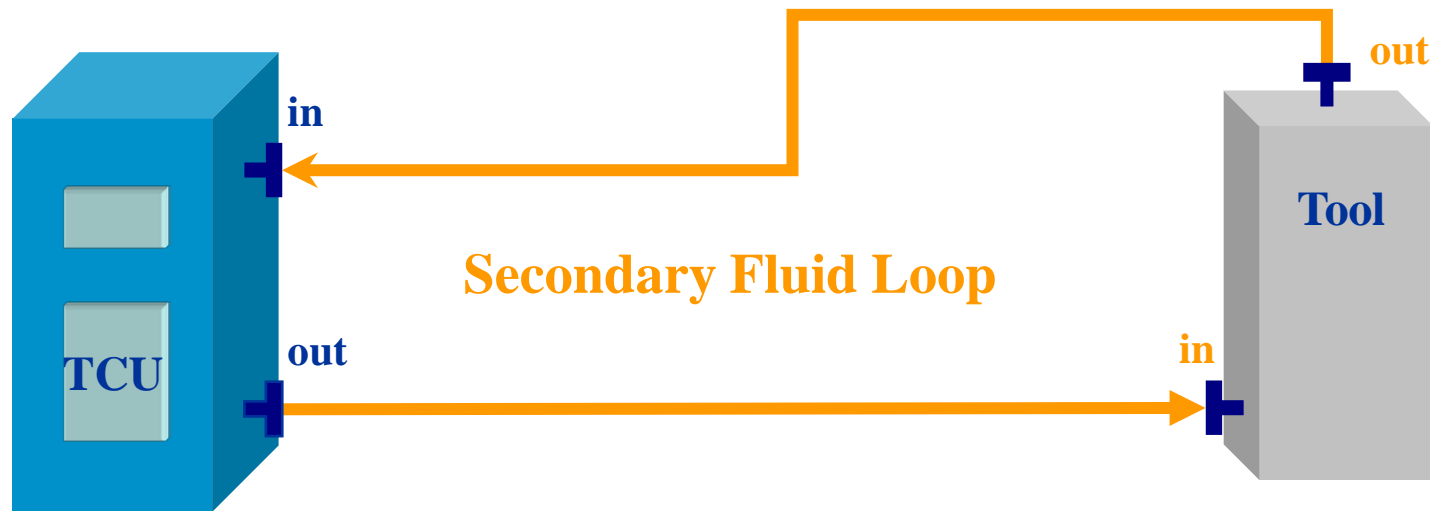
55°C to 270°C

Special Grades for:

- Heat Transfer (**HT** grade)
- Electronic Testing (**D** grade)
- Vapour Phase Heating (**LS-HS** grades)

Heat Transfer Fluids

Galden HT and H-Galden ZT are two lines of dielectric fluids with excellent dielectric properties, high chemical stability, that combined with their capacity to operate at very low as well as elevated temperatures make them the best Heat Transfer Fluids for the aggressive conditions used in Semiconductor, Electronic Industry, Pharmaceutical and CPI.

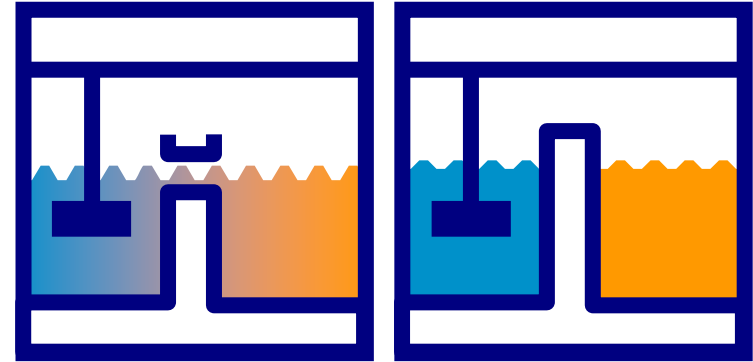


Reliability testing

Thermal Shock Test

Thermal Shock testing is performed to check the resistance of electronic devices to extreme changes of temperature. The test is carried out by alternately dipping the devices in liquids maintained at two different temperatures.

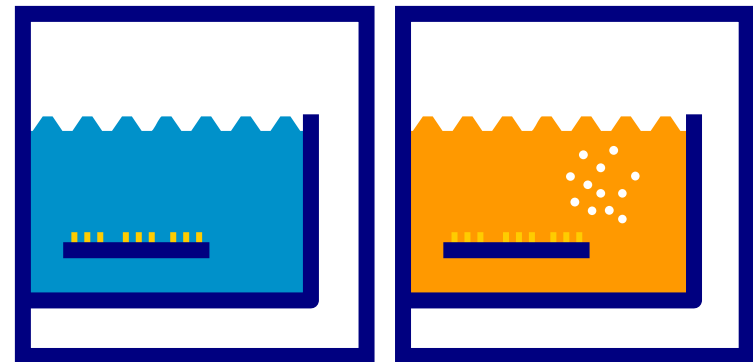
Galden D fluids can be used both for single and dual fluids systems.



Hermetic Seal Test

Electronic devices must be completely sealed to avoid moisture to penetrate and damage the electrical response of the silicon chip.

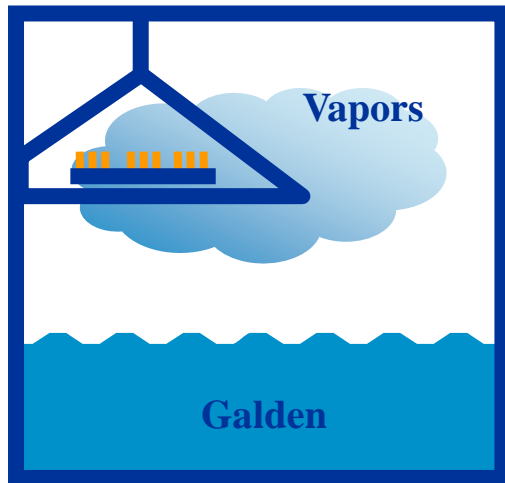
Galden D fluids being extremely inert and residue free are currently used as detector and indicator fluids in leak test procedure.



Galden Applications

Vapor Phase Soldering Fluids (Galden LS and HS)

Finally when the chips are packaged and tested, they must be assembled on mother boards..



VPS' principle is to use the latent heat of condensation of Galden vapors in order to melt solder paste and hence to obtain reliable metal joints.

The narrow molecular weight distribution as well as the very strong carbon-fluorine bond and the flexible ether link provide the properties which make Galden ideal for use in VPS.

Vapor Phase Soldering

- This method uses soldering pastes (solder plus flux) to control the properties of the joints.
- The paste is applied on the board and then the IC is positioned.
- Heating at temperature above the melting point of the soldering alloy, the paste reflows and form a soldered joint.

There are several methods to provide heat for soldering the paste: IR, Convection and Vapour Phase

Competing Technologies

Infrared

- **Color Dependent**
- **Shadow Effects**
- **Hot Spots**
- **Inert Gas Needed to Avoid Oxidation**

Convection

- **Slow Heat Transfer**
- **Inert Gas Needed to Avoid Oxidation**

Golden Fluids and VPS

Vapour Phase Reflow

- Heat is provided to the substrate by the latent heat of condensation of vapours.
- Provided the liquid boils at a temperature higher than the melting point of the solder....



.... And the paste will reflow

VPS: advantage

- **Rapid and Uniform Heating**
- **Heating Independent from the work piece geometry and complexity**
- **Soldering or Curing in an Inert Atmosphere**
- **Precise Temperature Control**
- **High Vapor Density: absence of air, no oxidation, no inert gas needed**

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Galden LS and HS grades

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Galden LS - HS Features and Benefits

Features

- Wide choice of grades with different vapors temperatures
- Narrow Molecular Weight Distribution
- Vapor Density greater than Air
- Excellent thermal stability
- No flash or fire point

Benefits

- Better optimization of VPS process
- Process Stability and repeatability, no boiling point drift
- No inert atmosphere is required
- No corrosion or reaction with materials
- Enhanced safety even at high temperatures

Galden LS-HS Grades

Galden LS and HS fluids are available over a wide range of boiling points from 155°C to 260°C

Traditionally with tin/lead solder paste the % share among grades was in favor of LS grades (155, 165, 215)

With the introduction of the “lead free” technology, new Galden VPS fluids were designed to meet the soldering temperature requirements

Updated product offering for the Vapor Phase Soldering process

Galden LS-HS Grades

LS Serie

- LS200
- LS215
- LS230

The Widest Range of Boiling Points, while liquid at room temperature!

HS Serie

- HS240
- HS260

Galden LS-HS

The Galden LS and HS fluids are specifically distilled for Vapor Phase Soldering process. A strict control of the molecular weight distribution and of the vapors temperature is performed by measuring respectively:

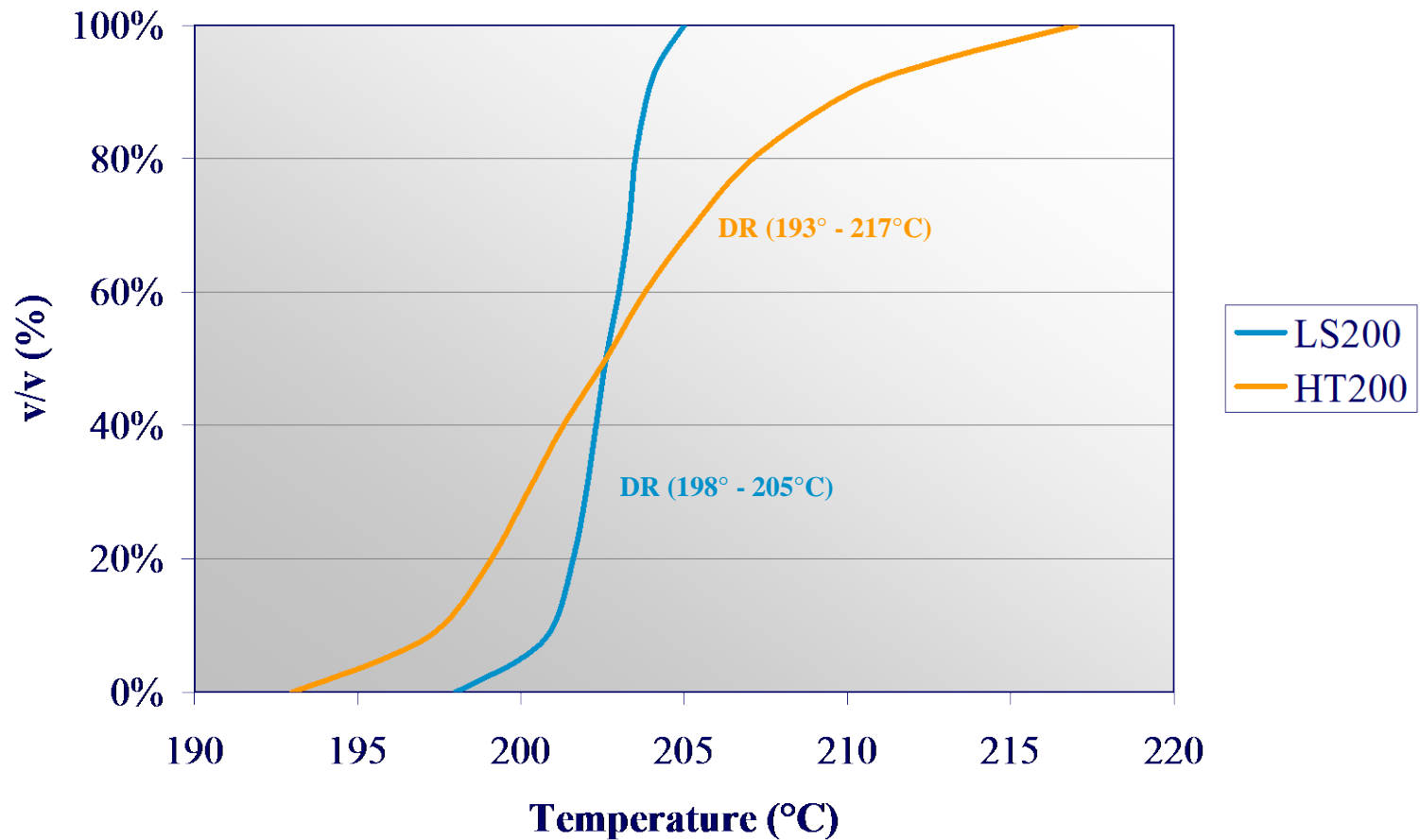
- Distillation Range (ASTM D1078)
- Boiling Temperature (TRV - ASTM D1120)

The above characteristics are always included in the Material Specifications:

Property	LS200	LS215	LS230	HS240	HS260
Dist. Range (° C)	196 - 212	212 - 223	222 - 235	237 - 250	256 - 273
Bpt –TRV (° C)	194 - 200	212 - 218	227 - 233	237 - 243	260 - 265

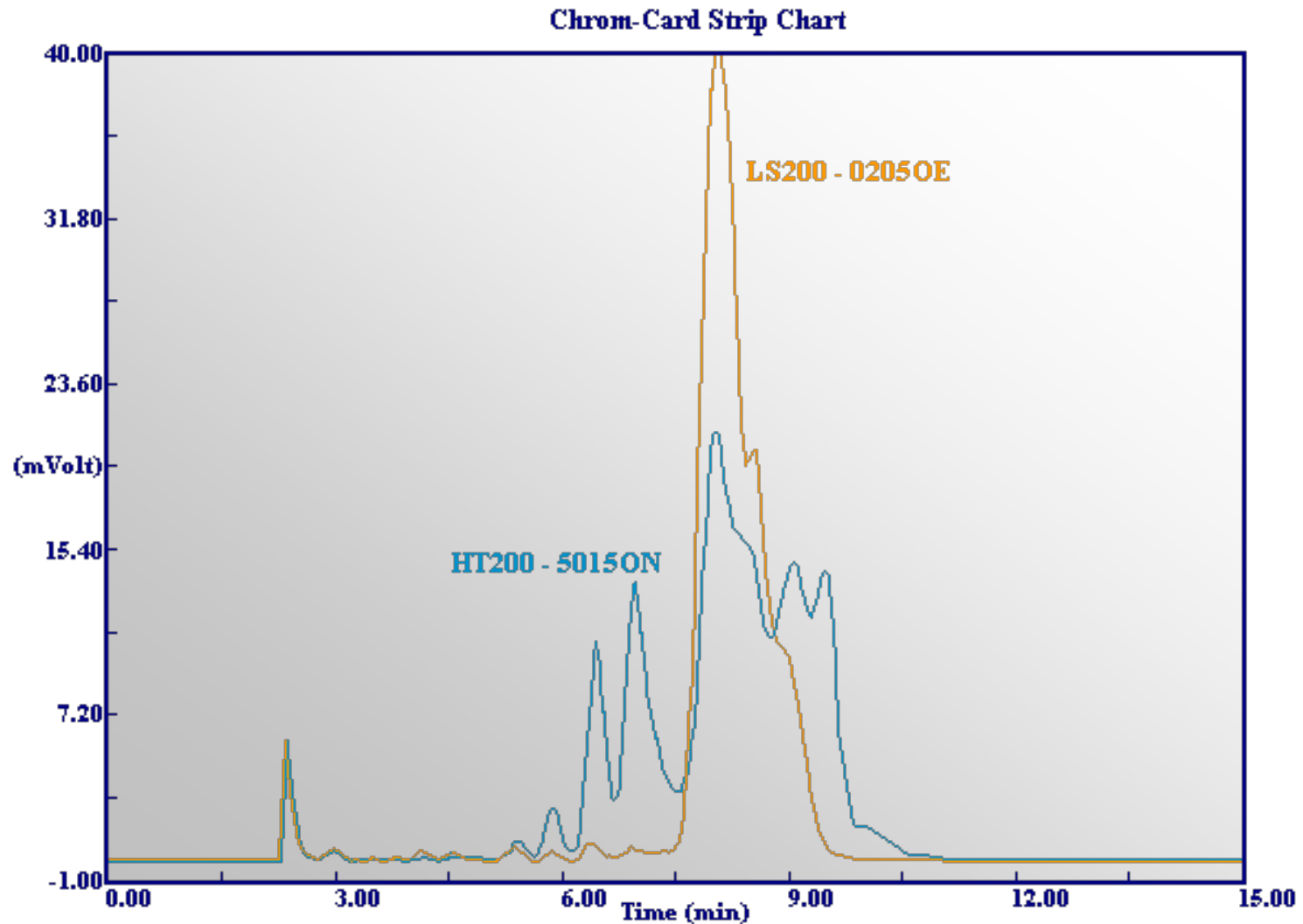
Distillation Range (F.A.Q.)

Galden HT200 vs. Galden LS200 Distillation range



Narrow MWD

Galden HT200 vs. Galden LS200 GC analysis



Sharp MWD

The sharp Molecular Weight Distribution eliminates the preferential evaporation of low boiling components during VPS process.

This phenomenon leads to higher losses of the fluids as well as a shift towards higher vapor temperature with time



undesired boiling point drift

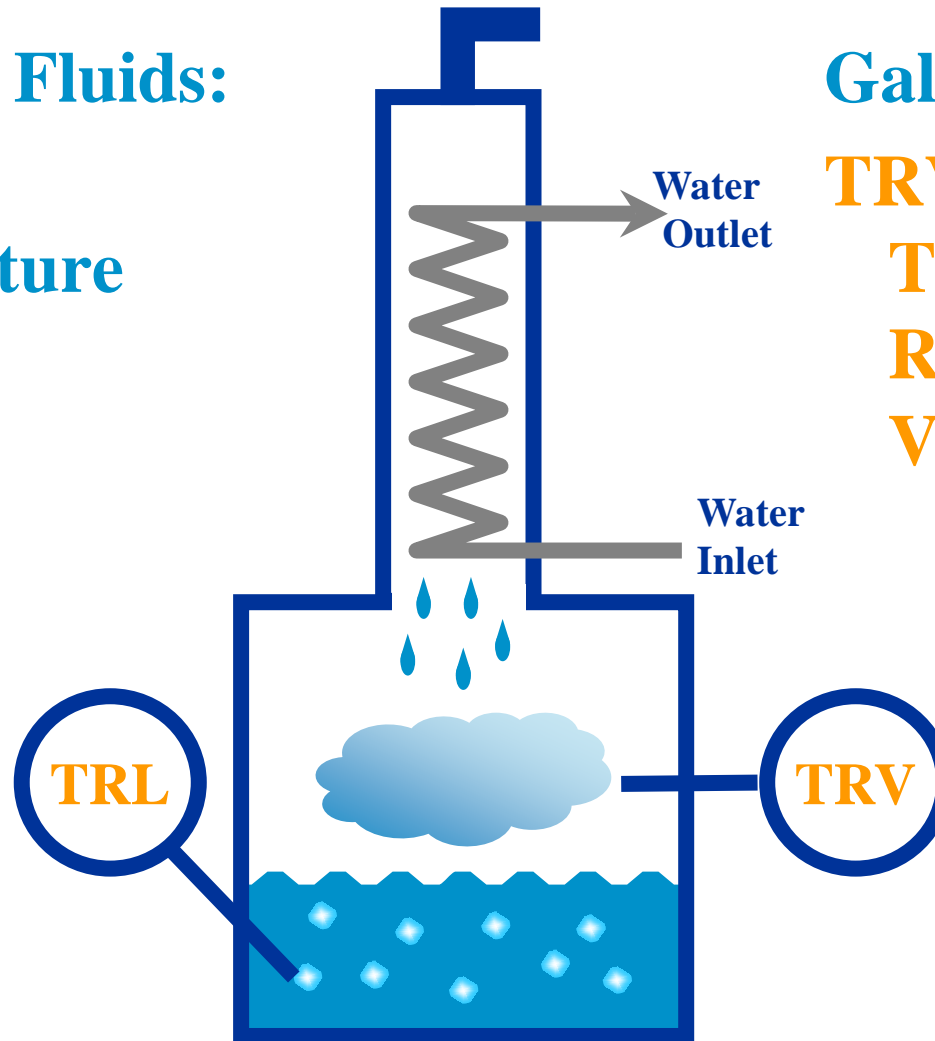
Boiling Temperature ASTM D1120

Galden HT Fluids:

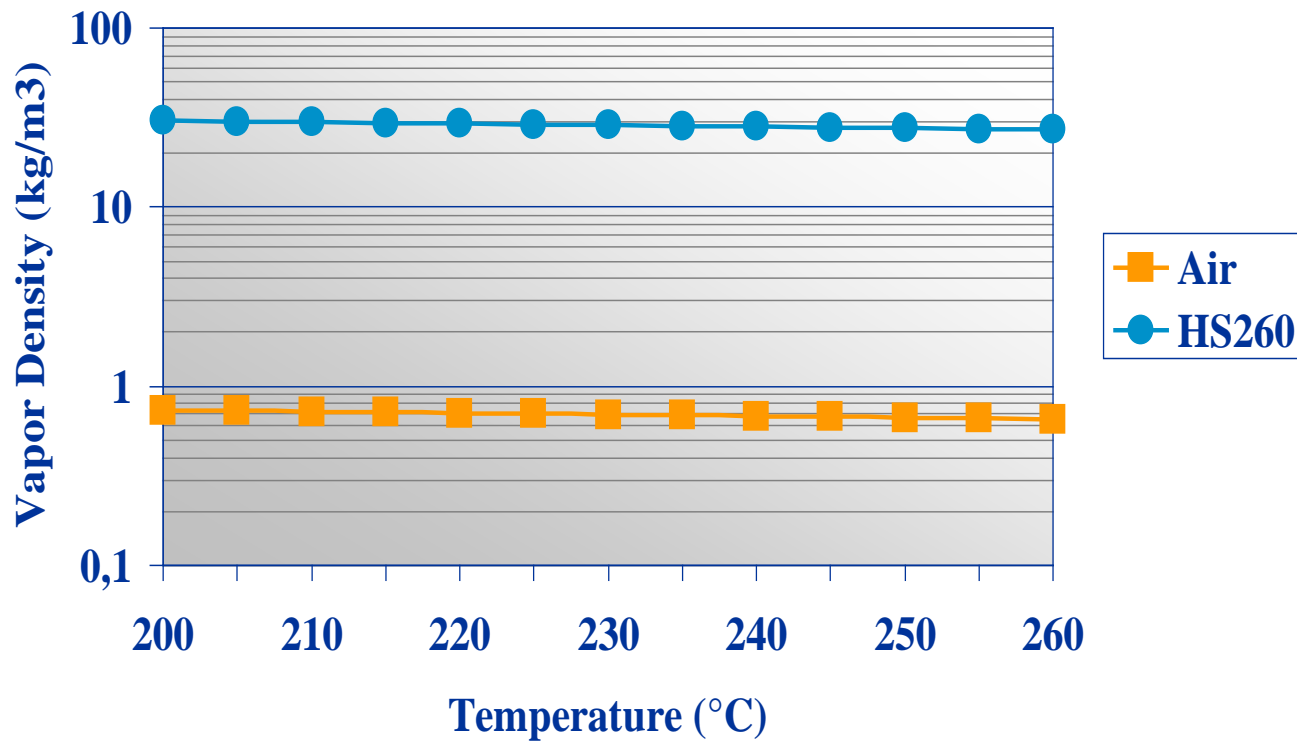
TRL =
Temperature
Reflux
Liquid

Galden LS/HS Fluids:

TRV =
Temperature
Reflux
Vapor

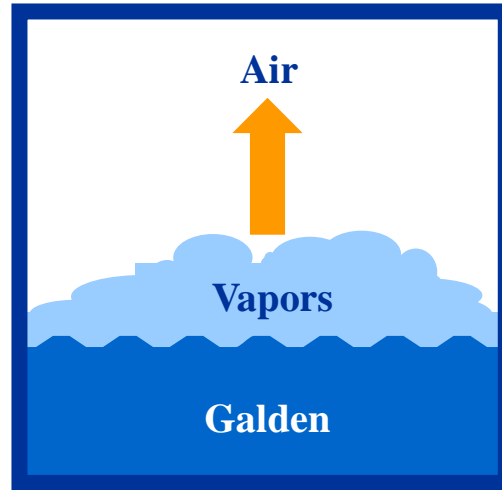
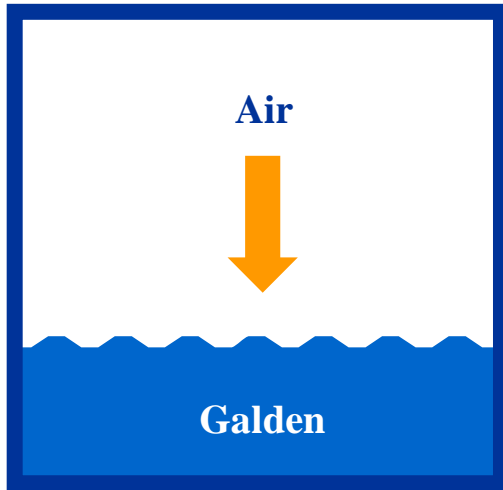


Vapor Density



Galden's vapor is at least 40 times heavier than air ($\sim 30 \text{ kg/m}^3$ vs. $\sim 0,7 \text{ kg/m}^3$), so no inert atmosphere is needed

Air in the vapor phase



Flux and requirements

For the formation of an inter-metallic bond, metal surface must be free of contaminants in particular of metal oxides.

Fluxes are used to chemically react with oxides and quickly produce a fresh, clean oxide free surface.

Fluxes can be classified into three classes:

- Inorganic Acid
- Organic Acid
- Rosin

Flux and requirements

Inorganic Acid

- Inorganic acid fluxes are highly corrosive and seldom used in the electronic industry.
- They are generally used for non electronic applications as they might leave behind active residues causing serious field failures.
- Inorganic fluxes are mainly used as brazing of copper pipes.

Flux and requirements

Organic Acid

- The organic fluxes are stronger than Rosin fluxes but weaker than the inorganic ones.
- They are water soluble and hence they can easily be cleaned by water.
- Organic fluxes are widely used in soldering of electronic components and meet MIL spec for cleanliness

Flux and requirements

Rosin

- Rosin fluxes are used for both waves soldering and for reflow soldering.
- Rosin is inactive at room temperature but becomes active when heated to soldering temperatures.
- As the rosin fluxes are weak, halide activators can be used. Rosin fluxes can be classified into three groups:
 1. Rosin Activated (RA)
 2. Rosin Mild Activated (RMA)
 3. Rosin (R)

Flux and requirements

Properties of fluxes

Flux Type	Corrosion of residues	Residue removal	Activity
Rosin	Non corrosive	Not critical, but required	Fair/Good
Organic acid	Corrosive	Water wash required	Fair/Good
Inorganic acid	Highly corrosive	Very critical, requires thorough cleaning	Very good

Flux solubility

When the assemblies enter the vapors, some flux is washed off into the boiling sump depending on the amount of fluxes and on the total throughput.

An excessive flux in Galden results in:

- Cloudy appearance
- Thin oil layer floating on fluorinated fluid

Since VPS is an oxygen-free soldering technique, the need for flux is limited to the amount required for cleaning the part to be soldered.

FM Approval - www.fmglobal.com

FM Global is one of the world's largest commercial and industrial property insurance and risk management organizations specializing in property protection.

FM Approvals is the BU that certifies industrial and commercial products and services for thousands of companies worldwide.

When a product or service meets FM Approvals' standards, it is issued the FM APPROVED mark to signify it will perform as expected and support property loss prevention.



**FM tested GALDEN and H-GALDEN and will label them as
“NON FLAMMABLE INDUSTRIAL WORKING FLUIDS”**



Certificate of Compliance

INDUSTRIAL FLUIDS

This certificate is issued for the following materials:

GALDEN® HT-55, HT-70, HT-90, HT-110, HT-135, HT-170, HT-200, HT-230, HT-270, E-85, DET, D02, D02-TS, D03, D05, D-20, D-40, HS-240, HS-260, LS-155, LS-165, LS-200, LS-210, LS-215, LS-230, PFS-1, PFS-2, SV-55, SV-70, SV-80, SV-90, SV-110, SV-135,

H-GALDEN® ZT-85, ZT-100, ZT-130, ZT-150, ZT-180, ZV-80, ZV-75, ZV-85, ZV-100, AND

FOMBLIN® Y04, Y06, Y25, Y45, YR, YPL1500, YR1500, YR1800, YLVAC 05/6, YLVAC 14/6, YLVAC 16/6, YLVAC 25/6, YHVAC 18/8, YHVAC 25/9, YHVAC 40/11, YHVAC 140/13, LC-08, LC-55, LC-80, LC-200, LC-250, YLOX-100, YLOX-120

Manufactured by: Solvay Solexis S.p.A.
Viale Lombardia 20
20021 Bollate (MI)
Italy

FM Approvals confirms that the items have been found to comply with the following standard:

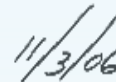
FM Approvals Standard 6930

Project Identifier: 3026109

Date of Approval: November 3, 2006




Richard P. Ferron, P.E.
Group Manager - FM Approvals


Date

Thermal Stability

- Thermal stability tests were carried out .
- After the test the gas phase was analyzed to determine the amount and the nature of the decomposition products.
- Data confirm that GALDEN IS STABLE UP TO 290°C

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Galden LS and HS **Environmental issues**

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Environmental issues

- EU directives on RoHS
- ODP
- EU directive on fluorinated greenhouse gases

Lead Free and VPS

After years of discussion and debate, EU directives on the Restriction of certain Hazardous Substances (RoHS) is in force across EU. RoHS is also known as “lead free” but this law deals with other five substances as well:

- **Lead**
- Mercury
- Cadmium
- Hexavalent Chromium
- Polybrominated biphenyls (PBBs)
- Polybrominated diphenyl ethers (PBDEs)

Lead is a concern when released to the environment as :

1. it can cause damage to the human body,
2. it can also accumulate in the environment and has acute and chronic effects on plants, animals and micro-organism.



Because of RoHS, manufacturers of electronic equipment will have to produce and deliver lead-free equipment in Europe; one of the first evidence of this has been the development of **lead free printed circuit boards (PBCs)**.

Galden HS: the solution!

Solder traditionally used ~**60%** of tin (**Sn**) and ~**40%** of lead (**Pb**), now alternative solder materials have been studied, the most common replacements for lead are silver (**Ag**), copper (**Cu**) and bismuth (**Bi**).

These alternative materials, however, bring a main challenge: higher melting temperature. Traditional tin/lead solders melt at ~**180°C** while lead free solder melts at ~**227°C**, soldering temperatures are, as well as, heating issues are ongoing concerns for PCBs assemblers. **Galden LS** and **HS** grades and Vapor Phase Soldering offers the right solution to lead free process...

1. **Galden LS and HS fluids are RoHS compliant**
2. **Galden LS and HS fluids offer the widest temperature range to lead free solders up to 260°C**
3. **Galden LS and HS fluids precise vapors temperature eliminates overheating**

RoHS Compliance

Galden LS and HS have been analyzed for heavy metals by ICP and found to content < 1ppm of the following metals:

- Lead, Mercury, Cadmium, Hexavalent Chromium

In addition, Galden LS and HS do not come in contact with the following compounds:

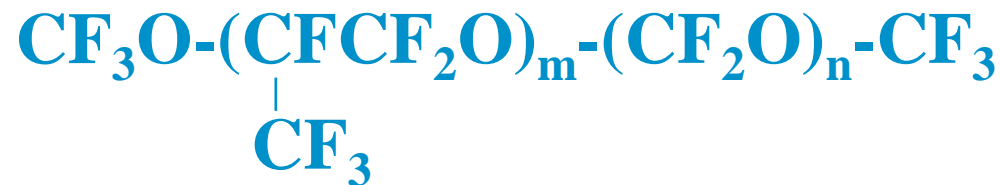
- Polybromide biphenyls (PBBs)
- Polybrominated dipheyl ethers (PBDEs)



Galden LS and HS fully comply with the EU directives 2000/53/EC and 2002/95/EC

Ozone Depletion Potential

Galden: PerFluoroPolyEther (PFPE)



Galden LS and HS **DO NOT** contain Cl, Br or I atoms



have **“ZERO”** Ozone Depletion Potential

EU Directive on Greenhouse Gases

This Directive applies to gases reported in the Kyoto Protocol: its objective is to contain, prevent and reduce the emission of fluorinated greenhouse gases covered by Kyoto Protocol. The listed gases are:

1. Carbon dioxide (CO_2)
2. Methane (CH_4)
3. Nitrous Oxide (N_2O)
4. Hydro-Fluoro-Carbons (HFCs)
5. Per-Fluoro-Carbons $\leq \text{C}_6$ (PFCs)
6. Sulphur Hexafluoride (SF_6)



The definition of PFCs $\leq \text{C}_6$ does not apply to Galden LS and HS for two reasons:

1. Galden LS and HS fluids are not a PFCs but they are PFPEs
2. They contain more than 6 atoms of carbon

Galden Fluid	LS200	LS215	LS230	HS240	HS260
N° of C atoms	~15	~16	~18	~19	~21

Approvals

Galden and H-Galden fluids are:

➤ NSF approved

Galden and H-Galden Fluids can be use in “food industries” and in case of accidental contact with food there is no problem of compatibility

No toxicity

➤ BAM approved

Galden Fluids can be used with oxygen without generation of explosive mixtures

Safety

➤ FM approved

Galden and H-Galden Fluids are “NON flammable fluids”

Safety

THANK YOU!

Please visit our website

www.solvaysolexis.com



a Passion for Progress®