

Versatill® SG 65i

1. Description

Versatill® SG65i is an azeotropic, non-flammable mixture of HFC-365mfc (pentafluorobutane) and t-DCE (1, 2-dichloroethylene). It was developed to meet the demands of the precision cleaning industries.

The phase-out of conventional solutions (e.g., CFCs and HCFCs) has required alternative products. Versatill SG65i offers product characteristics which are very close to HCFC-141b and CFC-113, with a Kauri Butanol (Kb) Index of 61. The cleaning intensity is in a perfect balance to more aggressive or inefficient standard solvents.

Versatill® SG65i is a new generation, environmentally acceptable solvent. A volatile, colorless liquid without ozone depletion potential (ODP=0), it has a relatively low global warming potential (GWP), as well as other properties which make it a superior replacement for CFCs and HCFCs.

For effective cleaning applications at 1 ATM, the boiling point of Versatill® SG65i is 36°C. It shows a density of 1.23 kg/dm³, which gives it enough mechanical strength for particle or dust removal.

Versatill® SG65i was designed to serve numerous applications and it is applicable as formulated. It can, however, be used as a starting point or component for more complex or customized solvent formulations which can be adjusted for the needs of the industry.

2. Applications

Versatill® SG65i can be used for a wide range of cleaning applications.

For example, it is used in vapor degreasing or vacuum cleaning machines to treat a wide variety of materials and parts. It can be used as a soil removal agent, removing such contaminants as particles or greases easily, quickly and with no residue. This is a basic requirement in PCB (Printed Circuit Boards) and in optical lens production. Excellent results were also achieved in oil removal. Versatill® SG65i also removes a wide range of different types of silicone oils, something that may not be achieved with standard solvents.

Versatill® SG65i is not as aggressive as other standard organic solvents, making it possible to remove soils without attacking assemblies. Due to the 36°C boiling point, fast and efficient drying can be achieved after the cleaning procedure, which helps to decrease manufacturing time.

Versatill® SG65i's can be used as a carrier fluid for deposition applications such as deposition of thin layer of corrosion protective agent or oil on products' surfaces, deposition of curable silicon compounds on medical, metal parts.

2.1 Precision Cleaning

Precision cleaning applications are characterized by the highest requirements for cleanliness of sensitive parts. They usually occur in the final assembly stages of a production process and typically involve parts composed of mixed materials. Versatill® SG65i's physical properties for precision cleaning processes includes low surface tension, good creeping properties and excellent material compatibility.

2.2 Defluxing Electronics

The world of electronics defluxing is changing and diversifying significantly. A larger selection of construction materials is used to manufacture smaller, tighter and more powerful components. While so-called "no-clean" fluxes are gaining momentum in some applications, they may not be an option for others; and often they may need post treatment. Versatill® SG65i is perfectly suitable for cleaning procedures in this segment especially in removing cured fluxes (natural or synthetic resin based) after wave soldering.

2.3 Cleaning of Optical Parts and Assemblies

Fiber optic products, lenses and camera assemblies all require diligent yet sensitive cleaning methods. Versatill® SG65i is very suitable for these applications, either as a pure substance or as a part of a customized formulation.

2.4 Degreasing

While hydrocarbon or aqueous systems are typically used for coarse or heavy duty cleaning, many require more precise and delicate cleaning methods. Versatill® SG65i Solvent is exceptionally suited for these applications. Due to a 36°C boiling point, a drying step is automatically included, making additional energy-intensive drying steps using hot air systems unnecessary. This is not only cost-effective, but also helps decrease the manufacturing time.

3. Physical Properties

	HCFC 141b	nPB	HFC 4310mee	Versatill® SG65i
Density at 25 °C g/ml)	1.23	1.35	1.58	1.23
Boiling Point (°C)	32.0	71.0	55.0	36.0
Freezing Point (°C)	-103.5	-109.9	-112.0	-42.6
Flash Point	N/A	No	N/A	No
Lower Flammability Limit*	5.6	4.0	N/A	5.4
Upper Flammability Limit*	17.7	7.8	N/A	9.4
Vapor Pressure (K Pa) 0 °C	28.0		8.2	36.0
20 °C	79.0	14.8	23.2	77.0
50 °C	184.0		84.3	169.0
Solubility of Water (20 °C) [ppm]	300			900
Solubility in Water (25 °C) [ppm]	2,700	2,400		1,700
Viscosity Liquid (20 °C) [mPa*s]	0.42	0.49	0.67	0.53
Refractive Index (20 °C)	1.369	1.434		1.325
Kauri Butanol Index	56	150	9	61
GWP – 100 yr.	725	0.31	1300	556

Table 1: Physical Properties

4. Solvency Strength: Looking for the Best Choice

The Kauri-Butanol index of Versatill® SG65i is comparable to that of CFC-113 or n-Hexane, but in some cases it offers advantageous solvent properties. It is low enough to be classified among the mild and selective solvents used in many fields like electronics, optics, precision cleaning, and treatment of assemblies made of various plastics.

The low surface tension of Versatill® SG65i allows for good wetting and excellent penetration ability. It is, therefore, well suited for the treatment of complicated parts.

Kauri-Butanol Value

The ASTM Kauri-Butanol method measures the relative power of solvents. This method includes an index ranking solvents for their ability to dissolve other materials. Although Versatill® SG65i has a moderate kb value, its solvency effect is more efficient than this value indicates, due to its polarity and chemical affinity.

Kauri-Butanol index of various	
HFE 4310mee	9
HFC 7100	10
HFC- 365mfc	13
n-Hexane	27
CFC-113	27
Hexane	34
Cyclohexane	54
HCFC-141b	56
Versatill® SG65i	61
p-Xylene	83
Perchloroethylene	93
Benzene	100
Toluene	105
Trichloroethylene	130
Methylene chloride	136

Table 2: Kauri-Butanol index

5. Versatill® SG65i: Examples of Removing Oils

The following chart rates visual cleanliness as well as results from a water drop test. The water drop test determines cleanliness from the contact angle at which a liquid forms on a surface; but it also depends on the surface material.

Attached comparisons of degreasing efficiency were made in a standard three chamber cleaning machine, which is equipped with ultrasonic of 32 kHz and tempered basins. The initial degreasing takes place at 32°C for three minutes, followed by rinsing at 36°C vapor for three minutes.

Contaminant	Visual test	Water drop test
Finger Print	acceptable	good
Low viscosity oil	good	good
Medium viscosity oil	acceptable	acceptable
High viscosity oil	acceptable	acceptable
Very high viscosity oil	good	acceptable
Chlorinated Oil	good	acceptable
Silicone Oil	good	acceptable
Water Soluble Oil	acceptable	acceptable
Wax	good	good
Silicone Varnish	good	acceptable
Water Sol. Varnish	good	good
Vaseline	acceptable	acceptable
Perfluorinated Grease	unacceptable	unacceptable

Table 3: Visual test/water drop test

6. Material Compatibility: Balanced Performance

Compatibility of materials with solvents is a major design criterion for any cleaning process. Such compatibility issues are known to be most critical for elastomers, plastics and other materials.

The market offers a wide variety of elastomer and plastic materials, which are made of similar raw materials and which are only differentiated by certain additives. These additives may affect thermal and mechanical stability, swelling properties, and resistance to ageing of elastomers and plastics. Compatibility tests were carried out with Versatill® SG65i in combination with different materials. Short term treatment resistance tests were done in standard vapor degreasing cleaning equipment, followed by cleaning, rinsing and drying steps. Total exposure to the solvent was six minutes. In addition, long term exposure compatibility was tested in static storage tests at defined temperatures for defined periods. The samples were examined for changes in volume, mass and appearance.

6.1 Metals

Tested standard metals containing alloys and tin ware such as Al/ Cu/ Fe / steel and Mg were not affected by Versatill® SG65i.

6.2 Plastics and Elastomers

Knowledge of resistance of assemblies or units is essential when designing a cleaning process. Different materials have been tested following a procedure that simulates automatic machine steps. These are: dipping in boiling solvent (pre-cleaning), cooling in condensate, flushing in vapor (each two minutes), and drying.

	Substance	Weight	Size
Plastics			
ABS	Acrylonitrile butadiene styrene	-	-
PA 6	Polyamide	+	+
PC	Polycarbonate	0	0
PE-HWST	Polyethylene	+	o
PETG	Polyethylene terephthalate	+	+
POM	Polyoxymethylene	+	+
PP	Polypropylene	+	+
PTFE	Polytetrafluoroethylene	+	+
PVC	Polyvinylchloride	+	+

	Substance	Weight	Size
Elastomers			
EPDM 70	Ethylene-propylene-diene rubber	+	+
CSM 70	Chlorosulfonated polyethylene	+	+
PFR	Fluorinated rubber	+	+
Si VMQ 70	Silicone-rubber VMQ	+	+
CR	Chlorobutadiene Rubber	–	o
NBR 70	Neoprene butadiene rubber	–	o
Vi FPM 70	Fluorinated rubber (Viton®)	–	–
NR	Neoprene Rubber	o	+

Table 5: Short term Plastic/Elastomer compatibility at 36°C. Symbols:

+ = compatible (changes < 1%) o = borderline (changes < 5%) – = incompatible (changes > 5%)

The resistance of elastomers must be checked before application. Due to various types of elastomers (chemical bonding or treatment during production), behavior can differ.

7. Environmental Effects and Regulations

After the phase-out of CFC 113 and HCFC 141b in major industrial nations, solutions for some solvent applications remain uncertain.

With the environmental issue concerning ozone depletion leading to an accelerated phase-out of HCFCs, the contribution to global warming by greenhouse gases becomes more and more a topic of interest.

Consequently, the Global Warming Potentials (GWP) of the new solvents used must be taken into consideration, as well as their material compatibility and safety related properties like toxicity and flammability.

Versatill® SG65i shows advantages in comparison to other solvents according emission, health protection, safety and environmental issues like ODP and GWP (see page 6, table 1).

When using solvents, national and respectively regional regulations, such as the European regulation EC 842/2006 on certain fluorinated greenhouse gases have to be considered.

Depending on the application, safety equipment has to be installed to comply with the individual emission limits.

8. Flammability

Versatill® SG65i shows no flash point according DIN 13736 and ASTM D93.

Standard precautions should be applied in form of good ventilation, grounding of equipment filling/refilling and pumping and avoiding contact with open fire or electrical sparks.

9. Safety and Handling

When working with Versatill® SG65i, protection should be exercised diligently. Below, are general safety and health instructions, for more information, please refer to the SDS.

Eye protection

Safety goggles must be worn when handling Versatill® SG65i. These goggles will prevent any liquid from coming into contact with eyes, preventing possible damage.

Hand protection

Versatill® SG65i dissolves grease and oil. If it comes into contact with skin, it removes the protective film of grease and makes the contact area sensitive to cold and infection. Suitable safety gloves will provide adequate protection.

Inhalation protection

If a high concentration of Versatill® SG65i vapor is inhaled, it displaces necessary oxygen with a risk of possible asphyxiation. Although its workplace permitted exposure level of 200 PPM is very high, it is always good to ventilate the workplace to avoid high concentrations of vapor.

Do not smoke while handling Versatill® SG65i. While it is neither flammable nor toxic, the high temperature that the cigarette reaches during inhalation may decompose Versatill® SG65i vapors into toxic substances.

10. Packaging and Storage

Versatill® SG65i standard packaging: 250 kg net metal drums and 23 kg net metal pails. It should always be stored in a cool dry place. When stored properly in the original container, a shelf life of 2 years is guaranteed.