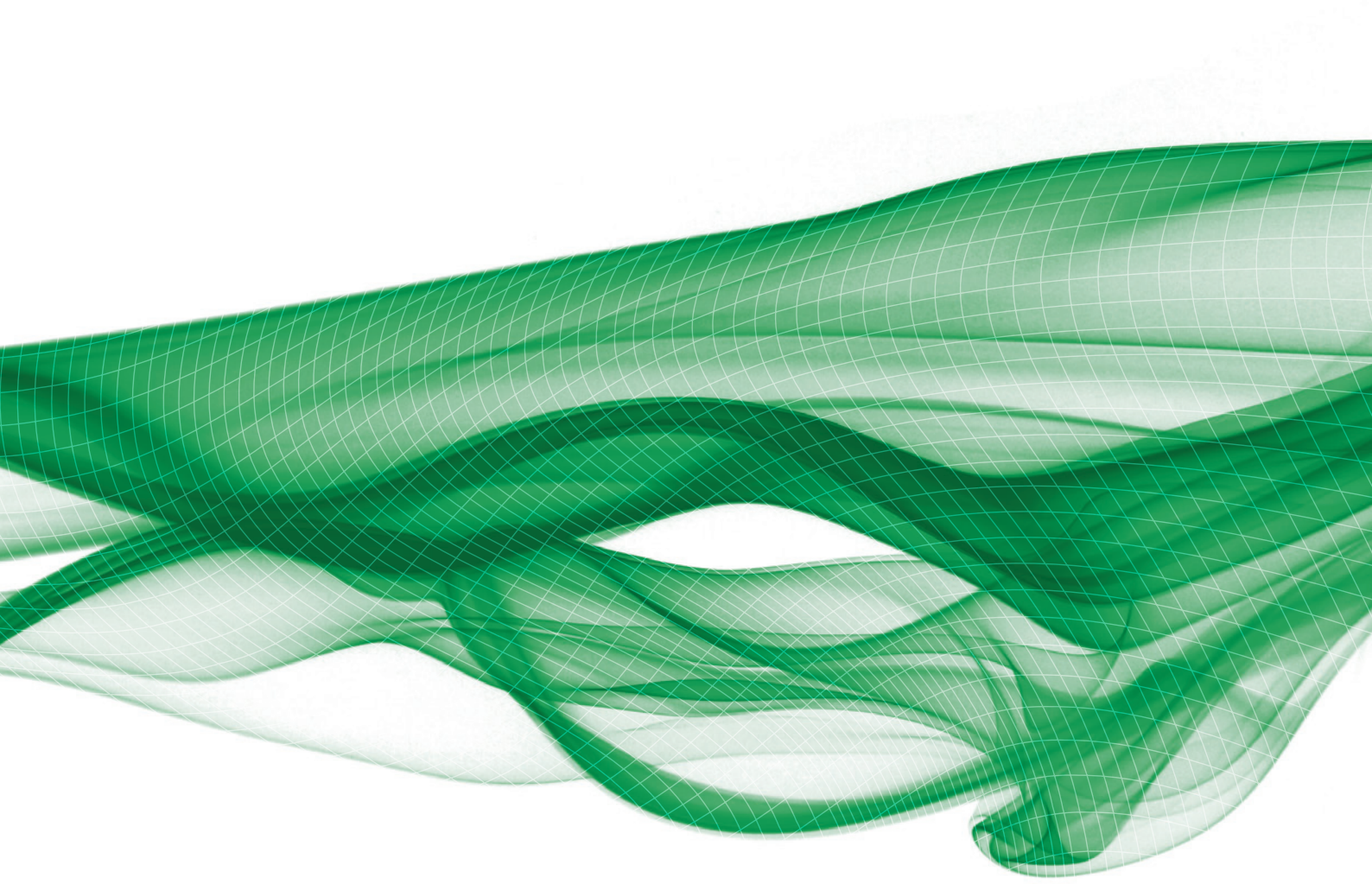
Electronic and General Purpose Cleaning

Wash away the worry of contaminants



ELECTROLUBE

THE SOLUTIONS PEOPLE

Electronic and General Purpose Cleaners

- Flux Removal
- Metal Degreasing
- Flammable & Non-flammable
- Bulk & Aerosol
- Water & Solvent Based

Cleaning is an essential process within electronics manufacture and has been used for many years to remove potentially harmful contaminants during PCB manufacture. Such contaminants include flux, solder and adhesive residues, and other more general contaminants such as dust and debris present from other manufacturing processes.

The purpose of cleaning, specifically within the rapidly expanding electronics industry, is to essentially improve product lifetime by ensuring good surface resistance and by preventing current leakage leading to PCB failure. This developing market sees modern and future electronics becoming smaller and smaller and the requirement for high performance and reliability is stronger than ever. In order to achieve good insulation resistance and ensure adequate adhesion of conformal coatings and encapsulation resins, the cleanliness of the electronic assemblies is essential.

There are many stages where cleaning is required; prior to stencilling and soldering in order to remove contaminants from the many previous production stages, after stencilling to remove excess solder paste/adhesive and after soldering to remove corrosive flux residues and any solder balls.

In industry today, many manufacturers are turning to ‘no clean’ processes, implying that cleaning is not required after soldering. In the ‘no clean’ process the solids content of the flux is lower than traditional types, however they still contain rosin and activator. Such residues, along with any other unwanted elements collected due to the missing cleaning stage, could cause issues with adhesion and possibly affect the performance of the protecting media applied, ie. Encapsulation Resins or Conformal Coating. It can therefore be stated that even with advances in new technologies, such as ‘no clean’ fluxes, cleaning is still an essential multi-stage process within the electronics industry.

Finally, there are also cleaning stages required for the removal of coatings and adhesives when re-work is necessary, for the cleaning of individual components and for maintenance of the production line.

Solvent and Aqueous Cleaners

Electrolube offer a range of solvent-based and aqueous electronic cleaners. Solvent-based systems are very efficient, allowing a convenient single-stage process. They are often flammable and so the health and safety of the operator as well as solvent emission levels must all be considered when using such materials.

With environmental concerns at an all time high many electronics manufacturers are moving away from traditional solvent cleaners that use ozone depleting chemicals or contain a high VOC (volatile organic compound) content, and replacing them with safer alternatives. Despite the easy application of many solvent cleaners, water-based cleaners have several advantages including non-flammable properties, low odour, low/non-VOC and very low toxicity.

There are different application options when using aqueous cleaners, including ultrasonic, spray under immersion or dishwasher type application and so identifying the correct product for the specific job is essential. Aqueous cleaners can utilise surfactant technology to assist the removal of contaminants from a PCB by reducing the interfacial tensions and suspending or emulsifying them in solution. Alternatively, water-based flux removers work by saponification, neutralising the flux acids.

As cleaning technologies have developed there has been the development of surfactant-free systems; based on glycols, these cleaners combine the advantages of water based and solvent based cleaners with only minimal rinsing required. In a micro-emulsion state, they provide highly efficient cleaning and can be utilised in all types of equipment. Electrolube have also developed materials in concentrate form with built-in corrosion inhibitors, eliminating yet another stage in the process. Supplying in concentrate form also reduces the transport cost, both in monetary and environmental terms.

Volatile Organic Compounds (VOCs)

- Volatile solvents used in electronic cleaners are classed as VOCs (Volatile Organic Compounds).
- VOCs contribute towards the formation of ground level ozone.
- Such pollution can have many detrimental effects on the environment, damaging forests and vegetation.
- In addition, some materials classed as VOCs can act as irritants and over exposure can lead to a variety of health problems.

VOC Definitions

EU Solvents Emissions Directive

'Any organic compound with a boiling point less than or equal to 250˚C at a standard pressure of 101.3 kPa.'

Previously the directive referred to the definition as 'Any organic compound, having at 20˚C a vapour pressure of 0.01KPa or more, or having corresponding volatility under the particular conditions of use".

As stated on the European Commission website, either method is suitable:
The "boiling point approach" was adopted for Directive 2004/42/CE because during negotiations Member States were generally more in favour of this definition of VOCs than the "vapour pressure approach" definition in Directive 1999/13/EC. The main reason is that the boiling point of a substance is easier to identify (and presumably more data are available) than the vapour pressure at room temperature of the same substance. Nevertheless, the results of the two approaches for any one substance are, to the knowledge of the EU Commission, in most cases identical.

EPA

"Volatile Organic Compounds (VOC) means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates and ammonium carbonate, which participates in atmospheric photochemical reactions".

Electrolube are continually developing ‘greener’ technologies, helping to minimise solvent emissions and their impact on the environment.

As environmental concerns heighten the transition to solvent-free and low-VOC materials continues to increase. Continual investment in research and development facilities allows Electrolube to remain at the forefront of cleaning technology, continually exceeding customers’ expectations throughout this period of change. Electrolube, as a responsible manufacturer, can provide both water-based and solvent based cleaning solutions for a wide variety of applications in the automotive, aerospace, military, domestic and medical sectors.

The Safewash Range

The Electrolube Safewash range is the most effective family of water-based cleaners available on the market. Primarily developed to replace ozone depleting chemicals as well as offering a solution to reduce solvent emissions, the range provides superior cleaning performance to both military and commercial standards at minimal cost. Water-based cleaning has several advantages over solvent based cleaners including non-flammable properties, low odour, low/non-VOC and very low toxicity.

Solvent Cleaners

Traditionally, chlorinated solvents dominated the market; however, due to their ozone depleting potential, they have been replaced by a more diverse range of solvent cleaners. This category is now typically divided into three sub-sections: flammable and non-flammable solvent cleaners and non-flammable fluorinated solvent cleaners. Electrolube flammable and non-flammable solvent-based materials are single stage cleaners characterised by relatively low levels of toxicity, good materials compatibility and a wide range of flash points and evaporation rates. Specialist equipment is generally required when using solvent based cleaners in high volume production; however they are essential for cleaning assemblies with unsealed components or water sensitive devices. Electrolube offer a diverse range of solvent based materials including flammable, non-flammable and fluorinated cleaners.

Application Conditions

Cleaning processes can be referred to as batch or in-line processes. Batch systems refer to a batch of PCBs taken through the entire process, whether it is ultrasonic or dishwasher application, for example. Cleaning processes can also be set up as in-line systems where PCBs are constantly transferred through each stage and a continuous production line is formed.

The following information explains the different application processes in more detail for aqueous products. Solvent-based cleaners can be used in ultrasonic and spray applications however the flammability of the solvent must be considered as well as any emissions given off. Occupational exposure levels must be adhered to in order to ensure operator safety.

For aqueous products, ultrasonic and spray application techniques are also possible however it is important to check the guidelines for each product carefully. A standard product designed for ultrasonic application may not be suitable for use in a dishwasher, for example. This is due to the pressure applied in the application, which in turn generates foam in the cleaning solution and therefore a low foam option is required for such applications.

Ultrasonic and Spray-under-Immersion

1. Cleaning

The Safewash in the first tank dissolves organic residues (grease, flux etc.) and ionic material keeping this contamination in solution. Due to the formulation of Safewash the cleaning also occurs underneath Surface Mount Devices (SMDs) and is complete in approximately 5 minutes (with agitation).

Safewash absorbs very high levels of flux residues before cleaning efficiency decreases. The first stage can use any form of agitation providing it does not damage the PCB or create a foam. Safewash is designed to work efficiently at ambient temperatures (10°- 30°C) but temperatures of up to 45°C may be employed if necessary.

As PCBs are removed from the Safewash cleaning stage, a small amount of Safewash fluid is pulled out with the board and enters into the rinse stage. This is commonly known as drag-out. Fresh Safewash can be added to top up the cleaning tank to maintain cleaning efficiency.

2. Tapwater Rinse

The second stage consists of a rinse in tap water, preferably with some type of agitation. The temperature of the rinsing solution can be ambient, although an increase in the temperature will accelerate and improve rinsing. As small amounts of Safewash are carried over into the rinse water, the rinse water should either be allowed to overflow to drain or be recycled through a carbon filter preventing the rinse water becoming progressively more contaminated.

If allowed to go to drain, your Local Water Authority should be consulted to ensure that the level of contaminated water being put to drain is within their guidelines. The use of a carbon filter, through which the tap water is permanently re-circulated, produces no liquid waste, as the filter will remove the Safewash and flux residues from the water.

3. Deionised Water Rinse

The third stage is a deionised water rinse. This removes any contamination present in the tap water from the PCB and gives a final rinse to ensure exceptional cleanliness. This stage may either consist of a re-circulating rinse or a spray system that is activated when the PCBs leave the tap water rinse. If military standard cleanliness is not required, this deionised rinse may not be necessary, though the PCBs may show some white streaking due to tap water impurities.

4. Drying

The final stage is drying. This is enhanced by equipment that uses high air flow as opposed to 'heat only' systems. In general, this stage takes approximately 10 minutes at 90°C. The length of time required to dry the PCB depends on the circuit design and the efficiency of the drying unit itself. Air-knives can be used as an optional extra to reduce temperature or total energy required.

Spray Application

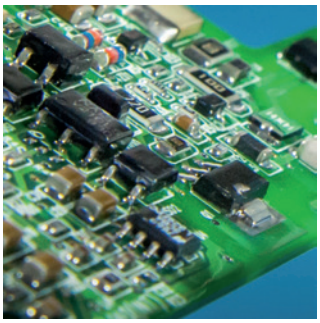
Ready-to-use, concentrated products are available for spray applications. Safewash Total (SWAT) can be used as an example. Safewash Total should be diluted to the required level, i.e. 20% with de-ionised water and applied for a wash time of 5-10 minutes at 40-60°C. The specific cycle required will be dependent on the age and type of residue being removed, the reflow profile and the effectiveness of the cleaning machine. The cleaning stage should be followed by a deionised water rinse and a drying stage. The length of time required for rinsing and drying the PCB depends on the circuit design and the efficiency of the rinsing/drying unit. Air-knives can be used as an optional extra to reduce temperature or total energy required.

A typical cycle using a Miele 6002 Industrial Washer:

1. Cleaning, Safewash Total diluted to 20% v/v, at 50°C for 10 minutes
2. Mains water rinse, 1 minute at 40°C
3. Deionised water rinse, 3 minutes at 70°C
4. Hot air dry, 15 minutes at 115°C

Once cooled to below 30°C the residues and soils will precipitate and can be filtered out of the cleaning solution, extending the life of the cleaner. Typically a 50-75 micron cotton wound filter would be suitable.

Cleanliness Levels



With the cleaning market continually developing to meet the demands of industry expansion, it is important that the level of cleanliness required is clearly defined. A significant proportion of potentially damaging flux residues and contaminants are not visible to the naked eye or even with the aid of magnification. It is therefore vitally important that the correct method is used to determine that the level of cleanliness achieved meets the standard specified by the electronics engineer. There are two types of residues; ionic and non-ionic and there are a number of methods that can assess the level of contamination after cleaning and accurately describe the term 'clean'.

Non-ionic residues including rosin, oils and grease are non-conductive and are usually organic species that remain after board fabrication or assembly. They have insulative properties which are a problem where plug-in contacts or connectors are utilized on assemblies. These can cause poor adhesion of solder mask, conformal coating and potting compounds as well as encapsulate ionic contaminants and foreign debris. Typical test methods include visual examination under magnification alongside other analytical methods, such as Fourier Transform Infrared Spectroscopy (FTIR).

Ionic contaminants are typically flux residues or harmful materials left behind after soldering. Water-soluble organic or inorganic residues that can disassociate in a solution as charged ions increase the overall conductivity of that solution. They can degrade the reliability of the electronic components and assemblies by contributing to current leakage between the circuitry, causing corrosion and promoting dendrite growth.

While both ionic and non-ionic contaminations both impact the operation and reliability of the device on which they are present, ionic contamination accounts for the larger proportion of failures. A common method of determining the degree of ionic contamination is to measure Resistivity of Solvent Extract (ROSE), also known as Solvent Extract Conductivity (SEC). The industry standard, IPC-TM-650, employs a solution of isopropanol and deionised water to extract the contaminants whilst the meter measures the change in conductivity. This type of testing is widely accepted and offers rapid results, it can be restrictive, however.

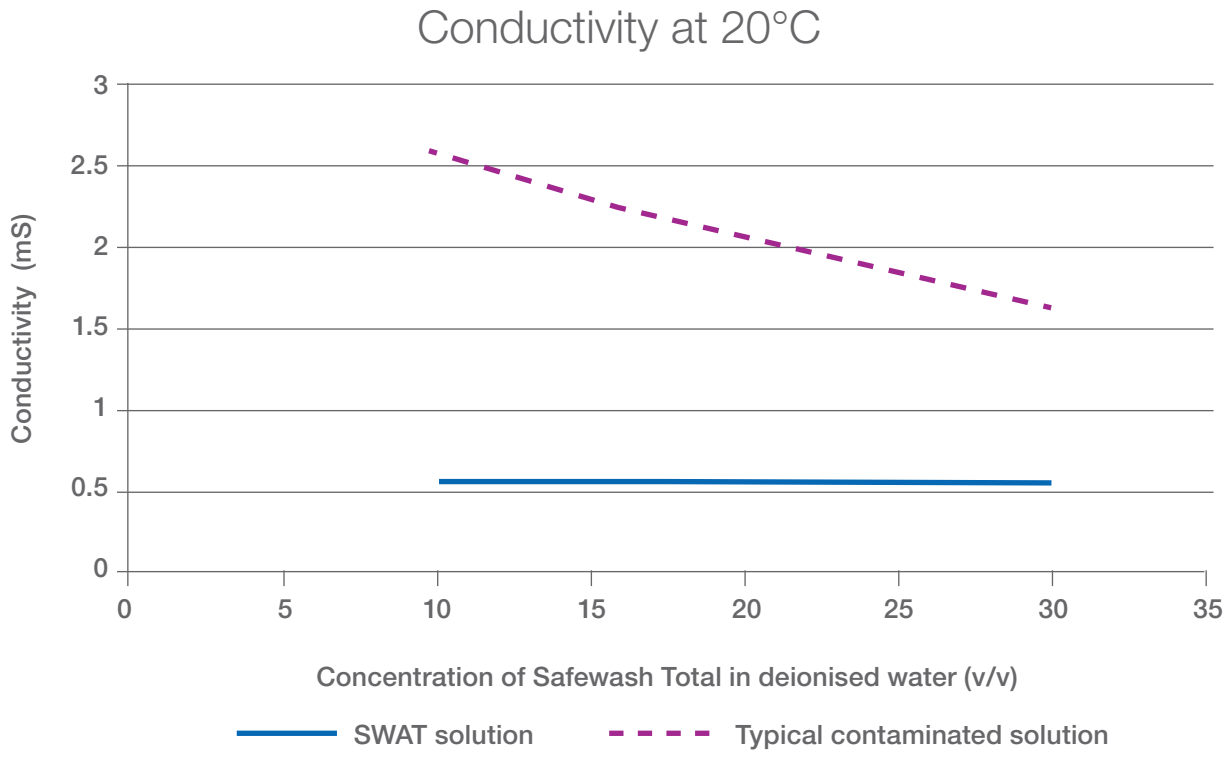
Two further methods can also be utilised to provide valuable data. These are Surface Insulation Resistance (SIR) and Ion Chromatography (IC). The former involves measuring the change in electrical current over time via an interleaved comb pattern PCB and is typically performed at elevated temperatures and humidity levels. The presence of contamination lowers the insulation resistance of the material between the conductors. The latter, Ion Chromatography (IC), is a newer method for cleanliness evaluation which can be used for identifying and quantifying specific ionic species that are present on an electronic device. The test method details a specific list of ionic residues which can be removed by specific media. Subsequent analysis of the fluid can separate, identify and quantify the residue. Substrate handling and preparation are critical for this method making it particularly expensive and time consuming. Therefore it is not used for general quality control purposes but as a more specific analytical technique.

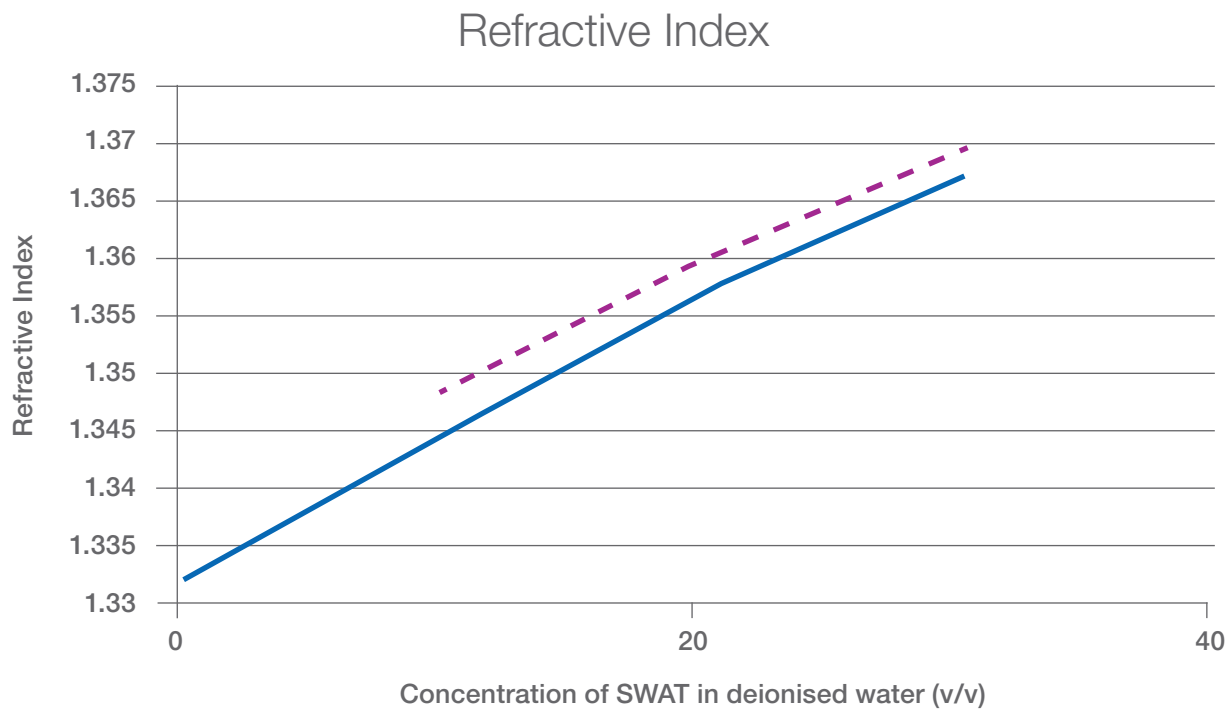
Solution Control: Aqueous Cleaners

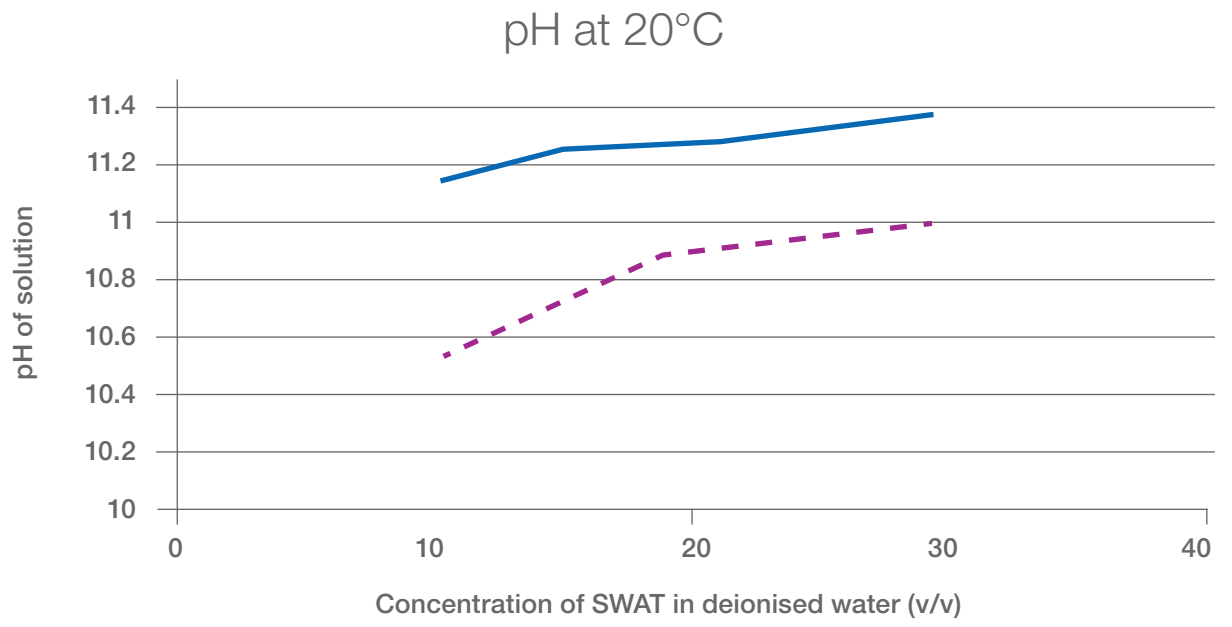
In addition to the level of contamination after cleaning, the control of the cleaning solution itself is essential. The method of solution control will depend on the cleaning chemistry and type of residues being removed; some possible methods shall be discussed, however.

- Acidic flux residues will generally lower the pH and increase the conductivity, while being relatively unaffected by variations in concentration.
- Refractive index, or BRIX, gives a measurement of the solids level in the cleaner. Although this can give some indication of contamination level, changes in refractive index over time are more likely to be as a result of variations in the concentration of the solution, often affected by drag out of the cleaning solution into the rinsing cycle.
- Cloud temperature measurement is another alternative method to control the solution. Simply warming a small sample of the cleaning solution and noting the temperature at which it becomes cloudy will indicate if the solution has become highly contaminated or the concentration has dropped due to drag out.

All these methods are simple and may require the use of a relatively inexpensive meter.







Further information on application parameters and solution control can be found on the individual datasheets for each product.

SWAT solution

Typical contaminated solution

The Product Range

Safewash Products

SWA/SWAJ/SWAS – Safewash 2000 Range

- The original Safewash (SWA) is ideal for removing flux residues and many other cleaning applications which do not contain sensitive metals. Can be used prior to plating operations as a micro etching process.
- SWAJ is specifically formulated for safe cleaning of all metals including aluminium, copper and brass. SWAJ is also used extensively to clean flow solder jigs or pallets to remove the build up of flux deposited throughout the wave soldering process.
- SWAS is similar to SWAJ but with enhanced cleaning performance. Cleans flux residues and no-clean flux to military cleanliness standards.
- All are low odour, non-hazardous and for use in cleaning systems using ultrasonic or spray-under-immersion.

SWAF/SWAP – Low Foam Safewash

- SWAF and SWAP have been designed as an extension to the Safewash range where low foam properties are required
- Suitable for use via high pressure application, such as dishwashers and in-line machines (spray-in-air machines)
- SWAF is supplied as a concentrate, designed to be diluted with deionised water
- SWAP is a ready to use version which includes a corrosion inhibitor for sensitive metals

SWAT – Safewash Total

- Surfactant-free, easy to rinse
- Low-foam
- Suitable for use in all application equipment; ultrasonic, dishwasher, etc.
- Contains a corrosion inhibitor for sensitive metals

SWAX – Safewash Extra

- For removal of solder pastes and surface mount adhesive from screens, stencils, misprinted PCBs and accessories
- Can be used in automated screen cleaning equipment, spray and in-line machines
- Low foam, low odour
- Excellent compatibility with plastics, metals and elastomers

SWMN/SWMP – Safewash Mechanical

- Designed to clean and degrease mechanical parts
- Removes dirt and grease deposits
- Non-hazardous with very low odour
- SWMP has enhanced performance properties for more stubborn deposits

SWNP/SWNS – Safewash Neutral

- Neutral pH for cleaning even the most sensitive surfaces
- Developed for the LCD and OLED manufacturing processes
- SWNS has been designed to remove any excess resin residues
- SWNP has been designed to remove any dust and grease from the LCD surface

The Product Range

Electronic and General Cleaners

ARW – Aerowipes

- Efficient removal of uncured and semi-cured adhesives and sealants
- Designed for the aerospace and automotive industries
- Available in liquid form and impregnated lint-free wipes
- Non-flammable

EWI – IPA Electrowipes

- Impregnated with an isopropanol and de-ionised water blend
- High quality cloths
- Packaged in individual sachets
- Excellent degreaser, also removes flux residues and metal oxide

CCC – Non-flammable Contact Cleaner

- Non-conductive with high materials compatibility
- Instant drying with almost no aroma
- Leaves no residue
- Supplied with brush and extension tube

FLU – Fluxclene

- Fast drying solvent cleaner for efficient removal of flux residues after soldering
- Leaves a perfectly clean, dry surface
- Harmless to most plastics, rubbers and elastomers
- Aerosol versions available with or without a brush applicator

DGC – Non-flammable Degreaser

- Electronics cleaner and degreaser
- Fast evaporating
- Versatile, non-corrosive and safe for use on all types of electrical circuit
- Plastics-safe

FRC – Non-flammable Flux Remover

- Effective on ‘no clean’ fluxes and many water based fluxes and pastes
- Quick drying and residue free
- Plastics safe
- Supplied with brush and extension tube

ECSP – Electronic Cleaning Solvent Plus

- Very fast evaporating cleaning solvent
- Removes grease, dirt and most fluxes
- Completely residue-free
- Highly flammable – not to be used on live equipment

GLC – Glass Cleaner

- Low-foaming glass cleaner
- Water-based
- Removes grease, oil and light organic contaminants
- Non-flammable

ECW – Engineering Cleaning Wipes

- Non-woven, cellulose/polyester blend
- High quality, general purpose wipes
- Extremely absorbent
- Exceptional tear and wet strength

IPA – Electronic Cleaning Solvent

- Efficient general purpose electronic cleaning solvent
- Removes contamination from PCBs
- Excellent plastics compatibility
- Economic in use

HFFR – Hexane Free Flux Remover

- n-Hexane Free
- Efficient removal of all flux residues
- Harmless to most plastics, rubbers and elastomers
- Leaves a perfectly clean, dry surface with no residue

SRI – Saferinse

- Aqueous, de-ionised solvent blend
- For rinsing electronic assemblies after cleaning with Safewash
- Recommended as a final rinse to ensure removal of all impurities
- Non-flammable

LFFR – Lead Free Flux Remover

- Fast drying solvent cleaner
- For quick removal of lead free flux residues, grease and oils
- Leaves a clean, dry surface
- Harmless to most plastics, rubbers and elastomers

SWA – Safewash Aerosol

- Water-based cleaning solvent
- Removes all types of flux residues
- Aerosol form with brush attachment to aid cleaning
- Non-flammable

ROC – Reflow Oven Cleaner

- Specially formulated micro-emulsion for cleaning reflow ovens
- Removes all types of flux residues
- Contains corrosion inhibitors
- Non-flammable

ULC – Ultraclens

- Highly penetrating cleaning solvent for removing heavy deposits
- Excellent cold cleaner for electronics and engineering
- High flash point, reduces the risk of fire caused by flammable solvents
- Ideal for stencil cleaning

SSS – Screen & Stencil Solvent

- Non-flammable solvent for cleaning of screens and stencils
- Excellent solder paste and adhesive removal
- Non-foaming and biodegradable
- Use with ECW025

ULS – Ultrasolve

- Excellent degreasing properties
- Also removes flux residues from PCBs
- Can be used to remove acrylic conformal coatings
- Harmless to most plastics, rubbers and elastomers

SSW – Screen & Stencil Wipes

- Superb cleaning power that removes pastes and adhesives
- Leaves screens and stencils clean and dry with no staining
- Large size (20x28cm)
- Convenient 100 wipe tub dispenser

WWC – Industrial Cleaning Concentrate

- General purpose industrial cleaner
- Non corosive to metals
- Easy to use: convenient application methods
- Non-flammable

**Various sizes are available for most products, including bulk*

Aqueous Cleaning

		SWA	SWAJ	SWAS	SWAP	SWAT*	SWAX	SWMP
		Safewash original	Safewash Jigwash	Safewash Super	Safewash Pressure-wash	Safewash Total	Safewash Xtra	Safewash Mechanical - Plus
Equipment	Ultrasonic	Yes	Yes	★★★★	Yes	Yes	Yes	Yes
	Pressure / Dishwasher / In-line	No	No	No	Yes	★★★★	Yes	No
	Spray under Immersion	Yes	Yes	Yes	★★★★	Yes	Yes	Yes
	Screen and Stencil Cleaner	No	No	No	Yes	Yes	★★★★	No
Soil Removal	Heavy Grease (& Organics)	★★☆☆	★★☆☆	★★★★	★★☆☆	★★☆☆	No	★★★☆
	No Clean Fluxes	No	★☆☆☆	★★★★	★★☆☆	★★★☆	No	No
	Flux / Ionics	★★☆☆	★★★☆	★★★★	★★★☆	★★★☆	★★☆☆	No
	Uncured Paste	★☆☆☆	★☆☆☆	★★☆☆	★☆☆☆	★★★☆	★★★★	No
	Uncured Adhesive	No	No	No	No	★★☆☆	★★★★	No
Other	Sensitive Metals	No	Yes	Yes	Yes	Yes	Yes	No
	Rinsability	★★☆☆	★★★★	★★★☆	★★☆☆	★★★☆	★★☆☆	★★☆☆
	Low Foam	No	No	No	Yes	Yes	Yes	No

Concentrate requires dilution, please refer to the Technical Data Sheet for more information.

Solvent Cleaning

		HFFR	LFFR	FRC	ULS	DGC	IPA	ECSP	ULC	SSS
		Hexane-Free Flux Remover	Lead-Free Flux Residue Remover	Non-Flammable Flux Remover	Ultrasolve Cleaning Solvent	Non-Flammable Degreaser	Electronic Cleaning Solvent	Electronic Cleaning Solvent – Plus	Ultraclens Cleaning Solvent	Screen and Stencil Cleaner
Typical Properties	Density (g/ml)	0.78	0.78	1.33	0.79	1.33	0.79	0.79	0.79	1.03
	Flashpoint (°C)	7	0	None*	-20	None*	12	-48	>60*	>60*
	Boiling Point (°C)	>80	>80	36	>80	36	82	36	>173	>100
	Vapour Pressure (kPa)	6	11.5	66.1	11.5	66.1	4.4	53.3	0.5	1.45
	Evaporation Rate (ether = 1)	11	16	<1	16	<1	6	1.5	66	>50
	TLV (ppm)	300	300	242	300	242	400	500	300	300
Soil Removal	Heavy Grease (& Organics)	★★☆☆	★★☆☆	★★☆☆	★★★★	★★★☆	★★☆☆	★★☆☆	★★★☆	No
	No Clean Fluxes	★★★☆	★★★★	★★☆☆	No	No	No	No	No	No
	Flux / Ionics	★★★★	★★★☆	★★★☆	★★☆☆	★★☆☆	★★☆☆	★★☆☆	No	No
	Uncured Paste	★★☆☆	★★☆☆	★★☆☆	★★☆☆	★★☆☆	★★☆☆	★★☆☆	★★★☆	★★★★
	Uncured Adhesive	No	No	No	No	No	No	No	No	★★★★

*Evaporation Rate: The higher the number the slower the rate of evaporation. *Classified as non-flammable.*