Technical Data Sheet

PRODUCT DESCRIPTION:	**Safewash 2000 Range**	**DATE:**	**03/97**
PRODUCT CODE:	**SWA/SWAJ/SWAF/SWAP/SWAS**	**PAGES:**	**9**

CONTENTS

1 SUMMARY
2 USER GUIDE

Safewash Original (SWA) - Original Version
Safewash J (SWAJ) - Inhibited Version
Safewash F (SWAF) - Low-Foam Concentrate
Safewash P (SWAP) - Inhibited Pressure Wash
Safewash S (SWAS) - Super

3 TYPICAL PROPERTIES
4 FURTHER INFORMATION
APPROVALS
EQUIPMENT
PRODUCT AVAILABILITY

APPENDIX 1 MONITORING THE FLUX CONCENTRATION WITHIN SAFEWASH
APPENDIX 2 ESTIMATED SAFEWASH USAGE
APPENDIX 3 COMPATIBILITY WITH PLASTICS, RUBBERS AND METALS

SUMMARY

The **Safewash** Range consists of water based electronics cleaning solvents specifically designed to remove the need for CFC-based solvents without any detrimental side effects. **Safewash** exhibits the following properties:

- Contains **NO** CFCs. 100% ozone friendly (including the aerosols).
- Far more cost effective than traditional CFC and HCFC cleaning solvents.
- Biodegradable in 10 days @ 5% concentration in the sewage system as approved by the Bavarian State Water Authority.
- Works at ambient temperature, thus saving electricity.
- Non-flammable.
- Lower toxicity than CFC-based solvents.
- Excellent materials compatibility (better than CFCs).
- Exceptional flux take-up ensures minimum water usage.

Safewash has been fully tested an approved by all of the major International electronics manufacturers and is now one of the leading products available worldwide, and the European Market Leader. It allows all types of flux (RA, RMA, no-clean and water-soluble) to be cleaned quickly and efficiently with minimal environmental effect using low cost readily available cleaning equipment. Cleaning is equally effective on solder paste screens, wave-soldering jigs and metal parts.

The **Safewash 2000** family are water-based, non-flammable, 100% ozone friendly, biodegradable solvent blends designed to clean to well within the world's military cleanliness standards.

USER GUIDE

Safewash SWA / SWAJ / SWAS

These variants have been specifically developed for use in batch cleaning systems using ultrasonics or spray-under-immersion, as a replacement for 1.1.1. trichloroethane & 113 solvents. The products are packaged in a concentration suitable for immediate use and further dilution is not recommended.

The main differences between these products are as follows:

SWA Ideal for cleaning PCBs and metals that are not sensitive to alkalis. Used for cleaning metals prior to plating operations to provide an extremely clean and slightly roughened surface, allowing excellent bonding of the plated material. **SWA** will not normally attack sensitive metals unless they are cleaned many times or unless the units are immersed for an excessive cleaning period.

SWAJ As above, but contains a corrosion inhibitor allowing the safe cleaning of all metals including aluminium, copper and brass, even if the units are to be cleaned many times per day. A common example is cleaning aluminium jigs used to support PCBs during the soldering operation.

SWAS As for **SWAJ**, but with enhanced performance for cleaning very stubborn flux residues and no-clean fluxes. The residues left by no-clean fluxes are extremely difficult to remove, but **SWAS** will remove them to military cleanliness standards. This is extremely useful for sub-contractors who do need to clean PCBs for some of their customers, but do not want to use two fluxes, two soldering machines etc. **SWAS** also has an even lower odour than the other Safewash variants as well as being easier to rinse.

These products are designed to be used in a three or four stage machine consisting of:

Ultrasonic Wash or Spray-Under-Immersion
Rinse (Tap Water)
Rinse (Deionised Water)
Hot Air Dry

The following sections give more detail on how this process works.

Batch Ultrasonic and Spray-under-Immersion

The **Safewash** in the first tank dissolves organic residues (grease, flux etc.) and ionic material keeping this dirt in solution. Due to the formulation of **Safewash** the cleaning also occurs underneath Surface Mount Devices (SMDs) and is complete in approximately 3 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°) but temperatures of up to 45°C may be employed if necessary. An existing CFC-based tank can often be used for this stage, with the heating turned off.

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. After a period of time, dependent on the volume of PCBs being cleaned, the level in the cleaning tank decreases to a point where an additional five litres of new **Safewash** can be added to the cleaning tank.

This periodic addition of new **Safewash** to replace the material that is dragged-out will normally ensure that the cleaning effect of the solution is never reduced to an unacceptable level (below MIL-P-28809A). This means that disposal of the cleaning material is not required.

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. Experience shows that a flow rate of approx. 20 litres per square metre of PCB cleaned, produces water with acceptable levels of contamination. 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.

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 polish to ensure exceptional cleanliness. This stage may either consist of a recirculating 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.

For ferrous metal cleaning operations it is possible to add a rust inhibitor (Code: **SRIA**) at 0.5% into this stage. This material will prevent flash rusting of ferrous metals when they are dried at high temperatures. A separate Technical Data Sheet is available for this product.

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 5 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.

LOW FOAM SAFEWASH (SWAF/SWAP)

While **SWA/SWAJ/SWAS** are suitable for ultrasonic and "spray-under-immersion" equipment, high pressure cleaning systems (in-line and industrial dishwasher-type) require versions of **Safewash** that do not foam when sprayed. **Safewash F (SWAF**) and **Safewash P (SWAP)** have been designed for users who prefer this type of equipment.

The main differences between these products are as follows:

SWAF Ideal for cleaning PCBs and metals that are not sensitive to alkalis. Supplied as a concentrate to be diluted with deionised water at between 5-25%. **SWAF** will not normally attack sensitive metals unless they are cleaned many times or unless the units are immersed for over the recommended cleaning period.

SWAP As above, but is supplied at a ready-to-use concentration and contains a corrosion inhibitor allowing the safe cleaning of all metals including aluminium etc., even if the units are to be cleaned many times per day. A common example is cleaning aluminium jigs used to support PCBs during the wave-soldering operation.

In-line Pressure Washers

Wash Stage

SWAF is dosed into the first tank to give a concentration of between 5% - 25% in deionised water. Depending on the nature of the soils being cleaned, wash temperatures in the range 20-60°C

should be used. **SWAP** is used without dilution if a product is required that includes a metal corrosion inhibitor.

Re-circulation of the solution via angled high pressure spray nozzles allows effective cleaning under components and on both sides of the board. The precise specifications of the machines vary between manufacturers but the models tested perform to within MIL standards of cleanliness.

Rinse Stage

From the wash stage, the PCBs proceed to tapwater and deionised rinse water stages. These stages usually involve recirculation.

Drying

The cleaned boards move into the drying stage where high pressure air knives remove excess moisture prior to infra red or hot air drying.

Product Life/ Disposal

As with Ultrasonic systems, used **Safewash** is carried over on the PCBs from the cleaning tank into the rinse water system.

The cleaning tank requires periodic topping up with new material. Monitoring the concentration of both **Safewash** and contaminants is possible by titration, conductivity or refractive index. See following sections for more information.

Rinse water should be recycled through carbon filters or disposed to waste sewer, subject to Water Authority approval.

Industrial Dishwashers

SWAF should be diluted to approximately 5-8% concentration to be used at a temperature of 40-60°C in these machines. After each rinse cycle, the dirty material is discarded to waste. Whilst the level of contamination in this water is generally below limits prescribed by Water Authorities, permission should be obtained prior to disposal.

If sensitive metals are to be cleaned, **SWAP** should be used undiluted in this type of equipment. In this case, the material should not be disposed of after each wash cycle, but re-cycled until exhausted.

Drying is either carried out as the final cycle in the cleaning chamber or as a separate operation similar to in-line systems.

TYPICAL PROPERTIES

Order Code	**SWA**	**SWAJ**	**SWAF**	**SWAP**	**SWAS**
Boiling point	98°C	98°C	171°C	98°C	98°C
Freezing point	-5°C	-5°C	-10°C	-5°C	-5°C
Specific gravity	1.002	1.002	0.99	1.00	1.002
Flashpoint	None	None	94°C	None	None
Viscosity (cPs)	5-10	5-10	15-25	25-30	5-10
pH	11.7	11.7	12.3	11.7	11.7
Electrical Conductivity (mS @ 18°C)	1.15	1.56	0.01	1.20	1.25
Colour	Green	Green	Blue	Blue	Blue

FURTHER INFORMATION

DISPOSAL

As mentioned previously, the necessity for disposal of concentrated **Safewash** often does not arise because of the drag-out effect. In this situation only the rinse stage water has to be disposed of. **Electrolube** have contacted the Local Water Authorities in the United Kingdom to gain approval for the disposal of the rinse solution through the normal sewage system. The replies to date have all shown acceptance although users are obliged to contact their own Local Water Authority for approval. Contact names and copies of our approvals are available to aid this process.

Tests within Germany have indicated that the rinse water may be disposed of in this way, with no effect on local waterways. Unused **Safewash** may be disposed of at your local sewage farm, again with Local Authority permission, or could be diluted sufficiently to allow for disposal in the ways shown above. Permission has been successfully gained in the UK and within mainland Europe for the safe disposal of both wash and rinse water.

APPROVALS

Safewash has been tested and approved by both military and commercial electronics manufacturing companies across the world. The British Ministry of Defence (Directorate General of Defence Quality Assurance) have tested **Safewash** on various fluxes and have found that the product cleans to well within Defence Standard 00-10 (and it performed approximately 10 times better than 1.1.1. Trichloroethane based solvents).

These results have been backed up by Siemens Central Research Laboratories in Erlangen. Their conclusions were:

> "The residual contamination found on the circuit boards and components after cleaning with **Safewash 2000** is significantly below the limit value of 1.56 micrograms NaCl/cm^2 permitted by MIL-P28809A." From the point of view of a high level of cleaning efficiency, the bio-cleansing agent "**Safewash 2000**" can be released for cleaning purposes in electrical engineering".

A copy of the full Siemens report is available on request.

EQUIPMENT

All grades of **Safewash** have been tested by many equipment manufacturers. **Safewash** has performed well within Military standards in ultrasonic, immersion jet spray, dishwasher and jig cleaning equipment.

Equipment manufacturers recommending **Safewash** include:

Branson
C & C Fabrications
Dage
Electrovert
Kerry Ultrasonics
Ultrasonic Engineering

This list is updated on a regular basis and if you would like to trial **Safewash** in your equipment and would like us to include your company's name above, please contact us for further information.

PRODUCT AVAILABILITY

Safewash Original		
5 Litre Bulk		SWA05L
25 Litre Bulk		SWA25L
200 Litre Bulk		SWA200L
Safewash J		
5 Litre Bulk	**NATO STOCK NO. 6850-99-500-1969**	SWAJ05L
25 Litre Bulk		SWAJ25L
200 Litre Bulk		SWAJ200L
Safewash F		
5 Litre Bulk		SWAF05L
25 Litre Bulk		SWAF25L
Safewash P		
5 Litre Bulk		SWAP05L
25 Litre Bulk		SWAP25L
200 Litre Bulk		SWAP200L
Safewash S		
5 Litre Bulk		SWAS05L
25 Litre Bulk		SWAS25L
200 Litre Bulk		SWAS200L
Safewash 2000 Aerosol	400ml	SWA400H
SAFERINSE 2000 Aerosol	400ml	SRI400H

APPENDIX 1

Evaluation of Flux Concentration - Conductivity Method

The electrical conductivity of a **Safewash** solution will increase with flux concentration (and other ionic contaminants). This may be used as a **guide** for the replacement of **Safewash** with fresh material. It needs to be tied to the cleanliness level achieved in an individual production process.

The basic operations are:-

1) Establish a graph of conductivity Vs flux concentration (as described below).
2) Correlate the conductivity/ flux concentration to the limit of cleaning required by your process.

After this process has been completed the effectiveness of the cleaning process can be controlled by simply measuring the electrical conductivity of the solution. A conductivity meter such as Jenway Model 4070 (or equivalent) is suitable.

Whilst conductivity and other methods may be used to assess contamination of **Safewash**, the critical test for replacement is when the process is not cleaning the boards to the desired standards.

Safewash will absorb up to 15% of its weight of most fluxes without affecting cleaning so a range of flux / **Safewash** solutions should be made up at 0.5, 2.5, 5, 7.5, 10 and 15%.

For Solder Pastes

Thoroughly mix 100g of the paste with 100g of the **Safewash** variant used. Heat the mixtures to 50°C for 4 hours. Cool to room temperature and measure the conductivity at a suitable fixed temperature. If the flux content of the paste is 10%, this gives a figure for the 10% flux in Safewash. Serial dilution of this master solution will allow a graph of conductivity/ concentration to be prepared.

NOTE: the conductivity of the clear solution (above the metal particle/ gels) should be measured.

For Wave Solder Fluxes

Take 150ml of a 10% flux** and evaporate to ca 50ml. (**CARE** - solvent is usually isopropanol which is highly flammable). Dissolve this material in 100ml of **Safewash** to give a standard 15% solution. Measure conductivity at 20°C. Construct the graph as previously.

In production, the conductivity of the cleaning solution may now be monitored. When the conductivity indicates flux levels of typically 10-15%, the bulk material should be replaced.

NOTE: conductivity increases sharply with increasing temperature - monitor at 20°C.

Typical results could be as follows:

Flux Concentrations %	0	0.5	2.5	5	7.5	10	15
Conductivity mS	2.25	2.7	3.5	4.2	4.6	5.1	7.2

The above data is not designed to be used by customers to monitor their process as the results vary dependant on the type of flux used.

** **NOTES**

The concentration of flux solutions may vary - check the data sheet. Volumes of solution can be adjusted to give 10g - 15g of flux.

The level of flux dissolving in **Safewash** may vary with the flux type. Dissolving the flux in **Safewash** may require sonification at 40°C. Cool to 20°C before measuring the conductivity.

APPENDIX 2

ESTIMATED Safewash USAGE

The method below can give a rough estimate on the amount of **Safewash** that will be used in a production process cleaning printed circuit boards.

Flux is normally sold at one of three concentrations in alcohol. The table lists the normal amount of contamination on a PCB at these concentrations. These figures depend greatly on PCB design and population.

Flux Concentration	Contamination per square metre of PCB (per fluxed side of PCB)
20%	11 - 13 grams
10%	5 - 8 grams
5%	2 - 5 grams

Safewash will absorb a maximum of 5% - 15% of its weight of flux while still cleaning to military standards. An estimate of how much **Safewash** is required, based on a 5% uptake of flux is obtained as follows:

10% RMA flux on single sided PCB	-	5 -8 grams per metre of PCB
10 square metres of PCB cleaned per day	-	50 - 80 grams per day
Each litre of **Safewash** absorbs 5% of weight	-	1-2 litres required per day of flux, i.e. 50 grams

Therefore for a customer cleaning 10 m^2 of double sided PCBs will use 1 to 2 litres of **Safewash** per day if he is using a 10% RMA Flux.

If a temperature of between 20°C and 40°C is used and the geometry of the PCBs is not too severe up to 15% of RMA flux may be absorbed before cleaning efficiency drops.

In addition to the **Safewash** that it is used to absorb the flux, material is lost due to drag-out. Please see below.

USAGE - LOSSES BY DRAG-OUT

The drag-out of material into the rinse stage usually means that topping up the **Safewash** keeps the solution below the 5% concentration of flux. Typical figures for drag-out are as follows:

PCB Drag-out (without Air-Knife)	100 ml/m^2
PCB Drag-out (with Air-Knife)	20 - 50 ml/m^2

These figures are based on a batch ultrasonic or spray-under-immersion system. Drag-out is higher in in-line equipment due to the continuous operation of the conveyor belt.

APPENDIX 3

COMPATIBILITY WITH PLASTICS, RUBBERS AND METALS

Plastics (One day immersion 40°C)

Material	Trademark	Rating
ABS	-	OK on most but test.
Acetal	Delrin	OK
Acrylic	-	Test
Epoxy	-	OK
Fluorocarbons (PTFE)	Teflon	OK
Fluorocarbons (PVDF)	Kynar	OK
Nylon	Zytel	OK
Polycarbonate	-	OK on most but test
Polyester PBT	Valox	OK
Polyester PET	Rynite	OK
Polyetherimide	Ultem	OK
Polyethylene	Alathon	OK
Polyimide	Kapton	OK
Polyphenylene oxide	Noryl	OK
Polyphenylene sulphide	-	OK
Polypropylene	-	OK
Polystyrene	-	OK
Polysulphone	-	OK
Polyvinyl chloride	-	OK

Note that the normal cleaning process will be less than 5 minutes at less than 25°C. Under these conditions there should be no problem with plastics commonly used in the electrical / electronic fields.

Rubbers/Seals

The material has also been tested on a wide range of rubber elastomers, e.g. neoprene, nitrile, Buna without problem (1 day 40°C).

Metals

Metals will not be discoloured under the specified cleaning conditions of time and temperature.

Notes

For most elastomers above there are no problems after 4 months at 45°C (aqueous based product).

For machinery/pipework - use SS316 for **SWA / SWAF.**
In presence of aluminium, copper or brass use only **SWAJ / SWAP / SWAS** if exposure will be greater than 24h at 45°C.