ELECTRONICS CLEANING TERMS AND DEFINITIONS
(AS THEY RELATE TO PRINTED CIRCUIT ASSEMBLY CLEANING)

ABSORPTION The penetration of one substance into the inner structure of another.

ADSORBED CONTAMINANT A contaminant which is attracted to the PWB surfaces and held captive in the form of a gas or liquid.

ACID A substance that ionizes in solution to release the positive ion of the solute. The strength of tile acid is proportionate to the amount of ions released in solution. The strongest acids have the lowest pH readings, ie. closest to I.O.

AIRKNIFE A means, usually a slotted tube, by which air can be directed into a focused flow toward a surface. Airknife shapes and orifices can vary. The term airknife can also refer to the curtain or "knife" of air itself. Typically airknives are fed by high velocity or high volume blowers.

ANHYDROUS Free of water.

ANION A negatively charged ion that migrates to an anode, as in electrolysis.

AZEOTROPE A solvent blend that has the same composition and characteristics in the vapor phase as it does in the liquid phase, This property enables ail azeotropic solvent to go front the liquid state to the boiling state (evaporation) and be cooled (condensed) back to the liquid state for recovery or distillation. DuPont's FREON™ TMS is an example of an azeotrope.

BASE A substance that ionizes in solution with water to release negatively charged hydroxyl (OH,) ions. The strength of the base is proportionate to the amount of hydroxyl ions released in solution. The strongest bases have the highest pH readings, ie. closest to 14.0. (Base is also referred to as alkali or alkaline).

BIODEGRADABILITY The propensity of a substance to decompose by microorganisms normally found in the environment.

B.O.D/C.O.D. Biological oxygen demand/chemical oxygen demand. A relative measure of impact, in terms of oxygen demand, of dissolved and colloidal organic matter oil the biological units (bacteria) required to maintain a properly functioning waste treatment facility. Chemical additives to aqueous cleaning systems will often raise BOD/COD over the acceptable limits of the POIV.

CFC Abbreviation for Chlorofluorocarbon.

CFC-113 A common name for the most common CFC solvent-- 1,1,2-trichloro-1,2,2-trifluoroethaiie. CFC-113 has an ODP of approximately O.8.

CALORIE The amount of heat necessary to raise one gram of water one degree centigrade (at 1 atmosphere pressure). A Calorie (with a capital "C") is the amount of heat needed to raise one kilogram of water one degree centigrade.

CAPILLARY ACTION The interaction between a liquid and a small diameter opening in a solid. Because of surface tension, the liquid is drawn into tile opening by this action. The Young-Laplace equation of differential pressure can demonstrate this phenomenon.

CASCADE SYSTEM A system configuration whereby cleanest water is used in one tank, or section, and overflows to the previous tank or section relative to board movement. A typical example would be deionized water entering the final rinse section of a cleaner, flowing to a recirculating rinse section, then to a wash, then to a

prewash, and then to drain. Thus, the board assembly is exposed to progressively cleaner water as it moves through tile system. This flow configuration is typically used when cleaning without wash additives, such as with water soluble fluxes.

CATION A positively charged ion that migrates to a cathode during electrolysis.

CHEMICAL ISOIATION A term developed by Hollis Automation referring to an enhanced dragout section in an in-line cleaner. Instead of a simple airknife/blower combination, chemical isolation uses a low-flow water spray in between two sets of airknives to flush residual wash water from connector bodies, under components, etc. The water from this section may be supplied from the rinse section or from an external source.

CHEMICAL COMPATIBILITY This term refers to the acceptability of use of a chemical relative to the machine in which it's used, and tile product it cleans. Some chemistries will have degradative effects oil equipment and/or boards. Chemical compatibility should be verified prior to implementing a cleaning process.

CHLORINATED POLYVINYL (CPVC) A plastic often used in cleaner plumbing which is similar to commercially available PVC found ill domestic plumbing, however, it can handle greater temperatures and pressures. It is available in Schedule 40 or Schedule 80 grades, with 80 being the most durable. CPVC plumbing is easy to work with because it does not require threading or welding, it is glued.

CHLOROFLUOROCARBON (CFC) A compound consisting of carbon, hydrogen, chlorine, and fluorine to have a negative impact oil the earth's protective ozonosphere. These compounds are being phased out of production by edict of the Montreal Protocol.

CLEANLINESS TESTING Any of a family of tests used to verify a required cleanliness specification. Testing may include residual ionic evaluation (conductivity testing), surface insulation resistance testing (SIR), chromatography evaluation.

CONORMAL COATING A protective material applied in a thin, uniform layer to a printed wiring assembly.

CONDENSATION The change of state from a gas to a liquid.

CONDUCTIVITY TESTING Also known as residual ionic evaluation, solvent extract resistivity testing and Omegameter/Ionograph testing. A quantitative evaluation of residual conductive (ionic) material left on a board in which this material is expressed as an equivalent of micrograms of salt (NACI) per square inch. This test involves immersing the board in a known volume of solution of isopropyl alcohol and deionized water at a known initial conductivity. In some machines this solution is heated and agitated during the test period. During the typical 10 minute test, residual ionics go into solution, thus increasing the conductivity of the solution. By analyzing this change in conductivity relative to the surface area of tile board, an equivalent measurement of contamination call be determined. There are many specifications covering this test, but the most quoted is Mil-P-28809.

CONTAMINANT An impurity that may or may not affect the performance of a circuit assembly. Typically, contaminants are classified as polar, non-polar or particulate in nature.

DECANT In semi-aqueous cleaning most hydrocarbon-based and terpene-based solvents will separate from water and rise to tile top in a tank. This enables tile solvent to be recovered from water, as in when wash SA solvent is carried or dragged out into tile water rinse section, by separating into a weir.

DEFOAMING AGENT Ail additive to wash or rinse tanks in a cleaner which will reduce the tendency to produce a head of foam in the tank.

DEIONIZED WATER Water which has had a degree of positive and negative ions removed so as to decrease its conductivity (raise resistivity). Typically, this is done in the ion exchange process. in general, the highest degree of deionization possible under normal conditions will result in resistivity of 18.2 meg-ohms. Tap water has resistivity

as low as 1-5 kilo-ohms. In addition to having low conductivity potential, DI water is prone to absorbing ions aggressively in the rinse process. Because of low dissolved mineral content, DI water is also less prone to leaving water spots oil a board. In the cleaning process, it is rarely necessary to deionize to the 18.2 meg-ohm extent. Desired results can usually be achieved in the 500k to 3 megalith range.

DENDRITIC GROWTH An indicator of electro-migration. The appearance of stalk-like growth between conductors to which a bias voltage has been applied indicating that electrolytic transfer has occurred, and, hence a potential problem for current conductivity exists. This is a visual test usually tinder 2-8X magnification.

DETERGENT A cleaning agent that exerts an emulsifying action at polar/non-polar interfaces, as in oil/water, so as to separate them and enable them to be rinsed away.

DISTILIATION A process of boiling, evaporation and condensation of a substance for purification by separating out contaminants. This process was typically used for recovery of solvents in CFC cleaning.

DRAG-OUT The carryover of water, wash chemistry, and/or contaminants in solution from one functional section of a cleaner to another.

ELECTRICAL LEAKAGE A phenomenon associated with the degradation of surface insulation resistance on a circuit board leading to partial conduction of current electrical trace and on to the substrate.

EMULSION A suspension of small globules of one liquid in a second liquid with which the first will not mix. This can occur with some semi-aqueous solvents in water.

EVAPORATION The process by which a liquid vaporizes into tile surrounding atmosphere. This process can generally be accelerated by adding heat. One cause of the loss of water in a cleaning system is evaporation.

FINAL RINSE Tile last wet section of a cleaner. Typically, this is where deionized water is introduced to the machine. It may or may not cascade to preceding sections.

FILTRATION The process of separating suspended solids from a liquid by forcing the mixture through a porous barrier.

FLASH POINT The temperature at which a volatile liquid mixes with air in such proportions as to produce a flammable gaseous mixture. This mixture will flash when exposed to a flame or spark, but will not necessarily continue to support combustion.

HALIDES A compound containing fluorine, chlorine, bromine, iodine, or astatine. These materials are sometimes present in the activators of soldering fluxes. Halide residues must be cleaned off the circuit board.

HARD WATER Water containing a relatively high content of calcium carbonate or other minerals which tend to collect oil cleaner tank walls and in plumbing, forming a hard-to-remove scum layer.

HYDROPHILIC Having a strong tendency to absorb, attract, or be dissolved in water.

HYDROPHOBIC Incapable of dissolving in water. Water "fearing."

HYGROSCOPIC The tendency of a material to readily absorb water, usually from the air.

INORGANIC A chemical compound not having the element carbon, with the exception of carbon dioxide and compounds containing the carbonate radical.

ION A positively or negatively charged particle. Ionic residues are conductive.

ION EXCHANGE The utilization of coated resins called anionic and cationic to remove positive and negative ions in solution. Typically, this process is combined with a carbon tank to remove organic contaminants and a bag or cartridge filter to remove large particulates. This process is used to deionize water.

IONIC CONTAMINATION Residual material left on a board that is ionic in nature, and, therefore, is potentially conductive.

ISOLATING CURTAINS Flexible curtains, usually silicone rubber or BUNA-N, mounted between cleaner stages to help limit overspray and dragout.

NON-POLAR A substance that will not breakdown electrically into positive and negative components in solution. A non-polar contaminant can only be removed by a non-polar solvent. Rosin is a non-polar contaminant.

ODP Ozone-depleting potential.

ORGANIC Containing carbon.

OZONE A gas formed **when** oxygen is ionized by, for example, the action of ultraviolet light or a strong electric field. It has the property of blocking the passage of dangerous wavelengths of ultraviolet light. Although it is a desireable gas in the atmosphere, it is toxic to living organisms at ground level.

OZONE DEPLETING POTENTIAL A relative index indicating the extent to which a chemical product may cause ozone depletion. The reference level of 1.0 is the potential of CFC-11 and CFC-12 to cause ozone depletion. If a product has an ozone depletion potential of 0.5, a given weight of the product in the atmosphere will, in time, deplete half the ozone that the same weight of CFC-11 will deplete.

pH The measure of acidity or alkalinity of a solution. A pH of 7.0 is considered neutral; greater than 7.0 is alkaline (basic) and less than 7.0 is acidic. The greater the deviation from 7.0, the stronger the acid or base. The scale runs from 1.0 to 14.0 and is exponential. There are many tests to determine pH, the most common being litmus paper.

PARTICULATE CONTAMINATION General classification of residues left on a board that are not attributed to flux. This may be router dust, room dust, metal shavings, etc.

POLAR A term describing a substance at the atomic level which will breakdown in solution into positive and negative electrical components. A polar contaminant can only be dissolved by a polar solvent. Water is a polar solvent.

POLYPROPYLENE A polymer of propylene that is a thermoplastic resin. It is often used in the manufacture of cleaning systems because of its ease of assembly, resistance to chemicals, and cost-effectiveness.

POTW Publicly owned treatment works. Refers to a community's public sewage treatment facility.

PREWAGH The first stage in a cleaner. The function of this section is to remove gross contamination to drain, without carrying over into the recirculating wash station. In straight aqueous (non-saponified) systems, this stage should always go to drain. In saponified systems, this stage should not be plain water, but should be an extension of the wash section, spraying saponified water on to the board.

PRESSURE EQUALIZATION AND BALANCING Refers to a setup process in a cleaner whereby the upper spray manifolds and airknives are biased to a slightly higher pressure than the lowers so as to avoid a tendency for the board to lift up off the conveyor belt from the pressures delivered by the lower manifolds and airknives.

PROCESS WINDOW A term used to describe the range of settings for various process parameters within which success of the process is achieved.

PUMP PERFORMANCE CURVE A curved graph supplied by a pump's manufacturer plotting flow on one axis and pressure on the other. A properly designed cleaner will have spray manifolds optimized so that pressure and flow fall along this curve for a Oven pump. An increase in pressure will result in a corresponding decrease in flow, and vice versa.

RESIN A solid or semi-solid organic compound lacking a crystalline structure. Resins are characterized by the lack of a definite melting point**,** and are usually not conductors of electricity. Natural resins originate in plants, such as pine sap, and are not water soluble. The rosin used in flux is a resin. Synthetic resins may have many or all of the properties of natural resins.

REVERSE OSMOSIS A mechanical process of a concentrated solution through a membrane to yield clean water. Membrane porosity determines the purity of the water. The smaller the pores in the membrane, the more pure the resultant water, however, smaller pores allow lower flow rates.

RINSE A stage in the cleaning process of removing residual soils or wash solutions left from the previous stage. In a cleaning system, there may be multiple rinses, they **may** cascade, they may have fresh water inputs, and/or they may recirculate.

ROSIN A naturally occurring resin, usually associated with pine sap. It is widely used in flux. R is rosin, non-activated, RMA is rosin, mildly activated, and RA is rosin activated.

SALT A compound formed by the reaction between an acid and a base. The hydrogen ion of the acid is replaced by the metal associated with the base, and tile hydroxyl ion of the base is replaced by the negative ion from the acid. The hydrogen and hydroxyl ions combine to form water. A common example ofthe formation of a salt is table salt, NaCl, formed from the **reaction** of hydrochloric acid, HCI, and sodium hydroxide, NAOH. Salts ionize in water and are conductive.

SAPONIFIER A general term applied to a solution of organic or inorganic bases and various agents, such as wetting agents and dispersants, for promoting the removal of non-water soluble contaminants, such as rosin fluxes, greases, oils, etc. The removal of rosin flux is based on the chemical reaction between acids in the rosin and the alkaline saponifier, which results in a water soluble or dispersable rosin "soap."

SATURATED SOLUTION A solution in which the solvent can accept no more solute. The result of adding more solute is usually particles in suspension or which precipitate to the bottom of the containment vessel.

SEMI-AQUEOUS As applied to cleaning, refers to a process of cleaning with a solvent in the wash stage, typically a terpene, hydrocarbon, or alcohol blend**,** followed by water rinse (s).

SOFT WATER Processed water in which the calcium and/or magnesium ions causing hardness have been replaced through a water softening process with sodium ions. Caution must be taken when using softened water, as opposed to deionized water, in rinse stages because it may increase residual ionic readings.

SOLIDS CONTENT In rosin fluxes, refers to the percentage by-weight of rosin and other solids in a particular formulation.

SOLUTION A homogeneous mixture in which a solid, liquid or gas is dissolved in a liquid, called a solvent, and it forms a clear or transparent mixture. SPRAY BAR A pipe plumbed from a feed manifold having one or more spray nozzles on it.

SUBLIMATION A physical process whereby a solid evaporates directly into a vapor without passing through a liquid phase. Evaporation of dry ice is an example of this.

SURFACE INSUIATION RESISTANCE TEST (SIR) An accelerated aging test that evaluates the resistance on the surface of a board which undergoes temperature and humidity cycling. Typically this test involves a grid test

pattern on the board which has a bias voltage applied during testing. if conductive material remains oil the board, when exposed to temperature and humidity cycling, this will manifest itself by decreasing the surface insulation resistance, which will be measurable. Mil-Std 2000 includes the acceptable test measurements. SIR testing usually takes 168 hours. While this test is highly accurate at the area evaluated, it does not provide an overall analysis for the entire board surface.

SURFACE TENSION A property of liquids whereby molecular forces tend to contract the volume into a form with the least surface area. The higher tile surface tension, the greater the tendency of a droplet to bead up from a flat surface. Droplets with lower surface tension tend to spread out, or wet the surface. Surface tension, in and of itself, is not an accurate measurement of a droplets ability to penetrate a tight space. Capillary action must also be evaluated. As a general rule, higher surface tension favors penetration, but lower tension favors rinsability. Surfactants can reduce surface tension of a liquid.

SURFACTANT A chemical agent that acts upon a liquid to reduce its surface tension.

SUSPENSION A mixture of liquid or solid in a liquid that is not a true solution because discrete droplets or particles are visible, and the solution is not clear. If the particles are small enough to pass through a filter, or do not settle out after standing, the mixture is called a colloid.

THERMAL COEFFICIENT OF EXPANSION The incremental factor of change in dimension of a material due to temperature rise. These factors become important when mating different materials to each other. If they expand at dissimilar rates, the method of attachment must compensate for the differing growth rates to avoid stress fractures, leaks, etc.

TURBINE BLOWER A combination of a motor driving a rotary fan assembly, typically via belt, at very high rpm (relative to direct drive, or "squirrel cage" blowers). The effect is to produce a high velocity air flow which has proven to be very effective in drying when directed through an air knife.

ULTRASONIC CLEANING A process in which ultrasonic energy is added to a liquid to impart energy to it and enhance its cleaning ability. Ultrasonic energy causes alternate rarefaction and compression of the liquid to create small vacuum cavities which then collapse or implode during compression. This is a rapid process, called cavitation, and it is responsible for developing the scrubbing action and ability to penetrate blind areas which is unique to ultrasonics. The cavity size is determined by the frequency used. Low frequencies generate large, but relatively few, cavities with high cleaning ability. High frequencies generate a great number of small cavities, which have good penetrating ability. There is an optimization that must be achieved, with 40 KHz being the best "all-around." The cleaning chemistry's physical characteristics also affect cleaning ability. The solution will ideally soften the soils, yet mustcavitate and rinse easily.

V-JET NOZZLE A general term applied to spray nozzles which project a pattern like the letter "v" with the vertex emanating from the nozzle orifice. The spray may be flat or slightly elliptical. A round pattern is indicative of a cone nozzle.

VAPOR PRESSURE The pressure exerted by a vapor in equilibrium with its solid or liquid phase. The pressure exerted by the vapor is dependent oil temperature and the higher the vapor pressure, the greater the volatility and evaporation rate.

VESICATION A blistering defect which may occur on boards with conformal coatings when excessive residues are present.

VOLATILE ORGANIC COMPOUND (VOC) Constituents that will evaporate at their temperature of use and which, by a photochemical reaction, will cause atmospheric oxygen to be converted into potential smog-promoting tropospheric (ground level) ozone under favorable climatic conditions.

VOIATILITY The relative rate of evaporation of a liquid.

WASH Refers to the functional section or process within a cleaner in which the primary removal of contaminants takes place. The wash may be with straight water, straight solvent chemistry, or a mixture of water and saponifier or solvent.

WATER SOLUBLE Capable of being dissolved in or by water.

WHITE RESIDUE A general name for a milky white residue that sometimes appears on the board after the cleaning process. There are many possible causes for this, some of which are functionally harmful, and some not. Possible causes include incomplete flux residue removal, leeching of material from the laminate, and incomplete cure of the solder resist on the board.

ABOUT SMEMA

The Surface Mount Equipment Manufacturers Association (SMEMA) is a non-profit organization of companies manufacturing equipment or producing software for surface mount board production. its objectives are to: promote standards for the interface and operation of equipment, provide users with the ability to select equipment with the assurance that the equipment will interface easily, advance SMT and promote its use, and investigate areas where the association can act to the benefit of all member companies.