



WHAT IS
SCIENCE
WITHOUT
CARE?

TECHNICAL REPORT

Prepared For:

Henkel LOCTITE GC 10

Because we want you to achieve the highest levels of performance, we connect care with leading science to continuously improve, problem solve and create the most effective cleaning solutions to suit your specific needs.

KYZEN is an ISO 9001:2008 certified company.

Scope: This document reports *Best Fit Cleaning Agent* process parameters for removing LOCTITE GC 10 solder paste flux residue. Solubility testing was used to evaluate the effectiveness of Kyzen Electronic Assembly cleaning agents for removing the flux residue set.

LOCTITE GC 10 solder paste is a halogen free, no-clean, low voiding, Pb-free solder paste specially formulated to provide added long term stability over a range of temperature conditions.

Objective: To characterize the cleaning and solubility properties of LOCTITE GC 10 flux residue.

Process Cleaning Rate

The process cleaning rate theorem holds that the rate at which a solvent or cleaning agent dissolves a residue (static rate) plus mechanical energy (dynamic rate) equals the process cleaning rate. To determine the static cleaning rate (rate at which the cleaning agent dissolves the residue in the absence of mechanical energy), Kyzen uses two static cleaning tests. The first test (Phase 1) develops a Hansen Solubility Parameter for each flux residue. The Hansen Solubility Parameter provides insight into the material sets that dissolve the residue. The Phase 1 test exposes the processed flux residue on test coupons to a series of solvents with known solubility parameters. The test coupons are graded (Figure 1) based on each solvent's ability to dissolve the residue

The confidential Phase 1 test values will not be included in this report however they are available upon request.

The second test (Phase 2) exposes each flux residue to different Kyzen cleaning agents in an effort to match up the right cleaning agent to the soil matrix. This testing provides insight into the technology base options for cleaning the specific residue set.

Procedure: Phase 2 - Matching the Cleaning Agent to the Flux Residue

The objective of Phase 2 testing is to develop the static cleaning rate. Static cleaning rates measure the cleaning agent's affinity to dissolve the soil in the absence of mechanical forces. High static cleaning rates indicate a strong match for the soil in question.

Wash concentration of the Aquanox materials was set at 10, 15 and 20% and testing temperature was 40 and 60°C.

The semi – aqueous and solvent materials are processed as neat solutions. Testing temperature was 40 and 60°C.

Time is fixed at 10 minutes. The test vials are rotated to assure that the cleaning agent is well mixed during the test.

The test vials are rotated at specific temperatures in a LabRoller to assure that the cleaning agent is well mixed during the test.

Figure 1 illustrates the grading scale used to score the test coupons.



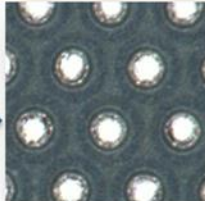
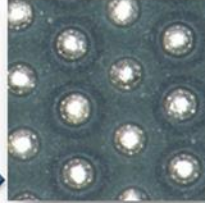
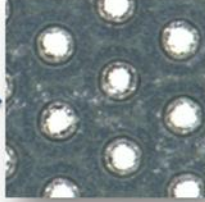

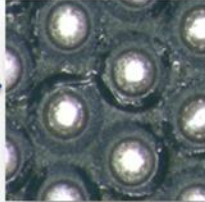
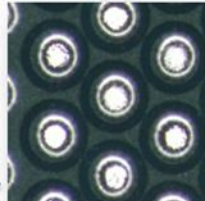
Score	Description		
1	No visible residues	→	
2	Slight visible residues	→	
3	Some visible residues	→	
4	Significant visible residues	→	
5	Minimal cleaning effect on residues	→	
6	No effect	→	

Figure 1: Grading Scale 1-6

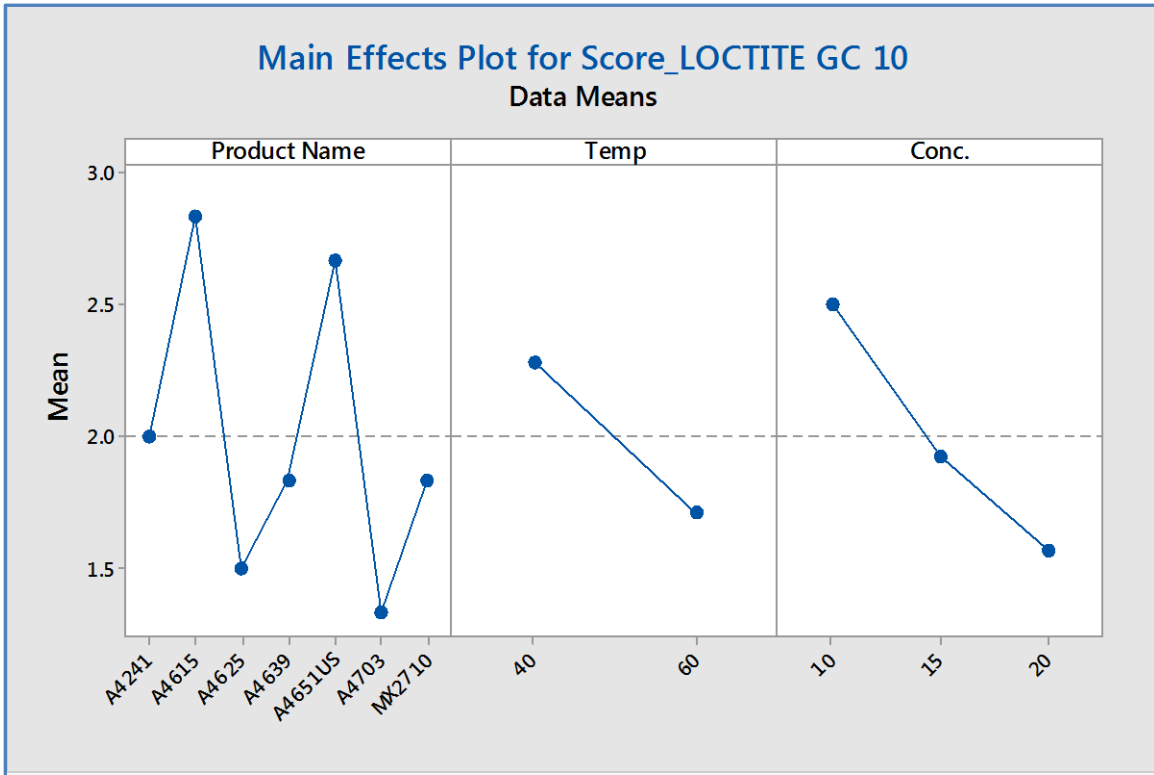
Data Findings:

The response scores were placed into Minitab statistical software package. The main effects plot provides insight into the cleaning agents that best match up with the LOCTITE GC 10 flux residue. The cleaning agents tested were grouped into the following product categories:

1. Aqueous Defluxing
2. Semi-Aqueous Defluxing



AQUEOUS CLEANING AGENTS

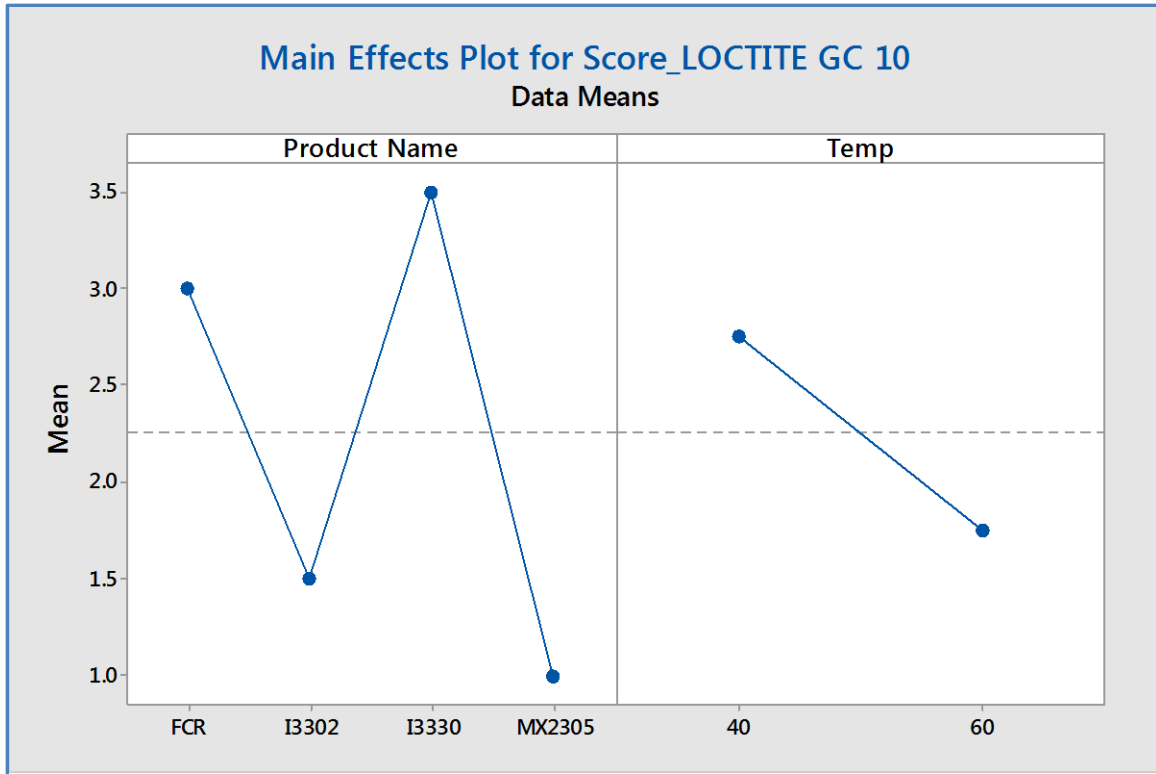


1. Aquanox A4241 is an engineered aqueous cleaning agent designed to remove both wet solder paste and reflowed flux residues with spray in air cleaning equipment. The static testing indicates that Aquanox A4241 is effective at removing LOCTITE GC 10 flux residue.
2. Aquanox A4615 is an engineered inorganic based aqueous cleaning agent designed for use in highly populated areas with stringent VOC air regulations. Aquanox A4615 is designed for use with spray in air and ultrasonic cleaning equipment. The static testing indicates that Aquanox A4615 is marginally effective at removing LOCTITE GC 10 flux residue.
3. Aquanox A4625 is an engineered aqueous cleaning agent designed to remove reflowed flux residues with spray in air cleaning equipment. The static testing indicates that Aquanox A4625 is most effective at removing LOCTITE GC 10 flux residue.
4. Aquanox A4639 is a next generation single chamber batch cleaning solution that provides exceptional cleaning results and protection of metallic surfaces with minimal monitoring and no sump-side additives. The static testing indicates that Aquanox A4639 is effective at removing LOCTITE GC 10 flux residue.
5. Aquanox A4651US is a low pH aqueous cleaning solution designed exclusively for use in ultrasonic immersion cleaning systems. The static testing indicates that Aquanox A4651US is effective at removing LOCTITE GC 10 flux residue.
6. Aquanox A4703 is a pH neutral range engineered aqueous cleaning agent designed to remove reflowed flux residues with spray in air cleaning equipment. The static testing indicates that Aquanox A4703 is most effective at removing LOCTITE GC 10 flux residue.

7. MICRONOX® MX2710 is a neutral pH chemistry designed for the flip chip and wafer level packaging, and is particularly effective on copper pillar technology. MX2710 is effective on all flux types including no-clean and water soluble flux residues. MICRONOX® MX2710 is compatible and safe for gold and aluminum bonding pads.

Aqueous Cleaning Recommendations – LOCTITE GC 10				
Cleaning Agent	Soil	Wash Conc.	Wash Temp.	Wash Tool
Aquanox A4241	Solder Paste Flux Residue	20-25%	60°C	Batch / Inline SIA
Aquanox A4615	Solder Paste Flux Residue	NR	NR	Batch / Inline SIA
Aquanox A4625	Solder Paste Flux Residue	15-20%	60°C	Batch / Inline SIA
Aquanox A4639	Solder Paste Flux Residue	15-20%	60°C	Batch SIA
Aquanox A4651US	Solder Paste Flux Residue	>20%	60°C	Ultrasonic
Aquanox A4703	Solder Paste Flux Residue	15-20%	60°C	Batch / Inline SIA
Micronox MX2710	Solder Paste Flux Residue	15-20%	60°C	Batch / Inline SIA

SEMI-AQUEOUS CLEANING AGENTS



1. Ionox I3330 is a semi-aqueous cleaning agent designed to remove reflowed flux residues. The static testing indicates that Ionox I3330 is effective at removing LOCTITE GC 10 flux residue.
2. Ionox I3302 is a semi-aqueous cleaning agent designed as a broad spectrum high strength solvent for semiconductor, flip-chip and wafer level packaging. The static testing indicates that Ionox I3302 is most effective at removing LOCTITE GC 10 residue.
3. Micronox MX2305 is an engineered semi-aqueous solvent blend designed to remove difficult flux and paste residues including lead-free, rosin, no-clean, and tacky flux from wafer bumps found in flip chip, chip scale and μ BGA packages. The static testing indicates that Micronox MX2305 is most effective at removing LOCTITE GC 10 flux residue.
4. Ionox FCR is a high strength concentrated cleaner containing a blend of organic solvents and inhibitors. It is multi-metal safe and can be used in immersion agitation, ultrasonic or centrifugal systems. As a legacy cleaning solution Ionox FCR is effective for the removal of virtually all types of pastes and fluxes including rosin, low residue/no-clean and organic acid flux. The static testing indicates that Ionox FCR is effective at removing LOCTITE GC 10 flux residue.

Semi-Aqueous Cleaning Recommendations - LOCTITE GC 10				
Cleaning Agent	Soil	Wash Conc.	Wash Temp.	Cleaning Machine
Ionox I3330	Solder Paste Flux Residue	100%	60°C	Spray Under Immersion, Ultrasonic & Direct Energy Wet Bench Processes
Ionox FCR	Solder Paste Flux Residue	100%	60°C	Spray Under Immersion, Ultrasonic & Direct Energy Wet Bench Processes
Ionox I3302	Solder Paste Flux Residue	100%	40-60°C	Spray Under Immersion, Ultrasonic & Direct Energy Wet Bench Processes
Micronox MX2305	Solder Paste Flux Residue	100%	40-60°C	Spray Under Immersion, Ultrasonic & Direct Energy Wet Bench Processes

Phase 3: Dynamic Cleaning Energy

The third important cleaning parameter is represented by the energy used to deliver the cleaning agent to the soil. Fluid dynamics increase the cleaning rate using fluid flow and pressure.

Aqueous cleaning processes are dramatically improved with dynamic cleaning energy and temperature. One benefit when formulating aqueous cleaning agents is the ability to engineer a material set that matches up to the residue. The concentration range for these products is typically 10% to 20% for No-clean and rosin fluxes and 3-8% for water soluble fluxes.

Applying spray in air impingement energy and elevated wash temperatures opens the process window for excellent cleaning results. The data in this report characterized both the flux residue and cleaning agents.

Semi-aqueous cleaning agents drive more with the static rate than with the dynamic rate. The solvency of semi-aqueous cleaning agents with the flux soil is a critical parameter for predicting cleaning performance.

The Ideal Cleaning Condition is dependent on many factors and does not solely rest on the cleaning agent. It is important to review the variables present as outlined in below Figure 2.

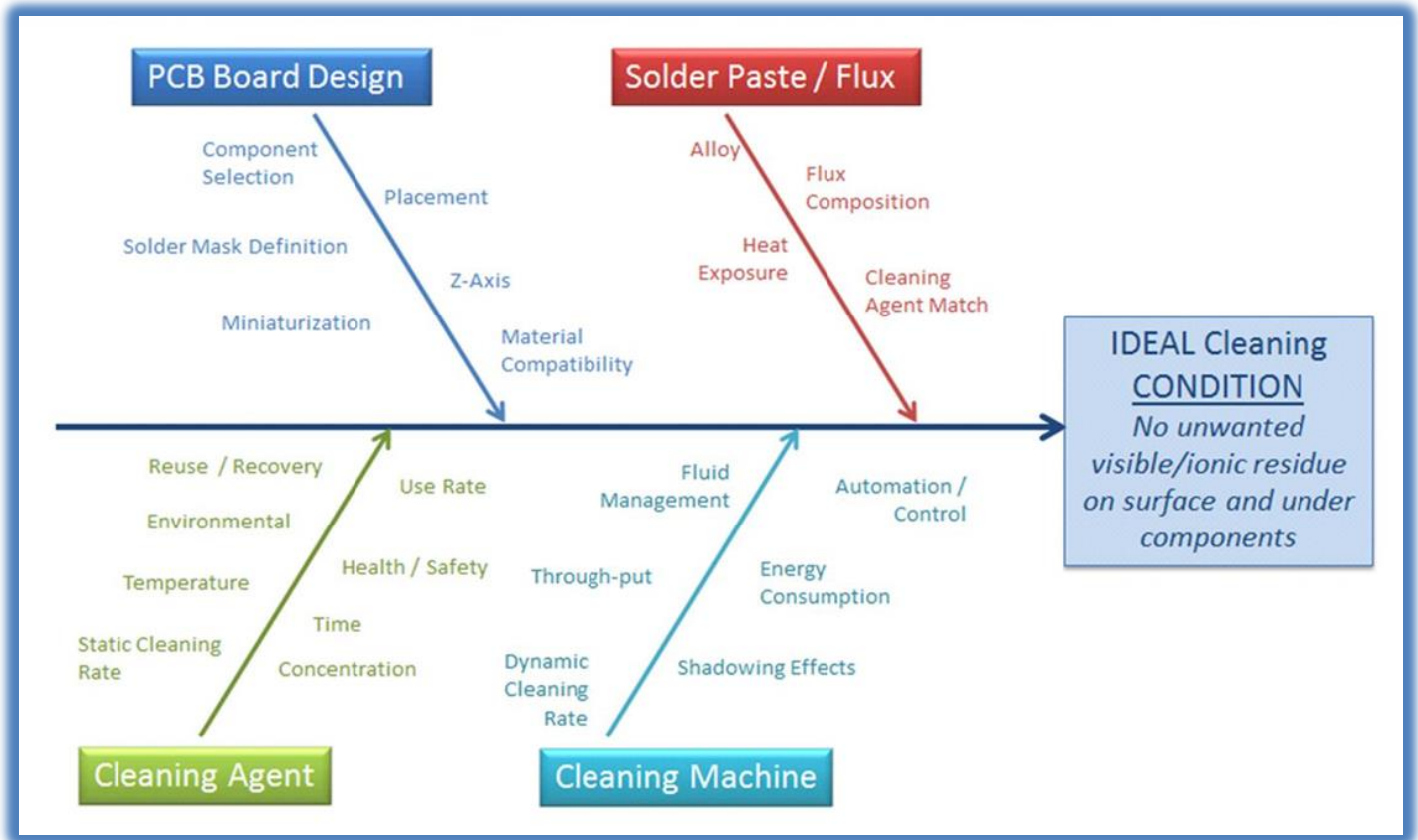


Figure 2

Inferences and Recommendations from the Data

Static material property testing confirms that solder flux residues are different in composition and their ability to be cleaned must be closely matched to the cleaning agent.

The data in this report characterized both the flux residue and cleaning agents. Flux residues that form a hard clear shell require longer wash times to dissolve in the cleaning agent, thus requiring increased wash bath exposure time to effectively clean these residues. The data finds that LOCTITE GC 10 solder paste flux is defined as a no-clean flux formula that has shown to be cleanable when exposed to Kyzen cleaning solutions.

The core technologies provided in KYZEN cleaning agents can, with a defined cleaning process effectively clean LOCTITE GC 10. For bench top and spot rework cleaning KYZEN Cybersolv 141R is recommended.

As the report details, KYZEN engineers a wide range of cleaning agents designed to match up with client needs. Contact your local KYZEN representative for the best recommendation and product samples for testing.

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