

# Dishwashing Durability Testing For Success





## INTRODUCTIONS:

I am Keith Ladd. I have almost 40 years of experience at Custom Deco in the ceramics and glass printing industry. Having spent 20 years as Quality Manager, I now serve as Production Manager.

Over the years, dishwashing durability has come up consistently as a big challenge in our industry.





## THE GOAL:

To develop and align customers and decorators with dishwasher standards related to drinkware in the U.S.



Currently there are differing opinions among decorators regarding the dishwashing durability of different inks.

For Example:

- With UV inks we can expect up to 1,000 cycles with our decorations .

TO

- Handwash is recommended for all UV products.

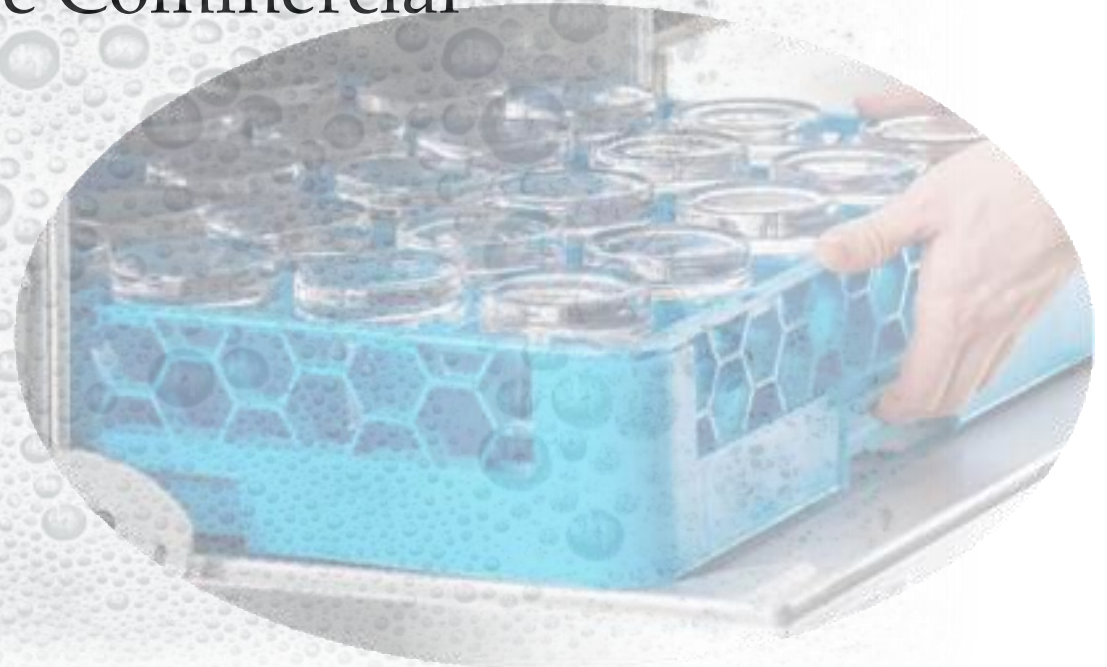
## Variables affecting durability:

- Types of Dishwashers
- Types of Detergents
- Types of inks
- Other factors
- Current Standards



## 3 Types of Dishwashers:

- High Temperature Commercial
- Low Temperature Commercial
- Residential



## Dishwasher Differences

- Cycle times range from 90 seconds to over 3 hours long depending on type make and settings.
- Residential dishwashers have top racks and bottom racks that can give different results.
- Water temperatures vary from each type and can affect the durability.

## Other Variables

- Detergents
- Rinse Aids
- Sanitizers

Which ones are best for decorated glassware?

How many different combinations are there?



Some detergents are considered hazardous waste and gives special disposal requirements.

While others say they are not for decorated products



## Many detergents are corrosive and have different kind of acids in them.

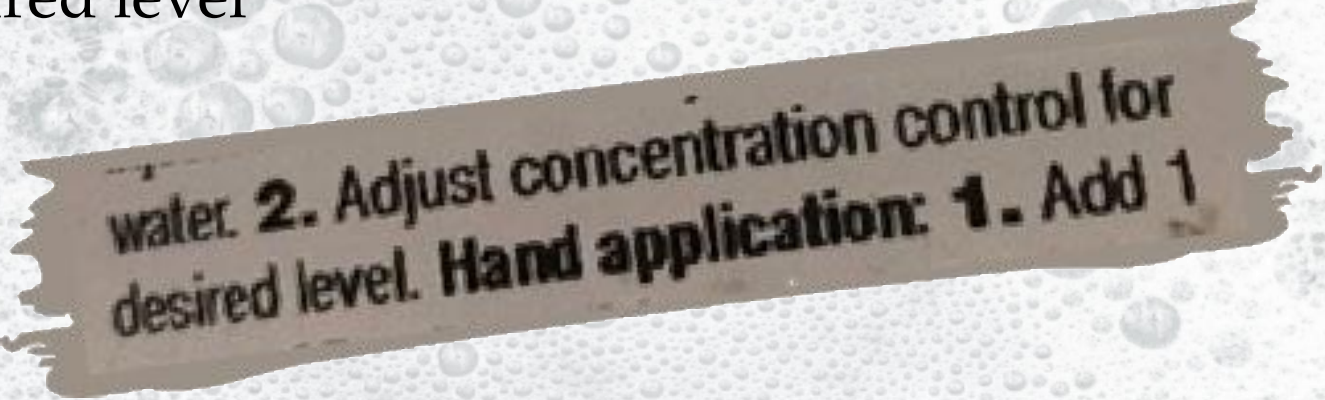
| Chemicals                                           | Hazards                                              | Notes                                                                                                                                                                                              |
|-----------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sodium hydroxide                                    | Skin corrosion/irritation                            | Waste from residues / unused products is considered a hazardous waste according to Federal regulations (40 CFR 261.4 (b)(4))                                                                       |
| Trisodium citrate                                   | Serious eye damage/eye irritation                    |                                                                                                                                                                                                    |
| Aminotrimethyl phosphonic acid                      | Metal Corrosion                                      |                                                                                                                                                                                                    |
| Sodium hypochlorite                                 | Causes severe burns                                  | Had product that was sent out to 3rd party testing lab and passed twice. Negative reviews on Lemishine website stating that it took the decoration off or ruined dishes.                           |
| Sodium hydroxide                                    | Corrosive                                            |                                                                                                                                                                                                    |
| Trisodium Nitrolocriacetate                         | Harmful if swallowed                                 |                                                                                                                                                                                                    |
| Potassium Hydroxide                                 | Very toxic to aquatic organisms                      |                                                                                                                                                                                                    |
| SDS says Supplier Trade Secret                      | Acute Health Hazard<br>Causes serious eye irritation | SDS says to not mix with any other product or chemical. Customer was using with DIVERFORCE. unused products is considered a hazardous waste according to Federal regulations (40 CFR 261.4 (b)(4)) |
| Bottle says Natural citric extracts and citrus Oils |                                                      |                                                                                                                                                                                                    |
| Phosphoric acid                                     | very corrosive                                       |                                                                                                                                                                                                    |
| Hydrochloric acid                                   | causes permanent eye damage                          |                                                                                                                                                                                                    |
| D glycol methyl ether                               | causes permanent skin damage                         |                                                                                                                                                                                                    |
| Formaldehyde                                        |                                                      |                                                                                                                                                                                                    |

## **Some chemicals known to deteriorate ceramic enamels quicker if present in dishwasher detergents:**

- Hydrochloric Acid
- Sodium Hypochlorite
- Formaldehyde
- Amino Trimethylene Phosphoric Acid (ATMP)
- Potassium Hydroxide
- Trisodium Citrate
- Trisodium Nitrolocriacetate
- Phosphoric Acid

## Concentration of detergents used

- Most detergents do not offer a recommended amount of use.
- Most common phrase is to adjust concentration for desired level



water. 2. Adjust concentration control for desired level. Hand application: 1. Add 1

## Concentration of detergents used (cont.)

- Our High temp commercial dishwasher has settings that go from 2% to 9.5% detergents.
- Inhouse testing showed the higher the concentration the less durable the inks.

Lemi Shine in a residential dishwasher with the proper amount in the soap dispenser was fine. Putting the same amount on the bottom of the dishwasher took the entire decoration off in one washing with the exact same item decorated at the same time.



## Types of Ink

There are many different types of inks as well as many different versions of those types.

- Ceramic Enamels
- UV Inks
- Sprays
- Colors of Ink



## Ceramic Enamels

- Substrate and firing temperatures affect dishwasher durability. Typically, the hotter the fire temperature the better the durability.
- There are different types of flux used to make the ceramic enamels that will affect dishwasher durability.



## UV Inks

- Pretreatment type – Pyrosil vs flame treatment or only post cure. All will have different results in dishwasher durability.
- Some use a primer to help adhesion.
- Bulb intensities and rotation under the lamps will affect dishwasher durability.
- Belt speed on a UV tunnel will affect the dishwasher durability.



## Colors of Ink

- All inks have different compounds and components that make up the different colors. I have seen different colors have different results of dishwasher durability.



## Other Factors

- Hard or soft water
- City or well water
- Chemicals in the water like iron for example
- Drying temperatures
- Contamination of the substrate
- Internal mistakes we first made.

## Current Standards

- DIN EN 12875
- ASTM C676
- ASTM C724

**There are no current US standards today  
that actually use some type of dishwasher for testing.**

## DIN EN 12875

DIN EN 12875 is a European standard specifying methods for testing the mechanical dishwashing resistance of household articles, such as ceramics, glass, metal, and plastics. It evaluates durability against chemical, thermal, and mechanical stresses, with Part 1 covering standard tests (often 125 cycles).

## DIN EN 12875 (cont.)

DIN EN 12875 is a European standard using the following guideline

- 125 cycles
- 149F water temperature
- 1 hour cycle

\*Common water temperatures in the US are 170F to 180F in a high temp commercial dishwasher. Some US dishwashers run for 3 hours.

## ASTM C676

- Uses a soaking method of testing in a bath of chemicals.
- Does not use a dishwasher.
- Is for ceramic enamel decorations only.

## ASTM C724

- Standard test method for acid resistance of ceramic Decorations on architectural-type glass

## What is considered pass or fail and how do we align with our customers?

- Loss of color?
- Loss of gloss?
- Total degradation?

All subjective in the market



We are looking for a collaboration of help from the community of fellow decorators & ink manufactures to develop a standard that will help with the proper testing methods and education within the community.

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# Thank You!