# Comparison of Klucel G Pre-made Mending Tissue Using Isopropanol and Ethanol and Three Methods of Reactivation

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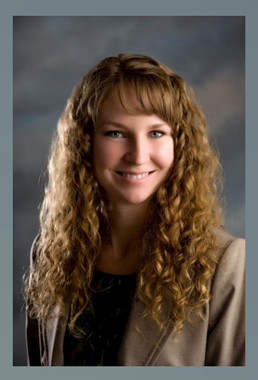


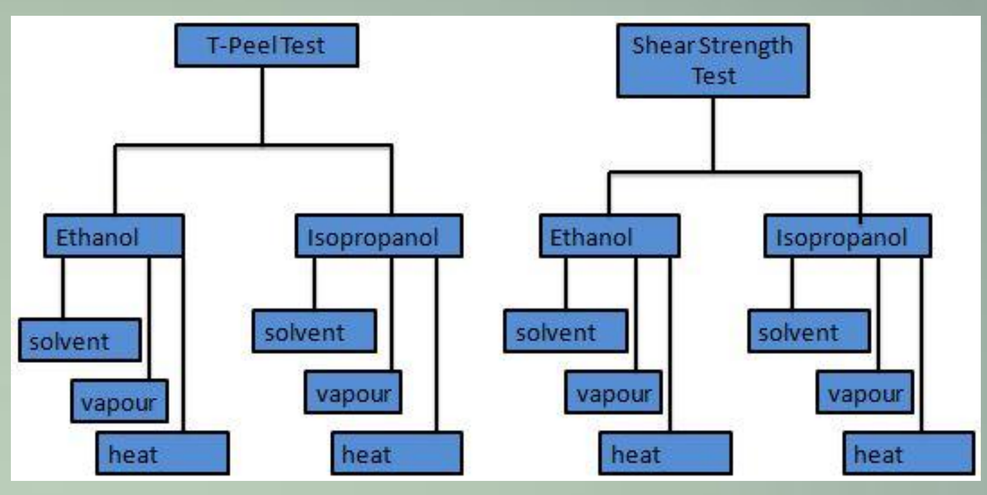
## Introduction

Two solutions of Klucel G adhesive were made, one with isopropanol and one with ethanol. The mending tissue was made by applying the adhesive to Kizukishi Japanese tissue. The adhesives were reactivated using each of three methods of reactivation; brush application of the solvent, solvent vapour, and heat. The tissue sample with the reactivated adhesive was adhered to another tissue sample. Bond strength was determined with the T-Peel Test and the Lap Joint Shear Strength (LJSS) Test according to the American Society for Testing Materials standards (ASTM). The force needed to break the sample or pull it apart (depending on the test) was recorded. Klucel G was dyed with a Procion MX dye, applied to the tissue, then examined to see how far the adhesive penetrated into the tissue. The tensile testing data was used to determine that the solvent reactivation produced the strongest bond. This data along with the microscopy data determined that isopropanol reactivation made the strongest bond.

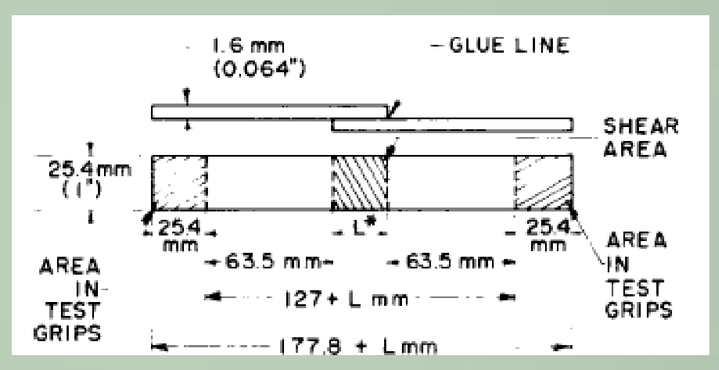
## Background

- Klucel G is a brand name for hydroxypropyl cellulose
- Soluble in water and polar solvents
- Used in low concentrations as a red rot consolidant and used in higher concentrations as an adhesive
- Pre-made mending tissue was used, as opposed to direct application of the adhesive, to determine if the adhesive could be reactivated using one of three methods and if the bond was strong enough for a good mend
- Klucel G adhesive was made with ethanol or isopropanol to determine if these two solvents affected the bond strength
- The depth of adhesive penetration was determined by using dyed adhesive to make the samples

## Sample Preparation

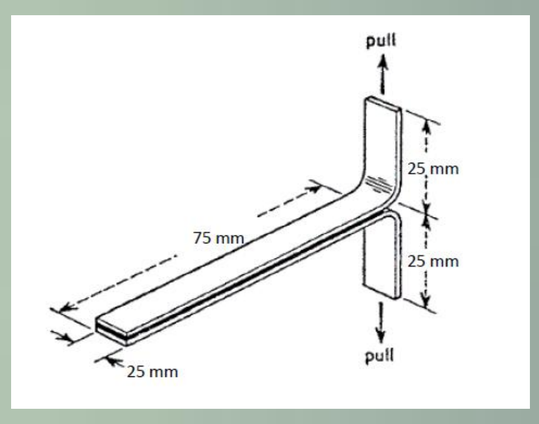



### Lap-Joint Shear Strength Test



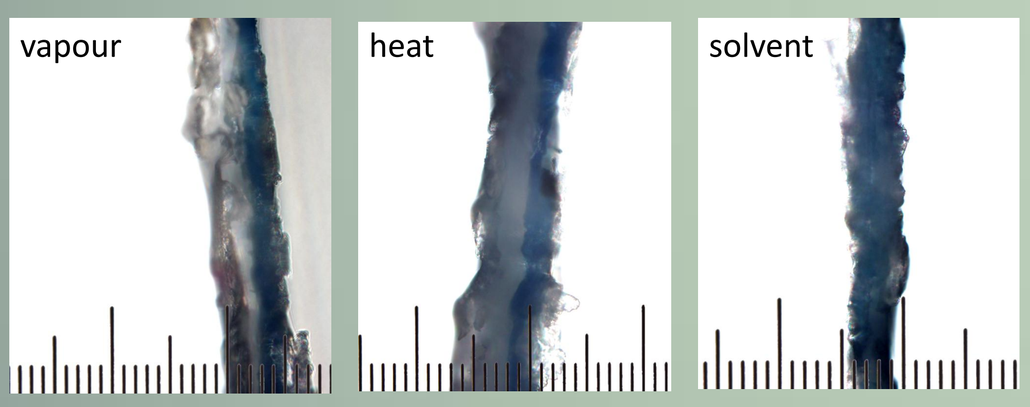

ASTM. 2010. Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal), D1002 – 10. Philadelphia: American Society for Testing and Materials.

### T-Peel Test

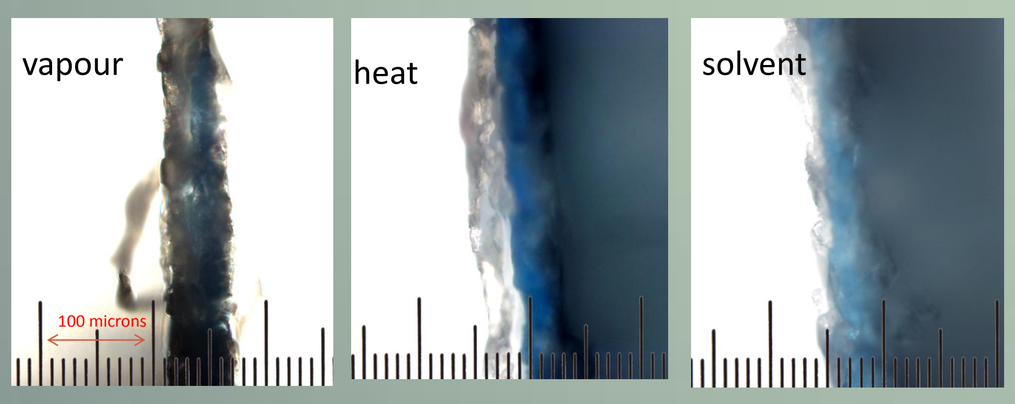



ASTM. 2008. Standard Test Method for Peel Resistance of Adhesives (T-Peel Test), D1876 – 08. Philadelphia: American Society for Testing and Materials.

Ethanol




Isopropanol



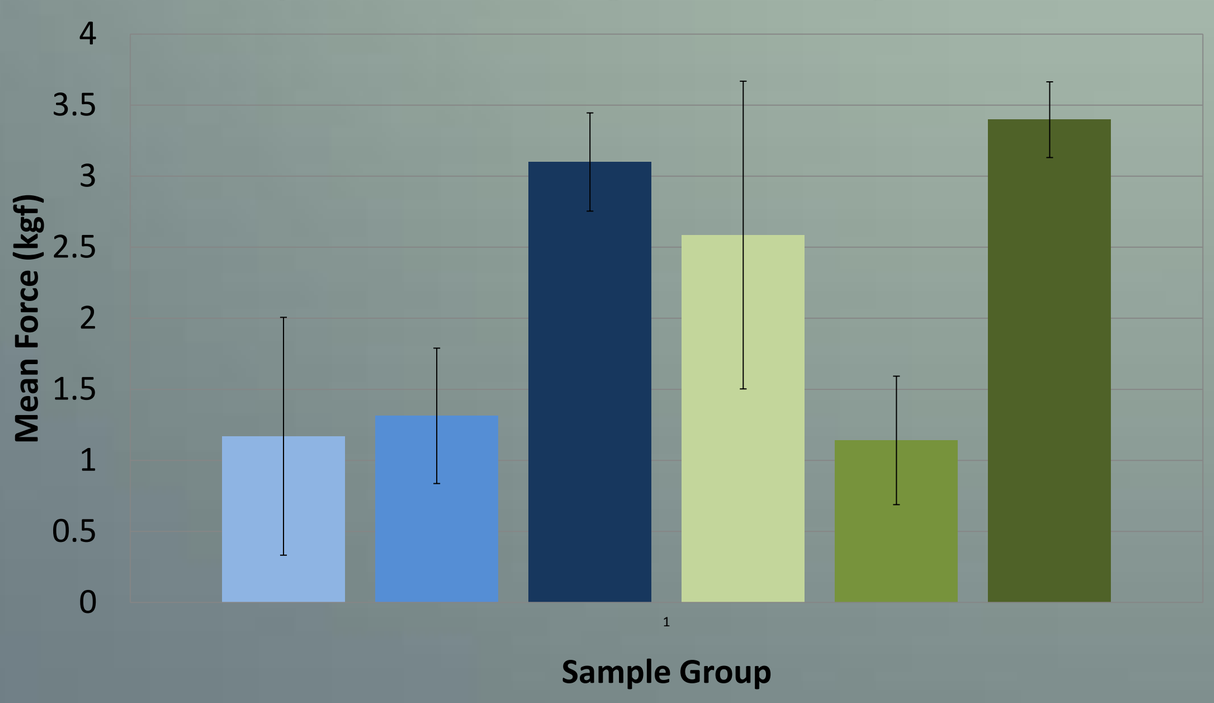

## Results

- Lap-Joint Shear Strength Test: isopropanol and solvent reactivated samples had the strongest bond
- T-Peel Test: isopropanol and solvent reactivated samples had the strongest bond
- Microscopy: isopropanol and solvent reactivation penetrated the tissue more than the others

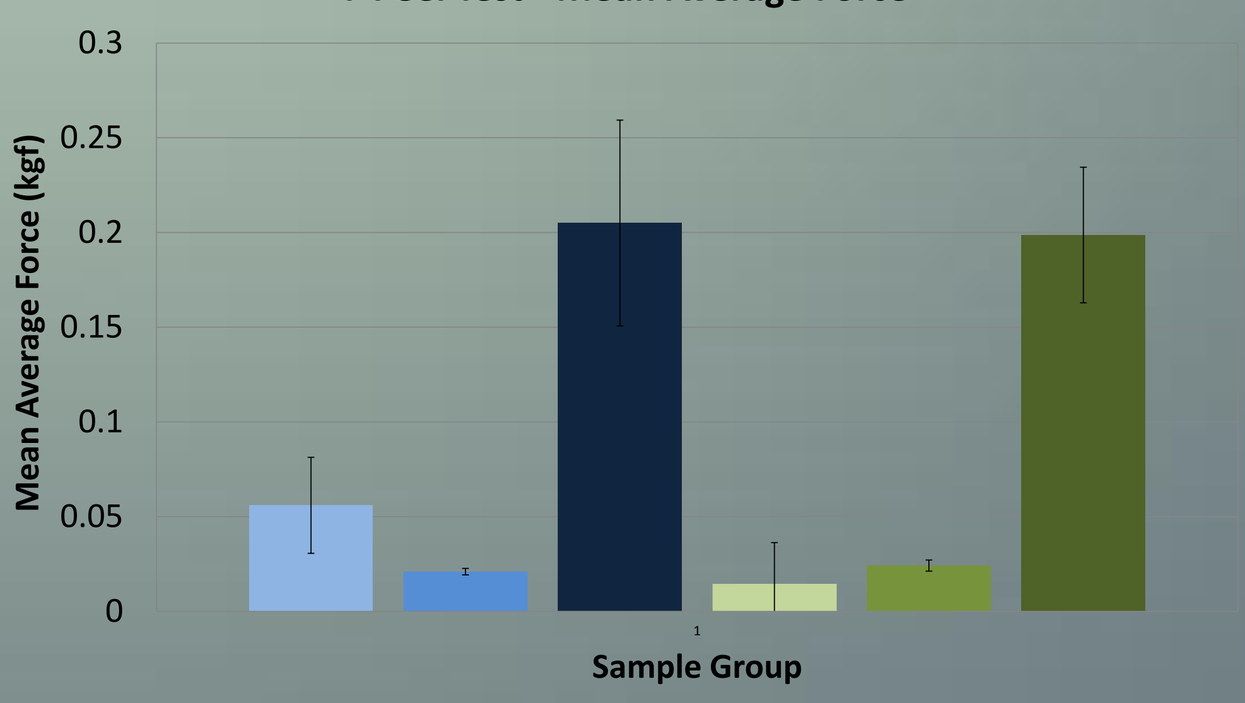
## Summary

- No correlation between solvent used to prepare the adhesive and strength of bond
- Isopropanol reactivation made the strongest bond
- Direct application of the solvent produced the strongest bond
- Depth of adhesive penetration corresponds to bond strength

**Lap-Joint Shear Strength Test - Average Force**




**T-Peel Test - Mean Average Force**

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