

3M™ Filtek™ Supreme Flowable Restorative: Now With Expanded Indications

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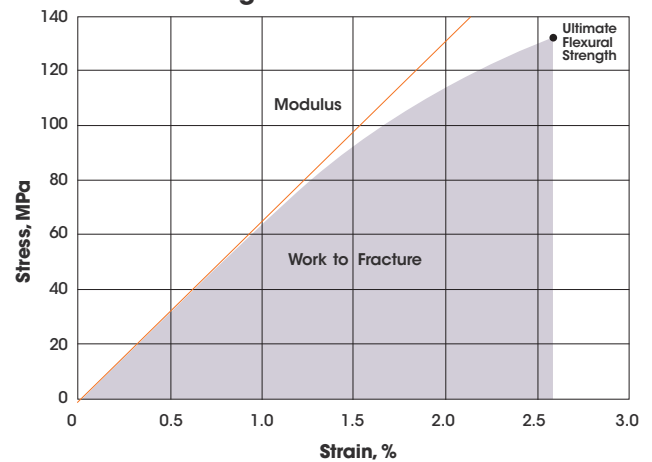
INTRODUCTION:

3M™ Filtek™ Supreme Flowable Restorative has been used by clinicians since 2010. 3M has now expanded the indications for use to include all restoration classes (I-V). To provide evidence that this product can be used for expanded indications, DENTAL ADVISOR has independently tested critical material properties including flexural strength, fracture toughness, polishability and surface roughness. **Filtek Supreme Flowable Restorative** was compared to three other materials which all can be used for all classes of restorations. These composites were **VOCO Grandio®SO Heavy Flow**, **Shofu Beautiful Flow Plus® X F00** (high viscosity version), and **Ivoclar Tetric EvoCeram® Universal Restorative**.

RESULTS SUMMARY:

Filtek Supreme Flowable Restorative has similar or better material properties than the other 3 materials tested which are indicated for Class I-V restorations. In particular, **Filtek Supreme Flowable Restorative** has the best maximum polishability, low surface roughness, high flexural strength and fracture toughness which rivals conventional composites.

Flexural Strength Stress-Strain Curve



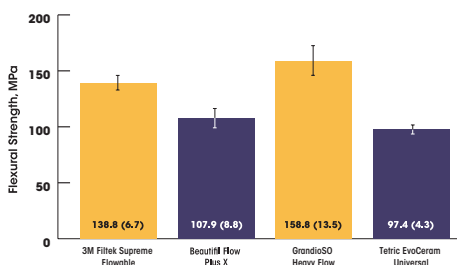
Here is an example stress-strain curve from a flexural strength test with Filtek Supreme Flowable Restorative. The Elastic Modulus is based on the slope, the Ultimate Flexural Strength is the highest load before fracture, and Work to Fracture is based on the area under the curve and is a measurement of the total energy absorbed until failure.

Flexural Strength is an important test of mechanical strength especially for class I and II restorations which tend to be the most load bearing. The FDA and ISO 4049 require over 80 MPa for any intra-orally cured composite restorative. Flexural strength is tested by bending 2x2x25 mm bars until failure.

Work to Fracture describes the total energy that the flexural strength bar undergoes until fracture. This is a useful metric to differentiate between materials that break at a high force while also absorbing a lower amount of energy before breaking.

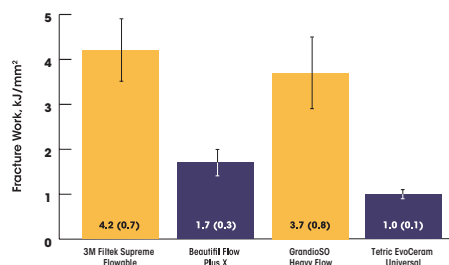
Flexural Modulus is the resistance to deforming (non-permanently) when stress is applied and is also referred to as the stiffness of the material. Brittle materials tend to have a higher flexural modulus. For example, ceramics have a flexural modulus of 50 GPa and composites have a modulus typically between 5-12 GPa.

Flexural Strength, MPa



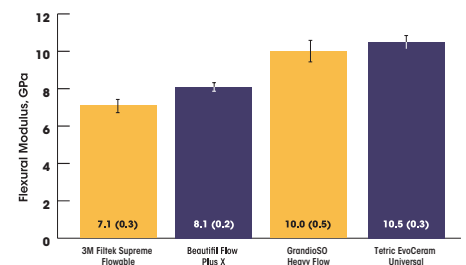
Filtek Supreme Flowable Restorative tested with a high flexural strength of 139 MPa, which is similar to many packable conventional composites.

Fracture Work



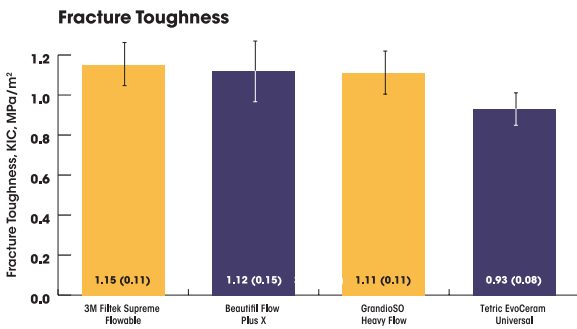
Filtek Supreme Flowable Restorative absorbed the most energy before breaking of the composites tested.

Flexural Modulus, GPa

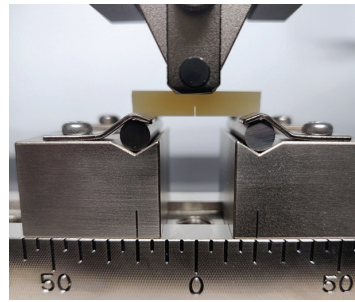


Filtek Supreme Flowable Restorative has a slightly lower modulus than the other materials tested, which may allow the product to absorb more energy in flexure.

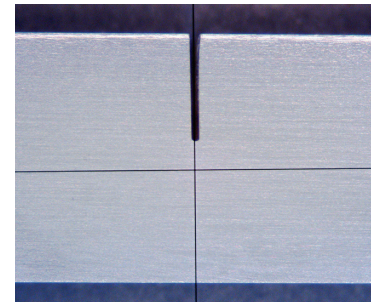
Fracture Toughness is closely related to a material's ability to resist chipping. It is tested by creating a defect in a bar of the material and is then tested similarly to flexural strength. Fracture toughness is particularly important for restorations on incisal edges (such as class IV restorations) where chipping most often occurs.



Filtek Supreme Flowable Restorative has similar or better fracture toughness than the other composites.



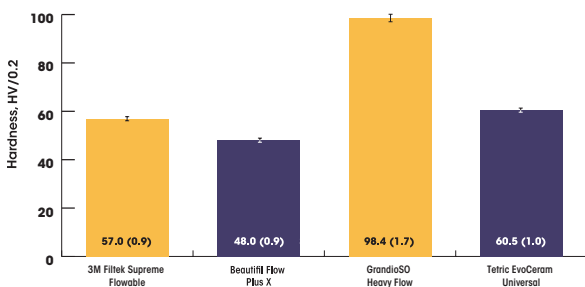
Notched Bar loaded in 3-pt flexure



2 mm notch with 5 mm thickness

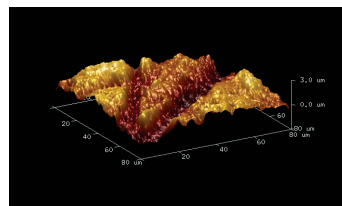
Hardness of dental restoratives is an important property which measures the resistance to deformation by a hard object, in the case of the Vickers hardness test, a diamond pyramidal indenter. Hardness is generally related to the surface wear resistance of dental composites, where a low hardness might indicate a higher wear rate from eating and brushing.

Micro-Vickers Hardness

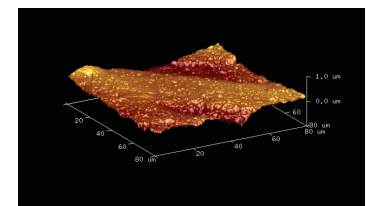


Filtek Supreme Flowable Restorative has a Vickers microhardness of 57 HV, which is similar to many packable composites which typically have a hardness over 50 HV.

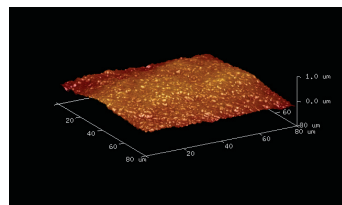
Filtek Supreme Flowable Restorative



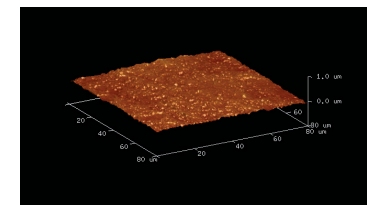
Initial 320 grit



20s



40s



60s

Polishability of composites is an important property for surface-based restorations. Polishability can be analyzed by looking at the specular reflectance, also known as gloss. Gloss values (GU) over 60 are typically thought of as clinically acceptable but higher values can be achieved with longer polishing time. Higher gloss is also correlated with lower surface roughness. Composites should have a mean surface roughness (Ra) of under 200 nm to minimize bacterial adhesion, and under 100 nm Ra to minimize staining. First, samples were abraded with 320-grit sandpaper to simulate an irregular surface. Next, the gloss and surface roughness were measured after 20, 40, and 60 seconds of polishing with the **3M™ Sof-Lex™ Diamond Polishing System**. The surface roughness was measured with an Atomic Force Microscope having a higher accuracy than many profilometers.

RESULTS:

Parameter	Polishing, means (standard deviations)											
	Filtek Supreme Flowable			Beautifil Flow Plus X			Grandioso Heavy Flow			Tetric EvoCeram		
	20s	40s	60s	20s	40s	60s	20s	40s	60s	20s	40s	60s
Gloss, gu	62.7 (5.4)	76.8 (3.6)	91.2 (0.8)	60.3 (5.5)	78.4 (2.1)	90.4 (0.5)	59.0 (6.0)	70.8 (4.7)	86.3 (2.5)	65.0 (4.4)	78.0 (2.8)	88.7 (1.8)
Roughness, Ra, nm	87.2 (21.4)	71.4 (8.0)	30.3 (4.3)	89.3 (12.4)	36.0 (16.7)	25.1 (0.6)	72.4 (34.5)	54.0 (22.1)	41.6 (2.9)	81.9 (10.0)	62.5 (3.7)	42.3 (3.0)

Filtek Supreme Flowable Restorative had the highest final gloss of all of the composites tested. All of the composites tested showed clinically acceptable polish of at least 60 GU and under 100 nm Ra after 20 seconds of polishing with the **Sof-Lex™ Diamond Polishing System**.