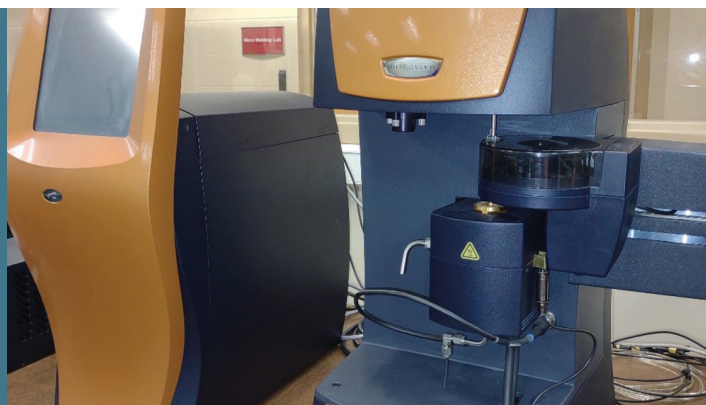




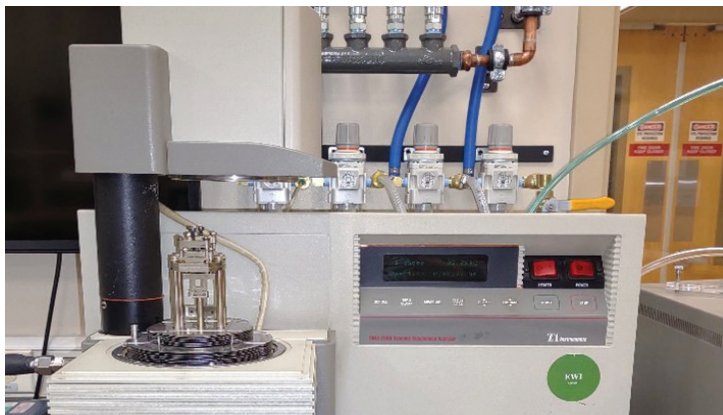
EWI Polymers Lab

CHARACTERIZATION AND TESTING SERVICES



EWI has expertise in thermoplastics, thermosets (adhesives and rubbers), carbon-based materials, and polymer-based composites. Our team offers manufacturing expertise at every stage of the product design cycle – *innovation, material selection, design, joining, testing, and qualification* – to help de-risk product development, ensure a successful launch, and field a durable product.

Characterizing materials and examining processes early in the design cycle of a product can save time and money. EWI applies fundamental knowledge of polymer strengths and weaknesses to downselect the most suitable product materials. Physical, mechanical, thermal, chemical, time-dependent, degradation, and processing factors are taken into consideration to mitigate the risk of product failure and lead to the creation of robust products in a competitive, constantly shifting marketplace.



Capabilities

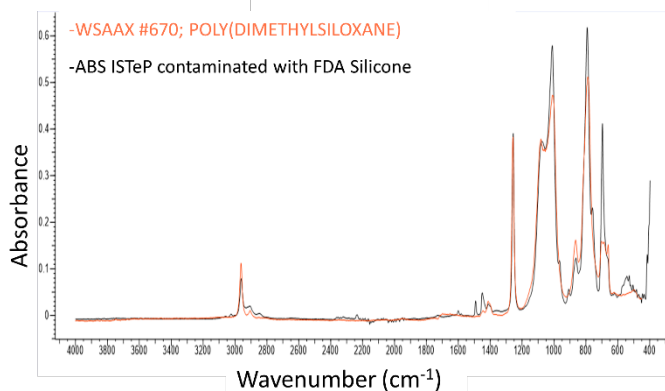
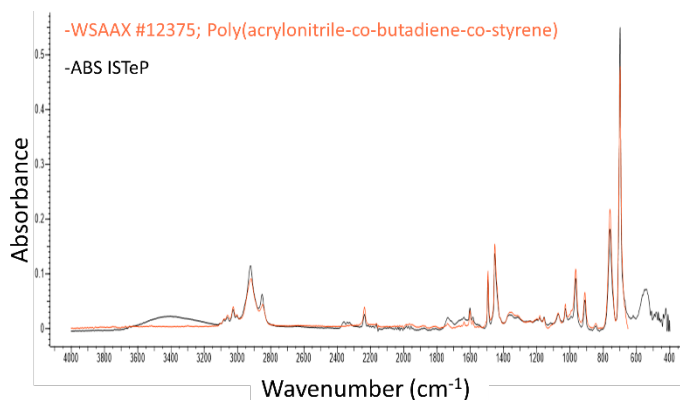
The EWI Polymer Lab performs quality assessment and failure analysis for issues related to products in development and in the market.

Our services include:

- *Fourier Transform Infrared Spectroscopy (FTIR)*
- *Dynamic Mechanical Analysis (DMA)*
- *Differential Scanning Calorimetry (DSC)*
- *Thermogravimetric Analysis (TGA)*
- *Microscopy*
- *Leak Testing*
- *Mechanical Testing*

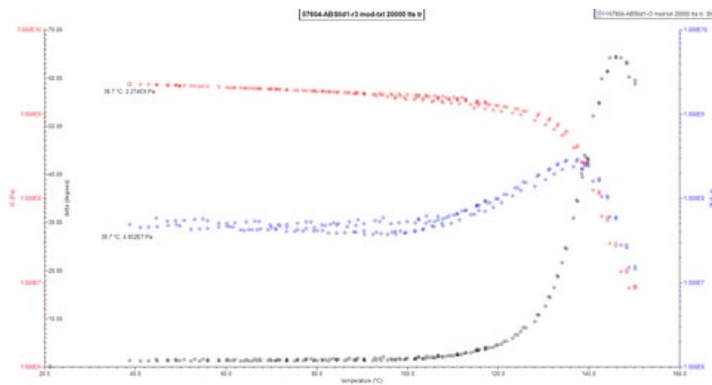
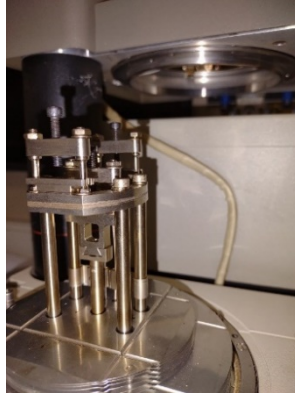


Fourier Transform Infrared Spectroscopy (FTIR)



Name	Reference	Description
Organic material Identification	ASTM E1252	Reflective, transmissive, or attenuated total reflection (ATR) is used to identify a material.
Surface Contamination Evaluation	ASTM E1252	ATR is used to determine whether a surface is contaminated, and potentially, to identify the contaminant.

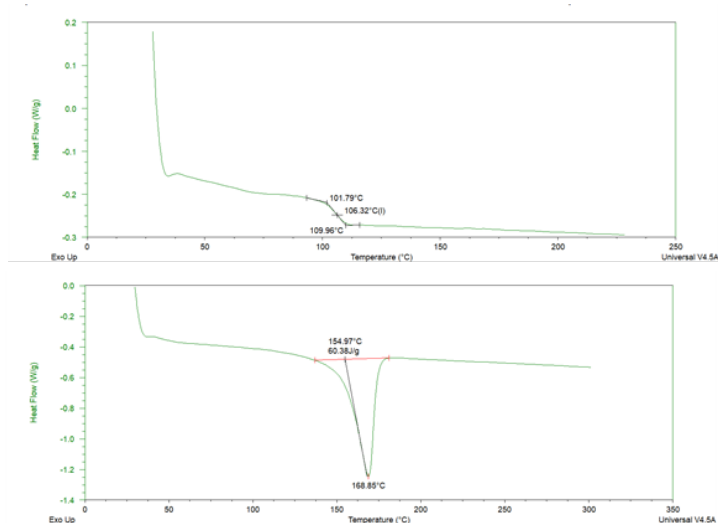
Dynamic Mechanical Analysis (DMA)



Name	Reference	Description
Characterization of Material Mechanical Properties	ASTM D4065, D4440, D5279, D7028	Determines elastic modulus (or storage modulus, G'), viscous modulus (or loss modulus, G'') and damping coefficient (Tan D) as a function of temperature, frequency or time.
Accelerated Long-Term Stress Relaxation or Creep	ASTM D2990	Time-temperature superposition (TTS) analysis to determine long-term properties during short-term tests.
Glass Transition (T_g) Analysis	ASTM D7028	Determine the T_g of a material.
Coefficient of Thermal Expansion (CTE)	ASTM E831	CTE can be measured over a temperature range and used for stress at temperature calculations or FEA modeling inputs.



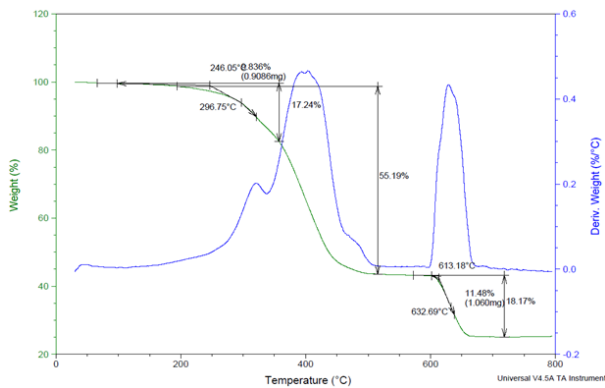
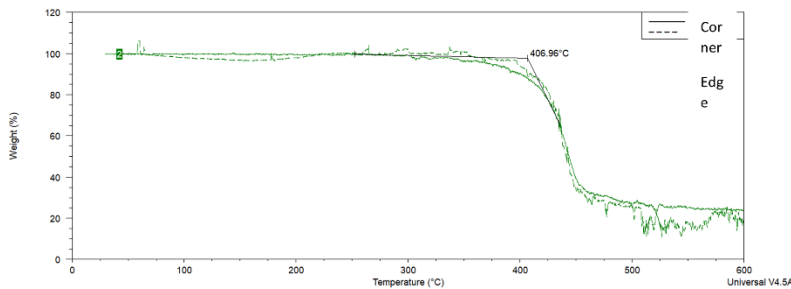
Differential Scanning Calorimetry (DSC)



Name	Reference	Description
Glass Transition (T _g) Analysis	ASTM D7426	Determine the T _g of a material.
Polymer Crystallinity	ASTM D3418	Area under the melt peak can be used to determine the percentage of crystallinity in a sample
Degradation Temperature	ASTM D3418	The onset temperature of degradation can be identified and used for setting a processing window.
Heat of Reaction or Extent of Reaction	ASTM E2160	For curing chemistries, the heat of reaction (endothermic or exothermic) can be measured under difference times and temperatures



Thermogravimetric Analysis (TGA)

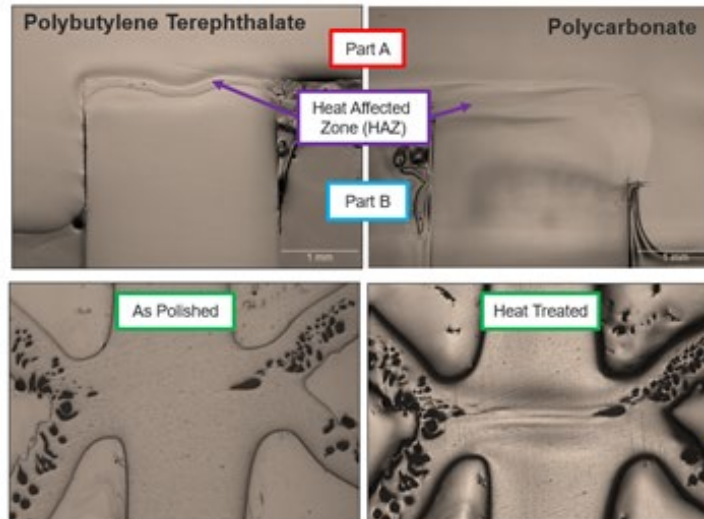


Name	Reference	Description
Moisture Analysis	ASTM E1131	Moisture has effects on polymer mechanical properties and joining operations, its wt.% can be measured.
Filler Weight and Identification	ASTM E1131	Filler wt.% can influence polymer mechanical properties, it can be measured.
Degradation Temperature	ASTM E1131	The onset temperature of degradation can be identified and used for setting a processing window.

Microscopy

Semi-crystalline polymers show the heat affected zone (HAZ) lines due to a change in crystallinity in the heated area.

Amorphous polymers show the HAZ lines due to a change in polymer chain orientation in the heated area.



Good welds with intermolecular diffusion (no separation line across joint)

No intermolecular diffusion (separation line across joint)

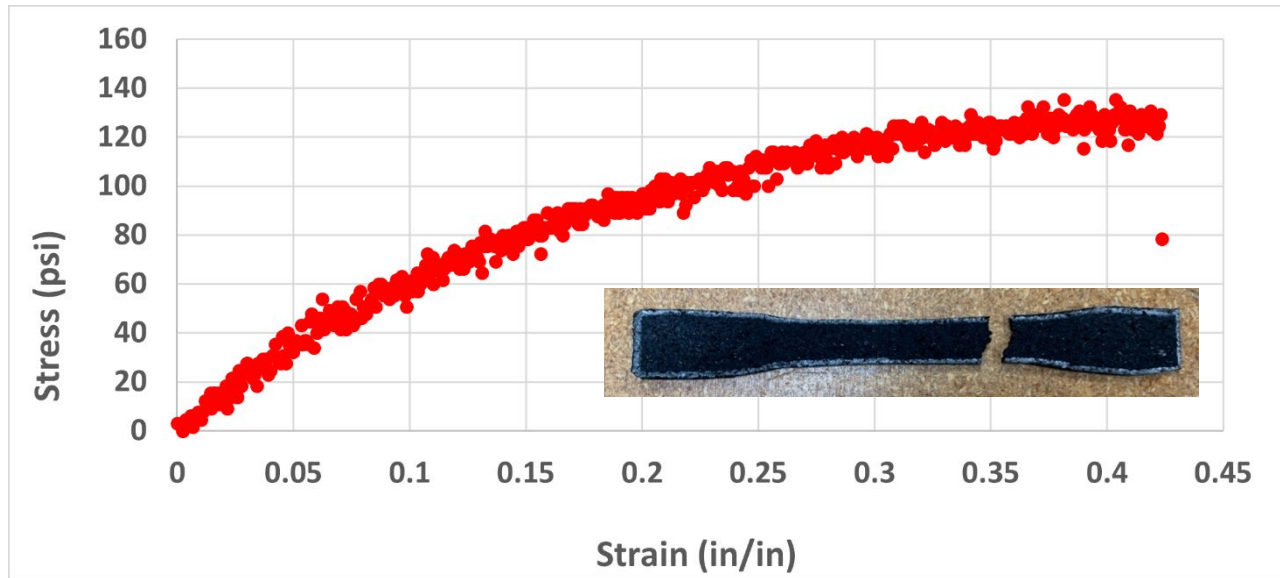
Name	Reference	Description
Weld Evaluation, including intermolecular diffusion assessment	EWI Proprietary	Heating After Cross-Sectioning (HACS) Analysis is performed to show details of the weld quality such as intermolecular diffusion, gaps, voids, inclusions, cracks, flash, and degradation.
Surface Roughness	N/A	Keyence non-contact profilometer is used to measure surface roughness.
Fractography	N/A	Scanning electron microscopy (SEM) can be used to determine type and initiation point of failures
Filler Material Identification	ASTM E1508	Energy dispersive x-ray spectroscopy (EDS) can be used to atomically identify an unknown material

Leak Testing



Name	Reference	Description
Leak Testing – Pressure / Air	Custom per application	Assembly is pressurized with air and the loss in pressure over time is measured to quantify leak rate.
Leak Testing – Vacuum / Helium	Custom per application	Vacuum is pulled through the assembly and a Helium sniffer is used to check for discrete small leaks.

Mechanical Testing



Name	Reference	Description
Tensile	ASTM D638	Dogbone shaped samples are pulled to failure on an Instron.
Peel	ASTM D1876	T-Peel (Coach Peel) determines adhesive bond strength between flexible adherends.
Shear	ASTM D3163	Method for determining strength of bonded rigid plastic lap-shear joints in shear by tension loading.
3-Point Bend	ASTM D790	Flexural test on plastics.