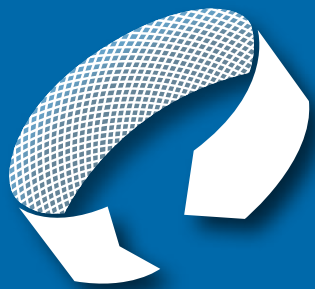


Transforming vision into reality.



# TECHNOLOGY

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## SOLUTIONS CENTER

High Performance Plastic Film and Sheet Development Solutions

## Who is Raven and what value can we add?

Raven Industries Engineered Films Division is a leading manufacturer of high quality flexible film and sheeting; capabilities include lamination, blown and cast extrusion in addition to extensive conversion processes used in many diverse applications throughout the U.S. and abroad. Our products are manufactured using a wide range of prime raw materials and additives, including polyethylene (LDPE, LLDPE, HDPE, MDPE, Metallocene), and polypropylene (PP), ethylene vinyl acetate (EVA), ethylene vinyl alcohol (EVOH), thermoplastic polyolefin (TPO), and nylon based resins.

We don't over-design your material, we custom manufacture within your specifications under the strict guidelines of our ISO 9001:2008 Certified Management System. Our product development team is capable of designing mono-layer up to complex multi-layer film and sheeting from ultra thin 0.25 mil up to 80 mil thick, as well as highly technical engineered laminates and coated fabrics. We have an extensive range of blown extrusion capabilities to produce large seamless gusseted widths up to 40' wide. This provides our customers with the ultimate in flexibility for film and sheeting design options. Simply let us know your criteria such as barrier properties, heat seal-ability, tear resistance, impact strength, chemical resistance or any other critical properties, and we will work closely with you to develop or recommend a product to meet your expectations.

To get started and submit your product requirements, go to [www.RavenEFD.com](http://www.RavenEFD.com) and click [Custom Product Request](#).

# No other

industrial film manufacturer offers the broad range of sizes and available capabilities.



## 4-5

### **The Raven Technology Solutions Center:**

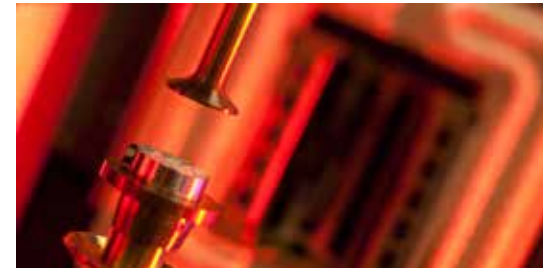
Providing full spectrum product development dynamics from conceptual ideas to scale-up products. Raven will be here to guide you through the process with the in-depth attention your project deserves by our dedicated team of specialists. ●



## 6-9

### **Raven Pilot Lines - Capabilities:**

The Technology Solutions Center includes two state-of-the-art scaled pilot lines within the production area of the Center providing the same technical capabilities of blown extrusion, coating and lamination found in our full-scale equipment. ●



## 10-12

### **Raven Accredited Testing Laboratory:**

Included in the Center is an impressive advanced testing facility conveniently located next to the scaled pilot lines for prompt testing during trial runs. Review our newest featured lab equipment and the unlimited possibilities. ●



View from the upper observation area overlooking the pilot production lines. The pilot lines include an comprehensive 9-layer blown film line with nine individual extruders capable of blowing complex films and sheeting including barrier film configurations. The second line is a cast/coating line capable of unsupported cast film or sheet, coated fabrics, laminated and cast reinforced films.



## Product Development at its Finest

# Technology Solutions Center /

**“Our team of development professionals support and understand the critical demands of today’s complex market needs and step up to the challenge by delivering a product solution custom tailored to your specific requirements.”**

### Development Area

The Raven Technology Solutions Center includes a generous sized conference meeting room with the latest video and audio equipment available. A well-stocked refreshment area is conveniently located next to our state-of-the-art pilot lines and fully equipped testing laboratory.

### Process Objectives

Our objective is to promote creativity and innovation in a stimulating work environment for the development and refinement of new products through these sessions:

- Brain storming/idea generation
- Problem solving/strategizing
- Concept ideas to design planning
- Technical process & product support
- Material test/performance analysis

Our strategy is to minimize development costs and product time-to-market, while creating superior products with exceptional value.

**“By creating the Technology Solutions Center we have substantially invested in future product innovation. We are fully committed in research and development to assure continuous advancements in polymer film and sheeting solutions.”**

— Anthony Schmidt, Vice President & General Mgr



View of the refreshment lounge and smaller discussion area to provide open dialog and personalization of the entire process. ◀◀



▶▶ View of our design/development conference room fully equipped with the latest in electronics.



▶▶ A partial view of the lounge area where product concept ideas can easily start flowing.

## **Process Collaboration**

We encourage full communication between designers, vendors, processors and end users in an effort to develop new innovative material solutions for even the most technical or demanding applications. The development area is designed to promote a seamless work flow from beginning to end.



## Raven Pilot Line Capabilities

# 9-Layer Blown Film Pilot Line /

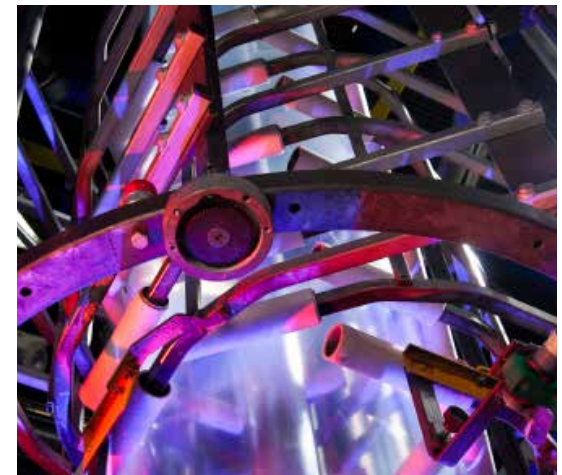


▲ View down from the upper deck of our 9-layer extrusion pilot line capable of producing a broad range of blown film/sheeting design formulations.

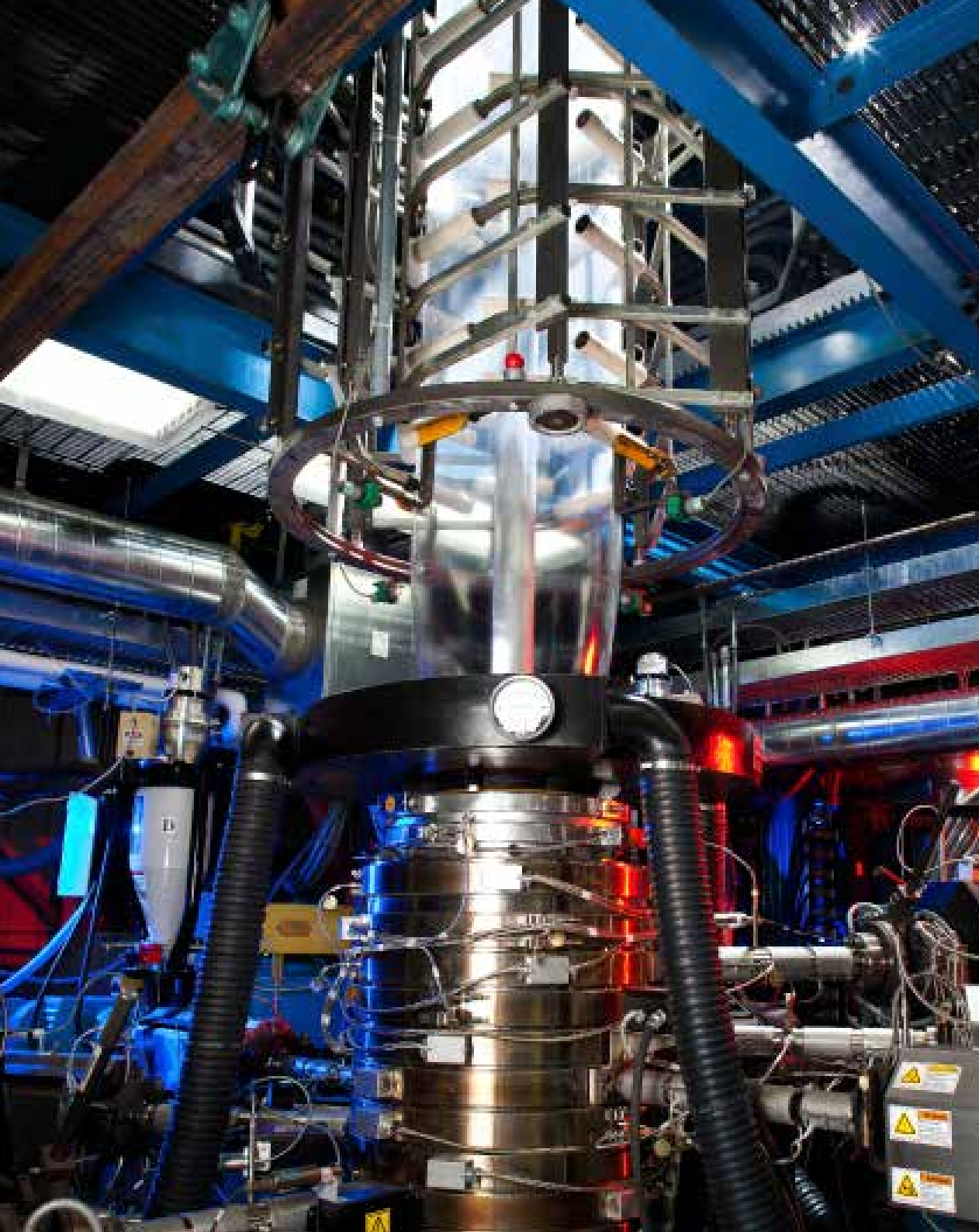
The new 9-layer blown film pilot line is a valuable addition to prototyping film and sheeting at a fraction of the cost and time it would run in full scale production. This line features nine individual extruders allowing for unique formulation elements and versatility. Our 9-layer film line is capable of producing an extensive range of film configurations from adding EVOH barrier layers to formulating highly complex multi-layer films. Our team of specialists believe in listening to our customers and will work closely to develop a product that exceeds your expectations.



▶ View of the extrusion line winder section with a maximum roll capacity of 24" inch diameter.



▶ View of a clear blown polyethylene film, this line produces a maximum circumference of 114 inches.



## 1 Size Capabilities

- Film/Sheeting thickness ranging from .25 mil up to 60 mil.
- Minimum circumference of 30 inches.
- Maximum circumference of 114 inches.

## 2 Process Capabilities

- Nine individual layers with nine individual extruders.
- Common resins processed: LDPE, LLDPE, MDPE, HDPE, PP, TPO, TPU Ionomer, mLLDPE, EVA, EVOH, Nylons, and others.
- Corona treating.

## 3 Product Capabilities

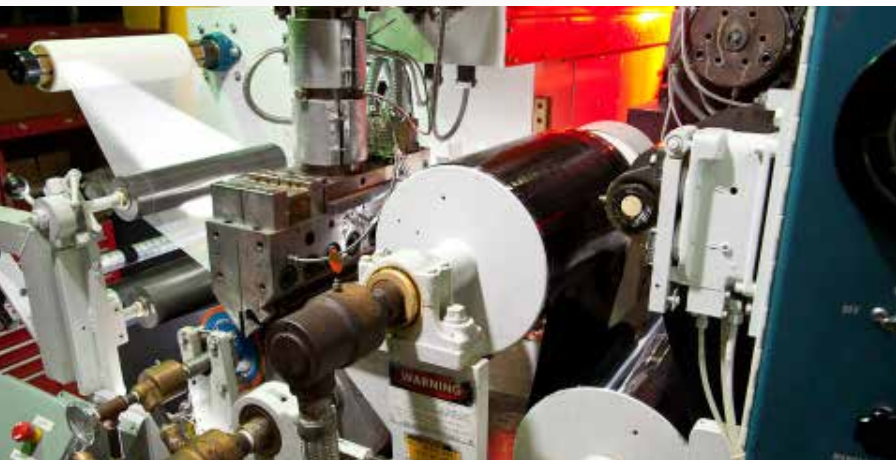
- Maximum roll diameter of 24 inches.
- Core size of 3" OD on the winder.
- Maximum bag width of 58".

The Raven 9-layer blown film pilot line is capable of prototyping unique film and sheeting configurations to develop the perfect fit for your product specifications.



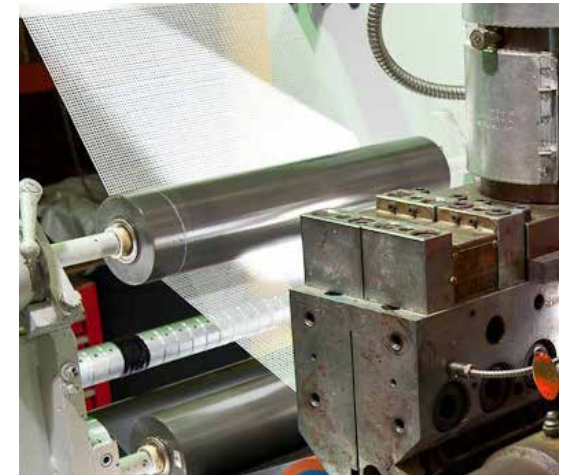
## Raven Pilot Line Capabilities

# Cast-Coating Pilot Line /



- ▲ View of our cast/coating pilot line producing a fiber reinforced black polyethylene. This line is highly versatile and can support many preformed scrims or fabric substrates. Custom surface texturing can also be added as required.

The new cast-coating pilot line is capable of producing a wide range of unsupported or supported cast film or sheet, coated fabrics, laminated film and sheeting, as well as surface texturing. Within our facility we can produce complex blown films tailored to your specifications and then further process them through our cast line adding reinforcement layers of preformed scrim or other fabrics to produce highly engineered finished products. We can add custom formed surface texturing or our in-house exclusive textures. Bring us your design specifications, and let us help take them to the next level!



- ▶ View of preformed polyester scrim being introduced as a reinforcement layer to increase material strength and stability.



- ▶ View of our reinforced polypropylene along with our textured reinforced polyethylene product containing our exclusive GeoGrip™ surface texturing.





## 1 Size Capabilities

- Film/Sheeting thickness ranging from 1 mil up to 60 mil based on product formulation.
- Maximum width of 16 inches.

## 2 Process Capabilities

- Nip rollers are chilled with a matte, mirror (smooth) or textured surfaces.
- Custom textures available with appropriate lead time.
- Two extruders (ABA or AB layer configurations).
- Common resins processed are LDPE, LLDPE, MDPE, HDPE, PP, TPO, mLLDPE, EVA & others.

## 3 Product Capabilities

- Core Size of 3" OD on the winder and unwind.
- Cast Film/Sheeting, coated fabrics, supported - unsupported - textured

View of our cast-coating pilot line capable of producing a broad range of supported or unsupported cast film or sheet, coated fabrics, laminated films, and custom textured film or sheeting to meet your requirements.



## Raven Analysis & Research Capabilities

# Accredited Testing Laboratory /



### ▲ Standard Test Performed:

Mechanical Properties	Physical Properties
Permeation Properties	Burn Characteristics
Optical Properties	Chemical Composition
Accelerated Weathering	Friction Properties
Environmental Stress Crack	Chemical Immersion
Thermal Analysis	Surface Microscopy

The process of testing and analyzing the data after prototypes are produced provides all the information required to determine if material formulations meet expectations. The Raven laboratory is one of a handful of GAI-LAP accredited labs nationwide, and our processes meet the stringent criteria of our ISO 9001:2008 certified management system. Our laboratory provides extensive testing capabilities, and our technical staff is well versed in sample preparation, conditioning and testing procedures. The lab is equipped with the latest equipment, and our committed team of specialists guarantee precise attention to the details. The team consists of technical professionals working closely through each step of the process to assure accuracy.

### ▶ UV Accelerated Weatherometer

Ultraviolet light causes almost all the photo-degradation to materials exposed outdoors. The QUV Weatherometer reproduces only the UV portion of the spectrum. By simulating short-wave sunlight, it is especially useful for comparing the performance of different types of polymers and stabilizers.



### ▶ Differential Scanning Calorimetry (DSC)

The DSC is used to measure a number of characteristic properties of polymer samples. Using this technique it is possible to observe crystallization events as well as glass transition temperatures. The DSC can also be used to study oxidative stability.

The test methods listed throughout this section represent a portion of our regular test methods. If you are interested in methods not listed, please check with our development team for availability.

### Permeation

ASTM D3985, ASTM F1927, ASTM D1434  
ASTM F1249, TAPPI T557  
Mocon Ox-Tran 2/21  
Mocon Permatran 3/33 Plus

### Thermal Analysis - TGA

ASTM D4218, ASTM E1131

### Chemical Composition - FT-IR

Various Internal Test Procedures

### Permeation

The ability to measure oxygen, water vapor and gas transmission rates that pass through a substance over a given period of time. These areas of control are critical in many industries including foods, pharmaceuticals, and construction.



### Flammability & Burn Characteristics

This device measures ignition resistance of plastic film products. We use various procedures to determine product flammability and burn rates.



### Thermogravimetric Analysis (TGA)

Determines changes in sample weight in relation to change in temperature. Such analysis relies on a high degree of precision in measurements of weight and temperature. By combining an FT-IR with the TGA equipment, we can also analyze the gas evolved during a TGA method.



### Fourier Transform Infrared Spectroscopy (FT-IR)

Determines the waveform generated as IR radiation passes through a sample. Some energy is absorbed through the sample and is used to calculate a signature waveform. FT-IR can be used to identify unknown materials, quality control of materials, and formulations.

### Burn Characteristics

Govmark 701L Large Scale Flammability Test  
NFPA 701 Large Scale and Test Method 1 & 2  
CAN/ULC S109

### Accelerated Weathering

QUV Accelerated Weathering Tester  
with humidity cycle - Multiple Units

### Chemical Composition - DSC

Melt Point Curve  
ASTM D3895  
ASTM D5885



# Raven Analysis & Research Capabilities

# Accredited Testing Laboratory /



## ▲ Universal Testing Machines

▲ Universal testing machines equipped with fixtures to perform a variety of physical properties including tensile, tear, peel, shear, and puncture tests. Environmental chambers allow for select tests to be performed at temperatures ranging from -100°C to 350°C.

The test methods listed throughout this section represent a portion of our regular test methods. If you are interested in methods not listed, please check with our development team for availability.

## Physical Properties

Instron Universal Testing Machines

ASTM D1004, ASTM D4437, ASTM D4533, ASTM D4833, ASTM D638, ASTM D7003, ASTM D882, ASTM D7004, ASTM D752, ASTM D5884

## Physical Properties - Cold Chambers

ASTM D1922, ASTM D1004, ASTM D4437, ASTM D4533, ASTM D4833, ASTM D638, ASTM D7003, ASTM D882, ASTM D7004, ASTM D752, ASTM D5884

## ▶▶ Cold Chamber Testing

The cold chamber apparatus can be added to the Universal Testing Machine to perform a variety of testing in cold temperature environments.



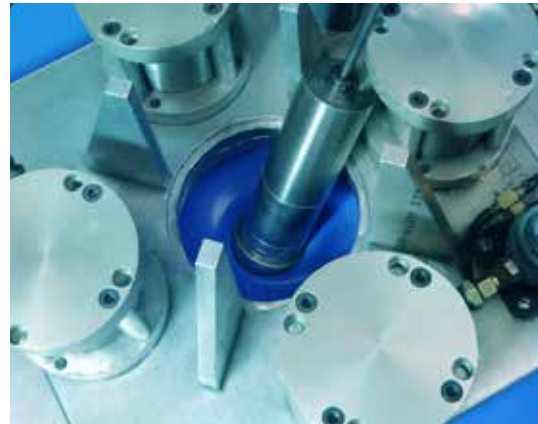
## ▶▶ Elemdorf Cold Chamber Testing

A test used for nonreinforced materials to measure the average force to tear through the remaining length of plastic film after a tear has been initiated. This test can be performed with or without cold temperature environmental chambers.



### Drop Dart Testing

A destructive test to measure how well a material resists rupture when an object falls on it. The test is performed by dropping an elongated weight with a rounded head (the dart) from a specified height onto a mounted material sheet to determine impact resistance.

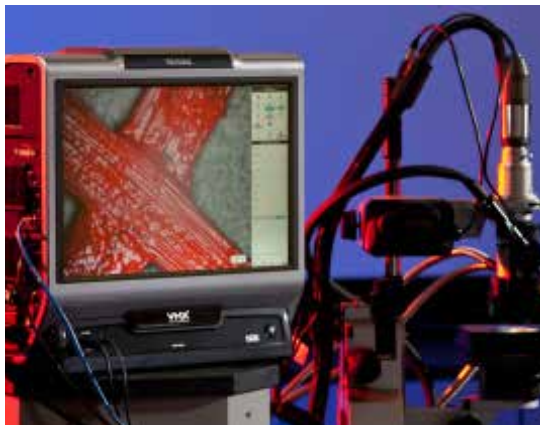


### Physical Properties - Drop Dart Test

ASTM D1709 - Method A and B  
Impact Resistance

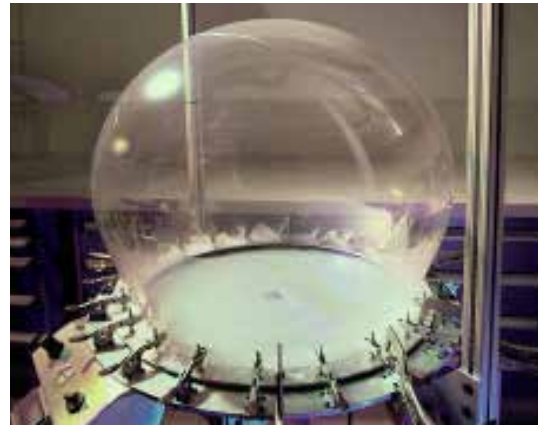
### Surface Microscopy - Digital Microscope

The Keyence VHX-1000 2D/3D digital microscope measures a wide variety of illumination, filtering, and imaging options to characterize products with up to 1000x magnification.



### Digital Microscope - Keyence VHX-1000 2D/3D

A high-resolution digital microscope used to determine characteristics using both detailed inspection and high accuracy measurement of material specimens.



### Multi-Axial Tension Test

Tension testing simulates out-of-plane deformation of a membrane. By measuring internal pressure and the extent of strain at burst, a material's strength and elongation can be determined.

### Rheology

An important parameter for processing properties of plastics or polymers is flow behavior, or rheology. Rheological properties of polymers are linked with their molecular structure. Rheological analysis is used to characterize viscoelastic properties..



### Mechanical Properties - Multi-Axial

ASTM D5617 Standard Test Method for Multi-Axial Tension Test for Geosynthetics

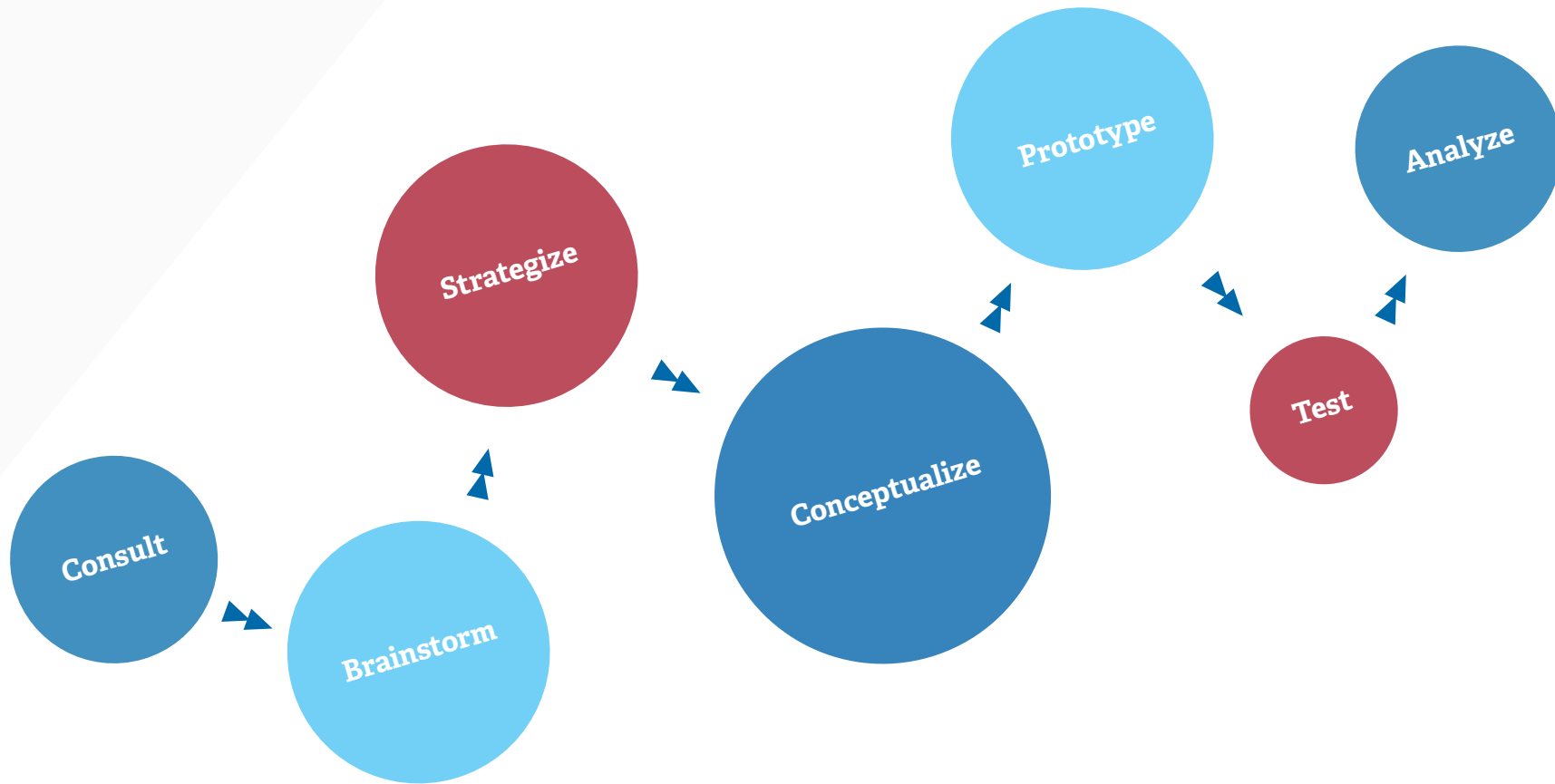
### Mechanical Properties - Rheology

ASTM D4440 Dynamic Mechanical Properties Melt Rheology

ASTM D1238 Melt Flow Rates of Thermoplastics by Extrusion Plastometer

## How to Get Started

Visit [www.RavenEFD.com](http://www.RavenEFD.com) and click  
Custom Product Request



## Raven's Campus

**“The Technology Solutions Center is a tremendous tool that will enable customers, suppliers and our development team to create innovative products offering exceptional value. The cast and 9-layer blown film pilot lines offer an economical approach to product development and provides the insight to make sound business decisions.”**

— Tom Stuebner, Business Development Manager

We are a division of Raven Industries, Inc., a solid manufacturer founded in Sioux Falls, SD, in 1956 to produce high-altitude research balloons for N.A.S.A. From that single product line we evolved into a successful, diversified manufacturer publicly traded on Nasdaq (RAVN). Today's product lines are incorporated into four divisions including Applied Technology, Electronic Systems, Aerostar and our division; Engineered Films.

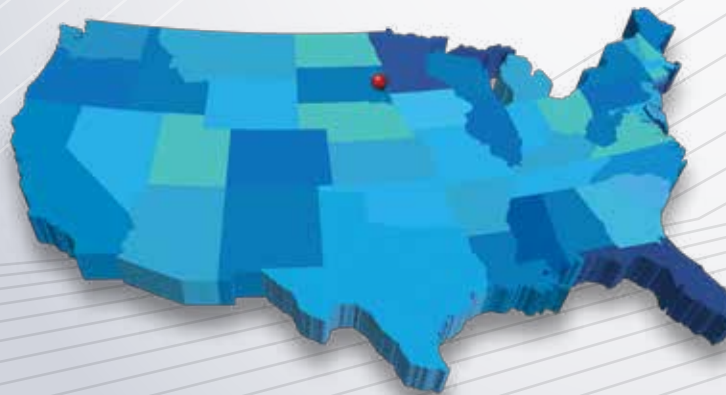


▲ Our 300,000 square foot South Dakota facility produces one of the widest ranges of size, material and thickness in the industry.

## Location

**Raven Industries, Inc**  
821 W. Algonquim Street  
Sioux Falls, SD 57104  
United States of America

Toll Free: 1-800-635-3456  
Phone: 605-335-0174  
Fax: 605-331-0333  
Web: [www.RavenEFD.com](http://www.RavenEFD.com)



Peak Performance. Delivered.

EFD 1278 07/13

# Have a Challenging Material Project?

Get in touch, we're ready to help you find a solution!

Raven Industries, Inc

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Sioux Falls, SD 57117-5107

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