

Jackel, Inc.
Specifications for

Filament Wound Fiberglass Basins

Process Specifications and Comparisons

Effective September 1, 2002

Jackel, Inc.

Filament Wound (FRP) Basins

Specifications and Comparisons

General

Filament winding began an expansion in the early 1960's which transformed it from primarily an aerospace process to one with a broader commercial significance.

Generally speaking, filament winding is the glass fiber-reinforced plastic (FRP) fabrication process in which resin-impregnated strands of continuous glass rovings are wrapped around a mandrel by a machine and subsequently cured.

In the filament winding process, the degree of orientation of glass in the completed part can be closely controlled. Winding machines are programmed to wind an exact pattern of continuous filaments; and therefore, a consistently high degree of efficiency in the utilization of filament strength can be obtained.

Jackel's use of computer-controlled-winding has given this process the capability of high levels of precision and control.

There are several functions of the resin matrix in a filament wound basin. The resin's basic functions are to fill space between filaments, to fix the alignment and to distribute the bonding and shearing loads. Due to the much higher modulus of the glass, and its normally high percentage of volume in the filament wound composite, the strength effect of the resin is quite small. As in the case with all FRP systems, the resin plays an important role in determining the chemical and environmental durability of the total system. It also controls the thermal, electrical and visual appearance characteristics of the final basin.

Jackel uses in its FRP process, quality glass filaments and resins with documented properties. This is extremely important in order to obtain accuracy and consistency between actual performance and design criteria.

Jackel's Manufacturing Process **(Method of Construction)**

In Jackel's filament winding process, glass fiber rovings are drawn from a series of spools through an impregnation bath where resin is applied. The wet rovings are then tensioned and led through guidance eyes where the bands are formed and then onto a rotating mandrel. Our process ensures a complete wet-out of the glass thus avoiding dry-spots which could cause the basin to delaminate. The impregnation bath carriage is computer guided and moves parallel to the mandrel applying wetted rovings in a specific helical and hoop pattern. When all layers of the winding have been applied, the basin is partially heat cured and removed from the mandrel for the basin to completely cure.

In order to obtain accurate placement of the glass rovings, it is necessary to maintain them in tension throughout the process. As the fiber tension increases, so does the glass content of the finished basin. Jackel achieves 65% glass content in its process and as a result achieves higher density, tensile strength, compressive strength and modulus of elasticity, all with wall thickness' well below that of a chopped spray basin. A chopped spray process achieves between 20-30% at best glass content. (See Chart 1 for density comparisons and Chart 2 for strength comparisons).

Materials Used

Jackel uses high quality and documented glass rovings and resins which offer specific corrosion resistance in septic and sewage applications. The resins corrosion resistance properties are also applicable for other applications. Jackel will review individual applications for the appropriate resin.

Jackel uses resins designed to meet the harshest septic or sewage application. The glass roving used is an E-type continuous glass fiber which is well known for this type of application.

Process Comparison Summary

Chart 3 summarizes the physical properties and dimensions between Jackel's filament winding process (helical + hoop) and a chop spray process.

Summary

Key Features of Jackel's Filament Winding Process

1. Filaments are aligned

- Offers directional reinforcement

2. Filaments are tensioned

- Provides even stress distribution. Uses high percentage of glass roving strength.
- Provides high glass content, 65%. Excess resin is squeezed out of laminate.

3. High performance materials

- Glass rovings provide high tensile strength in both the hoop and axial directions.
- Resins offer corrosion and chemical resistance applicable in septic and sewage environments.

4. Precision fabrication process

- Uniform product; dimensional and physical properties are computer controlled.

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Fiberglass Density

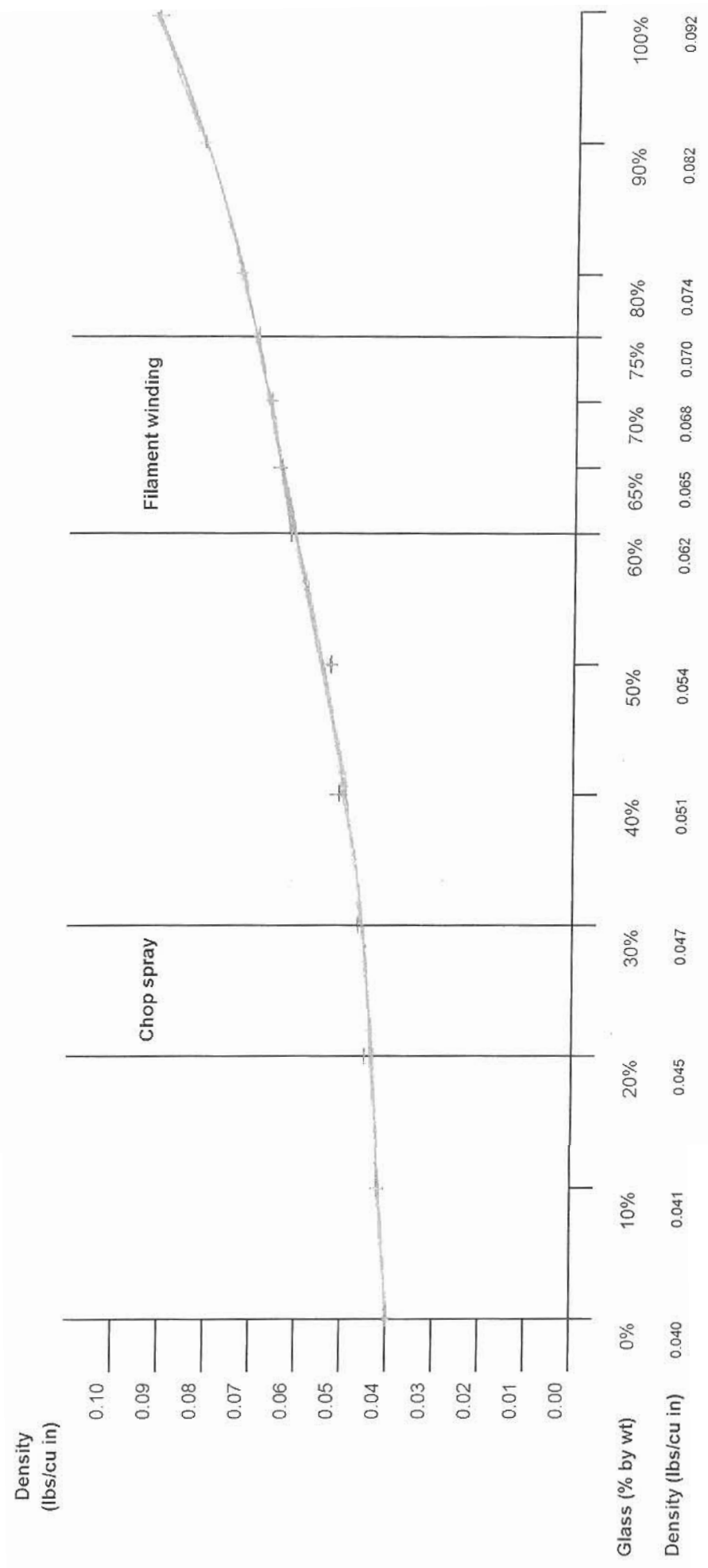


Chart 1

Tensile Strengths Industry Nominal Figures

<u>Process</u>	<u>% Glass</u>	<u>Density</u>	<u>Tensile Strength</u> (psi)	<u>Strength Direction</u>
Chop spray	20%	0.045	15,000	
	25%	0.046	25,000	
	30%	0.047	35,000	
Filament winding	60%	0.062	110,000	Axial & hoop
	65%	0.065	120,000	Axial & hoop
	70%	0.068	130,000	Axial & hoop
	75%	0.071	140,000	Axial & hoop
	80%	0.074	150,000	Axial & hoop

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 Process Comparison Summary
 Preliminary Findings

Jackel Basin
 Filament Wound
 Helical and Hoop Wrap

Chop Spray Basin

Physical Properties

Tensile Strength	100,000 - 150,000 psi in both axial and hoop direction	15,000 - 35,000 psi
Maximum Applied Load prior to buckling	6 psi	2 psi
Ex. 24 x 72, assume same wall thickness (inches)	0.1002	0.1002
Modulus - Hoop	5,000,000	2,000,000 or less
Modulus - Axial	2,800,000	2,000,000 or less

Physical Dimensions

Wall thickness required to withstand same loads (Ex. 24 x 72)	0.1002	0.3300
% Glass	65 - 70%	20 - 30%
Density (lbs/cu in)	0.065	0.046
Dimensional accuracy basin to basin	within 2%	Variable, operator dependant