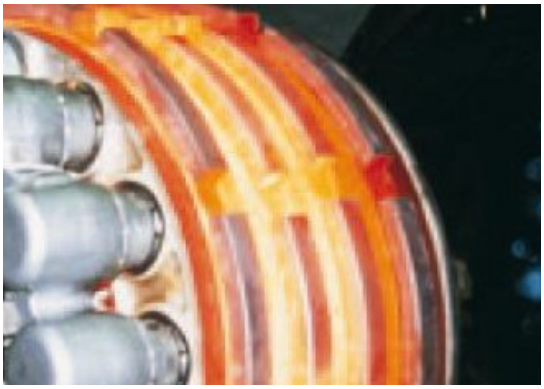
Aircraft Brake Disk Manufacture



Introduction

Aircraft braking systems have long been using carbon/carbon brake disks. Able to withstand temperature of up 1000 deg C., carbon brake discs are lighter compared to metals, enabling more payload to be carried per flight and savings in fuel consumption. Carbon/Carbon (C/C) brakes have been made from industrial grade heavy tow (320K x 1.7 dtex) precursor from the Bluestar Grimsby site for over 30 years. Aircraft programs such as the Boeing 747 and others have successfully been running with Bluestar precursor.

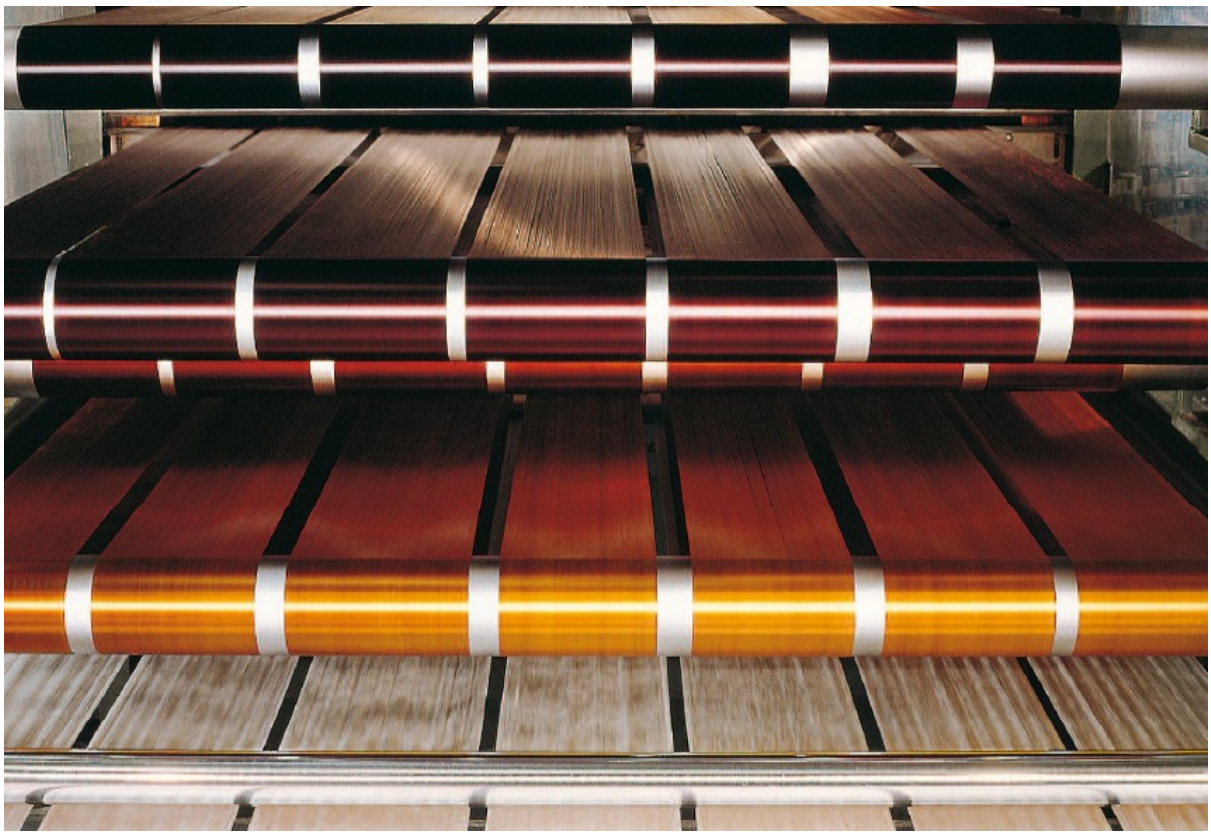
A Process to make C/C aircraft brakes

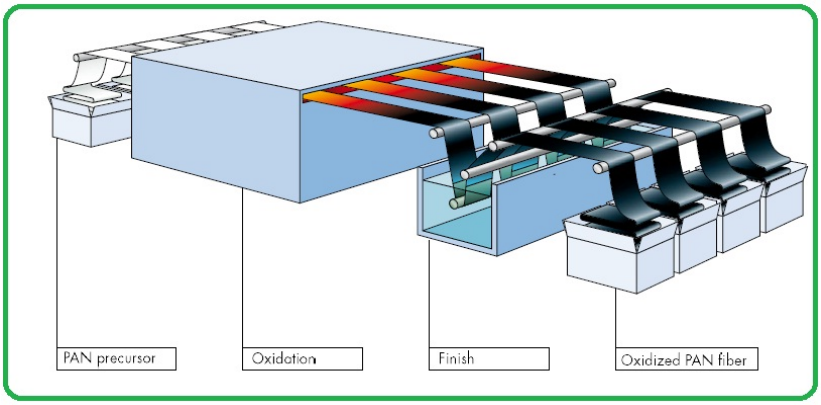
1. Precursor
2. Oxidation
3. Felting
4. Carbonization of oxidized felt
5. Stamping out and stacking of carbonized felt
6. Carbon vapor deposition
7. Machining to final shape and dimensions

1. Precursor

   320K x 1.7 dtex Bluestar precursor is a common starting material for the manufacture of C/C brakes.

2. Oxidation





Typical oxidized density 1.36 to 1.38 g/cm^3

The fiber finish is an antistatic textile lubricant to help further processing.

3. Felting

Using conventional textile conversion (e.g. needle punching) the oxidized PAN is converted to a fabric. These felts from Zoltek are typical of what is required:

Technical Datasheet

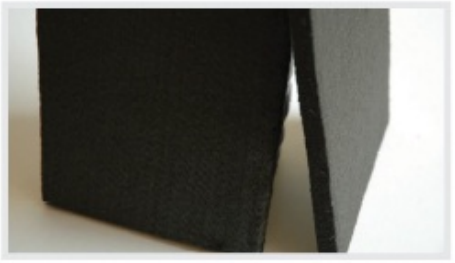
ZOLTEK

Pyron® Carbon Felts

Non-woven, Needlepunched, Oxidized / Stabilized PAN Fiber (OPAN) Felts

Description

Produced from 100% Pyron® oxidized PAN fibers, needlepunched felts are for use as thermal / acoustical insulation in aerospace, automotive or general industrial high temperature applications. Valuable as a low cost – high performance fire or spark barrier.



Material Overview	FT0500-200 SI	FT0500-200 US	FT0575-095 SI	FT0575-095 US
*Areal Weight**	500 g/m²	15 oz/yd²	576 g/m²	17 oz/yd²
Width	203 cm	80 in	94 cm	37 in
Roll Length	100 m	109 yds	45 m	50 yds
Thickness	4.2 mm	0.17 in	6.4 mm	0.25 in
Fiber Input	1.7 or 2.2 dTex			
Construction	Needlepunch			

*Custom weights available

Fiber Properties	
Density	1.36 g/cc min
Diameter	1.25 micron
LOI	40%+
Color	Black
Resistivity	8x10⁸ ohms cm

Chemical Composition (%)	
Carbon Content	62
Nitrogen	21.5
Oxygen	12
Hydrogen	4.5
Sodium	<0.1
Trace Metals	<0.01

Chemical Resistance	
Strong Acids	Good
Weak Acids	Excellent
Strong Bases	Poor
Weak Bases	Good
Organic Solvents	Excellent

4. Carbonization of Oxidized Felt

Felts are carbonized in an LT furnace under Nitrogen to around 1000 deg. C.

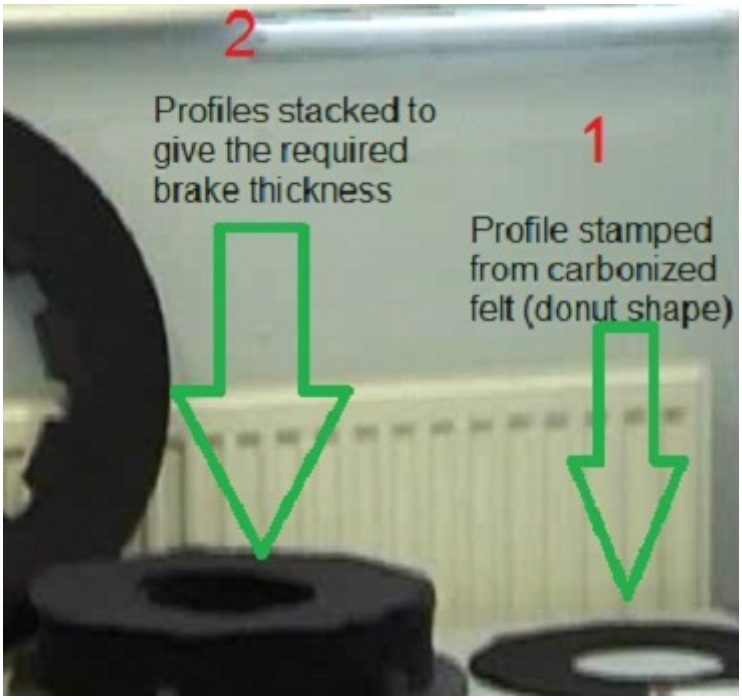
Oxidized acrylic fiber felt, prior to carbonization

Drive nip to furnace entrance

Wind-up of felt after carbonization

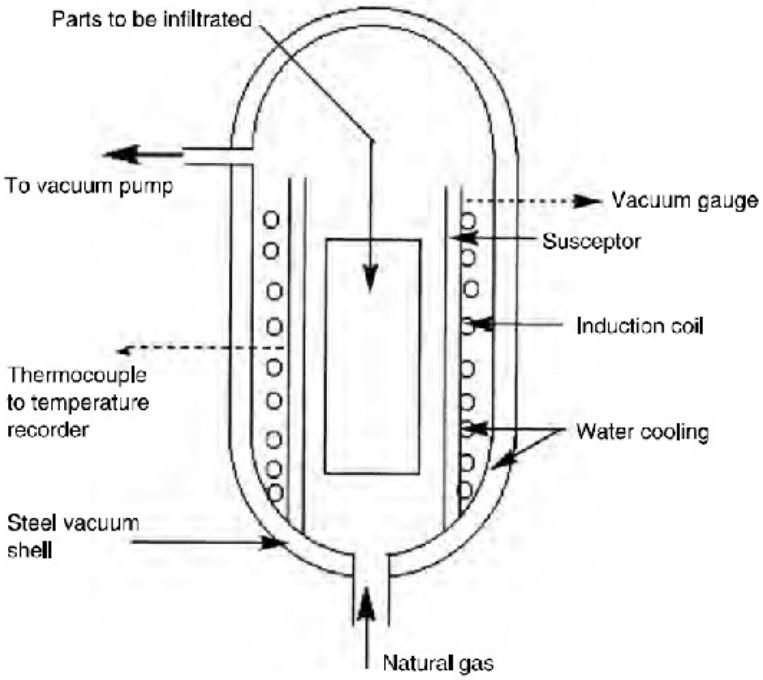
Finished carbon felt rolls

5. Stamping out and Stacking of the Carbon Felt.

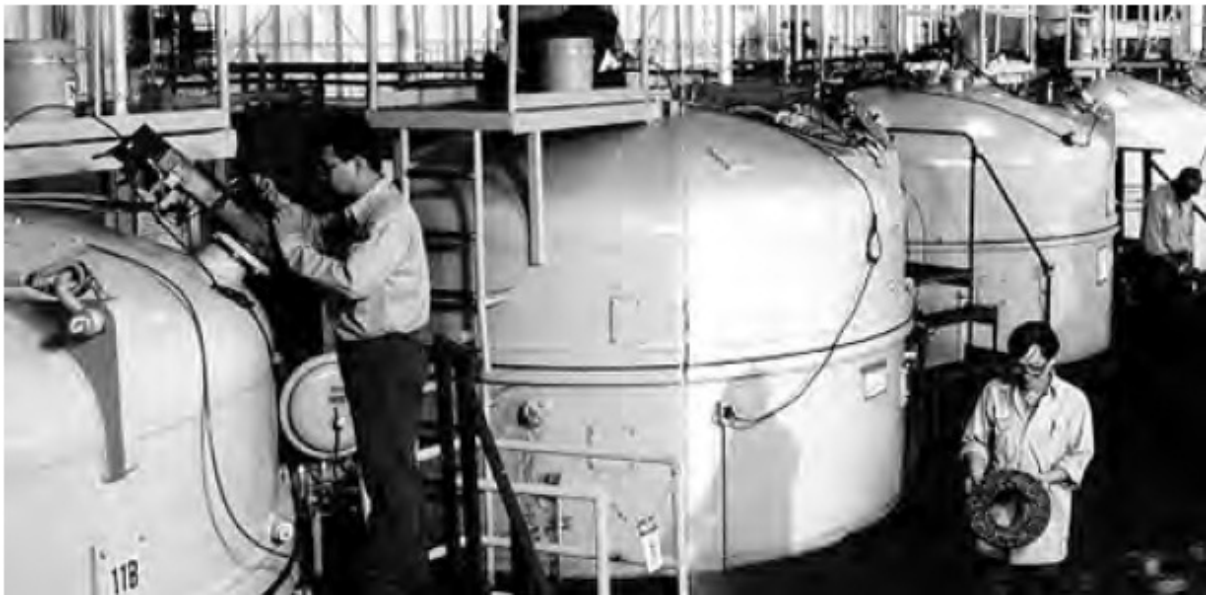


6. Carbon Vapor Deposition (CVD Process)

Principle of the CVD Process (for stacked donut preforms)



Actual CVD furnaces



Residence time in the CVD furnaces can be days or even weeks. During this process, carbon is deposited onto the fibers and make a solid disk.

7. Machining to final shape and dimensions

The disks are finally machined to the required dimensions before release to the final brake assembly

Vince Kelly