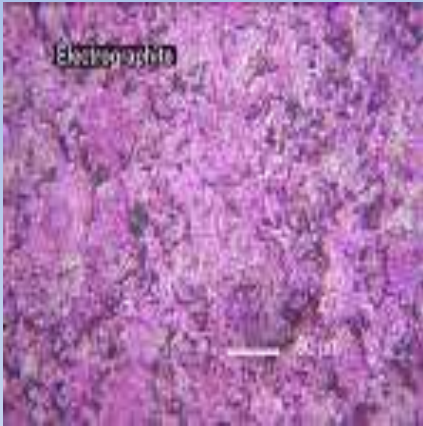




Technical presentation

Carbotech Provides Full Range of Carbon Product Technologies

Electro graphite (EG)



Typical Applications:
Corded AC -Professional,
Industrial Demand

These grades are the most widely used on Industrial and Traction applications, DC drives, both motors and generators.

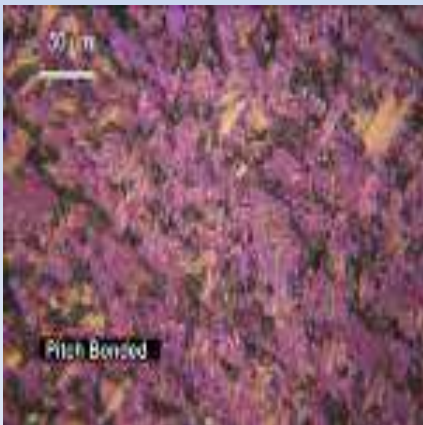
Resin Bonded (IM,GB)



Typical Applications:
Corded AC – Light Duty
Demand

These grades have a very low friction with a much higher contact drop than electrographitic materials

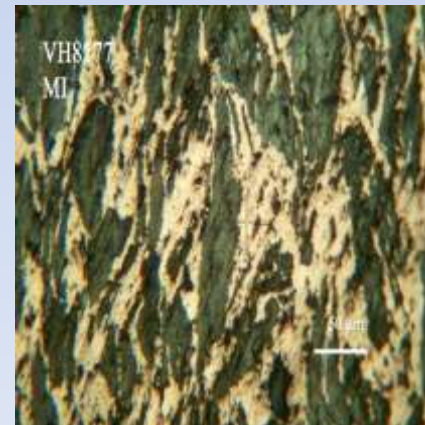
Pitch Bonded Graphite (PM)



Typical Applications:
Corded AC - Professional
Demand

These grades tend to have higher friction and are used on applications where some sparking is inevitable and a grade with cleaning properties is desirable.

Copper Graphite(CM)



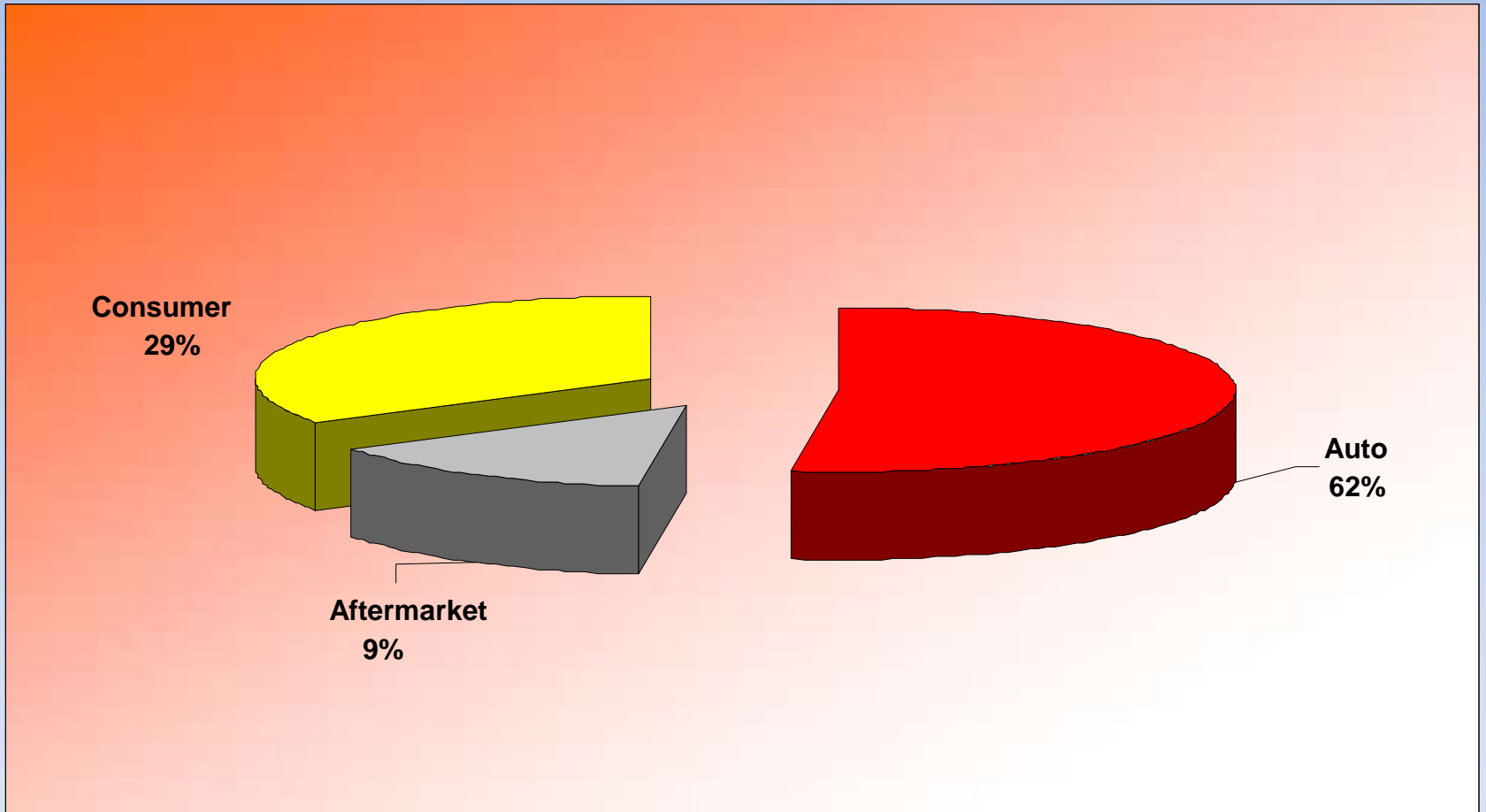
Typical Applications:

DC – All Ranges of
Demand

These grades are mainly used for current collection with low contact drop. They generally exhibit low friction.



Technological development of Carbotech focuses primarily on copper and resin bonded materials, because they cover almost completely the automotive and consumer markets, which are the core business of the company.



Main CARBOTECH grades for carbon brushes

Type of material	Grade name	Copper %	Standard applications
Electrographite	EG845	N/A	VC 110V , Powertools
	EG236S	N/A	VC 110V
Pitch bonded graphite	PM52	N/A	Washing machine
	C12	N/A	Powertools (110-230V)
Resin bonded graphite	GB631	N/A	High speed VC 230 V
	IM76	N/A	Hydrocleaners
	4X	N/A	FHP < 500 Watt
Copper graphite	CM231 (VL)	33	HVAC, seat movers
	CM213 (VL)	40	ECF, Pump motor
	CM245 (VL)	35	ECF
	CM232	40	Wipers and other applications
	CM247 (DL)	34	Window lift

Main CARBOTECH grades for brushes

Carbotech has more than 80 grades for the automotive and about 30 grades for the consumer market, which are able to cover almost all the applications:

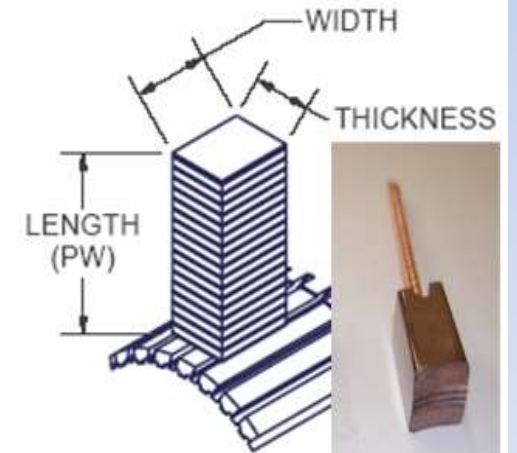
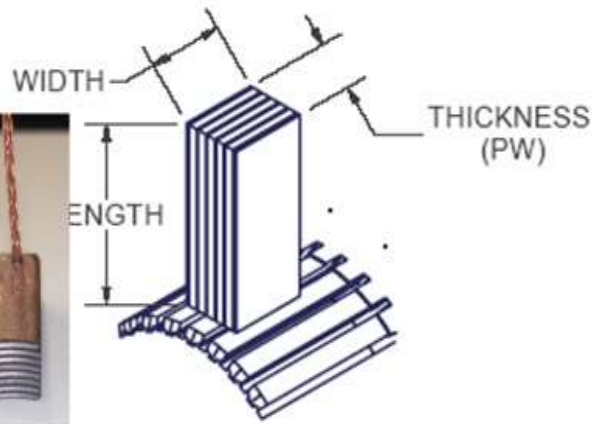
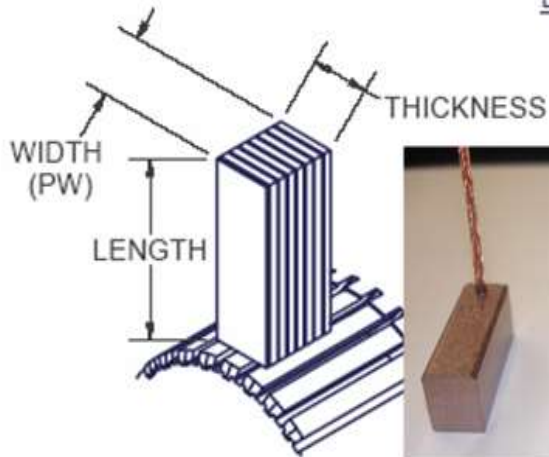
Automotive	Consumer
Starters	Drill
Alternators	Saw
HVAC	Angle grinder
ECF	Vacuum cleaners
Wipers	Meat mincer
Window lift - Sunroof - Seat movers	Hair dryer
Pump motor for electro-hydraulic automated manual transmission	Washing machine

These grades are developed both in MECL and in Elettrolitica del Basso Nera. Furthermore, Carbotech is able to develop any kind of grade basing on over 50 years of experience and through a process of continuous innovation.

Grain direction



BRUSH GRAIN DIRECTION VS PRESSING



G.C. - CIRCUMFERENTIAL

G.A. - AXIAL

G.T. - TANGENTIAL

Material Testing (on the brush sample)

Physical testing for:

Density	g/cm ³	
Resistivity	microOHM m	
Strength	N/mm ²	
Hardness	Rockwell	Shore
If flexed:	MVD	mOHM
	Flex pull strength	N

The Electrical Test Lab



CARBOTECH Test Lab's Objective

- To Provide Technical Support For CARBOTECH and Customers
- Maintain Test Capabilities for the Growing Markets
- Pro-active role in Grade Development and Grade Application

Customer Requirements

- Technical support
- EMI Testing
- Product Endurance Testing
- Performance Testing
- Failure Analysis
- Product Evaluation

Meeting the Needs

- Continuous Improvement of Test Facilities
- Wide Variety of Test Capabilities
- Generic Equipment Designs for Wide Range of Applications
- Automotive, Consumer

Automotive Segment

- HVAC
- ECF
- Window lift
- Wipers
- Alternators
- Starters
- ABS

HVAC

- HVAC motors
- 4 stations
- 12 VDC
- Temperature up to 80 degree C.
- Time and Speed Cycling.
- 24 Hour Operation



Heat Chamber

- Engine Cooling Fans
- 4 stations
- 12 VDC
- Temperature -40 to 180 degree C.
- controlled humidity
- Time and Speed Cycling.
- 24 Hour Operation



Alternators

- 4 Test Stands
- 4 With Temperature Control to 120 C
- Up to 21,000 RPM
- 150 Amp DC Load
- Speed Cycling
- Load Cycling
- 24 Hour Operation



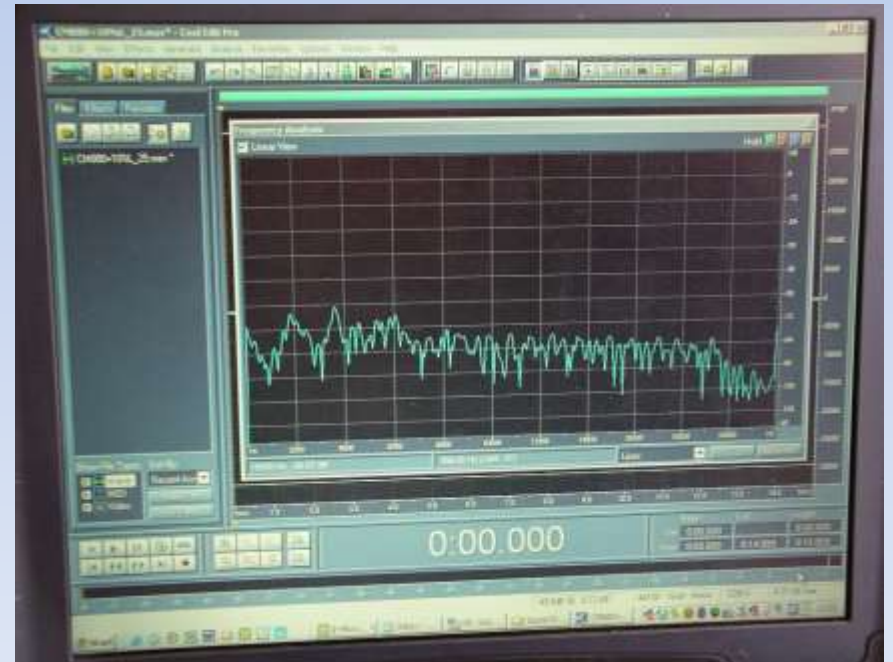
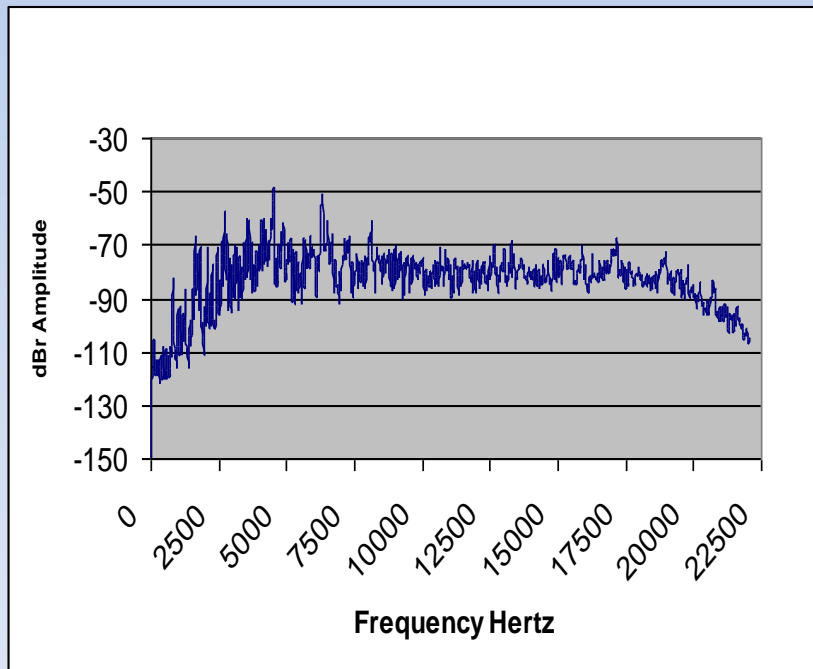
Starters (Passenger Car)

- One, 2 Station Rig
- Three, 1 Station Rig
- Performance Curves
- Up to 1,500 Amps DC
- Infinite Time Cycle Capabilities
- 24 Hour Operation



Audible Noise Testing

- Car Accessory
 - HVAC Blowers
 - Window Lifts
 - Seat Movers



Consumer Segment

- Vacuum cleaner
- Washing machine
- Hair dryer
- Power Tools

Vacuum cleaner Endurance Testing

- 2 Eight station test rigs
- Voltage 100 - 240 V
- stabilized power supply
- different cycles programmable



Power Tool Testing

- 4 Hysteresis Brake Loads.
- Programmable Cycles
- Programmable Loads
- Up to 3 kW Load Capability
- Cordless Applications
- Drills, Saws, Planers, Grinders

Power Tool Testing

- 4 Alternator Brake Loads.
- Up to 1 kW Load Capability
- Cordless Applications
- Drills, Saws, Planers, Grinders

Power Tool Testing



Washing Machine Testing

- 8 WM available for endurance testing
- Temperature monitoring
- 24h per day



➔ When there are some special requests by the customer, or a brush problem and it's necessary to investigate deeply, or in a specific phase during the development, we collaborate with two laboratory certificated and with Engineering Materials Department of University of L'Aquila which are able to do the following analysis :

- Analysis of components (Copper, MoS₂, Ash, ecc.)



- TGA – DSC



- Metallography microscopy



- Spectral analysis (FT-IR)



Manufacturing technologies

- **Presses** (monocavity / multicavities)
- **Mechanical and hydraulic presses** from 4 to 50 Tons
- **100%** control of pressing force
- **Rapid prototyping**
- **Finishing**

Automatic equipment for grinding operation and shunt end welding

Carbotech QUALITY CERTIFICATE

ISO9001 - ISO/TS 16949:2002

