Technical presentation

Carbotech Provides Full Range of Carbon Product Technologies

Electro graphite (EG)

Typical Applications:
Corded AC -Professional, Industrial Demand

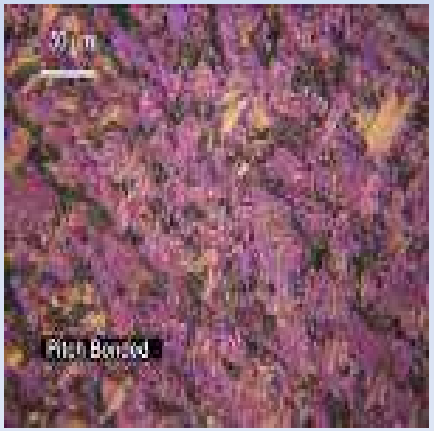
These grades are the most widely used on Industrial and Traction applications, DC drives, both motors and generators.

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

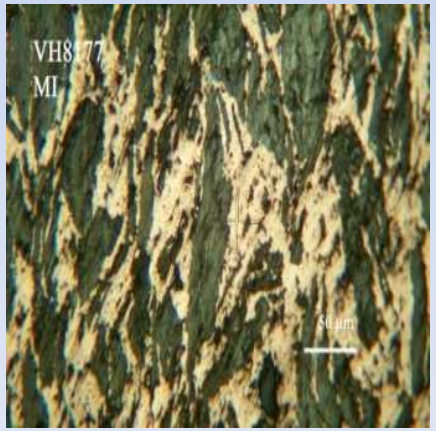
Pitch Bonded Graphite (PM)



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)

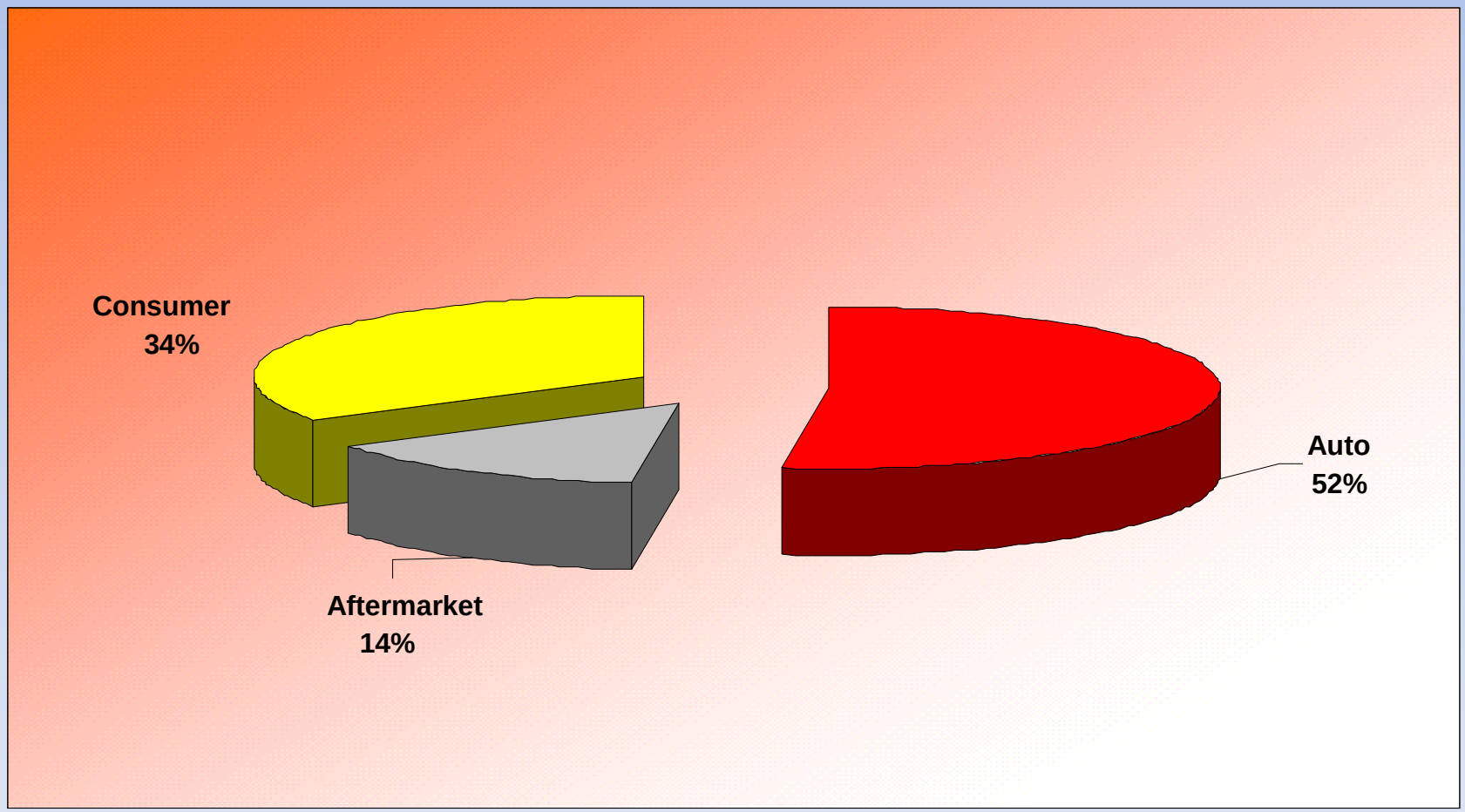


Typical Applications:

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
	CM222 (VL)	45	HVAC
	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.

Carbotech History

1962	• The factory is first installed under name ELETTROLITICA DEL BASSO NERA (EBN). Brushes for electric motors is Core business.
1973	• EBN becomes part of the Morgan group; alongside with brushes, also mechanical carbon production is started
1995	• First Quality Certification is achieved by EBN and its people
2000	• QS9000 Automotive Quality Certification

Carbotech History

2004

- Morgan Crucible sells the Auto/Consumer Business to MidMark Capital, USA
- Energy Conversion Systems is born from:
  - MECL (UK)
  - EBN (It)
  - Karahm (Korea)
  - Krug (Brazil)
  - Morganite Inc (USA)
  - Multicraft (USA)
  - Tanjin (China)
  - Rekofa (Germany)
- ECS Italy was a merge between MECL (Morganite:UK) and EBN (Italy)
- A new customised site was built to house this new company.

Carbotech History

Feb 2009

- On 12th February, 2009, ECS Italy was acquired from the ECS Holdings by the local Italian management team.
- While no longer a part of ECS Holdings, ECS Italy has the sole rights to use of all local grade technology and the perpetuity usage of the grade technology supplied and owned by other parts of the ECS group. The level of service and technology offering will in no way be diminished by this transaction which secures the future of supply from the Italy location.

May 2009

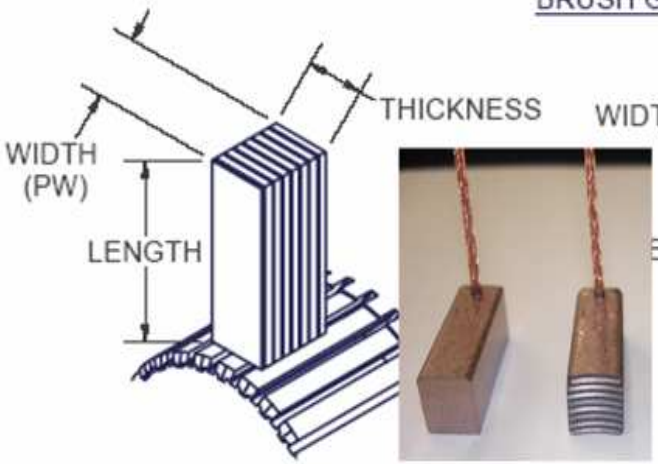
- A Commercial Partnership is established with Logotec for the German and Switzerland market.

Jan 2010

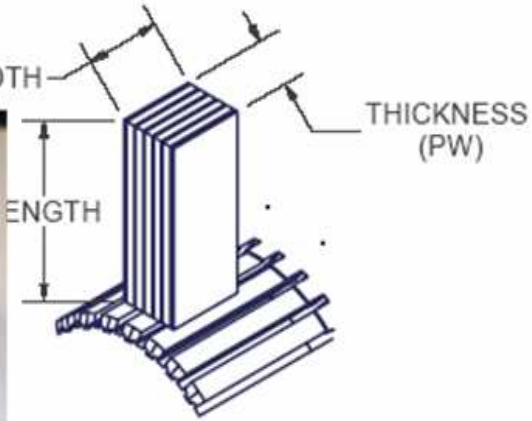
- Company Name change to Carbotech srl.
- Nothing is changed with regards to every other aspect.

Grain direction

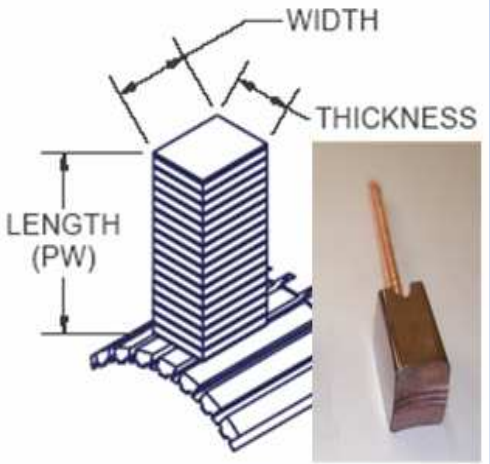
BRUSH GRAIN DIRECTION VS PRESSING



G.C. - CIRCUMFERENTIAL



G.A. - AXIAL



G.T. - TANGENTIAL

How CARBOTECH develops a new grade for an application

The black mix is controlled through a series of physical analysis:

Type of analysis	Instrument	Comments
PSD	Air jet sieve	PSD's check through a series of sieves DIN, weighing an exact amount of powder at the beginning and after each sieving. Each powder has a specific PSD which must remain within certain limits.
Bulk Density	Scott Volumeter	Typical values for premix : 0.6 – 0.7 g/cm^3 for powder 0.85 – 1.1 g/cm^3 for granules
Green Density (pellets)	Balance	This characteristics is strongly correleted with the bulk density, we measure it specially for double checking
Weight loss (120°)	Oven & Balance	This simple analysis is very important to control our process mixing: this value allows us to understand whether the mixing process lasted the right time or if the premix has been discharged too soon or too late. If these two events occur there may be problems to pressing carbon brushes.
Curing (only for epoxies)	Continuos kiln & balance, caliper	We press two blocks at standard pressure (10 TSI), then kilning at 280°C to calculate weight loss and exspansion of material (along pressway Direction) Typical values: 4 – 6 % weight loss 1 – 3 % expansion

How CARBOTECH develops a new grade for an application

After the milling process, before adding copper and eventually other additives, it's necessary to do the homogenisation of the powder, in order to get a mix with equal characteristic in every parts. For this operation we use blender with various dimension.

Addition of copper

Copper	Specific Surface Fisher (cm^2/g)	Apparent Density (g/cm^3)	Cut (mm)
Dendritic	1800	0.8	<0.08
	1400	1.0	<0.08
	700	1.85	<0.08
	1800	1.0	<0.045
Flake	4000	1.1	<0.045
	7500	1.1	<0.045
	>10000	0.8	<0.045
Atomized	-	2.6	<0.125

How CARBOTECH develops a new grade for an application

The addition of copper occurs at RT, then we press a series of 5 blocks to determine the right pressure of grade (usually 3-4 T/cm²), then we kiln the blocks in our batch ovens or continuos kiln.

TSI	L	W	Th	Wt	L	W	Th	Wt	N	R/W	G.D	C.D	Res	BS	DW	PW	Wt Loss
8	71,62	13,76	11,05	29,96	71,26	13,69	10,82	28,76	207	89,1	2,751	2,725	0,4	11,0	9,95	9,79	4,01
12	71,62	13,76	11,14	30,73	71,2	13,69	10,88	29,47	264	89,2	2,799	2,779	0,4	13,9	9,94	9,77	4,10
16	71,62	13,76	10,82	30,58	71,19	13,69	10,54	29,38	323	99,6	2,868	2,860	0,3	18,2	9,94	9,74	3,92
20	71,59	13,76	10,39	30,46	71,14	13,67	10,14	29,29	404	99,4	2,976	2,970	0,3	24,6	9,94	9,76	3,84
24	71,59	13,76	10,39	30,5	71,15	13,68	10,12	29,34	425	95,8	2,980	2,979	0,3	25,9	9,94	9,74	3,80

Choosing the right pressure is derived from considerations of various parameters, such as the geometry of the brush (thickness, presence or absence of points are subject to easy breakage, etc..), or the final characteristics of the material that you want to get (for example, more or less soft material).

How CARBOTECH develops a new grade for an application

For heat treatment we have two types of furnaces (continuous or batch) which differ not only in form, even for the reducing atmosphere that circulates within them:

	N° furnaces available and characteristics	Reducing atmosphere	Comments
Continous kilns	4, the furnace is composed of 4 chambers at different temperatures and a carrier belt where brushes are positioned. We set the temperatures of 4 chambers and the speed of the belt depending on the type of product we want to kiln.	ALNAT	The ALNAT™ Endo atmosphere is based on the catalytic reaction at high temperature between Air and an Hydrocarbon such as natural gas to produce an active protective atmosphere containing H2 and CO species. This kiln is used for 70% in the consumer products and 30% in the automotive ones, especially when there're no problems of copper oxidation.
Pagnotta (batch)	3, the furnace is composed of a metal box inside which there are some metal platforms where the brushes are positioned. The thermal cycle is much longer than the continuous furnaces (450 °C /45 ° C/h / 7hours)	H_2	Flow : 15 l/min H_2 Used only for automotive products
BA11 (batch)	1, same as above batch	H_2	Flow : up to 90 l/min H_2 It's not much used, but with this furnace we have solved oxidation problems for some critical applications

How CARBOTECH develops a new grade for an application

Material Testing (on the brush sample)

Physical testing for:

Density	**g/cm³**	
Resistivity	**microOHM.m**	
Strength	**N/mm²**	
Hardness	**Rockwell**	**Shore**
If flexed:	**MVD**	**mOHM**
	Flex pull strength	**N**

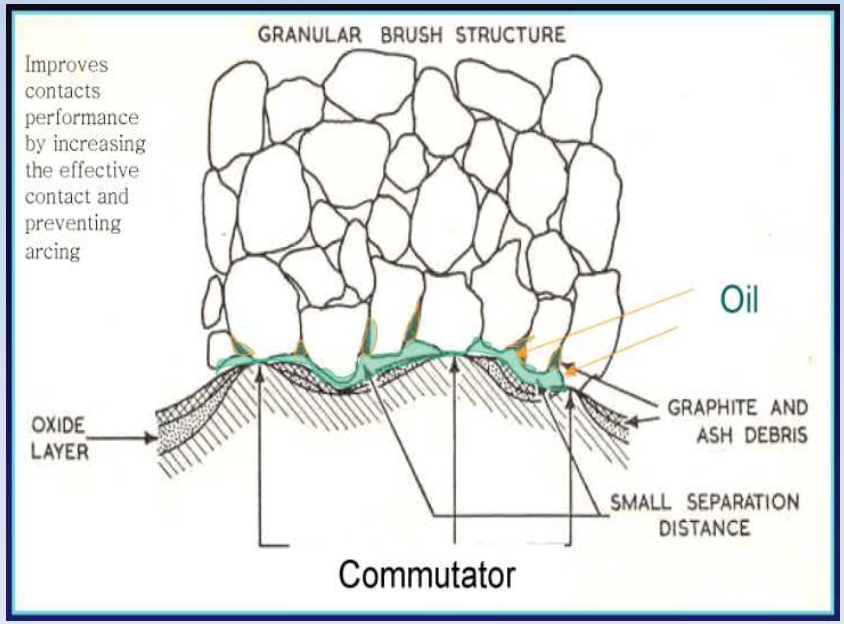
How CARBOTECH develops a new grade for an application

In the automotive segment, we can supply our brushes impregnated with a specialized contact oil (impregnation technology).
We use two concentration of oil (W/W) :
DL = 10% (Window lift)
VL = 20% (ECF & HVAC)

This operation usually improve the following characteristics:

- Brushlife
- Audible noise

Usually, during the initial phase of a new project, we don't supply our brushes impregnated but if the material doesn't satisfy customer requirements, we are able to provide this improvement.
Recently, in one application with hard noise problems, with impregnation DL we have decreased about 8 dB.



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

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

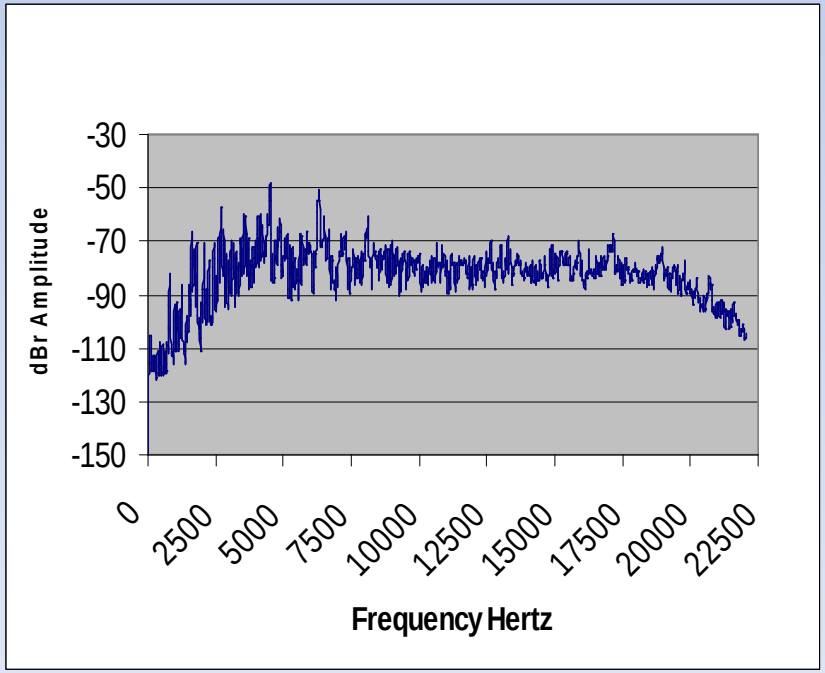
- 4 Test Stands
- 4 With Temperature Control to 120 C
- Up to 21,000 RPM
- 150 Amp DC Load
- Speed Cycling
- Load Cycling
- 24 Hour Operation

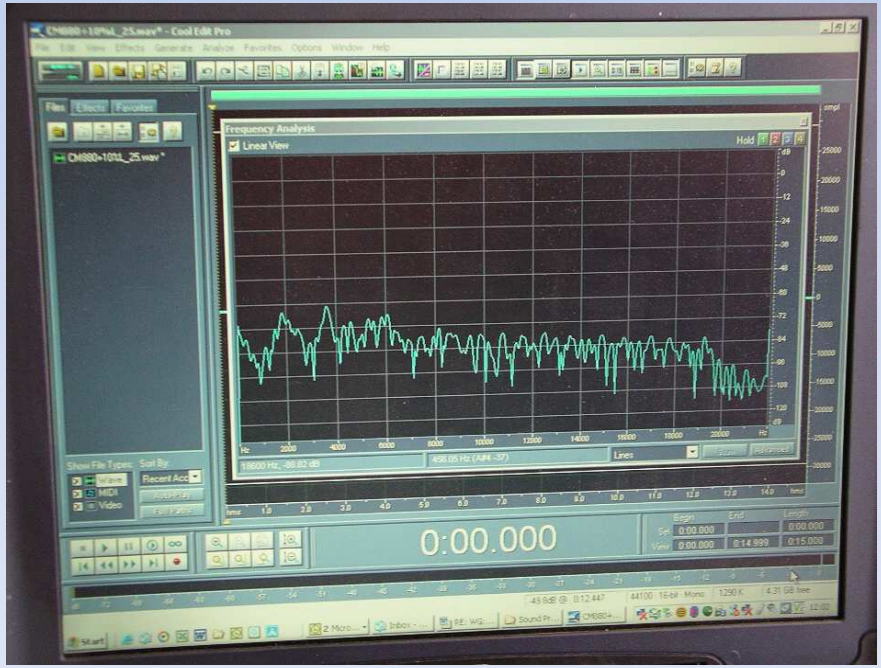
Starters (Passenger Car)

- 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



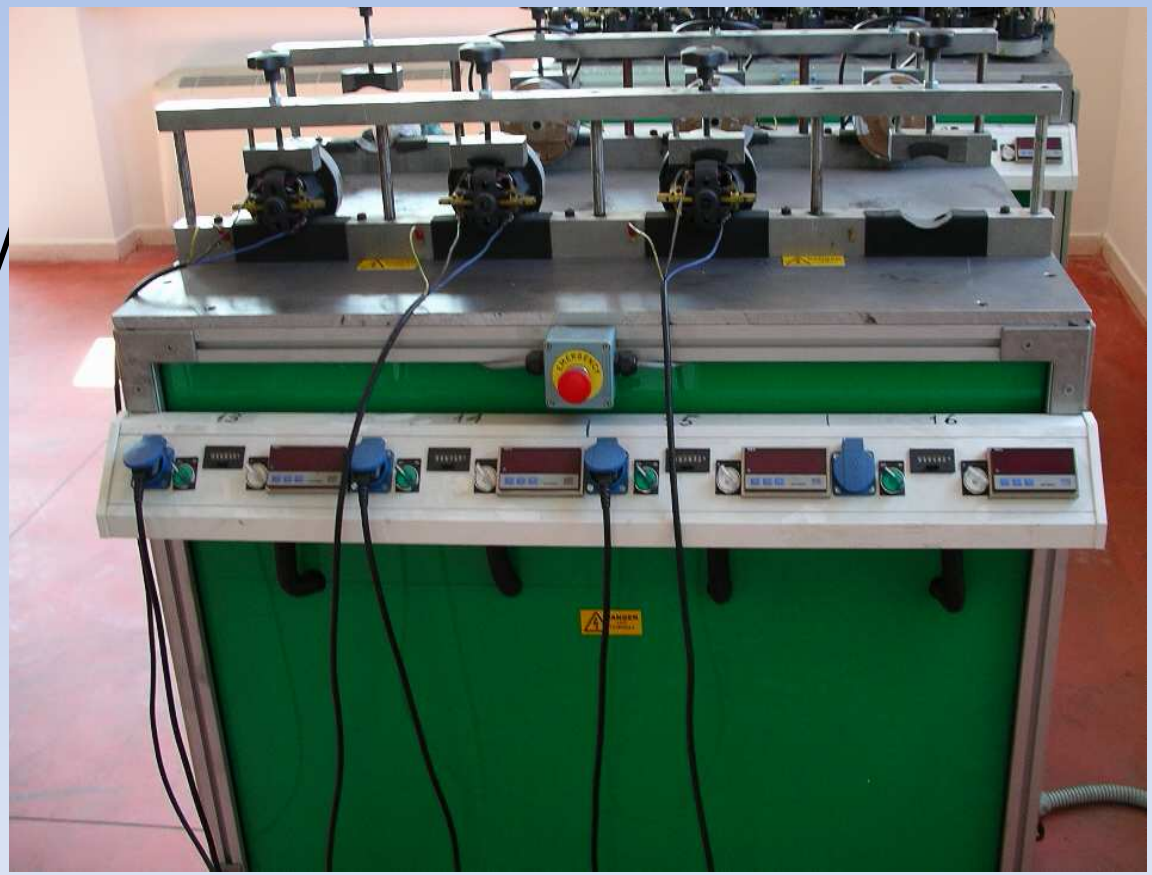


Consumer Segment

- 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

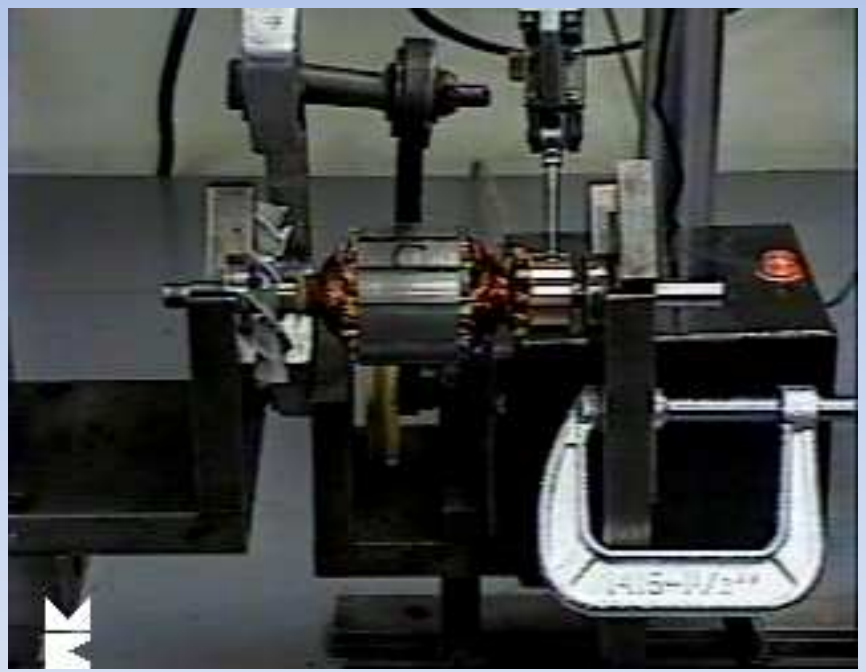
Power Tool Testing

Washing Machine Testing

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

Motor Analysis

- Failure Analysis
- Commutator Total Indicated Roundness
- Bar to Bar
- Brush Life
- Commutator Stability
- Commutator Machining Quality



Chemical and physical analysis

When there are some special requests by the customer, or if there some 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, MoS_2, Ash, ecc.)

- TGA – DSC

- Metallography microscopy

- Spectral analysis (FT-IR)

Carbotech QUALITY CERTIFICATE ISO9001 - ISO/TS 16949:2002

Certificate N. IT05/1057

SGS

The quality management system of

CARBOTECH S.r.l.

Via dell'Industria, snc - 64014 MARTINSICURO (TE) - Italy

has been assessed and certified as meeting the requirements of

ISO 9001 / UNI EN ISO 9001:2008

For the following activities

Design and development, manufacturing and trading of brushes and assemblies for electric motors in the automotive sector.

EA Sector: 15

This certificate is valid from 14/11/2008 until 14/11/2011 and remains valid subject to satisfactory surveillance audits.
Re certification audit due before 14/11/2011.
Issue.3. Certified since 07/11/2005.

Further clarifications regarding the scope of this certificate and the applicability of ISO 9001:2008 requirements may be obtained by consulting the organization.

SINCERT

Authorized By
Paolo Pineschi

SGS ITALIA S.p.A. - Systems & Services Certification
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SGS

Certificate IATF 0074504
Certificate SGS IT08/0986

The management system of

CARBOTECH S.r.l.

Via Dell'Industria snc
Martinsicuro (Teramo), 64014, Italy

Has been assessed and certified as meeting the requirements of

ISO/TS 16949:2002
Edition 2

For the following activities

Design and development, manufacturing of brushes and assemblies for electric motors in the automotive sector.

EXCLUSIONS: none
3 Year certification is valid from 13 January 2009 until 12 January 2012 and remains valid subject to satisfactory surveillance audits
Version no. 4 Current version updated 01 March 2010
Re certification audit due before 17 October 2011
Certified since 16 November 2005

Authorised by

Veto Power Authority

Contracted Office: SGS United Kingdom UK, Ltd 8 Bridgend Business Centre, Bennett Street, Bridgend Industrial Estate, Bridgend, CF31 3SH, UK. Telephone 01656.648494. Fax 01656.647837.
e mail Neil.Hall@sgs.com

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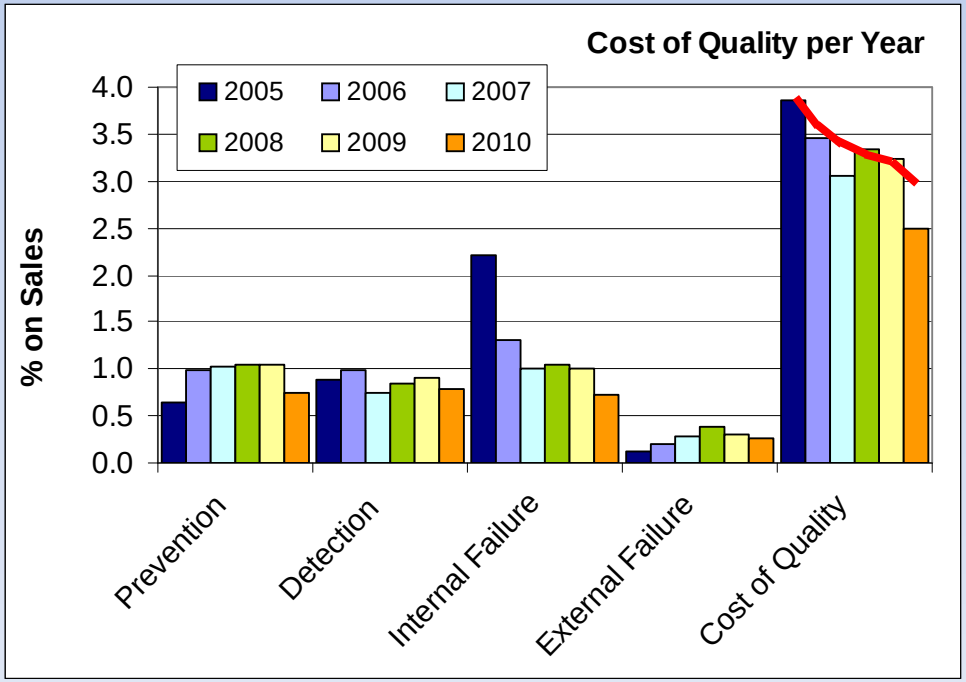
Quality Tools

Long Experience

Management Involvement

Monitoring and Targets



Prevention enforcement

- Planned & Preventive maintenance
- Internal Audits (process – system – product)
- Culture and awareness
- Training plan
- Monitoring and Performance rating
- Potential Improvement Opportunities

Detection actions

- Product characteristic definition
- Process parameters and instructions
- Control Plans
- Task assignement
- On-line SPC checks by operators
- Early stage detection

Failure reduction

Focus on:

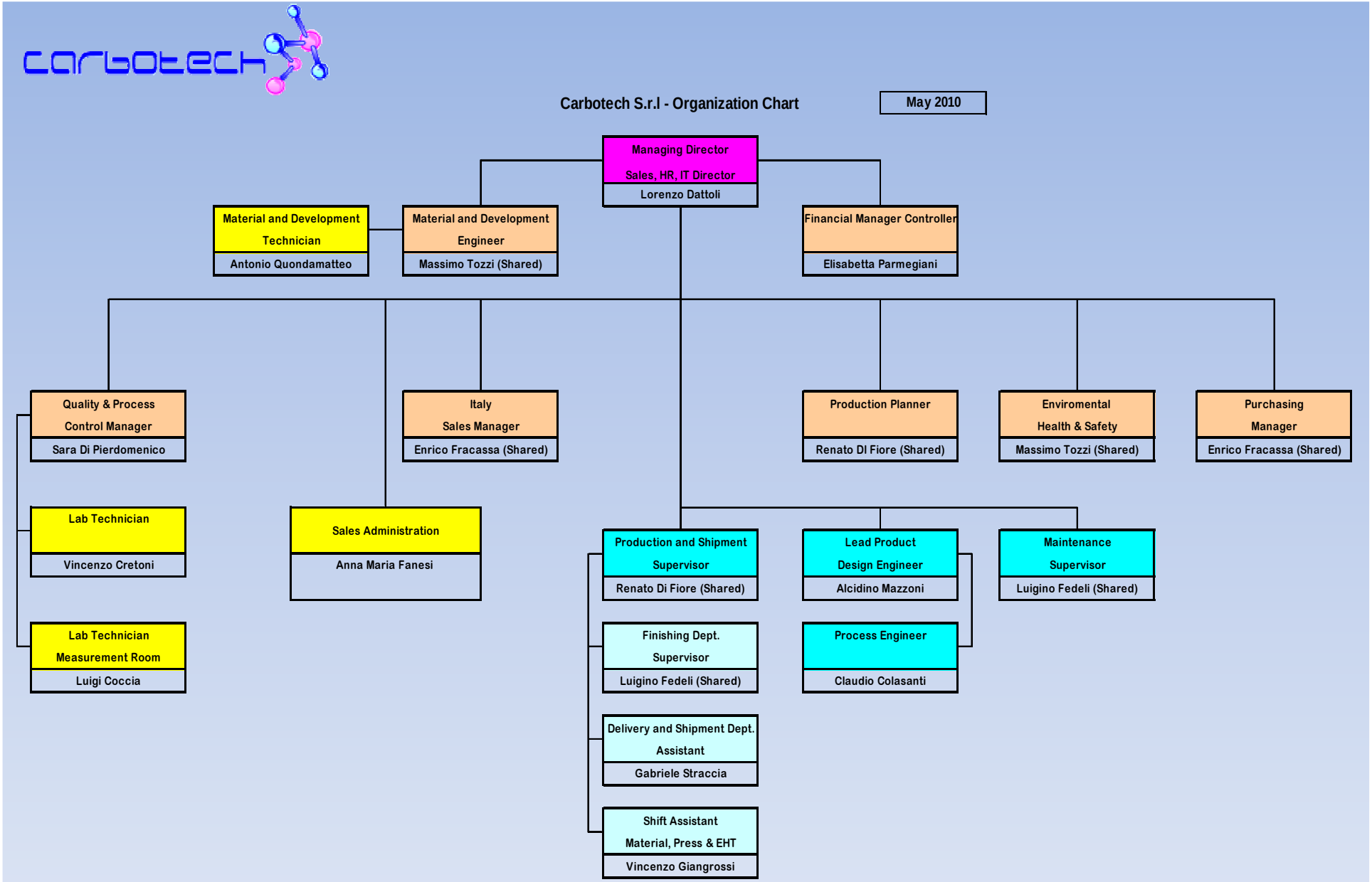
- Scrap reduction
- Machine downtime reduction
- Early stage detection
- Equipment optimization

- Customer communication
- Technical documentation and intructions
- Internal awareness
- Cause detection and elimination

Training
Awareness
Error-proof
APQP
Preventive maintenance
SPC
Safe Launch

Continuous Improvement
D, P & Logistic FMEA
Audits
8D approach
MSA R&R
5 Why and Fishbone
Risk Analysis

Key Tools


Carbotech S.r.l - Organization Chart
May 2010
Managing Director
Sales, HR, IT Director
Lorenzo Dattoli
Material and Development Technician
Antonio Quondamatteo
Material and Development Engineer
Massimo Tozzi (Shared)
Financial Manager Controller
Elisabetta Parmegiani
Quality & Process Control Manager
Sara Di Pierdomenico
Italy Sales Manager
Enrico Fracassa (Shared)
Production Planner
Renato DI Fiore (Shared)
Enviromental Health & Safety
Massimo Tozzi (Shared)
Purchasing Manager
Enrico Fracassa (Shared)
Lab Technician
Vincenzo Cretoni
Sales Administration
Anna Maria Fanesi
Production and Shipment Supervisor
Renato Di Fiore (Shared)
Lead Product Design Engineer
Alcidino Mazzoni
Maintenance Supervisor
Luigino Fedeli (Shared)
Lab Technician Measurement Room
Luigi Coccia
Finishing Dept. Supervisor
Luigino Fedeli (Shared)
Process Engineer
Claudio Colasanti
Delivery and Shipment Dept. Assistant
Gabriele Straccia
Shift Assistant Material, Press & EHT
Vincenzo Giangrossi