



PRIMA DENTAL

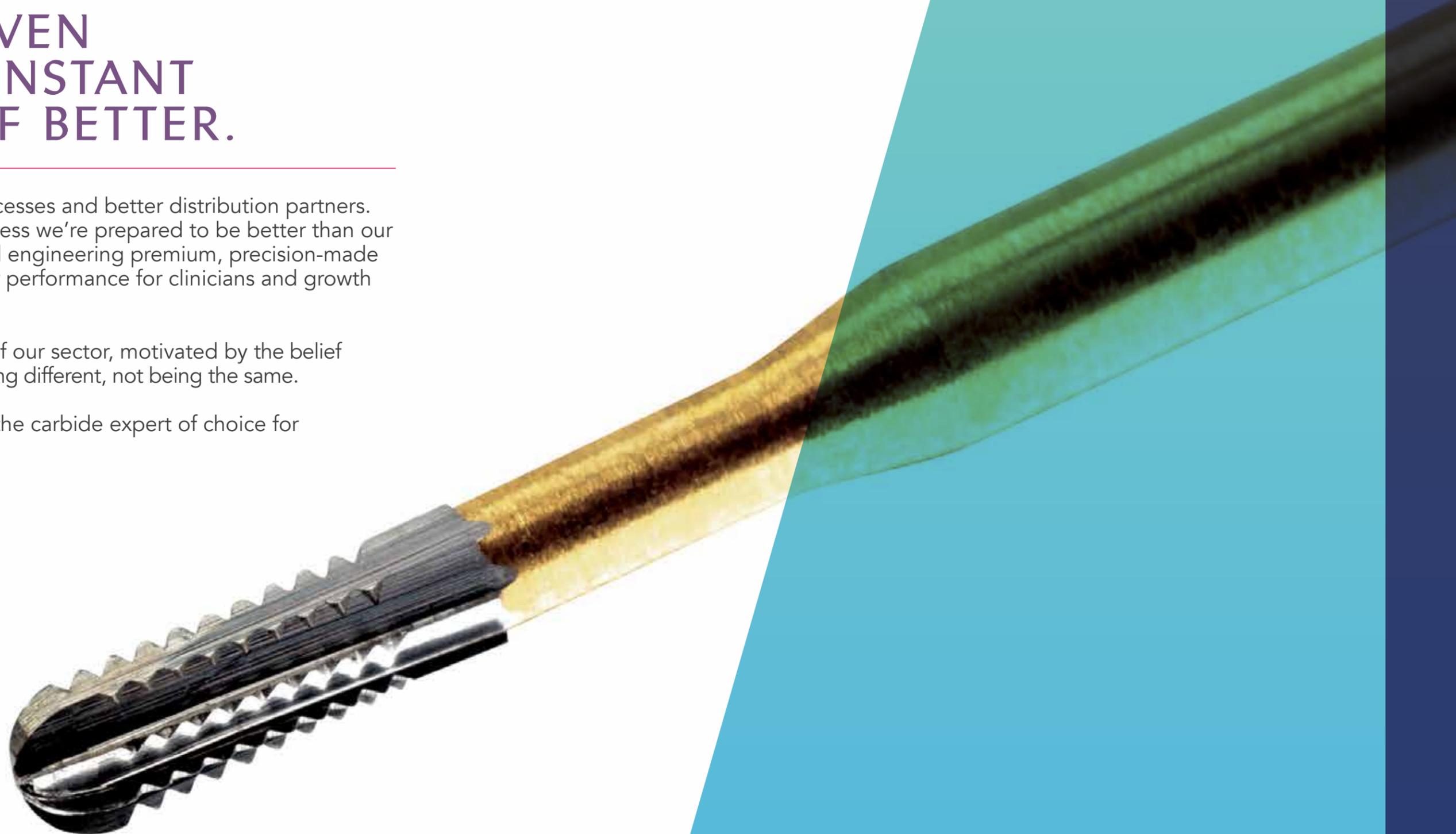
Prima Dental
Better, by Design
Quality Comparison

WE'RE DRIVEN BY THE CONSTANT PURSUIT OF BETTER.

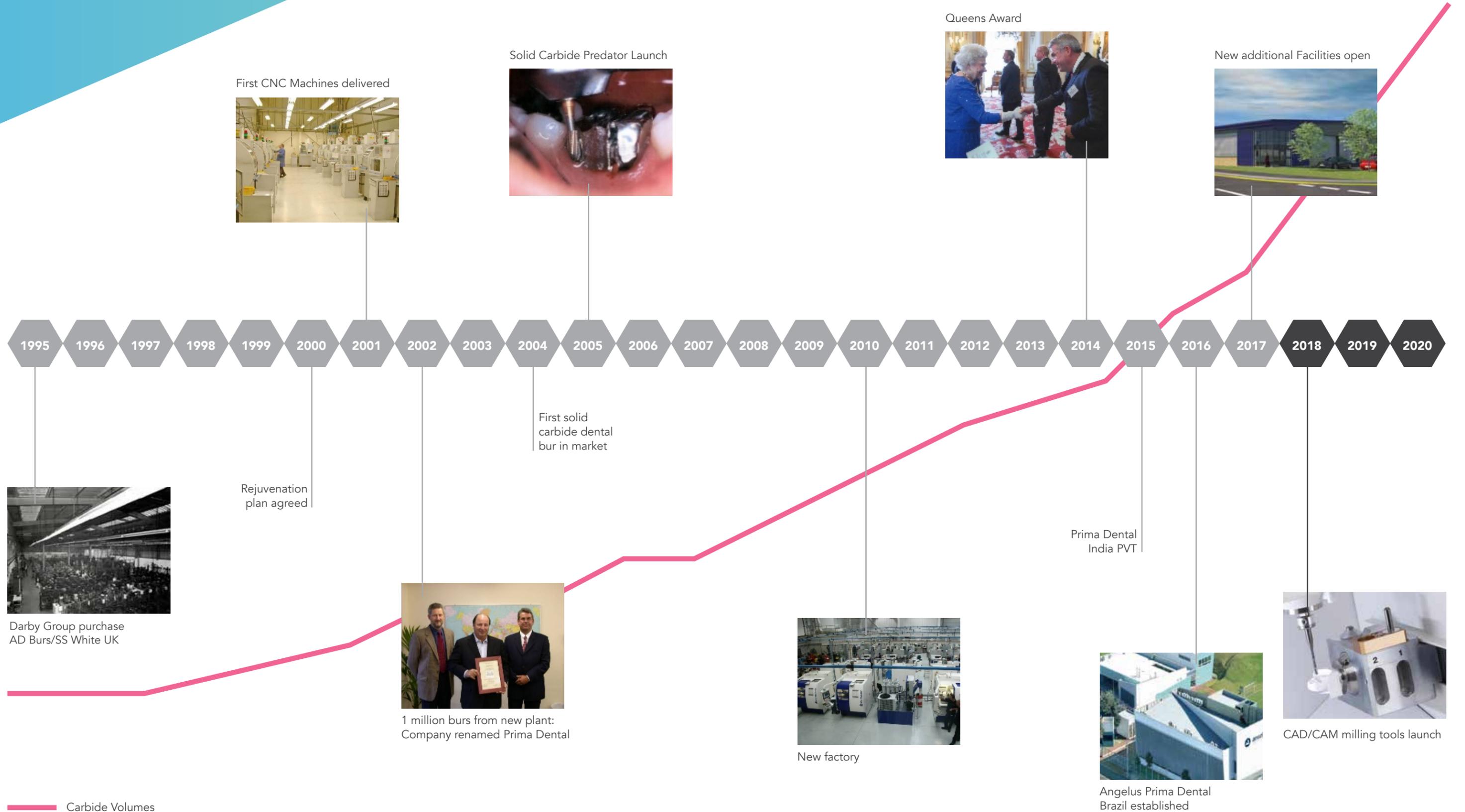
Better products, better processes and better distribution partners. In every aspect of our business we're prepared to be better than our competitors. Designing and engineering premium, precision-made dental products that deliver performance for clinicians and growth to our customers.

We're at the cutting edge of our sector, motivated by the belief that success comes from being different, not being the same.

This is why Prima Dental is the carbide expert of choice for leading global distributors.



A HISTORY OF QUALITY



Darby Group purchase AD Burs/SS White UK

Rejuvenation plan agreed



1 million burs from new plant: Company renamed Prima Dental

First solid carbide dental bur in market



New factory

Prima Dental India PVT



Angelus Prima Dental Brazil established



CAD/CAM milling tools launch

WHAT IS QUALITY?

Regarding the practitioner's perspective on the quality of burs the leading comments are:

"Bur breakage" (two piece issues have scarred some dentists).

"Tactile feedback" (excessive chatter and how this varies depending on the cutting substrate).

"Cutting ability through various restoratives."

"Lifespan vs cost."

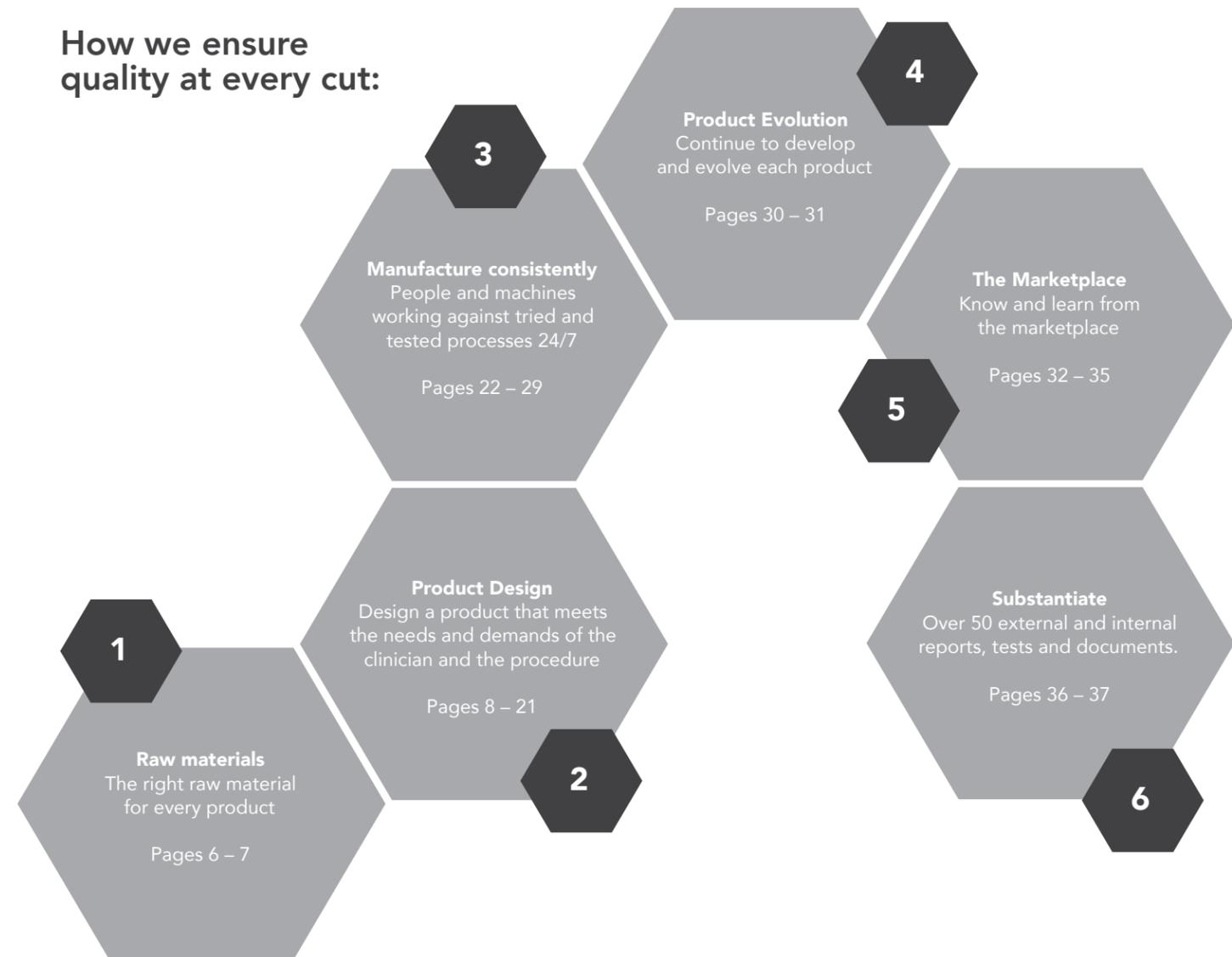
"When using rotary tools at high speeds in a patients mouth clinicians need to have total confidence."

In any medical procedure there are risks – using Prima Dental's burs means there is one less risk to consider."

Charlie Nicholas BDS. Snr Clinical Advisor to Global Corporations Internationally recognised Endodontist



How we ensure quality at every cut:



"In my clinical practice, I recommend the control of oral hygiene for all patients. However, sometimes, I observe on literature that after years, some patients presented marginal infiltration or secondary caries. There are many factors that influence on secondary caries or marginal gaps like: type of restorative material, quality of adhesive bonding interface, quality of light-activation process by LEDs and how the clinicians remove contaminated dentin, caries and do the cavity dental preparation. In my opinion, the quality of dental bur is primordial for success of restoration. This image shows one type of Prima Dental bur for controlling and standardization of dental preparation before insert the restorative material."

*Prof Paulo Vinicius Soares DDS, MS, PhD
Scholar Visiting and PostDoctoral Dental College University of Illinois*

RAW MATERIALS QUALITY OF SUBSTRATE

Testing carbide substrates means that each of our products are made using the most appropriate carbide for their procedure.¹

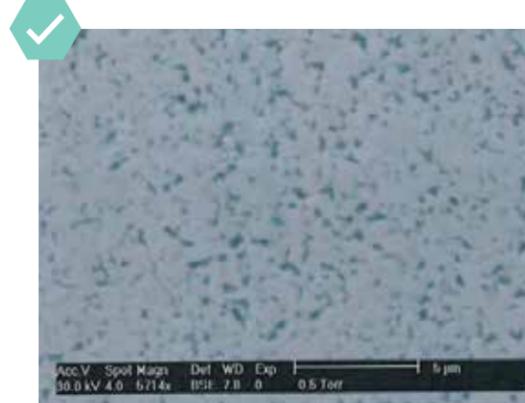
To ensure our carbide is the best quality available we commissioned independent tests on a range of carbide suppliers.

The results show that by purchasing the substrate we use for Predator metal cutting burs from a different supplier, we could improve the product strength.

Testers investigated grain consistency and strength, we chose 'Supplier C' from the table below.



Inconsistent grain sizes in the Carbide



Consistent grain size throughout the Carbide

Material	Overall percentage failure
Supplier A	25%
Supplier B	37%
Supplier C	19%

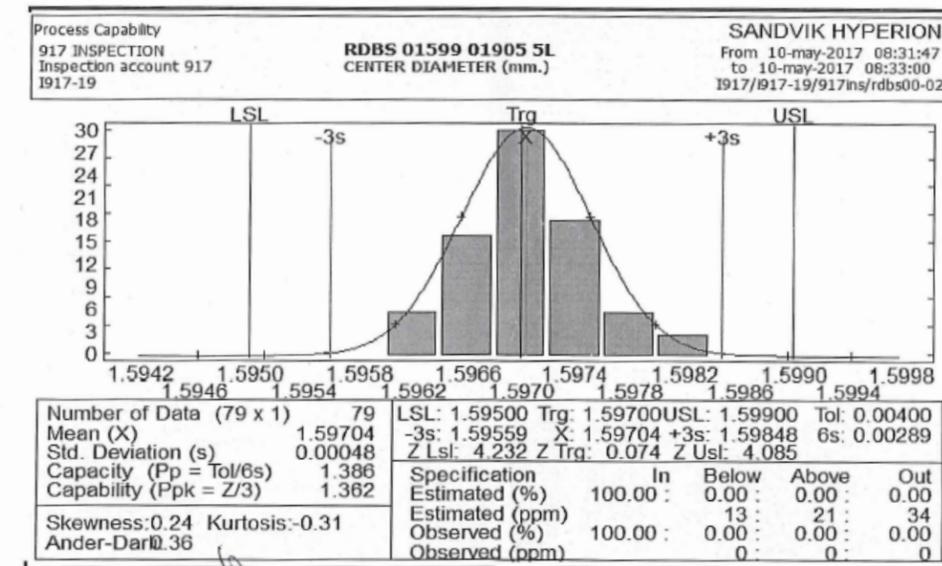
RAW MATERIALS CONCENTRICITY

It is vital that our products begin life with concentricity of 0.01mm.^{2, 3, 4}

Our suppliers meet our diameter tolerance of just a tenth of a millimetre to ensure a premium product for clinicians.

Concentricity of incoming raw material is verified using the Demm concentricity gauge. We have a goods in tolerance of 0.01mm and an in process tolerance of 0.05mm. This enables us to stay within the 0.1mm once all operations have been completed.

This graph shows that 100% raw material is within the specified limit with a PPK of 1.362 - over 4pts better than statistically expected - this contributes to our product tolerances that are 60% tighter than ISO requirements (see page 28)



"Operative dentistry is a highly sensitive craft. To be able to carry out procedures with the greatest accuracy the operator must have the ultimate confidence in the point of contact with the tooth or bone. To ever have concerns as to the durability, precision or cutting ability of the bur would simply undermine the entire procedure. This could manifest itself in the loss of confidence to be able to accurately produce the desired preparation or the worry that the bur could fracture, potentially leading to patient damage or even inhalation."

Dr Charlie Nicholas BDS



"When using a dental bur that has poor concentricity I have less control over the cuts it makes, the risk to promote micro fractures in my patients tooth is higher. This is all very stressful for the patient and I. I have observed that it is safer when I apply Prima Dental burs in my clinical practice. I am completing not managing risk factors when using Prima Dental burs."

Prof Paulo Vinícius Soares DDS, MS, PhD

PRODUCT DESIGN 1 PIECE BUR

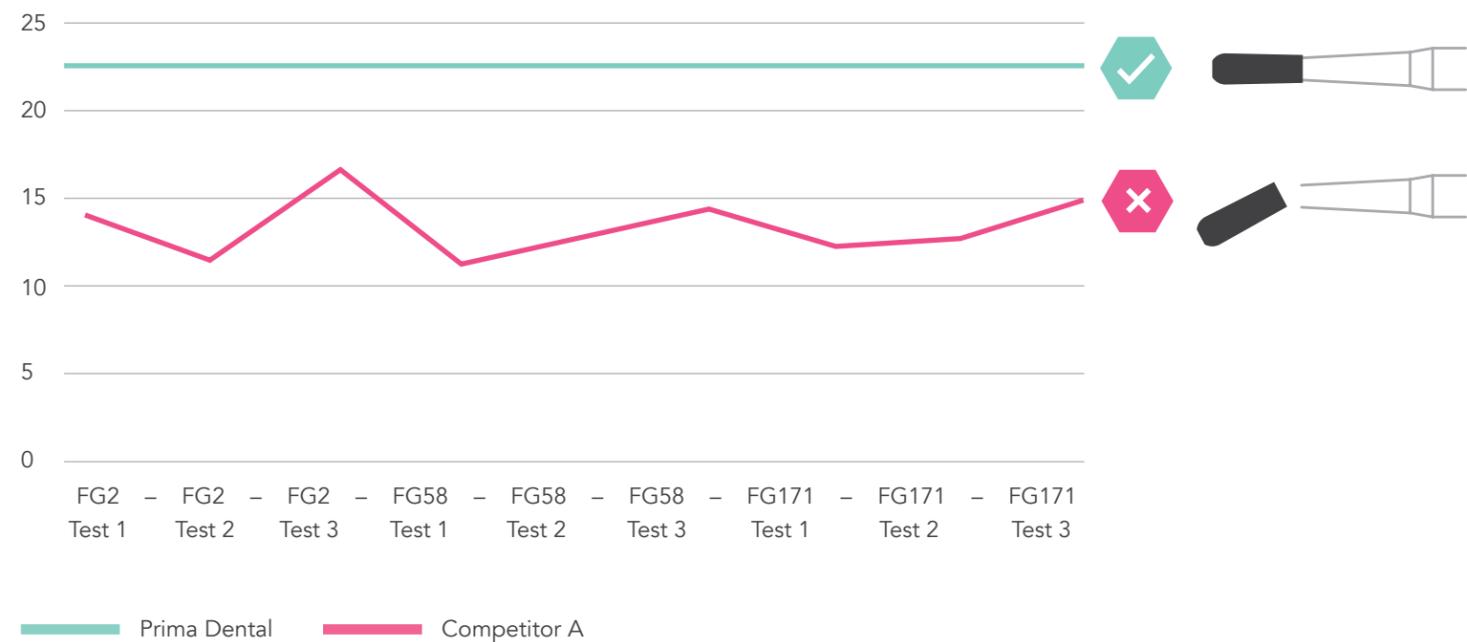
The strongest burs in the world come from a single piece of high quality carbide milled in Gloucester.^{5, 6, 7, 8, 9, 10, 11, 12, 13, 14}

Prima Dental single piece burs are at least 2 x stronger than our competition.

The below graph shows load testing of 9 comparable Prima Dental and Competitor A burs. An increasing load up to 23lb or fail was applied to each bur.

Prima Dental burs reached the maximum load of 23lb and did not fail. All nine Competitor A comparable designs failed between 12 and 16lbs.

Load testing comparison between Prima Dental and Competitor A.



PRODUCT DESIGN 2 PIECE BUR

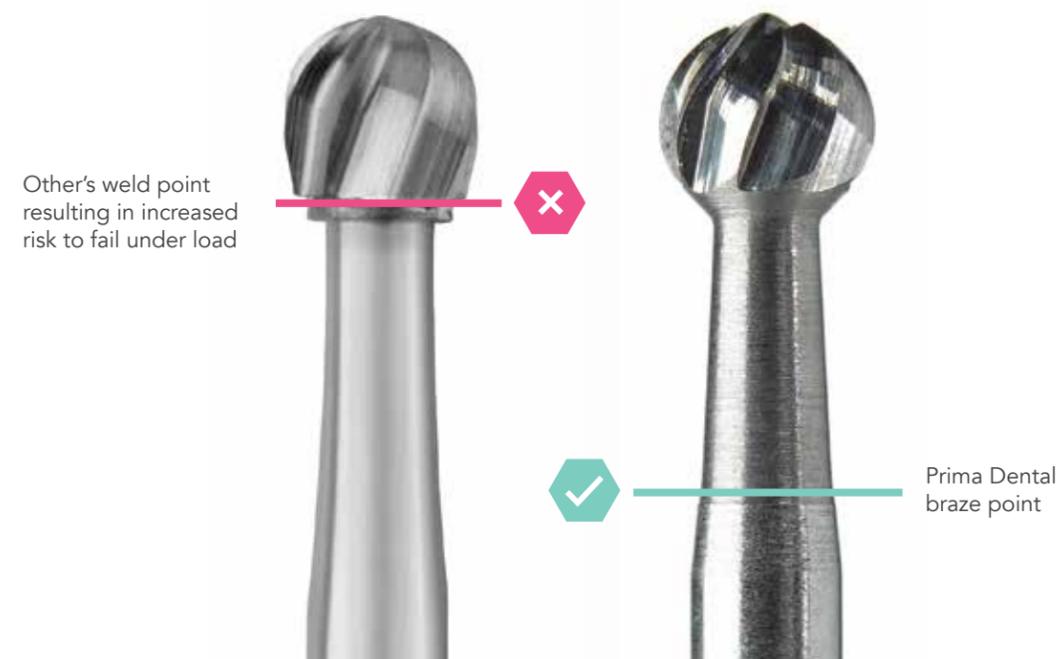
Our brazing position exceeds ISO expectations by 273%.¹⁵

We braze our carbide burs at the base of the neck to ensure maximum strength.

We then test the load capability of our two piece burs up to 273% above ISO recommendations.

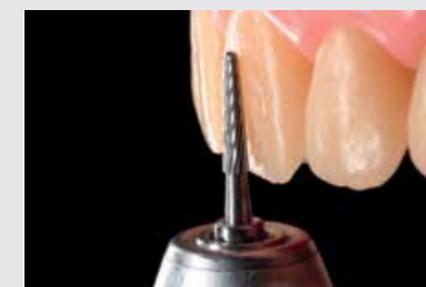
This table shows the results of a load test on a Prima Dental two piece bur.

Head length	Head diameter	Neck diameter	Braze diameter	Braze area	Applied load	ISO compliance	Post-forming testing	% above ISO
6.12mm	2mm	1.32mm	1.92mm	2.9mm ²	20.00lb	5.4lbs	16.6lbs	272.6%



"Much better... Much Faster, more durable... Than conventional carbide."

Reality Publishing



"Smooth cutting, durable (multi use). Also no corrosion at cutting head – shank interface. A winner!"

G Hart DDS

PRODUCT DESIGN 1 PIECE VS 2 PIECE BURS IN MARKET

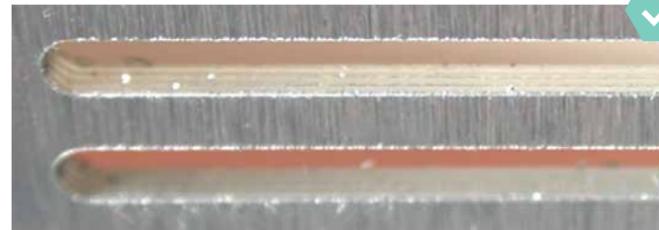
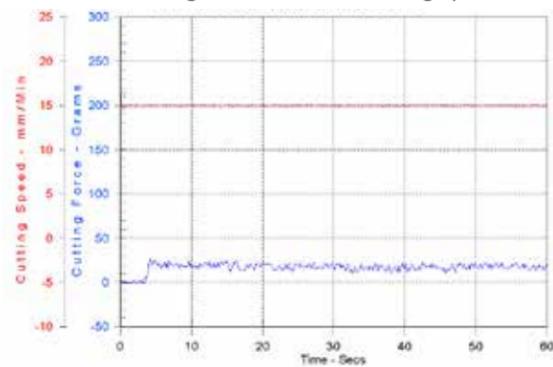
Using less force, more speed and resulting in a cleaner cut; the Predator leaves the Competitor B product stuck in the metal.^{16, 17, 18}

Below are like for like tests between the Predator single piece metal cutting bur and the Competitor B product comparable 2 piece.

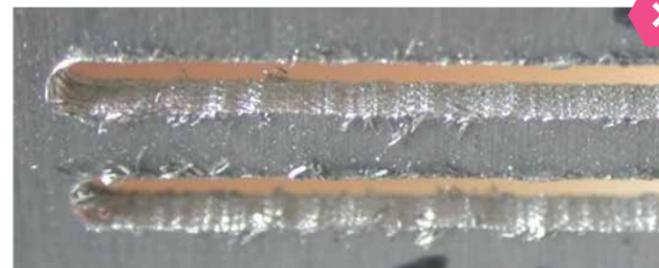
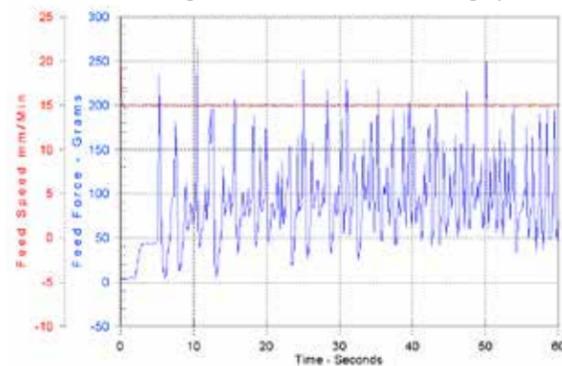
The key aspect of the Competitor B product test results is the amount of vibration created when the Competitor B product cuts. This is shown by the peaks and troughs of the blue 'Cutting Force' line on the charts.

In three of the four tests the amount of force required to keep the feed rate constant reaches a level where the bur jammed in the metal, thus ending the test.

PREDATOR PR TURBO
Cutting force at 15mm cutting speed



Competitor B product
Cutting force at 15mm/min cutting speed



"The cut is smoother and requires less pressure than burs we were using".

Albert Clark, DDS



Figure 2A



Figure 2B

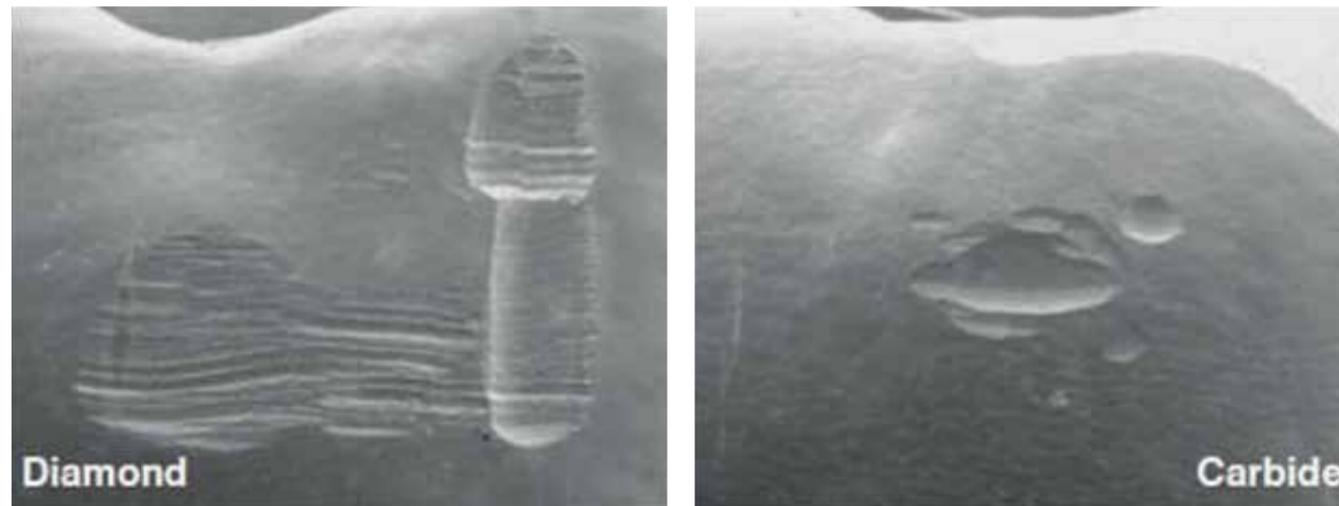
"The Contemporary Dentistry is based on simplification of procedures, e.g. restorative procedures, impression techniques, dental preparation protocols and amount of steps for unsatisfactory restoration's replacement. When completing a procedure within someone's mouth a calm and controlled manner is paramount. Metal cutting can be loud which may cause the patient stress. The professional needs to use a single and efficient dental bur because when more steps, more risk to failure. Its important therefore that it is completed as quickly as possible with the least amount of vibrations and pressure. A two piece metal cutting bur needs more force than a Predator single piece. The Figures 2A and 2B present metal crown removal by specific Predator model from Prima Dental."

Prof Paulo Vinícius Soares DDS, MS, PhD

Carbide leaves a tooth surface smoother and with less damage than a diamond bur.^{19, 20}

Cutting a surface with a carbide bur leaves a smooth surface when compared to the grinding of a surface with a diamond bur.

Below are two macro photographs showing tooth surface after using diamond and carbide burs.



Clinician's Report research have shown that 70% or more of adjacent teeth are damaged while cutting proximal box preparations unless protective measures are taken. Diamonds left rougher marks than carbides.

"When performing cavity preparation a true round bur is needed in order to reach the cavity without the removal of healthy tooth."^{21, 22, 23}

Prof Vinicius Soares

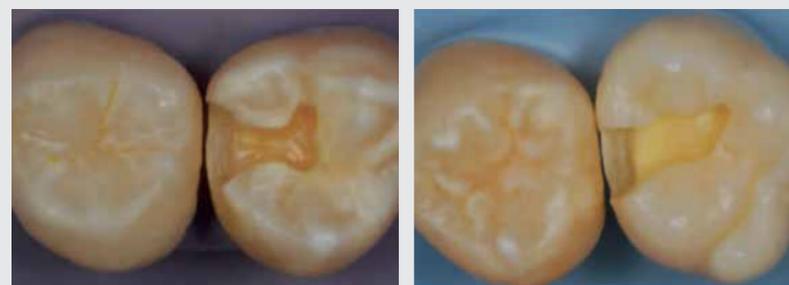
Unlike Competitor C and other manufacturers Prima Dental are able to cut a true 'round bur' allowing better access and removal of caries.

The images below show a Competitor C 'round' bur alongside a Prima Dental 'round' bur.



Carbide bur

Diamond bur



"Diamonds do not cut the tooth but grind at it which can result in less precision and the removal of healthy tooth. These images show the amount of precision achieved by a carbide bur vs a diamond bur."

Prof Paulo Vinicius Soares DDS, MS, PhD



"Round burs are the most famous and more used shape at Dentistry. I recommend the round burs for caries removal, contaminated dentin removal, endodontic access, occlusal reduction and others clinical application. MidWest have a round bur pattern in their range that better resembles a short Pear pattern. When performing cavity preparation a true round bur is needed in order to reach the cavity without the removal of healthy tooth. It is impossible to complete the cavity preparation without a spherical bur. This image shows a spherical Prima Dental bur being applied in my practice."

Luana Oliveira-Haas, DDS, MS, PhD

The Prima Dental helix angles ensure a 17% smoother surface finish.^{24, 25}



The Competitor C burs have a zero degree helix angle which results in varying depth of tooth.

This along with the lack of a 'spiral' effects the removal of waste and in turn increases the cutting force risking chatter and patient discomfort.



Competitor C bur

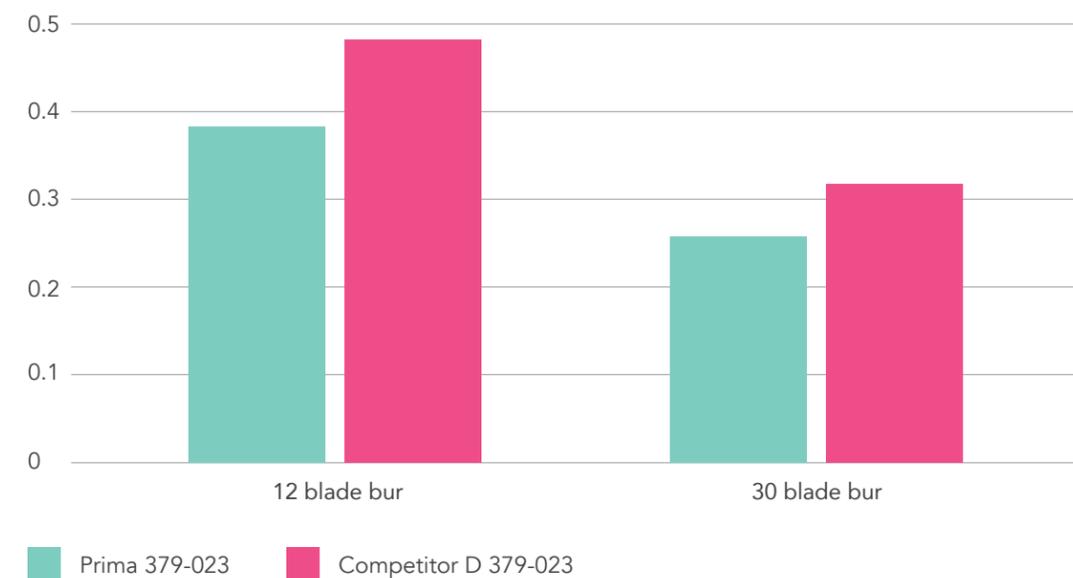
Prima Dental bur



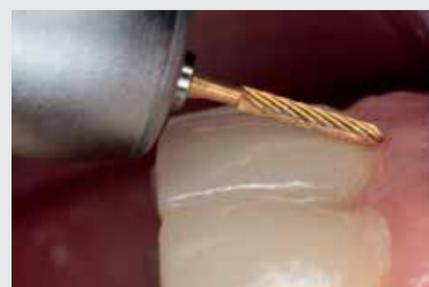
The helix acts as a spiral that drives the waste material away from the cutting portion of the bur tooth.

The design has a consistent and maximum length of depth of the bur tooth reducing chatter.

Surface roughness on cut surface Prima 379-023 Vs Competitor D 379-023²⁶



The above graph shows the roughness of a ceramic material after cutting it with 12 blade and 30 blade finishing burs.



"In aesthetic dentistry many direct and indirect restorative procedures are made day by day. Direct procedures are represented by composite resin restorations. Indirect restorative procedures are represented, for example, by ceramic restorations adhesively fixed on enamel and/or dentin. Irrespective of restorative procedure, always the finishing and trimming steps are vital for clinical longevity of restorations. For composite restorations and adhesive interface finishing on ceramic restoration, the Prima Dental burs presented many options of models, shapes and sizes. The inclination and homogenous distribution of blades/flutes are very important to high quality of finishing and trimming steps. Observe the images opposite. You can see the perfect parallelism of flutes and micro details of high quality Prima Dental burs"

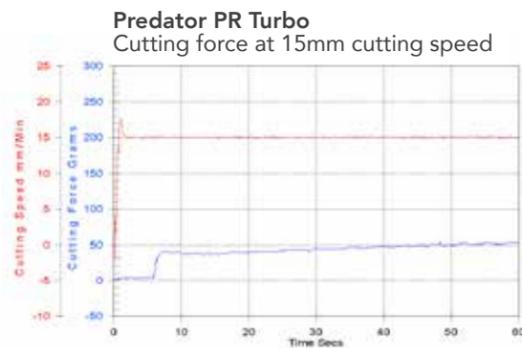
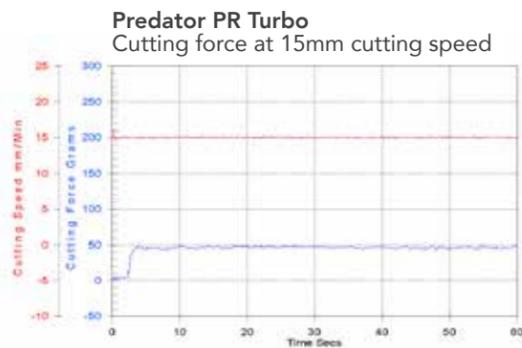
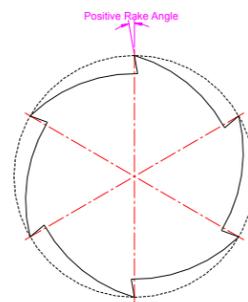
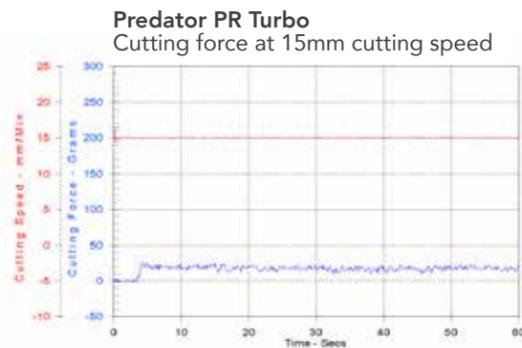
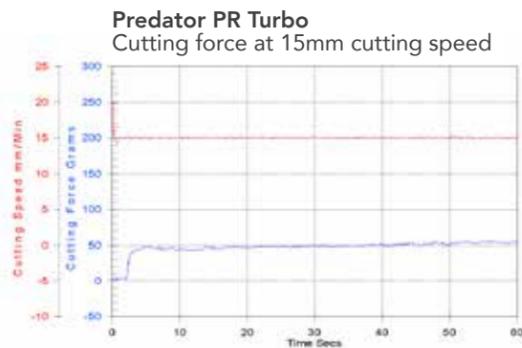
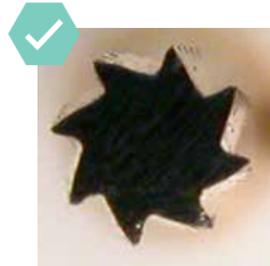
Prof Paulo Vinícius Soares DDS, MS, PhD

We understand the difference 0.5 degrees of a rake angle can make to a metal cutting or finishing procedure – that’s why our products are designed for the job they do.^{27, 28}

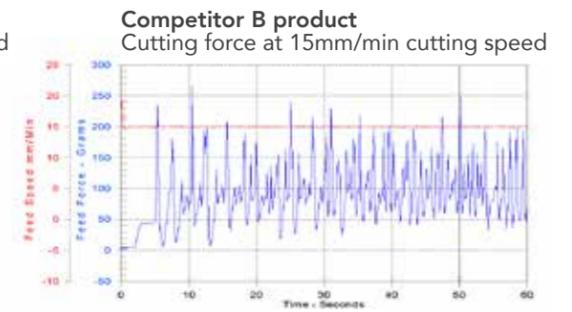
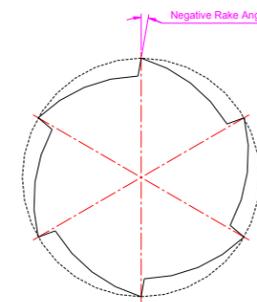
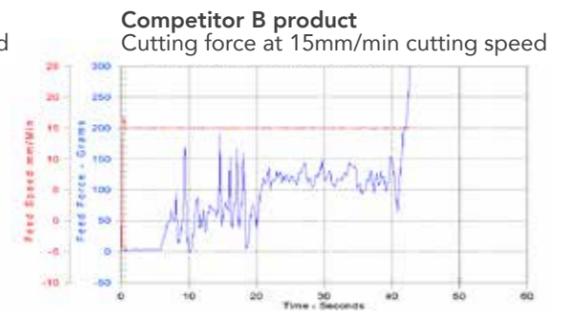
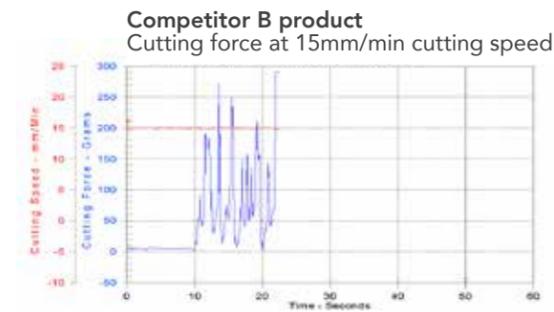
When designing or improving a product we make minor adjustments to the rake angles, we then manufacture prototypes and complete split testing to ensure every change is monitored. We then test against competitors products. Below are examples of the Predator (Positive rake) V Competitor B product (Negative rake). The force needed for the competitor product to perform at the same speed as the Predator resulted in breakage, bent burs and aborted tests.

When tested against the Competitor C comparable bur the cutting force exceeded the test rig limits within 10 seconds and was aborted.

Positive rake angle



Negative rake angle



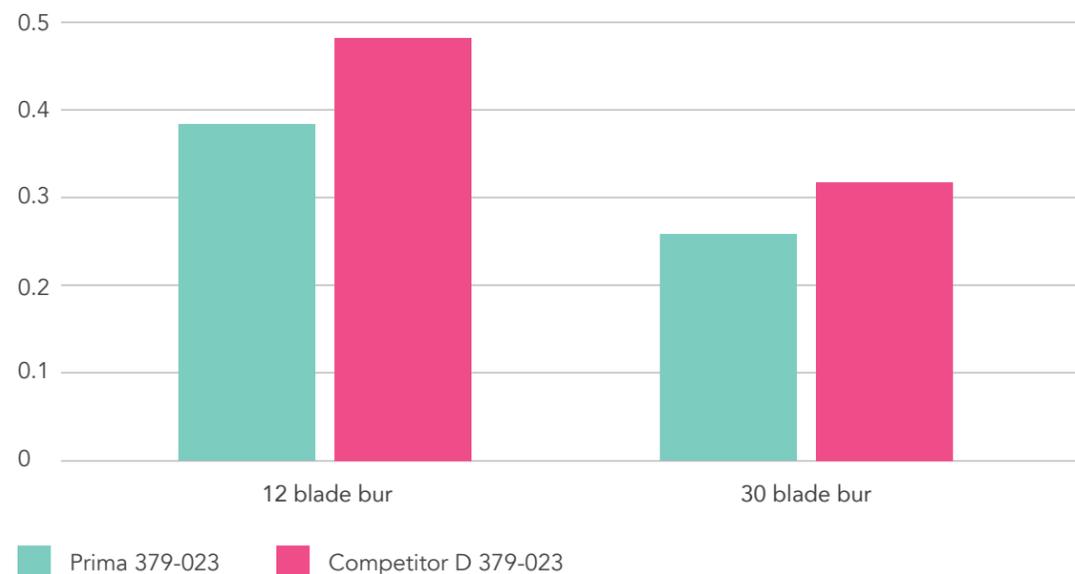
“Fastest, smoothest cutting bur I have ever used.”

Robert Derice DMD

Prima Dental burs outperformed the Competitor D equivalent by 17% smoothness tests.²⁶

Once reassured that Carbide burs leave a smoother surface than diamonds we commissioned independent tests with the Aston University to compare the Prima Dental finishing burs to the Allemann equivalent bur.

Surface roughness on cut surface Prima 379-023 Vs Competitor D 379-023²⁶

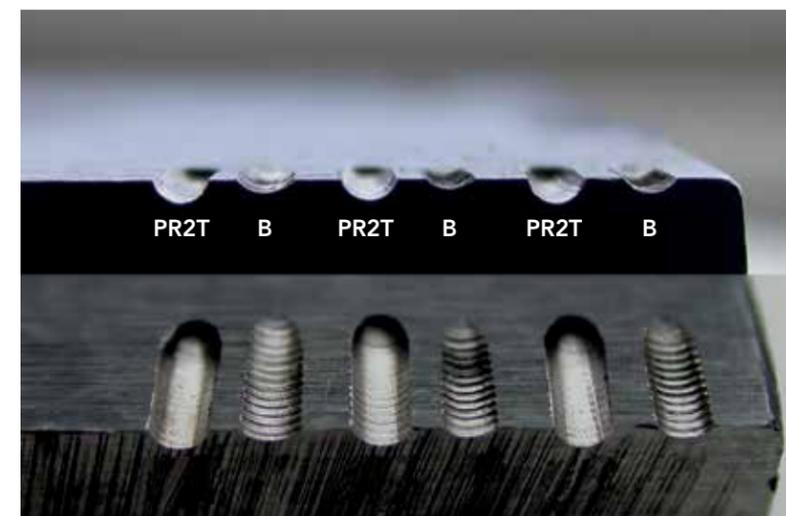


The above graph shows the roughness of a ceramic material after cutting it with 12 blade and 30 blade finishing burs.

Time in the chair is important to both the patient and the doctor. We work to reduce this time at every design stage.^{6, 7, 8, 9, 10, 11, 12, 13, 14, 29}

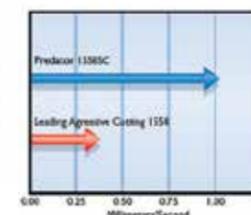
In three, controlled, one minute tests the Predator not only cut further but created a smoother surface clear to the naked eye. Cutting through metal in this way will result in a faster and better procedure with reduced risk of infection.

The below image shows that the Predator results in a longer and smoother cut at a consistent depth when compared to the Competitor B product.



AGGRESSIVE

The unique flute angle and cross-cut blade geometry make SabreCut carbides extremely efficient at cutting amalgam, metal, enamel and dentin. Internal testing shows that on average the SabreCut 1558SC cuts 2 times faster than the leading aggressive cutting 1558®



“Smoother surface finish may indicate less vibration to the material and less likelihood of fracturing surface topography. Smoother surface may indicate a more concentric tool is being used in the dental hand piece.”

Aston University, UK

“Ideal speed and a clean cut are key when removing a metal crown or unsatisfactory restoration. The Predator metal cutting bur cuts consistently in every way without excessive force. This makes for a less stressful experience for the patient, low heat dissipation, a short procedure time in total and a better result. The figures 5 present these aspects on restorations removal.”

Luana Oliveira-Haas, DDS, MS, PhD

“The Predator Turbo is exceptionally smooth and vibration free. It’ll cut through the toughest metal castings and amalgams with ease and precision. In my opinion the Predator Turbo bur is the most dependable and the bur to use!”

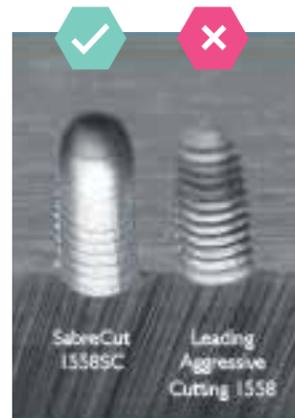
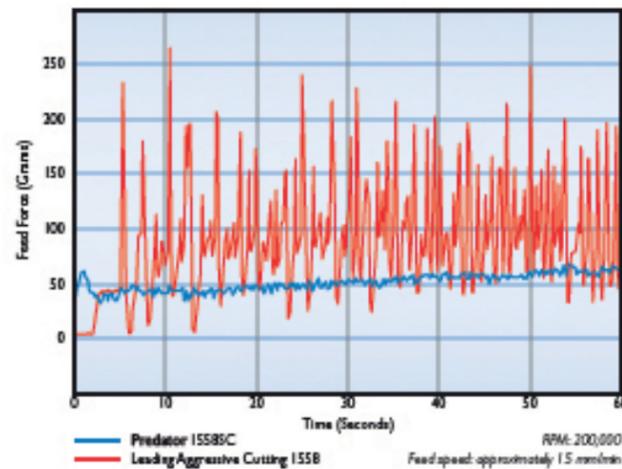
Dr Sherri Donniger DDS

“Predator carbides require less force and generate less vibration (chatter).”^{7, 14, 31, 32}

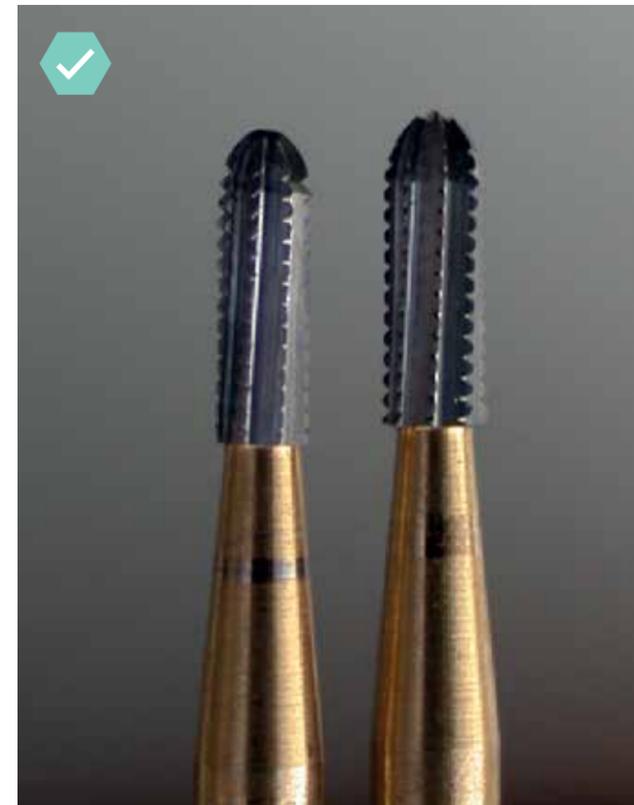
Comparing the two tests below, we see the Predator[®] Turbo creates minimal vibration as requires around one third of the pressure to keep the same feed rate.

By contrast the Competitor B product bur exhibits significant vibration with high peaks and troughs denoting tooth chipping which makes the bur no longer usable.

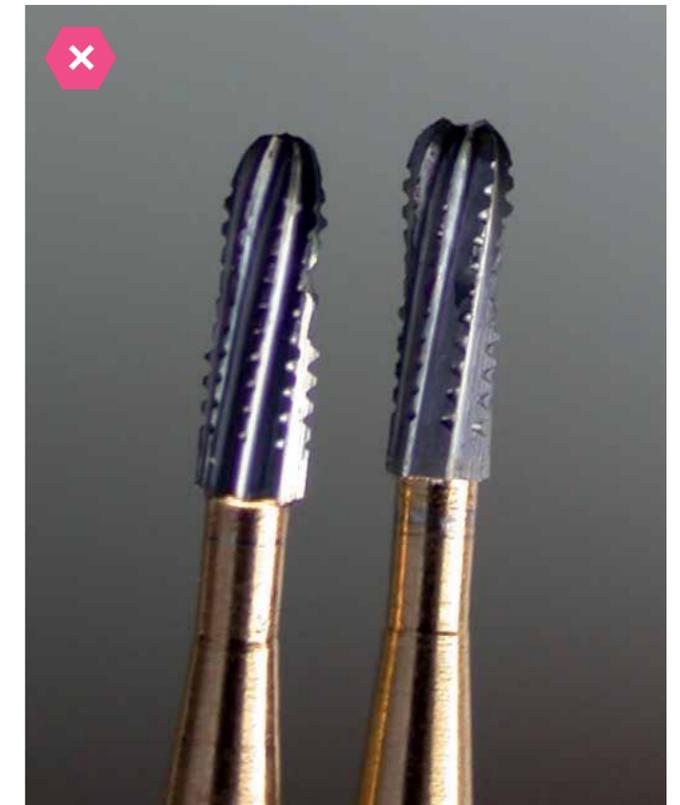
Predator carbides require less force, generate less vibration (chatter) and aggressive cutting carbide.



Predator after testing at 20mm/min³³



Competitor B product after testing at 15mm/min



The images above show two burs from Prima Dental and Competitor B after use. Note the chipping and tooth loss on the Competitor B bur.



“These burs are scary fast. Sixth time using them is as fast as the first!”

Bruce D Miller DDS

“Prima Dental is using our machines with more skills and efficiency than anyone else in their sector.”

*Damien Wunderlin
Executive board member, Rollomatic*

“Rollomatic is a private Swiss company specializing in the design and manufacturing of high precision CNC machines for production of cutting tools and dental instruments applications. With a position of world leader in the dental tools field Rollomatic is very proud to have such a privileged relationship with Prima Dental. The UK based company own the largest number of Rollomatic in dental field and the expertise Prima have acquired along the years by using Rollomatic Nano5, RPG's and CNC246 machines has meant that Prima Dental is using our machines with more skills and efficiency than anyone else in their sector. Prima demand such high standards from our machines and software that we have develop bespoke programmes alongside their expert engineers to meet their precise needs.”

The production of high quality tools has always driven Rollomatic in its design choices of machines. In order to guarantee optimal precision and superior machining quality, this machine has been designed in an innovative and advanced way, with the following distinctive advantages: Compact design with the shortest possible travel distances allow for minimal thermal expansion and increase the production stability and allow to keep diameter tolerances within a range of 0.01mm. Direct drive 1.5 kW spindle motor and PerfectArbor™ flange system increases surface finish quality and ensure precise and repetitive grinding wheel mounting within 0.002 mm.



Direct drive 1.5 kW spindle motor and PerfectArbor™ flange system increases surface finish quality and ensure precise and repetitive grinding wheel mounting within 0.002 mm.



Our burs are checked every 60 minutes 24 hours a day during manufacturing.^{34, 35, 36}

Our processes and systems are designed to allow our machines and our people to work seamlessly with one another. This ensures a consistently high quality product and early detection of any challenges.

Every machine operator uses 'workmanship samples' to enable them to see features that you wouldn't necessarily see using drawings and shadowgraphs. Independent checks from QC take place at regular intervals to ensure that all of the critical features are to the Prima standard.

Our inspection team carry out routine quality inspection every 60 - 90mins 24 hours a day to verify that the bur is within its tolerances. To understand if there is any process shift or variation we also take a measurement of the head diameter and the head length at every inspection.

All teams throughout the supply chain are trained to check and identify anomalies including the last department, packaging.



Cell Model and LEAN manufacturing are ensuring a smooth capacity increase at Prima Dental.^{37, 38, 39}

We are introducing Cell Model manufacturing which will increase productivity, increase quality control and reduce scrappage.

The cells primary focus after safety has been the quality of the burs being produced, and the best practices in achieving this.

Statistical Process Control (SPC) is a methodology in which statistical methods are used for measuring and controlling quality during the manufacturing process. Our precision equipment allows us to undertake detailed measurement of our product and process to improve consistency of quality.

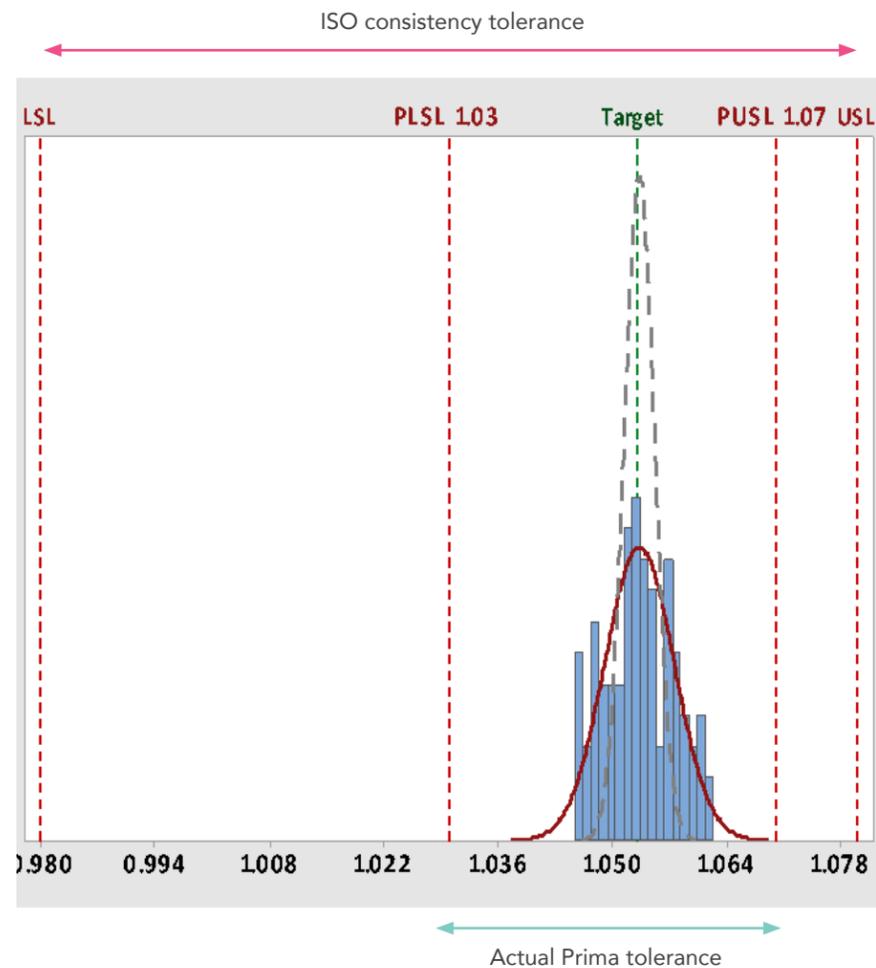
With the application of SPC on our highest volume product we have achieved a standard deviation of 0.0038.

Cellular manufacturing has raised the bar again with quality standards by introducing spot checks and critical information feedback to the teams, highlighting problems and the preventative measures put in place to stop them happening again.



Cell Model management area

Industry leading design and innovative thinking is nothing without consistency of product. This is why our consistency tolerances are 60% tighter than ISO recommendations.^{40, 41}



Our tolerances are **60% tighter** than ISO recommendations.

We don't simply settle for manufacturing the world's leading metal cutting bur. We constantly pursue better.⁴⁴

The Prima Dental Predator bur has out performed the competition since launch yet we still ensure it receives the same level of review to identify opportunities for improvement.

We have adapted the design of the Predator head so that the cuts covered 60% rather than 100% of the head. This increased the tools load bearing tolerance and reduced breakages without effecting the speed, strength and precision that make it the worlds best metal cutting bur.

Our products are always evolving in order to better meet the needs of clinicians.^{42, 43}

The result is that our tooth design is in its third generation and, by partnering with a customer we have designed a unique blended neck.

87% of independent evaluators rated ease of use as excellent.

The next generation of this previously well accepted tool has increased sales by 30% in its first year and sees continued growth.

This partner has now requested that the blended neck be rolled out across the range.



"Every patient is different and every procedure has its own nuances. Knowing that every Prima Dental bur I use is the same as the one before removes an unnecessary variable in our clinic. This image illustrates an orthodontic Prima Dental bur applied for adhesive cement removal. The morphology, amount and inclination of blades promote high performance of this bur. My colleagues and I can concentrate on the patient in our chair rather than the bur in our hand piece."

Prof Paulo Vinícius Soares DDS, MS, PhD

"The Predator Turbo is an excellent product that would lead to 'Sanpou-Ichiryō-Toku' meaning the patient, dental clinic and dentist profit equally."

Dr Satoshi Kokima DDS

"Cuts teeth quicker Single-piece construction and blended-neck design virtually eliminates breakage Smoother cuts with little to no vibration / chatter Disposable, single-use, individually packaged"

Dental Product Shopper

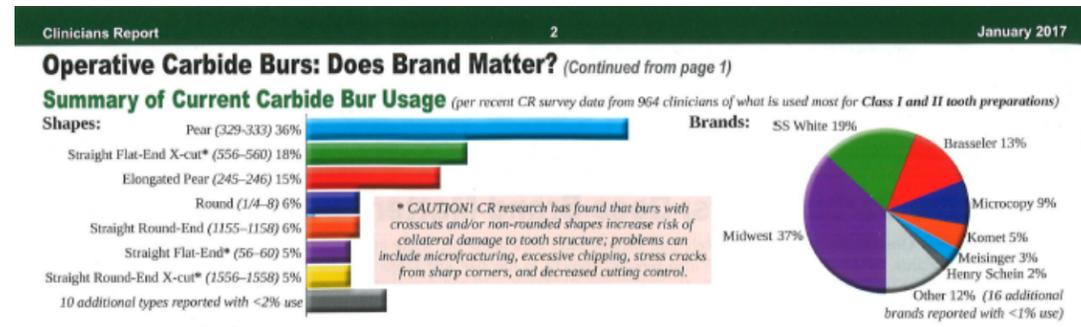
"Used approximately 100 burs without breakage during any of my procedures."

John Horn DMD Hegins, PA (Following independent tests)

Prima Dental are the designers and manufacturers of two of the top three products.⁵¹

964 independent clinicians tested multiple shapes across ranges against the following criteria:

- Clinical tactile rating
- Bur strength
- Speed of material removal
- Tip length
- Micro fracturing at margins
- Cost of bur



Comparison of Carbide Bur Brands

As noted above, multiple shapes and sizes of carbide burs are currently used clinically for Class I and II preparations with the most popular being the 329-333 (pear-shaped) bur. CR has identified multiple representative brands offering the 330 operative carbide bur and compared key characteristics among them in the following table. Overall ratings were given based on overall scores consisting of weighted individual category scores, including (beginning with most important): clinician tactile rating, tip length, bur strength, microfracturing at margins, speed of material removal, and cost per bur.

Bur ID Company	Cost/Bur	Bur Profile	Tip Length	Bur Strength	Speed of Material Removal	Microfracturing at Margins (less is better)	Clinician Tactile Rating	Overall Score	Overall Rating
Alpen 330 FG Coltene/Whaledent	\$2.50		1.9 mm	Excellent	Excellent-Good	Minimal	Excellent	.8629	Excellent CR Choice
FG 330 Henry Schein	\$2.10		2.0 mm	Excellent	Excellent	Moderate	Excellent	.8587	Excellent CR Choice
NeoBurr FG 330 Microcopy	\$1.90		2.0 mm	Excellent	Good	Minimal	Excellent-Good	.8586	Excellent CR Choice
330 FG Meisinger	\$1.70		1.8 mm	Excellent	Excellent	Moderate	Excellent	.8027	Excellent-Good
FG330 Dentsply Sirona Midwest	\$3.80		2.1 mm	Excellent	Good	Moderate	Excellent	.7958	Excellent-Good
Optimum 330 FG Benco Dental	\$1.30		1.7 mm	Excellent	Excellent	Moderate	Excellent	.7915	Excellent-Good
330 FG Tri Hawk	\$2.00		2.0 mm	Excellent	Excellent-Good	Moderate	Excellent	.7897	Excellent-Good
Cauk Super Bur 330 FG Dentsply Sirona Restorative	\$2.50		1.7 mm	Excellent	Good-Fair	Minimal	Excellent-Good	.7762	Excellent-Good
H7.31.008 Brasseler USA	\$1.00		1.6 mm	Excellent	Excellent	Moderate	Excellent-Good	.7725	Excellent-Good
H7.FG.008 Komet USA	\$2.30		1.8 mm	Excellent	Excellent	Moderate	Excellent-Good	.7687	Excellent-Good
Great White 330 SS White	\$2.60		2.0 mm	Good-Fair	Excellent	Heavy (crosscut blades)	Excellent	.7672	Excellent-Good
330FG Patterson Dental	\$1.60		1.7 mm	Excellent	Fair	Moderate	Excellent	.7657	Excellent-Good
BluWhite 330 FG Kerr - Beavers Dental	\$2.60		2.1 mm	Excellent	Good-Fair	Moderate	Excellent	.7560	Excellent-Good
Axis NTI 330 FG Kerr	\$2.40		1.6 mm	Excellent	Excellent-Good	Moderate	Excellent-Good	.7096	Good

Notes on testing procedures:

- **Tip length:** Longer tip length was noted by CR clinicians as a favorable characteristic.
- **Bur strength:** Bur tips were side-loaded per ISO configuration, up to point of permanent deformation or fracture.
- **Speed of material removal:** Multiple cuts made through standard plate glass over set time; amount of material removed was quantified.
- **Microfracturing at margins:** Class II preparations made on freshly extracted teeth, fluorescent dye penetrant applied, and sample observed under blacklight microscope.
- **Clinician tactile rating:** Qualitative grade of bur operation given by multiple in-house CR clinicians.

CR CONCLUSIONS: Multiple brands of carbide burs currently available are serving well clinically; all brands evaluated were acceptable. Carbide burs with highest overall ratings in CR testing were: Alpen 330 FG (Coltene/Whaledent), FG 330 (Henry Schein), and NeoBurr FG 330 (Microcopy). Use round-ended burs (example: pear-shaped) instead of flat-ended right-angled versions to decrease risk of collateral damage to tooth structure. Single use of carbide burs is recommended for accomplishing tooth preparations.

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