

Place • Measure • Improve

Mantec Technical Ceramics is the home of the globally renowned and industry standard Bullers Temperature Control Devices. **Bullers™ Rings** and **Bullers™ Process Control Discs (BPCDs)** are an essential part of any Quality Assurance System and utilised by many of the world's leading ceramic manufacturers to check and monitor the control and uniform application of 'heat work' that has taken place inside a kiln or furnace.

Frequently Asked Questions

1) Why should ceramic manufacturing sectors use either Bullers Rings or BPCDs?

Even within the most sophisticated kilns, thermocouples will only provide a spot reading for temperature and as such cannot monitor the effects of '**heat work**' and other variations on the overall firing process inside a kiln.

Only the use of a set of carefully placed Bullers Rings or BPCDs can lead to reliable kiln firing mapping, which ultimately provides the information needed to establish the optimum firing regime for product type and firing cycle.

The use of Bullers Rings and BPCDs in heat work monitoring therefore ensure **kiln uniformity, consistent and reproducible firings** as well as **maximum yields and profits**.

2) What is the difference between Bullers Rings and BPCDs?

The principle for making **Bullers Rings** was determined over 110 years ago and are manufactured today using the latest production technology. As a prime innovator in its field, with many decades of experience to support its research efforts, Mantec Technical Ceramics has extended the Bullers™ product offering and developed **Bullers™ Process Control Discs (BPCDs)** as the new generation of Bullers Temperature Control Devices

Both Bullers products are designed to do exactly the same job, i.e. providing an independent, accurate and measurable means of assessing heat work performance inside kilns.

The most common applications for Bullers products are in the firing of:-

Ceramic Sector	Bullers Rings	BPCDs
Tableware	✓	✓
Sanitaryware	✓	✓
Bricks	✓	
Wall/Roof Tiles	✓	
Refractories	✓	✓
Technical Ceramics	✓	✓
Electronics		✓
Insulators		✓
Ferrites		✓
Grinding Wheels	✓	✓

3) What is heat work and why should I measure it?

Heat work is the action and combined effect of temperature over time on a ceramic product, often referred to as 'heat energy'. Simply put, heat work is a defined measurement of how a ceramic product has been cooked or processed while in production.

Bullers Rings and BPCDs will make the same 'thermal journey' as the ceramic product being fired. Their shrinkage is a key indicator of consistent and optimal firing regimes and therefore they give an independent, accurate, reliable and essential indication that the firing of the ceramic product is correct and unaffected by any variations in temperature and kiln loading.

For a given kiln setting temperature, Bullers Rings or BPCDs will continue to shrink as soak times increase so they allow you to understand the effect that temperature and time have on the ceramic product and what action is required to prevent costly production problems occurring on future firings.

When used correctly and consistently, Bullers Rings and BPCDs will maximise yields and ensure profitable firings time after time. Early notifications of under fired products allow you to re-fire to the correct quality, saving scrap products while maintaining capacity and profitability.

Only heat work measuring and monitoring will allow you to understand what has happened to a ceramic product in the kiln or furnace independently of temperature and time.

4) Do Bullers Rings and BPCDs measure temperature inside a kiln or furnace?

Bullers Rings or BPCDs are **NOT** designed to measure and confirm the actual kiln setting temperature; they are a measurement of heat work or how much heat has been transferred to the fired ceramic product.

The 'Ring Temperatures' and 'Disc Temperatures' referred to in the Temperature Correlation Charts are only **approximate** and act as a guide to a kiln's peak firing temperature.

Due to differing firing rates, air flow, kiln loadings and kiln atmospheres, the actual performance of Bullers Rings or BPCDs when used by the customer may be different from the Temperature Correlation Charts, which Mantec Technical Ceramics have determined under strictly controlled firing conditions.

A reference to either Ring or Disc Temperature is an easy and useful way to compare against historical results but it is **not necessarily the same** as the actual kiln temperature.

Whilst some users of Bullers products prefer to record shrinkage results in terms of temperature, Mantec Technical Ceramics however instead recommends that customers describe their kiln firings in terms of **Bullers Ring Value - BRV** (As determined by the brass Bullers Ring Gauge TR100 or Metal vector Gauge TR200) or in terms of **Disc Diameter** (When using BPCDs). By doing so, this avoids confusion with the true kiln setting temperature measured by thermocouples.

5) What are the suitable temperature ranges for Bullers Rings and BPCDs?

Bullers Rings temperature ranges:-

Temperature Range	Temperature Range	Product Code
Very Low Temperature	750°C – 1000°C	TR89/05
Low Temperature	960°C – 1100°C	TR55/84
Standard Temperature	960°C – 1250°C	TR27/84
Extended Temperature	960°C – 1320°C	TR75/84
High Temperature	1280°C – 1420°C	TR73/84

BPCD temperature ranges :-

Temperature Range	Temperature Range	Product Code
Very Low Temperature	770°C – 950°C	BPCD-VLT3.5
Low Temperature	900°C – 1150°C	BPCD-LT3.5
Medium Temperature	1050°C – 1320°C	BPCD-MT3.5
High Temperature	1250°C – 1550°C	BPCD-HT3.5
Very High Temperature	1500°C – 1770°C	BPCD-VHT3.5

6) How do I select the most suitable Bullers Ring or BPCD?

Select a Bullers Ring or BPCD, whose central temperature spread is nearest to the kiln’s peak firing temperature. This reason for this is because rings or discs are most sensitive to temperature changes in this central temperature range rather than at the extreme ends.

7) How do I establish my own acceptable standard for Bullers Rings or BPCDs?

If Bullers Rings or BPCDs are being used for the first time, acceptable minimum and maximum Bullers shrinkage results – based on either **Bullers Ring Value -BRV** (As determined by the Bullers Ring Gauge) or **Disc Diameter** (When using BPCDs) in conjunction with the quality of the fired ceramic product – need to be determined over a number of firings. These results should then be recorded as the **standard or norm** for comparison against future firings.

Any Bullers shrinkage results that deviate significantly from the accepted standards or norms will highlight quickly that corrective action may be required to ensure the correct product quality.

8) What Quality Control procedures are in place in the manufacturing of Bullers Rings and BPCDs?

Each batch of spray dried materials used to make Bullers Rings and BPCDs is pre-tested to Mantec's exacting standards before being released into its sophisticated **ISO9001:2008** accredited manufacturing process. This consistency ensures a reliable and reproducible quality time after time.

9) Why do Bullers Rings and BPCDs only need one set of Temperature Correlation Charts?

The manufacturing of Bullers Rings and BPCDs is very tightly controlled before despatch to ensure that, when fired in a customer's kiln, they consistently perform in accordance with the same predetermined calibration curves. This means that one only set of Temperature Correlation Charts is ever needed for each product type. The same charts can therefore be used time and again for all production batches, thus avoiding the need to have multiple charts.

10) Why can there be slight variations in the diameter and thickness of unfired Bullers Rings and BPCDs within the same batch and between batches?

The **consistent press density** of unfired Bullers Rings and BPCDs is a critical factor, which determines the overall consistent performance of Bullers Ring and BPCDs when fired.

In order to maintain a consistent press density within a batch and between batches of unfired Bullers Rings and BPCDs, minor changes to their diameter and thickness are sometimes necessary. These minor size differences between unfired products **ARE IRRELEVANT** to the products' performance as the strict quality control procedure employed by Mantec Technical Ceramics to maintain consistent press densities ensures consistent and reproducible results when Bullers Rings and BPCDs are actually fired inside a kiln.

If the rings and discs were always made to an exact diameter and thickness, the resulting varying press densities would adversely affect their fired performance. Mantec therefore avoids this risk by making any necessary size and thickness changes to the unfired product.

11) Do I need to measure the diameter of Bullers Rings and BPCDs before they are fired?

Due to the changes that can be seen in the unfired Bullers products, as described in point 9) above, it is **not** necessary to measure the size of Bullers Rings and BPCDs before they have been fired as these measurements are meaningless and can only lead to confusion.

It is therefore only necessary to record and compare the results of **fired** Bullers Rings and BPCDs and act on any adverse changes to the normal expected post firing standard or norm.

12) Why should I calibrate Bullers Rings and BPCDs between batches?

Once you have received a new batch of Bullers Rings or BPCDs, it is necessary to calibrate them against your existing batch under your own normal firing conditions. By calibrating between batches, it is possible to maintain meaningful records of your kiln performance over days, weeks, months and years.

13) How do I calibrate new batches of Bullers Rings and BPCDs?

Place rings or discs from your new delivered batch next to those from your existing batch. Once firing has been completed, measure the two sets of rings or discs. In many cases, the two sets of results will be almost identical. However, in practice, there may be slight differences between the two sets of readings, which will mean that a corrective factor needs to be determined for the new batch.

Example for Bullers™ Rings TR27/84:-

Batch	Minimum BRV	Maximum BRV	Average BRV	Correction Factor (a-b)
Existing	30	32	31 (a)	
New	31	33	32 (b)	-1

In the above example, all readings from the new delivery should have **1 BRV point** deducted so that they correspond to the BRV readings from the existing batch.

Example for BPCD-MT3.5:-

Batch	Minimum	Maximum	Average	Correction Factor (a-b)
Existing	1170°C / 19.20mm	1183°C / 19.13mm	1177°C / 19.16mm (a)	
New	1177°C / 19.16mm	1191°C / 19.09mm	1185°C / 19.12mm (b)	-8°C / 0.04mm

In the above example, either all 'Disc Temperature' readings should have **8°C deducted** or all diameter measurements should have **0.04mm added** so that they correspond to the readings from the existing batch.