

bulletin

CASE STUDY NO.25
MAY 2003

Bisplate Hardness Testing – Made Easier

Just as Bisalloy holds a unique place in Australia as the only manufacturer of quenched and tempered steel, we also have a unique responsibility to our customers.

Bisalloy is relied upon by companies in many industries to supply steel of the highest quality and consistent hardness for many vital, even life-saving, applications, when supplying our high hardness, through hardened wear plate grades. To ensure that consistency, we're extra-hard on ourselves, too:

Bisalloy is the only manufacturer in the world to test each individual plate in a customer order. Other manufacturers test only one plate in every 20 or 40 tonnes supplied.

Our Test Results vs. Customer Test Results

In our NATA certified laboratory, we employ rigorous, standards-based testing procedures, using the Brinell hardness test method to Australian Standard AS 1816, audited on a monthly basis and checked daily against calibration blocks.

If you, as the customer, need to do your own hardness testing to verify our results we need to ensure we are all following the correct procedures as outlined in this document. This will give the most reliable results. If not, then discrepancies can occur. This may result in unnecessary inconvenience, needless repetition of



tests, time lost, and extra costs to all involved.

So, to help clarify our testing process for our customers and demonstrate the thoroughness and accuracy of our hardness testing of Bisplate, this bulletin sets out and explains the various testing methods.

It also emphasises the need for all parties to apply correct procedures and thorough preparation, whichever method is used, to ensure their own

testing produces consistent, reliable results, directly comparable with our own.

First, some basics.

What is Hardness?

Hardness is the resistance of material to plastic deformation – usually by indentation or penetration. It also defines the ability of material to resist scratching, abrasion or cutting.

Why Test For It?

Hardness testing is undertaken to:

- 1) Specify and certify a range of wear resistance products.
- 2) Double check the tensile strength of structural grade materials
- 3) Assist in failure analyses and material identification.

Method	Standard	Basis	Measurement	Accuracy Approx %	Max Temp
Brinell ⁽⁴⁾	AS1816	10mm Tungsten Carbide ball ⁽¹⁾ impressed under 3,000kg load	Surface area for known load	± 2	50°C
Vickers (HV)	AS1817	136° Diamond pyramid impressed under load	Surface area for known load	± 2	50°C
Rockwell (HR) A, B, C	AS1815 ISO6517-1	120° Conical Diamond Steel ball used for soft metals	Depth of impression under known load (15–150kg)	± 2	50°C
Equotip ⁽²⁾	NIL	“Rebound” Method	Height of rebound	Poor	–
Poldi ⁽³⁾	NIL	10mm Ball impressed with hammered test bar	Comparative impression	Very Poor (± 20)	–

Table 1 – Comparisson of Testing Equipment

Where To Test?

Testing can be carried out in the laboratory, workshop or on site.

However, site testing with portable equipment can often have difficulties of access, surface preparation and vibration, which may reduce the accuracy of testing.

Testing Procedures and Equipment

The table above sets out the methods of identifying common indentation hardness, and other types of hardness tests.

It is absolutely vital to understand the specific uses, strengths and any weaknesses of – and correct requirements and procedures demanded by – each of these methods in order to ensure consistent, comparable results in testing.

Interpreting Table 1 – Some Important Considerations

- (1) Where the maximum hardness of the work exceed 450 HB, but doesn't exceed 650 HB, the standard says a tungsten carbide ball must be used.
- (2) Equotip is a “rebound” method of hardness testing, which does NOT measure hardness (indentation or plastic deformation) but gives a result convertible within a restricted range into an indentation hardness figure.

This method is not standardised and gives only indicative results. It is extremely dependent on the operator, test material and surface condition. It is NOT recommended on quenched or tempered steel, or surfaces that aren't bright and smoothly ground.

- (3) The Poldi test is sometimes employed in the field. Even though it is an impression method, it displays very poor accuracy. It is not recommended for quenched and tempered steel.

- 4) The Brinell test is strongly recommended for all Bisplate grades as it is widely accepted as the industry standard. (Brinell gives a more definite reading, by leaving a more definite impression on the plate). It is the standard employed at Bisalloy and by other manufacturers, both on the production line and in the laboratory.

The hardness rating on a certificate issued by Bisalloy is measured in Brinell hardness. Converted values from other methods such as Rockwell or Vickers (more often used in laboratory testing using small samples of steel, or in small-parts engineering, and not ideal for use in the production environment) can cause small discrepancies from the Brinell rating on the certificate.

Proper Preparation of The Test Surface

Since BISPLATE is a quenched and tempered steel, some decarburisation will occur on the plate surface during the heat treatment process. The thickness of the decarburised layer (the very thin surface layer which has lost carbon during austenitising) will vary depending on the plate thickness. This decarburised layer will get thicker as the plate thickness increases.

To ensure testing accuracy, surface scale and the decarburised layer must always be removed by either grinding or machining from the areas where hardness measurements are taken. The minimum grinding or machining depths are listed in the Table 2.

Plate Thickness	Min Grinding or Machining Depths (mm)
≤ 6	0.2
>6 – 10	0.3
> 10 – 20	0.5
>20 – 50	0.7
>50 – 80	1.0
>80	1.5

Table 2 – Minimum Machine Grinding Depths

Without removing the entire decarburised layer by grinding or machining, the results of the hardness test will be invalid.

It should also be noted that the area tested should be a min. of 75mm from any thermally cut surface to avoid any heat-affected zone.

The tested area must represent the whole material, must be clean, free from unwanted scale, and must be flat, sufficiently thick and smooth. The test piece must be well supported and not subject to movement or vibration.

Calibration

To further ensure accuracy and consistency, all testing equipment must be calibrated (usually 3 yearly) and checked daily against calibration blocks.

Personnel Competency

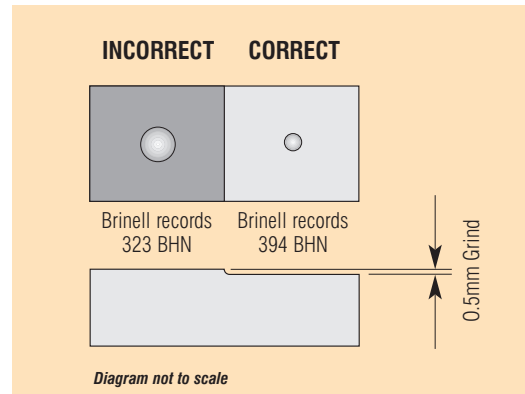
For all tests, the operator requires training in the correct methods and assessments acceptable to the employer. Preference is given to NATA registered laboratories for high-risk applications.

Reporting

Reporting should include plate identification, location, method, result, date, surface condition, operator's name and signature. Refer to AS1816-2002.

Table 3 – Typical or Specified Hardness of BISPLATE

Grade	Specified Hardness (HB)	Typical Hardness (HB)
BIS80		255
BIS320	320 – 360	340
BIS360	360 – 400	380
BIS400	360 – 430	400
BIS425	400 – 460	440
BIS500	477 – 534	500



Typical Grinding Depth for BIS360, 10-20mm thick

Bisalloy Testing No Half Measures – Literally

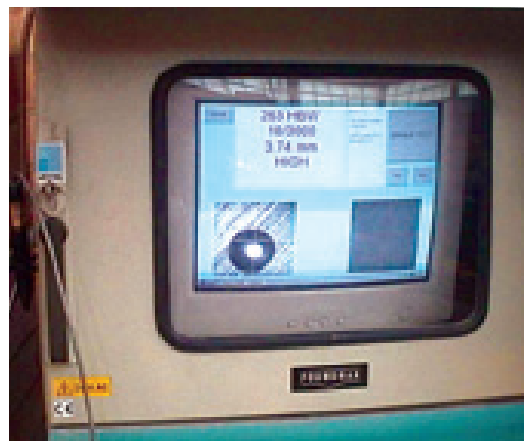
Client, or manufacturer, we both have the aim to get the most accurate results possible, first time.

As with our manufacturing process, we believe our testing standards are second to none.

But anything can be improved.

Currently – already unique among other manufacturers – Bisalloy goes to the extent of manually testing every plate produced – that is, each one goes through the full process of grinding, test and measure.

The size of the indentation is measured using the latest video imaging technology, which is interfaced with a dedicated computer to generate a BHN number to within one point.



In the near future, this testing procedure will become fully automated including automated grinding and indentation, guaranteeing an even greater and more consistent level of accuracy and repeatability.

This technology will put Bisalloy ahead of any of its competitors in the hardness testing of quenched and tempered plate.

At Bisalloy, we will always look for ways to offer more.

We wouldn't expect you to accept anything less.

Drilling, Countersinking and Tapping Recommendations for Bisplate Quenched and Tempered Steel

All grades of Bisplate are able to be drilled, countersunk and tapped although, as with most fabrication aspects, care should be taken with these grades of steel.

In all cases, suitable high powered and rigid drilling equipment should be used.

Drilling of High Strength Structural Grades

When drilling the Bisplate grades 60.70 and 80 the use of cobalt type high speed steel drills is recommended. Drills equipped with replaceable carbide inserts can also be used.

Drilling of Wear/Abrasion Resistant Grades

Bisplate 320, 360 and 400 grades may be drilled with either cobalt type high speed steel drills or drills equipped with replaceable carbide inserts.

With regards to the drilling of Bisplate 425 and 500 grades, we recommend only the use of drills equipped with replaceable carbide inserts.

Recommendations for Improved Results

- The supporting bars under the plate should be placed as close to the hole as possible.
- If possible, use a plain carbon steel backing plate under the Bisplate.
- The drilling head should be placed as close as possible to the main support.
- Short length drills are preferred.
- The last part of the hole to be drilled should be done with manual feed.
- Usage of adequate coolant (water and oil emulsion mixture).



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