BOSSARD
Proven Productivity

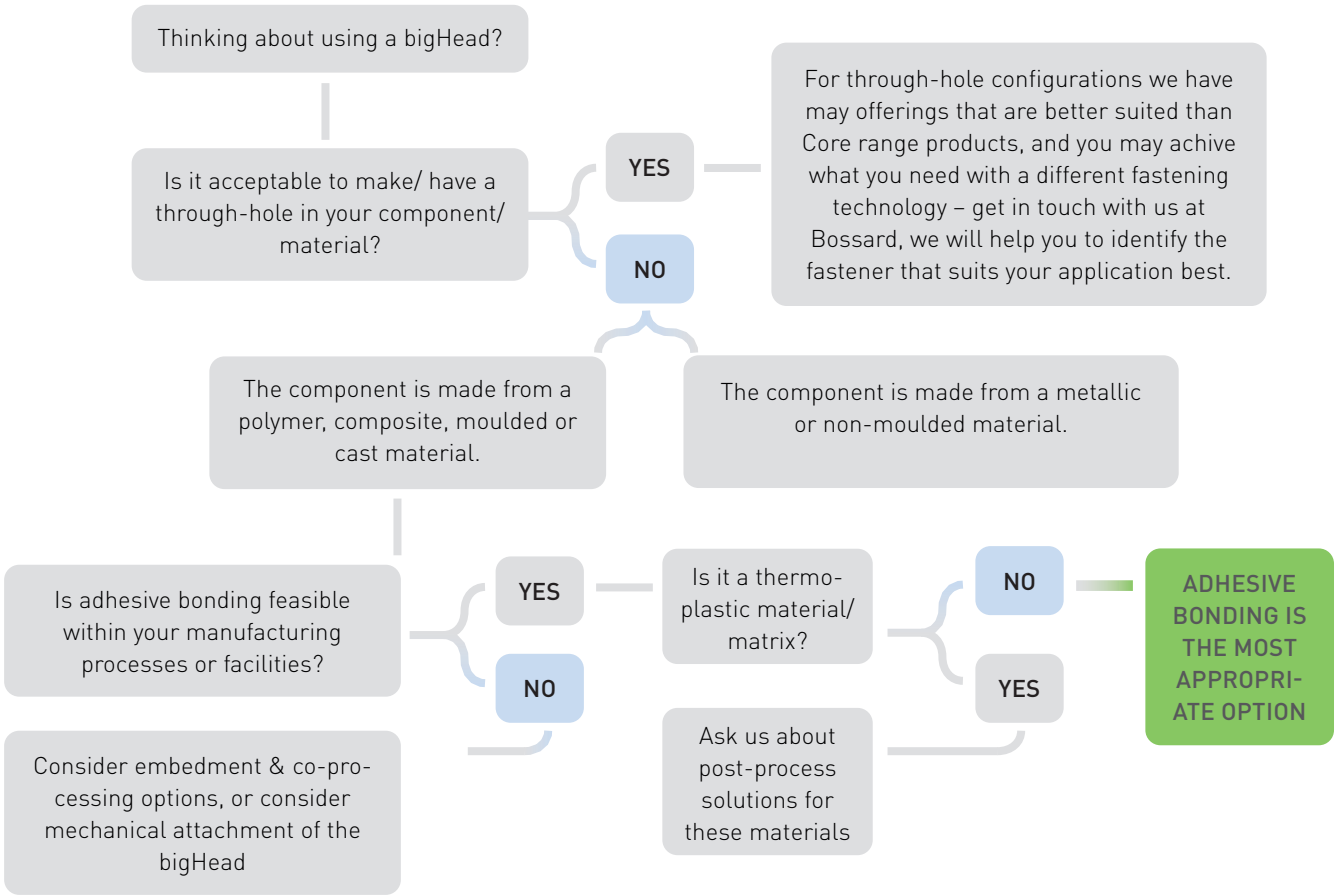
bigHead®

Adhesive applications guidance

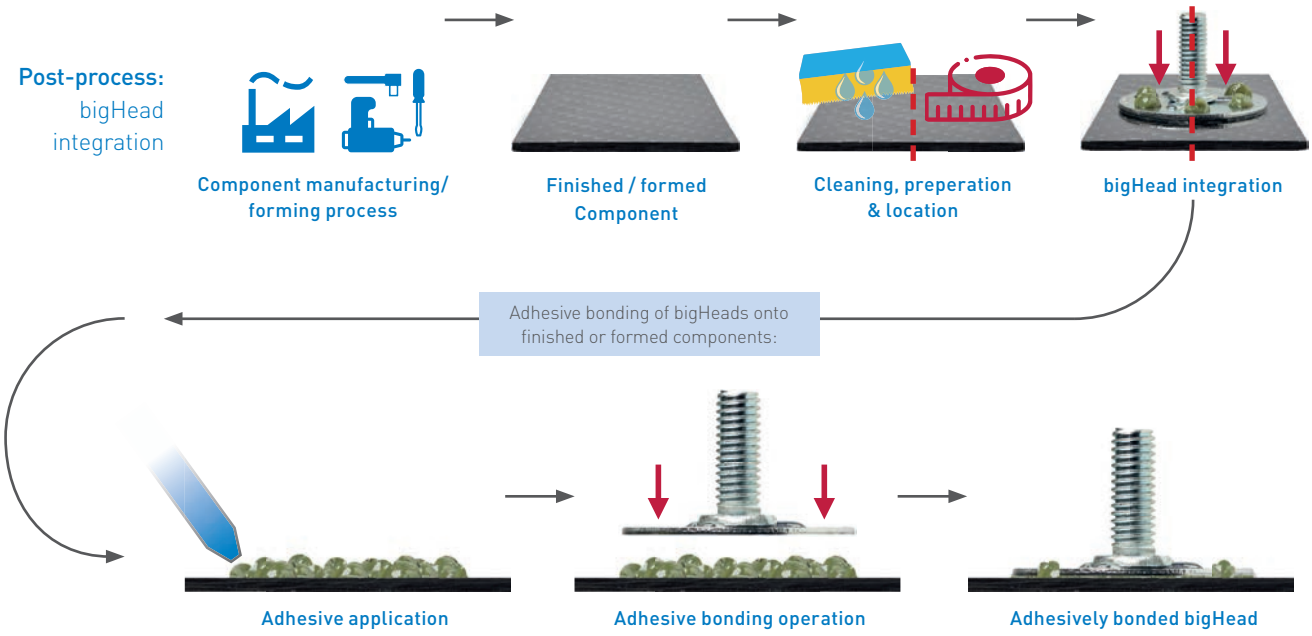
«every bigHead® is perfectly engineered.»

Contents

When to consider adhesive bonding?



Adhesive bonding of bigHeads – typical process



Before we continue, please take note

Always follow adhesive manufacturer's instructions and recommendations

We provide our guidance material and indicative data:

- **To raise awareness** of issues that can affect the suitability of adhesive bonding bigHeads in different applications.
- **To give example**s of how our products perform with different adhesives.

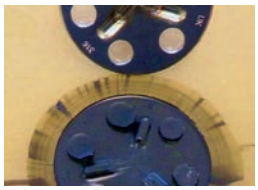
So you don't have to spend time and effort in learning this through experience, but we offer this guidance and data without guarantee, warranty or liability; so you should always determine application suitability before implementing adhesive bonding of bigHead products with your selected/ chosen adhesive. Different adhesive products will have varying process requirements, and offer varying levels of materials compatibility and mechanical performance, which may affect how suitable the adhesive is for your application.

Adhesive manufacturers and suppliers should always be your go-to for adhesive bonding expertise – so if in doubt, always discuss your usage of adhesive bonding for bigHeads with your adhesive supplier or the adhesive manufacturer. Don't forget we are always happy to work together with customers and partners to find the right solution for a given application.

Adhesive bonding considerations for achieving optimum performance

Successful adhesive bonding of a bigHead is dependent on several factors within the adhesive bonding process itself. Considering these factors in advance of proceeding to implementation can help ensure optimum performance and avoid the need for corrections.

Surface preparation



Materials compatibility

Bondline thickness

Managing overspill

Surface preparation considerations

Here we provide guidance on topics related to surface preparation and cleaning, of the bigHeads themselves and the components they are being bonded onto.

Surface preparation of componentes / substrates

Check with your adhesive supplier

Unless advised / agreed otherwise by your adhesive supplier or through testing, we recommend to always prepare and/ or clean the component surfaces using an appropriate technique prior to bonding a bigHead in place. This may include a combination of mechanical and chemical techniques, and selecting the most appropriate process will depend on the materials and manufacturing processes used to create your component. Whilst we can offer basic guidance, bigHead will always refer inquiries about component surface preparation to the adhesive's technical data sheet or the respective adhesive supplier/ manufacturer.

Grit or media blasting of bigHeads

DO NOT DO THIS

We very strongly advise against media or grit blasting of bigHeads prior to bonding. Media or grit blasting of metallic adhesive bonding surfaces is usually only required when the presented surface is heavily oxidised or contaminated. We take care to ensure our products arrive to you without any kind of oxidisation or contamination that could interfere with adhesive bonding operations. There may be a little dust or residual oil...but this is easily cleaned off by less aggressive methods.

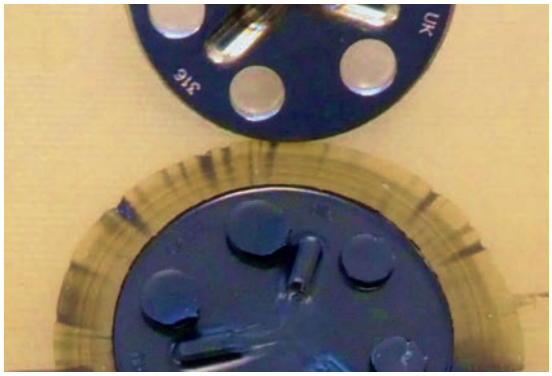
bigHead bonding surface cleaning

DO THIS wherever practicable

In some cases, it may not be essential to clean the bigHead prior to bonding – some adhesives can even tolerate a small presence of oil on the bonding surfaces. However, dust can accumulate on our products during transit and storage – and not all adhesive's have oil dispersants in them – so it is always a good idea to clean the bigHeads prior to adhesive bonding operations. You can either solvent dip clean the bigHeads, or solvent wipe the bonding surface clean with a lint free cloth – we recommend to use Isopropyl alcohol (IPA), but take care to let the parts dry thoroughly before commencing adhesive bonding. Suitability of other solvents or cleaners should always be determined by appropriate testing.

Materials compatibility

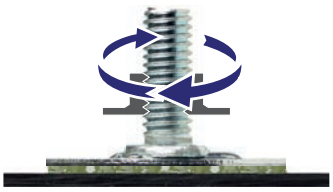
When selecting adhesives, it is important to consider the adhesive's compatibility with both the bigHead and the component you are bonding it onto. Adhesives that work well with composite and polymer materials may not be suited to the metallic materials of a bigHead. Some adhesives may not be compatible with the bright-zinc-plate (BZP) Zinc based electroplate finish used on our carbon steel products.



Adhesion limitations on metallic surfaces
Some adhesive types, for example many single component polyurethane (PU) products, offer limited adhesion to metallic materials, especially 316 stainless – as you can see to the left, these adhesives typically detach completely from the bigHead surface at relatively low forces.

This may present an undesirable mechanical performance or assembly force limitation – so it is important to evaluate whether the bonded bigHead will survive both the **in-service loading expectations, and also any loads that may be encountered during assembly operations.**

Application
In service loading



Forces
during assembly operatioins

Chemical incompatibility
For corrosion protection, we finish our carbon steel products using a Zinc electroplate process.

The chemical cure mechanisms of some adhesives can be interrupted or inhibited by the presence of Zinc or other metal oxides

This can be a common issue with Methacrylate (MMA) adhesives, but the issue can also affect products/ grades of different types.

Also, be aware that there may be **no visual indication** of inhibited cure – so you only find out about an issue when the bigHead undergoes mechanical loading.

Adhesives that are stated to be suitable for bonding on galvanized steel typically also offer compatibility with our BZP finish, **but it is essential to always check/ determine chemical compatibility by appropriate testing and/ or in consultation with the adhesive supplier or manufacturer.**

Zn

Adhesive bondline thickness

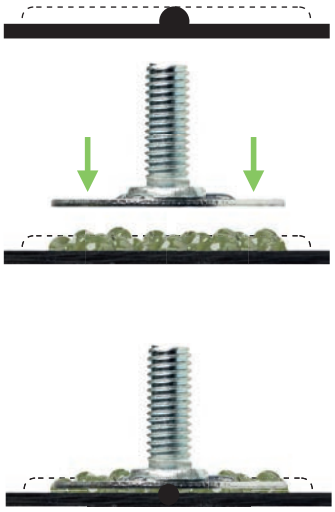
For many adhesive systems, observing bondline thickness recommendations is critical for ensuring a satisfactory level of cure and for achieving optimum mechanical properties. bigHead, and usually adhesive suppliers and manufacturers too, do not accept liability for any failure of an adhesively bonded bigHead that is attributable to improper bondline thickness – therfore it is important to consider how proper bondline thickness will be achieved for a given adhesive and bigHead combination.

Definition of bondline thickness for an adhesively bonded bigHead

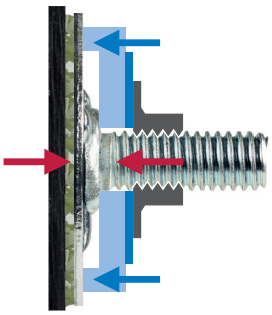
The adhesive bondline thickness is defined by the gap-height between the lowermost surface of the bigHead and the surface of the material or component to which the bigHead is bonded onto (A). It is not the height of the adhesive withn the perforation holes of the bigHead (B).

There are different approaches to setting this height during adhesive bonding.

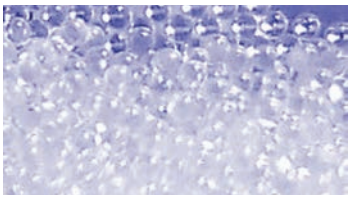
Possible methods for ensuring correct bondline thickness



Projection features in the component material/ surface
If it is feasible to produce such features in the component, this will offer one of the simplest and fastest way to ensure correct bondline thickness during adhesive bonding of bigHeads.

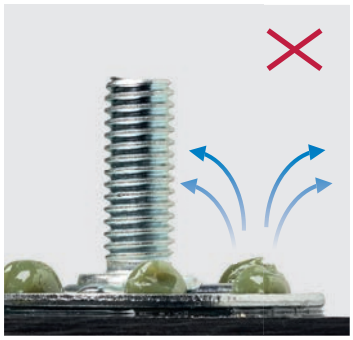


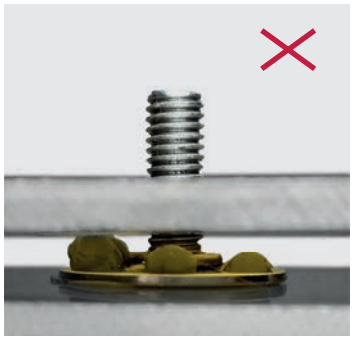
Bonding fixtures or jigs
An effective method, but very likely to increase overall production complexity and cycle time unless the process can be automated.

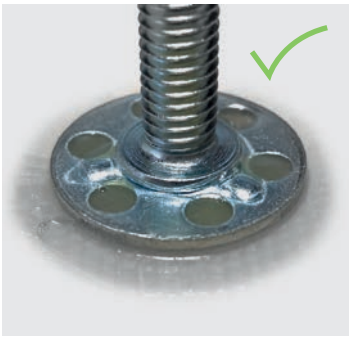


Beads or spheres in the adhesive
Some adhesives are supplied with beads or spheres inside for this purpose – manual addition of spheres or beads is best reserved for test specimens, prototyping and one-off production.

Managing overspill



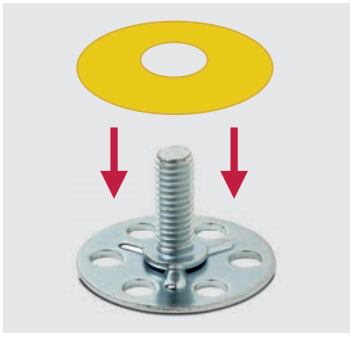


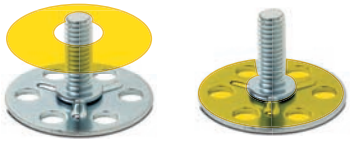


Unless somehow restricted, adhesives often flow into and out of the bigHead perforation holes during the bonding operation. **Exact behaviour will depend on the thixotropy of the adhesive used.**

However, this adhesive **overspill may prevent correct fitment of adjoining components** onto the bigHead fixing **during assembly operations.**

bigHead **do not supply products** with this film in place, but we are happy to advise on suitable cutting sizes, film choice and possible cutting methods.

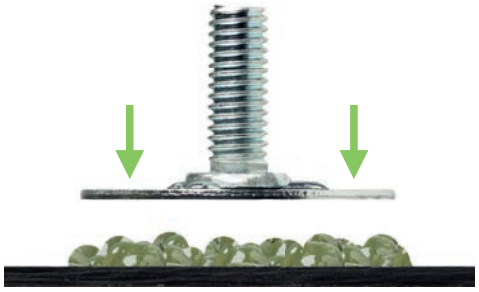




Overspill control film: Applying a transparent self-adhesive film to the upper side of the bigHead prior to bonding offers the following benefits:

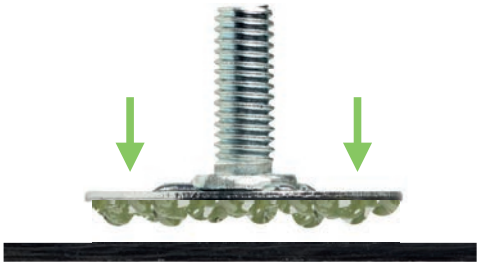
- Eliminates excessive adhesive overspill from the bigHead perforation holes
- Operatives can visually confirm satisfactory adhesive spread across the bondline
- Reduces adhesive usage and wastage, and forces adhesives to fully fill the perforation holes – maximises rotational force resistance attributable to filling the perforation holes with adhesive
- Eliminates the need for adhesive removal during the bonding operation, or mechanical removal of cured adhesive lumps prior to assembly
- Can prevent air inhibition of adhesives that would otherwise cure with a tacky surface

Other considerations

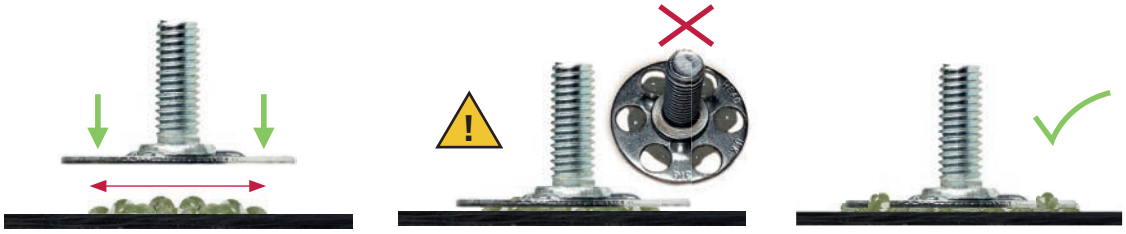


Apply adhesive onto the substrate or the bigHead? You can choose.

Unless your adhesive supplier advises otherwise, whichever works best for your adhesive bonding operation and/ or with the adhesive's thixotropy.

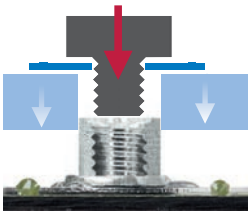


To achieve optimum loading capability, always ensure the adhesive spreads fully across the bigHead surface. Avoid a situation where only the centre of the bigHead is covered by adhesive:



Fastening techniques of adhesively bonded bigHeads

Adhesively bonded collar fixing bigHead on component

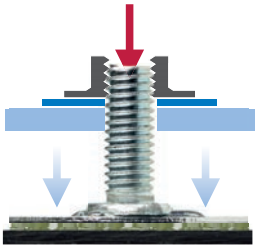


Adjoining component fitted over bigHead collar, retained by screw and washer

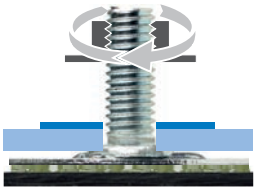
Screw tightened into bigHead collar to secure assembly

Completed assembly

Adhesively bonded stud fixing bigHead on component



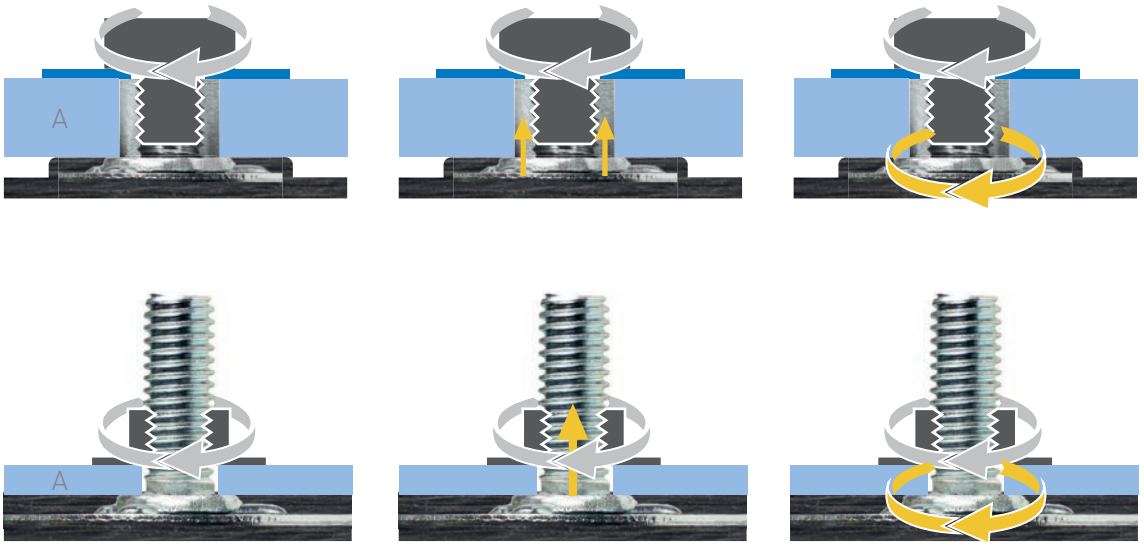
Adjoining component fitted over bigHead stud, retained by nut and washer



Nut tightened into bigHead stud to secure assembly

Completed assembly

Assembly loads due to tightening forces



Assembly tightening operations to secure the adjoining component (A) onto the fixing of the embedded bigHead will create resultant forces in the bigHead.
Depending on the assembly design/ configuration, forces may also occur in the component/ embedment material.
...this is not the same loading condition as a tensile or torsional load occurring during application usage!

Resultant tensile forces
If the adjoining component lands onto the bigHead shoulder surface, the resultant forces will be borne by the bigHead fixing material, and not the surrounding material. However, this is dependent on managing assembly gaps and clearance hole sizes.
See our **Assembly Guidance** document for detailed information on assembly loading considerations.

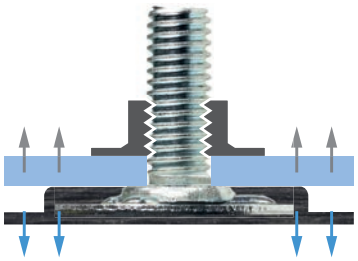
Resultant torsional forces
During tightening operations, some of the rotational force can transfer into the surrounding material, especially in the event of inadvertent cross-threading. It is essential to ensure that the surrounding material is capable of withstanding the applied rotational forces during assembly.
Core range embedded data:typical loading expectations are available on page 15 and individual product specific data is available on request.

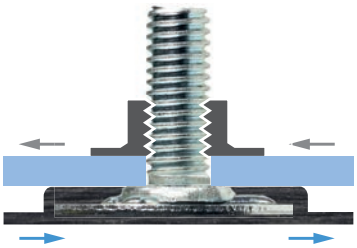
Application/ in-service loads

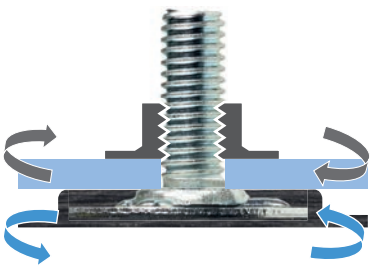
Tensile loads
Tensile loads typically occur on the bigHead and the surrounding material during service when there are opposing forces acting on the fastened components in perpendicular directions to the surface plane and in line with the fastener axis.

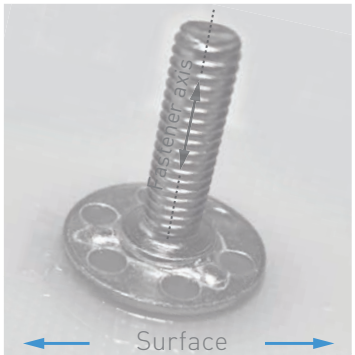
Shear loads
Shear loads typically occur on the bigHead and the surrounding material during service when there are opposing forces acting on the fastened components in directions parallel to the surface plane.

Torsional loads
Although a relatively uncommon service loading case, rotational forces on the bigHead and the surrounding material may occur if the fastened components rotate in opposite directions around the fastener axis.









Here we explain how shear, tensile and torsion loads are generated in the bigHead and/ or the surrounding material, depending on which directions the forces act during application/ in-service usage.

Different adhesive type to the one bigHead used?

We made our tests with bigHeads bonded onto a 3 mm thick glass fibre reinforced epoxy laminate using 3 different adhesive chemical compositions, or generic "types" – Epoxy, Methacrylate (MMA) and Polyurethane (PU).

The adhesive materials we selected are commonly available, and representative of typical adhesives found in numerous applications. There are infinite combinations of adhesive and substrate materials, but our results give an indication of how our products will perform when adhesively bonded using similar adhesives or substrate materials.

Not forgetting materials compatibility, which must be evaluated/ tested on a case-by-case basis, **our data indicates the performance you can expect from:**

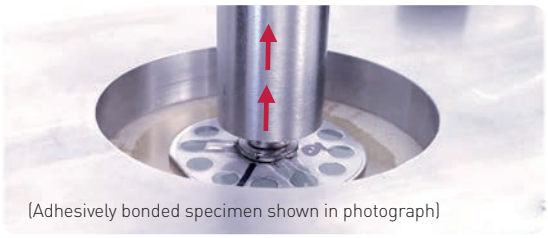
Epoxy, or other adhesives
Having 20~30 MPa lap shear strength, and up to around 5% elongation (e.g. aerospace applications)

Methacrylate (MMA), or other adhesives
Having 15~25 MPa lap shear strength, and 5~10% elongation (e.g. marine, industrial products and land transport applications)

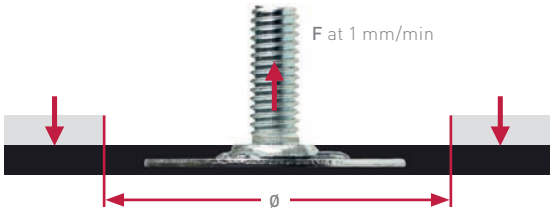
Polyurethane (PU), or other adhesives
Having around 2.6 MPa lap shear strength and >300% elongation (e.g. automotive assembly applications)

Testing fixtures and parameters used for application tests of bigHeads

Tensile test:
bigHead is pulled through the aperture plate, with substrate plate retained beneath aperture, to impart tensile force (F). Aperture diameter is determined by fixing size.

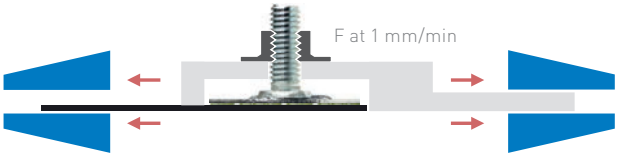


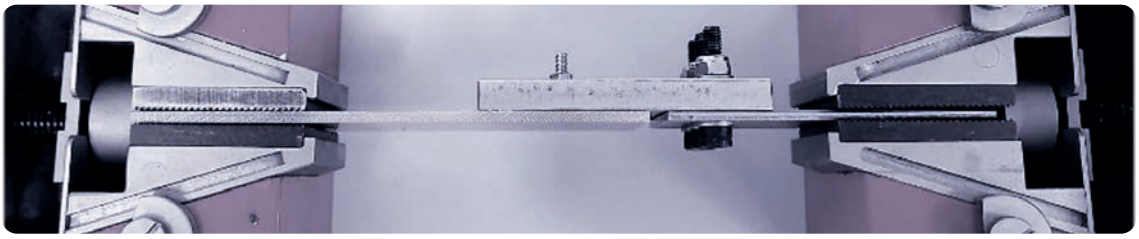
(Adhesively bonded specimen shown in photograph)



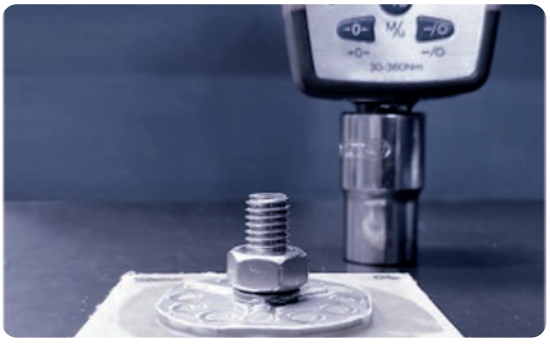
Fixing thread size (studs & collars)	Aperture Ø
M4	34 mm
M6	50 mm
M8	63 mm

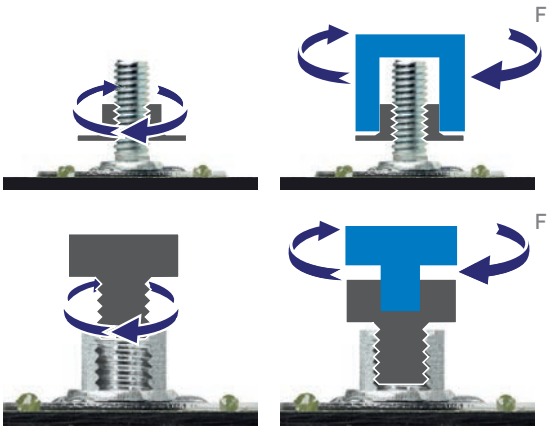
Shear test:
bigHead fixing is assembled and secured into fixture. Fixture and substrate plate are wedge gripped and pulled in opposite directions to impart shear force (F).





Torsion test:
Nut and washer (studs) or bolt & washer (collars) are assembled onto bigHead fixing. Nut/ bolt and washer are tightened onto bigHead fixing with torsional force (F) with the substrate plate fixed in place.





Application load expectations for adhesive bonded bigHeads

This table indicates combined test results for stud and collar products, in carbon and stainless steel, for the given Head/ thread size combination.

Exact material properties and bigHead product configuration will significantly influence these results, so we offer this information for indication only without warranty or guarantee of performance. For tensile tests, the table indicates the upper expectation of achievable load for the given Head size. However, for application usage, it is important to always check and observe the maximum recommended tensile load values for specific bigHead product Head/ fixing combinations.

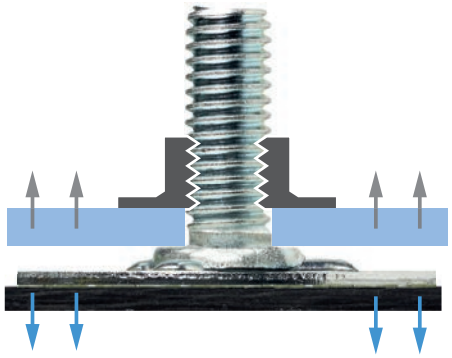
The applied torsion/ rotational forces reported in this table, and subsequent resistance of the embedded bigHead to rotation within the component material do not imply assembly tightening torque resistance, which must always be determined by suitable assembly testing

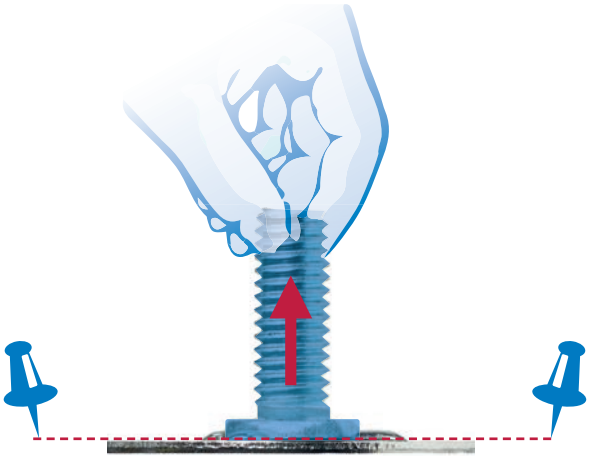
	Epoxy adhesive 3M EC7202, 0.15 mm thick			Methacrylate (MMA) adhesive SCIGRIP SG5000-06, 1 mm thick		
Product Head size:	B20	B30	B38A	B20	B30	B38A
Typical peak Tensile load (kN)	0.8 to 1.1	1.6 to 1.7	2 to 2.6	2.6 to 3.2	2.7 to 3.7*	2.5 to 3.6*
Typical peak Shear load (kN)	0.8 to 1.1 M4 fixing	2.0 to 2.5 M6 fixing	3.9 to 4.2 M8 fixing	1.5 to 1.7 M4 fixing	2.5 to 4,5 M6 fixing	3.1 to 5.1 M8 fixing
Typical peak Torsion load (Nm)	5 to 7 M4 fixing	15 to 39 M6 fixing	42 to 69 M8 fixing	5~7 M4 fixing	16 to 42 M6 fixing	43 to 71 M8 fixing

	Polyurethane (PU) adhesive Sika Sikaflex 252, 1 mm thick		
Product Head size:	B20	B30	B38A
Typical peak Tensile load (kN)	0.2 to 0.3	0.8 to 0.9	1.0 to 1.2
Typical peak Shear load (kN)	0.1 to 0.2 M4 fixing	0.3 to 0.4 M6 fixing	0.4 to 0.5 M8 fixing
Typical peak Torsion load (Nm)	2 M4 fixing	6 to 9 M6 fixing	8 to 13 M8 fixing

* Where the adhesive offers high levels of cohesive strength, there is a typical Head size at which tensile performance reaches an optimum level, and increasing the Head size may not increase tensile strength performance.

Maximum recommended load values of bigHead Core Range products





Weld loading condition

For adhesive bonded bigHeads in an application/ in-service tensile loading condition, it is sometimes possible to reach the maximum recommended weld load limit (WLL) of the bigHead part. For guidance on application loading limitations for adhesive bonded Core range bigHeads (where WLL applies), please see the table ↓

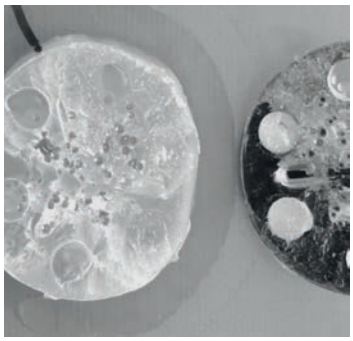
In shear or torsion loading conditions, the adhesive material has much greater influence on overall loading limitations; limitations for application/ in-service loading of adhesive bonded bigHeads in shear or torsion must always be determined by appropriate testing.

Head types

Threadsize	B20	B30	B38A
M4	2 kN	3.5 kN	3.5 kN
M5	4 kN	5 kN	5.5 kN
M6	4 kN	5 kN	6 kN
M8	5 kN	6 kN	8 kN

These are generic recommendations: actual performance of individual Head/ thread size combinations may vary and loading limitations should always be confirmed/ determined in consultation with bigHead or your distributor, and validated by appropriate testing.

Maximum recommended load values of bigHead Core Range products



Detailed loading data and failure mode information
The purpose of this guidance document is to provide a general level of mechanical performance information to assist with identifying potential bigHead product/ adhesive configurations that may meet a given application requirement. There is much more detailed information that we simply could not fit into this one document. We are happy to support inquiries, on a case-by-case basis, for further details about our testing results at individual specimen level (for example load/ extension data and photographic examples of failure typical modes).

Detailed information on testing methods
We make no secrets about how we test bigHeads, but, within the space of this document it is only possible to show the basic information/ parameters that would be required for repeating our testing. In fact, because there is no formally recognised standard for applications testing of our type of products, we are happy to share information and support others in testing bigHeads and other fasteners in a comparable manner, so that we can try to make it faster and easier to select and qualify fasteners for different applications/ loading scenarios in future.

Detailed information on specimen manufacturing
To ensure repeatability of our testing, this document includes only basic information on the materials, processing methods and specimen manufacturing techniques that we used to create our adhesive testing data. For all materials used, further details of mechanical properties and any applicable processing recommendations are typically available from the respective manufacturer's technical data sheets. We recognise our specimen manufacturing methods and techniques may be unique to bigHead and bigHead type fasteners, so we are happy to discuss or provide further information on this.

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