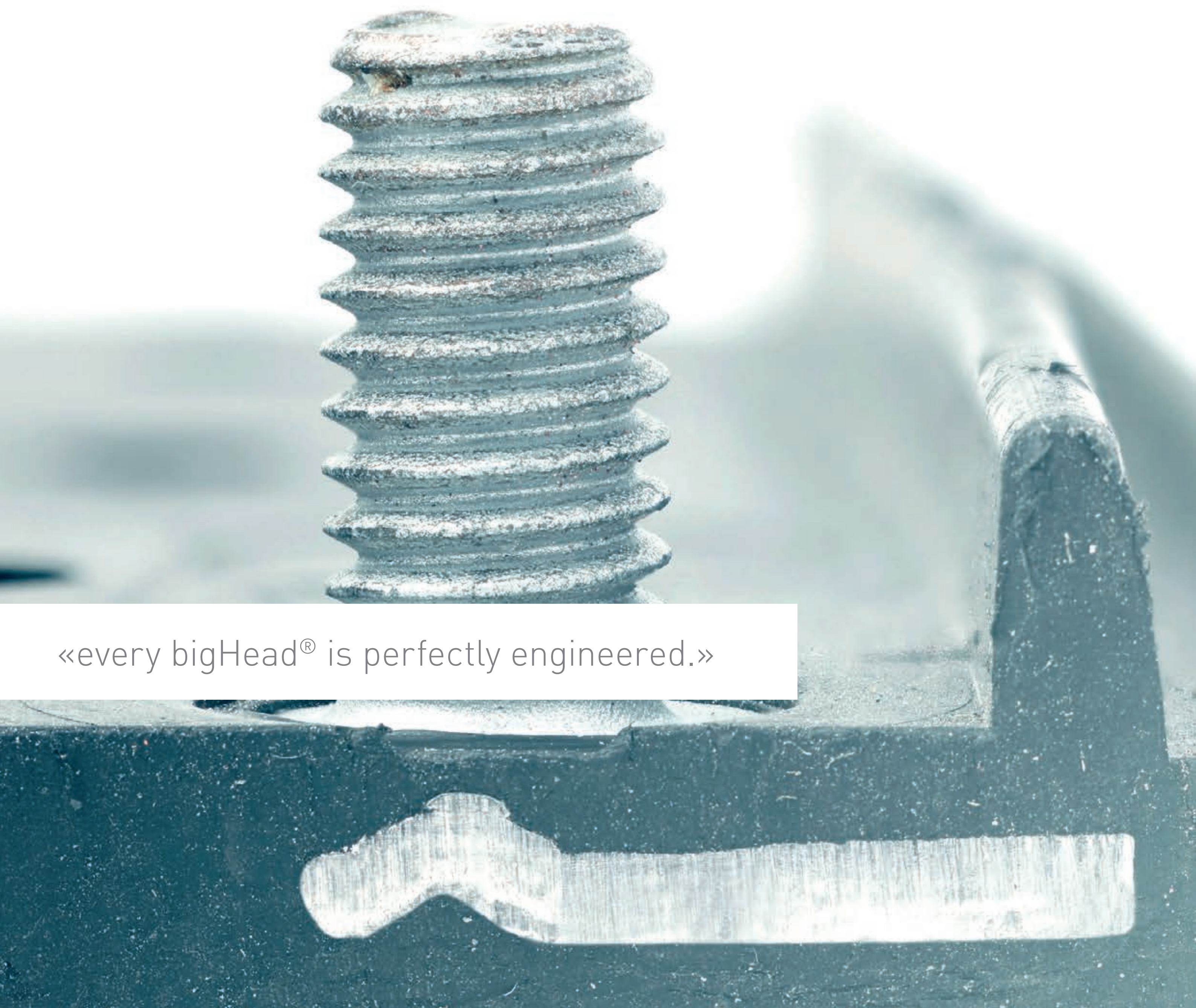
Proven Productivity

bigHead®

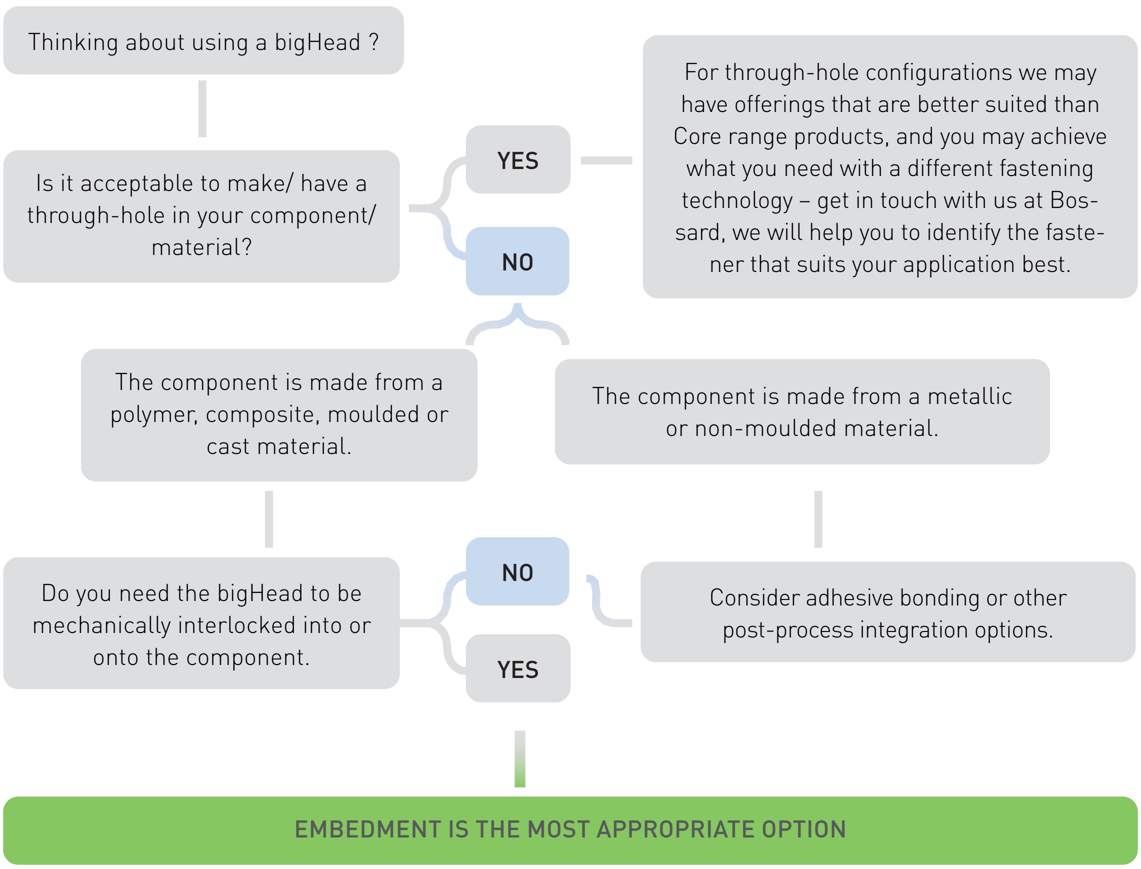
Core range - Embedded applications guidance



«every bigHead® is perfectly engineered.»

Contents

When should I consider embedment?



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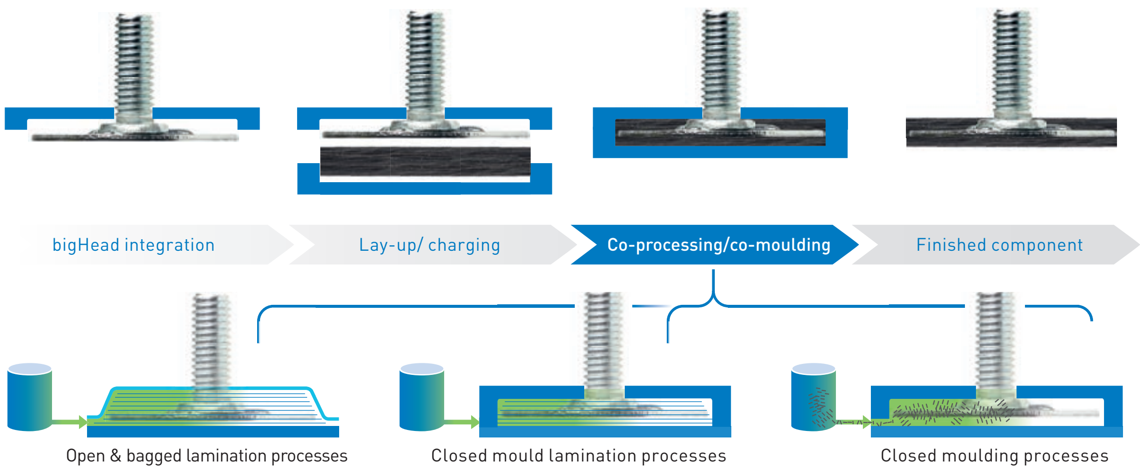
Co-Processeing typical processes



Generic process and material types

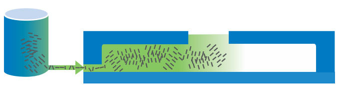
Open & bagged lamination

Hand-lay
Chopped glass fibre mat
Polyester
Vacuum infusion
Glass fibre woven & non-crimp fabrics (NCF), Polyester/ Vinylester/ Epoxy
Pre-preg/ tape-lay
Unidirectional carbon fibres
Epoxy, Polyamide

Closed mould lamination

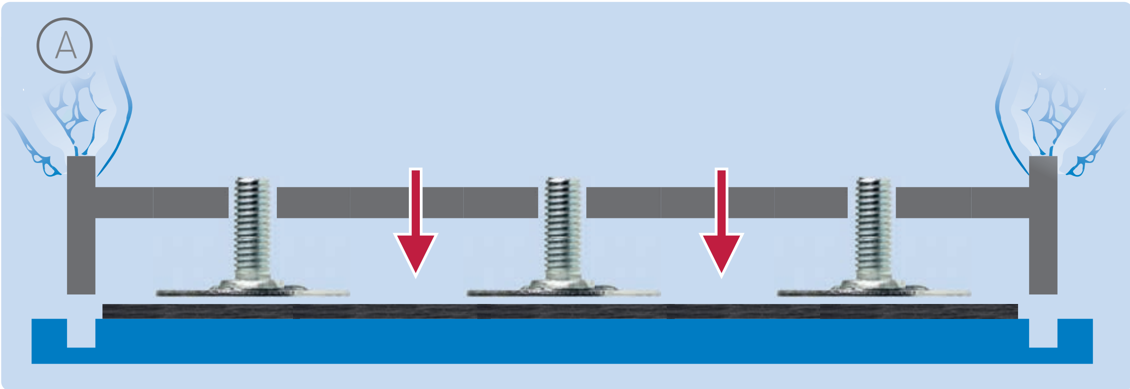
RTM
Combi mat glass fibres
Polyester/ Vinyl-ester
Compression-moulding
Woven glass & carbon fibres
Epoxy, Polyamide, Polypropylene
Liquid compression moulding
NCF glass & carbon
Epoxy

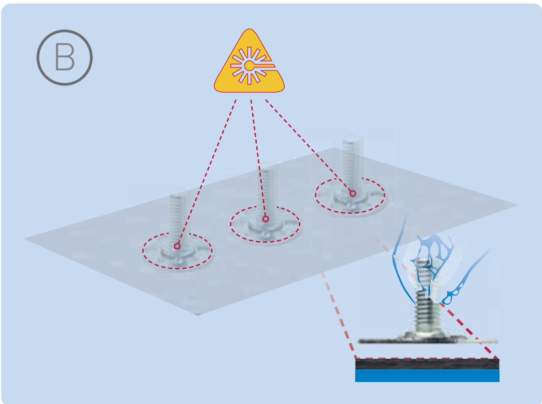
Closed moulding

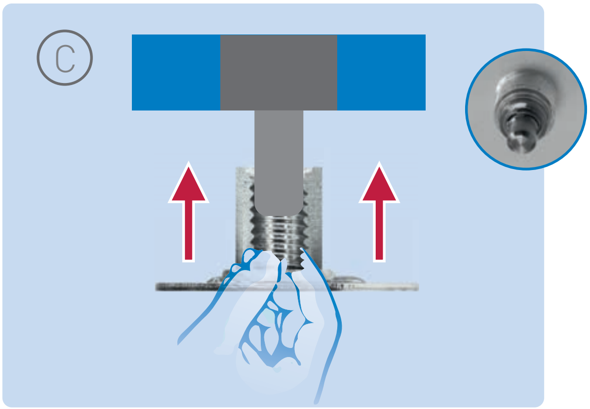


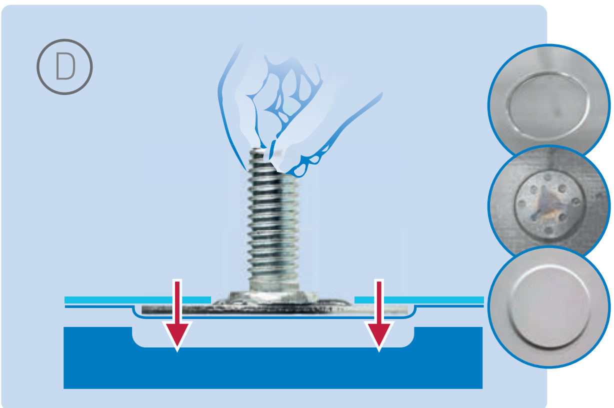
Reaction Injection Moulding (RIM)
often PU/ PUR
Polyurethane (PU), Polyurethane + glass fibres (PUR)
SMC/ BMC/ DMC
Chopped glass & carbon fibres
Polyester, Vinyl-ester & Epoxy
Injection moulding
Short (<15 mm) glass & carbon fibres Polyamide, ABS, Polypropylene, POM

Process integration – location of bigHeads







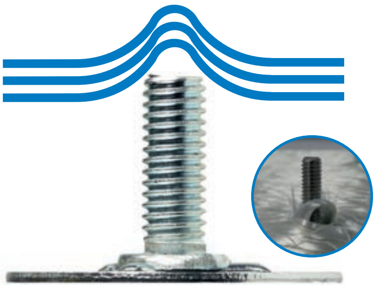


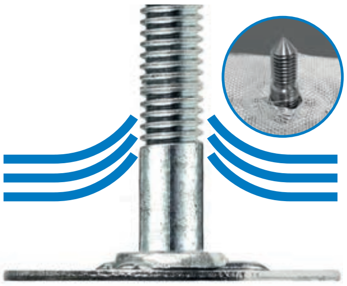
Please contact Bossard or your distributor if you would like further advice or engineering support with this topic.

Location techniques
There are many possible ways to locate bigHeads within a component or within mould-tooling prior to processing. Here we show some basic examples.
Physical jigs/ fixtures (A) or laser projection (B) can provide accurate ways of placing big-Heads into the correct position/ location.

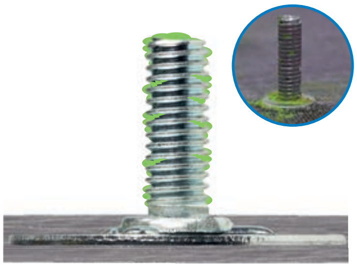
Alternatively, it may be possible to use **spe-cific devices (C) or features (D) within the component tooling to locate the bigHead.** Tooling devices can also provide a sealing solution that, especially when combined with specialist bigHead products, prevents resin/ polymer ingress into threaded fixings during co-processing.

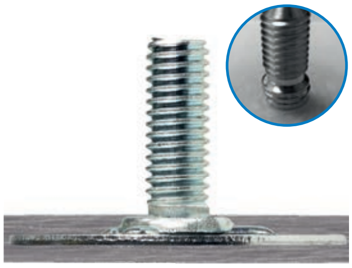
Process integration – incorporation into fibre/ fabric reinforcements



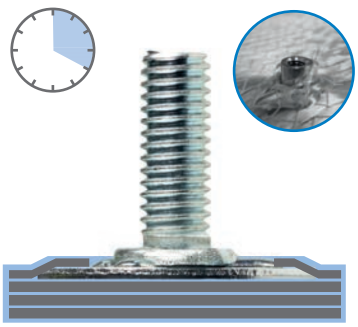


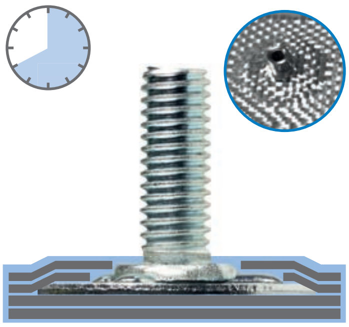
Fibre/ fabric broaching
It can be challenging to quickly and easily pass bigHead fixings through reinforcement materials during the lay-up or pre-forming process – **to assist with this, we can offer specialist engineered to order products or features.**



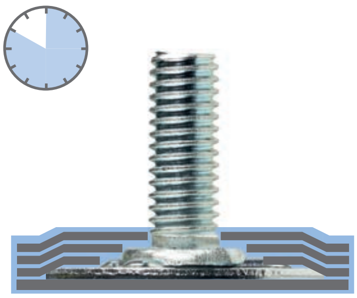


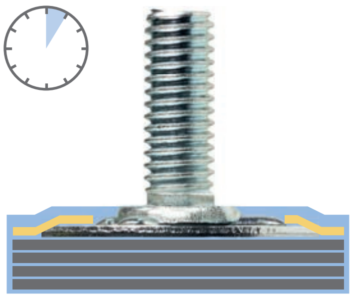
Thread ingress sealing
There are various ways to seal bigHead threads against resin/ polymer ingress – but some can be time-consuming, and require further clean-up work. **We can offer products or product features to make this easier and simpler.**



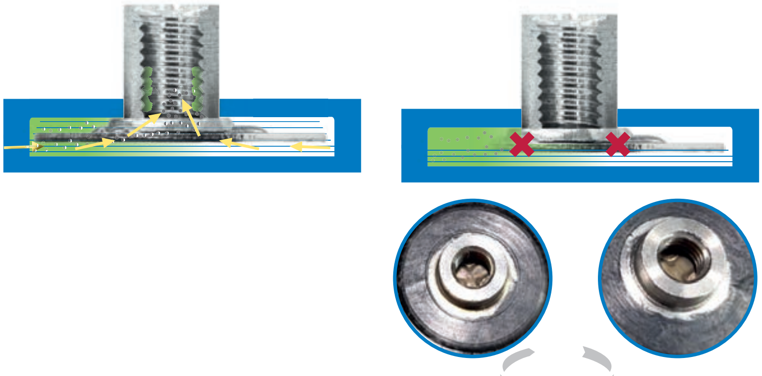


Incorporation into lay-up/ pre-forming
Incorporating a bigHead into lay-up or pre-forming sequences of laminate material usually requires a manual operation, and can disturb reinforcement fibres – in many cases, **an over-patch is a faster & simpler way to incorporate the bigHead.**

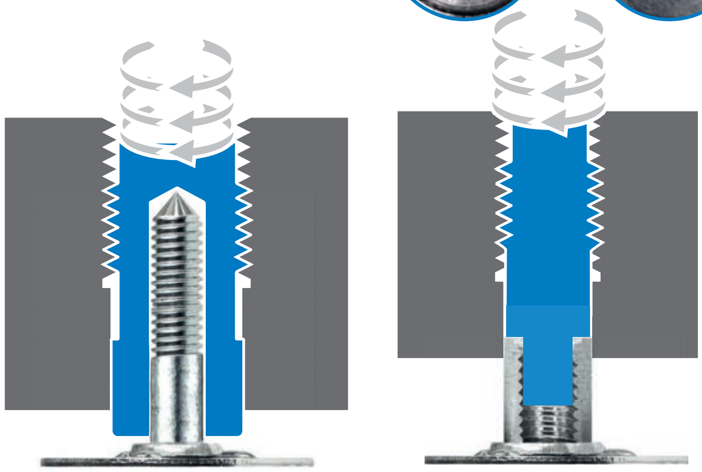




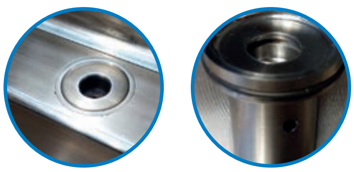
Incorporation into closed mould processes

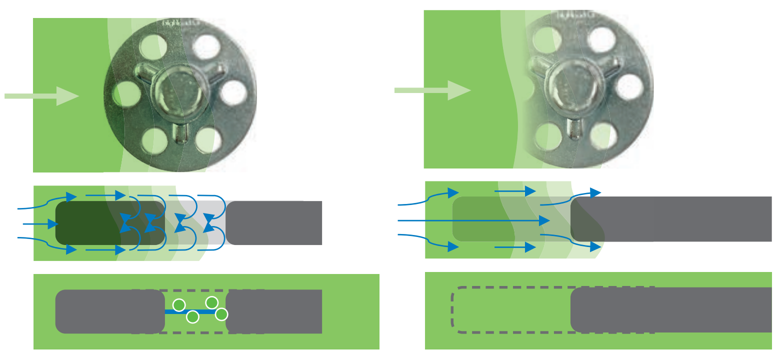


Resin/ polymer ingress into threads
Certain materials forming processes will involve high pressures inside the mould/ tooling. Under such pressures, it is easy for resins and polymers to find their way into threaded sections of co-processed fasteners. Contact us or your distributor to ask us about our specialist solutions for this.



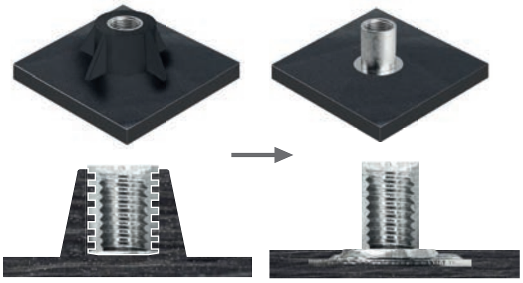
Incorporation into tooling
Co-processing of bigHeads within closed-mould requires a method of locating and retaining the bigHead. We can offer you engineering support and specialist product designs for tooling incorporation solutions if and when required.

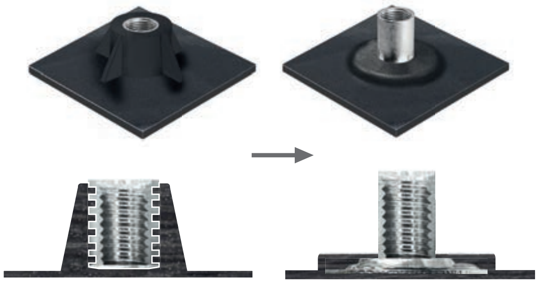




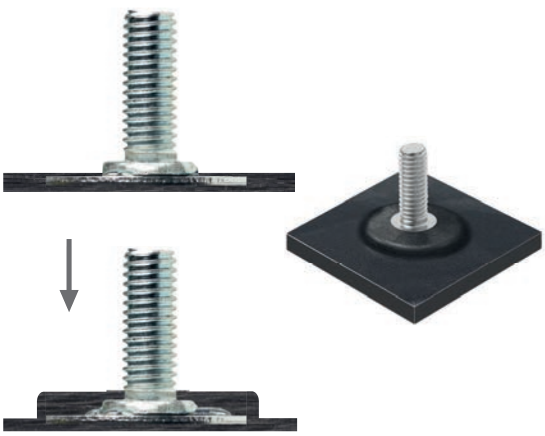
Perforation hole filling
The perforation holes in Core range products may present co-processing challenges for some materials, especially those containing highly oriented fibres. In such cases, please ask us or your distributor about alternative product offerings.

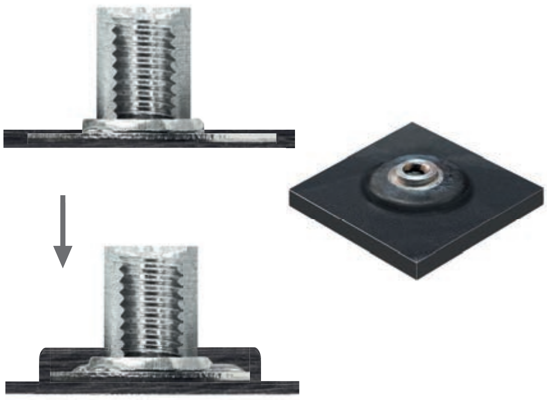
General design considerations





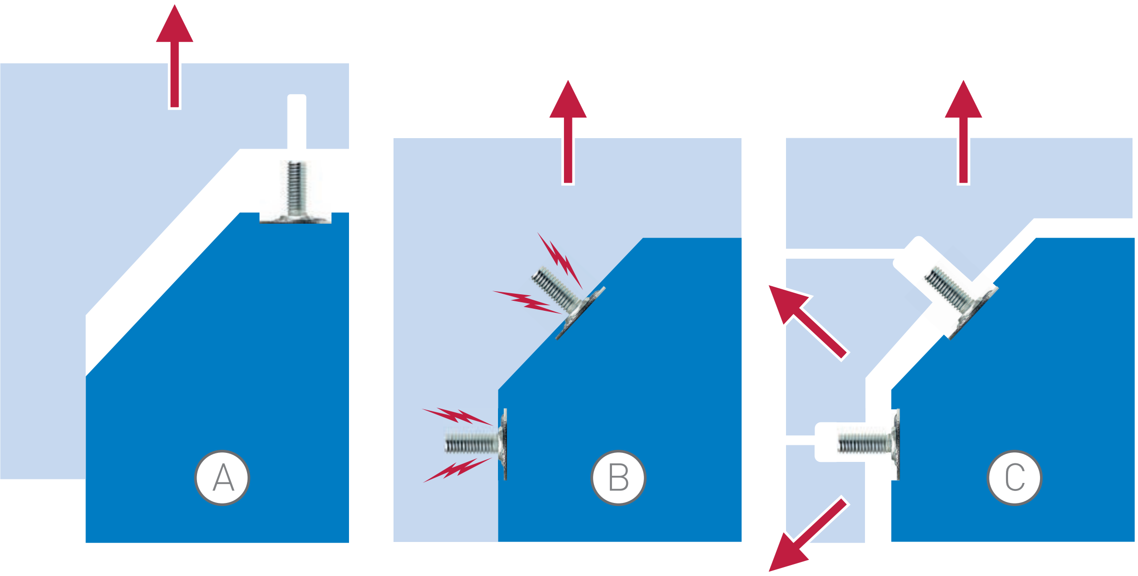
Boss/ rib features
Collar fixing bigHead fasteners do not require a large boss or section of supporting material around the threaded fixing. Embedment of the Head component into the material is enough to provide a secure threaded socket fixing/ fastening point on/ within a component.



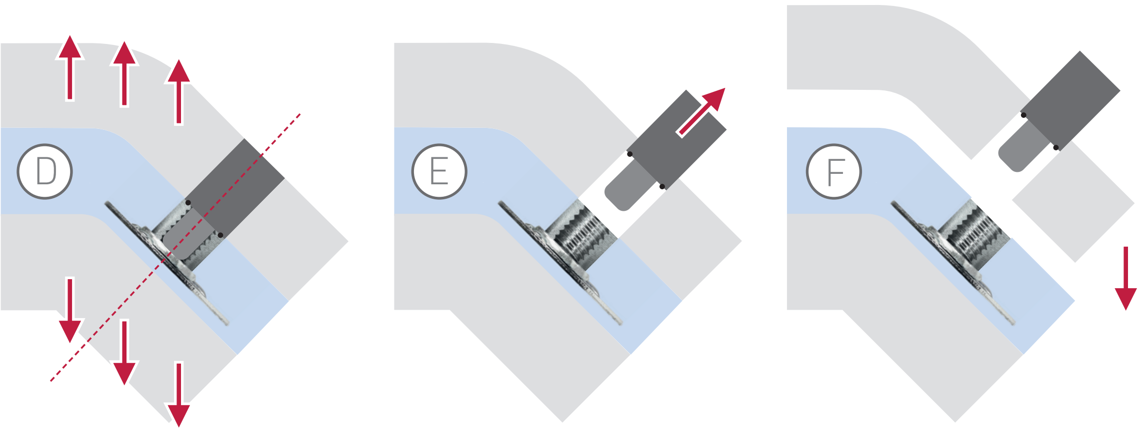


Thin material sections
If the component material is less than 3 mm thick, it can be challenging to fully embed/ incorporate the bigHead without risking break-out or material flow issues. Where practicable, this is easily managed by locally increasing the material thickness around the bigHead, so that the Head sits in a "pocket" feature:

Tooling ejection



With embedded/ co-processed bigHeads it is important to consider tooling ejection paths or split lines.
Orienting the axis of the bigHead fixing in line with the ejection path (A) minimises tooling complexity. The overall component geometry and assembly design may require axial orientation of the bigHead fixings in a different direction (B), preventing ejection. Depending on the permissible tooling complexity, it may be feasible to accommodate the bigHead by adjusting tooling spilt lines and opening directions (C).

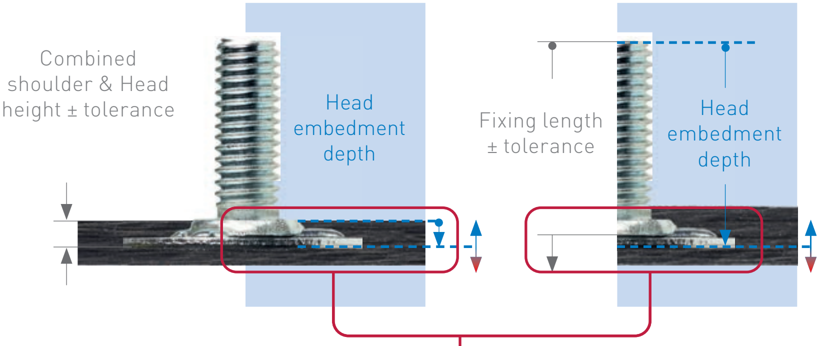


Where it is necessary to orient the bigHead fixing axis in a different direction to the ejection path (D), retractable tooling location devices can provide a solution (E). Retractable devices can locate/ retain the bigHead during processing and then withdraw from the bigHead to clear ejection of the moulded component from the tooling (F).
Please contact bigHead or your distributor if you would like further advice or engineering support with this topic.

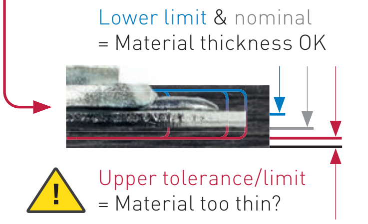
Detailed design & usage considerations – dimensions and tolerances

Design & tooling integration consideration:
Embedment with shut-off on fixing shoulder.

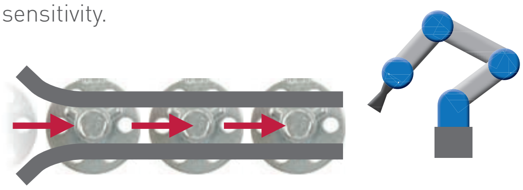
Design & tooling integration consideration:
Embedment height set by fixing length.



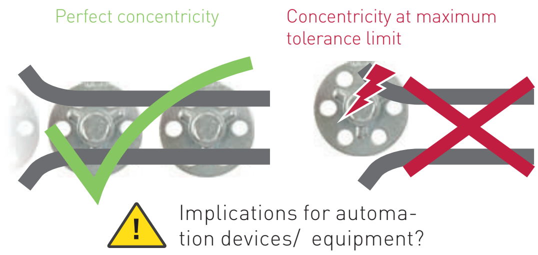
Check the criticality of material thicknesses around the bigHead: Material section thicknesses can be affected by the ± tolerance of different dimensions.



Automation integration consideration:
Head/ fixing concentricity sensitivity.

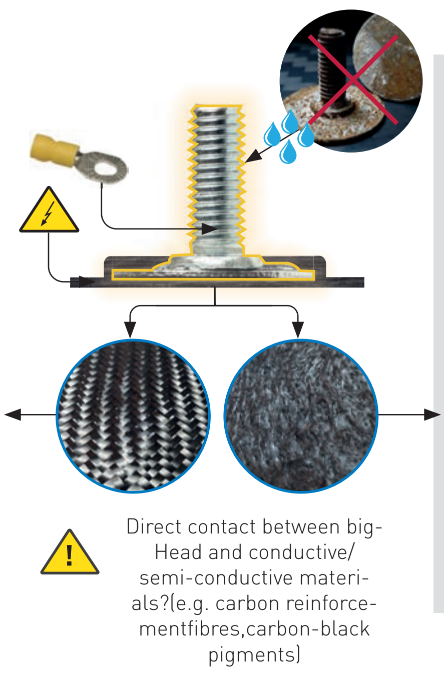


Check the sensitivity to bigHead manufacturing tolerances throughout the whole manufacturing process



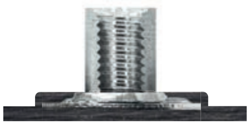
Materials compatibility

Electrical conductivity/ isolation implications?
Embedment into materials containing conductive or semi-conducting materials may have implications for electrical conductivity/ isolation and earth grounding of components and assemblies.
Depending on your application requirements, you may need/ want to consider a non-metallic, non-conductive coating or finish option for the bigHead.
Please contact us or your distributor to discuss specialist coating/ finish options.

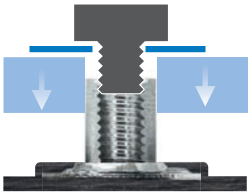


Anti corrosion / galvanic implications?
Embedment into materials containing carbon fibres or carbon-black pigments may have implications for corrosion resistance of the bigHead in certain environmental conditions.
Performance is dependant on exact materials combinations and environmental conditions, so we always recommend suitable environmental exposure testing of representative parts/ assemblies in order to determine application suitability.
Please contact us or your distributor to discuss specialist coatings and anti-corrosion treatment options.

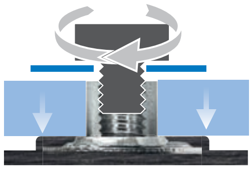
Typical assembly fastening techniques of embedded bigHeads



bigHead with collar fixing embedded into component.



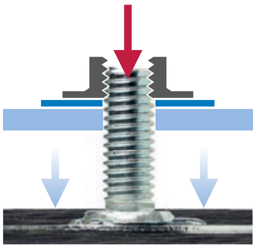
Adjoining component fitted over bigHead collar, retained by screw and washer.



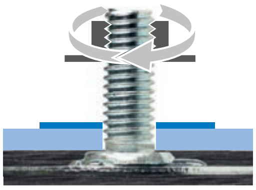
Screw tightened into bigHead collar to secure assembly.

Completed assembly

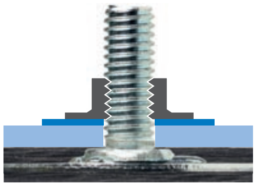
bigHead with stud fixing embedded into component.



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

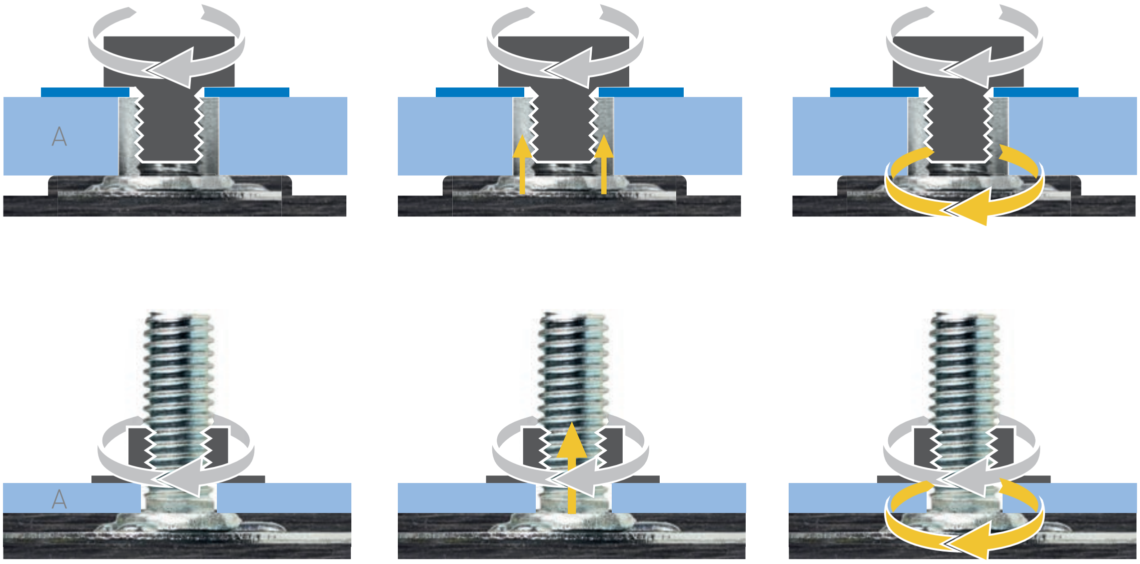


Nut tightened onto bigHead stud to secure assembly.



Completed assembly.

Assembly loads due to tightening forces

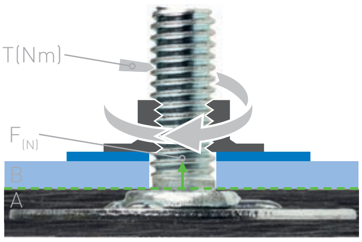


Assembly tightening operations to secure the adjoining component (A) onto the fixing of the embedded bigHead will create resultant forces in the bigHead.
Depending on the assembly design/ configuration, forces may also occur in the component/ embedment material...
...this is not the same loading condition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

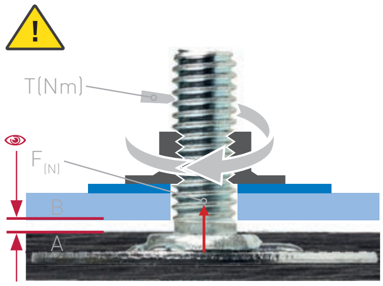
Resultant tensile forces
If the adjoining component lands onto the bigHead shoulder surface, the resultant forces will be borne by the bigHead fixing material, and not the surrounding material. However, this is dependent on managing assembly gaps and clearance hole sizes.
See our Assembly Guidance document 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 17 and individual product specific data is available on request.

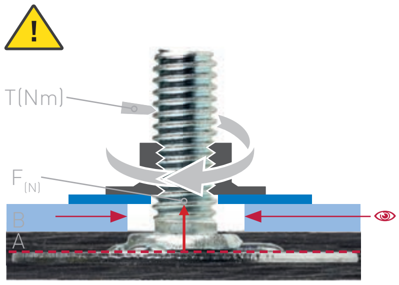
Assembly design awareness



Correct condition:
Adjoining component (B) meets shoulder and clearance hole is smaller than bigHead shoulder diameter



Incorrect condition:
Gap between component with bigHead (A) and adjoining component (B).

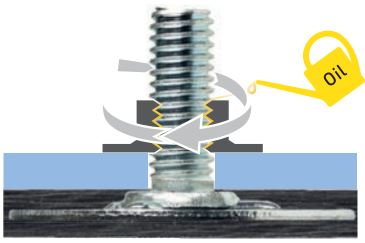


Incorrect condition:
Clearance hole for stud fixing in adjoining component (B) is greater than 80~90% of bigHead shoulder diameter.

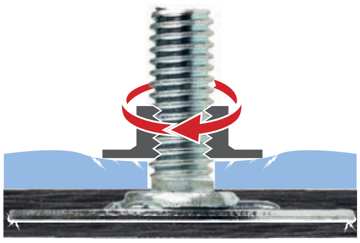
In the correct condition, tightening the nut with torque T (Nm) creates resultant force F (N), which clamps the adjoining part (B) against the fixing shoulder Incorrect conditions, especially with stud fixings, very often cause overloading and subsequent failure of the bigHead or failure of the component (A) material during assembly operations; If you are unable to avoid these incorrect conditions in your design, please contact bigHead or your distributor for further information and/ or advice about options for alleviating or managing these conditions.
Optimum or maximum tightening torque T (Nm) for an assembly design always depends on the exact combination of bigHead product, additional fasteners (e.g. nut, bolt, washer), component material and adjoining material, and should always be determined and validated by appropriate testing.

Please always contact Bossard or your distributorfor further information or advice about tightening torques and assembly testing.

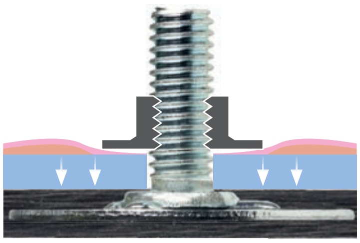
Factors that affect assembly operations



Thread friction coefficient and presence of lubricants on threads
Thread friction coefficients and presence of lubricants within the assembly will affect the transfer of radial forces (e.g. applied torque) into axial forces (e.g. resultant forces). Variations in the amount of force transfer may affect the suitability of assembly parameters, e.g. tightening torque value. Always clarify thread friction coefficient values and determine if any lubricants are present in the assembly.



Compression of the assembly materials during tightening
Tightening operations on bigHead assemblies may create high levels of compressive clamp force on the assembly materials, with subsequent damage to or failure of the materials. Applications testing is typically required to determine clamp-load behaviour, and appropriate tightening parameters/ profiles for a given material and assembly configuration.



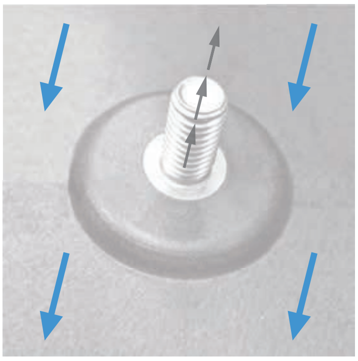
Creep relaxation within the assembly
Creep relaxation is a critical consideration if the assembly materials are susceptible to creep under compressive loading (e.g. thermoplastic polymers or polymer matrix composites). Especially if the adjoining component material is known to be susceptible to creep-relaxation, it is imperative to undertake appropriate testing to determine or qualify long-term assembly integrity expectations.

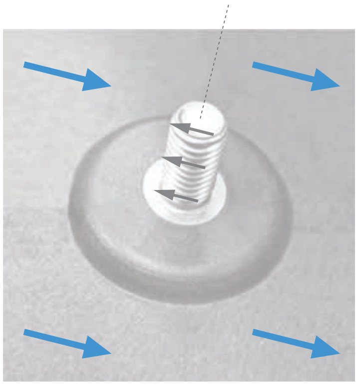
Application/ in-service loads

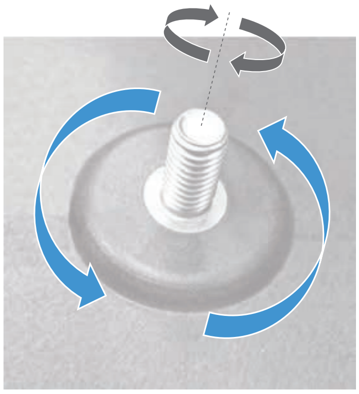
Tensile loads
Tensile loads typically occur on the bigHead and the surrounding material during service when there are opposing forces acting on the fastened components in perpendicular directions to the surface plane and in line with the fastener axis.

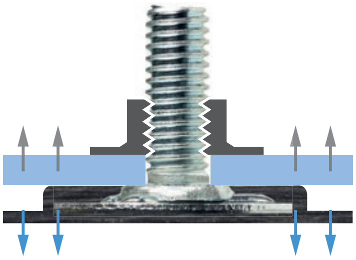
Shear loads
Shear loads typically occur on the bigHead and the surrounding material during service when there are opposing forces acting on the fastened components in directions parallel to the surface plane.

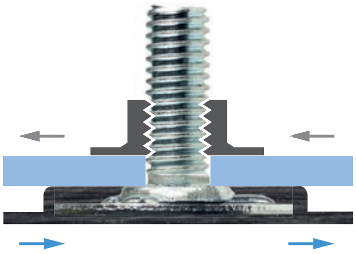
Torsional loads
Although a relatively uncommon service loading case, rotational forces on the bigHead and the surrounding material may occur if the fastened components rotate in opposite directions around the fastener axis.

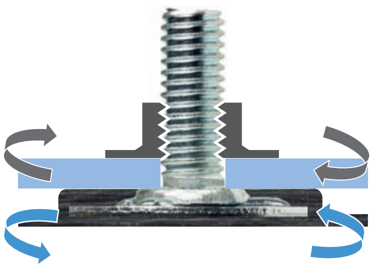


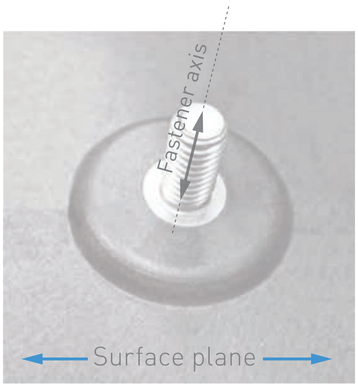












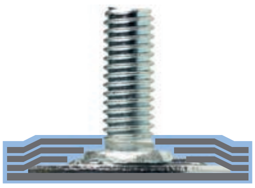
Here we explain how shear, tensile and torsion loads are generated in the bigHead and/ or the surrounding material, depending on which directions the forces act during application/ in-service usage.

Embedment data from bigHead

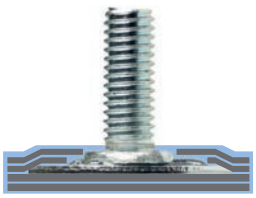
We have tested Core range bigHeads embedded in a 4.8 mm thick glass fibre reinforced (GFRP), vinyl-ester matrix composite material using 4 different configurations: deep, mid, shallow embedment, and over-patched. We tested tensile, shear and torsional loading conditions.

The reinforcement fibre and matrix polymer products we selected are commonly available, and representative of a typical glass fibre reinforced polymer composite. There are infinite combinations of reinforcement and matrix materials, but our results give an indication of how our products will perform when embedded at different depths into similar materials or laminate configurations.

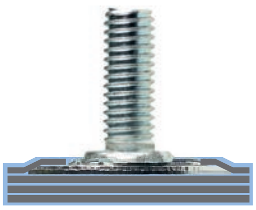
Not forgetting that exact materials/ laminates must be evaluated/ tested on a case-by-case basis, our data indicates the performance you may expect from:



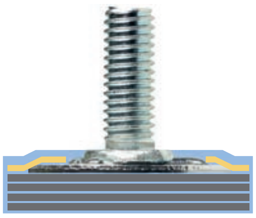
Deep embedded bigHead
bigHead embedded ~ 80 % into a material / laminate



Mid embedded bigHead
bigHead embedded ~ 50 % into a material / laminate



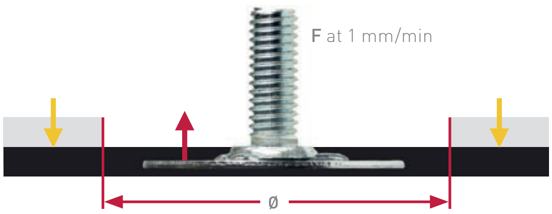
Shallow embeddment
bigHead embedded ~ 20 % into a material/ laminate

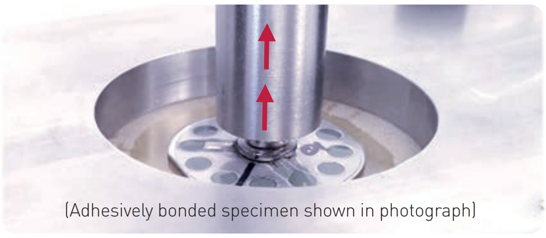


Over patched bigHead
bigHead embedded within a 1.2 mm thick over-patch

bigHead embedded test methods

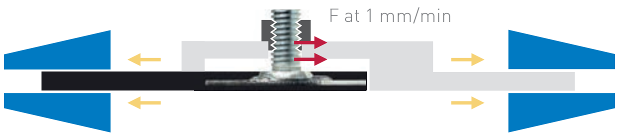
Tensile test:
bigHead is pulled through the aperture plate, with substrate plate retained beneath aperture, to impart tensile force (F). Aperture diameter is determined by fixing size.

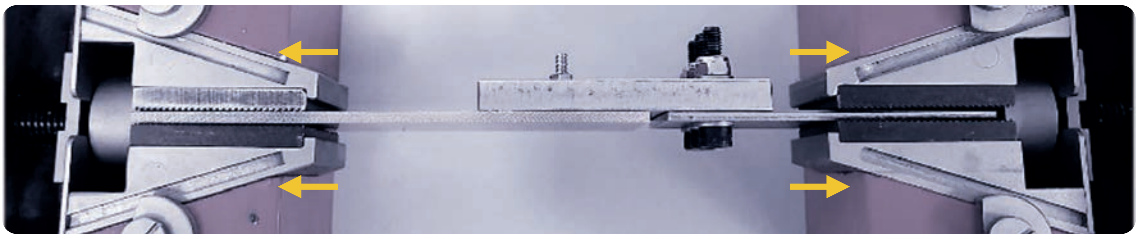



(Adhesively bonded specimen shown in photograph)

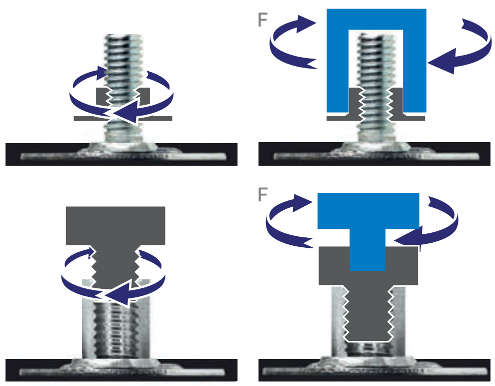
Fixing thread size (studs & collars)	Aperture Ø
M4	34 mm
M6	50 mm
M8	63 mm

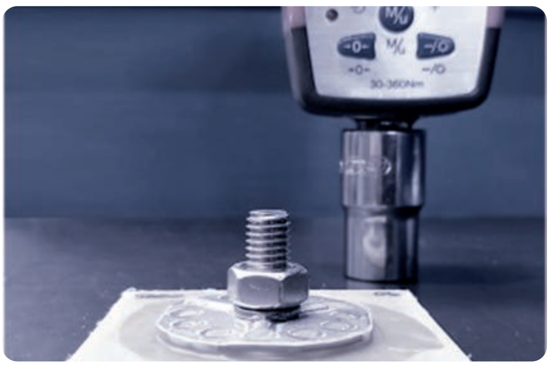
Shear test:
bigHead fixing is assembled and secured into fixture. Fixture and substrate plate are wedge gripped and pulled in opposite directions to impart shear force (F).





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 embedded 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.

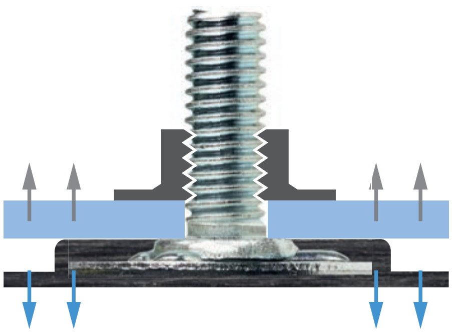
The applied torsion/ rotational forces reported in this table, and subsequent resistance of the embedded bigHead to rotation within the component material do not imply assembly tightening torque resistance, which must always be determined by suitable assembly testing

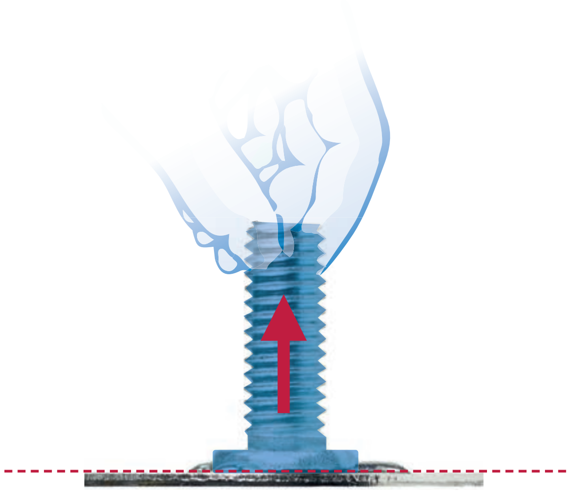
* Testing limitations for the shear test prevent determination of upper limits for bigHead products with B20 Head and M4 thread size combination

	Deep embedment			Mid embedment		
Product Head size:	B20	B30	B38A	B20	B30	B38A
Typical peak Tensile load (kN)	Typically in excess of max. recommended tensile load for bigHead product			Typically in excess of max. recommended tensile load for bigHead product		
Typical peak Shear load (kN)	3~* M4 fixing	9~14 M6 fixing	13~20 M8 fixing	3~* M4 fixing	8~15 M6 fixing	12~17 M8 fixing
Typical peak Torsion load (Nm)	5~6 M4 fixing	22~26 M6 fixing	50~70 M8 fixing	5~7 M4 fixing	21~27 M6 fixing	50~75 M8 fixing

	Shallow embedment			Over-patched		
Product Head size:	B20	B30	B38A	B20	B30	B38A
Typical peak Tensile load (kN)	<5	<6	<7	<3	<4	<5
Typical peak Shear load (kN)	3~6 M4 fixing	7~12 M6 fixing	12~15 M8 fixing	3~4 M4 fixing	6~8 M6 fixing	8~12 M8 fixing
Typical peak Torsion load (Nm)	5~7 M4 fixing	21~30 M6 fixing	50~75 M8 fixing	6~7 M4 fixing	21~27 M6 fixing	50~65 M8 fixing

Application loading limitations of bigHead products





For embedded 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 embedded Core range bigHeads (where WLL applies), please see the table →

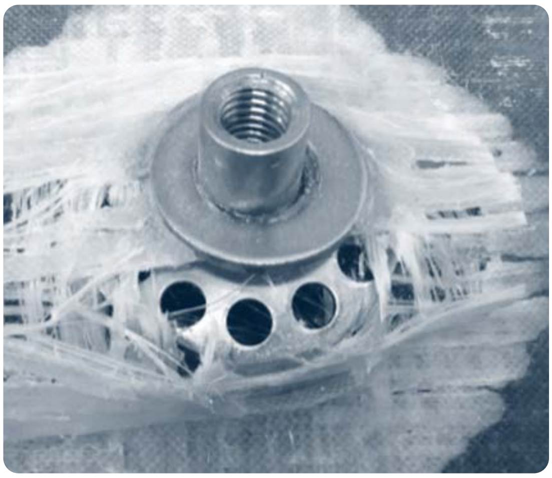
In shear or torsion loading conditions, the embedment material has much greater influence on overall loading limitations; limitations for application/ in-service loading of embedded bigHeads in shear or torsion must always be determined by appropriate testing.

Maximum recommended Weld Load Limits (WLL) (kN) for Core range bigHeads:
Applies to stud and collar products incarbon steel and 316 stainless.

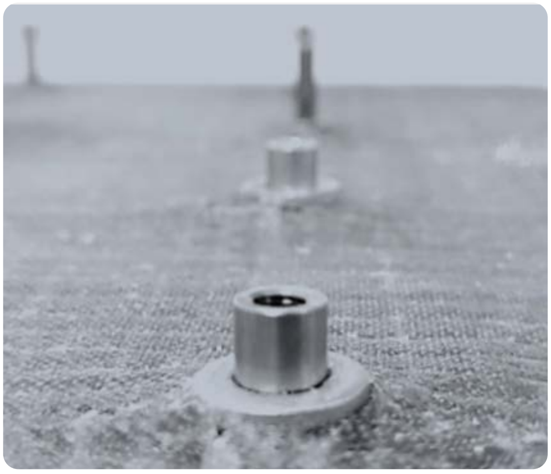
	Head type		
fixing thread size	B20	B30	B38A
M4	2 kN	3.5 kN	3.5 kN
M5	4 kN	5 kN	5.5 kN
M6	4 kN	5 kN	6 kN
M8	5 kN	6 kN	8 kN

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.

Further detail on mechanical test data we can provide on request



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/ embedment 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, as specimen sets or 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 embedded 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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