

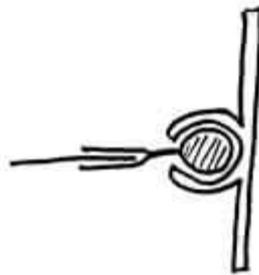
What is Keder and How is it Used?

Keder is a practical product with a straightforward function but to fully understand even the simplest application, there is a great deal of technical information to master.

To ensure that the overall structure will be properly configured to withstand the forces acting on it, and to be sure that the finished structure appears as designed and performs its intended functions effectively, it's important to be aware of the size and material calculations for the product itself, how it will be attached to the fabric it will support and how it will connect into a frame structure.

Going back to early European nomadic tribesmen (to whom we owe the derivation of the Germanic word “köder”, hence our now universally generic term), the concept of a rope or rod in a channel has been understood as a means of fastening two parts.

The rope or rod fits into the channel; fabric attached to the rope or rod protrudes out of a slot in the channel, but the slot is too narrow for the rope or rod to be pulled through.

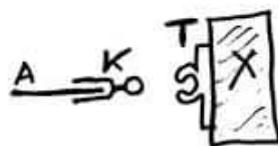


This is an ingenious invention that dates back so far that we could never identify its inventor. It is a method that has been used to hoist a sail on a mast for years, and can be accomplished using very simple tools, materials, and techniques – such as lashing a rope to a piece of fabric – as has been done for centuries.

With modern materials and structures, there are many configurations of the basic product and a growing number of applications for its use. In the world of fabric structures, it is used in tents, clearspan structures, temporary buildings, temporary roofs, agricultural environments, and scaffold covers. Keder is used to attach awnings to buildings, camping vehicles, and boats, as well as on sailboats to attach sails to spars.

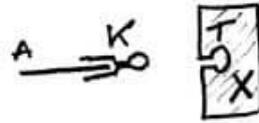
This method is increasingly used in the sign industry to mount fabric signs and banners into frame systems on walls, on the sides of trucks, and various types of free-standing displays. This system may commonly be called: bead, cord, piping, welt, or welting – depending on the application and industry.

Since there are so many variations of materials, configurations and applications, it's more logical to define it by its function. That is, the concept as an attachment mechanism is more identifiable by the role it plays in a structure i.e. what it does rather than by what it is.



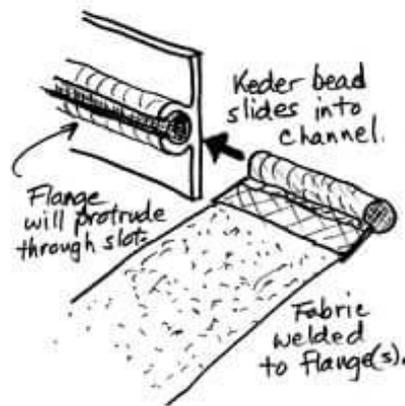
There is only one true defining function – connecting a sheet to a rail; a basic system of attachment. The intent is to connect a fabric sheet (A) to a solid rail (X). The system

must include two parts, the keder itself (K) and a track (T) to hold it. Sometimes the track is built into the solid rail and other times it's added on. Therefore, the application can be either a four-part connection: A and K joins T and X; or a three-part connection: A + K joins to TX.



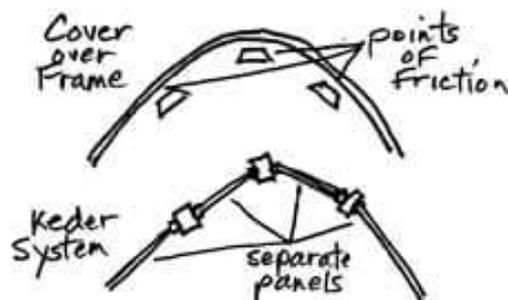
The track forms a basic attachment, usually by being slid into and pulled through the length of the track, resisting normal forces that would pull it out laterally through the slot.

The attachment of a keder-edged fabric to a track is installed with the intent, or at least the possibility, of it being removable by being slid back out the way it went in. Typically, the attachment of it to the sheet is normally intended to be permanent, as is the attachment of the track to the beam if, in fact, the track is not built indivisibly into the beam itself.



There are many advantages of this system. Fabric structure engineers will note that the connection produces no friction between the sheet and truss, unlike in a structure which employs a cover over a frame. The structures can be strong enough for long-term, semi-permanent installations.

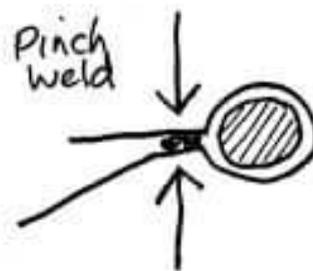
They are also simple and efficient enough for quick set-up and easy dismantling. While the functionality of the dynamic keder-to-track attachment is the primary concern of the structure designers, it is first necessary to break down and understand the requirements and performance variables of the two mechanical attachments necessary to fabricate the system – they are: a.) the attachment of it to the sheet and; b.) the attachment of the track to the solid structure. These are the concerns of the structure builders.



Understanding how a product is made helps with the explanation of how it can be attached to a sheet of fabric and how it will perform in a track. Making it can be simple, but for larger technical applications, the construction of a specified keder can be critical in delivering the performance expected by a designer.

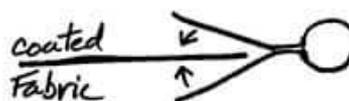
Both designers and builders should be aware of the standard parts of the trip, of possible differences in manufacturing methods and materials, and possible variations in the finished configuration, all of which can and do affect performance.

It's normally put together by tightly welding a narrow strip of coated-on-one-side, abrasion-resistant fabric around a core of dense-but-flexible cord to produce the "bead" that will eventually slide into a compatible track. Welders can be small and hand fed or can range up to large, automated production machines. They variously use high frequency, hot air, or hot wedge technologies. The weld produced is referred to as the "pinch weld". The width of the pinch weld is an important dimension in planning the installation. This area is sometimes called the "neck" of the keder.

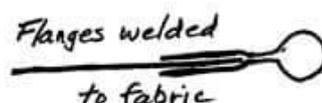


CONFIGURATION AND PERFORMANCE

The primary assumption on which a modern installation is based is that the edge is properly attached to a sheet of fabric. This is normally accomplished by joining the coated side of the flange or flanges to a compatible coating on the surface of the sheet of broad fabric using hot air or high-frequency welding techniques.



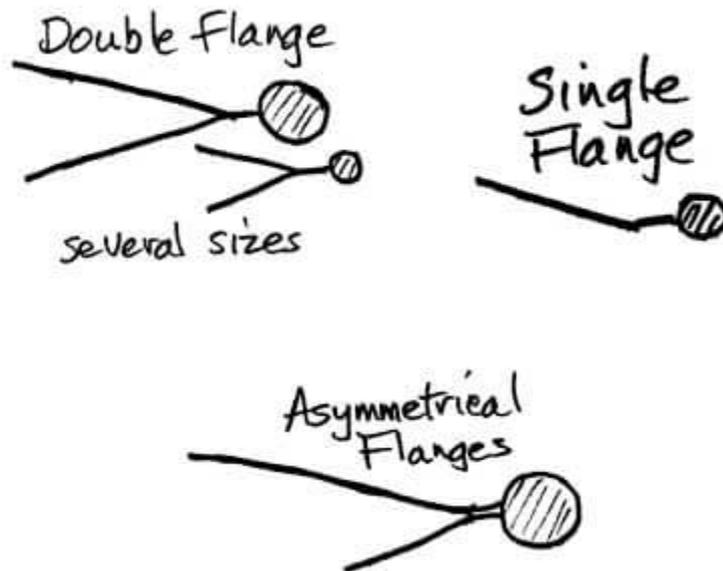
Most commonly vinyl (PVC) coating is used, however, they can often be used with other types of industrial fabrics with different materials and coatings such as polyethene or urethane. This allows manufacturers to prepare compatible fabrics with various coating materials in addition to PVC coated polyester.



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means manufacturers may prepare compatible fabrics with various coating materials in addition to PVC coated polyester.

Standard types are produced for various applications with simple single or double flange configurations ranging from 25 to 50 mm, roughly one to two inches. Double flanges are normally symmetrical and these widths are commonly appropriate for standard welding (hot air) nozzles or (high frequency) sealing bars. Other flange configurations can be custom made including extra width to provide additional surface area and asymmetrical variations which employ extra width on one side opposite a narrower flange, making for a cleaner installed appearance on the opposite side.



Stitching may be used to reinforce the flange-to-fabric weld. Some are simply stitched without welding and some are built with a solid fabric flange that can only be stitched. Other non-welding methods of attaching are occasionally used with lighter applications in the sign and awning industries including using standard solvent adhesives or double-sided tapes, usually with single flange configurations.

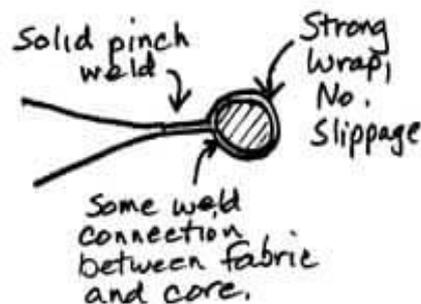
The size of the core material, plus the thickness of the fabric wrapped around it, determines the outside diameter of the bead. This dimension is often used as the primary identifier of different types although, as we have already seen, there are many other variables in configurations. The most commonly used bead sizes are 8.5mm, 11mm, and 13mm.

Although many other sizes are made for many different applications ranging from 4mm up to 15mm and even larger. Bead size selection is a question of matching core mass to the loads that will be encountered in each installation, primarily determined by the size of the track with which it will be used. In most applications, it is advisable for the bead diameter to be approximately 80% of the inside diameter of the track with which it will be used.

Selecting appropriate and dependable keder for a specific job can involve numerous material and construction quality considerations remembering that, in most cases, it is an important element in a structural system. The strengths and surface characteristics of the fabric are based on: a.) yarn density, stated in either "dtex" or denier (measures of fiber mass); and b.) fabric finish. Lighter may be made with standard fabrics not much different from the sheets to which they are being attached. But for heavy tents and tensile structures, fabrics are noticeably very dense weaves and their non-coated surfaces are heavily varnished to produce a smooth, slippery surface.

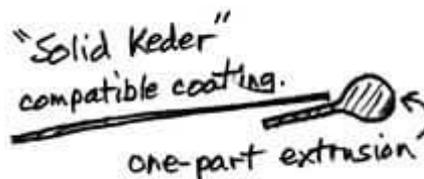
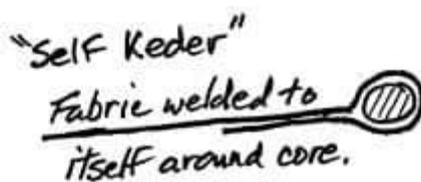
The vinyl coating of the cloth should be a heavy layer to produce a strong weld. PVC can be variously pigmented and modified using different additives. The two key variables in structural coatings are colour, e.g. black to eliminate translucency, and whether it complies with flame retardancy requirements for its structure.

The builder and the installers of the structures expect to be able to depend on a solid edge to a broad panel of heavy fabric. Thus, an additional quality consideration is the tightness of the pinch weld holding the core material inside the bead. The core should not move in the bead which means that, in addition to the cloth being tightly wrapped around the core, if the core is also PVC, the heat or radio wave agitation used during the weld should have spilled out causing the coated side of the fabric to weld to the core as well as to the opposite side of the pinch weld.



A well-installed, high-quality product will produce an easy slide during installation, even across long track runs and through the angles of gable beams. Its strength will not only be clear as it attaches large panels to structural beams but also by proving to be durable and rugged in repeated installation and dismantling operations.

Two variations of lightweight construction methods sometimes used in the sign and awning industries include: "self keder" – when the edges of the sheet of fabric are simply wrapped around a core or a rope without the need for heavier cloth; and "solid keders" – simple one-piece PVC weldable extrusions that can be attached to fabric to produce a bead that is not wrapped in fabric.



CONFIGURATION AND PERFORMANCE

Keder track is accomplished by shaping two distinct open-space areas into a relatively long, solid material.

The two open spaces are: a.) the channel, into which the bead slides; and (b.) the slot, through which the neck protrudes.

Most track spare some variation of extruded aluminium, available in dozens of profiles based on the type of structure for which it is intended.

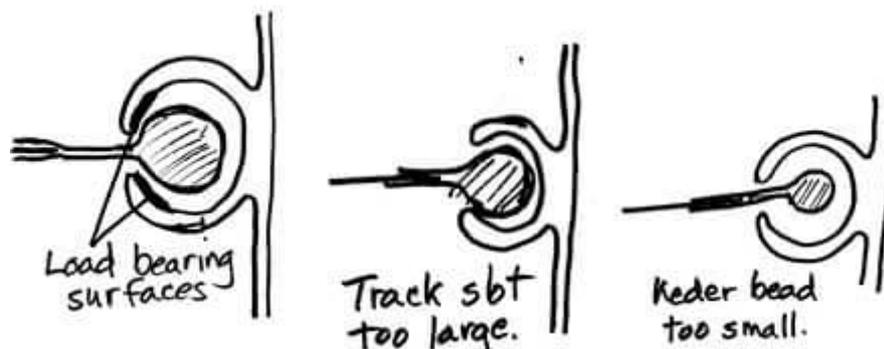
Some profiles, such as a tent beam, have as many as four tracks formed directly into their shape. Other extruded profiles are designed as separate pieces to be fixed to beams, trusses, or walls.

The track function in some large structures may be accomplished by building up the desired channel and slot spaces using bolted metal plates and bars, sometimes offering the opportunity to bolt directly through. This is to achieve an additional clamping attachment force. Finally, a track may be accomplished by machining space into a solid beam to produce a slot and channel set into the mass of the material.

The overall attachment system performance is determined by the relationship between it and the track. While there are many track, channel and slot profiles, the actual load bearing surfaces of the track are the inside walls of the channel on either side of the slot. In a tubular channel, ideally, the bead is approximately 80% of the channel's inside diameter. If the slot width is approximately 20-25% of the inside diameter, then the bead can bear on slightly more than 50% of the structural wall of the channel.

Ideally, the structure will be designed for the pull of the fabric sheet to be perpendicular to the opening of the slot, resulting in an equal pressure of the bead on the inside wall of the channel on both sides of the slot. Advance microanalysis of the fabric-keder-channel-structure relationship is worthwhile to be sure of attaining the best possible material-to-frame fit, especially for significant tensile designs where it is important to eliminate wrinkling and puckering.

If the slot is wider than 25% of the channel, or if the bead is much less than 80% of the slot, then the possibility of the bead pulling through the slot exists. This is classed as a system failure. So, it is important to consider the dimensions in conjunction with the channel and slot sizes. It is also important to be sure that the edges of the slot on which the neck will rub are smooth and free of any sharp metal spurs or edges.



Designers and builders working with tracks have many choices. It is always appropriate to match material and design considerations with known loads and functions. For example, it is common to use 13mm (heavier) attached to tent top fabric but only 11mm attached to side panel fabric in the same size tracks. Overall, the system must retain and support the fabric as intended, withstanding load and stress forces without failure.

When tracks are installed as sections, it is important to be certain that joints are clean and free of sharp edges to prevent beads from catching, snagging, or ripping as they are pulled through the full length of the assembly. This is primarily a question of careful mechanical installation when joining the track sections. But even when an installer is confident that sections bearing will fit without misalignment, it is not uncommon for a detail minded craftsman to use a rounded file to smooth the edges of the channel openings of any track sections that will have to be joined, further reducing the possibility of problems pulling bead through the joined pieces.



Note that some industries, the rental tent business in particular, have developed additional parts and pieces that are intended to be slid into the track. By using simple clamp-on plastic balls, it is possible to create an uncomplicated tent wall that will attach to a frame structure. Other attachments are available to hang various devices such as lighting or rain gutters using track channels.

Structural components such as tent doors are being built with the tracks shaped into the frames so that they can attach directly into the fabric of the tent. And a different extrusion has been designed to fit into the track to allow solid sidewall panels to drop into simple forms attached to the vertical tracks. Thus, the concept of sliding a bead into a channel has been expanded and will continue to be used to enhance many products in the future.

Well installed, the systems function both to create better products and to save labour. A temporary frame building can provide immediate extra working or storage space. A stadium or truck side sign can be changed to a new message in minutes. But even after having selected and attached the ideal type and size and track, the user must be aware of appropriate handling and maintenance procedures to ensure a good fabric-to-frame fit and to attain the longest possible working lifespan for the panels. Installers must always be careful when pulling panels into tracks. The pull must be steady and even on both sides of the panel. Feeders must be sure that the panel is even and free to run into the track. And both pullers and feeders need to be in instant communication with each other to be sure to be able to stop immediately if a snag is encountered.

Various other frame systems offer different methods of managing panel installations and change outs. Truck side sign systems use a variety of mechanisms ranging from flat strips with a number of parallel narrow channels into one of which a thin bead is pushed – and then clamped into place with a cover plate. Other types of tensioning systems may use a cam or spring mechanism attached to a movable track strip, all with the idea of pulling a sign into a tight, flat position.

Some structures are designed using attachments and intended for relatively long installations. But most businesses using temporary fabric structures and changeable fabric signage expect to regularly install, dismantle or remove, and re-install new configurations. Thus, regular handling, transportation, storage, and re-handling is unavoidable. Especially for larger structures that are frequently moved, installation operations require care and attention to keep the panels clean and damage free. Nonetheless, over time, welds can peel, the cloth may tear, and fabric adjacent to the flange may develop a crease weakness that eventually can rip or even “zipper off” causing a long break in the panel.

Edges can be repaired in several ways depending on the type of damage. Sometimes it is helpful to add a line of stitching to reinforce the weld near the ends of a run. If the fabric is completely ripped at the edge of a flange, the old keder can be removed and replaced with a new strip of “repair keder”, a type that has extra-wide flanges that can make up the difference in panel size for the dimension of the removed keder. Ideally, repair keder can be applied to the entire length of the run, thus avoiding the need to join

pieces of core in the bead. But there are products on the market intended to facilitate the joining of core material by inserting a short length of brass or aluminium into the mated ends. Because the joint is made stiffer using this method, it can cause problems for the runs that are required to be pulled up and over gable tracks.

It is certainly not a standard maintenance activity, but one of the aspects of keder-connected structures is that they are modular and thus panels can be interchanged and replaced. So, when and if a panel is faded, damaged, or has reached the end of its practical life, the owner of the structure does have the option of purchasing new panels. This may be an expensive maintenance option. But it is certainly cheaper than buying an entirely new building. And the new panels come with brand new keder!

There is a full plate of information in the marketplace from various makers, component suppliers, make-it-yourself equipment manufacturers, importers, resellers, and manufacturers who endorse specific products. There is a growing number of related accessory products and manufacturing variations pushing various marketers to make sometimes questionable claims – one says he is the only manufacturer with colour coded cores when a competitor has been doing it for years; another says their brand pulls through track more easily based on the quality of fibres in the cover cloth while a competitor says a different product slides more easily because of the fabric finish. One company will sell you a special insert to install in the leading end of the run, while another will tell you that such an add-on device is a waste of time. It is a lot to sort through.

No one should doubt the good intentions of the people involved with these various products but it is important to sort through all the market information to be sure that each feature is appropriate for each user's specific application. There is keder built, for example, with a reinforcing strand of wire inside its extruded core. But it is not clear how that feature improves the performance of the product once it is inside a track.

One reality is that coils are heavy. Thus, there is a decision to be made whether to buy in smaller coils which are easier and cheaper to ship...but which create the real possibility that a larger number of short ends will waste a significant amount of material. Full-sized, industrial coils are 300 meters long and can weigh well over 100 lbs. each. Coils like that are best handled on a turn-table type dispenser to prevent the need to handle and carry the heavy coils. So, there is more work involved dealing with full-sized coils but using that coil quantity ensures that waste will be kept to a minimum.

It is now made all over the world. It's clear that it can be shipped efficiently and competitively between continents in full container loads. It is also clear that smaller orders for custom sizes and configurations are probably best directed to closer manufacturers. But the distributors selling full coils of it based on importing container loads can usually be price competitive. It is usually more important to be aware of the welding capabilities, quality control, and experience of the manufacturer because, if they are in the business of producing it for export, they will probably be able to be price competitive around the world.

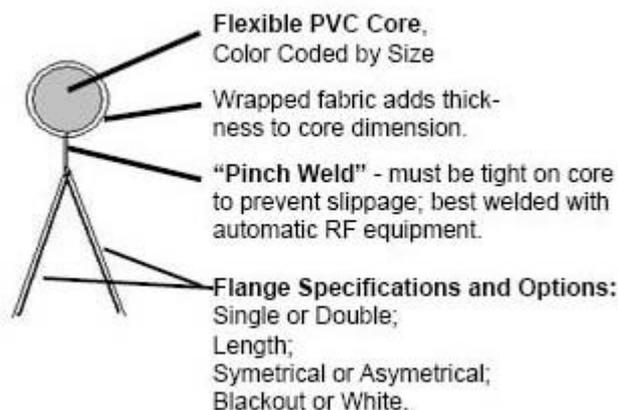
It's a big job sorting through all of the relevant technical information, selecting the appropriate system and materials to meet the design requirements of a large structure, and dealing with the business considerations involved with selecting a distributor and making a purchase. On the one hand, a small sign shop can print a banner, stick on a ten-foot length of using banner tape, and sell a sign "system" including a piece of aluminium track to local customer. That can lead to good repeat business for the shop and it is a relatively uncomplicated matter. On the other hand, a large design firm employing certified architects and registered engineers must go through a complicated selection process to settle on the physics of a new fabric structure and then hire a

qualified builder to construct it. They certainly specify just about every detail of their project, including the type of fabric to be used. But whom do they trust when it comes to specifying the proper keder? The fabric manufacturer? The builder? A competitive distributor? The closest manufacturer? Or an experienced manufacturer from the other side of the world? It would certainly be possible to receive five or more competitive quotes based on technical differences as well as price. And to whom might such a designer go to do comparative testing or product analysis on different products based on the projected loads and stresses of his proposed new project? All of this represents a challenge to the designer wishing to have maximum confidence in his material choices.

Nonetheless, given all the applications and the growing number of structures using these designs, these are questions that will earn more and more attention through the coming years. The products will continue to be important installations and structures as more industrial fabrics are employed for new applications in the future based on more emphasis on “green” technology, more mandates for shade structures, and the introduction of solar-sensitive industrial fabrics, just to name a few.

This is an important product and it’s important to understand a fair amount of technical product detail to be confident in specifying it, purchasing it, and using it. One suggestion might be to deal as much as possible with companies that not only make it but who use their own in building structures. That is one test of quality and confidence. Overall, it is important to remember those nomadic tent dwellers who realized that it was possible to attach a sheet to a beam by sliding a bead through a channel. It is that simple...but it is also now a fascinating new frontier.

- More than Standard Sizes and Configurations available from Stock.
- Colour Coded Cores for easy identification and repeat orders.
- Custom core sizes, flange configurations, and colours available as special orders.
- Colour-identified cores, produced in England by JJ Carter, and proven worldwide in all sizes of tensile structures.
- High Quality woven coated fabrics for high abrasion resistance.
- Standard coil size is 300 meters (330 yards) to give maximum yield over long runs.
- Sold worldwide in sufficient quantities to offer highly competitive prices.
- Made in England in accordance with Quality Standards ISO 9001



If you are a regular user of keder or have questions about new designs or applications, be sure to contact us on **+44 (0) 1264 721630** or **sales@jjcarter.com** for full information and a price quote.