CONVEYOR ACCESSORIES
BELT FASTENERS & TOOLS

PLATEGRIP RIV-NAIL

Technical Bulletin

Bulletin # 1003

Mechanical Fasteners

The following information has been provided by: NIBA-The Belting Association

Mechanical fasteners offer an economical, reliable and long lasting belt splice method. They are the most common belt splicing method in use today, for both light and heavy duty conveyor belt applications. Mechanical belt fasteners are easily installed with only a modest amount of mechanical skills and tools. The purpose of this section of the NIBA ENGINEERING HANDBOOK is intended to acquaint the reader with some of the mechanical fasteners available today. The information contained herein is intentionally general in nature. It is recommended that the fastener manufacturers be consulted for specific product and application information and recommendations.

The majority of belts being manufactured today are made of synthetic materials which lend themselves to mechanical attachment and most modern conveyor belts are designed for use with mechanical fasteners. This coupled with constantly improving designs and materials in mechanical belt fasteners provide belt operators with a reliable, long-lasting and quite inexpensive way to splice belts. The combination of belts designed for mechanical fastener splices and improved fastener designs has extended the use of mechanical fastener splices to service at higher tensions, and this trend will continue with further fastener and belt developments.

Mechanical fastener splices today offer a permanence once considered not available with them. This is due to the combination of fasteners designed and made with improved materials and modern belts that are designed for fastener splices. It also is due to other features designed for fastener splices such as countersinking which permits maintaining the belt profiles. All belt fastener processes, fastener installation, countersinking, etc. are designed for short notice rather than waiting for outside contractors. This translates into significant cost savings as downtime is minimized and production may continue without substantial interruption.

In summary, some of the benefits of using mechanical fasteners are:

Cost — Typically, mechanical fasteners offer the lowest cost approach to belt splicing. This is due to lower splice material cost for the mechanical fastener splice components and the fact that the work can be done in-house.

Speed of Installation — Typical splices can be installed in minutes, reducing downtime.

Ease of Installation — Splicing requires relatively simple and inexpensive tooling which is readily available and can usually be kept on site. While some mechanical skill is needed, it is relatively simple to splice with mechanical fasteners.

Safe to Use — There is little or no exposure to chemicals, sharp instruments or heat when installing mechanical fasteners.

Ease of Inspection — Splices are visible and give signs of impending failure.

Little Extra Belt Length Required — The only belting cut off and discarded is that generated in squaring the belt ends when making mechanical fastener belt splices. The extra length of belt required for mechanical fastener splices is measured in inches.

No Shelf Life Limitation — Mechanical fastener splice materials do not deteriorate while in storage.

Mechanical fasteners are in use today in many applications involving conveyor belts. Some specific applications where belt fasteners are used include coal mining, hardrock mining, including quarrying and sand and gravel facilities, package handling and distribution centers, as well as agricultural harvesting and food processing.

Types of Mechanical Fasteners

Mechanical conveyor belt fasteners are manufactured in two styles, solid plate and hinged. Each has its particular advantages and the selection of fasteners should begin with this basic understanding. Solid plate fasteners span opposing belt ends that have been butted together, forming a tight, sift-free splice. Hinged belt fasteners are applied as individual segments to each belt end and then brought together and connected by means of a connecting hinge pin.

Solid plate fasteners are generally employed where a sift-free splice is required, such as bulk conveying applications. The two belt ends, having been brought firmly together, prevent fines from sifting through the splice area. Generally, solid plate fasteners are considered as a permanent attachment and are seldom used where the belt or the conveyor must be frequently taken apart. For the most part, solid plate fasteners require larger minimum pulley diameters than hinged fasteners.

Hinged fasteners, as implied above, can be operated on systems employing smaller pulley diameters. This inherent design feature allows for a broader range of applications than is available with corresponding solid plate fastener styles. Hinged fastener splices can be separated for belt removal or maintenance by removing the hinge pins. Some hinged fasteners have a sift preventing component and thus can be used on belts conveying fines, but they are more frequently applied in other applications.

As the "working" part of a hinged fastener splice, the hinge pin should be selected as carefully as the fastener itself. Quite often it makes sense to select a pin of the same material as the fastener. For example, a stainless steel pin would be chosen for a stainless steel fastener. Solid (single) wire pins are the easiest to insert and are most often used on non-troughing applications. Stranded cable wire pins are recommended for troughing conveyors given their greater flexibility.

Both solid wire pins and stranded cable pins are offered either with or without an external polymer covering. This polymer "jacket" serves as a lubricant when positioned between the loops of the hinged fasteners. As such, this pin style is less likely to wear or corrode. However, they are not the preferred choice where fine abrasive materials are being conveyed, wherein a solid wire or unjacketed cable pin is a better selection.

Other hinge pin choices include nonmetallic pins for smooth running at lower belt operating tensions as well as notched or corrugated pins which reduce the likelihood of pin migration.

Hinge pin selection is as important as proper hinged fastener selection. Properly selected and installed, they contribute to maximum splice life and performance. As with selecting hinged fasteners, the fastener manufacturers should be consulted for hinge pin recommendations.

The market for conveyor belt fasteners generally breaks down into two major segments, light duty and heavy duty. NIBA designates light duty belts as those having a tension rating of 160 PIW or less, and heavy duty belts as those with tension ratings over 160 PIW. Light duty conveyor belt fasteners include wire hooks, common bar lacing, stapled plate fasteners, plastic hinged plate fasteners and plastic spiral loop fasteners. Heavy duty conveyor belt fasteners include bolted and riveted plate fasteners and stapled, bolted and riveted hinge fasteners. Heavy duty fasteners are available for operating tensions up to 1500 PIW. While it is suggested that the individual manufacturer’s fastener catalogs be consulted for application information, a representative sampling of fastener types is illustrated in the following pages for reference.

Notable Features:

Bolted Hinge

Heavy duty bolt hinge fastener for bulk haulage applications. Commonly used in low to medium tension industrial belts requiring a hinged splice. The fastener plates are compressed into the belt by special bolts and nuts. Only simple hand tools needed for installation.

Riveted Hinge Plate

Heavy duty riveted hinge fastener for medium to high tension bulk haulage applications. Available in several types of rivets and fasteners. Special rivets are driven through the belts, without pre-punching holes, to compress the fastener plates into the belt.

Heavy Stapled Plate

Heavy duty stapled hinged fastener for medium to high tension bulk haulage applications. High strength staples are driven through the belts without pre-punching holes, to compress the fastener plates into the belt. Provides a very flexible splice.

Bolted Solid Plate

Solid plate butt joint compression belt splice. Like the bolt hinge, special bolts and nuts are used to compress the plates into the belt surfaces. These fasteners are generally used for the heavier bulk haulage applications where a sift-free, more permanent belt installation is needed. Only simple hand tools needed for installation.

Riveted Solid Plate

Solid plate butt joint compression belt splice for medium to high tension bulk haulage applications. Special rivets are driven through the belts without pre-punching holes. These fasteners are generally used for applications where a sift-free, more permanent belt installation is needed.

Mechanical Fastener Selection

Mechanical fasteners for belting are to be selected in much the same process as belting. To properly select a mechanical belt fastener both the physical and environmental factors must be considered, but not to be forgotten are the experience factors. Many belting manufacturers provide a recommended belt fastener style based on working tension, pulley size and construction of the belting. Mechanical belt fastener manufacturers provide tables which are to be used as a guideline based on belt thickness and pulley diameters.

While the user/installer should refer to the belting and fastener selection guides, the decision process must then include product based on type of service desired (Hinged - Solid Plate), type of material (Carbon Steel - Stainless Steel - Plastic - Other), installation techniques (Hand or Power Tools, or Specialized Machines).

The technical manual has provided a description of the various types of mechanical fasteners, the notable features and a chart entitled Fastener Selection which summarizes the range of specifications they may fit. In addition, a Fastener Materials chart is shown that illustrates the "normal use" of each material.

Description of Metals

Mild Carbon Steel

General service where corrosion, sparking or magnetic attraction is not a consideration, sometimes plated to prevent rusting.

High Carbon Steel

Same as above, except for improved tensile strength and abrasion resistance.

Hardened Alloy Steel

Highly abrasion resistant, providing several times service life of regular steel in highly abrasive situations. Not recommended for corrosive environments.

Stainless Steel

400 Series
Provides some corrosion and chemical resistance when compared with carbon steel; is magnetic and can be used with magnetic tramp removal devices.

300 Series

Non-rusting and provides extra resistance to corrosion from acids and chemicals; excellent where sanitation requirements are high; basically non-magnetic.

Others

Ask your fastener manufacturer for other special materials, metallic and non-metallic, for operating environments.

Mechanical Fastener Installation Recommendations

Whenever a mechanical fastener is installed, the steps required (which could include pulling slack, squaring, cutting, skiving, lacing, installing hinge pin, etc.) can be made easy and safe by the use of proper tools and procedures. It is recommended that you contact a NIBA member with the specifics of your application. They can make an appropriate recommendation regarding the products and techniques available to meet your need.

Squaring Belt Ends

Having carefully selected the best fastener style suited to the application, properly installing these fasteners will greatly improve the splice service life. The first step towards ensuring that the fasteners and belt will work effectively in tandem with each other, and the supporting framework, is to install the fasteners square to the belt centerline. With any mechanical splice, the most common installation error is not applying the splice straight.

Although there are many suggested methods of accomplishing this, placing a carpenter's square along an average centerline of the belt (taken at several points along its length) is the simplest. Using the belt edge as a squaring guide is not generally recommended. Preparation of the belt ends is important and operators should be sure they have the right tools for doing the job properly. These include cutters, pull-up clamps and any special equipment for recessing fasteners in the belt cover. This procedure is generally helpful to extend fastener life and avoid operating problems. Splice life may also be prolonged through a good program of preventive maintenance, including periodic inspection and, where necessary, replacement of worn splice sections or entire splices.(Refer to Tech Note #14 Establishing Centerlines and Squaring Belt Ends for Splicing noted on last two pages of bulletin.)

Counterskiving / Skiving

While mechanical conveyor belt fasteners can be readily applied directly to the belt covers, there are some instances where it is advantageous to lower the fasteners into the belt. Countersinking the fasteners lowers the overall profile of the splice and is most frequently done on the carrying side of the belt. Depending on the belt construction, fasteners may also be countersunk into the bottom covers.

When fasteners have been countersunk, less material is left exposed to contact with the contents being conveyed, scrapers, plows, idlers and other related conveyor hardware. Wear through abrasion is greatly minimized thereby extending splice service life. Under running conditions there is also less abusive impact wear to both the splice and the belt.

Countersinking is equally suited to light or heavy-duty belts, although generally there are subtly different reasons for choosing to install belt fasteners in this fashion. In the greater number of instances, light-duty belts are more apt to be suspended on slider beds. In these cases, countersinking will reduce abrasive wear of both the fastener and the slider bed.

"Hidden" splices are a form of countersunk fastener. After the belt ends have been prepared and the fasteners installed, replacement cover stock is laid over the fasteners and cured. This replacement cover stock may be from such materials as two component systems or uncured rubber stock. The replacement top cover that hides the splice also serves to protect the fasteners from impact and abrasive wear.

Preparing a belt for countersinking is readily accomplished using only some additional portable tooling. The options range from small hand held tools to larger, more mechanical, devices. All are designed for field use by company personnel. The fastener manufacturers offer these tools, and should be consulted for information relating to them.

Belt Notching

In hinge fastener splices, it is often important to notch or chamfer the corners of the belt ends in the splice, usually at an approximate 60º angle. This will help prevent hang-up of the belt corners on conveyor structure should such contact arise. In one-directional belts, it is only necessary to notch the trailing belt end.

Mechanical Fastener Troubleshooting Guide

Problem Solution Code

Fastener "comb-out" through end of belt without opening
6,2,3,4,5

Fasteners open up and release from belt
2,1,3,7

Belt breaks behind fastener
2,4,6

Splice failing at edges
3,1,5

Fastener parts fracture and fail
5,3,2,4,7

Belt fails under splice
6,3,1

Fastener wears out prematurely
7,8

Solution Codes

1=Improper fastener installation, including splice not in squarely.

2=Improper fastener selection, particularly in the choice of too large a fastener.

3=Tension excessive and/or counterweight excessive.

4=Pulley problems, worn lagging, dual pulley speed differential, too small pulleys, material buildup on pulleys.

5=Splice "hang-up" on worn idlers or other parts of the conveyor.

6=Conveyor drive under belted.

7=Improper metal selection.

8=Failure to recess splice

Most Common Types of Failure Associated With Mechanical Fasteners

Tensile failure of belt. (Warp yarns fracture with fasteners intact.)

Tensile failure of fasteners. (Fasteners open or break with belt intact.)

"Comb through" tensile failure of belt. (Fill yarns comb out of end of belt with warp yarns and fasteners left intact.)

Fatigue/wear failure of belt. (Used belt fractures warps and ruptures behind fasteners. Differentiated from tensile failure of belt by fact that failure occurs only after extended running time.)

Fatigue/wear failure of fasteners. (Fasteners break or open up after extended running time.)

Wrong size fastener selected. User tries to standardize one size for all belts.

"Bigger is better" mentality. User has failure, so he goes to next size bigger fastener for more strength.

CONVEYOR ACCESSORIES
BELT FASTENERS & TOOLS

PLATEGRIP RIV-NAIL

Fastener Selection Chart

	Bolted Hinge	Riveted Hinge Plate	Heavy Stapled Hinge Plate	Bolted Solid Plate	Riveted Solid Plate
Recommended Minimum Pulley Diameter for Smallest Size	6” or 150mm	9” or 225mm	6” or 150mm	12” or 300mm	18” or 450mm
Belt Thickness Range (after countersinking, if used)	¼” – 7/8” or 6.4mm - 22.2mm	7/32” –11/16” or 5.6mm – 17.5mm	3/16” – 7/8” or 4.8mm – 22.2mm	3/16” – 1-3/16” or 4.8mm – 30.2mm	7/32” – 15/16” or 5.6mm – 23.8mm
Materials Offered	Steel Stainless Bronze Alloy steel wear plates	Steel Stainless	Steel Stainless	Steel Stainless Bronze Nickel Alloy Alloy steel wear plates	Steel Stainless Alloy steel wear plates
Maximum Belt Rating	Contact Fastener Mfg.	Contact Fastener Mfg.	Contact Fastener Mfg.	Contact Fastener Mfg.	Contact Fastener Mfg.

PLATEGRIP RIV-NAIL

BELT FASTENERS & TOOLS

TECH NOTE #14

Establishing Centerlines and Squaring Belt Ends For Splicing

Crooked flat belt splices cause a number of operational problems that probably could be avoided if accurate centerlines or square lines had been established when the splices were made. All flat belt splicing requires careful establishment of reference or cut lines that ensure that the belt alignment will be straight through the splices. In vulcanized splices, this applies to a number of lines on both belt ends, all of which are referenced to a centerline or transverse line that is truly accurate. In mechanical fastener splices, this applies to the transverse cut line on the two ends to be joined. There are some mechanical fastener splices that are made at an angle, and these also require establishment of an accurate transverse line.

There are several methods for establishing accurate reference and cut lines in belt splices. NIBA recommends the method illustrated on the next page. This involves measuring across the belt width on both belt ends at five points spaced one to two feet apart, starting from the belt ends, and marking the center at each point. Then, a centerline is marked through the five points, using a long straightedge or a chalk line.

In most cases, the center marks will not be perfectly aligned, so the centerline mark will have to be that line that lies closest to the most center marks. Having marked the two centerlines, mark a transverse line at the desired location on each belt end by laying one leg of a carpenters square along the centerline, and a straightedge along the transverse leg of the carpenters square, and apply a mark across the belt. This will be the cut line for mechanical fastener splices, and the reference line for laying out the cut and other reference lines for vulcanized splices.

The other methods of establishing cut and reference lines are the centerline arc method, squaring off the existing belt edges method, and the triangulation method. All of these methods are either more complex than the NIBA recommended method, or they depend on straight, undamaged belt edges, a condition that probably exists in new belting, but rarely does in used belting. The NIBA method minimizes the effect of damaged or worn belt edges.

www.conveyoraccessories.com Phone (800) 323-7093 Fax (630) 655-4209

PLATEGRIP RIV-NAIL