Subject:  Unit Strap Lifting Method (USLM) for Two-point Lifts
Reference: Supersedes Previous USLM Information

WARNING

IMPORTANT!
DO NOT DESTROY

This bulletin is designed to educate personnel on the safe use of the Unit Strap Lifting Method (USLM). All operating personnel must read and understand this bulletin prior to utilizing the USLM system.

Copies of this bulletin must be made available to all employees who work with or around USLM applications, and are available through your local Signode sales representative.

Failure to follow any of the recommendations in this bulletin could result in serious injury or death.
The information in this bulletin provides general guidelines for using the USLM system. Any modification of the methods and recommendations described within this bulletin must adhere to a 4:1 safety factor. See Calculating Strapping Requirements on page 11.

Failure to follow any of the recommendations in this bulletin could result in serious injury or death.

For additional assistance or information on specific commodities, consult your Signode Sales Representative. Contact information can be found at Signode’s website; www.signode.com

The following are important safety aspects of the Signode USLM System that will be described in detail throughout this bulletin:

- Two-point lift is mandatory
- Bridle angle must not exceed 40 degrees
- Three Microgrip® Seals, each with 2 crimps, must be applied to secure each strap
- Edge protection must be used when load corners are sharp
- Lifting capacity must not be exceeded
- The lifting gear chain lengths must be equal
- Identification markings on the strap must face outward
- Proper lifting hooks must be used
1. The USLM System

The Signode USLM (Unit Strap Lifting Method) system permits the lifting and handling of unitized loads with specialized USLM strapping. The method is used to lift and position break-bulk cargo into and out of the holds of ships, reducing loading and unloading time. USLM strapping encircles the load to become an integral part of the lifting system. This eliminates the need to position and subsequently remove slings or other lifting hardware, thereby reducing time and labor requirements. The USLM system has been used successfully on a variety of bulk cargo including bales of wood pulp, plywood, lumber, logs, and metal products such as aluminum ingots, copper cathodes, and zinc slabs. The original requirements for the USLM method were specified by the Port of Rotterdam and are recognized internationally.

2. Safety Considerations

The Signode USLM system can present a serious safety hazard if improper lifting techniques are used. Compliance to all safety aspects of the application is critical to protect workers. Since workers are required to be in close proximity to the load in order to attach lifting gear and signal the crane operators, improperly applied straps, seals, or lifting hardware could result in serious personal injury or death.

The Signode USLM system utilizes Signode tensioners, sealers, strapping, and seals in conjunction with user supplied lifting gear. All components work together to ensure that loads can be lifted safely. Non-Signode strapping components may not meet Signode’s standards and, therefore, could result in a serious safety hazard due to strap breakage or seal joint separation during lifting.

Signode USLM lifting recommendations maintain a 4:1 safety factor to meet or exceed all known requirements of port authorities. Shipping companies must thoroughly train all employees who work with the Unit Strap Lifting Method in proper lifting techniques as described in this bulletin. Signode representatives can provide assistance if you have any questions or concerns regarding the safety considerations in this bulletin.
The following general procedures must be followed whenever utilizing the USLM system to ship or receive cargo.

✓ Only use new Signode USLM strapping. Never reuse USLM strapping after removal from loads. While used strapping might look good, it may be damaged and could break if reused. Never splice two lengths of strapping together.

✓ Never lift cargo with damaged straps. Cargo can shift in transit, and strap damage may have occurred between the time of loading and discharge. Inspect all strapping components prior to lifting.

✓ Never stand near a load while lifting. A damaged strap could break at the beginning of a lift, causing the broken end to rebound outward at a velocity that could cause serious personal injury or death.

✓ Never stand or walk beneath a suspended load.

✓ Only use Signode USLM seals with a properly crimped joint. Never lift if seal joints show any signs of damage, have been crimped improperly, or if the required quantity of seals and crimps have not been applied to each joint.

✓ Never lift with non-USLM strapping or by the load’s packaging straps. Lift only by properly marked and applied USLM straps. See Figure 1.

✓ Never lift with improper lifting hooks, damaged hooks, or with hooks that show signs of abrasion or scoring.

✓ Lifting hooks must be equipped with a swivel attachment.

Figure 1.
3. Strapping

There are significant differences between Signode USLM grade Magnus® strap and standard Signode Magnus strap:

✓ USLM strap has a lower elongation and higher break strength compared to standard Magnus strapping.

✓ Quoted break strength and joint strength values of USLM Magnus strapping are minimums, not averages.

✓ All USLM Magnus strapping is marked according to thickness.

✓ USLM Magnus strapping is wound on continuous coils with no production welds.

Specifications

Signode USLM Magnus strap is manufactured in a single 1-1/4" width, and three thicknesses. See Table 1. All USLM strapping is marked with groups of 2 circles, 3 circles, or 3 circles plus the letter “M” to designate strap thickness and lifting capacity. The letter “S” in each circle designates Signode as the manufacturer. These markings were originally specified by the Port of Rotterdam and are recognized internationally. Straps must be applied with the markings facing outward.

<table>
<thead>
<tr>
<th>SIGNODE STRAP SIZE</th>
<th>FT/LB</th>
<th>PART NO.</th>
<th>MARKINGS</th>
<th>MINIMUM STRAP STRENGTH</th>
<th>MINIMUM JOINT STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>INCHES (mm)</td>
<td>(m/kg)</td>
<td></td>
<td></td>
<td>POUNDS (N)</td>
<td>POUNDS (N)</td>
</tr>
<tr>
<td>1 ¼ x .044 P&amp;W</td>
<td>5.3</td>
<td>OX3247</td>
<td></td>
<td>8,500</td>
<td>8,200</td>
</tr>
<tr>
<td>(31.8 X 1.12)</td>
<td>(3.56)</td>
<td></td>
<td>⃝��</td>
<td>(37,800)</td>
<td>(36,470)</td>
</tr>
<tr>
<td>1 ¼ x .050 P&amp;W</td>
<td>4.7</td>
<td>OX3241</td>
<td></td>
<td>9,700</td>
<td>9,200</td>
</tr>
<tr>
<td>(31.8 x 1.27)</td>
<td>(3.16)</td>
<td></td>
<td>⃝����</td>
<td>(43,150)</td>
<td>(40,920)</td>
</tr>
<tr>
<td>1 ¼ x .057 P&amp;W</td>
<td>4.1</td>
<td>OX7844</td>
<td></td>
<td>11,000</td>
<td>10,500</td>
</tr>
<tr>
<td>(31.8 x 1.45)</td>
<td>(2.76)</td>
<td></td>
<td>⃝���� M</td>
<td>(48,930)</td>
<td>(46,700)</td>
</tr>
</tbody>
</table>

Table 1.
4. USLM Microgrip® Seals

Using the proper type and quantity of seals is critical for the safe application of the USLM system. Signode USLM Microgrip seals are coated inside with a high friction grit material to provide maximum joint strength. Special lithography identifies these seals as Signode USLM seals.

The 117 HDG-OF (Part No. 000585), is a snap-on type seal that can be applied to the overlapping straps after tensioning.

The 117 HDG-TO (Part No. 0X4308), is a thread-on type seal that must be applied to the overlapping straps before tensioning.
5. Unitizing Methods

There are two types of unitizing methods used with USLM systems; the conventional method and the basket handle method.

The conventional method utilizes USLM encircling strap(s) to contain multiple units for lifting. See Figure 3. Loads of lumber and plywood are examples of products that typically utilize the conventional lifting method.

![Figure 3. Conventional method](image)

![Figure 4. Basket handle method](image)

The basket handle method uses an additional length of strap as part of the USLM unitizing strap. See Figure 4. This extra length of strapping forms a handle to which the two lifting hooks attach. The basket handle method is generally used for smaller or denser loads, where it can be difficult to insert lifting hooks under tightly applied USLM strapping.

To apply a basket handle strap, the main encircling portion of the USLM strap is tensioned, and then sealed off with a single seal. The tail of the continuing strap loop is attached to the encircling portion of the strap on the opposite side of the load with three seals. This forms the basket handle to which the lifting hooks attach. When using the basket handle method, the orientation of the seals must be correct - the tail portion of the applied strap that forms the basket handle must utilize the three seal pattern to safely form the lifting strap. See Figure 4.
6. Two-point Lifting Technique

Proper lifting techniques are required to maintain a safe work environment. This requires the use of two lifting hooks for each lifting strap (Figure 5). A properly configured two-point lifting setup, using a spreader bar, will prevent tipping or shifting of loads that might occur if a single lift point were used. A properly configured two-point lift with spreader bar also provides for the required bridle angle, to prevent excessive tension on the lifting strap(s).

Never use a single lifting point (Figure 6) to raise units. When a single lifting point is used, high bridle angles result, causing excessive tension in the lifting strap. A single-point lift is also unstable and can cause a load to shift during lifting (Figure 7).

Correct: Two-point Lift

Incorrect: Single-point Lift

Figure 5.

Figure 6. Do not use a single lift point which can result in a large bridle angle and high strap tensions.

Figure 7. Do not use a single lift point, as the load can shift.
7. Effect of Bridle Angles on Lifting Gear

The tension in lifting gear elements is dependent on the bridle angle (lifting angle). Whether the lifting gear uses chains, wire rope, web belts, or strapping, the tension in the lifting gear will vary with the bridle angle. Examples of how the tension changes with the bridle angle are shown below.

Figure 8.
The effect the bridle angle (lifting angle) has on the strap tension during lifting is graphically illustrated in Figure 9. As the lifting angle increases, the strap tension increases, and the load carrying capacity of a given strap size is reduced. To limit the loss in load carrying ability, the bridle angle must always be limited to 40 degrees or less.

Figure 9.
8. Calculating Strapping Requirements

The lifting capacity of a Signode USLM strap is dependent upon the break strength of the strapping and the bridle angle at the lift points of the load. In determining the lifting capacity of a given strap size, a maximum outside bridle angle of 40° is used to calculate safe lifting capacity. Lifting capacity is based on the minimum seal joint strength, not the minimum strap strength, and is reduced by a factor of 4:1 to provide for the appropriate safety margin. See Figures 10 & 11 to determine the required strap size when taking into consideration the effects of load weight, joint strength and bridle angle on strap tension. Lifting capacities for Signode USLM strapping are specified on page 6.

**Bridle lifting angle limit**

\[ T = \frac{F}{\cos \theta} \]

\[ T = \frac{(W/2)}{\cos \theta} = \frac{W}{2 \cos \theta} \]

\[ T_{\text{max}} = \frac{J.S._{\text{min}}}{S.F.} = \frac{W_{\text{max}}}{2 \cos \theta} \]

\[ W_{\text{max}} = 2J.S._{\text{min}} \cos \theta / S.F. \]

\[ N = \text{Load Weight} / W_{\text{max}} \text{ rounded up to the next whole number} \]

<table>
<thead>
<tr>
<th>Angle (°)</th>
<th>COS Value</th>
</tr>
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<tbody>
<tr>
<td>10</td>
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<tr>
<td>15</td>
<td>0.966</td>
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<tr>
<td>25</td>
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<td>0.819</td>
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<tr>
<td>40</td>
<td>0.766</td>
</tr>
</tbody>
</table>

**Figure 10.**

**Figure 11.**
9. Lifting Gear

Spreader bars

To ensure the recommended two-point lifting technique and to maintain proper bridle angles, spreader bars are used to position and suspend the lifting hooks. A spreader bar fixes the position of the lifting hooks laterally in relation to the load being lifted.

Spreader bars must be assembled, fitted, and tested to achieve a bridle angle that is within a range of 10° to 40°, as measured between the lifting hook and the vertical plane of the load. See Figure 12. The presence of at least a small lifting angle is required to help keep multiple bundles or packages from spreading or shifting during lifting and handling. To prevent excessive tension on the strap, bridle angles must not exceed 40°. By limiting the maximum angle to 40°, lifting capacity per strap is not reduced significantly.

The bridle angle exhibited during lifting will depend on the applied strap tension, the compressibility of the load, and the length of the spreader bar relative to the load width.

Figure 12.
Lifting frames

To maximize loading and unloading productivity, lifting frames may be used in conjunction with the Signode USLM system. See Figure 13 & Figure 14. By suspending several spreader bars from a lifting frame, multiple unit loads can be handled with a single lift. Special hooks are also available that provide for the automatic crane release of the strap after the load has been set into position. This helps to minimize labor during load positioning, and allows a more efficient use of the lifting crane.
Hooks

Special lifting hooks are used by stevedores to transport packages on and off of ships to utilize the USLM lifting method. These types of lifting hooks are specially designed products manufactured by hook manufacturers with many years of experience in the shipping industry. Lifting hooks must be equipped with a swivel attachment, either on the hook itself or on the supporting chain, in order to prevent twisting and potential damage to the strapping.

Never use a conventional hook to lift packages. Conventional hooks may cause the strap to break, resulting in the load free-falling to the ground.

Lifting hooks and additional lifting equipment are typically provided by the ship owner or the stevedoring company. If the lifting hooks remain at the dock after the ship has left port, it is necessary to have another set of proper lifting hooks at the destination port for the safe off-loading of cargo.

If you have any questions concerning the above, contact your hook supplier.
10. Configuration of Lifting Straps

The chain lengths of the lifting apparatus at each lift point must be exactly equal. The strap lengths of the USLM strapping must also be exactly equal. This will avoid overloading any individual lifting strap. Some examples of common USLM applications showing typical strapping configurations are shown below.

Pulp Bales

Plywood and Lumber

Ingots

Pulp Logs
11. Special Applications

The information in this bulletin provides general guidelines for using the USLM technique on two-point lifts. Special lifting applications may exist that are different, and will modify the methods and recommendations described within this bulletin. These applications may require special techniques to allow for the safe lifting of those particular products. The one constant that must be adhered to for any USLM application is the utilization of a 4:1 safety factor.

Certain special applications may alter the recommended strap finishes and/or seals specified in this bulletin. Consult your Signode representative prior to implementing any changes to the methods contained in the bulletin.

Whenever lifting loads are calculated, the strap size, joint strength, and strap count chosen for a given package must use the 4:1 safety factor as the overriding constraint.

12. Tensioners

FN-114T (Part No. 008810)
The FN has a built-in cutter. Because the straps are separated during tensioning, it can be used on painted or painted and waxed strap finishes. This tool pulls up to 3,000 lbs. (13,350N) tension. The cutter cannot be used on .057" strapping.

HN-1-114 (Part No. 027050)
The HN slides one strap over the other during tensioning and works only with painted and waxed finishes. This tool pulls up to 4,000 lbs. (17,000 N) of tension and can be used on all USLM strap sizes. It does not have a cutter.

When applying USLM strapping to a load, strap tension requirements will differ depending on the product. For example, compressible products such as wood pulp bales must be strapped at higher tension levels to pull the units together and avoid excessive slack in the strap during lifting. Rigid products, such as lumber, plywood, or ingots, may be strapped at lower tension. This allows some slack to remain in the strap and makes it easier to slide the lifting hooks between the load and the strap. If the load corners are sharp, edge protection must also be applied under the strapping. To maintain proper adjustment as recommended in the tool instruction manual, tensioners must be cleaned and lubricated frequently.
13. Sealers

a. The N-1444-50-LSH (Part No. 024271) is used on 1-¼" x .044" (31.8 mm x 1.12 mm) strapping.

b. The N-1457-LSH-2A (Part No. 423810) is used on 1-¼" x .050" (31.8 mm x 1.27 mm) and 1-¼" x .057" (31.8 mm x 1.45 mm) strapping.

14. Strap Dispensers

DA-34-114 (Part No. 020400)
Heavy-duty dispenser. Feeds strapping easily with little pulling effort.

DH-1-114 (Part No. 047537)
Inexpensive dispenser for intermittent use. Not recommended for .057" (1.45 mm) strap.

DM-1 (Part No. 020750)
Mobile dispenser with air filter, pressure regulator, lubricator, and tray top for tools and seals. Holds spare coil of strap.

DC-1A (Part No. 005720)
Heavy duty dispenser with built-in strap cutter for precutting straps. Holds two coils of strap.
15. Testing joint strength

High joint strength is critical to the safety of all USLM applications. Each joint must be formed with three seals abutting each other, and two pairs of crimps applied to each seal. Failure to follow this procedure could result in strap separation and load failure. Before making a USLM crimp seal joint, read the sealing tool’s Operation, Parts and Safety Manual. A properly formed USLM crimp joint will appear as shown in the illustration below. If the USLM double crimp joint does not appear exactly as shown in the illustration, review the tool’s instructions to be certain that it is being used properly before applying additional straps. Remove straps with improperly applied joints prior to applying new straps and seals.

Signode recommends joint tests be accomplished for each USLM sealer at intervals of 3,000 cycles. Local regulations may require more frequent testing and would take precedence over Signode recommendations. Test results will help detect sealer wear or broken parts, which may result in unacceptable joint strength.

![Joint Illustration](image-url)
Joints may be tested locally, either in plant or through a commercial testing laboratory. If facilities are not available, Signode can perform these tests at the locations listed below. There may be a charge for this service. Shippers should only use Signode testing services to audit their testing results, not for routine testing.

Location of Signode Testing Facilities

UNITED STATES
Signode Corporation
3650 West Lake Avenue
Glenview, IL 60026
U.S.A.
Attn: Manager, Quality Assurance
Consumable Products Operations
Steel Division

UNITED KINGDOM
Signode Ltd.
Queensway, Fforestfach
Swansea, SA5 4ED, United Kingdom
Attn: Quality Control Manager

GERMANY
Signode System GmbH
Magnusstrasse 18
46535 Dinslaken, Germany
Attn: Quality Control Manager

AUSTRALIA
Signode
Lot 61 Mitchell Avenue
Weston NSW 2326 Australia
Attn: Quality Control Manager

Customers requesting joint testing must provide three joint samples per sealing tool with an 18" (450 mm) long piece of strap on either side of the three seals, plus one strap 18" (450 mm) long with the following information:

a. Customer name and address.
b. Name and address of person to whom the report is to be sent.
c. Date joint samples were made.
d. Serial number of each sealing tool used to make joint samples.
e. Date code of Signode strap.
f. Date code of Signode seals.

IT IS IMPORTANT TO CLEARLY IDENTIFY THE JOINT SAMPLE WITH THE SEALING TOOL.