

# **ICHCA International Limited**



INTERNATIONAL SAFETY PANEL  
SAFETY BRIEFING PAMPHLET SERIES #32

## **Safe Use of Cargo Strapping for Lifting Purposes**

by

Paul Auston  
and  
Peter Hull

ICHCA INTERNATIONAL PREMIUM MEMBERS:



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For more information on ICHCA International and its services please visit/contact –

*ICHCA International Limited  
Suite 2, 85 Western Road,  
Romford, Essex, RM1 3LS  
United Kingdom*

*Tel: +44 (0) 1708 735295  
Fax: +44 (0) 1708 735225  
Email: [info@ichca.com](mailto:info@ichca.com).  
Website: [www.ichca.com](http://www.ichca.com).*

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John Alexander, UK  
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Paul Auston, *Checkmate UK Limited*, UK  
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## ABOUT THE AUTHOR

### **Paul Auston**

Paul's early career was at sea and when he came ashore he took a position with a rope manufacturing company based in Northern Ireland. This led to a lifelong fascination with the use of synthetic fibres and their development into lifting materials. He set up the company Checkmate of which he is now Chairman. Paul has written or contributed to a number of Panel publications.

### **Captain Peter D. Hull**

Peter was born in 1942 and is a class 1 Master Mariner. He served his apprenticeship with P&O-Orient Lines and then later employed in various seagoing ranks to Master in Gearbulk vessels. Subsequently he worked ashore for Gearbulk Ltd as Operations Manager both in U.K. and overseas, and also for Wallenius Wilhelmsen Lines. Since 2000 he has been freelance Marine Consultant specialising in Ocean Transport and Logistic Solutions (with special reference to Operations and Productivity in the carriage of Forest Products).

### **Checkmate Avon**

Checkmate Avon consists of two specialist manufacturing divisions in the United Kingdom. Textile lifting products are produced at Sheerness in Kent and Avon Fabrications based at Melksham in Wiltshire specialise in the design, development and production of specialist rubber fabrications, predominantly for the marine industry and are used on high speed craft throughout the world. The company holds ISO 9002 certification, in addition to Type Approvals, on its products from a number of Classification Societies.

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## SAFE USE OF CARGO STRAPPING FOR LIFTING PURPOSES

### 1 Introduction

- 1.1 The trend towards unitisation and unit lifting methods has been driven by the need for better and simpler handling systems, improved productivity, damage free transportation, and cost reduction generally.
- 1.2 To help reduce the amount and cost of packaging materials used.
- 1.3 To use packaging materials that can be easily recyclable
- 1.4 To compete with other handling systems such as containers, pallets and lifting slings, many products are strapped together to form units such as aluminium ingots, bales of woodpulp, plywood, waste paper, steel tubes, billets, etc. These units may then be handled individually by conventional methods, or banded together into larger, multiple units using wires or bands designed for lifting.
- 1.5 Woodpulp and ingots are commonly handled in this way to make multi-unit lifts of regular dimensions suitable for direct stowing in ocean vessels.
- 1.6 This pamphlet is concerned with how such systems are designed and applied and can safely be used.

### 2 Cargo strapping (general)

- 2.1 Many cargo units are often strapped or banded simply to keep the contents secure and well packaged. For example bales of wool or cotton, steel coils, plywood or pallets and packages of many types. However this type of banding does **not** imply that the units may be lifted by the strapping.

Figs 1 and 2: typical packages of plywood and steel coils strapped with flat steel bands to maintain the integrity of the pack – **not** for lifting



- 2.1.1 Nevertheless, it is important that all cargo units are securely strapped before stowing in a vessel, whether they are lifted by slings, strops, or banded together with strapping (see examples above)
- 2.2 However, many such items of cargo may be strapped together to form larger units more suited to systematic handling, such as woodpulp or aluminium ingots where a number of items are strapped together to form a unit. In these instances the cargo may be lifted by the additional strapping – if suitable conditions are met.



Fig 3: Strapped Unitized Aluminium ingots (showing lifting bands)

- 2.3 Where strapping is used for lifting purposes certain rules apply with regard to the methodology, the safe working load, the testing requirements, and the certification regime. This pamphlet is intended to explain how this may safely be achieved. Only strapping designed to be used for lifting purposes should be used in this way.
- 2.4 It should be noted that the actual unitising of cargo, once the method is approved, is not done under inspection, but that the responsibility for the observance of the required standards, the making of tests and adherence to good quality control, rests with the person offering for shipment such unitised goods.
- 2.5 Approval of banding material and unitising methods may be obtained by application to the appropriate maritime authority for the country. Approval will be granted on the basis of satisfactory tests.

### **3 Types of cargo strapping**

- 3.1 Essentially there are two methods of strapping cargo for lifting -

- Flat strapping unitising system

- Round wire unitising system

### 3.2 Flat strapping unitising system

- 3.2.1 Flat strapping consists of a flat steel band passed round the cargo, tightened and crimped with a metal seal. Flat strapping materials may be carbon steel or non-metallic. However for lifting purposes steel is normally used. This method is sometimes called the '**unit strap lifting method**' (**USLM**). The system with a loop or basket handle is now obsolete.

#### Magnus® steel strapping



Fig 4

For **USLM** applications such as unitizing pulp bales for ocean shipments, heavy-duty 31.8mm x 1.12mm - 1.45mm (1-1/4" x .044" - .057") Magnus® steel strapping may be used,



Fig 5 - **APEX** is a cold-rolled, low carbon steel banding manufactured to meet the requirements of tensional strapping.

- 3.2.2 Such systems consist of hand tools or otherwise an automatic machine capable of applying and sealing the banding. The banding material, seals, and the lifting arrangement are all part of the 'system'.
- 3.2.3 Each manufacturer of flat strapping must obtain approval for his particular strapping and seals, lifting gear, method of unitizing by strapping, and in conjunction with any hand tools
- 3.2.4 Hand tools, or alternatively, pneumatic powered hand tools are typically used to reduce operator fatigue, improve strapping efficiency and provide uniform tensioning necessary lifting gear. The method of lifting must be approved- see 3.2.12.



Figs 6 and 7

3.2.5 The use of a power strapping machine is the most efficient method for strap application. It ensures uniform strap placement and load integrity for high production applications. Available in semi- and fully-automatic models. Power strapping systems can be integrated into new or existing production lines. Combined with stretch wrapping equipment and corner protection, these systems can provide a complete packaging solution, protecting the products from the hazards of handling, shipping, storage, and stacking.



Fig 8: Automatic banding machine: **Model 9500 Unityer®**

- Meets international standards for safety in ship loading and unloading
  - Achieves high levels of production

### **3.2.6 Mill certificate**

3.2.6.1 A mill certificate is to be supplied with the strapping.

3.2.6.2 The coils are to be numbered and referenced by that number on the mill certificate.

3.2.6.3 The mill certificate should show at least the following:

- Identifying number of each unit, or an identifying quality stamp mark,
- Width and thickness of the strapping,
- If coated, the type of coating,
- Ultimate tensile strength.

3.2.6.4 It is the responsibility of the person applying the strapping to check that each coil is referenced on the mill certificate and is adequate for the intended use.

### **3.2.7 Seals**

3.2.7.1 The type, number fitted, and number of crimps per seal, are to be as directed by the supplier of the strapping.

3.2.7.2 The ductility of the strapping must be sufficient to accept the seal crimp, without cracking.

3.2.7.3 Sample joints must be tested periodically

### **3.2.8 Basic seal joint types**

3.2.8.1 Snap-on seals are placed over the overlapping strap ends either during or after tensioning. This eliminates pre-threading and speeds the strapping operation.

3.2.8.2 Thread-on seals must be threaded over the overlapping strap ends before the tensioning tool is applied. Generally used on bales, bundles and the larger strap sizes.

Fig 9



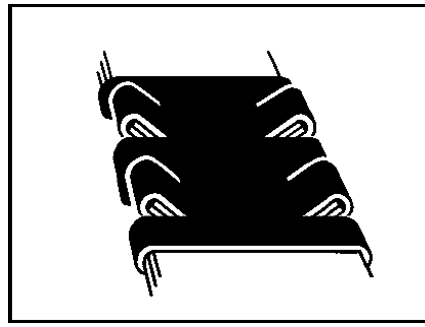


Fig 10

3.2.8.3 Notch joints mechanically lock strapping ends together. The sealer cuts through the seal and strapping to form one or two sets of tabs. The tabs are pushed down (down notch joint – see fig 9) or up (reverse notch joint – see fig 10). Notch joints are typically used on waxed strapping in packaging and unitizing applications.

3.2.8.3.1 A double notch seal joint can be created when using either standard or high tensile steel strapping.



Fig 11: double notch seal joint

3.2.8.4 Signature seals show the identity of the shipper and display the name or trademark on every package. They can be used for coding products according to size, type, units, etc.



Fig 12: signature seal

### 3.2.9 Equipment compatibility and test requirements

3.2.9.1 The strap tensioning gear, seals, and crimper, as well as the strap itself, if from the same supplier, can be accepted as being compatible.

3.2.9.2 Where seals or strapping or equipment are not from the same supplier, the person applying the system should obtain written assurance from the different suppliers that the intended combination is a compatible one.

3.2.9.2.1 Independent testing by a competent person, to establish compatibility, may be used to resolve impasses.

3.2.9.3 The strength of the joints is to be established by testing.

3.2.9.4 The frequency of testing will be prescribed by the appropriate national authority (for example one test per 300 units, or one test per 1000 tonnes of cargo might be typical)

### **3.2.10 Test record and test certificate**

3.2.10.1 A record of tests is to be retained at the establishment where the cargo was unitised and must be signed by the person doing or supervising the testing.

3.2.10.1.1 The test record and the units covered by the sample testing are to be identifiable one to the other by an identifying number.

3.2.10.1.2 A test certificate similar to that shown in the Appendix shall be prepared by the person responsible for the unitising of the cargo and a copy of the certificate shall accompany the units.

### **3.2.11 Strapping strength**

3.2.11.1 All units banded for single lift purposes must be so banded as to provide a minimum safety factor on the strapping. All units banded for multiple lift purposes, by which it is permitted to lift the unit on four separate occasions, must be so banded as to provide a minimum safety factor on the strapping of 4:1.

3.2.11.2 Other than in special cases, all units are to be banded to provide for a bridle angle of 40 degrees. The minimum strength of the banding shall therefore be:

Safety Factor X Half Weight of Unit X Secant of Bridle Angle

The bridle angle referred to is that angle contained between the vertical and the maximum allowable angular departure of the strapping from the vertical under the lift conditions, that is to say it is the angle at one of the top corners of the unit, contained between the vertical and the lifting strap.

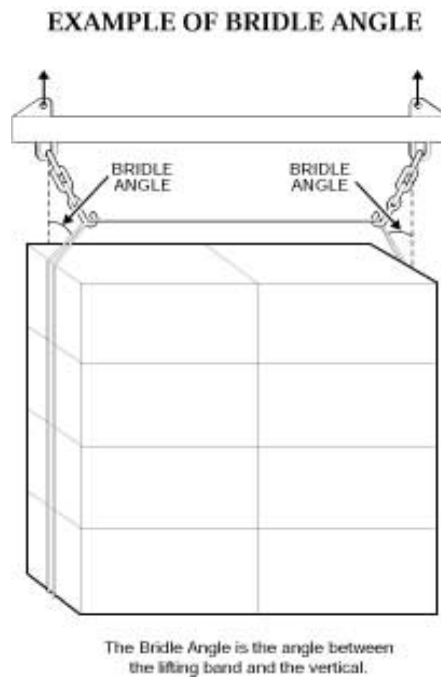


Fig 13



Fig 14: units of aluminium being lifted by flat bands

### 3.2.12 Use for Lifting

3.2.12.1 Banding should be in virtually new condition at time of first use.

3.2.12.2 Units awaiting shipment should be reasonably protected.

3.2.12.3 In each case, the method of lifting must be approved and only approved lifting gear should be used on the strapping. Refer to fig 22 for guidance.

3.2.12.4 The lifting hooks and the lifting band should fall reasonably within the same vertical plane (see fig 22)

### 3.2.13 Safety Hazards

- 3.2.13.1 All working strapping is under tension when in use. Sudden release of this tension will produce a hazard when the loose ends snap free after being intentionally or accidentally cut, frayed, or otherwise released. Cutting a tensioned strap is hazardous.
- 3.2.13.2 When cutting a tensioned strap, always stand to one side 'such that the severed ends of the strap will not reach the operator when they burst apart'
- 3.2.13.3 Warning signs should be clearly placed in work areas where the cutting of strapping is to take place.
- 3.2.13.4 Never stand directly over or in front of a strap being tensioned
- 3.2.13.5 Do not extend the length of the handle on manual tensioners, nor exceed the recommended pneumatic pressure on pneumatic tensioners
- 3.2.13.6 Strapping should not be reused since previous tensioning may alter the mechanical properties of the strapping.

### 3.3 Round Wire Unitizing system

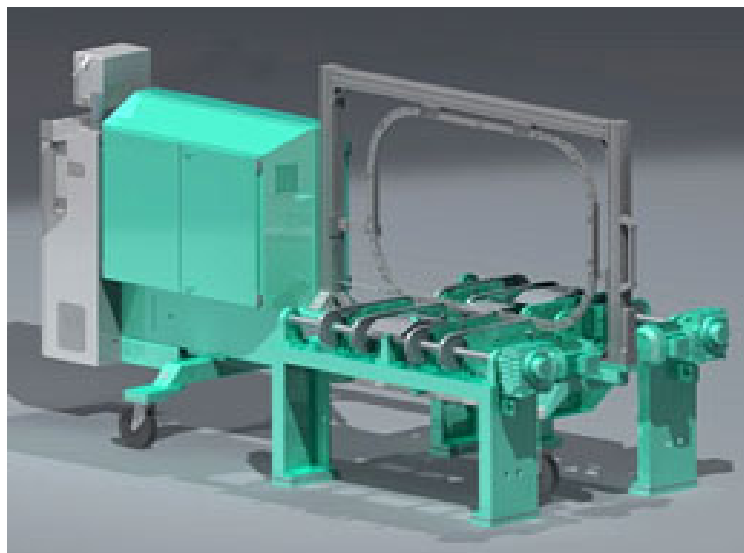
- 3.3.1 The system consists of the wire-applying machine, wire used, and lifting arrangement.
- 3.3.2 The round wire unitising system comprises a number of turns of wire passed round the unit of cargo and knotted by an approved method/machine
- 3.3.3 Each manufacturer of round wire banding must obtain approval for his particular wire, method of knotting the wire, lifting gear, method of unitising by wire banding, and in conjunction with any necessary lifting gear, the method of lifting must be approved.



Fig 15: woodpulp unitised for lifting with a round wire lifting system

- 3.3.4 A common cargo unitised by the round wire lifting system is woodpulp. Typically pulp is produced in sheets of uniform dimensions, and they are pressed to form approx 250-kg bales. Eight bales make up one 2,000-kg package to make storage and transportation easier.
- 3.3.5 Cranston Machinery is one such manufacturer and is a supplier of wood pulp bale handling and finishing equipment. The pulp bale finishing products include the conveyors, scales, bale presses, wrapper dispensers, strappers (wire and paper), gluing systems, folders, printers, stackers, unitisers, palletisers, elevators and PLC/PC controls. Cranston also offers overhead attachment gear for warehouse lifting of unitised pulp.

Fig 16: a baling process



Model E9700 Wire Tying Machine

Fig 17: Automatic wire threading and clearing

### **3.3.4 Mill Certificate**

3.3.4.1 A mill certificate is to accompany all wire used in unitising.

3.3.4.1 Each coil of wire is to be identifiable to the mill certificate.

3.3.4.2 The mill certificate should show at least the following:

- Identifying number of each coil,
- Diameter of wire,
- Straight line breaking strength.
- Knotted breaking load, or alternatively the elongation in a 10" test piece.

3.3.4.5 The elongation in such a test piece is not to be less than 7%.

3.3.4.6 It is the responsibility of the person applying the wire to check that each coil is referenced on the mill certificate and is adequate for the intended use.

### **3.3.5 Equipment Compatibility**

3.3.5.1 The wire applying equipment as well as the wire itself, if from the same supplier, can be accepted as being compatible.

3.3.5.2 Where equipment and wire are from different suppliers, the person applying the wire is to obtain written assurance from both suppliers, that the combination of wire and equipment being used is compatible.



Fig 18: one example of pneumatic release hooks used for top attachment loading and unloading of wood pulp, lumber, plywood and many other products.

### **3.3.6 Test frequency**

3.3.6.1 The schedule of tests for round wire banding is one test of the straight wire, and one test of the wire in the knotted condition every time the coil is changed; and in addition one test of the wire in the knotted condition each shift (a shift is considered to be eight hours of production run).

### **3.3.7 Test records**

3.3.7.1 A record of tests is to be retained at the establishment where the cargo was unitised, and must be signed by the person doing or supervising the testing.

3.3.7.2 The test record and the units covered by the sample testing are to be identifiable one to the other by an identifying number.

3.3.7.3 A test certificate shall be prepared by the person responsible for the unitising of the cargo, and a copy of the certificate shall accompany the units.

### **3.3.8 Banding strength**

3.3.8.1 All units banded for multiple lift purposes, by which it is permitted to lift the units on four separate occasions, must be so banded as to provide a minimum safety factor on the banding of 4:1. This is the minimum required for international shipment.

3.3.8.2 It must be particularly noted that in the case of several strands of wire forming the lifting band, it is essential that all be evenly tensioned.

3.3.8.3 Other than in special cases, all wire banded units are to be banded to provide for a bridle angle of 40°. The minimum strength of the banding shall therefore be:

Safety Factor X Half Weight of Unit X Secant of Bridle Angle

The bridle angle referred to is that angle contained between the vertical and the maximum allowable angular departure of the wire banding from the vertical under the lift conditions, that is to say it is the angle at one of the top corners of the unit, contained between the vertical and the lifting band (see 3.2.11.2)

**The following sections apply to both wire and flat band systems**

## **4 Suitability of lifting gear**

4.1 The method of lifting should be part of the approved lifting system determined by the manufacturer.

4.2 In any instance where cargo unitised with flat strapping or wire of a particular manufacturer, is to be lifted with gear other than that originally approved for the banding or wire in question, then to establish that such combination of banding or wire and lifting hook is compatible, a test consisting of not less than 20 sequential lifts with the banding in a 100% overload condition shall be made.

Where no damage occurs to either the banding or lifting hook, as a result of the test, the combination will be considered a safety arrangement.

In the instance of tests relating to the use of lifting gear for multiple lift purposes, a sample of the banding in way of the lifting hook is to be tested to destruction with no significant reduction in tensile strength being noted.

4.3 In most cases manufacturers will specify that special purpose lifting hooks, frames, and spreaders are used and that 2 hooks will be engaged on any one strap

4.4 The International Labour Office's (ILO) Code of Practice 'Safety and Health in Ports' refers to the safe use of cargo strapping for lifting purposes and provides that -

- In the case of unitised loads, hooks or lifting devices may be so used, provided that:
  - They are specially designed for the purpose
  - The wire, strap, band or other fastening has been properly secured to the load
- The wire, strap, band or other fastening is compatible with the hook or lifting device used
- At least two hooks or lifting devices are used, and each is secured to a band or group of wires

Figs 19 and 20: Types of pneumatic-controlled releasing hook

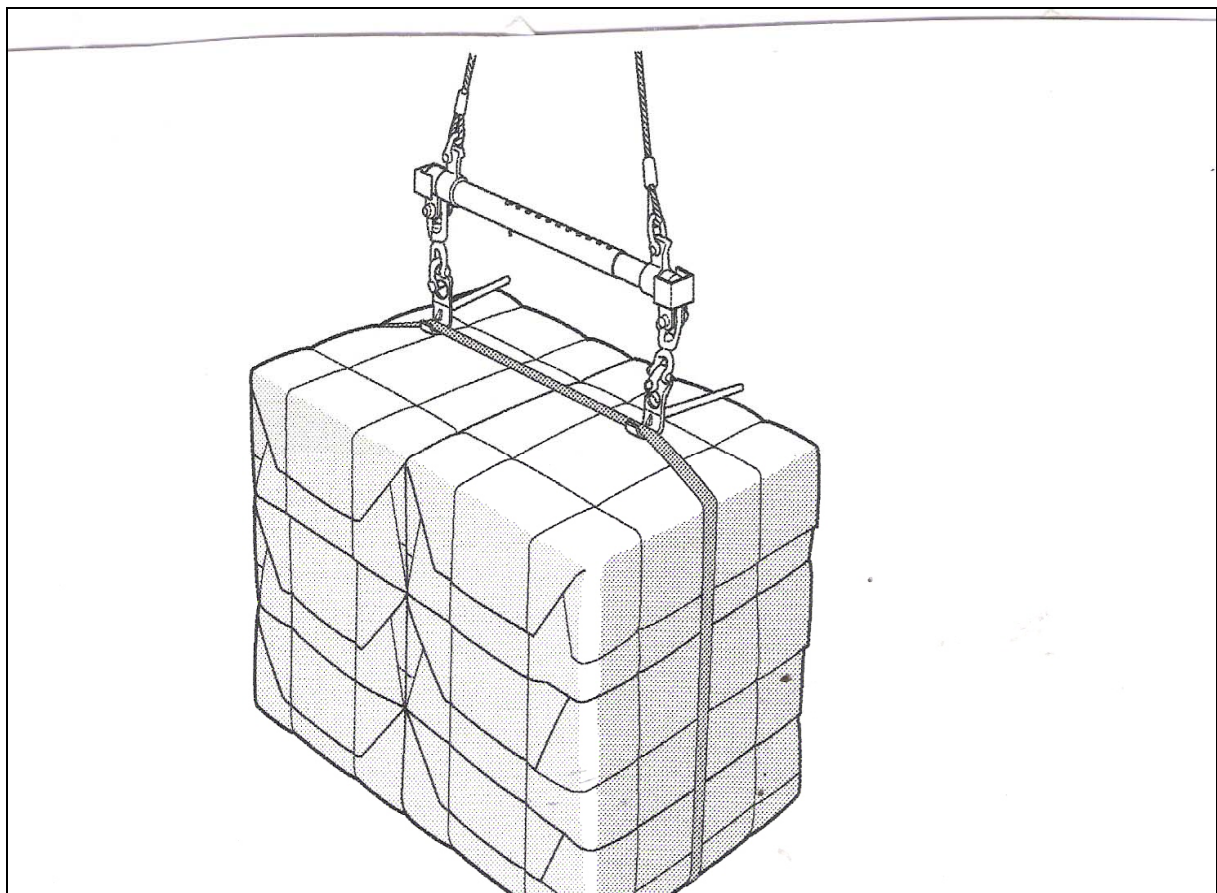


Pneumatic, semi-automatic lifting hooks suitable for flat strapping or wire banding



Fig 21: Typical arrangement of lifting gear for unitised woodpulp with pneumatic semi-automatic hooks in operation. (Note two hooks per unit)

Fig 22: Typical arrangement using manual hooks and 'loose gear'



## 5 Summary of safety points

- The method of lifting should be part of the approved lifting system determined by the manufacturer.
- In most cases manufacturers will specify that special purpose lifting hooks, frames, and spreaders are used and that 2 hooks will be engaged on any one strap
- They are specially designed for the purpose
- The wire, strap, band or other fastening must be properly secured to the load
- The wire, strap, band or other fastening must be compatible with the hook or lifting device used
- The safety factor on the banding for international shipment to be not less than 4:1.
- The maximum number of lifts of the subject unit by its lifting band shall not exceed four lifts subject to a safety factor of 4:1.
- The duration of any lift shall not exceed four minutes (this is to avoid excessive transportation of the unit by its banding)
- Where however, in cargo processes, circumstances cause the duration of the lift to exceed the above limitation in order to accommodate practical requirements, then every effort must be made to minimise the actual duration of the lift. The interval between the first and the last occasion on which the unit is lifted by its banding shall not exceed four months.
- A test certificate relating to the subject units, and similar to that shown in the appendix, must always accompany the shipment.
- This certificate, shall in addition to attesting to the quality of the banding, and identifying the units to which it relates, show the lifting history.



Fig 23

### Ovalmatic Wire Cutting and Recycling

KRC-6 Pneumatic Heavy Duty Bale and Unitying Wire Cutters. (Ideal for mill de-wiring stations and is an acceptable tool to cut the wires when disposal is called for.