***RECOMMENDED STANDARD SPECIFICATION***

***For***

# *Synthetic Polyester Roundslings*

WSTDA-RS-1

This recommended standard specification has been formulated as a guide to users, industry and government to insure the proper use, maintenance and inspection of synthetic polyester roundslings. The existence of this recommended standard specification does not, however, prevent members of the Web Sling & Tie Down Association, Inc. and other manufacturers from manufacturing or selling products beyond the scope of this recommended standard specification.

# FOREWORD

This recommended standard specification applies to roundslings made of polyester fibers used for the lifting, suspending, transporting, lowering, and other load handling under known conditions. It recommends construction, identification and marking of these roundslings. In addition, it provides sling capacity information and important practical advice on the use, maintenance and inspection of roundslings.

For roundslings made of high performance yarn, see WSTDA-RS-1HP Recommended Standard Specification for High Performance Yarn (HPY) Roundslings. Roundslings made from any other materials shall be used in accordance with the recommendations of the roundsling manufacturer or qualified person. The specifications contained in this Recommended Standard Specification for polyester roundslings were formulated under the auspices of the Web Sling & Tie Down Association, Inc. The recommended standard specification is intended to assist users in specifying the proper polyester roundsling for their particular needs; to serve as a guide to industry in the construction and use of synthetic roundslings; and to serve as a guide to governmental and other regulatory bodies responsible for the proper use and inspection of polyester roundslings. For information not contained in this Recommended Standard, consult the roundsling manufacturer.

Safety is the paramount consideration involved in the use of any roundsling. The appropriate roundsling shall be selected for the specific lift. Users of roundslings shall have knowledge and training on the proper method of lifting item(s) and how to adjust rigging methods as lifting situations change. Also, users shall be knowledgeable about industry local, state, federal and provincial regulations applicable to the lift. Figures shown in this standard are for illustration only and are not intended to represent usage, design or manufacturing processes.

## Mandatory & Advisory Rules

Mandatory rules of this Recommended Standard Specification are characterized by the use of the word "**shall" or "must"**. If a rule is of an advisory nature, it is indicated by the use of the word "**should**", or is stated as a recommendation.

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# CONTENTS

# CHAPTER 1.0 TERMINOLOGY & DEFINITIONS

## Section 1.1 PURPOSE

1.1 .1 This chapter provides a description of polyester roundslings and definitions which apply to such roundslings.

## Section 1.2 DESCRIPTION

1.2.1 A roundsling is comprised of continuous load bearing core(s) made from synthetic yarns, not woven, fully enclosed in a protective cover(s) with or without fitting(s).

## Section 1.3 BASIC TYPES

1.3.1 ENDLESS - A roundsling in which the load bearing core(s) is wound in a continuous manner and fully enclosed within a protective cover(s). (See figure 1-1.)

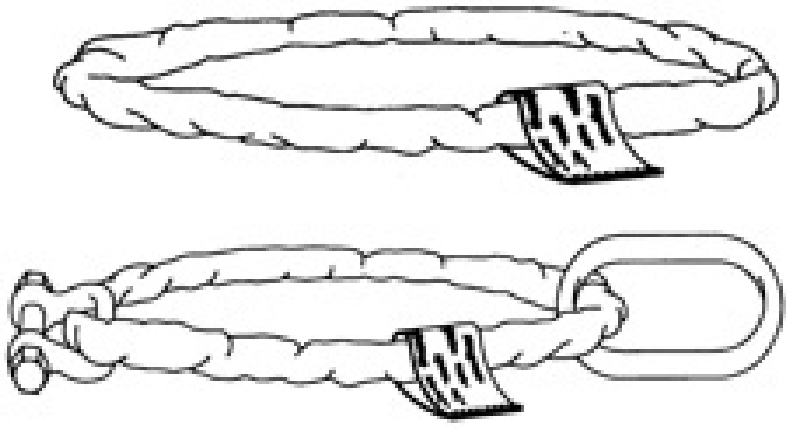


*Figure 1-1*

1.3.2 EYE & EYE - A roundsling with a loop eye at each end, typically formed by placing an additional sleeve, or other cover material, over the body. (See Figure 1-2.)

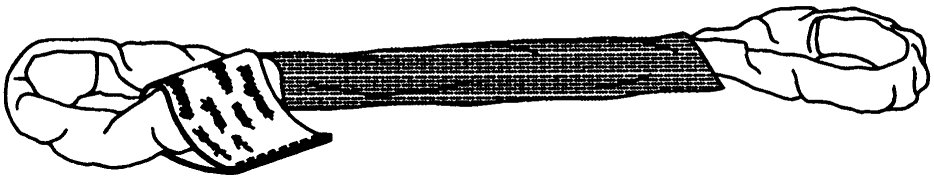


*Figure 1-2*

1.3.3 BRIDLE (Multi-Legged) A sling assembly featuring a single top connection point with sling leg(s) and may have connection hardware at the bottom of the leg(s). (See Figure 1-3.)

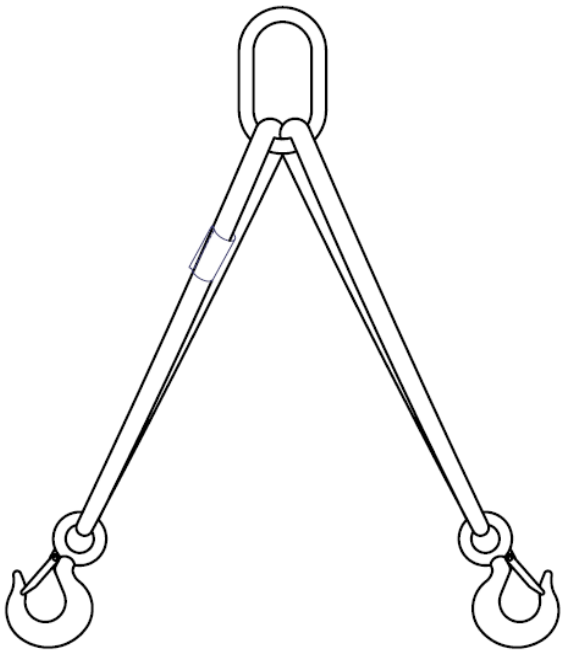


*Figure 1-3*

## Section 1.4 DEFINITIONS of TERMS

**Abrasion** - The mechanical wearing or scuffing of a surface, resulting from frictional movement between two materials or objects.

**Bearing Stress –** The compressive stress located at the contact surfaces between two objects that occurs when they are attached together and then loaded in tension.

**Breaking Strength** - That load in pounds or kilograms at which point any load-bearing core of the roundsling fails.

**Coating -** A finish applied to the load-bearing core, cover and/or protective sleeve for a special purpose.

**Coupling -** A load bearing device for the purpose of attaching fittings to the roundsling.

**Core -** That yarn which comprises the load bearing part(s) of the roundsling.

**Cover -** A seamed or seamless protective material that completely encloses the core(s).

**Design Factor -** The ratio of the breaking strength to the rated capacity for each new roundsling.

**Designated Person -** Selected or assigned by the employer or employer's representative as being competent to perform specific duties.

**Elongation -** The measurement of stretch, at a given load, expressed as a percentage of the original unloaded length.

**Fitting -** A load bearing device that is attached to the roundsling.

**Hitch / Vertical -** A method of rigging in which the load is attached to one end of the roundsling and the other end of the roundsling is attached to the lifting device. (See Figure 1-4.)

**Hitch / Choker -** A method of rigging in which the roundsling is passed around the load, passed back through itself, and then attached to the lifting device. (See Figure 1-4.)

**Hitch / Basket -** A method of rigging in which the roundsling is passed around the load and both ends are attached to the lifting device(s). (See Figure 1-4.)

**Hitch / Double Wrapped Choker -** A method of rigging similar to a Choker Hitch except that the roundsling is passed around the load twice. (See Figure 1-4.)

**Hitch / Double Wrapped Basket -** A method of rigging similar to the Basket Hitch except that the roundsling is passed around the load twice. (See Figure 1-4.)

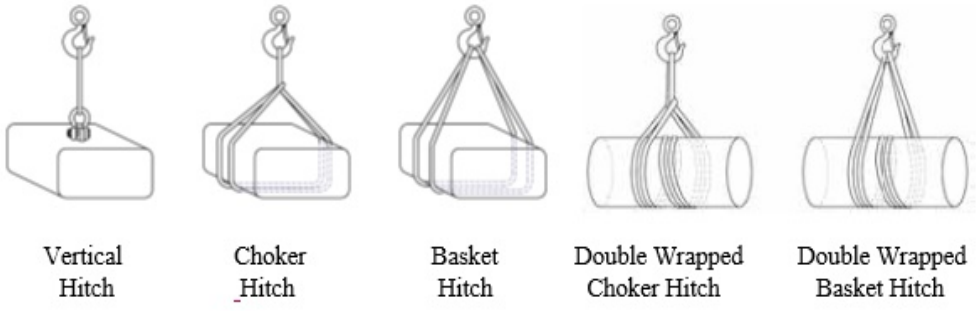



Figure 1-4

**Hitch / Adjusting -** A method of rigging that is similar to a choker hitch, but where the choked section of the sling is also passed around the lifting device. And the bottom portion of the sling is either attached to the load, or is passed around the load. The adjusting hitch can be used to implement the ability to effectively adjust the length of roundslings, which is accomplished by repositioning the choke point. (See Figure 1-5)

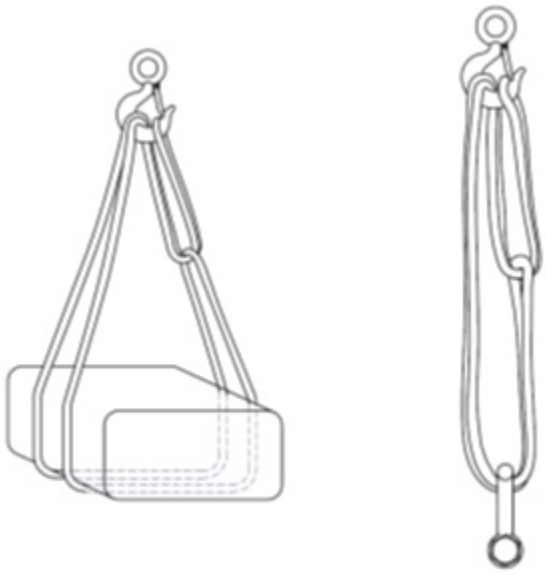


Figure 1-5

Examples of Adjusting Hitches

**Length (Reach**) - The distance between the extreme end bearing points of the roundsling, including fittings if applicable; (See Figure 1-6.)

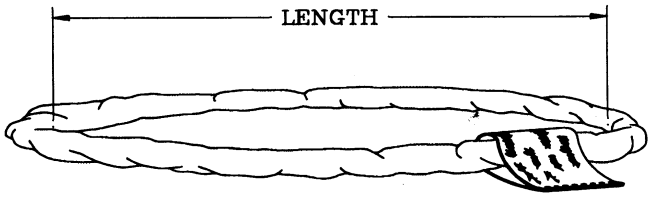



Figure 1-6

**Lifting –** Raising or lowering an unencumbered load.

**Proof Load Test -** A non-destructive load test of the roundsling to some multiple of the rated capacity of that roundsling, including fittings if applicable (Usually two (2) times the rated capacity for lifting applications).

**Qualified Person** - A person who by possession of a recognized degree, or certificate of professional standing in an applicable field or who by extensive knowledge, training, and experience has successfully demonstrated the ability to solve or resolve problems related to the subject matter and work.

**Rated Capacity (Working Load Limit) -** The maximum allowable loading force for each roundsling assembly for the type of hitch being used.

**Roundsling -** A sling type used for general lifting or load handling purposes that is comprised of a load bearing core(s), made from synthetic yarns of unwoven continuous filament fibers, which is fully enclosed in a protective cover(s).

**Shock Loading** – A condition of rapid lift, sudden shifting of load, or arrest of a falling load that causes the forces in a sling to notably exceed that which would have occurred during normal loading conditions.

**Sling Contact Width -** The effective width or spread of the sling that results at contact areas with the load or connection hardware when the roundsling is tensioned.

**Sling Protection –** Material of sufficient strength, thickness and construction used to protect the sling from abrasion or cutting. Some forms of protection will not prevent cutting and provide abrasion protection only.

**Sling Service**

**Normal Service** – The use of slings in typical operating conditions, which will not cause a rapid rate of observable degradation in sling materials. This includes the use of slings wherein the rate of sling wear is not accelerated due to the rate of operation, or exposure to highly abrasive surfaces or to edges that generate cutting of any of the sling materials.

**Severe Service** – The use of slings in conditions that may cause a rapid rate of observable degradation in sling materials. This could include the use of slings at a

high rate of operation, direct exposure of the slings to materials in a manner that may generate an elevation of surface temperatures, or cause a high rate of abrasive wear or cutting of the sling materials.

**Special Service** – The use of slings intermittently or in a manner that may result in an inconsistent rate of observable degradation in sling materials. This includes use of slings at an inconsistent rate of operation, or exposure of the slings to surfaces in a manner that may generate a highly variable rate of sling wear or other degradation.

**Synthetic Fiber** - Man-made fibers.

**Thread -** The synthetic yarn used to sew the cover.

**Working Load Limit** - See rated capacity.

**Yarn –** Synthetic fibers that are used to make the roundsling core, cover and thread materials.

# CHAPTER 2.0 MATERIALS & CONSTRUCTION

## Section 2.1 PURPOSE

This chapter provides an outline of materials and construction characteristics of polyester roundslings.

## Section 2.2 CORE YARN

2.2.1 The polyester core yarn shall be comprised of continuous filament fiber and shall conform to the strength or tenacity requirements designated by the sling manufacturer.

2.2.2 The load bearing core yarn of each roundsling shall be wound in a manner that will yield a suitable distribution of yarn tensioning during sling loading conditions. The initiation, splicing and/or termination of this process may include knotting of the yarn.

## Section 2.3 COVER

The cover(s) may be made of either the same fiber type as the load-bearing cores(s) or of a different fiber material. When the cover is of a different fiber type than the load-bearing core, follow the manufacturer's recommendations for use.

## Section 2.4 THREAD

The thread used to sew the cover shall be of polyester, even when the core and cover are of different fiber types.

## Section 2.5 STITCHING

All stitching shall be lock-stitched and preferably continuous. When not continuous, they shall be backstitched at the ends to prevent raveling.

## Section 2.6 FITTINGS

This section relates to fittings of metal, or other suitable materials, which may be attached to the roundsling for the purpose of engaging a lifting device. The fitting(s) may be a permanent or detachable part of the roundsling.

2.6.1 **Material** - The fitting material selected shall be compatible with the mechanical and environmental requirements imposed on the fitting.

2.6.2 **Design Criteria** - Fitting(s) shall be properly sized per section 4.7, and have a minimum design factor of five (5), and have sufficient strength to sustain a proof load of twice the rated capacity without it causing any permanent deformation.

2.6.3 **Finish -** All surfaces shall be cleanly finished. All areas of the fittings that will come into contact with the roundsling during use must be smooth and any edges shall have sufficient radii to prevent cutting, or other forms of damage to the roundsling.

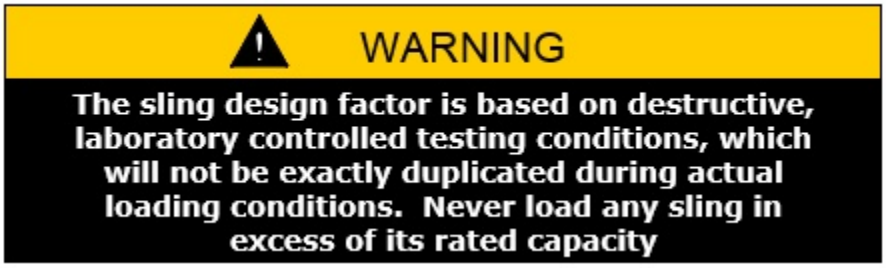
2.6.4 **Reuse of Fittings** - Fittings shall be inspected prior to reuse. Fittings shall not be used if excessive wear, pitting, corrosion, cracks, distortion or breaks are visible.

2.6.5 **Proof Load Test** – Permanently attached fittings that are reused or welded fittings shall be proof tested to a minimum of two (2) times the rated capacity.

## Section 2.7 COATINGS

If any finishes or coatings are applied to the sling materials, they shall be compatible with material of the core(s) and cover(s), and shall not impair the performance of the roundsling.

## Section 2.8 DESIGN FACTOR




2.8.1 The design factor for new roundslings shall be a minimum of five (5) when tested in accordance with Chapter 3 for lifting and controlled load handling purposes. Consult the manufacturer for other applications.

2.8.2 The design factor for new roundslings incorporating fittings may, in some cases, be less than five (5) when they are tested as a complete assembly. All hardware attached directly to polyester roundslings should conform to the requirements of Section 4.7. For special applications wherein the maintenance of a design factor of five (5) or higher is required, consult with the sling manufacturer.

## Section 2.9 IDENTIFICATION

2.9.1 **Identification Requirements -** Each roundsling shall be durably marked or labeled by the manufacturer to show:

a. Rated capacity values for:

- The three basic hitches (Vertical, Choker, Vertical Basket) for single leg slings.

- At least one angle from the horizontal for multi-leg bridle slings such as 60, 45 and/or 30.
- The designated hitch of intended use for special applications.

b. Length (Reach) - bearing point to bearing point.

c. Core fiber type – If the cover(s) is of a different fiber type, both fiber types shall be identified.

d. Name or trademark of manufacturer.

e. Manufacturer's code or stock number.

f. The number of legs, if more than one.

### 2.9.2 Additional Identification Information -

a. If the polyester roundsling cover is color coded, its color *should* correspond with the rated capacity shown in Table 2-1.

b. Roundslings, however, may be colored differently from those shown in Table 2-1. ALWAYS CHECK THE IDENTIFICATION TAG TO DETERMINE IF THE ROUNDSLING'S RATED CAPACITY IS APPLICABLE FOR THE LIFT.

c. Each manufacturer should internally identify their product with their name or trademark for traceability.

d. Instructions for use and inspection shall be included with each new roundsling.

e. If a sling is made for a *non-lifting application*, it shall be marked “Not for Lifting”.

f. If a sling in service is used for a non-lifting application where the sling loading is unknown or may have exceeded rated capacity (i.e. pulling under unknown restraint, etc.) it shall then be marked “Not for Lifting” and not be returned to lifting service.

g. If a sling is used for non-lifting applications under known loading circumstances and within the rated sling capacity, it may be returned to lifting services.

### 2.9.3 Maintenance of Sling Identification – Sling identification should be maintained by the user so as to be legible during the life of the sling.

### 2.9.4 Replacement of Sling Identification – Replacement of the sling identification shall be considered as a repair as specified in section 4.10. However, proof testing is not required for this repair.

## Section 2.10 RATED CAPACITY

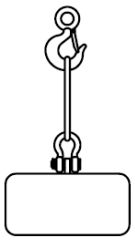
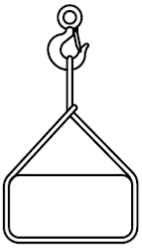
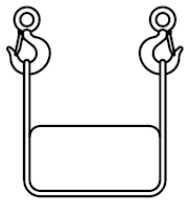
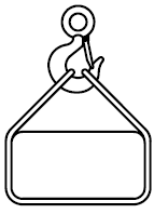
2.10.1 Roundslings shall not be loaded in excess of the identified rated capacity shown on its identification tag. Rated Capacities shown in this section are for reference only and may vary amongst manufacturers. Other sling types are available and shall be used in accordance with the manufacturer's recommendations.

2.10.2 Each manufacturer shall retain the test data used to validate the roundsling specified breaking strength. Destructive tests shall be conducted periodically, according to the test procedure outlined in Chapter 3.

2.10.3 The choker hitch capacity shall be rated at a maximum of 80 percent of the vertical capacity.

2.10.4 The vertical basket hitch capacity shall be rated at a maximum of two (2) times the vertical capacity.

**Table 2-1: Rated Capacity for Polyester Roundslings**

| Roundsling Size / # | Color |  VERTICAL | |  CHOKER | |  VERTICAL BASKET | |  45° BASKET | |
|---|---|---|---|---|---|---|---|---|---|
| | | Lbs. | Kgs | Lbs. | Kgs | Lbs. | Kgs | Lbs. | Kgs |
| 1 | Purple | 2,600 | 1,200 | 2,100 | 1,000 | 5,200 | 2,400 | 3,700 | 1,700 |
| 2 | Green | 5,300 | 2,400 | 4,200 | 1,900 | 10,600 | 4,800 | 7,500 | 3,400 |
| 3 | Yellow | 8,400 | 3,800 | 6,700 | 3,000 | 16,800 | 7,600 | 11,900 | 5,400 |
| 4 | Tan | 10,600 | 4,800 | 8,500 | 3,800 | 21,200 | 9,600 | 15,000 | 6,800 |
| 5 | Red | 13,200 | 6,000 | 10,600 | 4,800 | 26,400 | 12,000 | 18,700 | 8,500 |
| 6 | White | 16,800 | 7,600 | 13,400 | 6,000 | 33,600 | 15,200 | 23,800 | 10,700 |
| 7 | Blue | 21,200 | 9,600 | 17,000 | 7,600 | 42,400 | 19,200 | 30,000 | 13,600 |
| 8 | Orange | 25,000 | 11,400 | 20,000 | 9,100 | 50,000 | 22,800 | 35,400 | 16,100 |
| 9 | Orange | 31,000 | 14,100 | 24,800 | 11,300 | 62,000 | 28,200 | 43,800 | 19,900 |
| 10 | Orange | 40,000 | 18,200 | 32,000 | 14,500 | 80,000 | 36,400 | 56,600 | 25,700 |
| 11 | Orange | 53,000 | 24,100 | 42,400 | 19,300 | 106,000 | 48,200 | 74,900 | 34,100 |
| 12 | Orange | 66,000 | 30,000 | 52,800 | 24,000 | 132,000 | 60,000 | 93,000 | 42,400 |
| 13 | Orange | 90,000 | 40,900 | 72,000 | 32,700 | 180,000 | 81,800 | 127,300 | 57,800 |

** Caution: Color codes and rated capacities may vary among manufacturers. ALWAYS CHECK THE IDENTIFICATION TAG TO DETERMINE IF THE POLYESTER ROUNDSLING RATED CAPACITY IS APPLICABLE FOR THE LIFT.*

*** The listed choker hitch capacity values are for angles of choke of 120 degrees or greater. For angles of choke less than 120°, see also paragraph 4.5.2 and Table 4-4.*

# CHAPTER 3.0 STANDARD PROCEDURES FOR TESTING

## Section 3.1 PURPOSE

This chapter provides standard procedures for the testing of polyester roundslings.

## Section 3.2 TYPE of TESTS

3.2.1 **Destructive** - A tensile test of a roundsling for the purpose of verifying the breaking strength. Roundslings being destructively tested shall be pulled until the maximum peak load has been reached. Roundslings shall typically be tested in a vertical hitch. Roundslings manufactured to suit a specific purpose that are to be destructively tested, including those being used in a specific attachment configuration or made to a specific length, may be tested in an alternative configuration.

3.2.2 **Proof Load** - A non-destructive load test of a roundsling to some multiple of the rated capacity of the roundsling, including fittings if applicable, usually two (2) times the rated capacity when made for lifting application.

## Section 3.3 TEST CHARACTERISTICS

3.3.1 **Sample** – When testing for the purposes of verification of the minimum breaking strength, the roundsling test sample shall be made in the same manner being used for production slings.

3.3.2 **Length** - roundsling length, pull to pull, should be a minimum of three (3) feet (900 mm) not including fittings.

3.3.3 **Fittings** - roundslings incorporating fittings shall be tested with the fittings attached.

3.3.4 **Hitches** (For Testing Only)

**A.** **Vertical** - The roundsling shall be rigged in the test machine so that tension is applied in a straight-line pull. (See Figure 3-1.)

Figure 3-1

**B.** **Choker** - The roundsling shall be rigged in the test machine so that the minimum angle (a) of choke is 120 degrees. (See Figure 3-2)

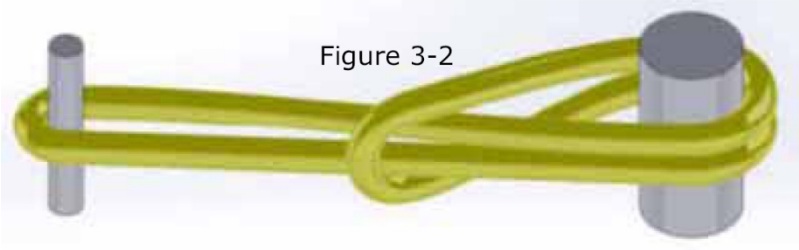


Figure 3-2

**C.** **Basket –** Alternatively, roundslings may be tested in a basket hitch. (See Figure 3-3)

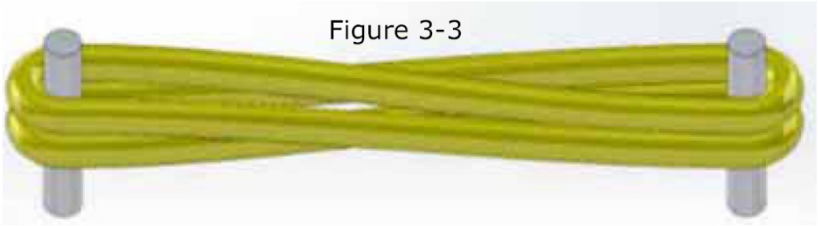


Figure 3-3

## Section 3.4 PROOF TESTING REQUIREMENTS

3.4.1 **Proof Testing** – Unless specified by the purchaser, polyester roundslings are not required to be proof tested prior to their initial use if all components of the sling are new. All roundslings incorporating previously used fittings at the time of manufacture shall be proof tested by the manufacturer, or a qualified person.

3.4.2 **Proof Testing Procedures** – When roundslings are proof tested, the testing should be conducted using a pin diameter sized in accordance with Section 3.5, and shall be tested in accordance with the following:

a. For single-leg or multiple-leg slings and endless slings, each leg shall be proof loaded to a minimum of 2 times the single-leg vertical hitch rated load.

b. The proof load for fittings attached to single legs shall be a minimum of 2 times the single-leg vertical hitch rated load.

c. Master links for two-leg bridle slings shall be proof loaded to a minimum of 4 times the single-leg vertical hitch rated load.

d. Master links for three-leg bridle slings shall be proof loaded to a minimum of 6 times the single-leg vertical hitch rated load.

e. Master links for four-leg bridle slings shall be proof loaded to a minimum of 8 times the single-leg vertical hitch rated load.

3.4.3 **Proof Test Certificate** - When a certificate of testing is required, the certificate, issued by the company performing the test, shall show :

- The test date.
- A description of the test method.
- Product stock and serial number (if applicable).
- The amount of applied load.
- Product rated capacity.
- Any indicated result.

## Section 3.5 PROCEDURES FOR DESTRUCTIVE PULL TESTING


3.5.1 Destructive testing of roundslings, excluding sling with fittings, shall be tested on pin diameter within the range listed in Table 3-1. The pins shall be capable of sustaining the maximum applied load without deformation or failure.

3.5.2 Roundslings shall be tested in a manner that allows the load bearing fibers to spread out and share the load evenly.

3.5.3 All roundslings shall be pulled at a uniform head speed. For roundslings tested by someone other than the manufacturer, consult the sling manufacturer for further test guidelines.

3.5.4 Roundslings should be tested at ambient temperatures unless otherwise specified.

3.5.5 Each pull test machine shall be certified annually to ASTM E4.

3.5.6 Test Report – The test report, issued by the company performing the test, shall include the following information:

- The name of the company performing the test.
- The test date.
- A description of the sling, including the rated capacity.
- A description of the test arrangement, if different than a vertical hitch, including the test pin size.
- A description of any pretest conditioning describing any loading applied to the sling prior to performing the destructive test.
- The test result including the amount of applied load.

## Table 3-1: Pin Size Range for Destructively Testing Roundslings

| Rated Capacity (Lbs.) | Sling Contact Width* | Min Pin Dia. (Inches) | Max. Pin Dia. (Inches) | Rated Capacity (Lbs.) | Sling Contact Width* | Min Pin Dia. (Inches) | Max. Pin Dia. (Inches) |
|---|---|---|---|---|---|---|---|
| 6,000 | 1.38 | 1.00 | 1.48 | 30,000 | 3.00 | 2.00 | 3.31 |
| 8,000 | 1.56 | 1.14 | 1.71 | 40,000 | 3.50 | 2.62 | 3.81 |
| 10,000 | 1.75 | 1.31 | 1.88 | 50,000 | 3.88 | 2.88 | 4.25 |
| 12,000 | 1.91 | 1.40 | 2.10 | 60,000 | 4.25 | 3.12 | 4.69 |
| 14,000 | 2.06 | 1.50 | 2.27 | 70,000 | 4.62 | 3.38 | 5.06 |
| 16,000 | 2.20 | 1.61 | 2.42 | 80,000 | 5.00 | 3.62 | 5.38 |
| 18,000 | 2.34 | 1.71 | 2.57 | 90,000 | 5.25 | 3.88 | 5.69 |
| 20,000 | 2.50 | 1.81 | 2.69 | 100,000 | 5.50 | 4.00 | 6.06 |
| 25,000 | 2.75 | 2.00 | 3.00 | | | | |

*Note: An analysis of the pin size and material should be performed by a qualified person to prevent damage or failure of the pin during testing.*

*While the pin sizes listed per table 3.2 are the suggested sizes for use with industry standard sling sizes, any pin size falling within the listed range per table 3.1 may be used to determine conformance to this section 3.5.*

*For slings with capacity values that fall in between those listed above, the proper minimum and maximum diameter of the test pins shall be determined by using the values from the next higher capacity sling.*

*Use of pin sizes smaller than those prescribed above for the purposes of destructive testing may yield artificially low test results.*

**The estimated sling width is noted for informational purposes only.*

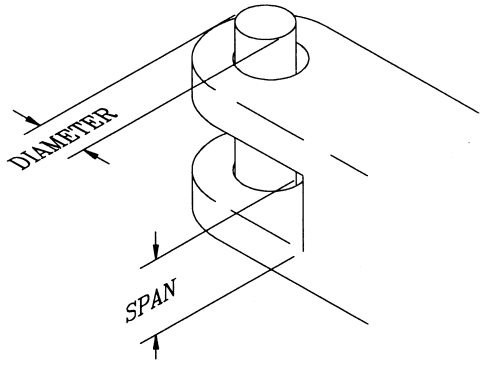



**Figure 3-3**

**Table 3-2. Recommended Pin Sizes for the Destructive Testing of Roundslings**

| Sling Capacity Range (Lbs.) | Referenced WSTDA Sling Size Number | Sling Vertical Hitch Capacity* (Lbs.) | Pin Span, Minimum (Inches) | Pin Diameter (Inches) |
|---|---|---|---|---|
| Up to 6,000 | 1<br>2 | 2,600<br>5,300 | 2.19 (56 mm) | 1.12 (28 mm) |
| 6,001 To 15,000 | 3<br>4<br>5 | 8,400<br>10,600<br>13,200 | 2.75 (70 mm) | 1.50 (38 mm) |
| 15,001 To 30,000 | 6<br>7<br>8 | 16,800<br>21,200<br>25,000 | 3.25 (82 mm) | 2.00 (50 mm) |
| 30,001 To 60,000 | 9<br>10<br>11 | 31,000<br>40,000<br>53,000 | 6.00 (150 mm) | 3.25 (82 mm) |
| 60,001 To 100,000 | 12<br>13 | 66,000<br>90,000 | 7.00 (175 mm) | 4.00 (100 mm) |

*Caution: The above pin sizes should be used to develop the roundsling minimum breaking strength. For roundslings having a vertical capacity of 10,000 lbs. or greater, alternative pin sizes may be used, as prescribed in Table 3-1. The pin sizes shown in this table are recommended for use in testing roundslings.* ***These sizes are not intended to be prescribed for general operational use of these slings.*** *See section 4.7 for information regarding the selecting of appropriate connection hardware during general sling use.*

**These pin sizes are designated for use in testing slings in a vertical hitch, and may not be adequate for testing roundslings in a basket configuration.*

*Other information is available in the Associated Wire Rope Fabricators (AWRF) "Test Bed Safety Guide".*

## Section 3.6 SAMPLE DESTRUCTIVE TESTING

3.6.1 **Random Testing of Roundslings** – Roundsling samples, representative of slings that are produced by each manufacturer, may randomly be destructively load tested in accordance with Section 3.5 of this standard. Additionally, this testing shall be completed by the manufacturer when any changes are made to the composition of the roundsling load bearing materials or manufacturing procedures.

3.6.2 **Pass Criteria** – If all test values meet or exceed the required breaking strength value, the sample group meets this test criteria.

3.6.3 **Retest Criteria** – If any single test value falls below the required breaking strength, two additional samples shall be tested. These two additional samples shall meet or exceed the required breaking strength value, or otherwise the process is rejected.

3.6.4 **Rejection Criteria** – If the retest of the sample group fails to meet or exceed the required breaking strength value the sample group fails and the process is rejected.

3.6.5 **Corrective Action** – Following any process rejection, the manufacturing practice shall be examined and adjusted as necessary. After corrective action has been completed, the product shall be re-tested to determine compliance per 3.6.2 prior to any distribution.

# CHAPTER 4.0 RECOMMENDED OPERATING PRACTICES

## Section 4.1 PURPOSE

4.1.1 The purpose of this chapter is to provide guidelines to the designated person responsible for sling selection, inspection, and usage in accordance with recommended operating practices. This standard does not purport to address all safety concerns associated with sling usage. It is the responsibility of the user of the sling to establish appropriate safety practices and determine the applicability of all regulatory requirements prior to use.

## Section 4.2 TRAINING REQUIREMENTS


**The following six points briefly summarize some important safety issues. All sling users shall be trained in the following areas:**

- *Sling Selection* – Understand the limitations of each sling type and their associated components and materials.
- *Sling Inspection* – Understand how to properly inspect slings, so damaged slings can immediately be removed from service.
- *Prevention of Sling Damage* – Know how to prevent sling damage, including how to properly protect them from being cut or damaged from direct contact with corners, edges, protrusions, or abrasive services.
- *Proper Use of Slings* – Each sling user shall be competent in considering all risk factors prior to using a sling, and be able to verify that each sling will not be loaded in excess of its rated capacity.
- *Remaining Alert When Lifting Loads* – Whenever using slings, all personnel shall be trained to remain alert, and stand clear of any lifted load, or possible path of danger in the event of sling failure.
- *Proper storage of slings* – Users should know where to store slings in an environment where they will not become damaged by exposure to heat, chemicals, sunlight/UV Light degradation, environmental or other mechanical damage.

Users should read, understand and follow the information contained in this publication, as well as all applicable provincial, state, federal, OSHA regulations and ASME B30.9 guidelines.

## SECTION 4.3 SLING SELECTION CONSIDERATIONS

**Some notable polyester roundsling characteristics include the following**:

- Lightweight, flexible, and easy to handle and rig.
- Polyester roundsling elongation at rated capacity is approximately 3%, which is less than comparable nylon and polyester webbing slings.
- Wear points can be easily rotated to extend sling life.
- Polyester roundslings are less damaging on contacting load surfaces than metal type slings.
- The exterior cover aids in protecting the load bearing core yarn from surface abrasion and UV degradation.

**Some Notable Roundsling Limitations:**

- Polyester roundslings can be cut by contact with unprotected edges.
- Moderate temperature limit.
- Liquids may tend to accumulate and drain slowly from the cover when being used in wet operations.

## Section 4.4 SLING INSPECTION

**A three stage procedure is recommended to help ensure that slings are inspected with appropriate frequency.**

4.4.1 **Initial Inspection –** Prior to use, all new, altered, modified, or repaired roundslings shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter.

4.4.2 **Frequent Inspection –** Roundslings must be inspected for forms of damage listed in Section 4.4.4, Removal Criteria, before each use by the user or other designated person. Written records are not required for this frequent inspection.

This inspection frequency may be reduced to once each day or shift, prior to sling use, when a qualified person is continually monitoring the condition of the slings for any signs of damage and is able to verify that they are not being exposed to any severe service conditions.

4.4.3 **Periodic Inspection –** A complete inspection for forms of damage listed in Section 4.4.4, Removal Criteria, shall be performed by a designated person. This inspection should be

done by someone other than the individual(s) that most commonly performs the frequent inspection.

a. **Periodic Inspection Frequency** - Periodic inspection intervals shall not exceed 1 year. The frequency of periodic inspections should be based on:

   1. Frequency of sling use
   2. Severity of service conditions
   3. Nature of lifts being made
   4. Experience gained on the service life of slings used in similar circumstances.

b. **Time Interval Guidelines** - The guidelines for time intervals are as follows:

   1. *Normal service* – yearly
   2. *Severe service* – monthly to quarterly
   3. *Special service* – as recommended by a qualified person

c. **Written Records** - A written record of the most recent periodic inspection must be maintained. The inspection process should provide some means of identifying which slings have been inspected. It is not required that the condition of individual slings be recorded during the periodic inspection. If documentation of individual slings is maintained, it should be based upon a unique sling serial number, color coding or electronic tracking (RFID) or other means. If individual tracking is not maintained, the inspection process should provide some means of identifying which slings have been inspected at the periodic level of inspection.

4.4.4 **Removal Criteria –** A roundsling must be immediately removed from service if any of the following forms of damage are visible:

a. Holes, tears, cuts, embedded particles, excessive abrasive wear, or snags that expose the core fibers of the roundsling.
b. If core yarn has been broken or damaged. Any evidence of a broken core yarn(s) present in the form of a substantial reduction of the core yarn within any area of the roundsling and/or by a substantial accumulation of core yarn bundle within any section of the roundsling.
c. If roundsling identification tag is missing or not readable.
d. If roundsling has been tied into one or more knots or has been joined by knotting.
e. Melting, charring or weld spatter of any part of the roundsling.
f. Acid or alkali burns of the roundsling.
g. Broken or worn stitching in the cover which exposes the core fibers.
h. Distortion, excessive pitting, corrosion or other damage to fitting(s).
i. Any conditions which cause doubt as to the strength of the roundsling.

## Section 4.5 LIFT PLANNING CONSIDERATIONS


4.5.1 **Effect of Angle** – Sling tensions are affected by angle of lift (sling angle), measured from the horizontal, when used with multi-legged roundslings or choker/basket hitches. The effect of this angle may be determined by using either of these two methods:

- Increased Tension Method (Recommended Method)
- Reduced Sling Capacity Method (Alternative method)

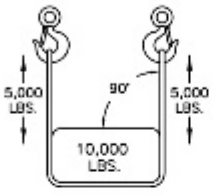
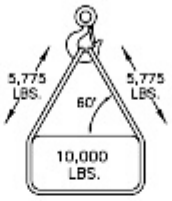
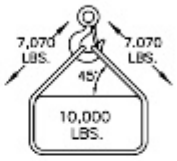
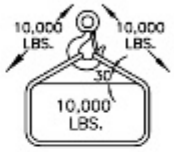
4.5.1.1 **Increased Tension Method** (Recommended Method) –
To use this method, the user must:

1. Determine the load weight.
2. Determine the sling angle, as measured from the horizontal, and the corresponding tension factor. (From Table 4-1).
3. Determine the share of the load applied to each sling leg.
4. Multiply the sling leg's share of the load by the tension factor to determine the sling leg tension.
5. The capacity of the selected sling must meet the calculated tension value.

**Table 4-1 Effect of Sling Angle – Tension Factor Chart**

| Angle in Degrees from Horizontal | Tension Multiplier | Angle in Degrees from Horizontal | Tension Multiplier |
|---|---|---|---|
| 90 | 1.000 | 55 | 1.221 |
| 85 | 1.004 | 50 | 1.305 |
| 80 | 1.015 | 45 | 1.414 |
| 75 | 1.035 | 40 | 1.555 |
| 70 | 1.064 | 35 | 1.742 |
| 65 | 1.104 | 30 | 2.000 |
| 60 | 1.155 | | |

**Table 4-2 Example of the effect of Sling Angle on Tension**

| Tension in the Sling Increases as the Sling Angle Decreases |  |  |  |  |
|---|---|---|---|---|
| Sling Angle (from Horizontal) | 90° | 60° | 45° | 30° |
| Tension Multiplier | 1.00 | 1.155 | 1.414 | 2.000 |
| Sling Leg Tension (Lbs. Per Leg) | 5,000 | 5,775 | 7,070 | 10,000 |
| Required Sling Capacity (Lbs. Basket Hitch) | 10,000 | 11,550 | 14,140 | 20,000 |

4.5.1.2 **Reduced Sling Capacity Method (Alternative Method)** – To use this method, the user must first determine the angle and multiply the sling capacity by the appropriate loss factor for the specific angle. The result is the *Reduced Sling Capacity.*

1. Determine the sling angle, as measured from the horizontal.
2. Determine the corresponding (sling capacity) loss factor (From Table 4-3)
3. Multiply the sling capacity by the loss factor to determine the actual sling capacity at the given angle of lift.

   The result is the reduced sling lift capacity.

**Table 4-3 Effect of Sling Angle – (Sling Capacity) Loss Factor Chart**

| Angle in Degrees from Horizontal | Loss Factor | Angle in Degrees from Horizontal | Loss Factor |
|---|---|---|---|
| 90 | 1.000 | 55 | 0.819 |
| 85 | 0.996 | 50 | 0.766 |
| 80 | 0.985 | 45 | 0.707 |
| 75 | 0.966 | 40 | 0.643 |
| 70 | 0.940 | 35 | 0.574 |
| 65 | 0.906 | 30 | 0.500 |
| 60 | 0.866 | | |

***Example***: A polyester roundsling, size no.1 (purple), and rated at 5,200 lbs. in a vertical basket hitch rating, is being used in a basket hitch at a 60-degree angle. What is its lifting capacity at this lifting angle?

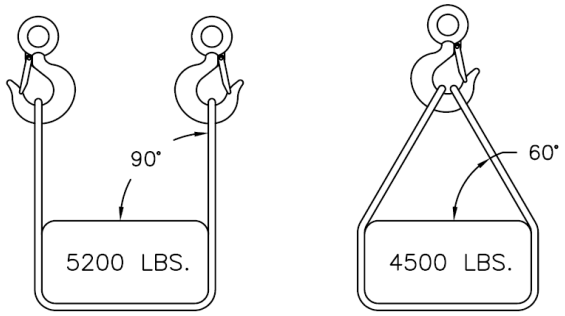



*Figure 4-1*

***Answer***: Its lifting capacity at a 60 degree lifting angle equals its basket hitch capacity times the angle factor, from table 2-3, of .866 for a 60 degree angle.

**5,200 lbs. x .866 = 4,500 lbs.**

4.5.2 **Sling Lift Capacity of Choker Hitch** - When the angle of choke is less than 120 degrees, the sling choker hitch lift capacity is affected. To determine the actual lift capacity at a given angle of choke, multiply the sling choker rating by the appropriate reduction factor determined from table 4-4. (See Figure 4-2).

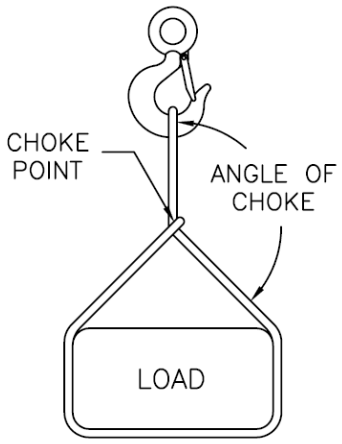



*Figure 4-2*

## Table 4-4 Angle of Choke Reduction Factor

| Angle of Choke (Degrees) | | Angle of Choke Reduction Factor |
|---|---|---|
| Equal to or greater than | Less Than | |
| 120 | 180 | 1.00 |
| 105 | 120 | 0.82 |
| 90 | 105 | 0.71 |
| 60 | 90 | 0.58 |
| 0 | 60 | 0.50 |

4.5.3 **The Adjusting Hitch** - When using the adjusting hitch, the sling must not be loaded in excess of the sling's vertical hitch rated capacity. (See Figure 4-3).

*Figure 4-3*

## Section 4.6 PROPER USE OF POLYESTER ROUNDSLINGS AROUND EDGES

**WARNING**

**Always protect roundslings from direct contact with edges, except where the contacting edges meet the following minimum, edge criteria**

4.6.1 **General Statement**

The strength of roundslings can be significantly affected when they are allowed to come into direct contact with edges of the load, or connection hardware, if the size and shape of these edges are not suitable. Shearing or cutting of the synthetic sling material is the single most common cause of accidents involving sling failure. This can result when roundslings are allowed to come into direct contact with edges that are not adequately rounded to a suitable radius. Roundslings must always be protected from being in direct contact with all edges, unless the contacting edges meet the following criteria.

4.6.2 **Determining when roundslings need to be protected from contact with edges.**

Sling protection must be utilized whenever the edges of the load or connection hardware do not meet the requirements specified in the following:

**Edge Shape** - Roundslings must be properly protected from edges that are not smoothly rounded. This includes chamfered edges.

Roundslings must only be allowed to come into direct contact with edges if they are smooth and are well rounded to a suitable edge radius. Direct contact of roundslings with edges that are machined at an angle, such as a 45 degree angle, can cut into the sling and significantly reduce sling strength. Roundslings must not be allowed to come into direct contact with edges that are chamfered, or flattened at an angle, unless the edges conform to edge radius requirements, as noted in Table 4-5. (See Figure 4-4)

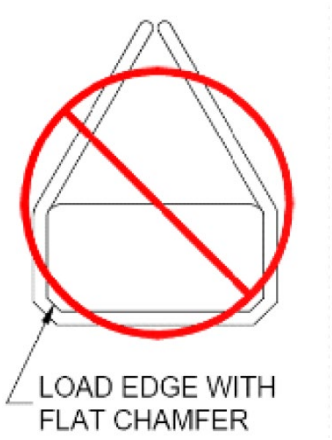



Figure 4-4

**Required Radius of Rounded Edges** – Polyester roundslings must be properly protected from rounded edges if the size of the edge radius is not adequately large. The required size of the edge radius depends on the sling capacity and increases with the size of the sling. Please see table 4-5 for a listing of the minimum edge radius appropriate for each sling size. These values hold true regardless of the type of hitch being used.

**Measuring the radius of an edge** – One method of measuring an edge radius is shown in the Figure 4-5:

Place the leading edge of the ruler or tape measure along the leading edge of the radius that is being measured (Point A). Measure the distance from this leading edge, Point A, to the point where the radius initiates from the bottom edge of the surface, Point B. In this Figure, a radius of 1/2" is shown. (See Figure 4–5).

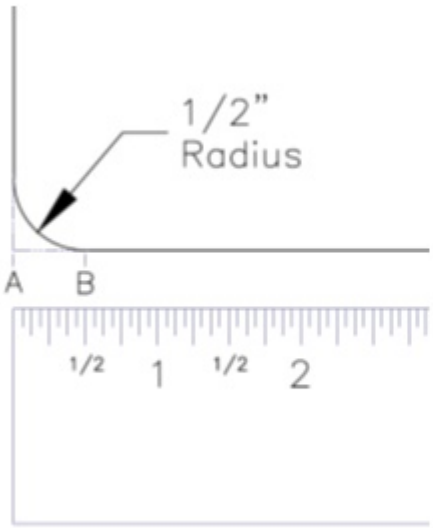



Figure 4-5

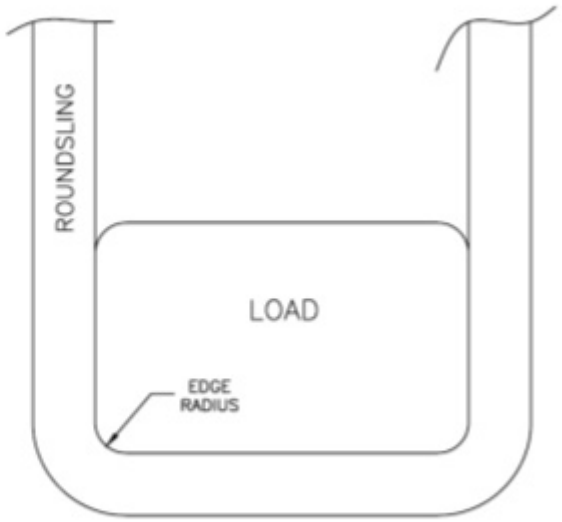



Figure 4-6

**Table 4-5. Minimum Edge Radii suitable for Contact with Unprotected Polyester Roundslings***

| Sling Size | Vertical Rated Capacity (Lbs.) | Minimum Edge Radii (Inches) | Minimum Edge Radii** (Inches) | Sling Width at Load (Inches) |
|---|---|---|---|---|
| 1 | 2,600 | 0.14 | **3/16** | .97 |
| 2 | 5,300 | 0.21 | **1/4** | 1.29 |
| 3 | 8,400 | 0.26 | **5/16** | 1.66 |
| 4 | 10,600 | 0.30 | **5/16** | 1.78 |
| 5 | 13,200 | 0.33 | **3/8** | 2.00 |
| 6 | 16,800 | 0.40 | **7/16** | 2.13 |
| 7 | 21,200 | 0.41 | **7/16** | 2.62 |
| 8 | 25,000 | 0.44 | **7/16** | 2.85 |
| 9 | 31,000 | 0.50 | **1/2** | 3.15 |
| 10 | 40,000 | 0.56 | **9/16** | 3.57 |
| 11 | 53,000 | 0.67 | **11/16** | 4.00 |
| 12 | 66,000 | 0.72 | **3/4** | 4.60 |
| 13 | 90,000 | 0.87 | **7/8** | 5.22 |

*The radii values apply to the roundslings that are fully tensioned to their rated capacity. When roundslings are tensioned to lower force values, consult the manufacturer for the minimum radii values. (See Appendix 1 for further information)
**Fractional equivalent, rounded up to the nearest 1/16".

**Note**: Sling users must follow the sling manufacturer's recommendations if they publish values that differ from those shown in Table 4-5.

## Section 4.7 SELECTION OF PROPER CONNECTION HARDWARE


4.7.1 For polyester roundslings, connection hardware should be selected such that it either:

- Conforms to the size requirements listed in Tables 4-6 and 4-7,

**OR**

- Sized such that that the bearing stress value at the connection does not exceed 7,000 Lbs./in$^2$ during sling loading. (See calculations below).

**Table 4-6 Suitable Connection Hardware Sizes for Polyester Roundslings, When Used in either a Vertical or Choker Hitch**

| Roundsling | | Hardware Size | | | |
|---|---|---|---|---|---|
| WSTDA Roundsling Size | Rated Capacity - Vertical Hitch (Lbs.) | Minimum Stock Diameter or Thickness (Inches) | Minimum Stock Diameter or Thickness (Inches)*2 | Minimum Effective Contact Width*3 (Inches) | Minimum Effective Contact Width*3 (Inches) *2 |
| 1 | 2,600 | .39 | 7/16 | .97 | 1 |
| 2 | 5,300 | .59 | 5/8 | 1.29 | 1 3/8 |
| 3 | 8,400 | .72 | 3/4 | 1.66 | 1 3/4 |
| 4 | 10,600 | .85 | 7/8 | 1.78 | 1 7/8 |
| 5 | 13,200 | .95 | 1 | 2.00 | 2 |
| 6 | 16,800 | 1.12 | 1 1/8 | 2.13 | 2 1/8 |
| 7 | 21,200 | 1.15 | 1 3/16 | 2.62 | 2 5/8 |
| 8 | 25,000 | 1.25 | 1 1/4 | 2.85 | 2 7/8 |
| 9 | 31,000 | 1.41 | 1 1/2 | 3.15 | 3 1/4 |
| 10 | 40,000 | 1.60 | 1 5/8 | 3.57 | 3 5/8 |
| 11 | 53,000 | 1.90 | 2 | 4.00 | 4 |
| 12 | 66,000 | 2.05 | 2 1/8 | 4.60 | 4 5/8 |
| 13 | 90,000 | 2.46 | 2 1/2 | 5.22 | 5 1/4 |

**Table 4-7 Suitable Connection Hardware Sizes for Polyester Roundslings, When Used in a Basket Hitch***

| Roundsling | | Hardware Size | | | |
|---|---|---|---|---|---|
| WSTDA Roundsling Size | Rated Capacity - Basket Hitch (Lbs.) | Minimum Stock Diameter or Thickness (Inches) | Minimum Stock Diameter or Thickness (Inches)*2 | Minimum Effective Contact Width*3 (Inches) | Minimum Effective Contact Width*3 (Inches) *2 |
| 1 | 5,200 | .54 | 9/16 | 1.37 | 1 3/8 |
| 2 | 10,600 | .83 | 7/8 | 1.82 | 1 7/8 |
| 3 | 16,800 | 1.02 | 1 1/16 | 2.34 | 2 3/8 |
| 4 | 21,200 | 1.20 | 1 1/4 | 2.52 | 2 1/2 |
| 5 | 26,400 | 1.35 | 1 3/8 | 2.80 | 2 7/8 |
| 6 | 33,600 | 1.59 | 1 5/8 | 3.00 | 3 |
| 7 | 42,400 | 1.63 | 1 5/8 | 3.71 | 3 3/4 |
| 8 | 50,000 | 1.77 | 1 7/8 | 4.00 | 4 |
| 9 | 62,000 | 2.00 | 2 | 4.45 | 4 1/2 |
| 10 | 80,000 | 2.26 | 2 3/8 | 5.06 | 5 |
| 11 | 106,000 | 2.69 | 2 3/4 | 5.62 | 5 5/8 |
| 12 | 132,000 | 2.90 | 3 | 6.50 | 6 1/2 |
| 13 | 180,000 | 3.50 | 3 1/2 | 7.38 | 7 3/8 |

*The values in Table 4.7 apply to the use of roundslings in a basket hitch when the two ends of the sling are attached to a single connection point. Use table 4.6 when roundslings are used in a basket hitch when the two ends of the sling are attached to separate connection points.

*2 These values are rounded up the closest fractional equivalent.

*3 These values also equal the approximate natural flattening width of the roundsling.

4.7.1.1 **Effective Contact Width between the Sling and Connection Hardware**

a. Connection to Flat-Bottom Surfaced Hardware – Such hardware connections include pins, bolts and trunnions. The value of the effective contact width is equal to the opening width or spread of the sling at the connection area (See Figure 4-7). Please note, however, that the effective contact width will never exceed the natural flattening width of the sling as listed in Tables 4-6 and 4-7.

b. Connection to Round-Bottom (or Curved) Surfaced Hardware – Such hardware connections include links, hooks, or the bow ends of shackles. To determine the value of the effective contact width, multiply the inside opening width of the hardware by a factor of .75 (See Figure 4-8). For connections to the base of hooks, multiply the value of the radius at the hook base by a factor of 1.5 to determine the effective contact

width. Please note, however, that the effective contact width will never exceed the natural flattening width of the sling as listed in Tables 4-6 and 4-7.

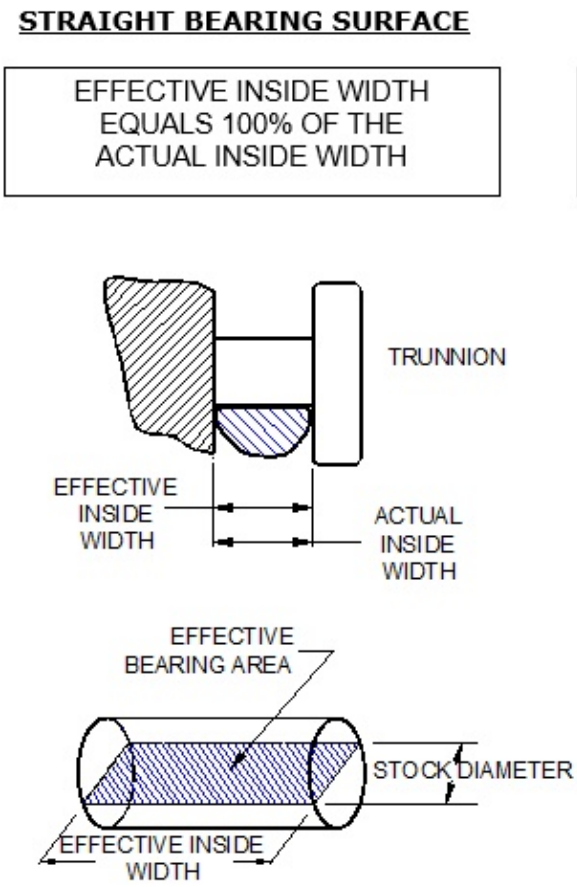



*Figure 4-7*

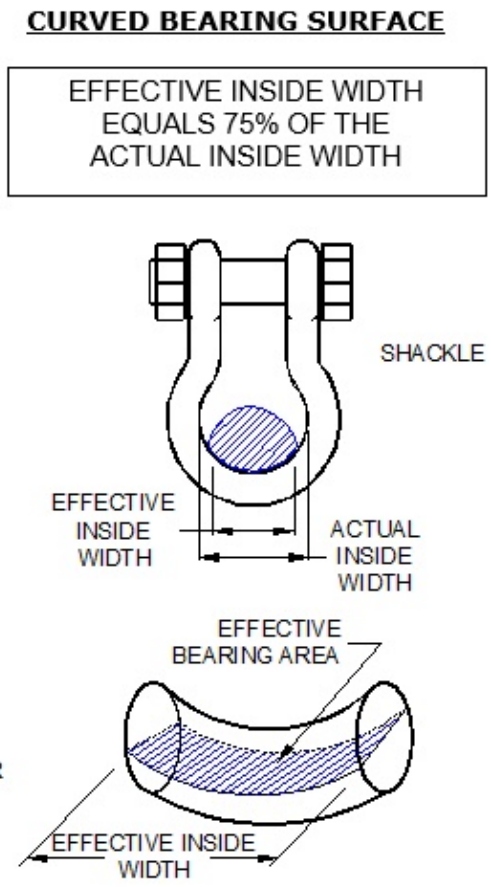



*Figure 4-8*

*Note:*

*Roundsling strength is affected by the size of the connection hardware. For special applications wherein a retained design factor of 5 is required to be maintained, contact the sling manufacturer, as a capacity reduction of 20% may be appropriate in order to satisfy this criteria.*

4.7.1.2 **Load Bearing Area at the Hardware Connection** – The load bearing area at the hardware connection is determined by multiplying the thickness or stock diameter of the hardware by the effective contact width at the connection.

**Load Bearing Area = (Hardware Thickness or Stock Diameter) x (Effective Contact Width)**

4.7.1.3 **Calculating Bearing Stress Values at the Hardware Connection** – The bearing stress value is determined by dividing the amount of loading on the sling by the load bearing area at the hardware connection.

$$\text{Bearing Stress} = \frac{\text{Sling Load Value (in Pounds)}}{\textbf{Load Bearing Area}}$$

***Example:*** A size 3 polyester roundsling, rated at 8,400 lbs. in a vertical hitch, is connected in a vertical hitch using the rounded bow end of a shackle that is smaller in size to that listed in Table 4-6. The shackle has a stock diameter of only .62 inch, and an inside opening width of 2 inches. However, a force of only 6,000 lbs. is applied, noticeably less that the rated capacity of the sling (See Figure 4-9). Is this use of the selected shackle acceptable?

6,000 Lbs. of Force ←

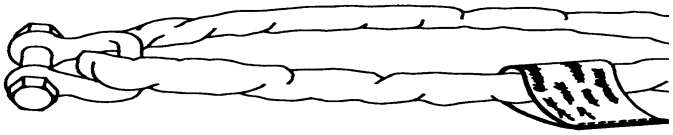


*Figure 4-9*

***Answer:*** Since the shackle size is smaller than recommended for a size 3 roundsling per Table 4-6, we need to establish that the bearing stress value does not exceed 7,000 Lbs./$in^2$ during use.

Since the bearing surface of the shackle is rounded;

Effective Contact Width = (.75) x (The shackle inside width) = (.75) x (2 inches)
= **1.50 inches**

And;

Load Bearing Area = (The shackle stock diameter) x (The Effective Contact Width)
= (.62 inches) x (1.50 inches) = **.93 in$^2$**

Bearing Stress Value = (The Applied Force) / (Load Bearing Area)
= (6,000 Lbs.) / (.93 in.$^2$)
= **6,451 Lbs. / in.$^2$**

Therefore, since the bearing stress value is less than 7,000 Lbs./in$^2$ during use, **the selected shackle size is suitable for use.**

## Section 4.8 OTHER MECHANICAL CONSIDERATIONS

4.8.1 Roundslings in contact with edges, corners, or protrusions MUST ALWAYS be protected with materials of sufficient strength, thickness, and construction to prevent sling damage.

4.8.2 Roundslings should be protected from abrasive surfaces.

4.8.3 Determine the weight of the load. Roundslings must not be loaded in excess of the rated capacity. Consideration must be given to the sling angle, which affects rated capacity. (See Effect of Sling Angle, Section 4.5.1).

4.8.4 Select roundslings having suitable characteristics for the type of load, hitch and environment.

4.8.5 Roundslings with fittings that are used in a choker hitch must be of sufficient length to ensure that the choking action is on the roundsling, and never on the fitting or sling tag.

4.8.6 Roundslings used in a basket hitch must have the load balanced to prevent slippage and maintain control of the load.

4.8.7 The openings in fittings must be the proper shape and size to ensure that the fittings will seat properly on the roundsling, crane hook, or other attachments.

4.8.8 All surface areas of fittings that will come into contact with the roundsling during use must be smooth and any edges shall have sufficient radii to prevent cutting or other forms of damage to the roundsling.

4.8.9 Roundslings should not be dragged on the floor or over an abrasive surface.

4.8.10 A half twist (180$^{o}$) may be applied to any roundsling to facilitate its attachment. However, roundslings must not be twisted further or be tied into knots to shorten their length or be joined to another roundsling by knotting them together. Roundslings must be shortened, lengthened or adjusted only by methods approved by the manufacturer.

4.8.11 Roundslings should not be pulled from under loads when the load is resting on the roundsling.

4.8.12 Roundslings must not be used for pulling against stuck, snagged or restrained objects.

4.8.13 Do not drop roundslings equipped with metal fittings.

4.8.14 Roundslings that appear to be damaged must not be used unless inspected and accepted as usable under Section 4.4 by a qualified person.

4.8.15 Roundslings must be hitched in a manner providing control of the load.

4.8.16 Personnel must not stand under, on or next to suspended loads or rigging that is under tension.

4.8.17 All portions of the human body must be kept from being placed between the roundslings and the load, and from between the roundsling and the crane or hoist hook.

4.8.18 Personnel must not ride roundslings, or loads suspended by the roundslings, and roundslings must not be used as bridles on suspended personnel platforms.

4.8.19 Shock loading must be avoided.

4.8.20 Load applied to a hook must be centered in the bowl of the hook to prevent point loading.

4.8.21 During use, personnel must be alert for possible snagging of the load or roundsling.

4.8.22 The roundsling legs (branches) must contain or support the load from the sides above the center of gravity when using a basket hitch.

4.8.23 Tags and labels should be kept away from the load, hook and point of choke.

4.8.24 Roundslings should not be constricted or bunched between the ears of a clevis or shackle, or in a hook. When a roundsling is used with a shackle, it is recommended that it be used (rigged) in the bow of the shackle. When this is not possible, protect the sling connection areas from damage.

4.8.25 Place blocks under load prior to setting down the load, to allow removal of the roundsling, if applicable.

4.8.26 For lifts using multiple slings or multiple-leg bridle slings on nonsymmetrical loads, an analysis by a qualified person should be performed to prevent overloading of any leg.

## Section 4.9 ENVIRONMENTAL CONSIDERATIONS

4.9.1 Roundslings, when not in use, should be stored in a cool, dry, and dark place to prevent loss of strength from exposure to sources of ultraviolet light. Roundslings must not be stored in chemically active areas or where mechanical or environmental damage could occur.

4.9.2 If roundslings are cleaned, use only mild soap and water. Rinse slings thoroughly and allow to dry completely before storing. Do not machine wash slings. Machine washing of roundsling will result in significant strength loss.

4.9.3 Chemically active environments can affect the strength of roundslings in varying degrees ranging from little to total degradation. The roundsling manufacturer, or qualified person, should be consulted before roundslings are used in a chemically active environment. Each chemical application must be evaluated, taking into consideration the following:

a. Type of acid or alkalis
b. Exposure conditions, i.e. liquid, vapor, mist
c. Concentration
d. Temperature
e. Duration of exposure

4.9.3 Roundslings incorporating aluminum fittings must not be used where fumes, vapors, sprays, mists or liquids of alkalis and/or acids are present, unless the compatibility is verified.

4.9.4 Roundslings containing polyester load bearing yarn must not be used at temperatures in excess of 194° F (90° C), or at temperatures below minus 40° F (-40° C). For short term, single exposure applications at temperatures elevated slightly higher than the above values, sling users may consult with the sling manufacturer and seek written approval to allow this practice.

## Section 4.10 REPAIRS

4.10.1 There shall be no repairs of load bearing fibers.

4.10.2 Repairs to the protective covers shall be done only by the original manufacturer or their appointed agent. When slings are repaired, the sling should be tagged to identify the repair agent.

4.10.3 Only roundslings which can be identified from the information on the identification tag shall be repaired.

4.10.4 All repaired roundslings shall be proof tested to a minimum of two (2) times the rated capacity before being put back into service. Certification of proof test should be provided.

4.10.5 Temporary repairs of roundslings or fittings shall not be permitted.

## Appendix 1 - The USE OF ROUNDSLINGS AROUND EDGES – Calculation Method

A.1.1 *Required Radius of rounded edges* – Alternate Calculation Method

As an alternative to the chart, the minimum radius size for use with polyester roundslings may be calculated using the following formula*:

$$\text{Minimum Edge Radius in Inches} = \frac{\text{(Sling Vertical Hitch Rated Capacity in Lbs. )}}{\text{20,000 x (Sling Width in Inches)}}$$

* Reference information is available in Appendix A.1.2, describing the basis for this calculation.

Note:

- *Slings not loaded to their full capacity* - If a roundsling will not be tensioned to its full rated capacity, then the minimum edge radius will decline proportionately to the reduction in tension that is applied to the sling. This adjustment can be made by multiplying the value from the above equation, or from Table 4-5, by the percentage of load relative to the sling's capacity for the hitch type in use. For example, if a sling is tensioned to 50% of its rated capacity, then the minimum edge radius value will equal one-half of the value listed in table 4-5.
- *Sling contact width that is restricted during use* - If the sling width will be restricted at the edge contact area, such that the sling contact width will be less than the values shown in table 4-5 for the sling width at load, then the minimum edge radius will increase by an amount that is inversely proportional to this reduction.
- *Slings being pulled at angles* - If the slings are being used at an angle, then use section 4.5.1 to help determine the actual tension that is applied to the sling.
- *Polyester roundslings being used in a choker hitch* – For the purpose of simplicity, the minimum edge radius values shown in table 4-5 have been prescribed for the use with polyester roundslings, independent of the hitch type in use. However, the adoption of a 20% reduction in the edge radius from the charted values may be applied for use in a choker hitch is also an acceptable practice. This is due to the fact that the choker hitch rated capacity values are 20% less than the vertical hitch capacity values.
- *Using multiple slings or bridle slings with multiple legs* – Whenever an application requires rigging that consists of multiple slings or sling legs that are not all rigged uniformly, then calculations can be completed for each sling or sling leg. In many cases, however, users may find it simpler to first determine which leg, if any, will be exposed to the most severe conditions and then use this information to determine if edge protection is required for all edges in contact with the sling(s).

- *Sling Protection* – Generally, when sling protection is chosen for the purpose of guarding roundslings from direct contact with unsuitable edges, it should be capable of generating an edge radius that conforms to the size noted in this section. However, contact your sling supplier for recommendations that will be suitable for your particular sling application.

***Example:***

A quantity of two, size 3 roundslings, each rated at 16,800 lbs. in a basket hitch per Table 2-1, are being used in a basket hitch to lift a bundle of steel weighing 20,000 lbs.. If they are tensioned equally and pulling straight up, then will sling protection be required if the load edges have a .19 inch radius?

***Answer:***

Firstly, we know that the radius of .19 inches does not conform to the radius value of .26 inches that is prescribed for a size 3 sling per table 4-5. Thus, we will need to confirm whether the tension applied to the sling is low enough to preclude the need to use edge protection. We will use the following calculation:

$$\text{Min. Edge Radius} = \frac{\text{Sling Vertical Rated Capacity (Lbs.)}}{20{,}000 \times \text{Sling Width (Inches)}} \times \frac{\text{Actual Loading for hitch used (Inches)}}{\text{Rated Capacity for hitch used}}$$

If we understand that the sling width at the contact areas with the load is not restricted, we will prescribe a sling width, from table 4-5, of 1.62 inches. In this example, each of the two slings will be tensioned to a force equal to one half of the load weight, or 10,000 lbs. each. This tension value is considerably less than the full sling capacity value of 16,800 lbs. in a basket hitch. We will use the above calculation to determine the actual minimum allowable edge radius as follows:

$$\text{Min. Edge Radius (Inches)} = \frac{8{,}400}{20{,}000 \times 1.62} \times \frac{10{,}000 \text{ Lbs.}}{16{,}800 \text{ Lbs.}}$$

**Minimum Edge Radius (Inches) = .154 inch**

**In this example, sling protection will not be a requirement because the actual edge radius of .19 inch is larger than the minimum required radius of .154 inch.**

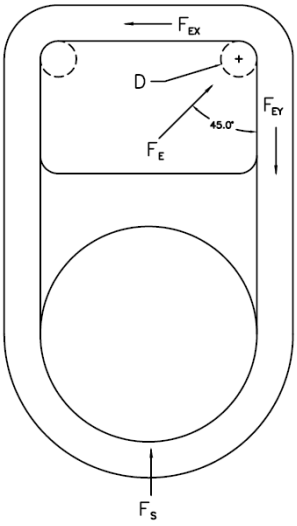
Note: The first part of the calculation represents the required edge radius when the sling is tensioned to its full rated capacity value. This applies even if the sling is being used in a basket hitch, because, in comparison to a vertical hitch, the increase in capacity is offset by the fact that twice as many contact points are made with the load.

The second part of the equation represents the proportion or percent of loading relative to the full rated capacity of the sling. In this example the sling is tensioned to only 59.5%

of its rated capacity. Thus, the required minimum edge radius will be only 59.5% of the table values shown for a sling being used at its full rated capacity. In this case, 59.5% of the prescribed edge radius of .26 inch equals a value of .154 inch.

A.1.2 Required Radius of rounded edges –Supporting Calculations

For the purpose of aiding sling manufacturers in reviewing special sling designs or materials, the supporting sling calculations are noted. The equation for checking the suitability of contacting edges, as shown in Appendix A.1.1, was established from the following calculations, where the Force along an edge ($F_E$), is directly associated to the total Force applied to the sling ($F_S$). The bearing pressure value at the contacting edge was set to a chosen limit of 7,000 lbs./in$^2$. This limit was chosen based on the examination of an edge test study completed by WSTDA. This value was chosen so as to limit the effect on the sling by a controlled amount, whereby a minimum design factor of at least 4 for the average test values for each manufacturer in the study was maintained.




FORCE CALCULATIONS:

$F_{EY} = .5 \times F_S$

$F_{EX} = F_{EY}$ (ASSUMED)

$F_E = F_{EY}/\cos(45) = .5(F_S)/.707$

$F_E = .707 \times F_S$

*Figure A1-1*

Calculations:

$$\text{Bearing Stress at the Edge} = \frac{FE}{(\text{Sling Width}) \times [\text{Edge Diameter, or } 2 \times (\text{Edge Radius})]}$$

$$\text{Edge radius} = \frac{FE}{2 \times (\text{Sling Width}) \times (\text{Bearing Stress})}$$

solving for Edge Radius yields >

Substituting from above FE = .707 x FS

and where the Maximum Bearing Stress = 7,000 Lbs./in$^2$

$$\text{Minimum edge radius (inches)} = \frac{\text{FS (Lbs.)}}{(20{,}000\ \text{Lbs./in}^2) \times \text{Sling Width (inches)}}$$

Note: A value of 19,800 was rounded up to 20,000 in this equation

## *WEB SLING & ROUNDSLING INSPECTION*

Page ___ of ___

Company _____ Distributor _____

Address _____ Contact _____

_____ Email _____

Contact _____ Date _____

_____ Survey By _____ And _____

Rev. 9/08

| | LOCATION | DESCRIPTION / PRODUCT NO. | MANUFACTURER | LOT / SERIAL NO. | LENGTH (FT.) | CONDITION | | | CUT | TORN | BURN | PUNCTURE | DAMAGED FITTING | NO / ILLEGIBLE TAG | SPECIAL INSTRUCTIONS OR COMMENTS |
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# WEB SLING & TIE DOWN ASSOCIATION PUBLICATIONS

## *Recommended Standard Specifications for:*

- Synthetic Web Slings (WSTDA-WS-1)
- Synthetic Polyester Roundslings (WSTDA-RS-1)
- High Performance Yarn (HPY) Roundslings (RS-1HP)
- Synthetic Webbing for Slings (WSTDA-WB-1)
- Sewing Threads for Slings & Tie Downs (WSTDA-TH-1)
- Synthetic Web Tie Downs (WSTDA-T-1)
- Winches Used With Web Tie Downs (WSTDA-T-3)
- Synthetic Webbing Used for Tie Downs (WSTDA-T-4)
- Load Binders Used with Chain Tie Downs (WSTDA-T-6)
- Strength & Elongation Test Method for Sling & Tie Down Webbings (WSTDA-TM-1)

## *Operating, Care & Inspection Manuals for:*

- Synthetic Web Slings (WSTDA-WS-2)
- Synthetic Polyester Roundslings (WSTDA-RS-2)
- Synthetic Web Tie Downs (WSTDA-T-2)

***Download free, single-use copies of the above Standards and Manuals at www.wstda.com***

***Available for Purchase from Web Sling & Tie Down Association:***

### *Warning Products: Available in English, Spanish and French*

- Warning Labels: Web Slings, Roundslings, High Performance Yarn Roundslings, Web Tie Downs
- Safety Bulletins: Web Slings, Roundslings, High Performance Yarn Roundslings, Web Tie Downs

### *Illustrated Wall Chart*

- Inspection of Web Slings & Roundslings (WSTDA-WSWC-1)

### *UV Degradation Reports*

- UV Degradation Testing Program for Web Slings: Summary Report (2003) (WSTDA-UV-Sling-2003)
- UV Degradation Testing Program for Web Slings: Graphs (Mini Manual) (WSTDA-UV-MM-2005)
- UV Degradation Testing Program for Web Slings: Report (1981, revised 2005) (WSTDA-UVDR-1981)
-

***For ordering information and prices, contact the association office or visit our website:***

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Email: wstda@stringfellowgroup.net
Web Site: www.wstda.com

This Recommended Standard Specification has been formulated as a guide to users, industry and government, to ensure the proper use, maintenance and inspection of synthetic roundslings. The existence of this recommended standard specification does not prevent members of the Web Sling and Tie Down Association, and other manufacturers, from manufacturing or selling products beyond the scope of this recommended standard specification.