Disclaimer for

AWRF Recommended Guideline for Proof Test Procedures for Slings

Part I: Alloy Chain Slings

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1. Scope

This Recommended Guideline describes the requirements and recommended procedures for proof testing of alloy steel chain slings (e.g. grade 63, 80, 100, or higher) and components on horizontal or vertical test machines that meet or exceed the requirements of the referenced standards and specifications. The chain slings shall be welded or mechanically assembled using manufacturer's specified procedures.

2. Reference Documents:

ASME B 30.9 Chapter 1:
Alloy Steel Chain Slings: Selection, Use, and Maintenance

ASTM A 906/A, 906M:
Standard Specification for Grade 80 and Grade 100 Alloy Steel Chain Slings for Overhead Lifting

ASTM A 952/A 952M:
Standard Specification for Forged Grade 80 and Grade 100 Steel Lifting Components and Welded Attachment Links

NACM:
Welded Steel Chain Specifications

3. Definitions

3.1 Proof Test: A non-destructive quality control test applied to a chain sling or components of a sling. It is the force that the sling and/or components have withstood under a test in which a constantly increasing force has been applied in direct tension.

4. Test Machine Requirements

4.1 The test machine shall be of suitable type and construction to fit the intended use.

4.2 Test machines and/or load sensing devices shall be calibrated to the latest revision of either of the following specifications:
ASTM E4
Standard Practices for Force Verification of Testing Machines

ISO 7500-1
Metallic materials – Verification of Static Uniaxial Testing Machines – Part 1: Tension/compression testing machines – Verification and calibration of the force-measuring system – Class 1

5. Precautions and Hazards

It is recommended that the load testing and operation of the test equipment be conducted following the AWRF “Practices and Guidelines for the Operation of Test Machines”. (Document available in 2007)

6. Sample Preparation and General Proof Test Requirements

6.1 Slings should be reasonably clean to enable a visual inspection.

6.2 Slings should have passed visual inspection per ASME B30.9 or other applicable specifications before proof testing.

6.3 Slings shall be loaded into the test machine without any twists, in direct tension.

6.4 The test machine fixtures shall ensure that the sling is aligned with the direction of the applied force.
Note: Off-centered load test attachments or sensing devices may result in false load indications.

6.5 The proof test load should be applied for a minimum of 5 seconds.

6.6 After the proof test has been completed, slings shall be visually inspected for any dangerous defects. Additional inspection methods for chain attachments, such as die-penetrant or magnetic particle, may be performed.

7. Proof Test Load Requirements

7.1 All components attached to single legs shall be proof tested to 2 times the manufacturers published working load limit for the size and grade chain or the lowest rated component.

7.2 All components, such as master links and master coupling links, attached to two legs shall be proof tested to 4 times the working load limit of the lowest rated component.

7.3 All components, such as master links, attached to three or four legs shall be proof tested to 6 times the working load limit of the lowest rated component.

7.4 The required proof test loads for all components attached to standard size and grades of alloy chains are given in Table 1.
8. Proof Test Requirement

8.1 All Slings

8.1.1 All components of a chain sling shall have been proof tested before the sling is put into service.

8.2 New Slings

8.2.1 Welded chain slings shall be proof tested before the sling is being put into service.

8.2.2 Mechanical components that have previously been proof tested that have not been modified from the original manufactured condition are not required to be proof tested.

8.2.3 It is recommended to proof test the entire sling after manufacture.
8.3 Repaired Slings

8.3.1 All components of a repaired chain sling shall have been proof tested before the sling is put into service.

8.3.2 All repaired chains and components that involved welding or heat treating shall be proof tested prior to be returned to service.

8.3.3 The entire sling assembly should be proof tested after any repairs have been made.

8.3.4 The repaired sling shall be marked with the month, year, and the company which performed the inspection, repair, and proof test.

9. Recommended Practice for Proof Testing Slings

9.1 Single leg slings

9.1.1 Apply the required proof test load to the entire sling, with the load points being the upper end fitting and the lower end fitting.

\[ 2 \times \text{vertical capacity of single leg (2 x WLL)} \]

9.2 Double-leg Slings

9.2.1 Each Leg: Apply the required proof test load to each leg of the sling, with the load points being the master ink and each of the lower end fittings.

\[ 2 \times \text{vertical capacity of single leg (2 x WLL)} \]

Alternately, if the sling will fit into the test equipment, the proof test for each leg may be applied to both legs at the same time. The load points would be the two lower end fittings. (Note, the master link would be in the middle).
9.2.2 **Master Link**
Apply the required proof test load to the master link. The load shall be applied to the master link by itself, or with the load points being the master link and both lower end fittings. (See 9.2.3.) For master link test pin sizes refer to section 10.1

![Master Link Diagram](image)

9.2.3 **Entire Sling**
The proof test requirements of 9.2.1 and 9.2.2 can be met by applying the required proof test load to the entire sling providing the following load conditions. The load points would be the master link and both lower end fittings provided that there is a load equalizing method to assure that the proof test load is equalized between both legs and that there is less than a 10° included angle between the legs. For master link test pin sizes refer to section 10.1

![Entire Sling Diagram](image)

9.3 **Single Basket Slings**

9.3.1 **Entire Sling**: Apply the required proof test load with the load points being the master link and the bottom of the basket. The fixtures used at the bottom of the basket should follow Section 10.5. For master link test pin sizes refer to section 10.1

![Single Basket Sling Diagram](image)
9.4 **Endless Sling**

9.4.1 **Entire Sling:** Apply the required proof test load with the fixtures following Section 10.5.

![Diagram of Endless Sling]

\[
4 \times \text{vertical capacity of single leg (4 x WLL)}
\]

9.5 **Triple and Quadruple-leg Slings**

9.5.1 **Each Leg:** Apply the required proof test load to each leg of the sling, with the load points being the master link and each of the lower end fittings.

![Diagram of Triple and Quadruple-leg Slings]

\[
2 \times \text{vertical capacity of single leg (2 x WLL)}
\]

Alternately, if the sling will fit in the test equipment, the proof test for each leg can be applied to two legs at the same time in the manner described in Section 9.2.1.

![Diagram of Alternate Test Procedure]
9.5.2 Master Coupling Links / 2 legs at the same time: Apply the required proof test load to each master coupling link, with the load points being the master link and both of the lower end fittings attached to the master coupling link provided that there is a load equalizing method to assure that the proof load is equalized between both legs and that there is less than a 10° included angle between the legs.

9.5.3: Master Coupling Link Assembly / 4 legs at the same time: The proof test requirements of 8.2.1 and 8.2.3 can be met by applying the required proof test load to the entire sling providing the following load conditions. The load points would be all of the end fittings provided that there is a equalizing method to assure that the proof test load is equalized between each pair of legs and that there is less than a 10° included angle between the legs.

NOTE: This test method does NOT qualify as a ‘complete sling test’ as the master link requires to be tested to 6 times the vertical capacity of the single leg (6 x WLL); see Table 1.

9.5.4 Master Link: Apply the required proof test load to the master link. The load shall be applied to the master link itself. For master link test pin sizes refer to section 10.1
9.6 Double Basket Slings:

9.6.1 Each Basket: Apply the required proof test load to each of the baskets with the load points being the master link and the bottom of the basket. The fixtures used at the bottom of the basket should follow the guidelines of Section 10.5 and ensure that there is less than a 10˚ included angle within the basket.

![Diagram of Double Basket Slings]

4 x vertical capacity of single leg (4 x WLL)

NOTE: This test method does NOT qualify as a ‘complete sling test’ as the master link requires to be tested to 6 times the vertical capacity of the single leg (6 x WLL); see Table 1.

9.6.2 Master Link: Apply the required proof test load to the master link. The load can be applied to the master link by itself, or with the load points being the master link and the bottom of both baskets. The fixtures used at the bottom of the basket should follow the guidelines of Section 10.5. and ensure that there is less than a 10˚ included angle within the basket. The included angle between the centerline of the basket slings shall not exceed 80˚. For master link test pin sizes refer to section 10.1

![Diagram of Master Link Test]

6 x vertical capacity of single leg (6 x WLL)

This configuration for master link testing ONLY

Note: Alternate to large collars or pins: a slotted wheel fixture is a preferred method to connect the bearing section of a chain basket to the proof test fixture. Each chain diameter shall require a separate slotted wheel of having a minimum diameter of a 10:1 D/d ratio. For further details refer to section 10.5
9.7 Adjustable Slings:

9.7.1 Each Leg: The adjustable legs on adjustable slings shall meet the proof test requirements for single leg slings. The proof test on the adjustable leg shall be applied per the methods described in Section 9.2.

9.7.2 Master Link and all 4 legs: The below graphic displays a test method to test all legs and the master link at the same time since the adjustment legs are not counted as load carrying connections to the master link. The load equalization fixtures must ensure that there is a less than 10° included angle between the sling legs.

Note: The adjustable legs are not counted as connections to master coupling links or master links for determining the proof test load applied (number of legs) to these components.

9.7.3 Master Link: If the above method as described under 9.7.2 is unsuitable for a particular test machine or setup the load shall be applied directly to the master link. For master link test pin sizes refer to section 10.1
9.8 Adjustable Basket Slings:

9.8.1 **Adjustable Single Basket Sling:** The proof test shall be applied to a single adjustable basket by either treating the assembly as a double leg sling (see Section 9.2) or by using a fixture to place the chain into the grab hook and proof testing as a single basket chain (see Section 9.3). The fixtures used at the bottom of the basket should follow the guidelines of Section 10.5. For master link test pin sizes refer to section 10.1

Note: The above configuration tests the master link AND the basket leg at the same time and must ensure that there is less than a 10° included angle between the basket legs.

The test leg fixtures should follow section 10.7
9.8.2 **Adjustable Double Basket Sling:** The proof test shall be applied to a double adjustable basket by either treating the assembly as a quadruple leg sling (see Section 9.5) or by using a fixture to place the chain into the grab hooks and proof testing as a double basket chain (see Section 9.6). The fixtures used at the bottom of the basket should follow the guidelines of Section 10.5 and must ensure that there is less than a 10˚ included angle between the basket legs. For master link test pin sizes refer to section 10.1

NOTE: The above test method does NOT qualify as a 'complete sling test' as the master link requires to be tested to 6 times the vertical capacity of the single leg (6 x WLL); see Table 1.
Master Link Test
For master link test pin sizes refer to section 10.1

The fixtures used at the bottom of the basket should follow the guidelines of Section 10.5. and ensure that there is less than a 10˚ included angle within the basket. The included angle between the centerline of the basket slings shall not exceed 80˚.

NOTE: The above test method does NOT qualify as a ‘complete sling test’ as the master link requires to be tested to 6 times the vertical capacity of the single leg (6 x WLL); see Table 1 which is less than the combined proof test load of all sling legs.

9.9 Long Leg Slings:

9.9.1: When chain legs are longer than the proof test equipment bed, it is permissible to apply the proof test in sections. The fixtures used for the chain should follow the guidelines of Section 10.6.

10. Guidelines for Proof Test Fixtures for Slings

The fixtures used for proof testing chain slings will vary depending on the type of sling, the type(s) of components in the sling, the type of test equipment, and the number of intended uses for the fixtures. Determining the correct fixtures for each specified test will require experience, training and appropriate rigging practices by the tester.

Fixtures and operation should comply with the AWRF “Practices and Guidelines for the Operation of Test Machines” (available 2007). Permanent test fixtures should be marked to indicate the maximum load for which they are to be used.

Care should be taken so as to select fixtures that do not cause point loading, localized damage or deformation to the components and slings being proof tested. Below are the recommended guidelines:
10.1 **Master Links:** Suitably large pins or fixtures should be used to prevent localized point contact damage to master links. Ideally, the radius of the pin should match that of the inside radius of the master link. From a practical standpoint, the minimum pin diameter should be at least 40% of the inside width of the master link if not specified by the manufacturer.

![Diagram of pin size comparison](image)

10.2 **Hooks (except grab hooks):** Suitably large pins or fixtures should be used to prevent localized point contact damage to hooks.

10.3 **Grab Hooks:** Grab hooks should be loaded at the bottom of the hook. A practical way to achieve this is to insert a appropriate sized master link into the hook as the fixture (applies only to grab hooks without support cradle). It is also acceptable to use a piece of the correct size and grade chain as the fixture for grab hooks (see 10.7).

10.4 **Claw Grab Hooks:** A piece of the correct size and grade chain is the easiest and most practical fixture (see 10.7).

10.5 **Basket Slings:** Suitably large pins or fixtures should be used to prevent localized point contact damage to the chain. Ideally, the fixture should be slotted to allow the vertical plane of the chain to remain vertical. From a practical standpoint, the slotted wheel shall have at least an outside diameter of 10 x the nominal chain diameter (D/d of 10:1), the slot width shall ensure a snug fit of the chain, the slot depth shall be at least equal to the inside width of the chain.

![Diagram of slotted wheel](image)
10.6 **Continuous Chain:** The fixtures used to test sections of continuous chain should securely support the shoulders of the link. The slot opening should be no more than 125% of the actual diameter of the chain. One way to achieve this is to have a set of adjustable blocks set at 45-degree angles from their vertical or 90-degree included angle between blocks (see photograph).

![V-Block Assembly](image)

Another method is a pouch block fixture for each chain size (see photograph).

![Pouch Block Fixture](image)

10.7 **Chain Ends:** Chain slings shall be proof tested by applying the proof test load up to and including the last chain link. The fixtures used to test this free end of chain should be of the same diameter or larger and of the same strength or greater than the chain. From a practical standpoint, it is easy to use cut pieces of chain of the same diameter or the next larger size.

![Chain Ends](image)
Reference Document addresses:

American Society of Mechanical Engineers (ASME),
Three Park Avenue,
New York NY 10016-5990
U.S.A.

www.asme.org

ASTM International (ASTM)
100 Barr Harbour Drive
P.O. Box. C700
West Conshohocken, PA 19428-2959
U.S.A.

www.astm.org

National Association of Chain Manufacturers (NACM)
P.O. Box 22681
Lehigh Valley, PA 18002-2681
U.S.A.

www.nacm.info

International Organization for Standardization (ISO)
Case Postale 56
CH-1211 Geneve 20
Switzerland

www.iso.org

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