Reversed vs. Non-Reversed Risers

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By **Relative Workshop**

The term, reversed riser, refers to those risers which are builtwithout putting a grommet through the riser itself. Instead, these risers have a piece oftape with a grommet set through it which is attached above the 3-ring. The loop, whichtypically goes over the uppermost part of the smallest ring and back through a grommet setthrough the riser, now goes under the uppermost part of the ring and through the grommetin the tape. Reversed, or grommetless risers have a higher breaking strength than typicalType-17 risers which have a grommet set through the riser webbing; however, the methodthese reversed risers use to secure the 3-ring produces higher forces needed to cutawaythan risers using the typical method of 3-ring closure.

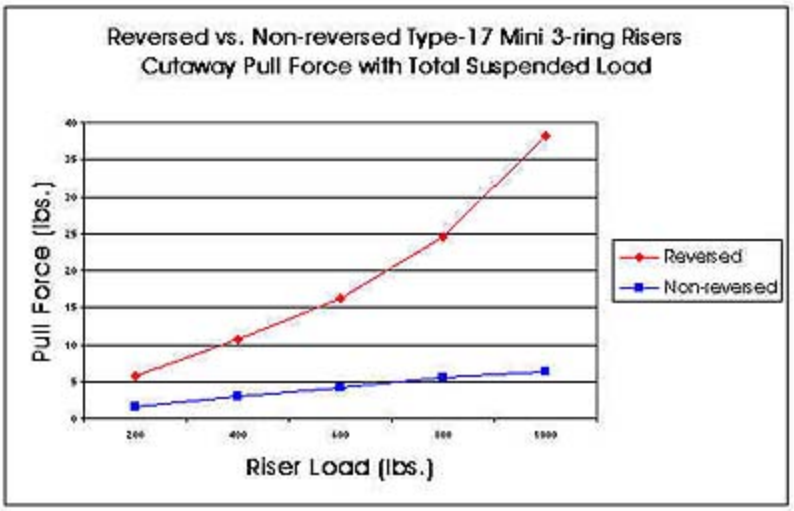
The two 3-ring sections at the right are identical and both can beclosed either in the typical, non-reversed fashion, or in the reversed fashion as shown. Ariser like this was used to measure the cutaway pull force at various riser loads usingboth methods of 3-ring closure.

In Table 1, the results from single riser tests have been doubled toapproximate the total cutaway force vs. total suspended load, assuming a 50/50 right andleft riser load distribution. The graph of this data can be seen in Figure 1. The valuesfor cutaway pull force in Table 1 do not account for the left risers long housing friction.

Table 1: Reversed vs. Non-reversed CutawayPull Force Comparison

Total Suspended	G-Force	Total Cutaway Pull Force (lbs.)*	
Load (lbs.)	*200 lb. Jumper*	**Reversed**	**Non-reversed**
200	1	**5.7**	**1.5**
400	2	**10.8**	**3.0**
600	3	**16.2**	**4.1**
800	4	**24.7**	**5.5**
1000	5	**38.3**	**6.4**

*Values do not account for the left riser's longhousing friction.



What's the Difference?: Lower Mechanical Advantage

Figure 2 depicts the 3-ring closing method of a typical, non-reversed riser. The loop, shown in red, travels around the top of the small ring, creating a pulley with a mechanical advantage of approximately 1.5. Thus, the cable sees only 67% of the force needed to hold the small ring upright.

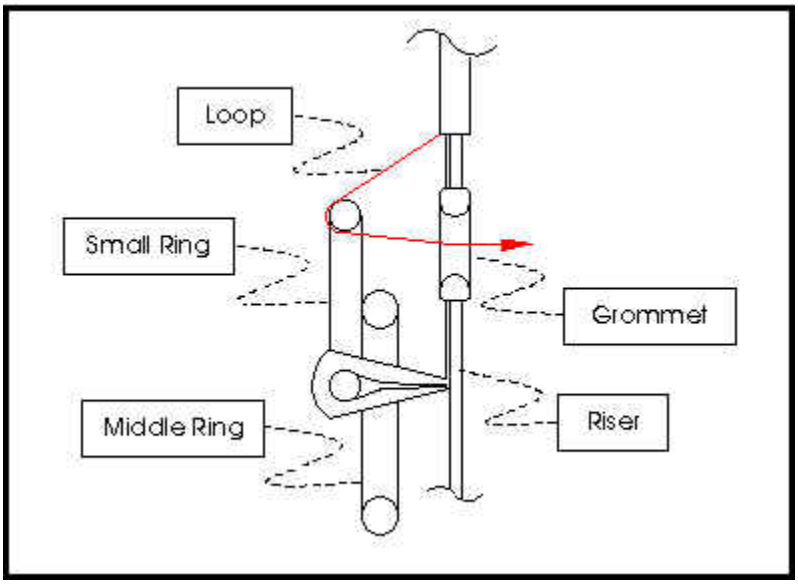


Figure 2: Typical Riser 3-Ring Closing Method

Figure 3 depicts the 3-ring closing method of a reversed riser. Because the loop, shown in red, does not go around the small ring, NO pulley is created. Therefore, NO mechanical advantage is added with the loop. The cable sees at least the force needed to hold the small ring upright.

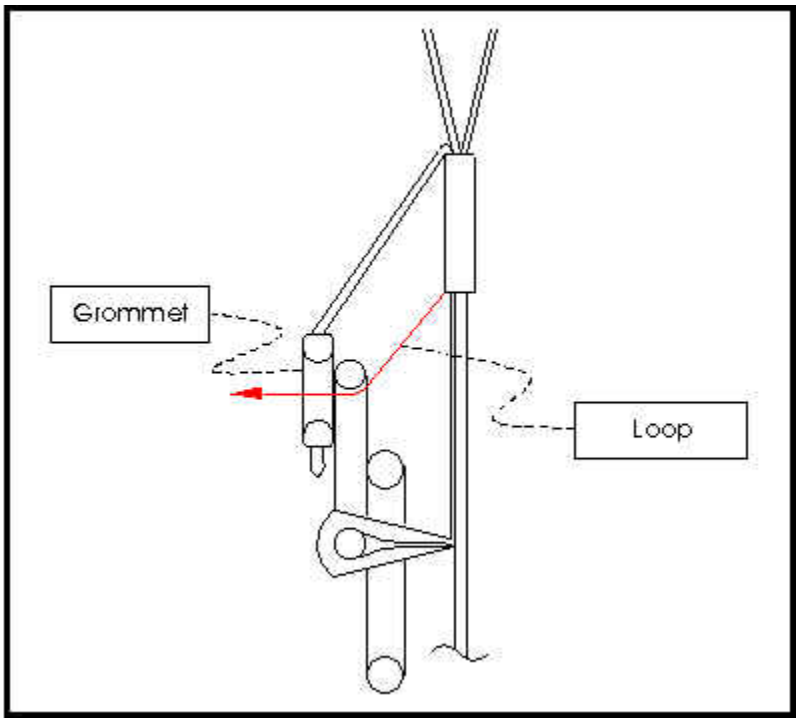


Figure 3: Reversed Riser 3-Ring Closing Method

What's the Difference?: Increased Loop Force During Riser Stretch

Figure 4 depicts how the geometry of a typical, non-reversed 3-ring system is affected by riser stretch during loading. Because the loop and small ring act like a pulley, the small ring is given more freedom to move away from the loop attachment when forced by the middle ring during riser stretch. This freedom helps to prevent the loop from exerting excessive forces on the cable as the riser is loaded.

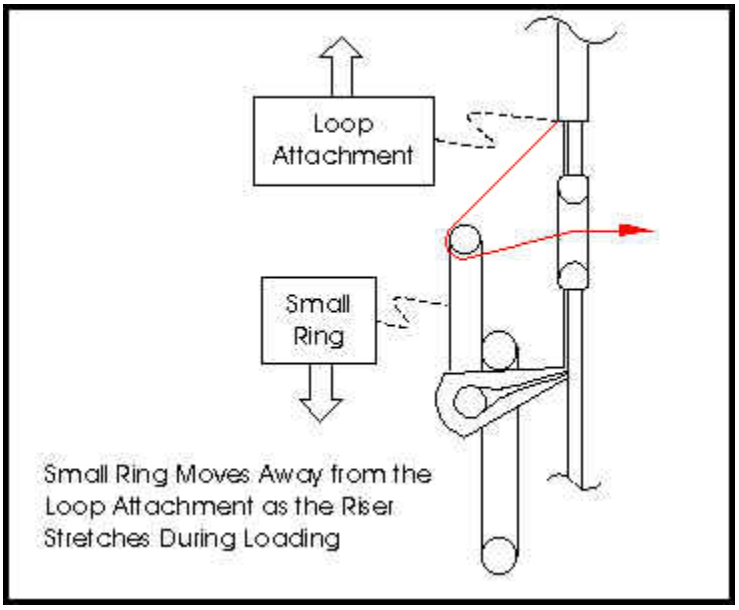


Figure 4: Typical Riser 3-Ring Under Heavy Load

Figure 5 depicts how the geometry of a reversed 3-ring system is affected by riser stretch during loading. Because the loop and small ring DO NOT act like a pulley, the ring has no freedom to move away from the loop attachment when forced by the middle ring during riser stretch. This lack of freedom causes the small ring to exert force on the loop as it moves away from the loop attachment and grommet. This force is transferred directly to the cable.

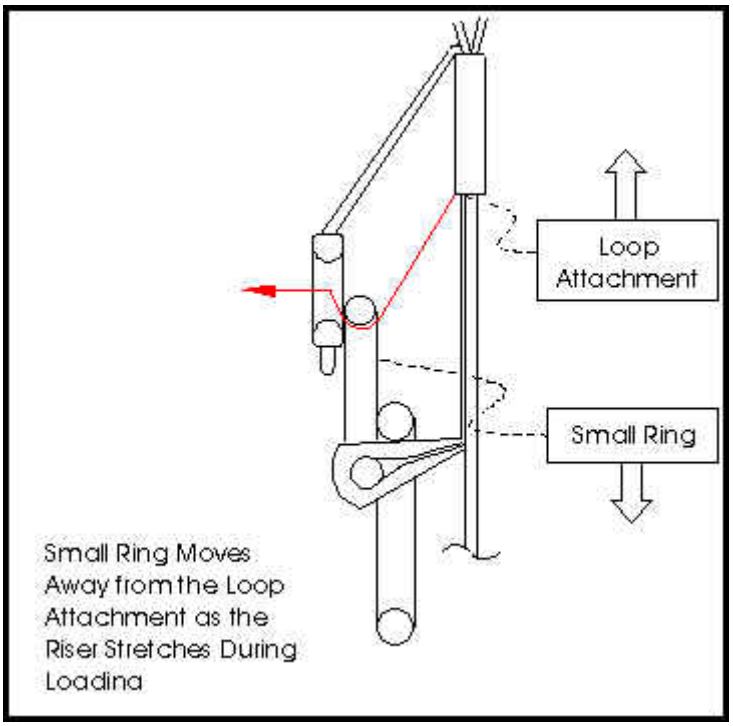


Figure 5: Reversed Riser 3-Ring Under Heavy Load

Ability to Cutaway More Important Than Riser Breaking Strength

The chance that you will need to cutaway from a malfunctioning maincanopy is higher than the chance you will find yourself with a broken main riser. The needto be able to cutaway in a highly loaded situation is the most important function of yourriser.

Prior to 1993, Type-17 Mini 3-ring Risers were built without Type-3tape reinforcement. These risers had an average breaking strength of 2,500 lb. Due toreports of broken risers from the field, manufactures attempted to increase the breakingstrength of the riser. Two solutions hit the market. One solution was to reinforce theriser with tape. Another solution was the Reversed Riser, which has no grommet through theriser webbing which weakens that area.

The breaking strength of two Reversed, Type-17 Mini 3-ring Risersamples were compared with four samples of Non-reversed, Type-17 Mini 3-ring Risers; twobuilt to the May, 1993 specification and two built to the August, 1998 specification. Allsamples had tape reinforcement.

While the average breaking strength of the reversed risers was 455lbs. higher than the May, 1993 spec risers and 460 lbs. higher than the August, 1998 spec.risers, both reversed riser

samples malfunctioned at just over 2000 lbs. In both samples,the yellow cable was pulled through the grommet by the loop *(See the section of thisdisplay entitled "What's the Difference?").* None of the non-reversedsamples malfunctioned prior to breaking.

Reversed **Type-17 Mini 3-ring**	**Non-reversed – May, '93** **Type-17 Mini 3-ring**	**Non-reversed – Aug., '98** **Type-17 Mini 3-ring**
Breaking Strength: Sample 1 – 3942 lbs. Sample 2 – 3849 lbs. *Average – 3891 lbs.* Notes: The cable was pulled through the grommet at just over 2000 lbs. for both samples. This malfunction can, and most likely will, prevent a cutaway.	Breaking Strength: Sample 1 – 3277 lbs. Sample 2 – 3595 lbs. *Average – 3436 lbs.* Notes: The cable was pulled through the grommet in Sample 1 immediately after riser break due to the riser breaking at the grommet. This does not prevent a cutaway.	Breaking Strength: Sample 1 – 3312 lbs. Sample 2 – 3551 lbs. *Average – 3431 lbs.* Notes: Both broke at main ring contact. In neither case was the cable pulled through the grommet. *Ask about how the 08/98 spec. is designed to reduce breaking at grommet.*

Note From Relative Workshop:

Our work with Reversed Riser (or Grommetless Riser) has continued beyond the writing of this piece of information. What we have found is that not all reversed risers look like those pictured in this article. We have actually found some which function - with respect to pull force vs. riser load - much better than those pictured. However, the risers are still faced towards the harness which can create a problem.

The main problem with reversed risers is that there is no standard published on how to build them right. We have only tested one set out of...I'd say...20 that had a nice pull force vs. riser load curve. Just look at three reversed risers built by three different manufacturers and you'll realize that none look identical.

Relative Workshop has a published specification for the 3-ring release system, and most people follow it because we've done a great deal of testing to arrive at those specifications. The same should be true for reversed risers, but it isn't unfortunately. Also unfortunately, the general skydiving public does not know this. They just trust that the manufacturer of their equipment is doing it right.

Send comments or questions to aimee@relativeworkshop.com