Rigging Working Group

E1.43 - 202x, Performer Flying Systems
Public Review 1 Comment Resolutions

Reference document: E1.43 - 202x, *Performer Flying Systems* (Document number Rig/2020-2032r0e)

ANSI Public review period: 11 August 2023 through 25 September 2023

Question: In your opinion, do you think the requirements of E1.43 - 202x*, Performer Flying Systems* (DCN Rig/2020-2032r0e) are reasonable, and adequately address the intended subject matter?

Please answer the question using one of the options below. Select “Yes”, “Yes, but…” (provide comments to support your opinion), or “No, with reasons” (the document’s requirements are unacceptable or unreasonable).

Responses:

Tyler DeLong, DeLong Rigging Solutions (TD)	Yes, but...
Reid Neslage (RN)	No, with reasons
Steve Gale, Radiant Productions LLC - DBA Imagination Entertainment (SG)	No, with reasons
Ryan Kunkel, TAIT (RK)	Yes, but...
Nate Edie, Pirates Voyage - World Choice Investments LLC (NE)	No, with reasons

Individual Comments:

No.	Commenter	Ref. section	Comment	Response
1	TD	Foreword	In the foreword it is stated that " it has been assumed in the drafting of this standard that the execution of its design provisions is entrusted to appropriately qualified and experienced people, and that the fabrication and use is carried out by qualified and suitably experienced people and organizations." and in the scope it is stated that the" document establishes a minimum level of performance requirements for the design, manufacture, use, and maintenance of statically hung, manually driven, mechanized, and automated performer flying systems used in the production of entertainment events." While this draft of E1.43 is a notable step in the right direction, I find it hard to reconcile the two above statements with the fact that there appears to be a double standard within the document.	**Reject.** Commenter offers an opinion but does not propose a change in these two paragraphs. Rigging Working Group believes comment leads into subsequent comments (No. 3 below).
2	RN	6.1.6	AS STATED: *6.1.6 Where the performer flying system is attached to rigging equipment or other components deemed not suitable for flying people by the*	**Accept in principle.** Revise text as follows: “6.1.6 If the flying system designer determines

			manufacturer, the flying system designer shall use RA/RR to determine appropriate use and take on full responsibility for this use. REVISE TO: *6.1.6 Where the performer flying system is attached to rigging equipment or other components, the flying system designer shall use RA/RR to determine appropriate use and take on full responsibility for this use.* REASON: A standard should not be written so that a product labeled not for a specific use (flying people) by the manufacturer, may now be used, provided a third party states by their determination, that is now acceptable and without the manufacturer's knowledge. Public	that it is appropriate to use or attach to rigging equipment or other components considered by the manufacturer to be unsuitable for flying people as part of the performer flying system, the flying system designer shall take full responsibility for such use. In such cases, documentation of the rationale for such use based on RA/RR shall be included in system documentation." **Reject.** The difference is that 8.5.4.1.2 allows lower design factors based on either physical testing or engineering calculations. Empirical testing offers a level of reliability greater than data listed from a supplier, but the testing must be conducted under the supervision of a qualified person. Similarly, if engineering calculations are used to improve reliability of the data, they must be prepared by a qualified person. A key issue here is that a "qualified person" is only qualified in the context of their experience. For example, the qualified Engineer preparing the calculations is likely not a qualified person to assemble the flying rig, or a qualified aerial rigger may not have sufficient experience to be qualified to supervise material physical testing.
3	TD	8.5.4.1.1 and 8.5.4.1.2	8.5.4.1.1 Unless otherwise noted in this standard, flexible lifting medium (e.g., cable, rope, chain, band, webbing) shall be designed with a minimum design factor of 10 X working load, 6 X characteristic load, and 3 X peak load. 8.5.4.1.2 In situations where the characteristic loads and peak loads are confirmed by documented empirical testing data conducted under the supervision of a qualified person or by engineering calculations prepared by a qualified person, the flying system designer is permitted to reduce the design factor to 5 X characteristic load and 2 X peak load. Why is the lesser design factor only acceptable when you have empirical evidence? The Standard is supposed to be the minimum that as an industry it is agreed upon to consider " safe" . For this standard, as with all standards, an individual (whom we' ve established is assumed to be appropriately qualified and experienced) can and should exceed the minimum established by this standard when their Risk Assessment (which is required by section 5.1 .1 RA/RR) deems the minimum design factor is insufficient. So, which do we consider the minnimum [sic] that "appropriately qualified and experienced" individual should use? Is it "6 X characteristic load, and 3 X peak load" or "5 X characteristic load and 2 X peak load"?	

4	SG	8.5.4.1.2	CURRENT: 8.5.4.1.2 In situations where the characteristic loads and peak loads are confirmed by documented empirical testing data conducted under the supervision of a qualified person or by engineering calculations prepared by a qualified person, the flying system designer is permitted to reduce the design factor to 5 X characteristic load and 2 X peak load. CHANGE: 8.5.4.1.2 In situations where the characteristic loads and peak loads are confirmed by documented empirical testing data conducted under the supervision of a qualified person or by engineering calculations prepared by a qualified person, the flying system designer is permitted to reduce the design factor to 5 X characteristic load and 2 X peak load, or 4 X characteristic load and 4 X peak load. REASON: We have been flying aerialists since 1998 using 3/16 7x19 galvanized wire rope with a working load limit of 420 Lbs. and a breaking strength of 4200 Lbs. This has been utilized with various performer flying hoists since 2000 that are grooved for 3/16" wire rope. In 2008 we had load cells placed on an array of circus acts for 6 months on a TV show called Celebrity Circus on NBC. Then, after the original performer flying standard was published in 2016, we started measuring the characteristic and peak loads of acts we had traditionally flown on these hoists. We found the characteristic and peak loads of 4 X were in line with what the 3/16" wire ropes had been utilized in thousands of productions over the last 25 years. Furthermore, design factors higher than 4x would mean changing to larger diameter ropes than had historically been used, not to mention changing the hoist drums and pulley diameters of associated gear that has proven itself since 1998 for us as well as others. This data had also been documented by the hoist manufacturer, and various circus studios and gyms around the country that we have been associated with for the same time frame. These include Gymcats Henderson, Inversion Entertainment, Cirque Mechanics, De Leon Dynamics, Aerial Warehouse, Aerial Revolution, The Aerial Studio and Cirque School LA. These gyms have adults and kids on average for 4 hours a day for 5-6 days a week utilizing the same gear. We have also used these winches at circus competitions where there are multiple aerial acts. A single competition will have approximately 800 uses and we have done 8 of these to date.	**Accept in Principle.** The Rigging Working Group has proposed reduced design factors from the original publication of E1.43 and has concluded that the stated design factors are appropriate. The appropriate method for justifying a lower characteristic design factor is to use RA/RR preferably supported by empirical load testing. The Rigging Working Group has added the following clause that is in the current standard to support this statement: **6 Intent.** The intent of this section is to establish requirements for the design and engineering of performer flying systems and system components. Variations on the design requirements listed in sections 6, 7 (Engineering) and 8 (System Components) shall be permitted pursuant to RA/RR, or review and approval by a Professional Engineer.

5	NE	8.5.4.1.2	CURRENT CLAUSE: 8.5.4.1.2 In situations where the characteristic loads and peak loads are confirmed by documented empirical testing data conducted under the supervision of a qualified person or by engineering calculations prepared by a qualified person, the flying system designer is permitted to reduce the design factor to 5 X characteristic load and 2 X peak load. CHANGE by adding the following clause afterwards: 8.5.4.1.3 In situations where the characteristic loads and peak loads are confirmed by documented empirical testing data conducted under the supervision of a qualified person or by engineering calculations prepared by a qualified person, and the characteristic load is also the peak load, the flying system designer is permitted to reduce the design factor to 4 X characteristic load if the peak load is increased to 4 X. The reason is as follows. We have automated performer flying systems that were installed in one of our venues in 2011. These systems do around 350 performances and 1400 rehearsals annually. There is an aerialist drop at the finale which generates a force of 925 lbs. This is both the characteristic load and the peak load. The flexible lifting medium is 3/16" 7x19 stainless steel aircraft cable with a published breaking strength of 3700 lbs. This is a design factor of 4x (3700÷925=4). This cable is changed annually during which it's subjected to 1750 cycles. After the cable has been removed from its destructive tested and shows no degradation of breaking strength. We have 12 years of data, which is also documented by the flying system manufacturer, ZFX Inc. We feel this demonstrates that 10x,4x,4x design factors which we use are safe for flexible lifting medium and should be incorporated into the standard.	**Accept in Principle.** The Rigging Working Group has proposed reduced design factors from the original publication of E1.43 and has concluded that the stated design factors are appropriate. The appropriate method for justifying a lower characteristic design factor is to use RA/RR preferably supported by empirical load testing. The Rigging Working Group has added the following clause that is in the current standard to support this statement: **6 Intent.** The intent of this section is to establish requirements for the design and engineering of performer flying systems and system components. Variations on the design requirements listed in sections 6, 7 (Engineering) and 8 (System Components) shall be permitted pursuant to RA/RR, or review and approval by a Professional Engineer.
6	RK	8.5.4.3.2 and 8.6.1.2	In regards to 8.5.4.3.2 and 8.6.1.2, do WLL checks apply? If not necessary the standard should explicitly note they do not apply. Does the engineer need to perform Ultimate checks at WLL still even through there isn't a yield consideration?	**Accept in principle.** Proposed edits are as follows (edits underlined): 2.10 Design Factor: A ratio of the Ultimate Load Carrying Capacity of a material or component to the design load. 2.11 Design Factor Against Yield: A ratio of the minimum yielding value of a material or component to the design load. 8.5.4.3 Rigid Lifting Medium 8.5.4.3.1 Rigid Lifting Medium shall be designed with a minimum Design Factor of 8 X Working Load, 5 X Characteristic Load, and 2 X Peak

				Load. 8.5.4.3.2 Where design code equations include analysis of material yield stress and ultimate stress, analysis at Working Load is not required. Static Load Bearing Components shall be designed with a minimum Design Factor Against Yield of 3 X Characteristic Load and 1.5 X Peak Load and a minimum Design Factor per 8.5.4.3.1 for Characteristic Load and Peak Load. 8.6.1 Strength 8.6.1.1 Static Load Bearing Components shall be designed with a minimum Design Factor of 6.5 X Working Load, 4 X Characteristic Load and 2 X Peak Load. 8.6.1.2 Where design code equations include analysis of material yield stress and ultimate stress, analysis at Working Load is not required. Static Load Bearing Components shall be designed with a minimum Design Factor Against Yield of 2.5 X Characteristic Load and 1.25 X Peak Load and a minimum Design Factor per 8.6.1.1 for Characteristic Load and Peak Load.
7	RK	8.6.1.2	In the factors of safety table, 8.6.1.2 row says "w/ confirmed characteristic load" but shouldnt it say "including material yield"?	**Accept in principle.** Change chart in A7.1.2 to read: “8.6.1.2 Static load bearing components including material yield.”
8	RK	Factors of Safety	and custom components with hand calcs, I think the "include material yield" line is confusing. Seems like a bearing calc for example would fall under this category even though it only considers ultimate strength. With the added explanation I understand but if I were reading this with no context I wouldn't understand when to use that second set of safety factors. I think the word "yield" should be taken out and replaced with "when the strength of the component is determined through analysis" or something similar.	**Accept in principle.** See response to No. 6 above.

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9	RK	Factors of safety table	The factor of safety table was a sweet add. Any chance we can make that table a comprehensive deal and include all clearly defined factors of safety for yield and rupture in that table for all diff classifications of elements? That would be one thing I would like to try and improve in there and make it a fast one stop shop.	**Reject.** The table is included in the Annex to assist users but is not meant to replace the clauses in which each design factor is presented in the standard.
10	RK	Weld design	Please clarify weld design. The standard states all welds shall comply to AWS, but no reference in definitions of what FS apply to welds. Do these just need to follow the Static Load Bearing Component FS or can there be a section added in similar to Load Bearing Hardware?	**Reject.** Design factors for welds are addressed in Sections 7.1.2 and 7.4.
11	RK	Performer tethering	Per the standard all performers on flying vessels, platforms, or props must be tethered to load path. For a large platform or ride on prop, can engineered handrail or walls be used instead of a tether. Requiring an artist to be tethered is sometimes impractical.	**Accept in principle.** Clause to be edited as follows (edits underlined): 8.3.2.5 All Flying Performers riding on or in flying vessels, platforms, or Ride-on Props shall be tethered directly to the Load Path, unless other means are provided for protecting the Flying Performer as determined by RA/RR.
12	SG	11.5	CURRENT: 11.5.3.4.3 Dynamic proof load test: 1 X WLL with Category 1 stop if applicable, Full Speed in both directions. Distances traveled after initiation of stop shall be recorded and included with SAT documentation. CHANGE: 11.5.3.4.3 Dynamic proof load test: 1 X WLL with Category 1 stop if applicable, Full Speed in both directions. REASON: When performing the commission test, the travel distance information is useless to us and everyone asking for us to do the testing. These recorded distances change constantly based on the speed where the limit is hit as well as the weight of the performer. This constant changing variable of measured distance doesn't help anyone recording it or looking at it. Generally, we have to explain why the distances are all over the place based on the speed and weight of the performer and that it's only important that the limits either work or don't. What ends up being important is that the limits stop before injury or damage has occurred.	**Accept in principle.** Clause to be edited as follows (edits underlined): 11.5.3.4.3 Dynamic proof load test: 1 X WLL with Category 1 stop if applicable, Full Speed in both directions. Distances traveled after initiation of stop shall be recorded and included with SAT documentation, unless determined by RA/RR to not be needed.