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It takes careful planning to provide fall protection on portable structures, particularly ones used outdoors, but ANSI E1.39 helps. (2011 Nuit Blanche, Toronto, Ontario)

What is a portable structure? Fall arrest requirements you need to know about from *ANSI E1.39-2015*

BY KEITH BOHN

HAVE YOU HEARD? The PLASA Technical Standards Program has successfully completed a new ANSI standard from the Rigging Working Group. *ANSI E1.39-2015, Entertainment Technology – Selection and Use of Personal Fall Arrest Systems on Portable Structures Used in the Entertainment Industry*, is now available at http://tsp.plasa.org/tsp/documents/index.html.

Like quite a few of the documents coming from the Rigging Working Group, this standard assists in bridging the gap between many existing general industry standards and entertainment rigging. As those of us in entertainment know, there are scenarios that we encounter regularly that don't always fit into the nice little box currently outlined in the existing guidance, at least not without tracking down a lot of information and doing a fair bit of interpretation.

There is good info in *ANSI E1.39*, which is relevant to anyone who designs, manufactures, specifies, sells, inspects, or uses fall protection equipment in the entertainment industry. A quick glance over the table of contents provides some sense of what is addressed, but, let's get started with the scope. It reads, "This standard establishes minimum requirements for the selection and use of personal fall arrest

systems (PFAS) on portable structures in the entertainment industry. In addition, the standard establishes minimum requirements for products and portable structures used in the services of PFAS. The requirements for other methods used to protect workers from fall hazards such as safety nets, guard rails, and rope access techniques are not included in this standard. This standard does not preclude the use of other appropriate standards to promote fall protection safety."

There are a couple things that should jump out to readers. One, is the use of the word "minimum." I have regularly heard or read comments on other standards from users saying they do more than what a given standard might require. Great! If you want to exceed what is outlined here, that's wonderful, however, this is where the bar is set, so meet this at a minimum.

Next, notice that not only are PFAS included in the scope, but also the products and structures "used in the service" of PFAS. The explanatory notes, which are helpfully adjacent to the clause they address, identify some examples. In entertainment, this could include scaffold, truss structures, and tents, to name a few.

Moving on within the scope, the last two sentences are important as they set some additional boundaries for the document. For example, there are worker protection techniques and devices that, while helpful and necessary in various applications, are not considered PFAS and not addressed. Additionally, the use of this document does not eliminate or replace the use of other pertinent fall protection safety standards.

Knowing now what is covered within the pages, the remaining part of the first section of *ANSI E1.39-2015* outlines a few other important factors. The stated intent of the document is indeed bridging the gap between existing standards and the entertainment industry, including theatre, film, touring, etc. Lastly, is a list of reference documents that range from aluminum truss (*ANSI E1.2-2013*) to fall protection (*ANSI A10.32-2004*) and PFAS systems (multiple parts of *ANSI Z359*), to applicable *Code of Federal Regulations (CFR)* standards, which are the OSHA references.

Section 2 outlines definitions needed to understand *E1.39-2015*. As with all standards, this is an important section to review prior to reading the rest of the document. Even if you figure that you know what a specific word or phrase means, it is important to understand how it is defined within the context of the standard at hand. All of the definitions listed are important, but let's limit this discussion to a critical few.

The lucky winner is "structure," as in "use of PFAS on portable structures." We are compelled to understand exactly how "structure" is defined, and this document establishes three critical structure types. The first of these is simply "portable structure," defined as "an assembled system of reusable structural components specifically designed to be disassembled and moved easily." This clearly identifies the range of what is included, as mentioned earlier. It is important to note the use of the word "portable" as opposed to "temporary." In this context, "portable" could include structures that are in place for an indefinite amount of time, whereas "temporary" clearly implies a time limit and is defined in a variety of ways depending on which code or standard you reference.

The next two definitions related to "structure" are also helpful in understanding the next section of the document. "Supported structure" is essentially one that is ground-supported, an assembly of components that "bear on grade and the stability of which is provided primarily by elements acting in compression." The inverse to this, is the next definition

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Stu Cox proposed to his fiancée, Tina Lachance, on a portable structure, while a horizontal life line, full-body harnesses, and helmets helped protect both of them from injury. (2014 Much Music Video Awards, Toronto, Ontario)

of "suspended structure." This would include structures that are hanging from a supporting structure above "and the stability of which is provided primarily by elements acting in tension."

Based on these last two definitions, it is possible to have multiple structures at a single entertainment event. It is also possible that an event could have both types of structures with a suspended structure requiring PFAS, hanging from a supported structure also requiring PFAS. This becomes quite a complicated scenario since there will be a multitude of layers and potential reactions that must be considered throughout. That is, the potential loads created by the arresting forces on the suspended system must be added to the self-weight of the suspended system in order to get a total load, or reaction, that will then be a load on the supported (ground-based) structure. This is really no different than hanging a lighting truss and assessing the suitability of the rigging points within a building. However, anyone recognizing the potential complex nature of a ground support system will understand how quickly these loads can become unmanageable.

Moving on to Section 3, the document begins to identify the specific requirements for the aforementioned structures. As you would guess, there are some clauses covering all structures and some that are specific to the two sub-types. Within the general guidelines in Section 3.1, the first few clauses speak to ensuring that a structure is properly designed, used, and suitable for fall arrest forces. Also outlined are requirements that a structure must include anchorages for a minimum of one user and one rescuer simultaneously, but there is a design allowance to reduce that to one user if the rescue plan does not require access to the structure itself.

Within Section 3, there are requirements for drawings. While the Section 5 requirements for documentation do not explicitly mention the drawings identified in the structures section, it is important to realize that a risk assessment and hazard plan are going to be impossible to complete without them. The structure drawings, to be completed by a qualified person, include identifying expected equipment loads, maximum number of simultaneous workers and their locations, locations of fall arrest anchorages, and details of the anchorages themselves.

Specific to suspended structures in Section 3.2, there are only four clauses, but each requirement is critical to safety. First, all the loads must be analyzed through each of the supporting components all the way to the supporting structure. The word "all" is used here, so this is including reactions from arresting forces, equipment loads, and structure self-weight.

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The second clause states that "the arresting forces shall not cause a suspension member to become unloaded during the arrest." This is referring to the possibility of a chain hoist, or other suspension device becoming slack and unloaded if an arrest takes place. This is a likely reaction if a horizontal life line is attached between two chain hoists and not properly anchored. Once the arrest takes place on the horizontal line, the two chain hoists would be pulled together, and for a period of time, the load on the hoists would be zero. What will happen next is that the load would get reapplied to the hoists, but now with a dynamic force that the system may, or may not, be capable of withstanding. Imagine a lighting truss bouncing when this happens. In the past, attachment of fall protection in this manner was a frequent occurrence. Fortunately, more knowledge within the industry has created safer situations and most have moved away from this practice.

Lastly, for suspended structures there are requirements to limit the movement of the structure created by an arrest. Furthermore, each structure shall be designed to support equipment loads plus twice the weight of the maximum number of workers anywhere on the structure.

Quickly comparing the suspended structure requirements to that of a supported structure, the only addition is the requirement of PFAS if a tower is used to access the structure. Rounding out Section 3, there are requirements for planning PFAS for use on a scaffold structure.

Regarding all this discussion on structure requirements, there has been industry discussion regarding the suitability of aluminum truss and PFAS and it is appropriate to include it here. Most aluminum truss is manufactured as a purpose built component. Its usage parameters, i.e. load tables, are usually quite clearly, and narrowly, defined. For example, a given length of truss span of a certain size of truss, is capable of supporting a specific static load, indoors, centered beneath the main axis of the truss, if the truss is supported at panel points, and the load is applied at panel points, based on using a specific length of truss module, with no cantilevers. See all the specifics in that? The reason standard truss usage is so tightly defined is simply that there is no way to cover all of the possibilities. There has to be some baseline as a starting point for loading.

Fall arrest systems on aluminum truss is yet another variable in an infinite list of possibilities. It is this variability that *E1.39-2015* addresses by requiring the system to be designed specifically for the loads. Some of the critical design factors in determining if a span of truss is suitable to PFAS would not simply be limited to the length of span and location of anchorage, but also location of equipment loads, relative distance between anchorage and supports, and the height of anchorage on the truss. So while a standard manufactured truss module may be completely appropriate for the equipment

loads and requirements of a PFAS, someone (a qualified person) must validate the details to ensure complete system suitability. Sorry. It isn't as simple as taking stuff off the shelf.

. . . a discussion here can't replace the value of reading the standard itself.

If you're still with me here, we can move on to the rest of the document.

Section 4 addresses the requirements for the PFAS. Once again, everything in this standard is important, and included for good reason. The general section here discusses conflicts between standards, transferring between systems, potential fall path consideration, resulting structure deflection and limits for arrest force (900 lb.) and deceleration distance (42"). This section further addresses limits on users for a horizontal lifeline, and lanyard requirements. Lastly, in Section 4, are the requirements and specifics related to a rescue plan. The first requirement is that a rescue plan must be written. The plan shall encompass requirements during erection and dismantle of the portable structure as well as retrieval of a fallen user and availability of rescue personnel.

As with many things now, word-of-mouth or napkin sketches don't quite cut it anymore. *ANSI E1.39-2015*, Section 5 requires that all documentation be written and available at the work site. A written hazard plan shall be completed as well as the rescue plan that is outlined in the previous section. Moreover, user instructions and details of anchorage points shall be made available to the users.

Section 6, PFAS Equipment Selection, Installation, and Use, is the most detailed of all sections within the standard. While arguably the most important part of the document, a discussion here can't replace the value of reading the standard itself. It includes the following specific sub-sections: General, Anchorage, Connector, Harness, Horizontal Lifeline, Lanyard, Self-Retracting Lanyard, User Owned Equipment, and Vertical Lifeline. There are details in these pages addressing hoist suspension of portable structures, removal from service, connector rollout, freefall distance, and horizontal lifeline positioning.

Without question, none of this guidance does any good without proper training. Section 7 requires training for both users and rescuers. For users, this includes use, inspection, and limitations of the systems and components. Additionally, the training for users must take place prior to using the PFAS.

Since unsuitable or damaged equipment would negate the effectiveness of the equipment, inspection requirements are outlined in Section 8. A couple things of special note here including clause 8.2, that points out the inspection must encompass all of the equipment within the system, portable structures, and hoists included. As noted in the explanatory notes, there may be different inspection procedures for other components in other standards, such as *ANSI E1.2-2013* for aluminum truss and towers.

Inspections are required prior to each use, and at least annually by a competent person who is not the user. One key responsibility for the competent person that performs the annual inspection, is to validate that the equipment meets or exceeds the regulation requirements at the time of the inspection. Any equipment not meeting this criteria must be removed from service. Lastly, part 8.7 provides a list of other conditions that would necessitate removal from service.

Consistent with *ANSI Z359.1-2007*, storage of PFAS is also included here. While this seems to be another one of those topics that are a given, this is yet another key part of maintenance. Depending on the materials, environmental conditions can have a detrimental effect. The list in Section 9, while not inclusive, mentions considerations like sunlight, corrosive substances, and temperature changes. There is also a requirement that PFAS be air dried prior to storage.

The final section of *ANSI E1.39-2015* is comprised of a simple sketch. This sketch demonstrates one way in which a horizontal lifeline can be attached on a truss, as well as how the lower rigging could be installed to improve lateral stability in the structure.

I implore every person involved with entertainment rigging to become familiar with this document and its contents. There are a number of specifics in this standard that should already be common considerations within the entertainment industry. However, making light of any of them in the sense that "everyone should already know this" is a stupid and arrogant stance that does a disservice to you and anyone who might be depending on you. You never know, you might learn something new, and at the very least you might be validating your own good practices.

Keith Bohn has been in the entertainment industry for over 25 years, involved in the use, manufacturing, and design of structural rigging solutions ranging from simple truss to complex permanently installed structures. Keith has also served the industry through PLASA as a principle voting member for the Rigging Working Group since 1998, and chaired the Task Groups assigned to create and revise *E1.21-2013, Temporary Structures Used for Technical Production of Outdoor Entertainment Events* and *ANSI E1.39-2015, Entertainment Technology – Selection and Use of Personal Fall Arrest Systems on Portable Structures Used in the Entertainment Industry*. A founding contributor of the Event Safety Alliance, Keith contributed on topics contained in *The Event Safety Guide*. He has taught classes on the safe use of truss and outdoor structures worldwide. Keith is currently the Business Development Manager for Production and Rigging Resources in Dallas, TX.