IAAF NEWS

19:1; 47-51, 2004

Hammer throw safety cages

By Benoit Laruel, Denis Wilson, Ray Young

ABSTRACT

The safety of athletes, officials and spectators when the hammer is being thrown is paramount. The IAAF has recently passed new Rules for the construction of hammer cages that will dramatically reduce the danger zone for hammer throwing at international events. The seemingly slow progress in meeting safety challenges for this event has now been overcome. The plans for suggested new hammer cages are shown as well as options for modifying existing cages to improve throwing safety. A method for determining the approximate danger zones and comparing design possibilities is given.

AUTHORS

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Introduction

The IAAF Congress in Paris in August 2003 approved rule changes affecting the design of hammer throw safety cages. The new cage design was based on experience gained at the IAAF Throwing Centre at Szombathely, Hungary. One purpose of this paper is to advise some of the options for bringing existing hammer cages up to the new IAAF rule standards that came into force from 1 January 2004.

History

The last significant change to hammer cage design was in 1994-1995, when the height of the cage netting and particularly the cage gates were significantly increased.

The need for new cage designs arose as it became apparent that the danger zone with 2002-2003 and earlier vintage hammer cages is approximately 85°. With longer distances being thrown in men's hammer events, there was an increased risk of wayward hammers landing on the front and the back straights of the track, even when the cage gates were operated correctly. Three deaths in hammer throwing accidents in Europe in 2000 made it imperative for safety to be increased. The IAAF Technical Committee considered proposals for reducing the distances thrown by increasing the weight of the hammer and/or reducing the length of the hammer, and/or limiting the

number of turns that a hammer thrower can make. However, the Committee decided to improve the cage design as a first step rather than changing the nature of the discipline.

Calculation of throwing danger zone

To determine the approximate maximum danger zone, the release of the hammer head is arbitrarily taken as being tangential to a circumscribing circle 1.4m outside the hammer circle (i.e. 2.407m radius from the centre of the circle) as indicated in Figure 3. A study conducted at the 1999 IAAF World Championships in Athletics Seville during the hammer throw finals seemed to confirm the reasonableness of this assumption, particularly when one takes into account the final positioning of the thrower's feet at the front of the circle and the physical characteristics of the thrower[1].

The danger zone can be determined mathematically or, more approximately, by drawing the release trajectory. The mathematical calculation method gives an 83° danger zone for the pre-2004 cage design compared with the 85° that had been quoted in the IAAF Handbook for many years.

Obviously the point of release of the hammer by different throwers will depend on their throwing technique, final release position within the circle and anthrometrical measurements. However, for the purposes of comparing the effectiveness of different designs this is a reasonable tool.

The new IAAF hammer cage

The basic new hammer cage illustrated in Figure 1 has gates 2.00m wide, is 10m high and has two new panels at least 10m high that move the new gate pivot points out 2.80m parallel to the centreline of the 34.92° landing sector. The danger zone for this new cage is approximately 53° compared with 85° for the present cage design.

The new design reduces dramatically the danger of a hammer thrown by a right handed thrower from a cage near the 1500m start landing on the main straight. As the cage gates are now further away from the throwing circle the throwers will feel less intimidated and there is less danger of the hammer rebounding back on the thrower.

However, the increased distance from the thrower to the gates means the vertical angle to the top of the gates is less than before, so there is some increased risk of a wild throw hitting near the top of the gate and tearing the netting. There will also be a slightly increased risk of an otherwise legitimate

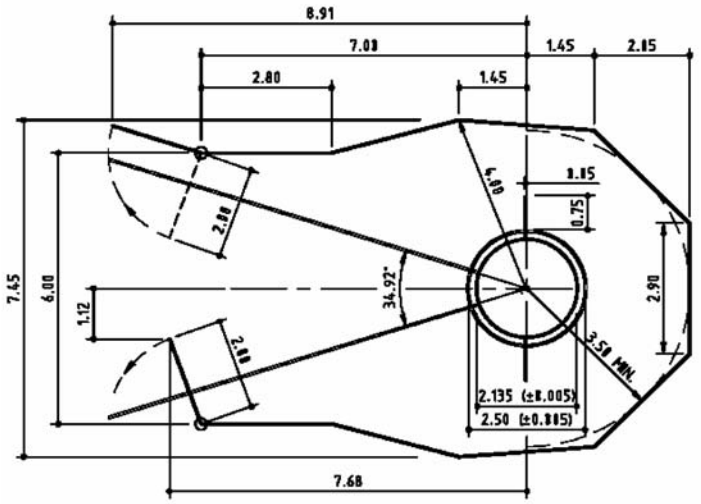

Figure 1: Combined discus and hammer cage with concentric throwing circles. (Dimensions in m)

throw being stopped by the far side netting as the gate netting pivot point is further out from the circle. Nevertheless this is the cage arrangement preferred by the elite throwers and will be the type of cage used at international events.

Hammer cage with separate discus circle

The new hammer cage arrangement is not recommended for existing cages where a separate discus circle is located behind the hammer circle within the same cage. This is because the length of the cage sides with the gates drawn aside, measured from the centre of the discus circle, would be 9.31m compared with the recommended 7m for a stand-alone discus cage.

For new cages, with separate hammer and discus circles, the discus circle will be placed in front of the hammer circle and the hammer gates extended parallel to the centre line of the landing sector to give side wings 6.63m long compared with the 7.00m length for the stand alone discus cage. This arrangement is shown in Figure 2.

IAAF Product Certificate

Hammer cages used at major international events must have an IAAF Product Certificate. Such a certificate will not be granted until a cage constructed to the technical drawings submitted to the IAAF can be examined in situ.

The characteristics that are expected in a well-designed cage would include:

- The cage meets the dimension requirements of the IAAF Rules
- The netting mesh is strong enough so that it does not break under the impact of the hammer, abrade where it is attached or deteriorate unduly under the effects of ultra violet ray exposure
- The net can be quickly raised and lowered
- There is a secure attachment of the netting at ground level, which maintains the net in correct relationship to the throwing circle(s)
- The gate pivot posts and frame are not be exposed so that an implement can hit either and cause damage
- The netting is hung loosely clear of the support posts so that a thrown implement does not strike the posts
- The gates are easy to open and close manually with a positive positioning arrangement in the fully open and closed positions
- The gates maintain their integrity with long-term usage
- The supporting frame is stiff enough so that it does not deflect out of position unduly under the weight of the net and the force of the wind

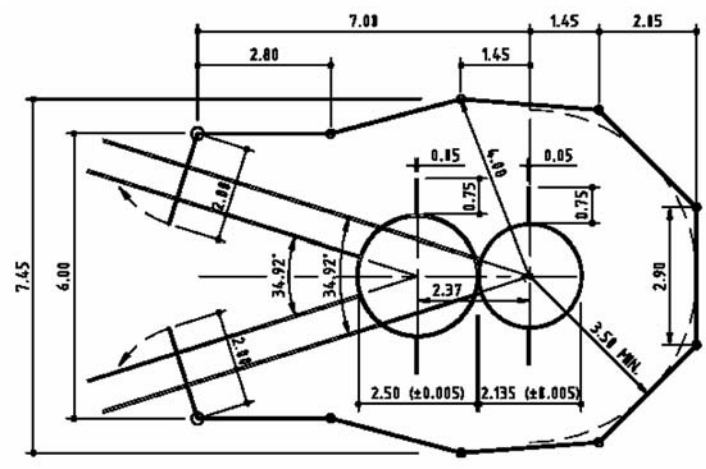

Figure 2: Combined discus and hammer cage with separate throwing circles. (Dimensions in m)

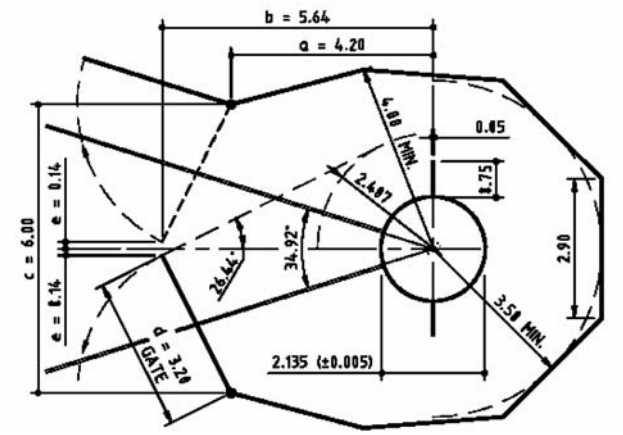

Figure 3: Hammer cage with 3.2m gates (gate to be perpendicular to the throwing line) (Dimensions in m)

Other options:

For existing stadia, the IAAF Rules allow for other cage designs that give at least the same degree of safety as the recommended design. The simplest alternative may be to increase the length of the existing gates from 2m to 3.2m. This arrangement shown in Figure 3 could be cheaper in some circumstances than the IAAF recommended cage alteration but the ease with which officials could shift the gates should be assessed. Also the large gates would be more susceptible to twisting movement in high winds.

The advantages of the increased gate width option are that:

- There is less restriction to hammer throwers on the far side of the cage
- The cage is easier to fit in the D area, especially when a football pitch is used
- The cage would not be restrictive to discus throwers where a discus circle is placed behind the hammer circle in the same cage as the length of the side of the cage, with the hammer gates pulled aside, measures 6.57m from the centre of the discus circle
- The vertical angle to the top of the hammer cage gates remains the same as with the old cage design

If 3.2m wide hammer cage gates are positioned parallel to the landing area centre line with a 6.00m wide gate opening, the total length of the side wings measured from the centre of a concentric discus circle is 7.44m compared with the 7.00m length required for the new discus cage design. The same safety zone angle of 69° can be achieved with a discus cage opening of 6.47m with the 3.24m wide gates angled.

Those cages that have separate hammer and discus circles within the one cage constructed to the design shown in the IAAF Handbook 1998-1999 and earlier could be converted to a concentric discus and hammer circle with the centre line of the circle 5.7m from the cage opening. Using existing 2m wide gates for the hammer throw would give a danger zone of 64°. Increasing the gate width by 0.6m would bring the danger zone down to approximately 53°. Of course, there is still the option of keeping the separate circles but increasing the gate width by 1.2m.

Another possibility is to discard the front hammer circle and convert the rear discus circle to a concentric circle. To ensure that there is 3.5m radius to the rear netting it would be necessary to reduce the overhang of the netting from the rear posts and/or move the posts plus insert a section of new netting. This would also provide the opportunity to reduce any tautness in the existing netting. With the existing 2m gates the danger zone for hammer throwing would be 56°.

Table 1 gives pertinent dimensions for various hammer cage possibilities.

Other Considerations

The location of the existing cage might preclude extending the sides of the cage as it might impinge on the infield used for football.

The manufacturer/designer of the existing cage might be consulted for their recommendations on how their design might be modified to meet the intent of the new IAAF Rule.

Cages that are to designs in the IAAF Handbook 1992-1993 or earlier are not suitable for modification for competitive hammer throwing, as the gates are only 5.5m high. Such cages must be replaced or modified for use for discus throwing only.

	C/L to Pivot a	C/L to Gate Opening b	Cage Opening c	Gate Length d	C/L Opening e	Width of Opening Gate closed	Approximate Danger Zone Degrees	Comments
Pre 2004 Separate Circles Cage converted to concentric circles	5.70	6.30	6.00	2.00	1.09	4.09	64	Use with concentric circles
Pre 2004 Separate Circles Cage converted to concentric circles and the gates increased to 2.6m	5.70	6.86	6.00	2.60	0.67	3.67	53	
Pre 2004 Separate Circles Cage existing discus circle converted to concentric circles.	6.57	7.50	6.00	2.00	1.23	4.23	56	
Pre 2004 Design	4.20	4.88	6.00	2.00	1.12	4.12	83	
2004 Design	7.00	7.88	6.00	2.00	1.21	4.21	53	
Alternative design	4.20	5.66	6.00	3.20	0.14	3.14	53	recommended

Table 1: Alternative hammer cage designs.

Reference

1 GUTIÉRREZ, M.; SOTO, V.M. & ROJAS, F.J. (2002): A biomechanical analysis of the individual techniques of the hammer throw finalists in the Seville Athletics World Championship 1999. IAAF New Studies in Athletics 2.2002, 15-26.

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