Designation: F 1162 – 02

An American National Standard

Standard Specification for Pole Vault Landing Systems[1]

This standard is issued under the fixed designation F 1162; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers minimum requirements of size, physical characteristics of materials, standard testing procedures, labeling and identification of pole vault landing pads intended for users up to 19 ft (5.74 m).

1.2 The values as stated in inch-pound units are to be regarded as the standard. The values in parentheses are given for information only.

1.3 The following safety hazards caveat pertains only to the test methods portion, Section 8, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 Definitions

2.1.1 *base unit sections*, *n*—those components of the primary landing system that provide the majority of the padding behind the planting box. In most pole vault landing systems, they are several large rectangular-shaped sections that compose the vast majority of this portion of the landing system. Base unit sections should be covered by a common top cover. (See Fig. 2.)

2.1.2 *box collar*, *n*—two to four inches of secondary (supplementary) padding around the sides and rear of the planting box that eliminates any and all hard surfaces between the front buns and the edges of the planting box. (See Fig. 3.)

2.1.3 *coaches box*, *n*—a painted or sewn contrasting rectangle on the common top pad, 8 ft (2.68 m) deep and 10 ft (3.05 m) wide, beginning 3.5 ft (1.06 m) behind the zero line. (See Fig. 1.)

2.1.4 *common top cover*, *n*—the top surface of the primary pole vault landing system. It is designated initial landing point. It may function both as padding and as a binder to help hold the base units and front bun sections in place during use, and it also provides a smooth safe surface upon which to land. (See Fig. 2.)

2.1.5 *front bun sections*, *n*—those components of the primary landing system that pad the areas between the standard bases and around the planting box. They should be bound together with straps to each other and to the base unit sections and to the common top pad to provide one continuous landing system. (See Fig. 2.)

2.1.6 *multi-component landing system*, *n*—consists of several component parts or sections that form an integrated system and provide a safe, efficient landing environment.

2.1.7 *pole vault landing pad*, *n*—a device used to decelerate a free-falling human body while pole vaulting.

2.1.8 *primary landing system*, *n*—that portion of a multi-component landing system where the pole vaulter intends to land. It consists of several components (sections) held together with binders so that a continuous safe landing surface is provided.

2.1.9 *secondary (supplementary) padding*, *n*—padding beyond the primary system landing areas that does not have to be covered by a common top pad. Box collars, standard base pads, and additional perimeter padding all fall into this category.

3. Minimum Overall Dimensions of Pole Vault Landing Systems

3.1 Overall dimensions must be based on the kinematics of the human body and the shock-absorbing quality of the material. They must also be based on the comfort and safety of the user.

3.2 If the human body impacts with a 100 % vertical force, the dimension must exceed the length and width of the body.

3.3 If the human body impacts with the horizontal component, the length and width of the landing surface must be derived mathematically based upon the kinematic variables involved in the performance.

NOTE 1—Several studies of pole vaulters indicate the following assumptions that were used to determine the pit dimensions. A vaulter reaching 19 ft (5.80 m) would have a push off horizontal velocity of 4 ft/s (1.2 m/s). This velocity plus the length of the body would not exceed the 16 ft 5 in. (5.0-m) pit length. Less skilled vaulters reaching 10 ft (3 m) may have a push off horizontal velocity of 8 ft/s (2.4 m/s). This velocity plus the length of the body would not exceed the 16 ft 5 in. (5.0-m) pit length.

[1] This specification is under the jurisdiction of ASTM Committee F08 on Sports Equipment and Facilities and is the direct responsibility of Subcommittee F08.67 on Pole Vault.

Current edition approved Sept. 10, 2002. Published November 2002.

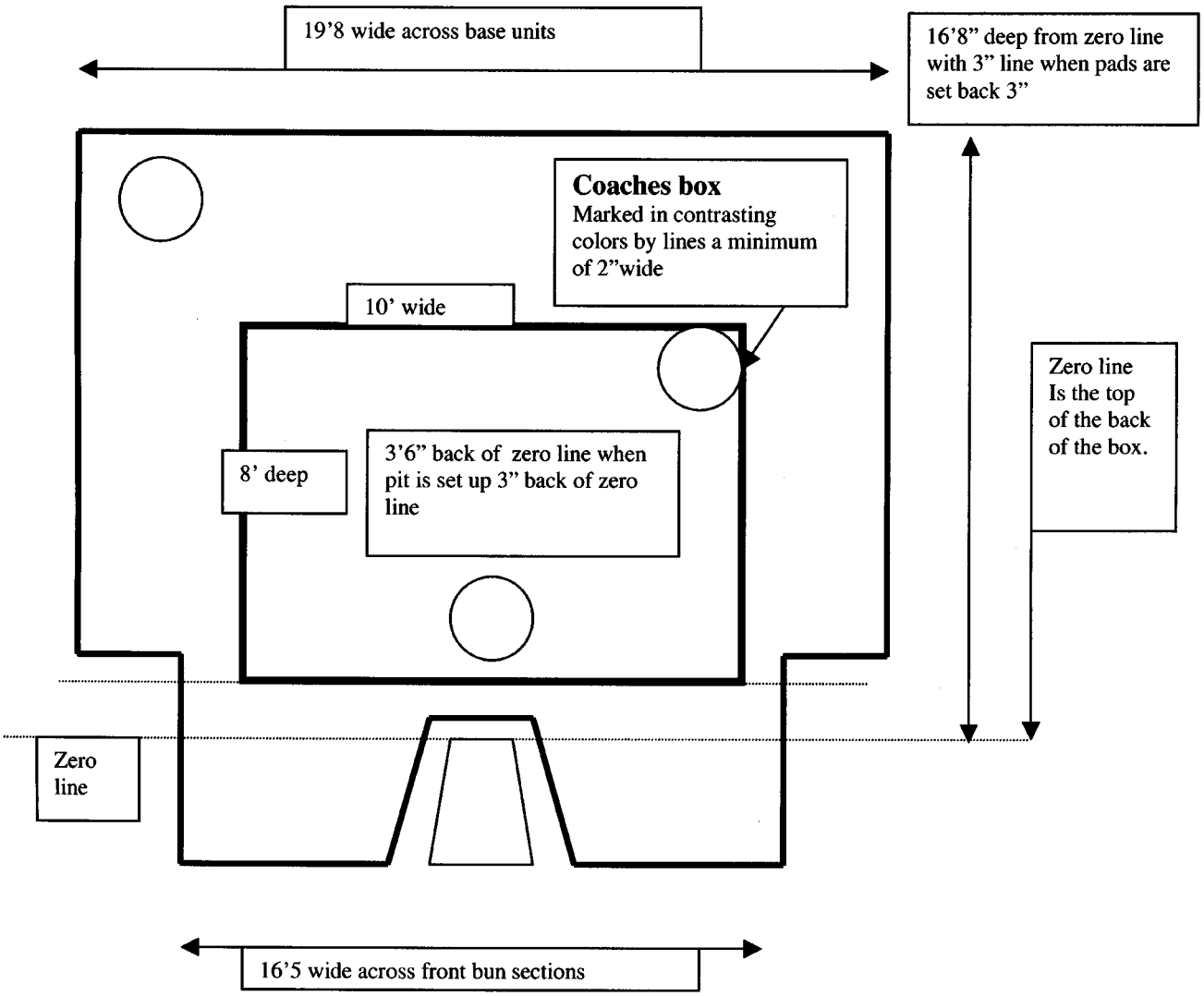

FIG. 1 Suggested Coaches Box and Testing Points

3.4 The minimum pole vault landing system dimensions stated within this document are based upon the investigation of the reported catastrophic pole vaulting accidents over the past 20 years.

3.5 The minimum size and design specifications for pole vault landing pads are as follows: 19 ft 8 in. (6.00 m) wide across the base unit sections by 16 ft 5 in. (5.00 m) deep, when set in the most preferred position 3 in. (0.076 m) behind the vertical plane of the stop board with a uniformly high landing surface with a minimum height of 26 in. (0.66 m). The front portions of the pit that surrounds the planting box (the front buns) shall be 16 ft 5 in. (5.00 m) wide and extend at least 45 in. (1.14 m) from that portion of the front buns where the padding begins behind the back of the planting box. Thus the front of the front bun sections cover the entire area between the planting box and the inside edge of the base of the standard base rails to the front edge of the planting box when the pads are placed 3 in. (0.76 m) behind the back of the planting box. The minimum overall pit size is 19 ft 8 in. (6.00 m) wide by 20 ft 2 in. (6.14 m) long from the from the front of the front buns to the rear-most portion of the landing area. (See Fig. 2.) The height of the front units may taper down in 15 in. (0.381 m) at the front in order to give the vaulter a clearer approach to the vaulting box. In addition, the front buns should taper into the planting box area so that they provide protection yet allow the vaulting pole to bend and rotate undisturbed with the primary landing system a minimal distance behind the back of the planting box. (See Fig. 2.)

3.6 In those special cases where a rectangular minimum size landing system will not fit into a facility, the rear half of the base unit sections may be rounded slightly along the outside edges to accommodate the shape of the running track or other obstruction alongside or behind it. In these special cases, the side and rear padding may be curved based upon a radius the length of the width of the base unit area of the system, from a

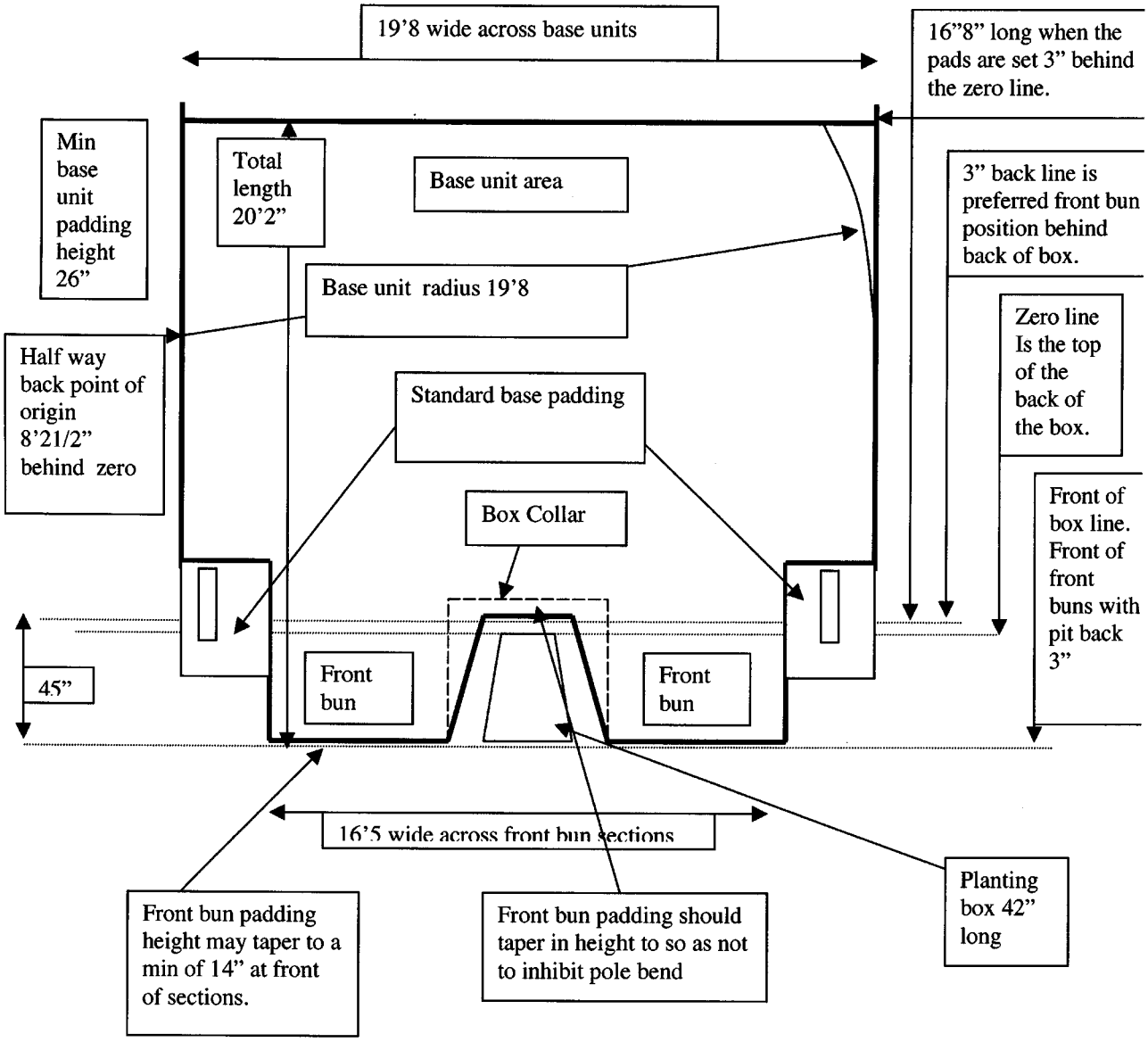

FIG. 2 Minimum Pole Vault Landing Systems Footprint

Minimum Landing Pad Dimensions: Overall minimum size: 19 ft. 8 in. (6.00 m) (wide across base unit sections behind standards) by 20 ft 2 in. (6.14 m) (from front of front buns to rear of pit). Primary landing areas shall be a minimum of 26 in. in depth. Front buns may taper to a minimum of 14 in. at their frontmost portions. Front buns should extend to a minimum of the front edge of the planting box so that pad is in its most appropriate position. For most pads with tapered front bun sections, this position is 3 in. back of zero.

point of origin halfway back on the side of the landing system (See Fig. 2 and Fig. 4).

3.7 Upgrades and additional supplementary padding may be used to increase the size of existing landing systems that no longer meet the new minimum specifications of this specification. Supplementary sections of padding should be attached in some way to the existing (primary) landing system to keep them from separating away from the primary landing system or each other. However, a common top cover need only cover the primary portion of the pit and not the secondary (supplementary) padding beyond the primary landing system. Secondary (supplementary) padding may also take the form of protection on the standard bases and around the planting box. (See Fig. 4.)

3.8 Standard base padding is considered supplementary (secondary) padding. Standard base pads should be designed so that the uprights move freely both forward and back for efficient, accurate standard adjustments. Standard base padding systems should be approximately the same height as the front of the front buns for which they are built. However, standard base padding should not exceed the height of the front bun sections that they sit next to. Standard base padding should be a minimum of 20 in. (0.51 m) wide so that they minimally extend from the sides of the front bun sections to the outside edges of the base unit sections. The openings for the uprights should not be more than 8 in. (0.20 m) wide. For solid foam systems, a minimum of 14 in. of padding should cover all hard

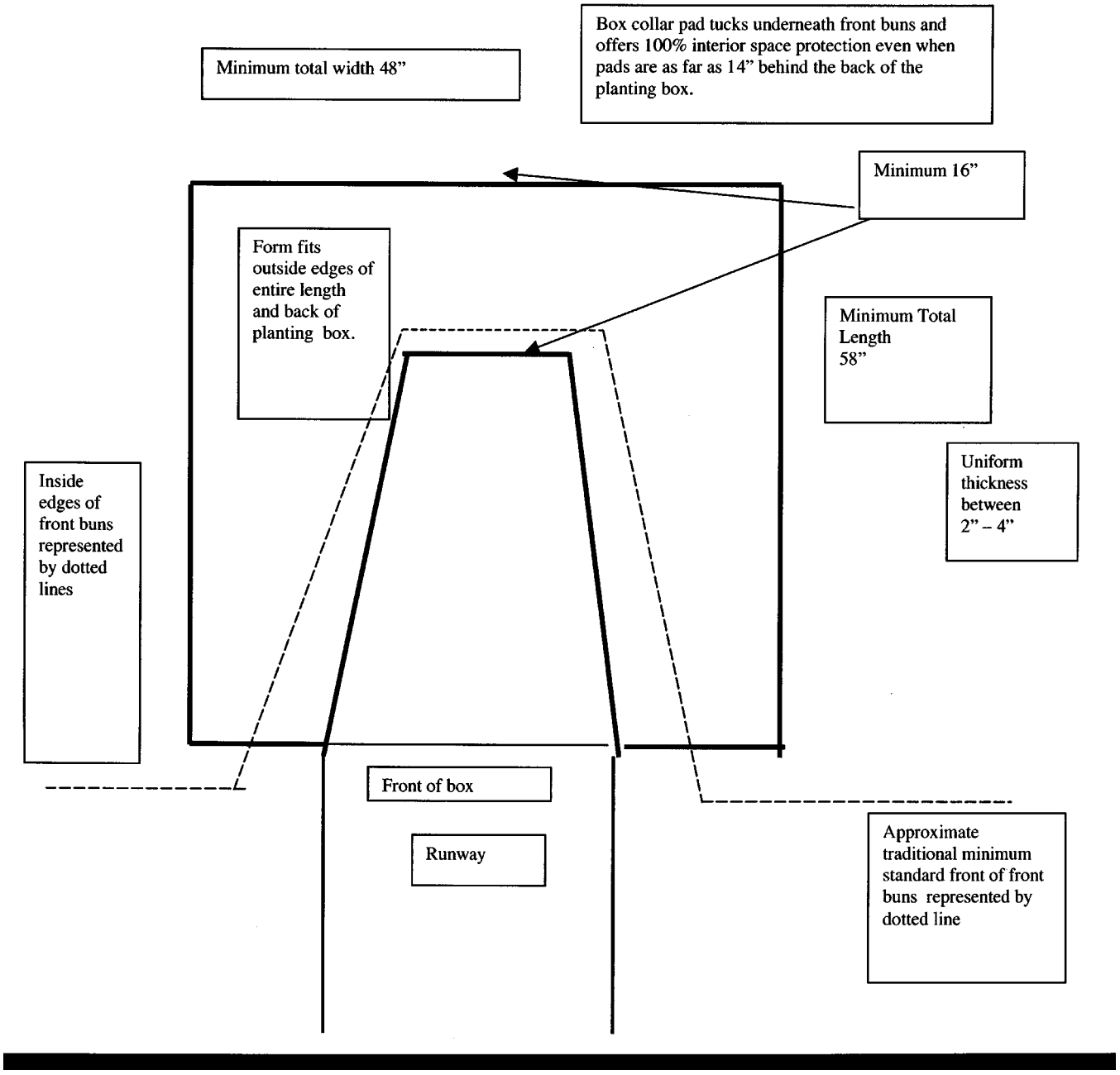

FIG. 3 Pole Vault Box Collar Minimum Specifications

The pole vault box collar is a secondary (supplementary) type of protection designed to eliminate all hard surfaces and edges between the pole vault box and the inside edges of the front bun padding around it.

1. Pole vault box collars shall be a minimum of 2 in. (0.07 m) thick but not more than 4 in. (0.10 m) thick. So that it offers protection yet allows the vaulting pole to bend and roll in an undisturbed manner and does not disturb the setting of the front buns.

2. It shall be made of dense foam padding with a vinyl covering or a material similar to a wrestling mat.

3. It shall form fit the entire length and width of the planting box so that when placed in proper position all hard surfaces are padded, even if the front buns are slid back to the national HS minimum of 14 in. (0.35 m).

4. Box collar padding shall be long enough and wide enough to extend under all inside edges of the front buns so that the weight of the front buns will hold it in a secure position.

standard base and underlayment hard surfaces. For plywood standard base type systems, a minimum of 8 in. of padding should be present. In both systems the padding should cover the entire area of the standard bases and all hard surfaces on which they rest. They should also minimally pad the entire area between the front buns and the adjacent base unit sections.

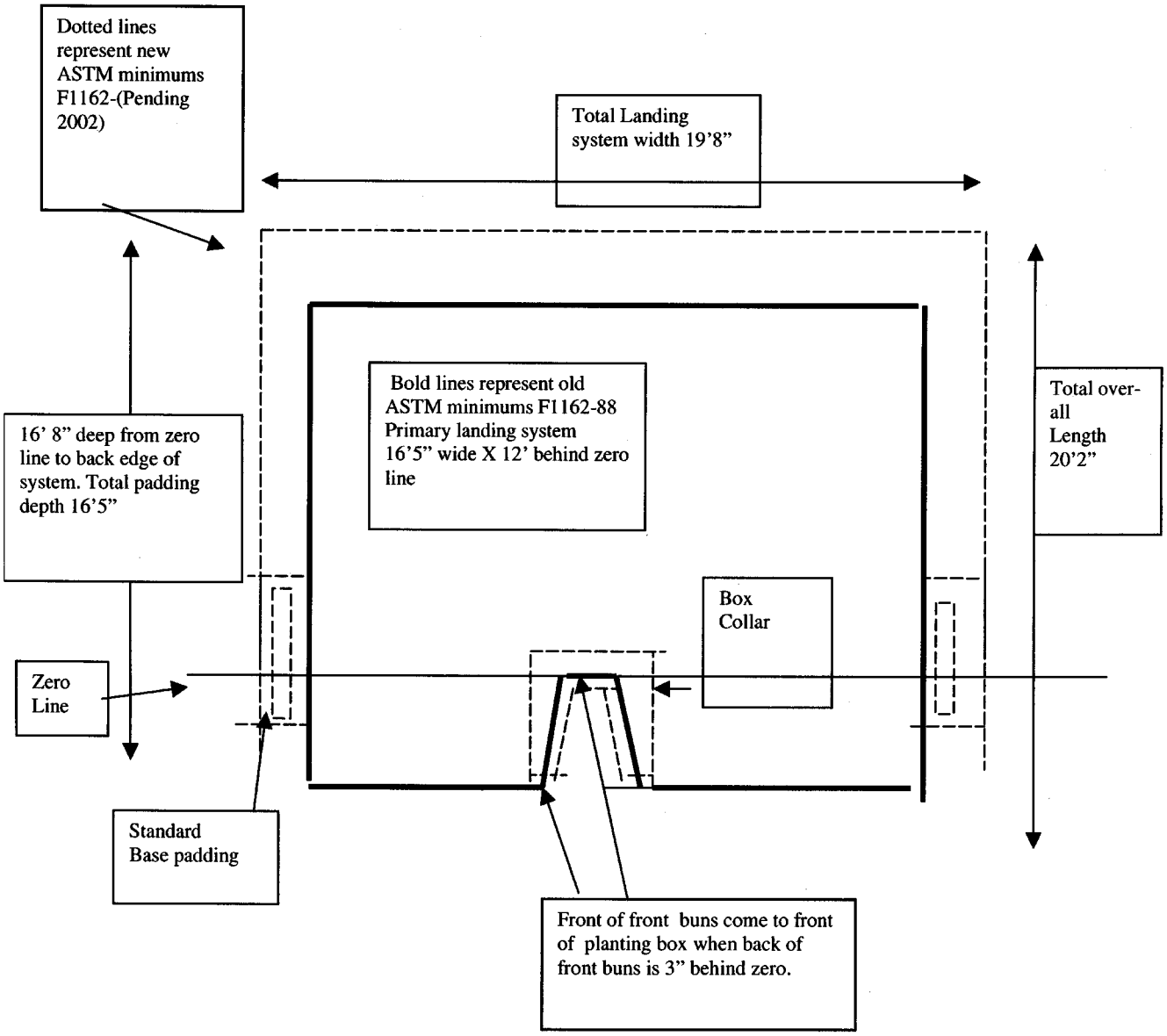

FIG. 4 Generalized Footprint From Specification F 1162 – 88 and New Footprint From Specification F 1162 – 02.

Standard base protectors do not need to be covered with the common top pad or attached to the rest of the landing system. (See Figs. 5-7.)

3.9 Box collars are considered secondary (supplementary) padding. They are designed to pad the area between the outside edges of the vaulting box and the inside edges of the front buns. Box collars do not need to be covered with a common top cover. However, they should form fit exactly to the top of the outside edges of the planting box and extend beneath the landing pad front bun sections so that they are held in place by the weight of the front buns and yet remain adjustable. (See Fig. 3.)

3.10 In order to meet the new minimum standard of 20 ft 2 in. (6.14 m) by 19 ft 8 in. (6.00 m), supplementary (secondary) padding may be added to the perimeter of existing landing systems. This additional padding shall meet the following criteria:

3.10.1 It must be of similar height and construction to the primary landing system;

3.10.2 In order to provide more stability, individual additional perimeter sections for the purpose of increasing the overall length or width of a landing system shall not be narrower at the base than they are tall;

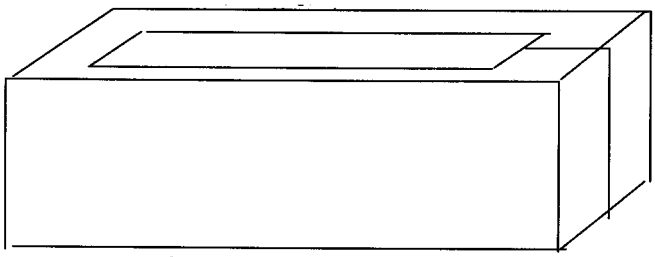

FIG. 5 Flat Unit General Diagram

Pole vault standard base pads are classified as secondary (supplementary) protection. They are designed to offer protection to pole vaulters in the event of accidental landings in the standard base areas. Standard base pads may be divided into two groups: solid foam pads or plywood frames with padding systems. Within each of these groups, flat or sloped units are permissible.

Standard Base Padding Specifications

1. Plywood frame type padding must be a minimum of 8 in. (0.20 m) thick, solid foam type systems 14 in. (0.35) thick.

2. Padding must cover the entire standard base framework and all hard surfaces under it, between the front bun sections and to the outside edges of the base unit sections.

3. Standard padding systems must allow uprights to move forward and back a minimum of 0 to 32 in. behind the zero line.

4. The minimum overall height of plywood or solid foam systems is 14 in.

5. The maximum width of the upright openings may not exceed 8 in.

6. Standard base padding must not exceed the height of the primary landing system pads when in proper position.

7. Standard depth settings must be plainly visible in inches and centimetres next to the uprights.

8. Standard base padding does not have to be attached to the primary landing system or covered with a common top pad.

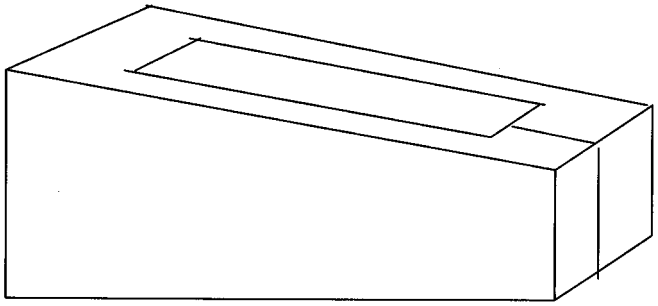

FIG. 6 Sloped Unit General Diagram

Anatomically follows line of top of front bun sections adjacent to the uprights.

3.10.3 Secondary (supplementary) padding does not need to be covered by a common top cover; and

3.10.4 Secondary padding for the purpose of increasing the width or the length of a landing system up to the minimum standard should be attached to the existing system via a prudent means of some kind.

3.11 Alternatives to upgrade existing pole vault landing systems to meet the new minimum specifications my include high jump, pole vault, or gymnastic pit sections. When these types of components are used, they should be attached to the existing system via any prudent means possible, including ropes, straps, bungee cords, or Velcro. However, they do not need to be under the common top pad.

3.12 *Coaches Box*—A painted or sewn contrasting rectangle on the common top pad, 8 ft (2.68 m) deep and 10 ft (3.05 m)wide, beginning 3.5 ft behind the zero lone. This box is intended to help vaulters and coaches as a reference point for safer and efficient landing purposes only. (See Fig. 1.)

4. Physical Characteristics of Material and Performance Specifications

4.1 The landing pit will be made of a material which will cause deceleration of the missile by landing pit deformation less than 75 % of the pit thickness during impact testing conducted in accordance with Section 8.

4.2 When impact testing is performed in accordance with Section 8 missile rebound shall not exceed 1.48 ft (0.45 m) above the surface of the nondeformed landing pit.

4.3 Rebound and deformation characteristics shall be ±10 % throughout the 19 ft 8 in. by 20 ft 2 in. (6.00 m by 6.14 m) area to within 1 ft (0.304 m) of the edge of the main portion.

4.4 Peak deceleration shall not exceed 20 *g* when a landing pit is tested in accordance with Section 10.

5. Significance and Use

5.1 The dynamic data obtained with the procedures given in this specification measure the cushioning properties of the landing pits tested.

5.2 The size of the pole vault landing pit is specified with respect to the kinematics of body movement.

6. Testing Apparatus

6.1 *Testing Machine*—Any type of dynamic testing apparatus that impacts the specimen on a solid, rigid surface (typical of service conditions) with the prescribed missile at the prescribed impact velocity and monitors and records impact deceleration-time histories.

6.2 The missile described in 8.1 is constructed in three sections and is more clearly defined as follows: (see Fig. 8).

NOTE 2—The missile constructed for initial testing was of marine grade plywood. The missile could be made of various materials and methods provided it maintains the specific dimensions and weight.

6.2.1 Top disk with cross-sectional area 387.5 in. ^{2} (0.25 m^2) outer radius 11⅛ in. (0.282 m) height 1⁷⁄₁₆ in. (0.0371-m) and weight.

6.2.2 Inverted frustum of cone with major radius 11⅛ in. (0.282 m), minor radius 8¾ in. (0.222 m), height 4⁹⁄₁₆ in. (0.1158 m) and weight.

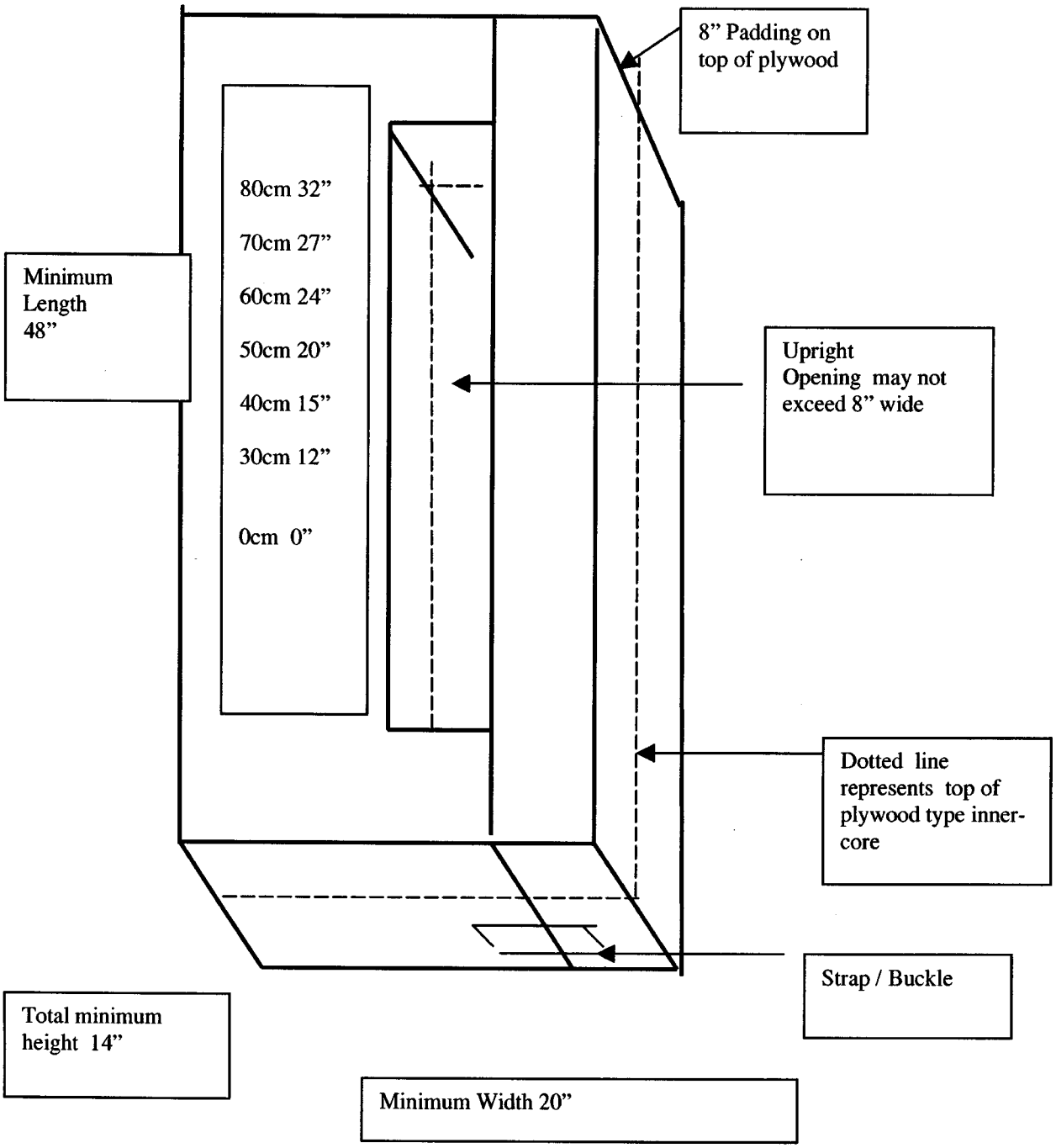

FIG. 7 Standard Base Padding With Depth Settings

6.2.3 Spherical segment with radius of curvature 9 13⁄16 in. (0.25 m), enclosed arc 124.8°, height 5 5⁄16 in. (0.1342 m) and weight.

6.2.4 The acceleration transducer shall be mounted within 5° of the vertical center of the impactor (see Fig. 8).

6.2.5 The total mass of the impactor with its associated mounting hardware shall be 29.5 ± 1.1 lb (13.6 ± 0.45 kg).

6.3 *Deceleration Time*—The selection of specific deceleration-time recording instrumentation, including transducers and recorders is discretionary. Nonetheless, the recording system shall exhibit frequency response adequate for measurement of peak deceleration to an accuracy of ±5 % of the true value. The total system, including transducer and recording instrumentation, shall be capable of measuring deceleration pulses with amplitude at least equal to 200 g and frequencies ranging between 0 and 1000 Hz to an accuracy of ±5 %.

6.4 *Impact and Rebound Velocities*— The dynamic testing equipment must be capable of recording impact and rebound velocity to an accuracy of ±5 % of the true value. Any velocity

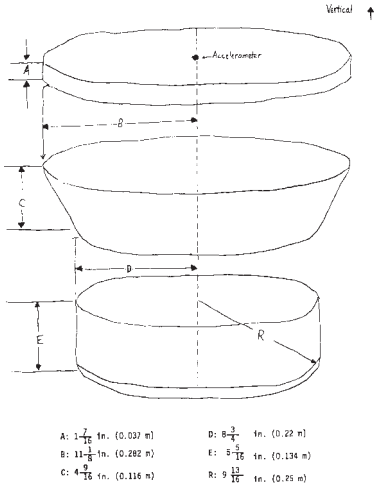

FIG. 8 Impacting Missile

measurement method that does not physically interfere with impact conditions is acceptable.

6.5 *Displacement-Time*—Displacement-time history shall be recorded. The test equipment must have means for determination of the top plane (baseline) of the landing surface from which the total penetration (displacement) is determined.

7. Conditioning

7.1 Landing pits shall be tested under ambient conditions that match those of intended use.

8. Impact Testing Procedure

8.1 *Summary of Procedure*—Test specimens are impacted at a specified velocity by an impacting missile of prescribed mass and geometry. A transducer is mounted in the missile so that the deceleration-time history of impacts can be recorded. The procedure described in this test method employs a missile with geometry similar to that of the human back.

8.2 Prewarm the recording instrumentation as recommended by the manufacturer. Calibrate deceleration-time and displacement-time instrumentation in accordance with procedures recommended by instrumentation manufacturers.

8.3 Place the landing pit under the missile or orient the dynamic test equipment over the landing surface.

8.4 Determine the displacement (penetration) baseline by lowering the missile to the surface of the landing pit without deflecting the surface (a visual determination is sufficient accuracy) and zeroing the instrumentation.

8.5 Raise the missile so that, upon impact, a velocity of 35.9 ft/s (10.9 m/s) is achieved. (Based on a 20-ft (6.10-m) drop height).

8.6 Orient the missile to a vertical position.

8.7 Release the missile and record the test results in accordance with the recommended procedures of the instrumentation manufacturers.

8.8 Make three successive impacts on the same area of the landing pit in the areas designated in Fig. 8. Successive impacts should be made at intervals of 3 ± 0.25 min.

9. Calculation

9.1 *Conformity of Deceleration and Velocity Instrumentation*:

9.2 Determine deceleration value (in *g*'s) at 1-ms intervals during the course of the entire impact.

9.3 Test conformity to the relation as follows:

$$(|V_I| + |V_R|) \times 1000/g = G \quad (1)$$

where:

$\lvert V_I \rvert$	=	impact velocity, m/s (absolute values),
$\lvert V_R \rvert$	=	rebound velocity, m/s (absolute values)
g	=	acceleration due to gravity at the earth's surface
G	=	sum of all deceleration values determined in accordance with 9.1.

9.4 Incongruity of more than 5 % indicates that either the deceleration-time instrumentation or the velocity measurement instrumentation has not been properly calibrated and that test results are void.

10. Report

10.1 Report the following information:

10.2 Complete identification of material tested, including type, source, manufacturer's lot number (if appropriate), thickness (if measurable), and any other pertinent information relating to sample identification.

10.3 Conditions of test including temperatures, humidity, and any other pertinent data.

10.4 Date of test.

10.5 Impact velocity.

10.6 Average values of impact parameters for the last two of three impacts or as specified.

10.7 Peak deceleration.

10.8 Duration of deceleration pulse.

10.9 Time from beginning of impact to peak deceleration (optional).

10.10 Maximum displacement (penetration).

10.11 Time from beginning of impact to peak displacement (optional).

11. Instructions and Labeling

11.1 Each landing pit shall be provided with instructions for proper assembly and installation.

11.2 Each landing pit shall be permanently labeled with the following items:

11.2.1 Identification of manufacturer,

11.2.2 Model designation,

11.2.3 Specific warning on installation, and

11.2.4 A warning label limiting the intended use.