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Fall protection - Performance test methods for fall protection systems

坠落防护 安全带系统性能测试方法

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Fall protection - Performance test methods for fall protection systems

1 Scope

This Standard specifies the test equipment, test methods, data processing, etc. for safety belts for working at heights.

This Standard applies to safety belts for working at heights.

This Standard does not apply to safety belts used in sports or the firefighting industry.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB 8965.1-2020, *Protective clothing -- Flame retardant protective clothing*

GB/T 10125, *Corrosion tests in artificial atmospheres -- Salt spray tests*

GB 12014-2019, *Protective clothing -- Static protective clothing*

GB 24540-2009, *Protective clothing -- Protective clothing against liquid acids and alkalis*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 force measuring apparatus

A test system consisting of a dynamic force sensor, a digital display or chart recorder and a filtering device.

3.2 safety space

A three-dimensional space located below the working surface where there are no objects that may cause collision injury to the falling person.

3.3 deploy distance

The vertical distance from the test hanging point to the lowest point of the torso dummy

4.2 Test chain

The length between the two connection points of the test chain in the suspended state is (2000 ± 25) mm. The chain diameter is not less than 6 mm.

4.3 Test structure

4.3.1 The test structure shall be a rigid structure, which can be integrated with the building structure or an independent frame structure. When the suspension point is subjected to a force of 20 kN, the maximum displacement is less than 1 mm.

4.3.2 The test structure shall be equipped with reserved holes and installation components for installing the safety belts, ensuring that the torso dummy does not collide with the test structure during the test.

4.3.3 The location of the test hanging point shall ensure that the torso dummy does not touch the ground when it is suspended in the air from the start of the test to the completion of the fall. The height shall be at least greater than the safety space specified in the product instructions.

4.3.4 The test structure shall have a lifting function. The relative position between the release point and the test hanging point shall be adjusted according to the test needs.

4.4 Release device

The release device shall ensure that the initial velocity of the simulated person is 0 when released, and the person falls in a free fall state.

4.5 Force measuring apparatus

4.5.1 The dynamic force sensor shall have a range of no less than 10 kN and an accuracy of ±2%.

4.5.2 The device response frequency is not less than 1 kHz and is equipped with a filtering device.

4.5.3 The continuous sampling time of the device shall not be less than 20 s.

4.5.4 The device can display the peak impact force within the sampling interval. The resolution shall not be less than 1 N.

4.6 Distance measuring device

The range of the distance measuring device shall meet the test requirements. The resolution shall not be less than 1 cm.

d) Take a (1000±10) mm lanyard and connect it to the loading device;

e) Start the loading device. Apply a load of (15+0.3) kN. Maintain the load for at least 3 min;

f) Observe and record the condition of the safety belt after unloading. Measure and record the displacement of the strap in the adjustment buckle.

5.1.3 Safety belt for restricted area with length adjustment

The test steps for safety belts with length adjustment devices for restricted area use are as follows:

a) Put the straps on the torso dummy according to the instructions. Fix the torso dummy to the test bench;

b) Connect the lanyard to the lanyard according to the instruction manual;

c) Mark the edges of all adjustment buckles on the laces;

d) Connect the adjustment device to the loading device. Make sure the distance between the tie connection point and the loading device is (1000±10) mm;

e) Start the loading device. Apply the load to (15+0.3) kN. Maintain the load for at least 3 min;

f) Observe and record the condition of the safety belt after unloading. Measure and record the displacement of the strap in the adjustment buckle.

NOTE: During the test, if the length adjustment device and the lanyard slip, they can be fixed in an appropriate manner.

5.2 Performance testing of fall protection system for fence operations

5.2.1 Test legend

An example of a safety belt test for a perimeter fence operation is shown in Figure 3.

5.2.2 Safety belt for fence work with only strap and lanyard

The test steps for a safety belt for fence work with only a strap and a lanyard are as follows:

a) Put the strap on the torso dummy according to the instructions. Connect the torso dummy head ring to the release device;

b) Connect the lanyard to the hanging points on both sides of the lanyard according to the instruction manual;

c) Mark the edges of all adjustment buckles on the laces;

d) Connect the midpoint of the lanyard to the test hanging point;

e) Lift the torso dummy. Raise the torso dummy to a free fall distance of (1800+50) mm. Make sure the horizontal distance from the release point to the test hanging point is no more than 300 mm. When the free-fall distance is less than 1800 mm, connect the test chain between the test hanging point and the midpoint of the lanyard;

f) Release the torso dummy;

g) After the torso dummy is stationary, observe and record the condition of the safety belt. Measure and record the displacement of the belt in the adjustment buckle.

5.2.3 Safety belt for fence work with length adjustment device

The test steps for the safety belt for fence work with length adjustment device are as follows:

a) Put the strap on the torso dummy according to the instructions. Connect the torso dummy head ring to the release device;

b) Connect the lanyard to the hanging points on both sides of the lanyard according to the instruction manual;

c) Mark the edges of all adjustment buckles on the laces;

d) Adjust the length adjustment device. Adjust the lanyard length to (2000±50) mm. If the length is less than 2000 mm, adjust it to the maximum length;

e) Connect the midpoint of the lanyard to the test hanging point;

f) Lift the torso dummy. Lift the torso dummy to a free-fall distance of (1800+50) mm. Make sure the horizontal distance from the release point to the test hanging point is no more than 300 mm. When the free fall distance is less than 1800 mm, connect the test chain between the test hanging point and the midpoint of the lanyard;

g) Release the torso dummy;

h) After the torso dummy is stationary, observe and record the condition of the safety belt. Measure and record the displacement of the belt in the adjustment buckle.

300 mm;

e) Release the torso dummy. Record the peak impact force of the safety belt while the torso dummy is in suspension;

f) After the torso dummy is stationary, observe and record the condition of the safety belt. Measure the deploy distance and record the displacement of the belt in the adjustment buckle;

g) Unload and adjust the laces. Re-mark all the adjustment buckle edges of the laces;

h) Replace the lanyard and buffer. Connect the lanyard and buffer to the lanyard and test hanging point respectively according to the product instructions. If the length of the lanyard is adjustable, adjust the length of the lanyard to the maximum length;

i) Connect the torso dummy hip ring to the release device. Lift the torso dummy hip ring to the same level as the test hanging point. Make sure the horizontal distance between the release point and the test hanging point is no more than 300 mm;

j) Release the torso dummy. Record the peak impact force of the safety belt while the torso dummy is in suspension;

k) After the torso dummy is stationary, observe and record the condition of the safety belt. Measure the deploy distance and record the displacement of the belt in the adjustment buckle.

5.3.3 Safety belt for fall suspension with lanyard, twin-tail lanyard and buffer

The test steps for safety belt for fall suspension containing only a lanyard, a twin-tail lanyard and a buffer are as follows:

a) Put the strap on the torso dummy according to the instruction manual. Connect the torso dummy head ring to the release device;

b) Connect the common end of the lanyard and the buffer to the lanyard according to the product manual;

c) Connect one of the connection points of the twin-tail lanyard to the test hanging point. Connect the other connection point to the tie connection point of the common end of the lanyard. When the two lanyards are of different lengths, select the longest lanyard to connect to the hanging point;

d) Lift the torso dummy to a point where the connection point between the harness and the lanyard is (1000+50) mm above the test hanging point. Make sure the horizontal distance from the release point to the test hanging point is no more than 300 mm;

5.3.5 Safety belt for fall suspension with strap and speed differential controller

The test steps for a fall suspension safety belt containing only a strap and a speed differential controller are as follows:

a) Put the strap on the torso dummy according to the instruction manual. Connect the torso dummy head ring to the release device;

b) Connect the speed difference automatic controller to the strap and test hanging point according to the product manual;

c) Mark the edges of all adjustment buckles on the strap;

d) Lift the torso dummy to the point where the lanyard of the speed differential controller is pulled out (1000+50) mm. Make sure the horizontal distance from the release point to the test hanging point is no more than 300 mm;

e) Release the torso dummy. Record the peak impact force of the safety belt while the torso dummy is in suspension;

f) After the torso dummy is stationary, observe and record the condition of the safety belt. Measure the deploy distance and record the displacement of the belt in the adjustment buckle;

g) Unload and adjust the laces. Re-mark all the adjustment buckle edges of the strap;

h) Replace the speed difference controller. Connect the speed difference controller to the strap and test hanging point according to the product manual;

i) Connect the torso dummy hip ring to the release device. Lift the torso dummy hip ring to the same level as the test hanging point. Make sure the horizontal distance between the release point and the test hanging point is no more than 300 mm;

j) Release the torso dummy. Record the peak impact force of the safety belt while the torso dummy is in suspension;

k) After the torso dummy is stationary, observe and record the condition of the safety belt. Measure the deploy distance and record the displacement of the belt in the adjustment buckle.

5 - self-locking device;
6 - rigid guide rail;
7 - flexible guide rail;
8 - torso dummy;
9 - strap;
10 - guide rail fixing device (if any).

Figure 6 -- Example of the first impact test of a fall suspension safety belt with a self-locking device

5.4 Rescue performance test of safety belt

5.4.1 Test legend

An example of testing a safety belt with a rescue function is shown in Figure 7.

5.4.2 Safety belt with rescue function

The test steps for safety belts with rescue function are as follows:

a) Put the strap on the torso dummy according to the instruction manual. Connect the torso dummy head ring to the release device;

b) Connect the test chain to the strap rescue hanging point according to the instruction manual;

c) Mark the edges of all adjustment buckles on the strap;

d) Connect the other end of the test chain to the hanging point;

e) Lift the torso dummy. Raise the connection point between the lanyard and the harness to the free fall distance of (600+50) mm. Make sure the horizontal distance from the release point to the test hanging point is no more than 300 mm;

f) Release the torso dummy;

g) After the torso dummy is stationary, observe and record the condition of the safety belt. Measure and record the displacement of the belt in the adjustment buckle.

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