GB

NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

ICS 13.340.99

CCS C 73

GB 6095-2021

Replacing GB 6095-2009

Fall Protection - Personal Fall Protection Systems

坠落防护 安全带

Issued on: August 10, 2021 **Implemented on: September 1, 2022**

Issued by: State Administration for Market Regulation;

Standardization Administration of the People's Republic of China.

Table of Contents

Fall Protection - Personal Fall Protection Systems

1 Scope

This document specifies the classification and marking, technical requirements, test methods, inspection rules and identification, and information provided by the manufacturer of personal protection systems for working at height.

This document applies to personal protection systems used when the sum of the user's weight and load is no more than 100 kg during operations at height.

This document does not apply to personal protection systems used for sports and firefighting, etc.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in the text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 6096-2020 Fall Protection - Performance Test Methods for Fall Protection Systems

GB/T 8427 Textiles - Tests for Color Fastness - Color Fastness to Artificial Light: Xenon Arc Fading Lamp Test

GB/T 23268.1 Specifications for Protective Equipment for Sports - Part 1: Dynamic Mountaineering Ropes

GB/T 23469 Personal Fall Protection Equipment - Connectors

GB 23525 Safety Technical Criterion for Personal Board-type Sling Equipment for Suspending Work

GB/T 24537 Personal Fall Protection Equipment - Guided Type Fall Arrester Including a Flexible Anchor Line

GB/T 24538 Personal Fall Protection Equipment - Energy Absorbers

GB 24539-2021 Protective Clothing - Chemical Protective Clothing

GB 24542 Fall Protection - Guided Type Fall Arrester Including a Rigid Anchor Line

GB 24543 Personal Fall Protection Equipment - Lanyards

GB 24544 Fall Protection - Retractable Type Fall Arrester

GB 30862 Personal Fall Protection Equipment - Anchor Devices

GB/T 38230 Personal Fall Protection Equipment - Descender Devices

GB 38454 Personal Fall Protection Equipment - Horizontal Lifeline Device

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 personal fall protection systems

A system of individual fall protection equipment that secures operating personnels' positions during operations at height, climbing and suspension operations, prevents them from falling, or safely suspends them after a fall.

3.2 work positioning systems

An individual fall protection system that uses ropes or belts wrapped around a fixed structure to bind the human body to the vicinity of a fixed structure to prevent the person from slipping and allow the operating personnels' both hands to perform other operations.

3.3 restraint systems

Individual fall protection systems that restrain the range of movement of operating personnels to prevent them from reaching areas where a fall may occur.

3.4 fall arrest systems

When an operating personnel falls, individual fall protection systems that will safely suspend the operating personnel through braking.

3.5 lanyard

A rope or strap that connects the harnesses to the anchor in the personal protection systems.

NOTE: lanyard generally serves to expand or restrain the wearer's range of movement and absorb the impact energy.

3.6 energy absorber

A component connected in series between the harnesses and the anchor to absorb part of the impact energy and reduce the impact force when a fall occurs.

3.7 retractable type fall arrester

A component connected in series between the harnesses and the anchor, equipped with a rope or belt that can be extended or retracted as the personnel moves, and can trigger a locking and

braking effect due to speed changes when a fall occurs.

3.8 guided type fall arrester

A component attached to the anchor line that triggers the braking action when falling.

3.9 harnesses

A component that attaches the personal protection systems to the human body, and supports and controls the human body, and disperses the impact force when falling.

NOTE: the harnesses are made of webbing, buckles and other metal components. There are generally full-body harnesses, single waist harnesses and half-body harnesses.

3.10 primary strap

The webbing in the harnesses that directly bears the impact force.

3.11 secondary strap

The webbing in the harnesses that does not directly bear the impact force.

3.12 deploy distance

During the test, when the fall stops, the vertical distance from the test anchor to the lowest point of the torso test mass in the suspended state.

3.13 fall distance

The maximum vertical distance from the starting point of the fall or the operating surface to the lowest point of the body that wears the personal protection systems.

3.14 safety space

A three-dimensional space located below the operating surface, without objects can cause collision damage to the falling person.

3.15 locking distance

During the test of the guided type fall arrester or retractable type fall arrester, from starting to stopping of the movement, the movement distance of the guided type fall arrester on the anchor line or the distance the lanyard extends from the cavity of the retractable type fall arrester.

3.16 adjusting buckle

A part used to adjust the length of the primary strap or secondary strap.

3.17 fastening buckles

A part used to tighten or loosen the primary strap.

4.2 Marking of Personal Fall Protection Systems

4.2.1 The marking of the personal fall protection systems consists of two parts: category of operations and additional functions of the personal fall protection systems:

---Category of operations of the personal fall protection systems: regional restriction is represented by the letter Q, work positioning is represented by the letter W, and fall arrest is represented by the letter Z.

---Additional functions of the personal fall protection systems: anti-static function is represented by the letter E, flame retardant function is represented by the letter F, rescue function is represented by the letter R, and chemical resistance function is represented by the letter C.

4.2.2 The marking of the personal fall protection systems shall be clearly indicated on the product identification in the form of Chinese characters or letters.

EXAMPLE 1: the restraint systems indicated as “Q”; the personal fall protection systems that can be used for work positioning, fall arrest, and have flame retardant, rescue and chemical resistance functions are indicated as “W/Z-FRC”.

EXAMPLE 2: the restraint systems indicated as “regional restriction”; the personal fall protection systems that can be used for work positioning, fall arrest, and have flame retardant, rescue, and chemical resistance functions are indicated as “work positioning / fall arrest - flame retardant and chemical resistant”.

5 Technical Requirements

5.1 Overall Structure of Personal Fall Protection Systems

5.1.1 Parts and components used in the personal fall protection systems shall be smooth and without sharp edges, and the parts in contact with the webbing shall have rounded corners.

5.1.2 Animal leather used in the personal fall protection systems shall not have seams.

5.1.3 The webbing in the personal fall protection systems shall be a whole piece, and there shall be no seams between the two attachment points of the same webbing.

5.1.4 When the personal fall protection systems are designed as an integral part of the work clothes, they shall not be enclosed in the lining.

5.1.5 The primary strap fastening buckles in the personal fall protection systems shall be secure and shall not accidentally open or cause damage to the webbing.

5.1.6 The waistband in the personal fall protection systems shall be used together with the comfort pad.

5.1.7 The sewing threads used in the personal fall protection systems shall not react chemically with the material being sewn and its color shall be clearly different from the material being sewn.

5.1.8 Metal ring-like parts used in the personal fall protection systems shall not be welded and shall not have openings.

5.1.9 The lanyard connected to the harnesses in the personal fall protection systems shall not be knotted in the design structure.

5.1.10 When the lanyard in the personal fall protection systems is connected to the connector, a bracket or cushion shall be added.

5.2 Requirements for Components in the Personal Fall Protection Systems

5.2.1 The harnesses used in the personal fall protection systems shall comply with the requirements of Appendix A.

5.2.2 The lanyard used in the personal fall protection systems shall comply with the requirements of GB 24543.

5.2.3 The connectors used in the personal fall protection systems shall comply with the requirements of GB/T 23469.

5.2.4 The retractable type fall arrester used in the personal fall protection systems shall comply with the requirements of GB 24544.

5.2.5 The guided type fall arrester used in the personal fall protection systems shall comply with the requirements of GB 24542 and GB/T 24537.

5.2.6 The personal board-type sling equipment used in the personal fall protection systems shall comply with the requirements of GB 23525.

5.2.7 The descender devices used in the personal fall protection systems shall comply with the requirements of GB/T 38230.

5.2.8 The energy absorber used in the fall arrest systems containing only lanyard and energy absorber shall comply with the requirements of GB/T 24538.

5.2.9 The anchor device connected to the personal fall protection systems shall comply with the requirements of GB 30862.

5.2.10 The horizontal lifeline device connected to the personal fall protection systems shall comply with the requirements of GB 38454.

5.3 Composition and Design of Personal Fall Protection Systems

5.3.1 Composition and design of restraint systems

adjustment device or a lanyard retrieving device shall be installed;

---When the work positioning systems can be used for multiple categories of operation, they shall meet the requirements of the corresponding categories.

5.3.3 Composition and design of fall arrest systems

5.3.3.1 The fall arrest systems shall contain at least the following constituent parts:

---Harnesses that can connect the components for fall arrest;

---One of the following: lanyard and energy absorber, retractable type fall arrester and guided type fall arrester, etc. that can be connected to the harnesses and the anchor device or structure;

---Ring-type components and connectors that can connect the various constituent parts of the fall arrest systems.

5.3.3.2 The design of the fall arrest systems shall at least meet the following requirements:

---The harnesses for fall arrest shall be full-body harnesses;

---The harnesses shall include one or more attachment points for fall arrest;

---The harnesses attachment points shall be located on the user's chest or back;

---When the fall arrest components in the personal fall protection systems only contain the fall arrest lanyard, the lanyard shall have energy absorption function or be used together with the energy absorber;

---The length of the fall arrest lanyard, including the undeployed energy absorber shall be less than or equal to 2 m;

---When the personal fall protection systems can be used for multiple categories of operation, they shall meet the requirements of the corresponding categories.

5.4 Performance of the Personal Fall Protection Systems

5.4.1 Performance requirements for restraint systems

The restraint systems shall meet the following requirements:

a) Each component of the restraint systems shall be able to withstand the corresponding test load;

b) The buckle shall not become loose, and the torso test mass shall not slip off the harnesses;

c) There should be no obvious asymmetric slippage of the harnesses;

d) The connector shall not be opened, and the components shall not break;

e) The maximum slippage of the webbing or rope in each adjusting buckle shall be less than or equal to 25 mm.

5.4.2 Performance requirements for work positioning systems

The work positioning systems shall meet the following requirements:

a) The buckle shall not become loose, and the torso test mass shall not slip off the harnesses or fall to the ground;

b) The connector should not be opened, and the components shall not break;

c) There should be no obvious asymmetric slippage of the harnesses;

d) When the torso test mass is suspended in the air, there shall be no metal parts under the torso test mass's armpits or inside thighs;

e) When the torso test mass is suspended in the air, no components shall press on the torso test mass's throat or external genitalia;

f) The maximum slippage of the webbing or rope in each adjusting buckle shall be less than or equal to 25 mm.

5.4.3 Performance requirements for fall arrest systems

The fall arrest systems shall meet the following requirements:

a) The buckle shall not become loose, and the torso test mass shall not slip off the harnesses or fall to the ground;

b) The connector should not be opened, and the components shall not break;

c) The peak impact force of the personal fall protection systems shall be less than or equal to 6 kN;

d) The personal fall protection systems shall be marked with the deploy distance, and the deploy distance shall be less than or equal to the value indicated in the permanent identification;

e) The torso test mass shall not appear headfirst when suspended in the air;

f) The harnesses shall not show obvious asymmetric slippage or asymmetric deformation;

g) When the torso test mass is suspended in the air, there shall be no metal parts under its armpits or inside its thighs;

be exposed.

5.5.3.2 The point-to-point resistance of the materials of the webbing and sling used in the personal fall protection systems shall be between 1×10^5 Ω and 1×10^{11} Ω.

5.5.4 Chemical resistance

The breaking strength reduction rate of the webbing, rope and metal components used in the personal fall protection systems shall be less than or equal to 30%.

5.6 Corrosion Resistance of Metal Components of the Personal Fall Protection Systems

Metal components used in the personal fall protection systems shall be tested in accordance with 5.8 of GB/T 6096-2020 and no visible red rust shall appear.

6 Test Methods

6.1 General

6.1.1 When testing the performance of the personal fall protection systems, a brand-new energy buffer component shall be used for each test.

6.1.2 When the harnesses have multiple attachment points, each attachment point shall be tested.

6.1.3 The test in 5.2 shall be type inspected in accordance with the corresponding standards or clauses or the entrusting party shall provide a type inspection report.

6.1.4 Please refer to Appendix B for the inspection rules of the personal fall protection systems.

6.2 Composition and Design Test of the Personal Fall Protection Systems

6.2.1 Torso test mass wearing test

Suspend the torso test mass in mid-air and put the personal fall protection systems on the torso test mass to check whether it complies with the requirements of 5.1 and related clauses.

6.2.2 Lanyard length test

6.2.2.1 Connect one end of the lanyard including the connector to the test bench and keep it vertical. Hang a test weight of (10 ± 0.1) kg on the other end. Keep the load applied for (60 ± 10) s and measure the length of the lanyard. The test results are retained to 0.01 m.

6.2.2.2 If the lanyard has multiple endpoints or is equipped with a length adjustment device, the longest rope part shall be selected, and the length shall be adjusted to the longest length using the length adjustment device before testing.

6.3 Performance Test of Restraint Systems

The test in 5.4.1 shall be carried out in accordance with 5.1 of GB/T 6096-2020.

6.4 Performance Test of Work Positioning Systems

The test in 5.4.2 shall be carried out in accordance with the requirements in 5.2 of GB/T 6096-2020.

6.5 Performance Test of Fall Arrest Systems

The test in 5.4.3 shall be carried out in accordance with the requirements in 5.3 of GB/T 6096-2020.

6.6 Rescue Performance Test

The test in 5.5.1 shall be carried out in accordance with the relevant requirements in 5.4 of GB/T 6096-2020.

6.7 Flame Retardant Performance Test

6.7.1 Flame retardancy of materials

The test in 5.5.2.1 shall be carried out in accordance with the relevant requirements of 5.5 of GB/T 6096-2020.

6.7.2 Flame retardancy of sewing threads

The test of 5.5.2.2 shall be carried out in accordance with the relevant requirements of 5.5 of GB/T 6096-2020.

6.8 Anti-static Performance Test

The test in 5.5.3.2 shall be carried out in accordance with the requirements in 5.6 of GB/T 6096-2020.

6.9 Chemical Resistance Test

The test in 5.5.4 shall be carried out in accordance with the requirements in 6.25 of GB 24539-2021.

7 Identification of Personal Fall Protection Systems

7.1 The identification of the personal fall protection systems shall be fixed to the harnesses.

7.2 The identification of the personal fall protection systems shall be covered or protected in other necessary ways.

7.3 The identification of the personal fall protection systems shall include at least the following contents:

Appendix A

(normative)

Technical Requirements and Test Methods for Harnesses

A.1 Technical Requirements

A.1.1 Design and structure

A.1.1.1 The breaking strength of the single filament of the fiber used to produce the harnesses shall be greater than or equal to 0.6 N/tex.

A.1.1.2 The harnesses styles shall be single-waist, half-body and full-body harnesses. The half-body style has at least 2 shoulder straps added to the single waistband. The full-body style includes at least 2 leg straps that go around the thighs and a pelvic strap located at the hips based on the half-body harnesses.

A.1.1.3 The harnesses shall not have any metal components under the armpits or on the inner thighs, and shall not have any components that press on the throat or external genitalia.

A.1.1.4 The primary strap fastening buckles in the harnesses shall be secure and shall not accidentally open or cause damage to the webbing.

A.1.1.5 The surface of metal components in the harnesses shall be smooth and shall not cause damage to the webbing.

A.1.1.6 Sewing threads shall be made of a material that does not chemically react with the webbing material, and its color shall be clearly different from that of the webbing.

A.1.1.7 The webbing shall be a whole piece, and there shall be no seams between the two attachment points of the same webbing.

A.1.1.8 The width of the primary strap shall be greater than or equal to 40 mm, and the width of the secondary strap shall be greater than or equal to 20 mm.

A.1.1.9 The waistband shall be used together with the comfort pad. The overall stiffness of the comfort pad shall be greater than or equal to the stiffness of the waistband, the width shall be greater than or equal to 80 mm, the length shall be greater than or equal to 600 mm, and the side in contact with the waist shall be made of soft, sweat-absorbent and breathable material.

A.1.1.10 The folds of the webbing and the connections between the webbings shall be sewn with thread and shall not be burned after sewing.

A.1.1.11 There shall be no loose threads at the ends of the webbing and each end shall have a corresponding strap hoop.

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