
Sizing and Fit of MSA's EVOTECH™ Fall Protection Harness

Introduction

The collaboration of MSA and NIOSH's Division of Safety Research resulted in the creation of significant new fall arrest full body harness design criteria and sizing scheme to achieve best fit for the modern American workforce.

Fall Protection Body Support

Early efforts to protect workers from accidental falls involved a simple fall protection system consisting of a waist belt and lanyard. Studies of falls in waist belts conducted in the early 1970s highlighted hazards resulting from falls into waist belts. Reports of serious injury resulting from prolonged suspension in body belts led safety professionals to recommend use of full body harnesses exclusively for fall arrest.

The full body harness is an arrangement of straps designed to contain the human torso and distribute fall arrest loads to bodily areas best able to resist fall forces, load-bearing around upper thighs, pelvis, chest, and shoulders. In 1992, U.S. Federal OSHA proposed personal fall arrest system rules in general industry which permitted the use of body belts in fall arrest, but only when forces were reduced to 900 pounds or less. Full body harnesses were required in any application where forces exceed 900 pounds and established a statutory limit of 1,800 pounds maximum arrest force.

At this time, the American National Standards Institute published the ANSI Z359.1-1992 standard on Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components. This standard recommended that only full body harnesses were to be used in personal fall arrest systems and established new harness design and testing criteria. In 1999, OSHA promulgated a construction standard under 29 CFR Part 1926 Subpart M, which prohibited continued use of waist belts for fall arrest and specified that only full body harnesses shall be used in personal fall arrest systems.

Origins of Harness Sizing Schemes

The modern full body harness has evolved to become a more comfortable, easy-to-use body support system that offers a high level of security for a variety of work tasks at height. However, the basis for determining proper modern full body harness fit is rooted in data extrapolated from earlier military studies conducted on service-age males from the 1970s and 1980s. Manufacturers of full body harnesses were left to develop their own sizing schemes over the past several decades based upon anecdotal end-user customer evidence. U.S. regulations and national consensus standards offered no fall protection harness proper size and fit guidance.

OSHA specifies fall protection equipment test procedures that apply to workers with all-up weight of up to 310 pounds, including clothing, tools, and other user-borne objects. U.S. ANSI standards are intended for use by personnel weighing between 130 and 310 pounds. In actual practice, workers beyond these weight ranges are entering the workforce in growing numbers and are in need of fall protection harnesses.

Changes in the Modern Work Force

Unlike the early 1990s workforce when full body harnesses first achieved widespread use, today's workforce includes a wider range of body sizes and weights, as well as increased participation by female workers exposed to workplace fall hazards.

U.S. demographic changes have resulted in many smaller, lighter-weight workers in the U.S. labor force from Asia and Latin America. Changes in U.S. diet have also created demand for heavy worker fall protection, those whose weight exceeds 310 pounds. Manufacturers found themselves adapting older harness designs to fit a more diverse population beyond previous weight ranges and increasing numbers of female users. Some harness manufacturers attempted a one-size-fits-all approach to harness sizing in efforts to simplify selection and reduce costs.

The Importance of Proper Fit

The efficiency of the full body harness in distributing fall forces to bodily areas best able to resist these loads depends greatly upon how harnesses fit the body. Fundamental harness design principles include these key points:

- Body position at fall arrest onset should be upright, with spine aligned vertically in the strongest position for absorbing compressive fall arrest forces.
- Fall forces should be transmitted from the fall arrest attachment element to the bony mass of the hips and large muscles of thighs, chest, and shoulders, and away from groin, gut, neck, and female breast soft tissues.
- After a fall, the body should be supported in an upright posture to facilitate evacuation or rescue to a safe level.

The goal of harness design is to establish the minimum number of sizes capable of achieving proper harness fit to the widest range of foreseeable body shapes and sizes.

Significance of NIOSH Harness Sizing Study

The NIOSH Division of Safety Research entered into the harness sizing study with input from experienced fall protection manufacturers, including MSA. The study results therefore bear data that is immediately useful to manufacturers in establishing the goal of achieving proper fit with the least number of different size combinations. The collaboration of the NIOSH Division of Safety Research and MSA has yielded significant rewards to the fall protection industry. Among the most important are:

- A more thorough understanding of design differences necessary to accommodate female workers to achieve best fit in full body harnesses.
- Rationally-based criteria for establishing uniformity among harness sizes across a broad spectrum of workers, taking into account variations of sex, body shape, size, and weight.
- Simple harness sizing scheme creation to optimize number of harness sizes for the current U.S. working population.

New MSA EVOTECH Full Body Harness Design

MSA design engineers were directly involved in the NIOSH harness sizing study and observed first-hand the results of harness fit tests performed by NIOSH researchers. MSA designers then reviewed the statistical data and sizing schemes developed by NIOSH scientists.

The study quantified the effect of different torso shapes on harness fit based upon 3-D scans of over 100 men and 100 women. Data was then applied to 600 representative body scans from a national database of 2,382 participants. The study outcome (Hsiao, 2009) suggested these traditional harness design changes:

- Move D-ring location higher on the back for harnesses worn by women workers to better accommodate female forms, and
- A sizing structure comprised of three discrete sizes for males and three sizes for females

MSA design engineers have incorporated these recommendations into the new EVOTECH Full Body Harness that uses a strap configuration with optimized fit for both male and female torso shapes. A range of four unisex sizes takes into account the recommended strap length range that can be properly adjusted for best fit. Four MSA sizes properly fit both men and women within each of the size/weight categories provided, including sizing for smaller, lighter-weight workers as well for as larger, heavier harness wearers.

NIOSH torso shape research data has been correlated with personnel height and weight measurements. Since nearly everyone knows their own height and weight when fully outfitted for work, it makes sense to present a sizing structure based upon these commonly known factors. This information has been compiled into the EVOTECH Harness Sizing Chart.

ft (m)													
6'-6" (2.0)													
6'-4" (1.9)													
6'-2" (1.9)													
6'-0" (1.8)													
5'-10" (1.8)													
5'-8" (1.7)													
5'-6" (1.7)													
5'-4" (1.6)													
5'-2" (1.6)													
5'-0" (1.5)													
lb (kg)	110 (50)	130 (59)	150 (68)	170 (77)	190 (86)	210 (95)	230 (105)	250 (114)	270 (123)	290 (132)	310 (141)	330 (150)	400 (181)

Conclusion

MSA's EVOTECH Harness sizing scheme strikes a balance between the need for reduced workplace equipment inventory and a wide range of worker body types without compromising proven advantages of best fit for worker safety. The EVOTECH Harness also complies with the latest requirements of U.S. and Canadian standards. To see and feel the EVOTECH Harness difference, contact your MSA distributor or call MSA Customer Service at 1.800.967.2222 or online at msanet.com.

References:

Hsiao, Hongwei, Friess, Martin, Bradtmiller, Bruce and Rohlf, F. James (2009) 'Development of sizing structure for fall arrest harness design', Ergonomics, 99999:1.

Note: This bulletin contains only a general description of the products shown. While uses and performance capabilities are described, under no circumstances shall the products be used by untrained or unqualified individuals and not until the product instructions including any warnings or cautions provided have been thoroughly read and understood. Only they contain the complete and detailed information concerning proper use and care of these products.



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