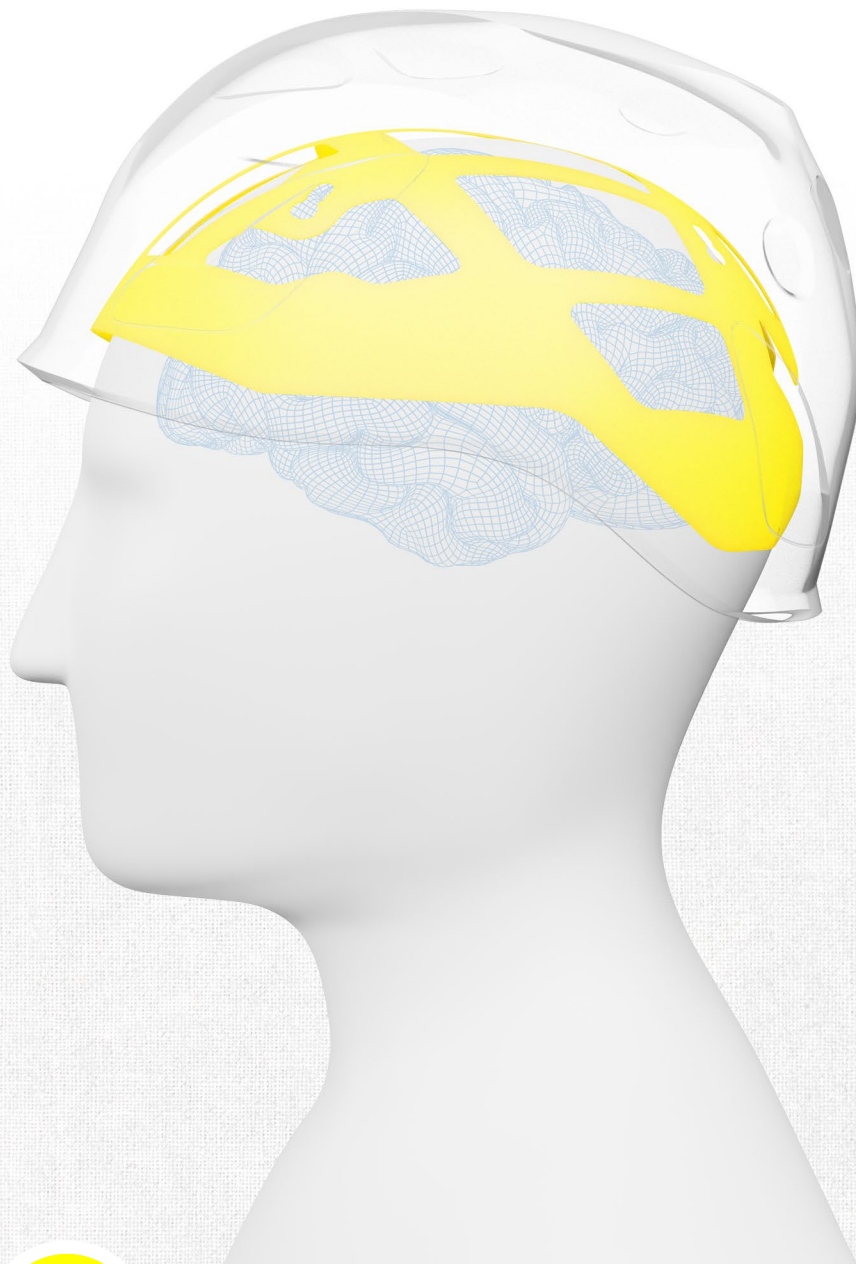




# Understanding Traumatic Brain Injury

How Mips® Brain Protection System for Industrial Safety Helmets  
Can Help Enhance Head Protection



**Mips**

*Content courtesy of Mips helmet safety technology experts.*

**WE KNOW WHAT'S AT STAKE.**

# Understanding Traumatic Brain Injury

Year over year, industrial workers in the United States continue to experience on-the-job injuries and fatalities related to falling objects/equipment and slips, trips, and falls.

During 2021-2022, some of the top causes of days away from work were:

- “Falls, slips and trips” with 450,540 cases
- “Contact with objects and equipment” with 450,050 cases.<sup>1</sup>

An average of 364 construction workers died annually from slips, trips, or falls between 2017 and 2021.<sup>2</sup>

One of the most serious types of injuries that can result from falling objects and equipment or slips, trips, and falls is **Traumatic Brain Injury (TBI)**.

## What is Traumatic Brain Injury (TBI)?

A traumatic brain injury, or TBI, is an injury that affects how the brain functions. There are different types of TBIs, and usually they are categorized in three levels: mild, moderate or severe. The most common form of a mild TBI is a concussion which is caused by a sudden blow or jolt to the head and diagnosed by its symptoms. The symptoms can range from low to high severity: headache, dizziness, memory loss and varying degrees of unconsciousness.<sup>3</sup> Mild injuries, including concussions, may also lead to long term chronic illnesses such as Chronic Traumatic Encephalopathy (CTE).<sup>4</sup>

TBI may be caused by “a forceful bump, blow, or jolt to the head or body, or from an object entering the brain.”<sup>4</sup> TBI are considered as either:

### Penetrating

Occurs when an object pierces the skull and enters the brain tissue, which may damage the brain tissue or the blood vessels inside the skull. These types of injuries typically affect only part of the brain.<sup>4</sup>

### Non-Penetrating

Occurs when an external force or rapid movement of the head causes the brain to move inside the skull without a skull fracture, which may stretch/shear the brain tissue or rupture the blood vessels in connection to the brain.<sup>4</sup>

## Injuries & Fatalities

Related to Objects/Equipment and Slips, Trips, and Falls



**450,540**

Falls, Slips, and Trips  
2021-2022<sup>1</sup>



**450,050**

Contact with Objects  
and Equipment  
2021-2022<sup>1</sup>



**364**

Fatalities Annually  
2017-2021<sup>2</sup>



**>500,000**

Industrial Workers Treated  
for TBIs in Emergency Rooms  
Over a 10 Year Period<sup>6</sup>

## How common are work-related TBIs?

TBIs sustained on-the-job have been prevalent for industrial workers. A study found that more than 500,000 workers were reported treated for TBIs at emergency rooms over a 10 year period.<sup>5</sup>

## Non-fatal TBIs

Non-fatal TBIs are most commonly associated with incidents involving contact with objects and equipment, closely followed by falls.<sup>5</sup> Workers between the ages of 15-24 had the highest TBI rates of all workers, with the leading cause being contact with objects and equipment.<sup>5</sup>

## Fatal TBIs

A total of 7,294 occupational TBI fatalities were identified over a five year period, accounting for 22% of all work-related injury fatalities during this time.<sup>6</sup> Falls were cited as the cause of 29% of all occupational TBI fatalities, and contact with objects and equipment was cited as the cause of 18%.<sup>6</sup> Falls were the leading cause of death for those in the construction industry and accounted for more than half of all TBI fatalities in that industry during this time period.<sup>6</sup>

On-the job TBIs also have an impact on organization productivity and cost. In fact, according to OSHA, the average direct costs associated with a concussion are \$54,571.<sup>7</sup>

## What is rotational motion?

In most instances when people fall and hit their heads, the impact does not include linear forces only. Rather, they fall at an angle or impact an object that is angled relative to the fall. When a head hits something at an angle, it forces the head into a rotational motion, which studies have shown can be more dangerous than linear motions when it comes to brain injury.<sup>8</sup>

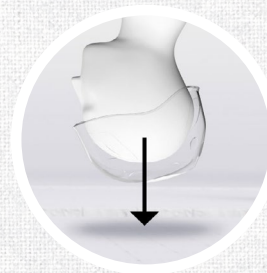
## Why is the brain sensitive to rotational motion?

Many often think of the human brain as a semi-firm organ. But in reality, it has a consistency more similar to a gel. Because the brain primarily consists of water, like most biological tissues, it does not compress during impacts which makes it fairly resistant to linear motion. However, the brain, just like water, has a low shear stiffness. This makes the brain extra sensitive to shear deformations. "Shear" refers to unaligned forces pushing the brain in two different directions. When the head is forced into rotation, the brain starts to "swirl" due to its low shear stiffness and the brain tissue can be stretched. This all correlates to the brain being sensitive to rotational motion.<sup>9, 10, 11, 12</sup>

## How does the revolutionary and patented Mips® brain protection system for industrial safety helmets help reduce damaging rotational motion in PPE?

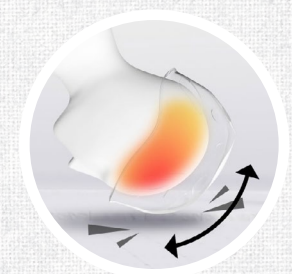
The Mips® system is a revolutionary innovation that is designed to help reduce rotational motion and the risk of brain injury from certain angled impacts. The Mips® system allows the helmet to move relative to the head at impact. This relative movement redirects energies and reduces the harmful rotational motion of the head. This technology can enhance the safety of workers in various industries and environments. Backed by extensive research and testing, the Mips® system has become the gold standard for rotational protection worldwide.<sup>13</sup>

- At impact the Mips® system is designed to help reduce the amount of rotational energy transferred to the head by redirecting the forces that are generated by the impact.
- The Mips® system allows for a 10-15 mm relative movement between the helmet and the head during the critical first 5-10 ms of the impact.
- During the short duration of an impact, the point load on the helmet can be very high. The Mips® system is designed to allow the helmet to move even under such pressure.



Traditional helmets are designed and tested for straight impacts. In the event an angled impact occurs, this can cause rotational motion to the head.

The rotational motion can cause brain injuries.



The Low Friction Layer is intended to help reduce the rotational motion to the head in certain angled impacts.



## MSA Industrial Head Protection Solutions Featuring the Mips® System

OSHA regulates head protection for general, construction, and maritime industries and requires employers to ensure affected workers wear appropriate head protection.<sup>14</sup> As the leader in industrial head protection, MSA is committed to designing products that help keep workers safe and comply with industry recommendations and standards, while providing a vast array of options to help address specific jobsite concerns, hazards, and employer and worker preferences.

The **V-Gard H2™ Safety Helmet** helps provide protection against top and lateral impacts with ANSI Z89.1 Type II certification and is available with optional Mips® system integration for additional rotational impact protection to help protect against potential traumatic brain injury resulting from lateral impacts. The V-Gard H2 Safety Helmet with the Mips® system is an excellent option for working at height applications where slips, trips, and falls may be more likely, such as construction or tower climbing. V-Gard H2 Safety Helmets with the Mips® system are compatible with nearly all MSA V-Gard® and V-Gard H1™ Safety Helmet accessories, can be quickly and easily customized with logos and reflective stripes, and feature an integrated chinstrap for enhanced helmet retention.



## Learn more about the Mips® system and integration with V-Gard H2 Safety Helmets.

<https://us.msasafety.com/V-GardH2>

### Sources:

<sup>1</sup> <https://injuryfacts.nsc.org/work/work-overview/top-work-related-injury-causes/>

<sup>2</sup> *Construction deaths due to falls, slips, and trips increased 5.9 percent in 2021*. The Economics Daily: U.S. Bureau of Labor Statistics (bls.gov)

<sup>3</sup> *Concussion - StatPearls - NCBI Bookshelf* (nih.gov)

<sup>4</sup> *Traumatic Brain Injury (TBI) | National Institute of Neurological Disorders and Stroke* (nih.gov)

<sup>5</sup> Konda S, et al. *Inj Prev* 2015

<sup>6</sup> Tiesman H, et al. *AJ Prev Med*, 2011

<sup>7</sup> *Estimated Costs of Occupational Injuries and Illnesses and Estimated Impact on a Company's Profitability Worksheet | Occupational Safety and Health Administration* (osha.gov)

<sup>8</sup> Meaney et al. "The Mechanics of Traumatic Brain Injury: A Review of What We Know and What We Need to Know for Reducing Its Societal Burden" *J of Biomechanical Engineering* 2014

<sup>9</sup> Holbourn, A. H. S. *British Medical Bulletin* 1945

<sup>10</sup> Holbourn, A.H.S. *Lancet* 1943

<sup>11</sup> Gennarelli, T. A., et al *STAPP* 1972

<sup>12</sup> Kleiven, S. *Front Bioeng Biotechnol* 2013 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4090913/>

<sup>13</sup> No helmet or impact protection system can protect a user from all injuries. Although the Mips® system has been shown to reduce rotational energies to the head in certain impacts, which may lead to brain injuries, there are limits to the protective capabilities of all helmets, including helmets with the Mips® system.

<sup>14</sup> [https://www.osha.gov/sites/default/files/publications/safety\\_helmet\\_shib.pdf](https://www.osha.gov/sites/default/files/publications/safety_helmet_shib.pdf)

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