



Safety and health in
the steel industry
Data report 2023

Openness and
transparency are key to
improving safety and
health in the industry

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For terminology definitions and calculations, please refer to the worldsteel publication *Safety and health principles and definitions* available at worldsteel.org.

The World Steel Association (worldsteel) is one of the largest and most dynamic industry associations in the world, with members in every major steel-producing country. worldsteel represents steel producers, national and regional steel industry associations, and steel research institutes. Members represent around 85% of global steel production.

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Foreword

worldsteel's safety and health benchmarking is based on balanced and collective metrics.

Monitoring and reporting on accidents and diseases globally ensures adequate risk-based prioritisation and focused global efforts to guarantee the availability of adequate and effective risk controls. Openness and transparency are key to improving safety and health in the steel industry.

The safety statistics for 2022 were derived from data provided by 55 organisations, representing 60% of worldsteel members. In terms of crude steel production coverage, worldsteel collected data covering 487 Mt of crude steel, corresponding to 26.6% of global crude steel production.

In terms of general industry performance, this report shows progress, with lagging indicators reaching record lows. However, despite this cause for cautious optimism it is important to recognise that 90 fatalities were reported to worldsteel in 2022. Our immediate focus needs to remain on the reduction and elimination of fatalities across our industry.



worldsteel's position on lagging indicators

The most popular lagging indicators, such as Lost Time Injury Frequency Rate (LTIFR) or Total Recordable Injury Frequency Rate (TRIFR), will be kept within the worldsteel reporting framework and as a reference of the industry's general performance.

However, comparisons between organisations or local sites should not be made using LTIFR or TRIFR.

Below are the main reasons:

- These indicators correlate poorly with the severity of accidents and injuries and do not provide a valid or reliable measure of safety and health controls and initiatives.
- The size of an organisation (number of hours) positively impacts injury frequency rates. The number of hours worked (global and regional) don't allow a comparison on a like-to-like basis.
- Although worldsteel has a definition for Lost Time Injury (LTI) and Total Recordable Injury (TRI), companies vary in their definition of what constitutes an LTI and TRI.

These two indicators should not be part of individual, team or organisation objectives, bonuses, or incentives as they can foster a negative attitude towards reporting, limiting the organisational ability to learn and improve.



Safety and health reporting frameworks are evolving. To keep up, our industry must invest resources and time to better monitor safety and health performance. This will result in more effective and reliable data to reflect the true story and the challenges of our operations and people.

Potential Serious Injuries and Fatalities (PSIF)

A Serious Injury is a permanent impairment or life-altering state, or an injury that, if not immediately addressed, will lead to death or permanent or long-term impairment.

A Potential Serious injury or Fatality is a near miss incident that could have resulted in a serious injury or fatality if not for specific barriers or countermeasures or if one factor around the event had been changed.

A precursor of PSIF is a high-risk situation in which control methods are absent, ineffective, or not complied with, and if allowed to continue, would potentially result in a fatality or serious injury.



In 2022, 91% of sites reported PSIFs, and 9% did not use a PSIF framework.

The number of individual sites reporting to worldsteel the use of the PSIF framework has increased in recent years. The figures below only include data from companies/sites reporting PSIFs and combine contractors and employees.

Figure 1: Potential Serious Injuries and Fatalities triangle 2022 for employees and contractors

Fatalities*	Total	PSIF	
	53		
Lost time injuries	1,830	456	25%
All other injuries**	18,448	187	1.01%
Near misses	176,541	6,756	3.82%
Precursors	2,939,655	139,066	4.73%

* In 2022, there were 90 fatalities reported to worldsteel. In order to preserve the ratios within the PSIF section of this report, Fatalities reported by organisations that were not able to provide PSIF information have been excluded from this analysis.

** All other injuries includes Restricted Work Cases (RWC), Medically Treated Injuries (MTI) and Minor Injuries (MI)





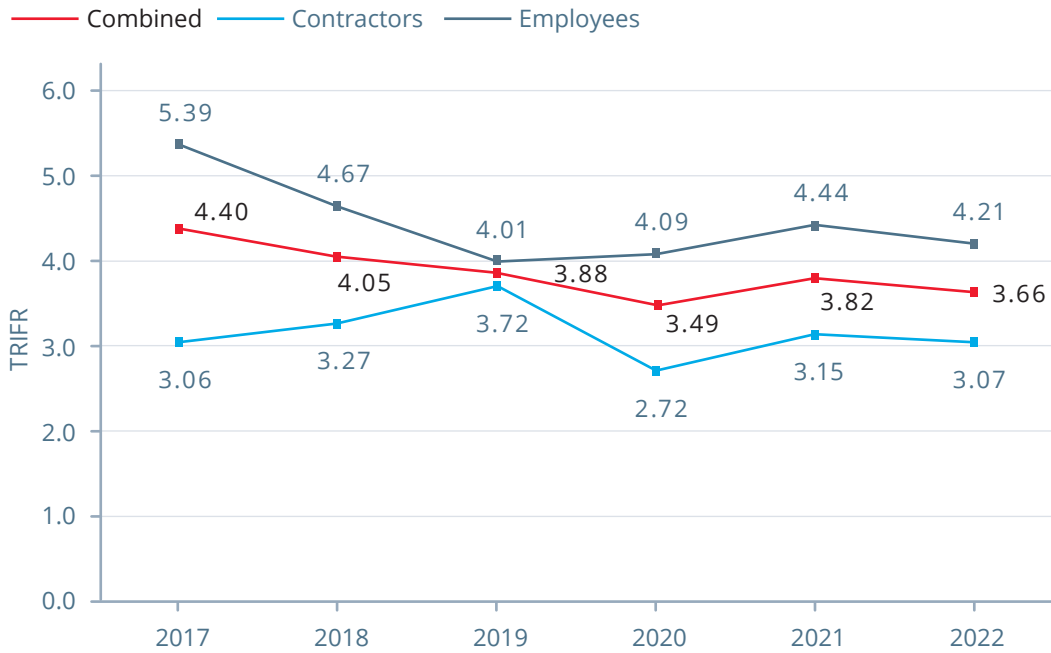
It has been indicated that typically around 20% of incidents have the potential to become serious injuries or fatalities.

The steel industry should increase the early identification of precursors and adequate investigation for near misses and injuries with the potential to cause fatalities and serious injuries.

Total Recordable Injury Frequency Rate (TRIFR)

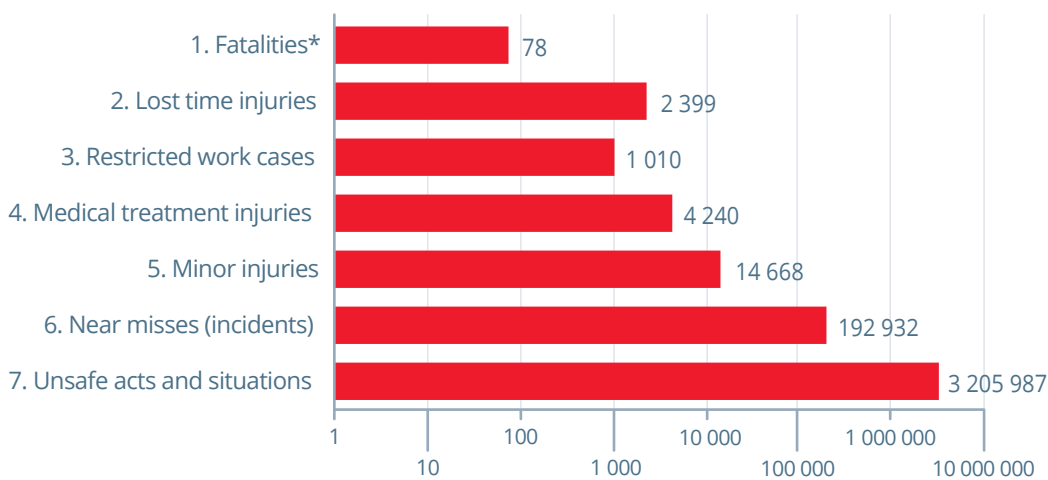
Total Recordable Incidents comprise Fatalities (F), Lost Time Injuries (LTI), Restricted Work Cases (RWC) and Medically Treated Injuries (MTI). In the data survey, restricted work cases and medically treated injuries are reported separately. Working hours are counted only on sites that have reported at least one restricted work case or medically treated injury.

Figure 2: Total Recordable Injury Frequency Rate 2017-2022




 Total Recordable Injury Frequency Rate (TRIFR) decreased from 3.82 in 2021 to 3.66 in 2022.

Figure 3: Safety pyramid 2022

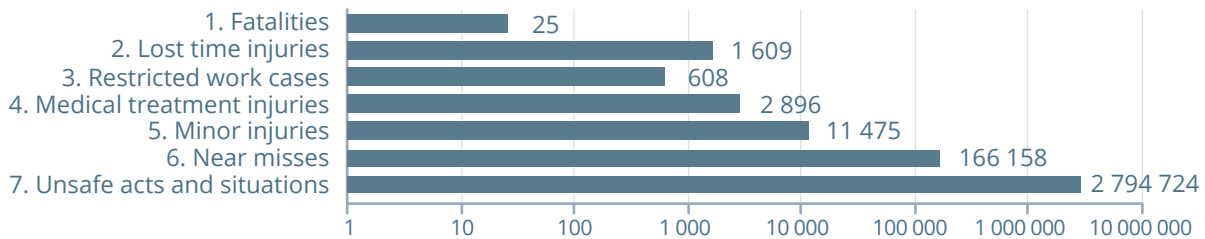


* In 2022, there were 90 fatalities reported to worldsteel. In order to preserve the ratios within the TRIFR section of this report, Fatalities reported by organisations that were not able to provide TRIFR information have been excluded from this analysis.

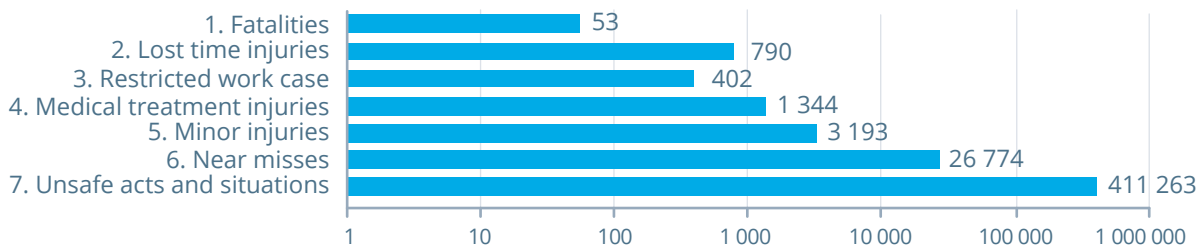
Safety pyramids can be used to compare the shape of a company's incident triangle. In case the company triangle is narrower, it could mean that not all incidents are reported, or that fatality prevention requires more attention. It should be noted that the average incident triangle is not necessarily optimal; it should probably be wider. Reducing the number of more minor incidents does not directly reduce the probability of severe incidents, but having those reported allows action to be taken to mitigate risks that might otherwise cause severe incidents.

Figure 4: Safety pyramids 2022 for employees and contractors

Employees:



Contractors:



Contractor management systems related to injury prevention need to be improved within the steel industry.

Table 1: Ratio Lost Time Injury vs Fatality 2004-2022

Cause	Lost Time Injuries (LTIs)	Fatalities	Ratio LTIs per 1 Fatality
Gassing and asphyxiation	227	136	1.67
Explosion	228	92	2.48
Rail	216	73	2.96
Fire	320	74	4.32
Electrical	425	76	5.59
Structural failure	325	55	5.91
Fall from height	1849	306	6.04
On site road vehicle	856	125	6.85
Forklift	286	33	8.67
Overhead crane	885	99	8.94
Moving machinery	3003	291	10.32
Hot metal	718	63	11.40
Falling object	1896	164	11.56
Other mobile equipment	790	52	15.19
Off site road vehicle	322	13	24.77
Hot substances	460	15	30.67
Product loading	650	17	38.24
Product handling storage	1936	38	50.95
Exposure to chemicals	172	3	57.33
manual tasks tools	2416	7	345.14
Slip, trip and fall	3300	6	550.00



The types of injuries with the smallest ratio between Lost Time Injuries and Fatalities are covered by Process Safety events. Companies should act if they are experiencing Lost Time Injuries of this nature. A PSIF approach should be used, and leading and lagging Process Safety-focused metrics should be in place.

The table shows the ratio between Lost Time Injuries and Fatalities by cause. Small ratios mean that per Fatality, there are, on average, only a small amount of Lost Time Injuries; a big ratio indicates there are many Lost Time Injuries per Fatality. If these were drawn as an incident triangle for each cause, the triangles for the small ratios would be very narrow.

These ratios show that to prevent Fatalities, it is more important to undertake comprehensive and robust incident investigations and instigate preventive measures for those incidents with a low ratio. It is precisely these incidents that are most likely to lead to Fatalities without effective prevention. These ratios also emphasise the usefulness of categorising Potential Serious Injuries and Fatalities among other incidents.



Lost Time Injury (LTI) analysis

Lost Time Injury (LTI). Any work-related injury resulting in the employee or contractor being unable to return to work for their next scheduled work period. Returning to work with work restrictions does not constitute a Lost Time Injury status, no matter how minimal or severe the restrictions, provided it is at the employee's next scheduled shift. However, if an Injury deteriorates and time is later lost, an LTI should be recorded. Lost Time Injury Frequency Rate (LTIFR) is calculated by combining Fatalities (F) and LTIs.

Figure 5: Number of Lost Time Injuries, 2013-2022

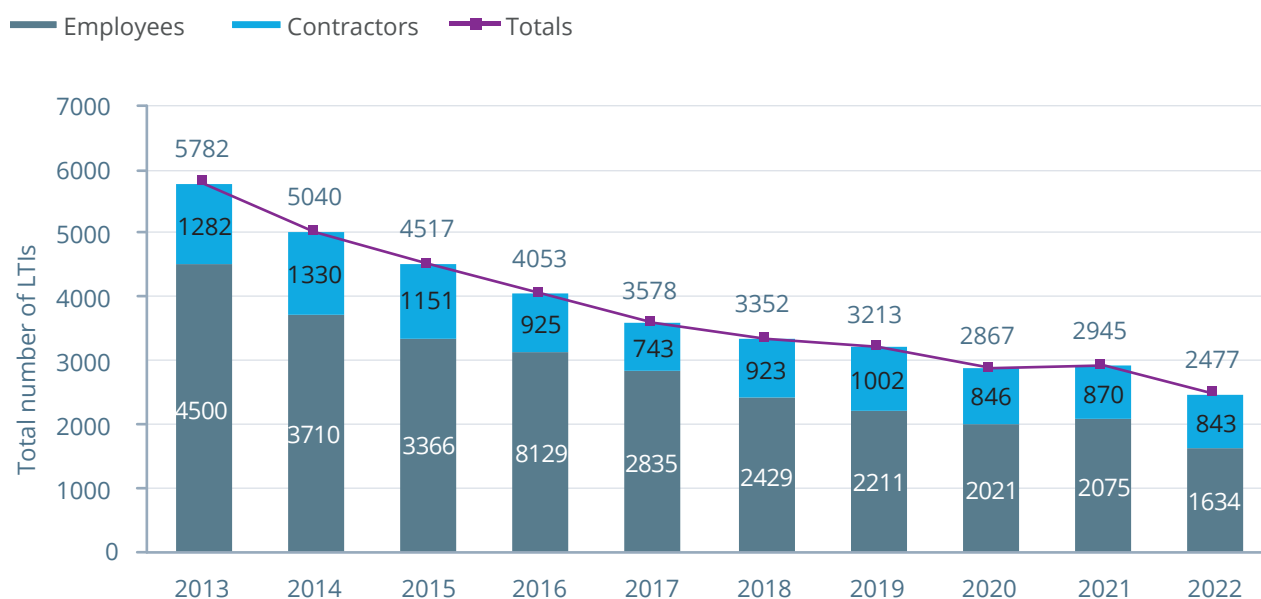
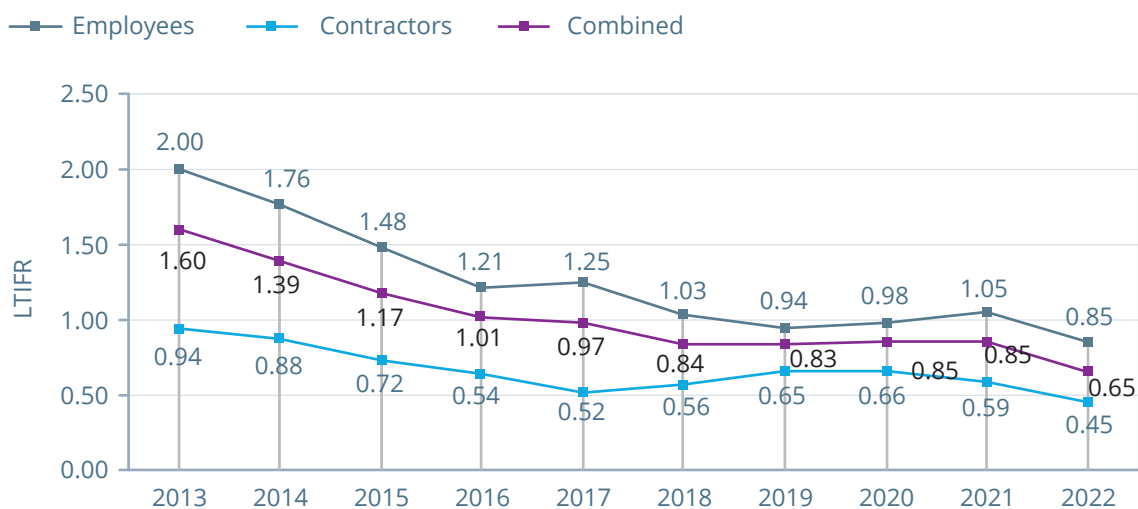


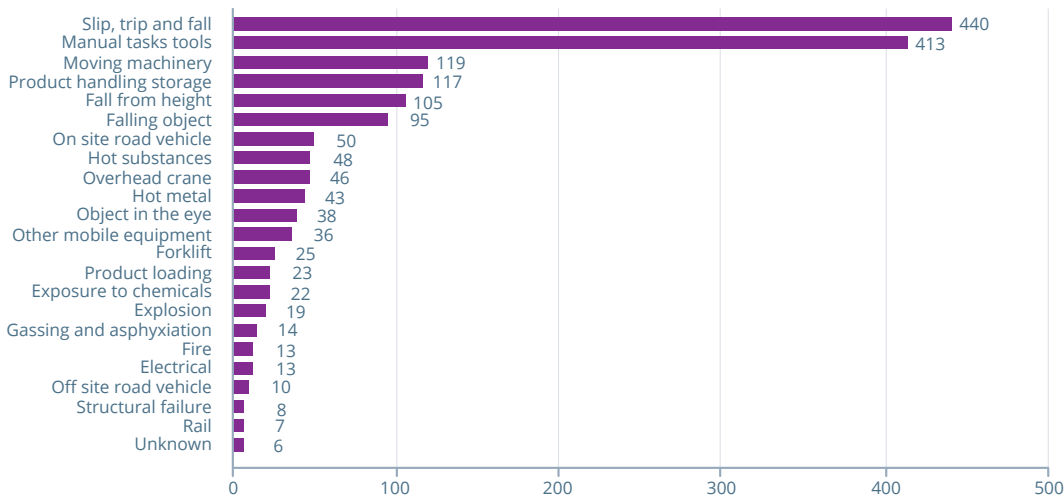
Figure 6: Lost Time Injury Frequency Rate (LTIFR), 2013-2022



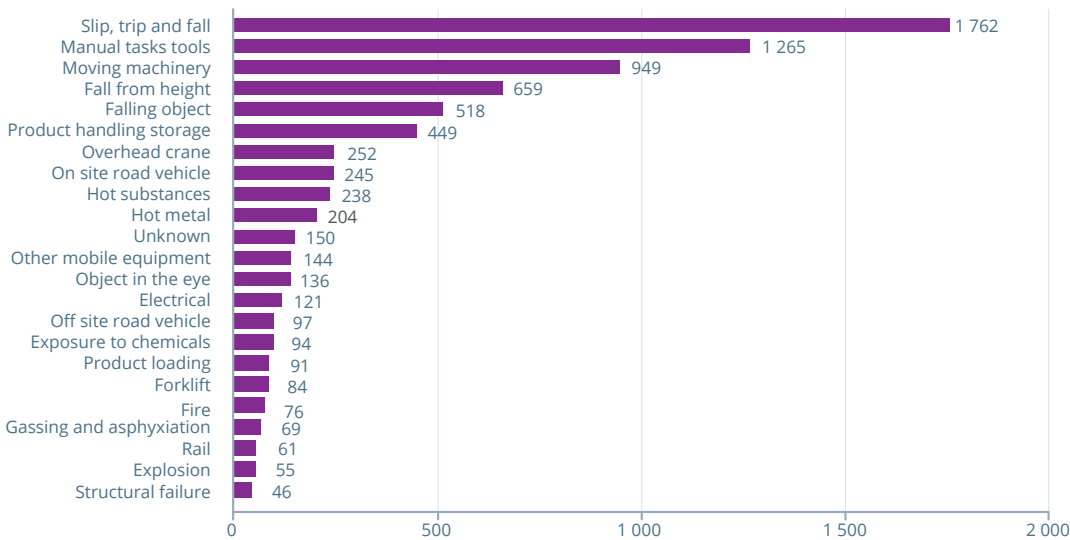
Lost Time Injury Frequency Rate (LTIFR) decreased from 0.85 in 2021 to 0.65 in 2022.

Figure 7: Causes of Lost Time Injuries 2013-2022

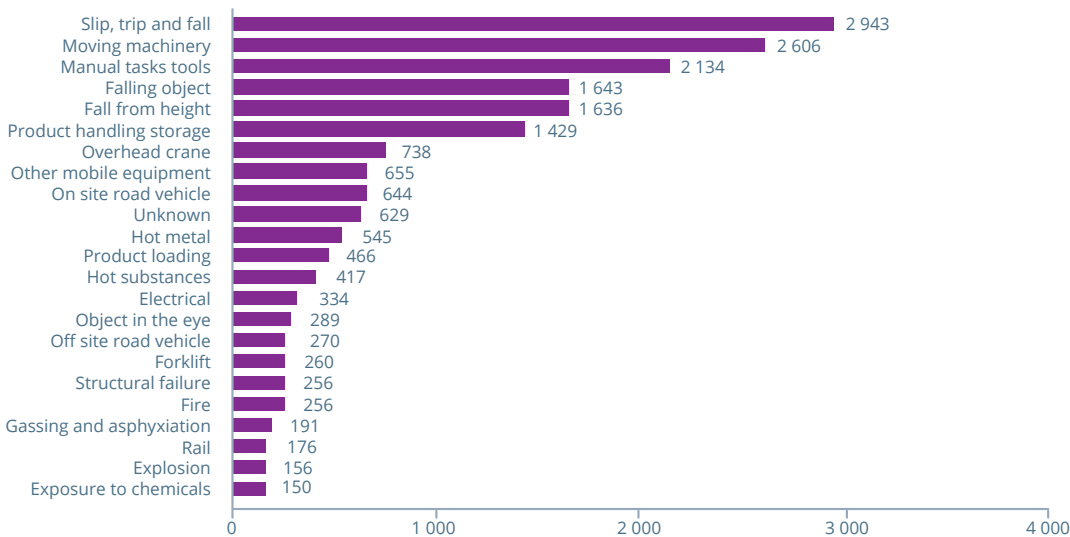
Causes of Lost Time Injuries 2022



Causes of Lost Time Injuries last 5 years (2018-2022)



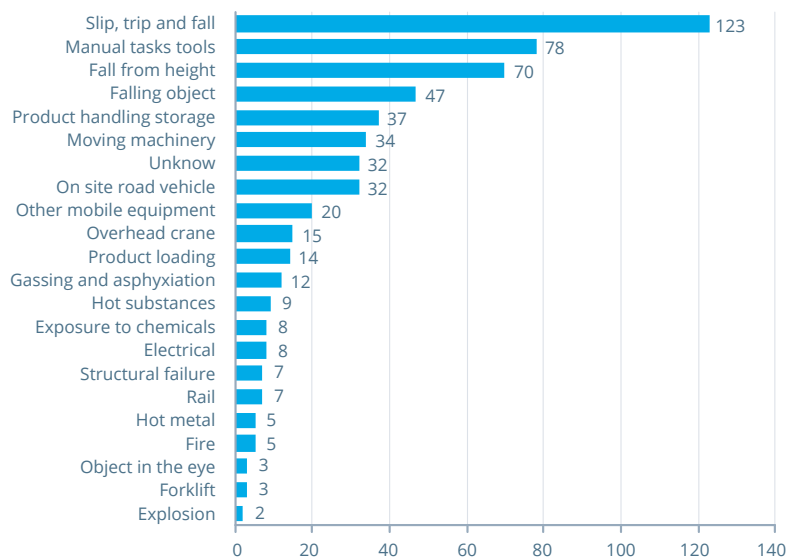
Causes of Lost Time Injuries last 10 years (2013-2022)



The following graphs show the distribution of causes separated by employees and contractors.

Figure 8: Causes of Lost Time Injuries in 2022 for employees and contractors

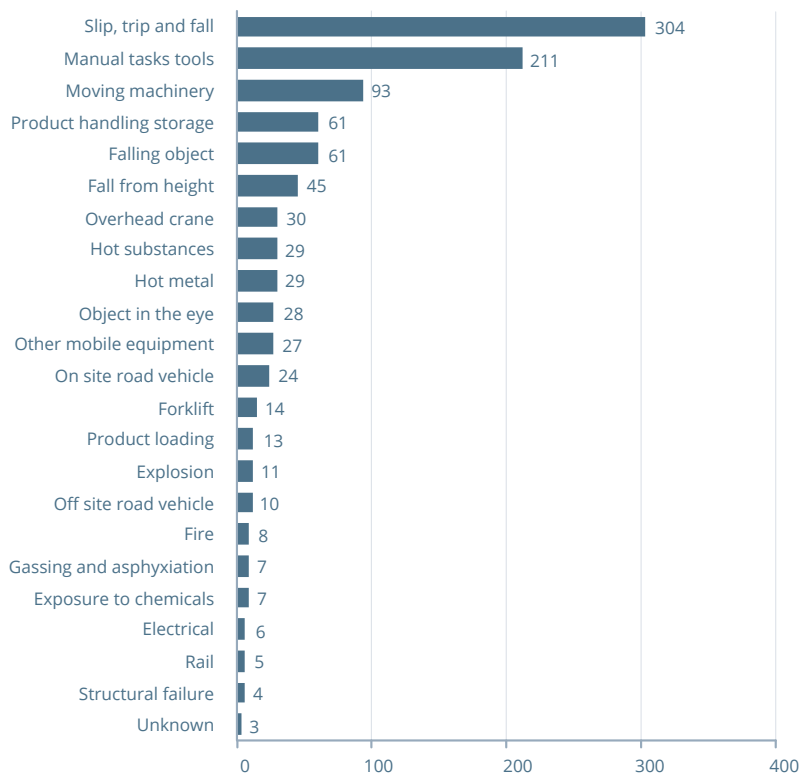
Causes of Lost Time Injuries - contractors 2022



The top five causes of Lost Time Injury in 2022 for both employees and contractors were: slipping, tripping and falling, use of manual tools, moving machinery, product handling and falling from height.

Causes of Lost Time Injuries - employees 2022

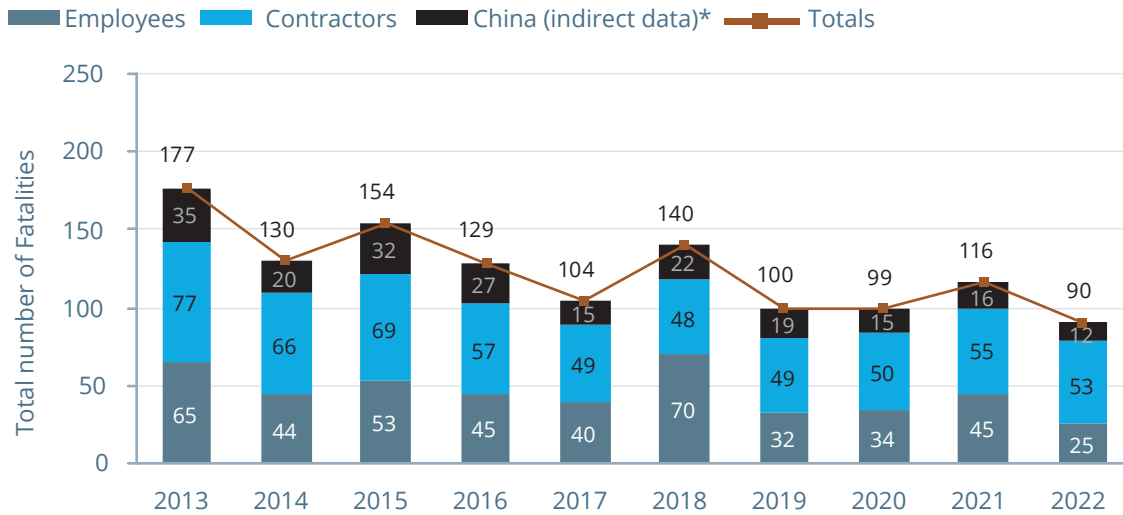
Causes of LTIs - employees 2022



Fatality analysis

Death from a work-related injury, certified by a medical professional. Fatality Frequency Rate (FFR) is calculated on the number of Fatalities per million man hours.

Figure 9: Number of Fatalities 2013-2022

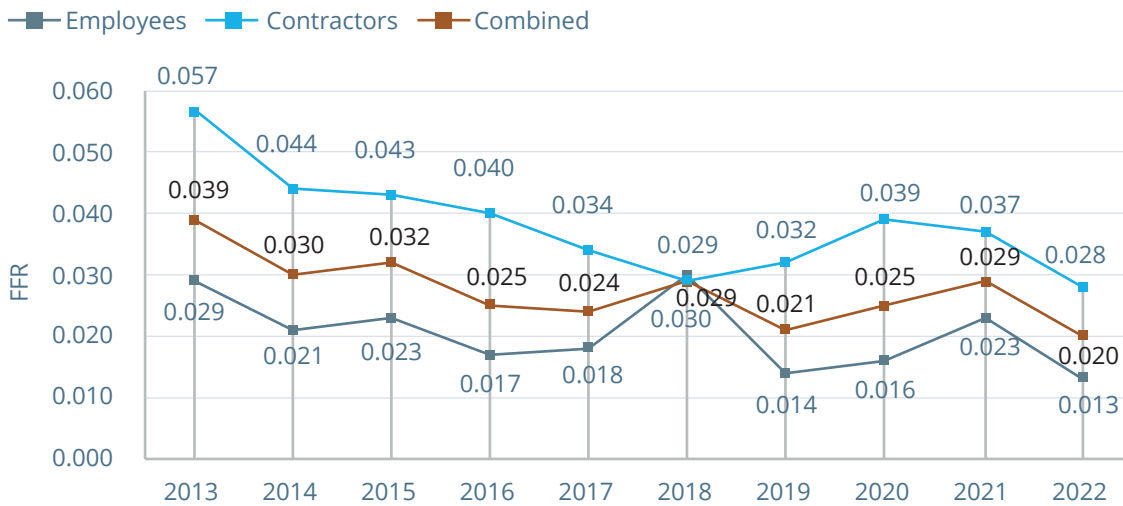


* Data received from China via Sinosteel Wuhan Safety & Environmental Protection Research Institute (SEPRI) does not distinguish between employees and contractors. Data received directly from Chinese worldsteel members does and is included in the analysis.



The total number of fatalities reported to worldsteel during 2022 was 90, which represents a decrease of 21% compared to 116 in 2021.

Figure 10: Fatality Frequency Rate 2013-2022

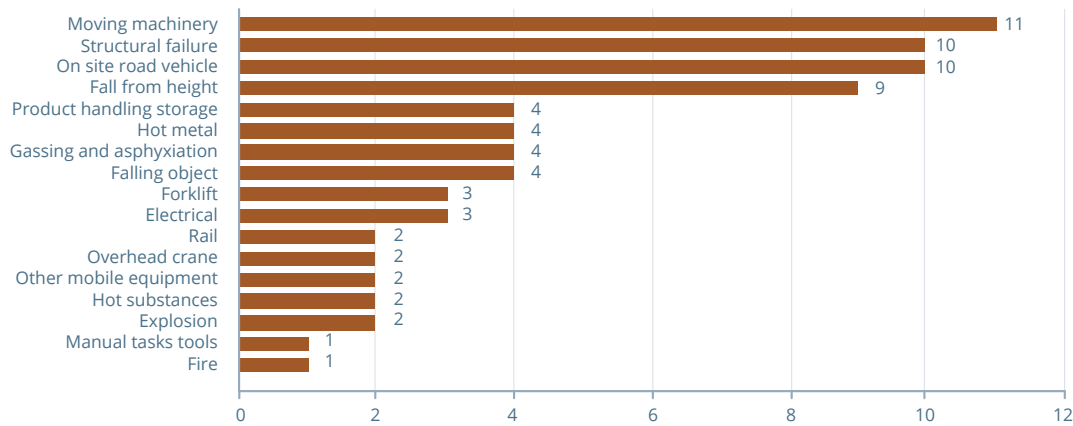


The Fatality Frequency Rate decreased from 0.029 in 2021 to 0.020 in 2022.

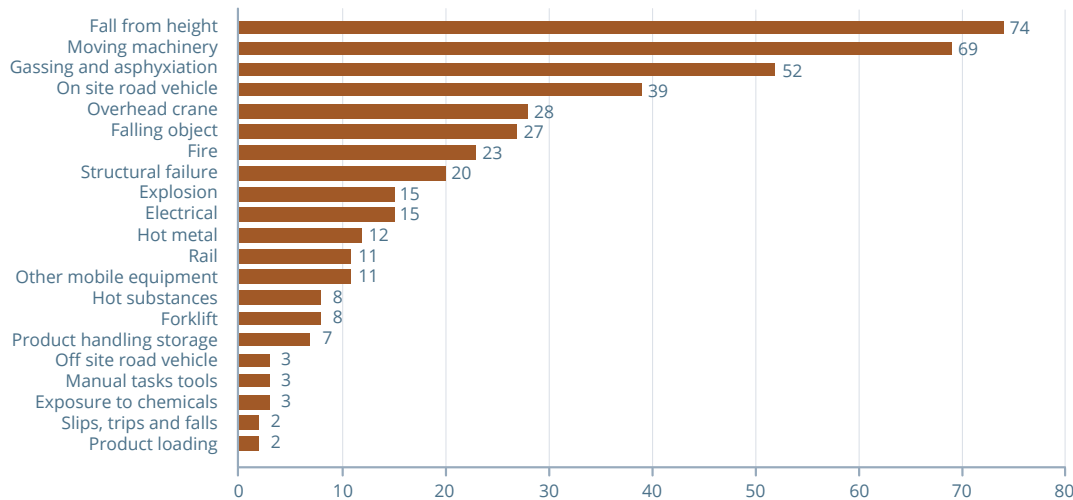


Figure 11: Causes of Fatalities 2013-2022

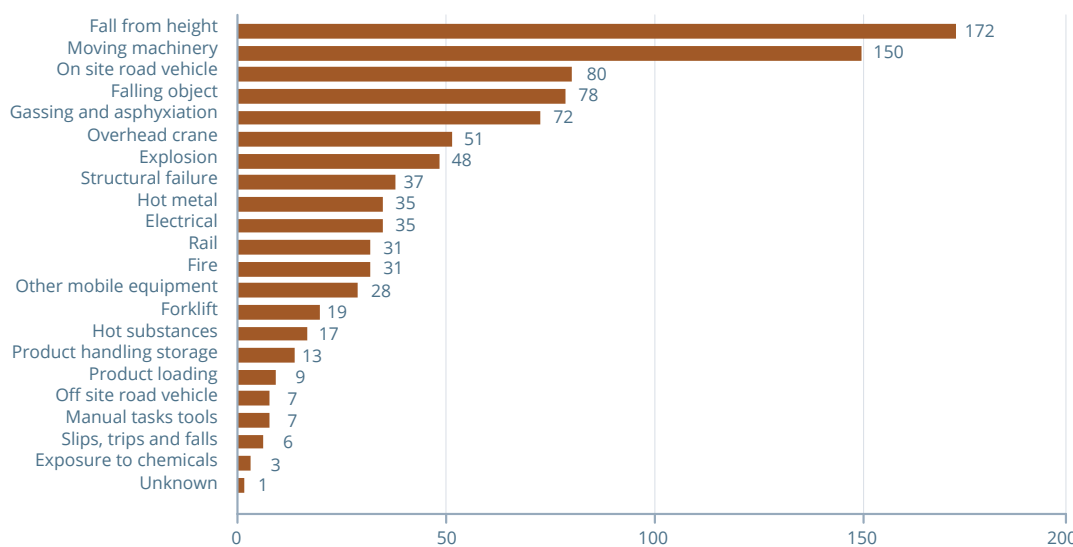
Causes of Fatalities, 2022



Causes of Fatalities last 5 years (2018-2022)



Causes of Fatalities last 10 years (2013-2022)



Note: events registered as 'Other' or 'Unknown' are not included.



The top 5 causes of fatalities over the past decade were falling from height, moving machinery, on site road vehicles, falling objects, and gassing and asphyxiation. These are consistent over time.



The following graphs show the distribution of causes split by employees and contractors.

Figure 12: Causes of employee Fatalities in 2022

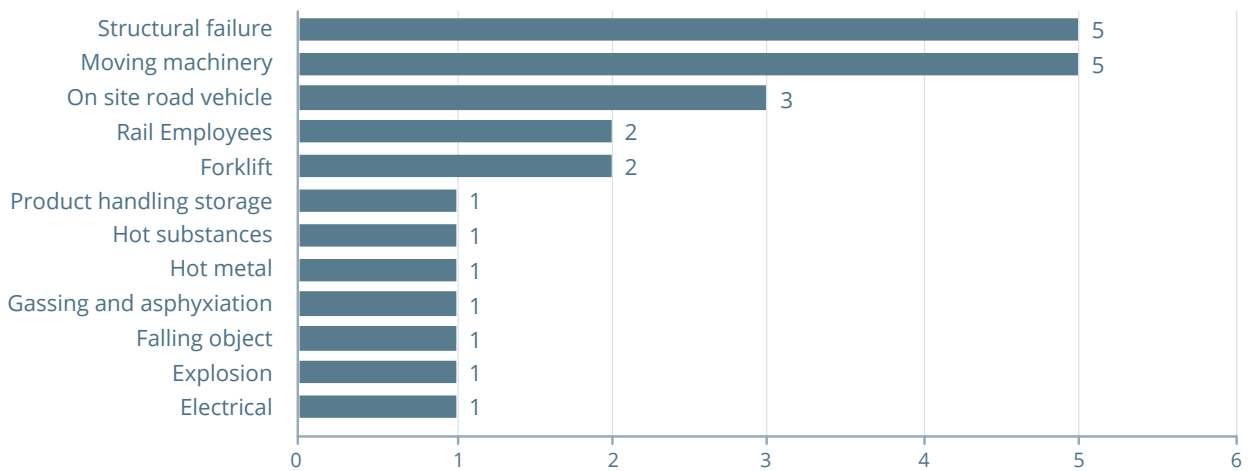
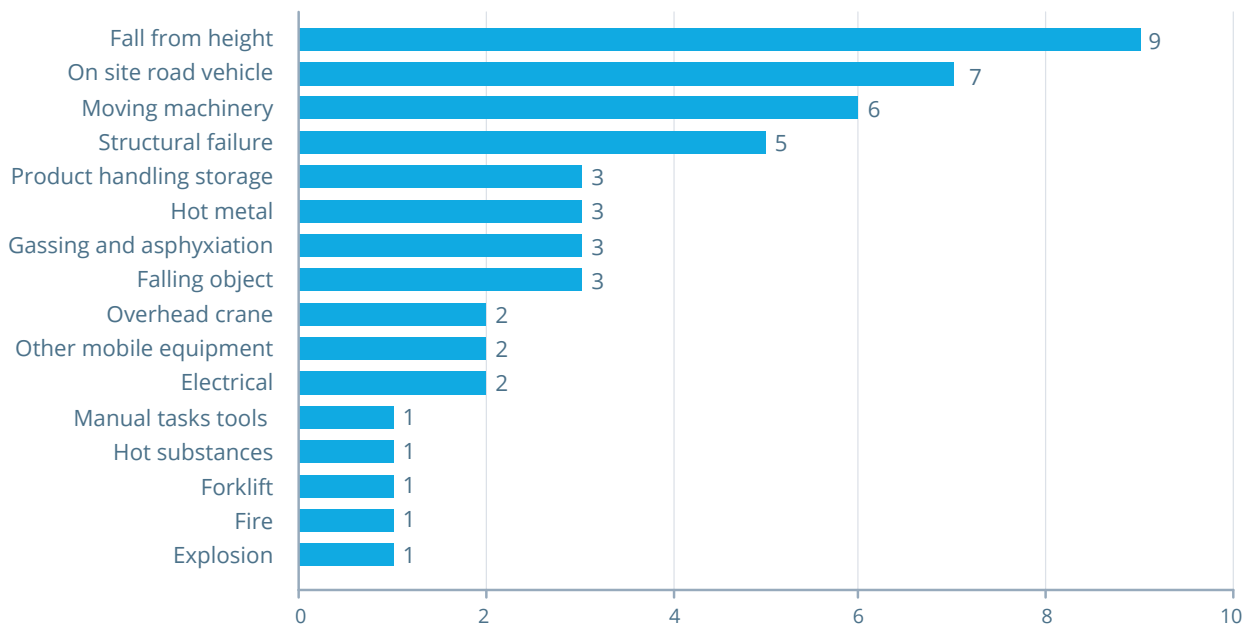
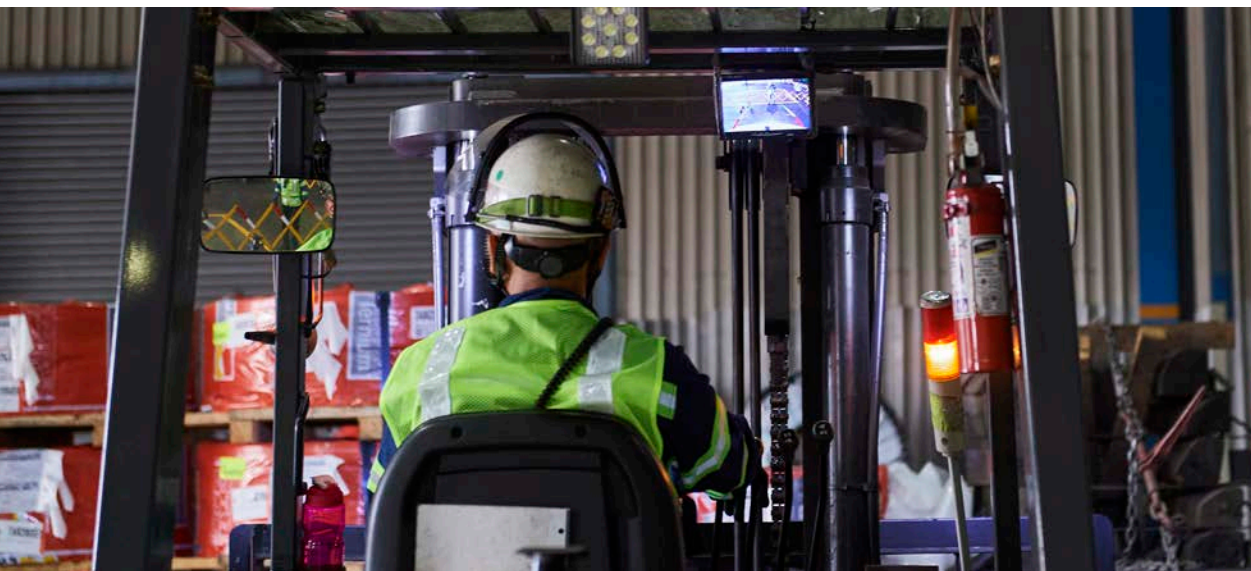


Figure 13: Causes of contractor Fatalities in 2022



Note: events registered as 'other' or 'Unknown' are not included.



In 2022, contractors led lagging performance with the most fatalities. Causes of fatalities for contractors and employees are different, reflecting the different activities and risks faced by each group.

Process Safety Management (PSM) analysis

Process Safety Management (PSM) is a blend of operational, engineering and management skills focused on preventing catastrophic accidents and near misses, particularly explosions, fires, structural collapse, and damaging releases associated with a loss of containment of energy or dangerous substances such as molten metals, fuels, and chemicals.

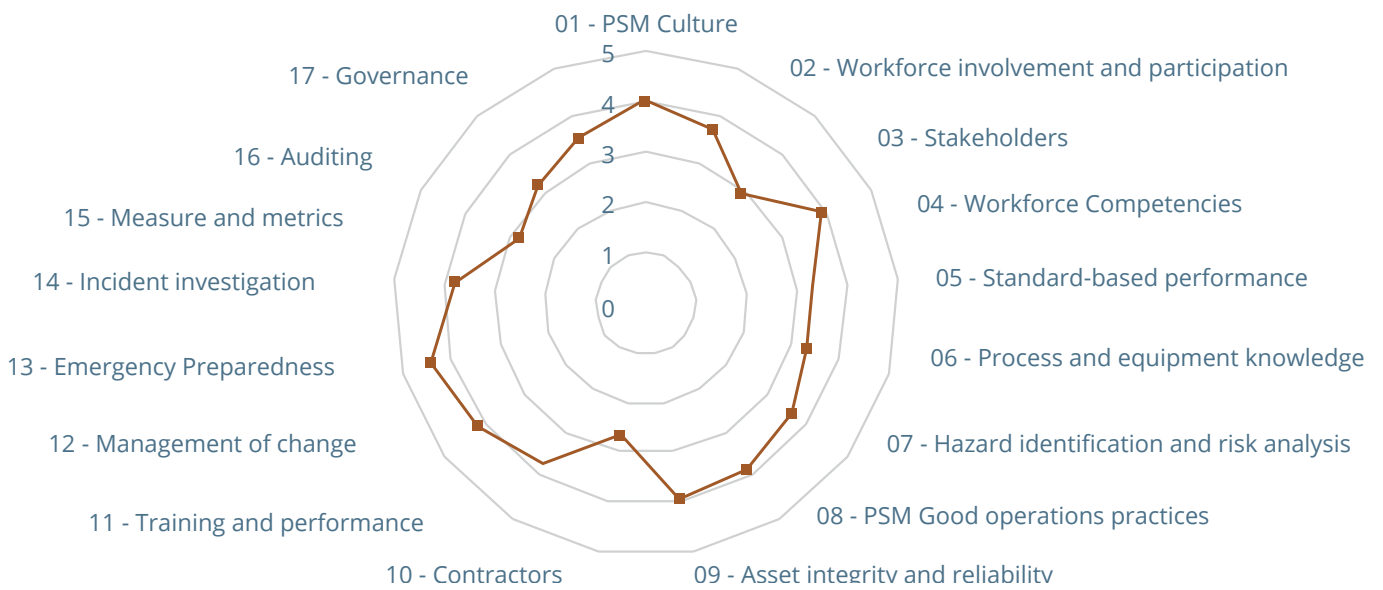
The manufacturing of steel involves processes with intrinsic hazards that need careful management. The measures required to control these hazards are often complex. The focus of Process Safety Management is not limited to protecting the people within the company but also includes the environment, assets, and the surrounding community.

Table 2: Significant events benchmark

Typical process safety events	Quantity	Main causes
Fires	761	<ul style="list-style-type: none"> Inadequate Inspections Falling of Spatter Electric Flash Inadequate engineering design Strip offset/friction on cold rolling mill Poor Housekeeping Poor material quality Splashing of Slag Electrical equipment failure Inadequate preparation of hot work Small stockpile fires in recycling yards/scrap bins Condition of the integrity of fuel Oil injection pipes and hoses Continuous casting plant hydraulic fire BOF Molten metal splash, Chemical reaction due to the entry of fuel carbon into the combustion chamber of the electric furnace Liquid metal leakage
Explosions	35	<ul style="list-style-type: none"> LNG Gas explosion Basket scrap having some pressurised cans. Hydrogen explosion Blast when loading the furnace with scrap metal. Flammable gas accumulation Mixing blast furnaces gas and gasoil in the boiler (human error + technical ability to do the mix)
Molten metal and water reactions	78	<ul style="list-style-type: none"> Water in the slag drum and slag handling Ladle Breakouts, Spills, Splashes Rainwater/snow in scrap bucket when charging Rapid phase change Water in scrap metal Torpedo car derailment event Water leakage from the furnace roof's delta area leading to water accumulation on molten slag and falling attached slag pieces from roof Blast Furnace molten metal release related to channel damage
Gas and liquid releases (flammable, toxic or asphyxiant gases)	998	<ul style="list-style-type: none"> Reformer Gas header rupture due to erosion. Mechanical integrity (erosion/corrosion), valves, flanges, and pipelines. Lack of maintenance Hydraulic systems Gas leakage through pipelines/flanges. CO release due to feeding mixed gas hose bottom flange cladding leakage. Leakage of Ammonia through Cylinder Assembly Corrosion



Figure 13: Process Safety Management maturity assessment results 2022



The Process Safety Management maturity analysis was derived from data provided by 28 organisations, representing 30% of worldsteel members.

Increasing maturity in process safety management can be observed. The industry has grown in experience and expertise in process safety management; however, there is an important area of improvement for element 15 (measurement and metrics). Process Safety KPIs are different

from Occupational Safety KPIs. This issue has led to requests from worldsteel members to provide effective indicators for benchmarking and monitoring purposes. In the past, worldsteel has referenced well-accepted frameworks (e.g., RP API 754); however, a specific set of indicators and guidance will be developed.



The manufacturing of steel involves processes with intrinsic hazards that need careful management. The focus of Process Safety Management is not limited to protecting the people within the company but also includes the environment, assets, and the surrounding community.

Sickness absence

Sickness absence [Percentage] is calculated as the total number of hours of sickness absence per total work hours. This indicator is only calculated for employees.

The following table shows the sickness absence per region.

Table 3: Sickness absence per region 2015 – 2022

% Sickness absence	2015	2016	2017	2018	2019	2020	2021	2022
Africa and Middle East	0.13	0.25	0.23	0.29	1.06	0.18	1.01	2.51
Asia/Pacific	0.12	0.08	0.08	0.19	0.15	0.05	0.11	0.54
CIS	0.75	1.26	1.41	0.6	1.38	1.88	1.73	2.33*
Europe	1.11	2.02	2.26	1.92	3.32	3.89	4.36	5.59
North America	0.14	0.14	0.14	0.23	0.22	0.42	0.14	1.31
South America	0.3	0.53	0.48	0.43	0.75	0.46	0.42	3.03

* In 2022, CIS data is derived from member companies/sites located in Ukraine and Kazakhstan



