ISSF
INTERNATIONAL STAINLESS STEEL FORUM

Good Safety Practice in Stainless Steel

Introduction

Message from the Chairman

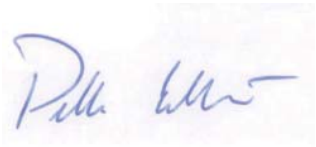
The safety and health of the people who work in the stainless steel industry is our top priority. All injuries and work-related illness can and must be prevented to make our industry a safe and reliable place to work.

The stainless steel industry is committed to the goal of an injury-free, illness-free and healthy workplace. As part of our efforts to develop a sustainable industry, we aim to set the benchmark in safety and health. Despite the progress achieved in recent years, improvements are needed in our safety performance.

As Chairman of ISSF's Health and Environment Committee I am delighted to introduce the first "ISSF Safety Book." It includes case studies that describe the good practices that our member companies have developed at their plants.

The book also includes details of accidents that have occurred and the lessons that have been learnt from these events. We hope that others will be able to learn from these examples and that they will serve to help us develop workplaces that are accident free.

Thanks to valuable support from ISSF members around the world, the book was produced in a very short time. I hope you find it of real value in identifying ways in which the culture and behaviour of everyone working in a modern stainless steel plant can be changed to make it a safer environment.



Pekka Erkkilä
Chairman, ISSF Health and Environment Committee

About This Book

The examples in this book have been provided by 22 ISSF member companies from North & South America, Europe, Africa and Asia. We collected a total of 72 case studies. This book contains 60 of those case studies. They have been divided into two sections: return on experience (known as REX) and examples of good practice.

A CD-ROM of this book is also available from the ISSF website: worldstainless.org. The CD contains all 72 examples that were collected.

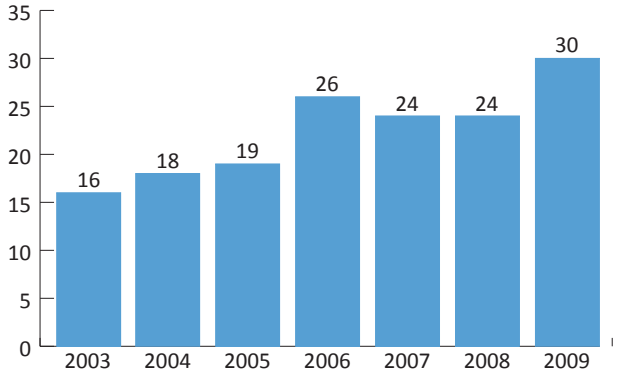
The examples shown cover a wide range of incidents that have occurred in stainless steel plants. However, no examples of incidents involving electricity were submitted. We plan to publish another edition of this book in the future and we would welcome examples of this type of incident.

Safety Data Collection

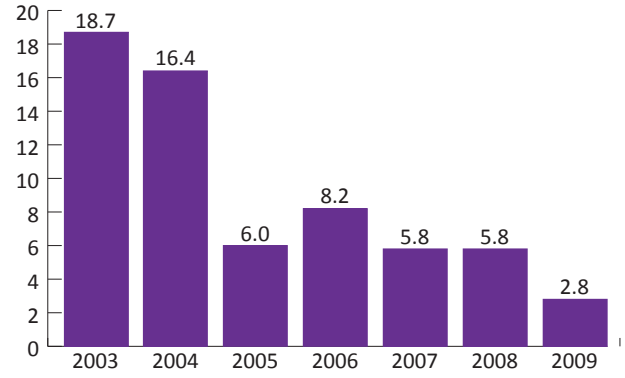
Since 2006, ISSF's Health and Environment (H&E) Committee has been collecting safety data from the production sites of stainless steel producing members. The results of the data collection can be found in the following graphs.

While the H&E Committee recognised the importance of the data collection, it also realised that creating a safe stainless steel industry requires more than just data. The Committee resolved to collect more real cases and best practices from interested members. The result is the brochure you are reading now: *Good Safety Practice in Stainless Steel*.

The information is presented for the benefit of all members. By collecting data and sharing real-life case studies, , ISSF aims to improve the industry's awareness of safety and ultimately improve its safety performance.

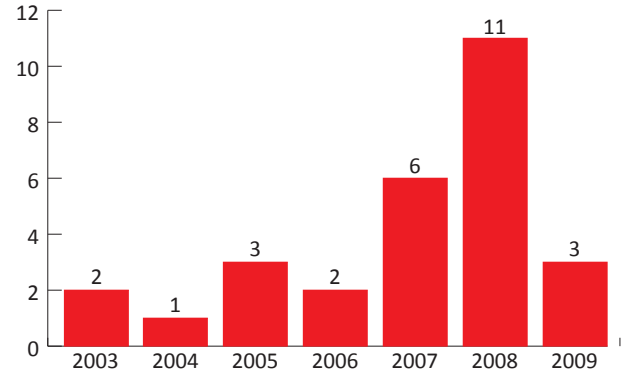


Number of reporting companies



Lost-time injury frequency rate (all workers)

Lost-time injury frequency rate (by worker type)



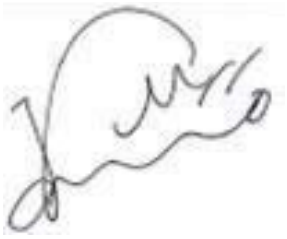
Number of fatalities

Author's Note

I am very pleased to have had the opportunity to prepare the first Book of Good Safety Practice for ISSF. The book is part of the initial phase of ISSF's drive to make the stainless steel industry a safer place to work. We hope that further safety books will be published on a regular basis in the future.

I would like to express my gratitude for the support provided by ISSF's member companies in the preparation of this book. I would also like to thank the consultants who provided assistance, in particular Jonathan Kuhry (safety consultant) and Dan Smith (editorial).

I would also like to ask for your continued support in order to achieve our goal of zero accidents in the stainless steel industry. For that purpose, your cooperation is indispensable.



Masayuki Kamoshida

Technical Assistant, Health & Environment
International Stainless Steel Forum (ISSF)

The following ISSF member companies have contributed data for this book:

- Acerinox
- Aichi Steel
- ArcelorMittal – Stainless
- ArcelorMittal Inox Brazil
- Baosteel – Stainless Steel Branch
- Columbus
- Daido Steel
- Deutsche Edelstahlwerke
- JFE Steel
- Nippon Kinzoku
- Nippon Metal Industry
- Nippon Steel & Sumikin Stainless Steel (NSSC)
- Nippon Yakin Kogyo
- Nisshin Steel
- Outokumpu
- POSCO
- Shanghai Krupp Stainless (SKS)
- Sumitomo Metal Industries
- Thainox Stainless
- ThyssenKrupp Mexinox
- ThyssenKrupp Nirosta
- ThyssenKrupp Terni
- Yieh United Steel Corporation (YUSCO).

Good Practice Case Studies

Good Practice Case Studies

Good safety practice can be defined as any practical activity or action that aims to improve safety and health in the workplace. The examples in this section describe some of the initiatives that ISSF member companies have implemented to improve the safety and health of their workplaces and employees.

In most cases the actions are practical actions that can be implemented in almost any stainless steel plant in the world. It is hoped that by sharing these examples, the safety and health performance of the entire stainless industry will be improved. The goal is zero harm to anyone working in the stainless steel industry.

The examples included in this section have been categorised by improvement type. The table below shows the different types and the page on which the example is shown.

Note: The word 'operator' is used in these examples to mean the worker, factory hand or labourer who was performing the task.

Types of Improvement

The following table summarises the types of improvements that can be found in this section.

Type of improvement	**Pages**
Activity for management	17, 23, 25, 33
Activity for operators	10, 12, 14, 16, 17, 18, 19, 21, 33
Education or information campaign	12, 14, 19, 33
Equipment improvement and new tools	17, 19, 21, 25, 37, 38, 39, 40, 41, 45
Improvement measure	12, 16, 17, 19, 20, 21, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 36
Recognition action	21, 22, 25, 31, 33
Training or information session	9, 10, 11, 12, 13, 14, 15, 19, 33, 42, 43, 44

Changing Safety Behaviour

A study of accidents at this plant found that most accidents were caused by the behaviour of employees.

Keywords: behaviour

Associated risk: All risks

Health/Safety: Safety

Improvement type:
- ➔ Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:
- ➔ Melt shop
- ➔ Hot rolling
- Cold rolling
- ➔ Finishing
- ➔ Other

Description

To change employee behaviour, external consultants were engaged to run a course for all employees titled “Changing Behaviour for Safety.” The training addressed the root cause of the poor behaviour and showed how employees could work in a safer manner. It is hoped that the training will lead to a reduction in the number and severity of accidents on the site.

Additional comments

The main principles of the training have been outlined in a new booklet titled *Behaviour Based Safety*. The booklet has been distributed to all employees.

Workopoly

During the first week of their apprenticeship, new apprentices undertake a number of introductory activities, including playing Workopoly.

Keywords: occupational safety, games, new employee

Health/Safety: Safety

Associated risk: Injuries due to incorrect machine operation

Improvement type:

- ➔ Training or information session
- Education or information campaign
- ➔ Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- Melt shop
- Hot rolling
- Cold rolling
- Finishing
- ➔ Other

Description

Workopoly is a game devised to educate employees about safety in the workplace. The game shows the basic aspects of occupational safety.

The game is designed for two to six players. Each player chooses a token and receives five safety points at the beginning of the game. Players move around the board by throwing a dice. If they land on a Question or Action square, the player must take a card from the relevant deck. To gain a point the player must either perform the action or answer the question on the card. A correct answer (or action) means they gain another safety point. Incorrect answers or actions lose a point. The winner is the first player to reach the finish line with 15 safety points.

Additional comments

The game is a useful and effective supplement to machine-based instruction. It helps apprentices to learn the occupational safety rules in an entertaining and motivating way. The company has noticed an improvement in the safety behaviour of the apprentices during their training. Some employees have expressed an interest in extending Workopoly to other parts of the plant.

New Employee Safety Education

By carrying out a virtual experience, the sensitivity of an employee to danger can be evaluated.

Keywords: new employee, training

Associated risk:

Improvement type:
- ➔ Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:
- ➔ Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

As part of a new employee's safety education, the employee is exposed to a number of different virtual experiences that simulate the effect of an accident. The training is carried out by an outside organisation, just before or just after the employee is assigned to a new task.

Photos courtesy of TABMEC Co., Ltd

Fire Training

All employees in the cold rolling mill have taken part in training on fire-fighting procedures and equipment.

Keywords: fire safety, training

Associated risk: Fire safety

Improvement type:
- ➔ Training or information session
- ➔ Education or information campaign
- ➔ Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:
- Melt shop
- Hot rolling
- ➔ Cold rolling
- Finishing
- Other

Description

A new fire-safety campaign has seen all employees receive training in first aid and the use of fire extinguishers, the fire truck, hydrants, and foam generators. The training included information on housekeeping and the maintenance of safety tools. Regular inspections and audits will be carried out to ensure the skill level remains high.

Additional comments

The training is designed to be undertaken by everyone working at the plant.

Safety Training for Supervisors

To improve the practice of safety at this plant, supervisors undertake extensive training. The training helps the supervisors to ensure a safe workplace.

Keywords: technical knowledge, training

Health/Safety: Safety

Associated risk: All risks

Improvement type:

- ➔ Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- Melt shop
- Hot rolling
- Cold rolling
- Finishing
- ➔ Other

Description

Supervisors at this plant are extensively trained to improve their technical knowledge of safety. The supervisor or foreperson at each plant becomes the core safety person within their team and are recognised as the safety experts by other team members and contractors.

The training is carried out twice a year (in spring and autumn) in groups of five to six people. The training takes approximately two months and is conducted both on-site and at the Safety and Health Department which is situated in the headquarters of the company. The headquarters is in a different location to the worksites, enabling the staff to concentrate on the training without distractions from their daily duties.

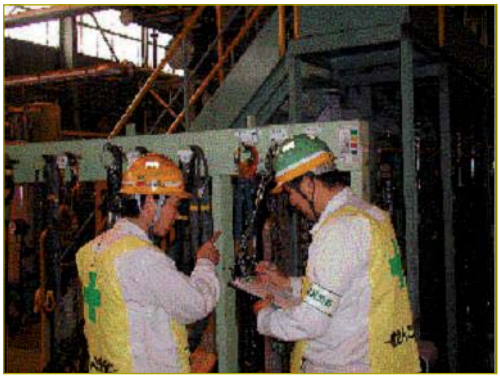
Additional comments

The training that is carried out at headquarters takes 25 days and covers:

- Industrial safety and health law
- Fire law
- Labour standards
- Risk assessment
- Health
- Internal rules.

The on-site training takes 20 days and covers:

- Practical implementation of safety procedures
- Minimisation of dangers in the workplace
- Continual improvement in safety practice.



Immediate Post-accident Training

An employee's hands were caught while he was cleaning a working roller. Training was immediately organised for all staff on the line to ensure the accident did not happen again.

Keywords: accident, caught

Health/Safety: Safety

Associated risk:

Improvement type:

- ➔ Training or information session
- ➔ Education or information campaign
- ➔ Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- Finishing
- Other

Description

Just after the employee had been injured, the section supervisor and all employees on the line were trained in the correct way to clean the roller. The training took place on the same line where the accident had occurred. The trainer showed the employees which tool should be used and the correct method for manually cleaning the rollers.

Additional comments

An automatic cleaning device was added to the rollers the day after the accident to minimise the need for manual cleaning of the rollers. The cleaning device has also been added to all of the bridle rollers on the line.

Images show the new cleaning device on the roller.

Safety Declaration

After an accident in this plant, everyone working there is encouraged to declare that they will undertake an action to prevent that accident from happening again.

Keywords: individual actions, prevention

Health/Safety: Safety

Associated risk: All risks

Improvement type:
- ➔ Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

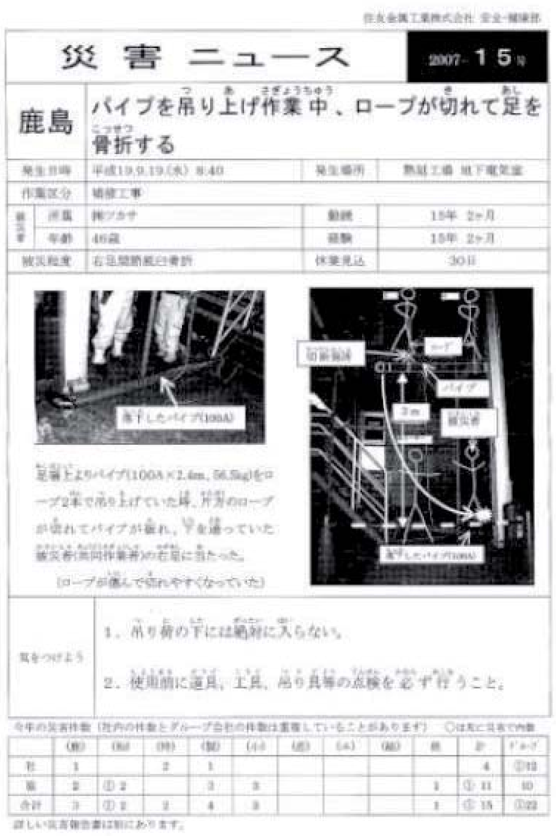
Plant section:
- Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

Information about all accidents in this plant is distributed to everyone working there. The accident notification contains an area where each person can declare a safety action that they can undertake in order to prevent it occurring again. All of these actions are also distributed.

Additional comments

The aim is to make everyone conscious that accidents must not be repeated.



Prevention of Pinched and Caught Accidents

Incidents in which employees are caught or pinched in moving machinery account for 35% of all accidents at this plant. This poor result has prompted the company to undertake additional measures to prevent this type of accident.

Keywords: precautions, machinery

Associated risk: Pinched and caught in moving machinery

Health/Safety: Safety

Improvement type:

- Training or information session
- Education or information campaign
- ➔ Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- ➔ Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

All equipment in the plant has been examined to determine if there is a risk of employees being pinched or caught while it is in use. The examination is undertaken by the managers and operators of the production administration section of the plant, the head of the plant and the person in charge of safety. The investigation team recommends actions to be taken to make the machinery safer for operators.

Additional comments

The programme began in June 2009 and will continue indefinitely. Already 420 improvements have been implemented including:

- Installation of safety fences around the conveyor belt equipment
- Installations of covers on the back of the motor belt.

Stop, Observe, Act and Review (SOAR)

Stop, Observe, Act and Review (SOAR) is a systematic methodology that has been developed to measure safety behaviour and compliance to safety requirements.

Keywords: feedback, procedures

Health/Safety: Safety

Associated risk: All risks

Improvement type:

- Training or information session
- Education or information campaign
- ➔ Activity for operators
- ➔ Activity for management
- ➔ Improvement measure
- ➔ Equipment improvement or new tool
- Recognition action

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

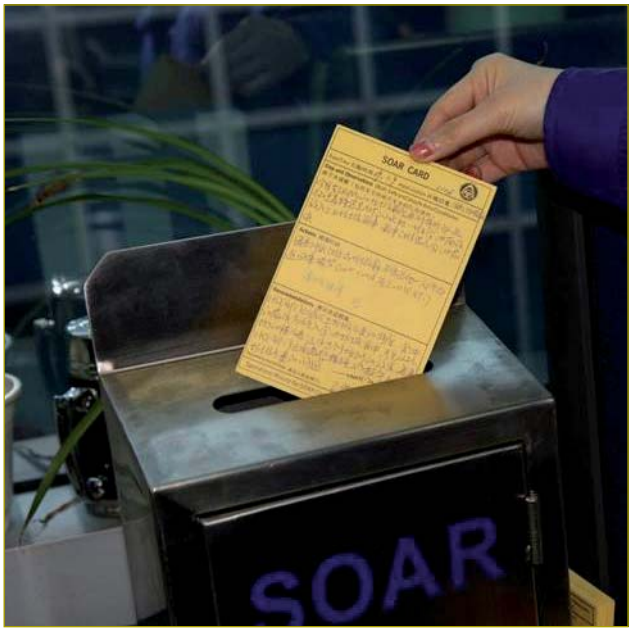
Description

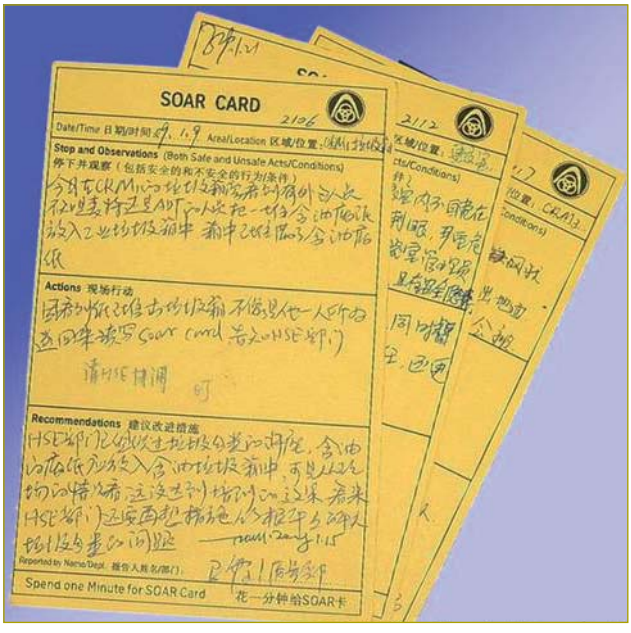
A SOAR Card system is in operation throughout the plant. There are sixteen collection boxes throughout the plant, all of which have a stock of SOAR cards available. If anyone in the company sees any unsafe behaviour (such as incorrect safety equipment, dangerous conditions or practices) they are encouraged to complete a SOAR card and put it in the box. The system remains active during night shifts, weekends and public holidays and has proved to be a very good way to monitor safety performance in the plant.

The boxes are emptied every week and every single card is analysed and acted upon. That means that every member of staff, from management to subcontractors, is continuously monitoring all activities in the plant. Since the system was introduced three years ago, more than 17,000 cards have been completed. All of them have been examined and corrective action has been taken.

Additional comments

The level of safety awareness among staff has improved greatly since SOAR was implemented. The programme ensures that staff maintain self-discipline and strictly follow safety instructions. Staff members also use the safety criteria to check the working conditions and behaviour of the entire plant. SOAR has helped this plant to achieve its safety targets.





Periodical Safety Equipment Checks

Implementation of periodical inspections of safety elements in the process line of the cold rolling mill.

Keywords: guards, machinery

Associated risk: Unguarded machinery, cutting and trapping

Health/Safety: Safety

Improvement type:

- Training or information session
- Education or information campaign
- ➔ Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- Finishing
- Other

Description

In addition to the daily inspections carried out by production staff, the Safety and Health Department have developed a number of checklists to ensure the safety elements in the process line are in good condition and working correctly. The inspections are carried out once a month by technical staff from the Department.

Additional comments

The following list shows just some of the safety equipment that is checked during the inspections:

- Safety gates
- Fire systems
- Emergency stop buttons
- Safety scanners.

If a fault is found, the workers on the line are responsible for creating a work order to have the equipment repaired.

Weekly Safety Hour

Each team spends one hour a week examining their procedures to determine how safety can be improved.

Keywords: accident, prevention

Associated risk: All risks

Improvement type:

- ➔ Training or information session
- ➔ Education or information campaign
- ➔ Activity for operators
- Activity for management
- ➔ Improvement measure
- ➔ Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- Finishing
- Other

Description

Once a week, employees in each area of the cold rolling mill spend at least one hour checking the safety of their procedures and tasks. The Safety Hour provides an opportunity for the employees to suggest changes and improvements that will make their work safer.

Additional comments

The people who do the work have the best knowledge of unsafe practices. The Safety Hour provides an opportunity to gather this valuable knowledge and experience.

Small Groups Identify Risks

Risk assessment is tackled by small groups of workers who are responsible for a particular area of the plant.

Keywords: prevention, improvement, risk assessment

Health/Safety: Safety

Associated risk: All risks

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- Finishing
- Other

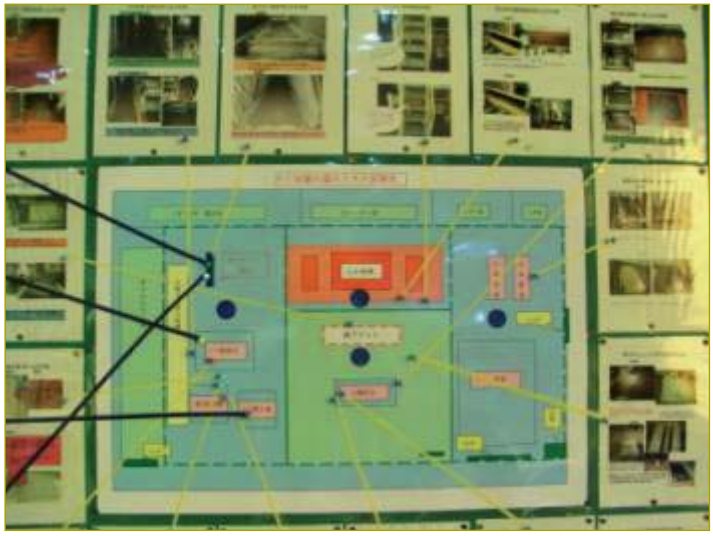
Description

Workers in the cold rolling mill meet regularly to perform risk assessments in a designated area of the plant. The entire plant is assessed by these groups. The aim is to prevent accidents before they occur. All types of risks in the workplace are assessed and analysed by the groups. Changes are implemented wherever necessary. Details of the issues examined by the small groups are distributed around the plant to ensure that everyone is aware of the risk and the action that should be taken.

Additional comments

One small group came up with the idea to colour-code the entire plant to show the different work areas. The areas are displayed on a map. The colours help everyone to find their way to their correct area, saving time and unnecessary journeys.

The map also includes photographs which show the work areas before and after implementation of the safety improvements suggested through the small groups.



Small Group Training Activities

Small groups of employees meet regularly to discuss safety issues relating to a specific theme. The activities help to develop the safety knowledge and awareness of all employees.

Keywords: communication, training

Associated risk: All risks

Health/Safety: Safety

Improvement type:

- Training or information session
- Education or information campaign
- ➔ Activity for operators
- Activity for management
- ➔ Improvement measure
- ➔ Equipment improvement or new tool
- ➔ Recognition action

Plant section:

- ➔ Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

A study of accidents and safety incidents within this company found that there was insufficient training provided within group units. All workers at the company's manufacturing sites now take part in small group activities to develop practical skills to improve safety. A specific theme or subject is adopted by each group and the activities pertain to this topic.

In the first year, 263 teams participated in this type of training. The performance of each team is evaluated at the end of the training to determine how successful it has been. The average score across all 263 teams was 67.2 points out of 100. The company aims to improve on this result in future years.

Additional comments

The small group activities have resulted in a number of safety improvements in this workplace.

Eliminating high-temperature work	High-temperature products sometimes jammed in the rolling machinery. Operators would use a metal bar to lever the caught material away from the obstruction. However, the small group recognised that there was a high risk that an operator could be burnt. The group came up with the solution of installing a guidance plate in the machine. This ensures that the product does not become stuck, and eliminates the risk of an operator being injured.
Providing space between people and vehicles	Forklifts were passing an area where workers had to walk backward carrying sample materials and mill ends for processing. The small group identified that there was risk workers may come into contact with a forklift. A new safety fence was installed and the distance between the forklift path and the working area was increased.

I Always Act Safely

Many accidents result from the actions of an individual. Instilling the idea that “I am a person who always acts safely” helps everyone to think about safety before they perform any action.

Keywords: prevention, behaviour

Health/Safety: Safety

Associated risk: All risks

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- ➔ Recognition action

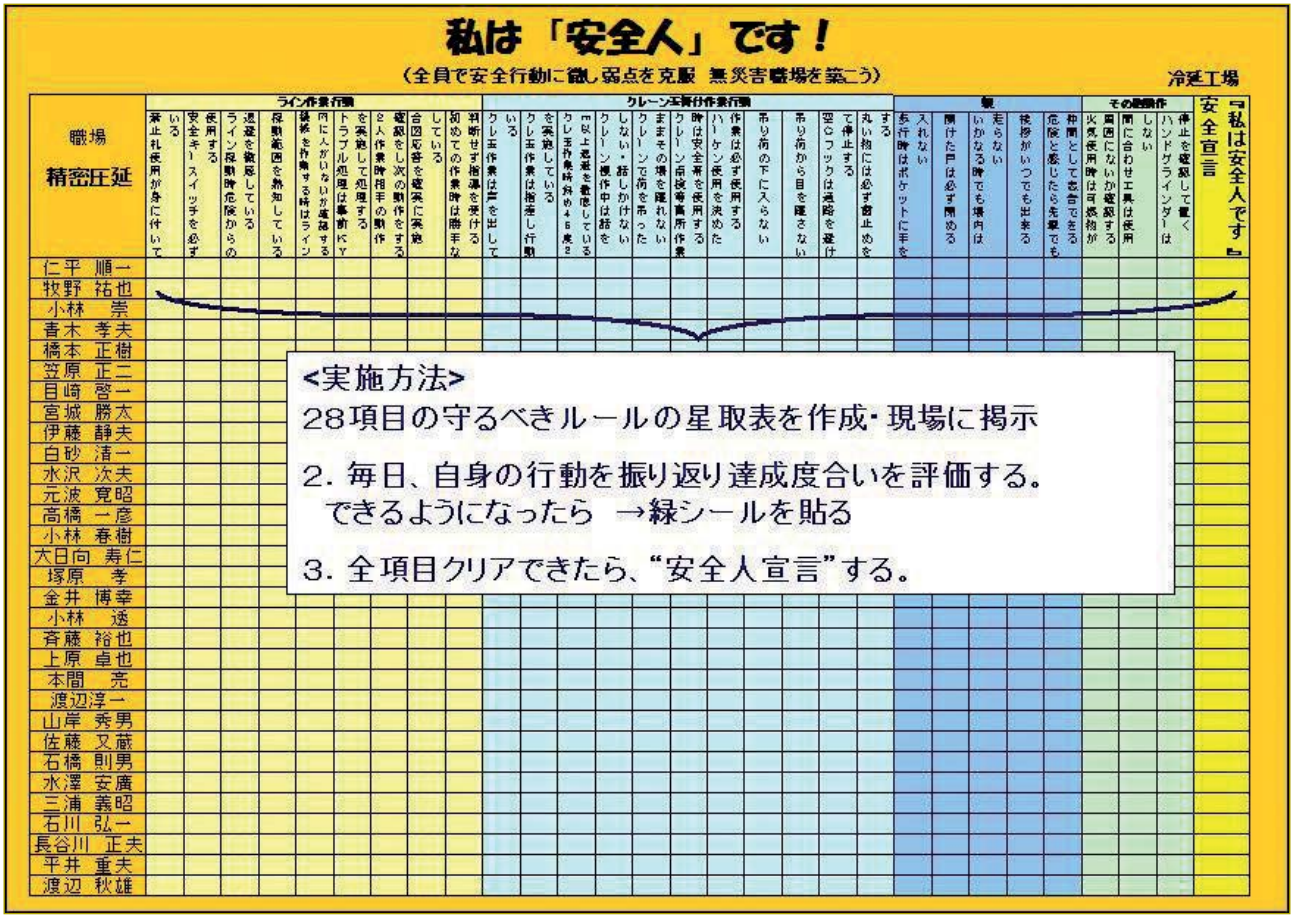
Plant section:

- Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- Finishing
- Other

Description

To demonstrate the concept, this company came up with the idea that each workplace should identify 28 safety “rules.” Each rule is listed on a board, along with the names of everyone who works in the plant. Rules can include things such as a safety task or a level of safety performance (for example, a lower level of lost time due to accidents).

If someone thinks they are already performing the task, or that they have achieved the level of performance they place a green sticker against that task. Before the start of each shift, everyone is encouraged to review their performance against that of their colleagues. Competitive spirits are fuelled!



Workplace Health Survey

An occupational health workplace survey is carried out regularly as a part of risk assessment procedures.

Keywords: health, survey

Associated risk: Exposure assessment in steel production

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- ➔ Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Health/Safety: Health

Plant section:

- Melt shop
- Hot rolling
- Cold rolling
- Finishing
- ➔ Other

Description

As part of the plant's risk assessment procedures, an occupational therapist does a workplace survey for all positions within the stainless steel factory. Each position is assessed once every three to four years. The survey includes a description of the position and its exposure to noise, dust fumes, chemicals, vibration, radiation and extremes of temperature. The physical and psychological stresses of each position are also measured. The level of risk and details of any personal protective equipment needed to do the job are also covered by the survey.

Additional comments

The survey helps to prepare a total risk assessment profile for each position in the plant. It also makes a good record of a worker's personal exposure to workplace stresses. It can also be used as a tool to evaluate a person's suitability for work.

Supervisor Audits of Near-misses

Supervisor audits are carried out on every shift for each near-miss reported.

Keywords: insurance, near miss

Associated risk: Insurance

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- Finishing
- Other

Description

Each supervisor in the plant is responsible for checking any tasks that have resulted in a near-miss. The supervisor checks the task to see why the near-miss happened. They then prepare a report for the safety department detailing the changes they have implemented and any further actions that should be taken. The safety department audits the new procedure and checks that other shifts adopt the new practices.

Additional comments

All supervisors are now auditing near-misses in their areas.

Friday Safety Meeting

Every member of the plant's executive management team must attend the Friday Safety Meeting which is designed to inform top management of safety and health related issues. Each week, one member of the executive is responsible for walking through the plant with a camera to record any problems they find.

The photos are presented at the Friday Meeting with the comments of the executive on duty that week. All problems are recorded and corrective action plans are made. A designated person is made responsible for each action item. The first topic at the following week's meeting is a review of open issues from the previous meeting. No issues are removed from the agenda until they have been corrected.

Keywords: communication, feedback, improvement

Associated risk: All risks

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- ➔ Activity for management
- ➔ Improvement measure
- ➔ Equipment improvement or new tool
- ➔ Recognition action

Health/Safety: Safety

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

The Friday Safety Meeting is a part of the weekly Friday Management Meeting. The meeting reviews all safety and health activities and events as well as the items found during the executive walkthrough of the plant.

Informing top management about safety and health activities makes it possible for this organisation to develop a strong safety culture from the top down. It complements the bottom-up reporting that comes from the daily and weekly safety awareness meetings held at every level of the company.

Additional comments

The Friday Safety Meeting covers all safety and health activities that are planned or that have been carried out in the past week. The meeting also discusses potential safety hazards (reported through the weekly executive walkthrough or SOAR cards) and any other open safety issues. (SOAR stands for Stop, Observe, Act and Review. More information on this initiative can be found on page 17.)

Practical Use of 4M and 4E

Vital data can be gathered from employees involved in near-misses.

Keywords: methodology, near miss

Health/Safety: Safety

Associated risk: All risks

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- ➔ Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

Employees who are involved in a near miss take part in a review of the incident with their supervisor. The aim is to determine why an accident almost occurred and what can be done to avoid it happening in the future. The meeting takes place as quickly as possible after the near-miss occurs.

The purpose of the meeting is to find out what caused the near miss and what corrective measures can be implemented to avoid it occurring in the future. This can be effectively achieved utilising the 4M and 4E theory. The possible causes are known as the four Ms (4M): Man, Machine, Media or Management. The actions to be taken are referred to as the four Es (4E): Education, Engineering, Environment and Enforcement.

For example, the cause of an accident may be Man because the person's education, knowledge and experience are inadequate. The correct 4E response to this cause is Education.

Additional comments

The following table shows the 4Ms and their corresponding 4E.

4M	4E	Cause	Measure
Man	Education	Education, knowledge or experience inadequate	Education, skills transfer
Machine	Engineering	Machine fault	Improvement of machine
Media	Environment	Working clearance	Extending the surrounding space
Management	Enforcement	Method in which instructions are given	Education, training, reorganisation

Reducing Mechanical Failure

A number of technical actions have been undertaken at this plant to reduce mechanical failures, a major cause of fires in the plant.

Keywords: fire safety, mechanical failure

Associated risk: Fire

Health/Safety: Safety

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- Finishing
- Other

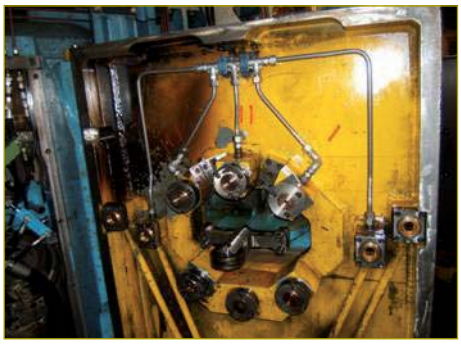
Description

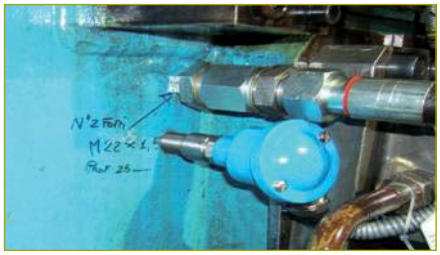
Data analysis showed that the most common cause of fire in the cold rolling mill of this plant was mechanical failure. Mechanical failure causes machinery parts to rub together, generating high levels of heat which often result in fires. A number of modifications have been made to the cold rolling mill to reduce the risk including:

- An increase in bearing lubrication and cooling.
- Monitoring of temperatures at bearings and joints. Joint break alarms have also been fitted to warn in case of failure.
- Reducing accidental friction during processing.
- Utilisation of better quality bearings (for example, using roller bearings instead of tapered roller bearings).
- Strip skidding scanning and alarm.

Additional comments

The number of fires in the cold rolling mill dropped by 36% in the first six months after the changes were implemented.





Clockwise from top left: An increase in bearing lubrication; monitoring of temperature at bearings and joints; reduction in accidental friction; utilisation of better quality bearings; and strip skidding scanning.

Transparent Gate

Better visibility and more natural light have been provided thanks to a new transparent gate.

Keywords: traffic, visibility, ergonomics

Health/Safety: Safety

Associated risk:

Improvement type:

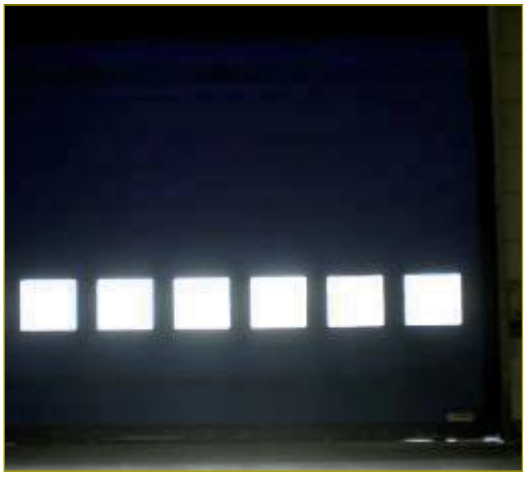
- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- ➔ Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

The old gate in the production hall has been replaced by a transparent gate. A lot of pedestrians, forklifts and other plant equipment use this area. The new gate has improved visibility (and therefore safety) and has also improved the mood of the people working nearby.



Safety Road

Studies of traffic flows on the grounds of the plant found that truck drivers were not respecting stop signs.

Keywords: traffic

Associated risk: Traffic accidents on site

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:

- Melt shop
- Hot rolling
- Cold rolling
- Finishing
- ➔ Other

Description

As existing stop signs seemed to be inadequate, high level signs were installed at each intersection. Regulations and other information for drivers were also posted at the entrances to the site.

Safety Bar Controls Truck Movements

Removable wooden bars have been installed on the floor of the loading dock. The bars limit the speed and movement of trucks as they enter the dock to load or unload material.

Keywords: shop floor, improvement, transport, loading

Health/Safety: Safety

Associated risk: Collision with pedestrians or stored products

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- Melt shop
- Hot rolling
- Cold rolling
- ➔ Finishing
- ➔ Other

Description

The wooden bars provide a physical reminder of the instructions the truck driver received from the local operator.

Fixed Contacts for Safety

Dedicated contact persons have been identified to deal with safety issues on the annealing and pickling lines.

Keywords: contact people

Associated risk: All risks

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- ➔ Recognition action

Health/Safety: Safety

Plant section:

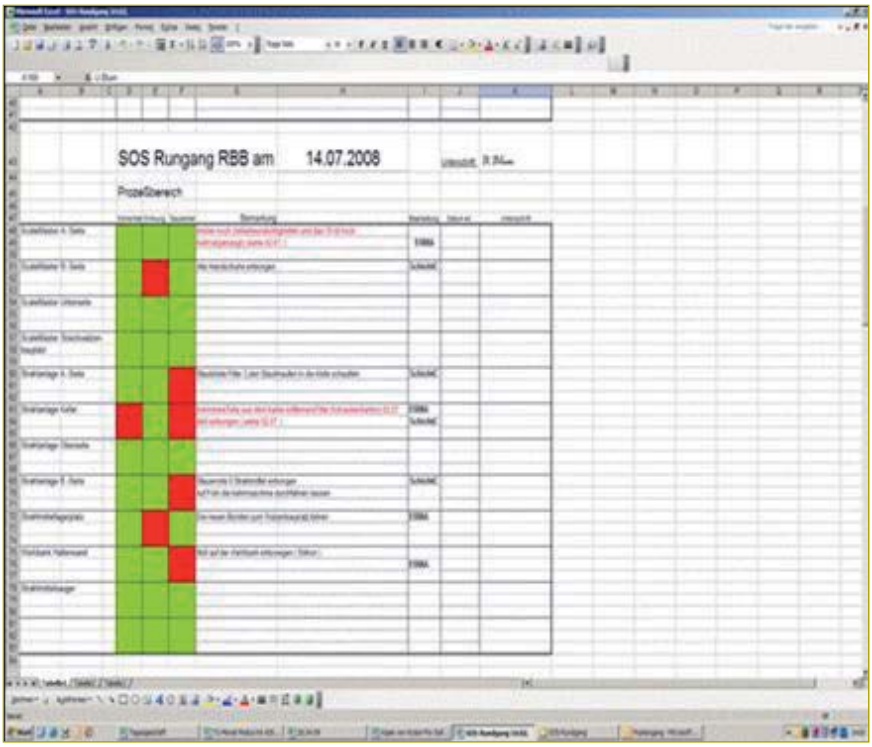
- ➔ Melt shop
- Hot rolling
- Cold rolling
- Finishing
- ➔ Other

Description

The foreman of each shift on the annealing and pickling lines is now the dedicated safety contact person for their area. The contact person is responsible for identifying, documenting and eliminating safety deficiencies. This includes tidiness, cleanliness and fire protection. The foreman utilises a checklist to confirm their area is safe during regular inspections.

Additional comments

A list of lines to be inspected is published regularly. Each line must be checked for safety, tidiness, cleanliness and fire protection. Green indicates that the area is in good order while red means that improvements are needed. There is space for comments to describe any problems. Another field shows who is responsible for eliminating the problem. That person must sign the form once the problem has been rectified.



Replacing a Clamping Mount

Simple guides help to avoid the risk of workers being crushed or pinched.

Keywords: pinch, caught

Associated risk:

Health/Safety: Safety

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

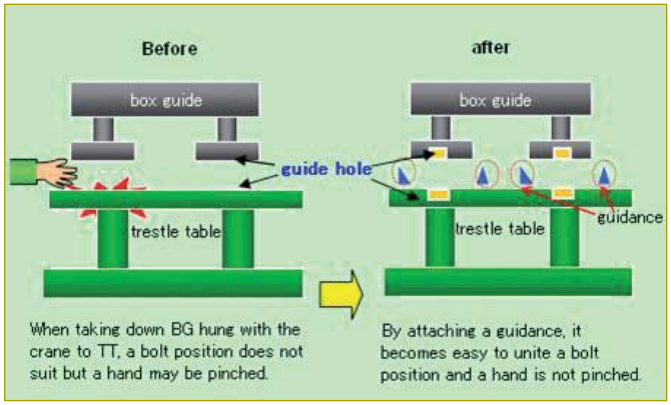
- Melt shop
- Hot rolling
- Cold rolling
- ➔ Finishing
- Other

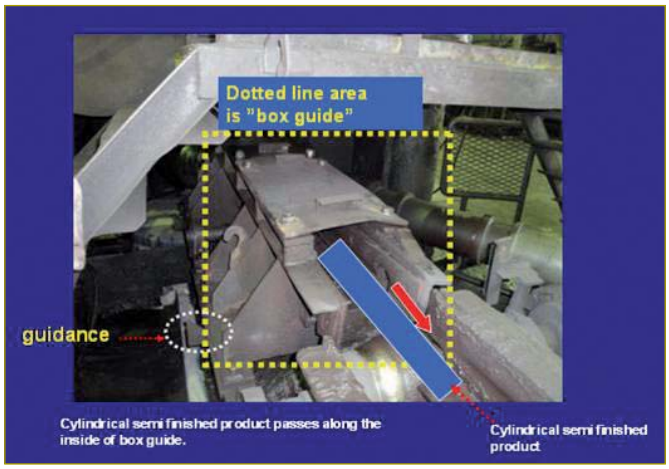
Description

When using a crane to replace a clamping mount it is necessary for the worker to move close to the mount so they can guide the crane accurately. Installing guides on a trestle table enables the operator to accurately move the mount without needing to be close. The risk of the mount falling on or pinching the operator is avoided.

Additional comments

This change has been implemented on the maintenance and inspection line.





Stop, Point, Call at Crossings

To prevent traffic accidents on-site, this plant has adopted a new procedure whereby pedestrians stop at designated points and call out before crossing the road.

Keywords: traffic

Associated risk: All risks

Improvement type:
- ➔ Training or information session
- ➔ Education or information campaign
- ➔ Activity for operators
- ➔ Activity for management

Improvement measure

Equipment improvement or new tool

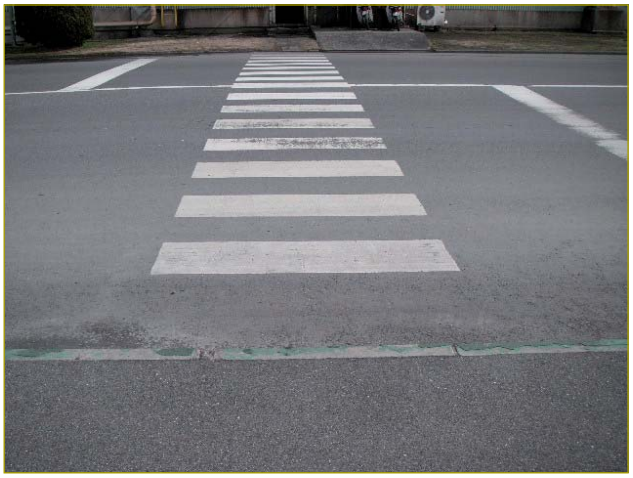
- ➔ Recognition action

Health/Safety: Safety

Plant section:
- ➔ Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

To ensure that pedestrians check for oncoming traffic, new rules have been implemented at thirteen pedestrian crossings in busy traffic areas of this plant. The pedestrian must stop, point in the direction they are visually checking for oncoming traffic and then call out. Regular patrols check that everyone is adhering to the new rules. The new rule is carried out by all on-site workers in order to accustom to pointing and calling.



Images, clockwise from top left:
Unregulated pedestrian crossing; Regulated pedestrian crossing; Road signage indicating where point and call check should be performed; Pole signage indicating where point and call check should be performed. The text reads: “Stop! Right OK! Left OK! Look forward OK!”

Fire Equipment Monitoring

A new software system has been installed at this plant to automatically identify and monitor fire detection equipment.

Keywords: fire safety

Associated risk: Fire

Health/Safety: Safety

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- ➔ Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

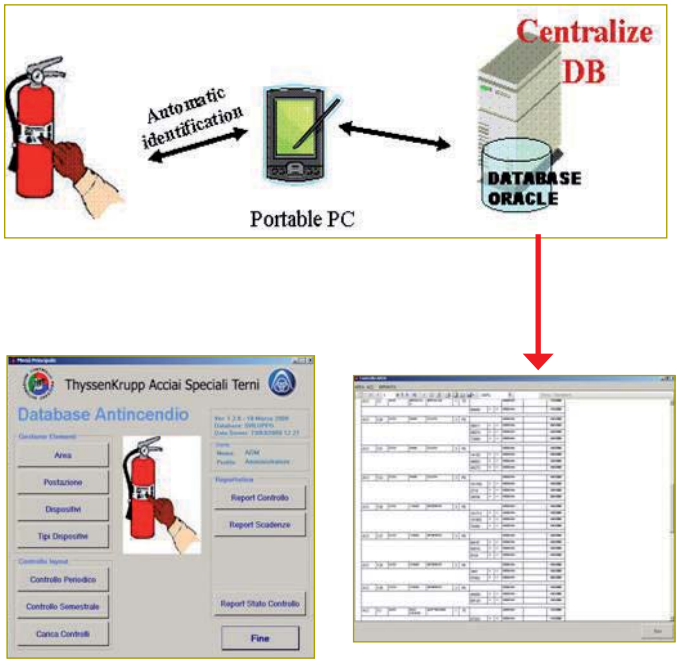
Description

Each piece of fire detection and fire-fighting equipment in the plant is tagged with an electronic identification tag. The tag utilises Radio Frequency Identification (RFID) technology so that fire prevention staff can accurately pinpoint its location.

All control and sensitive information about the equipment is stored in a centralised database which can be easily accessed through an Internet interface. As well as ensuring the information about the equipment is accessible in an emergency, the RFID also makes it easy to keep the database up to date. The database also simplifies the process of completing regulatory and other paperwork.

Additional comments

The use of RFID on fire equipment is part of a company-wide plan to exploit web technology.



Round Bar Stopper

Round bars are delivered to the stockyard in bundles that are banded together. When the bands are loosened there is a risk that the bars will roll or fall onto the nearby workers.

Keywords: pinch, fall

Health/Safety: Safety

Associated risk:

Improvement type:

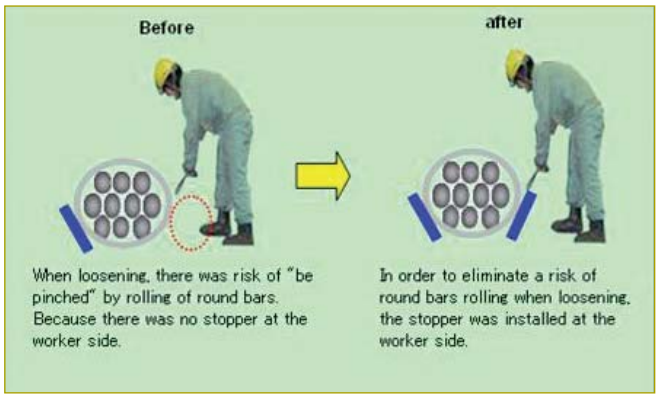
- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:

- Melt shop
- Hot rolling
- Cold rolling
- ➔ Finishing
- Other

Description

To solve the problem, a stopper was installed on the operator's side of the rolls. The stopper effectively prevents the bars rolling and hurting anybody.



Purpose-built Shooter

The process of feeding shot into the shot-blaster was identified as a safety risk.

Keywords: caught

Associated risk: All risks

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- ➔ Improvement measure
- Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- Finishing
- Other

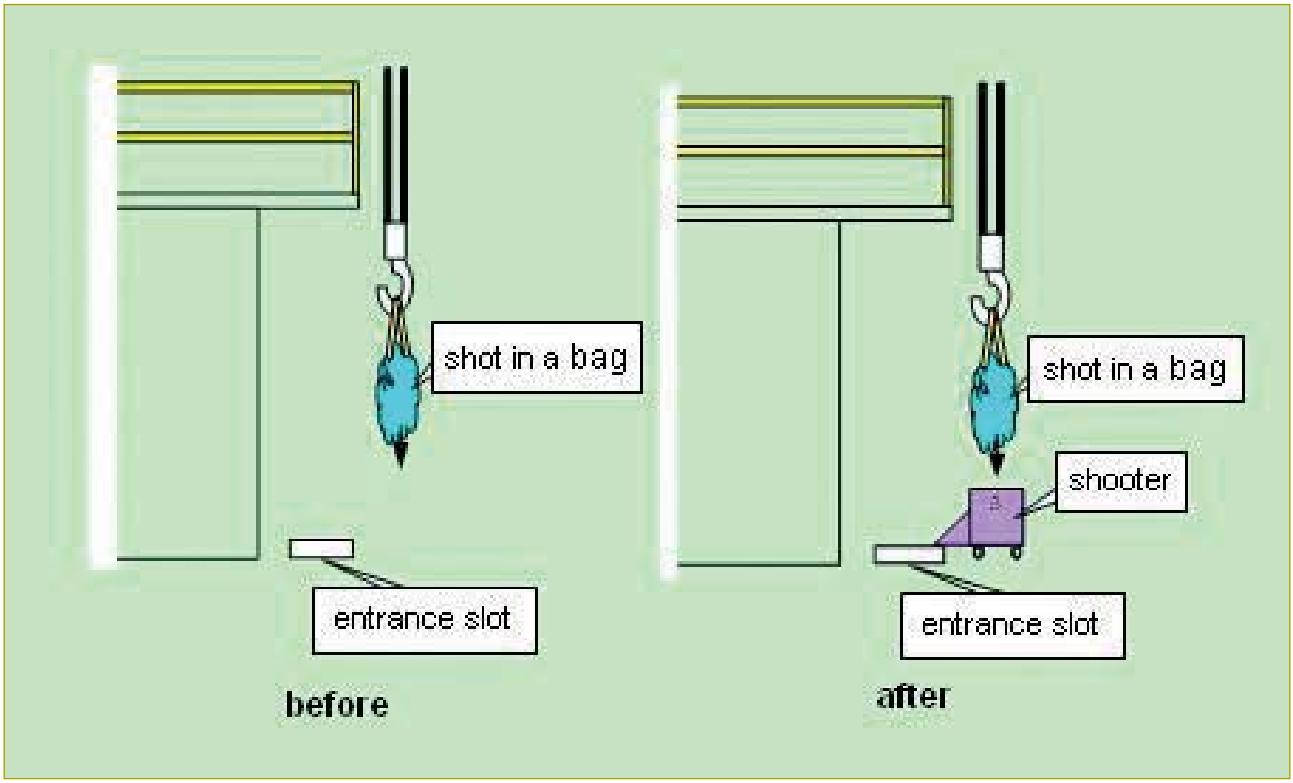
Description

Until recently at this plant, shot was transferred to the shot-blaster by crane. A safety risk was identified because the crane was obstructed, forcing workers to split the bag of shot and feed it into the blaster manually from a height. There was a risk that shot, or the bag itself, may fall onto a worker.

To solve the problem, a shooter was built. The crane now lowers the bag over the shooter where it is split by a cutter built into the shooter. The shot falls into the shooter from where it feeds into the shot-blaster.

Additional comments

There is no need for operators to be under the bag of shot.



Improved Placement of Refractory Bricks

After analysing accidents in the Refractory Section of this plant, the Safety and Health Department decided to undertake an ergonomic study of the process for placing refractory bricks in ladles or AOD converters.

Keywords: improvement

Health/Safety: Safety

Associated risk: Manual handling, repetitive work, physical loads

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- ➔ Equipment improvement or new tool
- Recognition action

Plant section:

- ➔ Melt shop
- Hot rolling
- Cold rolling
- Finishing
- Other

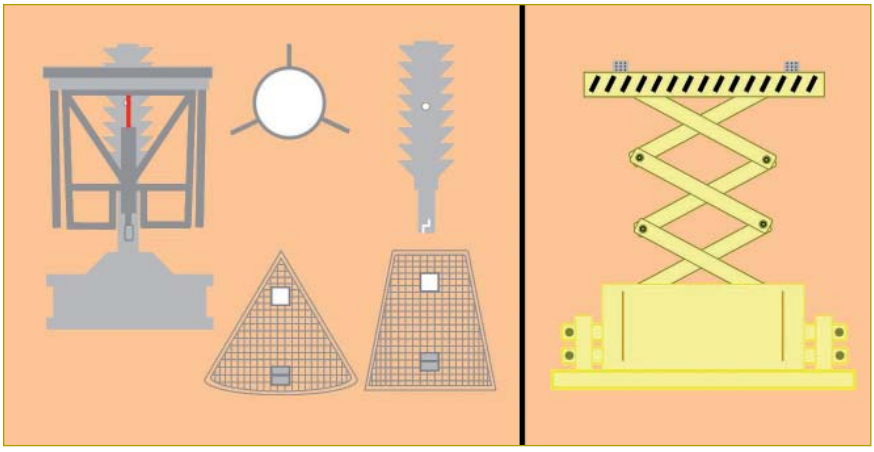
Description

Technical safety staff studied the placement process, examining factors such as the type and weight of the bricks, worker posture and movement and the handling tasks required to place the bricks. They then evaluated the manual handling and ergonomic conditions. The study was carried out in accordance with guidelines set out by the national safety institute.

Additional comments

Following the study, the following improvements were made:

- New equipment to place the bricks was installed
- New work tables were acquired that enabled workers to place the bricks at different heights
- A specific manual handling training course was developed and delivered to the workers
- An investigation was started to determine if a robot could be designed to place the bricks.



Replacing Ladders to Improve Safety

As employees age, there is a risk that they might fall when using vertical ladders. To address this problem, ladders have been replaced by stairways.

Keywords: fall

Associated risk: Fall from height

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- ➔ Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- Finishing
- Other

Description

During 2008 and 2009, the safety manager at each plant was asked to identify areas where vertical ladders should be replaced by stairs to improve safety. Work orders when then raised so that the maintenance department could undertake the necessary work.

Additional comments

Workers at the plant need to regularly check bag filters to see if they need emptying. Before the stairway was installed, the workers had to establish temporary footholds on the bag platform. However, there was a major risk that the worker would fall as they set-up the footholds. In this case the maintenance department built a permanent work deck and replaced the ladder with steps. This is just one example where the workplace has been made safer by upgrading the ladders to stairs.

Safety Barrier Modification

Existing gates at this plant consisted of a manually operated bar which often stayed open after the gate was used.

Keywords: access, guards, improvement

Associated risk: Freely accessible danger zones

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- ➔ Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:

- Melt shop
- Hot rolling
- Cold rolling
- Finishing
- ➔ Other

Description

A technical modification to the gate ensures that it closes by itself once the person has walked through. The gate is easy to open.

Additional comments

The new gate is suitable for use in a number of dangerous areas of the plant.

Touch-free Vertical Roll Hangar

A new touch-free mechanical hanger has been designed for use when exchanging vertical rolls.

Keywords: improvement, tools

Associated risk: Fall of a roll

Health/Safety: Safety

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- ➔ Equipment improvement or new tool
- Recognition action

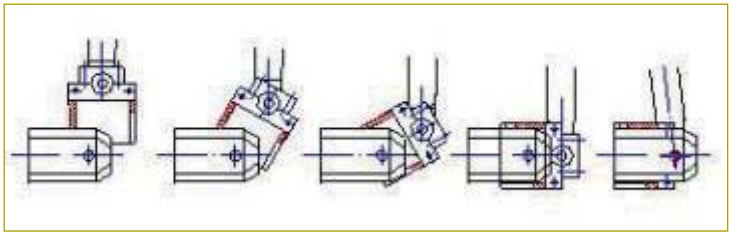
Plant section:

- Melt shop
- Hot rolling
- Cold rolling
- Finishing
- ➔ Other

Description

In the wire and bar plant, rolling is performed by two rolls. When a roll needs to be extracted from a vertical rolling mill, the extraction and transport of the roll are carried out using a hanger. The hanger consists of a wire and a shackle. The shackle is attached to the roll on a two metre high deck. When the shackle needs to be removed, a worker stands on a conveyance cart. This operation poses a significant risk that the worker may fall or be caught under the roll.

A touch-free mechanical hanger had already been installed to extract and convey rolls horizontally from the horizontal rolling mill. As the name implies, the employees do not need to touch the roll while it is being extracted or transported. The plant has now adapted this design for use with vertical rolls, thereby abolishing risky high-level work.



Changing Trimming Knives Safely

Development of a safety holder to prevent trimming knives and ejector rings from falling while they are being changed.

Keywords: tools, improvement

Associated risk: Serious foot injuries

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- ➔ Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:

- Melt shop
- Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- Other

Description

The holder reduces the risk of foot injuries from falling trimming knives and ejector rings.

Additional comments

The device enables the operator to safely remove the tie rod, trimming knife and ejector ring from the shaft.

Post-accident Training

Training courses are provided for all workers who have been involved in an accident in the workplace.

Keywords: accident, training

Associated risk:

Improvement type:
- ➔ Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Health/Safety: Health Safety Both

Plant section:
- ➔ Melt shop
- Hot rolling
- Cold rolling
- Finishing
- Other

Description

After analysing the accident, the Safety and Health Department implements post-accident training for the workers involved. The aim is to remind them of safety procedures and the use of personal protective equipment (PPE).

The training normally takes between one and two hours and is conducted outside of the normal work timetable. During the training, a technical member from the Safety Department explains the results of the risk assessment. Depending on the nature of the accident, the worker may also be given documentation which outlines the correct use of the PPE supplied.

Safety Experience Training

Thirty minute training sessions are conducted in this company to provide workers with the sensory experience of being involved in an accident. The aim is to encourage workers to utilise the correct safety procedures and equipment in their daily work.

Keywords: heights, tools, electricity

Health/Safety: Safety

Associated risk: All risks

Improvement type:
- ➔ Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Plant section:
- ➔ Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

A wide range of different activities are covered by this training. Some examples include:

Activity	Sensory experience
Welding at heights	• Five metre fall • Shock of safety belt stopping the fall.
Slinging work	• Finger of a hand being pinched. • Risk of a load swaying.
Revolving or moving machinery	Power of solid and high-velocity revolutions.
Electrical work	• Contact with a high-voltage line • Motor short-circuit.

Work-based Skills Competition

The lifting and carrying of heavy loads is a common task in stainless steel plants and is known as slinging. Injuries are easily sustained if workers do not take due care during slinging work. To improve the basic skills and knowledge of slinging, this company organises a competition between sections of the plant.

Keywords: heavy loads

Associated risk: All risks

Improvement type:
- ➔ Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:
- ➔ Melt shop
- ➔ Hot rolling
- ➔ Cold rolling
- ➔ Finishing
- ➔ Other

Description

The competition consists of three parts:

1. A practical test which involves twenty minutes of slinging work.
2. Tests to determine if the candidate can identify the weight and centre of gravity of the load (five minutes is allowed per item).
3. A one hour examination that tests the candidate's theoretical knowledge of slinging.

Self-reporting

An operator at this plant injured his hand when removing the scrap baller from the machine. The operator posted a reminder on the notice board to alert other workers to the danger.

Keywords: reporting

Associated risk: Injury to hand

Improvement type:

- Training or information session
- Education or information campaign
- Activity for operators
- Activity for management
- Improvement measure
- ➔ Equipment improvement or new tool
- Recognition action

Health/Safety: Safety

Plant section:

- Melt shop
- Hot rolling
- Cold rolling
- ➔ Finishing
- Other

Description

The accident occurred when the finishing operator pulled the scrap baller by hand. The baller moved slightly, cutting the operator's hand. The operator posted a reminder on the notice board, alerting other operators that they must remove the scrap baller using an adjustable wrench.

Return on Experience Case Studies

Return on Experience (REX) Case Studies

While all members of ISSF strive for an accident-free workplace, sometimes accidents do occur. Often the accident is caused by an action or event that was not foreseen. The case studies detail real accidents that have occurred in stainless steel plants around the world. The data was provided by ISSF member companies.

The corrective action that has been taken is included, enabling all plants to learn from the experiences of others.

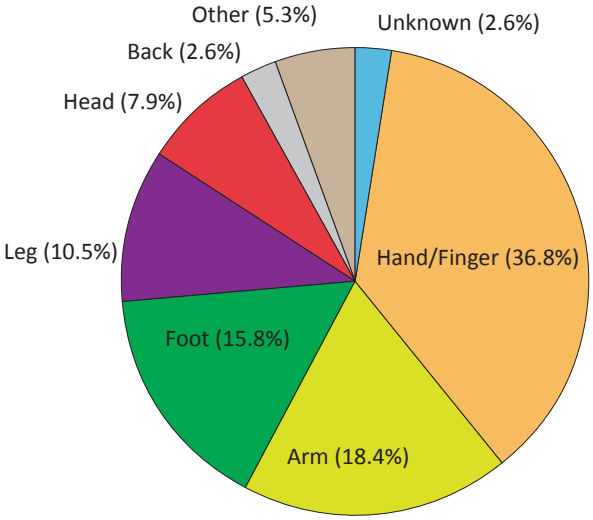
Note: The word 'operator' is used in these examples to mean the worker, factory hand or labourer who was performing the task.

The data was collected through a survey form. The following table explains some of the fields that appear in this section:

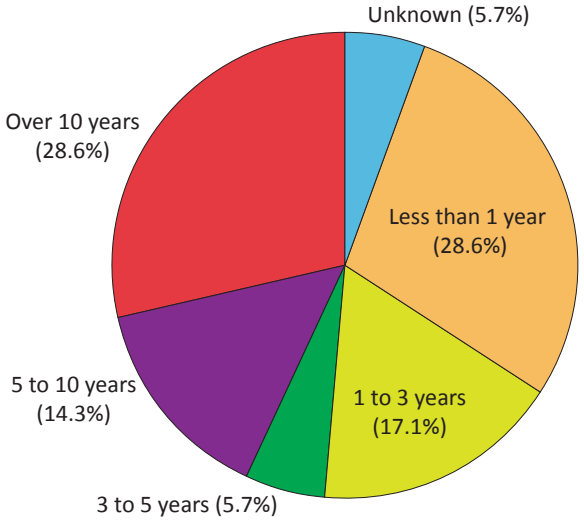
Incident type:	***Accident with lost time***	The operator was absent from work for one or more days.
	Accident without lost time	The operator took less than one day off to recover.
	Fatality	The operator died.
	First-aid case	The operator needed treatment from a first-aid officer or doctor on-site.
	Near-miss	No injury was sustained.
Direct cause:	***Substandard actions***	For example, unsafe actions, poor training or lack of motivation.
	Substandard conditions	For example, poor work organisation, missing procedures, or inappropriate tools supplied.
Involved:	***Employee***	An active employee who is on the direct payroll.
	Temporary worker	A person who is employed by the company but does not work full-time.
	Subcontractor	An operator supplied by a third party.
	Other	For example, a visitor to the site.
Body part affected:	Multiple selections possible	Available options included: arm, back, foot, hand, head, leg and shoulder.
Type of event:	***Caught***	The operator was caught in, between or under a piece of equipment.
	Contact with	Part of the operator's body came into contact with, for example, asbestos, cold, electricity, an explosion, gas, heat, noise, radiation, or toxic substances.
	Cut by	The operator sustained a cut or laceration.
	Fall from height	The operator fell from a step, ladder or other height.
	Fall on the same level	The operator fell to the same level on which they were working (for example, a slip or tripping).
	Struck against	Part of the operator's body came into forcible contact with a piece of equipment.
	Struck by	The operator was hit by a moving object or was running when they hit an object.
Plant section:	Multiple selections possible	Available options included: cold rolling mill, finishing, hot rolling mill, melt shop or other (for example, carpark, green areas).
Root cause:	***Ergonomics***	Poorly designed equipment or tasks.
	Housekeeping	Untidy or disorderly work area.
	Position	The operator's physical position was inappropriate.
	PPE	Missing or faulty personal protective equipment (for example, helmets, gloves, goggles, or overalls).
	Procedures	The work instructions were incomplete or inaccurate.
	Tools/equipment	The tools or equipment used were inappropriate for the tasks or in poor condition.

Summary of REX Examples

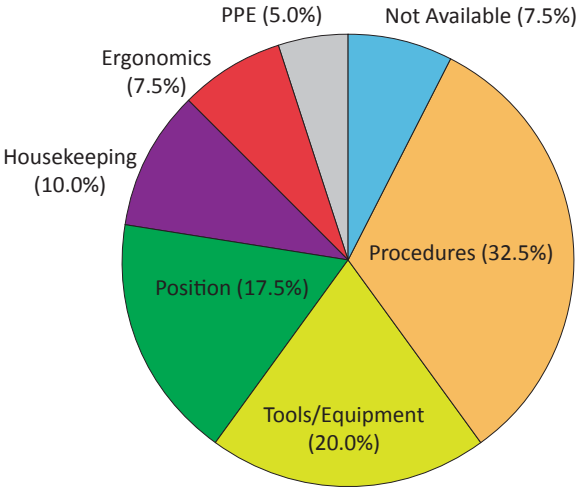
The following graphs summarise the details of the REX case studies included in this brochure.



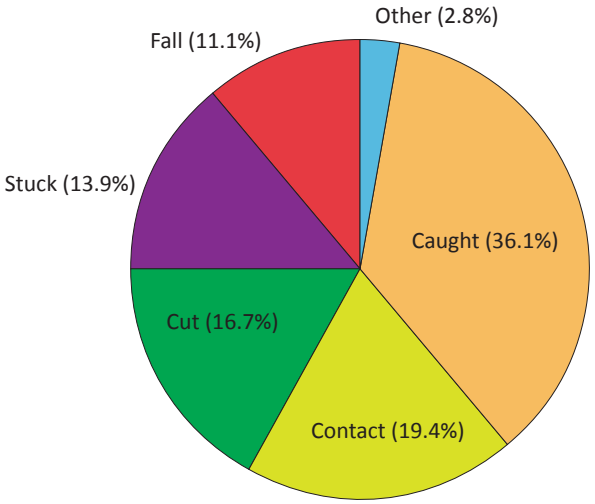
Body part affected by accident



Experience (in years) of operators involved in accidents



Root cause of the accident



Type of accident

Types of Event

The following list provides summarise the types of events that are included in this section.

Event	Pages
Caught	50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 77, 78, 79
Contact with	57, 60, 61, 62, 63, 80, 81
Cut by	69, 70, 71, 72, 82, 83
Fall	73, 74, 75, 84
Struck by	64, 65, 66, 67, 68
Other	76

Falling Cylinder Injures Finger

Three operators were using a hoist cylinder and guide rolls to replace a deflector roll. The cylinder weighs around 70 kilograms. The yoke had been lifted and tested to ensure it was secure. The operators then fastened wire to the cylinder in order to remove it. In order to check interference, one operator placed his left hand on the yoke mount. The cylinder fell, injuring the middle finger on the operator's left hand.

Keywords:	caught, tools, training	**Time and date:**	11.20 – March 2009
Incident type:	Accident without lost time	**Direct cause:**	Substandard actions
Involved:	Subcontractor	**Activity:**	Replacing a deflector roll
Age:	53	**Experience (years):**	20
Body part affected:	Arm	**Type of event:**	Caught
Plant section:	→ Other	**Root cause:**	→ Position

Immediate action

An education campaign was undertaken to warn operators of the importance of keeping away from hanging loads.

Procedures to identify potential hazards were updated to ensure that all members of the team check the risks on each job, in this case, the safety of hanging loads. Managers are also now required to follow-up these checks with a safety patrol.

Corrective action

An aperture with a retractable cover has been installed on the top hood plate. The operator can use a set of small portable steps to reach the top hood plate. By opening the cover they can then check for interference.

Misunderstanding Leads to Arm Injury

An operator was trying to catch the strapping strip at the point where the mandrel (coil support) enters the coil. There was a misunderstanding between the floor and panel operators. As a result the coil started to move, damaging the operator's arm.

Keywords:	caught, lost time, tools	**Time and date:**	03.25 – June 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions
Involved:	Employee	**Activity:**	Coil preparation
Age:	42	**Experience (years):**	13
Body part affected:	Arm	**Type of event:**	Caught
Plant section:	➔ Cold rolling	**Root cause:**	➔ Procedures

Immediate action

The machine was stopped immediately and the operator's colleagues took him to a nearby hospital. The supervisor spoke with other operators to inform them of the accident.

Corrective action

New tools have been installed and the procedure has been change. The floor operators now carry out this task by themselves.

Slitter Restart Cuts Fingers

An operator was changing and adjusting circular blades in the slitter. As he cleaned the blades he told a colleague to start the slitter. However, he did not remove his hand in time and suffered severe injuries to the index, middle and ring fingers on his right hand. The operator was taken to hospital where he underwent immediate surgery to reconstruct his fingers. It is likely he will make a good recovery.

Keywords:	caught, lost time	**Time and date:**	09.45 – November 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions
Involved:	Employee	**Activity:**	Changing slitter blades
Age:	39	**Experience (years):**	19
Body part affected:	Hand	**Type of event:**	Caught
Plant section:	➔ Cold rolling	**Root cause:**	➔ Procedures

Immediate action

The slitter was immediately stopped. The supervisor spoke with the operator's colleagues to inform them about the accident and to gain an understanding of what happened.

Corrective action

The company is now actively checking that operators are respecting safety procedures. A new safety guard will also be installed on the slitter. Employees were also encouraged to utilise the company's SAKE methodology to discuss risk in the workplace.

Miscommunication Leads to Finger Injury

To equip the narrow diameter (Type B) sealing sleeve with a tension reel in the continuous pickling line, an operator must first remove a wide diameter (Type A) sealing sleeve. The sealing sleeve pushing board is then attached to the work side of a coil car, and the sealing sleeve is placed in the car.

In this case an operator moved the coil car to the machine side. However, the sealing sleeve was not set properly and the operator had to move the car back to the work side. The second operator thought the operation was complete when the coil car moved to the work side. He began to remove the pushing board. At the same time, the first operator raised the coil car again to push the sealing sleeve in again. However, the tip of the second operator's right thumb became caught between the pushing board and the sealing sleeve.

Keywords:	communication, lost time	**Time and date:**	07.10 – May 2008
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions
Involved:	Employee	**Activity:**	Replacing sealing sleeve
Age:	28	**Experience (years):**	4
Body part affected:	Hand	**Type of event:**	Caught
Plant section:	➔ Cold rolling	**Root cause:**	➔ Procedures

Immediate action

Operators were instructed to perform a stop before entering the operational area. A compatibility check was carried out between the work procedure for this task and the actual work carried out.

Corrective action

The entry route into the operational area was modified. The safety fence around the coil car was modified and a safety door switch installed.

Ignoring Procedure Results in Injury

A pre-charge plate had just been trimmed and exited the machine on the tension (exit) side. Once the plate had cleared the machine, an operator began to clean the rolls on the pay-off (entry) side. The procedure for this task specifies that the operator should raise the upper roll and insert a stopper to prevent the roll falling before starting to clean. They should then start to clean, turning the upper roll toward the pay-off (entry) side to avoid their fingers becoming caught.

Because these steps were not taken the rolls continued to turn towards the tension side. As the operator cleaned the rolls his fingers became trapped between the two moving rolls. His right middle, ring and little fingers were caught, causing significant injuries.

Keywords:	lost time, procedures	**Time and date:**	05.10 – July 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions and conditions
Involved:	Employee	**Activity:**	Pinch roll cleaning
Age:	19	**Experience (years):**	0.25
Body part affected:	Hand	**Type of event:**	Caught
Plant section:	➔ Cold rolling	**Root cause:**	➔ Procedures

Immediate action

Inexperienced operators were prohibited from working alone until the corrective action described below could be implemented.

Corrective action

A pendant switch was installed. This is worn around the operator's neck and enables him to open the rolls, thereby reversing the direction in which the rolls turn. An interlock switch with indicator light was fitted to the machine, enabling the operator to easily tell when the rolls are in the correct cleaning position.

The work instruction was revised to include steps for using the pendant switch and interlock light.

Falling Stopper Hits Leg

An operator was carrying tundish stoppers from the product shop to the drying basket one at a time. Each stopper was placed with its tip at the bottom of the drying basket. When the operator set the seventh stopper into the basket the entire basket tipped to the front. There was a foreign object at the bottom of the basket which meant the stopper could not sit properly, leading to the basket tipping. The operator tried to catch the stopper to avoid the entire basket collapsing. However, the entire basket fell and one of the stoppers hit and injured the operator's left leg.

Keywords:	caught, procedures	**Time and date:**	10.30 – October 2009
Incident type:	Accident without lost time	**Direct cause:**	Substandard actions
Involved:	Subcontractor	**Activity:**	Drying the tundish stopper
Age:	53	**Experience (years):**	20
Body part affected:	Arm	**Type of event:**	Caught
Plant section:	➔ Melt shop	**Root cause:**	None specified

Immediate action

Stabilisation hardware was fitted to both sides of the basket. Procedures were changed to ensure that each stopper was fixed with a chain once it had been placed in the basket.

In order to secure the centre of gravity for each stopper in the basket, holes were created in the shock absorbing material at the bottom of each hole. This helps to stabilise the entire basket.

Operators were also instructed to check for foreign objects on the floor where the basket sits and in the bottom of the basket. Education on the danger of heavy loads in the workplace was also carried out with all operators.

Corrective action

The company is examining the method of storing tundish stoppers in the drying basket. There are two ideas under consideration:

- Hanging the stoppers perpendicularly so that the basket can be surrounded by a fence.
- Hanging the stoppers horizontally so that they can be entered into the basket sideways.

Finger Pinched Between Roll and Plate

A new employee was working with his instructor and a colleague levelling plates in the plate shop. The new operator was levelling on one side of the plate while the instructor and the other operator were grinding the other side of the plate.

As the new operator went to measure the flatness of the plate with a square rule in his right hand, he placed his left hand between the revolving conveyance roll and the plate. The forefinger of his left-hand was pinched between the conveyance roll and the plate. (The conveyance speed of the plate was 6 m/minute and the roll was rotating nine times per minute.) There was no safety fence to prevent contact with the conveyance roll.

Keywords: lost time, new employee
Incident type: Accident with lost time
Involved: Employee
Age: 19
Body part affected: Hand
Plant section: ➔ Hot rolling

Time and date: 02.30 – October 2009
Direct cause: Substandard actions
Activity: Levelling plates
Experience (years): 1
Type of event: Caught
Root cause: ➔ Position
➔ Procedures

Immediate action

Operators were instructed not to measure the flatness of the plate until the power supply to the conveyance roll is stopped using a safety key switch.

Corrective action

The work standard was re-examined and it was decided to mechanise the measuring of plate flatness. The installation of an automatic device to cut power (such as a light curtain) is also under investigation.

Fallen Ingot Causes Fatality

An operator was moving scrapped ingots out of the continuous casting line. The ingots are six metres long and have a surface temperature of 600° C. The operator noticed that the left side of an ingot was leaning down. Although he pushed the return button, that side of the ingot fell.

The operator prepared the radio-controlled crane and lifting wire before passing under other ingots to approach the fallen ingot. He attached the wire to the left side of the ingot and raised it with the crane before moving to the right side. When he tried to raise the right side of the ingot it fell on top of him. The operator suffered injuries which proved to be fatal.

Keywords:	caught, fatality	**Time and date:**	13.50 – August 2007
Incident type:	Fatality	**Direct cause:**	Substandard actions and conditions
Involved:	Employee	**Activity:**	Moving scrapped ingots
Age:	52	**Experience (years):**	11
Body part affected:	Foot and leg	**Type of event:**	Caught and contact
Plant section:	➔ Melt shop	**Root cause:**	➔ Position

Immediate action

Instructions on how to sling ingots were distributed to all relevant operators. Information about the accident was also distributed. Management encouraged employees to attend a meeting where they could exchange ideas on how to make the process safer.

Corrective action

A thorough check of all incidents of fallen ingots were re-examined. The work procedures for moving fallen ingots were also examined.

A stop position sign was placed to the right of the ingots and a new receiver was added to the line to stop ingots from falling.

A sign warning all operators to report to the supervisor was placed at the entrance to the area. Loudspeakers were installed to alert operators of potential accidents. The practical use of communication tools such as intercoms is also being encouraged.

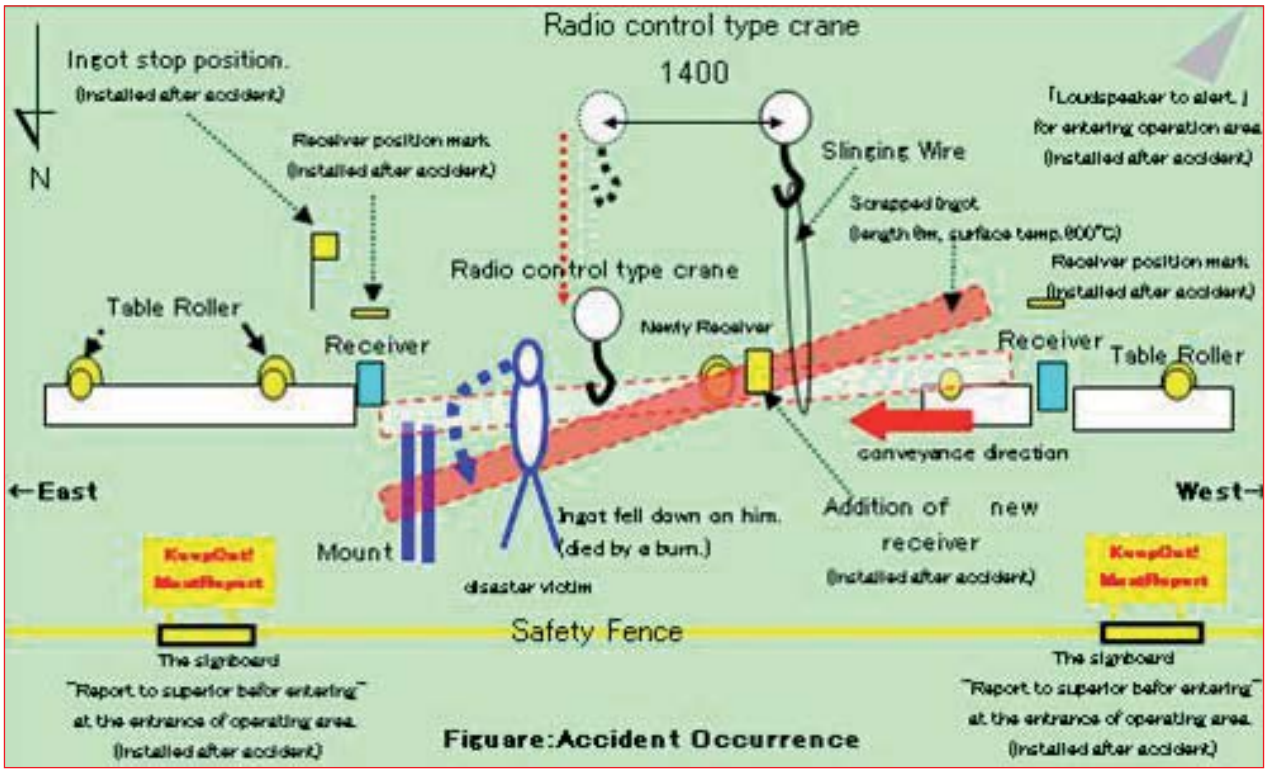


Figure: Accident Occurrence

Hand Trapped Replacing Work Roll

During normal cold rolling operations on a coil, the side of the coil fractured. This meant that the work roll needed to be replaced. In order to extract the faulty work roll, the upper first intermediate roll was attached to a support tool at the tip of the roll.

The operator then lifted the first intermediate roll using a jig. While this was occurring, another operator was on the other side of the machine trying to press the support implement into the opposite side of the first intermediate roll.

The first operator unfastened the support implement, trapping the hand of the operator on the other side between the support implement and the lower neck piece of the first intermediate roll.

Keywords:	caught, lost time	**Time and date:**	04.05 – October 2008
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions
Involved:	Employee	**Activity:**	Replacing a faulty work roll
Age:	46	**Experience (years):**	28
Body part affected:	Hand	**Type of event:**	Caught
Plant section:	➔ Cold rolling	**Root cause:**	➔ Ergonomics

Immediate action

In order to prevent injury if the hookup is unfastened while operators are working, a cushion is placed on a lower roll.

Corrective action

A new block was manufactured, eliminating the need for the rolls to be lifted by operators. A grapple was added to the connector.

The work instructions were changed to ensure that the length of the spring used to lift the roll is appropriate to the diameter of the roll.

A risk assessment was carried out on all tasks where there was a chance of operators being pinched by or caught under a piece of machinery.

Caught While Cleaning Working Rollers

The cold rolling Annealing and Pickling section was informed that strip from the production line had surface defects. The section leader immediately inspected all the working rollers with a diameter of 1,000 mm. He found that a loop roller in the exit area had dirt stuck to its surface. He slowed down the line speed and then tried to remove the dirt from the loop roller using a simple hand-tool made of banding strip. The section leader's hands became caught in the working roller as he was cleaning.

Keywords:	lost time, training	**Time and date:**	15.30 – May 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions
Involved:	Employee	**Activity:**	Cleaning working rollers
Age:	28	**Experience (years):**	2.5
Body part affected:	Hand	**Type of event:**	Caught
Plant section:	➔ Cold rolling	**Root cause:**	➔ Tools/equipment

Immediate action

The safety education and training of employees in the cold rolling Annealing and Pickling section has been strengthened. Operators have been instructed to use the right tools and to slow down working target rollers.

Corrective action

An automatic cleaning device was added to the rollers the day after the accident to minimise the need for manual cleaning of the rollers. The cleaning device has also been added to all of the bridle rollers on the line.

Touching Hot Cover

An experienced operator entered the torch cutting machine (TCM) to check the torch just after a slab had been cut. The operator was almost burnt when he touched the hot TCM cover. An investigation sound that the gap at the bottom of the TCM cover was too narrow, forcing the operator to stoop as they entered the TCM. This put the operator in close contact with the hot cover.

Keywords:	near miss, tools	**Time and date:**	13.00 – October 2009
Incident type:	Near miss	**Direct cause:**	Substandard actions
Involved:	Employee	**Activity:**	Checking torch cutting machine
Age:	41	**Experience (years):**	19
Body part affected:	Back	**Type of event:**	Contact with
Plant section:	➔ Finishing	**Root cause:**	➔ Tools/equipment

Immediate action

The near miss was registered in the plant's safety and disaster prevention system so that all details of the accident are distributed to all employees. Recurrence prevention measures were implemented to prevent this type of accident from occurring in the future.

Corrective action

Doors were installed on both the left and right side of the TCM. This enables the operator to check the torch by opening the doors rather than entering the machine. Additional doors were installed on the machine cover to prevent the operator coming into contact with it when they need to enter the TCM.

Hot Crucible Burns Finger

Two operators were performing an oxidation test in the large heat treatment furnace. A palette of ten crucibles, each containing a specimen, was placed into the furnace which was operating at around 1,150° C. The palette was made of ceramic fibre.

At the end of the treatment, the operators signalled for the furnace to be opened and removed the palette, placing it on a stand nearby. To prevent the scale from scattering, the operators started placing a lid on each crucible. The operators were using normal work gloves for this operation, rather than the aluminium gloves specified. When the lid was placed on the first crucible, the palette broke. One of the operators removed their hand quickly so that the crucible would not fall. However, as they did this their glove touched the crucible, burning the finger of one of the operators.

Keywords:	burn, ergonomics	**Time and date:**	10.45 – August 2009
Incident type:	Accident without lost time	**Direct cause:**	Substandard actions
Involved:	Employee	**Activity:**	Oxidation test
Age:	26	**Experience (years):**	2
Body part affected:	Arm	**Type of event:**	Contact
Plant section:	➔ Other	**Root cause:**	➔ Position

Immediate action

Oxidation tests were stopped until the palettes could be reinforced and a cover could be developed.

Corrective action

Reinforced palettes were developed. The method of examining the crucibles was also standardised. Operators now wait until the crucibles have cooled before removing the covers and inspecting the specimens.

Acid Leakage Leads to Burns

The supervisor of the stainless steel factory discovered that hydrofluoric acid was leaking from the flange of the sub-nozzle on a tank on the continuous annealing and pickling line. He requested that an emergency team repair the flange.

Half an hour later the emergency team arrived and the supervisor briefed them on danger from the leaking fluid. The team was also instructed to wear their protective equipment including a gas mask, latex gloves disposable overalls and a personal cooling device (man cooler). Two hours later the work to insert a rubber sheet in the flange was completed and the leak had stopped.

Around 15 minutes after he finished work, one of the members of the emergency team started to notice pain in his left knee and the tip of a finger on his left hand. The operator went to wash the affected areas and reported to his supervisor.

Keywords:	lost time, irritants, procedures, PPE	**Time and date:**	11.15 – January 2005
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions and conditions
Involved:	Subcontractor	**Activity:**	Repair to flange on acid tank
Age:	42	**Experience (years):**	1.75
Body part affected:	Hand and leg	**Type of event:**	Contact
Plant section:	➔ Cold rolling	**Root cause:**	➔ PPE ➔ Procedures

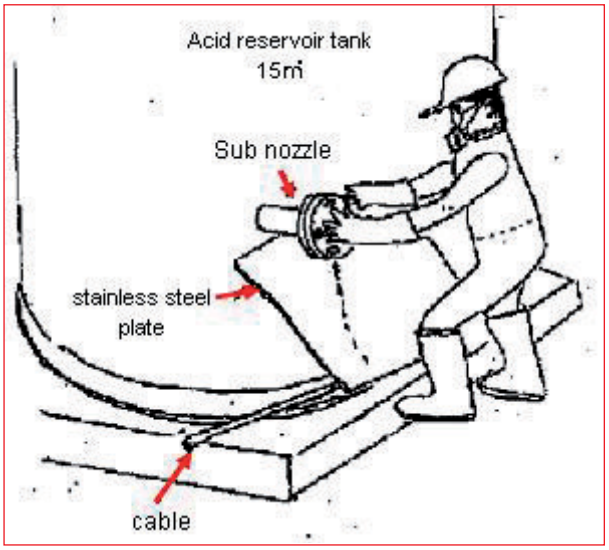
Immediate action

Ointment was applied to the affected areas as first aid and the operator was taken to the hospital by ambulance.

Corrective action

Additional training was carried out for operators to remind them of the dangers of working with hydrofluoric acid and the correct equipment to be used. The work procedure was update to include all the necessary protective equipment needed when handling hydrofluoric acid.

The hydrofluoric acid leak was repaired and the equipment modified to prevent a leakage occurring again.



Hole in Glove Results in Chemical Burn

A mechanical technician was assigned to change the hydrofluoric acid mainline valve in the acid storage area. The operator removed the valve and cleaned it in the mechanical shop. During the cleaning operation the technician wore safety goggles and acid-resistant gloves. The technician did not notice that the gloves had a small hole in them. As a result, the acid penetrated the gloves, burning his finger.

After repairing the valve, the technician washed his hands well and went for lunch. After lunch he noticed some irritation on the finger of his left hand. He washed his hand again and then went to the medical room for treatment.

The nurse found a white spot (indicating a chemical burn) on the knuckles of the technician's middle and ring fingers. The nurse rinsed the wound with water and calcium gluconate solution and sent the technician to hospital. The technician was admitted to hospital for three days.

Keywords:	lost time, chemical burn	**Time and date:**	11.00 – April 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard conditions
Involved:	Employee	**Activity:**	Cleaning valve of main acid line
Age:	36	**Experience (years):**	10
Body part affected:	Hand	**Type of event:**	Contact
Plant section:	➔ Cold rolling	**Root cause:**	➔ PPE

Immediate action

A memorandum was sent to all maintenance technicians instructing them that gloves must be properly disposed of immediately after use.

Corrective action

The company held a One Point Lesson (OPL)* so that other operators could learn from this accident. The lesson outlined the approved maintenance procedures for acid storage, including the correct use of personal protective equipment.

The technician involved in the accident was also reminded about the hazardous nature of hydrofluoric acid and the steps they can take to protect themselves.

*A One Point Lesson (OPL) is a group instruction session that is held whenever an accident occurs in the plant. The aim of the OPL is to improve the basic knowledge of each operator and to teach or inform them how to ensure the accident does not reoccur in the future.

Crushed During Movement of Mast

After the electrode mast of the electric arc furnace was changed, the worn cylinder was placed in the middle of the tundish storage area. To avoid disruption to production the next day, the operators were asked to move the worn cylinder to the service point of the furnace. As the mast was being moved by crane it began to spin. One of the operators grabbed grounding stake on the cylinder to prevent movement.

The operator became stuck between the vertical metal girder of the furnace repair stand and the cylinder. The crane operator was 9.7 metres above the floor and did not have a good view of the area below. The crane operator tried to gently move the cylinder about ten centimetres in the direction of the repair stand. However, the crane moved at top speed, displacing the cylinder about two metres and crushing the operator against a girder.

Keywords: ergonomics, lost time, procedures, tools
Incident type: Accident with lost time
Involved: Employee
Age: Unknown
Body part affected: Ribs
Plant section: → Melt shop

Time and date: 10.00 – August 2009
Direct cause: Substandard actions and conditions
Activity: Movement of electrode mast
Experience (years): Unknown
Type of event: Struck by
Root cause: → Housekeeping
→ Position
→ Procedures

Immediate action

The low and high speed thresholds of the crane were modified and all other cranes in the plant were checked. Operators working in this area were also reminded of the importance of respecting rules. Training in the basic rules of handling heavy objects was also provided.

Corrective action

Everybody on the site was reminded of the importance of taking five minutes before acting and the ten cardinal rules of safety. They were also advised that if any of the cardinal rules is not being respected, work should stop until it is.

Hand Stuck in Hoop

An operator from the cold rolling plant entered the pickling workshop in order to replace a set of circular blades needed to process the next coil. After he replaced the downward-facing circular blade, the operator's right hand became stuck by the hoop of upward-facing circular blade as he removed the hoop from the blades.

Keywords: ergonomics, lost time
Incident type: Accident with lost time
Involved: Employee
Age: 36
Body part affected: Hand
Plant section: → Cold rolling

Time and date: 09.30 – October 2009
Direct cause: Substandard actions and conditions
Activity: Maintenance of a circular blade
Experience (years): 0
Type of event: Struck by
Root cause: → Position

Immediate action

The first aid team went to the scene of the accident to offer immediate medical assistance. The operator was then taken to the nearest hospital where X-rays revealed he had suffered fractures to the little and middle fingers on his right hand. The operator was off work for 30 days to recover.

Corrective action

Letters were sent to all operators in the company who perform similar work to inform them of the accident. All new staff were provided with training to improve their safety knowledge. A REX about the accident was also written to remind operators of the importance of carefulness in the workplace.

Loose Flap Injures Knee

An operator was changing a roll in the grinding machine. Usually the lifting was done with a smaller and less powerful crane. However, on this occasion a powerful bridge crane was used and lifted the flap too high. The flap detached from its fastener and the whole package fell onto the operator, injuring his knee.

Keywords: lost time, procedures
Incident type: Accident with lost time
Involved: Employee
Age: 35
Body part affected: Leg
Plant section: → Cold rolling

Time and date: November 2009
Direct cause: Substandard actions
Activity: Changing a roll in the cold rolling mill
Experience (years): 10
Type of event: Struck by
Root cause: → Procedures

Immediate action

The flap was tied to the arm of the crane with a hoisting belt and the fasteners were repaired.

Corrective action

A lock system was developed so the flaps could be secured when lifted. Instructions were developed and operators were trained in the new system.

The investigation carried out after the accident recommended that modified procedures (including risk assessment) should be followed for even the smallest change in lifting technique.

Moving Cart Strikes Hand

An operator was extracting a work roll from the machine while holding the extractor cart with one hand. When he moved the cart his hand was struck against the edge of the work roll by the cart, fracturing and cutting the first finger of his right hand.

Keywords: lost time, tools
Incident type: Accident with lost time
Involved: Employee
Age: 39
Body part affected: Hand
Plant section: → Cold rolling

Time and date: 23.00 – July 2009
Direct cause: Substandard actions
Activity: Extracting a work roll
Experience (years): 12
Type of event: Struck by
Root cause: → Tools/equipment

Immediate action

The extractor cart was taken out of service.

Corrective action

A handle was installed on the operator's side of the cart so that it could be held more securely. Safety meetings were also held to improve the attention level of the operators.

Broken Deflector Strikes Leg

When an operator on the shearing line was inserting a buffer board to prevent scratches on the inner side of the coil, the cylinder used to operate the movable deflector broke. (The cause of the break was found to be metal fatigue.) The movable deflector fell, pinching the operator's leg between the coil cars. The operator's right leg was broken in two places. He was absent from work for six months.

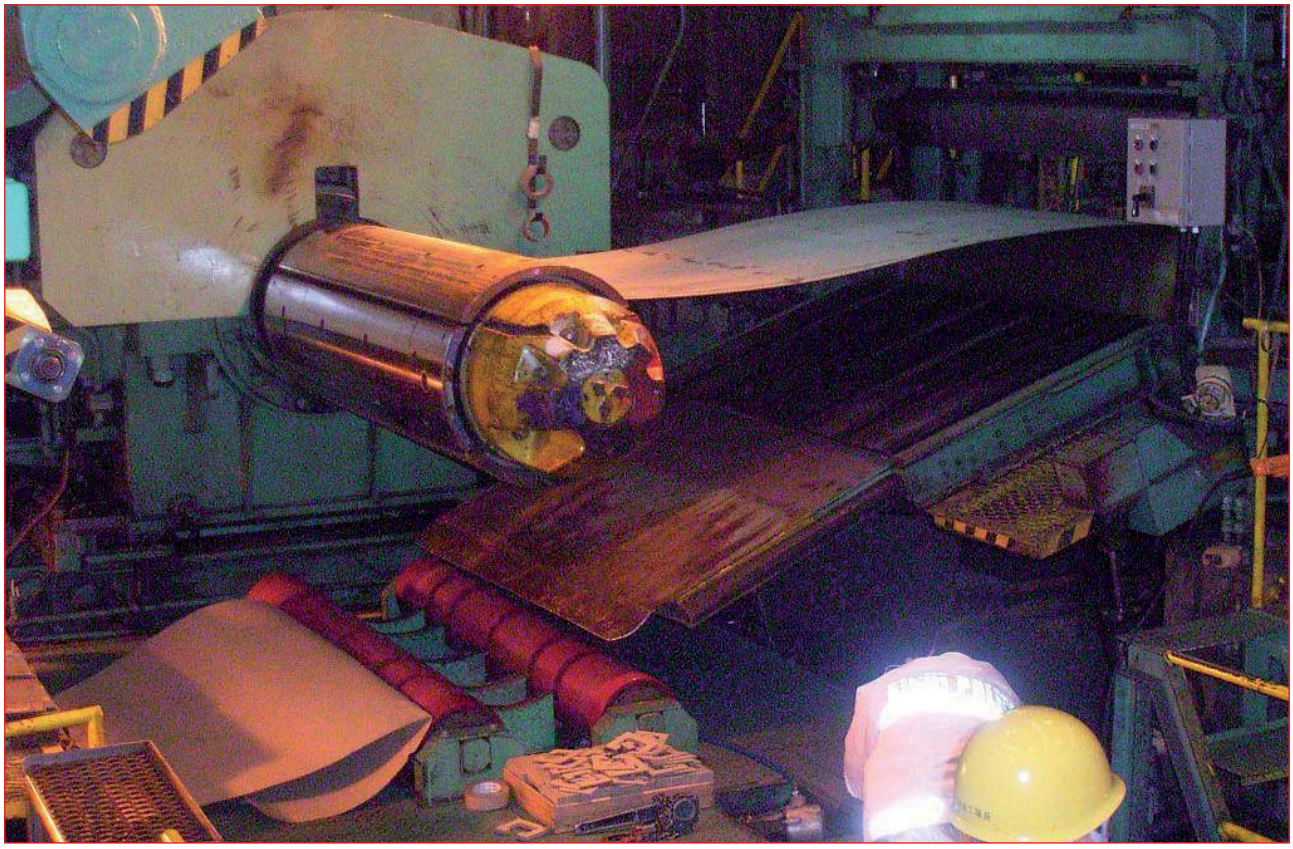
Keywords:	lost time, tools	**Time and date:**	10.15 – February 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard conditions
Involved:	Employee	**Activity:**	Inserting buffer board on shearing line
Age:	20	**Experience (years):**	2
Body part affected:	Foot	**Type of event:**	Struck by
Plant section:	➔ Cold rolling	**Root cause:**	Not specified

Immediate action

Work stopped until repairs could be made to the line.

Corrective action

The existing work procedure was revised. An interlock was installed on the line and linked to an indicator light. If the cylinder breaks the interlock is activated and prevents the cylinder from moving. The cylinder was replaced with one made of stronger material and with a larger diameter.



Sharp Edges Cut Hand

Two types of repair were required for the tension leveller. The mechanical staff planned to replace the bridle roll, while the electrical staff wanted to make a temporary wiring repair to the power supply of the hot-air dryer. Work instructions specify that a safety meeting must be held when two or more teams are working in the same place. Due to the late arrival of the electrical team, no meeting was held.

The bridle roll repair work started before the electrical team arrived. Ten people were involved in this repair.

When they arrived on site, the three person electrical team started to check a wiring rack. A few minutes later a supervisor told the electrical team where they could connect power. At this time, two of the team moved to the hot-air dryer to check the capacity of the motor.

The remaining member of the electrical team went to the wiring rack where he found a set of steps. The operator tried to use the steps to climb up and access the rack. However, what he thought was a set of steps was actually a coupling cover which had been removed by the mechanical team who were repairing the bridle roll. The electrical operator lost his balance and started to fall. He grabbed the edge of a machine to steady himself, however, a sharp edge cut into the base of the thumb on his right hand.

Keywords:	cut, fall, procedures	**Time and date:**	08.35 – January 2009
Incident type:	Accident without lost time	**Direct cause:**	Substandard conditions
Involved:	Employee	**Activity:**	Repairing small tension leveller
Age:	52	**Experience (years):**	34
Body part affected:	Hand	**Type of event:**	Cut by
Plant section:	➔ Other	**Root cause:**	None specified

Immediate action

All operators were re-educated on the importance of holding safety meetings when two or more teams are working in the same area.

Corrective action

The coupling cover had been split into two parts and had been painted in the colour used to indicate a walkway or step. This made it easy for the operator to confuse the cover with a step. To ensure the accident did not occur again the cover was reconnected to form one piece and repainted according to the rules of the plant.

Tendons Cut on Stored Coil

An operator was helping the driver of a truck to retract the brake of the trailer. The brake is situated in front of the rear wheel. To access the brake the operator needed to pass between the trailer and the coil storage area. As the operator walked to the brake they tripped over a piece of wood on the ground and fell. To prevent the fall the operator grabbed the metal packaging of a steel coil. The packaging cut the tendons in the operator's middle and ring finger on their left hand.

Keywords: cut, ergonomics, lost time
Incident type: Accident with lost time
Involved: Employee
Age: 41
Body part affected: Hand (finger)
Plant section: ➔ Other

Time and date: 20.30 - November 2009
Direct cause: Substandard actions and conditions
Activity: Retracting the brake on a truck
Experience (years): 0.5
Type of event: Cut by
Root cause: ➔ Housekeeping
➔ Position

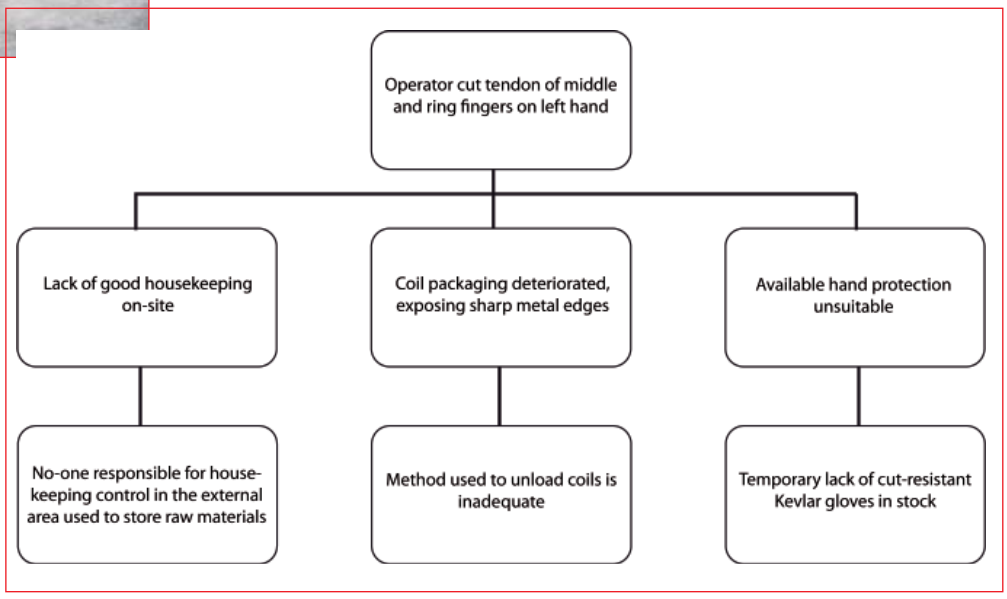
Immediate action

An investigation was carried out which showed that a lack of good housekeeping contributed to the accident. The packaging of the coil had also deteriorated, exposing the metal.

Corrective action

Better gloves and cut-resistant sleeves have been issued to all staff working in the freight forwarding and trucking area. Additional training in the use of the new personal protective equipment has also been provided. Handrails have also been installed to prevent people accessing the area at risk. Other similar areas of the plant have also been inspected to ensure that proper attention is paid to housekeeping.

The packaging of the steel coils has also been reviewed and parts that can create a risk have been removed. New methods of unloading coils that do not damage the packaging have been examined. These include using overhead cranes or a new platform that sits under the coils on the truck.



Fall While Carrying

An operator had just cleaned the de-gasser and started to climb down the stairs holding a 14 kilogram bag of dust with both hands. He missed his footing on the third step from the top and slid down the stairs. The back of the operator's head was badly cut as his helmet shifted during the fall, exposing his head.

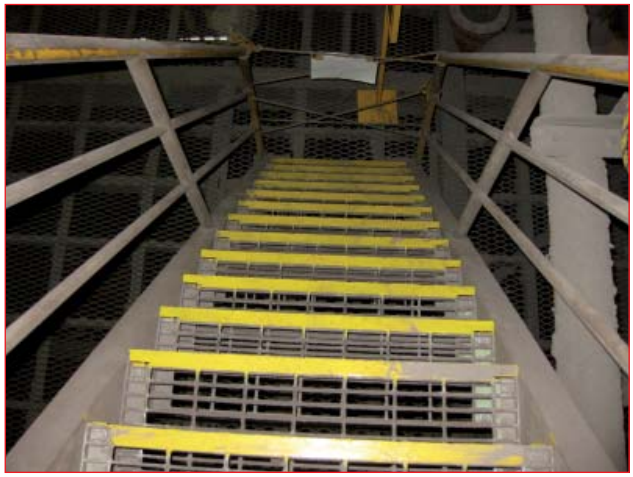
Keywords:	cut, fall, loads	**Time and date:**	10.45 - July 2009
Incident type:	Accident without lost time	**Direct cause:**	Substandard actions and conditions
Involved:	Subcontractor	**Activity:**	Dust collection
Age:	20	**Experience (years):**	1
Body part affected:	Head	**Type of event:**	Cut by
Plant section:	→ Melt shop	**Root cause:**	→ Ergonomics

Immediate action

An on-site briefing about the accident was carried out by the safety manager and the supervisor in charge. Other stairs in the plant were examined to ensure they were safe.

Corrective action

A flat bar was attached to the lip of each step so that the edge of the stair is at a different level to the tread. A winch and shooter were also installed so that the dust did not need to be carried down the stair. Checks by supervisors are now carried out when spot work is done.



Clockwise from top left: Stairs prior to accident, stairs after accident, new winch.

Cut by Falling Grinder

An operator was turning to remove defects from a flat bar when the whetstone from a hand grinder fell and hit his right thigh. The flat bar is 6.8 metres long and weighs 29.6 kilograms.

Keywords: cut, tools, procedures
Incident type: Accident without lost time
Involved: Employee
Age: 32
Body part affected: Foot
Plant section: ➔ Finishing

Time and date: 14.15 – April 2009
Direct cause: Substandard actions
Activity: Removing a defect from a flat bar
Experience (years): 0.5
Type of event: Cut by
Root cause: ➔ Procedures
➔ Tools/equipment

Immediate action

Not specified.

Corrective action

The company:

- Prohibited operators from removing defects at the examining table. A special stand was created for the specific purpose of removing defects.
- Implemented a review of the work procedure instructions.
- Undertook additional risk prevention training for operators.
- Installed appropriate covers on all grinders.

Fall Into Uncovered Hole

An operator was working in the cable room of the cold rolling mill to connect a grounding wire. The wire was situated near an uncovered cable hole. Without looking, the operator took a step forward over the hole and fell down.

Keywords: fall, lost time, procedures, tools
Incident type: Accident with lost time
Involved: Employee
Age: 39
Body part affected: Arm
Plant section: ➔ Cold rolling

Time and date: 16.30 – December 2009
Direct cause: Substandard actions and conditions
Activity: Connecting a grounding wire
Experience (years): 11
Type of event: Fall from height
Root cause: ➔ Procedures
➔ Tools/equipment

Immediate action

The cover was replaced over the hole. All other cable holes in the plant were checked and covered where necessary. The accident was reported to all electrical and mechanical operators.

Corrective action

All employees were invited to spend some two minutes with their colleagues to discuss risk and how it can be eliminated using the company's SAKE methodology. SAKE provides a framework for employees to discuss risk using the following four items as discussion points:

Speak	Discuss with your colleagues the task you perform.
Actions	Explain what you do, how you do it and the possible effects of your actions on them.
Knowledge	Discuss the knowledge do you need about procedures, activities and equipment to do your job.
Equipment	Explain what equipment (for example, tools or personal protective equipment) you need to complete the task.

Fall From Moving Train

In two separate incidents, operators fell from the steps of a train when it moved suddenly. Both accidents resulted in serious injuries to the operators' legs.

Keywords: fall, lost time, train
Incident type: Accident with lost time
Involved: Employee x 2 (Two separate incidents.)
Age: 50/Not specified
Body part affected: Foot and leg
Plant section: ➔ Other

Time and date: July 2007 and July 2008
Direct cause: Substandard actions and conditions
Activity: Transportation by rail
Experience (years): 2 months/Not specified
Type of event: Fall from height
Root cause: ➔ Tools/equipment

Immediate action

None specified.

Corrective action

The treads of the steps on the train were enlarged and the hand-holds improved significantly. The images show the steps and hand-holds before and after they were improved.

Fall on Sloping Ground

Four people were involved in the operation to remove tree branches from the green area of the factory. They included three operators and a manager. A safety meeting was held at the start of the day during which specific tasks were assigned to each of the people involved.

After the meeting, operators B and C started to cut the tree branches using high-level machinery. Operator A, who was in charge of collecting and accumulating the cut branches, waited until he received an instruction from the manager to start collecting the branches. He then began to gather the cuttings on a sloping area of the site.

As the manager and operators B and C were moving the high-level machinery to the next position, operator A fell backward and hit his hip hard against the ground. The manager noticed that operator A was crouching down and went to his assistance. The manager realized that the operator had been injured and immediately called an ambulance, notified the supervisor and the safety department of the plant.

Keywords:	lost time, fall	**Time and date:**	12.00 – April 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions and conditions
Involved:	Subcontractor	**Activity:**	Tree cutting
Age:	61	**Experience (years):**	1
Body part affected:	Hip	**Type of event:**	Fall (same level)
Plant section:	➔ Other	**Root cause:**	➔ Procedures

Immediate action

The operator was transferred to a local hospital by ambulance for a check-up.

Corrective action

The company took the following actions:

- Accumulation of tree cuttings on sloping ground was prohibited. Operators were instructed to accumulate the cuttings on flat ground.
- Risk-prevention training was given to operators involved in tree cutting.
- A manual was prepared and circulated to the operators.
- Additional safety education was provided for supervisors.

Hit by Falling Ingot

A risk prevention meeting was held at the start of the nightshift. Routine operations had been suspended so that eight-metre long ingots could be blown out and then placed into the electric arc furnace (EAF). This operation is undertaken about once every three months.

The first frame containing seven ingots was carried by the group leader to the blow out area with a side fork. All seven ingots were blown out by the group leader and deputy group leader. The area was tidied and the next frame of ingots carried to the blow out area.

The group leader blew out three of the seven ingots in the frame as a model for the new operator. The group leader then asked the operator to blow out the next ingot as he gave one-to-one instruction from behind.

The fourth and fifth ingots were blown out correctly. However, as the operator was blowing out the sixth ingot, the seventh ingot fell from the layer and onto the operator's foot. Although the ingot was pulled-off quickly, the operator sustained heavy injuries to his foot.

Keywords:	new employee, procedures	**Time and date:**	03.10 – May 2009
Incident type:	Accident without lost time	**Direct cause:**	Substandard conditions
Involved:	Employee	**Activity:**	Blowing out an ingot
Age:	19	**Experience (years):**	0.25
Body part affected:	Foot	**Type of event:**	Other
Plant section:	➔ Melt shop	**Root cause:**	➔ Housekeeping ➔ Procedures

Immediate action

The blowout work was halted immediately and the operator was taken to the plant's medical facilities.

Corrective action

The plant undertook the following corrective actions:

- A gap-prevention stopper was attached to each frame.
- A fall prevention stopper was attached to the bottom rail of the frame.
- A work instruction for blow outs was created and all relevant operators undertook training in the process.
- A full check of similar work areas was undertaken to determine if there was also a risk of items falling on to operators.

Force Causes Platform to Bend

A platform was being used to repair the engine cover of a furnace cooling device. The platform lowered as the operators put force onto the cover during its replacement. Once the force was released, the platform lifted, trapping the operator's arm between the platform and the engine cover. The operator was absent from work for 14 days as a result of the accident.

Keywords:	ergonomics, lost time	**Time and date:**	18.00 – June 2009
Incident type:	Accident with lost time	**Direct cause:**	Unknown
Involved:	Employee	**Activity:**	Work with platform
Age:	Unknown	**Experience (years):**	Unknown
Body part affected:	Arm	**Type of event:**	Caught in/between/under
Plant section:	➔ Melt shop	**Root cause:**	➔ Position

Immediate action

The crane operator was informed about handling problems. Operators who work on platforms were informed about the accident and its causes.

Corrective action

The engine cover was modified to ensure this type of accident could not occur again.

Compression Trauma to Fingers

An operator was removing a device from the ladle when they suffered a compression trauma on one of the fingers on his right hand. The carbon steel pin is used to lock and unlock the device as it rolls over the ladle. It had been in use for some time. When the device was hooked by the crane, the axis of the pin deformed due to wear, trapping the operator's finger.

Keywords: lost time, tools
Incident type: Accident with lost time
Involved: Employee
Age: 35
Body part affected: Hand
Plant section: ➔ Melt shop

Time and date: 03.15 – October 2008
Direct cause: Substandard actions
Activity: Removing a device from the ladle
Experience (years): 8
Type of event: Caught
Root cause: ➔ Tools/equipment

Immediate action

As it is difficult to manufacture a pin that will not wear over time, a spacer was placed into the metal pin. This enables the operator to lock or unlock the device without their hand coming into contact with the metal structure.

Corrective action

The new metal pin with spacer was installed.

Foot Trapped Under Product

As a product was being rolled it collapsed, trapping the operator's leg underneath. The product is 0.6 mm thick, 98 mm wide, 1,050 mm long and weighs 512 kilograms.

Keywords: ergonomics, lost time
Incident type: Accident with lost time
Involved: Subcontractor
Age: 61
Body part affected: Foot
Plant section: ➔ Finishing
➔ Other

Time and date: 08.30 – January 2008
Direct cause: Substandard conditions
Activity: Rolling product
Experience (years): 8
Type of event: Caught
Root cause: ➔ Ergonomics

Immediate action

The products were moved to a designated measuring space until a meter could be fitted to the crane.

Corrective action

To enable operators to measure the product without it moving, the meter was installed on the crane.

Chemical Splash

While removing a flow meter from its housing in a pipe, an operator was splashed by droplets of a chemical (acidic) product. The operator suffered a hyperaemia (congestion of blood) at the conjunctiva* of his right eye.

Although operators in the plant had declared the pipe safe and had authorised the maintenance work, the pipe still contained fluid at pressure. Fortunately the operator was wearing the correct personal protective equipment (such as goggles and face shield) required for this type of operation. This prevented him suffering worse injuries as a result of the accident.

*A transparent lubricating mucous membrane that covers the eyeball and the undersurface of the eyelid.

Keywords:	lost time, procedures	**Time and date:**	12.00 – October 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions
Involved:	Employee	**Activity:**	Removing a flow meter
Age:	28	**Experience (years):**	5
Body part affected:	Head	**Type of event:**	Contact
Plant section:	➔ Other	**Root cause:**	➔ Procedures

Immediate action

Not specified.

Corrective action

A discharge valve system was installed in every flow-meter pipe, enabling them to be completely depressurised.

Burst Nitric Acid Pipe

An operator was checking equipment in the acid treatment plant when a nitric acid pipe burst. The operator was splashed with acid.

Keywords:	acid, safety screen, pipe, lost time	**Time and date:**	22.10 – July 2009
Incident type:	Accident without lost time	**Direct cause:**	Substandard conditions
Involved:	Employee	**Activity:**	Equipment check
Age:	35	**Experience (years):**	1
Body part affected:	Head	**Type of event:**	Contact
Plant section:	➔ Cold rolling	**Root cause:**	➔ Tools/equipment

Immediate action

The operator washed themselves in the emergency shower in the area. They were then taken to hospital by ambulance.

Corrective action

The pipe was repaired immediately. Safety screens were also installed around the risk area.

Detail of pipe

Cut to Hand

An operator was pushing the service tail to the centre of service tail loading skid. The tail fell onto the operator who was wearing inappropriate safety gloves. The operator suffered a cut to the second finger of the right hand.

Keywords:	cut, personal protective equipment, lost time	**Time and date:**	18.50 – September 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions
Involved:	Employee	**Activity:**	Service tail movement
Age:	23	**Experience (years):**	2
Body part affected:	Hand	**Type of event:**	Cut by
Plant section:	➔ Cold rolling	**Root cause:**	➔ PPE

Immediate action

The operator went to the factory's medical service immediately.

Corrective action

The operator received special training to address the cause of the accident. The operator was instructed that they must use mechanical safety gloves with the protection code 4 3 4 4. The code indicates the level of protection provided in four different categories:

Abrasion	4	Maximum
Cut resistance	3	Mean
Tear strength	4	Maximum
Puncture	4	Maximum

Slip in Scrap Storage Area

A subcontractor entered the outdoor scrap storage area as part of his work. To reach the area where he was working, the subcontractor had to walk across the scrap metal that littered the area. As it was raining, the metal was slippery. The subcontractor slipped and fell, cutting his right arm on a piece of scrap. He suffered a five centimetre cut to his arm which severed the artery.

Keywords:	lost time, slip	**Time and date:**	09.00 – July 2008
Incident type:	Accident with lost time	**Direct cause:**	Substandard conditions
Involved:	Subcontractor	**Activity:**	Slip in scrap storage area
Age:	35	**Experience (years):**	10
Body part affected:	Arm	**Type of event:**	Cut by
Plant section:	→ Other	**Root cause:**	→ Housekeeping

Immediate action

The subcontractor was sent to hospital. All other subcontractors on site were warned to be aware when working in the rain.

Corrective action

All scrap was removed from the area where the subcontractors were working. An accident report was written and distributed to all employees and subcontractors. The report reminded everyone to ensure the plant was kept in a clean and tidy state.

Fall Due to Missing Footbridge

A subcontractor was cleaning the cooling chamber of the dust hopper. During the cleaning the subcontractor removed the footbridge connecting the hopper to another work area without warning the company operator. When the company's supervisor went to check the works, they did not realise the footbridge had been removed and they fell to the ground.

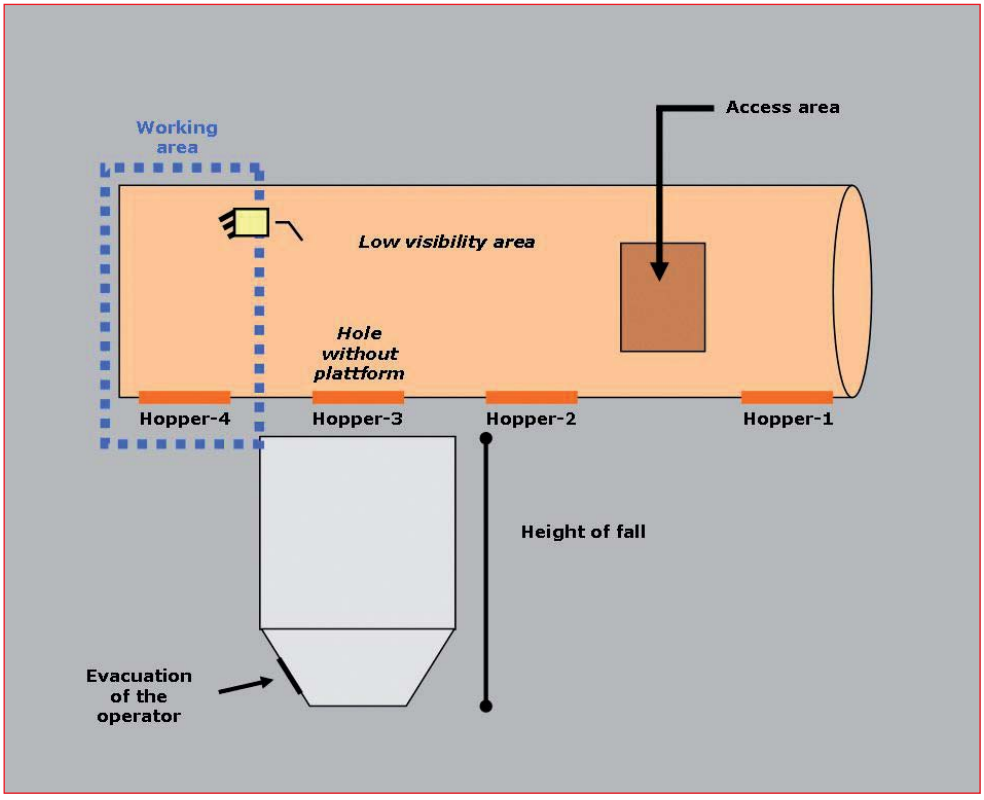
Keywords:	lost time, fall	**Time and date:**	08.00 – September 2009
Incident type:	Accident with lost time	**Direct cause:**	Substandard actions and conditions
Involved:	Subcontractor	**Activity:**	Cleaning dust collectors
Age:	40	**Experience (years):**	2
Body part affected:		**Type of event:**	Fall from height
Plant section:	➔ Melt shop	**Root cause:**	➔ Procedures

Immediate action

The supervisor was taken by ambulance to hospital. Technical safety staff stopped the cleaning operation until corrective measures were identified.

Corrective action

Floodlights have been installed in the area to improve visibility and platforms have been installed on all holes. Technical safety staff are checking the changes and will decide if there is any further risk in this task.



Index of Keywords

Appendix: Safety Leadership Cards

The Safety Leadership Cards below are designed to be cut-out and carried by all managers who want to improve safety and health in the workplace.

Safety Leadership:
From Principle to Action!

"Managers are responsible and accountable for safety and health performance."

Principle 2 of worldsteel's Safety and Health Principles Guidance Book

This pocket card has been developed in order to turn principle 2 of worldsteel's Safety and Health Principles into concrete actions. It is intended for managers who want to improve safety and health in the workplace. Below, you will find a list of seven practical tips you can follow in order to raise employees' safety awareness.

1. **Be visible on the shop floor.**

   Talking with people about safety on the shop floor will help to demonstrate leadership's commitment to safety. It allows you to cultivate an open and trusting relationship with employees. You will earn credibility.

2. **Set an example.**

   As a manager, your words and actions have a significant impact on your employees. Always act as an example and "do what you say." Always wear the required PPE. Do not take shortcuts and always follow all the procedures that are in place. If you are a front-line leader or the direct supervisor of a team, try to spread the health and safety information yourself. Your Health and Safety department will support you and provide you with all the necessary documents.

3. **Practice shop-floor audits on a regular basis.**

   Shop-floor audits are a powerful tool to change the mind-set of your operators. The audits should consist of a constructive discussion. They should not be perceived as an opportunity for punishment. Stay open and positive. Try to use open-ended questions.

4. **Recognise and reinforce safe behaviours.**

   When you notice safe behaviours, reinforce them. Encourage employees with your personal recognition.

5. **Demonstrate commitment to changing at-risk behaviours.**

   If you identify at-risk behaviours, you must stop and correct them. Talk to employees about their behaviour. Were they aware of the risks encountered? Ask why they decided to adopt at-risk behaviour? Then try to get employees to commit to working safely by discussing the potential consequences of the observed at-risk behaviour.

6. **Identify key points for improvement.**

   Always try to clarify safety standards and expectations. Are the standards appropriate? Are there barriers preventing employees from complying with the standards? Involve employees in identifying key points for improvement.

7. **Be rigorous with follow up.**

   If you detect any issues that need correction or improvement, follow them up diligently. Corrective actions in the field of safety and health should always take priority.

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6. Identify key points for improvement.
7. Be rigorous with follow up.

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