UK P&I CLUB

# Risk Focus: Burns

Burns are bad news wherever they occur, but when they happen at sea, remote from shore medical facilities, the consequences can be grave

UK P&I CLUB
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# Minimising the risk of seafarers suffering burns at sea

Burns can be some of the most painful and dangerous of personal injuries that may be inflicted both at work and in domestic situations. The potential sources and causes of burn injuries can be varied and may range from a painful but minor inconvenience to life changing injury and death.

In the majority of cases, burn casualties reported to the Club were able to make a full recovery after receiving appropriate first aid or professional medical treatment ashore. However, some were not so fortunate, with seafarers suffering appalling physical pain, disfigurement, amputations and loss of life.

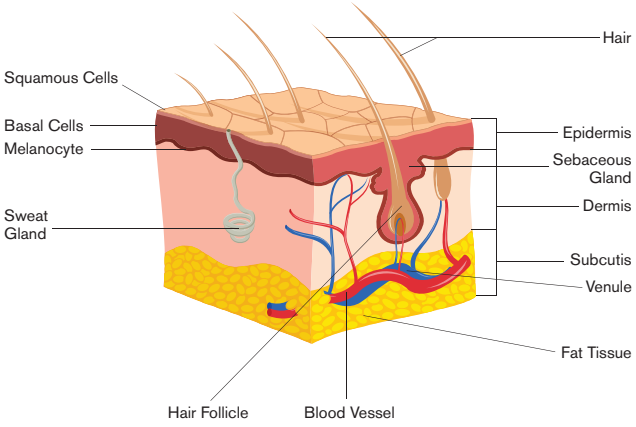
Burn injuries are bad news whenever and wherever they occur, but when they happen at sea, remote from shore medical facilities, the consequences may become dangerously aggravated. A serious burn will require prompt professional medical attention and special facilities which are unlikely to be available on a merchant ship navigating in mid ocean. For this reason it is particularly important that seafarers are fully aware of the risks presented by hot (and cold) appliances and systems as well as the necessary safety precautions to take, both on and off duty.

**What is a burn?**

A burn is damage to skin tissue which causes the affected skin cells to die resulting in swelling, blistering, redness, charring and tissue loss. The most common causes of burn injuries to crew on board ships may be summarised as follows:

- Steam and hot fluid burns
- Contact with heated surfaces
- Exposure to hot or burning solids, liquid or gas
- Chemical burns
- Electrical burns
- Cold burns

**Structure of human skin**




**Classification of burns**

Source: The Ship Captain's Medical Guide

The severity of a burn is graded according to the depth of the injury through the skin.

Skin has an outer layer (epidermis) and a deep layer (dermis). The latter contains the sweat glands, hair follicles and nerves relaying sensation and pain to the skin.

**First degree burns** affect only the outer skin layer, causing redness, mild swelling, tenderness and pain.

**Second degree burns** extend into the deeper skin layer (the dermis):

Superficial, second degree burns cause deep reddening, blister formation, considerable swelling and weeping of fluid.

Deep second degree burns may not be easy to distinguish from third degree burns immediately after the injury. Pain may be severe because of damage to the nerve endings.

**Third degree burns** involve the whole thickness of skin, and may extend to the underlying fat, muscle and bone. The skin may be charred, black or dark brown, leathery or white according to the cause of the burn. Pain may be absent due to destruction of the nerve endings.

The treatment of burns will depend upon the cause of the burn, how deep it is and how much of the body it covers. Ship's masters need to be fully aware of the potentially life threatening complications that may present in a casualty due to the loss of the protective skin layer, including infection, hypothermia, dehydration and shock, even in the case of burns of a relatively minor bodily extent. It is therefore of vital importance that burn injuries are quickly assessed and professional medical advice obtained as soon as possible, even if they initially appear to be trivial. The apparent seriousness of burn injuries can be easily misjudged by laymen, with casualties in the early stages presenting as being alert or not even in great pain due to the effects of shock or the destruction of nerve endings. This can engender complacency and delays in seeking appropriate medical attention with sometimes tragic consequences.

The high risk of burn injuries leading to serious complications means that in the event of a crew burn incident, the master, ship manager or telemedicine service will often require or recommend that the vessel deviates to the nearest port or place where medical facilities are available to administer appropriate treatment. This is a commonly recurring feature of burn incidents which will inevitably result in an escalation in claim costs.

As "prevention is better than cure" the different types of burn injury and preventative safety precautions may be examined as follows:

**Steam and hot fluid burns and scalds**

This is perhaps the most common type of burn injury to which ships crews are exposed. The Club's claims experience indicates that the largest proportion of steam and hot fluid burns occur in the machinery spaces although other high risk environments include the galley, mess rooms and areas where high temperature tank cleaning or cargo operations are being performed.

Accidents often occur in the engine room when steam and hot oil systems are opened up for maintenance or inspection. Typically, unwary engine room crew will dismantle a valve, pipe flange or other machinery component in the mistaken belief that the system has been properly isolated, de-pressurised and drained, with the result that they become exposed to steam or hot fluid ejected from the system. This is frequently attributable to an absence of or inadequate pre-work planning, where the risks of steam or fluid discharge are not properly assessed and required safety precautions not put in place. Not surprisingly, hot water and steam injuries in machinery spaces commonly arise in connection with work on boilers and their associated systems, including hot wells. All heated oil systems are a potential hazard, particularly bearing in mind that fuel oil service temperatures may typically be in the region of 125°C to 140°C. In this respect, work associated with fuel pumps, fuel filters, fuel settling and service tanks and waste oil tanks regularly feature in burn accident reports. Unfortunately there is a tendency to view work relating to the operation and maintenance of these systems as routine and not deserving of a proper risk assessment or pre-work tool box talk. Raising hazard awareness through on board training, familiarisation and the implementation of Permit to Work procedures for tasks of this nature could go a long way to preventing many avoidable injuries. This would include the use of appropriate Personal Protective Equipment (PPE) such as heat resistant gloves or gauntlets, aprons and full face visors.

Burn injuries occasionally occur on deck during cargo tank cleaning or steaming operations due to poor working practices or improperly made connections. Particular care should be taken when personnel are required to enter cargo tanks to assist with the stripping of heated vegetable oils. Crew should also be aware that pressurised hydraulic oil in mooring winches and other machinery may reach very high temperatures.

Galleys and catering facilities are obvious high risk area for burn injuries, containing a wide range of heated appliances and receptacles for hot or boiling water and very high temperature cooking oils.

**CASE STUDY 1**
**Leaking steam system valve**

When conducting early morning rounds of the engine room, the first engineer noticed that the auxiliary boiler steam dump valve gasket was leaking. He therefore instructed the second and third engineers to stop the boiler and drain all steam and water from the system. After later being informed by the third engineer that the system was drained, the first engineer started work on opening up the valve to check the cause of the leak. However, during removal of the valve bonnet, steam and hot water was discharged from the joint. The first engineer suffered extensive burn injuries to arms, left leg and back, requiring medical evacuation by helicopter for treatment ashore. Although the accident report did not explain why steam and water was still present in the system after reportedly being drained by the third engineer, it is evident that the line had not in fact been properly drained and isolated from other parts of the system. Care should be taken when breaking open joints, ensuring that securing bolts are slackened off to the minimum and as far as practicable, keeping well clear.

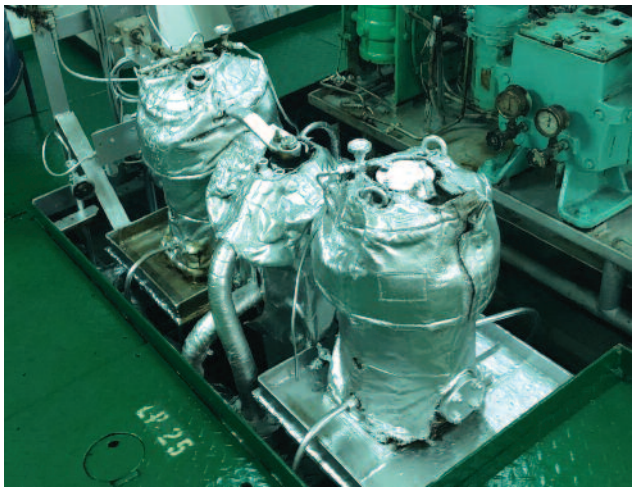
**CASE STUDY 2**
**Cargo pump malfunction**

During cargo oil discharging operations, the sea water cooling system low pressure alarm sounded in the engine room. The duty engineer checked the source of the alarm and noticed that sea water cooling pump no.2 was not delivering sufficient pressure and immediately informed the chief engineer. The chief engineer then started sea water cooling pump no.1 and the other pump was stopped. Shortly after, the cargo pump condenser low vacuum alarm sounded and the chief engineer proceeded with the duty engineer to the cargo pump turbine platform to close the steam delivery valves from the boiler to prevent over-pressurisation of the condenser. While they were closing the valves, the turbine expansion joints blew out, exposing both men to high pressure steam resulting in very serious second and third degree burns over large areas of their bodies. The incident report indicated that the standby no.1 cooling pump had not been properly lined up and was ineffective when started. The sea water cooling water intakes were also found to be fouled with debris, restricting the flow. It was furthermore reported that the chief engineer had the option of shutting the steam valves from a remote stop position rather than on the turbine platform itself.

## CASE STUDY 3
### Cleaning oil filters

While the vessel was at anchor, the chief engineer instructed the duty crew to clean the duplex filters for the fuel oil booster pumps. The diesel generator was changed over from Heavy Fuel Oil (HFO) to Diesel Oil (DO), the HFO heater was shut off and the feed and booster pumps stopped. The third engineer was said to have closed the valves before and after the filters and then slackened off the air vent plug to relieve the pressure in the filter unit. As the third engineer commenced removing the filter cover, hot fuel oil was ejected from the casing, causing extensive first and second degree burns to his arms, legs and feet. The engineer was quickly transferred ashore and hospitalised.

The actions reported to have been taken to isolate the FO filters and relieve pressure were consistent with standard practice and yet there remained enough fuel and pressure in the system to cause the discharge of hot oil from the opened filter casing. This shows that it should never be blindly assumed that the system is 100% safe when being opened up – what if a drain or vent is blocked or a valve is not closing properly?



When working on steam or hot fluid systems, it is good practice to ensure that valves which have been closed to isolate the system are locked or tied shut and notices attached to the effect that they are not to be opened. Other measures to de-pressurise, drain and cool the system should also be positively identified and recorded by the work team. In all cases, the manufacturer's instructions for operation and maintenance should be strictly adhered to.

## CASE STUDY 4
### Oil tank level gauge

As the third engineer was conducting routine rounds of the engine room, he noticed that the waste oil settling tank level was low. He decided to fill up the tank and at the same time, opened up the top cover of the level gauge as he suspected the float was stuck. As he removed the float, pressurised, high temperature sludge was discharged from the gauge column resulting in second degree burns to his face and hands.

This is only one of numerous crew burn injuries the Club has handled attributable to inadequately planned opening up of engine room oil storage tank level gauges. The third engineer should not have opened up the gauge without consulting with a more senior officer and exercising proper job planning. The injuries may not have been so severe if the engineer was wearing a full face visor when doing the job.

## CASE STUDY 5
### Galley scalding

The mess man was cleaning in the galley while the vessel was experiencing heavy weather. During an alteration of course, the vessel rolled heavily causing a large electric kettle to topple from a nearby work top, spilling boiling water over the mess man's lower legs and hands resulting in serious scalding injury.

Catering personnel should wear appropriate work wear that does not leave the skin overly exposed. Suitable safety footwear should be worn with open top type sandals being strictly prohibited. When heavy weather is expected, appropriate precautions should be made to ensure hot pots and pans are properly secured against movement and not over-filled. This would include the fitting of safety bars around galley cooking ranges. In very heavy weather, consideration should be given to limiting cooking activities.

**Contact with heated surfaces**

This is a very common cause of personal injury, particularly in machinery spaces and in the galley. Wherever possible, exposed hot surfaces should be effectively insulated and shielded to reduce the risk of direct contact. This will include machinery casings, steam and hot oil system pipelines and valves, exhaust manifolds and uptakes. Otherwise crew members should be fully alert to components that may be hot and use made of warning notices and signage.


Crew serving on tankers must also be aware that cargo lines and tank heating systems may also attain high temperatures. In the case of asphalt tankers where the cargo is typically carried at up to 160°C, the cargo system pipelines and valves require to be fully insulated.

Galley crew must take care when handling hot cooking pots, baking trays and other utensils as well as when attending to hot plates and ovens. Good quality oven gloves should be available and worn.

**Exposure to burning solids, liquid or gas**

Matters relating to the cause and effect of major shipboard explosions or fire casualties fall outside the scope of this Risk Focus. Nevertheless, burn injuries resulting from mishandling of flammable materials or improper use of burning machinery and equipment do often occur. Inhalation of smoke and hot gases associated with burning materials may also result in injury to airways and lungs.

Whatever the activity, it is essential that fire prevention training and precautions as required by the vessel Safety Management System are fully observed at all times, no matter how apparently minor the job. Hot work should always be subject to a risk assessment and the issuance of a Permit to Work, particularly when performed outside the engine room workshop. Crew involved in hot work must use and wear appropriate personal protective equipment, which may include heat resistant gloves, gauntlets, aprons, safety boots and eye protection. Work wear should preferably be of natural fibre as some synthetic fibre garments are more flammable and can melt on to the skin at high temperature.

Numerous accidents occur due to incorrect use and maintenance of oxy-acetylene type burning gear. Flame cutting and welding should only be performed by persons properly trained and familiarised with the equipment on board, the care and maintenance of which should be incorporated into the vessel planned maintenance system. Appropriate hot work precautions must never be neglected, including ensuring that the object being worked on is clear of and does not contain flammable materials, liquids or vapours. It should also be borne in mind that cutting gear such as rotary disc cutters and grinders will generate a lot heat and sparks during use which may also be a potential source of ignition. Fatalities have resulted from crew

using this equipment to cut open empty oil or chemical drums whereby the vaporised oil/air mixture in the drum was ignited by heat from the cutting operation, causing the drum to explode.

Work associated with burning machinery such as oil fired boilers and incinerators must be properly supervised and manufacturer's instructions for operation, inspection and maintenance strictly observed. Boiler blow back incidents sometimes occur due to the failure to observe correct flame failure re-start procedures. The neglect to properly purge the furnace with air before re-lighting the boiler may ignite residual fuel vapour and cause a dangerous explosion. In such an event, any crew working at or near the boiler firing unit are at high risk of very serious impact and burn injuries.

### CASE STUDY 6
### Leaking hydraulic pipework

A fitter was instructed to replace leaking hydraulic pipework associated with the cargo hold hatch cover operating system. An oxy-acetylene torch was being used to apply heat to the connecting flange bolts in order to disconnect the pipe joints. During this work, hydraulic fluid within the pipework leaked out and was ignited, engulfing the fitter and the burning gear in flames. Nearby deck crew quickly doused him with water and closed the valves on the oxy-acetylene cylinders. Fortunately for the fitter, the vessel was at a port anchorage enabling him to be transferred to a local hospital burns unit in good time, where he was assessed as suffering from second degree burns over 15% of his body.

The accident was caused by a failure to properly assess the risks involved with this work and poor working practices. A proper risk assessment and observance of the relevant SMS Permit to Work for hot work should have identified the potential for residual hydraulic oil or vapours being present within the pipes. Using burning gear in this manner on pipework, drums or other vessels which may contain inflammable liquids or vapour is extremely hazardous.

### CASE STUDY 7
### Engine room incinerator

The oiler was instructed by the second engineer to burn oily rags and other combustibles in the engine room incinerator. About one hour after the start of the operation, and in order to speed up the process, the oiler decided to open the incinerator in order to rake unburnt materials. To do this, he opened the outer feeding door, using his left hand to by-pass the door micro-switch, the activation of which would have made it impossible to open the inner incinerator sluice door. He used his right hand to operate the control switch for opening the sluice door and with the same hand, used a steel rod to rake the combustibles within the furnace. During this action, the sluice door closed automatically, trapping his right hand at the wrist. His screams for help were heard by a nearby crew member who assisted in removing his hand, which was by this time severely burnt. Although the seaman was landed ashore the next day for emergency treatment, it was unfortunately not possible to save his hand. The lesson here is that machinery safety devices should never be tampered with or by-passed in any circumstance.

### CASE STUDY 8
### Improvised barbecue grill

The crew arranged a barbecue on the poop deck using the type of improvised grill not uncommon on board vessels. After lighting the charcoal, the bosun decided to pour paint thinner from a ¼ filled 20 litre drum onto the charcoal in order to speed up the burning process. As he was doing this, the drum exploded, covering the bosun and two other nearby crew members in burning solvent. They all suffered severe and extensive burn injuries, requiring the vessel to deviate for an emergency evacuation.

Using highly inflammable chemicals in such a negligent manner is extremely dangerous. The fact that the actions of the crew were associated with a leisure activity does not mean that the application of shipboard safety precautions and common sense may be disregarded.

### Chemical burns

All ships carry on board a wide range of chemicals used in numerous applications in all departments. Many of these chemicals are potentially injurious to health and can result in serious burns to skin and eyes if proper protective precautions are not observed. Hazardous chemicals carried on board may be used variously for general cleaning, de-greasing, de-scaling, water and oil treatment, solvents, additives and hold and tank cleaning agents. Other possible sources of exposure may also include battery fluids and certain chemicals carried as cargo. Many of these chemicals are strongly acidic, alkaline and toxic.

As a starting point, it is important that all chemicals used for shipboard applications are obtained from reputable suppliers. Chemical containers and packaging should display hazard warning labels, pictograms and information on the hazard presented, with which all seafarers should be familiar. Crew should also be properly instructed and informed of the risks presented by chemicals with which they are required to use in the course of their duties as well as the precautions to be taken. Any work involving the use of chemicals should also be subject to a risk assessment in order to evaluate the exposure hazard and to put in place appropriate preventative controls to eliminate or minimise risk. Where hazardous chemicals are carried as cargo, industry guidelines for handling and containment must be rigorously observed, with decontamination showers on deck always ready for use.

Prior to using any hazardous substance, it is essential that crew make reference to the manufacturers Material Safety Data Sheet (MSDS) in order to be fully appraised of the potential hazards and to ensure that the appropriate personal protective equipment (PPE) and working practices are used. Such PPE will include chemical resistant gloves or gauntlets, aprons, chemical suits, boots and eye protection in the form of goggles or full face visors as appropriate to the assessed risk. The MSDS will also provide advice on first aid measures in the event of skin or eye contact.


All chemicals should be carefully handled, stored and inventoried and only used with the authority of a responsible officer. They should only be stored in designated well ventilated spaces with controlled access and with all the relevant MSDS available on file. Storage lockers and other areas where chemicals can be expected to be used should also have PPE and a first aid kit on station, the latter including a good supply of medicated eye wash. Skin or eyes splashed with chemicals should be drenched with water as soon as possible, which should be continued for at least ten minutes or more as directed.

The indiscriminate mixing of chemical cleaning or de-scaling products is potentially very hazardous, possibly resulting in a violent reaction and/or the production of asphyxiating or toxic gases.

### CASE STUDY 9
### Chemical drain cleaner

An assistant cook was using chemical drain cleaner to clear a blocked sink waste pipe in the galley. After pouring in the fluid, a sudden release of back pressure from the drain caused the chemical to splash into his face, resulting in burns to the exposed skin and eyes. The seafarer was evacuated ashore for medical treatment and was assessed to have sustained serious damage to the cornea of one eye with the effect that his sight was permanently impaired. In this incident, it was apparent that the crew member failed to appreciate the hazard presented by drain cleaning agents, which are highly aggressive chemicals. The work was improperly supervised and there was a failure to wear appropriate PPE. This is a clear demonstration that an apparently routine task involving the use of chemicals can result in very seriously consequences.

### CASE STUDY 10
### Water treatment chemicals

One of the ship's engineers was routinely tasked with adding water treatment chemical to the boiler hot well tank. The chemical was contained in a 25 litre plastic drum and on this occasion, was almost full. After opening one of the hinged lids on top of the hot well, the engineer unscrewed the container cap and stepped up on to a pipe bracket in order to pour the chemical into the tank. As he was doing this, he lost his balance and fell onto the deck, causing the chemical to splash onto his face and neck. He immediately flushed his skin and eyes using a nearby fresh water hose and was assisted by other engine room crew to the workshop where medicated eyewash was also applied. The engineer was quickly transferred ashore to a hospital for professional medical attention.

Water treatment chemicals are highly alkaline (pH of 13-14 undiluted) and can cause severe burns and eye damage. In this case, the seafarer was fortunate in that appropriate first aid could be very quickly given and that the vessel was in port enabling prompt transfer ashore. A number of factors relating to deficient working practices contributed to this incident, including inadequate arrangements for handling and transfer of the chemical, the routine nature of the task engendering complacency, a lack of appreciation as to the very hazardous nature of the chemical and the absence of a proper working platform to perform the job safely.

## Electrical burns

Working with or using electrical machinery, appliances, welding gear and tools not only expose personnel to the risk of electric shock but also to the possibility of associated burn injuries. All crew members are potentially at risk as modern ships are packed with a wide variety of electrical equipment, some of which may operate at high voltages. Not surprisingly, a large proportion of injuries involve engineer and electro-technical officers working with live electrical systems. The risk of electrical shock and burns is increased in conditions of damp and high humidity, reducing the contact resistance of the human body. Electrical burns can be broadly categorised as contact burns when a part of the body touches a live power source or arc flash burns, associated with both high and low voltage equipment. An arc flash occurs when an electrical current flows through an air gap, ionising the surrounding air and creating a large quantity of thermal energy. Therefore, direct contact with the electrical appliance is not necessary and very severe burns may result. Electrical burns, which do not look significant on the surface, may be misleading as serious damage may occur to underlying tissues. It is for this reason that electrical burns should always be assessed by a medical professional.

It is beyond the scope of this Risk Focus to describe the full range of precautions that should be taken when using, working with or maintaining electrical equipment. However, the following basic principles should always be strictly adhered to:

- Persons working on electrical equipment must be properly trained and competent to do so
- Work should always be subject to thorough risk assessment, job planning and the issuance of a Permit to Work, with which all involved personnel should be appraised
- Before any work is performed, fuses should be removed and circuit breakers opened to ensure that the electrical equipment is “dead”, which should be confirmed using a voltage indicator
- Switches and circuit breakers should be open and warning notices posted to prevent accidental reconnection
- Work on or near live equipment should always be avoided
- Where work on live equipment or high voltage systems (greater than 1,000 Volts) is considered necessary, additional robust precautions must be taken
- All electrical machinery, equipment and tools must be properly cared for and incorporated into the shipboard Planned Maintenance System
- Appropriate Personal Protective Equipment must be worn, including insulted gloves where practicable, and insulating mats placed adjacent to switchboards

(Refer to the Code of Safe Working Practices for Merchant Seafarers)

### CASE STUDY 11
### Faulty washing machine

Before commencing work on checking a faulty washing machine in the crew laundry, the electrician switched off the electrical power supply. When carrying out the task, he received a powerful electric shock when his hand touched a terminal on the primary side of the 440/220 V transformer. As a consequence, his hand also sustained a serious third degree burn injury.

The master of the vessel promptly reported the injury to his managers and the nearest Maritime Rescue Coordination Centre (MRCC) with whom arrangements were made to deviate from the voyage route and transfer the seafarer ashore for hospitalisation. The accident investigation revealed that the electrician had forgotten to test for any residual voltage in the washing machine electrical components after switching off the supply. It was this residual voltage that caused the electric shock and burn injury when he touched the transformer terminal.

This accident demonstrates that even when carrying out apparently routine work on everyday electrical appliances, the failure to observe correct working practices can lead to serious and potentially fatal injury.

### CASE STUDY 12
### Live electrical components

The chief engineer instructed the electrician to troubleshoot a fault on the 440 Volts main switchboard relating to the operation of no.2 generator. The electrician opened the relevant rear switchboard panel before starting work on

identifying the defect. While carrying out his checks, it appears that the electrician touched a live component, which delivered an electric shock, rendering him unconscious. When later discovered lying next to the switchboard by the chief engineer, he was transferred to the ship's hospital where he recovered consciousness after first aid was given. Both hands sustained severe third degree burns down to the bone. The next day, the electrician was transferred ashore for professional medical attention and later endured a long and painful period of treatment and rehabilitation as well as permanent disability.

Investigation of the accident revealed a serious neglect to comply with the Company Safety Management System. The generic Risk Assessment forms relating to electrical maintenance and fault finding at the main switchboard were not consulted, no Permit to Work was prepared and no tool box talk was carried out. Despite both the chief engineer and the electrician being experienced, trained seafarers, there was a demonstrable lack of hazard awareness and observance of basic safety precautions. Certainly the electrician should not have been working unattended and the fact that the vessel was rolling at the time would not have provided a stable working platform.

### Cold burns

Contact with very cold substances or materials can damage skin and tissue in a way similar to heat burns. This type of injury is relatively rare on board ships, with most notable incidents being related to the loss of containment of pressurised or refrigerated gases. However, bare skin contact with uninsulated surfaces at sub-zero temperatures, as may be found in refrigerated cargo holds, provision stores or gas tanker deck fittings, may also cause injury.

Liquefied gases carried as cargo on Liquefied Natural Gas carriers (LNG) and Liquefied Petroleum Gas carriers (LPG) may be carried at very low temperatures. In the case of LNG, the cargo carriage temperature is -162°C and for LPG carriage temperatures on fully refrigerated vessels may be down to -48°C. In tankers designed for the carriage of ethylene, the cargo is maintained as a fully refrigerated liquid at -104°C. At such low temperatures, it is of the utmost importance that these cargoes are rigorously contained in the interests of the safety of the ship and personnel.

Although cold burns may sometimes appear the same as heat burns, the required treatment differs. For example cold burn injuries should only be bathed in lukewarm water (not cold). As with all burns, prompt professional medical advice should always be sought.

### CASE STUDY 13
### Seized ullage gauge

This incident occurred on board an LPG/Ethylene carrier of 4500 $m^3$ capacity. Shortly after the commencement of loading a cargo of ethylene, the ullage gauge in one of the tanks was found to be seized, requiring the suspension of operations. The float gauge operated from a 2 mm stainless steel wire wound on a drum on the gas side. In order to repair the fault, the chief officer lowered the tank pressure and donned a protective gas suit. When the chief officer removed the gauge side plate, a large quantity of ethylene vapour at about -100°C was released, which resulted in serious third degree burns to both arms. He immediately rinsed his arms under the emergency deck shower and was transferred ashore to hospital. The injury was very painful and took approximately four months to fully heal up.

The chief officer did not appreciate that the pressure in the tank was too high to perform this work. A proper risk assessment and pre-work planning would have identified the potential hazards involved in the task as well as the appropriate safety precautions to be put in place. Any maintenance work relating to liquefied gas cargo systems must always be subject to special measures with the safety of the operation being very carefully considered prior to approval.

### CASE STUDY 14
### Air conditioning unit charging

The second engineer noted that the quantity of refrigerant gas within one of the accommodation air conditioning units was at a low level. With assistance of a junior engineer, a cylinder of spare refrigerant gas was taken to the air conditioning room and connected to the system charging port by flexible hose. When the system was charged, the second engineer shut the valves of the cylinder and charging port. However, when the hose was disconnected, gas was released under pressure from the charging port, impacting both of his hands and producing a burning sensation. In accordance with advice contained in the relevant MSDS, other crew members responded by bathing his hand in lukewarm water in the engine room workshop. As the vessel was at a port anchorage, the second engineer was soon transferred ashore to hospital.

Investigation into the incident determined that the air conditioning unit charging port valve was defective and had failed to close properly before the hose was disconnected. The sudden expansion of the escaping gas caused rapid cooling of the surrounding environment, including the second engineer's leather gloved hands, a process known as adiabatic cooling. Although the failure of the valve could not reasonably be foreseen, it serves as a lesson to take great care when handling compressed gases. On the other hand, the crew actions were commendable in giving appropriate first aid enabling the seafarer to make a full recovery.

**Personal Protective Equipment**

In this Risk Focus, numerous references have been made to the importance of crew wearing appropriate work clothing and making use of protective equipment when performing work that may expose them to the risk of burn injury. Doing so could possibly have prevented or at least reduced the impact of many of the injuries to crew that come to the attention of the UK P&I Club.

PPE should be of good quality, fit for purpose and approved by a recognised product safety certifying authority. It should be readily available on board in sufficient quantity and maintained as part of the vessel planned maintenance system. Any defective items should be discarded and promptly replaced. At a basic level, all ships should carry on board a good stock of facial and eye protective goggles and full face visors, gloves, gauntlets, aprons, overalls and foot wear providing the necessary thermal, chemical and electrical protection as appropriate to the job. On board familiarisation, training and safe working procedures should also emphasise the importance as well as necessity of crew using PPE no matter how small the risk appears to be.

**Medical attention**

Appropriate first aid must be used to treat any burns or scalds as soon as possible. This will limit the amount of damage to the skin.

The type of treatment given to the casualty will depend upon the cause, location, skin area affected and severity of the burn. Ship's crew should be trained so as to be able to effectively deal with burn cases as presented and have an understanding of the correct first aid to administer for the particular injury. Seafarer first aid training and knowledge needs to be regularly refreshed and supplemented by readily accessible medical information suited to the treatment of burns in a shipboard environment. "The ship captain's medical guide" has served seafarers for decades and remains a valuable resource.

For a burn injury occurring when a ship is in port, first aid treatment given on board would be similar to that practiced ashore until such time as the casualty is transferred to shore medical facilities. At sea, additional intervention by the ship's officers will be required, which should always be performed after seeking prompt advice from shore medical professionals. Traditional sources of radio medical advice are increasingly enhanced by improvements in ship telecommunications technology and digital image handling, enabling the introduction of specialised telemedicine systems. However, the important guiding principle is that in the event of a burn injury, professional medical advice is sought as soon as possible. Underestimating the seriousness of a burn or neglecting to provide appropriate treatment could have potentially fatal consequences.

**Hot spots**

- Raise awareness of the potential risks of burn injury to crew of all ranks
- Carry out ship specific training and familiarisation on hazard recognition and safe working practices
- The requirement to apply meaningful risk assessments, permits to work and tool box talks to operations which may expose crew to risk of burns should be incorporated into the vessel SMS
- Identify potential hazards and take steps to safely remove, isolate or control them
- Always wear proper work clothes and use PPE
- There should be a system in place for crew to openly report defects or unsafe working practices which may increase the risk of burn injury
- If in any doubt, stop the job and re-assess the safety of the operation
- Strictly observe manufacturer's instructions and SMS requirements for operation and maintenance of machinery and equipment
- Be vigilant and never make assumptions as to the safety of heated systems
- Where practicable, keep clear when opening up heated systems
- Raise awareness to the potential seriousness of burn injuries, no matter how apparently minor
- Be aware of proper first aid actions when treating burn casualties
- Seek professional medical advice using established tele-medical procedures