TIC Council

Petroleum and Petrochemicals Committee

Safety Code

Part 1: Field Inspection

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COUNCIL

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1. Introduction

Independent inspection carries a unique set of safety risks, even when compared with the mainstream petroleum and petrochemicals industry. In addition to the relatively well recognised hazards associated with the products involved, petroleum inspectors are often working alone at all times of day and night at terminals or on-board vessels which they are not familiar with.

Ensuring that risks are assessed and mitigated in these circumstances requires not only training and awareness on the part of the inspectors and their management but also cooperation and understanding from terminal and vessel personnel and also from the Client(s) - the clients who have contracted the inspection company to carry out the work. It should be noted that the Client, while having a commercial interest in the cargo which is the subject of the inspection, may not have any direct control or contractual arrangement with the terminal or the vessel involved.

TIC Council Member Companies have developed training programmes which provide their employees with the necessary knowledge and awareness to enable them to work under these conditions, the basic components of which are mandated as part of the TIC Council IFIA Certification Programme (ICP).

This document provides additional detail which can be included in training programmes and also presents the agreed industry view of the issues involved and the safety training which is necessary for inspectors and which can be audited by relevant authorities. Misunderstandings have arisen as the role does not "fit" with recognised petroleum industry contractor classifications.

Information, issues and data relating to safety have been shared between TIC Council Member Companies for many years and Clients also hold regular safety meetings to exchange information and address specific issues with inspection companies. As a further development in this cooperative process, a joint safety conference was organised by TIC Council in October 2018 involving TIC Council Member Companies, Clients and other interested parties. One of the outcomes was universal support for TIC Council to develop this Safety Code.

This document sets out the expectations which TIC Council Member Companies should meet with regard to safety conduct and also the responsibilities which other parties involved are expected to fulfil in order to ensure that inspection work continues to be carried out in a safe manner.

Key safety issues are each addressed with requirements and recommendations clearly stated. The document provides safety guidance for inspection companies, terminals, vessels and Clients and can be used as part of training for personnel in each of these groups.

The document has been reviewed and contributed to by oil companies and other involved parties and will be subject to regular review and updates to accommodate changes in technology, cargo characteristics and working practice.

It should be noted that TIC Council has published the IFIA Code of Practice for petroleum inspection work and also publishes and maintains technical bulletins, a number of which address safety issues. These are available for download at http://www.tic-council.org/publications.

2. Responsibilities

TIC Council Member Companies are responsible for ensuring that their personnel are trained, equipped and competent to perform the tasks to which they are assigned, not only in terms of technical requirements but also from a safety standpoint. Key safety topics which inspectors will be familiar with are presented below. All safety incidents are to be reported.

Inspectors are also trained to be aware of the safety of others working around them and will intervene where others are seen to be acting in an unsafe manner.

Refineries, terminals and other facilities are expected to provide safety training to all visitors and contract personnel, including inspection personnel. Training should cover all local safety requirements and procedures, including general site orientation, and typically runs to a half or one day classroom course, supplementing the detailed training provided by employers.

Inspectors are normally working alone and, unlike most contractors, are frequently required to move around the site, inspecting metering systems, cargo lines, gauging or taking samples from a number of tanks, pipelines, etc. While it is not seen as practical for inspectors to be accompanied at all times by site personnel, this is preferred. However, if inspectors cannot be accompanied, continuous contact with site personnel must be provided; normally via a radio linked with the control room. Regular checks should be organised (approximately every 15 minutes) so that site personnel are aware of the inspector's location at all times.

The risks when working on board a ship or barge (vessel) are seen to be greater than when working on shore as the inspector is unlikely to be familiar with the particular vessel concerned and the potential or need for entry to confined spaces or inadvertent conflicts with shipboard operations is greater. Inspectors should therefore be accompanied by a responsible member of the vessel's crew at all times. This crew member will be responsible for the opening and closing of any valves or hatches required as part of the inspection work.

Whether working in a terminal or on board a vessel, the terminal or vessel personnel are responsible for providing a safe working environment for the inspector, including safe access to the various locations where gauging, sampling or other inspection work is required, and, of course, safe access to and from the vessel itself.

An important element of ensuring that the work is carried out safely is the "key meeting" which should be arranged before any work begins. This will involve the inspector along with responsible terminal and vessel personnel and must cover not only the technical and operational requirements of the work but also relevant safety issues including product safety information (SDS), accompanying personnel, communications, access, equipment and any aspects where a risk assessment may be needed.

Where any of the key personnel change during the work (e.g. shift changes) sufficient time must be provided for hand-over of the information from the key meeting.

3. Key safety issues

3.1 Personal Protective Equipment (PPE)

Whilst this is the last barrier in the Hierarchy of Health and Safety controls for any activity, PPE is vitally important for the protection of the individual.

The wearing of PPE is **Mandatory** and shall include:

- Personal identification / Pass
- Goggles or safety spectacles
- Flame Resistant or Retardant Clothing incorporating high visibility panels (or high vis vest)
- Safety boots with toe protection
- Heavy duty impervious gloves
- Hard hat
- Ear defenders to be carried wherever there is risk of exposure to noise
- Personal H_2S monitors when working in Hydrocarbon environments

Where defined by risk assessment or client requirements additional PPE may include (but not be limited to);

- 4-Gas personal gas monitors for other substances (VOC's, low Oxygen etc.)
- Emergency life-saving apparatus (ELSA) or other breathing apparatus (BA) to allow safe evacuation.
- Cartridge-type filter masks where there is risk of relatively low-level exposure to airborne contaminants.
- Life jacket or personal floatation device where there is risk of a fall into water.
- High visibility cold/wet weather jacket.
- Lanyards or descenders when working at height
- "Man down" devices (or regular radio checks) for lone workers.

In addition, and subject to a Permit to Work (PTW), self-contained breathing apparatus (SCBA) may be required but this must only be worn by fully trained personnel and with all aspects of the PTW complied with.

Additional environmental considerations in some locations, such as extreme heat and extreme cold, need to be addressed by risk assessment.

3.2 Driving and Journey Planning

Road traffic regulations and local legislation shall be observed at all times as a minimum requirement.

Seatbelts must always be worn by drivers and both front and rear seat passengers. This is a legal requirement in many countries.

Use of mobile phones while driving is hazardous. Mobile/cell phones should therefore ideally be turned off when driving. However, minimum use of hands-free phones is acceptable when this is important for the operation. Conversations should be very short and arrangements made to call back when parked. Any other use of mobile phones while driving, such as texting or emailing is prohibited.

Regular breaks should be taken during all long journeys. These should be built into the journey plan and taken at least every 2 hours or more frequently if fatigued. Journey plans do not typically need to be documented but can be part of the dynamic risk assessment for the work assignment (see 3.3 below). The journey plan should consider: the route, potential traffic congestion, duration of travel, and planned breaks. If journeys become extended or fatigue sets in, then the individual (inspector) should stop and rest.

Checks should be performed at least annually to ensure drivers are still permitted to drive legally. If personal vehicles are used for business, then the personal insurance documents should be verified to ensure these cover business use.

Motor vehicles shall be well maintained. Road worthiness checks should be performed regularly and include tyres, oil, water, screen wash and lights. Servicing shall be carried out in accordance with manufacturers recommendations. Similar road worthiness checks also apply to bicycles where these are used inside terminals to ensure they are working correctly.

When transporting hazardous goods in a vehicle, local hazardous goods regulations must be followed. Vehicles should be fitted with suitable fixed containment for samples, e.g. sample “coffins”, DOT boxes or UN specified packaging. A sample manifest and copies of the Safety Data Sheets should be carried in the vehicle.

3.3 Risk Assessments and Hazard Awareness

There are two types of risk assessment:

3.3.1 Formal risk assessment (FRA)

These are led by the employer (TIC Council Member company), undertaken by people who are suitably qualified and competent and are used to explain to the personnel engaged in the work activity what the hazards are and how the associated risks should be controlled so that they are as low as reasonably practicable (ALARP).

Standing or generic risk assessments should be carried out for regular activities where hazards are present and should be documented and available to all staff. However, the hazards do not always remain constant and these assessments should be reviewed and updated regularly as required.

There will also be a need for FRAs to be performed for new or non-standard activities which are seen as potentially hazardous. Again, these should be formal and documented.

3.3.2 Dynamic risk assessment (DRA)

A DRA (sometimes referred to as Job Hazard Awareness, Job Safety Analysis or Last-Minute Risk Assessment) should be carried out by the inspector before starting (possibly using a check list) and then continuously reviewed throughout the work. Through application of the DRA process the inspector should be able to identify hazards, to control associated risks and to respond to any new hazards or changes in risk level as the work proceeds.

The aim is to maintain risks so they are As Low As Reasonably Practicable (ALARP) and to ensure the continued safety, not only of the inspector but also of other personnel who may be present.

Although a checklist may be used at the start of the work, DRA is a continuous process and will not be documented.

Using the principals of ALARP, chronic unease, hazard and situational awareness the inspector should apply DRA through:

Sense checks – a thought process that is structured and promotes an awareness of hazards and potential risks at each stage of the work. Various approaches are used, for example; 'think twice', 'take two', 'take five'.

Checklists – filled out as a pre-work document. Where checklists are used they must be completed as fully as possible. One limitation with a checklist that must be appreciated is that there may always be sources of risk that are not included.

To rationalise the DRA process a traffic light system may be used:

- If hazards are uncontrolled, the risk is unacceptable and cannot be reduced then this is a red-light situation. Work must NOT proceed and a Stop Work Authority (SWA) should be implemented.
- If hazards are present but appear to be controlled, then this is considered as an amber-light situation. Work can proceed with caution, reviewing the controls until the risk is seen as being As Low As Reasonably Practicable (ALARP).
- A green-light situation exists only when the work situation is considered safe. Work can proceed but hazard awareness and the DRA approach should continue; re-assessing the risk throughout.

3.4 Intervention and Stop Work Authority (SWA)

SWA Definition:

"The right and responsibility to stop any operation, which has imminent hazard to safety, health, equipment, and/or the environment."

Where a TIC Council Member Company employee believes that the task or the working conditions involve risk of harm to personnel, and/or the environment, he or she has full authority to refuse to start or to refuse to continue the task. This is commonly referred to as exercising "Stop Work Authority". In such circumstances the task shall not be undertaken until those responsible for controlling the conditions have addressed the issues raised and an assessment confirms that it is safe to proceed.

TIC Council Member Companies will provide training for their personnel, including but not limited to guidance on recognition of common hazards and the assessment of associated risks. These hazards include: confined space entry, static electricity, exposure to hazardous substances and gases such as hydrogen sulphide. Personnel will be trained to exercise appropriate good judgement in a sense check and to exercise a SWA when appropriate.

Clients will be advised when SWA has been used and is causing a delay in the operation.

In case the use of a SWA is disputed by other parties involved in the operation, the issue will be escalated to the Client for their intervention. TIC Council Members expect that their Clients will support inspectors in these situations.

3.5 Slips, Trips and Falls

3.5.1 General

Slips, trips and falls are the most common causes of workplace injury.

- Slips occur when there is too little traction or friction between the shoe and walking surface. For example, when walking on wet, oily or icy surfaces.
- Trips occur when a person's foot contacts an object or drops to a lower level unexpectedly, causing them to be thrown off-balance. A trip most often results in a person falling forward, while a slip most often results in the person falling backward.
- A fall occurs when a person is too far off-balance usually as a result of a slip or trip or through leaning or reaching too far.

There are many contributing factors to slips, trips, and falls including environmental conditions, insufficient or inadequate lighting, changes in elevation, and housekeeping issues in working and walking areas. These factors are outside the control of inspection personnel and it is the responsibility of the vessel or terminal to provide a clean, clear and well-lit working environment.

To reduce risks further, personnel should face the steps when using ladders or stairways and use three points of contact (i.e. both feet on rungs/steps and one hand on the railing).

TIC Council Member companies advise their employees to:

- be vigilant regarding warning signs, barriers, etc.
- always maintain three points of contact when using ladders and stairways;
- if necessary, walk more than once to and from the job location to keep at least one hand free when transferring equipment or samples on ladders or stairways;
- face the steps when descending stairs or ladders;
- ensure that adequate lighting is available on stairways and walkways;
- watch for changes in elevation caused by bumps, cracks and potholes in the walking surface;
- be vigilant for slippery surfaces, caused by oil spills or (winter) weather conditions;
- always wear a hard hat, to avoid head injuries walking under low objects, pipe-racks, etc.
- wear clean safety footwear with sufficient tread profile on the sole

Walkways in office environments shall be kept clear of electrical cords, boxes and other obstacles. Cables in the walkways shall be taped down.

3.5.2 Ships and barges (vessels)

As noted above, slips, trips and falls are the most common causes of workplace injury. The risk of such incidents is greater in the marine environment due to the configuration and motions of a vessel.

Generally, on a horizontal surface there is less risk of slips and falls. However, the floors or decks on a vessel are rarely horizontal. There is almost always some trim, list or camber involved in addition to the motion of the vessel itself. There are also frequently structural deformations created during and after construction, leading to uneven surfaces and, finally, the presence of water in working areas is more common than with land-based facilities. Where the amount of water is substantial hydroplaning can occur.

The key to prevention of slips and falls in the marine environment is that of traction. Appropriate footwear is vital and it should be noted that levels of traction that are appropriate for non-marine environments are not necessarily sufficient for the marine environment.

The risk of trips and falls on vessels is increased due to the many obstacles on deck, especially when vessels are in port. These include such things as mooring lines and other ship handling equipment in addition to permanently mounted obstacles such as cleats, eyebolts, etc. all of which are trip hazards.

Mooring ropes and lines must NEVER be stepped over and loading hoses should NEVER be walked under. Ducking under or climbing over deck piping and other obstacles should be avoided, using marked walkways where provided.

Inspectors and other personnel need to be made aware that while getting onboard a marine vessel can be a challenge in itself the deck and other areas on-board present a very different environment to land based facilities and one that requires care and conscious effort to navigate safely.

3.6 Lifting and carrying

More than a third of all workplace accidents reported are related to lifting and carrying loads. Hazards are increased when these activities are carried out repetitively and/or under dynamic environmental conditions which is often the case during cargo inspection work.

Government and regulatory agencies worldwide are imposing safety and environmental regulations that prohibit tank vessel operations from releasing hydrocarbons into the atmosphere. This has resulted in the restriction and, in some cases, the prohibition of traditional methods of obtaining cargo measurements and samples. Consequently, equipment is now being used that allows cargo measurements and samples to be taken with no vapour release (closed) or with very limited vapour release (restricted).

TIC Council Member companies have provided their inspectors with this equipment. However, it is bulky and for a typical measurement and sampling operation on a vessel the weight can frequently exceed 20 kilos (~45 lbs).The inspector will also need to carry the samples which will add another 10-20 kilos (~23-45 lbs) to the total load.

Eliminating unnecessary samples will help to reduce the weight, but with increased use of closed or restricted equipment, some operations will require more than one journey and/or inspector to be in attendance. This is particularly the case where operations need to be completed quickly, such as early departure procedures for vessels, where a single inspector does not have time to transport equipment and samples safely.

3.7 Vessel Access (On and Off Shore)

3.7.1 General

Minimising risks associated with vessel access, particularly offshore, is a key issue. Clients, charterers and vessel owners need to be involved and alerted when risks are noted.

TIC Council Member companies provide training in the proper use of ladders and gangways to embark/disembark vessels and barges. In addition, inspectors, who are assigned to perform activities offshore as a minimum, should be able to swim and have the physical fitness to climb pilot ladders.

Offshore transfers are inherently hazardous and should be avoided. Where possible, clients should consider delaying cargo inspection until vessels are at berth. Transfers should be avoided during the hours of darkness.

Vessel crew members should be available to assist at all times and in particular with transfer of equipment (sampling equipment, samples, etc.).

For offshore transfers FRAs (Formal Risk Assessments) will probably be available for all or part of the transfer process and all precautions identified by these should be implemented. However, the whole operation must be also subject to DRA (Dynamic Risk Assessment), ensuring particularly that the following factors are taken into account immediately before and throughout the transfer process:

- Wind Speed and Direction
- Sea state including swell height and direction
- Tide speed and direction
- Weather conditions; rain, snow, ice, fog, etc.

Risk assessment methodology must be applied throughout.

The ultimate decision to proceed with a transfer at sea remains with the inspector involved. If in the opinion of the inspector the transfer cannot be done in a safe manner, SWA should be exercised.

3.7.2 Gangways and ladders

Terminals and vessel owners are responsible for providing appropriate and well-maintained equipment for safe transfer on and off the vessel and/or launch.

3.7.3 Transfers by Launch

The party organising the transfer should ensure that safety requirements are met.

<u>The Launch</u>
The launch should be in seaworthy condition and fully operational, with emergency equipment (water, flares, torch/flashlight, life jackets, man overboard equipment) a competent crew, and a VHF radio to communicate with Vessel/Shore.

The launch crew, inspector and vessel crew must share a common language to ensure good communications.

The deck must be sufficiently clear so as to allow the inspectors to embark and disembark from an open area determined by risk assessment to have no obstructions or projections which could increase the risks of trips, snagging, collisions, etc.

The launch crew must assist during the transfer by communicating with the vessel throughout the process and physically helping the inspector during the transfer.

<u>Transferring between Launch and Vessel by ladder</u>
The transfer process must be agreed with all parties before starting. Shipping Industry Guidance on Pilot Transfer Arrangements must be followed, complying with IMO/SOLAS

regulations. This can be obtained from the International Chamber of Shipping at: http://www.ics-shipping.org/docs/default-source/resources/safety-security-and-operations/shipping-industry-guidance-on-pilot-transfer-arrangements.pdf

- For Vessel freeboard above 9 metres, a Pilot Ladder / Accommodation ladder combination MUST be used. (accommodation ladder at an angle not greater than 45 degrees).
- For Vessel Freeboard below 9 metres a Pilot Ladder MUST be used
- Under no circumstances should a transfer be attempted using the accommodation ladder only.

Equipment and personal baggage should be transported on or off the vessel by a heaving line. Items such as sampling equipment, bags or rucksacks must not be carried or worn during transfers.

Transferring between Launch and Vessel by personnel basket

Transfers by basket (Billy Pugh, Personnel Transfer Capsule) are high risk operations and should be undertaken only where transfer is essential and cannot be achieved by any other means.

Personnel baskets should be visually checked before use to ensure all parts are in working order. Tag lines must be used.

The crane and wire must be certified for personnel transfer. The operator manning the transfer must be certified.

3.7.4 Transfers by Helicopter

Before any employee may use a helicopter to travel to a vessel or other installation offshore (e.g. platform; sea island), they should have received HUET (Helicopter Underwater Escape Training) or T-HUET for tropical regions only.

3.7.5 Additional Personal Protective Equipment requirements for work over water

Personal floatation devices or lifejackets (preferably automatically inflating) with crotch straps must be provided together with high visibility clothing, whistles and water activated lights. For use offshore or in extreme conditions 275 N lifejackets should be used. For use inshore 150 N lifejackets may be used as an alternative.

Emergency personal response beacons

For work offshore or where there is a risk of being swept away by strong currents or tides a Personal Locator Beacon (PLB) should be carried.

Immersion survival suits

For work in cold water regions where there is a significant risk of falling into the water, an immersion survival suit must be worn. A lifejacket must also be worn, as stated above. This is normally defined by the terminal or location.

All safety equipment must be maintained/replaced in accordance with manufacturers' instructions.

3.8 Flammability

3.8.1 Explosive limits and Ignition sources

TIC Council Member Companies frequently conduct their activities in hazardous areas where ignitable concentrations of flammable gases or vapours are likely to occur under normal operating conditions.

Explosive limits specify the concentration range of a material in air which will burn or explode in the presence of an ignition source. There are two types of explosive limits: lower explosive limit (LEL) and upper explosive limit (UEL). The explosive limits are usually given as the percent by volume of the material in the air (i.e., 5%) in section 9 of a safety data sheet (SDS).

Lower explosive limit (LEL): the lowest concentration of gas or vapour which will burn or explode if ignited.

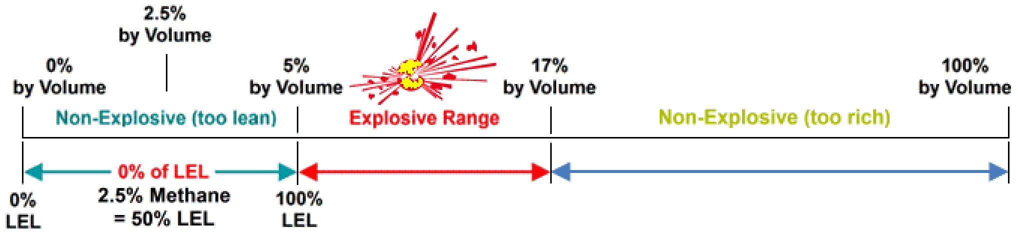
Upper explosive limit (UEL): the highest concentration of gas or vapour which will burn or explode if ignited.

From the LEL to the UEL, the mixture is explosive. Below the LEL, the mixture is too lean to burn. Above the UEL, the mixture is too rich to burn. However, concentrations above the UEL are still very dangerous because, if the concentration is lowered (for example, by introducing fresh air), it will enter the explosive range.

Regulatory Implications of Explosive Limits
Exposure limits are only required for materials that may end up in air to cause an explosion. Such materials may include gas, vapour and dusts (i.e., metal powder). Engineering control measures need to be taken to reduce the concentration of such materials in air to avoid potential explosion.

Flammability should be tested using an explosimeter.

Methane - LEL: 5% by volume in Air / UEL: 17% by volume in Air:



While noting the above, the assumption should be that a flammable atmosphere can be present at any time when working in a refinery, terminal or tank vessel. It is therefore vital that all ignition sources are avoided.

There are many possible ignition sources including sparks from electrical equipment, hot work, or metal to metal contact, (e.g. damaged safety shoes) vehicle exhausts and static electricity. Motor vehicles must be used in accordance with terminal regulations.

TIC Council Member Companies frequently use portable electrical and electronic devices to conduct their activities. Devices which are not certified will be used only in designated safe areas, such as control rooms. Outside these designated areas the devices will be switched off.

If such devices are to be used, a risk assessment will be performed in order to establish if the device can pass through hazardous areas at the terminal/refinery safely and to identify appropriate controls for managing the use of the device.

If the risks are still not acceptable or where local regulations forbid it, the device will not be taken into the hazardous area. This could result in operational delays.

Devices and equipment which are not intrinsically safe should not be used.

Other devices should be certified for the appropriate zone in which they will be used (Ex classified).

3.8.2 Static Electricity

Static electricity is the result of an imbalance in electrical charge between two objects. This imbalance can be created by friction between two materials including when liquids move through pumps, pipelines, enter vessels, or are poured or agitated.

Liquids such as paraffin, gasoline, toluene, xylene, diesel, kerosene and light crude oils have significant ability for charge accumulation and retention while flowing through pipelines into tanks. If the electrical charge is allowed to build-up it may increase to the point where sparks could result from introducing any ungrounded metal conductor (tape, bob, sample cage, thermometer probe, rope, etc.) into the tank vapour space.

If the vapour concentration is at a level which supports ignition (see above) an explosion will occur. Note again that vapour concentrations above the UEL are never assumed to indicate a safe condition as ingress of air due to external factors could quickly reduce the vapour concentration to the flammable range.

When static electricity is created, it will not dissipate spontaneously as the liquid products are typically poor conductors – hence the recommendation to allow relaxation time before gauging or sampling a recently filled tank. The addition of anti-static additives to products helps to prevent or safely dissipate the build-up of static electricity. However, it should be noted that these become less effective over time and must not be relied upon when considering gauging and sampling operations.

All equipment used by TIC Council Member Companies, such as measuring tapes and sampling containers, should be electrically grounded in order to provide a route for the static electricity to discharge to ground safely. Personnel are provided with anti-static and flame resistant or retardant work clothing.

TIC Council Member inspectors will not gauge or sample tanks during filling of the tanks or vessels in order to avoid possible static discharge. At least 30 minutes relaxation time should be allowed for the static to be dissipated before commencing any inspection work.

No gauging and sampling will be conducted during thunderstorms (or when these are forecast) or beneath powerlines.

3.9 Substances hazardous to health

3.9.1 General

The harmful effects of substances depend on the chemical properties and the level of exposure. The level of exposure depends on the concentration of the hazardous chemical and on the period of contact time.

A substance may have acute and chronic effects. Both acute and chronic conditions can result in permanent injury; acute effects occur immediately after a short exposure. Chronic effects involve repeated exposure and a delay between the first exposure and the appearance of adverse health effects which then worsen over time.

Exposure to petroleum products may cause contact dermatitis, headache or nausea. These effects can be acute and temporary. However, exposure can also lead to chronic effects and irreversible, permanent, injury to the nervous system.

The chemical properties of a substance varies with the composition and therefore it is vitally important to review the SDS (Safety Data Sheet) for a particular product before considering sampling or other activities which may involve contact with the product or associated vapour. The SDS will contain details of the composition and the associated hazardous properties.

There are four modes or routes through which a substance can enter the body, namely inhalation, skin or eye absorption, ingestion and injection. The SDS will explain the exposure mode(s) and the type of PPE to be worn when there is a risk of exposure to the specific substance concerned.

TIC Council Member clients must ensure that accurate SDSs are provided to inspection companies and personnel for products which are being inspected. SDSs shall be of recent date and meet mandatory legal requirements. Field staff should consult the SDS for the product they are inspecting to have knowledge of the dangers involved with the specific product and the action to be taken in case of an emergency/spill.

TIC Council Member companies assess the risk of exposure to toxic substances and, together with clients, terminals and vessels shall have procedures in place detailing the operational controls necessary to minimise hazardous exposure, using the following risk control hierarchy:

- Minimise emission, release and spread
- Consider routes of exposure
- Choose control measures proportionate to the risk
- Choose effective control options
- Personal protective equipment – the final control option
- Review the effectiveness of controls
- Provide information and training

Two highly toxic chemicals that are frequently encountered in the sampling of petroleum products are hydrogen sulphide and benzene. Hydrogen sulphide is the most common cause of acute health issues with benzene the most commonly encountered chemical with a risk of chronic health effects.

3.9.2 Hydrogen sulphide (H_2S)

Hydrogen sulphide is a gas which appears as a contaminant in crude petroleum and some petroleum fractions. Health effects that have been observed in humans following exposure to hydrogen sulphide include death and respiratory, ocular, neurological, cardiovascular, metabolic, and reproductive effects. Respiratory, neurological, and ocular effects are the most sensitive end-points in humans following inhalation exposures.

The US Occupational Safety and Health Administration (OSHA) publish the following table which summarises the health effects of H_2S exposure.

Concentration (ppm)	Symptoms/Effects
0.01-1.5	Odor threshold (when rotten egg smell is first noticeable to some). Odor becomes more offensive at 3-5 ppm. Above 30 ppm, odor described as sweet or sickeningly sweet.
2-5	Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep. Airway problems (bronchial constriction) in some asthma patients.
20	Possible fatigue, loss of appetite, headache, irritability, poor memory, dizziness.
50-100	Slight conjunctivitis ("gas eye") and respiratory tract irritation after 1 hour. May cause digestive upset and loss of appetite.
100	Coughing, eye irritation, loss of smell after 2-15 minutes (olfactory fatigue). Altered breathing, drowsiness after 15-30 minutes. Throat irritation after 1 hour. Gradual increase in severity of symptoms over several hours. Death may occur after 48 hours.
100-150	Loss of smell (olfactory fatigue or paralysis).
200-300	Marked conjunctivitis and respiratory tract irritation after 1 hour. Pulmonary edema may occur from prolonged exposure.
500-700	Staggering, collapse in 5 minutes. Serious damage to the eyes in 30 minutes. Death after 30-60 minutes.
700-1000	Rapid unconsciousness, "knockdown" or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.
1000-2000	Nearly instant death

Inspectors should not work in environmental concentrations greater than 5 ppm and should be equipped with an H_2S monitor set to alarm at concentrations of 5 ppm or greater (10ppm in some jurisdictions). Should the working environment have concentration above this threshold the Inspector should immediately leave the area until a risk assessment has been carried out and appropriate measures put in place to minimise the risk.

Self-contained Breathing Apparatus (SCBA) can be used when higher concentrations of H_2S are present. However, it must be noted that SCBA should not be used or be necessary for regular or routine activities and that, apart from emergency use, situations where SCBA may be needed should be subject to a formal risk assessment and the work carried out under permit to work arrangements.

TIC Council members will not expose their inspectors to levels at or above 500ppm. If the concentration exceeds 500 ppm then work should be stopped until the level has dropped.

It is the responsibility of the terminal or vessel concerned to ensure that H_2S levels are adequately monitored and remain within the limits specified.

3.9.3 Benzene (C_6H_6)

Benzene is highly toxic and can enter the body via inhalation and skin absorption. The exposure limits are extremely low therefore all work involving benzene exposure should be undertaken wearing suitable respiratory equipment and impervious clothing for protection from skin contact. For personnel subject to the risk of repeated exposures a suitable health monitoring regime should be instituted.

The health effects depend on benzene concentration and exposure time. Immediate effects of a single exposure to a high concentration (hundreds of ppm and more) can include headache, tiredness, nausea and dizziness. Unconsciousness can be caused by exposure at high concentrations (thousands of ppm). Long-term exposure to lower concentrations of benzene can result in bone marrow suppression leading to serious blood disorders such as anaemia and forms of leukaemia and other white-blood-cell cancers.

3.10 Confined Space Entry

A confined space is a place which has limited or restricted means of entry or exit; is large enough for a person to enter to perform tasks; and is not designed or configured for continuous occupancy. Serious injury can occur from hazardous substances or conditions within the space or nearby e.g. lack of oxygen.

Confined space entry should only take place under a Permit to Work (PTW) with identified controls in place. Closer collaboration with terminals and vessels is needed to ensure that this process is followed.

It is the responsibility of vessel(s) and terminal personnel to identify confined spaces and to establish procedures for safe entry. Pump rooms, deck tunnels, cargo tanks, cofferdams, double bottom tanks, shore tanks, floating roofs or any enclosed space may be subject to oxygen deficiency as well as the presence of hydrocarbon or other toxic gas.

Inspectors must consult the responsible vessel officer or terminal operator to determine whether entry into such confined spaces is permitted and shall be accompanied by a representative of the vessel and/or the terminal, as appropriate, at all times.

Suitable notices should be prominently displayed to inform personnel of the precautions to be taken when entering tanks or other confined spaces and of any restrictions placed upon the work permitted there.

Extra care should be taken when moving around inside tanks as surfaces may be slippery and lighting may be poor.

Entry into confined spaces shall only commence on the production of a valid permit issued by responsible terminal or vessel personnel. The entry permit should confirm that the atmosphere has been tested to be safe on all occasions immediately prior to entry. In addition to the entry permit the responsible person should ensure that:

- The appropriate atmosphere checks have been carried out and the PTW has been signed by the responsible person and the actual date and time of the check is recorded.
- Effective ventilation will be maintained continuously while personnel are in the enclosed space.

- Lifelines and harnesses are ready for immediate use. Where possible, pump room lifelines should be already rigged and an unobstructed direct lift provided.
- Approved breathing apparatus and resuscitation equipment are ready for use at the entry to the confined space.
- Appropriate PPE is worn.
- Where possible, a separate means of access is available for use as an alternative means of escape in an emergency.
- A member of the crew/terminal personnel is in constant attendance outside the confined space in the immediate vicinity of the entrance and in immediate contact with the responsible person in the control room.
- Where possible, the attendant outside the confined space should be in permanent visual contact with the personnel inside.

In the event of an emergency, under no circumstances should the attendant enter the confined space before help has arrived. The lines of communication for dealing with emergencies should be clearly established and understood by all concerned.

Pump rooms and deck tunnels, by virtue of their location, design and operation, constitute a particular hazard and therefore necessitate special precautions. No-one should enter a pump room or deck tunnel at any time without first obtaining the permission of a responsible officer.

It is the duty of the responsible vessel's officer in charge of cargo operations to ensure that there is adequate ventilation of the pump room or deck tunnel and that the atmosphere is suitable for entry. Approved breathing apparatus and resuscitation apparatus should be available in an accessible location. At no time should a cargo inspector enter a pump room or deck tunnel unless accompanied by a responsible member of the vessel's crew.

To further assist, please find a simple checklist as Annex A

3.11 Working at Height / Road tankers and Rail tankers

Working at height constitutes work in any place where, if no precautions are taken, a person could fall a distance liable to cause personal injury.

Fixed barriers or edge protection should be installed at locations where routine inspection activities are carried out.

Non-routine activities of any kind, carried out on top of rail tank cars, road tankers, tank containers and ISO tanks and other rolling stock, are subject to potential falls from height. Risk assessments shall be made to avoid or reduce risk for persons, carrying out these activities, and the safest practicable solution shall be devised, based on the below hierarchy of access methods:

- Avoidance of tank top activity
  Usually require specific equipment, as weigh bridges and inline samplers

- Gantry rails fully surrounding the work area with access by stairs
  Used at busy locations, but requiring suitability to object type

- Mobile gantry with integral stairs and pulpit providing fully surrounding railing

Used at sites where there may be a large number of loading/discharge points, none frequently used

- Object with built-in access ladder, tank top walkway with fall protection fencing and fall restraint system, with self-retracting lifeline.
  Used at remote sites where no gantry is available, but overhead anchor point is available

- Object with built-in access ladder, with fall arrestor, shock absorbing lanyard and tested anchor point.
  Used at remote sites, like rail yards and parking places. Harnesses attached to untested anchor points are not to be used. This step is to be taken after all others have been exhausted.

If none of above conditions are met, the TIC Council inspection company will advise its clients that the activities cannot be carried out in a safe manner and that Stop Work Authority is being used.

Working in situations where rolling stock is moving is not recommended and can result in the use of Stop Work Authority.

3.12 Human factors

For the Inspector in the field it is of vital importance that they have the necessary physical and mental ability to perform their work activities, and the cognitive skills to organize, and apply information in the making of decisions and solving of problems. Physical and/or mental ability can be impaired, for example, by illness, fitness levels, hydration and nutrition, drugs and alcohol, the use of some prescription medicines, and fatigue.

Work related fatigue can be caused by long work hours; prolonged periods of physical or mental activity; insufficient break time between shifts; inadequate rest; excessive stress; or a combination of these factors. Fatigue can cause a multiplicity of effects on an individual such as: physical weakness, slowed reflexes and responses, and impaired decision-making and judgement. This affects the individual's ability to perceive risk and their behaviour.

In view of the above it will be necessary for member companies to have processes in place to verify the fitness of Inspectors; to manage hours of work, rest periods and meal breaks, and welfare facilities; have policies to deal with Drug and Alcohol abuse and to manage prescription medicines; to ensure a suitable working environment and support the use of Stop Work Authority; provide work equipment and personal protective equipment that is as ergonomically designed as possible; and the ability to detect any adverse indication demonstrated by the Inspector and act on it as necessary.

As stress at work is a contributory factor to fatigue it will be necessary for TIC Council Member Companies to have a positive supportive Health and Safety Culture embracing the principles embodied in this Safety Code which will help to reduce the stress levels experienced by the Inspectors.

4. Conclusions

This Code has been prepared by TIC Council Member Companies with support from several client companies and following cooperation over many years aimed at reducing the risks involved in independent inspection activities.

It is an expectation that TIC Council Member Companies and their clients together with terminal and vessel owners and operators will follow the spirit of this code.

The Code is a living document and will be reviewed on a regular basis as safety techniques, technology and the requirements of the work continue to develop.

Feedback from users is welcome and should be addressed to:

secretariat@tic-council.org

ANNEX A - CONFINED SPACE ENTRY CHECKLIST

The below checklist can be used to compliment a Permit to Work system to ensure all aspects are verified.

Task	Yes	No	N/A	Comments
Has a Permit To Work (PTW) been issued by the terminal or vessel				
Have atmosphere checks been performed on the space to enter?				Result:
Is there enough lighting available within the confined space?				
Is ventilation maintained continuously whilst personnel are in the confined space?				How will this be maintained?
Are harnesses available and worn at all times with lifelines available?				
Are lifelines already rigged and an unobstructed direct lift provided?				
Is appropriate PPE being worn? (Coveralls, shoes, hard hat, gloves, safety glasses, gas monitor)				
Is approved breathing apparatus ready for use at the entrance to the confined space?				
Is resuscitation equipment ready for use at the entrance to the confined space?				
Is there an alternative means of access and escape in an emergency?				
Is a member of the crew/terminal personnel in constant attendance outside the confined space and in constant communication with the personnel inside?				
Are they in immediate contact with the responsible person in the control room?				
Is emergency squad trained in extraction present?				
Have all pumps and lines been isolated?				

Inspector Terminal Vessel