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Industrial Laser Incident-Accident Report Forms

Abstract: This paper and presentation discuss the importance of incident/accident report forms in the context of a written laser safety program. It emphasizes the need, as identified by ANSI Z136.1 "*Safe Use of Lasers*", for addressing actual or suspected laser radiation over-exposures and conducting incident investigations.

It is noted that while other agencies or healthcare providers may have the requisite report forms, these may not always be sufficient for effective root cause determination. Where a diligent Laser Safety Officer (LSO) or Environmental Health and Safety (EH&S) committee would conduct simulated laser incidents, an element often overlooked is including the creation of an injury report form in response to the hypothetical event.

In cases where such forms are not readily available, this paper provides two suggested report forms (ocular and body), along with a review of an actual suspected injury to demonstrate their utility. Complementary to this, is a suggested incident investigation report form for those facilities that do not have an established document for such. This comprehensive approach ensures a robust written laser safety program, facilitating effective incident response and prevention in the workplace.

By following the guidance provided, users can ensure they are achieving Light Applied, Safely, Efficiently, and Reliably (a play on the L.A.S.E.R. acronym attributed by this author to Dr. David Sliney, Ph.D.).

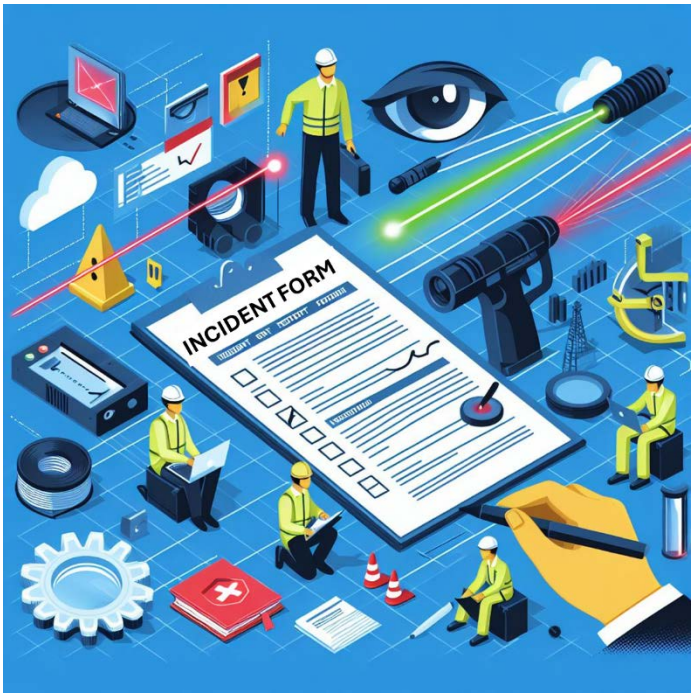

Figure 1: MS Bing AI Image of Incident Report Form, 16-May-2024

Note: This paper, in and of itself, does not constitute comprehensive guidance regarding laser incident report forms. It is intended to identify the need for an application specific risk assessment, directed towards regulatory compliance, as part of an organization's OHS and continuous operational improvement plans.

Preface: A laser safety program at work is a plan that ensures employee health and safety. It shows an organization's effort to identify potential laser hazards, assess their risk, and take protective measures. This is done to meet their 'general duty of care' in line with regulations and standards. Essential (but not exhaustive) parts of a responsible laser safety program include:

1. Risk Assessment: A structured approach (using ANSI B11.0 or ISO 12100) to identify and assess actual and possible beam and non-beam dangers from using lasers at work.

2. Engineering Controls: Implement technical or engineering controls to minimize exposure to laser (beam and non-beam) hazards.

3. Administrative Controls: Establish administrative controls such as standard operating procedures (SOPs), safety protocols, and training programs to ensure that employees are aware of the laser and associated hazards and corresponding proper safe work practices.

4. Personal Protective Equipment (PPE): As required, provide appropriate PPE, including laser protective eyewear, gloves, and clothing, to employees working with or near lasers. Ensure that the PPE is properly selected (rated), fitted, and maintained.

5. Training and Education: Conduct regular training sessions to educate employees about laser safety principles, safe work practices, emergency procedures, and the proper use of PPE. Training should be tailored to the specific roles and responsibilities of each person.

6. Medical Surveillance: Active medical surveillance is no longer a requirement per ANSI Z136.1-2022. An appropriate medical response plan to actual or suspected laser beam over-exposure is critical and must be in place.

7. Emergency Preparedness: Develop and implement emergency procedures for responding to laser-related incidents, including accidental exposures, fires, or other emergencies. Ensure that employees are trained in emergency response protocols and evacuation procedures.

8. Compliance Monitoring: Monitor compliance with safety regulations, consensus standards, and internal policies, conducting regular audits, inspections, and reviews.

9. Documentation and Recordkeeping: Maintain up-to-date records of laser equipment (it's risk assessment and protective measures), safety procedures, training activities, incident reports, and medical data.

10. Continuous Improvement: Regularly evaluate and improve the laser safety program, incorporating new technologies, best practices, and regulatory updates through feedback mechanisms.

Incorporating these key aspects into a health and safety plan can help companies reduce laser-related risks and ensure a safe workspace for all staff and affected personnel.

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Introduction

This whitepaper addresses one essential element within a responsible written laser safety program: that of laser incident-accident report forms and their utility. As will be shown, ANSI Z136.1:2022 identifies the principled need for such, though guidance on its scope, structure and applicability is lacking. This is not necessarily a product of neglect but due to its contributing members and the Z136 Accredited Standards Committee not wanting to prescribe such when serving a wide-ranging field of sectors and applications where lasers are used, thereby constraining some and underserving others. Also, while not directly stated in Z136.1, it is left to the LSO to determine, adapt, and implement those incident/accident report forms representative of or commonly used in their sector/field of application.

This whitepaper is intended for the industrial or manufacturing sector which employs lasers in their operations, for incident-accident reporting, documentation, and corrective action(s). It can serve as a reference framework for other sectors such as education, medical, research and development, outdoor, and defense industries.

By synthesizing current knowledge, practices, and templates, this document proposes a format and procedure tailored to meet the needs of the industrial/manufacturing sector in developing their laser safety program. The aim is to furnish a comprehensive reference document, complete with informative content and reasoning, to support the establishment of a proficient occupational safety and health initiative. This resource is designed to enable organizations to conduct self-assessment and continually enhance their operations in the event of adverse occurrences.

Baseline resources:

References and resources utilized for this whitepaper include:

- ANSI Z136.1:2022 "*Safe Use of Lasers*" for the principles and objectives.
- ANSI B11.0:2023 "*Safety of Machinery*" for the scope of hazards and potential injuries.
- Canadian Centre for Occupational Health and Safety, for protocols and guidance.
- CAN/CSA Z1005-21 "*Workplace Incident Investigation*"
- U.S. Occupational Safety and Health Administration (OSHA), for protocols and guidance.
- U.S. OSHA "*Small Business Safety and Health Handbook*" for general guidance on an organization's occupational health and safety program.

As part of emergency preparedness, the incident-accident response plan and associated documents are critical for a successful written laser safety program. Incident documentation is required for reporting to the responsible agency having authority for workplace occupational health and safety, it is also essential for root cause analysis to effect corrective measures and improvements.

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Context

That message comes through which changes your workday "*...we've had an accident...*". As the person responsible for workplace safety with lasers, we're to be trained to overcome our human reflex in thinking '*... someone got stupid...*". Rather, it is a question of "*...what got missed in our risk assessment and protective measures plan...*". Root cause analysis of an unplanned workplace event is to identify and correct the gap that occurred in the risk assessment not only for that subject process/equipment but for how an organization evaluates its hazards and enacts safety for affected personnel.

Reframing our appreciation of the accident pyramid:

Let's briefly revisit a comparison between the Heinrich pyramid and the concept of Significant Injury or Fatality (SIF) potential.

Heinrich Pyramid:

- **Origin**: Introduced by William Heinrich in 1931, the Heinrich pyramid is a safety management model.
- **Focus**: It suggests that by addressing near misses and first aid incidents (at the bottom of the pyramid), we can reduce fatalities and lost time injuries (at the top).
- **Criticism**:
    - **Blaming Individuals**: The pyramid places excessive blame on workers, ignoring systemic factors.
    - **Underreporting**: Fear of blame can lead to incidents going unreported.
- **Flaws**: The theory doesn't fully explain the decrease in injuries and illnesses alongside an increase in fatalities over time.[1]

SIF Potential:

- **Definition**: SIF (Serious Injury and Fatality) potential refers to situations that could result in serious harm or death.
- **Modern Approach**: Safety professionals now recognize that Heinrich's ratio is flawed. Instead of solely focusing on near misses, they consider SIF potential.
- **Root Causes**: Rather than blaming individuals, the focus shifts to understanding root causes, including system failures.
- **Question**: Managers ask, "What can we do to influence employees' choices for better safety?".[2]

[1] https://www.pro-sapien.com/blog/sif-potential-heinrich-pyramid/
[2] https://www.naem.org/connect/blog/read/green-tie/2024/02/21/the-key-to-sif-prevention-evaluating-the-effectiveness-of-controls

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While the Heinrich pyramid has limitations, the concept of SIF potential offers a more nuanced approach to preventing serious incidents. It emphasizes systemic factors and encourages a proactive safety culture.

Given that the equipment design, build, operation, maintenance and service involve humans making decisions, it stands to reason that improving workplace safety comes down to understanding and minimizing our fallibilities. Operations research and management science continue to expand upon and detail the elements that are contributing factors to workplace incidents. The study "*The Role of Senior Leadership*" by Joy Wade in 2012 summarized that 96% of all workplace incidents involve human choice:

- The choice of decisions made during equipment design, installation, training and commissioning,
- The choice of the employee to not follow procedures,
- The choice of the supervisor to walk by a sub-standard condition because one doesn't have the time to deal with it,
- The choice of the unit manger to talk about safety as a high priority but behave in a way that demonstrates that it isn't.

Incident investigation is NOT about assigning blame with repercussions, but root cause analysis to correct a flaw in how an organization went about its risk assessment and protective measures implementation. This paper brings attention to the guidance provided by internationally recognized occupational health and safety agencies on this matter through example report forms dealing with an industrial laser system in manufacturing.

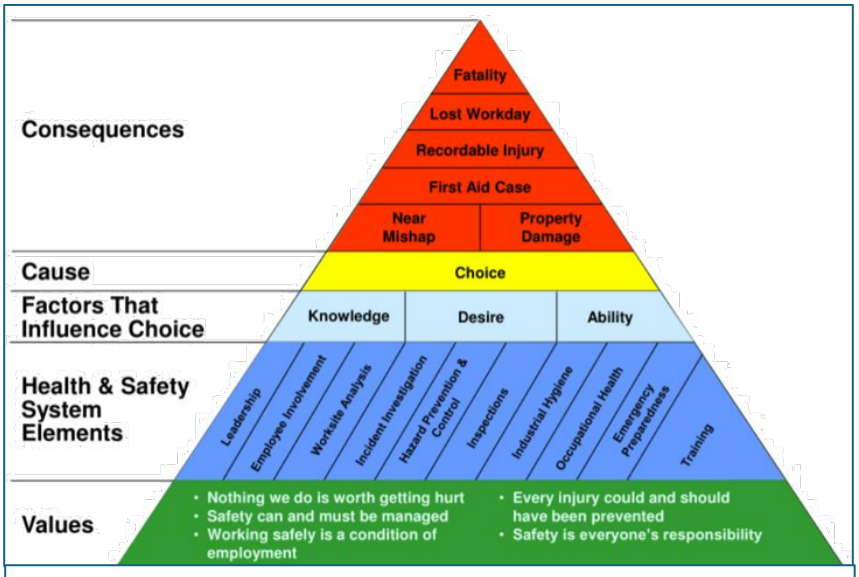

Figure 2: Human Factors Influencing Workplace Safety, Joy Wade, 2012. "The Role of Senior Leadership".

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Workplace Laser Incident Report Forms

Of 'accidents', 'incidents', and 'hazardous occurrences': In the past, and especially for society, the term 'accident' is often used when referring to an unplanned, unwanted event, suggesting that it was random and could not have been prevented. Since nearly all workplace fatalities, injuries, illnesses and 'near misses' are preventable, this paper will utilize the more current and correct term of 'incident' when referring to an actual or potential hazardous event.

For the industrial/manufacturing sector, the premise of ensuring a safe work environment for personnel with equipment, is that a risk assessment (e.g., per ANSI B11.0 or ISO 12100) has been conducted (by the equipment supplier, systems integrator, or end customer – owner of the equipment) to ensure that all hazards have been identified, with commensurate protective measures applied and deployed. This process demonstrates due diligence in fulfillment of the applicable Occupational Safety and Health requirements for the 'general duty of care' by the employer for user safety as well as regulatory equipment build performance features.

The report forms are to be utilized together with the equipment/process risk assessment documentation and the written laser safety program for review when conducting an incident investigation.

ANSI Z136.1:2022 the American National Standards Institute document "*Safe Use of Lasers*" identifies the need for a Written Laser Safety Program (WLSP) when employees are working within the Nominal Hazard Zone (NHZ) of or exposed to Class 3B or Class 4 lasers, during normal their operation. The WLSP is also required for those systems (Class 1 to Class 3R) with embedded Class 3B or Class 4 lasers, where access to the inherent laser hazard is possible during maintenance or service. The scope of the WLSP includes:

" 1.3.2 Laser Safety Program Provisions. *The laser safety program established by the employer shall include the following provisions:*

...

c) *incident investigation, including reporting of alleged accidents to or by the LSO, and preparation of action plans for the prevention of future accidents following a known or suspected incident,*

..." Highlight added for emphasis.

Guidance regarding essential elements or considerations for the incident investigation are not specifically identified or referenced in Z136.1, though it is the LSO's responsibility to develop a plan addressing such, as provided in the normative Appendix A of the standard:

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"***A1.2 LSO Specific Duties and Responsibilities.***

a) ***Accidents.*** *The LSO should develop a plan to respond to notifications of incidents of actual or suspected exposure to potentially harmful laser radiation. The plan should include the provision for medical assistance for the potentially exposed individual, or investigation of the incident, and documentation for reporting the results of the investigation.*"

It is often presumed in the manufacturing sector of developed countries that when an injured worker is treated at a medical facility, there is an appropriate record available upon request, should the LSO or designate conduct an incident investigation. Just as with the initial risk assessment, if an element is not verified, it is erroneous to make a presumption regarding matters concerning workplace safety.

Benchmarking for success:

There are numerous styles of incident report forms across various sectors and agencies addressing workplace safety. Many jurisdictions which have regulations requiring serious injury or fatality reporting and investigation have well structured forms for information gathering and submission. A 'distilled' or simplified version of such can provide means for an organization to establish internal reporting and documentation for their continuous improvement efforts (encompassing those incidents which do not require reporting), which ensures alignment and familiarity with criteria of the jurisdiction having authority when addressing reportable incidents.

A successful manufacturing operation will have minimal 'unplanned downtime' events, which includes mitigating potential hazardous events. Those operations which start with risk assessment when implementing processes and equipment are markedly ahead towards that objective and can demonstrate due diligence of their general duty of care for affected personnel. Should a hazardous event occur, there is an established structure for re-assessing the risks associated with that equipment or process operation in response to and for the investigation of the incident to identify root cause of the protective measure failure and to implement the appropriate control measures for safety, productivity and quality.

If no risk assessment (for Class 3R, Class 3B, or Class 4 lasers and potential beam exposure conditions) is available for that equipment or process, then that also is arguably another failure point in how an organization brought a hazard into their place of work. Attempting to 'slap on' a control measure specific to that hazardous event, does not address the root cause of the occurrence – the absence of a structured approach for workplace safety with hazards.

Many report forms do provide guidance for gathering information about the hazardous event, less so for details of the injury sustained, which can be of great assistance for root cause determination

when conducting an incident investigation. This was demonstrated with a recent situation at a laser materials processing lab.

Synopsis of example situation

An abbreviated version of an actual laser incident will illustrate the apparent gap in guidance for LSOs and essential personnel to adequately document and investigate.

Example situation: Consider a process development lab for a systems integrator in the manufacturing sector. It utilizes both Far InfraRed (CO_2) and Near InfraRed (Yb) industrial lasers for materials processing solutions work. The initial risk assessment determined the NHZ for perimeter controls of the lab (which housed the Class 4 laser radiation beam paths and fields). Appropriate Standard Operating Procedures (SOPs) with the requisite Personal Protective Equipment (PPE) were developed for the lab operator. Non-Beam Hazards (NBHs) were also identified and evaluated in the risk assessment, with requisite measures including fume extraction and filtration employed.

While monitoring a process solution for a marking application of a highly reflective material using a q-switched Yb:fiber laser, the operator experienced a pain in the cornea, terminating the procedure and sought medical attention at the local hospital. Condition was assessed and treatment provided with full recovery anticipated (and experienced).

Initial incident investigation: The initial internal review of the incident concluded that the established procedures were being followed and the PPE readily met the requirements of ANSI Z136.1 for laser protective eyewear. It was questioned whether the reflected LTIR (laser-target interaction radiation) was capable of causing the injury to the cornea. As a root cause was not yet determined, the facility LSO and management elected to seek assistance outside of their operations.

In gathering information for a more comprehensive investigation, it became evident that no medical examination record was available from the hospital outside of very cursory notes regarding the injury. This was in keeping with the level of documentation for the severity of the injury treated at the hospital, yet insufficient for a workplace technical investigation effort.

Incident questions:
What was the degree of damage to the cornea?

- Was it abrasive or thermal damage to the cornea?

Where was the injury located on the cornea?

- Was it associated in-line with visual acuity (on-axis)?

How large and deep was the corneal damage?

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Information to the above questions would facilitate incident root cause determination with appropriate corrective measures identified and resolved per the updated equipment/system risk assessment.

Laser incident investigation and report form guidance

When reviewing the information and guidance provided by government occupational health and safety agencies regarding incident reporting and investigation, it is well structured within the lifecycle confines of the hazardous event itself. Where manufacturing equipment incorporate feedback loops on safety circuits and system lifecycle considerations during the risk assessment process at the start of a build effort, a hazardous event during equipment operation (or its maintenance or service) must revisit that initial risk assessment as part of the root cause evaluation. Once determined, the risk assessment is reapplied to ensure that the control measure(s) are sufficient and do not introduce a new hazard.

The degree of reporting and investigation is to be commensurate with the hazardous event and its risk level. Establishing those appropriate forms and investigation criteria in advance is not only of assistance when a hazardous event occurs, but also contributes to the initial risk assessment process.

Depending on a facility's OHS policy and jurisdictional requirements, categories of incident report forms may include:

- Positive observations
- Unsafe acts (including harassment, threats, and violence)
- Near misses
- Minor injuries
- Lost time incident
- Fatalities

Likewise, the types of investigation reports may include:

- Preliminary investigation report
- Interim corrective action report
- Full investigation report
- Full corrective action report

With regards to the subject incident as an example, a key question that arose is how to document an ocular injury when it come to laser safety in the workplace. From there, other associated report

forms were sought that were available from government agencies for occupational health and safety, rather than attempting to derive anew. This progressed into bracketing such forms between initial/summary and detailed as available in the provinces and territories, seeking coordination by the guidance provided by the Canadian Centre for Occupational Health and Safety.

Documentation of acute and chronic laser injuries:

Throughout the reporting process, stakeholders may have an aversion to 'doing the paperwork' however critical and essential it may be to effect health care benefits through to root cause analysis and corrective measures implementation. It is a challenge to accumulate key information about an incident without devolving into an excessive form and questionnaire, depending on the organization and sector, gathering information can be an iterative process using a generic and simplified incident report form, to more detailed report forms respective of the type of incident.

Basic incident report form: To provide the basis for rapid intake of critical information for a variety of workplace incidents, a short form (~ 3 pages) is suggested, consisting of:

- Incident situation: reported by, contact, date and time of occurrence, location of occurrence, incident type.
- The hazardous event description: What happened and initial assessment of contributing factors.
- Effects of the hazardous event: Results of the hazardous event in harm and/or damage.
- Corrective measures to be taken: What actions were taken to immediately address the hazard(s) related to the incident.
- The affected person: Relationship to the organization, name and contact information.
- Witness details: Name(s) and contact information.
- First aid: Provision, time, attendant, contact information, details of first aid provided.
- Post incident: What happened next (hospital, home, return to work), notification of responsible person/committee.

Worker injury report form:

An established worker injury report form facilitates the reporting, documentation, and investigation process for the employee and employer. Drawing from the agency guidance noted, the following general format is suggested, with an example template provided. This is the first person (injured party) report form which may be in various styles depending upon whether it needed updating as the worker is treated and recovering from the injuries, or part of formal filing to the workplace health and safety agency having jurisdiction requiring such. This form may be in addition to or an expansion of the basic incident report form, including such information as:

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- Mapping of what portion of the body was injured.
- Medical treatment tracking.
- Past injuries reference.
- Return to work plan and tracking.
- Employment information.

Medical injury assessment report form:

As part of incident response planning with laser equipment, determining what facilities have the staff and means to treat a potential laser injury (e.g., ability to provide a vitrectomy for a NIR laser retinal injury if necessary) is crucial. When doing so, other elements to review should include:

- Types of lasers employed and potential injuries per the risk assessment of the equipment
- Recommendations by the medical professional on patient stabilization, etc., for a given injury (e.g., retinal injury: Patient lying face down? Special instructions for first responders?)
- Supporting documentation for laser injury treatment protocols.[3,4]. *Note: Provision of such information is for reference purposes only and does not supersede the training, practices, and judgement of the attending medical professional.*
- Inquire regarding injury documentation, suggested format provided. Depending on hospital policy, this may be supplied in their own format or example completed by them, or to be completed by the responsible person following up with the medical professional.

Workplace injury reporting requirements in Canada:

External to any organization's continuous improvement efforts, there is the need for reporting workplace injuries to the respective Jurisdiction Having Authority (JHA). Note that each may have their own definitions of what is a 'recordable' and 'reportable' workplace injury, illness, or incident definition.

In general, the employer will need to report an injury or illness to the workers' compensation board for their jurisdiction when:

- a worker experiences a work-related injury or illness that requires medical attention,
- the injury leads to one or more missed work shifts, or
- the worker requires modified duties.

[3] "*Prevention and Medical Management of Laser Injuries (FM 8-50)*", Approved for public release. Field Manual 8-50, Headquarters - Department of the Army, Washington, DC, 8 August 1990.
[4] "*United States Air Force School of Aerospace Medicine Laser Injury Guidebook*", Approved for public release. AFRL-SA-WP-SR-2012-0005, Case #: 88ABW-2012-2704, 8 May 2012, Air Force Research Laboratory, Wright-Patterson AFB, OH 45433-7913

There are additional reporting requirements for serious incidents, injuries, and fatalities across Canada (Federal, Provincial, and Territory jurisdictions). These events must be reported to the government department responsible for health and safety. The regulations will include requirements for investigations and their timely responses. [5]

Incident investigation process and form:

To reframe the perspective and approach of an incident investigation and how it is conducted, the foundation for this would be initial risk assessment of the laser equipment or process itself. The investigation can be treated like a troubleshooting effort on 'what' was missed, determining the appropriate corrective measure (in accordance with the hierarchy of controls), updating the risk assessment and ensuring that the additional or new control measure achieves the desired outcome without introducing a new hazard or increasing the risk level of any hazard associated with the subject laser equipment or process.

Risk assessment essentials:

For those unfamiliar with the risk assessment process, fear not: it is NOT a highly abstract numerical probability effort. Rather, it is a structured approach to first identifying those hazards present with equipment or process, determining their potential for harm, then their likelihood to cause injury. Two internationally recognized consensus standards addressing this subject are: ANSI B11.0 "*Safety of Machinery*" and ISO 12100 "*Safety of machinery — General principles for design — Risk assessment and risk reduction*". The principles and guidance of these standards are applied beyond equipment to processes and hand-held devices. If one wishes to delve into this, their common foundational document ISO/IEC Guide 51 "*Safety aspects — Guidelines for their inclusion in standards*" is available in the public domain to download and review.[6]

Dominant laser beam hazard(s) identified in a risk assessment:

[5] CCOHS: Health and Safety Legislation in Canada - Injury Reporting
https://www.ccohs.ca/oshanswers/legisl/legislation/injury_reporting.html
[6] ISO - Publicly available resources
https://www.iso.org/resources/publicly-available-resources.html?t=Ruvyk3OTE1FejG9wJie0LojrUDDf3weEqbMekT5NvH7ARf5jR7ng2dLlMyUmadiO&view=documents#section-isodocuments-top

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If there has been an initial risk assessment when designing/acquiring the laser equipment, it will have identified all hazards associated with its operation, maintenance, and service. Dominant bio-effects associated with each region of the optical radiation spectrum are illustrated in Figure 3.

	Ultraviolet (Invisible)			Visible	Infrared (Invisible)		
EM Region	UV-C (180 – 280 nm)	UV-B (280 – 320 nm)	UV-A (320 - 400 nm)	VIS (400 – 700 nm)	IR-A (700-1,400 nm)	IR-B (1,400-3,000 nm)	IR-C (3,000 nm – 1 mm)
Eye Hazards	Photokeratitis,		Photochemical cataract	Photochemical and thermal injuries	Retinal burn, IR cataract	Corneal burn, aqueous flare, possible cataract	Corneal burn only
Skin Hazards	Erythema, Accelerated skin aging, Skin cancer		Pigment darkening, Photosensitive reactions, Skin burn		Skin burn	Skin burn	Skin burn

Figure 3: Dominant Bio-Effects of Optical/Laser Radiation

Additional information regarding beam and non-beam hazards associated with laser equipment can be found in ANSI B11.0 (incl. Appendix D) and ANSI Z136.1 (incl. Sections 3 and 7).

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The root cause analysis with the initial risk assessment would include a review of the actual, suspected or potential injury itself and the control measure for such, with a determination if the control measure was sufficient (e.g., being active, robust, and reliable). If sufficient, then an examination of what other hazard(s) could have caused similar injury and whether these were accounted for with the control measures assigned.

Per figure 4, then, with an actual or potential hazardous event, the risk associated with the hazard was not tolerable requiring an appropriate risk reduction measure to be applied.

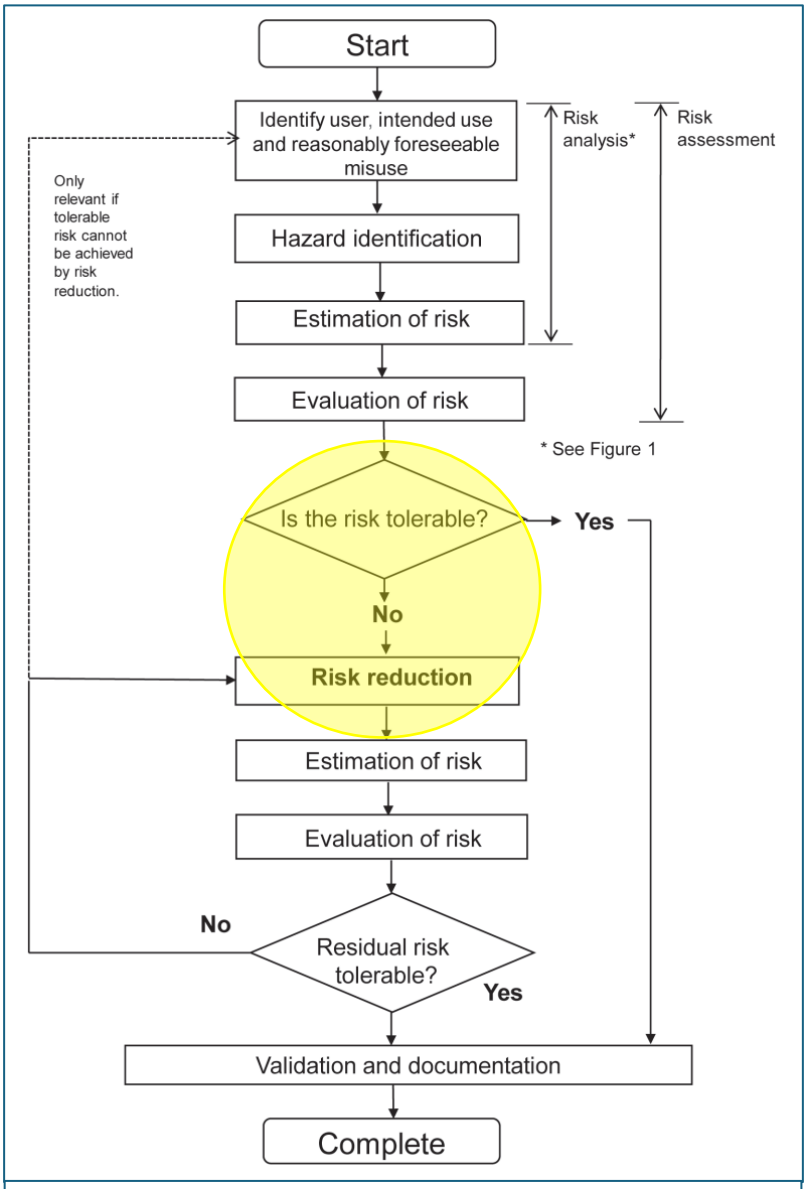

Figure 4: Essential Risk Assessment Process,
Ref. ISO/IEC Guide 51 "Safety aspects — Guidelines for their inclusion in standards"

If there was no initial risk assessment for the equipment, more homework is required during the root cause analysis, akin to that of risk assessment itself. Without a structured approach in the evaluation of a hazard and the performance level of the control measure, affected personnel will potentially be at risk to injury in the future, with the owner/operator of the equipment/process considered as being negligent in their responsibility and execution of their general duty of care.

<u>The incident investigation process</u>:

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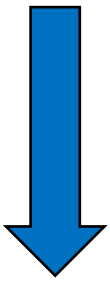
Federal or 'national' level guidance addressing the incident investigation process are provided by CCOHS[7] and OSHA[8]. A synopsis of the incident investigation process encompasses:[9]

Prepare:

- Who conducts and participates in investigation
- What incidents to investigate
- What information to collect
- Prepare investigation kit
- Create investigation and interview forms
- Document investigation procedures
- Select and train investigators

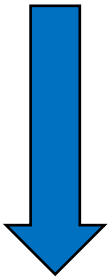


Incident:

- Actual or potential hazardous event occurs

Enact:

- Arrange for first aid or medical treatment of injured person(s)
- Secure the scene
- Identify and gather witnesses
- Retrieve investigation kit
- Interview injured worker and witnesses
- Document scene with photos or videos
- Collect information



Analyze:

- Review documentation
- Identify causal factors (root causes) using the "Why" method
- Determine corrective actions
- Prepare report
- Communicate report

Correct:

- Implement and track completion of corrective actions
- Share information with others
- Critique process for continuous improvement

[7] CCOHS: Incident Investigation, https://www.ccohs.ca/oshanswers/hsprograms/investig.html
[8] Microsoft Word - IncInvGuide4Empl_Dec2015.docx (osha.gov), https://www.osha.gov/sites/default/files/IncInvGuide4Empl_Dec2015.pdf
[9] how-to-conduct-an-incident-investigation.pdf (nsccdn.azureedge.net) https://nsccdn.azureedge.net/nsc.org/media/site-media/docs/workplace/how-to-conduct-an-incident-investigation.pdf?

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Determination/Outcome of example situation

Circling back to the example situation: it was essentially resolved, with certain provisos as documentation of the actual injury (corneal damage) was lacking. So absolute certainty could not be achieved.

The technical challenges and 'disconnects':

The operator was working with a NIR, q-switched, Yb laser, operating at 1,064 nm. At this wavelength, the human organs at risk for injury from overexposure are the skin and the retina. This wavelength is nominally transmissive through the cornea, where the lack of absorption should not induce a thermal load and incur damage.

The operator was wearing laser protective eyewear (LPE), with sufficient optical density at the laser operating wavelength, the requirement and capability for the LPE was confirmed. There was no retinal damage which would be expected if the operator was unprotected against the NIR laser radiation from the ablation process development work.

Absorption wavelengths of the cornea were reviewed and compared against what the LPE did not attenuate (absorb). Any wavelengths passing through the LPE would not be absorbed by the cornea.

An energy/power intensity analysis was conducted for the laser beam on the reflective material, which did not indicate that second order effects (e.g., plasma, x radiation) would have been generated by the laser-target interactions.

The verbal communication of the damage to the cornea was that it was to the outer surface, circular in shape, approximately 1 mm diameter, with the appearance of a cut/burn.

> – For investigation purposes, the phrase cut/burn is a dichotomy. A burn would indicate damage due to absorption of electromagnetic energy, a cut would indicate an abrasion, such as due to ablation particulate(s). An image of the damaged area would have clarified this and assisted with the investigation.

- The small size of the 'witness' mark/damage to the cornea indicated either small beam of sufficient wavelength and intensity to effect such or was the result of a particle.

The ablation process was occurring on a curved surface which would have further dispersed incident laser and process re-radiation towards the operator.

Additional example information and assessment:

The impression was soon coalescing, that such laser user safety standards could or should have at least informative guidance on incident investigation, including nominal or reference information on absorption and transmission curves vs wavelengths for the human body (especially the cornea) should a LSO become involved, in an informative appendix of such consensus standards.

For the example incident investigation, the selection of LPE was re-assessed to determine if a better selection was possible against more restrictive criteria than just laser radiation protection itself. Additional considerations included the ablation process re-radiation (metal-vapour plume illumination). The original LPE selection still met the heightened criteria along with two other choices, allowing for the operator and LSO determine 'best fit'.

The potential for the NIR ablation laser beam to generate a second-order effect electromagnetic energy or wavelength, that was highly directional for this application was evaluated and reasonably discounted with a high degree of certainty as highly unlikely.

What remained as possible and probable cause of the injury to the operator was a particulate over the course of a workday causing the abrasion to the cornea. When reviewing literature from welding societies regarding similar concerns and process arrangements, this is a high concern with appropriate recommendations provided. These recommendations were then reviewed and applied, which included:

- Improved fume extraction
- Workplace hygiene to include facial and hand washing to minimize the risk of particulate abrasion of the cornea
- Awareness and training for affected personnel (operator and LSO) regarding this hazard potential and response

General improvements/enhancements included:

- Review of incident report forms to include enhanced documentation of injury location, description and imaging, if possible, for investigation purposes. LSO appreciation that in response planning, importance of working with medical facilities and their constraints in providing sufficient information to support an incident investigation.
- Referencing best practices beyond jurisdictions and other sectors.
- Understanding of the process itself regarding incident investigation as a matter of due diligence to ensure the safety of all affected personnel.

Conclusions:

A variation of the P5 rule in manufacturing is that "*Proper Planning Provides Premium Performance*", this duly applies for incident response planning, right down to having the appropriate report form(s) and medical response plan(s) in place. Two essential elements that are often overlooked in the example incident report forms made available in the public domain are crucial for an effective laser safety program in the workplace:

1. Documentation of the injury details to assist with the root cause analysis of the incident investigation.
2. An examination of the initial equipment or process risk assessment. If the RA is absent, that is arguably a system failure of the organization and places a greater burden to develop an equivalent risk assessment during the incident investigation process if true root cause analysis is to be effected.

Understanding the requirements of the occupational health and safety agency having jurisdiction for reportable hazardous events and the need for an organization to examine those potential hazardous events internally is an essential component or feedback loop for continuous improvement of its health and safety management systems.

It is not necessary to generate from scratch such report forms, as there are professionally developed ones available from recognized OHS agencies. Looking beyond one's jurisdiction and to other sector's, any gaps in a local reference incident report form can be filled when drawing from other best practices. Just as with any equipment troubleshooting effort where good information is critical to solve the problem, so too are the means for responding to a hazardous event and associated documentation essential for effective root cause analysis to implement the requisite control measures for safety, productivity, and quality of operations.

The attachments provided address one type of an incident report form, together with an incident investigation process checklist and report structure. They can provide the basis for other internal incident report forms of an organization.

Acknowledgments:

Meet the Author(s)

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Barbara Sams Contrata: Former LIA Director of Standards Development and Executive Director for the Board of Laser Safety, Barbara provides consulting services through Samata Enterprises LLC. Primarily contributing administrative support to and development of laser safety training materials, Barbara participates in remote laser safety training and course promotion. Her most recent joint venture with Randolph Paura is the Industrial Laser Safety Officer Webinar for Canadian Laser Safety (CLS).

Resources and bibliography

Below are a partial listing of national OHS agency public domain resources addressing incident reporting and investigation.

Canada, CCOHS

- CCOHS: Health and Safety Legislation in Canada - Injury Reporting
  https://www.ccohs.ca/oshanswers/legisl/legislation/injury_reporting.html
- CCOHS: Incident Investigation
  https://www.ccohs.ca//oshanswers/hsprograms/investig.html#section-1-hdr
- CCOHS: Influencing Attitudes Toward Workplace Illnesses and Injuries
  https://www.ccohs.ca/products/publications/influencingattitudes.html

EC/EU, OSH Wiki

- Accident investigation and analysis - OSHwiki | European Agency for Safety and Health at Work (europa.eu)
  https://oshwiki.osha.europa.eu/en/themes/accident-investigation-and-analysis
- Learning from incidents and accidents - OSHwiki | European Agency for Safety and Health at Work (europa.eu)
  https://oshwiki.osha.europa.eu/en/themes/learning-incidents-and-accidents
- Near misses - OSHwiki | European Agency for Safety and Health at Work (europa.eu)
  https://oshwiki.osha.europa.eu/en/themes/near-misses

U.K., HSE

- Investigating accidents and incidents: A workbook for employers, unions, safety representatives and safety professionals HSG245 (hse.gov.uk)
  https://www.hse.gov.uk/pubns/hsg245.pdf
- Human factors in accident investigations (hse.gov.uk)
  https://www.hse.gov.uk/humanfactors/topics/investigation.htm

U.S., OSHA

- Incident Investigation - Overview | Occupational Safety and Health Administration (osha.gov)
  https://www.osha.gov/incident-investigation

Attachments:

The following attachments were developed in preparation for this conference. These are not absolutes and are intended for internal purposes with potential improvements as required. These will be similar to, but not necessarily fulfill requirements of the jurisdiction having authority for workplace safety in reporting incidents as most agencies require additional personal information and organization identification/registration data.

Attachment A: Content Considerations for Incident Report Forms.

Attachment B: Incident Report Form – General, with Injury Mapping.

Attachment C: Laser Incident Investigation Process

Attachment D: Laser Incident Investigation Report Structure

Attachment E: Summary Canada Workplace Health and Safety Information Links

Attachment F: Summary USA Workplace Health and Safety Information Links

Attachment A:

When creating an internal incident report form for root-cause investigation within the manufacturing sector, this may be the initial one for rapid intake or capturing of the event, consider the following content elements:

1. **Incident Situation**:
   - **Report by**: Name, department, contact information.
   - **Date and Time**: Record the exact date and time of the incident.
   - **Location**: Specify where the incident occurred (e.g., production line, warehouse, equipment identification, building column number, etc.).
   - **Product Information**: Include details about the product/equipment/process involved (e.g., product name, batch/lot number, station ID, serial number).
   - **Type**: Positive observations, Unsafe acts (including harassment, threats, and violence), Near misses, Minor injuries (requiring in-house first aid), Lost time incident, Fatality
2. **Description of Incident**:
   - Provide a clear and concise description of what happened.
   - Include relevant context and any contributing factors.
   - Document the sequence of events leading up to the incident.
3. **Outcome/Effects of the Hazardous Event**:
   - Results of the hazardous event in harm and/or damage.
4. **Corrective Measures Taken**:
   - What actions were taken to immediately address the hazard(s) related to the incident, to avoid further harm or damage?
   - This may be securing the scene under LO-TO for a full investigation where reporting to the responsible agency is required, or an interim measure to mitigate/avoid any further harm/damage.
5. **The Affected Person**:
   - Relationship to the organization, name and contact information.
6. **Witness Details**:
   - Name(s) and contact information.
7. **Injury Mapping**:
   - Provides means for an initial recording of the injured area of the body. This may be revised/updated/amended by medical professionals if so involved.
   - Body, hand, eye.

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8. **First Aid**:
   - Provision, time, attendant, contact information, details of first aid provided.
9. **Post Incident**:
   - What happened next (hospital, home, return to work), notification of responsible person/committee.
10. **Additional Notes**:
   - Provision of space for miscellaneous or supplemental information that the nominal form does not capture or the person reporting wishes to contribute and have noted for follow-up.

Optional considerations: Be mindful that the initial incident report form can assist with completing a formal report to the responsible agency, even if the initial event or situation did not appear to be serious. Depending upon an organization's safety culture and operating health and safety policy, it may be desirous to have a succinct 'initial capture' or 'intake form' of an incident, to facilitate ease of completion by those present at the incident, versus a more comprehensive report form that may require valuable time and resources to complete. Other elements that may be included are:

11. **Signatures of the reporting person, injured person, witnesses:**
   - This has positive and negative implications for a preliminary or initial report form.
12. **Witness Statements and Interviews:**
   - Gather statements from witnesses or employees who observed the incident.
   - Conduct interviews to understand different perspectives and gather additional information.
13. **Current Job Hazard(s) Analysis (JHA) or Risk Assessment (RA) for the Equipment/Process**:
   - This is the document that determined the hazards and their potential for harm, with the appropriate control measures identified. Where there has been an actual or potential hazardous event, it would indicate that the JHA or RA had missed a crucial element. The availability of a JHA or RA will greatly facilitate and expedite the incident investigation process.
   - Identifier or filename of the relevant document.
14. **Root-Cause Analysis:**
   - This is more properly reserved for the incident investigation effort and report itself, though the latter portion of the initial form could provide means for this, so there is continuity in one document.
   - Investigate the underlying causes of the incident. Consider factors such as:
     - Equipment malfunction or failure.
     - Human error.
     - Process deviations.
     - Material defects.

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- Use tools like the 5 Whys or Fishbone (Ishikawa) Diagram to identify root causes.

15. **Corrective and Preventive Actions (CAPA):**
    - Likewise with element # 13, this is more properly reserved for the incident investigation effort and report itself, though the latter portion of the initial form could provide means for this, so there is continuity in one document.
    - Propose corrective actions to address the immediate issue.
    - Suggest preventive measures to avoid similar incidents in the future.
    - Assign responsibility for implementing CAPA.
16. **Documentation of Evidence:**
    - A separate area of the form to allow for a more thorough documentation of the hazardous situation.
    - Attach relevant evidence, such as photographs, diagrams, or data logs.
    - Maintain a chain of custody for physical evidence.
17. **Reporting to Government Agencies:**
    - If required by regulations, prepare a separate report for government agencies.
    - Ensure compliance with reporting deadlines and guidelines.
    - Highlight the root cause and corrective actions taken.
18. **Confidentiality and Privacy:**
    - Protect sensitive information related to employees, trade secrets, and proprietary processes.
    - Be mindful of privacy laws when sharing incident details externally.

Thorough and accurate documentation is crucial for effective root-cause analysis and continuous improvement. If you have specific industry standards or regulations to follow, incorporate those into your incident report forms.

As the responsible LSO is required to periodically review the Written Laser Safety Program[10], continuous improvement of such documents based upon experience, knowledge, and referencing current best practices may see their development progress from an initial intake form to one document with subsequent stages identified or contained within associated with the incident, up to and including the format of the investigation report.

[10] ANSI Z136.1:2022 (A1.2, c).

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References:

By no means exhaustive.

Nunavut:

- "*Worker's Report of Injury Form*", Worker's Report of Injury | WSCC | Workers' Safety and Compensation Commission, https://www.wscc.nt.ca/documents/workers-report-injury
- "*Hand Injury Report Form*", 101-CS009_EN_Hand injury Report Fillable-Aprvd_1.pdf (wscc.nt.ca), https://www.wscc.nt.ca/sites/default/files/documents/101-CS009_EN_Hand%20injury%20Report%20Fillable-Aprvd_1.pdf
- "*Medical Report Eye Injuries*", 101-CS005_EN_Medical Report Eye Injuries_Fillable-Aprvd.pdf (wscc.nt.ca), https://www.wscc.nt.ca/sites/default/files/documents/101-CS005_EN_Medical%20Report%20Eye%20Injuries_Fillable-Aprvd.pdf
- "*Incident Investigation Form Template*", https://www.wscc.nt.ca/sites/default/files/documents/Incident%20Investigation%20Report%20Form%20English.docx

Ontario:

- "*Health and Safety Incident Report Form*", H-S-Incident-report-form (whsc.on.ca), https://www.whsc.on.ca/Files/Resources/H-S-Documentation-Tools/H-S-Incident-report-form
- "*Incident Investigation Form*", Incident-Investigation-Form-interactive_Jul20 (whsc.on.ca), https://www.whsc.on.ca/Files/Resources/H-S-Documentation-Tools/Incident-Investigation-Form-interactive_Jul20

U.S. (OSHA and NIOSH):

- OSHA: "Injury & Illness Recordkeeping Forms – 300, 300A, 301," including OSHA Form 301 Injury and Illness Incident Report and equivalent forms guidance. https://www.osha.gov/recordkeeping/forms
- OSHA: 29 CFR 1904.29 "Forms," identifying use of OSHA 300, 300-A, and 301 or equivalent forms for recordable injuries and illnesses. https://www.osha.gov/laws-regs/regulations/standardnumber/1904/1904.29
- OSHA: "Small Business Safety and Health Handbook," recordkeeping and reporting guidance relevant to internal incident documentation and program administration. https://www.osha.gov/sites/default/files/publications/SMALL-BUSINESS.pdf
- NIOSH: "Occupational Injury and Illness Reporting," checklist referencing OSHA Form 300 and OSHA Form 301 or equivalent supplementary records. https://www.cdc.gov/niosh/docs/2004-101/chklists/r1n02r~1.htm
- NIOSH: Fatality Assessment and Control Evaluation (FACE) Program, providing investigation-based case reports and prevention recommendations comparable to incident investigation documentation frameworks. https://www.cdc.gov/niosh/face/about/index.html
- NIOSH: NIOSH Publications and Products, including FACE and Health Hazard Evaluation resources that can inform investigation report structure and evidence gathering. https://www.cdc.gov/niosh/pubs/default.html

Attachment B: Example initial incident report form

1. Incident Situation:	
Reported by:	Department:
Email:	Phone: Ext:
Date of occurrence:	Approx. time of occurrence:
Exact location (equipment ID, plant location):	
☐ Positive observation(s), ☐ Unsafe act(s) (including harassment, threats, and violence), ☐ Near misses, ☐ Minor injuries (requiring in-house first aid), ☐ Lost time incident, ☐ Fatality	
2. Description of Incident:	
Provide a clear and concise description of what happened. Include relevant context and any contributing factors. Document the sequence of events leading up to the incident.	
3. Outcome/Effects of the Hazardous Event:	
Results of the hazardous event in harm and/or damage.	
4. Corrective Measures Taken:	
What actions were taken to immediately address the hazard(s) related to the incident, to avoid further harm or damage? This may be securing the scene under LO-TO for a full investigation where reporting to the responsible agency is required, or an interim measure to mitigate/avoid any further harm/damage.	

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5. The Affected Person:	
☐ Worker/employee ☐ Other (e.g. visitor, contractor)	Name:
Address:	Date of birth:
E-mail (work): Phone (work):	E-mail (personal): Phone (personal):
Employer's name if other than worker:	
Employer's address if other than worker:	
Employer's phone if other than worker:	
6. Witness Details:	
Name(s) and contact information:	
Name(s) and contact information:	
Name(s) and contact information:	

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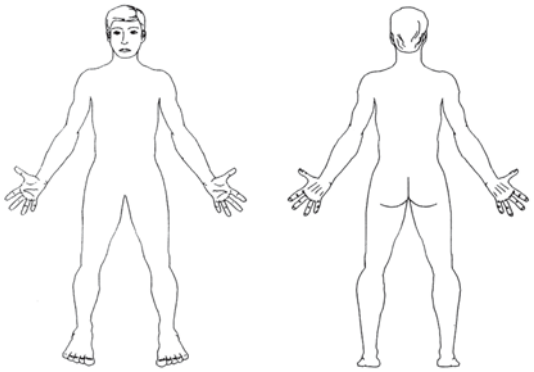
7. Injury Mapping:

Provides means for an initial recording of the injured area of the body.
This may be revised/updated/amended by medical professionals if so involved.

Body:

What part of your body did you injure? (left/right side, hand, eye, back, etc.)
Please also indicate the body part on the diagram.



Hand:

Which hand is injured?

- ☐ Left
- ☐ Right

Which is the dominant hand?

- ☐ Left
- ☐ Right

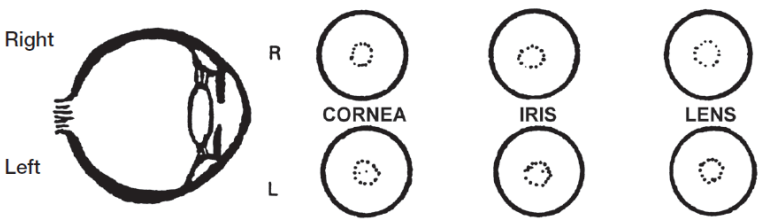
Other information

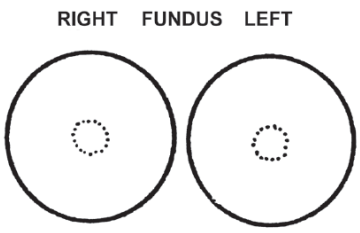
- ☐ *Left hand (top)*
- ☐ *Right hand (bottom)*

- ☐ *Right hand (top)*
- ☐ *Left hand (bottom)*

Eye:

Identify what portion of the eye was (or suspected to be) injured?
Circle and mark applicable areas. May be amended by attending physician.





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8. First Aid:
First aid provided: ☐ Yes ☐ No ☐ N/A
Time of attendance:
By whom:
Contact information:
Details of first aid provision:
9. Post Incident:
What happened next (hospital, home, return to work), notification of responsible person/committee.
Where did the person involved in the incident go next? ☐ To the hospital ☐ Home ☐ Returned to work ☐ Other Comment:
Was a member of the joint health and safety committee and/or the LSO notified of the incident? ☐ H&S Committee Member (name): ☐ LSO (name): ☐ No
10. Additional Notes:
Miscellaneous or supplemental information that the nominal form does not capture or the person reporting wishes to contribute and have noted for follow-up.

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Attachment C: Laser Incident Investigation Process

The following format/process for a workplace laser incident investigation is an amalgam of those noted citations following, for review by an organization when drafting/reviewing their written laser safety program to ensure that means, tools, and procedures are developed as applicable. It may also be utilized to ensure that the appropriate essential steps in the process are completed/fulfilled by all team members.

The provision of this material is intended for reference purposes only for the responsible person(s) developing incident investigation response plans or conducting them, this **does not** infer either minimal or maximal scope.

Description of Guidance	Done	TBC	N/A	Responsibility	(DD-MMM-YYYY)
1. Definition of terms					
• Incident – Any unforeseen event, which causes fatality, injury, or property damage. An actual hazardous event.					
• Near Miss – Any unforeseen event that causes a disruption in the workflow, however it does not cause any fatalities, injuries, or property damage. A potential hazardous event.					
• For the purpose of this worksheet an incident refers to both an actual and potential hazardous event.					
Description of Guidance	**Done**	**TBC**	**N/A**	**Responsibility**	**(DD-MMM-YYYY)**
2. Purpose of the incident investigation					
• The prevention of another future incident is the purpose of incident investigation, not to lay blame or find who's at fault. The investigation should identify the causes of the incident so that controls can be put in place to prevent the same incident from happening again.					
• The findings from the investigation should be recorded and kept on file however these findings should not be used to discipline anyone. This encourages individuals to report all incidents and it also encourages witnesses to tell investigators everything they know.					
• Incident facts:					
o The majority of hazardous events are forecasted by near misses in the workplace.					

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o Incidents can be prevented by eliminating the causes.					
o By investigating and addressing all incidents you can eliminate the causes.					
o Unless causes are eliminated then the same incident will likely occur in the future.					
• The incident investigation should:					
o Determine what happened.					
o Determine the cause of the accident.					
o Identify corrective actions.					
o Injury requiring first aid treatment only with potential for serious injury					
o Injury due to protective measure failure (engineering, procedural, PPE)					
Description of Guidance	**Done**	**TBC**	**N/A**	**Responsibility**	**(DD-MMM-YYYY)**
3. Incident investigation preparation					
• There should be very little time between the occurrence of the incident and the investigation. The preparation (pre-planning) before an incident is necessary to make sure that all your resources are available at the time of the incident.					
• Incident investigation team should include the following:					
o Upper management					
o Personnel from the area not involved in the incident					
o Maintenance supervisor					
o Safety supervisor					
o Supervisor from affected area					
o Safety committee members					
o Laser Safety Officer					
• Essential investigation equipment					
o Writing pad and clipboard (or digital equivalent)					
o Tape measure – preferably 100' (30 m) or ranging meter as applicable					
o Digital camera and NIR or FIR camera as applicable					
o Sensor and meter for errant radiometric emissions measurements					
o Graph paper					
o Straight-edge ruler					
o Pencils, pens, highlighter, coloured grease pencils					
o Flashlight					

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o High visibility plastic tape					
o Envelopes					
Description of Guidance	**Done**	**TBC**	**N/A**	**Responsibility**	**(DD-MMM-YYYY)**
4. Visiting the incident scene					
• When it comes to incident investigation, speed is necessary to preserve evidence and record eyewitness accounts before they are forgotten.					
• The following must be done in order when arriving at the scene:					
o Make sure the area is safe for you and others					
o Ensure the injured personnel are properly cared for					
o Ensure management is notified of the situation					
o Secure the affected area					
o Identify potential sources of information such as witnesses, injured personnel, and any physical evidence.					
o Sketch the scene:					
▪ Place important information in the center and draw relevant information around it.					
▪ Measure the area					
▪ Note the position of personnel and evidence					
o Photograph the evidence					
▪ Start by photographing the general area to get an idea of where the incident took place					
▪ Then photograph the specific scene of the incident					
▪ Take photos from all angles and viewpoints					
▪ Use a straight edge ruler in some photos to give a better idea of the size of the evidence					
o Collect any critical evidence that will have to be analyzed at a later date					
o AVOID JUMPING TO CONCLUSIONS!!!!!!!!!					
Description of Guidance	**Done**	**TBC**	**N/A**	**Responsibility**	**(DD-MMM-YYYY)**
5. Interviewing the witnesses					
• Once the witnesses have been identified you need to separate them so that they don't lose their individual perceptions of the incident.					
• Have each witness write out what they saw happen before, during and after the incident.					
• Interview witnesses as soon as possible while the incident is still fresh in their minds.					

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• Categorize witnesses:					
o Eyewitness – those who actually saw the incident happen or were involved in the incident.					
o Personnel who came on the scene immediately after the incident.					
o Personnel who witnessed events leading up to the incident.					
o Personnel who have expertise in the work tasks that were being performed when the incident happened.					
• Interviewing witnesses:					
o Put the witness at ease:					
▪ Let them know that your primary goal in conducting the investigation is to prevent the recurrence of the incident.					
▪ Inform the witness that you are not there to get anyone in trouble or point fingers at the guilty parties.					
▪ Choose a private location to conduct the interview.					
▪ Don't place yourself between the witness and the door. This eases the witness's fears of feeling trapped.					
o Review their written statement with them and clear up any discrepancies. If possible, show them photographs from the scene to help them remember pertinent information.					
o Use the W-5 method:					
▪ WHAT happened?					
▪ WHO was witness to or was involved in the incident?					
▪ WHERE did the incident occur and where was the witness?					
▪ WHEN did the incident happen?					
▪ By answering the previous questions, you are able to answer WHY and HOW the incident happen.					
o Use open ended questions, such as:					
▪ Tell me what you saw?					
▪ Tell me about…					
▪ Explain how this job is done?					
▪ Where were you at the time of the incident?					
▪ Who else saw the incident?					
o Some common mistakes to avoid:					

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	▪ Do not ask leading questions (e.g. “Do you think that…”)					
	▪ Do not intimidate the witness (e.g. “That was a stupid way to do that job”)					
	▪ Note taking should not interfere with the interview process					
	▪ Do not interrupt the witness while they are talking					
	▪ Do not use a tape recorder during the interview process. This usually makes the witness uncomfortable, and they do not give as much information as freely.					
	Description of Guidance	**Done**	**TBC**	**N/A**	**Responsibility**	**(DD-MMM-YYYY)**
6.	**Analyzing the evidence**					
•	Review the risk assessment or JHA for currency, relevancy, and benchmarking					
•	Review standard operating procedures for the task that was being performed					
o	Was the safe work procedure used?					
o	Were the appropriate tools used?					
o	Was the required PPE used?					
o	Were safety devices in place?					
•	Require that maintenance analyze any equipment that was involved and review equipment manuals.					
o	Was there an equipment malfunction?					
o	What was the cause of the failure?					
o	Was the equipment being used correctly? (Deviation from the SOP)					
o	Was the equipment modified in any way? (Includes tooling, programming, etc.)					
•	Review witness statements and cross reference each of them to point out any discrepancies. If discrepancies are found then you will have to re-interview witnesses.					
•	Review photographs to paint a possible picture of what happened based on the witness statements.					
•	Review the training records of the workers involved in the incident:					
o	Was the individuals properly trained?					
o	When did they last receive training?					
o	Who provided them with the training?					
o	What experience did the worker have?					
o	Were they tested and succeeded at demonstrating competency?					

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• Review the environmental factors involved in the incident:					
o Weather (including humidity)					
o Time of day					
o Temperature (including humidex)					
• Review whether or management had enforced the policies and the rules and whether management had provided a safe and healthful workplace.					
• Above all, keep asking WHY until you come to the root cause of the incident.					
Description of Guidance	**Done**	**TBC**	**N/A**	**Responsibility**	**(DD-MMM-YYYY)**
7. Writing the report					
• The intent of the incident report is to effect change so that the incident does not happen again in the future. This report should also be retained for future reference.					
8. Conclusion					
• For the incident investigation to be effective, management must have a plan in place for implementing the corrective actions and making system improvements. Management must also periodically evaluate the quality of the incident investigation process to make sure that it is still an effective tool.					
• Review with management, sign-off for implementation per the organization's health and safety program.					

References:

- Accident Investigation Outline (osha.gov)
  https://www.osha.gov/sites/default/files/2018-11/fy14_sh-27638-sh4_Incident-Investigation-Outline.pdf
- CCOHS: Incident Investigation
  https://www.ccohs.ca/oshanswers/hsprograms/investig.html
- Investigating accidents and incidents: A workbook for employers, unions, safety representatives and safety professionals - HSG245 (hse.gov.uk)
  https://www.hse.gov.uk/pubns/books/hsg245.htm
- Accident investigation and analysis - OSHwiki | European Agency for Safety and Health at Work (europa.eu)
  https://oshwiki.osha.europa.eu/en/themes/accident-investigation-and-analysis

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Attachment D: Laser Incident Investigation Report Structure

The following format for a workplace laser incident investigation report is an amalgam of those noted citations following, for review by an organization when drafting/reviewing their written laser safety program to ensure that means, tools, and procedures are developed as applicable. It may also be utilized to ensure that the appropriate essential steps in the process are completed/fulfilled by all team members.

The provision of this material is intended for reference purposes only for the responsible person(s) developing incident investigation response plans or conducting them, this **does not** infer either minimal or maximal scope.

Description	Done	TBC	N/A	Responsibility	(DD-MMM-YYYY)
1. Employer and equipment information					
• Organization legal name and address					
• Representative name, position, and contact information					
• Equipment/process risk assessment (or job hazard analysis), SOP, and identifier(s)					
2. Injured person					
• Name, position					
3. Place, location, date, and time of incident					
• Facility, area, equipment/process, time, date					
4. Type of occurrence (identify all that apply)					
• Death of a worker					
• Serious injury to a worker					
• Major equipment failure					
• Major release of a hazardous substance					
• Incident of fire or combustion/explosion with potential for serious injury					
• Minor injury or no injury with potential for causing serious injury					
• Injury requiring medical treatment beyond first aid					
• Injury requiring first aid treatment only with potential for serious injury					
• Injury due to protective measure failure (engineering, procedural, PPE)					

5. Report type					
• Preliminary investigation report					
• Interim corrective action report					
• Full investigation report					
• Full corrective action report					
6. Reference applicable regulations and consensus standards					
• Jurisdiction Having Authority (JHA) 'general duty clause' and other applicable					
• ANSI B11.0 or ISO 12100					
• ANSI B11.21					
• ANSI Z136.1 or IEC/TR 60825-14					
• CSA E60825-1, IEC 60825-1, or US FLPPS					
• EN 12198-1					
• ISO 11553-1					
• Controls & HMI, Electrical, Ergonomic, Guarding,					
7. Witnesses (persons present other than those injured)					
• First & last name, title/position					
8. Other persons whose presence might be necessary for proper investigation					
• First & last name, title/position					
9. Sequence of events that preceded the incident					
• Summary of elements or events that preceded the incident occurrence. May include training dates, changes to equipment, procedures or management. To be updated in the full report version if required.					
10. Contributing factors to the incident (e.g. environment, equipment, acts, procedures, etc.)					
• Description of anything present or absent that contributed to the hazard and its potential for harm. Ideally the components for risk of a hazard being realized as harm should be identified, reference ANSI B11.0.					

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11. Nature of the serious injury (applicable if there has been an injury)					
• *Note: ANSI B11.0, Annex E, Table 8 provides further guidance on the grading of injuries; catastrophic, serious, moderate, minor. Depending on the JHA, those injuries which are serious to catastrophic will having regulatory reporting and corrective action requirements.*					
• Life threatening or loss of consciousness]					
• Major broken bones in head, spine, pelvis, arms or legs					
• Major crush injuries					
• Major cut with severe bleeding					
• Amputation or arm, leg, or large part of hand or foot					
• Major penetrating injuries to eye, head, or body					
• Severe (third-degree) burns					
• Punctured lung or other serious respiratory condition					
• Injury to internal organ or internal bleeding					
• Injury requiring CPR or other critical intervention					
• Diving illness such as decompression sickness or near drowning					
• Serious chemical or heat/cold stress exposure					
• Electromagnetic (wave) energy injury to skin, cornea, retina. Ref. ANSI B11.0, Annex E, Table 8.					
12. Brief description of the incident					
• Summarize sequence of event events, unsafe factors, and resulting injury, if any					
13. Brief description of post-incident					
• Summarize what happened immediately after the incident					
14. Corrective actions identified					
• Corrective actions to be prioritized according to the principles of the hierarchy of controls					
15. System improvements					
• Recommendations/requirements to improve procedures and policies that indirectly caused the incident.					
16. Explanation of blank areas of preliminary report, if any					
17. Persons who carried out or participated in the report					
End of preliminary report					

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To be included in full/final report					
18. Laser beam hazard evaluation and risk assessment					
19. Non-beam hazard evaluation and risk assessment					
20. Determination of causes of incident					
21. Full description of the incident					
22. Estimated cost of the incident					
23. Applicable corrective actions necessary to prevent recurrence of similar incidents					
24. Intended results and positive impact of recommended/required changes					
25. Persons who carried out or participated in the full investigation					
• Names, titles, approval signatures, abstention notes					
26. Other relevant workplace parties/stakeholders					
End of report					

References:

- Accident Investigation Outline (osha.gov)
  https://www.osha.gov/sites/default/files/2018-11/fy14_sh-27638-sh4_Incident-Investigation-Outline.pdf
- CCOHS: Incident Investigation
  https://www.ccohs.ca/oshanswers/hsprograms/investig.html
- Investigating accidents and incidents: A workbook for employers, unions, safety representatives and safety professionals - HSG245 (hse.gov.uk)
  https://www.hse.gov.uk/pubns/books/hsg245.htm
- Accident investigation and analysis - OSHwiki | European Agency for Safety and Health at Work (europa.eu)
  https://oshwiki.osha.europa.eu/en/themes/accident-investigation-and-analysis

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Attachment E: Summary Canada OH&S Information Links

Below are various links from the respective health and safety agencies in Canada addressing matters associated with workplace incident reporting. Note that this is not an exhaustive list.

CCOHS: Canadian Centre for Occupational Health and Safety

Reporting requirements: A summary guide on reporting requirements for an injury or serious incident in the workplace for all jurisdictions in Canada.

> CCOHS: Health and Safety Legislation in Canada - Injury Reporting, https://www.ccohs.ca/oshanswers/legisl/legislation/injury_reporting.html

Incident investigation: Summary guidance on considerations and scope of incident investigation in the workplace.

> CCOHS: Incident Investigation, https://www.ccohs.ca//oshanswers/hsprograms/investig.html

Laser equipment/system safe design, build and use:

Following is a partial listing of relevant consensus standards dealing with laser equipment over its lifecycle. Nominally, these will identify those ancillary and additional supporting standards.

ANSI B11.0 "*Safety of Machinery*", standard that specifies basic terminology, principles, and a methodology for achieving acceptable risk in the design and the use of machinery. It provides the essential requirements to estimate, evaluate and reduce the risks associated with the use of machinery.

ANSI Z136.1 "*Safe Use of Lasers*", is the foundation for laser safety in various applications, providing crucial information and guidelines to protect individuals and equipment from laser hazards.

CSA E60825-1 "*Safety of laser products — Part 1: Equipment classification and requirements (Adopted IEC 60825-1, with Canadian deviations)*", applicable to safety of laser products, systems, and equipment emitting laser radiation in the wavelength range 180 nm to 1 mm.

IEC 60825-1 "***Safety of laser products - Part 1: Equipment classification and requirements***", applicable to safety of laser products, systems, and equipment emitting laser radiation in the wavelength range 180 nm to 1 mm.

Guidance for Laser Products - Canada.ca, provides general guidance to help manufacturers, importers, and distributors understand and comply with Canada's regulatory requirements for laser

products. It also explains how Health Canada applies these rules so that oversight of laser products is fair, consistent, and aligned with the Radiation Emitting Devices Act and Regulations.

Incident [Accident] Investigation Guidance:

Following is a partial listing of resources and guides regarding a workplace incident investigation.

ANSI/ASSP "*Resource Guide: Incident Investigation*", brings together a variety of materials to support EHS professionals in conducting thorough and effective incident investigations. It's designed to help you identify root causes, strengthen corrective actions and build a stronger safety culture.

CSA Z1005 "*Workplace Incident Investigation*", positioned as the primary CSA standard on principles of occupational incident investigation as part of an established Occupational Health and Safety Management System.

ISO 45001 "*Occupational health and safety management systems — Requirements with guidance for use*", specifies requirements for an occupational health and safety (OH&S) management system. It provides a framework for organizations to manage risks and improve OH&S performance.

EU Accident investigation techniques - OSHwiki | European Agency for Safety and Health at Work, https://oshwiki.osha.europa.eu/en/themes/accident-investigation-techniques

UK Investigating accidents and incidents: A workbook for employers, unions, safety representatives and safety professionals HSG245

Attachment F: Summary U.S. OS&H Information Links

Below are various links from the respective health and safety agencies in the U.S. addressing matters associated with workplace incident reporting. Note that this is not an exhaustive list.

OSHA: U.S. Occupational Safety & Health Administration

Reporting requirements: A summary guide on reporting requirements for an injury or serious incident in the workplace for all jurisdictions in the United States.

§ 1002.20 Reporting of accidental radiation occurrences by laser mfrs in their annual reports.
FDA-CDRH Annual Report by Laser OEMs FORM FDA 3636

Recordkeeping - OSHA's Recordkeeping Rule 2014 | Occupational Safety and Health Administration

Recordkeeping - A summary of the Fatality and Severe Injury and Illness Reporting Requirements | Occupational Safety and Health Administration

Incident investigation: Summary guidance on considerations and scope of incident investigation in the workplace.

Incident Investigation - Overview | Occupational Safety and Health Administration

Laser equipment/system safe design, build and use:

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ANSI Z136.1 "*Safe Use of Lasers*", is the foundation for laser safety in various applications, providing crucial information and guidelines to protect individuals and equipment from laser hazards.

IEC 60825-1 "*Safety of laser products — Part 1: Equipment classification and requirements*", applicable to safety of laser products, systems, and equipment emitting laser radiation in the wavelength range 180 nm to 1 mm.

US HHS Publication FDA 86-8260 "*Compliance Guide for Laser Products*", explains the regulatory requirements that manufacturers of laser products must meet under the Federal Food, Drug, and Cosmetic Act, including performance standards, labeling, reporting, recordkeeping, and procedures for variances, defects, and recalls. Its purpose is to help manufacturers understand how to design, test, certify, and document their laser products so they comply with U.S. federal radiation safety regulations.

Incident [Accident] Investigation Guidance:

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CSA Z1005 "*Workplace Incident Investigation*", positioned as the primary CSA standard on principles of occupational incident investigation as part of an established Occupational Health and Safety Management System.

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UK Investigating accidents and incidents: A workbook for employers, unions, safety representatives and safety professionals HSG245

CCOHS: Incident Investigation

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