

ARTIFICIAL OPTICAL RADIATION OPTICAL RADIATION IN THE GAS INDUSTRY

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1. Introduction

a. What is artificial optical radiation?

The Directive 2006/25/EC on the minimum health and safety requirements regarding the exposure of workers to risks arising from optical radiation during their work defines optical radiation as any electromagnetic radiation in the wavelength range between 100 nm and 1 mm. The spectrum of optical radiation is divided into ultraviolet radiation (UV), visible radiation and infrared radiation (IR). Ionizing radiation like X-rays or gamma rays, electromagnetic fields such as microwaves and radio frequencies are not covered by the directive.



The exclusion of natural sources of radiation, such as the sun, from the Directive was a controversial issue during the legislative process.

b. Health effects of exposure to optical radiation

Optical radiation is absorbed in the outer layers of the body and, therefore, its biological effects are mostly confined to the skin and eyes but systemic effects may also occur. Different wavelengths cause different effects depending on which part of the skin or eye absorbs the radiation, and the type of interaction involved: photochemical effects dominate in the ultraviolet region, and thermal effects in the infrared. Laser radiation can produce additional effects characterized by very rapid absorption of energy by tissue, and is a particular hazard for the eyes where the lens can focus the beam. Exposure of the eyes to optical radiation can damage the cornea and lens, and produce pain and symptoms similar to that of sand in the eye. The effects on the skin range from redness, burning and blistering and accelerated ageing through to various types of skin cancer.

2. Objective and scope

The aim of the Directive 89/131/EEC is the prevention and timely detection of any adverse health effects on workers, as well as the prevention of any long-term health risks and any risk of chronic diseases. The directive lays down minimum standards for the prevention and early diagnosis of damage to the eyes and skin from optical radiation, and for the prevention of long-term health risks. It sets exposure limit values and includes provisions on employees' right to information, training, consultation and health checks.

A key aspect of the preventive approach is the obligation of the employer to adapt working methods to avoid or minimize the duration and level of exposure, to incorporate preventive measures into the design of the workplace and to provide appropriate protective equipment. Adjustments of work processes should take account of technical progress and scientific knowledge to control the risk at source.

This document, elaborated by the MARCOGAZ Working Group Health and Labour Safety, is intended to:

- Define the requirements of the artificial optical radiation Directive for the Gas Industry.
- Communicate the most current sources of optical radiation in the natural gas transmission sector.
- Provide with a list of prevention measures used in the gas transmission sector.
- Show the results of the risk assessment in some gas installations in line with Articles 6(3) and 9(1) of Directive 89/391/EEC.

3. Requirements of the artificial optical radiation Directive for the Gas Industry.

The requirements for the protection of workers from risks to their health and safety arising or likely to arise from exposure to artificial optical radiation during their work in the gas industry are as follows:

- Employer must ensure that workers are not exposed to levels of artificial optical radiation above exposure limit values. The employer will demonstrate this through information supplied with sources, through generic assessments or by doing measurements.
- Worker information and training: Workers should be aware that many of the sources of artificial optical radiation in the gas industry do not present a risk to their health, but in those areas where risks have been identified must provide training and information.
- Health surveillance: A medical examination should be available for workers if it is expected or known that they have been exposed to artificial optical radiation above exposure limit value. Workers should be informed of the results and should receive information and advice regarding follow-up health surveillance

4. Applications of optical radiation in the gas sector.

For other applications, assessment is needed. The identified main applications for the gas sector are mainly: **welding activities, gas cutting, optic teletransmission fiber and laser gas leak detector** (handheld, fixed and mobile on vehicle).

Sources like fluorescent lamps, computer screens, photocopier, gas luminous radiant heaters, indicator LED's, vehicle lamps, street lighting can be considered as trivial sources and no further assessment is required.

Wavelength (nm)		Eye	Skin
100 – 280	UVC	Photokeratitis Photoconjunctivitis	Erythema Skin cancer
280 – 315	UVB	Photokeratitis Photoconjunctivitis Cataracts	Erythema Elastosis (photoageing) Skin cancer
315 – 400	UVA	Photokeratitis Photoconjunctivitis Cataracts Photoretinal damage	Erythema Elastosis (photoageing) Immediate Pigment Darkening Skin cancer
380 – 780	Visible	Photoretinal damage (Blue Light Hazard) Retinal burn	Burn
780 – 1400	IRA	Cataracts Retinal burn	Burn
1400 – 3000	IRB	Cataracts	Burn
3000 – 10 ⁶	IRC	Corneal burn	Burn

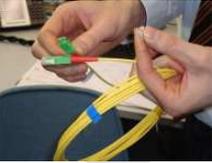
5. Mitigation measures

Artificial optical radiation covers a very wide range of sources that employees may be exposed to in the workplace and elsewhere. These sources will include area and task lighting, indicator devices, many displays and other similar sources which are essential to the well-being of workers. Therefore, it is not reasonable to take a similar approach to many other hazards by necessarily minimizing the artificial optical radiation hazard.

General measures to minimize the artificial radiation hazard are:

- Try to avoid or limit the use of dangerous artificial optical sources.
- Inform and train the exposed people about the results of the risk analysis.
- Inform about presence of radiation by putting warnings on places where there is radiation sources.
- Use collective protection.
- Limit access and fence.
- Wear individual protection.
- Avoid looking into the light (attention also for reflection).
- Carry out medical enquiries:
 - if link with disease
 - if probable link with work conditions
 - when exposed above the limit values

The following table shows the control measures more common used in the gas industry to minimize the risk:

Concerned activities	Concerned people	Prevention measures
<p>Welding activities</p> 	<p>Welder, all people around like grinders</p>	  <p>Place welding curtain, place symbols, wear welding mask, wear UV filtering glasses (for the grinder who works in the environment).</p>
<p>Flame cutting</p> 	<p>Technician in charge of cutting</p>	<p>Wear UV filtering glasses</p> 
<p>Optic fibre teletransmission</p> 	<p>Teletransmission technicians</p>	<p>Power off, wear UV wear UV filtering glasses, place symbols.</p> 
<p>Laser gas leak detector</p> 	<p>Field technicians</p>	<p>Do not look into the beam, no specific complementary measure needed</p>

The listed sources are not limitative and everyone should carry out his own assessment in order to make a correct identification en take the right measures. Take note that the local legislation could also impose additional measures.

6. Methodology

The methodology used to carry out a risk analysis is as follows:

- Inventory all source of artificial optical radiation

- Decide which sources are 'safe light'. Therefore, use for example the list proposed under 2.3 of the *non-binding guide to the artificial optical radiation directive 2006/25/EC* from the Health Protection Agency
- Decide which exposures scenarios need assessment (when people are exposed to this sources)
- Evaluate or measure or calculate the possible radiation level for the workers
- Take measures for reducing or avoid exposition (see point 7)
- Update the risks analysis

7. Results of risk assessment in the context of the Directive in the Gas Industry

The Directive stipulates that employers must carry out risk assessment in line with Articles 6(3) and 9(1) of Directive 89/391/EEC. Where the risk assessment indicates any possibility that the exposure limit values may be exceeded, the employer shall devise and implement an action plan comprising technical and/or organizational measures designed to prevent the exposure exceeding the limit values.

After the study of data and wavelength from devices used in LNG Terminals, it was concluded that no exposition measures were needed. Risk assessment was concluded as acceptable based on exposition and use of the different sources:

Equipment	Source / Exposition time	Part of the body exposed / Hazard	Assessment
DETECTORS			
Portable gas detector	Portable equipment/ Occasional use	n.d.	Not applicable
Gas detector	Not applicable	n.d.	Not applicable
Flame detector	Not applicable	n.d.	Not applicable
Smoke detector	Not applicable	n.d.	Not applicable
Testing flame detector device	3 days/trimester, 1 hour daily	n.d.	ACCEPTABLE According to exposition and use
SHIPS			
Tide sensor	Operator always out of range	No applicable	ACCEPTABLE According to exposition and use

Equipment	Source / Exposition time	Part of the body exposed / Hazard	Assessment
Ship proximity Laser	Laser is always headed to the sea.	Skin / Burns	ACCEPTABLE According to exposition and use
SECURITY ELEMENTS			
Metallic material detector		Not applicable	Not applicable
Encroachment barriers		Not applicable	Not applicable
Movement detector		Not applicable	Not applicable
OTHERS			
Thermography camera	3 days/trimester, 8 h/day	Eyes, skin / burns	ACCEPTABLE According to exposition and use
Laser meter	1 day/trimester, 8 h/day	Eyes, skin / burns	ACCEPTABLE According to exposition and use
Laser thermometer	20 min/day	Eyes, skin / burns	ACCEPTABLE According to exposition and use
Personal Distant Assistant PDA (Motor Operated(MOV actuator))	1 day/month, 1 h/day	Eyes, skin / burns	ACCEPTABLE According to exposition and use
Dew point meter	Occasional use	n.d.	ACCEPTABLE According to exposition and use
Projector's remote	Occasional use	Eyes, skin / burns	ACCEPTABLE According to exposition and use

8. Bibliography

- European Parliament and the Council of the European Union, *Directive 2006/25/EC on the minimum health and safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation)*, Strasbourg, 5 April 2006.
- Health Protection Agency Centre for Radiation, *A Non-Binding Guide to the Artificial Optical Radiation Directive 2006/25/EC*, Oxfordshire, 2011.

NOTE: The information and data included in this document have been compiled by MARCOGAZ from a variety of sources from its Members. MARCOGAZ will not accept any liability for the data accuracy and completeness.



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- MARCOGAZ chief mission is to serve its Members as the European window for any technical issue regarding natural gas.
- As the representative organisation of the European Natural Gas Industry, it aims at monitoring and taking influence when needed on European technical regulation, standardisation and certification with respect to safety and integrity of gas systems and equipment and rational use of gas.
- Environment, Health and Safety issues related to natural gas systems and utilisation are also of paramount importance for MARCOGAZ