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Guidance

Issuing certificates of competence at level 1 or 2 for events involving laser radiation

Ordinance to the Federal Act on Protection against Hazards Arising from Non-Ionising Radiation and Sound (O-NIRSA) – Section 3: Events involving Laser Radiation

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1 Introduction

Since 1 June 2019, events involving laser radiation in Switzerland have been regulated by the Federal Act of 16 June 2017[1] on Protection Against Hazards Arising from Non-Ionising Radiation and Sound (NIRSA) and the associated Ordinance of 27 February 2019[2] (O-NIRSA). With the entry into force of the O-NIRSA, the Sound Levels and Laser Ordinance of 28 February 2007[3] (SLO) was repealed. However, events involving laser radiation may continue to be conducted in accordance with the SLO until 1 December 2020.

Under the NIRSA, for commercial or professional use of potentially hazardous products, the Federal Council may require that a certificate of competence be obtained and may define requirements for the relevant training. In Article 16 O-NIRSA, the Federal Council has availed itself of these powers with regard to events involving laser radiation.

Persons operating laser devices of Class 1M, 2M, 3R, 3B or 4 at events involving laser radiation must complete a laser training course, including a final examination. In line with the potential hazards, two courses of different lengths are offered. For events involving laser radiation in the audience zone, a certificate of competence at level 2 is required. For events without laser radiation in the audience zone, a certificate of competence at level 1 is sufficient.

1.1 Purpose of the guidance

The training and the examination for the acquisition of a certificate of competence must reflect the current state of science and technology, as specified in Article 16 paragraph 3 O-NIRSA, and meet the requirements set out in Annex 3 Number 3 O-NIRSA. This FOPH guidance is designed as an aid for examining bodies wishing to issue certificates of competence at levels 1 and 2. It elaborates the requirements of the O-NIRSA and indicates the current state of science and technology.

1.2 Structure of the guidance

The guidance consists of 10 sections. Section 2 describes the criteria and the process for designating and issuing certificates of competence at levels 1 and 2 listed in the Ordinance of the Federal Department of Home Affairs. Section 2 also defines the application documents which have to be submitted by the examining bodies. Sections 3 and 4 specify the responsibilities of the FOPH and the examining bodies. Sections 5 and 6 describe the conduct and the content of training. Sections 7 and 8 define the orientation and performance objectives which have to be attained so that the training and examinations reflect the current state of science and technology. Also defined is the ratio of practical to theoretical examination assignments. Sections 9 and 10 deal with the conduct and content of examinations.

[1] SR 814.71
[2] SR 814.711
[3] SR 814.49

2 FDHA Ordinance

The Federal Department of Home Affairs (FDHA) has enacted an Ordinance[4] (subsequently referred to as the FDHA-O), which lists the certificates of competence at level 1 or 2 which may be issued by a particular examining body. The examining body can issue certificates of competence at level 1, level 2, or both levels, conducts the relevant examinations and generally also offers the necessary training. This Section outlines the process which is to be followed by an examining body, the criteria which must be met, and the documents which are to be submitted so that an examining body's certificate of competence at level 1 or 2 can be included in the FDHA-O list.

2.1 Criteria for the listing of certificates of competence at level 1 or 2 in the FDHA-O

In the following sections, the guideline explains the criteria for the inclusion of certificates of competence and confirmations of competence in the EDI-V. Listed in the FDHA-O are certificates of competence at level 1 or 2 issued by examining bodies which guarantee that the training and examinations for the acquisition of competence meet the requirements specified in the O-NIRSA (Annex 3 Number 3) and reflect the current state of science and technology.

Applications for listing in the FDHA-O can only be accepted from non-Swiss bodies abroad which specify a postal address in Switzerland and conduct training and examinations in Switzerland. Applications from non-Swiss bodies wishing to conduct training and examinations abroad cannot be considered. Independently of the FDHA-O, an individual's training qualifications may, however, be reviewed and recognised as equivalent by the FOPH in accordance with Article 16 paragraph 5 O-NIRSA.

If applicants' training and examination documents fully meet the requirements set out in this guidance, then they can assume that their certificates of competence at level 1 or 2 will be listed in the FDHA-O. If applicants intend to deviate from this guidance, then they should comment on the divergent points in their application and show that these points reflect the current state of science and technology and meet the other requirements of the O-NIRSA. On the basis of this information, the FOPH can decide whether such a deviation is permissible.

2.2 Process for the listing of certificates of competence at level 1 or 2 in the FDHA-O

The process for the listing of a certificate of competence at level 1 or 2 in the FDHA-O is as follows:

1. Interested bodies submit applications for the listing of certificates of competence at level 1 or 2 to the FOPH via the laser mailbox (laser@bag.admin.ch) no later than 30 April.
2. On behalf of the FDHA, the FOPH reviews each application, including the training and examination documentation submitted (see Section 2.3), using the criteria defined in this guidance.
3. If the documents submitted comply with Annex 3 Number 3 O-NIRSA and reflect the current state of science and technology, as essentially described in the FOPH guidance, then the certificates of competence at level 1 or 2 will be listed in the FDHA-O.
4. If the documents submitted do not comply with Annex 3 Number 3 O-NIRSA or do not reflect the current state of science and technology, then the applicant will be informed of the deficiencies by the FOPH in writing and requested to remedy these deficiencies.
5. If an application has to be rejected in spite of efforts to remedy deficiencies, then the applicant cannot submit another application to the FOPH any earlier than 30 April of the following year.

2.3 Documentation to be submitted and checklist for listing in the FDHA-O

With their application, applicants must submit all the documentation listed in Tables 1 and 2. These Tables can thus be used as a checklist to determine whether all the documentation has been prepared and the application is ready for submission.

[4] SR 814.711.31

Table 1. Training documentation to be submitted

Documents to be submitted/information on the conduct of training:	Prepared:
Structure of training: Daily planning with theoretical and practical components and duration of training (see Sections 5.3, 5.4 and 5.7)	☐
Timetable with training content, times, units and methodology, plus name of trainer (see Section 5.7)	☐
Detailed description of training (notes) (see Section 5.7)	☐
Theoretical and practical presentation material and presentations (see Sections 5.6 and 5.7)	☐
Teaching materials (see Section 5.7)	☐
Training documents for participants (see Section 5.7)	☐
Details of trainers' professional and teaching qualifications and experience in the area of show lasers (see Section 4.1)	
Information on quality assurance for training (see Section 5.8)	☐
Information on the announcement of training (registration and cancellation) (see Section 5.1)	☐
Information on costs (see Section 5.1)	☐
Criteria for eligibility for training (see Section 5.2)	☐
Information on the training venue (classrooms, equipment and teaching aids) (see Section 5.6)	☐
Information on the training language(s)	☐
Information on the maximum number of participants (see Section 5.5)	☐
Training programme: planned frequency of training dates for certificate of competence at level 1 and/or level 2	☐
Information on how participants can prepare for training	☐
Contact details of the person responsible for training	☐

Table 2. Examination documentation to be submitted

Documents to be submitted/information on the conduct of examinations:	Prepared:
Description of the procedure (notes), form and duration of the examination (see Section 9.4)	☐
Practical and theoretical assignments: questions and answers for (at least) one or more examinations (see Sections 9.4, 10.3, 10.4 and 10.5)	☐
Qualifications of the expert examiners (see Section 4.1)	☐
Specification of the criteria for passing the examination (see Section 9.8)	☐
Description of how the examination can be retaken (see Section 9.8)	☐
Description of appeals procedure and retention of examination documents (see Section 9.2)	☐
Information on quality assurance for examinations (see Section 9.9)	☐
Criteria for eligibility for examinations (see Section 9.3)	☐
Information on the examination venue and the equipment available, and on the theoretical and practical examination materials (see Section 9.6)	☐
Information on the announcement of examinations (registration and withdrawal) (see Section 9.2)	☐
Information on costs (examination fees) (see Section 9.2)	☐
Information on the issuing of certificates (see Section 9.2)	☐
Information on the examination language(s)	☐
Information on aids (see Section 9.5)	☐
Information on the maximum number of candidates for examinations (see Section 9.7)	☐
Examination programme: planned examination dates	☐
Information on how candidates can prepare for examinations	☐
Contact details of the person responsible for conduct of examinations, for issuing certificates of competence at level 1 or 2, and for maintaining examination statistics	☐

Applicants must inform the FOPH whether the application concerns the listing of a certificate of competence at level 1 or level 2 in the FDHA-O, or whether training and/or examinations of both kinds are to be offered.

If an examining body submits an application to issue certificates of competence at levels 1 and 2, the documentation must be clearly separated. In each case, only the training and examination materials relevant for the certificate in question are to be covered.

In the interests of comprehensibility, all training and examination documentation should use the same terminology as is used in this guidance.

3 Responsibilities of the FOPH

The responsibilities of the FOPH are described in Sections 3.1-3.3.

3.1 Reviewing applications for listing in the FDHA-O

The FOPH reviews the training and examination documentation submitted with each application (see Section 2.3) and, following a successful review, proposes to the FDHA that the certificate of competence at level 1 or 2 be listed in the FDHA-O.

3.2 Monitoring compliance of the training and examination documentation

At least once every five years, the FOPH assesses whether the training and examination documentation and the professional qualifications continue to reflect the current state of science and technology. If the FOPH identifies deficiencies in the quality of the documentation, it will contact the examining body to discuss a revision of the documentation. If the recommendations of the FOPH are not implemented and if the FOPH determines that an examining body no longer meets the requirements specified in Article 16 paragraphs 1 and 3 O-NIRSA, then the certificate of competence at level 1 or 2 has to be deleted from the Annex to the FDHA-O.

3.3 Notification portal for events involving laser radiation

The FOPH operates an electronic notification portal for events involving laser radiation. The competent persons must notify the FOPH of events involving laser radiation via this portal. The FOPH uses the data exclusively for the tasks defined in the O-NIRSA and ensures that the notification portal reflects the current state of technology with regard to data protection and data security. It makes available online the document “Q&A NPL”, which provides answers to questions concerning the notification portal for events involving laser radiation and offers guidance on registration and the preparation of notifications.

4 Responsibilities of examining bodies

Only examining bodies whose certificates of competence at level 1 or 2 are listed in the FDHA-O may hold examinations and issue individual certificates of competence at level 1 or 2 to successful candidates.

The requirements for and responsibilities of examining bodies are described in Sections 4.1–4.5 and in Article 17 O-NIRSA.

4.1 Requirements for expert examiners and trainers

Expert examiners and trainers should come from the laser field, with specialist knowledge and practical experience of show lasers. In the application, the examining body should provide information on the professional and teaching qualifications and experience of the expert examiners and trainers in the area of show lasers.

4.2 Conduct and notification of training and examinations

The examining body's expert examiners conduct the theoretical and practical examinations. Sections 7 and 8 define the orientation and performance objectives which must be attained so that the training and examinations reflect the current state of science and technology. Also defined is the ratio of practical to theoretical examination assignments. Further details on examinations can be found in Sections 9 and 10.

The examining body must notify the FOPH by e-mail (laser@bag.admin.ch) 14 days in advance of any planned training or examinations, specifying the date, the venue and the laser products that are to be used.

4.3 Issuing certificates of competence at level 1 or 2

The examining body issues certificates of competence at level 1 or 2, containing the following information:

- designation,
- name of the examining body issuing the certificate,
- first name and surname of the person who has obtained the certificate of competence at level 1 or 2,
- date of birth of the person who has obtained the certificate of competence at level 1 or 2,
- examination date and place.

4.4 Examination statistics

The examining body maintains examination statistics, providing information on pass/fail rates. Each year, it communicates these statistics to the FOPH no later than 31 October. The examining body notifies the FOPH of the dates of planned training and examinations in good time (see Section 4.2). Whenever examinations have been conducted, the examining body reports to the FOPH within a month, via data entry in the online portal, the first name, surname and date of birth of the persons awarded certificates of competence at level 1 or 2.

4.5 Training and examination documentation

The examining body notifies the FOPH without delay of amendments to training and examination documentation designed to reflect the current state of science and technology, and of changes in the professional qualifications of trainers and expert examiners.

5 Training

This section describes in more detail the content of the documentation to be submitted with applications to conduct training for certificates of competence.

5.1 Organisation of training

The following information should be included with the application:

- Announcement: registration for training and cancellation
- Costs of training

5.2 Eligibility conditions

The conditions of eligibility for training (e.g. specialist knowledge expected of participants or preparatory assignments to be completed before training) are to be defined in the application, if the training requires certain prior knowledge.

5.3 Duration of training

The duration of training depends on the future area of activity of the competent person. The certificate of competence at level 1 for events not involving laser radiation in the audience zone is to be obtained within a shorter period than the certificate of competence at level 2 for events involving laser radiation in the audience zone. The minimum amount of training, depending on participants' prior knowledge, should be around 1 day for the certificate of competence at level 1, and around 4 days for the certificate of competence at level 2. Training for the certificate of competence at level 2 can be spread out over a period of several weeks.

5.4 Ratio of practical to theoretical training

Trainers conduct both theoretical and practical training. For the certificate of competence at level 1, the theoretical component should make up about 40–50% and the practical component 50–60% of the training; for the certificate of competence at level 2, 50–60% should be devoted to the theoretical and 40–50% to the practical component. The ratio of practical to theoretical training must be clearly apparent from the training documentation.

5.5 Number of participants

In view of the practical component, the number of participants for training to obtain a certificate of competence must not exceed 10 for level 2, and 12 for level 1.

5.6 Requirements for training facilities and venue

A workspace is to be made available, and the necessary equipment should be in perfect condition. Ideally, training should take place *in situ* (e.g. at an event venue), so that both participants and trainers are confronted with the practical everyday problems. Also conceivable is the simulation of problems arising from typical practical application scenarios, e.g. involving reflective materials, or other practical challenges.

It is recommended that, per 3 participants at most, the following materials (at least) should be available for the practical component of training:

- 1 programmable show laser (with CE marking and laser class label in accordance with SN EN 60825-1:2014), with an emergency shut-off
- 1 laser show software for laser system control, installed on each laptop
- stand or alternative laser system mounting device, e.g. traverse system
- laptop
- enclosed space
- diaphragms, diverging lenses, filters, etc. with suitable mounting (only for training for certificate of competence at level 2)

Further training materials:

- fast photosensor and oscilloscope, or fast recorder (to measure pulse duration) (only for training for certificate of competence at level 2)
- optional: one or more calibrated laser power meters (only for training for certificate of competence at level 2)
- additional materials for demonstrating real-life situations (different types of show laser, control software, safety glasses, disco balls, flammable materials, etc.)

For the certificate of competence at level 2, participants may be asked to bring along and use their own show laser materials.

5.7 Training documentation

To provide an overview of training, the examining body should indicate the overall structure, showing the daily schedule (with the theoretical and practical components) and the duration of training. The ratio of theoretical to practical training is specified in Section 5.4, and the duration of training in Section 5.3.

A detailed timetable is to be prepared, showing the content of training, the time for each lesson, the instruction units (45 minutes = 1 unit) and the methods used for each unit.

It should be described in detail how the training proceeds and how the individual types of content are communicated. For this purpose, the examining body – with the aid of the training content and performance objectives listed in Sections 7 and 8 – prepares notes describing the training procedure. The training material must cover the examination topics. The participants must know what is training material and what is a possible examination topic.

The examining body prepares the training documents for participants. These documents should cover the orientation and performance objectives specified in Sections 7 and 8. These training documents enable the participants to learn the material required for the examination and to prepare themselves as effectively as possible for the practical and theoretical examination. The training documents provided must refer to the provisions of the O-NIRSA and the laser product safety standard SN EN 60825-1:2014.

Theoretical and practical presentation materials should be used in an auxiliary manner. PowerPoint presentations can provide a sound basis for training. They should cover the most important learning objectives (using graphics or key points and brief texts).

The examining body should list in the application any teaching aids which may be used. If reference is made to comprehensive specialised literature, it is important to include specific page and chapter references which are relevant for those who wish to obtain a certificate of competence at level 1 or 2.

5.8 Training quality assurance

In the application, the examining body should describe how the quality of training is to be assured. It is recommended that an evaluation is conducted with the participants during and/or after each training event, and that the results are recorded in writing and analysed. Based on the feedback, the planned teaching times and content, the methods used, the training documents, etc., should be reviewed at regular intervals and, if necessary, adjusted. Also recommended are regular self- and third-party assessments of trainers. Amendments to training documents and changes in the professional qualifications of trainers must be reported to the FOPH.

6 Content of training

This guidance gives a detailed account of the training content defined in the O-NIRSA. It describes, via orientation and performance objectives, the knowledge and skills which a person must have to obtain a certificate of competence at level 1 or 2.

6.1 Training content: certificate of competence at level 1

The content of training for the acquisition of a certificate of competence at level 1 must reflect the current state of science and technology and be based on Annex 3 Numbers 3.1–3.3 (O-NIRSA). The topics to be covered and the performance objectives to be attained are described in detail in Section 7.

6.2 Training content: certificate of competence at level 2

The content of training for the acquisition of a certificate of competence at level 2 must reflect the current state of science and technology and be based on Annex 3 Numbers 3.1–3.4 (O-NIRSA). The topics to be covered and the performance objectives to be attained are described in detail in Section 8.

6.3 Plan of the venue

With each notification, at least one plan of the venue, with the laser equipment marked, must be submitted. Using this plan, the FOPH checks whether the necessary safety distances from the audience zone are maintained and whether the audience zone will be subject, at most, to the maximum permissible exposure (MPE). Laser equipment must not impede or block passage through areas designated as emergency exits.

From the plan of the venue (maximum clarity is provided by a side view in addition to a ground plan), the following points must be apparent:

- Scale
- Audience zone (indicating 2.5 m to the side and 3 m above) (e.g. marked in green)
- Minimum distance to the audience zone (not the audience)
- Location of all laser equipment:
    - position and orientation of laser projectors
    - beam-shaping apertures
    - projection surfaces, etc.
- All objects connected with the laser show:
    - reflective surfaces (mirrors, windows, etc.)
    - mirror ball, etc.
    - or an indication that there are no reflective surfaces
- Place from where the system is operated
- Facilities such as stage, mixing console, bar
- Escape routes, emergency exits (ensure that no equipment or laser projections obstruct the escape routes and emergency exits)
- Barriers for laser equipment
- For open-air laser events: neighbouring facilities and buildings
- Laser zone where the maximum permissible exposure is not complied with is to be marked e.g. in red

6.4 Description of laser shapes

For the submission of a notification of an event involving laser radiation in the audience zone, a description of the laser shapes is required. From the description of the laser shapes to be displayed, it should be apparent, insofar as can be determined in advance without measurement:

- where the laser beams are scanned within the space
- the minimum beam scanning velocity (speed of change of direction of the laser beam) or the maximum pulse duration that occur in the entire laser show
- the peak output power
- in addition, the critical points in the space where the greatest risk exists for the audience (irradiance, exposure duration and maximum laser pulse duration) are to be specifically indicated.

6.5 Orientation and performance objectives

The participants must become capable of safely conducting an event involving laser radiation. The laser radiation employed at events must not endanger the health of the audience, performers or event staff and must not lead to eye or skin injuries or to dazzling with safety implications. The orientation and performance objectives are described in Sections 7 and 8. The orientation objectives define the behaviour that learners must exhibit in particular situations. The performance objectives elaborate the individual orientation objectives. The orientation and performance objectives are presented in tabular form.

7 Orientation and performance objectives for the certificate of competence at level 1

Orientation objectives 1 and 2:
Persons holding a certificate of competence at level 1 understand the fundamentals of lasers, know how risks can be reduced to a minimum and are familiar with various safety measures. They are aware of the hazard potential of a laser, and of possible effects on human health.

Table 3. Performance objectives relating to orientation objectives 1 and 2 for the certificate of competence at level 1

Topic	Performance objective	Examination
1. Laser technology and safety: certificate of competence at level 1		
1.1 Principle & structure of a laser device		
1.1.1 Laser	Describes the essential differences between a laser and a conventional light source. Enumerates different types of laser. Understands what a continuous wave (CW) laser is.	Theory
1.1.2 Show laser principle	Knows that a laser show mainly consists of one or more laser beams deflected by a high-speed mirror galvanometer (galvo), and that, in this process, lasers of different wavelengths are used, with additional colours being generated by superposition. Knows the difference between a beam show and a graphics show.	Theory
1.1.3 Show laser components	Describes and indicates the essential components of a show laser (dichroic mirror, galvanometric scanner, shutter, interfaces, software, emergency shut-off, laser mainboard).	Practical
1.2 Laser classes		
1.2.1 Laser class limits	Knows the various laser classes (1, 1M, 1C, 2, 2M, 3R, 3B and 4) in accordance with SN EN 60825-1:2014.	Theory
1.2.2 Hazards of particular classes	Knows the hazards associated with the various classes, i.e. that Class 1 is safe for long-term exposure, Class 2 assumes a protective blink reflex within 0.25 seconds, Class 3R poses an increased risk, Class 3B is always hazardous for the eyes and Class 4 is hazardous for the eyes and skin. Knows that the sale of laser products classified as Class 3B or 4 according to DIN EN 50689:2022-12 to consumers is prohibited.	Theory
1.3 Risks & safety measures		

1.3.1 Risks	Identifies any risks present.	Practical
1.3.2 Direct hazard – direct, reflected, scattered laser radiation	Describes how eye and skin hazards can arise both from direct and from reflected or diffusely scattered laser radiation.	Theory
1.3.3 Direct laser radiation	Explains that only a Class 1 laser is “safe” as regards direct hazards, and that with Class 2 an active blink reflex is necessary.	Theory
1.3.4 Uncontrolled reflected radiation	Is aware of the possibility of stray laser radiation from reflective objects.	Theory
1.3.5 Diffusely reflected radiation	Distinguishes specular and diffuse reflection. Knows that the radiant flux is much higher with direct than with diffuse reflection.	Theory
1.3.6 Indirect hazards	Describes how laser radiation poses risks to humans through dazzling, the development of toxic or carcinogenic vapours, or the ignition of materials (secondary hazards).	Theory
1.3.7 Material damage	Knows that Class 4 (and possibly also Class 3B) lasers may also present a fire hazard. Knows that cameras and projectors can be destroyed by laser radiation.	Theory
1.3.8 Safety measures	Uses appropriate safety measures to prevent any direct or indirect hazards associated with laser radiation according to the TOP principle (first: T = technical & structural safety measures; second: O = organisational safety measures; third: P = personal safety measures).	Theory/ Practical
2. Health effects: certificate of competence at level 1		
2.1 Eye and skin injuries		
2.1.1 Anatomy of the eye	Knows the anatomy of the eye and thus the following terms: conjunctiva, cornea, pupil, iris, crystalline lens, vitreous body, retina, macula, fovea, cones, rods, blind spot and optic nerve.	Theory
2.1.2 Retinal image of conventional light source and laser	Describes how a conventional light source (relatively large image) and a laser (point-type image) are represented on the retina.	Theory
2.1.3 Retinal injuries/damage	Understands that laser-induced retinal damage is often irreversible and severe since non-regenerable nerve cells are destroyed. Knows that such injuries are not immediately detected due to the lack of pain receptors.	Theory
2.1.4 Skin hazards and skin damage	Knows examples of skin damage and is aware that the risk is greatest for performers or other event staff (outside the audience zone).	Theory
2.2 Dazzling, distraction		
2.2.1 Dazzling and vision	Is aware of the dazzling issue and understands that dazzling can temporarily impair vision.	Theory

2.2.2 Disturbance/distraction; dazzling; afterimages; damage	Describes the various effects of a laser on the eye.	Theory
2.3 Hazards for third parties and persons performing safety-critical activities		
2.3.1 Hazard potential and effects on third parties	Understands the direct and indirect hazard potential and possible effects on third parties.	Theory
2.3.2 Accident situations	Knows that in the event of accidental eye injuries immediate referral for ophthalmological treatment is required.	Theory
2.3.3 Particular hazards involved in working with laser radiation	Understands that working with laser radiation involves particular hazards which, unless precautions are taken, can lead to serious accidents and damage to health.	Theory
2.3.4 Persons performing safety-critical activities	Understands that dazzling temporarily impairs vision and that, in persons performing safety-critical activities and in third parties, this visual disturbance leads to an increased risk of accidents (afterimages lasting up to several minutes).	Theory

Orientation objectives 3 and 4:

Persons holding a certificate of competence at level 1 are familiar with the legal foundations and with the specific responsibilities, roles and powers relating to the various areas of activity, and they know who is required to notify what via the notification portal, and how and when this is to be done. They can conduct an event involving laser radiation (Class 1M, 2M, 3R, 3B or 4) in such a way that no exposure occurs in the audience zone.

Table 2. Performance objectives relating to orientation objectives 3 and 4 for the certificate of competence at level 1

Topic	Performance objective	Examination
3. Legal foundations: certificate of competence at level 1		
3.1 Legislation and O-NIRSA		
3.1.1 Regulations for events involving laser radiation (O-NIRSA)	Is familiar with Annex 3 O-NIRSA and knows that the O-NIRSA regulates situations involving health hazards associated with high-power laser products.	Theory
3.1.2 Audience zone (Art. 10 let. b O-NIRSA)	Knows the definition of the audience zone for an event in accordance with Art. 10 let. b O-NIRSA and determines this zone. Ensures, by means of barriers and other measures (TOP principle), that no audience members, performers or event staff can enter laser zones.	Theory/ Practical
3.1.3 Protection through the O-NIRSA and occupational safety law	Knows that the protection afforded by the O-NIRSA is restricted to the audience, performers and other event staff operating in the stage and audience zone, insofar as they are not employed by the event systems company. Otherwise they are covered by employee protection requirements.	Theory
3.2. Requirements of O-NIRSA for events not involving laser radiation in the audience zone (person with certificate of competence at level 1)		
3.2.1 No laser radiation in the audience zone, either during operation or in case of malfunction (O-NIRSA Annex 3, No. 1.1.1)	Ensures that laser radiation does not enter the audience zone either during scheduled operation or in the event of malfunction and that, to this end, the laser equipment is appropriately positioned or that the laser radiation is contained or shut off by physical or electronic equipment.	Theory/ Practical
3.2.2 Reflective surfaces (O-NIRSA Annex 3, No. 1.1.2)	Ensures that laser radiation does not strike reflective surfaces or objects in an uncontrolled manner.	Practical
3.2.3 Secure installation (O-NIRSA Annex 3, No. 1.1.3)	Sets up laser devices, mirrors, targets and protective screens in such a way that they are all securely installed and capable of withstanding shocks, vibrations and wind.	Practical
3.2.4 Performers and other event staff (O-NIRSA Annex 3, No. 1.1.4)	Ensures, through appropriate planning, that laser radiation does not endanger either performers or other event staff. Takes appropriate safety measures in accordance with the TOP principle (in particular, laser adjustment eye-protectors or safety glasses and protective clothing for performers) and warns the persons concerned about hazardous laser radiation. If relevant, the movement sequences of performers are	Practical

	checked in advance depending on the direction of the laser beam. If necessary, the movement sequences are adjusted and the lasers are set up to always ensure the safety of performers.	
3.2.5 Not endangering third parties (O-NIRSA Annex 3, No. 1.1.5)	Ensures that laser radiation does not endanger third parties.	Practical
3.2.6 Successful test run (O-NIRSA Annex 3, No. 1.1.6)	Carries out a successful test run before the start of the event; i.e. the competent person fulfils all the requirements specified in Annex 3 Number 1.1.	Practical
3.2.7 Visual contact (O-NIRSA Annex 3, No. 1.2.4)	The person with a certificate of competence at level 2 or the person instructed by him/her with a certificate of competence at level 1 ensures that visual contact is maintained at all times with all laser devices, recognises malfunctions and unplanned hazard situations, and is able to interrupt the laser event at any time.	Practical
3.3 Notification and notification portal O-NIRSA		
3.3.1 Notification content, certificate of competence at level 1 (O-NIRSA Annex 3, No. 2.1–2.2)	Submits a notification via the notification portal to the FOPH, with the appropriate content and the relevant documents, no later than 14 days before the beginning of the event (as specified in Annex 3 Numbers 2.1 and 2.2).	Practical
3.3.2 Mandatory notification	Understands what mandatory notification means and that the conduct of the event involving laser radiation is subject only to mandatory notification, not to approval. In other words, the O-NIRSA relies on the individual responsibility of the competent person.	Theory
3.3.3 Certificate of competence at level 1	Knows what type of event can be notified by a person with a certificate of competence at level 1 (event not involving laser radiation in the audience zone) and what type cannot (event involving laser radiation in the audience zone).	Theory
3.3.4 Instruction of a person with a certificate of competence at level 1 by a person with a certificate of competence at level 2	Knows that a person with a certificate of competence at level 2 may instruct a person with a certificate of competence at level 1 to supervise an event involving laser radiation in the audience zone. It lies within the responsibility and authority of the person with a certificate of competence at level 1 to conduct the event in accordance with the notification submitted by the person with a certificate of competence at level 2 and to ensure that visual contact is maintained at all times with all laser devices.	Theory
3.3.5 Plan of the venue with laser equipment marked	Prepares a complete plan of the venue for the event, including all the details specified in Section 6.3, with the laser equipment marked.	Practical
3.4 Product safety and employment law (optional)		
3.4.1 Product safety law	Knows that the Federal Act of 12 June 2009 on Product Safety (PrSG; SR 930.11) regulates the safe placing on the market of products. Thus, under the PrSG, with regard to product use, only the safety of the product can be controlled and not whether the user actually uses the product in accordance with the manufacturer’s safety instructions.	Theory

3.4.2 NEV	Knows that most laser products are regulated by the Ordinance on Low-Voltage Electrical Equipment (NEV; SR 734.26) and that the competent supervisory authority is the Federal Inspectorate for Heavy Current Installations (ESTI). This means that, in the event of problems with the laser product, the competent person can contact the ESTI.	Theory
3.4.3 Product safety – inappropriate use	Knows that if high-power laser devices are inappropriately used, limits can be exceeded and the health of the audience can potentially be endangered as a result. Knows that these products are only safe if all the manufacturer's safety instructions are complied with and if they are used by a specially trained competent person.	Theory
3.4.4 Competent use (O-NIRSA)	Knows that, over and above the PrSG, the O-NIRSA regulates the competent use of laser devices. Knows that the O-NIRSA is designed to improve safety in the use of laser products and therefore makes competence a requirement and regulates the entire exposure situation at events open to the public.	Theory
3.4.5 Occupational safety law	Knows that occupational exposure from sources of non-ionising radiation (NIR) within the enterprise is covered by the Ordinance of 19 December 1983 on the Prevention of Accidents and Occupational Illnesses (VUV; SR 832.30), which is based on the Federal Act of 20 March 1981 on Accident Insurance (UVG; SR 832.20) and the Federal Act of 13 March 1964 on Work in Industry, Trade and Commerce (ArG; SR 822.11).	Theory
3.4.6 Protection against NIR sources at the workplace	Understands that occupational safety law is designed to protect employees and that the State Secretariat for Economic Affairs (SECO) and the Swiss National Accident Insurance Fund (SUVA) are responsible for protection against NIR at the workplace.	Theory
3.4.7 Protection through the O-NIRSA	Knows that the protection afforded by the O-NIRSA is restricted to the audience and performers or other event staff, insofar as they are not employed by the event systems company. Otherwise they are covered by employee protection requirements.	Theory
3.5 Rights and duties under O-NIRSA		
3.5.1 Responsibilities of the enforcement authority (Art. 24 O-NIRSA)	Knows the responsibilities of the FOPH: operating the notification portal for events involving laser radiation, reviewing notifications, verifying compliance with requirements on site, transmitting notifications concerning laser radiation emitted into airspace to the body responsible for air traffic control.	Theory
3.5.2 Event involving laser radiation emitted into airspace – notification (Art. 14 para. 2 O-NIRSA)	Knows that events involving radiation emitted into airspace by a laser of any class must be notified to the FOPH no later than 14 days before the beginning of the event.	Theory

3.5.3 Event involving laser radiation emitted into airspace – definition of airspace	Understands that airspace is defined as any part of the sky in which a manned aircraft (aeroplane, helicopter, balloon, etc.) may possibly be present.	Theory
3.5.4 Event involving laser radiation emitted into airspace – information (Art. 24 para. 1 let. b O-NIRSA)	Knows that the notification of emissions into airspace submitted via the notification portal is automatically passed on by the FOPH as information to the Special Flight Office of skyguide (air traffic control authority).	Theory
3.5.5 Event involving laser radiation emitted into airspace – details of emissions (Annex 3 Number 2.1 O-NIRSA)	Knows what additional details (coordinates, laser beam direction with azimuth 0–359° and elevation -90° – +90°)) are required for an event involving laser radiation emitted into airspace.	Theory
3.5.6 Safety of emissions into airspace (Art. 14 para. 1 O-NIRSA)	Knows that any person who operates a laser device of any class emitting laser radiation in or into the open air must not endanger other people; in particular, pilots must not be dazzled.	Theory
3.5.7 Special Flight Office	Knows that the Special Flight Office can neither approve nor reject the emission of laser radiation into airspace. Knows that air traffic control is responsible for the monitoring of control zones (CTR = zones with the densest air traffic) and has no influence on aircraft movements outside the CTR. Is familiar with the control zones and is aware of non-controlled aircraft movements outside the CTR, e.g. in the vicinity of hospitals (helipads).	Theory
3.5.8 Controls by enforcement bodies and cooperation duties (Art. 27 O-NIRSA)	Knows that unannounced inspections and measurements can be carried out at any time and evidence collected. Knows that any information required must be provided free of charge, that any documents required must be made available, and that access must be granted to premises and event venues.	Theory
3.5.9 Immediate on-site measures ordered by the FOPH (Art. 9 NIRSA)	Knows that, in the event of on-site inspections, measures ordered by the FOPH are to be taken without delay so as to ensure protection of the health of the audience, users, performers or other event staff.	Theory
3.5.10 Revocation of certificate of competence (Art. 9 para. 3 let. e NIRSA)	Knows that, should it be necessary in order to protect the health of users, performers, other event staff or the audience, the FOPH may, in the event of repeated inappropriate use of potentially hazardous products in a commercial or professional context, have the certificate of competence revoked.	Theory
3.5.11 Fees (Art. 26 O-NIRSA)	Knows that fees may be charged by the enforcement authorities, according to the time required, and that no fees are charged for controls, either in the notification portal or on site, which do not reveal any non-compliance.	Theory
4. Theoretical and practical foundations: certificate of competence at level 1		
4.1 Show laser set-up and operation		
4.1.1 Cable connection	Safely connects the cables required for a show laser.	Practical

4.1.2 Device installation & operation	Ensures that the laser device is stably mounted (including a stable base). For this purpose, uses (if available) stage trusses or solid stands. Ensures that the emergency shut-off switch is positioned in such a way that it can be operated at any time by the person responsible. Installs diaphragms, filters, etc. with suitable, secure mounting.	Practical
4.1.3 Projection zone	Determines the laser projection zone (direction, angle, height). Limits the projection zone (using masks, diaphragms, etc.).	Practical
4.1.4 Knowledge of control software	Knows the essential features of the control software or control solution used. Starts the software and uses it to define the projection zone.	Practical

8 Orientation and performance objectives for the certificate of competence at level 2

Orientation objectives 1 and 2:
Persons holding a certificate of competence at level 2 understand the fundamentals of lasers, know how risks can be reduced to a minimum and are familiar with various safety measures. They are aware of the hazard potential of a laser, and of possible effects on human health..

Table 3. Performance objectives relating to orientation objectives 1 and 2 for the certificate of competence at level 2

Topic	Performance objective	Examination
1. Laser technology and safety: certificate of competence at level 2		
1.1 Principle & structure of a laser device		
1.1.1 Laser	Describes the essential differences between a laser and a conventional light source. Enumerates different types of laser. Understands what a continuous wave (CW) laser is.	Theory
1.1.2 Laser parameters	Names the essential parameters (beam diameter, beam divergence, wavelength, radiant exposure, irradiance, radiant flux, radiant energy, angular velocity, emission time) and the associated units (mm, mrad, nm, J/m^2, etc.).	Theory
1.1.3 Show laser principle	Knows that a laser show mainly consists of one or more laser beams deflected by a high-speed mirror galvanometer (galvo), and that, in this process, lasers of different wavelengths are used, with additional colours being generated by superposition. Knows the difference between a beam show and a graphics show.	Theory
1.1.4 Show laser components	Describes and indicates the essential components of a show laser (dichroic mirror, galvanometric scanner, shutter, interface, software, emergency shut-off, laser mainboard).	Practical
1.1.5 Hardware characteristics	Knows the essential differences in quality between devices with regard to optical power, beam geometry, galvo speed, modulation technology. Knows that information on the galvo speed for the ILDA Test Pattern is only meaningful if the projection size is given. Knows the difference between analogue and TTL modulation.	Practical
1.1.6 Control technology	Describes the advantages and disadvantages of the various control technologies (automatic, music, DMX, ILDA, network, other) and uses the control technologies.	Theory/ Practical
1.2 Laser classes		
1.2.1 Laser class limits	Describes the various laser classes (1, 1M, 1C, 2, 2M, 3R, 3B and 4) in accordance with SN EN 60825-1:2014. Knows that Class 2 and 2M only apply to visible-light lasers. Knows the limits applicable to the laser classes for continuous wave (CW) laser radiation in the visible range. Knows that the limit depends on the emission duration.	Theory

1.2.2 Hazards of particular classes	Knows the hazards associated with the various classes, i.e. that Class 1 is safe for long-term exposure, Class 2 assumes a protective blink reflex within 0.25 seconds, Class 3R poses an increased risk, Class 3B is always hazardous for the eyes and Class 4 is hazardous for the eyes and skin. Knows that the sale of laser products classified as Class 3B or 4 according to DIN EN 50689:2022-12 to consumers is prohibited.	Theory
1.3 Limits & MPE		
1.3.1 Laser standard	Is familiar with the currently valid laser safety standards (i.e. SN EN 60825-1:2014). Knows that the standard serves as the basis for the classification of laser products.	Theory
1.3.2 MPE values	Distinguishes the maximum permissible exposure (MPE) and the accessible emission limit (AEL).	Theory
1.3.3. Multiple pulses	Knows that with modulated laser radiation various limits need to be considered (single pulse, multiple pulse, pulse sequence) and the lowest limit is applicable.	Theory
1.3.4 NOHD	Knows that a hazard exists if a viewer is closer to the laser source than the nominal ocular hazard distance (NOHD).	Theory
1.3.5 Influence of fog and water	Knows that fog and water (as a medium) do not influence the hazard potential in a way which can be reliably estimated.	Theory
1.4 Risks & safety measures		
1.4.1 Risks	Identifies any risks present.	Practical
1.4.2 Direct hazards – direct, reflected, scattered laser radiation	Describes how eye and skin hazards can arise both from direct and from reflected or diffusely scattered laser radiation.	Theory
1.4.3 Direct laser radiation	Explains that only a Class 1 laser is “safe” as regards direct hazards, and that with Class 2 an active blink reflex is necessary.	Theory
1.4.4 Uncontrolled reflected radiation	Is aware of the possibility of stray laser radiation from reflective objects.	Theory
1.4.5 Diffusely reflected radiation	Distinguishes specular and diffuse reflection. Knows that the emission is much higher with direct than with diffuse reflection.	Theory
1.4.6 Indirect hazards	Describes how laser radiation poses risks to humans through dazzling, the development of toxic or carcinogenic vapours, or the ignition of materials (secondary hazards).	Theory
1.4.7 Material damage	Knows that Class 4 (and possibly also Class 3B) lasers may also present a fire hazard. Knows that cameras and projectors can be destroyed by laser radiation.	Theory
1.4.8 Safety measures	Uses appropriate safety measures to prevent any direct or indirect hazards associated with laser radiation according to the TOP principle (first: T = technical & structural safety measures; second: O = organisational safety measures; third: P = personal safety measures).	Theory/ Practical

1.5 Optimal laser systems		
1.5.1 Optimum laser power level	Determines the optimum laser power level, based on the venue dimensions and beam divergence.	Practical
1.5.2 Small venues	Knows that most show lasers are not suitable for small venues and in particular for ceiling heights < 3 m.	Theory
1.5.3 Large halls, outdoors	Understands that the hazard at short distances is distance-independent, but that at greater distances it decreases according to the beam properties.	Theory
1.5.4 Projection distances	Selects a suitable device according to the projection distance and venue size (optical power and divergence).	Practical
1.5.5 Modulation	Understands that, with TTL modulation, the hazard can only be mitigated to a limited extent.	Theory
2. Health effects: certificate of competence at level 2		
2.1 Eye and skin injuries		
2.1.1 Anatomy of the eye	Knows the anatomy of the eye and thus the following terms: conjunctiva, cornea, pupil, iris, crystalline lens, vitreous body, retina, macula, fovea, cones, rods, blind spot and optic nerve.	Theory
2.1.2 Macula	Describes the macula (yellow spot). Knows that the macula is 3 mm in diameter and contains 4,000,000 of the total of 6,800,000 photosensitive cells (cones) which are responsible for colour vision.	Theory
2.1.3 Fovea	Describes the fovea. Knows that in the centre of the macula lies the fovea (about 1.5 mm in diameter), the area with the highest visual acuity.	Theory
2.1.4 Retinal image of conventional light source and laser	Describes how a conventional light source (relatively large image) and a laser (point-type image) are represented on the retina.	Theory
2.1.5 Comparison of 1 mW laser and sunlight	Understands that a 1 mW laser pointer produces a 10 times higher irradiance on the retina than the sun.	Theory
2.1.6 Spectral sensitivity of the human eye	Knows in which wavelength range the eye is at most risk.	Theory
2.1.7 Spectral sensitivity, red and green wavelengths, and power	Understands that, at the same power of the green and red wavelengths, the eye has greater spectral sensitivity towards green radiation (i.e. for the same perceived brightness of the two colours, the power must be reduced for green).	Theory
2.1.8 Spectral sensitivity, blue wavelength	Knows that the human eye has lower spectral sensitivity in the blue wavelength region and that therefore a higher power would need to be used for it to be perceived as of equal brightness to other colours. Knows that the limits partly depend on the wavelength and are most restrictive in the blue wavelength region.	Theory
2.1.9 Mechanisms of action of laser radiation on tissue	Understands that, depending on the wavelength, irradiance and duration of exposure, a laser may have various biological effects on the eye, which can be classified as thermal effects, photochemical effects, photoablation and photodisruption.	Theory

2.1.10 Thermal effects in the VIS & IR-A wavelength regions	Knows that in the wavelength range from 400 nm to 1400 nm, depending on laser power, the retina in particular can be damaged, and that in the IR-A region clouding of the crystalline lens is also possible.	Theory
2.1.11 Examples of thermal retinal damage	Knows examples of retinal damage and knows the effects caused by focusing the beam on the macula (dark spots in the visual field), on the blind spot (destruction of nerve tracts with considerable impairment or even complete loss of vision), or on peripheral areas of the retina (severe visual disturbances).	Theory
2.1.12 Retinal injuries/damage	Understands that laser-induced retinal damage is often irreversible and severe since non-regenerable nerve cells are destroyed.	Theory
2.1.13 Factors influencing retinal hazards	Names the factors on which retinal hazards depend (wavelength, power, emission duration, pulse duration, pulse number, viewing angle).	Theory
2.1.14 Photochemical effects in the UV (and 400–600 nm) wavelength region	Knows that in the UV and 400–600 nm wavelength region photochemical effects also occur, which show particularly low exposure limits.	Theory
2.1.15 UV-A, UV-B, UV-C and IR-B and IR-C	Knows that laser radiation in these wavelength regions can cause damage especially in the front of the eye, the crystalline lens, cornea and conjunctiva.	Theory
2.1.16 Skin hazards and skin damage	Knows examples of skin damage and is aware that the risk is greatest for stagehands, performers or other event staff (outside the audience zone).	Theory
2.2 Dazzling, distraction		
2.2.1 Dazzling and vision	Is aware of the dazzling issue and understands that dazzling can temporarily impair vision.	Theory
2.2.2 Disturbance/distraction; dazzling; afterimages; damage	Describes the various effects of a laser on the eye.	Theory
2.2.3 Causes of flash blindness and afterimages	Describes how flash blindness and afterimages are caused by a sudden influx of light (retinal photopigments are oversaturated, so that no information-bearing electrical impulses can be sent to the brain).	Theory
2.3 Hazards for third parties and persons performing safety-critical activities		
2.3.1 Hazard potential and effects on third parties	Understands the direct and indirect hazard potential and possible effects on third parties.	Theory
2.3.2 Accident situations	Knows that in the event of accidental eye injuries immediate referral for ophthalmological treatment is required.	Theory
2.3.3 Particular hazards involved in working with laser radiation	Understands that working with laser radiation involves particular hazards which, unless precautions are taken, can lead to serious accidents and damage to health.	Theory

2.3.4 Persons performing safety-critical activities	Understands that dazzling temporarily impairs vision and that, in persons performing safety-critical activities and in third parties, this visual disturbance leads to an increased risk of accidents (afterimages lasting up to several minutes).	Theory

Orientation objectives 3 and 4:

Persons holding a certificate of competence at level 2 are familiar with the legal foundations and with the specific responsibilities, roles and powers relating to the various areas of activity, and they know who is required to notify what via the notification portal, and how and when this is to be done. They can perform the necessary advance calculations, planning, installation and calibration for and conduct an event involving laser radiation from Class 1M, 2M, 3R, 3B or 4 devices with a show laser of any kind in such a way that the MPE is complied with in the audience zone.

Table 4. Performance objectives relating to orientation objectives 3 and 4 for the certificate of competence at level 2

Topic	Performance objective	Examination
3. Legal foundations: certificate of competence at level 2		
3.1 Legislation and O-NIRSA		
3.1.1 Regulations for events involving laser radiation (O-NIRSA)	Is familiar with Annex 3 O-NIRSA and knows that the O-NIRSA regulates situations involving health hazards associated with high-power laser products (i.e. not the products themselves – see the Product Safety Act, SR 930.11).	Theory
3.1.2 Audience zone (Art. 10 let. b O-NIRSA)	Defines “audience zone” and knows that the maximum permissible exposure (MPE) must always be complied with in the audience zone. Determines the audience zone for an event. Ensures that no audience members, performers or other event staff can enter the area where the MPE values are exceeded (laser zone).	Theory/ Practical
3.2. Requirements of O-NIRSA for events involving laser radiation in the audience zone (person with certificate of competence at level 2)		
3.2.1 Compliance with MPE during operation and in case of malfunction (O-NIRSA Annex 3, No. 1.2.1)	Ensures that laser radiation in the audience zone does not, either during scheduled operation or in the event of malfunction: (a) exceed the maximum permissible exposure (MPE) for the cornea, as specified in SN EN 60825-1:2014; (b) exceed the level of 0.02 x MPE for the cornea, if it cannot be ensured that instruments such as binoculars are not used by the audience.	Theory/ Practical
3.2.2 Reflective surfaces (O-NIRSA Annex 3, No. 1.2.2)	Ensures that laser radiation does not strike reflective surfaces or objects in an uncontrolled manner.	Practical
3.2.3 Secure installation (O-NIRSA Annex 3, No. 1.2.3)	Sets up laser devices, mirrors, targets and protective screens in such a way that they are all securely installed and capable of withstanding shocks, vibrations and wind.	Practical
3.2.4 Visual contact (O-NIRSA Annex 3, No. 1.2.4)	The person with a certificate of competence at level 2 or the person instructed by him/her with a certificate of competence at level 1 ensures that visual contact is maintained at all times with all laser devices, recognises malfunctions and unplanned hazard situations, and is able to interrupt the laser event at any time.	Practical

3.2.5 Performers and other event staff (O-NIRSA Annex 3, No. 1.2.5)	Ensures, through appropriate planning, that laser radiation does not endanger either performers or other event staff. Takes appropriate safety measures in accordance with the TOP principle (in particular, laser adjustment eye-protectors or safety glasses and protective clothing for performers) and warns the persons concerned about hazardous laser radiation. If relevant, the movement sequences of performers are checked in advance depending on the direction of the laser beam. If necessary, the movement sequences are adjusted and the lasers are set up to always ensure the safety of performers.	Practical
3.2.6 Not endangering third parties (O-NIRSA Annex 3, No. 1.2.6)	Ensures that laser radiation does not endanger third parties.	Practical
3.2.7 Successful test run (O-NIRSA Annex 3, No. 1.2.7)	Carries out a successful test run before the start of the event; i.e. the competent person fulfils all the requirements specified in Annex 3 Number 1.2, tests all the emergency procedures and ensures in particular that the MPE is not exceeded in the audience zone.	Practical
3.3 Notification and notification portal O-NIRSA		
3.3.1 Notification content, certificate of competence at level 2 (O-NIRSA Annex 3, 2.1 & 2.3)	Submits a notification via the notification portal to the FOPH, with the appropriate content and the relevant documents, no later than 14 days before the beginning of the event (as specified in Annex 3 Numbers 2.1 and 2.3).	Practical
3.3.2 Mandatory notification	Understands what mandatory notification means and that the conduct of the event involving laser radiation is subject only to mandatory notification, not to approval. In other words, the O-NIRSA relies on the individual responsibility of the competent person.	Theory
3.3.3 Certificate of competence at level 2	Knows that all types of notifications can be submitted by a person with a certificate of competence at level 2.	Theory
3.3.4 Instruction of a person with a certificate of competence at level 1 by a person with a certificate of competence at level 2	Knows that a person with a certificate of competence at level 2 may instruct a person with a certificate of competence at level 1 to supervise an event involving laser radiation in the audience zone. It lies within the responsibility and authority of the person with a certificate of competence at level 1 to conduct the event in accordance with the notification submitted by the person with a certificate of competence at level 2.	Theory
3.3.5 Description of laser shapes	Prepares a fully detailed description of the laser shapes.	Practical
3.3.6 Plan of the venue with laser equipment marked	Prepares a complete plan of the venue for the event, with the laser equipment marked.	Practical
3.4 Product safety and employment law		

3.4.1 Product safety law	Knows that the Federal Act of 12 June 2009 on Product Safety (PrSG; SR 930.11) regulates the safe placing on the market of products. Thus, under the PrSG, with regard to product use, only the safety of the product can be controlled and not whether the user actually uses the product in accordance with the manufacturer's safety instructions.	Theory
3.4.2 NEV	Knows that most laser products are regulated by the Ordinance on Low-Voltage Electrical Equipment (NEV; SR 734.26) and that the competent supervisory authority is the Federal Inspectorate for Heavy Current Installations (ESTI). This means that, in the event of problems with the laser product, the competent person can contact the ESTI.	Theory
3.4.3 Product safety – inappropriate use	Knows that if high-power laser devices are inappropriately used, limits can be exceeded and the health of the audience can potentially be endangered as a result. Knows that these products are only safe if all the manufacturer's safety instructions are complied with and if they are used by a specially trained competent person.	Theory
3.4.4 Competent use (O-NIRSA)	Knows that, over and above the PrSG, the O-NIRSA regulates the competent use of laser devices. Knows that the O-NIRSA is designed to improve safety in the use of laser products and therefore makes competence a requirement and regulates the entire exposure situation at events open to the public.	Theory
3.4.5 Occupational safety law	Knows that occupational exposure from sources of non-ionising radiation (NIR) within the enterprise is covered by the Ordinance of 19 December 1983 on the Prevention of Accidents and Occupational Illnesses (VUV; SR 832.30), which is based on the Federal Act of 20 March 1981 on Accident Insurance (UVG; SR 832.20) and the Federal Act of 13 March 1964 on Work in Industry, Trade and Commerce (ArG; SR 822.11).	Theory
3.4.6 Protection against NIR sources at the workplace	Understands that occupational safety law is designed to protect employees and that the State Secretariat for Economic Affairs (SECO) and the Swiss National Accident Insurance Fund (SUVA) are responsible for protection against NIR at the workplace.	Theory
3.4.7 Protection through the O-NIRSA	Knows that the protection afforded by the O-NIRSA is restricted to the audience and performers or other event staff, insofar as they are not employed by the event systems company. Otherwise they are covered by employee protection requirements.	Theory
3.5 Rights and duties under O-NIRSA		
3.5.1 Responsibilities of the enforcement authority (Art. 24 O-NIRSA)	Knows the responsibilities of the FOPH: operating the notification portal for events involving laser radiation, reviewing notifications, verifying compliance with requirements on site, transmitting notifications concerning laser radiation emitted into airspace to the body responsible for air traffic control.	Theory
3.5.2 Event involving laser radiation emitted into airspace – notification (Art. 14 para. 2 O-NIRSA)	Knows that events involving radiation emitted into airspace by a laser of any class must be notified to the FOPH no later than 14 days before the beginning of the event.	Theory

3.5.3 Event involving laser radiation emitted into airspace – definition of airspace	Understands that airspace is defined as any part of the sky in which a manned aircraft (aeroplane, helicopter, balloon, etc.) may possibly be present.	Theory
3.5.4 Event involving laser radiation emitted into airspace – information (Art. 24 para. 1 let. b O NIRSA)	Knows that the notification of emissions into airspace submitted via the notification portal is automatically passed on by the FOPH as information to the Special Flight Office of skyguide (air traffic control authority).	Theory
3.5.5 Event involving laser radiation emitted into airspace – details of emissions (Annex 3 Number 2.1 O-NIRSA)	Knows what additional details (coordinates, laser beam direction with azimuth 0–359° and elevation -90° – +90°) are required for the notification of an event involving laser radiation emitted into airspace.	Theory
3.5.6 Safety of emissions into airspace (Art. 14 para. 1 O-NIRSA)	Knows that any person who operates a laser device of any class emitting laser radiation in or into the open air must not endanger other people; in particular, pilots must not be dazzled.	Theory
3.5.7 Special Flight Office	Knows that the Special Flight Office can neither approve nor reject the emission of laser radiation into airspace. Knows that air traffic control is responsible for the monitoring of control zones (CTR = zones with the densest air traffic) and has no influence on aircraft movements outside the CTR. Is familiar with the control zones and is aware of and takes responsibility in relation to non-controlled aircraft movements outside the CTR, e.g. in the vicinity of hospitals (helipads).	Theory
3.5.8 Controls by enforcement bodies and cooperation duties (Art. 27 O-NIRSA)	Knows that unannounced inspections and measurements can be carried out at any time and evidence collected. Knows that any information required must be provided free of charge, that any documents required must be made available, and that access must be granted to premises and event venues.	Theory
3.5.9 Immediate on-site measures ordered by the FOPH (Art. 9 NIRSA)	Knows that, in the event of on-site inspections, measures ordered by the FOPH are to be taken without delay so as to ensure protection of the health of the audience, users, performers or other event staff.	Theory
3.5.10 Revocation of certificate of competence (Art. 9 para. 3 let. e NIRSA)	Knows that, should it be necessary in order to protect the health of the audience, users, performers or other event staff, the FOPH may, in the event of inappropriate use of potentially hazardous products in a commercial or professional context, the certificate of competence revoked.	Theory
3.5.11 Fees (Art. 26 O-NIRSA)	Knows that fees may be charged by the enforcement authorities, according to the time required, and that no fees are charged for controls that do not reveal any non-compliance.	Theory
4. Theoretical and practical foundations: certificate of competence at level 2		
4.1 Show laser set-up and operation	Can safely install and operate a laser device.	
4.1.1 Cable connection	Safely connects the cables required for a show laser. Is familiar with the signals transmitted via an ILDA interface or an integrated intelligent mainboard (galvo, laser power, emergency shut-off). Knows the fundamental requirements for a stable network infrastructure for laser shows.	Practical

4.1.2 Device installation & operation	Ensures that the laser device is stably mounted (including a stable base). For this purpose, uses (if available) stage trusses or solid stands. Ensures that the emergency shut-off switch is positioned in such a way that it can be operated at any time by the person responsible. Installs diaphragms, diverging lenses, filters, etc. with suitable, secure mounting.	Practical
4.1.3 Projection zone	Determines the laser projection zone (direction, angle, height). Limits the projection zone (using masks, diaphragms, etc.).	Practical
4.1.4 Emergency procedures	Describes the emergency procedures (risk assessment, risk mitigation).	Practical
4.2 Laser show programming	Can safely control a show laser.	
4.2.1 Frames, patterns, shapes	Knows which laser system is suitable for a graphics show or beam show.	Theory
4.2.2 Knowledge of control software	Knows the essential features of the control software or control solutions used. Starts the software, uses it to define the projection zone and uses the beam attenuation option for audience or sensitive zones.	Practical
4.2.3 Pulse durations, corners, lines	Adjusts the angular velocities, repetition rate and pulse durations.	Practical
4.2.4 Brightness in software and laser output power	Adjusts the average and peak output power (with software and/or hardware).	Practical
4.2.5 Brightness and geometries	Knows that shapes of equal brightness can pose different risks.	Theory
4.2.6 Shape with corners	Minimises the hazard posed by corners and final points (rounding corners, reducing output, adjusting initial and final points outside the audience zone).	Practical
4.2.7 Beam parameters	Describes the beam parameters (energy distribution, diameter, divergence, wavelengths).	Practical
4.2.8 Mirror galvanometer	Knows that deflection is not linearly related to the control voltage.	Theory
4.2.9 Effects of short pulses	Knows the typical pulse durations for show laser devices and can relate these to the hazard level.	Theory
4.2.10 Minimising hazards	Adjusts the show laser so that no hazards arise (software: adjustment of output power, pulse duration, scanning speed; hardware: lenses, grey filters, increasing distance, changing device).	Practical
4.2.11 Avoiding uncontrolled reflected radiation	Ensures that no hazards arise from reflected radiation.	Practical
4.2.12 Beam shut-off reaction time in case of malfunction	Knows, for the product used, the maximum reaction time of the automatic shut-off system in the event of malfunction.	Practical
4.3 MPE		
4.3.1 Calculation of MPE	Calculates the MPE for a visible, non-pulsed laser with low beam divergence, ideal beam profile and idealised pattern. Compares the MPE with the existing irradiance.	Theory
4.3.2 Laser beam modelling	Calculates the beam diameter for various distances with the pattern displayed	Theory

4.3.3 Calculation of NOHD	Calculates the NOHD for a visible, non-pulsed laser with low beam divergence and ideal beam profile for the pattern displayed.	Theory
4.3.4 Dispersing lenses	Determines the dimensions of a dispersing lens so that the limit is complied with.	Theory
4.3.5 Divergence	Knows the influence of beam divergence on irradiance.	Theory
4.3.6 Beam velocity	Calculates a pulse duration on the basis of the beam velocity, divergence and distance to the audience zone.	Theory
4.3.7 Repetition rate	Calculates the exposure duration on the basis of the parameters beam velocity and repetition rate.	Theory
4.4 Measurement techniques		
4.4.1 Measurement with power meter	Measures the actual exposure using a suitable sensitive photosensor and an oscilloscope and compares it with the maximum permissible exposure.	Practical
4.4.2 Requirements for measurement instruments	Knows the requirements for measurement instruments (e.g. 7 mm aperture, power and wavelength range).	Theory
4.4.3 Types of power meter	Knows different types of photometric devices (thermopile, pyroelectric radiometer, photodiode).	Theory
4.4.4 Beam power	Determines the beam power of a static beam.	Practical
4.4.5 Pulse duration/repetition rate	Determines the pulse duration at the target site and the repetition rate and maximum exposure duration of the laser pulse for the eye in the audience zone.	Practical
4.4.6 Beam energy	Determines the beam energy of a single pulse and a repeated shape.	Practical
4.4.7 Calibration	Only uses calibrated measurement instruments.	Practical
4.4.8 Optimisation	Makes specific proposals on how the MPE can be complied with if it is exceeded.	Practical
4.4.9 Checking calculations	Checks whether calculations are correct by means of measurement.	Practical

9 Examination

The certificate of competence at level 1 or 2 is acquired via an examination. The examination is designed to ensure that candidates are able to safely conduct a laser show with or without laser radiation in the audience zone (depending on the competence level), without in any way endangering the health of the audience, performers or other event staff.

9.1 Purpose of the examination

Candidates who successfully complete the examination receive:

- either a certificate of competence at level 2 and are qualified to:
    - plan, notify and conduct, without endangering the audience, performers or other event staff, an event involving laser radiation (Class 1M, 2M, 3R, 3B or 4), with or without laser radiation in the audience zone;
    - plan a safe laser show, submit a notification and instruct a person with a certificate of competence at level 1 to conduct an event involving laser radiation (Class 1M, 2M, 3R, 3B or 4), with laser radiation in the audience zone.

- or a certificate of competence at level 1 and are qualified to:
    - plan, notify and conduct, without endangering the audience, performers or other event staff, an event involving laser radiation (Class 1M, 2M, 3R, 3B or 4), without laser radiation in the audience zone;
    - following instruction by a person with a certificate of competence at level 2, conduct, without endangering the audience, performers or other event staff, an event involving laser radiation (Class 1M, 2M, 3R, 3B or 4), with laser radiation in the audience zone, in accordance with the notification submitted by the person with a certificate of competence at level 2.

9.2 Organisation of the examination

The following information should be included with the application:

- Announcement: registration for the examination and cancellation
- Costs (examination fees)
- Issuing of certificates
- Appeals procedure and retention of examination documents

9.3 Eligibility conditions

Persons wishing to acquire a certificate of competence at level 1 or 2, entitling them to conduct an event involving laser radiation, must have capacity to act, as specified in Articles 12 to 14 of the Swiss Civil Code (ZGB; SR 210) and thus be at least 18 years of age. Another important condition of eligibility is the candidate's written consent to the transmission of personal data (first name and surname, date of birth and examination results) to the FOPH.

Sound specialist knowledge in the field of lasers and of the NIRSA and O-NIRSA is required to pass the examination. For this reason, training attendance should be a requirement for eligibility to participate in examinations.

The examining body should describe any additional requirements for eligibility in the application.

9.4 Examination procedure, form and duration

The examining bodies should provide a detailed description of the examination procedure. From this description, the procedure for the theoretical and practical examination should be clearly apparent. The theoretical and practical examination questions and answers should be clearly and comprehensibly

formulated with the aid of Sections 7, 8 and 10.3–10.5. The examinations should cover all topics. The practical/theoretical ratio of the examinations for the certificate of competence at level 1 and 2 is clear from Sections 10.1 and 10.2, and also from Sections 7 and 8. The examination should take the form of open questions and practical problems. In the practical part of the examination, candidates should be given the assignments in writing and should have sufficient time to read and understand the assignment. The theoretical and practical examination should last 1 hour for the certificate of competence at level 1, and 2 hours for the certificate of competence at level 2.

9.5 Aids

During the examination, candidates should be able to make use of aids such as:

- calculator
- writing equipment
- dictionary for non-native speakers, or additional time
- O-NIRSA
- list of formulas (certificate of competence at level 2)
- training documents

9.6 Requirements for facilities and examination venue

A workspace is to be made available, and the necessary equipment should be in perfect condition.

It is recommended that, per 3 participants at most, the following materials (at least) should be available for the practical part of the examination:

- 1 programmable show laser (with CE marking and laser class label in accordance with SN EN 60825-1:2014), with an emergency shut-off
- 1 software for programming the laser show, installed on each laptop
- stand or alternative mounting device, e.g. traverse system
- laptop
- enclosed space
- diaphragms, diverging lenses, filters, etc. with suitable mounting (only for certificate of competence at level 2)

Other examination materials:

- fast photosensor and oscilloscope, or fast recorder (to measure pulse duration) (only for certificate of competence at level 2)
- additional materials for demonstrating real-life situations (different types of show laser, control software, safety glasses, disco balls, flammable materials, etc.)
- optional: at least one calibrated laser power meter

For the practical examination, the examining body’s show laser materials must be used, so that candidates can show that they can evaluate and safely use this device.

Each candidate must undertake the practical examination individually and independently (not working in a group) and have a device available.

9.7 Number of candidates

Because of the practical part of the examination, no more than 10 candidates should be admitted to obtain the certificate of competence at level 2, and no more than 12 for the certificate of competence at level 1.

9.8 Determination of examination results

To pass the examination, the following criteria must be met:

- The theoretical examination is passed if 80% of the answers are correct.
- The practical examination is passed if, for the certificate of competence at level 1, no laser radiation enters the audience zone and, for the certificate of competence at level 2, the MPE in the audience zone is complied with at all times.
- Both the practical and the theoretical parts of the examination must be passed.

- The answers to the calculation assignments (certificate of competence at level 2) must be completely correct.

Candidates who do not pass the examination can discuss the results with the expert examiner. Successful candidates obtain a certificate of competence at level 1 or 2 (see Section 4.3).

After what interval and in what form an examination can be retaken should be defined by the examining body in the application.

9.9 Examination quality assurance

In the application, the examining body should describe how the quality of examinations is to be assured. It is recommended that an evaluation is conducted with the candidates after each examination, and that the results are recorded in writing and analysed. Based on the feedback, the examination procedure and assignments should be reviewed at regular intervals and, if necessary, adjusted. Also recommended are regular self- and third-party assessments of expert examiners. Amendments to the examination documents must be reported to the FOPH.

10 Content of examinations

The content of examinations for the acquisition of a certificate of competence reflects the current state of science and technology and is based on Annex 3 Number 3.1–3.4 O-NIRSA for the certificate of competence at level 2, and on Annex 3 Number 3.1–3.3 O-NIRSA for the certificate of competence at level 1. Sections 10.1 and 10.2 describe in what proportions the various areas are to be covered in the examinations for the certificate of competence at level 1 or 2. Sections 7 and 8 provide details of the content and performance objectives to be examined and indicate whether they should be part of the theoretical or practical examination.

10.1 Examination content: certificate of competence at level 1

The theoretical part should make up 40–50% and the practical part 50–60% of the examination.

The theoretical part should cover the following areas:

- Laser technology and safety
    - Laser classes
- Health effects
    - Dazzling
    - Hazards for the audience, performers or other event staff
- Legal foundations
    - Legislation and O-NIRSA
    - Requirements of O-NIRSA for competent person
    - Notification O-NIRSA
    - Rights and duties under O-NIRSA

The practical part should cover the following areas:

- Principle of a laser device
- Identifying risks and taking safety measures
- Set-up and operation of the laser device
- Safe operation without laser radiation in the audience zone
- Notification portal: submission of notification (without laser radiation in the audience zone, with laser radiation emitted into airspace) and cancellation of notification if the event is cancelled
- Instruction and handover of the laser device

10.2 Examination content: certificate of competence at level 2

The theoretical part should make up 50–60% and the practical part 40–50% of the examination.

The theoretical part should cover the following areas:

- Laser technology and safety
    - Laser classes
    - Limits and MPE
- Health effects
    - Eye and skin injuries
    - Dazzling
    - Hazards for the audience, performers or other event staff
- Legal foundations
    - Legislation and O-NIRSA
    - Requirements of O-NIRSA for competent person
    - Notification O-NIRSA
    - Product safety and employment law
    - Rights and duties under O-NIRSA

The practical part should cover the following areas:

- Principle of a laser device
- Controlling show laser systems
- Optimum laser power level, based on venue dimensions and beam divergence
- Identifying risks and taking safety measures
- Set-up and operation of the laser device
- Measurement of laser radiation in the audience zone
- Safe operation with laser radiation in the audience zone, complying with MPE
- Instruction and handover of the laser device to the person with a certificate of competence at level 1
- Notification portal: submission of notification (with laser radiation in the audience zone, and with laser radiation emitted into airspace) and cancellation of notification if the event is cancelled

10.3 Theoretical examination assignments

The theoretical examination assignments and answers should be formulated by the examining bodies and submitted with the application for listing in the FDHA-O.

10.4 Practical examination assignments for the certificate of competence at level 1

Candidates should complete the following practical assignments:

- The candidate sets up a laser device, complying with all the requirements specified in Annex 3 Number 1 of O-NIRSA. In the process, he or she identifies any risks, takes safety measures and ensures safe operation, without laser radiation in the audience zone. Anything which cannot be shown in practice should be verbally explained by the candidate while the laser device is being set up.

- Candidates register themselves on the FOPH notification portal, complete a test notification fully and correctly (without laser radiation in the audience zone and with laser radiation emitted into airspace), without a valid certificate of competence (uploading a blank document headed “Examination for certificate of competence at level 1”), and send it to the FOPH with the reference: “Examination for certificate of competence at level 1” (correctly = complete with a full plan of the event venue and details of the radiation emitted into airspace).

10.5 Practical examination assignments for the certificate of competence at level 2

Candidates should complete the following practical assignments:

- The candidate sets up a laser device, complying with all the requirements specified in Annex 3 Number 1 of O-NIRSA. In the process, he or she identifies any risks, takes safety measures and ensures safe operation, including compliance with MPE in the audience zone. Anything which cannot be shown in practice should be verbally explained by the candidate while the laser device is being set up.

- Candidates register themselves on the FOPH notification portal, complete a test notification fully and correctly (with laser radiation in the audience zone and with laser radiation emitted into airspace), without a valid certificate of competence (uploading a blank document headed “Examination for certificate of competence at level 2”), and send it to the FOPH with the reference: “Examination for certificate of competence at level 2” (correctly = complete with a full plan of the event venue and details of the radiation emitted into airspace; with a full description of the laser shapes and correct calculations and details of the laser specifications).

- The candidate controls a show laser system, with the MPE in the audience zone being complied with at all times. He or she operates this laser system and measures the radiation.

- The candidate instructs and hands over the laser device to the expert examiner who assumes the role of the person with a certificate of competence at level 1. In the process, he or she

explains all the necessary details, so that the laser device can be operated safely and the laser show conducted as notified to the FOPH.