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Entertainment Technology – Codes of Practice - Part 5: Lifting and motion Operations in the Event Industry

Veranstaltungstechnik - Verfahrensregeln - Teil 5: Hub- und Bewegungsvorgänge in der Veranstaltungsindustrie

Technologies du spectacle - Codes de bonnes pratique - Partie 5: Opérations de levage et de mouvement dans l'industrie de l'événementiel

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97.200.10	Gledališka, odrska in studijska oprema ter delovne postaje	Theatre, stage and studio equipment

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 17795-5:2021) has been prepared by Technical Committee CEN/TC 433 "Entertainment Technology - Machinery, equipment and installations", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

Introduction

This document has been prepared by CEN/TC433/WG4 Codes of practice with the aim to produce a code of practice for rigging, lifting and motion operations within the event industry.

It is intended to provide general guidelines on planning and the process of lifting and motion operations, to production management, technical directors, technicians, manufacturers, performers and others working in local, national and international projects. It should facilitate a smooth process and a safe work environment when involved in such operations. This standard does not provide specific details in regard to any lifting and motion operations as described in the scope.

A project always starts with a concept, small or large, and often put forward by a person with an artistic mind and, above all, not hindered by gravity. This creates the technical challenge questioning: "Can we do it, can we do it safe?"

To be able to answer this question, many smaller and larger details need to be addressed, such as:

— Loads (lights, sound, set, video);

— The spatial ordering of all loads and structures carrying it;

— Is the equipment in rest or in motion?

— What are the effects of the motion: acceleration, deceleration?

— What are the effects of a possible e-stop?

— Will there be performer flying?

— And if so: where do they start and where do they land?

— What are the demands on all types of equipment?

— What skills are needed to put it in, and operate it?

— What are the time schedules?

— What is the structure of the venue like where the lifting will take place?

— What is the structural capacity and integrity?

The more complex the concept, the more questions, the more planning and complex engineering is needed.

CEN/TC433 has published EN 17206:2020 *Entertainment technology - Machinery for stages and other production areas - Safety requirements and inspections*. This standard provides guidelines for determining the 'use case' of a lifting appliance and clarifies the safety requirements for lifting machinery that come with each use case.

Typical lifting and motion operations may include but are not limited to the following:

— Auditorium elevators;

— Compensating elevators;

— Fly bar systems (manual and motor driven);

— Lighting bars;

—— Movable lighting towers;

—— Movable stage platforms (stage wagons);

— Movable proscenium arches;

— Orchestra elevators;

— Point hoists;

— Chain hoist

— Projection screens (manual or motor-driven);

— Scenery storage elevators;

— Side stage and rear stage shutters;

— Stage elevators;

— Tiltable stage floors;

— Trap elevators.

Besides the engineering, the management process required for a safe rigging and lifting operations shall be robust.

This code of practices describes the process of working and the issues that shall be considered operations can take place. If, somewhere in this process, changes have to be made, some of the previous phases may have to be repeated. Figure 3 shows a flowchart.

Aside of the process and flowchart (see Figure 3), this document states the requirements to be met of all actions in the flowchart, see Annex A through H.

Furthermore, this standard describes several functions of technicians involved in the rigging and lifting operations. This can be helpful when organising the crew.

The process and flow chart describe several preparatory phases and the lifting operation itself. It's a description of actions that leads to results, who bears responsibility for that result and, if applicable, on which normative references it is based.

The whole process description (see chapter 5) is based on a large-scale production in the event industry, e.g.

— Big rock concerts in arenas;

— Large musicals;

— Festivals with several stages;

— Big operas.

Smaller productions with less complex rigging and lifting movements can follow the same process and structure. However, they may combine several phases.

1 Scope

This code of practice provides a set of guidelines for lifting and motion operations related to machinery and machinery installations used in staging and production facilities for events. Such facilities may include, but not exclusively, theatres, multipurpose halls, studios, production facilities for film, television or radio, concert halls, congress centres, schools, exhibition centres, trade-fair centres, museums, discotheques, amusement parks, sports facilities and open-air-theatres.

Events are, for example, concerts, shows, congresses, exhibitions, presentations, demonstrations, film or television recordings, etc.

This document covers the use of machinery employed in the event industry including machinery defined in point j Article 1.2 of Machinery Directive (2006/42/EC): "*machinery intended to move performers during artistic performances*"

For the purposes of this document, machinery installations are all technical installations and equipment used for operations in stage and production facilities in the event industry. Such installations are used to lift, lower, suspend and move loads which may include but not exclusively, scenery or objects, truss systems, lighting, audio-visual, sound equipment or performers.

The guidelines in this document also apply to machinery installations based on new technologies or specially designed installations which are not expressly mentioned here but which nevertheless operate in a similar manner or are meant for similar purposes to those listed above. This document does not provide specific details but is intended to provide **general guidelines** on planning and the process of lifting and motion operations.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 12100, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100)*

EN 17206, *Entertainment technology - Machinery for stages and other production areas - Safety requirements and inspections*

EN 17115, *Entertainment technology - Specifications for design and manufacture of aluminium and steel trusses*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 17206, EN 17115 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
attachment points
facility provided to enable the load to be connected to the lifting machine, usually by use of a lifting accessory

3.2
code of practice
set of written guidelines that explains how people working in a particular profession should plan, manage and execute their work

3.3
communications protocol
system of rules and etiquette enabling orderly communication amongst multiple users of a communications system

3.4
communications system
reliable means of communication between parties, typically utilizing wired intercom or two way radios. Video can supplement audio

3.5
commissioning
taking into service
final phase in the installation of equipment, when it is demonstrated to be compliant with all the specified criteria and to be fully operationa

3.6
competent person
person with sufficient practical and theoretical knowledge and experience to carry out the person's duties, and who is aware of the limits of the person's competency, expertise and knowledge

[SOURCE: EN 17206:2020, 3.11]

3.7
Worker with role(s)
WR
competent person with function(s) assumed in a particular situation

Note 1 to entry: See Annex A

3.8
regulatory inspection
evaluation by observation and judgement accompanied as appropriate by measurement, testing, gauging and documentation

3.9
Pre-use Inspection
visual examination of equipment thereof to verify that it appears to be in operating condition and is free of physical damage

3.10
Functional responsibilities
different tasks that all workers involved in the event shall do during the event. The list of functions described is only indicative and not exhaustive. In Annex I is explained in detail the role tasks of each worker with role

3.11
determinate load System
system which has the minimum number of primary suspension points required to support the load

Note 1 to entry: Characteristics are

— Reaction forces are predictable and can be calculated using basic mathematical equations.

— By definition and for purposes of calculation they do not have redundant suspensions.

— Variations in an object's lift height caused by operating one or more hoists in a group will not result in unpredictable or large changes in reaction forces.

Examples: Above examples assume adequate support is provided. See Figure 1.

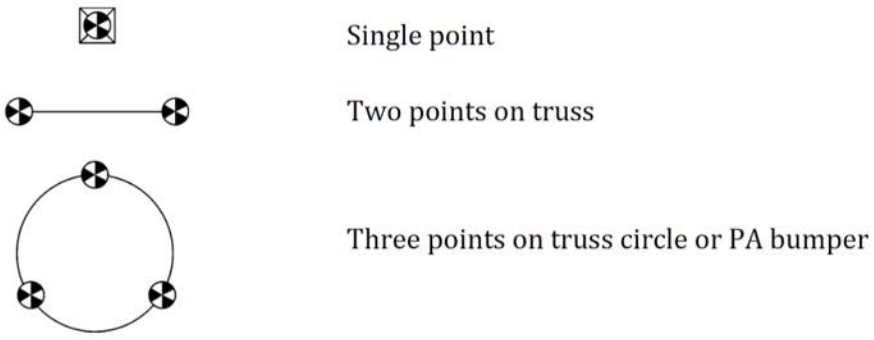


Figure 1 — Determinate load system

3.12
indeterminate load System
system which has more primary suspensions than required to support the load

Note 1 to entry: Characteristics are:

— Reaction forces can only be calculated using complex analytical methods.

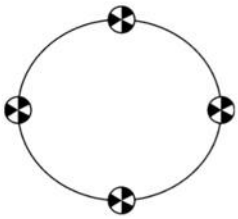
— Small variations in lift height can produce potentially dangerous variations in reaction forces.

— Reaction forces shall be verified on site using load monitoring equipment.

— The number of suspensions in an indeterminate system can provide redundancy, making it possible for a suspension failure to occur without causing collapse of the system. Shock loads shall be considered.

Examples: See Figure 2.

Three or more points on a truss;



Four points on truss circle grid

Four points on truss grid

Note: In the examples above, it may be theoretically possible to remove one suspension and have the objects remain stable. In practice, adequate support shall be provided to ensure stability

Figure 2 — Determinate load system

3.13
lifting plan
rigging plan
Set of procedures, schedules, drawings, tables, and documents needed for a safe Lifting Operation

3.14
load
Load refers to the object or objects to be lifted

3.15
mousing
use of wire or other material to prevent the unintentional opening of a connector or hook

3.16
overhead obstruction
object that blocks the intended flight path of a lift

3.17
performer flying
suspending, lifting or moving a performer

3.18
point load
concentrated load applied at a single location

3.19
primary suspension
minimum number of suspension points required to support the load as dictated by the rigging design

Note 1 to entry: See also 3.21 “Redundancy.”

3.20
qualified person
person who has the professional credentials required to solve or resolve problems relating to the subject matter

3.21
redundancy
use of additional measures that share load to safeguard against a suspension failure

3.22
rigging
installation, removal or other activity using lifting or suspension equipment or accessories used in tension for lifting or supporting display, production, performance or event technical requirements

3.23
rigging assembly
combination of hardware that is connected together

3.24
rigging points
connection of concentrated loads to a support structure according to the rigging plan

3.25
rigging system
any equipment used for suspension below the supporting structure

3.26
risk assessment
formal process used to identify hazards and mitigate risk

3.27
risk management plan
document detailing procedures to ensure the ongoing identification of hazards and mitigation of risk

3.28
secondary suspension
safeties
safety points
additional rigging used to support the load in case of equipment failure

3.29
sling angle factors
multipliers that account for increased forces in slings when they are not vertical

3.30
suspension
equipment in the load path that supports the load

3.31
title block
portion of a drawing that identifies the drawing contents

3.32
trim height
vertical distance from a datum to a specified point on a suspended object

3.33
working load limit (WLL)
maximum allowable load to be applied to a lifting component as specified by the manufacturer

3.34
safe working load (SWL)
useful load which is borne by the load carrying or securing device, or directly by the load bearing equipment

Note 1 to entry: SWL is defined by the user according to the reduction of the WLL or the ELL, due to the load applied to the load bearing device, the self-weight of the load carrying devices (p. ej truss), normative o legal requirements, environmental conditions, or any other condition that may require any reduction in favour of greater security.

3.35
entertainment load limit (ELL)
maximum load that an item of lifting equipment is designed to raise, lower or sustain.

[SOURCE: EN 17206:2020, 3.2.4]

3.36
entertainment load limit at rest (ELL/R)
maximum load that an item of lifting equipment is designed to sustain at rest

Note 1 to entry: Due to additional measures (such as locking pins in elevators), the Entertainment Load Limit at Rest could be higher than the entertainment load limit that the machine is capable of moving.

[SOURCE: EN 17206:2020, 3.2.5]

3.37
equipment failure
termination of the ability of an equipment to perform a required function

Note 1 to entry: After failure the equipment has a fault

Note 2 to entry: "Failure is an event, as distinguished from "fault", which is a state

4 Introduction of planning

4.1 General

Artistical designs in the event industry generally involve lifting operations to fulfil the design. Planning lifting operations start with the question: "How can this operation be done in a safe way?"

The "safe way" is dependent on:

— The building or structure where the lifting will take place

— The lifting equipment intended use

— The Use Case according to EN 17206 (if applicable)

— The load

— The movement

— The technical skills of the responsible persons.

It is evident that in case the loads are bigger and heavier, the movements of the loads are more complex and risk full and with possible environmental conditions that have an impact on the situation, the more complex the engineering will be, to meet all the requirements in the artistic plan.

Besides the engineering the management process required for a safe lifting operation shall be robust.

This code of practices will describe the process of working and some of the issues that shall be considered before the lifting operation can take place. If somewhere in this process changes have to be made some of the previous phases have to be repeated. See Figure 1. This code of practices will also describe how to act during the lifting operation and how to maintain the lifting equipment for subsequent use.

The process describes several preparatory phases and the lifting operation itself. It's a description of actions that leads to results, who bears responsibility for that result and, if applicable, on which normative references it's based.

The whole process description (see chapter 5) is based on a very large production in the event industry.

Productions like:

— Big rock concerts in arenas;

— Large musicals;

— Festival with several stages;

— Big operas.

Smaller productions or simple lifting movements follow much the same process and structure, however they may combine several phases.

Depending on the kind of event the organizational structure will be different. The employer is responsible for setting up an organizational structure with work descriptions, safety rules, employment protection regulations and a responsibility structure.

The employer can assign duties to other employees. When assigning duties, these should be detailed defined in writing.

To ensure a safe event all content and processes is planned in detail to guarantee a safe event (see applicable local laws and regulations for additional information).

Risks shall be assessed and adequate measures for control of the risks shall be recorded in writing. A risk assessment shall assess the risks of subcontractors and other people that may be affected. When a risk assessment includes machinery hazards during lifting and motion operations, it should follow EN ISO 12100 guidelines and EN 17206.

An evaluation after the event will help with future planning, estimating risks and to optimize the process.

4.2 Project workflow and stakeholders

4.2.1 Project workflow

The project workflow is a schematic process description (see Figure 1), based on a very large production in the event industry.

Depending on the kind of event the organizational structure can be less comprehensive but remains basically the same.

The project work flow is time-wise split up in 4 phases:

— Design;

— Installation;

— Use;

— Dismantling and de-rigging

A detailed description of all steps is given in chapter 5.

4.2.2 Stakeholders

4.2.2.1 Initiator

The initiator of a project could be a private person, persons or company initiating a project and hiring all staff and the venue only for this project; or it could be the director / employer at a particular venue like an opera house with a mix of fixed employed personnel and sub-contractors.

In this standard, the initiator has the role of employer in the sense that it is highest in rank regarding safety and safe work environment. Sometimes the initiator also could have the role of artistic designer.

4.2.2.2 Venue owner

The venue owner is a legal person or a legal entity owning the venue where the production takes place. This can be, but is not limited to:

— A permanent building made of e.g. concrete and bricks with a permanent stage, stages or production areas

— A permanent location that is temporarily used for staging or production purposes, like an old factory;

— Temporary demountable structures.

The venue owner shall provide documentation of the building's structural capacity and operational code of practice.

4.2.2.3 Artistic designer

The artistic designer shall cooperate with the production staff to achieve a safe and creative solution to the task at hand.

4.2.2.4 Technical production entity

The technical production entity can be one person, or a company with various persons carrying out this task together.

Its responsibilities include:

— Overlaying all drawing from all departments in one set of drawings;

— Foreseeing, detecting problems and conflicts and addressing them to the client and other stakeholders;

— monitoring the executing of tasks and responsibilities of others;

— Handing over plans to authorities for verification;

— Organising, chairing and documenting meetings;

— Formulating agreements between parties;

— Budgeting;

— Planning from concept (5.1) to evaluation (5.11)

4.2.2.5 Contractors

The contractors are the parties that carry out tasks as defined by the technical production. Contractors can be companies like lighting, rigging companies (included self-employed) or departments of a production house or venue.

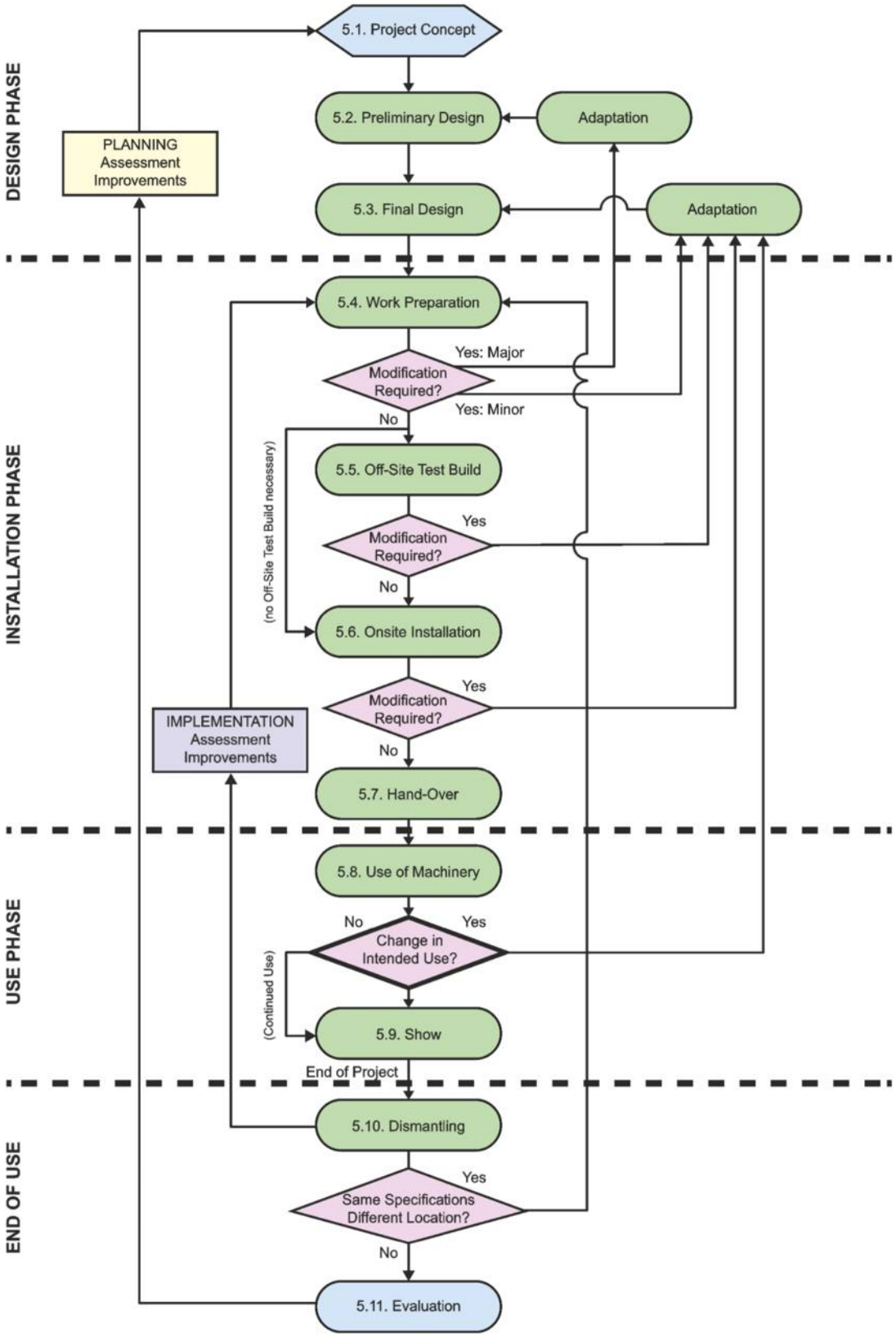


Figure 3 — Work flow for a large production

5 Project phases for lifting and motion operation

5.1 Project concept: Develop a rough draft of the design

During the concept phase the artistic team develops a rough draft of the design, a 'sketch'. In the concept phase the assignment of the technical production and/or a WR G is required.

The technical production team should evaluate:

— The extent of the load.

— The structural load-bearing capacity of the building or structure where the lifting and motion operation will take place.

— Environmental conditions

— The physical effects of the requested movements.

— Whether the lifting operation will take place above people.

5.2 Preliminary design: Working out the initial design concept

In the preliminary design phase, the initial design is worked out in more detail and drawings. In this phase, one or more WR F and/or G work out the following:

— Spatial design of all elements/loads to be lifted, expected lifting equipment types and capacities, secondary suspensions should be avoided if possible and the rigging design should favour redundancy.

— Motion elements, possible fly paths and choreography;

— If applicable: necessary motion equipment;

— If applicable: possibilities and restrictions for motion equipment;

— Estimated load plan, and load variations;

— Global structure of the team of technicians;

— Global planning;

— Assigning tasks and responsibilities for the design phase (technical production, rigging and lifting plans, light design, sound design etc);

— Preliminary budget and estimate of the costs;

— Assigning a person responsible for the risk assessment, method statement and implementation of risk control measures.

— Preliminary risk inventory, possibly resulting in topics to be investigated.

— Planning shall take into account applicable standards as well as best practices (see local regulations for additional information).

The preliminary design will be approved by a WR G, with support of a WR F. After approval, it is submitted to the client:

— If the preliminary design is approved, the project can continue into the final design;

— If the preliminary design is rejected, either the concept or the preliminary design needs to be changed, depending on the reason and extend of the rejection.

After a change, the preliminary design shall to be submitted for approved once more.

5.3 Final design: Transferring the preliminary design to a final concept

In the final design phase, all ideas will be worked out into plans that actually will be build. In this phase e.g. the following will be worked out:

— Spatial design of all elements/loads to be lifted, expected lifting equipment types and capacities, secondary suspensions should be avoided if possible and the rigging design should favour redundancy

— Motion elements, fly paths and choreography;

— Lift-off and landing zones of flying performers;

— If applicable: necessary motion equipment (with type, maximum and minimum speed, capacity etc.);

— If applicable: possibilities and restrictions for motion equipment;

— Detailed load plan, with load variations;

— Schedule of the circumstances in which the requested movement shall be performed

— Set-up of the structure of the team of technicians;

— Set-up planning for the installation, use and end/dismantling phases;

— Identifying tasks and responsibilities for the installation, use and end/dismantling phases;

— Determination of budget and costs;

— Execution of a risk assessment, writing method statement and implementation of risk control measures.

— Engineering and drafting structural load-bearing of the building or structure where the load will be applied.

The final design will be approved by a WR G, with support of a WR F. After approval, it is submitted to the client:

— if the final design is approved, the project can continue

— if the final design is rejected, either the concept or the final design needs to be changed, depending on the reason and extend of the rejection, all above actions shall be repeated.

— After a change, the final design shall to be submitted for approved once more.

Furthermore, a final scheme / drawing with all the point loads to be applied to the structure of the venue shall be sent in for approval to a WR J.

— If the final point load scheme is approved, the project can continue into the installation phase;

— if the final point load scheme is rejected, either the final design or the preliminary design or the concept needs to be changed, depending on the reason and extend of the rejection.

After a change, the final point load scheme shall to be submitted for approved once more.

All actions in the final design shall reflect the actions listed in Annex A "Requirements for Pre-Installation, Planning and Engineering".

All drawings shall be in accordance with Annex B "Drawing Conventions".

Equipment selections shall be in accordance with EN 17206:2020, Annex C "Requirements for Equipment Selection" is highly recommended as "applicable standard"

5.4 Work preparation: Preparatory phase for planning construction and dismantling; organization of all production processes

After the acceptance of the final design of the concept the risk analysis shall be completed.

Based on the final design and the risk analysis, the work preparation shall lead to working documents in which all requirements are detailed to enable the actual installation to take place at all venues.

In this phase all contractors will work out respective plans, with equipment, workers, tasks, responsibilities and if applicable, for different venues.

During the work preparation, the following will be worked out:

— Set-up of the structure of the team of technicians;

— Detailed planning for the installation, use and end/dismantling phases;

— Assignment of tasks and responsibilities for the installation, use and end/dismantling phases;

— Monitoring of budget and costs;

— Continuation of the risk assessment, writing method statement and implementation of risk control measures, with supervising those actions done by contractors;

— And, resulting from the risk assessment, set-up of inspection and maintenance scheme with items and intervals for the equipment operated during the show preparation and show period.

  o Time scheduling or another project management document showing:

  o Personnel calls

  o Materials and equipment requirements

  o Logistics

  o Communication procedures

5.5 Off-Site Test Build

This phase will not occur in every project. The purpose of this phase is to make the build-up at the actual location as efficient as possible.

The result of this phase will therefore be a fully developed project plan. Under the guidance of a WR E, the production will be built up and lifting movements tested.

In general, the following actions will take place when test building:

— Rigging assembly will be checked for conformity with design requirements, visual inspections will be done on parts and connections important for structural integrity;

— A test run will be done to confirm the designed flight path(s);

Where movement involves people:

— Fall protection systems will be tested for ergonomics, stability etc and will be adjusted if necessary;

— A test run will be done with a dummy load

The rigging assembly shall be approved by a WR G, with support of a WR F.

— If the rigging assembly is rejected, either the concept or the final design shall be changed and the appropriate steps on flow chart (see Figure 3) shall be repeated.

After the Off-Site Test Build, project planning will be approved by the WR E and the risk assessment shall be amended if necessary.

5.6 On site installation and lifting operations

5.6.1 On site installation

In this phase all rigging and lifting equipment (rigging assemblies) will be installed in the venue.

Before starting work, a toolbox meeting should establish a hierarchy and distribution of responsibilities, assign tasks and review communication procedures, security and emergency measures, both for the assembly itself and for the venue itself.

Works shall be done under supervision of a WR E.

PPE and equipment shall be visually checked for proper condition. Environments conditions shall be monitored for change and equipment assembled and used in accordance lifting plan and manufacturers instruction.

If secondary suspensions are needed, they should be installed such that time spent working at height is reduced to the minimum possible while employing the most appropriate means of access.

All on site installation work shall comply with Annex D “Requirements for On Site Installation”.

5.6.2 Lifting operations

Lifting operations shall be planned and coordinated in advance. In the toolbox meeting crew shall be briefed and a communications protocol shall be established.

All components and the integrity of the system shall be visually checked prior to any lifting operation. The capacity of the equipment shall meet or exceed the design specifications in the lifting plan. All equipment found to be defective shall be marked and quarantined.

Load shall be attached in a manner that does not damage the load and/or equipment, respects WLL and the ELL and the SWL of all components, prevents from swinging or shifting the load and is used in accordance to manufacturer's specifications.

The lifting plan and sequence should be adhered to at all times. Supervisor and operator shall visually check the system and flight path prior to any movement. All movements shall be supervised by a competent person with clear and direct view of the moving load and spotters assigned if necessary. Effective communication between operator, supervisor and spotters shall be established. Once the load is "floating" system integrity shall be verified.

All objects should be positioned at trim height according to the lifting plan ensuring appropriate load sharing and avoiding dynamics loading.

Load monitoring equipment is highly recommended when performing a multi-point lift or when dynamic loads are involved.

All Lifting operation shall ensure the safety of performers, crew and patrons in the event of equipment failure, without compromising the structural integrity of the building. Consideration shall be given to redundancy of multi-point (i.e. 3 or more) suspensions; accounting for the number and load capacity of suspensions and secondary suspensions if needed.

When the installations are taken into service, and their safe working or safe condition for the intended use is confirmed by a competent person like a WR E, H or J, the installation can be handed over for use.

All lifting operations shall comply with Annex E "Requirements for Lifting Operations".

5.7 Hand-over: Introduction to the User and Completion of construction

Now that the entire lifting installation is ready for use, it will be formally delivered to the client by the WR F or the WR E. Note that in case of a temporary installation, the lifting and motion equipment generally is operated by persons employed by the supplier of the lifting and motion equipment. And thus, this one technician's role shifts from 'installer' to 'user'.

The requested and agreed movements of the lifting installation are shown to the client or clients nominated contractor/operator.

After acceptance by the client or clients nominated contractor/operator the installation can be transferred to another user.

Presentation of the installation including any planned movements (cues) shall be thoroughly explained prior to handover.

Operating instructions for the lifting and motion installation and a description of the movements shall be handed over.

If necessary, training with the lifting and motion installation shall be given to the new crew or users.

In case a change is requested in the lifting plan, the workflow shall be followed, and changes shall be reviewed by a WR G and, if necessary, also approved by WR J.

5.8 Taking into service: Show preparations

This phase is intended to program, test and rehearse, it is normally done without audience.

Task and Responsibilities shall be clearly defined, and a review of the risk assessment and a method statement carried out. Communication protocols and systems shall be reviewed to ensure safety and smooth show operations.

Crew shall be trained, equipment checked and logged, movements rehearsed. Operator shall maintain good visual contact with the effect or direct camera and monitoring system. All crew members shall be

alert for any new risk situation that may occur. In performer flying a rescue plan shall be tested and rehearsed before the first rehearsal, and periodically rehearsed.

Scenic automation and controlled effects shall be provided with safety features/elements to ensure safe motion.

Any other potential hazard included in the Risk Assessment shall be considered.

The result of this phase shall be:

— A lifting installation that is put at the right trim;

— Lifting and motion equipment that is programmed and ready for show;

— Operators and crew members that are trained and prepared for the show.

Taking into Service and Show Preparations shall be done in accordance with Annex F "Requirements for Taking into service. Show Preparation "

WR D shall program movements within the limits of the installation for the show.

For single load liftings and rehearsed movements that are stored in the control system, less highly qualified WR D are needed.

5.9 Use of machinery: Show operations

Show operations shall be done in accordance with Annex F "Requirements for Taking into service. Show Preparation ".

During show periods inspections of the lifting and motion equipment is necessary. What and in what frequency should be inspected is stated in the manufacturer's instructions of that particular lifting equipment. Additionally, a risk assessment might increase the frequency of the inspections or detail additional inspections.

If there are new crew members, they shall be informed of the instructions for the use of the lifting installation.

5.10 Dismantling and de-rigging

In this phase all rigging and lifting equipment will be dismantled from the venue. This will be done under guidance of a WR E.

Dismantling shall be done in accordance with Annex G "Requirements for De-Rigging Work". After dismantling, the venue shall be handed over by technical production (see 4.2.2.4) to the owner of the venue.

After a clean-up of the venue, WR E or the management of the project, shall formally deliver the venue back to the owner.

5.11 Evaluation: Post Production

The result of this phase shall be an evaluation report in which finances, time and quality are described. Part of the quality report shall be the descriptions of any accidents or near misses that may have occurred.

Post production shall be done in accordance with Annex H "Requirements for Post Production".

Annex A
(normative)

Requirements for design

Sub-Heading	IndexNr.	Statement
General	A.1	All temporary installations shall be planned by competent persons.
	A.1.1	Accurate drawings depicting the rigging design shall be submitted to and approved by the enforcing authority and the venue prior to the commencement of any site work.
	A.1.2	The rigging design and engineering shall comply with applicable standards. (See local regulations for additional information)
	A.1.3	In cases where the lifting and motion installation exceeds or is not covered by pre-determined limits, the design shall be reviewed and approved by a qualified structural engineer with proven experience in entertainment.
	A.1.4	House rigging rules shall be complied with and incorporated into the rigging design.
	A.1.5	All critical site conditions affecting the proper execution, integrity and safety of the installation shall be site verified prior to submitting design documents for approval.
Documentation	A.2	Plans and documents shall include sufficient information to convey the location, magnitude and effect of all rigging forces. Peak dynamic loads shall be identified.
	A.2.1	When appropriate, the location and load capacity of the structure and attachment points shall be identified and shown in the design documents.
	A.2.2	The distribution of loads to supporting members and attachment points shall be shown in the design documents and plans. If secondary suspensions are required these shall be shown too.
	A.2.3	Venue obstructions which affect the proper execution of the rigging design shall be identified and shown in the documents.

Sub-Heading	IndexNr.	Statement
Engineering	A.3	All forces, including dynamic loads, shall be within the pre-determined limits of the supporting structure or, in non-conforming cases, approved by a qualified structural engineer.
	A.3.1	Point loads indicated on rigging documents shall include the self-weight of all equipment, crew and performers.
	A.3.2	Consideration shall be given to the physical nature of any load with potential for dynamic loading (e.g. equipment containing fluids).
	A.3.3	The behaviour of determinate and indeterminate rigging systems shall be considered in the rigging design.
	A.3.4	The effects of weather shall be accounted for in the rigging documents.
On site Work	A.4	Methods of access for work at height, fall protection systems and rescue shall be designed by a competent person and adequate for the proposed lifting.
	A.4.1	Crew and equipment requirements shall be determined and agreed upon by all stakeholders prior to the commencement of any lifting.
	A.4.2	Venue and temporary electrical service locations and capacities shall be verified as adequate for the proposed design.
Risk Assessment and Management	A.5	A risk management plan that mitigates risks to acceptable levels shall be authorized by a competent person prior to any work on site.
	A.5.1	The plan shall be approved and adopted by all stakeholders.
	A.5.2	The risk assessment shall specifically identify and consider the risks associated with the lifting operation, the installation, the assembly, and the dismantling of the equipment. The risk assessment shall be completed referencing: - Work environment/ building/ location/ workplace - Work phases/ processes/ tasks - Work equipment - Misuse of equipment (i.e. overload) - People who may be affected and he person who is responsible for the safety of the lifting operation and whom shall communicate the outcome of the risk assessment with all the involved people.

Sub-Heading	IndexNr.	Statement
	A.5.2.1	When assessing risk of equipment failure, consideration shall be given to redundancy in multi-point [3 or more] suspension systems; accounting for the number and load capacity of suspensions. NOTE If assessing risks from lifting equipment failure, a new compliance with Machinery Directive, EN 17206 and a new Declaration of Conformity is drafted
	A.5.4	The plan shall clearly identify the chain of command and individual responsibilities.
Rescue Plan	A.6	A rescue plan shall be developed and documented prior to commencement of any site work.
	A.6.1	The plan shall include contact information for outside emergency responders and medical services providers as agreed by all stakeholders.
	A.6.2	The plan shall include the means and methods for communicating emergency information to all stakeholders.
	A.6.3	Rescue personnel shall not be exposed to hazards beyond their training and ability when executing the plan.
	A.6.4	The plan shall be updated to reflect any on site changes.
Weather Related Procedures	A.7	The emergency response plan to the effects of weather shall include:
	A.7.1	Appropriate responses to the effects of weather such as rain, wind, snow, flood and other environmental conditions such as seismic, fire, etc. on the rigging installation.
	A.7.2	The potential effects of weather on indoor rigging systems due to hazards such as open freight doors or snow.

Annex B
(normative)

Drawing convention

Sub-Heading	IndexNr.	Statement
Introduction	B.1	All rigging work shall be carried out in accordance with drawings.
Title Block	B.2	A Title Block shall be used on all drawings and include the following information:
	B.2.1	Name of the event or act.
	B.2.2	Name of client.
	B.2.3	Name of venue.
	B.2.4	Venue address.
	B.2.5	Name of person responsible for the rigging design.
	B.2.6	Method for determining weights listed on plan.
	B.2.7	Name and contact information for the supervisor.
	B.2.8	Name and contact information of party responsible for rigging on site.
	B.2.9	Scale used on plan.
	B.2.10	Drawing number and draftsperson.
	2.2.11	Drawing version number and date.
	B.2.12	Drawing status (e.g. concept, approved, etc.).
All Drawings	B.3	All rigging drawings shall indicate the following:
	B.3.1	All rigging points shall be indicated by a symbol and a unique alpha-numeric designation.
	B.3.2	A key or legend to symbols used on drawings.
	B.3.3	Rigging point symbols shall convey information that is essential to the execution of the lifting operations (e.g. hoist type, capacity, speed, chain length, etc.).

Sub-Heading	IndexNr.	Statement
	B.3.4	The datum point (i.e. a defined position that measurements are taken from.)
	B.3.5	For point location purposes, the drawing shall utilize cartesian coordinates which reference the datum point. The datum axis lines on the drawing shall be labelled for clarity.
	B.3.6	Units of measurement used in association with dimensions, weights and forces on drawings shall be clearly identified.
	B.3.7	A scale bar (i.e. a graphic representation of the scale used).
	B.3.8	Required hook height (i.e. distance from venue floor to upper hook).
	B.3.9	Location of electrical power supply required for a lifting system including voltage, frequency, single or three phase, amperage, and connection (i.e. four or five wire and connector type
Point Specific Information	B.4	Point specific information shall be indicated on the drawings or be listed in a supplemental table and should include:
	B.4.1	Alphanumeric point designation.
	B.4.2	Point location relative to the datum.
	B.4.3	Static load of each point.
	B.4.4	Peak dynamic load of each point.
	B.4.5	Points associated with moving loads, or loads that vary, shall to have distinguishing symbols or otherwise be identified.
	B.4.6	Total static weight of all rigging.
Venue Specific Drawings	B.5	Drawings that are specific to a particular venue shall indicate the following:
	B.5.1	Venue structural elements including specific anchors that support the rigging.

Sub-Heading	IndexNr.	Statement
	B.5.2	Height of venue structural support elements above specified location (e.g. height of beam above venue floor).
	B.5.3	When appropriate, capacity of beams or anchors as specified by facility or engineer of record.
	B.5.4	Overhead obstructions and hazards that are part of the venue (e.g. height of airduct above venue floor).
	B.5.5	In venues where rigging can occur in multiple locations, a key plan shall be provided to indicate where rigging is to take place.

Annex C
(normative)

Requirements for equipment selection

Sub-Heading	Index Nr.	Statement
Selection	C.1	All equipment shall be fit for purpose and comply with applicable standards or be professionally engineered for its intended use.
	C.1.1	All equipment shall be used in accordance with the manufacturers' instructions and recommendations.
Load Capacity	C.2	The selection process for all equipment shall consider the highest anticipated load or combination of loads, including dynamic loads.
Risk Management	C.3	The equipment selection process shall take into account all foreseeable hazards to which the equipment may be subject.
Compliance	C.4	All equipment selected shall comply with applicable standards. (See applicable local regulations for additional information)
Non-Standard Equipment	C.5	In the absence of manufacturers' load ratings and specifications, or standards, a **competent** person shall review and approve the selection of equipment for its intended use to ensure safety. Non-standard equipment shall be provided with necessary markings and documentation to ensure safe use. (See applicable local regulations for additional information) NOTE If assessing risks from lifting equipment failure, a new compliance with Machinery Directive, EN 17206 and a new Declaration of Conformity is drafted
Custom Built Equipment	C.6	All custom-built equipment selected for a project shall be reviewed and approved by **a competent** person. Custom built equipment shall be provided with necessary markings and documentation to ensure safe use. NOTE If assessing risks from lifting equipment failure, a new compliance with Machinery Directive, EN 17206 and a new Declaration of Conformity is drafted
Traceability	C.7	All equipment shall be identifiable and traceable to the manufacturer.
Marking	C.8	All equipment shall be marked to indicate compliance with applicable standards. (See applicable local regulations for additional information)

Sub-Heading	Index Nr.	Statement
Maintenance	C.9	All equipment shall have current compliance with maintenance schedules per manufacturers' requirements and applicable standards at its time of use and for the duration of the event. (See applicable local regulations for additional information)
Maintenance Records	C.10	Maintenance records for equipment shall be readily available at the time of selection and for the duration of the event.

Annex D
(normative)

Requirements for on-site installation

Sub-Heading	Index Nr.	Statement
Clarification of Tasks and Responsibilities	D.1	Prior to start of work see Annex J
	D.1.1	Establishing a chain of command, defining and documenting tasks and responsibilities of each crew member
	D.1.2	The venue owner shall confirm the structural capacity of the building or structure where the equipment will be installed, venue specific rigging practices and the contractor will acknowledge acceptance of the building or structure as advised by the venue owner.
	D.1.3	Site induction or crew orientation shall take place prior to commencing the work.
	D.1.4	Confirm that all crew have valid licenses/permits for the tasks they will undertake as required.
Tool Box Talks	D.2.	A toolbox talk shall be held for every work shift and address the following:
	D.2.1	Identify supervisors, crew and specific tasks.
	D.2.2	General workplace safety and housekeeping.
	D.2.3	Identify hazards, including any specific production hazards, and explain how to manage them.
	D.2.4	Communicate how the work is to be accomplished. Overview of drawings and drawing conventions.
	D.2.5	Communicate the schedule and end of shift goals and handover procedures.
	D.2.6	Emergency procedures including rescue.
	D.2.7	Overview of communication and radio use.

Sub-Heading	Index Nr.	Statement
	D.2.8	Check that all crew have personal protective equipment (PPE) appropriate to the tasks.
	D.2.9	Coordination required between other contractors.
Supervision	D.3	
	D.3.1	Supervisors shall monitor changing circumstances and conditions, taking appropriate action when needed.
	D.3.2	Supervisors shall monitor the physical and mental condition of their crew.
	D.3.3	Supervisors shall report deviations from the rigging plan or schedule and initiate a modification of the final design.
Working Safely	D.4	In reference to D.3.1, crew members shall work safely by:
	D.4.1	Visually checking equipment and rigging assemblies for proper condition.
	D.4.2	Communicating clearly.
	D.4.3	Monitoring the environment for changes and new hazards, and react accordingly.
	D.4.4.	Wearing personal protective equipment (PPE) as instructed and required.
	D.4.5	Safeguarding the ground area below work at height.
	D.4.6	Visually checking their fall protection systems before use.
	D.4.7	Verifying the integrity of the rigging points and communicating when a point is ready to have a load applied.
	D.4.8	Verifying the power supply is appropriate for the equipment being used.
	D.4.9	Checking all electrical connections for proper functioning (i.e. checking the phases, doing visual inspections of cables)
	D.4.10	Assembling equipment in accordance with the rigging plan.
	D.4.11	Using equipment in accordance with manufacturers' instructions.

Sub-Heading	Index Nr.	Statement
	D.4.12	The capacity of the equipment shall meet or exceed the design specification in the lifting plan.
Secondary Suspensions (if needed)	D.5	
	D.5.1	Secondary suspensions should be avoided if possible and the rigging design should favour redundancy.
	D.5.2	Secondary suspensions, if required, should be installed (at their upper and lower attachments) such that time spent working at height is reduced to the minimum possible while employing the most appropriate means of access.

Annex E
(normative)

Requirements for lifting operations

Sub-Heading	Index Nr.	Statement
Planning, Tasks and Responsibilities	E.1	
	E.1.1	Lifting operations shall be planned and coordinated.
	E.1.2	Planning shall consider applicable standards as well as best practices. (See applicable local regulations for additional information)
	E.1.3	Check requirements for secondary suspensions to ensure compliance with standards. (See applicable local regulations for additional information.) The capacity of the rigging system, the nature of the load, its weight, and any characteristics that may affect load bearing capacity of the building (venue) and attachment points and its safe handling shall be communicated in a pre-operation briefing.
	E.1.4	Crew involved in the lifting operations shall be briefed about the communication protocol to be used.
	E1.5	The communication protocol shall allow the crew in the immediate lifting operation area to give a signal to stop the lifting operation.
Preparing the Equipment	E.2	
	E.2.1	All components shall be visually checked by a competent person each time they are attached to or removed from a load.
	E.2.2	The integrity of the system shall be visually checked prior to every lift and/or series of lifting operations.
	E.2.3	The capacity of the equipment shall meet or exceed the design specification in the lifting plan.
	E.2.4	Equipment shall be tagged or marked as required by applicable standards. (See applicable local regulations for additional information)

Sub-Heading	Index Nr.	Statement
	E.2.5	Any item of equipment found to be defective, or suspected of being defective, shall be removed from service and quarantined or disposed of immediately to prevent further use.
Attaching the Load	E.3	
	E.3.1	The load shall be attached to the equipment in a manner that shall not allow damage to the load or the equipment.
	E.3.2	The method of attachment shall not create forces that exceed working load limit (WLL) or the Entertainment Load Limit (ELL), whichever the lowest, of the lifting equipment or compromise the integrity of the load. Sling angle factors shall be considered.
	E.3.3	The method of attachment shall prevent sliding or shifting of the load.
	E.3.4	The load shall be attached to the equipment in accordance with manufacturer's specifications.
	E.3.5	If components could unintentionally loosen in use they shall be secured, e.g. “mousing” shackles.
Lifting	E.4	
	E.4.1	The lifting plan and sequence of lifting operations, if applicable, shall be adhered to at all times.
	E.4.2	Supervisor and operator shall perform a visual check of the system and flight path.
	E.4.3	Provide spotters as necessary to ensure effective visual monitoring of the moving load.
	E.4.4	All lifting operations shall be supervised by a competent person.
	E.4.6	The integrity of the system shall be verified after initial “floating” of load.
	E.4.7	Stop the load before landing it to ensure the landing zone is clear.
Trimming	E.5	
	E.5.1	All objects shall be positioned at trim height according to the lifting plan.

Sub-Heading	Index Nr.	Statement
	E.5.2	Method of trimming shall ensure appropriate load sharing.
	E.5.3	Method of trimming shall avoid repeated dynamic loading.
Load Monitoring	E.6	
	E.6.1	The use of load monitoring equipment is recommended.
	E.6.2	The use of load monitoring equipment is highly recommended when performing a multi-point lift or when dynamic loads are involved.
	E.6.3	If the load monitoring equipment is designed to perform a safety function, i.e it can stop the load, the load monitoring equipment and the respective lifting equipment shall conform to EN 17026.
Securing the Load at Trim	E.7	
	E.7.1	All rigging systems shall ensure the safety of performers, crew and patrons in the event of equipment failure, without compromising the structural integrity of the building. Consideration shall be given to redundancy of multi-point [3 or more] suspensions; accounting for the number and load capacity of suspensions.
	E.7.2	Requirements for secondary suspensions shall be checked to ensure compliance with applicable standards. (See applicable local regulations for additional information).
	E.7.3	Notice shall be placed at the control point of a lifting system when secondary suspensions are used.
	E.7.4	Secondary suspensions shall have capacity equal to or greater than the primary suspension.
	E.7.5	Secondary suspensions shall be taught to avoid shock loading.
	E.7.6	Where possible, secondary suspensions shall be attached to a supporting structure independent of the primary suspension.

Annex F
(normative)

Requirements for taking into service: show preparations

Sub-Heading	Index Nr.	Statement
Tasks and Responsibilities	F.1	The supervisor shall coordinate with all departments to ensure safe operations.
	F.1.1	A chain of command shall be established and clearly understood by all crew.
	F.1.2	The tasks and responsibilities of each crew member shall be clearly defined
Risk Management	F.2	A review of risk assessment and method statement shall be carried out
Communications Requirements	F.3	The communications protocol and systems shall be reviewed to ensure safety and smooth show operations:
	F.3.2	The communications system shall be capable of allowing specific teams to work independently of the main production.
	F.3.3	A clearly defined communications vocabulary shall be established to ensure safe operations in the vicinity of moving loads or performers.
Safety Protocols	F.4	
	F.4.1	Scene changes:
	F.4.1.1	Scene changes shall be rehearsed methodically, progressively adding elements such as show lighting, audio, effects, and cast only when proficiency is achieved.
	F.4.1.2	Scene changes shall be rehearsed periodically on longer runs to ensure actual work matches documentation and understanding.
	F.4.1.3	It shall be operated only by trained crew.
	F.4.1.4	It shall include a pre-performance check of all systems and components.
	F.4.1.5	Pre-performance checks shall be logged.

Sub-Heading	Index Nr.	Statement
	F.4.2.	Performer flying rigging:
	F.4.2.4	Rescue methods for all flying effects shall be planned and tested prior to first rehearsal.
	F.4.2.5	Rescue methods for all flying effects shall be periodically rehearsed.
	F.4.3	The operator shall ensure that all the safety features for a scenic automation or computer-controlled effects are in place and operational, in particular:
	F.4.3.1	A press and hold to operate device (dead man handle).
	F.4.3.2	Emergency stop, for example using a E-STOP button or an E-STOP line.
	F.4.3.3	An operator shall be able to stop any loads in motion under any circumstances.
	F.4.3.4	The operator shall maintain good visual contact with the effect. Alternatively, this could be achieved with a direct camera and monitor system.
	F.4.3.5	A pre-performance check of all systems and components.
	F.4.3.6	Pre-performance checks shall be logged.
	F.4.4	Potential hazards caused by special effects such as pyrotechnics, lasers, stunts, etc., shall be considered in the risk assessment:
	F.4.4.1	Reduced visibility.
	F.4.4.2	Operators being unfamiliar with other components of the show.
	F.4.4.3	Special effects that don't have a local safety switch being attached to flying elements.
	F.4.4.4	Increased noise levels.
	F.4.4.5	Special effects residue (heat, smoke, ash, confetti, etc.) with regard to proximity to performers, crew and equipment.
	F.4.5	Potential hazards to safe rigging operation caused by water, including ice and steam, shall be considered in the risk assessment. Some of the risks may include:
	F.4.5.1	Electrical circuits made unsafe.

Sub-Heading	Index Nr.	Statement
	F.4.5.2	The corrosion of metallic items through immersion and/or condensation.
	F.4.5.3	Chemical and biological hazards.
	F.4.5.4	Burning.
	F.4.5.5	Drowning, including fluid preventing air from being taken into the lungs.
	F.4.5.6	The effect on slippery surfaces.

Annex G
(normative)

Requirements for de-rigging work

Sub-Heading	IndexNr.	Statement
Tasks and Responsibilities	G.1	
	G.1.1	A chain of command shall be established and clearly understood by all crew.
	G.1.2	The tasks and responsibilities of each crew member shall be clearly defined
Prior to the Start of Work	G.2	
	G.2.1	New crew orientation shall take place prior to the start of work.
	G.2.2	Supervisors shall verify working conditions and identify new hazards.
Briefings - Tool Box Talks	G.3	A toolbox talk shall be held per shift and address the following topics:
	G.3.1	General workplace safety and housekeeping.
	G.3.2	Hazards.
	G.3.2.1	Identify hazards, including any specific production hazards, and explain how to manage them.
	G.3.2.2	Identify specific preparatory tasks that shall be completed prior to any de-rigging.
	G.3.3	Identify supervisors, crew and specific tasks.
	G.3.4	Communicate how the work is to be accomplished and in what order.
	G.3.5	Communicate the schedule and end of shift goals and handover procedures.
	G.3.6	Check that all crew have personal protective equipment (PPE) appropriate to the tasks.

Sub-Heading	IndexNr.	Statement
	G.3.7	Coordination required between teams.
	G.3.8	Overview of communication and radio use.
	G.3.9	Emergency procedures including rescue.
	G.3.10	Malfunctioning equipment shall be clearly marked.
On-Going Supervision	G.4	
	G.4.1	Supervisors shall monitor changing circumstances and conditions and take appropriate action when needed.
	G.4.2	Supervisors shall monitor the physical and mental condition of their crew.
	G.4.3	Supervisors shall compensate for and report deviations from the de-rigging plan or schedule.
Safe Work	G.5	
	G.5.1	All crew shall:
	G.5.2	In reference to 4.3.1, crew members shall work safely by:
	G.5.3	Visually checking equipment and rigging assemblies for proper condition.
	G.5.4	Communicating clearly.
	G.5.5	Monitoring the environment for changes and new hazards and react accordingly.
	G.5.6	Wearing personal protective equipment (PPE) as instructed and required.
	G.5.7	Safeguarding the ground area below work at height.
	G.5.8	Visually checking their fall protection systems before use.
	G.5.9	Verifying the power supply connection is appropriate for the equipment being used.
	G.5.10	Checking all electrical connections for proper functioning (i.e. checking the phases, doing visual inspections of cables)

Sub-Heading	IndexNr.	Statement
	G.5.11	The capacity of the equipment shall meet or exceed the design specification in the lifting plan.
	G.5.12	Using equipment in accordance with manufacturers' instructions.
	G.5.13	Verify that suspended equipment can be lowered safely, and equipment is operating correctly.
	G.5.14	Communicating when a point is ready to be lowered.
	G.5.15	Guide the rigging assembly during lowering and landing.
	G.5.16	Dis-assembling equipment in accordance with the rigging plan
	G.5.17	Disassemble and remove equipment as soon as possible to keep work area clear.
	G.5.18	Monitor hoist connections, cables, multicores, etc.
	G.5.19	Disassemble equipment and prepare for safe transport
Hand over	**G.6**	
	G.6.1	After a clean-up of the venue, WR J or the management of the project, shall formally deliver the venue back to the owner

Annex H
(normative)

Requirements for post-production

Sub-Heading	IndexNr.	Statement
Reporting	H.1	A postproduction report should be prepared by a competent member of the crew and should include:
	H.1.1	Start and end dates of production.
	H.1.2	Crew involved and their roles.
	H.1.3	Record of pre-operational checks.
	H.1.4	Details of incidents or deficiencies.
	H.1.5	Details of items needing repair or replacement.
	H.1.6	Details of alterations to plans or procedures required during the duration of the production.
	H.1.7	Comments and remarks about the production from crew.
	H.1.8	All documentation pertaining to safety generated for the production shall be held in the appropriate location for the period required by applicable documents.(See applicable local regulations for additional information).
Gap Training	H.2	Post production evaluation of crew skills and necessary training may be conducted by the employer to:
	H.2.1	Refresh skills.
	H.2.2	Upgrade skills required by new equipment or procedures.
	H.2.3	Upgrade knowledge due to changes in local regulations and/or standards.
	H.2.4	Upgrade skills to conform to industry best practice.

Annex I
(informative)

Roles and responsibilities

Role call (WR)	Description	Responsibilities	Tasks
A	This worker is deployed in all disciplines. He or she helps with: loading and unloading of trucks, transport and distribution of materials and cases in and around the venue; assembling (truss structures) and decors; manually handling, pushing raising and lowering of materials. He or she generally works in teams, under supervision of a technician with more knowledge and skills.	Own and colleagues safety on the work floor.	Various, and for various disciplines.
B	This worker is mainly deployed in lifting and rigging while not working at height. Being supervised, he or she can carry out tasks on his/her own. He or she has basic knowledge of lifting equipment, e.g. nomenclature; SWL, ELL; common slinging techniques; assembly and disassembly of truss.	Own and colleagues safety on the work floor. Can be foreman of a WR A team.	he or she helps with: distribution of lifting equipment; assembling lifting accessories into lifting chains; slinging of loads and truss; assembling and disassembling of loads and structures.
C	This worker is mainly deployed in lifting and rigging while not working at height. He or she can carry out tasks on his/her own, on instructions of the lifting foreman. He or she has intermediate knowledge and experience of lifting equipment like WR B, eg. special case slinging techniques; manually handling and operating of lifting machines; operating of static determined lifting assemblies in work light conditions;	Own and colleagues safety on the work floor, especially colleagues that are WR D. Can be foreman of a WR A or B team.	he or she helps with: assembling lifting accessories into lifting chains; slinging of loads and truss; manually preparing lifting machinery to "work height" (running chains in and out); assisting and guiding workers at height with attaching lifting equipment to the structure of the venue; visual check of the integrity of the lifting chains.

Role call (WR)	Description	Responsibilities	Tasks
D	This worker is mainly deployed in lifting and rigging while working at height. He or she can carry out tasks on his/her own, on instructions of the lifting foreman. He or she has intermediate knowledge and experience of lifting equipment like WR C, e.g. safe work at height;++ preferably industry recognized rescue training.	Own and colleagues safety on the work floor, especially colleagues that are WR C. Can be foreman of a WR A or B team.	he or she helps with: attaching lifting equipment to structure of the venue; visual check of the integrity of the lifting chains.
E	This worker is mainly deployed in lifting and rigging. He or she has expert knowledge and experience of lifting equipment, e.g. supervisor and leadership qualities; communication skills; knowledge and experience in assessing risks. Working at height	He or she is responsible for the execution of the rigging plan and the work at on site installation and dismantling.	he or she: supervises the work to be done; monitors safe work environment and safe work methods; communicates with technical production and other contractors about progress and work that is ahead; is responsible for 'taking into service' of the lifting machinery.
F	This worker is mainly deployed in the office, preparing lifting and rigging operations. He or she is expert in rigging calculations and work preparation with . eg. knowledge of lifting machinery; structural engineering knowledge to some extent.	He or she is responsible for implementing the project concept in various designs concerning lifting and rigging.	In the design phase he or she: invests the feasibility of concepts regarding venue structural capacity; works out concepts into solid plans, containing: rigging drawings, lifting plans, point load scheme; communicates with the structural engineer of the venue considering the approval of the point load schemes

Role call (WR)	Description	Responsibilities	Tasks
G	This worker is project manager lifting and rigging operations. He or she has expert knowledge of lifting equipment, and is experienced in rigging productions and lifting operations, like displayed in the work flow, see Figure 1.	He or she is responsible for all communications in the design, installation, use and post production phase.	In the design phase he or she: translates the project concept into rigging and lifting concepts and preliminary tests of concepts; communicates with WR F, in order to put concepts into drawings: supervises the design phase (considering rigging and lifting); In the installation and use phase he or she: monitors the actual progress; monitors safety and safe working conditions; communicates with technical production and the client and other contractors about the project. In the post production phase he or she: internally evaluates the project; evaluates the project with the technical production and the client.
H	This worker is deployed in motion control. His or her task is the installation, programming and use of automated lifting systems and hand operated personal fly systems ("motion"). He or she has expert knowledge and experience of lifting equipment, e.g. expert knowledge of the electrical control equipment, operating systems and operating consoles; experience in programming cues into shows;	*Program motions* *See WG 1 definitions for program motions*	He or she: assists with feasibility check in the designing phase; prepares equipment; installs all motion equipment in the installation phase; programs and operates the motion equipment; disassembles motion equipment during the dismantling.

Role call (WR)	Description	Responsibilities	Tasks
I	This worker examines, tests and inspects lifting equipment, accessories and/or installations.	examination, testing and inspecting lifting equipment, accessories and/or installations.	He or she: -examines, tests and inspects lifting equipment, accessories and/or installations.
J	This worker checks and approves the load scheme, containing all point loads to be applied to the structure of the venue. He or she usually is a worker of an external structural engineering bureau, assigned by the venue owner.	Checking of load scheme against structural integrity of the venue.	structural engineering, analysing load schemes.

Annex J
(informative)

Types of loads

J.1 General

This annex intends to clarify the load terminology in lifting equipment within the scope of this document.

Any modifications to a lifting equipment marking, including the intended use, load rating and safety factors, will be performed under Machinery Directive and its harmonized standards. This is outside the scope of this document.

When performing any modifications to a lifting equipment or its marking, the user or installer will automatically become the manufacturer of such lifting equipment, thus a set of public information, manufacturer declarations and liabilities may apply. Please refer to EN 17206:2020 for further clarifications.

J.2 Maximum load for lifting equipment designed for other industries – WLL

J.2.1 General

Any lifting equipment designed for other industrial use and then used within the entertainment industry might be subject to a further derating to achieve the desired safety factor. In case of machinery, it might also require a further risk assessment and further design measures. See EN17206:2020.

For further information on installation markings, see J.4

J.2.2 Loads and Forces

When using lifting equipment designed for other industrial use, one shall consider the different loads present in the system. See EN 17206:2020, 3.2

Table J.1

Loads and forces in normal operation		
	WORKING LOAD	This is the load that can be applied by the user.
+	WEIGHT OF LOAD CARRYING DEVICE	This is the bar or the truss or the elevator-platform
=	SYSTEM LOAD	This is the static load
+	DYNAMIC FORCES	
=	CHARACTERISTIC LOAD	Load to be considered by the manufacturer when designing the machine for normal use.
Loads and forces occurring at failure		
	WORKING LOAD	This is the load that can be applied by the user.
+	WEIGHT OF LOAD CARRYING DEVICE	This is the bar or the truss or the elevator-platform
=	SYSTEM LOAD	This is the static load
+	DYNAMIC FORCES AT FAILURE	
=	LOAD AT FAILURE	Load to be considered by the manufacturer when designing the machine in case of failure.

load carrying device
part of stage machinery which directly carries the intended load
EXAMPLE Fly bar of a bar hoist, platform of an elevator, truss, hook of a point hoist
Note: For trusses refer to EN 17115
[SOURCE: EN 17206:2020, 3.1.12]

Characteristic load
characteristic load is the sum of the system load and the dynamic forces occurring during normal operation
Note: Normal operation also includes holding of loads at rest.
[SOURCE: EN 17206:2020, 3.2.1]

Load at failure
sum of the system load and the dynamic forces occurring due to uncontrolled stops in case of failure
Note: Uncontrolled stops may occur e.g. due to:
a) failure in electric power supply.
b) pressure failure in hydraulic system.
c) activation of a safety device.
d) stalling of the motor due to snagging of the load/load carrying device.
e) sudden lifting of a load started with no tension on the ropes.
[SOURCE: EN 17206:2020, 3.2.6]

System Load
sum of the working load and the weight of the load carrying device
Maximum load which can be safely handled by the machinery installation under normal operating conditions, not taking dynamic forces into consideration.
[SOURCE: EN 17206:2020, 3.2.9]

J.3 Maximum load for lifting equipment designed for the entertainment industry – ELL

The entertainment load limit or ELL defines the maximum load that an item of lifting equipment is designed to raise, lower or sustain. The ELL will not be higher than the WLL. The ELL might vary depending on the use case. See chapter 8.3.2 in EN17206:2020.

The entertainment load limit at rest or ELL/R defines the maximum load that an item of lifting equipment is designed to sustain at rest. For example, due to additional measures such as locking pins in elevators.

Any loads between the ELL and the ELL/R can only be reached when the lifting equipment is at rest, never in motion, and when the lifting equipment has all its additional measures in place.

The ELL/R marking will always be accompanied by an ELL marking.

Lifting equipment designed for the Entertainment industry will have an ELL marking, and possibly an ELL/R marking. Such lifting equipment will not require further de-rating before use.

If lifting equipment does not display an ELL marking, it will include a WLL marking. The user may have to consider the safety factor of the lifting equipment before it can be used in the entertainment industry.

The ELL and the ELL/R intent to clarify the maximum capacity of a lifting equipment and to avoid all user de-rating calculations and safety factors considerations.

For further information on ELL markings see EN 17206:2020, 8.3

J.4 Installation markings - SWL

The WLL, the ELL and the ELL/R markings can only be altered by the manufacturer of the lifting equipment. The installer can reduce the load of an installed lifting equipment using the SWL marking.

The SWL is the useful load which is borne by the load carrying or securing device, or directly by the load bearing equipment.

The installer, during commissioning, may declare a SWL. The SWL might vary seasonally or under some environmental conditions. i.e. show on the roof of a venue.

The installer will declare a SWL when the maximum load supported by the lifting equipment attachment point is lower than the lifting equipment maximum load. Thus, the declaration of a SWL is at the discretion of the installer.

The SWL cannot be higher than any load marking declared by the manufacturer. The SWL cannot be higher than the ELL and the SWL cannot be higher than the WLL.

A lifting equipment or a group of lifting equipment might have different SWL at different pickup locations of the truss or flying bar.

Where a SWL is applicable and where the load is applied other than as a single vertical point load, a loading notice will be provided to indicate the SWL under the different permitted distribution conditions.

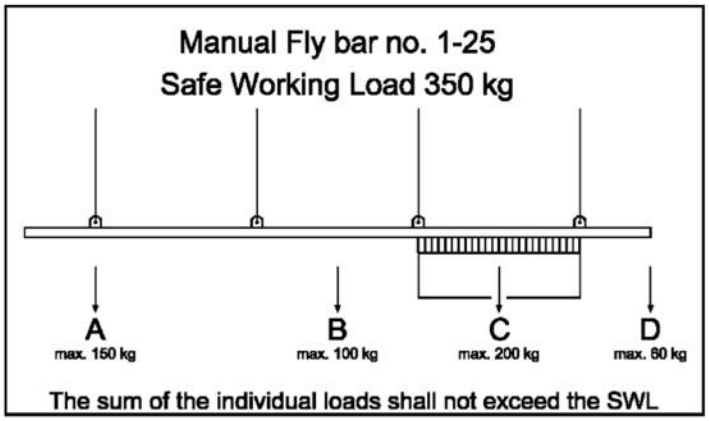


Figure J.1 — Figure title

Note that when a flying bar is considered a load carrying device which is part of the machine it will also be subject to ELL marking (See EN 17206:2020, 8.3.2)