IEC 63132-5

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Guidance for installation procedures and tolerances of hydroelectric machines – Part 5: Bulb turbines and generators

Lignes directrices des procédures et tolérances d'installation des machines hydroélectriques – Partie 5: Turbines et alternateurs de type bulbe

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GUIDANCE FOR INSTALLATION PROCEDURES AND TOLERANCES OF HYDROELECTRIC MACHINES –

Part 5: Bulb turbines and generators

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Draft	Report on voting
4/456/FDIS	4/462/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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GUIDANCE FOR INSTALLATION PROCEDURES AND TOLERANCES OF HYDROELECTRIC MACHINES –

Part 5: Bulb turbines and generators

1 Scope

The purpose of this document is to establish, in a general way, suitable procedures and tolerances for the installation of bulb turbine and generator. This document presents a typical assembly and whenever the words “turbine” and “generator” are used in this part, it refers to bulb turbine and generator. There are many possible ways to assemble a unit. The size of the machine, the design of the machine, the layout of the powerhouse, the sequence of concreting or the delivery schedule of the components are some of the elements that could result in additional steps, or the elimination of some steps and/or assembly sequences.

It is understood that a publication of this type will be binding only if, and to the extent that, both contracting parties have agreed upon it.

The document excludes matters of purely commercial interest, except those inextricably bound up with the conduct of installation. It also excludes specifications of the civil works but this aspect of the work should be taken into consideration during the assembly of the units.

Wherever the document specifies that documents, drawings or information are supplied by a manufacturer (or by manufacturers), each individual manufacturer will furnish the appropriate information for their own supply only.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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- IEC Electropedia: available at http://www.electropedia.org/
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4 Installation flowchart

4.1 Turbine and generator embedded parts

Figure 1 shows a generic installation flowchart for bulb turbine and generator embedded parts.

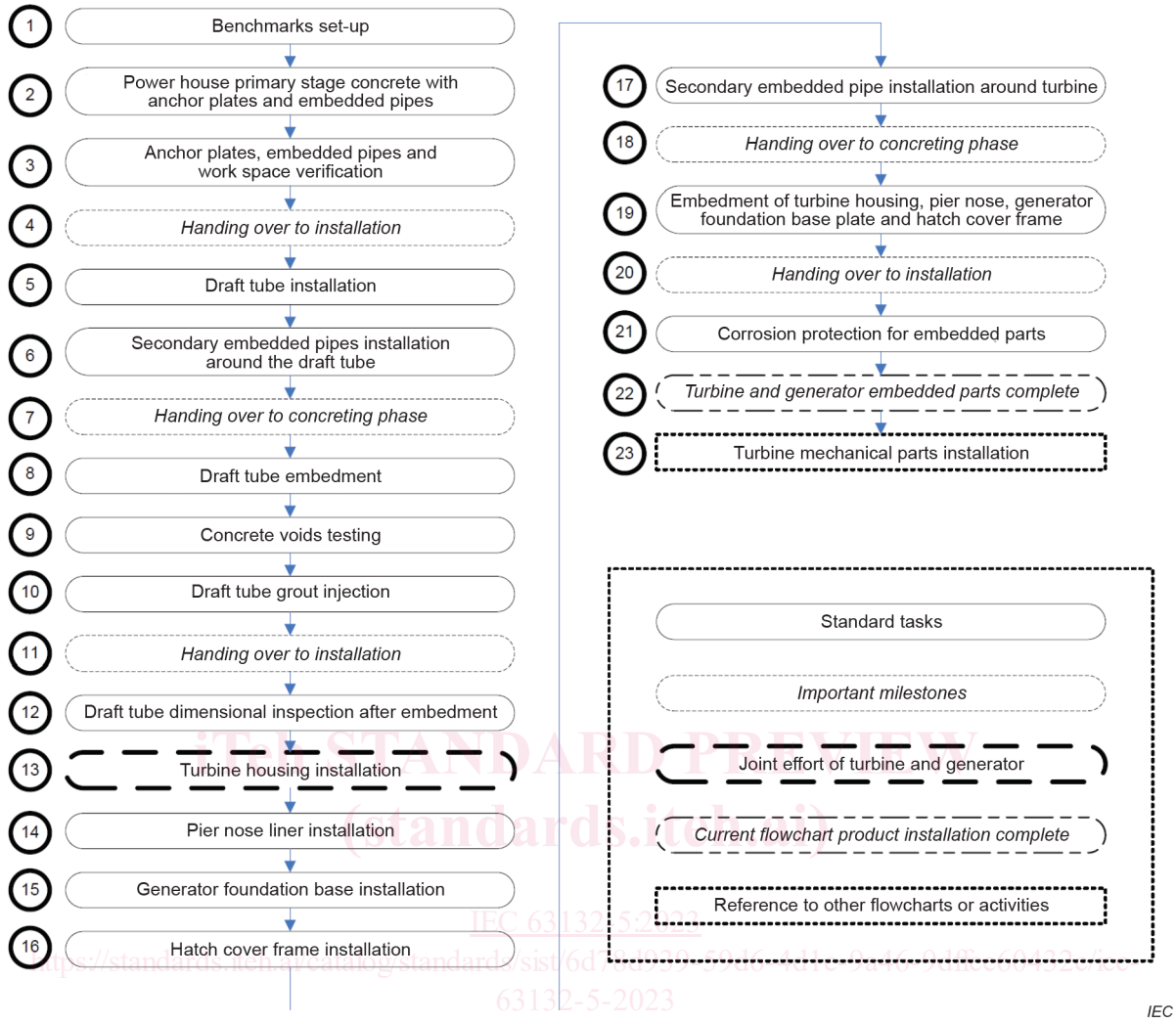

Figure 1 – Generic installation flowchart – Bulb turbine and generator embedded parts

4.2 Turbine and generator mechanical parts

Figure 2 shows generic installation flowchart for bulb turbine and generator mechanical parts.

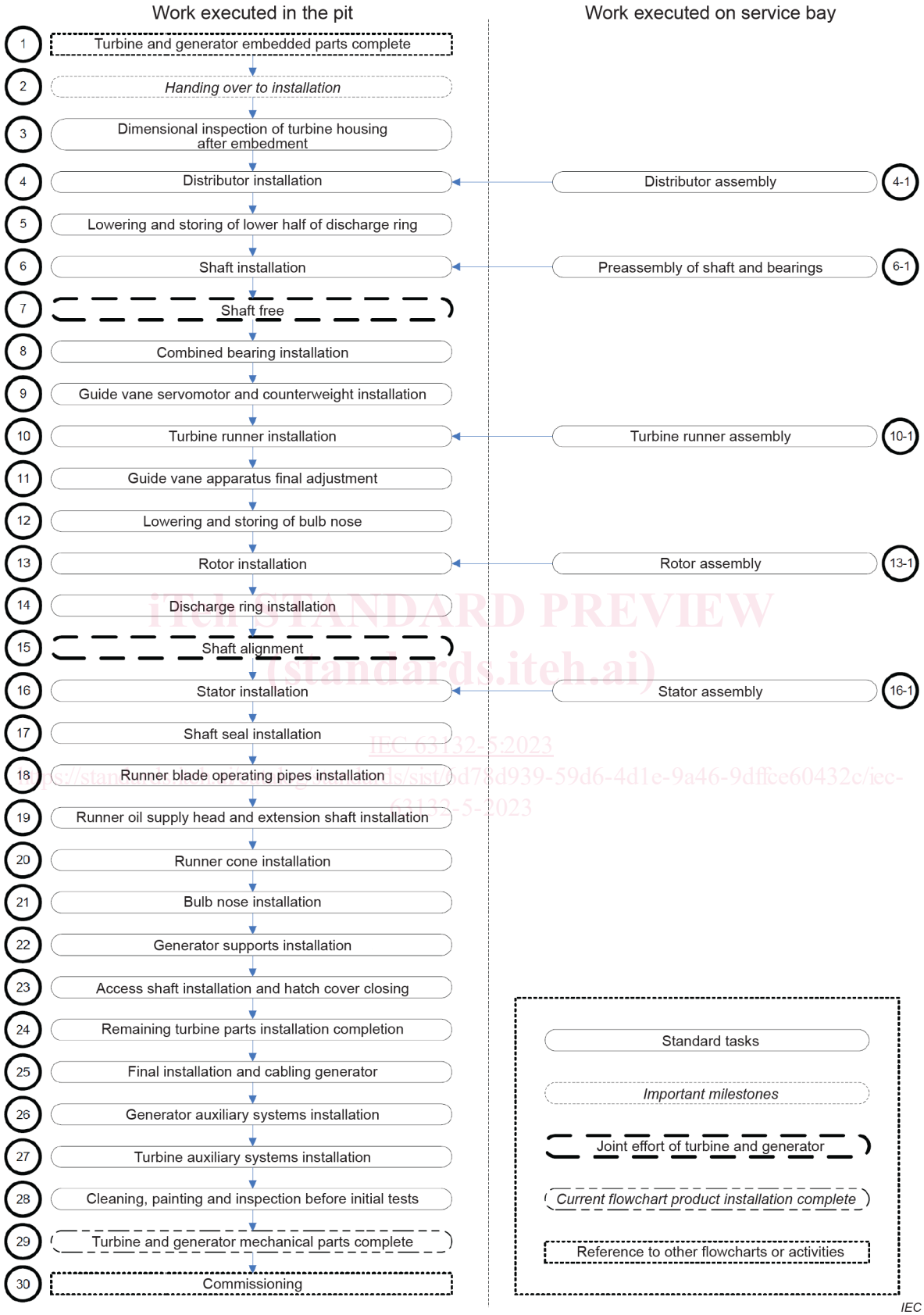

Figure 2 – Generic installation flowchart – Bulb turbine and generator mechanical parts

5 Steps

5.1 Turbine and generator embedded parts

5.1.1 Step 1: Benchmarks set-up

a) Objective of work in the step

- Set-up benchmarks to be used for starting proper installation of the turbine and generator.

b) Explanation of work

- Sufficient benchmarks should be provided to establish the unit centreline, axis and elevation.

c) Recommendations

N/A

d) Additional information

Depending on the project delivery system (EPC, design build, etc.), the benchmarks or their reference points could be provided by the owner, civil contractor, etc. Whoever provides the benchmarks or reference points is responsible to make sure they are correct.

The benchmark type (x, y, z coordinates, definition of the axis and elevations, etc.) should be agreed to before the beginning of the work.

The turbine supplier should take care to transfer the necessary benchmarks throughout the erection and/or concreting processes so that the benchmarks remain accessible as the unit is assembled.

5.1.2 Step 2: Powerhouse primary stage concrete with anchor plates and embedded pipes

a) Objective of work in the step

- Install primary embedded pipes, anchor plates and steel foundations in the correct locations.

b) Explanation of work

- Install the primary embedded pipes and supporting systems.
- Install the foundation components of the draft tube liner, servomotor, stay columns and pier nose.

c) Recommendations

Different designs require different tolerances; therefore, it is recommended that the turbine supplier should provide the tolerances. It is considered as a best practice to perform:

- Non-destructive tests as applicable (i.e. visual inspections, pressure tests of the piping, test of welding seams).
- Measures to prevent the concrete from entering the pipes or contaminating the machined surfaces of foundations during concreting.

d) Additional information

The contract should define which party is responsible to install the primary embedded pipes and/or the foundation components of draft tube liner, servomotor, stay columns and pier nose.

5.1.3 Step 3: Anchor plates, embedded pipes and workspace verification

a) Objective of work in the step

- Confirm that the foundation components of draft tube liner, servomotor, stay columns and pier nose have been installed in the correct place. Verify that the shape of concreted area is per the design and there is sufficient access to the workplace.

b) Explanation of work

- Ensure that the dimensions of the shape of concreted area match the design.
- Ensure that there will be no interference between the concrete structures, the reinforcing steels, the scaffolding, etc. and the foundation components of draft tube liner, servomotor, stay columns and pier nose.
- Once the workplace is acceptable, the turbine and generator installation work can start.

c) Recommendations

It is recommended to check that the foundation components of the draft tube liner, servomotor, stay columns and pier nose and the primary embedded pipes were installed within the tolerances provided by the turbine and generator supplier.

d) Additional information

N/A

5.1.4 Step 4: Handing over to installation

a) Objective of work in the step

- The work space is transferred to the turbine and generator supplier.

b) Explanation of work

- There is normally an official transfer of the working area from the civil contractor to the turbine and generator supplier. The transfer is typically documented with some type of signed form.

c) Recommendations

N/A

d) Additional information

N/A

5.1.5 Step 5: Draft tube installation

a) Objective of work in the step

- Install the draft tube (see Figure 3).

b) Explanation of work

- Transportation of the draft tube flange and the draft tube liner segments to the foundation and placing them on the foundation plates.
- Tack-welding of the draft tube flange and the draft tube liner segments.
- Inspection of the alignment and principal dimensions of the draft tube flange and the draft tube liner before welding.
- Welding of the draft tube flange and the draft tube liner.
- Inspection of alignment and measurement of principal dimensions of the draft tube flange and the draft tube liner after welding.

c) Recommendations

The items showed in Table 1 should be checked.

Table 1 – Draft tube installation tolerances

Item	Tolerance	Minimum number of measurements	Measurement location
Junction	To be determined by turbine supplier	8	Difference between the outlet end of the draft tube liner and the inlet of the concrete portion of the draft tube.
Elevation	To be determined by turbine supplier	2 for each side (Left and right)	Elevation of inlet and outlet
Flatness	To be determined by turbine supplier	8 when RD < 4m 16 when RD ≥ 4m	Flatness of inlet flange
Vertical Inclination	To be determined by turbine supplier	2 (Top and bottom)	Vertical inclination of inlet flange
Horizontal Inclination	To be determined by turbine supplier	2 (Left and right)	Horizontal inclination of inlet flange
Orientation	To be determined by turbine supplier	1	Orientation of inlet flange
Concentricity	To be determined by turbine supplier	4 at both inlet flange and outlet end	Concentricity of both inlet flange and outlet end to centre line
Circularity	To be determined by turbine supplier	8 at both inlet flange and outlet end	Circularity of both inlet flange and outlet end
Axial position	To be determined by turbine supplier	1	Axial position of inlet flange to turbine centre line

– Non-destructive tests of the welding seams.
– Proper fixation of the draft tube.

d) Additional information

The sequence for the installation of the draft tube flange and the draft tube liner should be provided by the turbine supplier.

If the downstream concrete portion of the draft tube cannot be completed prior to the installation of the draft tube liner, the outlet position of the draft tube liner cannot be determined by the junction method. Therefore, another method will be required to position the outlet of the draft tube liner. The downstream concrete portion would then be adapted to the draft tube liner outlet.

Adequate supports or bracing are required to prevent the draft tube flange and the draft tube liner from moving or changing shape during placing of the secondary concrete.

The draft tube flange and segments should be checked for any erosion or deformation to be fixed prior to welding/assembly tasks.

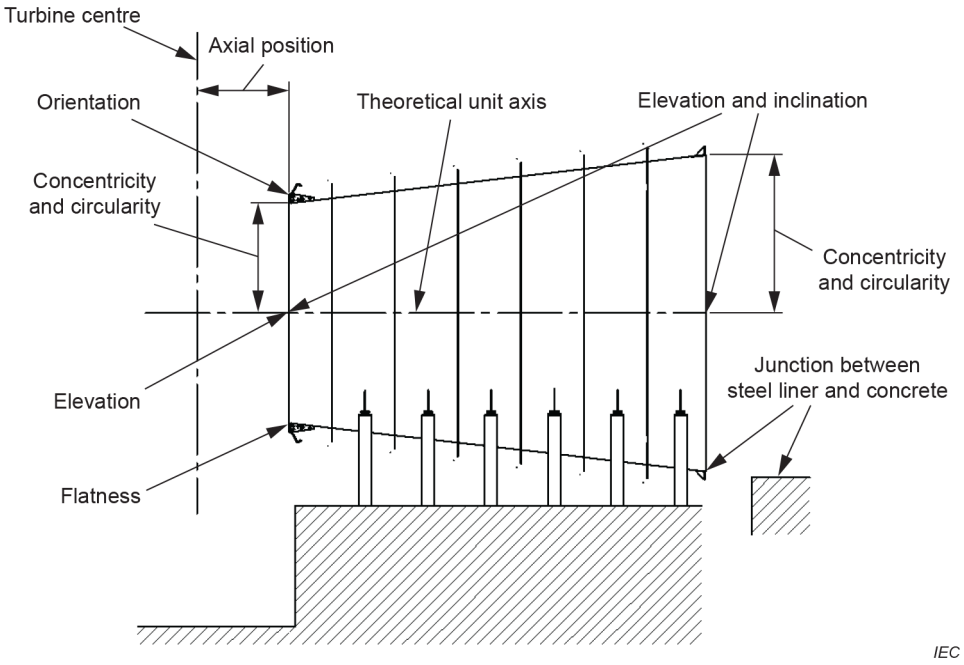

Figure 3 – Draft tube liner installation

5.1.6 Step 6: Secondary embedded pipes installation around the draft tube

a) Objective of work in the step

– Install the secondary embedded pipes.

b) Explanation of work

– Install the embedded pipes in the draft tube pit prior to concreting.

c) Recommendations

The following items should be checked:

– Non-destructive tests performed according to inspection and test plans.

– Dimensional checks of the locations of the pipes.

The following preventive measures should be considered:

– Support the pipes so they cannot move or be damaged during concreting

– Cover/block the pipe openings to prevent concrete from entering the pipes during concreting.

d) Additional information

Secondary embedded pipes should include draft tube dewatering piping, pressure tapping connections for testing or monitoring purposes, etc.

The condition of the piping, especially the small sizes, should be inspected for any deterioration.

5.1.7 Step 7: Handing over to concreting phase

a) Objective of work in the step

– The work space is transferred to the civil contractor.

b) Explanation of work

– The turbine supplier should confirm that the draft tube liner has been installed and aligned properly and is ready for concreting.

– There is normally an official transfer of the working area of the draft tube from the turbine supplier to the civil contractor. The transfer typically is documented with some types of signed form.

c) Recommendations

Refer to Table 1 at step 5 of turbine and generator embedded parts.

d) Additional information

– N/A

5.1.8 Step 8: Draft tube embedment

a) Objective of work in the step

– Embed the draft tube (see Figure 4).

b) Explanation of work

– Install the reinforcements.

– Position of the formwork.

– Pour concrete.

c) Recommendations

The concrete pour rate, pour/step heights and allowable differential levels should be agreed among the concerned parties during the early stages of project development, due to the critical impacts to deformation and misalignment.

d) Additional information

Care should be taken when placing concrete not to damage any of the embedded components or piping.

Figure 4 shows an example of a concreting plan.

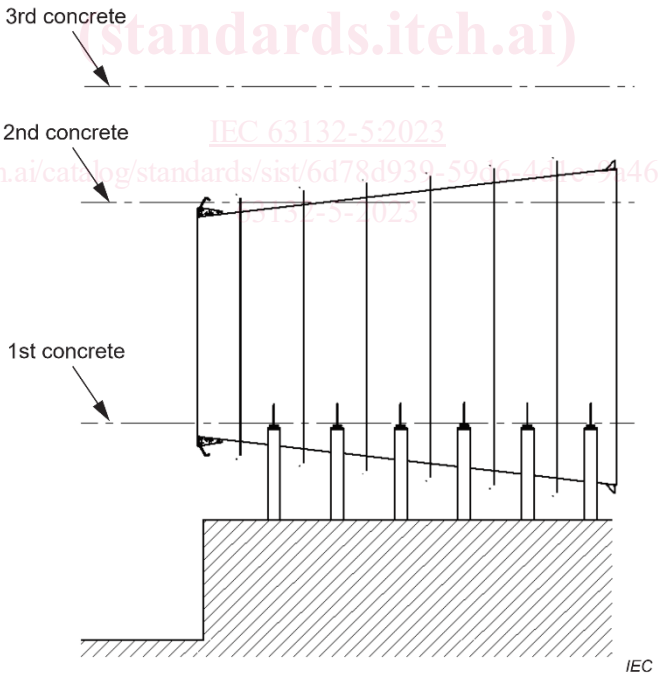

Figure 4 – Draft tube liner embedment plan

5.1.9 Step 9: Concrete voids testing

a) Objective of work in the step

– Determine if there are voids (hollow spaces) between the draft tube liner and the concrete.

b) Explanation of work

– A common method to detect voids is by tapping the inside surface of the draft tube liner with a hammer.