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**Guidance for installation procedures and tolerances of hydroelectric machines –
Part 6: Vertical Pelton turbines**

**Lignes directrices des procédures et tolérances d'installation des machines
hydroélectriques –
Partie 6: Turbines Pelton verticales**

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INTERNATIONAL
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**GUIDANCE FOR INSTALLATION PROCEDURES AND
TOLERANCES OF HYDROELECTRIC MACHINES –**
Part 6: Vertical Pelton turbines

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The text of this International Standard is based on the following documents:

Draft	Report on voting
4/457/FDIS	4/465/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 6: Vertical Pelton turbines

1 Scope

The purpose of this document is to establish, in a general way, suitable procedures and tolerances for the installation of Pelton vertical turbines. This document presents a typical assembly and whenever the word "turbine" is used in this document, it refers to a vertical Pelton turbine. There are many possible ways to assemble a unit. The size of the machine, the design of the machine, the layout of the powerhouse 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.

The tolerances in this document have been established upon best practices and experience, although it is recognized that other standards are specifying different tolerances.

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 reference

There are no normative references in this document.

3 Terms and definition

No terms and definitions are listed in this document.

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

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

4 Installation flowchart

4.1 Turbine embedded parts

Figure 1 shows a generic installation flowchart for Pelton turbine embedded parts.

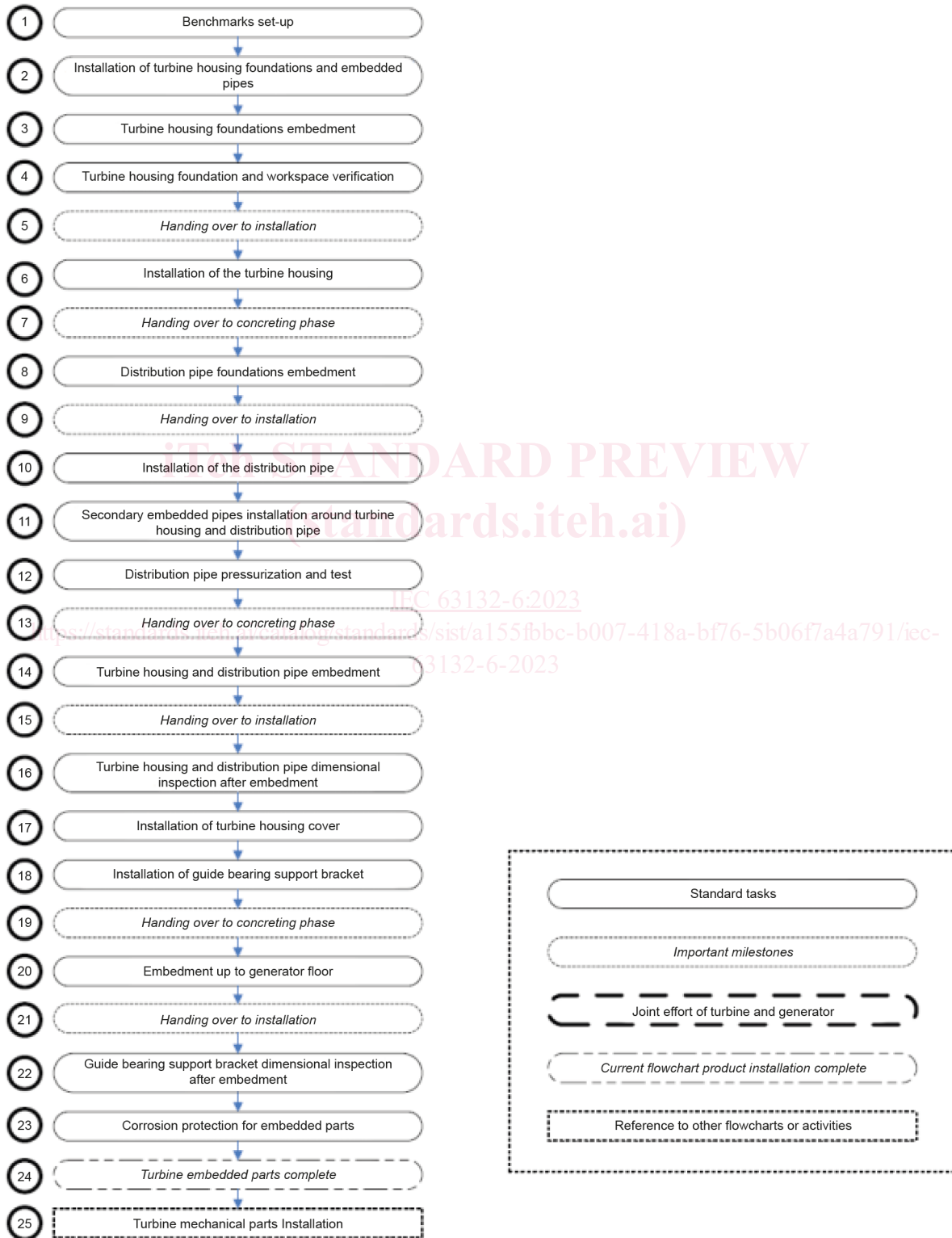


Figure 1 – Generic installation flowchart – Pelton turbine embedded parts

4.2 Turbine mechanical parts

Figure 2 shows generic installation flowchart for Pelton turbine mechanical parts.

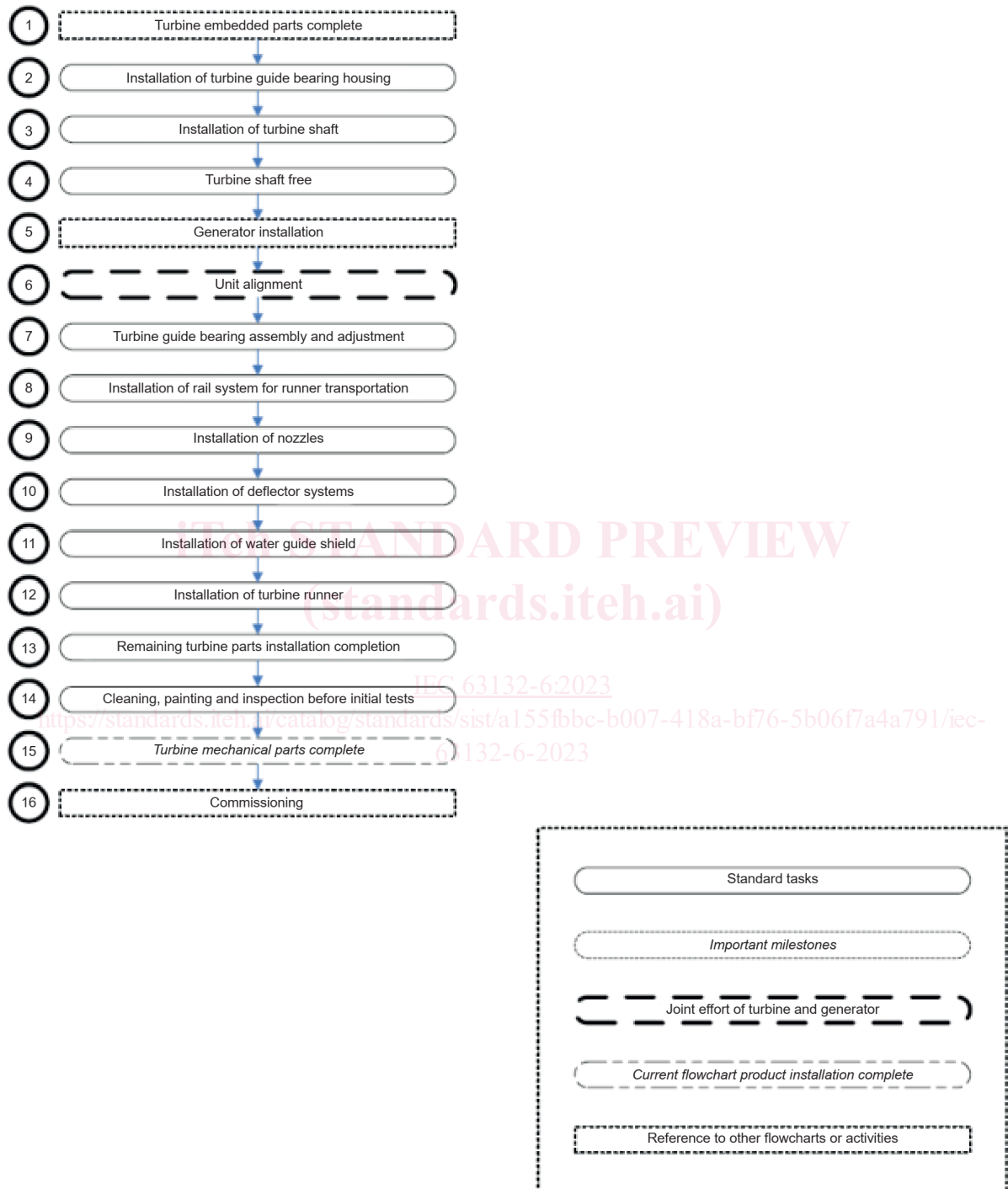


Figure 2 – Generic installation flowchart – Pelton turbine mechanical parts

5 Steps

5.1 Turbine 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, defining axis and elevations, etc.) should be agreed to prior to the work commencing.

The turbine supplier should take care of transferring 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: Installation of turbine housing foundations and embedded pipes

- a) Objective of work in the step
 - Install primary embedded pipes and turbine housing foundations in the correct locations.
- b) Explanation of work
 - Install the primary embedded pipes and supporting systems.
 - Install the foundation components for turbine housing and rail system for turbine parts transportation etc.

- c) Recommendations

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

- NDT 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.

Depending on the design, the rail system for turbine parts transportation may not require foundation components.

Depending on the size of unit, a support column for platform might be installed in the water passage below the turbine housing.

5.1.3 Step 3: Turbine housing foundations embedment

- a) Objective of work in the step
 - Embed the turbine housing foundations and the pipes in primary concrete.
- b) Explanation of work
 - Embed the foundation components for turbine housing and rail system for turbine parts transportation etc.
- c) Recommendations

Care should be taken not to damage any of the embedded components or piping when pouring concrete.
- d) Additional information

Depending on the design, the rail system for turbine parts transportation may not require the foundation components.

Depending on the size of unit, a support column for platform might be embedded in the water passage below the turbine housing.

5.1.4 Step 4: Turbine housing foundation and workspace verification

- a) Objective of work in the step
 - Confirm that the turbine housing foundation has been installed in the correct place, verifying that it is per the design and there is sufficient access to the workplace.
- b) Explanation of work
 - Once the workplace is acceptable, the turbine installation work can start.
- c) Recommendations

Check that the foundation components of the turbine housing were installed within the tolerances provided by the turbine supplier.
- d) Additional information

N/A

5.1.5 Step 5: Handing over to installation

- a) Objective of work in the step
 - Transfer the workspace to the turbine supplier/installer.
- b) Explanation of work
 - There is normally an official transfer of the working area of the turbine housing from the civil contractor to the turbine supplier/installer. Typically, the transfer is documented with some type of signed form.
- c) Recommendations

N/A
- d) Additional information

N/A

5.1.6 Step 6: Installation of the turbine housing

- a) Objective of work in the step
 - Install the turbine housing (see Figure 3).
- b) Explanation of work
 - Transport the turbine housing segments to the foundation and place them on the supports.
 - Tack-weld of the turbine housing segments.
 - Inspect the alignment and principal dimensions of the turbine housing before welding.
 - Weld the turbine housing.

- Inspect the alignment and principal dimensions of the turbine housing after welding.
- Install the inspection platform.

c) Recommendations

The items showed in Table 1 should be checked.

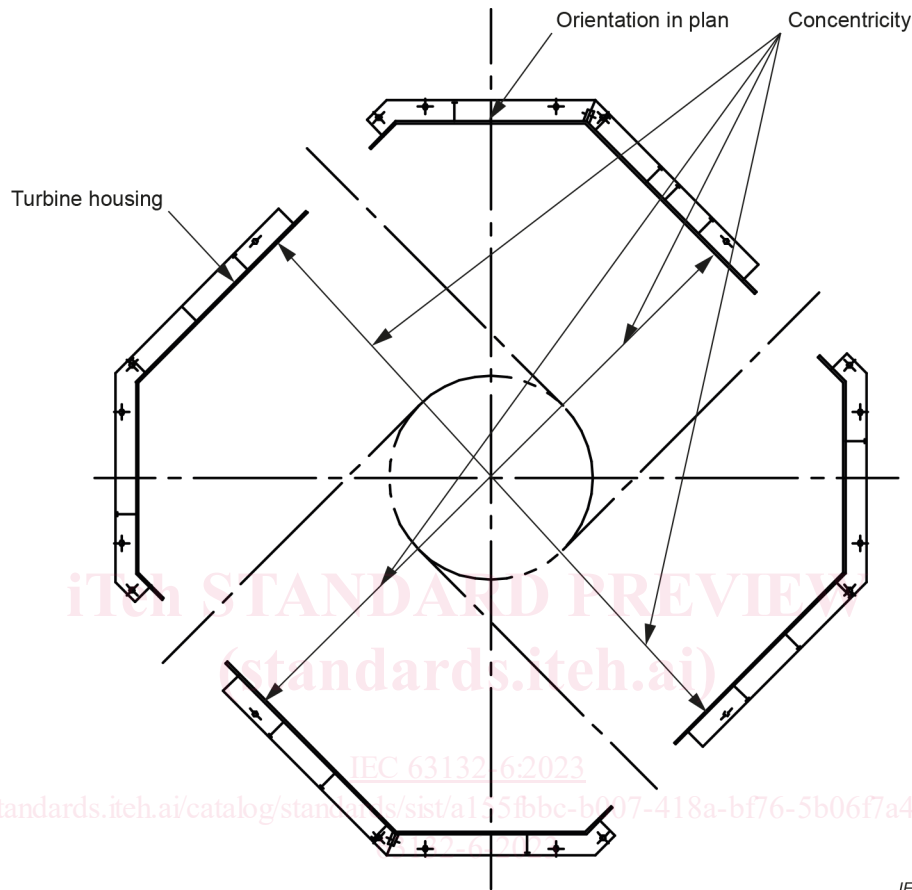


Figure 3 – Turbine housing installation

Table 1 – Turbine housing measurements

Item	Tolerance	Minimum no. of measurements	Measurement location
Concentricity	To be determined by turbine supplier	Number of nozzles	Inside walls of turbine housing
Orientation in plan	To be determined by turbine supplier	1	Orientation of turbine housing
Elevation	To be determined by turbine supplier	Number of nozzles	Top surface of turbine housing
Level	To be determined by turbine supplier	Number of nozzles	Top surface of turbine housing

- NDT of the welding seams
- Proper fixation of the turbine housing.

In addition to the above requirements, principal dimensions should be checked.

The tolerances and measurement locations of the principal dimensions are indicated in turbine supplier drawings.

The turbine housing should be set concentric to the theoretical unit axis (benchmark) and centreline.

d) Additional information

The sequence for the installation of the turbine housing should be provided by the turbine supplier.

Adequate supports or bracing are required to prevent the turbine housing from moving or changing shape during placing of the secondary concrete.

5.1.7 Step 7: Handing over to concreting phase

a) Objective of work in the step

- Transfer the workspace to the civil contractor.

b) Explanation of work

- The turbine supplier should confirm that the turbine housing has been installed and aligned properly and is ready for concreting.
- There is normally an official transfer of the working area of the turbine housing from the turbine supplier to the civil contractor. Typically, the transfer is documented with some type of signed form.

c) Recommendations

N/A

d) Additional information

N/A

5.1.8 Step 8: Distribution pipe foundations embedment

a) Objective of work in the step

- Install and embed distribution pipe foundations.

b) Explanation of work in the step

- Install the distribution pipe foundations. [IEC 63132-6:2023](#)
- Embed the distribution pipe foundations and lower section of turbine housing. [IEC 63132-6:2023](#)

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 schedule and costs) related to the design and installation of the turbine housing.

d) Additional information

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

5.1.9 Step 9: Handing over to installation

a) Objective of work in the step

- Transfer the workspace to the turbine supplier/installer.

b) Explanation of work

- There is normally an official transfer of the working area from the civil contractor to the turbine supplier/installer. Typically, the transfer is documented with some types of signed form.

c) Recommendations

N/A

d) Additional information

N/A

5.1.10 Step 10: Installation of the distribution pipe

a) Objective of work in the step

- Install the distribution pipe (see Figure 4).

b) Explanation of work

- Transport and assemble distribution pipe segments.
- Align distribution pipe flanges (elevation, orientation, distance and offset).
- Install and weld steel plates between distribution pipe flanges to turbine housing.

c) Recommendations

The items showed in Table 2 should be checked.

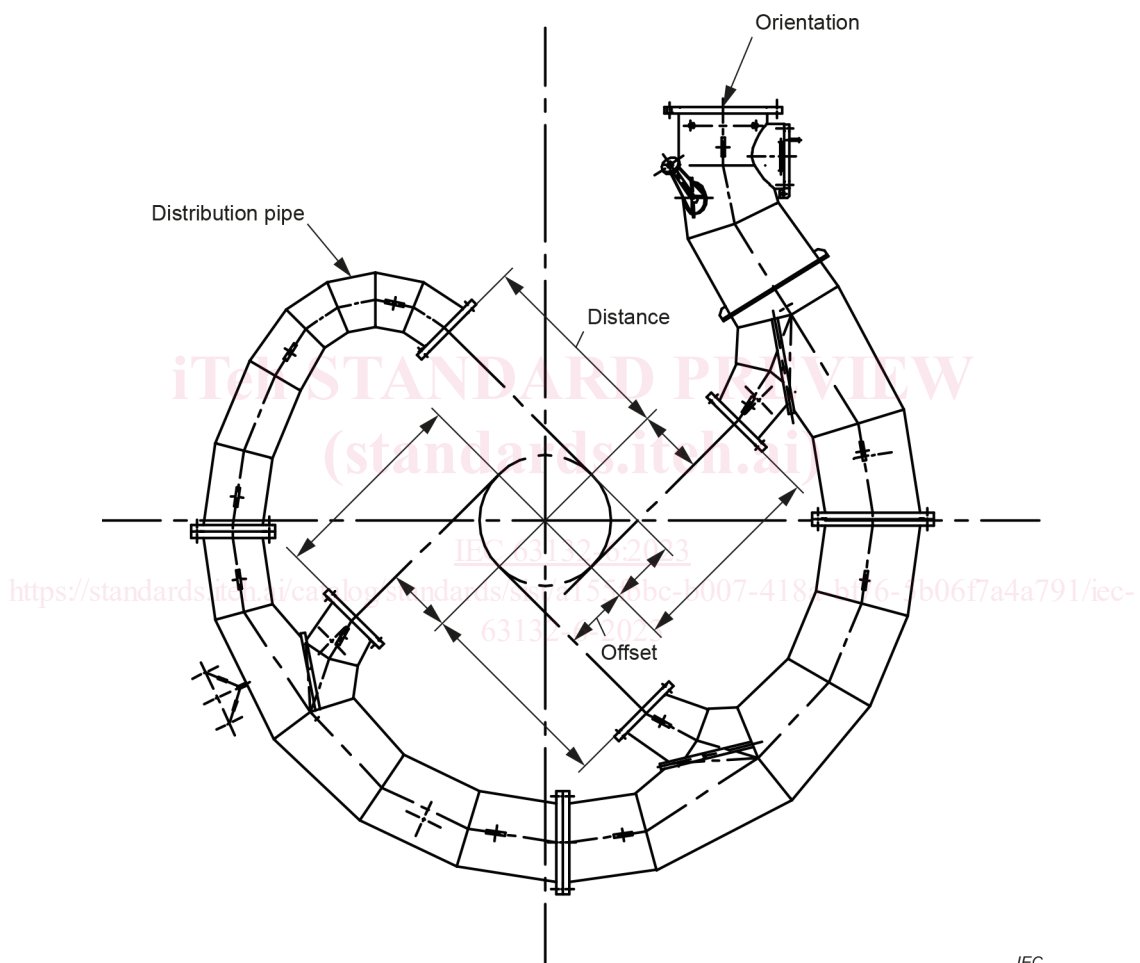


Figure 4 – Distribution pipe installation