

GENERAL SPECIFICATION

STRUCTURAL

GS EP STR 431

**Installation of piles for offshore steel structures.
Driven piles**

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1. Scope

The document defines the minimum requirements to the studies and works associated with the installation of piles and conductor pipes (CP) by driving.

The document also defines references for obtaining satisfactory and consistent quality in the reports to be provided by the Contractor in charge of pile or CP driving operations, in particular the drivability study and the pile driving monitoring report (if applicable).

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated in the CONTRACT, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT. References to superseded standards that may occur on technical documents will not over-write this clause.

Recognition of reference documents

Only the main reference documents are mentioned. The Contractor is responsible for complying with all secondary reference documents dealing with the subject of this document.

Unless otherwise indicated in the detailed contractual conditions, all the reference documents to be used as well as their supplements, shall be the latest editions.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
AISC 325	Steel Construction Manual
API RP 2A-WSD	Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design
API RP 2T	Planning, Designing and Constructing Tension Leg Platforms
DNVGL-RP-0005	Fatigue Design of Offshore Steel Structures
DNV-OS-H204	Offshore Installation Operations
ISO 19900	Petroleum and natural gas industries - General requirements for offshore structures
ISO 19901-4	Petroleum and natural gas industries - Specific requirements for offshore structures - Part 4: Geotechnical and foundation design considerations
ISO 19901-6	Petroleum and natural gas industries - Specific requirements for offshore structures - Part 6: Marine operations

Reference	Title
ISO 19902	Petroleum and natural gas industries - Fixed steel offshore structures
ISO 80000-1	Quantities and Units - Part 1: General

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP STR 100	Offshore steel structures - General
GS EP STR 101	Design of offshore jacket and subsea structures
GS EP STR 108	Requirements for evaluation of finite elements analysis and results
GS EP STR 201	Materials for offshore steel structures
GS EP STR 301	Fabrication of offshore steel structures
GS EP STR 401	Loadout, seafastening, transportation and installation of offshore structures
GS EP STR 404	Marine aspects for load-out, transportation and installation of offshore structures
GS EP STR 432	Installation of piles for offshore steel structures. Drilled and grouted piles

3. General

The ISO international system of units ([ISO 80000-1](#)) should preferably be used. However, the diameter and wall thickness of steel tubular pipes can also be expressed in inches (1 inch = 2.54 cm), and the pile penetration can also be expressed in foot (1 ft = 30.5 cm). When this is the case, the symbol used for the inch unit (" or in) or the foot unit (' or ft) shall be clearly indicated.

Unless otherwise indicated in the Particular Project Specifications, general marine operations shall be in accordance with the requirements of [ISO 19901-6](#) or [GS EP STR 401](#), whichever is the most stringent. Marine aspects shall comply with specification [GS EP STR 404](#). Some more specific requirements for the installation of driven piles are provided in [API RP 2A-WSD](#) and in [API RP 2T](#). Design and steel material shall comply with [GS EP STR 100](#), [GS EP STR 101](#), [GS EP STR 201](#) and [ISO 19900](#).

On specific items, [DNV-OS-H204](#) may be used as reference code, subject to written Company approval.

Proper installation of structure piling, including foundation piles and conductor pipes, is vital to the life and permanence of the platform. It requires each pile to be driven to the design target

penetration without damage, and all field-made structural connections to be compatible with the design requirements.

No piles shall be stabbed before the location and level of the jacket on the seafloor has been reviewed and approved Company.

The Contractor shall take all measures necessary to avoid dropping any equipment into the sea, and shall make good any faults occurring on the piles during installation.

When installing a tripod structure, particular attention shall be taken to the sequence in inserting the piles into the legs as the piles self-penetration can influence the on-bottom stability of such a tripod. When possible, a tripod structure should be secured alongside the installation vessel with non-tensioned polypropylene ropes.

4. Pile preparation and installation

4.1 General

Pile sections shall be identified with the chronological driving sequence. The Contractor shall ensure that the foundation piles pass freely through the structure legs or sleeves.

Unless otherwise accepted by Company, the Contractor shall mark the piles and the conductor pipes every 25 cm to allow the penetrated length to be read during pile driving, with zero reference level at the pile or CP tip at the seafloor.

If piles are locally reinforced with e.g. a larger wall thickness or weld beads, the Contractor shall attach particular importance to the penetration tolerances which shall be detailed on the construction drawings, with clear indication of limits in over-drive or under-drive length (if any).

The closure device on the lower end of the jacket legs or pile sleeves (when required) shall be designed to avoid interference with the installation of the piles. Such jacket member closures shall be either removed or destroyed as the pile passes. Removal of inflatable leg plugs without filling the empty leg with water is subject to Company approval.

4.2 Alignment and handling

Specific requirements are given in [API RP 2A-WSD](#) and [ISO 19902](#).

The Contractor shall be responsible for supplying and using lifting lugs, stabbing guides and any other accessories required. Hydraulic gripper or lifting tools shall be of good condition and tested at 125% of their nominal capacity. Test certificate shall be less than one year old at installation time, and the accessories lifting points shall be subject to NDT as per [GS EP STR 301](#) requirements considering special category class.

Alignment and stability of add-on piles or CP sections shall be ensured and demonstrated at any time of installation.

A minimum buckling length of 2.1 x stick-up length above the fixed point shall be considered and documented case by case.

Although the stabbing guides are theoretically designed to withstand alone the weight of a stabbed pile or CP section, a number of effects are often disregarded (wind, dynamic effects when removing the ILT mass, potential shock of an ILT on pile tip, crane pulling sideways due to lifting vessel motions). In that respect, as a minimum 50% of the pile (or CP) welding between

the two sections shall be achieved prior to disconnect crane lifting device (internal lifting tool ILT, shackles and the like) from the last stabbed add-on pile (or CP) section. The use of a minimum of 3 strongbacks (or equivalent device), evenly distributed on the circumference of the pile (or CP), is mandatory to ensure proper pile (or CP) add-on alignment.

When the lifting lugs or stabbing guides are removed, the Contractor shall grind flush the outer surface of the piles and shall perform 100% MPI (magnetic particle inspection) and 100% UT (ultrasonic) inspection according to specification **GS EP STR 301**.

4.3 Add-on pile or CP sections

Add-on pile or CP sections shall be provided with guides to facilitate stabbing and alignment. The guides shall be capable of safely supporting the full weight of the add-on section prior to welding.

Add-on sections shall be welded to the main pile sections already installed. Mechanical connectors may be used, subject to Company approval. Welding shall be performed as stipulated in paragraph 6.

The length and wall thickness of add-on pile sections (including the cut-off length) shall be designed according to the installation procedure (driving, drilling, etc.), and in agreement with the requirements of **API RP 2A-WSD** and **ISO 19902** with respect to acceptability of the buckling stresses induced into the pile or CP steel.

The maximum stick-up length shall be defined with $K = 2.1$ and with respect to the highest horizontal guide level, not the top of the jacket leg or sleeve.

5. Obtaining required pile penetration

5.1 General

To reach the design pile penetration the following techniques can be used (where applicable):

- Driving
- Drilling to assist driving
- Drilling for drilled and grouted insert piles.

The present document covers the requirements for the installation of piles and conductor pipes by driving. For the installation of drilled and grouted piles, reference shall be made to the specification **GS EP STR 432**.

5.2 Drivability study

Contractors shall perform a drivability study in order to assess the drivability of the piles with the proposed hammers (see **ISO 19901-4**, **ISO 19902** and **API RP 2A-WSD**). The drivability study shall include:

- The characteristics of the hammers and piles to be used, with the maximum stick-up length for each hammer-pile combination considered.
- The review of the soil conditions and geotechnical parameters.