

NORSOK STANDARD

COMMON REQUIREMENTS
MECHANICAL COMPLETION AND COMMISSIONING

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1 FOREWORD

NORSOK (The competitive standing of the Norwegian offshore sector) is the industry initiative to add value, reduce cost and lead time and remove unnecessary activities in offshore field developments and operations.

The NORSOK standards are developed by the Norwegian petroleum industry as a part of the NORSOK initiative and are jointly issued by OLF (The Norwegian Oil Industry Association) and TBL (The Federation of Norwegian Engineering Industries). NORSOK standards are administered by NTS (Norwegian Technology Standards Institution).

The purpose of this industry standard is to replace the individual oil company specifications for use in existing and future petroleum industry developments, subject to the individual company's review and application.

The NORSOK standards make extensive references to international standards. Where relevant, the contents of this standard will be used to provide input to the international standardisation process. Subject to implementation into international standards, this NORSOK standard will be withdrawn.

2 SCOPE

This standard defines the principles and structure of Mechanical completion and commissioning.

3 NORMATIVE REFERENCES

ISO 9000 series standards

4 DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

Normative references	Shall mean normative in the application of NORSOK standards.
Informative references	Shall mean informative in the application of NORSOK standards.
Shall	Shall is an absolute requirement which shall be followed strictly in order to conform with the standard.
Should	Should is a recommendation. Alternative solutions having the same functionality and quality are acceptable.
May	May indicates a course of action that is permissible within the limits of the standard (a permission).
Can	Requirements are conditional and indicates a possibility open to the user of the standard.
Project Completion System (PCS)	Is a computerised system for electronic documentation of Mechanical completion, commissioning and preservation by system, subsystem, area, commissioning package, MC package and/or individual tag.

System	<p>An operational system or a non-operational system.</p> <p>Operational systems are dynamic process, utility or facility systems such as sea water, diesel, HVAC, telecom, main power and control system</p> <p>Non-operational systems are systems such as surface protection, insulation, civil, structural steel, markings and signs, cable and tubing trays.</p>
Mechanical Completion Status Index (MCSI)	This is a listing of all items/tags with associated check record status for each MC (or commissioning) package. The MCSI should be produced from the EDP based Project completion system.
Subsystem	A system broken down into functional subsystems.
Commissioning Package	A practical scope of work unit within a system or subsystem for commissioning, constituting a functional unit which can be tested by commissioning to confirm its suitability for operation.
MC Package	A practical unit of the scope of work for one discipline within a commissioning package.
Commissioning (C)	Is the functional verification of equipment and facilities that are grouped together in systems.
Mechanical Completion (MC)	The checking and testing of equipment and construction to confirm that the installation is in accordance with drawings and specifications and ready for commissioning in a safe manner and in compliance with project requirements.
Preservation	The preventive maintenance carried out on equipment before it is taken into use.
Factory Acceptance Test (FAT)	Testing to be performed at suppliers workshop to verify the equipment's performance/functionality.
Mechanical Completion Certificate (MCC)	A MC Certificate issued by the Executor to document that his MC scope has been carried out. The MC Certificates shall be used per MC package.
Mechanical Completion Check Record (MCCR)	A discipline checklist for the various equipment. These records form the basis of the MC documentation. MC Check Records are prepared for one or more items for recording of the results from checking and testing performed during MC.
Punch List (PL)	A Punch List describes incomplete work or malfunction of equipment or construction.
Status "OK"	This status means that this item is cleared and there is no further work associated with this item.
Status "NA"	This status means that the check is not applicable to the item referenced in the Check Record (CR). The item may however be applicable for subsequent executors.
Status "PA"	This means that this check item is not completed, and that remaining work is category 'A', i.e. must be completed prior to commissioning.
Status "PB"	This means that this check item is not completed and that remaining work is category 'B', i.e. may be completed prior to or after commissioning.
Punch List Register (PLR)	A punch list register is a listing of all punch list items, prepared at a time when installation, functions or activities should have been completed.
Carry Over Work Register	A register where incomplete items are documented sufficiently for

(COWR)	work preparation and completion. The COWR is based on the Punch Lists Register and describes punch listed work to be transferred to the next project executor.
MC dossier	MC documentation compiled in MC package.
Commissioning dossier	Commissioning documentation compiled in Commissioning dossier.
Executor	An organisation, supplier, contractor that performs a predefined scope of work.

4.2 Abbreviations

C	Commissioning
COWR	Carry Over Work Register
CR	Check Record
FAT	Factory Acceptance Test
MC	Mechanical Completion
MCC	Mechanical Completion Certificate
MCCR	Mechanical Completion Check Record (MCCR)
MCSI	Mechanical Completion Status Index
MSL	Material Status List
PCS	Project Completion System
PL	Punch List
PLR	Punch List Register
RFCC	Ready for Commissioning Certificate

5 COMPLETION PRINCIPLES

5.1 Overall goal

The overall goal of Mechanical completion and commissioning is to verify that the system is designed and built to fulfil its purpose and specified requirements.

The completion execution and documentation shall have as a goal to fulfil "NPD" rules as given in "Regulations for production and auxiliary systems".

Life cycle cost principles and safety should govern all decisions and actions.

Early establishment of commissioning packages is essential for an orderly and effective project completion. The commissioning plan shall have maximum priority to enable reversed planning in all project phases. All fabrication and installation planning shall be system oriented.

Mechanical completion, commissioning, FAT, Preservation and suppliers assistance requirements shall be specified in the purchase orders.

Repeating of MC/C checks performed at suppliers and assembly sites should be avoided, wherever possible.

5.2 Completion phases

5.2.1 Definition phase

In this phase the following is carried out:

- Completion philosophy.

- Coding structure and system breakdown.
- Completion requirements to suppliers and contractors.

5.2.2 Engineering phase

In this phase the following is carried out:

- Commissioning Package & MC Package definition.
- Define commissioning network.
- Produce commissioning procedures.

5.2.3 Suppliers completion phase

Equipment suppliers shall execute MC, FAT and commissioning and preservation as specified in the purchase order. The completion shall be documented as part of the completion system which leads up to handover to the company/client.

5.2.4 Construction/assembly Phase

Executor shall perform MC and commissioning and preservation as specified in purchase order/contract documents. The completion is documented as part of the completion system which leads up to handover to the company.

5.3 Responsibilities

Responsibilities are defined in the contract.

MC execution and registration/documentation, shall be performed by anyone who has a scope of work to be performed, such as equipment suppliers, fabrication contractors, installation contractor and hook-up contractors.

Commissioning registration and documentation shall be performed by anyone who has this responsibility implemented in their scope of work.

5.4 Common requirements

This standard shall be used as a basis for preparing plans, procedures and documentation for Mechanical completion and commissioning. The implementation of this standard requires the use of a coding system for item and system numbering, e.g. NORSOK Z-DP-002, Coding system.

5.5 Documentation

Mechanical completion documentation shall be completed/executed per item/MC package.

Commissioning documentation shall be documented on a commissioning package level.

All check/test records shall end up in a status OK-PA-PB.

5.6 Project Completion System (PCS)

An electronic based system for administration of Mechanical completion, commissioning and Punch List Register, should be used.

5.7 Planning

All MC activities shall be planned on fully integrated fabrication, Mechanical completion and commissioning schedules on system prioritised basis in order to meet the optimal sequence of completion.

6 MECHANICAL COMPLETION

6.1 Introduction

This chapter forms the basis for the execution and documentation of mechanical activities.

Mechanical completion takes place through all phases of the project, starting at equipment supplier and continuing through fabrication up to commissioning phase.

- Mechanical completion encompasses all disciplines.
- The detailed responsibilities are described in the contract.
- Executor of MC activities is responsible for establishing and compiling the MC dossiers and report status into PCS.

6.2 Documentation for a MC Package

The MC package shall consist of an MC Certificate, a MC Status Index and a Punch List Register printout as described below.

A Mechanical Completion Certificate (MCC) is a form completed by the Executor after all MC is carried out. The MCC is the cover sheet for each MC package. A MC package shall when signed be ready for start of commissioning.

The Check Records (CR) are the forms on which the Executors record the results of all checks, inspections and tests carried out for each individual item.

A Punch List Register (PLR) shall be prepared by the Executor along with the MC activity. In each MC package a printout from the PLR shall be included to document the incompleted work.

A MC Status Index (MCSI) listing the status of all CRs for the completed MC package shall be included in the MC documentation dossier.

6.3 Handover at Mechanical completion

Handover at Mechanical completion to commissioning shall be at commissioning package level, documented by the Ready for Commissioning Certificate (RFCC).

6.4 Carry Over Work Register (COWR)

The Carry Over Work Register lists all punch items that the Project accepts as cannot be completed during present phase. The COWR is used for the release of the work from the Executor and will as such be an input to the scheduling and planning of outstanding work to be performed during later phases.

The COWR Item Number and cross reference to the Punch List Register/Check Records shall be given. COWR work shall be marked up on drawings or sketches and be included in the records.

COWR Material Status List (MSL) and marked up drawings/instruction shall contain sufficient information for job setting in a later phase.

6.5 Typical Mechanical completion activities

Mechanical completion activities includes checking of fabrication and installation work.

Executor shall complete packages related to listed disciplines and as required by the MCSI.

Executor shall complete the check list items as per the MCCR's. The activities shall include but not be limited to:

(see also Annex A for typical check records)

6.5.1 Mechanical

- Visual inspection for complete and correct installation.
- Internal inspection of tanks and vessels.
- Alignment.
- Load testing of lifting equipment.
- Hot oil flushing.
- Bolt tensioning.
- Dimension control.
- Preservation.

6.5.2 Electrical

- Visual inspection for complete and correct installation.
- Insulation and continuity testing of cables.
- Insulation testing of generator, transformers and motors, panels, distribution board etc.
- Earthing checks.
- Static check of switches and control devices.
- Battery preparations.
- Lighting and socket outlet checks.
- Area completion.
- Heat tracing.
- Preservation.

6.5.3 Instrument/Telecommunication

- Calibration and testing of instruments prior to installation.
- Visual inspection for complete and correct installation.
- Insulation and continuity testing of cables.
- Cleaning, flushing, pressure and leak testing of pneumatic and hydraulic tubing.
- Adjustment of control, alarm and shutdown settings.
- Loop testing.
- Function testing of control systems.
- Function testing of field instruments.
- Hot oil flushing of instrument tubing.
- Area completion.

- Preservation.

6.5.4 Piping

- NDE carried out.
- Welding procedures.
- Removal of all items subject to damage during flushing, cleaning and pressure testing.
- Flushing of pipework.
- Chemical cleaning and testing of pipework.
- Drying of tested pipework.
- Preservation of tested pipework.
- Reinstatement of all items after testing.
- Final inspection of pipework.
- Test ISO's and P&ID's showing the extent of each pressure test.
- Pneumatic and hydraulic tubing.
- Hot oil flushing of pipework.
- Bolt tensioning.
- Pipe supports completed.
- Insulation.
- Flow coding.

6.5.5 HVAC

- Visual inspection for complete and correct installation.
- Cleaning of ductwork.
- Leak testing of ductwork.
- Alignment checks.
- Mechanical functions checks of equipment.
- Preservation.
- Flow coding.

6.5.6 Safety

- Visual inspection for complete and correct installation.
- Preservation.
- Area completion

6.5.7 Mechanical completion of non-operational systems

Mechanical completion of non-operational systems includes completion status and checks on an area basis. Disciplines included structural, surface protection, insulation, fireproofing and architectural.

6.5.8 Structural

- Visual inspection for complete and correct installation.
- QC documentation.
- NDE carried out.
- Welding.
- Load testing of lifting lugs and monorails.