Subsea Engineering Competency Profile

SUBSEA EQUIPMENT MECHANICAL DESIGN ELECTIVE	ME-003
This competency demonstrates a subsea engineer is equipped with sufficient knowledge and experience to effectively perform or supervise or approve the design, verification and testing of subsea equipment.	

ELEMENT OF COMPETENCE	WHAT THIS COMPETENCE MEANS IN PRACTICE	TYPICAL EXAMPLES OF EVIDENCE Refer to only as many Indicators of Attainment as you need to demonstrate the Element of Competence
Expert in the mechanical design process including concept selection and concept validation. Expert knowledge of: ● The design review process ensuring that all options are considered and can draw on the knowledge and experience of all members in the team. ● Desktop testing, the verification of designs and the impact of test results on the selection of designs. ● The effect of applying appropriate tolerances and understands the cost associated with achieving the prescribed tolerances. Working knowledge of: ● how the engineer's equipment design integrates with the overall subsea system ● process safety fundamentals and how isolations and barrier proving influence the design	Can describe, acquire, consolidate and document all of the factors defining the objectives and that influence the solution. Can manage a team to ensure an expansive and inclusive review of all options, drawing on the knowledge and experience of all members of the team. Capable of reviewing the output of the engineering team and ensuring cost effective, efficient, lean and appropriate designs.	Has led a team through a creative concept development process. Has produced two Basis of Design documents identifying the technical and functional aspirations of a mechanical solution to a problem. Has chaired/led two or more design reviews and can demonstrate positive enhancements of the designs from those reviews. Can describe in detail the testing processes approximating or replicating real-world environments using tanks/pools, mock-up equipment and environmental chambers.
Expert knowledge of mechanical design including: ● material selection	Can design mechanical assemblies using: ● brainstorming of design options	Has produced FMEA/FMECA assessments for at least two mechanical designs.

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• material properties including stress, strain, fatigue and the effect of temperature • limits, fits, threads, geometric tolerances and tolerance stack-up • surface treatments and heat treatment • standard and non-standard interfaces for intervention • numerical modelling techniques including FEA Expert knowledge of how structural and machine elements are used in a mechanical design including: • threaded fasteners and design of bolted connections • spring design and analysis • pressure vessel design and analysis • structural design and analysis • weld size calculations • sealing groove design and seal selection • power transmission (gears, shafts, bearings, gearboxes, motors, etc.) • Actuator (cylinder) design • Hydraulic couplers (stab plates, hot stabs, etc.) • Tube & tube fittings Working knowledge of: • Piping and small-bore tubing design and supports • Design methodologies to avoid damage due to dynamic effects.	• concept ranking by criteria including cost to design, cost to manufacture, complexity, size/weight, maintainability, etc. • performing FMEA / FMECA • risk assessment and technology readiness • front end engineering and design to validate concepts • numerical modelling techniques including FEA • integration of lessons learned and industry best practice Can incorporate the appropriate machine elements in a mechanical design to meet the solution requirements. Can integrate design changes to accommodate the method of intervention (diver, ROV, ROT, etc.) Can critically review hydraulic designs completed by others.	Has produced at least five diverse designs of equipment that meet the requirements of client and all other stakeholders. Has installed permanent equipment or used intervention equipment deployed by diver or ROV. Has developed equipment that was intended for use in either permanent equipment or intervention equipment deployed by diver or ROV. Has participated in at least one of each of the following verification processes: • Factory acceptance testing • System integration testing • Fault Finding/Incident Investigation/Root Cause Analysis

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• Foundation design and impact on mechanical design Working knowledge of hydraulic system design including: • component selection, pressure losses, flow • hydraulic analysis • Accumulator sizing and application • Pipe connections including flanges, gaskets and proprietary systems		
Expert knowledge of how items are manufactured and assembled including: • Machining capabilities, limitations and the cost of processes • Welding and fabrication, access during fabrication, distortion due to hot processes • Application of coatings, restricted access that limits / prevents application / testing • Effects of coating thickness on interfaces	Can recognise and avoid manufacturing constraints and issues when developing a design. Can adjust a design to facilitate manufacturing and address fabrication constraints.	Can describe common manufacturing processes and the advantages and limitations of particular methods and describe examples where the engineer has applied lessons learned to subsequent designs. Has participated in equipment manufacturing design reviews.
Expert knowledge of: • Relevant standards for technical drawing • Part, assembly & fabrication drawings • General assemblies and general arrangements • Hydraulic schematics and P&IDs • Weld Symbols • Geometric tolerances	Can produce, review and approve complete and comprehensive drawings to ensure that the finished item accurately reflects the intent of the designer. Can interpret and critically review computer models and drawings for completeness and comprehension, against applicable standards, and against common industry practice.	Has produced, reviewed and approved computer models and drawings that have resulted in the successful delivery of subsea equipment.

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Working knowledge of CAD software to communicate the physical requirements of an item.		
Expert knowledge of relevant statutory, regulatory, industry and customer requirements.	Applies appropriate engineering and industry standards, best practices or recommended practices to the design and construction of equipment.	Has participated in, or have had designs subject to, a 3rd party verification.