PROJECT TITLE: SUPPLY OF SPM AND PLEM SYSTEM		CONT. No.: XXXX-XX-XX				Page: 1 of 32		
		DOCUMENT CODE						Class
		PLAN/PRJ	UNIT	PHASE	DISC	DOC. TYPE	SER. NO.	REV. NO.
		JT	1	000	PL	SP	130	D4

SPM – Technical Specification for Offtake Hawser

D4	11/01/2021	AFC	HA	ER	RB	OBT
D3	22/10/2020	AFC	HA	ER	RB	OBT
D2	28/09/2020	IFA	HA	ER	RB	OBT
D1	24/08/2020	IFA	HA	RB	PK	OBT
D0	14/07/2020	IFC	HA	ER	RB	OBT
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	ORIGINATOR

CLIENT	
MSH SHIP MANAGEMENT	
PROJECT	
OIL TERMINAL AND MARINE FACILITIES	

OBT DOCUMENT NUMBER

ORW-4082-RW-028

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JT-1-000-PL-SP-130

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31

TITLE

SPM – TECHNICAL SPECIFICATION FOR OFFTAKE HAWSER

REVISION HISTORY & ELECTRONIC SIGN OFF						
1	11/01/2021	Approved for Construction	HA	ER	RB	
0	22/10/2020	Approved for Construction	HA	ER	RB	
C1	28/09/2020	Issued for Approval	HA	ER	RB	
C	24/08/2020	Issued for Approval	HA	RB	PK	
B	14/07/2020	Issued for Comment	HA	ER	RB	
A	18/05/2020	Inter-Disciplinary Check	HA	RB		
REV	**DATE**	**STATUS**	**BY**	**CHK**	**APP**	**CLIENT**

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1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

MSH Ship Management Company (MSH) are assisting in the development of an offshore terminal and marine facilities in Jask. The project will involve the design, construction and operation of three (3) offshore tanker loading/offloading facilities, onshore storage facilities and associated infrastructure, pipelines and roads.

The facilities are to be designed to handle the loading and offloading of crude oil and condensates to and from Very Large Crude Carrier (VLCC) tankers up to 320,000 DWT with the objective to transfer one million barrels of crude oil per day via SPMs, subsea pipelines and other relevant facilities.

The proposed site for the SPM systems is located approximately 6-7 km from shore in water depths ranging approximately from 45m to 50m (LAT).

Orwell Barata Tambatan (OBT) have been requested to undertake the following:

- Provide the engineering for the three (3) SPM Systems and PLEMs;
- Undertake fabrication of one (1) SPM System and PLEM at SPM FABRICATOR to be advised;
- Supply all key equipment to MSH for two (2) SPM Systems and PLEMs;
- Supply of all external components to MSH for the three (3) SPM Systems and PLEMs;
- Provide supervision during MSH Fabrication of two (2) SPM Systems and PLEMs.

1.2 SCOPE OF DOCUMENT

The scope of this document is to present the SPM CONTRACTOR’s Technical Specification for Offtake Hawser for the SPM System and PLEM.

1.3 DEFINITIONS AND ABBREVIATIONS

1.3.1 ABBREVIATIONS

ABS	American Bureau of Shipping
CR	Conformance Report
DEC	Design Environmental Condition
DOC	Design Operating Condition
DWT	Deadweight Tonnage
FAT	Factory Acceptance Test
HAT	Highest Astronomical Tide

HSE	Health, Safety and Environment
IACS	International Association of Classification Societies
ISO	International Organisation for Standardisation
ISPM	International Standards for Phytosanitary Measures
ITP	Inspection & Testing Plan
LAT	Lowest Astronomical Tide
MBL	Minimum Breaking Load
MRB	Manufacturer's Record Book
MSH	MSH Ship Management
MSL	Mean Sea Level
NCR	Non-Conformance Report
NDE	Non-Destructive Examination
NDT	Non-Destructive Testing
OBT	Orwell Barata Tambatan
OCIMF	Oil Companies International Marine Forum
O&M	Operating & Maintenance
PLEM	Pipeline End Manifold
QA	Quality Assurance
QC	Quality Control
SDRS	Supplier Document Register Schedule
SI	Systeme Internationale
SPI	Schedule Performance Index
SPM	Single Point Mooring
SV	Schedule Variance
SWL	Safe Working Load
VLCC	Very Large Crude Carrier

1.3.2 DEFINITIONS

CLIENT	MSH Ship Management
SPM CONTRACTOR	Orwell Barata Tambatan
SPM FABRICATOR	Company quoting to fabricate the SPM Buoy and PLEM to SPM CONTRACTOR
SUPPLIER	Company quoting to provide Goods or Services to SPM CONTRACTOR
GOODS	Equipment procured from the SUPPLIER
INSTALLATION CONTRACTOR	TBA
CLASSIFICATION SOCIETY	American Bureau of Shipping
CERTIFYING AUTHORITY	TBA

1.4 CERTIFICATION

Orwell Barata Tambatan (OBT) will obtain a generic design approval for the SPM's under ABS certification, i.e. CLASSIFICATION SOCIETY. All site-specific loads and data will then be verified against the ABS approved generic design. The design of the PLEM and its foundations will be limited to verification by an independent third party and be outside of any generic buoy design approval.

A recognised independent body, i.e. the CERTIFYING AUTHORITY, will then be appointed to the design and fabrication approval for all key equipment of the SPM System and to oversee the construction and assembly of the SPM Buoy and PLEM, to ensure compliance following ABS rules for Building and Classing Single Point Moorings [1].

1.5 UNITS

SI units unless otherwise specified.

2.0 CODES, STANDARDS AND REFERENCE DOCUMENTS

The SPM Buoy and its mooring system will be designed in accordance with the latest editions of the following codes and standards that are in force at the time of contract.

2.1 CODES AND STANDARDS

[1] ABS – Rules for Building and Classing Single Point Moorings

[2] ABS – Moorings of Oil Carriers at Single Point Moorings

[3] ISO 9001:2015 – Quality Management Systems

[4] ISO 45001:2018 – Occupational Health and Safety Management System

[5] OCIMF – Standard for Equipment Employed in the Mooring of Ships at Single Point Moorings

[6] OCIMF – Tandem Mooring and Offloading Guidelines for Conventional Tankers at FPSO Facilities

[7] OCIMF – Guidelines for the Purchasing and Testing of SPM Hawsers

[8] OCIMF – Hawser Test Report

[9] OCIMF – Recommendations for Equipment Employed in the Bow Mooring of Ships at Single Point Moorings

[10] OCIMF – Mooring Equipment Guidelines (MEG3)

2.2 CLIENT REFERENCES

[11] 97-927-50-EB-SPM-DS-5008-B00 – Data Sheet for Hawser

[12] 97-927-50-EB-SPM-SP-5059-B00 – Specification for Mooring Hawser

[13] 97-927-50-EB-SPM-SP-5071-B00 – Installation Guidelines - Mooring Hawser

2.3 SPM CONTRACTOR REFERENCES

[14] OBT-4082-AS-013 – Health and Safety Plan

[15] OBT-4082-SG-017 – Basis of Design

[16] OBT-4082-SW-018 – Technical Specification for Single Point Mooring

[17] OBT-4082-HG-019 – SPM System Equipment List

[18] OBT-4082-RW-024 – SPM Mooring Design Brief

[19] OBT-4082-RW-025 – SPM Mooring Analysis

[20] OBT-4082-SM-069 – SPM Electrical, Instrumentation & Controls Functional Specification

[21] OBT-4082-DG-600-01 – SPM General Arrangement

[22] OBT-4082-DV-941-01 – SPM 1, 2 and 3 - Floating Hoses - GA and Details

[23] OBT-4082-DW-751-01 to 03 – SPM Mooring Arrangement, Component Layout

[24] OBT-4082-DW-752-01 – SPM Mooring Arrangement, Offtake Hawser

[25] OBT-4082-XG-010-02 – TQ-002 - Tanker Operational Frequency

2.4 OTHER REFERENCES

[26] Bridon Oil and Gas Catalogue

3.0 ENVIRONMENTAL CONDITIONS

3.1 WATER DEPTH AND LOCATION

The proposed site for the SPM systems is located approximately 6-7 km from shore in water depths ranging approximately from 43m to 49m (LAT) [15].

The water depth at all three SPM positions, given Table 3.1.

SPM Locations	LAT (m)	MSL (m)	HAT (m)
SPM 1	48.70	50.59	52.20
SPM 2	44.00	45.89	47.50
SPM 3	43.20	45.09	46.70

Table 3.1 Water Depths for all SPM Buoys [15]

3.2 DESIGN CONDITIONS

Design of a SPM system to CLASSIFICATION SOCIETY Rules requires the definition of two sets of environmental conditions. These are the Design Operating Condition (DOC) and the Design Environmental Condition (DEC), defined as stated in Table 3.2.

Condition	Description
Design Operating Condition (DOC)	Maximum sea state in which a vessel is permitted to remain moored to the SPM without exceeding the allowable loads.
Design Environmental Condition (DEC)	The environmental condition with maximum wave, wind and associated currents based on a 100-year recurrence interval. At this condition, no vessel is moored to the SPM system.

Table 3.2 Definitions of Environmental Conditions [18]

The DOC and DEC conditions are listed in Table 3.3 and Table 3.4.

Wave		
Hs (m)	Tp (s)	γ
2.7	5.9,7.5,9.0	5.0, 1.7, 1.0
Wind		
Velocity $U_{1\text{-hr, }10m}$ (m/s)		
14.1		
Current		
Velocity @MSL (m/s)		
1.1		

Table 3.3 DOC Extreme Sea State Parameters [18]

Wave		
Hs (m)	Tp (s)	γ
5.3	8.3,10.5,12.6	5.0, 1.7, 1.0
Wind		
Velocity $U_{1\text{-hr},\ 10m}$ (m/s)		
26.7		
Current		
Velocity @MSL (m/s)		
2.0		

Table 3.4 DEC Extreme Sea State Parameters [18]

3.3 MINIMUM DESIGN TEMPERATURES

The minimum design temperature is a reference point used as a criterion for the selection of the grade of steel to be used. For this purpose, the SPM CONTRACTOR will consider the minimum design air and sea temperature to be 0°C [15].

4.0 BASIS OF DESIGN

4.1 HAWSER ARRANGEMENT

The mooring hawser allows the offloading vessel to connect to the SPM Buoy. It comprises of chafe chains, shackles, support buoys, pick-up buoys and pick-up/messenger ropes.

As confirmed in [19], SPM CONTRACTOR recommends the mooring hawser assemblies to be 75.5m long to suit project specific needs and accommodate the berthing of VLCCs and.

Table 4.1 presents the load bearing parts of the hawser assembly [18] & [24].

Hawser Arrangement							
Items	**Material**	**Length [m]**	**Diameter [mm]**	**Weight [kg/m]**		**MBL [kN]**	
				Dry	**Wet**	**Dry**	**Wet**
Chafe Chain	R4 Studlink Chain	13.5	76.0	0.1270	0.1100	6,001.0	
Grommet	Nylon Rope	60.0	112.0	0.0166	0.0016	4,903.0	4,413.0
Chafe Chain	R4 Studlink Chain	2.0	76.0	0.1270	0.1100	6,001.0	

Table 4.1 Hawser Arrangement [18] & [24]

Refer to Attachment 1 for hawser sizing calculations.

4.2 DESIGN LIFE

The mooring hawser is a consumable item for which a retirement programme should be optimised. SPM CONTRACTOR will be able to develop such a programme within the O&M manual. The retirement programme will be based on standard industry practices for CALM Buoy offtake operations and include the following points:

- Factors based on retirement points whichever is earlier:
  a. 1,800/2,000 service hours;
  b. 6/12 calendar months; and
  c. 40/50 offtake operations.
- Regular visual inspection; and
- If any mooring hawser see loads in excess of the new dry break strength (i.e. 294t [24]), the mooring hawser shall be carefully considered for retirement as potential overload situations may have occurred.

Therefore, in compliance with SUPPLIER's recommendations, SPM CONTRACTOR would define the design life of the hawser to be between one (1) to two (2) years [15].

4.3 FATIGUE LIFE

The SPM CONTRACTOR shall provide fatigue load cycles for the mooring hawser extracted from [19] to enable the SUPPLIER to determine the mooring hawser fatigue life expectancy based on their in-house proprietary data.

The SUPPLIER shall calculate the mooring hawser fatigue life expectancy based on operational frequency [25] provided by the CLIENT and include it in the product design documentation.

4.4 SURVEY DURING CONSTRUCTION

The manufacture, assembly [24] and testing of the items will be subject to inspection by the SPM CONTRACTOR and the CERTIFYING AUTHORITY to confirm compliance with the Rules of the CLASSIFICATION SOCIETY. Inspectors from these organisations shall be given free access to the SUPPLIER's works and reasonable access and facilities are to be provided to allow inspection of all components. This also applies to facilities of any subcontractors to the SUPPLIER.

Any such inspection/access requirements will be planned in advance with the SUPPLIER. Components and materials used for manufacture of the goods shall be new and free of defects; reconditioned components shall not be considered as new and therefore shall not be accepted.

4.5 TESTING DURING CONSTRUCTION

Prior to commencement of manufacture, the SUPPLIER shall provide an Inspection and Test Plan (ITP) for the SPM CONTRACTOR to approve. The plan shall detail all tests, dimensional inspections, destructive and non-destructive testing to be performed on all materials and component equipment during the manufacturing process. These tests include but are not limited to the following:

- Measurement of weight per unit length;
- Measurement of new wet and dry breaking strength;
- Cyclic load test;
- Elongation measurement and stiffness properties of the hawser under tension; and
- Trial fittings of all items before shipment.

All documentation of testing and NDE shall be provided by a competent material testing laboratory with nationally recognised status in the country of component manufacture and endorsed by the CERTIFYING AUTHORITY. The SUPPLIER shall provide procedures for all function and system testing at least two (2) weeks prior to the test taking place.

5.0 SCOPE OF SUPPLY

5.1 MAIN COMPONENTS OF SUPPLY

The SUPPLIER shall provide mooring hawser assemblies for three (3) SPM systems. Table 5.1 presents the main components included in the scope of supply for one (1) SPM system.

No.	Item Descriptions	Unit	Quantities
1	200t SWL hawser shackle compliant with IACS W22 c/w load cell (load cell is outside of SUPPLIER scope of supply)	Each	2
2	250t SWL hawser shackle compliant with IACS W22	Each	2
3	CALM Buoy side chafe chain, R4, Ø76mm studlink chain assembly	Each	2
4	Heavy duty hawser shackle (250t SWL), galvanised finish, complete with double nuts and pins	Each	4
5	Mooring hawser, 14" circ. double braided, 100% nylon rope, polyurethane coated grommet spliced double end	Each	2
6	Shuttle tanker chafe chain, R4, Ø76mm studlink chain assembly	Each	2
7	Shuttle tanker side support buoy (chain through type buoy)	Each	2
8	Messenger line, 10" circ. 8-strand multiplait rope c/w protected soft eye spliced each end	Each	2
9	Pick-up line, 3" circ. 12-strand rope c/w protected soft eye spliced each end	Each	2
10	Shackle, 7/8" galvanised bow safety pin type shackle.	Each	2
11	Pick-up buoy, c/w steelwork fitted with a fixed eye each end	Each	2
12	Hawser tie-back system	Set	1

Table 5.1 Hawser Assembly Components [24]

5.1.1 MOORING HAWSER

The hawser is composed of one (1) section fibre rope with studlink chafe chain on each side, connecting to the Turret SPM Buoy and tanker respectively, as per OCIMF recommendations [10] and [24]. The fibre rope section selected is 100% nylon with grommet construction.

Refer to Attachment 1 for the mooring hawser sizing calculations.

5.1.2 HAWSER TIE-BACK

The SUPPLIER shall supply a device to enable the two (2) mooring hawser assemblies to be constrained together when not in use and tied back to the inner floating hose string, before the 1st set of winker lights [22]. The messenger rope shall also be secured to the floating hose string via the hawser tie-back.

The hawser tie-back shall be designed to prevent entanglement of the mooring hawser assemblies with the floating hose strings and maintain the integrity of both mooring hawser assemblies and floating hose strings.

The SUPPLIER shall present these operations in detail in their O&M manual.

5.1.3 Chafe Chains

For ships over 150,000 DWT, the chafe chain design specification is Ø76mm grade R4 or equivalent stud link chain manufactured to IACS W22 requirements, quenched and tempered, to enhance its anti-abrasive wear characteristics [9].

The tanker end chafe chain is approximately 13.5m long and shall consist of chafe chain not less than 8m c/w an enlarged link and a special end link at one end [9]. The SPM Buoy end chafe chain is to be 2m long and fitted with enlarged links and special end links at each end. The purpose of the chafe chains is to prevent the mooring hawser from coming into contact with metal edges and possible chafing of the synthetic hawser.

The chafe chain at the tanker end is to utilise an oblong plate for connecting the chain to the messenger line bow shackle.

5.1.4 Support Buoys

When not in use, the chafe chain at the tanker end will be supported by a floatation device which may be connected by a short length of line to the special end link of the chafe chain [24] or by the use of a through buoy fitted over the chafe chain or using a spherical pick-up buoy [9]. Support buoys should be conspicuously painted (e.g. in vivid colour such as orange or yellow) and should have a reserve of buoyancy equivalent to at least 20% of the weight in air of the chafe chain, oblong plate and shackle to be supported. The SUPPLIER shall provide supporting calculations to demonstrate the reserve buoyancy of the support buoys.

The SWL of the eyes at the top and bottom of the support buoy, as well as the bolt to which they are connected should be certified by the manufacturer of the support buoys [9].

5.1.5 Pick-up and Messenger Ropes

The pick-up rope is connected to pick-up buoy and the messenger line via galvanised bow safety type shackles at the tanker end, and typically consists of 2.5m of floating rope, yellow in colour.

The messenger line consists of 150m of floating rope [9], yellow in colour and complete with a small soft eye spliced at each end. It is attached to the end of the pick-up line with a shackle.

Typical methods of attachment of the pick-up rope are shown in Attachment 2.

5.1.6 Shackles

Shackles shall be part of the mooring hawser assembly [24] and provided by the SUPPLIER as per Table 5.1. Shackles shall be used to connect the ropes and other fittings [9].

5.1.7 Load Monitoring

Remote load monitoring of the hawser tension by the terminal is recommended and considered essential to safe operations [9].

Two (2) 200te rated load cells shall be supplied for each SPM Buoy with one (1) being integrated into each hawser chafe chain shackle pin. Load data will be transmitted to the PTU and displayed as independent and summative values in addition to estimated remaining life [20].

6.0 DOCUMENTATION AND QUALITY PROCEDURES

6.1 QUALITY SYSTEM

The SUPPLIER shall have in place an ISO 9001 Quality Management System [3] certified by an independent certification authority.

The SUPPLIER shall submit to the SPM CONTRACTOR for review and approval an electronic copy of the quality control certification and any QA procedures and quality control reports.

6.2 QUALITY PLAN

The SUPPLIER shall prepare and submit a Quality Plan covering all phases of the work to the SPM CONTRACTOR within twenty-eight (28) days of the effective date. The plan shall not be changed without prior consultation and express written approval of the SPM CONTRACTOR.

The quality plan shall include:

- Description of supply;
- Sub-vendor list;
- Job organisation chart;
- List of applicable procedures;
- Schedule;
- List of applicable specifications;
- Qualification of NDT operators;
- Internal audit plan;
- Progress report format;
- CR and NCR procedures;
- List of instruments with calibration expiry date; and
- List of QA/QC procedures.

If the SUPPLIER uses a subcontractor for some of the work, it is the responsibility of the SUPPLIER to ensure that the subcontractor has an established QA system that meets ISO 9001 [3].

6.3 QUALITY MANAGEMENT AUDIT

The Quality Assurance system will be subject to auditing and monitoring by the SPM CONTRACTOR. An audit plan shall be submitted within thirty (30) days of contract award and audits must be carried out as a minimum once every one hundred and eighty (180) days [3].

6.4 DOCUMENTATION

Prior to issue of contract, the SUPPLIER shall issue a Supplier Document Register Schedule (SDRS) identifying date and issue of all documentation. This SDRS shall allow the SPM CONTRACTOR and the CERTIFYING AUTHORITY to review and agree delivery dates for documentation.

All documents listed in the SDRS shall be signed by a SPM CONTRACTOR nominated representative and stamped by the CERTIFYING AUTHORITY prior to shipping. A full set of documents and five (5) copies shall be dispatched at the time of shipping. A soft copy of the full document package shall also be supplied to the SPM CONTRACTOR in '.pdf' format or similar.

Prior to shipping, the SUPPLIER shall obtain the necessary inspection release notes and acceptance certification from the CERTIFYING AUTHORITY and issue copies of all correspondence between the SUPPLIER and the CERTIFYING AUTHORITY to the SPM CONTRACTOR.

The following documentation is required 30 days before starting production:

- NDE Procedures (including calibration & verification procedures, acceptance criteria and equipment details);
- Dimensional & visual control procedure;
- Making procedure; and
- Traceability procedure.

6.5 DOCUMENT APPROVAL

The SUPPLIER shall provide certification by the CERTIFYING AUTHORITY to cover all aspects of material, manufacture, testing and inspection.

The SUPPLIER shall submit to the SPM CONTRACTOR, for review and approval, copies of certified documents and drawings of all components and/or assemblies, showing dimensions with relevant tolerances and total weight.

6.6 PRODUCTION AND DELIVERY SCHEDULE

The SUPPLIER shall submit to the SPM CONTRACTOR for review and approval copies of the production and delivery schedule within one (1) week of contract award.

6.7 PROGRESS REPORTING

Weekly progress shall be reported between Thursdays and Wednesdays and the report shall be provided to the SPM CONTRACTOR one (1) day later on the Thursday, progress meetings shall be chaired by the SUPPLIER. The SUPPLIER will submit minutes of meeting to the SPM CONTRACTOR for approval within two (2) days of meeting and upon three (3) days of the meeting and with the SPM CONTRACTOR's approval the minutes will be submitted final. The progress meeting reporting will include:

- Major activity highlights;
- Management summary;
- Project controls;
- Financial and change order status;
- Engineering progress:
    a. Schedule Variance (SV) analysis report;
    b. Schedule Performance Index (SPI) review;
    c. Project Schedule updates (Gantt chart);
    d. Project Schedule S-Curve updates showing actual progress against baseline progress for overall project; and
    e. Project Schedule and S-Curve baseline updates to reflect any schedule changes due to approved change orders.
- SUPPLIER work progress;
    a. Activities in progress for the reported week;
    b. Activities to begin in next weekly reporting period; and
    c. Areas of concern.
- Outstanding queries;
- External Interface Coordination;
- Man-hour and Manpower summary;
- Quality Assurance/Quality Control;
- Health, Safety and Environment;

- HSE statistics;
- Government and local authority (as necessary);
- Project Risk Management Plan; and
- Photographs.

Progress report is to continue during work execution until agreed otherwise with SPM CONTRACTOR.

6.8 INSPECTION AND TEST PLAN

The SUPPLIER shall submit to the SPM CONTRACTOR for review and approval, an electronic copy of the Inspection and Test Plan (ITP). The ITP shall indicate all QA procedures, inspection activities, acceptance criteria, and activity points. This will ensure that the essential personnel (SPM CONTRACTOR, CLIENT, CERTIFYING AUTHORITY and any other third-party personnel) are notified and involved at agreed hold, witness, review and monitoring key activity points throughout the project.

Hold

A critical step in manufacturing and testing where it is essential that the SPM CONTRACTOR, the CLIENT, the CERTIFYING AUTHORITY representatives participate in the inspection / process activity of the material/equipment in order to ascertain that the product for delivery complies with the specified requirements. Formal advance notification shall be given. The step shall not proceed without the presence of the SPM CONTRACTOR, the CLIENT, the CERTIFYING AUTHORITY representatives, or without a written statement giving a waiver.

Witness

A critical step in manufacturing or testing where it is desirable that SPM CONTRACTOR, CLIENT, CERTIFYING AUTHORITY representatives participate in the inspection/process activity of the material/equipment in order to ascertain that the product for delivery complies with the specified requirements. Formal advance notification shall be given. The step can proceed with or without the presence of the SPM CONTRACTOR, the CLIENT, the CERTIFYING AUTHORITY representatives after the designated time has passed.

Review

Documentation and records shall be available for verification/review at any time by the CLIENT representative.

Monitor

Activity will proceed as scheduled, without advance notification, but is subject to the SPM CONTRACTOR, the CLIENT, the CERTIFYING AUTHORITY witness as and when required. Monitor activities are intended for process verification, not product inspection.

6.9 Testing Requirements

Prior to commencement of inspection and testing, the SUPPLIER shall submit to the SPM CONTRACTOR, the CLIENT and the CERTIFYING AUTHORITY, for review and approval, all testing procedures and QA procedures [3].

The SUPPLIER shall submit, for review and approval, all testing results. This may include (but is not limited to) NDE, material certifications, procedure qualifications, dimensional control and Factory Acceptance Testing (FAT).

6.10 Manufacturer's Record Book

The SUPPLIER shall submit for review and approval copies of the following:

- Manufacturer's Record Book (MRB) Index (to provide the SPM CONTRACTOR and the CERTIFYING AUTHORITY a chance to comment on the arrangement of the document); and
- Final MRB which shall include, but may not be limited to:
  a. Un-priced Purchase Order;
  b. Minutes of Meeting of the Pre-Production Meeting;
  c. Product Design Documentation;
  d. Project Quality Plan;
  e. QA Procedures;
  f. Inspection & Test Plan (ITP);
  g. Manufacturing Procedure Specification;
  h. Handling, Transport & Storage Procedures;
  i. Manufacturing Procedure Qualification records;
  j. Material Certificates (chemical composition and strength);
  k. NDT Reports Sheet;
  l. Visual & dimensional survey test reports;
  m. Test Procedures and Results;
  n. Quality Control Reports;
  o. FATs;

p. Painting / Coating Reports;

q. Concession requests & Technical Queries (if any)

r. Non-Conformance Reports & Corrective Actions (if any)

s. Certificates of Compliance;

t. Inspection Reports & Certificates; and

u. Release Notes.

6.11 MANUALS

The SUPPLIER shall have available and will provide the following technical specifications, manuals, operating instructions, maintenance manuals for the goods and similar documentation as and when required by SPM CONTRACTOR including, but not limited to:

- Detailed installation instructions which specify recommended tools, tolerances and procedures related to proper installation;
- Manual of permitted operations, stating the operations which are allowed without causing failure and/or non-compliance with the functional and performance requirements to which the goods have been designed and for which the SUPPLIER provides a declaration of conformity;
- Operating instructions which provide instructions to the SPM CONTRACTOR personnel on how the goods operate; and
- Maintenance manuals, including drawings and detailed instructions, so that the SPM CONTRACTOR may order and replace spare parts in a safe manner. The maintenance manuals shall also include preservation and storage instructions.

6.12 DRAWINGS

The SUPPLIER shall submit for review and approval drawings (in .pdf and .dwg format) of all components and/or assemblies showing dimensions with relevant tolerances, total weight and product interface dimensions and specifications.

7.0 HEALTH AND SAFETY

To assure the SPM CONTRACTOR that Health and Safety is adhered to during manufacture the SUPPLIER shall be required to demonstrate that a health and safety system is in place. This system shall be based on the principal of ISO 45001:2018 [4] or equivalent.

The health and safety system will be subject to auditing and monitoring by the SPM CONTRACTOR.

7.1 SAFETY REQUIREMENT

The SUPPLIER shall ensure that all equipment used is at all times kept in a safe, sound and proper condition and used only for their designed purpose.

The SUPPLIER shall obtain all safety regulations that are applicable and pass a copy of these to the SPM CONTRACTOR.

The SUPPLIER will report within twelve hours of occurrence:

- Near miss;
- Personal injury; and
- Damage to property.

The SUPPLIER is to compile HSE statistics and pass to the SPM CONTRACTOR monthly.

8.0 INSPECTION AND TESTING

All FATs are to be conducted according to approved testing procedures and in accordance with relevant rules and regulations where necessary [5], [6], [7], [8], [9] & [10] as applicable. These tests include, but are not limited to:

- Measurement of weight per unit length;
- Measurement of new dry breaking strength and new net wet breaking strength;
- Cyclic load testing; and
- Elongation measurement and stiffness properties of the hawser under tension after cyclic loading.

8.1 ACCESS AND NOTIFICATION

Representatives of the SPM CONTRACTOR, the CERTIFYING AUTHORITY and the CLIENT shall have scheduled access to the components and assemblies for inspection purposes during the manufacturing process and during all testing. The SUPPLIER shall notify the SPM CONTRACTOR a minimum of ten (10) working days prior to any material, component, or assembly testing and dimensional verification testing, to allow for the scheduling of personnel to witness the testing.

8.2 ACCEPTANCE INSPECTION

After completion of manufacture and testing of the components and assemblies, but prior to shipment, the SUPPLIER shall provide the SPM CONTRACTOR with an acceptance inspection of the completed components and assemblies and review of the QA documentation in comparison with the acceptance criteria as stated in this specification, the ITP and the drawings.

8.3 PROOF LOAD TEST

The assembled mooring hawser shall be proof loaded at the factory, or a suitable facility, in accordance with the procedures prescribed by the OCIMF guidelines [7].

Additionally, the assembled mooring hawser shall undergo a 100% visual inspection test.

9.0 PACKING AND DELIVERY

9.1 SUPPLIER'S IDENTIFICATION

The SUPPLIER's identification information shall be permanently affixed to the components and chain bundles, as is the customary standard. As a minimum, the marking should specify manufacturer and purchaser names, serial number, manufacturing date, and operating parameters.

9.2 CERTIFYING AUTHORITY'S IDENTIFICATION

The CERTIFYING AUTHORITY identification information shall be permanently affixed to the components and assemblies, similarly to the CLASSIFICATION SOCIETY's regulatory standard.

9.3 SHIPMENT PREPARATION

The SUPPLIER shall submit, for review and approval, copies of the packing plan for shipping of the components and assemblies. Recommended lifting procedures and handling instructions shall be included. Individual package weights shall be provided.

The SUPPLIER shall prepare and package components and assemblies [24] for shipping, in accordance with worldwide sea/air freight shipping requirements (i.e. ISPM certified packing or equivalent), to ensure its safety in all transport stages prior to installation. Packaging of the component should be suitable for storage of up to six (6) months in a sheltered non-heated and non-air-conditioned location.

ATTACHMENT 1: HAWSER SIZING CALCULATIONS

The sizing of the mooring hawser has been carried out using the OCIMF [10] recommended method such that the required MBL of the single leg of a grommet hawser should be greater than or equal to:

$$MBL_{Rope} = \frac{LF\ x\ Fmax}{C_{WetStrength}\ x\ C_{Construction}}$$

where:

LF = Load Factor;

F_{Max} = Overall installation design maximum mooring force;

$C_{WetStrength}$ = Rope material wet strength factor;

$C_{Construction}$ = Rope construction factor.

Load Factor

The load factor is normally in the range 2.00 - 2.25 [6]. A factor of 2.25 will be used for conservatism.

Design Maximum Mooring Force

The design maximum mooring force in the hawser will be set to the value derived by the analysis [19].

Consequently, F_{Max} will be set at 225te for each hawser.

Rope Wet Strength Factor

Numerous hawser suppliers provide dry to wet strength ratios ranging between 0.92 and 0.95. Please refer to [26] and Attachment 3. However, OCIMF [6], Section 5.4.4, suggests using rope wet strength factor of 0.85 for nylon hawsers. Consequently, it is deemed satisfactory to consider that typical wet strength of nylon hawsers are approximately 90% of their dry strength.

Rope Construction Factor

The hawser will be of a looped grommet construction. The construction factor for this arrangement is 1.7 [6].

Required MBL of Rope for Grommet

The required MBL of the rope used to manufacture the grommet is given by:

$$MBL_{Rope} = \frac{2.25\ x\ 225}{0.9\ x1.7} = 330.9te$$

Referencing the Bridon Ropes catalogue [26], the required OCIMF 2000 nylon hawser size to give this MBL is 112mm (Dry MBL = 362te).

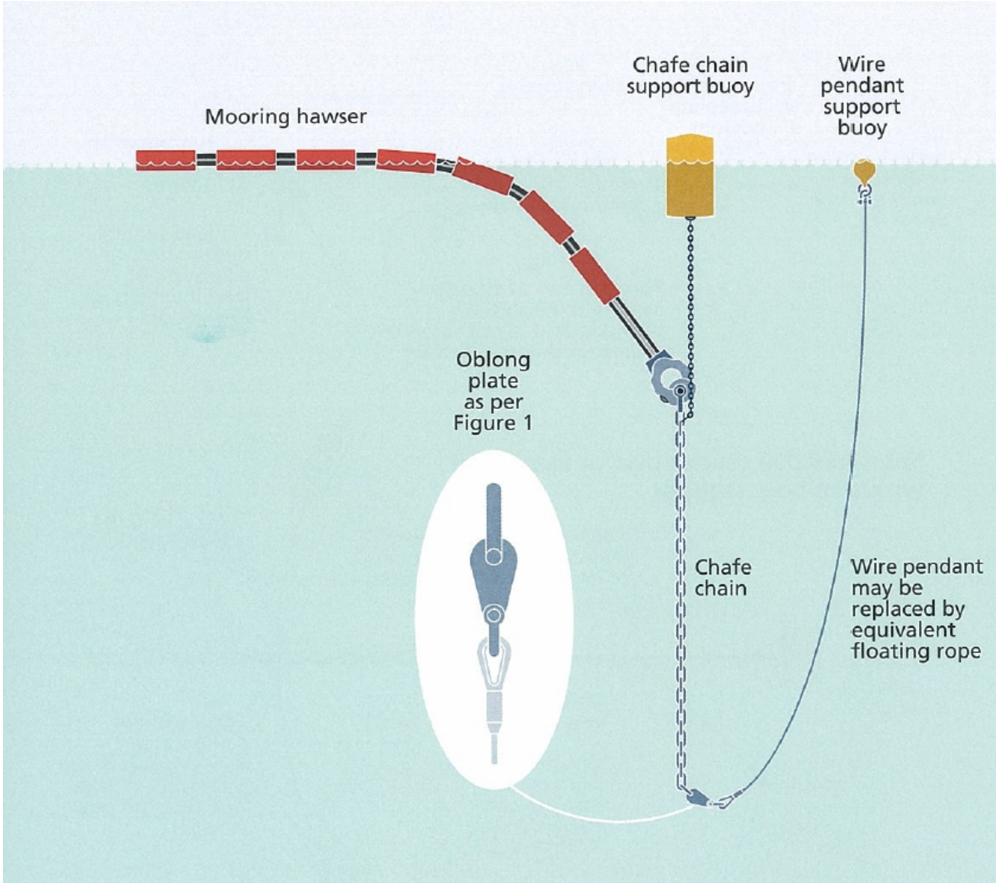
MBL of Grommet Hawser

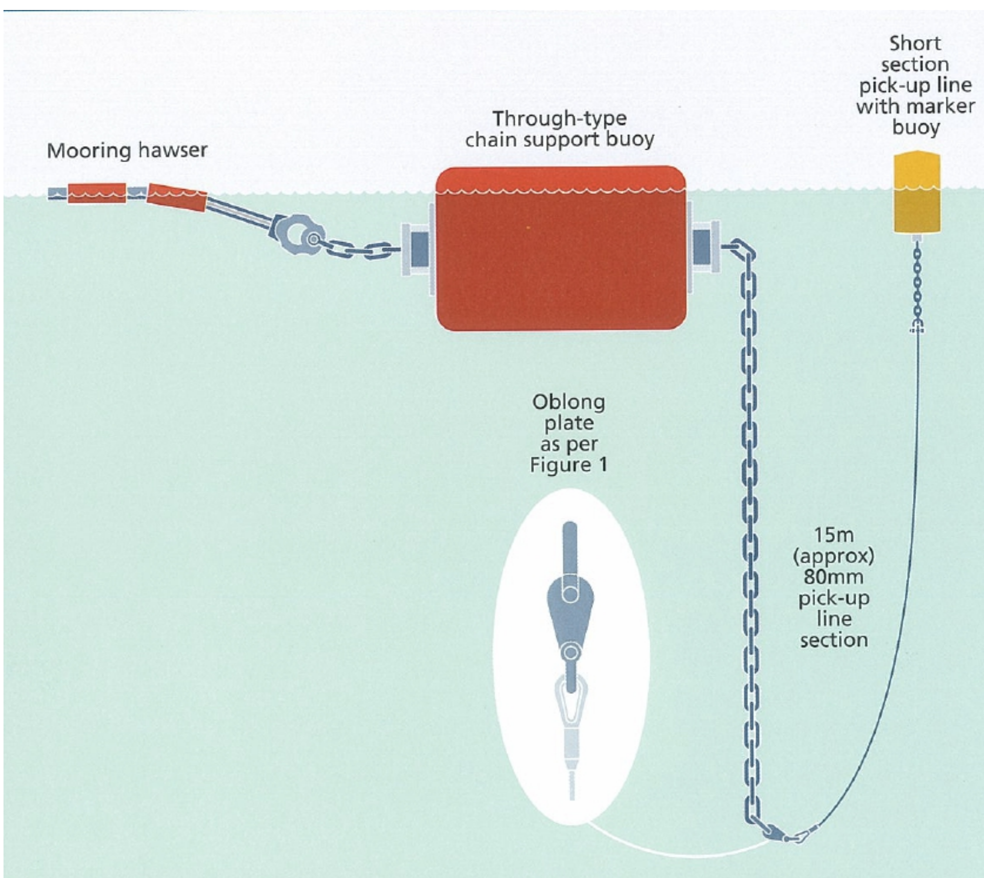
When the 112mm OCIMF 2000 nylon rope is spliced into a grommet, the MBL of the grommet becomes:

$$MBL\ Grommet,\ Dry = 362 \times 1.7 = 615.4te = 6{,}037.1kN$$

$$MBL\ Grommet,\ Wet = 362 \times 1.7 \times 0.9 = 553.9te = 5{,}433.4kN$$

ATTACHMENT 2: OCIMF TYPICAL ARRANGEMENTS TO FACILITATE CONNECTION / DISCONNECTION OF PICK UP ROPE


Mooring hawser
Chafe chain support buoy
Wire pendant support buoy
Oblong plate as per Figure 1
Chafe chain
Wire pendant may be replaced by equivalent floating rope


Mooring hawser
Through-type chain support buoy
Short section pick-up line with marker buoy
Oblong plate as per Figure 1
15m (approx) 80mm pick-up line section

ATTACHMENT 3: SUPERLINE NYLON BRIDON ROPE

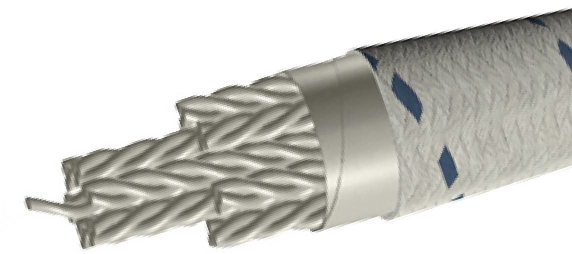
Superline™ Nylon

OCIMF 2000 Compliant*

Construction: Parallel laid load-bearing nylon core, protected by a nylon braided jacket

Key Features: Non load bearing sacrificial jacket, high damage resistance, easily repaired, excellent tension-tension fatigue performance

Options: HMPE jacket, particle filter, abrasion protection sleeves, PU coating, external & internal flotation systems



*Rope Diameter		Rope Circumference		Approximate mass				*Breaking Strength					
				In Air		Submerged		New Dry			New Wet		
mm	ins	mm	Ins	kg/m	lb/ft	kg/m	lb/ft	kN	Tonnes	Tons	kN	Tonnes	Tons
80	3 1/8	251.3	10	4.2	2.8	0.41	0.27	1779	181	200	1691	172	190
88	3 1/2	276.5	11	5.2	3.5	0.5	0.34	2163	221	243	2054	210	231
96	3 3/4	301.6	12	6.1	4.1	0.59	0.4	2585	264	291	2457	251	276
104	4 1/8	326.7	13	7.0	4.7	0.68	0.45	3046	311	342	2894	295	325
112	4 3/8	351.9	14	8.3	5.6	0.8	0.54	3546	362	399	3369	344	379
120	4 3/4	377.0	15	9.5	6.4	0.92	0.62	4084	417	459	3880	396	436
128	5	402.1	16	10.4	7.0	1	0.68	4662	475	524	4429	452	498
136	5 3/8	427.3	17	11.7	7.9	1.13	0.76	5278	538	593	5014	511	564
144	5 5/8	452.4	18	13.2	8.9	1.27	0.86	5934	605	667	5638	575	634
152	6	477.5	19	14.6	9.8	1.41	0.95	6629	676	745	6298	642	708
160	6 1/4	502.7	20	16.2	10.9	1.56	1.05	7364	751	828	6996	713	786
168	6 5/8	527.8	21	17.8	12.0	1.72	1.16	8139	830	915	7732	788	869
176	6 7/8	552.9	22	19.8	13.3	1.91	1.28	8952	913	1006	8505	867	956
184	7 1/4	578.1	23	22.2	14.9	2.14	1.44	9807	1000	1102	9316	950	1047
192	7 1/2	603.2	24	24.1	16.2	2.33	1.56	10700	1091	1203	10165	1037	1143

*** Manufactured, supplied & tested in accordance with:** OCIMF Guidelines for the Purchasing & Testing of SPM Hawsers First Ed. 2000

Material:	High Tenacity Nylon
Construction:	Superline
Colour:	Natural (white)
Markers:	Blue
Relative Density:	1.14
Melting Point:	218˚C
Torque Properties:	Torque Neutral
Shrinkage (Cold Water):	Up to 10%
UV resistance:	Good
Abrasion Resistance:	Excellent

Typical Applications:

- SPM Hawsers
- Tow Lines & Pendants
- Deep Water Lifting Pendants
- Mooring Tails

Features

- High strength:diameter ratio
- Excellent tension fatigue performance
- Easily repaired

Benefits

- OCIMF 2000 Compliant
- Damage resistance (sacrificial jacket)
- Extended Service Life

Load v Extension