

NORSOK STANDARD

COLLECTION OF METOCEAN DATA

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Please note that whilst every effort has been made to ensure the accuracy of the NORSOK standards neither OLF nor TBL or any of their members will assume liability for any use thereof.

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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 (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 future petroleum industry developments and operations, subject to the individual company's review and application.

The NORSOK standards make 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 Subject to implementation into international standards, this NORSOK standard will be withdrawn.

This NORSOK standard has been developed to replace the metocean part of Guidelines to regulations on environmental data for the petroleum activities, issued by NPD.

Annex A is normative. Annex B is informative.

INTRODUCTION

Offshore metocean monitoring systems can vary from simple weather stations for aviation purposes, to complete data acquisition systems incorporating a wide range of sensors and sophisticated data processing, display, storage and transmission features. By providing real-time information for operational use and long term records for engineering design purposes, offshore metocean monitoring systems play an important role in ensuring safe offshore operations.

This standard is intended as an initial reference for offshore operators when planning metocean monitoring equipment on offshore installations. It covers both statutory requirements and operator's own requirements, spanning applications such as weather forecasting, climate statistics, helicopter traffic, tanker loading, marine operations etc.

The collection of metocean data is normally the result of requirements imposed by NPD or other authority, and the operator's own needs. When specifying a metocean data collection system, this standard shall be supplemented by a list stating which requirements to fulfil. This standard contains the necessary information for the requirements normally imposed by NPD, and a check-list to identify operator's own needs.

1 SCOPE

This NORSOK standard presents functional requirements and common principles for the collection of metocean data, i.e. meteorological and oceanographic data.

2 REFERENCES

2.1 Normative references

The following standards and documents include provisions which, through reference in this text, constitute provisions of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognised standards may be used provided it can be shown that they meet or exceed the requirements of the standards referenced below.

- DNMI: Report 18/97 KLIMA. Recommended format (NORSOK) for the delivery of metocean data.
- Luftfartsverket: Forskrift om kontinentalsokkelflyging - Ervervsmessig luftfart til og fra helikopterdekk på faste og flyttbare innretninger til havs. Bestemmelser for sivil luftfart. BSL D 5-1, Oslo.
- NORSOK standard T-SR-100 (T-100) - Telecom subsystems
- NPD: Regulations relating to the collection of environmental data in the petroleum activities.
- WMO, 1995: Technical Regulations. Manual on Codes, Volume I.1, WMO-No. 306, Geneva.
- WMO/ICAO, 1996: Guide to the Provision of Meteorological Service for International Helicopter Operations. WMO-No. 842, Geneva
- WMO, 1996: Guide to Meteorological Instruments and Methods of Observation, WMO-No. 008, Geneva.

Note: The World Meteorological Organization, WMO, is the major international reference on many of the topics discussed herein. The technical documentation of WMO is extensive, therefore this standard makes specific references to relevant parts of WMO-documentation. Furthermore, DNMI has accepted the responsibility to provide easy access to updated versions of the WMO publications referenced herein.

2.2 Informative references

The following handbooks in Norwegian (distributed by DNMI) are standard equipment at all observing stations:

- DNMI: Meteorologisk Kode, SHIP, Maritime stasjoner
- DNMI: Meteorologiske koder for flyværtjenesten

3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

Informative references	Shall mean informative in the application of NORSOK Standards.
Normative references	Shall mean normative (a requirement) in the application of NORSOK Standards.
Shall	Shall is an absolute requirement to be followed strictly in order to conform to the standard. Shall requirements shall preferably be used in all NORSOK standards. Non-compliance to shall-requirements shall be subject to acceptance by the client.
Should	Should is a recommendation. Alternative solutions having the same functionality and quality are acceptable to the client.

3.2 Abbreviations

CTD	Conductivity-Temperature-Depth Sensor
DNMI	Det norske meteorologiske institutt (Norwegian Meteorological Institute)
ICAO	International Civil Aviation Organization
METAR	Aviation routine weather report
Metocean	Meteorological and oceanographic
MOR	Meteorological Optical Range
NPD	Norwegian Petroleum Directorate
RVR	Runway Visual Range
SHIP	Report of surface observation from a sea station
SPECI	Aviation selected special weather report
UTC	Universal Time Coordinated
WMO	World Meteorological Organization

4 COMMON REQUIREMENTS

4.1 General

Procedures which ensures the proper functioning of the measuring and recording system described in this standard as well as instrument accuracy and calibration shall be established and maintained.

Qualified personnel shall carry out observations, select, install, check and maintain the equipment and repair any faults or malfunctions.

When new types of instruments are introduced, a notification shall be given to all regular receivers of data.

Time references given in UTC shall be recorded together with the measured data or derived parameters. The time reference should not be dependent on manual setting following a possible stop in operation of the system. Local user interfaces should show both UTC and local time, clearly marked.

4.2 Instrumentation

The accuracy, range, type and location of the instruments should be determined with due regard to the purpose of the recordings.

The accuracy of metocean recordings should be chosen in accordance with Annex A (based upon the table in Annex 1.B of WMO No. 008).

5 METEOROLOGY

5.1 General

Details on instrument accuracy and calibration are found in Annex A and in WMO-No. 008, pp I.1-I.11.

Data that cannot be measured by means of instruments, shall be obtained by observation by qualified observers. Observers shall have completed relevant training at DNMI, or an equivalent course. During the first year of active observation duty, a refresher/repetition course shall be completed.

5.2 Weather observation and reporting for helicopter operations

The specifications given herein do only address environmental conditions, and do not constitute a complete system for offshore helicopter operations. Luftfartsverket, 1993 gives relevant regulations for helicopter operations.

A complete aviation routine weather report is specified in WMO-No. 306, under code FM 15-X Ext. METAR. The message consists of information derived from instrumental measurements and manual observations taken by a qualified observer (see Clause 5.1). The parameters included are:

- Wind direction
- Wind speed
- Visibility (according to METAR specifications, and RVR if available)
- Weather
- Cloud
- Dew-point temperature
- Air temperature
- Air pressure (QNH)

The wind measurements should be representative for the wind field at the helicopter deck. Experience has shown that this is best achieved if the location of the wind sensor is selected to minimize the influence from the construction itself (living quarters, cranes etc.). This means that top of derrick or mast is the best choice in most cases.

The measurement of these parameters does not replace the need for an easily perceptible wind cone.

The observations shall be recorded in accordance with WMO-No. 306, Section A, pp 25-36.

In addition to METAR, a code for special reports is specified in WMO-No. 306, under code FM 16-X Ext. SPECI.

The criteria for, and frequency of, issue of METARs and SPECIs is the responsibility of the relevant aviation regulations. International recommendations may be found in Chapter 4 of WMO-No. 842.

5.3 Weather observation and reporting for weather forecasting services

A complete weather observation report is specified in WMO-No. 306, under code FM 13-X SHIP. The message consists of information derived from instrumental measurements and manual observations taken by a qualified observer (see Clause 5.1). The parameters included are:

- Wind direction
- Wind speed
- Air pressure
- Air temperature
- Sea surface temperature
- Humidity
- Wave height
- Wave period
- Clouds
- Visibility (MOR)
- Weather
- Icing

Observations shall be made at standard synoptic hours, expressed in terms of UTC, at which, by international agreement, meteorological observations are made simultaneously throughout the globe. Standard synoptic hours are 00, 03, ... 21 UTC. The observations shall be recorded in accordance with WMO-No. 306, Section A, pp. 7-24.

5.4 Weather observation and reporting for climatological purposes

In addition to the data collected for the weather report (SHIP-format), the wave parameters; maximum wave height, peak period and wave direction shall be included if available. The normal recording interval shall be one hour, and the resolution of the data increased to the relevant instrument accuracy.

There is presently no WMO or other internationally recognised format for this sort of data. A flexible format in extensive use in Norwegian waters is documented in DNMI-report 18/97 KLIMA. The development and documentation of this format (according to user requirements) is the responsibility of DNMI, and this format should be used for delivery of climatologic data to DNMI.

5.4.1 Data quality control

Procedures shall be established to ensure that collected data are processed and standard analyses carried out in such a way that the quality of the data may be verified. The analyses should be sufficiently extensive to allow all significant errors to be discovered. The data should be compared to other recorded data to the extent this is practicable.

Recorded data together with a report concerning data quality should be submitted to DNMI within a month after the completion of the recording period. The recording period should typically be one month. The data shall be submitted by way of a computer readable medium in an agreed format. Necessary documentation shall accompany the data.

5.4.2 Annual reports

Annual reports shall be issued, and include a description of the recording methods and contain an assessment of data quality, frequency tables, calculations of mean values and extreme values as well as descriptions of special incidents.

The data should be presented in such a way as to allow other users to carry out extreme value analyses without having to resort to the original unprocessed data, for instance by presenting frequency tables including cumulative distributions for the year being reported upon as well as for the total data set if it consists of multiple years.

In the case of extreme environmental conditions of significance to safety conditions or to working environmental conditions, separate descriptions of these conditions should be included.

5.5 Weather observation and reporting for operational needs

The operator may have operational needs for metocean information. If such needs are identified, a plan for collection, storing and distribution of such data should be established. The plan should include a list of all required metocean parameters. A check-list including potential applications is given in Annex B.

The metocean parameters should preferably be selected from the parameter lists in clause 5.2, 5.3 and 5.4. If these parameters do not meet the operator's need, a specific reference to relevant WMO or other available publication should be established. Requirements for sensor location should be given.

6 OCEANOGRAPHY

6.1 General

In the context of this standard, the term oceanography shall mean:

- ocean currents at specified depths
- water level
- sea temperature at specified depths
- salt content (salinity) at specified depths
- oxygen content at specified depths
- icebergs, size and drift
- sea ice

Note: Ocean waves and sea surface temperature are defined as part of meteorology, and covered in Section 5.

Apart from ocean currents and water level, the measurements and observation of oceanographic parameters are not commonly included in platform metocean systems. The operator shall however consider his own need for collecting such data contingent upon the natural conditions at the location, the inadequacy of the data basis, the type of structure or installation, and the operational situation of the facility. A check list is given in Annex B.

6.2 Measurements and observations

Ocean currents should be measured at fixed depths (or bins), and at least include three depths in shallow waters: Near surface, mid depth and near bottom. For measurements in deeper waters, the following depths should be considered in addition to near surface and near bottom: 50 m, 100 m, 150 m, 200 m, 300 m and every 200 m to the bottom. The mean speed and direction of ocean currents shall be recorded at least once per hour.

Measurements of sea temperature and salinity should be performed as an integrated activity. If Nansen bottles or similar equipment is used, data should be recorded at standard depths: 0 m, 5 m, 10 m, 20 m, 30 m, 50 m, 75 m, 100 m, 125 m, 150 m, 200 m, 250 m, 300 m, 400 m, 500 m, 600 m, 800 m etc. If a CTD is used for measuring temperature and salinity, data should be stored for at least every 0.5 bar.

Oxygen content, if required, should be measured at a subset of the temperature/salinity depths given above. However, the number of depths may be considerably reduced.

The observation of sea ice and icebergs (size and drift), can be performed by combining e.g. manual observations, instrument recordings and remote sensing.

**ANNEX A - RECOMMENDED INSTRUMENT ACCURACY AND TYPICAL OPERATIONAL PERFORMANCE
(INFORMATIVE)**

This table is based on the very similar table presented in Annex 1.B, pp I.1-13 to I.1-15 of WMO 008. A system built according to these recommendations will fulfil the requirements set by DNMI and NPD.

(1) Variable	(2) Range	(3) Reported resolution	(4) Mode of measurement/ observation	(5) Recommended instrument accuracy	(6) Sensor time constant	(7) Output averaging time	(8) Typical operational performance	(9) Remarks
1. Temperature								
1.1 Air Temperature	-60 - +60 °C	0.1 °C	I	±0.1 °C	20 s	1 min	±0.2 °C	Operational performance and effective time constant may be affected by the design of thermometer solar radiation screen.
1.2 Extremes of air temperature	-60 - +60 °C	0.1 °C	I	±0.1 °C	20 s	1 min	±0.2 °C	
1.3 Sea-surface temperature	-2 - +40 °C	0.1 °C	I	±0.1 °C	20 s	1 min	±0.2 °C	

(1) Variable	(2) Range	(3) Reported resolution	(4) Mode of measurement/ observation	(5) Recommended instrument accuracy	(6) Sensor time constant	(7) Output averaging time	(8) Typical operational performance	(9) Remarks
2. Humidity								
2.1 Dewpoint temperature	< -60 - +35 °C	0.1 °C	I	±0.5 °C	20 s	1 min	±0.5 °C	If measured directly. Tending to ±0.1 °C when relative humidity nearing saturation.
2.2 Relative humidity	5 - 100%	1%	I	±3%	Wet-bulb temperature			
					20 s	1 min	±0.2 °C	Large errors are possible due to aspiration and cleanliness problems. If measured directly. Tending to
					Solid state and others			±1 % when relative
					40 s	1 min	±3 - 5%	Solid state sensors may show significant temperature and humidity dependence. humidity nearing saturation.
3. Atmospheric pressure								
3.1 Pressure	920-1080 hPa	0.1 hPa	I	±0.1 hPa	20 s	1 min	±0.3 hPa	Range to sea level. Accuracy seriously affected by dynamic pressure due to wind and temperature coefficient of transducer.
3.2 Tendency	Not specified	0.1 hPa	I	±0.2 hPa			±0.2 hPa	Difference between instantaneous values.

(1) Variable	(2) Range	(3) Reported resolution	(4) Mode of measurement/ observation	(5) Recommended instrument accuracy	(6) Sensor time constant	(7) Output averaging time	(8) Typical operational performance	(9) Remarks
4. Clouds								
4.1 Cloud amount	0 - 8/8	1/8	I	$\pm 1/8$	n/a		$\pm 1/8$	Period (30 s) clustering algorithms may be used to estimate low cloud amount automatically.
4.2 Height of cloud base	<30 m - 30 km	30 m	I	± 10 m for ≤ 100 m $\pm 10\%$ for > 100 m	n/a		≈ 10 m repeatability*	* Accuracy difficult to determine since no definition exists for instrumentally measured cloud base height.
5. Wind								
5.1 Speed	0 - 75 m s ⁻¹	0.5 m s ⁻¹	A	± 0.5 m s ⁻¹ for ≤ 5 m s ⁻¹ $\pm 10\%$ for > 5 m s ⁻¹	Dist. cont. 2 - 5 m	2 and/or 10 min	± 0.5 m s ⁻¹	Average over 2 and /or 10 minutes. Non-linear devices. Care needed in design of averaging process.
5.2 Direction	0 - 360°	10°	A	$\pm 5\%$	1 s	2 and/or 10 min	$\pm 5^\circ$	
5.3 Gusts	5 - 75 m s ⁻¹	0.5 m s ⁻¹	A	$\pm 10\%$		3 s	± 0.5 m s ⁻¹	Highest 3 s average should be recorded.
6. Visibility								
6.1 MOR	<50 m - 70 km	50 m	I	± 50 m for ≤ 500 m $\pm 10\%$ for > 500 m		3 min	$\pm 10 - 20\%$	Achievable instrumental accuracy may depend on the cause of obscuration.
6.2 RVR	50 m-1500 m	25 m	A	± 25 m for ≤ 150 m ± 50 m for $> 150 - \leq 500$ m ± 100 m for $> 500 - \leq 1000$ m ± 200 m for > 1000 m		1 and 10 min		

(1) Variable	(2) Range	(3) Reported resolution	(4) Mode of measurement/ observation	(5) Recommended instrument accuracy	(6) Sensor time constant	(7) Output averaging time	(8) Typical operational performance	(9) Remarks
7. Waves								
7.1 Timeseries of sea surface elevation	-15 - +20 m	0.1 m	I		0.5 s	n/a	±0.2 m for ≤5 m ±4% for >5 m	Length of timeseries 17 min (typical). Sampling frequency 2 Hz.
7.2 Variables from timeseries (zero crossing analysis)							Depends on averaging time and sea regularity as well as intrinsic instrument accuracy	
7.2.1 Significant waveheight ($H_{1/3}$)	0 - 20 m	0.1 m	A		n/a	17 min (typical)		
7.2.2 Average zero crossing period (T_z)	3 - 30 s	0.1 s	A		n/a	17 min (typical)		
7.2.3 Maximum waveheight (H_{max})	0 - 35 m		I		n/a	17 min		Observed value at location of sensor. New value every 30 min (typical).

(1) Variable	(2) Range	(3) Reported resolution	(4) Mode of measurement/ observation	(5) Recommended instrument accuracy	(6) Sensor time constant	(7) Output averaging time	(8) Typical operational performance	(9) Remarks
7.3 Wave spectrum			A			minimum 17 min	Depends on averaging time and sea regu- larity as well as intrinsic instrument accuracy.	Instruments may include wave buoys, altimeter, microwave doppler radar, HF radar, navigation radar etc. (1 Hz sampling frequency is sufficient).
7.3.1 1-D spectral density		$0.1 \text{ m}^2 \text{ Hz}^{-1}$					Shall be sufficient to achieve 7.4 req.ments.	
Frequency	0.035 - 0.3Hz	<0.01 Hz						
7.3.2 2-D spectral density		$0.1 \text{ m}^2 \text{ Hz}^{-1} \text{ rad}^{-1}$					Shall be sufficient to achieve 7.4 req.ments.	
Frequency	0.035 - 0.3Hz	<0.01 Hz						
Direction	0-360°	10°(see remark)						2-D spectrum may be based on parameterized directional distribution and reported as direction and spread parameters.

(1) Variable	(2) Range	(3) Reported resolution	(4) Mode of measurement/ observation	(5) Recommended instrument accuracy	6) Sensor time constant	(7) Output averaging time	(8) Typical operational performance	(9) Remarks
7.4 Variables from wave spectrum							Depends on averaging time and sea regularity as well as intrinsic instrument accuracy.	
7.4.1 Significant waveheight (H_{m0})	0 - 20 m	0.1 m	A				± 0.5 m or $\pm 10\%$, whichever is greatest	
7.4.2 Average period (T_{m02})	3 - 30 s	0.1 s	A				± 0.5 s or $\pm 10\%$, whichever is greatest	
7.4.3 Peak period (T_p)	3-30 s	0.1 s	A					Period of peak of frequency spectrum.
7.4.4 Mean direction	0-360°	10°	A				$\pm 10^\circ$	May be spectrally averaged or based on angular harmonics.
7.4.5 Direction spread	0-90°	10°	A					
8 Ocean currents								
8.1 Current speed	0-250 cm s ⁻¹	1 cm s ⁻¹	A	1-10 cm s ⁻¹	1 s	5-20 min	2-10 cm s ⁻¹	Achievable accuracy affected by type of measurement; direct or acoustic doppler profilers
8.2 Current direction	0-360°	1°	A	$\pm 5^\circ$	1 s	5-20 min	$\pm 5^\circ$	
9 Water level	± 3 m	1 cm	I	± 1 cm		10 min	± 5 cm	

(1) Variable	(2) Range	(3) Reported resolution	(4) Mode of measurement/ observation	(5) Recommended instrument accuracy	(6) Sensor time constant	(7) Output averaging time	(8) Typical operational performance	(9) Remarks
10 Temperature profile	-2 - +25 °C	0.1 °C	I	±0.01 °C	0.5 s	1 s	±0.05 °C	Achievable accuracy according to commonly used CTD sensors
11 Salinity profile	0 - 40 PSU	0.1	I	±0.01 PSU	0.5 s	1 s	±0.05 PSU	As per temperature profile Unit: PSU (Practical Salinity Unit) according to PSS78.
12 Oxygen	0 - 15 ml/l	0.1 ml/l	I	±5%	0.5 s	1 s	±5%	

NOTES:

- Column 1 gives the basic variable.
- Column 2 gives the common range for most variables; limits depend on local climatological conditions.
- Column 3 give the most stringent resolution as determined by the *Manual on Codes* (WMO-No. 306).
- In column 4:
 - I: Instantaneous. In order to exclude the natural small-scale variability and the noise, an average value over a period of one minute is considered as a minimum and most suitable; averages over periods of up to 10 minutes are acceptable.
 - A: Averaging. Average values over a fixed time period, as specified by the coding requirements.
 - T: Totals. Totals over a fixed time period(s), as specified by coding requirements.

ANNEX B - POTENTIAL APPLICATION FOR METOCEAN INFORMATION (INFORMATIVE)

Check list (in alphabetical order):

	Application	Comments
	Bridge and flotel disengagement	
	...	...
	Installation	Wind and wave data are usually needed for setting deck and modules, and currents can be important for running risers and stabbing TLP tendons.
	Crane operations	Wind and waves (or heave on a ship) do have an impact on safety margins for crane operations.
	Diving operations	May depend on a number of metocean parameters
	Evacuation	Metocean data is vital for decisions regarding time of evacuation and selection of evacuation means.
	Maintenance	Maintenance operations, especially outdoor work above open sea, are often subject to restrictions on weather and sea state.
	Marine operations	Various marine operations need reliable metocean information
	Production shut-down	
	ROV operations	May depend on a number of metocean parameters
	Search and rescue/man over board (SAR&MOB)	Accurate metocean information may be crucial to effective and safe SAR&MOB operations.
	Tanker loading	Tanker loading operations are sensitive to sea state and wind conditions, in particular during docking operations.
	Verification studies	A number of metocean parameters may be required for verification of offshore structures. Verification studies may depend on special metocean parameters or installation of standard instruments in special locations.