



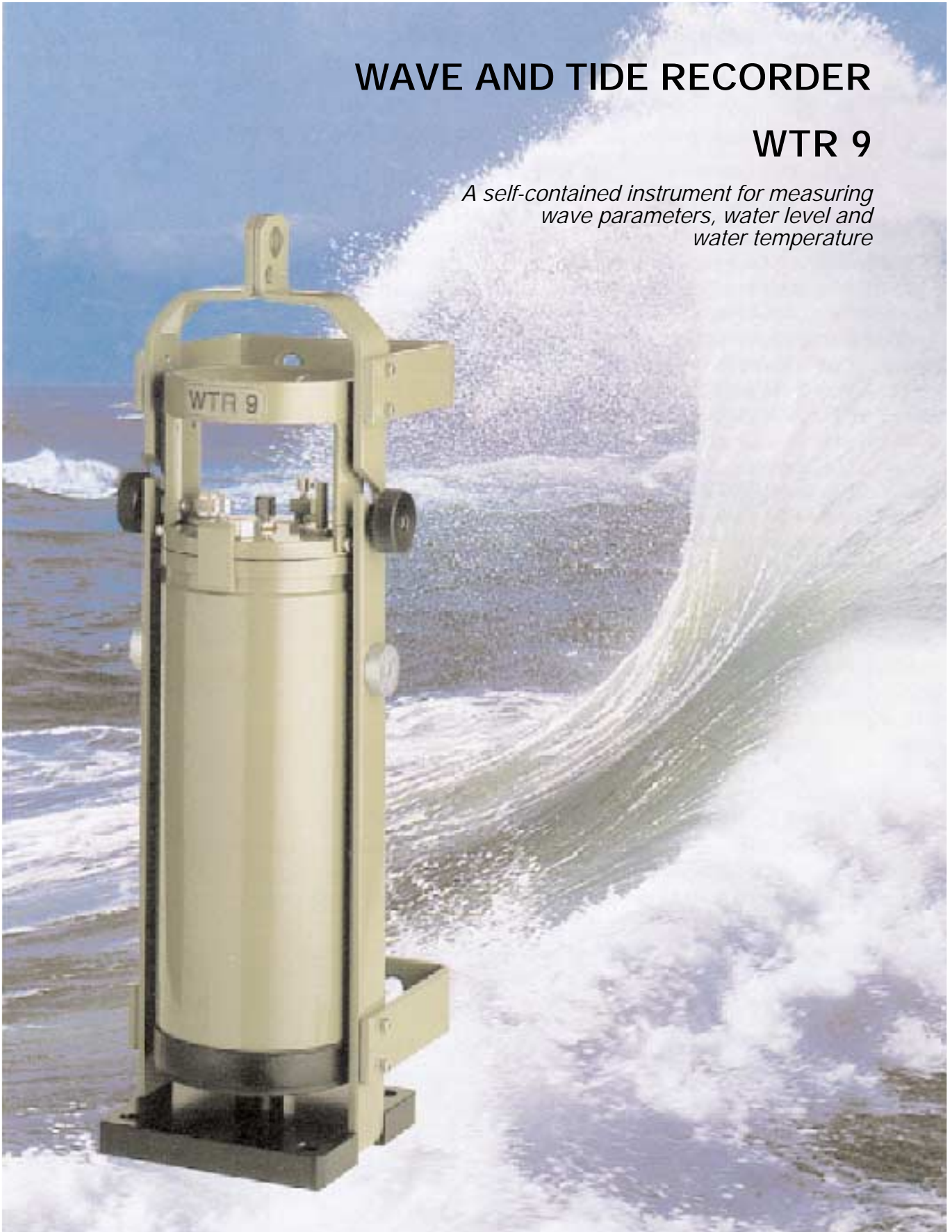
AANDERAA INSTRUMENTS

DATA COLLECTING INSTRUMENTS FOR LAND SEA AND AIR

WAVE AND TIDE RECORDER

WTR 9

*A self-contained instrument for measuring
wave parameters, water level and
water temperature*



Fields of Applications

The WTR 9 measures wave and tide conditions using a precision pressure sensor. Typical application areas are:

- Real time monitoring of waves and tide in ports
- Real time monitoring of waves and tide during marine operations
- Real time input of wave and tide information to forecast models
- Acquisition of long term wave and tidal data for climate studies

The instrument can either be deployed on the seabed in shallow waters, or be mounted on a fixed structure in the upper water column. The recommended deployment depth for wave measurements is in the range 5 to 15m and the maximum depth for tide measurements is 60m.

The wave measurement comprises; the significant, and maximum wave heights (H_{m0} and $E[H_{max}]$), and the mean zero crossing wave period (T_{m02}) based on a pressure time series over 8.5 minutes sampled at 2Hz. Tide, based on a 40s average hydrostatic pressure, temperature and waves are measured at selectable logging intervals from 0.5 to 24 hours.

Raw data in the form of 10 bit words are stored in the internal data storage unit. In addition, data can be transmitted by cable to an onshore receiving station, e.g. Deck Unit 3127 which converts the WTR 9 output signal to an RS232 signal or the Computing Unit 3015 where data in engineering units is made available to the user. The maximum recommended cable length is 1km.

Design

The WTR 9 is housed in a standard Aanderaa cylindrical pressure case made from OSNISIL, a copper-based alloy. The pressure port is positioned in the center of the top plate of the pressure case, and is equipped with a "pressure inlet" to avoid blocking of the port caused by sedimentation.

The pressure case contains a quartz pressure sensor mounted on the electronic board which is cast in polyurethane foam. Further, the instrument features a DSU 2990 or 2990E for stor-

age of raw data and an alkaline battery. The temperature sensor is based on a thermistor and is mounted in the top plate of the pressure case.

The electronic board is equipped with 3 function switches for selecting logging interval, distance from the WTR 9 to the seabed and a mode switch with a test and serial communication setting. The WTR 9 is controlled by a microcontroller and an internal clock.

A connector is mounted on the top plate of the pressure case for optional data transmission and power supply via cable.

A versatile mooring frame for mounting the instrument on the seabed comes with the instrument. A self leveling pyramidal mooring frame for deployment on the seabed is also available as are mounting brackets for fixing it to a wall, a platform leg or a pier etc. See illustration below.

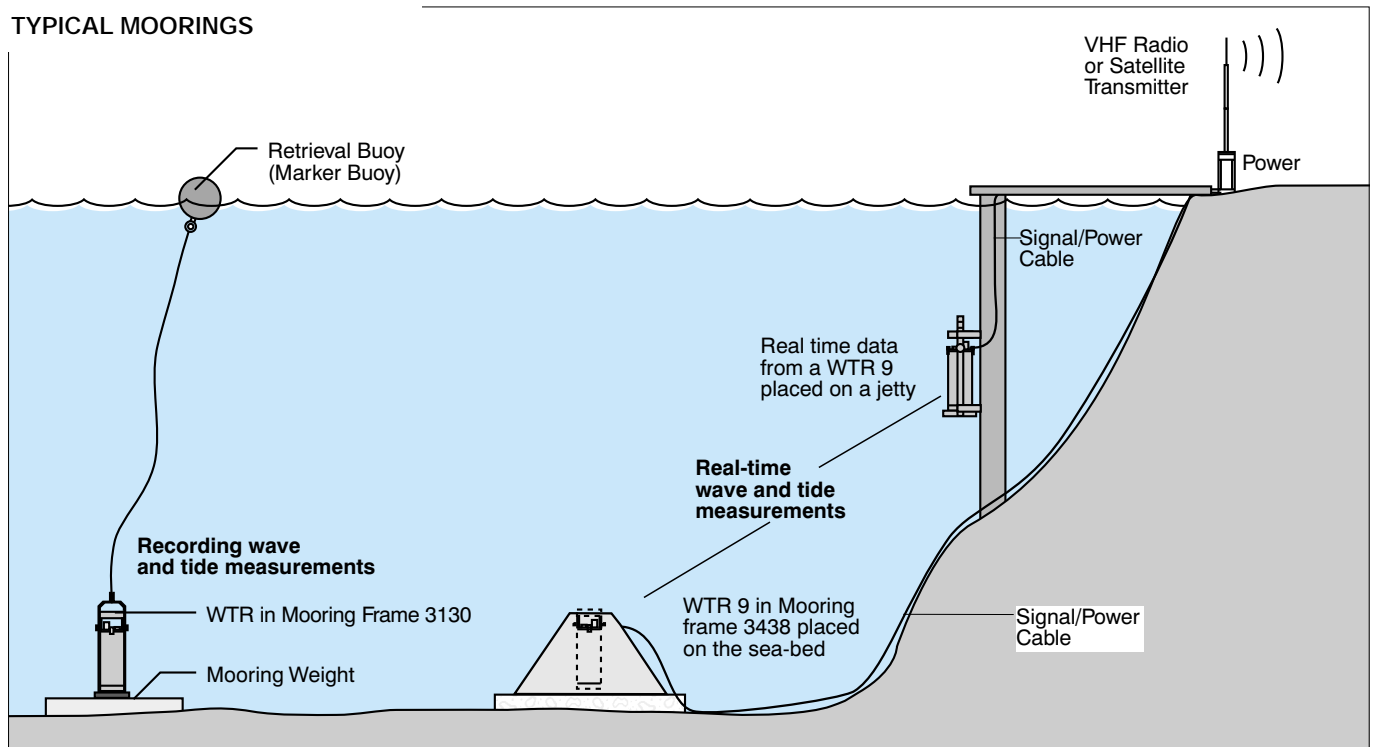
Working principle

The instrument operates in cycles triggered by the internal clock and remains in a low power quiescent state between cycles. When the WTR 9 is turned on, the electronics in the instrument are at rest until there is 15 minutes left of the selected recording interval. Then the measurements start, calculation of the parameters are performed and data are recorded and routed to the output receptacle. The recording intervals can be set between 0.5 and 24 hours.

The wave parameters are based on a pressure time series of 1024 measurements of about 8.5 minutes duration. These measurements are stored in RAM for subsequent data analysis. Immediately after the measurement a wave spectrum analysis is carried out. From the wave spectrum the significant wave height, the mean zero crossing period and the maximum wave height are calculated.

The tide measurement is a 40 second average of the hydrostatic pressure measurements. This is done by averaging the last 80 registrations in the 512 second long time series.

TYPICAL MOORINGS





WTR 9 electronic board.

In the WTR 9 temperature compensation is carried out for every pressure registration. Wave, tide and temperature data are stored in the DSU (and transmitted if a cable is connected) after the wave analysis is completed.

Data Storage Units DSU 2990 and 2990E

are standard data storage devices for Aanderaa data collecting instruments. They are rugged, waterproof and has LCD that shows the total number of data word stored. The 2990 version can store 65,000 10-bit data words and the 2990E version can store 262,000 data words.

A built-in quartz clock allows the time for the first measurement to be recorded in the DSU. Time is also recorded for the first measurement after midnight.

For a WTR 9 with internal data storage in DSU 2990 and powered by a 15Ah Battery 3614, the deployment time, limited by the battery capacity, is given in the table below.

Recording intervals	Months
0.5 hour	4.6
1 hour	8.9
2 hours	16.9
3 hours	23.0
6 to 12 hours	39.4

A 30Ah Battery 3677 is also available. Using this battery will give double the deployment time.

Reading of Stored Data

The data can be transferred from the DSU to a PC using the DSU Reader 2995 and a suitable communication program. The reader is an RS 232 interface between the PC and the DSU.

Data Reading Program 5059

is a new software program that may be used to download DSU 2990 data to a Personal Computer. The program is based on the latest software technology and is designed to be used with Windows 95, 98, 2000 and Windows NT.

The unit also has a remote start mode in which the instrument measures continuously. On reception of a remote start pulse the last calculated data is transmitted to the DSU and the output receptacle. If a cable is connected to the WTR 9 for transmission to an onshore receiving station, the output transmitted via cable, is identical to the data string stored in the DSU. Channel 1 is a built-in reference providing a fixed reading in every measuring cycle and serves as an instrument identification number and a performance test. Channels 2 to 7 comprise temperature, hydrostatic pressure and the calculated wave parameters. The hydrostatic pressure is stored as two 10 bit words and all other parameters are stored as single 10 bit words.

The instrument has a test mode to verify correct operation. In this mode 80 pressure measurements and a temperature measurement are taken during approximately 40 seconds and the output from the instrument is ; the reference number, the temperature and the hydrostatic pressure. The other parameters are set to zero.

Serial communication with the instrument is also possible by setting the mode switch to the "Menu" position. This enables the user to select number of samples and the sampling frequency. It also enables the accurate distance from the top plate to the seabed to be set. ♦

In addition to enable for downloading and exporting DSU data, it may also be used for data analysis. The 5059 include extensive charting and analysis facilities, and the resulting analysis graphs may be exported for use with other program such as Microsoft Word and Microsoft Excel. The modern user interface, including drag & drop facilities combined with an extensive built-in Help system makes the 5059 easy to use.

A sensor, station and instrument library allows you to build up a library holding configuration and calibration sets for all your instruments. A limited version is supplied free of charge. The full version is available at a moderate cost. Please contact the factory or visit our web site to obtain a 30 day fully functional trial version.



Engineering data graph from Data Reading program 5059

Specifications for Wave and Tide Recorder, WTR 9 (part no. 3659)

Maximum deployment depth: 60 m
Recommended deployment depths: Down to 15 m
Depth setting: - Deep water (Pos.1)
 (selectable) - Seabed (Pos.2)
 - Set distance from top plate to seabed in range 6 - 36.5m (Pos. 3 - 11)
 User specified position 12
Operating temperature: -2.5 to 35°C
Storage temperature: -30 to 40°C
Wave sampling frequency: 1 Hz/2 Hz (default 2 Hz)
Number of samplings: 256,512 or default 1024

Output parameters:

Ch.1 Reference: A fixed reading to check performance and to identify individual instruments

Ch.2 Temperature:

Sensor Type: Thermistor Fenwall GB32JM19
Accuracy: ±0.1°C
Resolution: 0.04°C
Range: -2.5 to +35°C
Response time: 30 s

Ch.3 & 4 Hydrostatic pressure:

Defined as: Average of 80 last pressure registrations in 512s time series sampled at 2 Hz
Sensor Type: Quartz pressure sensor based on a pressure controlled oscillator; frequency 30 - 45kHz
Inlet port (Reference level): 8 mm above top plate
Range: 0-690kPa¹⁾ (approx. 0 - 60m depth)
Accuracy: ± 210Pa
Resolution: 7Pa (approx. 0.07 cm)

Ch.5 Significant wave height, H_{m0}:

Based on: 512s pressure time series sampled at 2Hz
Resolution: 2.0 cm
Range: 0-20 m

Ch.6 Mean zero crossing period, T_{m02}:

Based on 512s pressure time series sampled at 2Hz
Resolution: 0.02s
Range: 0 - 20s

Ch.7 Maximum wave height, E [H_{max}]:

Based on: 512s pressure time series sampled at 2Hz
Resolution: 2.5cm
Range: 0 - 25m

Output signal: PDC-4 to DSU 2990 and external unit

Recording intervals: Selectable, 0.5,1,2,3,6,12 or 24 hours or remote start.²⁾ Stability: ± 2s/day within 0 to 20°C

External triggering: A 5 volt positive pulse to the signal output terminal on the top end plate activates the instrument

Recording System Aanderaa standard type
 Data Storage Unit 2990 or 2990E
Data Format: PDC-4. (Pulse Duration Code 4s.)
Storage Capacity:
 DSU 2990: 65500 10 bit words
 DSU 2990E: 262000 10 bit words

Power:

Supply: -7 to -14 volt DC
Battery: 3614 Alkaline Battery, 9V, 15Ah
Average quiescent current consumption: 100µA
Average active current consumption: 10mA

Materials and finish:

Pressure case: Epoxy coated Osnisil
 (95% Cu,3.5% Ni, 0.9% Si)
Top & bottom plate: Epoxy coated acid proof steel
Mooring frame : Acid proof steel SIS 2343
Printed Circuit Board: Casted in polyurethane

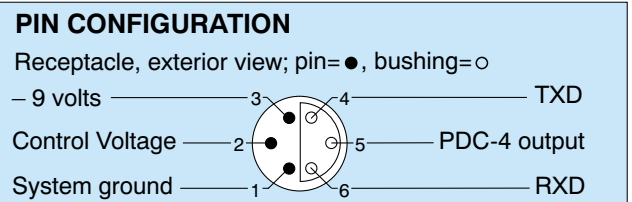
Dimensions and Weight:

Height, incl. guard ring: 432 mm
Outer diameter: 128mm
Weight: 13.7kg (in air), 9.2kg (in water)
Height & width, frame: 576 x 141 x169mm
Weight, frame: ~ 3.7kg (in air) ~ 3.2kg (in water)

Accessories

Included: Mooring frame 3130
 Programming Cable 3709
Optional: Underwater Signal/Power cable 3669
 (Max length of cable is 1km)
 Deck Unit 3127/Computing Unit 3015
 Brackets (2ea.) 3685 for Mooring frame 3130
 Self-leveling Mooring frame 3438 for seabed deployment

Electrical Terminal:



Packing:

Plywood case: 240 x 250 x 600mm

Warranty:

Two years against faulty materials and workmanship.
 Our standard warranty (2 years) is not applicable in cases where breakage or malfunction occur to the cable during installation or when caused by excessive wear or other external forces.

¹⁾ Overpressure is 1.5 x range

²⁾ In remote start, the instrument measures continuously and when the remote start trigger pulse is received, the last calculated data is transmitted.

Representative's Stamp

Latest version is on the Internet