EXTREME ENVIRONMENTS. EXTREMELY RELIABLE.

SDI-AWP-200/SDI-AWP-400

All Weather Precipitation Gauges

User's Manual

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Chapter 1 GENERAL

1.1 GENERAL

The FTS All Weather Precipitation (AWP) Gauge is an SDI-12 sensor which measures all types of precipitation within a wide temperature range. It is designed to withstand harsh wind and snow conditions without sacrificing sensitivity and accuracy. It boasts a combination of simple mechanical construction and sophisticated firmware, guaranteeing superior performance.

The AWP Gauge is available in two models which come with a mounting template for the installation of the pedestal and optional wind shield:

	SDI-AWP-200	SDI-AWP-400
Orifice area	200 cm^2	400 cm^2
Capacity	1500 mm	750 mm

The factory default address is 1. If your AWP will be used with a pre-set configuration, ensure it is set to the address used in the configuration file.

CAUTION! When the bucket is at capacity it weighs 30 kg (66 lbs).

1.1.1 KEY FEATURES:

- Measurements of solid and liquid precipitation with one-minute rain intensity, total sum of precipitation and rain duration
- Elimination of wind vibration, particles, false weight changes, evaporation and temperature fluctuation
- Easy to maintain
- Evaluation and accuracy check "in situ"
- Bucket capacity alert function
- Orifice heating optional
- Output: SDI-12
- Wind Shield and Pedestal (in 1m or 1.5m {3.3 ft or 4.9 ft} sizes) are available as well

1.2 PARTS

The following exploded view shows the major components of an AWP.

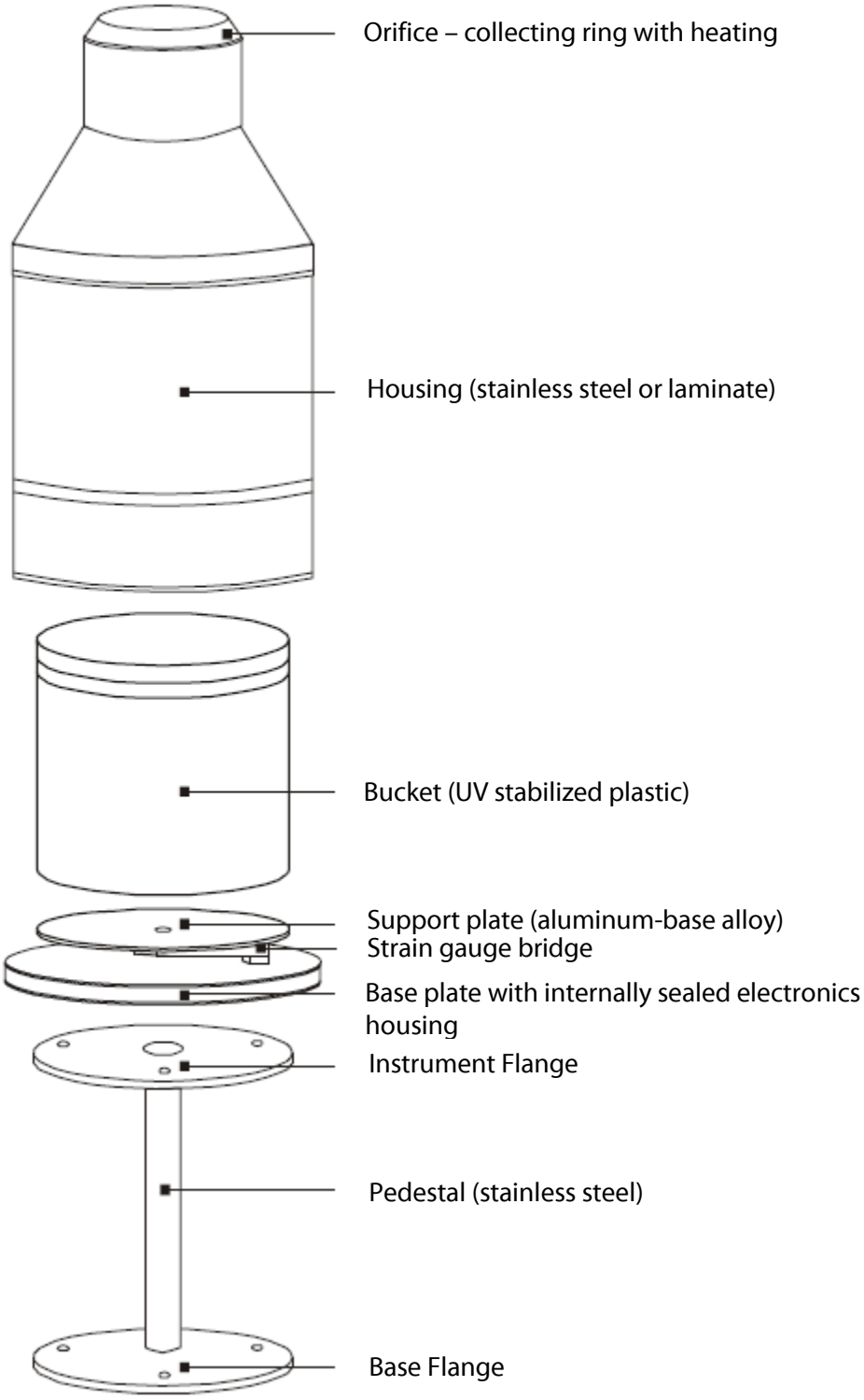


Figure 1-1: Major components of an AWP

1.3 MOUNTING HEIGHTS

Each model of AWP is mounted on a pedestal. There are two heights of pedestals for each model of AWP so that the resultant height of the orifice will be either 1m or 1.5 m. The pedestal sizes are identified by the resultant height of the AWP orifice not the pedestal height itself.

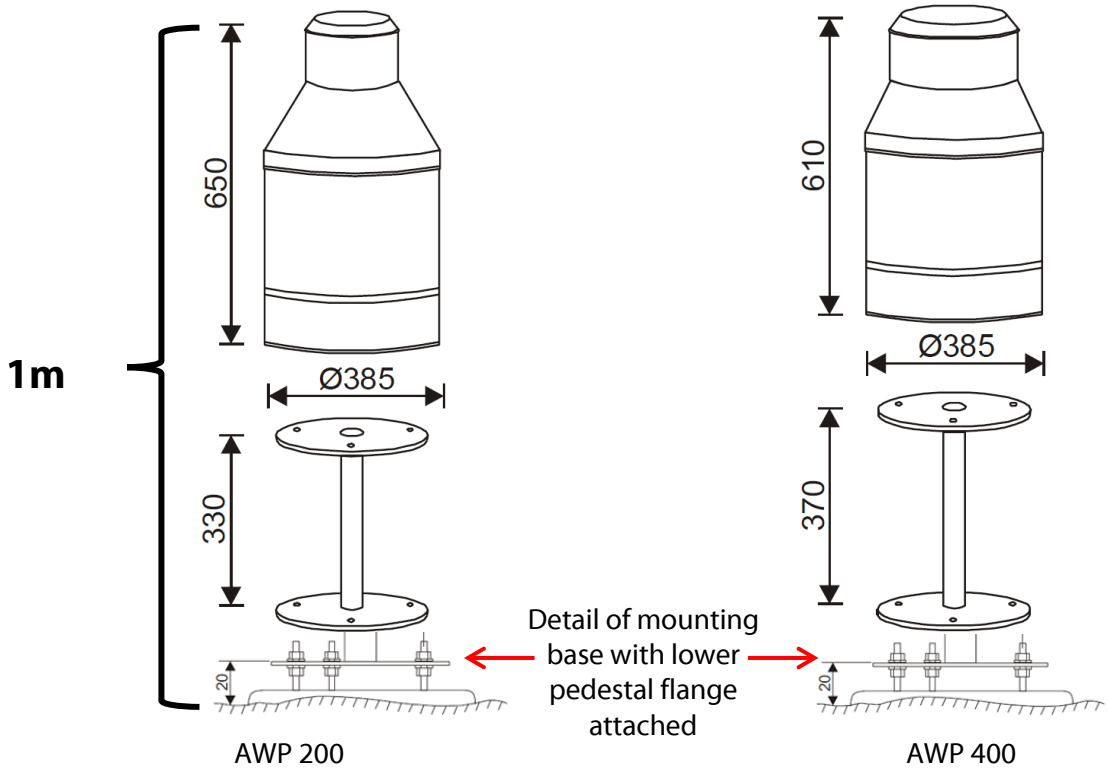


Figure 1-2: AWP200/AWP400 showing 1m pedestals
Unless otherwise indicated, all measurements are in mm.

Resultant orifice height is determined by:

The distance from the ground to the lower flange of the pedestal (20 mm) **+** pedestal height **+** AWP height.

Table 1-1: Pedestal Part Numbers

ITEM	**PART #**
AWP - 200 Gauge, 1m (3.3 ft) pedestal	19632
AWP – 200 Gauge, 1.5m (4.9 ft) pedestal	19633
AWP -400 Gauge, 1m (3.3 ft) pedestal	19071
AWP – 400 Gauge, 1.5m (4.9 ft) pedestal	19072

1.4 WIND SHIELD

An optional wind shield can be ordered for the AWP.

1m wind shield 1.5m wind shield

Figure 1-3: AWP with Wind Shield

ITEM	Description
AWP-WS-1M	Wind Shield, 1m (3.3 ft)
AWP-WS-1.5M	Wind Shield, 1.5m (4.9 ft)

Chapter 2 INSTALLATION AND MAINTENANCE

2.1 SITE SELECTION

- The installation site should be open but protected from winds.
- The distance from the gauge to any obstruction should be at least twice the height of the obstruction.
- The orifice should be 1 meter above the surrounding terrain

NOTE: If required by local conditions, the orifice may be positioned at a height of 1.5 meters above the surrounding terrain using the 1.5m pedestal

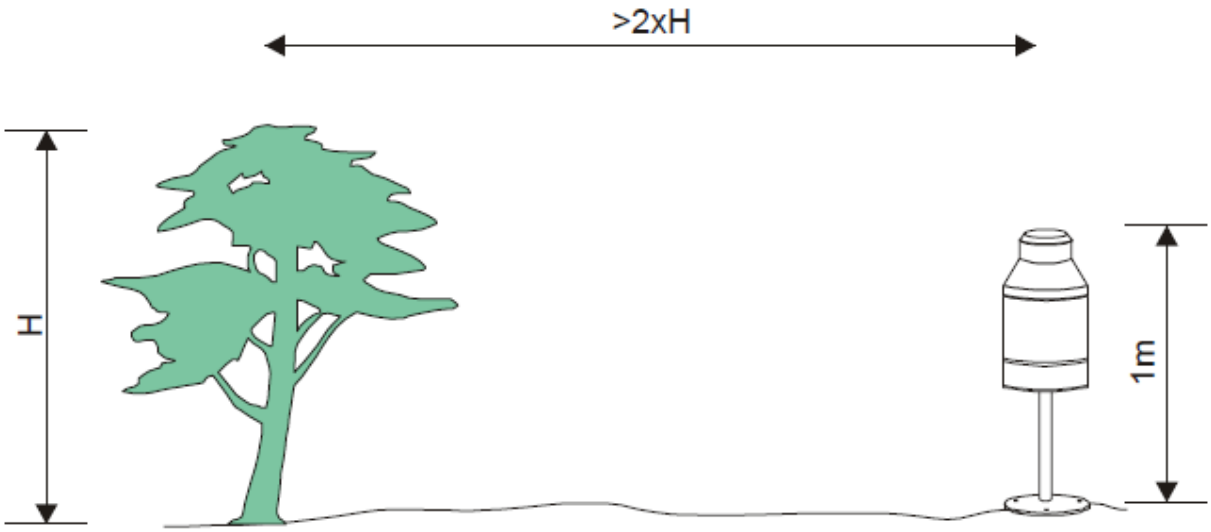


Figure 2-1: AWP placement

2.2 CONCRETE BASE

The stand should be bolted to a concrete base.

1) Prepare a level concrete base and attach three M8 or 5/16" bolts corresponding to the holes in the base flange of the mounting stand. Use the MPS TRWS Gauge template provided with your shipment (drawing #19634) which also includes the template for wind screen mounts.

IMPORTANT! When preparing the concrete base, ensure mounts for the wind screen (if being used) are also constructed.

2) Screw a nut onto each of the bolts so that the distance above ground level is 20 mm. Refer to Figure 2-2.

2.3 REQUIRED TOOLS

In order to install the AWP, the following tools are required:

- Philips #2 screwdriver
- M8 or 5/16" open end or combination wrench (in accordance with bolts in concrete base)
- 6 x M8 or 5/16" nuts (to match bolts in concrete base)
- 3 x washers for mounting the base flange
- One of a 20g, 25g, 50g or 100g weight (for calibration verification of the sensor)

2.4 MOUNTING

1) Place the lower flange of the pedestal onto the nuts

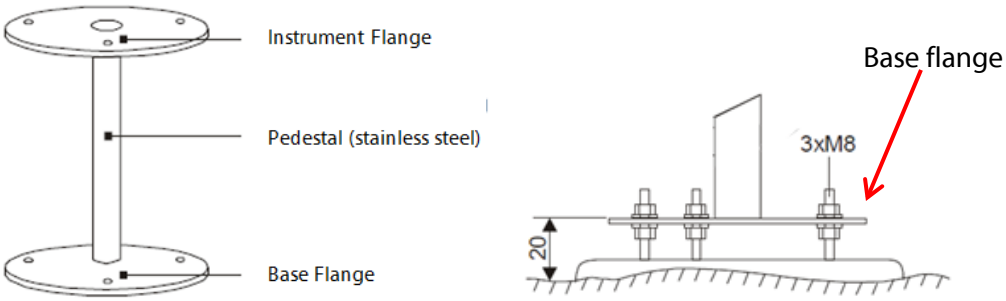


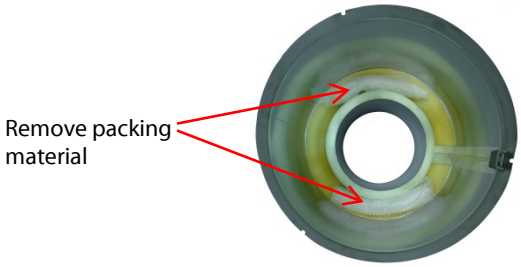
Figure 2-2: Base and mounting the pedestal

2) Confirm the stand is level by placing a bubble level on the instrument flange. Check the horizontal plane in two directions perpendicular to each other. Adjust the lower nuts as necessary to achieve a level horizontal plane.

3) Fix the stand using another 3 nuts and washers. Do not fully tighten the nuts.

4) Detach the stainless steel/laminate cover from the rain gauge base plate by loosening the three bolts at the bottom edge of the housing.

5) Remove the packing supports and packing material from the interior of the housing.



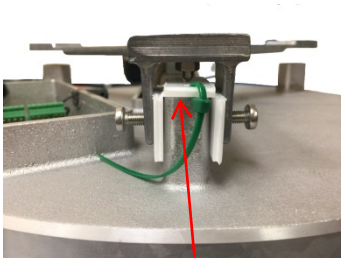
6) Lift the bucket from the support plate.

7) Attach the base plate to the stand using the three bolts with a locking washer.

8) Check the horizontal position of the support plate with a level and adjust the position using the lower flange nuts if necessary. Once level, tighten all nuts thoroughly.

9) The rain gauge's support plate is fitted with one of two styles of restraints to prevent damage during transport.

One has two transport screws and a transport detent to prevent damage during transport. Loosen both screws so that there is a space of at least 1mm between the tip of the screw and the body of the gauge and remove the transport detent. Retain the transport detent as it should be used any time the instrument is transported. See Figure 2-3.



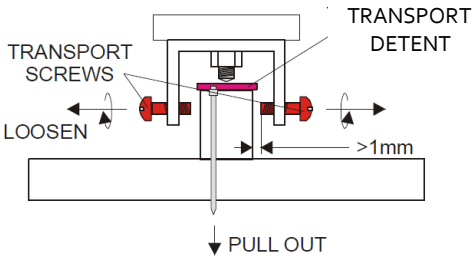
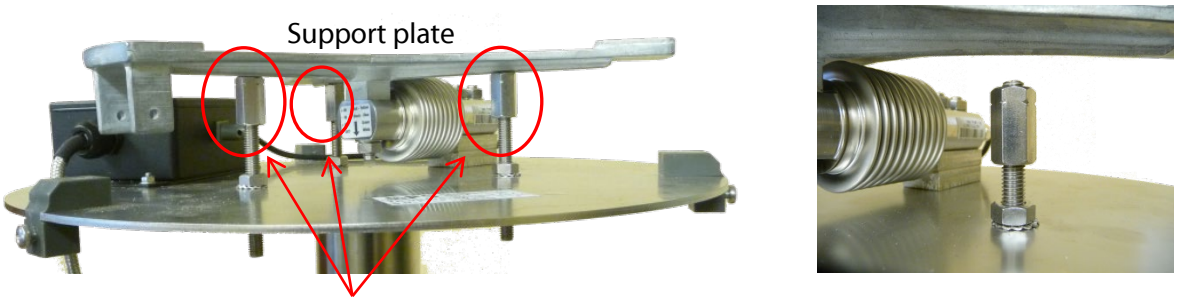


Figure 2-3: Transport restraints - detent

The other uses three transport bolts and with ½" nuts. Unscrew each nut enough to expose the top of the bolt.



Nuts positioned for transport

Nuts positioned for use

Figure 2-4: Transport restraints - bolts

10) Replace the bucket ensuring it is correctly centred.

11) Replace the housing, aligning the male part of the heat connector with the female connector located on the base plate and the outer slots with the bolt holes on the base. Press down firmly until there is no gap between the outer lip of the housing and the base ridge. Secure the housing with the bolts.

12) In order for the AWP to function correctly, there can be no contact between the bucket and the housing.

HINT: Run your finger between the bucket and the housing to ensure there is no contact between the two.

13) Connect the SDI-12 cable to one of the SDI ports on an Axiom data logger using the military connector.

14) Wait 4 minutes and check the weight reported by the gauge. A weight of approximately 1530g (the weight of the empty bucket) should be returned.

15) If the expected weight is not returned, review the setup and repeat #14. If the expected weight is still not returned, do a calibration verification.

16) If operating in an area in which freezing conditions are expected, add 500 ml of environmentally friendly antifreeze to the bucket. See section 2.6.3 for details of using antifreeze.

IMPORTANT! DO NOT add antifreeze directly to the bucket when it is on the support plate as that will be measured as precipitation. See section 2.6.3.

2.5 CALIBRATION VERIFICATION

Once the AWP is in place, powered, and configured with the Datalogger, you can conduct an optional calibration verification to ensure its operation and accurate conversion of weight to amount of precipitation.

1) Remove the housing and bucket. Empty the bucket and ensure it is dry and clean.

2) Replace the bucket and housing. Wait four minutes for the AWP to stabilize.

> IMPORTANT! The housing MUST be in place on the base prior to proceeding.

3) Confirm the weight reading is approximately 1530g.

4) Carefully place the weight in the bottom of the bucket. The housing can be removed in order to conduct this step, but it must be replaced prior to proceeding.

5) From the transparent mode, send the clear cumulative precipitation command (*a*XclrCV!)[1]

6) Wait four minutes for the cumulative precipitation calculations to complete.

7) Enter the continuous measurement command (*a*RØ!)[1]

8) The reply will consist of the following:

   a{Pr1m}{Wavg1}{PrTotal}
   In which:
   a = sensor address
   Pr1m = one minute sum of precipitation (mm) (range 0 – 120.000)
   Wavg1 = total weight (g) (range ±40000.00)
   PrTotal = overall sum of precipitation (mm) (range 0 –999.999

   Example Response for an AWP-200 using a 100g weight: 1+0+100.01+4.987

9) If the first value after the sensor address (Pr1m) is not zero, wait another minute and resend the continuous measurement command (further stabilization and averaging are required).

10) Compare the PrTotal to the reference table to ensure the returned value corresponds to the limits set out therein

[1] In which *a* is the sensor address

TABLE 2-1: REFERENCE TABLE FOR VERIFICATION PROCEDURE. RELATIVE ACCURACY 1%

Weight	AWP-200			AWP-400		
(g)	Min	Nom.	Max	Min	Nom	Max
20	*0.990*	**1.000**	*1. 01*	*0.495*	**0.500**	*0.505*
25	*1.238*	**1.250**	*1.263*	*0.619*	**0.625**	*0.631*
50	*2.475*	**1.500**	*02.525*	*1.238*	**1.250**	*1.263*
100	*4.950*	**5.000**	*5. 050*	*2.475*	**2.500**	*2.525*

In the example response in (8), we see the PrTotal of 4.987 for an AWP-200 using a 100g weight falls within the verification range.

11) Remove the housing, bucket and weight to reset the gauge.

12) If using antifreeze, add it to the bucket before replacing the bucket on the support plate. Replace the bucket and housing and secure.

2.6 MAINTENANCE

The AWP requires minimal maintenance. Refer to the following table for the recommended maintenance routine:

Table 2-2: Recommended maintenance schedule

Empty bucket	At every site visit or when bucket nears 80% of its full capacity
Visual Inspection	Annually (minimum); at every site visit
Add Antifreeze	If operating in freezing conditions

2.6.1 EMPTYING THE BUCKET

The bucket contents can be emptied at any time; however, it is prudent to empty it after long periods of precipitation or when the bucket is at 80% or more capacity. Should the bucket overflow, measurements will be inaccurate but the weighing mechanism and other electronics will not be damaged.

The contents of the bucket can be emptied by siphoning, pumping, or pouring. The first two are the preferred method if the bucket is at near capacity or if it has a wind shield. If pouring, there is a risk of injury if proper workplace techniques are not used.

CAUTION! When the bucket is at capacity it weighs **30 kg (66 lbs)**.

- Consider reducing the load by removing some contents by bailing, siphoning, or pumping.
- If necessary, solicit assistance
- Use proper lifting techniques
- Minimize twisting

To pour out the contents of the bucket, remove the cover as described in step 4 of section 2.4. Carefully lift the bucket from the base plate and pour out the contents. Inspect the interior for any debris and remove.

Replace the bucket, cover and screws. Ensure the bucket is properly seated by running your finger between the bucket and the cover to ensure there is no contact between the two.

2.6.2 VISUAL INSPECTION

When at the site, inspect for any signs of visible damage to the components including cable runs. Check all the fittings to ensure they are still tight.

Remove any dirt and debris which may have accumulated around the instrument and in the bucket.

Ensure the bucket is properly seated by running your finger between the bucket and the cover to ensure there is no contact between the two.

2.6.3 ANTIFREEZE

The collection bucket is very sturdy and will maintain its shape even if its contents freeze. If the AWP will be operating in temperatures below freezing, it is recommended to add 500 ml of environmentally friendly antifreeze to the bucket to prevent the collected precipitation from solidifying.

Selecting Antifreeze

When selecting an antifreeze product consideration should be given to the following:

- Propylene glycol based (or other environmentally friendly formulation)
- Water soluble
- Low evaporation point
- Compatible with AWP construction materials

> IMPORTANT! Follow manufacturer's directions for the safe handling, storage and disposal of the antifreeze being used.

Adding Antifreeze

The bucket should be removed from the support plate and its contents emptied before adding anti-freeze. Add the anti-freeze and then replace the bucket and housing.

> NOTE: DO NOT pour antifreeze directly into the bucket when it is sitting on the base plate as the AWP will register that as precipitation.

Disposal

When disposing of bucket contents treated with antifreeze, ensure all local regulations are observed and due consideration given to environmental protection.

2.7 TRANSPORTING THE AWP

When transporting the AWP, it should be prepared to prevent movement of the interior elements.

Restrain the support plate using the supplied transport detent/ transport nuts. Refer to Section 2.4 Step 9. Consider using a removable thread locker designed to lock the nuts against vibration loosening.

Use firm packing material in the narrow portion of the housing to hold the rain bucket in position on the support plate. See picture in section 2.4 Step 5.

Chapter 3 SDI-12 COMMANDS

3.1 NOTATION FOR SDI COMMANDS[2]

SDI commands are strings of characters sent to the SDI device. The format of the strings is important, and to specify the format of SDI commands different typefaces are used. All commands (and the replies from the device) are represented in a mono-spaced font. Different parts of a command are represented with variants on this text format

Item	Explanation	Font	Text representation
Command literal	Part of a command that must be reproduced literally as it appears	**Bold**	**X**
Command parameter	Part of a command that must be filled in with an appropriate value	*Italic*	*data*
Address part of command	First character of command (except Address Query). Valid values 0-9, a-z, A-Z.	*Italic*	*a*
Command Terminator	Mandatory character	**Bold**	**!**

3.1.1 BASIC COMMANDS

Command Name	Command Code	Response and Explanation
Address Query	**?!**	*a*
Acknowledge Active	*a***!**	*a*
Change Address	*a***A***b***!**	*b* is the new address, a single alphanumeric character in the range 0-9, a-z, A-Z
Send Identification	*a***I!**	*a*13MPSSYSTMTRWS6_vvvxxxxxxxxxxxxx *a* = address 13= SDI-12 compatibility number (SDI-12 version 1.3) MPSSYSTM = manufacturer identifier TRWS6 = sensor model number vvv = firmware version number xxxx…. :xxx = detailed firmware number: serial #

[2] A detailed description and explanation of SDI-12 commands can be found in, *"SDI-12: A Serial-Digital Interface Standard for Microprocessor-Based Sensors Version 1.3"*, published by the SDI-12 Support Group. http://www.sdi-12.org/archives/SDI-12%20Specification%201.3%20July%2025%202004.pdf

3.1.2 MEASUREMENT AND SEND DATA COMMANDS

Even though the M and D commands are implemented, it is highly recommended to use the R command (section 3.1.3) to get data from the AWP.

Command Name	**Command Code**	**Response and Explanation**
Start Measurement	*a***M!**	*a*tttn *a* = sensor address ttt = the time in seconds until the sensor will have the measurement(s) ready *n* = A digit between 1 and 9. The number of measurement values the sensor will make and return in response to a D commands.
Send Data	*a***DØ!**	*a*{Pr1m}{Wavg1}{PrTotal} *a* = sensor address Pr1m[1] = one minute sum of precipitation (mm) (range Ø – 12Ø.ØØØ) Wavg1 = total weight (g) (range ±4ØØØØ.ØØ) PrTotal = overall sum of precipitation (mm) (range Ø –999.999
Note 1 - sum of precipitation is accumulated from the time power is supplied to the AWP or the reset counter to zero command is entered.		

EXAMPLE:

Request: 1M! Sensor at address 1 take a measurement
Response: 10003 Address = 1, Measurement time = 0 sec, 3 measurement values

Request: 1D0! Sensor at address 1, send data
Response: 1+0.134+7995.146+21.246

Address = 1
Pr1m **=** +0.134 mm
Wavg = +7995.146 g
PrTotal = +21.246 mm

3.1.3 CONTINUOUS MEASUREMENT

Because the AWP is able to continuously measure, a start measurement command is not required. The R command can be used to read directly and return the data. The response is formatted like the D command.

Command Name	Command Code	Response and Explanation
Continuous Measurement	*a***R0!**	*a*{Pr1m}{Wavg1}{PrTotal} *a* = sensor address Pr1m[1] = one minute sum of precipitation (mm) (range 0 – 120.000) Wavg1 = total weight (g) (range ±40000.00) PrTotal = overall sum of precipitation (mm) (range 0 –999.999
Note 1 - sum of precipitation is accumulated from the time power is supplied to the AWP or the reset counter to zero command is entered.		

EXAMPLE:

Request: 1R0! Sensor at address 1, send data
Response: 1+0.134+7995.15+0.246

Address = 1
Pr1m **=** +0.134 mm
Wavg1 = +7995.15 g
PrTotal = +0.246 mm

3.2 X COMMANDS

3.2.1 RAIN COUNTER RESET

This command resets the state of the rainfall counter **RainSum** to zero. There is no need to use this command to reset the counter after each read as the counter will roll over automatically at the Rainsummax value of 100mm.

Command Name	Command Code	Response and Explanation
Reset Rain Sum Counter	*a***XclrCV!**	*a*N *a* = sensor address N = count of cleared cumulative values

3.2.2 TIME SYNCHRONIZATION COMMAND

This command synchronizes the internal measurements with the data logger's time. The time base of the AWP measurement is one minute. Therefore, the minimum interval between time synchronization commands must be an integer multiple of this base (60 seconds).

Command Name	**Command Code**	**Response and Explanation**
Synchronize Time	*a***XSYN!**	*a*
*Note 1 - When the AWP is used with a data logger, it is recommended to synchronise every minute at least 1 second **before** sending a request for data.*		

Chapter 4 SPECIFICATIONS

	AWP 200	AWP 400
MEASUREMENT		
Orifice area	200 cm^2	400 cm^2
Capacity	1500 mm	750 mm
Accuracy	0.1%	
Maximum Rain Intensity	120 mm/min	
Resolution	0.001mm	
Measuring Element	Strain-gauge bridge	
Air Temperature Measurement	Optional, -40 to +70 (± 0.5 °C)	
Wind Correction	Yes	
Wind Shield	Optional	
ELECTRICAL & INTERFACE		
Power supply	5 – 30V_{DC}/ 4mA max	
Serial output	SDI-12	
MECHANICAL		
Dimensions	385 x 650 mm	385 x 610 mm
Weight	9.5 kg	
ENVIRONMENTAL		
Operating Temperature Range	-40 to +70 °C	
Operating Humidity Range	0 – 100%	
Degree of Protection	IP65	

DOCUMENT REVISION HISTORY

Revision	Date	Description
1	04 Apr 2017	Original
2	18 Dec 2018	Added information on restraining bolts (Section 2.4) and preparation for transportation (Section 2.6.4)
3	18 Jul 2019	Corrected formatting in Table 2-1.