MODEL SADPμ

Portable Dewpoint Meter

Instruction Manual

Alpha Moisture Systems
Alpha House
96 City Road
Bradford
BD8 8ES
England

Tel: +44 1274 733 100
Email: info@amsystems.co.uk
Web: www.amsystems.co.uk

Model SADPµ

Automatic Dewpoint Meter

Instruction Manual

Doc No: 1456 Issue 7
16/06/22

Index

1 General Description

- The SADPµ is a battery operated portable unit designed for spot check or continuous use, and gives direct indication in Dewpoint temperature and parts per million on a 12cm. analogue scale.
- The SADPµ is fitted with a microprocessor based PCB which allows very accurate calibrations to be performed.
- The instrument is operated with its own internal batteries and requires no external power source. The instrument comes supplied with 6 "c"-size cells. In normal operation these will last for 5-6 months.
- The unique measuring head is designed to keep the sensor dry when the instrument is not in use, making spot checks a simple and speedy process with minimum air or gas usage.
- The instrument is provided as standard with a padded carrying case with shoulder strap, a moisture calculator, a screwdriver for the Automatic Calibration control, a special key for the security plate covering the battery carriers, and a 2 meter length of flexible PTFE (Teflon) sample pipe.
- The instrument is certified for use in hazardous areas (Ex ia IIC T3/T4 Ga).

1.1 Ranges

- Model SADPµ-SR -110 to –20ºC Dewpoint, 0 to 1000Vpm & 0 to 1Vpm
- Model SADPµ-RD -80 to –20ºC Dewpoint, 0 to 1000Vpm & 0 to 10Vpm
- Model SADPµ-GY -80 to 0ºC Dewpoint 0 to 6000Vpm & 0 to 10Vpm
- Model SADPµ-PL(**1**) -100 to 0ºC Dewpoint
- Model SADPµ-PL(**2**) -100 to +20ºC Dewpoint
- Model SADPµ-BL -80 to +20ºC Dewpoint

1.2 Cabinet

- Aluminium and zinc plated steel, stove enamelled. 202mm wide x 225mm deep x 276mm high (320mm high with test chamber (head) in the open position). Typical weight 5kgs. Four feet fitted for bench use.

2 Safety Information

- Read the safety information below, before use.

2.1 Warnings

The SADPµ is intrinsically safe. Therefore it can be used in hazardous areas.

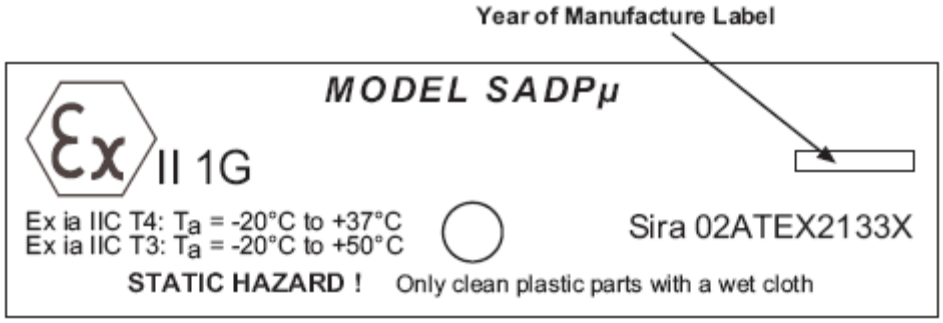
Certification: ATEX Coding –  II 1G
Ex ia IIC T4 Ga (Ta = – 20ºC to +37ºC)
Ex ia IIC T3 Ga (Ta = – 20ºC to +50ºC)

It is the responsibility of the user to ascertain the suitability of the SADPµ for use in hazardous areas. Risk assessments should be performed prior to use, taking into account the SADPµ certifications, the 'X' rating of the SADPµ, and the location and the gas being monitored etc.

2.2 Instructions specific to hazardous area installations

The following instructions apply to equipment covered by certificate **Sira 02ATEX2133X:**

- The certification marking is as follows:



- The equipment may be used in zones 0, 1 and 2 with flammable gases and vapours with apparatus groups IIA, IIB & IIC and with temperature classes T1, T2, T3 and T4.
- The equipment is only certified for use in ambient temperatures in the range -20^{o}C to +50^{o}C and should not be used outside this range
- The certificate number has an 'X' suffix, which indicates that the certificate contains one or more special conditions for safe use. Those installing or inspecting the equipment should have access to this section of the certificate. ***See Special Conditions of Use below.***
- Note that only the batteries specified on the equipment may be used.
- The equipment has not been assessed as a safety-related device
- Repair of this equipment shall be carried out by the manufacturer or in accordance with the applicable code of practice.

2.3 Special Conditions of Use - (denoted by the X after the certificate number)

Under certain extreme circumstances, external non-metalic parts of this equipment may generate an ignition-capable level of electrostatic charge. Therefore, when it is used for applications that specifically require group II, category 1 equipment, the equipment shall not be located where the external conditions are conductive to the build-up of electrostatic charge on such surfaces. Additionally the non-metallic parts of the equipment shall only be cleaned with a damp cloth.

Also the apparatus enclosure is made from light metals and presents a risk of ignition due to impact or friction. The apparatus must therefore be carried in the (antistatic) protective carry case supplied when being transported in a hazardous area.

2.4 Pressure Exposure

The maximum pressure to which the telescopic measuring head is exposed must not be more than

0.3barg, 4.35psig, 30kpag or 0.3kg/cm^{2}g

Exposing the measuring head to higher pressures may damage the instrument and result in injury to the operator or other personnel in the area

3 Installing the Air/Gas Sampling System

The piping installation schematic diagram (see section 3.2) shows all components, which could be used in a dry gas measurement application although not all the items shown will be required for every installation.

Care should be taken to ensure that the sample presented to the SADPμ is not contaminated with any component that will damage, contaminate or affect the SADPμ in a way that will impair the unit's accuracy.

It is strongly recommended that the sample should not contain particulate matter, oil, hydrocarbon or any other condensate. If these components contaminate the sample system and/or the measuring sensor, the SADPμ response time will be lengthened, although the sensor calibration will not be effected.

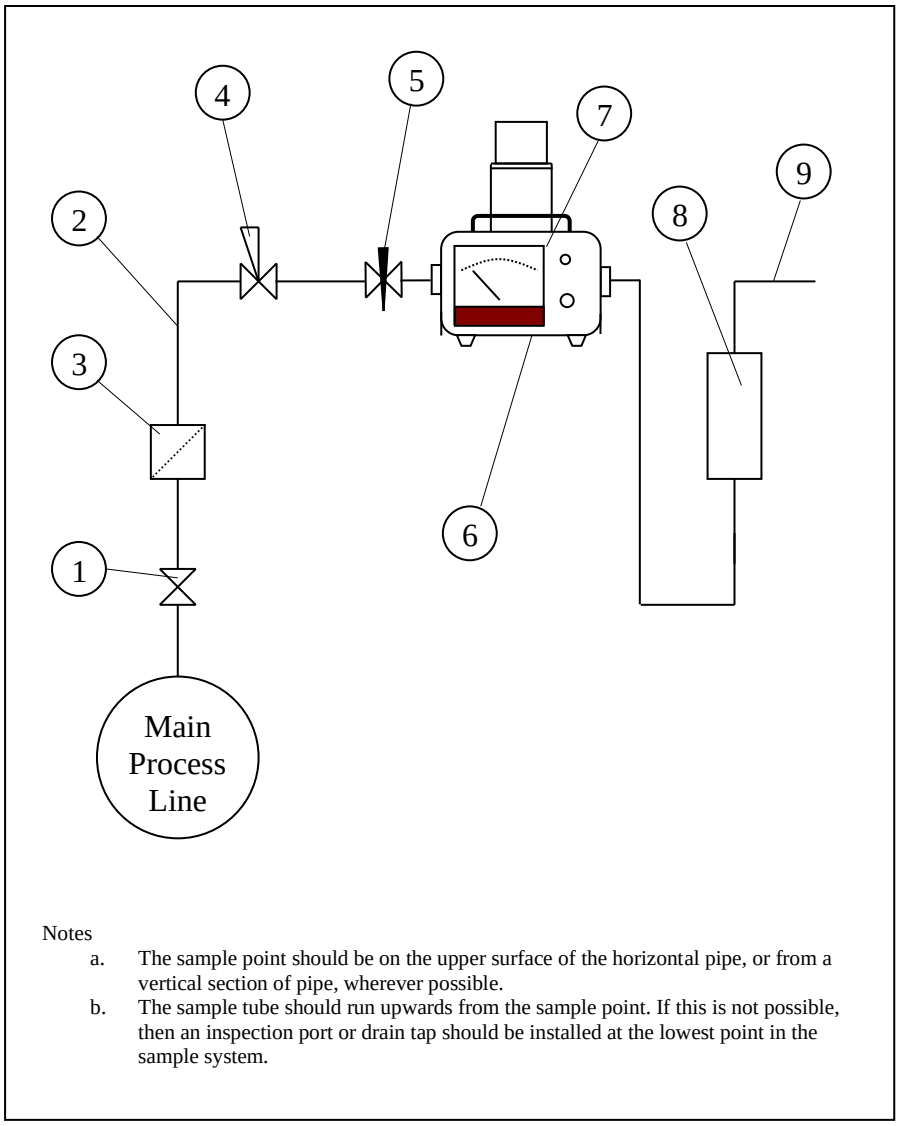
The flow rate, although not critical to the sensor measurement, should be low enough to avoid abrasion to the sensor surface without being so low as to extend the SADPμ response time to an unacceptable level. In general, a flow rate of between 5 and 8 litres/min at NTP will give the right balance.

The sensor used in the SADPμ is a variable capacitor, which is directly affected by changes in partial pressure of water vapour, and these changes, that are proportional to the dew/frost point temperature, are displayed on the instrument indicator.

3.1 Gases to Avoid

Corrosive Gases: The Sensor should not be exposed to corrosive gases (or corrosive contaminants in the gas sample) as these can chemically attack the sensor, impairing calibration accuracy and/or damaging it beyond economic repair. Examples of such gases are mercury (Hg), ammonia (NH3), chlorine (Cl2) etc. Strong oxidising agents such as ozone (O3) should also be prevented from coming into contact with the sensor.

3.2 Piping installation Schematic



Notes

a. The sample point should be on the upper surface of the horizontal pipe, or from a vertical section of pipe, wherever possible.

b. The sample tube should run upwards from the sample point. If this is not possible, then an inspection port or drain tap should be installed at the lowest point in the sample system.

3.3 Piping Schematic Component Index

1. Sample Isolation Valve - This is a recommended item as it allows access to the sample system without interrupting the main process line.
2. Sample Tube – This should be stainless steel for dry air or gas applications but copper or carbon steel can be used where wetter gases are to be measured. If any section of the sample tube must be flexible then PTFE should be used. In most cases, 3mm OD (1/8”) is sufficient as it provides good system response time with minimum flow. 6mm OD (1/4”) tube can be used where pressure drops across the 3mm tube are too high
3. Filter Unit – A filter unit is recommended when the samples are likely to contain particulate matter. If the air/gas sample contains heavy hydrocarbon condensate, the filter must be of the coalescing type with a drain. The filter unit should be positioned as close to the sample point as practical.
4. Pressure Reduction Valve or Pressure Regulator – the sample is measured at atmospheric pressure requiring that valve 4 is fitted to the system.

5. Flow Control Valve – This can be a separate item or combined with the flow indicator (8).
6. Sample Connection
7. SADPμ.
8. Flow Indicator – The recommended sample flow is >5 L/M.
9. Sample Exhaust – The exhaust is vented to atmosphere or returned to an atmospheric pressure line.
10. pressure line.

4 Purging the sample connection

Refer to the sample system schematic in section 3.2.

It is advisable to carry out an initial purge of the sample loop, before connecting the SADPμ, in order to avoid the possibility of sensor damage on start-up.

Open the sample isolation valve (1) slowly, until there is a small flow of air/gas at atmospheric pressure from the pressure reduction valve (4) into SADPμ line. Allow the air/gas to exhaust through the sample connection (9).

The SADPμ is not flow sensitive however the sample flow needs to be enough to purge the sensor head effectively, so anything less than 1 litre/min would mean that the instrument would take too long to settle to a stable reading. The flow should also not be so high that the gas velocity could physically damage the sensor or cause backpressure in the sensor head, so should not exceed about 8 litres/min.

Allow this purge to continue for 2 minutes to remove any residual moisture from the sample pipe work and components. Check that no liquid or particulate contamination, which could damage the sensor, is passing through the sample pipe. Directing the sample onto a piece of white paper (such as a filter paper) will make it easier to see any dust or oil mist in the sample.

4.1 Sample Connections

There is a push-on sample connection on each side of the test chamber (head) of the instrument. These connections are reversible and flow direction is not important. The fittings are designed for pipe having an internal bore of approximately 6mm (1/4"). Only the PTFE (Teflon) pipe provided should be used, as other materials are unsuitable. The sample pipe should be heated in a naked flame for a few seconds before being pushed onto the instrument connection for the first time. This will provide a good gas-type connection and ensure accurate results.

5 Normal Operation

In normal operation the following procedure should be used.

a) Switch the instrument to the battery check position and ensure that the indicator shows a value in or above the green section on the scale. Switch the instrument to the required range

Note: -When the instrument is switched to the read position, the processor takes approximately 5 seconds to initialise. The indicator will indicate full-scale deflection before returning to the actual sensor reading. This is normal.

Note: - Being a digitally controlled circuit, changes in value can be seen to move in a series of small steps (0.3ºC). This is also normal.

b) Connect the PTFE sample tube to the air or gas sample point.

c) Open the sample point to allow a flow of air of gas through the sample tube at a rate of between 5 and 15 L/min., exhausting to atmosphere. Ensure that no liquid is passing through the tube as this could damage the sensor.

d) After allowing the sample to flow for approximately 1 minute (to purge the sample point and sample tube), connect the tube to the instrument head assembly. This connection can be made to either side, whichever is most convenient.

e) After allowing the air or gas to purge the instrument head assembly for approximately 1 minute, restrict the outlet of the head assembly by placing a finger over the outlet tube. The instruments telescopic head assembly will extend under the pressure of the air or gas. Where very low air or gas pressures are present it may be necessary to draw the head open, by hand, but this should be done very slowly in order not to draw in ambient air through to exhaust tube.

f) When the head assembly is fully extended, remove the outlet flow restriction and allow the air or gas to flow through the head assembly.

g) The instrument indicator will respond to the change in moisture content and the reading should be taken when the indicator stops moving.

h) When the test is complete, push down the telescopic head, fully, turn off the air or gas flow and disconnect the sample tube. NOTE: While the head assembly is in the closed position the sensor will be dried, by the internal desiccant, ready for the next test.

i) Switch the instrument off.

Note:- It is very important that the instrument head should be either fully closed or fully extended or the desiccant within the head will become wet and will influence readings. The instrument should always be stored with the head in the closed position.

6 Field Calibration (Sensor Ranges up to 0ºC Dewpoint)

The major advantage of the instrument is the Automatic Calibration Feature.

The system relies on the fact that each sensor is designed to give no further increase in reading when it reaches its maximum moisture level. This means that, for instance, the Silver Spot or Red Spot sensor will read –20ºC Dewpoint when it is exposed to gas at –20ºC Dewpoint, but will continue to read -20ºC Dewpoint when it is exposed to wetter gas. The system can therefore be calibrated very simply by exposing the sensor to anything wetter than –20ºC Dewpoint and adjusting the reading to that point on the dial. For the Grey Spot Sensor the maximum level is 0ºC DP and the same principle applies.

In practice, the instrument's calibration is checked as follows:-

1. Switch the instrument ON to the dewpoint range.

2. Ensure that no gas sample is connected to the instrument head connections.

3. Raise the head of the instrument by hand and pump it up and down carefully a few times, ending in the raised position.

4. After about 1 minute (not critical, but not more than a few minutes) check the instrument reading. It should display the maximum level of Dewpoint for the instrument (i.e. –20ºC for Red and 0ºC for Grey).

5. If the reading requires adjustment locate the AutoCal control, which is on the front panel of the instrument, and using the small screwdriver provided, turn the control clockwise to increase the reading (wetter) or anticlockwise to decrease it (dryer).

6. Close the instrument head.

Note: - We suggest that this procedure should be carried out at a time when the head assembly can be allowed to dry thoroughly before any further test samples are measured.

7 Field Calibration (Sensor Ranges up to +20ºC Dewpoint)

In order to calibrate a +20ºC SADPμ, it is necessary to measure the ambient air Dewpoint by some other method. Careful use of a sling or whirling hygrometer can achieve accurate results or a cooled mirror device can be used.

The following procedure should be used:-

1. With the instrument switched on and all gas samples disconnected, raise the instrument head, by hand and pump it up and down a few times, leaving it in the raised position.

2. Compare the readings of the instrument, on the ambient air drawn into the head, with those obtained by another method and IF NECESSARY, adjust the AutoCal control until the values coincide.

3. Close the instrument head, switch off.

Note: - We suggest that this procedure should be carried out at a time when the head assembly can be allowed to dry thoroughly before any further test samples are measured.

8 Factory Calibration

Factory calibration is performed by firstly setting the span of the instrument, using the AutoCal potentiometer, on the instrument front panel, to +20ºC Dewpoint, while exposing the measuring sensor to air with a moisture content equivalent to +20ºC Dewpoint.

The instrument head and sensor are then dried. Thereafter, air at controlled Dewpoints is passed through the measuring head, in steps, from dry to wet and the instrument is adjusted to be correct at those points.

The results of the calibration are shown in the Certificate of Test and Calibration supplied with the instrument. The values of all calibration points are verified against a primary standard analyser, which is traceable to the British Standard Moisture Generator, held by the National Physical Laboratory.

Note: -The factory calibration of the instrument should be verified on a yearly basis.

9 The Sensor

Construction of the sensor starts with an ultra-high purity aluminium wire, which is coated with a hygroscopic layer and finally covered by a film of porous gold. The gold film and the aluminium core form the plates of the capacitor. The capacitance value, and the change in capacitance over the measuring range of each sensor is many times greater than any other device, resulting in a system which can operate at low frequency (50 or 60Hz) without any risk of interference or pickup from external cables or other sources.

Some of the water vapour molecules in the atmosphere surrounding the sensor will enter the dielectric layer where, due to the extremely small size of the pores, their Brownian motion will be limited, their energy will consequently be reduced and they will condense into liquid water. Due to the very high dielectric constant of water (about 80) compared with the other vapours, which may be present, this produces a marked change in the dielectric value of the sensor, which is then measured by the analyser. A dynamic equilibrium will exist between the water vapour outside the sensor and the condensed water within the pores. This equilibrium is maintained, and the response time of the sensor can generally be considered to be at least as quick as the system into which it is installed.

Molecules larger than water vapour (one of the smallest gas molecules) cannot enter the pores, making the sensor resistant to many contaminants and specific to water vapour pressure regardless of the carrier gas.

9.1 Gaining Access to the Sensor

The sensor is mounted inside the test chamber (head) of the instrument, and is accessible by removing the test chamber from the instrument as follows:-

1. Undo the three screws in the base flange of the head assembly and lift the complete head off the instrument. Pull out the plug from the sensor.

2. Using a 22mm A/F wrench, unscrew the sensor from the head assembly. Do not leave the head without a sensor fitted for more than a few minutes, as the desiccant will absorb moisture from the room air.

3. When refitting the sensor, push the coaxial plug in firmly and don't forget to fit the brass spacer.

10 Additional Information

10.1 Anti Static Carrying Case

The anti static carrying case supplied with the SADPμ has been designed for use in intrinsically safe areas. The SADPμ unit can be fully operated within the carrying case. It is recommended that the SADPμ is left in the carrying case whenever in the intrinsically safe areas.

10.2 Desiccant

The sensor is kept dry when not in use by the desiccant contained in the head assembly. The instrument is designed to maintain the sensor below –70ºC Dewpoint as this maintains the optimum responsiveness of the sensor.

The above readings should be obtained when the instrument has been left with the head in the closed position for a few hours e.g. overnight. After very long service, or in case of accident the desiccant can easily be replaced as follows:-

1. Hold the plastic ring, which separates the inner and outer sections of the head assembly and unscrew it until it can be removed. Pull the inner section out of the outer section.

2. Unscrew the plain brass base of the inner section, discard the old desiccant and replace with new.

3. Check that the black seal is in place in the base of the inner section and then reassemble the head assembly.

10.3 Batteries and Battery Check

When the battery check position is selected the reading should be in the green sector, or to the right of it. If the reading is to the left of the green sector (drier), then the batteries should be replaced.

To replace the batteries, first remove the instrument from its carrying case. The battery holders will be found on the instrument back panel, and protected by a metal plate. Remove the plate by removing the 2 special screws with the key provided, take off the cap of each battery carrier, and replace the batteries with 6 c-size (R14) cells. Always replace all 6 batteries at the same time, and do not leave completely discharged batteries in the instrument.

10.4 Temperature

Typical ambient variations experienced throughout the world are quite acceptable, but avoid placing the instrument in direct sunlight or near a source of radiant or convected heat. In countries that experience extremes of temperature, always carry out the Automatic Calibration with the instrument at its operating temperature.

10.5 Pressure

The Automatic Dewpoint Meter operates with the sensor at atmospheric pressure, and the readings given in Dewpoint temperature and parts per million are therefore correct at 1 bar (A). However, Dewpoint temperature is directly proportional to pressure, and the results obtained from the instrument can be referred to any other pressure by use of the pressure calculator, which is supplied with the instrument. Instructions for the use of the calculator are printed on it.

11 Problem Guide

PROBLEM	CAUSE	SOLUTION
ERRATIC READINGS	Static on Indicator	Moisten indicator face with 50/50 mixture of detergent & water, or use proprietary anti-static cleaner. DO NOT POLISH INDICATOR FACE.
FULL SCALE READING	Wet gas	Stop gas supply & switch analyser off.
	Short Circuit Cable or Plug	Disconnect plug from sensor & if the indicator still reads over full scale deflection. Cure the short circuit in the cable or plug or replace.
	Short Circuit Sensor	Disconnect the plug from the sensor & note the indicator falls to 0 deflection. Apply approx 24V DC to sensor terminals MOMENTARILY with the sensor in a dry condition. Polarity is not important, but the contact must be brief or the sensor may be damaged. If this fails to clear the fault the sensor must be replaced.
ZERO READING	Open Circuit on Cable	Disconnect plug from sensor and connect centre pin of plug to the outer connection. No reading will be obtained. Repair cable.
	Open Circuit on Sensor	Test as for open circuit on cable, but note that reading over FSD obtained. Check sensor connection or replace sensor.
	Autocal Wrongly Set.	Re-adjust to correct setting (i.e. carry out the Autocal procedure as on page 4).
	Instrument Unserviceable	Disconnect coaxial cable from instrument and connect short circuit across terminals and note no reading even with Autocal control turned up. Return instrument for service.

11.1 Problem Guide (Continued)

PROBLEM	CAUSE	SOLUTION
WET READING	Leak in System or use of Unsuitable Pipe	Cure leak, or replace unsuitable pipe with copper or stainless steel. Flexible connections should be made with PTFE pipe. NEVER use rubber or plastic pipe.
	Comparison with Secondary Standard Instrument or Calibration Gas	Ensure that samples are taken from same sample point. Re-check Autocal setting. If problems still occur change sensor.
SLOW RESPONSE	Free Water in System	Check drain & inspection ports in the main system & sample pipe work.
	Wrongly Sized or Incorrect Material on Sample Lines	Refer to page 1 of manual. & ensure sample tube material & flow rates are as recommended.
DRY READING	Autocal Wrongly Set	Refer to page 4 of manual & re-check Autocal. If this does not cure problem return for calibration.
	Comparison with Secondary Standard Instrument or Calibration Gas	Refer to page 4 of manual & re-check Autocal. If this does not cure problem return for calibration
CONSTANT READING	Condensation in Sample System	Condensation will occur if temperature of the sample system, or main pipe, at any point is below (colder) than the DP temperature of the sample gas. Once having formed, the sample reaching the sensor will a DP equal to temperature of the condensate, regardless of the DP at the sample point.

12 Hygrometric Equivalents

DEWPOINT ^0C	DEWPOINT ^0F	VAPOUR PRESSURE mmHg	PARTS PER MILLION by VOLUME	DEWPOINT ^0C	DEWPOINT ^0F	VAPOUR PRESSURE mmHg	PARTS PER MILLION by VOLUME
-150	-238	7 x 10 (-15)	9.2 x 10 (-12)	-52	-62	.02305	30.329
-140	-220	3 x 10 (-10)	3.9 x 10 (-7)	-50	-58	.02961	38.961
-130	-202	7 x 10 (-9)	9.2 x 10 (-6)	-48	-54	.03786	49.816
-120	-164	9 x 10 (-8)	1.2 x 10 (-4)	-46	-51	.04819	63.408
-118	-180	.00000015	.00020	-44	-47	.06108	80.368
-116	-177	.00000025	.00033	-42	-44	.07709	101.43
-114	-173	.00000041	.00054	-40	-40	.09691	127.51
-112	-170	.00000066	.00087	-38	-36	.12133	159.64
-110	-166	.00000107	.00141	-36	-33	.15133	199.12
-108	-162	.00000169	.00222	-34	-29	.1880	247.37
-106	-159	.00000266	.00350	-32	-26	.2328	306.32
-104	-155	.00000413	.00543	-30	-22	.2871	377.76
-102	-152	.00000636	.00837	-28	-18	.3529	464.34
-100	-148	.00000968	.0127	-26	-15	.4323	568.82
-98	-144	.00001459	.0192	-24	-11	.5277	694.34
-96	-141	.00002178	.0287	-22	-8	.6422	845.00
-94	-137	.00003224	.0424	-20	-4	.7790	1025.00
-92	-134	.00004729	.0622	-18	0	.9421	1239.61
-90	-130	.00006879	.0905	-16	+3	1.136	1494.74
-88	-126	.00009924	.1305	-14	+7	1.365	1796.05
-86	-123	.00014205	.1869	-12	+10	1.636	2152.63
-84	-119	.0002018	.2655	-10	+14	1.956	2573.68
-82	-116	.0002844	.3742	-8	+18	2.331	3067.11
-80	-112	.0003981	.5238	-6	+21	2.771	3646.05
-78	-108	.0005533	.7280	-4	+25	3.285	4322.37
-76	-105	.0007638	1.005	-2	+28	3.884	5110.53
-74	-101	.0010476	1.378	0	+32	4.581	6027.63
-72	-98	.0014275	1.878	+2	+36	5.292	6963.16
-70	-94	.001933	2.543	+4	+39	6.099	8025.00
-68	-90	.002603	3.425	+6	+43	7.012	9226.32
-66	-87	.003483	4.583	+8	+46	8.045	10585.53
-64	-83	.004635	6.099	+10	+50	9.209	12117.10
-62	-80	.006135	8.072	+12	+54	10.518	13839.47
-60	-76	.008076	10.626	+14	+57	11.988	15773.68
-58	-72	.010576	13.916	+16	+61	13.635	17940.79
-56	-69	.013780	18.132	+18	+64	15.478	20365.79
-54	-65	.01787	23.513	+20	+68	17.535	23072.37