



Particle Deposition Monitor®

Instrument documentation

SAC-Nederland b.v.

**5µm/50 cm²
PDM3 optical head
High End Series**

HE550

PDM3

**Manual
V3.2**

English

V04



Get the grip on surface cleanliness



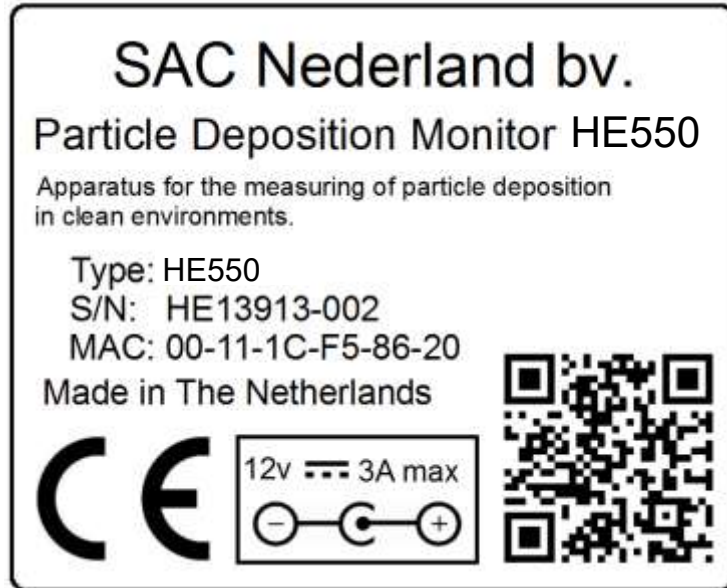
Certification listing

Serial number :	Date of production :
Date of certification : Expire date :	Trace number: Inspector:
Date of certification: Expire date :	Trace number: Inspector:
Date of certification: Expire date :	Trace number: Inspector:
Date of certification: Expire date :	Trace number: Inspector:
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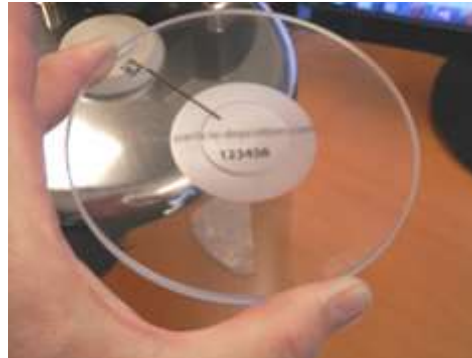
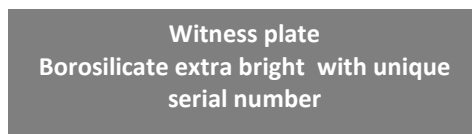
Example

Remarks article 9 tab 3 EMCdirective 2004/108/EG

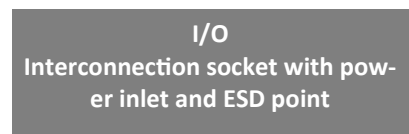
The HE550 unit has a weight of 14.3 kg and is to be lifted by means of two hands. Fingers should grab the bottom while the hand stabilizes the side of the unit. The unit should not be hand carried over 20 meters. Dropping the unit will cause damage to the unit and may cause personal injury.

Remarks article 9 tab 5 EMCdirective 2004/108/EG

The HE550 uses an intensive illumination for measuring the particles. Staring into the light source is to be avoided under all circumstances. The workspace of an operator should be setup in a way that direct view of the light source is obstructed by either the positioning of the HE550 or external shielding.



Note:
Plug the power and lock the power by means of the locking nut.





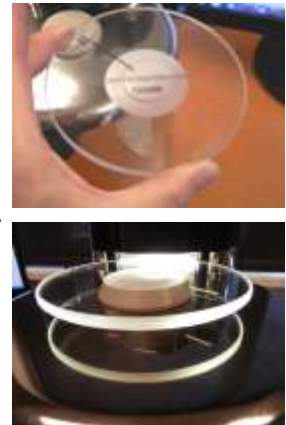
Particle Deposition Monitor®

Instrument documentation

General elucidation:

The instrument called Particle Deposition Monitor is intended to image the deposition of particles on a glass disk. The entire disk is imaged by means of a scanning system. The calibrated images are the output of the instrument. The instrument is constructed in such a way that only deposition on top of the disk is captured. The mechanical design of the instrument is optimised in order to avoid thermal airflows above the instrument. The system called Particle Deposition Monitor consists of

an instrument and monitoring software. The software measures particles found in the images made by the instrument. Output of these measurements are e.g. the box size of a particle (length and width), the surface of a particle and the number of particles in a certain size range.



Modes of operation

The Particle Deposition Monitor can be used in two modes:

Real time mode: In the real time mode the PDM is placed at the location of interest. The system measures at certain intervals the change of the surface cleanliness. That way it registers what is deposited during each interval. Slowly the Particle Deposition Rate (PDR) will build up.

Witness plate mode: From a set of witness plates the reference value (zero value) is measured before they are put at the sample location. After exposure to the particle deposition, these witness plates can be measured. This can be repeated in case the result is used as reference for ongoing measurement. In the witness plate mode about 50-60 witness plates can be measured per hour.

Hardware optical readout unit specification:

The HE550 optical readout unit for particle deposition is capable of scanning 12cm glass disks in real time mode or in witness plate mode. Both measurements can be done either direct from a pc to the unit or via a network. In the real time mode the operation can be automated thus carrying out a monitoring measurement series. Because of the swift measurements, each 20 seconds, the unit can report incidents as well. A typical read cycle

starts by loading the unit with a glass disk. Then the readout will be started. The unit will switch on the illumination and carry out a scan of a donut shaped area on the glass disk. In real time the image data will be transferred to the control software located on a local or remote computer. In the control unit imaging software will measure and size particles deposited on the glass disk. Upon completion the results will be processed and categorised made ready for display in a number of standard formats.

Mechanical specification:		Interconnections:	
Height	55 cm	TCP/IP	8 pin RJ45
Width	20 x 26 cm	Ground clip	ESD ground clip for electrostatic safe handling
Weight	14.1 kg	Power inlet	6mm ext.low voltage power source required 18V 3A center is + lead
Material	Aluminium cabinet. Cabinet is fully closed, no inside outside airflows	Speed:	About 3.8 sec per revolution
Surface Finish	Anodised	Optical readout	7 sec
Turntable	PEEK	Processing time	15 sec max . Average 5 sec
ESD common	Zero ohm to cabinet	Real time cycle	2 minutes minimum setting



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Sizing of particles

Several different ways can be defined to measure a particle. According to the ISO 14644-3 the manufacturer is allowed to define his own system of measuring. The PDM system uses a method of measuring widely used in machine vision. Airborne particle counters have a way of measuring the size equivalent to the polystyrene latex sphere (PSL) particle. Airborne particle counters use this method as the PSL's are used as well in their calibration method and because it fits better the sensor type used.

The PDM system uses an optical standard on a glass plate for calibration purposes. The measuring system therefore uses the flat projected particle in order to extract the dimensional information. Particles falling onto a surface will rest in their mechanical stable state. Consequently the particle will show its largest area to the detection system and therefore also their longest dimension. This was used

In the vision industry the "fitting box" length and width

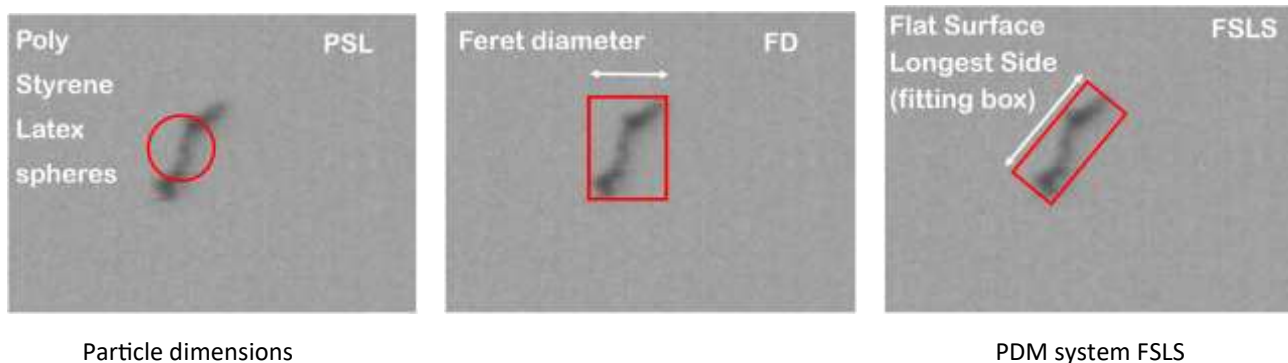
are used. For this the smallest rectangular fitting box is determined. The orientation of the box is not restricted to the axes of the Cartesian system used to measure.

In the drawing below a circle is shown. This circle represents the equivalent PSL particle diameter. The Feret's diameter as used in the microscopy is comparable to the Cartesian measurement system in the vision industry. In the ISO 14644-3 the fitting box is mentioned to measure the particle size.

The PDM uses the fitting box method and provides the longest dimension.

**The measurement method is called:
FSLs Flat Surface Longest Side**

In this manual the dimension measured by the fitting box method is called "the particle size".



Particle dimensions

PDM system FSLs

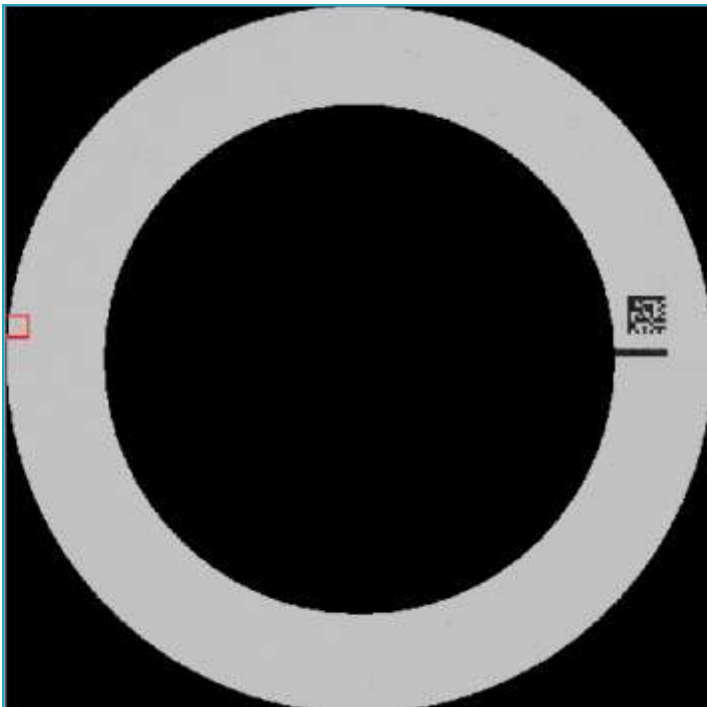
Note: The flat size diameter is mostly longer than the PSL equivalent.. Airborne sizes of realworld particles may show smaller than the same particles in deposition. Deposition equipment based on reflection show a kind of PSL equivalent.

Fibres touching the surface may show in the image as a dim fibre structure. In the results this may show up as a number of parts close to each other as a kind of cluster of part. Airborne equipment has difficulties in catching the fibres. Deposition equipment based on reflection may go into overflow mode.



Sampling field

The optical measuring system scans a predefined field on the used witness plates. For look and feel the size of the witness plate is the same as the size of a CD™, a well known shape. On the surface of the CD a donut shaped ring is scanned. The ring has a surface close to 50cm². ISO146644 allows this shape to be used. The large surface allows low detection times. The donut outer border starts 2.5mm from the edge of the disk and has a crosssection of 15.2mm.



Donut shaped field as shown
via the image tab.



Minimizing the measurement errors

Please contact your distribution company for training on this subject.

Note: * For a detailed explanation on the measurement method for the covered surface contact your sales representative. Upon request changes can be made to the method of measuring.

Differences between PDM ,PDM2 and PDM3

The original optical readout unit was called the PDM. On the type number it does read PDM and HE850. It is a particle deposition meter of the High End version with an optical resolution better than 8 micrometre and a readout area close to 50 square centimetre. It makes use of a mechanical arrangement containing a motor with a gearbox. The gearbox is clearly audible. White light is visible during a scan. When not connected the difference between a PDM and a PDM2 can be found in the disk support. In model 2 the support is reduced to 3 points clearly visible on the turn table.

The PDM2 is of the second generation and makes use of a silent type of motor. The light used during a scan is blue, monochromatic. Internally a large optical encoder

is used to sample the disk equidistant in combination with a large rotating mass ensuring less rotational displacement noise. Furthermore the turntable is improved in order to have less warp.

The PDM2 equipment is capable of using next generations of Vision Analysis software.

For the PDM 3 the optical resolution is down to 5micrometer. The disk system has not changed. The VAS software was changed to deal with the large amount of data from the PDM 3



Safety instructions

- Only use the unit with the original power supply unit.
- Lift the unit correct with 2 hands and fingers under the PDM, be aware of the high weight.
- Do not stare into the light source.
- The glass disk are made of special hard glass, but will produce normal glass shards. The glass will withstand breaking better than normal glass and will in case of breaking produce less particles than normal glass. Like any other laboratory glass it will however crack. The glass can be used over a wide temperature range as common for laboratory glass. Up to 150 deg centigrade no special requirements for the glass handling. Up to 500 deg centigrade slow heating and cooling should be taken care off. The laser printing is guaranteed to 200 deg centigrade.
- The ESD common is hard grounded via zero ohm to the cabinet. There is no internal resistor.
- Do not allow any dew. Keep the unit dry.
- Allow the unit to climatise for at least 10 min per centigrade.

Equipment parameters

Detectable particle size	> =5 µm	< 12,000µm
Measuring surface	49 cm ²	
Particle Deposition Rate	Remeasurable and can be verified by microscope	
Sample time	2 minutes	
Size	550 x 200 x 260 mm 21.6 x 7.9 x 10,2 Inch	
Weight	14,3 Kg	
Power	Power use 22W max average 14 W	
Optical light source	6 W power LED white	
Method	Contrast imaging	
Calibration	Production approved annual	
Packaging	In controlled environment	
Data storage	500 full images, 1500 compressed, 500.000 data sets	
Power	100-240V adapter 18V 3Amp	
Cooling	Internal air heat distribution over full body surface	
Measuring principle size	Flat surface fitting box method	
Measuring principle surface	Enclosed in contour *	

Note: * For a detailed explanation on the measurement method for the covered surface contact your sales representative. Upon request changes can be made to the method of measuring.



How to hook-up and switch on.

1. Place the PDM unit on a firm sturdy surface. Connect the mains adapter unit to the PDM and secure the connection by the locking nut. See page 4 for the interconnection block at the rear of the PDM unit. An ESD connection is normally not required.
2. Switch the PC with the VAS software on. Do not yet enter the VAS software.
3. Connect the ethernet cable between the PDM and the PC. In case an other configuration is required please contact your service centre.
4. Select the shortcut to the VAS software and press for starting the software.
5. See the interconnection tick change to active
6. If required change the type of device by means of right clicking on the device.
7. In case of lost interconnection click on the interconnection to re-connect



How to carry out a measurement.

1. Clean the disk by means of a wipe. Wipe from inside to outside and fold the wipe every new wipe action.
2. Put the disk on the turntable and press the scan button.
3. The disk will rotate for at least 2 full revolutions.
4. After completion of the scanning process the green progress indicator bar will stop at about 3/4 of its total length.



5. At this point the calculations of result take place. Depending on the amount of particles on the disk the calculation time may vary. For a few thousands of particles the time is about 35 seconds.
6. In case an error occurred during the scanning process i.e. because the rotational movement was obstructed, a red bar will occur. The measurement is now declared void and can be redone.
7. A completed measurement is automatically logged if the function is activated on the settings tab.



Improved response

The improved VAS software of the PDM 3 can make faster a connection and has improved facilities to maintain the connection.

In order to get faster results on the screen the software is changed to make first a screen dump of the data found. A few moments later the images arrive.

For measurement series requiring fast results the image calculations can be switched off.



Vision Analysis Software VAS

The Vision Analysis Software (VAS) extracts the information from the image and makes a representation of the information in tables, numbers and graphs. This reduces the information and allows for easy storage of the information in a database. Further database related actions are the basis of the monitoring programme.

System output:

- Channel Deposition Information
- Particle Area Coverage PAC
- Particle Deposition Rate PDR

Monitoring features:

- Differential measurement (zero measurement)
- Continuous incremental (real time)
- Incident measurement (real time)

Differential measurement

This type of result representation shows the difference between the actual measurement results and the nulling results. It is therefore the result of the deposition in the last measurement period. A=Actual B=Blank (nul or init)

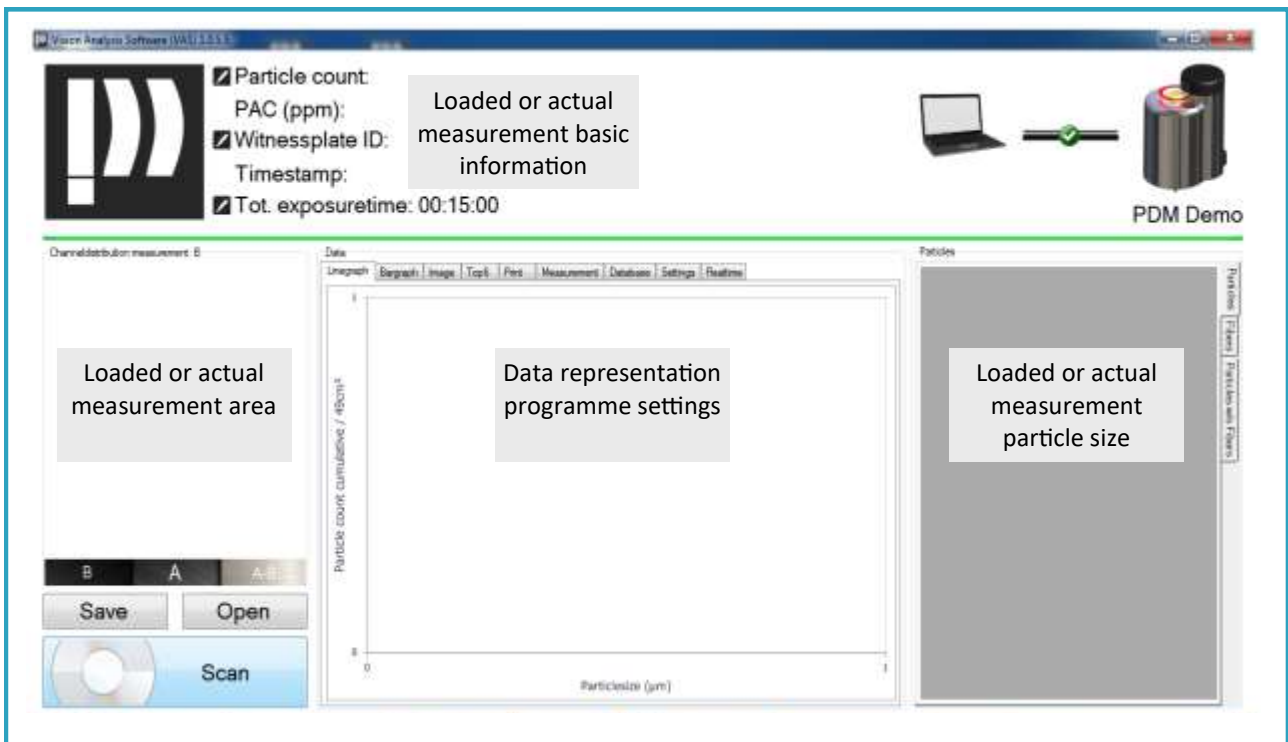
Continuous incremental

This type of result representation provides the build up of the PDR during the measurement. Initially it will not be accurate but after some time it will provide the actual level.

Incident measurement

This type of result shows after every sample what has been newly found on the disk. It shows the latest particles that dropped on the disk.

VAS opening page



Intuitive overview page

The one page overview allows access to:

- Interconnection right top corner
- Basic setting via setting tab
- Measurement operations lefthand lower corner
- Result formats tabs in general

The green bar indicates the activity and duration. A red bar indicates an exemption.

Follow the tooltip text and hover the fields. In the tab field right click options are available.



General description of particle deposition measurement

Particle deposition occurs in a clean room with particle sources like people and equipment in operation. When the clean room is at rest there is in general no particle deposition. Particle deposition is determined by measuring the surface cleanliness of a witness surface before and after exposure using the ISO 14644-9 approach.

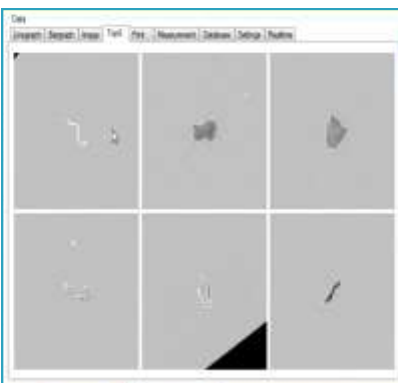
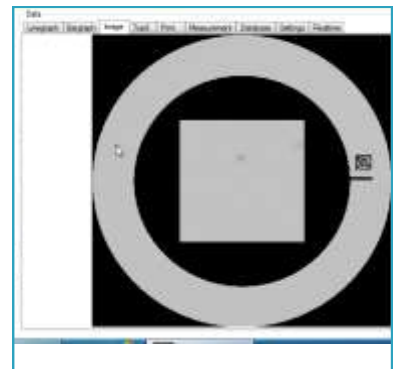
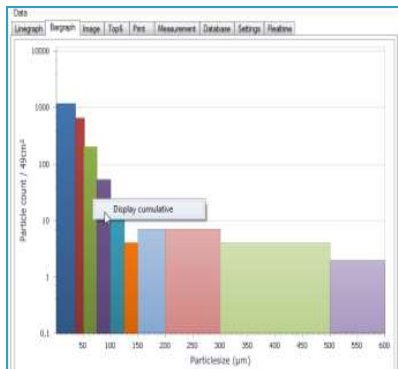
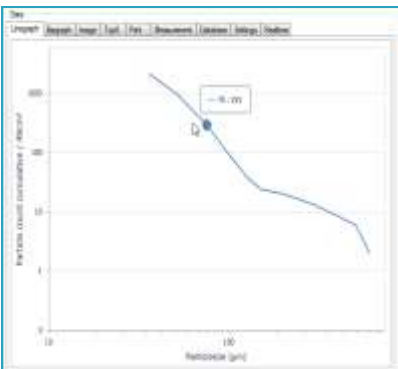
At critical locations data on particle deposition can be used for risk assessments. Particle deposition is different at each location and depends on the activity in the clean room. The average particle deposition of various locations demonstrates the average operational quality of a clean room.

The Particle Deposition Rate at a certain location is the change of surface cleanliness in number of particles $\geq 1 \mu\text{m}$ per dm^2 per hour, where the time, the time the clean room is in operation is taken. In stead of particle size of $1 \mu\text{m}$ various sizes d larger than $1 \mu\text{m}$ can be taken. In that case the number of particles $\geq d \mu\text{m}$ per dm^2 is multiplied by the size d . So PDR is n_1 per dm^2 per hour = $d \cdot n_d$ per dm^2 per hour, where n_d is there number of particle larger than $d \mu\text{m}$ per dm^2 and d is the length of the particle.

The Particle Deposition Rate can be expressed as a particle size distribution for particles $> 8 \mu\text{m}$ and chosen intervals like 20, 50, 100, 200 and 500 μm or as a PDR number being the larger product $d \cdot n_d$ in the particle size range of interest.

In some industries the total particle fall out during a project is important. Therefore it is also possible to determine the particle deposition (particle fall out) in ppm coverage by particles or PAC (percentage Area Coverage).

Various ways to show the particles and data found



Date	Time	Results	Witnessplate ID	Open
25-10-2013	10:50:20	Measurements for the user n...	000135	Load
25-10-2013	10:43:03	Measurements for the user n...	000135	Load
25-10-2013	10:59:07	Measurements for the user n...	000135	Load
25-10-2013	10:58:08	Measurements for the user n...	000135	Load
25-10-2013	10:52:46	Measurements for the user n...	000135	Load
25-10-2013	10:29:51	Results	000138	Load
25-10-2013	10:01:43	Results	000135	Load
25-10-2013	14:05:41	Results	000135	Load
25-10-2013	13:51:42	Results		Load
25-10-2013	13:49:03	Results		Load
25-10-2013	13:37:27	Results		Load
25-10-2013	13:36:01	Results		Load
25-10-2013	13:35:32	Results		Load
25-10-2013	13:29:33	Results		Load
25-10-2013	13:22:43	Results		Load
25-10-2013	13:17:25	Results	000141	Load
25-10-2013	13:04:11	Results	000141	Load
25-10-2013	13:00:12	Results	000141	Load
25-10-2013	12:59:21	Results	000141	Load

Particle count: 33467
PAC (ppm): 6983,65
Witnessplate ID: 000135
Timestamp: 15:32:46
Tot. exposuretime: 00:15:00

Channel	Start	Count	Subtotal
14 - 50	30000	13441	
37 - 52	7380	12499	
52 - 76	3132	5075	
76 - 101	811	1943	
101 - 126	318	1132	
126 - 151	152	818	
151 - 201	165	664	
201 - 501	157	490	
201 - 501	147	342	
> 501	185	785	



Storing of measurement data

The ways of storing.

1. The automatic way via the database resulting data to be stored in the DB directory
2. The manual way via the save button resulting data to be stored in the Data directory

The format used for storing the information is a proprietary format. All measurements of the PDM are stored in the database located in the DB directory of the installed programme. The way of storing the data depends on the setting for storing of information in the setting

Name	Date modified
Data	2014/10/1
DB	2014/10/1
DeviceData	2014/10/1
H11	2014/10/1

tab. For fast storing of the information it is advised not to store the full image in a non compressed format.

In the realtime mode when running at short interval time the responsivity of the system goes down when storing the data and the full non compressed image.

The following modes are available for the storing of information in the DB section.

The PDMmf extension is used to store the measurement data inclusive the full image information. These files are large.

The PDMmfs extension is used to store just the data and no image information.

Furthermore the txt extension is available for storing information in the Data section only. A comma separated tekst file is stored. This file can be imported in Excel.



General screen overview

General measurement results of actual or loaded measurement

Connection indicator showing the device and the connection status

Particle count(n>10): 377
 Particles/dm²(n>10): 755,2
 Witness plate ID: 000135
 Timestamp: 14:20:47
 Tot. exposure time: 00:15:00

Channel distribution measurement: A

Channel	Count	Count cumulative
10 - 41	258	377
41 - 70	104	119
70 - 100	8	15
100 - 150	4	7
150 - 300	1	3
300 - 500	0	2
500 - 700	1	2
700 - 1000	0	1
1000 - 1500	1	1
> 1500	0	0

Linegraph: Bargraph, Image, TopE, Filter, Measurement, Database, Settings, Realtime

Particle count cumulative / #scm²

Particle size (µm)

Area (µm ²)	Length (µm)	Width (µm)
41109	1223	282
18463	907	109
13288	147	117
7077	232	73
6462	100	85
5808	119	71
3824	73	68
3400	107	56
3215	122	62
2979	71	53
2510	68	46
2502	83	41
2073	71	42
2548	56	50
2041	77	36
2012	76	40
1878	65	44
1849	53	51
1860	58	47

Save Open Scan

Channel particle count info area
Loaded measurement

Action buttons

Data information and action field

Detailed information on each particle found to be sorted per parameter type
Actual or loaded measurement



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General measurements result

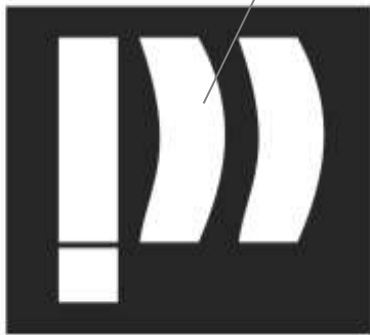
Link to website
www.particle-deposition.com
For more support

Total number of particles on disk
Setting for channel size

Surface coverage indicator
Setting via right click

Witness plate ID number and field
for entering remarks

Vision Analysis Software (VAS) 1.0.5.13



Particle count(n>10): 363

Particles/dm²(n>10): 727,2

Witness plate ID: 000135

Timestamp: 14:51:29

Tot. exposure time: 04:59:00

The unique timestamp for a measurement

Time the witness plate was exposed.
This time can be entered as a calculated time between two moments entered, or it can be entered as a time span.

Channel distribution measurement: A

Channel	Count		
10 - 41	258		
41 - 70	104	119	
70 - 100	8	15	
100 - 150	4	7	
150 - 300	1	3	
300 - 500	0	2	
500 - 700	1	2	
700 - 1000	0	1	
1000 - 1500	1	1	
> 1500	0	0	

Effective exposure time h:m:ss 4 : 59

Buttons: Save, Open, Scan

Note: The exposure time is automatically calculated if not entered manually in the hours minutes box on the lower right hand side.

If a manual change has to be made to the exposure time, the change is to be done for the A measurement. Only the actual (A) measurement can be changed

In case the B or A-B box is selected the change option is disabled and thus greyed out.

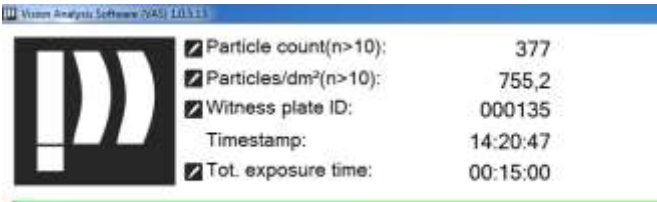
Manual entry of the exposure time is only possible for the A measurement, the last measurement .



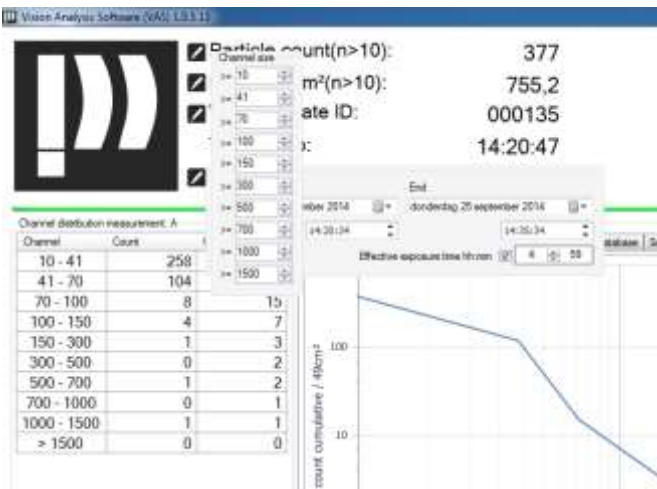
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Channel particle count info area



In the channel particle count info area the display format of the area can be changed. Channel size can be adjusted and the value showing the amount of particles on a normalised surface can be displayed for various surface sizes.

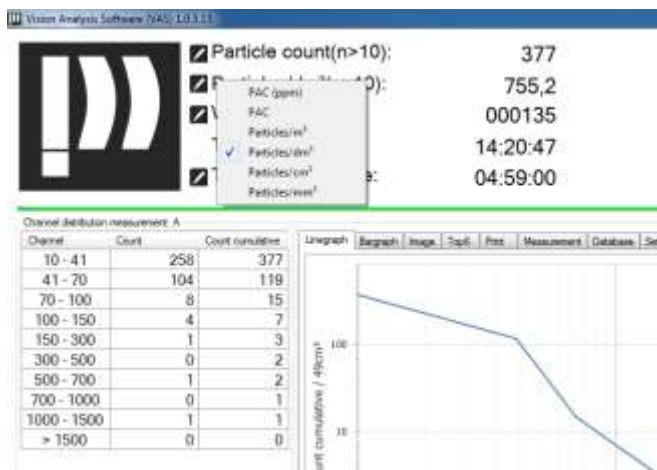


Channel size adjustment

The PDM measures the particles and stores the size of each particle together with the position of the particle and some other parameters. For analyses purposes the particles can be binned in a channel.

- The lowest size value registered in a channel is 10µm. Note*
- A channel is at least 15µm wide.
- Channels can be set prior to a measurement. The measurement will be done with the last setting of the channels.
- Modification of the channels can be done as well in a later stage.
- It is not required to have the same setting of the channels for the A or the B measurement. The calculation will be made when pushing the A-B button with the channel setting valid at that moment.
- Channels can not be adjusted in real time mode.

Note* Specification is only met at a setting of 14µm minimum for the lowest channel.



Particle surface coverage

- The PDM measures the surface covered by the particles. For this type of measurement the total area inside the contour is calculated and used as surface covered by the particle. In case of a 3 dimensional fibre structure the area thus registered will be larger than the touch down area of the particle. The total material content deposited justifies the increase of the value in the surface coverage. Therefore this method is initially implemented.

Upon request a different method of measuring based upon the amount of area obscured can be implemented as well as non metric surfaces.



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Channel particle count info area

Particle count: 2113
 PAC (ppm): 360,22
 Witnessplate ID: 000135
 Timestamp: 15:59:07
 Tot. exposure time: 01:00:00

Channel distribution measurement: A

Channel	Count	Count cumulative
14 - 37	1174	2113
37 - 53	648	939
53 - 76	200	291
76 - 101	53	91
101 - 126	14	38
126 - 151	4	24
151 - 201	7	20
201 - 301	7	13
301 - 501	4	6
> 501	2	2

B A A-B

In the channel particle count info area the channel distribution of particles is shown.

The box has three tabs. When a measurement is done it will automatically be stored behind tab A. A is the Actual measurement

In case of a differential measurement an older measurement will be loaded at the B tab and the difference between the A and B will be shown in the A-B tab. Actual minus Blank

Differential measurements can be started automatically via a setting in the Setting tab in the middle of the screen. Options will show up in this field.

Manually a differential measurement can be done via the Measurement tab.

In this way it is ensured that the origin of the data can be revealed easily.

Only loaded measurements will be shown on the lefthand side in the measurement field. Non loaded measurements will only be available for comparing in the measurement tab bottom field.

Channel hopping

Channel hopping is the phenomena that a particle initially binned in channel 1 may pop up in channel 2 after being measured a second time.

As the system makes use of a simple subtraction system it may occur that after the subtraction a negative number appears in the A-B field.

The smaller the channels and the smaller the differential numbers detected the possibility for negative numbers to appear increases.

For this reason the origin of a A-B measurement can easily be checked via the A and B tab if required.

A is the Actual or last measurement
 B is the Blank, ini or original measurement.



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Instrument documentation

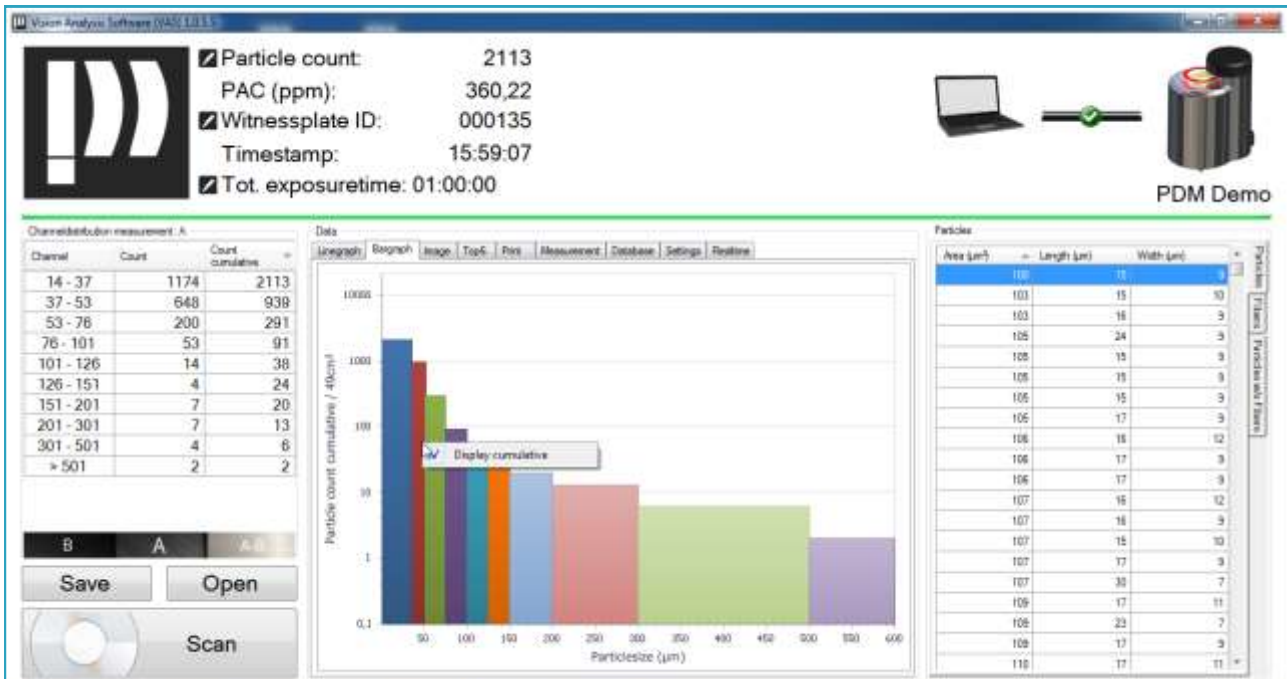
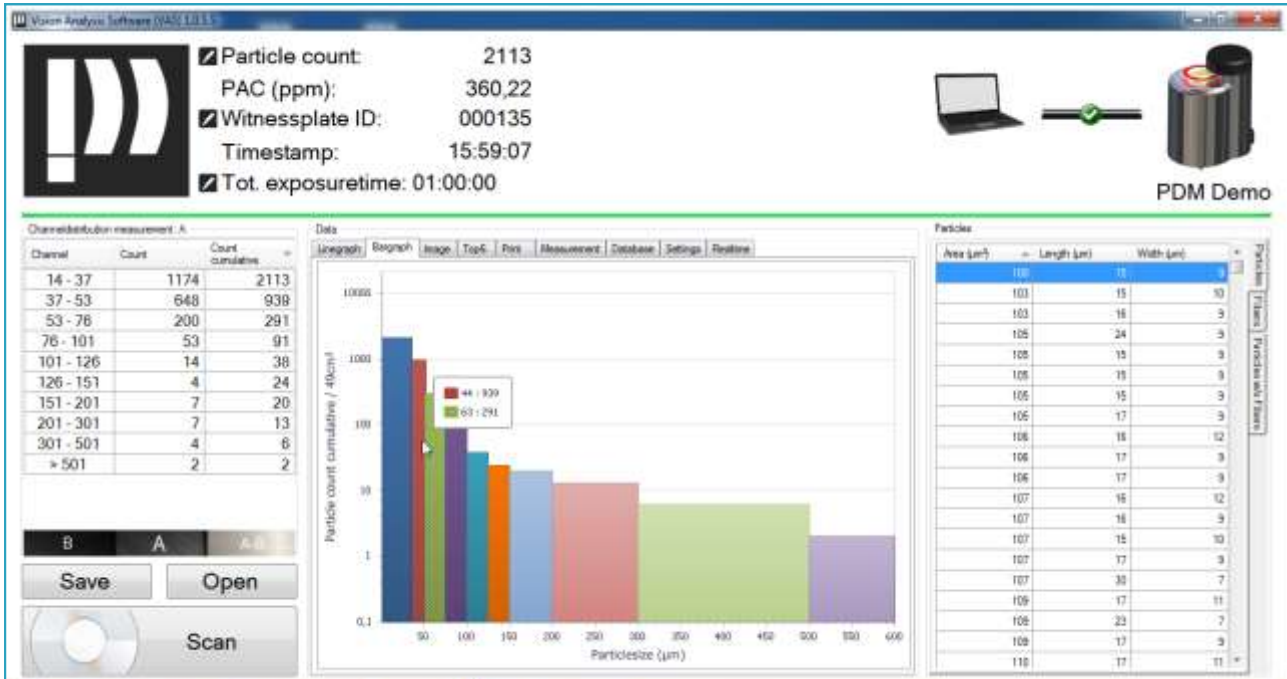
Data information action fields



By means of the right hand click a thick box can be opened to toggle between the cumulative line graph and the line graph per channel. The field merely shows the found data in another way.



Data information action fields



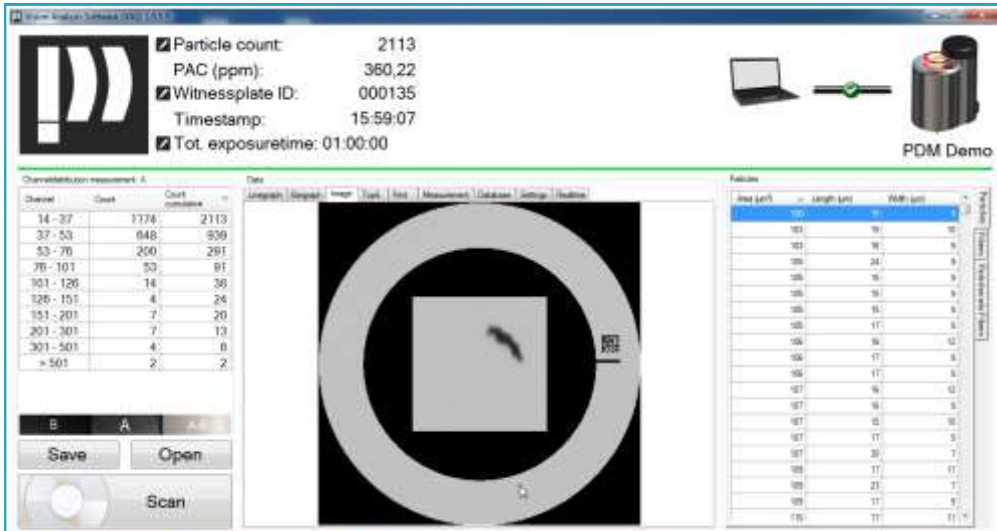
By means of the right hand click a thick box can be opened to toggle between the cumulative line graph and the line graph per channel. The field merely shows the found data in another way.



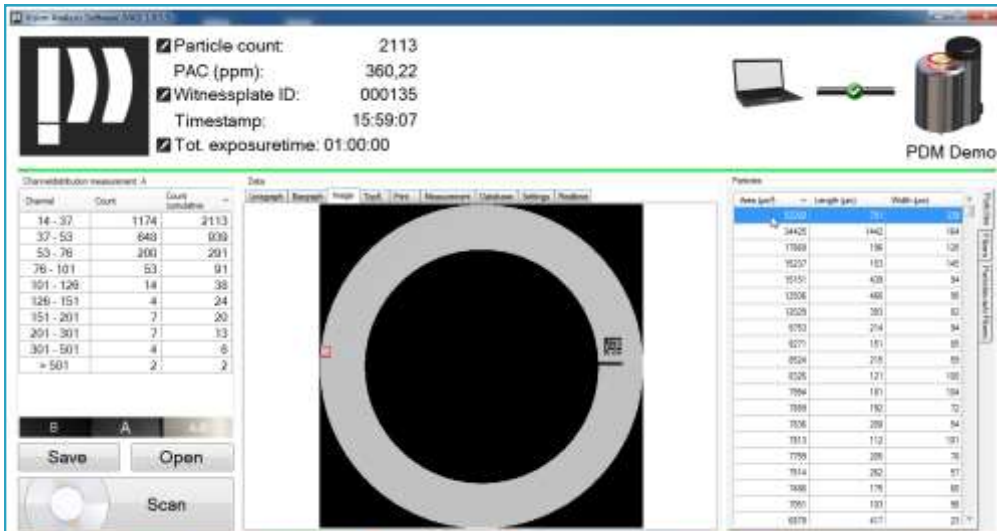
Particle Deposition Monitor®

Instrument documentation

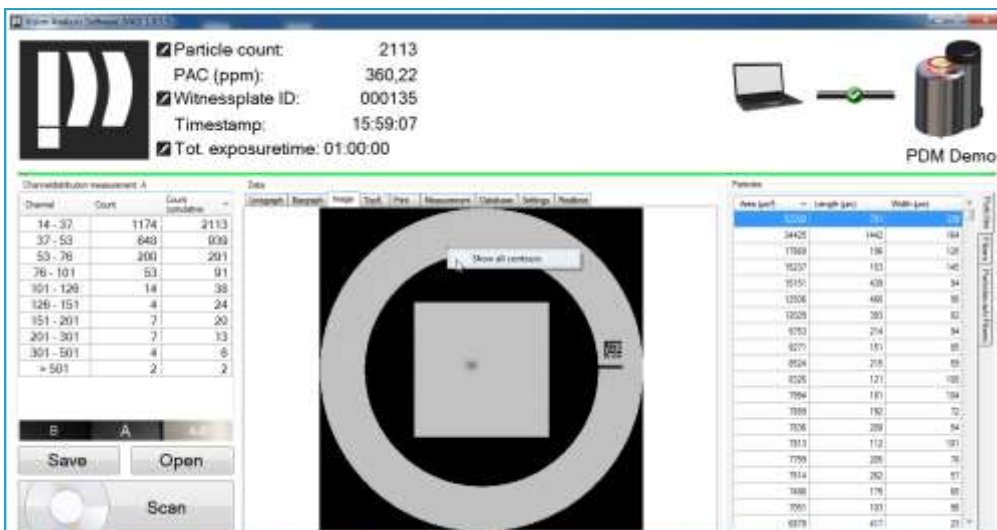
Data information action fields



The image tab allows to hover over the image and thus to see a particle enlarged in the square viewer in the middle of the donut.



Particle pointed out in the particle list to the right hand will show with location information on the donut. This tool supports the manual removal of a particle by means of a tip or wipe for analysis purposes



By means of a right hand click a box can be opened and ticked for showing all contour.



Particle Deposition Monitor®

Instrument documentation

Data information action fields

Channel distribution measurement A

Channel	Count	Count cumulative
14 - 37	1174	2113
37 - 53	648	938
53 - 76	200	291
76 - 101	53	91
101 - 126	14	38
126 - 151	4	24
151 - 201	7	20
201 - 301	7	13
301 - 501	4	6
> 501	2	2

Particles

Area (µm²)	Length (µm)	Width (µm)
13210	791	173
34425	1442	164
17885	196	128
15237	193	145
15151	439	94
12936	466	81
12029	383	82
9753	214	94
8271	151	85
8024	215	89
8326	121	100
7994	181	104
7685	192	72
7036	208	54
7013	112	103
7769	209	78
7014	262	57
7488	175	60
7051	103	98
5078	417	27

The contour showing mode allows see how particles are distributed over the donut surface. Meanwhile it shows in the viewer all particles in the particle list. Particles past the edge of the detection range will not show up with a red contour but may still be visible.

This mode allows to remove particles by means of a wipe tip and to see that the particle was removed by the tip. It can be used to train the cleaning of a disk by means of a wipe.



Data information action fields

The screenshot displays the Vision Analysis Software (VAS) interface. At the top left is the PDM logo. The main status area shows the following data:

- Particle count: 1407
- PAC (ppm): 236,44
- Witnessplate ID: 000135
- Timestamp: 16:50:20
- Tot. exposure time: 00:15:00

On the right, there is a 'PDM Demo' section with icons of a laptop, a green checkmark, and a cylindrical device. Below the status area, the interface is divided into several sections:

- Channel distribution measurement A:** A table showing counts for various channels.
- Data:** A grid of six images showing individual particles.
- Particles:** A table listing particle parameters.

Channel	Count	Count cumulative
14 - 37	707	1407
37 - 53	458	640
53 - 76	132	182
76 - 101	30	50
101 - 126	5	20
126 - 151	2	15
151 - 201	2	13
201 - 301	9	11
301 - 501	1	2
> 501	1	1

Area (µm²)	Length (µm)	Width (µm)
38316	1412	319
18280	188	151
16011	159	158
15570	431	174
11493	254	142
7851	215	51
7782	201	89
7678	104	35
7474	218	115
7085	228	57
6307	265	50
6273	202	85
5418	257	29
5071	170	88
5044	126	71
4794	89	78
4623	143	41
4504	107	84
4457	82	70
4419	87	74

The Top 6 of particles shows the largest 6 particles. These particles are selected on basis of their Area parameter. The Area parameter is the amount of square micrometers enclosed in the contour of the object found. In the screenshot above the particles in the particle list on the left hand side of the screen are sorted on the Area parameter. The top 6 of this list is now shown in the Data field. The orientation of the zoomed images is the same as on the image tab. The black triangle in the mid lower image originates from the edge of the donut.

Note:

Large fibers may be positioned like a 3D object on the surface. The points where the surface is touched will be dark. Other parts of the fiber may be grey or not visible at all.

Up to a fixed level the software will try to make one complete fiber of the found information. However the fiber may show up in the listing as 2 or more parts.



Data information action fields

The screenshot shows the PDM Demo software interface. At the top, there is a summary of measurement data:

- Particle count: 1407
- PAC (ppm): 236.44
- Witnessplate ID: 000135
- Timestamp: 16:50:20
- Tot. exposure time: 00:15:00

Below this, there are three main panels:

- Channel distribution measurement A:** A table showing counts for various channels. The selected channel is 14-37.
- Data:** A central panel showing a print preview of a measurement report. The report includes a title, a table of results, and a bar chart. The print button is highlighted.
- Particles:** A table showing individual particle measurements with columns for Area (µm²), Length (µm), and Width (µm).

At the bottom left, there are buttons for 'Save', 'Open', and 'Scan', along with a 'Scan' button next to a circular icon.

The Print tab opens an example of the sheet that will be printed if the print button is pushed. The print out of a measurement shows a set of the result representations. The measurement selected in the channel distribution field B, A or A-B is the measurement that will be printed. The print out sheet is only one sheet of the size A4.

It is not possible to print the result of a realtime measurement .

The **A** measurement is the Actual measurement taking place . (**A**t this moment)

Any other measurement took place **B**efore this moment or was considered to be the **B**lank measurement or initial measurement.



Data information action fields

Particle count(n>10): 825
 Particles/dm²(n>10): 1652,6
 Witness plate ID: 000135
 Timestamp: 14:47:19
 Tot. exposure time: 04:59:00

Channel distribution measurement A

Channel	Count	Count cumulative
10 - 41	581	825
41 - 70	213	244
70 - 100	18	31
100 - 150	7	13
150 - 300	4	6
300 - 500	1	2
500 - 700	1	1
700 - 1000	0	0
1000 - 1500	0	0
> 1500	0	0

Database

Current measurement (A)				Previous measurement (B)			
Timestamp	Remarks	Witness plate ID	Zero measurement	Loaded as	Timestamp	Remarks	Witness plate ID
25-09-2014	433348505	000135	--	--	25-09-2014	433348505	000135
25-09-2014	433348505	000135	--	--	25-09-2014	433348505	000135
25-09-2014	433348505	000135	--	--	25-09-2014	433348505	000135

Particle

Area (µm²)	Length (µm)	Width (µm)
16396	932	91
13356	149	118
9248	316	90
7946	243	48
6845	115	80
5734	247	72
5316	91	87
6005	165	50
5723	118	71
4900	153	80
4870	80	68
4091	78	68
3671	73	62
3515	85	65
3464	125	27
3436	80	55
3335	73	58
3004	90	63
3074	127	45

000135 - 000135, Difference in particle count: 0

Channel	Count A	Count A cumulative	Count B	Count B cumulative	A-B	A-B cumulative
10 - 41	581	825	581	825	0	0
41 - 70	95	95	95	95	0	0
70 - 100	6	6	6	6	0	0
100 - 150	3	4	3	4	0	0
150 - 300	1	2	1	2	0	0
300 - 500	1	1	1	1	0	0

Action Fields: Save, Open, Scan

The measurement tab allows to pick A and B measurements from a list. Thus selected A and B measurements can be used to complete a differential measurement. Both the A and B measurement will carry their time stamp. For a measurement the time lapsed during exposure needs to be set in the A measurement setting. In the Channel distribution field the A measurement needs to be selected and then the exposure time is to be set to the desired value. Only loaded measurements will show up in the left hand field.

Loading new measurements in the list can be done in the Database tab. Select the tab and load a measurement. It will show in the list. Measurements loaded in the list occupy a part of the memory. In case a measurement is stored with image information it will occupy a larger part of the memory. Measurements stored without image occupy only a marginal part of the memory. Measurements selected can be made active by means of a left hand button click.

Database

Timestamp	Remarks	Witnessplate ID
25-10-2013 15:4	Measurements 1	000135
25-10-2013 15:5	Measurements 1	000135

000135 - 000135, Difference in particle count: 0

Channel	Count A	Count A cumulative	Count B	Count B cumulative	A-B	A-B cumulative
14 - 31	1106	1106	1106	1106	0	0
37 - 63	719	889	719	889	0	0
63 - 76	202	270	202	270	0	0
76 - 101	39	58	39	58	0	0
101 - 125	10	50	10	50	0	0
126 - 151	6	20	6	20	0	0
151 - 201	5	14	5	14	0	0
201 - 301	5	5	5	5	0	0
301 - 501	2	3	2	3	0	0
> 501	0	1	1	1	0	0

The size of the boxes inside the middle field can be changed by means of dragging the double arrows in the black button up and down.

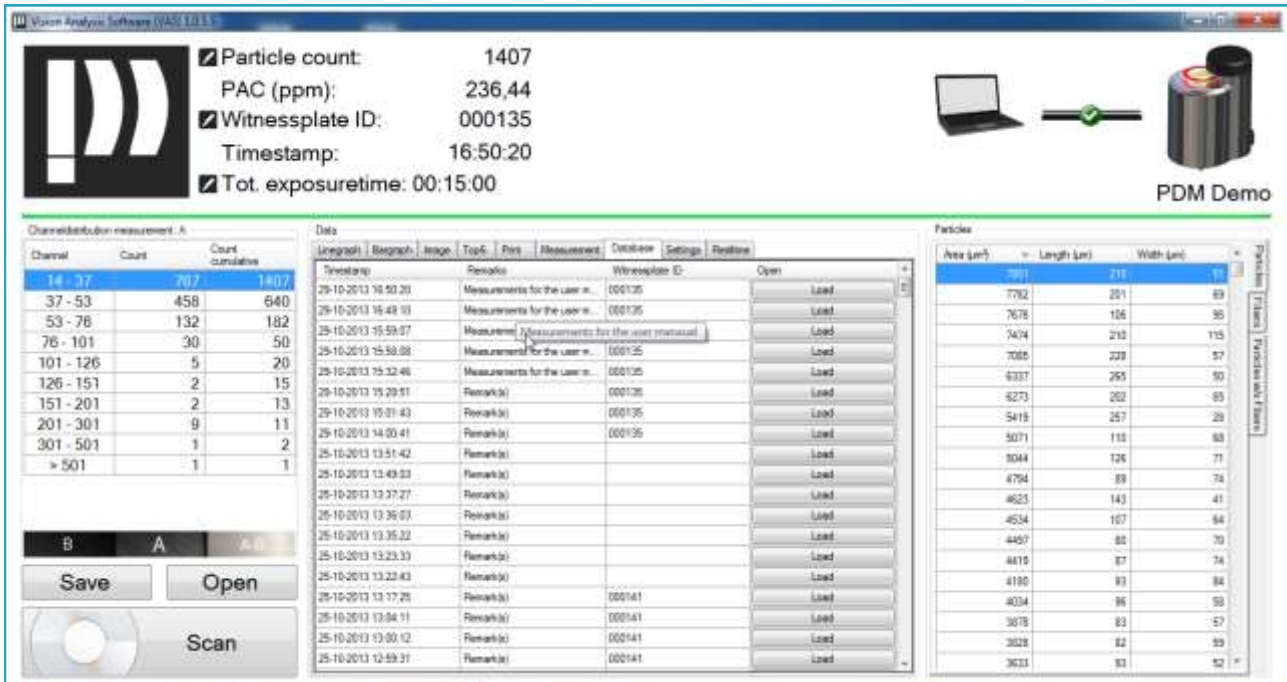
In case of a measurement all data fields for a differential measurement are shown in the lower box.

Please note that channel hopping may occur. This is the phenomena that particles occur in an other channel due to tolerances in the dimensional measurement.

Note: The lower field shows non loaded data. Therefore it may not be in line with the left hand and right hand fields in the display. The purpose is to compare quick.



Data information action fields



Measurements saved can be found in the Database . When saving a measurement the “save as” option becomes available. The way how the information is saved can be changed. It is a trade off between the amount of memory used and what needs to be saved for use later. Each image uses about 0.6 Gigabyte of the hard disk non compressed. The laptops can store less than 500 images non compressed. Without images the information of several millions of measurements can be stored.

Now the text in the remark box can be changed. Saving the information will take place automatically. The time stamp will not change.

Timestamp: 16:50:20

An other way of changing the information in the remark fields is via the wizards.

Witnessplate ID: 000135

In case the text in the remark box needs to be changed, the measurement first needs to be loaded. After loading the measurement the time stamp will show up next to the logo. The timestamp is the unique identifier for the measurement, it will not change.



Data information action fields



<input checked="" type="checkbox"/> Particle count(n>10):	4395
<input checked="" type="checkbox"/> PAC (ppm)(n>10):	882,80
<input checked="" type="checkbox"/> Witness plate ID:	000140
Timestamp:	10:20:18
<input checked="" type="checkbox"/> Tot. exposure time:	00:00:54





PDM

Channel distribution measurement: A

Channel	Count	Count cumulative
10 - 41	3627	4395
41 - 61	432	768
61 - 81	133	336
81 - 101	59	203
101 - 121	32	144
121 - 150	18	112
150 - 200	22	94
200 - 300	29	72
300 - 500	17	43
> 500	28	28

Particles

Area (µm²)	Length (µm)	Width (µm)
145476	698	954
129308	1967	855
91416	1133	552
86329	1565	770
55585	1687	368
53329	342	249
52650	1087	583
49175	507	141
48372	874	258
41799	335	169
40969	1787	398
36889	773	485
36021	1104	364
35742	911	339
35331	633	593
34178	1253	104
33960	274	181
26981	789	238
23439	237	141
23310	248	157

The settings tab offers settings for the general behaviour of the measurement equipment.

Language: The language tab is obvious.

Calculate difference

Skip

Most recent

Most recent zero measurement

The box to the left selects the way a measurement takes place.

The skip box means no difference is calculated only the **A measurement** is shown.

The most recent box means the difference is calculated between the last measurement of the disk with the same disk ID, now called B measurement, and the measurement taking place now, called the A measurement, **the difference A-B** is shown.

The most recent zero measurement box means the difference is calculated between the last measurement of the disk with the same disk ID and labelled as zero measurement, now called B measurement, and the measurement taking place now, called the A measurement, **the difference A-B** is shown.

The boxes to the left select between the type of pop-up that will show when a measurement is done. The Simple pop-up allows to enter some basic data for a measurement. The Wizard pop-up is a guide to follow in order to complete a measurement. The list to select the B measurement from is shown. The result of the actions is that the **difference A-B** is shown.

A default setting for type of data saved can be set in the setting area as well.



Data information action fields

The screenshot displays the software interface with the following data and components:

- Summary Data:**
 - Particle count(n>10): 1043
 - Particles/dm²(n>10): 2592,2
 - Witness plate ID: 000135
 - Timestamp: 15:53:25
 - Tot. exposure time: 00:02:58
- Channel distribution measurement A:**

Channel	Count	Count cumulative
10 - 41	803	1043
41 - 70	201	240
70 - 100	21	39
100 - 150	7	18
150 - 300	7	11
300 - 500	3	4
500 - 700	1	1
700 - 1000	0	0
1000 - 1500	0	0
> 1500	0	0
- Realtime Graph:** Shows particle count over time for various channels. The Y-axis ranges from 0 to 800. The X-axis shows timestamps from 15:35:02 to 15:53:23. A legend on the right lists channels 1 through 10 with their respective counts.
- Particle Data Table:**

Area (µm ²)	Length (µm)	Width (µm)
13973	606	152
13657	152	115
9897	377	88
9026	330	109
8291	247	103
8198	240	94
7698	117	88
6740	348	91
6708	247	98
6672	237	94
6026	32	88
5648	176	77
4741	89	68
4275	138	70
4122	191	60
3896	133	42
3643	94	51
3607	71	68
3604	78	58
- Controls:** Includes 'Save', 'Open', and 'Scan' buttons, and an 'Interval' dropdown menu set to 30.00.

The Realtime tab shows the increase of particles over time during exposure. The measurement intervals can be set in the right hand lower corner.

The minimum interval time is 30 second
The graph shows a for demonstration purposes a maximum of bin hopping.

In case a faster incident response is required please contact your sales representative for a special software set-up.



Normal start up procedure on a PC with pre-installed VAS software.

1. Connect the unit to the power supply. The illumination will light for a short moment and the turntable will rotate a few degrees.
2. Connect the Ethernet cable between the PC and the PDM unit
3. In less than 1 minute the software will find the PDM unit and show a green thick on the interconnection icon.
4. The PDM will show the last two characters of its MAC address to identify himself.

The indicator light at the top of the PDM will light up red for a short moment in the initialisation phase and afterwards it will light up green. No error messages or other status indication information is linked to the light.

Normal behaviour

Pushing the scan button a measurement starts. Upon completion of the scan cycle the old data is removed and all fields on the screen are cleared. After the calculation is completed the new data is put on the display.

Green bar activity indicator

The green bar activity indicator will show its green colour and will increase length during the measurement cycle. In case a measurement goes wrong the bar will turn red.

The bar will turn red if the disk is slowed down or removed during a measurement.

If the disk is removed during a realtime measurement the bar will go red. The machine will ignore the measurement and go in a wait state. If the disk is put back it will resume the measurements without the need to restart.

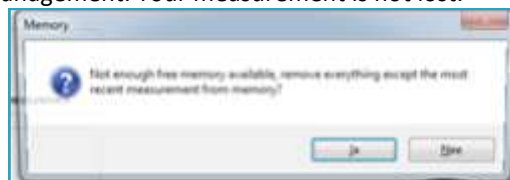
If the real time measurement is stopped by means of the stop button the red bar will show. Upon pushing the scan button the old measurement will be removed from the screen and a new measurement is started.

Corrective actions:

In case interconnection is lost to the PDM click on the red cross on the interconnection icon. A pop up screen with suggestions will show.

In case of a software hang up allow time to recover. If the recovery does not take place close the programme and restart the programme.

In case of the message below just click the message away. The software will handle the memory management. Your measurement is not lost.





Ways of operation

There are various ways of working for in order to get grip on the surface cleanliness. Taken into account that the witness plate should be used to find the change of surface cleanliness at a certain point in the production one can define a some methods to measure this change.

Basics.

When starting to work with a glas disk it is important to know if the disk is undamaged and clean. Just put the disk on the PDM and scan the disk.



The result is stored as A measurement, Actual. The result will show the particles on the disk found by the software. Be aware of particles with a size over 100µm remaining on the disk after cleaning. A large particle may be an indication of a scratch. After cleaning the disk with i.e. Isopropanol 99,9% some smear effect may remain on a non well dried disk resulting in a reading for a large particle.

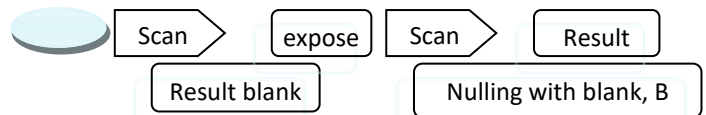
The initial reading of a disk after cleaning a disk is called the blank reading. It will result in showing the surface cleanliness of the blank. The reading can be stored in the database and can be labeled as a null measurement. Automatically it will be used next time using the same disk to subtract the results from the blank in order to find a nett result.

Clean disk operation



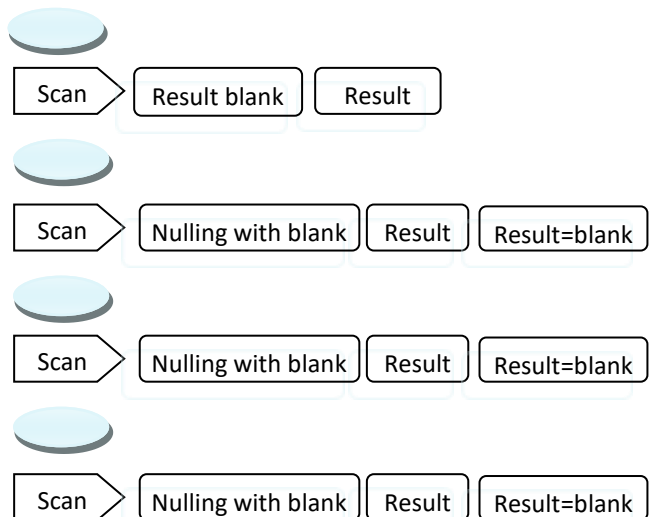
The clean disk operation assumes that the amount of particles on the blank is very low with respect to the amount of particles that will be measured at site. This type of operation can be used in office room, out in the air, in a hangar, etc. Places where one expects to land in excess of 250 particles on the witness plate. The blank should be cleaned in a certified process to be certain that the amount of initial present particles will be below 25 pcs and non of them with a size above 100µm.

Operation with nulling from blank disk



This differential mode is actually showing the decrease of surface cleanliness due to the exposure. Please note that the same disk is scanned twice. The result of the blank is used for the nulling of the final result.

On going operation with incremental dust collection



In this way of operation the disk is not cleaned but measured again and again. Every last previous measurement is substracted from the latest measurement thus showing the decrease of surface cleanliness during the last exposure period.

The database allows any measurement of whatever disk to be the blank for a new measurement. This allows for the integration of results. If one assumes that particles only increase, the differential results can be measured over a longer time without accumulating measurement errors.



Verification

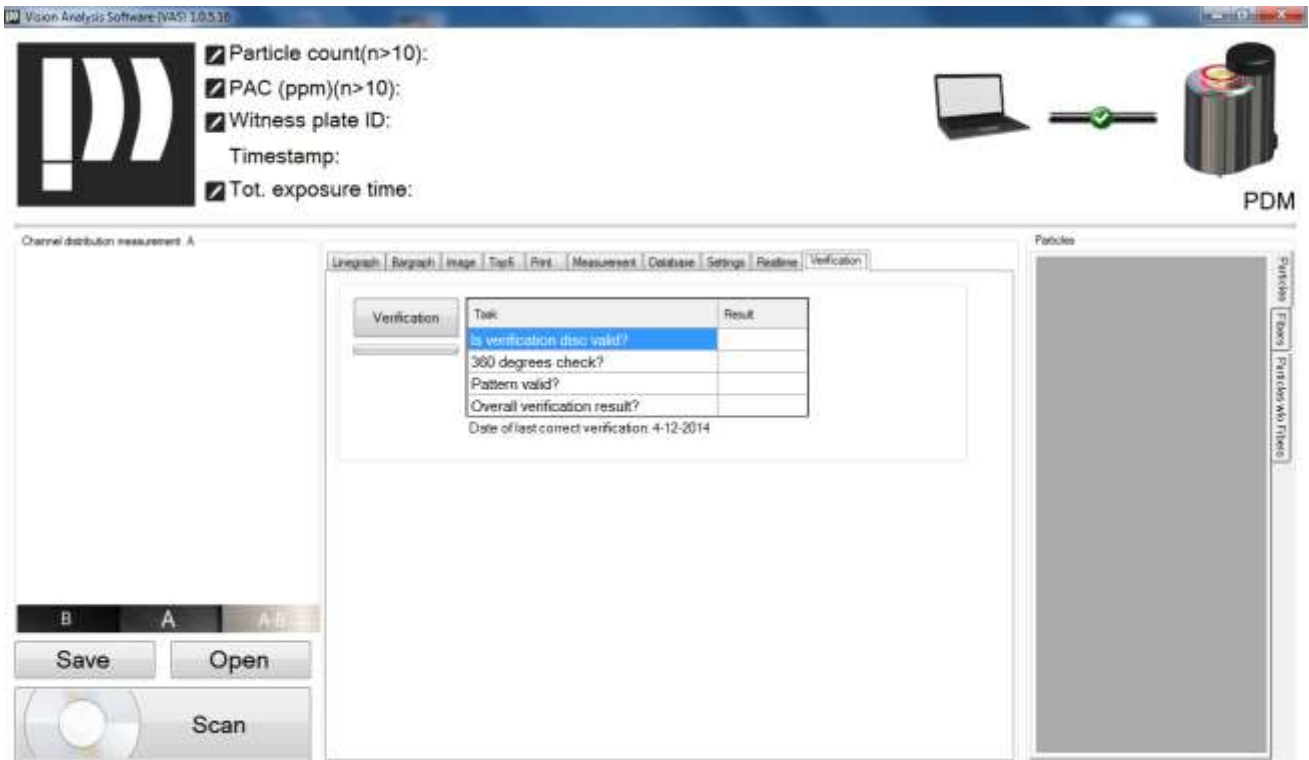
The verification function is only available for units from the PDM2 series onwards. In combination with the verification disk the local linear velocity is checked and the imaging of the unit. The pattern on the disk is a nanometer accurate pattern.

The verification may take up to a few minutes after pushing the button with the verification disk on the turntable.

The checks cover:

- Validity verification disc
- 360 degrees check
- Pattern check
- Overall result

Please handle the disk with care and store it in the special storage box. Keep the disk clean and cover it when not used.





Particle Deposition Monitor®

Instrument documentation

Option NIST test set

NIST test set

The PDM calibration can be verified by means of the NIST set. This allows the user at site to verify that the PDM properly detects and measures.

Pre installed PC

PC with software pre-installed plug and play

- Vision Analysis software pre-installed
- Runs as well Omneo units (only direct connection)
- Runs up to 3 HE 550 units via network
- PDM license not included. License is PDM linked.
- Comes with windows licence.



Software license key

Software license key

- Per PC required but PDM linked.
- A PDM license is a life-time license
- Runs as well Omneo units





Option flight case and shipping carton

Heavy duty flight case for shipping of the monitor system.

- Sufficient space for double bag cleanroom packing.
- Compartment for cleanroom Laptop
- Compartment for clean disks

Option Disk support

POM ESD safe disk support

- Easy to clean well rounded support
- Support on clamping zone of disk
- Glue chamber on bottom side for permanent fixation
- ESD dissipating material
- Large table top support



Option witness plate

Borosilicate glass disk

- Unique number serial number per disk
- New generation with laser marking (looks white)
- Machine readable DMC
- Human readable number
- www.particle-deposition.com





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