



500 Cardigan Road
Shoreview, MN 55126
USA
EIN 41-0843524

Tel:(651)490-2811
Fax:(651)490-3824
Web:www.TSI.com
Email:answers@TSI.com

Software License

Material AIM11
Software for TSI Counters and Sizers

Serial Number SOFT20180700004



AEROSOL INSTRUMENT MANAGER® SOFTWARE
with remote access to CPCs 375x, multiple instrument control
and data export

From a web browser, please go to the following link to create your account and download your software.

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CERTIFICATE OF CALIBRATION AND TESTING

TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 <http://www.tsi.com>

ENVIRONMENT CONDITION

Temperature	72.50 (22.5)	°F (°C)
Relative Humidity	24.1	%RH
Barometric Pressure	29.66 (1004.4)	inHg (hPa)

Model **308200**

Serial Number **3082001807001**

As Left
 As Found

In Tolerance
 Out of Tolerance

CALIBRATION BENCH EQUIPMENT

Measurement Variable	System ID	Last Cal	Cal Due	Measurement Variable	System ID	Last Cal	Cal Due
PRESSURE1	E003281	4-21-2017	4-30-2018	FLOW1	E003348	5-9-2017	5-31-2018
PRESSURE2	E003408	10-20-2017	10-31-2019	FLOW2	E003347	3-13-2017	3-31-2018
VOLTAGE1	E001802	10-17-2016	4-30-2018	SIZE1	E003578	3-30-2017	3-31-2018
VOLTAGE2	E004710	7-27-2017	7-31-2018	SIZE2	E003578	3-30-2017	3-31-2018
VOLTAGE3	E005366	10-2-2017	4-30-2018	COUNT	E003580	3-31-2017	3-31-2018
TEMP/RH	E004844	1-4-2018	1-31-2019				

SMPS EQUIPMENT

Measurement Variable	Model No.	Provided by Customer	System ID	Last Cal.	Cal. Due
Detector	3776	NO	E003580	03-31-2017	03-31-2018
DMA	3081	NO	E004988	10-28-2017	10-31-2018
Neutralizer	3088	NO	E005107	03-22-2017	03-31-2018

STANDARD PARTICLE

Lot No.	160629
Nominal Size	100 nm
Actual Size	100.0 nm
Size Std. Uncert.	1.5 nm
Std. Dev.	2.5 nm
Exp. Date	06-30-2018

TSI Incorporated does hereby state that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of NIST's calibration services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self-calibration techniques. TSI's Quality Management System is registered to ISO-9001:2015. This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the calibration organization issuing this report.

Calibrated

February 19, 2018

Date

HIGH VOLTAGE: NEGATIVE SUPPLY				System SV_W405_GAGE				<i>Unit: V</i>
#	Measured	Reference	Allowable Range	#	Measured	Reference	Allowable Range	
1	30.0	30.0	29.9~30.1	5	2001	2000	1997~2003	
2	100.0	100.0	99.0~101.0	6	4502	4500	4495~4505	
3	200	200	199~201	7	7500	7500	7492~7508	
4	600	600	598~602	8	10001	10000	9990~10010	

SENSOR VERIFICATION

Measured Parameter	Units	Measured	Reference	Allowable Range
Sheath Flow Pressure	kPa	99.1	99.14	98.1~100.1
Impactor Differential Pressure	kPa	6.01	5.99	5.87~6.10
Sheath Flow Temperature	°C	23.8	24.3	22.8~25.8
Sheath Flow Relative Humidity	%RH	26.6	23.8	20.8~26.8

SHEATH LEAK TEST

Measured	Allowable Range
<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL	≤ 5% in 60 Min

SHEATH FLOW RATE				System SV_W405_GAGE				<i>Unit: l/min</i>
#	Measured	Reference	Allowable Range	#	Measured	Reference	Allowable Range	
1	2.02	2.02	1.98~2.06	5	14.92	14.93	14.63~15.23	
2	2.99	2.98	2.92~3.04	6	19.98	19.95	19.55~20.35	
3	5.93	5.92	5.80~6.04	7	30.07	30.08	29.48~30.68	
4	9.90	9.90	9.70~10.10					

--- ISO 15900 Verification Results ---

LEAK TEST

Result	Measured		Allowable Range
DMA Leak	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL	$\leq 5\%$ in 60 Min
System Leak	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL	$\leq 5\%$ in 60 Min

ZERO TEST

Settings	Units	Value	Results	Measured	Allowable Range
Sample Flow Rate	l/min	1.5	DMA	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Sheath Flow Pressure	kPa	98.3	SMPS	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
Sheath Flow Temp	°C	23.8			
Sheath Flow Rate	l/min	14.9		Excess flow rate was equal to sheath flow rate during test. Exit aerosol flow rate and detector inlet flow rate were equal to sample flow rate during test.	
Size Range	nm	5.8 - 228.8			
Voltage Range	V	10.3 - 9555.8			
Voltage Scan Time	s	60			

PARTICLE CHALLENGE TESTS: NEGATIVE SUPPLY

Settings	Units	Value	Results	Units	Measured	Allowable Range
Sample Flow Rate	l/min	1.5	Mean Diameter	nm	103.0	$100 \pm 4\%$
Sheath Flow Pressure	kPa	98.3	Number Concentration	1/cm ³	5691	$6045 \pm 10\%$
Sheath Flow Temp	°C	23.8	Size Accuracy	%	3.0	± 4.0
Sheath Flow Rate	l/min	15.1	Size Resolution Sigma/d	%	3.7	≤ 4.3
Size Range	nm	6.0 - 220.7				
Voltage Range	V	10.3 - 9555.8		Excess flow rate was equal to sheath flow rate during test. Exit aerosol flow rate and detector inlet flow rate were equal to sample flow rate during test.		
Voltage Scan Time	s	60				

NOTES

None

Note: For data inversion algorithms used, please refer to SMPS User Manual Appendix B.



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Environment Conditions

Temperature	72.72 (22.6)	°F (°C)
Relative Humidity	22.5	%RH
Barometric Pressure	29.52 (999.7)	inHg (hPa)

Impactor Size **0.0457 cm**

Serial Number **4570584**

As Left
 As Found

In Tolerance
 Out of Tolerance

Measurement Variable	System ID	Last Calibrated	Calibration Date Due
PRESSURE1	E004988	10-28-2017	10-31-2018
PRESSURE2	E003408	10-20-2017	10-31-2019
FLOW	E003348	5-9-2017	5-31-2018

Leak Test		Allowable Range
<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL	≤ 5% in 60 min

- C a l i b r a t i o n V e r i f i c a t i o n R e s u l t s -

Impactor 0.0457 Flow Rate		System SV_W405_IMP		Unit: l/min
#	Measured	Reference	Allowable Range	
1	0.180	0.179	0.164~0.194	
2	0.260	0.261	0.246~0.276	
3	0.370	0.373	0.358~0.388	
4	0.455	0.456	0.441~0.471	
5	0.524	0.525	0.510~0.540	
6	0.584	0.584	0.569~0.599	
7	0.635	0.635	0.620~0.650	

TSI does hereby certify that the above described instrument conforms to the original manufacturer's specification (not applicable to As Found data) and has been calibrated using standards whose accuracies are traceable to the United States National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. TSI's calibration system is registered to ISO-9001:2015.

Calibrated

February 16, 2018

Date

Doc. ID: CERT_IMP_V8



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Environment Conditions			Impactor Size	0.0508 cm
Temperature	72.72 (22.6)	°F (°C)	Serial Number	5080585
Relative Humidity	22.5	%RH		
Barometric Pressure	29.52 (999.7)	inHg (hPa)		

As Left
 As Found

In Tolerance
 Out of Tolerance

Measurement Variable	System ID	Last Calibrated	Calibration Date Due
PRESSURE1	E004988	10-28-2017	10-31-2018
PRESSURE2	E003408	10-20-2017	10-31-2019
FLOW	E003348	5-9-2017	5-31-2018

Leak Test	Allowable Range
<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL	≤ 5% in 60 min

- C a l i b r a t i o n V e r i f i c a t i o n R e s u l t s -

Impactor 0.0508 Flow Rate		System SV_W405_IMP		Unit: l/min
#	Measured	Reference	Allowable Range	
1	0.281	0.281	0.266~0.296	
2	0.409	0.409	0.394~0.424	
3	0.586	0.588	0.573~0.603	
4	0.723	0.724	0.709~0.739	
5	0.841	0.839	0.824~0.854	
6	0.933	0.938	0.923~0.953	
7	1.020	1.021	1.006~1.036	

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Calibrated

February 16, 2018

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Environment Conditions

Temperature	72.72 (22.6)	°F (°C)
Relative Humidity	22.5	%RH
Barometric Pressure	29.52 (999.7)	inHg (hPa)

Impactor Size **0.0710 cm**

Serial Number **7100638**

As Left
 As Found

In Tolerance
 Out of Tolerance

Measurement Variable	System ID	Last Calibrated	Calibration Date Due
PRESSURE1	E004988	10-28-2017	10-31-2018
PRESSURE2	E003408	10-20-2017	10-31-2019
FLOW	E003348	5-9-2017	5-31-2018

Leak Test	Allowable Range
<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL	≤ 5% in 60 min

- C a l i b r a t i o n V e r i f i c a t i o n R e s u l t s -

Impactor 0.0710 Flow Rate			System SV_W405_IMP	Unit: l/min
#	Measured	Reference	Allowable Range	
1	0.579	0.580	0.565~0.595	
2	0.837	0.839	0.824~0.854	
3	1.200	1.204	1.189~1.219	
4	1.480	1.482	1.467~1.497	
5	1.710	1.711	1.696~1.726	
6	1.910	1.909	1.894~1.924	
7	2.080	2.086	2.071~2.101	

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Calibrated

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UNIT UNDER TEST	
Manufacturer	TSI Inc. (USA)
Model	3750
Serial Number	3750180701

ENVIRONMENTAL CONDITIONS		
Temperature	24	°C
Humidity	24	%RH
Atmospheric Pressure	98.6	kPa

As Left

In Tolerance

As Found

Out of Tolerance

FLOW VERIFICATION

Parameter	Units	Value	Allowable Range
Measured Inlet Flow	L/min	1.019	0.950 ~ 1.050

TEMPERATURE AND PRESSURE VERIFICATION

Parameter	Units	Value	Allowable Range
Saturator Temperature	°C	39.0	38.8 ~ 39.2
Condenser Temperature	°C	18.0	17.8 ~ 18.2
Optics Temperature	°C	40.0	39.8 ~ 40.2
Cabinet Temperature	°C	29.0	20.0 ~ 35.0
Pressure Drop Across Orifice	kPa	75.3	70.0 ~ 88.0
Pressure Drop Across Nozzle	kPa	2.47	2.2 ~ 3.2

ZERO COUNT TEST

Parameter	Units	Value	Allowable Range
Concentration Average over 12 hours	cm ⁻³	0.000	0.000 ~ 0.001

CONCENTRATION COMPARISON TO STANDARD

Parameter	Units	Value	Allowable Range
Reference Concentration (TSI 3750 CPC)	cm ⁻³	1990	—
Measured Concentration	cm ⁻³	1996	1500 ~ 2500
Concentration Error	%	0.29	-8.00 ~ 8.00

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REFERENCE EQUIPMENT				REFERENCE EQUIPMENT			
Reference Device	System ID	Last Cal	Cal Due	Reference Device	System ID	Last Cal	Cal Due
20 cc - 6 L/min Gilibrator Cell	E001598	6/1/2017	6/30/2019	Pressure, Temp, RH Meter	E005409	10/19/2017	10/31/2018
Precision RTD Thermometer	E005205	5/2/2017	5/31/2019	Temp/RH Probe	E005410	10/19/2017	10/31/2018
				TSI 3750 CPC (Ref. Conc.)	E010026	8/22/2017	8/31/2018

CALIBRATED BY

3/7/2018

DATE OF CALIBRATION