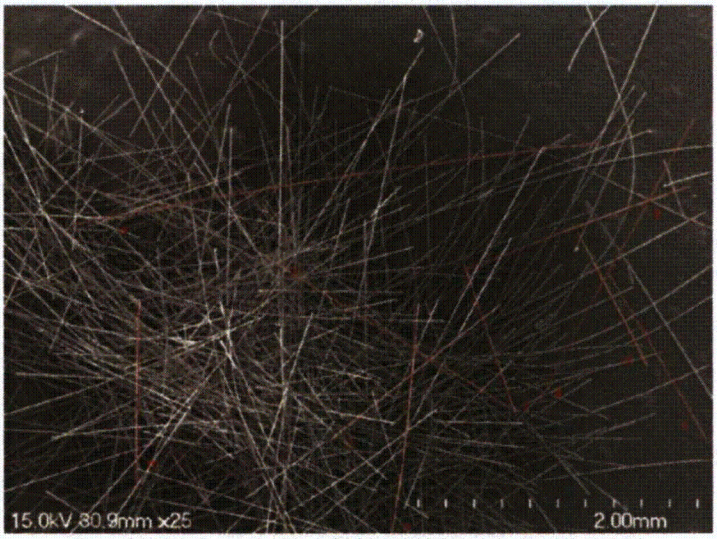

Figure 8.2.2.22 – Temp-Mat Fibers FE-SEM At 25X Magnification (d1_M05.Tif)

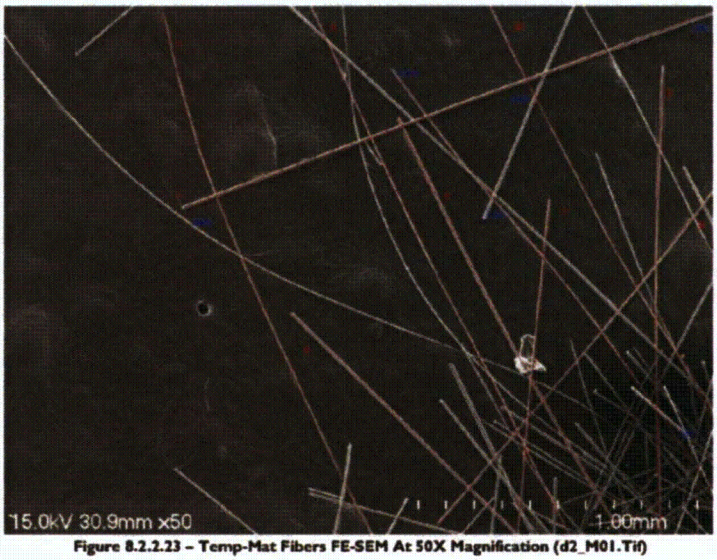

Figure 8.2.2.23 – Temp-Mat Fibers FE-SEM At 50X Magnification (d2_M01.Tif)

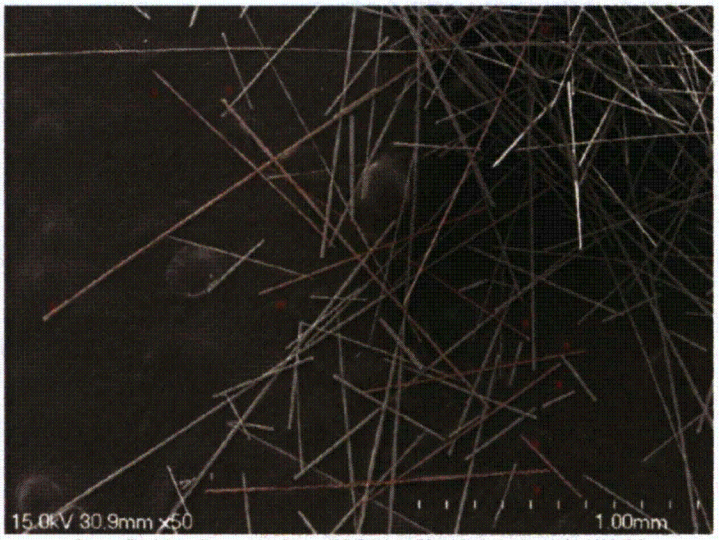

Figure 8.2.2.24 – Temp-Mat Fibers FE-SEM At 50X Magnification (d2_M02.Tif)

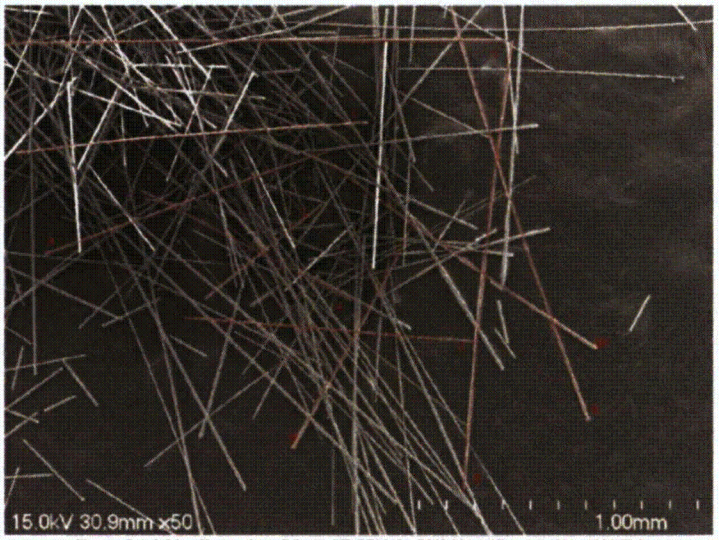

Figure 8.2.2.25 – Temp-Mat Fibers FE-SEM At 50X Magnification (d2_M03.Tif)

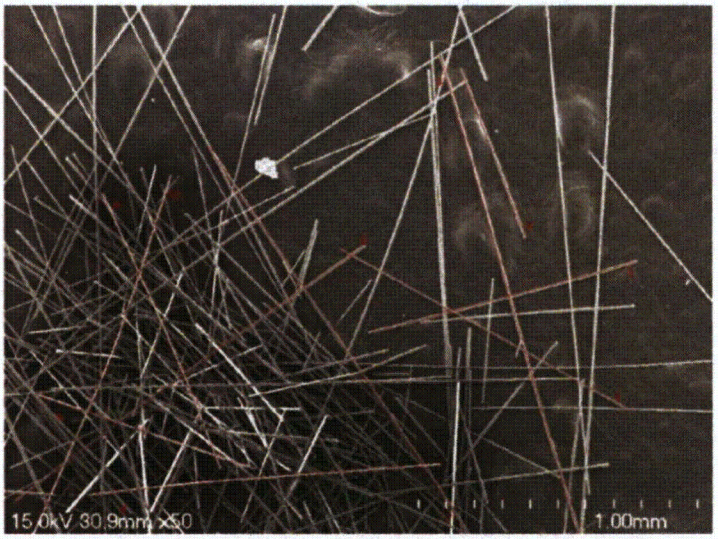

Figure 8.2.2.26 – Temp-Mat Fibers FE-SEM At 50X Magnification (d2_M04.Tif)

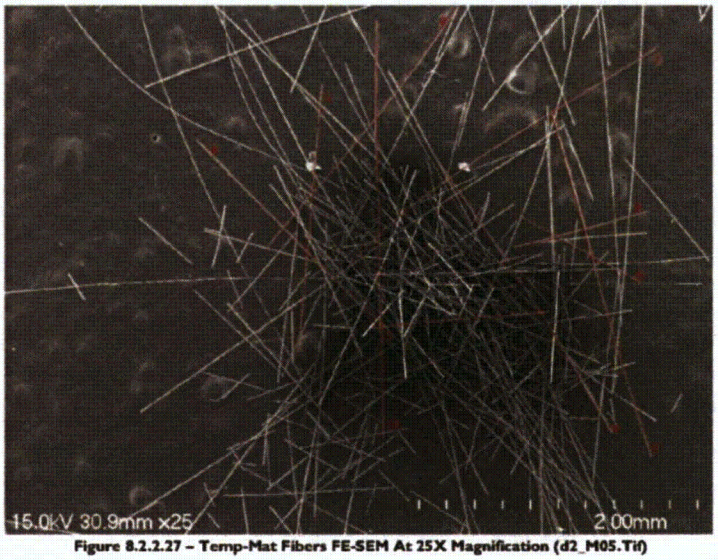

Figure 8.2.2.27 – Temp-Mat Fibers FE-SEM At 25X Magnification (d2_M05.Tif)

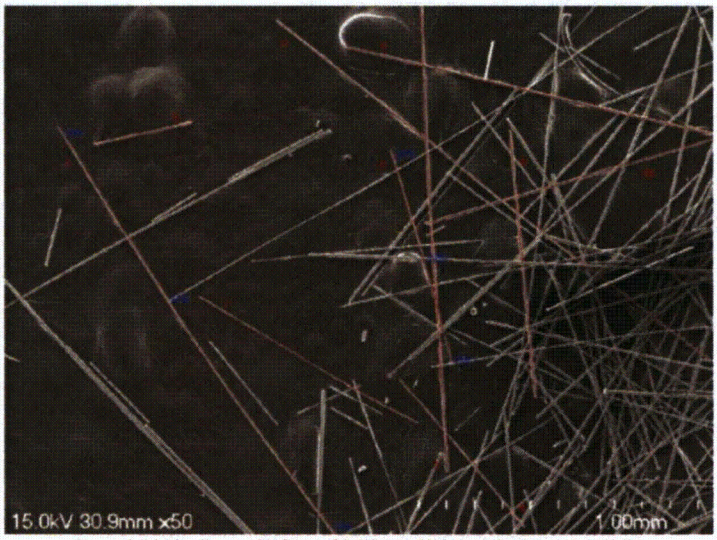

Figure 8.2.2.28 – Temp-Mat Fibers FE-SEM At 50X Magnification (d3_M01.Tif)

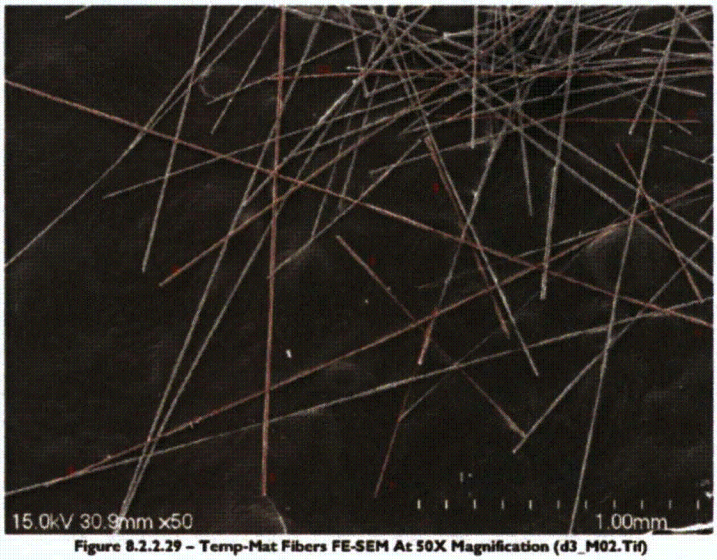

Figure 8.2.2.29 – Temp-Mat Fibers FE-SEM At 50X Magnification (d3_M02.Tif)

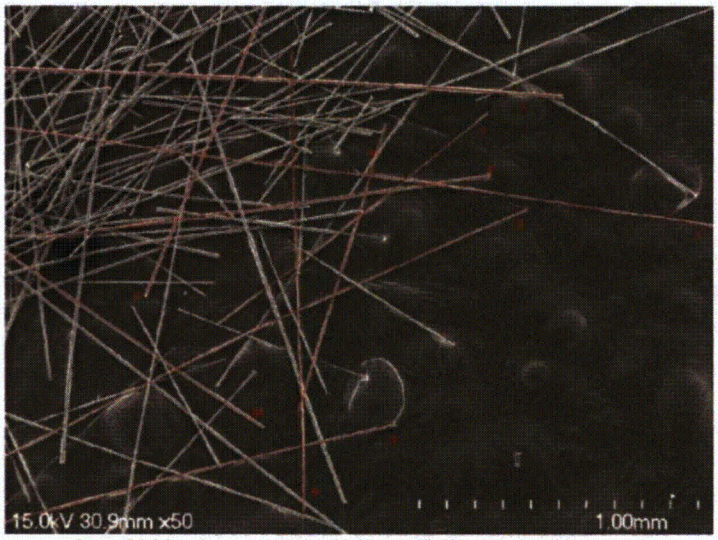

Figure 8.2.2.30 – Temp-Mat Fibers FE-SEM At 50X Magnification (d3_M03.Tif)

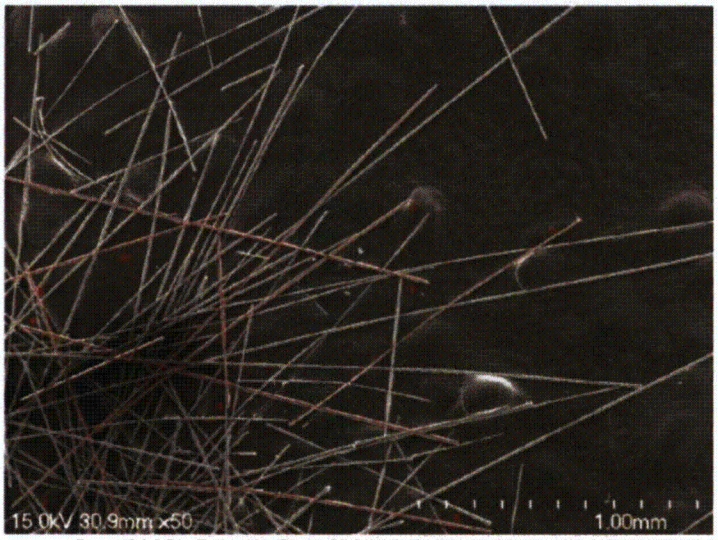

Figure 8.2.2.31– Temp-Mat Fibers FE-SEM At 50X Magnification (d3_M04.Tif)

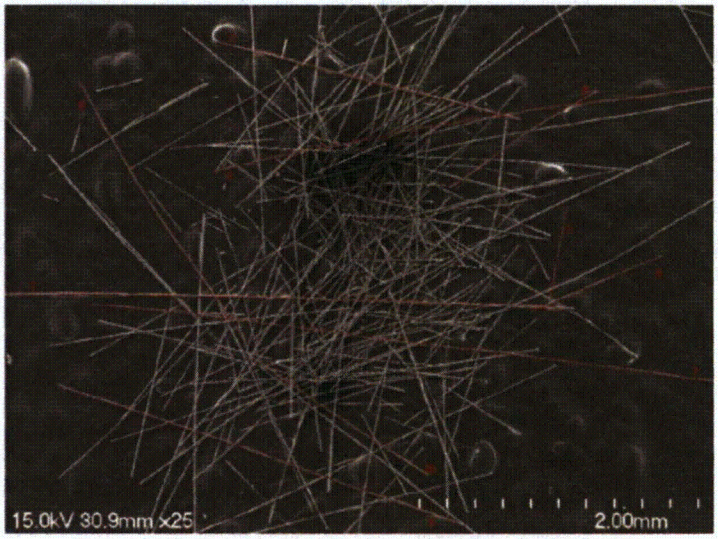

Figure 8.2.2.32– Temp-Mat Fibers FE-SEM At 25X Magnification (d3_M05.Tif)

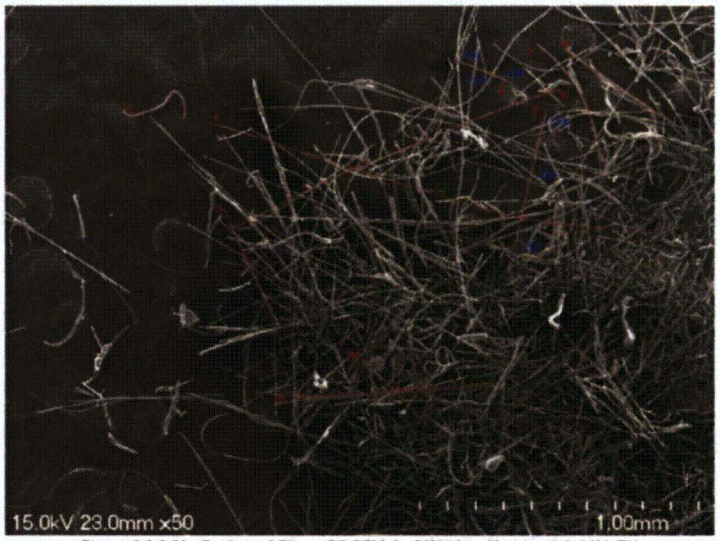

Figure 8.2.2.33– Rockwool Fibers FE-SEM At 50X Magnification (r1_M01.Tif)

Figure 8.2.2.34– Rockwool Fibers FE-SEM at 50X Magnification (r1_M02.Tif)

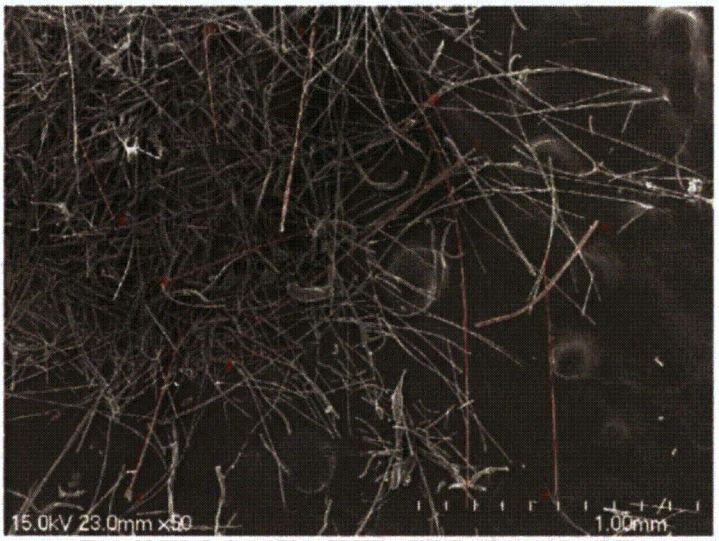

Figure 8.2.2.35– Rockwool Fibers FE-SEM at 50X Magnification (r1_m03.Tif)

Figure 8.2.2.36– Rockwool Fibers FE-SEM at 50X Magnification (r1_m04.Tif)

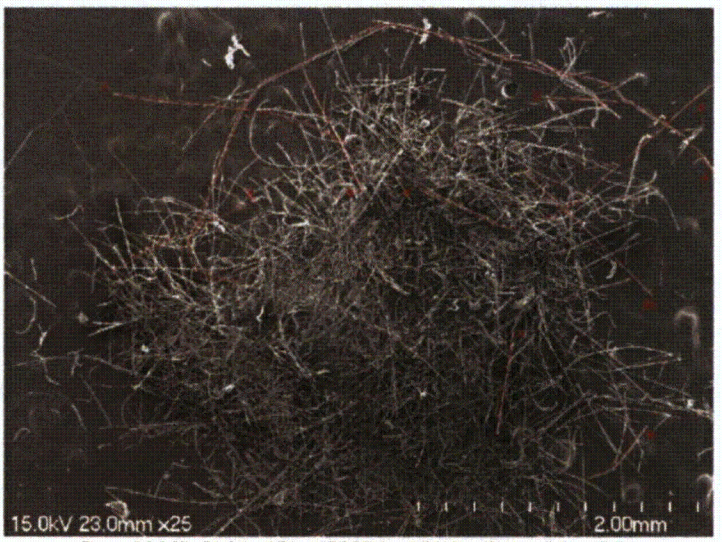

Figure 8.2.2.37– Rockwool Fibers FE-SEM at 25X Magnification (r1_m05.Tif)

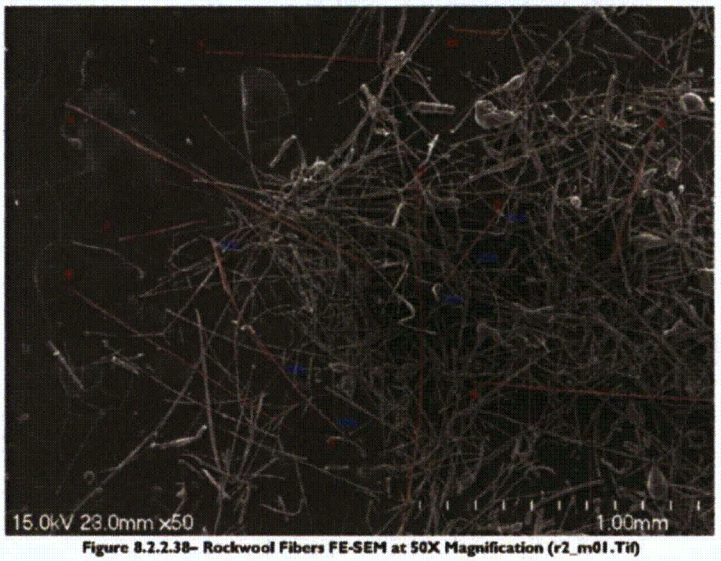

Figure 8.2.2.38– Rockwool Fibers FE-SEM at 50X Magnification (r2_m01.Tif)

Figure 8.2.2.39– Rockwool Fibers FE-SEM at 50X Magnification (r2_m02.Tif)

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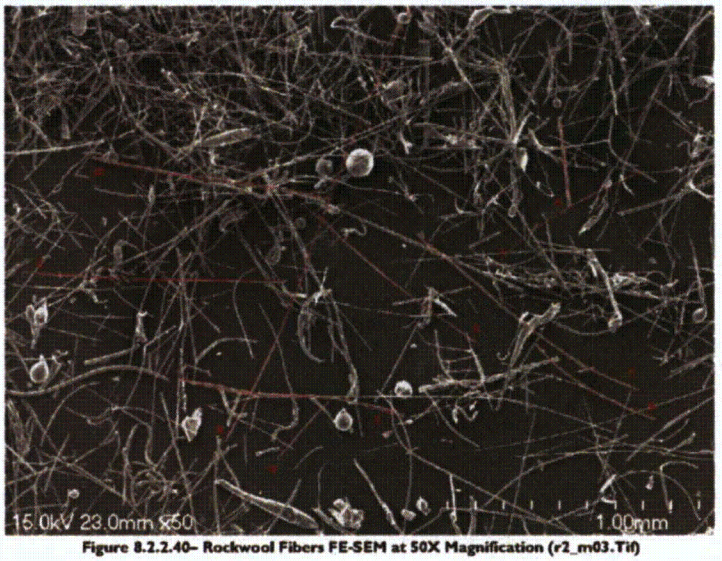

Figure 8.2.2.40– Rockwool Fibers FE-SEM at 50X Magnification (r2_m03.Tif)

Figure 8.2.2.41– Rockwool Fibers FE-SEM at 50X Magnification (r2_m04.Tif)

Figure 8.2.2.42– Rockwool Fibers FE-SEM at 25X Magnification (r2_m05.Tif)

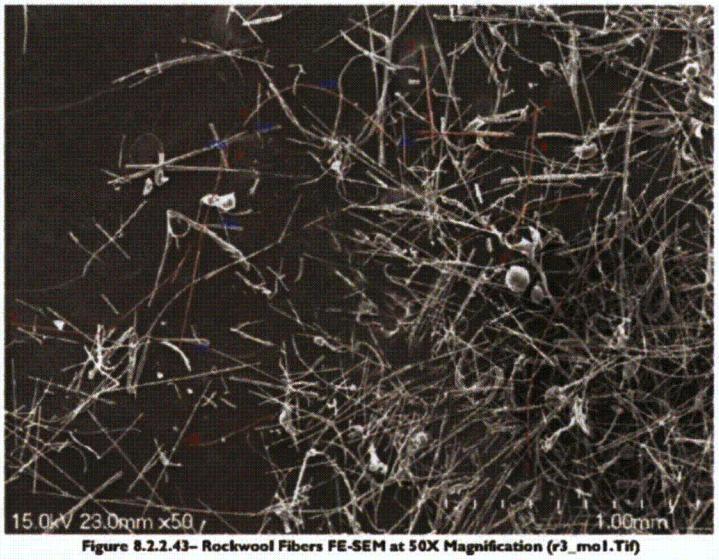

Figure 8.2.2.43– Rockwool Fibers FE-SEM at 50X Magnification (r3_m01.Tif)

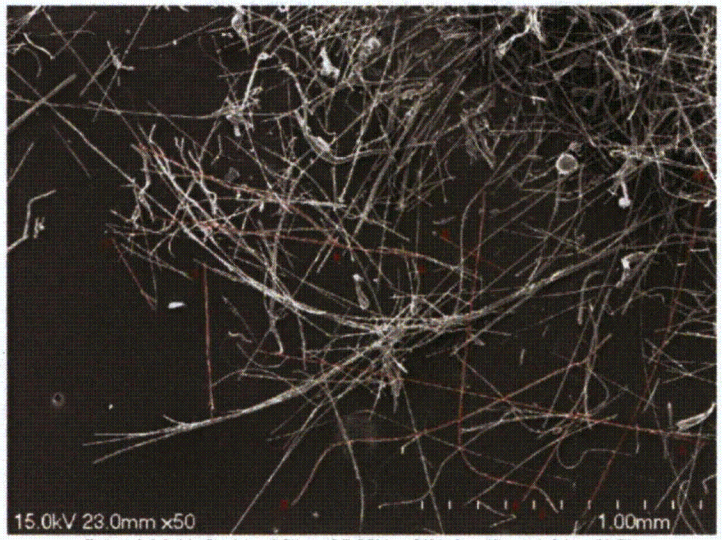

Figure 8.2.2.44– Rockwool Fibers FE-SEM at 50X Magnification (r3_m02.Tif)

Figure 8.2.2.45– Rockwool Fibers FE-SEM at 50X Magnification (r3_m03.Tif)

Figure 8.2.2.46– Rockwool Fibers FE-SEM at 50X Magnification (r3_m04.Tif)

Figure 8.2.2.47– Rockwool Fibers FE-SEM at 25X Magnification (r3_m05.Tif)

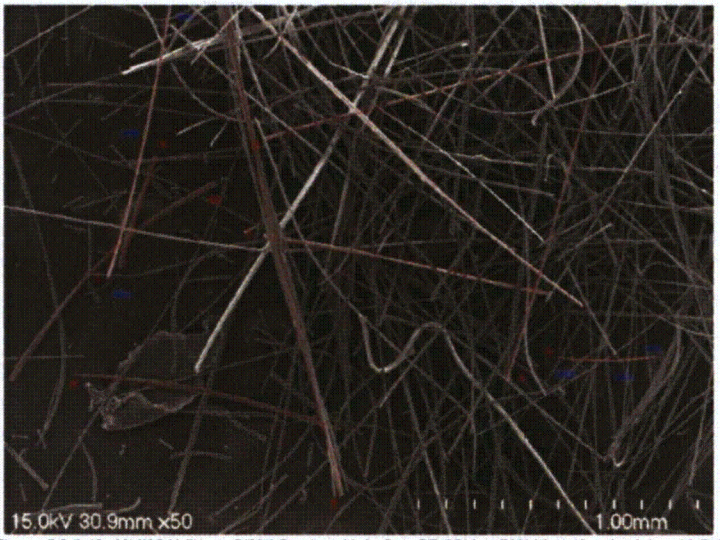

Figure 8.2.2.48– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification(s1_m01.Tif)

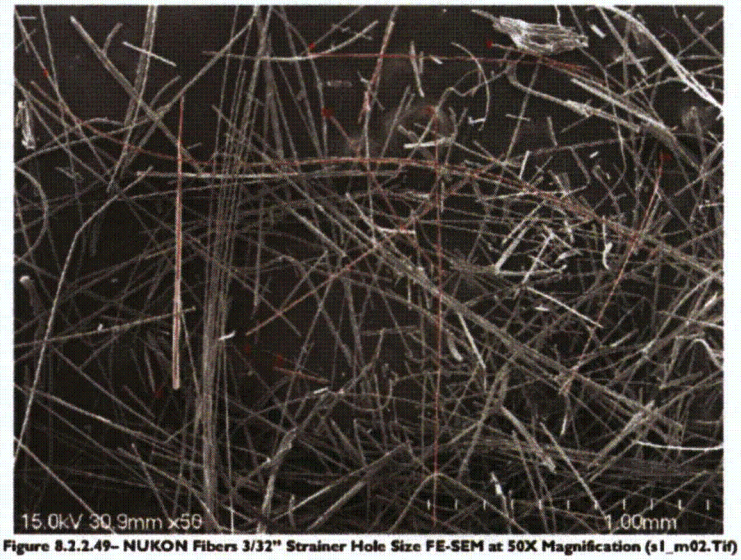

Figure 8.2.2.49– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s1_m02.Tif)

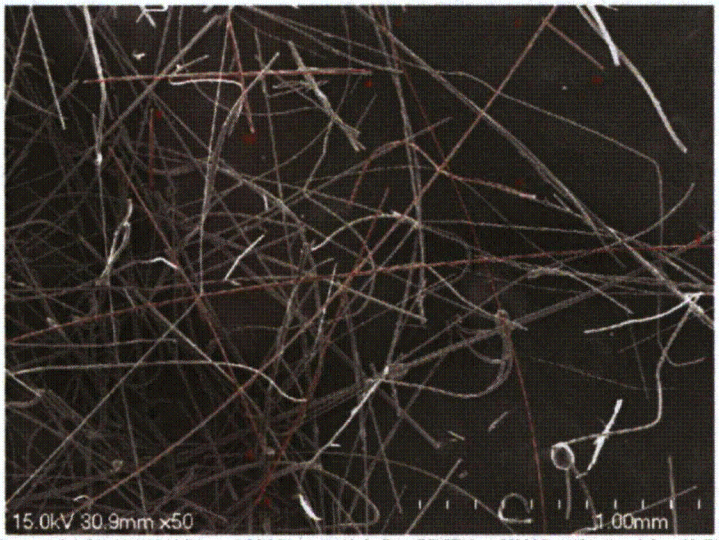

Figure 8.2.2.50– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s1_m03.Tif)

Figure 8.2.2.51– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s1_m04.Tif)

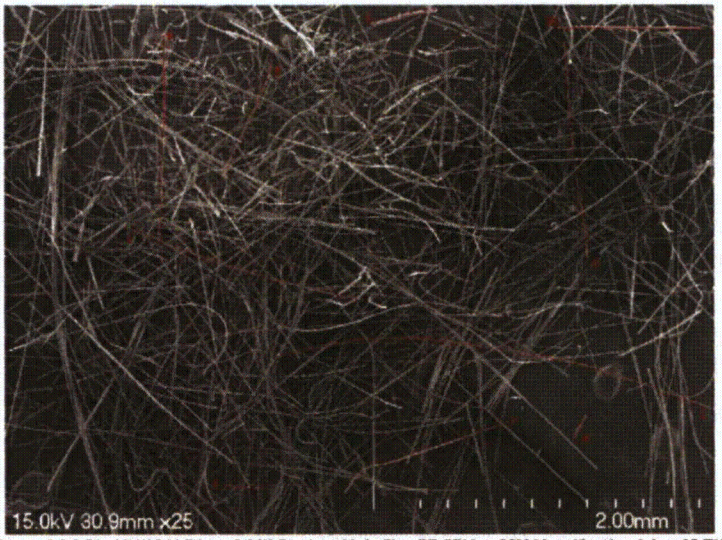

Figure 8.2.2.52– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 25X Magnification (s1_m05.Tif)

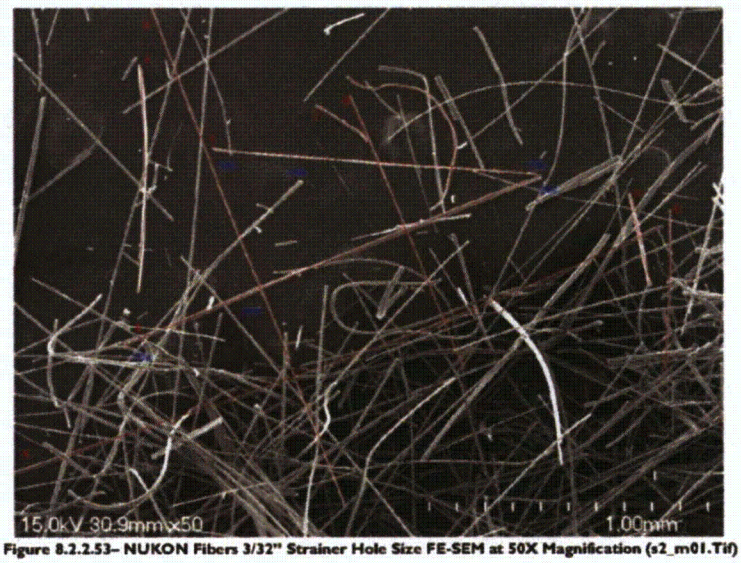

Figure 8.2.2.53– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s2_m01.Tif)

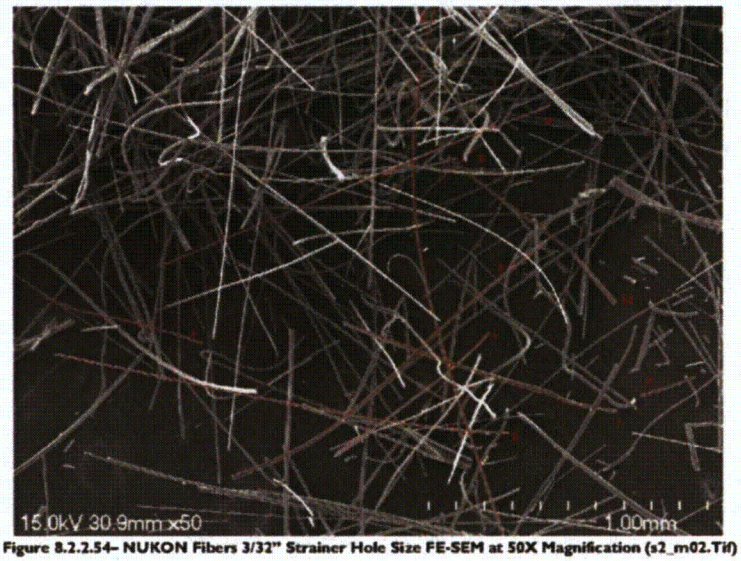

Figure 8.2.2.54– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s2_m02.Tif)

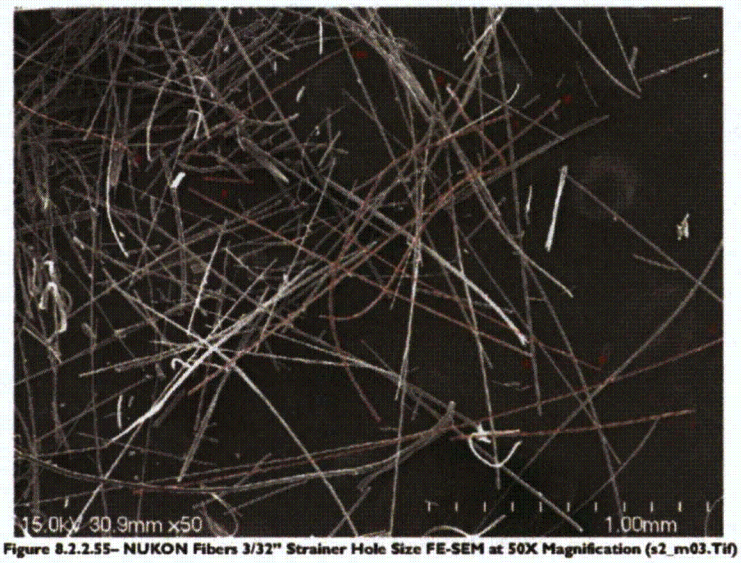

Figure 8.2.2.55– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s2_m03.Tif)

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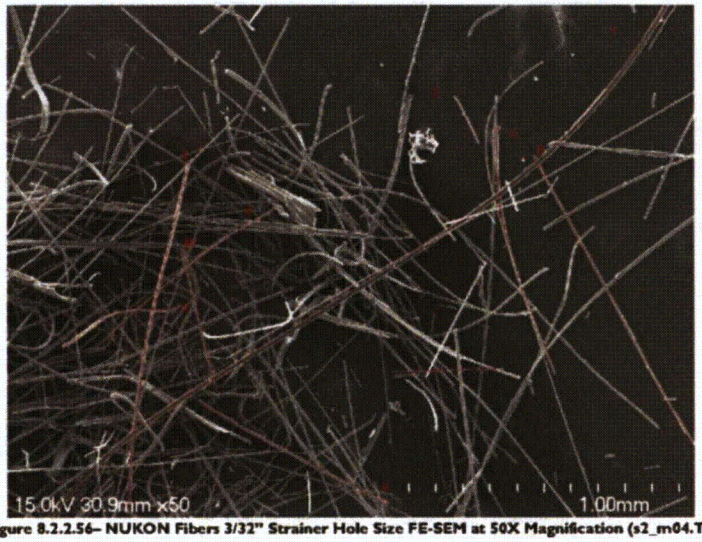

Figure 8.2.2.56– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s2_m04.Tif)

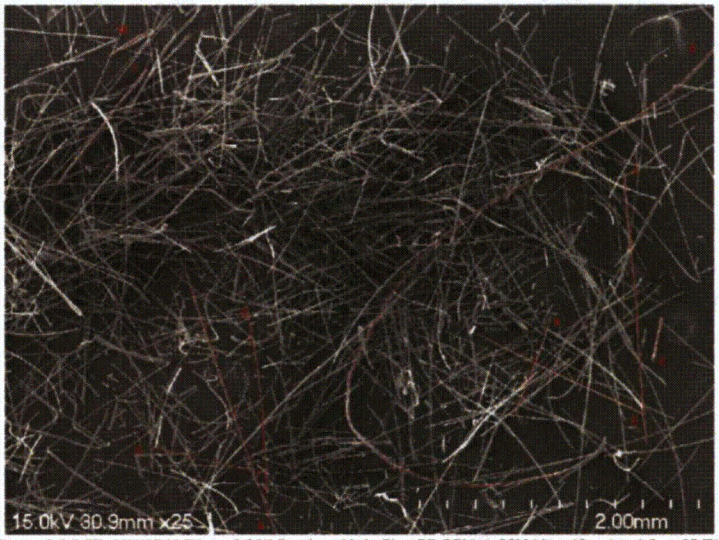

Figure 8.2.2.57– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 25X Magnification (s2_m05.Tif)

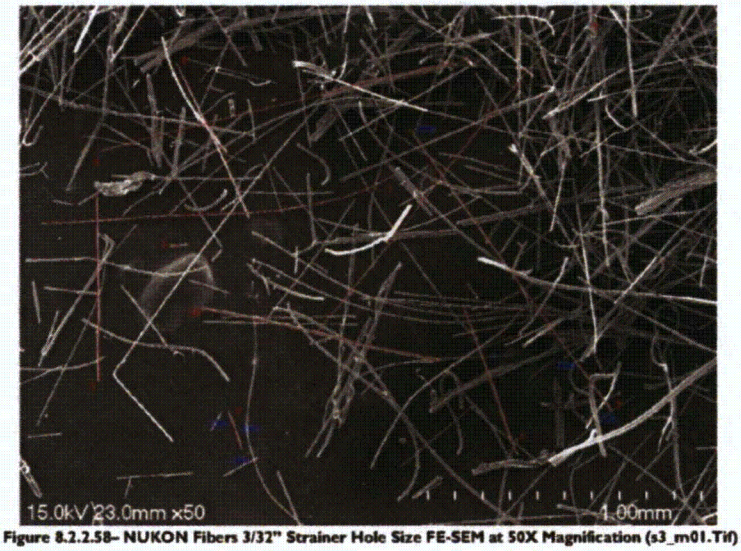

Figure 8.2.2.58– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s3_m01.Tif)

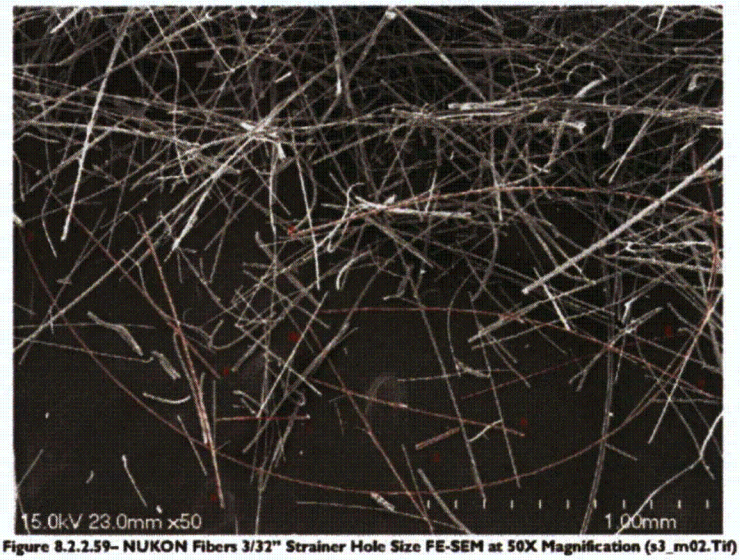

Figure 8.2.2.59– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s3_m02.Tif)

Figure 8.2.2.60– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnification (s3_m03.Tif)

Figure 8.2.2.61– NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 50X Magnifcation (s3_m04.Tif)

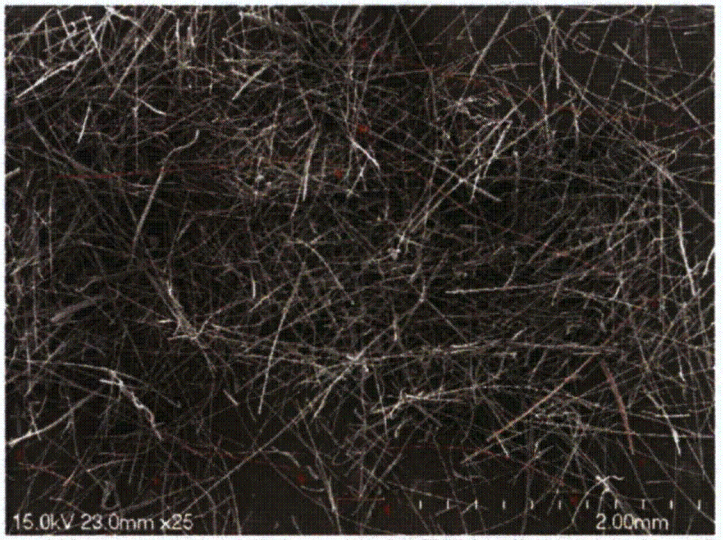

Figure 8.2.2.62 – NUKON Fibers 3/32" Strainer Hole Size FE-SEM at 25X Magnification (s3_m05.Tif)

9- References

1. **ALION-PLN-TPI-8497-016.** *ECCS Strainer Bypass Debris Test Plan WSN 1.* Revision 2 : s.n., 2012.

2. **ALION-SPP-LAB-2352-24.** *Optical or Scanning Electron Microscope Examinations.* Revision 3 : April 5, 2006.

3. **Geller Microanalytical Laboratory.** *Resource Guide for MRS-3XY.* 2011. ASTM E766-98 (Included as Attachment E).

ALION SCIENCE AND TECHNOLOGY	BWROG ECCS Strainer Bypass Test Report		
	Document No: BWROG-ECCS-TA13-004	Revision: 1	Page: O-93 of O-154

Attachment A: Alion Procedure ALION-SPP-LAB-2352-24, Rev 3

ALION SCIENCE AND TECHNOLOGY

TECHNICAL DOCUMENT COVER SHEET

CONTROLLED DOCUMENT

Document No: ALION-SPP-LAB-2352-24	Revision: 3	Page 1 of 14
Document Title: Optical or Scanning Electron Microscopic Examinations		
Project No: ALION-2352		
Project Name: GSI-191 Testing and Examination of Materials		
Client: Internal		
Document Purpose/Summary: The purpose of this procedure is to identify the steps necessary to perform optical or scanning electron microscopic examinations of material samples.		
Design Verification Method: ___ Design Review ___ Alternative Calculation ___ Qualification Testing		
Professional Engineer (if required) Approval: N/A		Date
Prepared By: Jan Bostelman (Printed/Typed Name)	Jan Bostelman (Signature)	4/5/06 (Date)
Reviewed By: W. Guerra (Printed/Typed Name)	W. Guerra (Signature)	4/5/06 (Date)
Approved By: D. F. Lincoln (Printed/Typed Name)	D. F. Lincoln (Signature)	4/6/06 (Date)

Controlled Copy # 2352-003
Date Issued: 8-17-2006
Issued By: Brenda Jones

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Revision Log

PAGE(S) AFFECTED BY REVISION	REVISED, ADDED, OR DELETED	DESCRIPTION OF REVISIONS
All	Added	Original Issue
All	Revised	Rev 1 – Changed the procedure format to reflect current program format.
All	Revised	Rev 2 – Revised Procedure to include Business Unit Manager's approval as required by our QA program.
All	Revised	Rev 3 – Included Optical Microscopy to Material Measurements

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1.0 Purpose

This procedure establishes the steps to be utilized to log in samples and process for performing Optical Microscopic or SEM measurements. It also establishes the means for recording measurement traceability. The purpose of this procedure is to provide a process that allows capturing of Optical Microscopic or SEM images for further measurement and statistical analyses.

2.0 Precautions

When handling fibrous insulation, personal involved must wear safety goggles, gloves, lab coat and a breathing filter mask. Don appropriate PPE identified per MSDS sheets for handling each sample (fibrous or particulate).

3.0 Application

3.1 This procedure applies to the receipt inspection of samples and recording of measurements for Optical Microscopic or SEM images.

3.2 Equipment and materials such as Optical Microscope or SEM holder, material handling equipment that are not directly associated with the measurement, acquisition or analysis of test data is exempt from the provisions of this procedure.

4.0 Procedure

4.1 Sample Shipments

To assure that samples are received such that the results of analyses are accurate and reliable, the appropriate documentation shall be retained in control files. These files will prove a readily accessible location for management and evaluation of all materials that support safety related analyses. If samples or shipping containers are damaged note as such on Attachment 7.

4.1.1 Material Control Index

A master material log shall be maintained that identifies all sample materials that are or will be used for Optical Microscopic or SEM imaging. Attachment 2 provides the Material Control Index Sample form. The file shall contain the following documentation as appropriate to its intended function:

- Purchase Order(s)
- Package Receipt Inspection documents
- Sample ID number to be logged into Alion material database
- Additional information (i.e. macrophotographs of each bulk sample)

Attachment 2 provides a sample index that may be used to track the documentation in the material control file. One form will be prepared for each sample that is examined via Optical Microscopic or SEM process.

4.2 Receipt Inspection

This section prescribes the requirements for the receipt of sample materials. The Project Manager or Project Engineers are responsible for the implementation of this guideline. QA is responsible for verifying receipt inspection attributes when requested by the Project Manager/Project Engineers.

4.2.1 Material Receipt Report (MRR)

A MRR is initiated by the Project Engineer/Designee for all sample materials to be evaluated for the project. Applicable inspection attributes must be completed on the MRR by the Project Engineer/Designee. The MRR must be retained in the Equipment/Material Control file.

Attachment 3 provides a sample MRR format. It is issued to record the acceptability of material receipt. Of critical interest is to ensure that the sample packages were not damaged during shipment. All other information on the form is not applicable for SEM processing.

4.3 Sample Handling Process

4.3.1 Take Bulk Shipment Packages to appropriate Optical Microscope or SEM facility.

4.3.2 Record and Note if any packages are marked hazardous materials. Log this on Attachment 4. For Chain of Record Documentation. Record Shipper, date of receipt inspection, material received, material returned after evaluations complete.

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4.3.3 Open shipment package in a laboratory hood with ventilation system in operation.

4.3.4 Observe condition of each sample provided in the shipment package. Note if any packages are breached that were sealed or condition of individual samples. Record observations on Attachment 3 for each individual sample. If individual samples are labeled by shipper, transfer that identification to Attachments 2 and 3 for consistency. If samples are not identified provide generic identification by material type and sample ID number.

4.3.5 Take macrophotographs of each individual sample and attach the images with Attachment 2 for each sample.

4.3.6 Record amount of sample taken from each individual sample for Optical Microscope or SEM evaluations. Record amount taken on Attachment 5. Each sample will have an attachment 5 log for traceability and control of sample.

4.3.7 Prepare Optical Microscope or SEM Holder, (for SEM only put double stick tape on each sample peg to hold a sample).

4.3.8 Note for SEM only-Place one sample on each sample peg. Note: allow space on specimen holder for calibrated grid or install calibrated grid in SEM chamber prior to measurements. If not performing SEM skip this step.

4.3.9 Take a photograph of Optical Microscope or SEM holder with samples. For SEM Only Record location of samples on SEM holder by drawing a figure and identifying the sample IDs on the figure. Identify the sample IDs on the image also. A photograph of the sample figure is to be included in the SEM report.

4.3.10 Perform startup process for Optical Microscope or SEM instrument per Optical/SEM Facility procedures.

4.3.11 Steps 4.3.12 through 4.3.29 are applicable to SEM instrument only. If not performing SEM go to step 4.3.30.

4.3.12 Once SEM instrument is ready ensure sample chamber is at atmospheric condition.

4.3.13 Open SEM chamber and insert SEM holder.

4.3.14 Pump down chamber to approximately 25 mPa or vacuum condition which does not cause charging of sample.

4.3.15 Set up beam scan speed for appropriate collection of SEM images.

4.3.16 Proceed to check calibrated grid block.

4.3.17 Check calibrated grid against SEM scaler. Record grid block data information in Attachment 6 and any relevant measurement. Several grid blocks can be utilized if Project Engineer desires.

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4.3.18 Take image of grid with SEM scale bar turned on, record image for documentation and attach to Attachment 6.

4.3.19 After recording image, confirm calibrated grid measurements and record Attachment 6.

4.3.20 Proceed to a sample specimen and began collecting SEM images.

4.3.21 Periodically check that samples are not charging.

4.3.22 Periodically check grid against SEM scaler.

4.3.23 Log sample ID on Attachment 1 data sheet. Record magnification, working distance, kV, image file name and date for each image collected for each individual sample.

4.3.24 Record an image at various magnifications. Record at least 3 images per sample at different magnifications. If sample is not charging. If sample is charging back off the vacuum such that sample is not charging and take at least 3 images. If sample charging precludes image collection will need to coat sample with either carbon tape or gold sputtering and perform high vacuum processing and repeat steps 3.3.21 through 3.3.24.

4.3.25 Document all images collected on Attachment 1 for each sample.

4.3.26 Once samples images are collected proceed to transfer collected images from SEM instrument to appropriate data storage devices (i.e. zip disks or CDs or equivalent).

4.3.27 Attach data collection storage device to project documentation.

4.3.28 Power down SEM instrument.

4.3.29 Put together a sample traveler package for each sample that contains Attachments 1, 2, 3, 4, 5 and 6 per sample. Transmit originals to project files.

4.3.30 The next steps are only applicable to performing Optical Microscopy.

4.3.31 Proceed to check calibrated grid block.

4.3.32 Check calibrated grid against Optical Microscope scaler if applicable. Record grid block data information in Attachment 6 and any relevant measurement. Several grid blocks can be utilized if Project Engineer desires.

4.3.33 Take image of grid with scale bar turned on if digital imaging is provided, record image for documentation and attach to attachment 6. If no digital imaging take a thermal scan or Polaroid image or photograph of grid scale. Provide as an attachment to Optical Microscopy Report.

4.3.34 After recording image, confirm calibrated grid measurements and record Attachment 6.

4.3.35 Proceed to a sample specimen and began collecting Optical images. Include images in Material Characteristic Report.

4.3.36 Periodically check grid against scaler if it is provided.

4.3.37 Log sample ID on Attachment 1 data sheet. Record magnification, image file name and date for each image collected for each individual sample.

4.3.38 Record an image at various magnifications. Record at least 3 images per sample at different magnifications.

4.3.39 Document all images collected on Attachment 1 for each sample.

4.3.40 Once samples images are collected proceed to transfer collected images from digital microscope instrument to appropriate data storage devices (i.e. zip disks or CDs or equivalent). If digital imaging not provided collect photographs or thermal scans.

4.3.41 Attach data collection storage device to project documentation.

4.3.42 Put together a sample traveler package for each sample that contains Attachments 1, 2, 3, 4, 5 and 6 per sample. Transmit originals to project files.

5.0 References

5.1 Geller Microanalytic Lab Certification for MRS-3XY

6.0 Quality Records

The current approved revision of this procedure (including attachments) shall be retained as a quality record in accordance with QAP 17.1 of the Alion QA program.

7.0 Associated Documents

7.1 None

8.0 Attachments

Attachment 1 – Optical Microscope or SEM Image Log
Attachment 2 - Material Control Index
Attachment 3 - Material Receipt Report
Attachment 4 – Hazardous Material Chain of Command
Attachment 5 - Material Usage/Configuration Control Log
Attachment 6 –Optical Microscope or SEM Calibration Grid Information
Attachment 7– Damaged Packages or Samples

Use or disclosure of this document is subject to the restriction on the Cover Page

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page A-8 of A-15

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg 8 of 14

Attachment 1 –

Optical Microscope or SEM Image Log

Sample ID#	Description	Date	Magnification	Voltage (kV) (N/A for Optical Microscope)	Working Distance (N/A for Optical Microscope)	Image File Name

Attachment 2 – Material Control Index

MATERIAL CONTROL INDEX

MATERIAL

Sample ID# (N/A for Material):

Component Description: Insulation Sample

Document	Entered By:	Date:
Purchase Order # _____		
Material Receipt Report		
Calibration/Certification Documentation N/A		
Installation Specification/Description (N/A for Material) N/A		
Post Installation Test Report (N/A for Material) N/A		
Configuration Control Log (Attach to this index) NA		

Additional Documentation: Photographs

Use or disclosure of this document is subject to the restriction on the Cover Page

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg. 10 of 14

Attachment 3 – Material Receipt Report

SPECIFICATION. #	P. O. # Sample ID #		QUALITY CLASSIFICATION	
ITEM/DESCRIPTION:	SUPPLIER/VENDOR		STORAGE INSTRUCTIONS	
INITIATED BY AND DATE:	REVIEWED/APPROVED BY AND DATE:			
RECEIVING INSPECTION REQUIREMENTS FOR SAFETY AND NON-SAFETY RELATED ITEMS	METHOD	N/A	PE or QA	DATE
A. VERIFY ITEM(S) ARE FREE OF DAMAGE CAUSED BY SHIPPING				
B. VERIFY THE LEVEL OF PACKING HAS BEEN MAINTAINED				
C. VERIFY IDENTIFICATION AND MARKINGS ARE AS SPECIFIED				
D. VERIFY COATINGS AND PRESERVATIVES ARE AS SPECIFIED				
E. VERIFY PROTECTION COVERS & SEALS MEET THEIR INTENDED FUNCTION				
F. VERIFY INERT GAS BLANKET PRESSURE IS WITHIN SPECIFIED LIMITS				
G. VERIFY DESICCANT IS NOT SATURATED				
H. VERIFY ITEM(S) MEET SPECIFIED CLEANLINESS				
I. VERIFY ITEM(S) ARE FREE OF PHYSICAL DAMAGE				
J. VERIFY DOCUMENTATION				
RECEIVING INSTRUCTIONS FOR SAFETY RELATED ITEMS NOT RELEASED BY PROJECT ENGINEERING				
A. VERIFY PHYSICAL PROPERTIES (SEE DOCUMENTATION)				
B. VERIFY DIMENSIONS/CONFIGURATION				
C. VERIFY WELD PREPARATIONS				
D. VERIFY WORKMANSHIP				
E. VERIFY LUBRICANTS/OILS				
F. VERIFY ELECTRICAL INSULATION				
UNIQUE INSPECTION REQUIREMENTS FOR ITEMS:				
A. VERIFY				
B. VERIFY				
C. VERIFY				
D. VERIFY				

ITEM DESCRIPTION SAMPLING USED: ☐ YES ☐ NO	TRACEABILITY NUMBER	QTY	SAMPLING TABLE	REMARKS/COMMENTS

I = Inspection, R = Review, W = Witness

All broken packages or damaged samples are to be noted in Attachment 7, and discussed with QA if a CAR should be written.

Use or disclosure of this document is subject to the restriction on the Cover Page

Attachment 4 – Hazardous Material Chain of Command

HAZARDOUS MATERIAL CHAIN OF COMMAND LOG

Material Description:
Origin of Material: ___

Method of Shipment _____

Testing Activity	Sample ID	Quantity Received	Quantity Used	Date Used:	Quantity Returned to Material Control

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page A-12 of A-15

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg 12 of 14

Attachment 5 – Material Usage/Configuration Control Log

USAGE/CONFIGURATION CONTROL LOG

Material Description:

Sample ID: _____

Origin of Material: ___ **Initial Quantity:** _____

In-Service Date: NA

Shelf Life (N/A if not applicable): NA

Expiration Date (N/A if not applicable): NA

Testing Activity	Quantity Used:	Date Used:	Collected By:

Attachment 6 – SEM Calibration Grid Information

Calibration Grid _____
Scale_____

Calibration Grid_____
Scale_____

Calibration Grid_____
Scale_____

Attachment 7 - Damaged Packages or Samples (N/A this form in table column below if no damage noted)

Sample ID	Date	Description of Damage	Resolution if Required	QA Notification Date

Project Engineer or Designee_____

Date:_____

ALION SCIENCE AND TECHNOLOGY

ENGINEERING CHANGE REQUEST

Add Continuation Pages as necessary

☒ Major Change ☐ Minor Change

ECR No. 2352-2010-01	Revision: 0	Date 5/28/2010
Project Name: GSI 191: Testing and Examination of Materials	Project No.: 261-2352	Client: Internal

Design Documents (and revisions) Affected By ECR:

ALION-SPP-LAB-2352-24, Revision 3—Optical or Scanning Electron Microscope Examinations

Reason for Change:

To allow for use of the Magnification Reference Standard between calibrations, the attached Attachment 8 can be appended to ALION-SPP-LAB-2352-24. Attachment 8 allows optical (visual and magnified) surveys of the Magnification Reference Standard before and after use to gauge the Standard's effectiveness between external cleaning and calibrations.

MB 9-7-11

Description of Change:

Supplemental to the guidance given in ALION-SPP-LAB-2352-17, Selection, Calibration, and Approval of M&TE, the Magnification Reference Standard may be optically verified as effective or otherwise for calibration purposes. A clean, undamaged Standard can be used as a qualified Calibration Standard for Quality-Assured work. Otherwise, the Standard must be sent out for external calibration and cleaning before use in QA work.

These surveys are taken before and after SEM examinations as detailed in Attachment 8

MB 9-7-11

This method of in-house calibration checking is acceptable because a well-cared for Standard is rarely subject to environments or circumstances that could compromise its effectiveness. Furthermore, any such damage would be easily observed prior to use.

Completed Attachments must be kept with the Standard's calibration paperwork.

Approval Status

Originator: Luke Bockewitz	Date: 6-1-10
Reviewer (if applicable): Jeffrey Poska	Date: 6-1-10
Project Manager Approval: Roger Bloom	Date: 6/1/10

ECR Closure

Design Documents Revised:

ALION-SPP-LAB-2352-24, Revision 3—Optical or Scanning Electron Microscope Examinations

Originator's Recommendation for Closure:	Date:
Project Manager's Approval for Closure:	Date:

Form 3.2.1
Revision 0
Effective Date: 2/28/07

ATTACHMENT 8

AAB 9-7-11

In-House Magnification Reference Standard Verification Checklist

Date:	

Project Number:	
Project Name:	

Calibration Reference Standard ID	
Calibration Reference Standard Model Number	

Any debris that brings the calibration grid into suspect that cannot be removed with gentle air dusting mandates external calibration and cleaning prior to use in Quality Assured work.

Any damage that brings the calibration grid into suspect mandates external calibration and cleaning prior to use in Quality Assured work.

Pre-Examination Verification (performed at 10X, 100X and 1,000X)

			Where on Standard?	Removed/Repaired?	
Debris	YES	NO		YES	NO
Damage	YES	NO		YES	NO
Deterioration	YES	NO		YES	NO
Disfigurement	YES	NO		YES	NO
External Calibration and Cleaning Required?				YES	NO

Notes: 1. If measurements are not required at 1,000X or greater then disregard the verification at 1,000X.
2. If measurements are done on SEM then disregard the 10X verification.

Post-Examination Verification (performed at 10X, 100X and 1,000X)

			Where on Standard?	Removed/Repaired?	
Debris	YES	NO		YES	NO
Damage	YES	NO		YES	NO
Deterioration	YES	NO		YES	NO
Disfigurement	YES	NO		YES	NO
External Calibration and Cleaning Required?				YES	NO

Notes: 1. If measurements are not required at 1,000X or greater then disregard the verification at 1,000X.
2. If measurements are done on SEM then disregard the 10X verification.

Store this completed document with the Standard's calibration paperwork when completed.

Verified By _____ _____
Print Sign

Attachment B: Receipt Inspection Logs

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg 9 of 14

Attachment 2 – Material Control Index

MATERIAL CONTROL INDEX

MATERIAL

Sample ID# (N/A for Material):
CS07, DC3, D17, SC3

Component Description: Insulation Sample

Document	Entered By	Date
Purchase Order # STP 4332229	JLB	3/2/12
Material Receipt Report BWROG-1	JLB	3/21/12
Calibration/Certification Documentation N/A		
Installation Specification/Description (N/A for Material) N/A		
Post Installation Test Report (N/A for Material) N/A		
Configuration Control Log (Attach to this index) NA		

Additional Documentation: Photographs
Attached with purchase order for CS07, DC3, D17, SC3

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg 10 of 14

Attachment 3 – Material Receipt Report Bwrog 1

SPECIFICATION #	P.O.# Sample ID #	QUALITY CLASSIFICATION
None	Sim-4-22222-1 CSD7 DD3 D17 S03	NUA-1
ITEM/DESCRIPTION:	SUPPLIER/VENDOR	STORAGE INSTRUCTIONS
Strainer Samples	Alion	in containers dry
INITIATED BY AND DATE: JLB 3/21/12	REVIEWED/APPROVED BY AND DATE:	

RECEIVING INSPECTION REQUIREMENTS FOR SAFETY AND NON-SAFETY RELATED ITEMS	METHOD	N/A	PE or QA	DATE
A. VERIFY ITEM(S) ARE FREE OF DAMAGE CAUSED BY SHIPPING	I		JLB	3/21/12
B. VERIFY THE LEVEL OF PACKING HAS BEEN MAINTAINED	I		JLB	3/21/12
C. VERIFY IDENTIFICATION AND MARKINGS ARE AS SPECIFIED	I		JLB	3/21/12
D. VERIFY COATINGS AND PRESERVATIVES ARE AS SPECIFIED		✓	JLB	3/21/12
E. VERIFY PROTECTION COVERS & SEALS MEET THEIR INTENDED FUNCTION		✓	JLB	3/21/12
F. VERIFY INERT GAS BLANKET PRESSURE IS WITHIN SPECIFIED LIMITS		✓	JLB	3/21/12
G. VERIFY DESICCANT IS NOT SATURATED		✓	JLB	3/21/12
H. VERIFY ITEM(S) MEET SPECIFIED CLEANLINESS		✓	JLB	3/21/12
I. VERIFY ITEM(S) ARE FREE OF PHYSICAL DAMAGE	I		JLB	3/21/12
J. VERIFY DOCUMENTATION	I		JLB	3/21/12
RECEIVING INSTRUCTIONS FOR SAFETY RELATED ITEMS NOT RELEASED BY PROJECT ENGINEERING				
A. VERIFY PHYSICAL PROPERTIES (SEE DOCUMENTATION)		✓	JLB	3/21/12
B. VERIFY DIMENSIONS/CONFIGURATION		✓	JLB	3/21/12
C. VERIFY WELD PREPARATIONS		✓	JLB	3/21/12
D. VERIFY WORKMANSHIP		✓	JLB	3/21/12
E. VERIFY LUBRICANTS/OILS		✓	JLB	3/21/12
F. VERIFY ELECTRICAL INSULATION		✓	JLB	3/21/12
UNIQUE INSPECTION REQUIREMENTS FOR ITEMS:				
A. VERIFY				
B. VERIFY				
C. VERIFY				
D. VERIFY				

ITEM DESCRIPTION SAMPLING USED ☐ YES ☐ NO	TRACEABILITY NUMBER	QTY	SAMPLING TABLE	REMARKS/COMMENTS

I = Inspection, R = Review, W = Witness

All broken packages or damaged samples are to be noted in Attachment 7, and discussed with QA if a CAR should be written. [illegible], P.E.

Attachment 4 – Hazardous Material Chain of Command

HAZARDOUS MATERIAL CHAIN OF COMMAND LOG

Material Description:
Origin of Material: ___

Method of Shipment: _____

Not Applicable

Testing Activity	Sample ID	Quantity Received	Quantity Used	Date Used:	Quantity Returned to Material Control

ALION SCIENCE AND TECHNOLOGY	BWROG ECCS Strainer Bypass Test Report		
	Document No: BWROG-ECCS-TA13-004	Revision: 1	Page: O-111 of O-154

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page: B-4 of B-11

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SFP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg. 12 of 14

Attachment 5 – Material Usage/Configuration Control Log

USAGE/CONFIGURATION CONTROL LOG

Material Description:

Sample ID: CSc7, Dc3, Dc7, Sc3

Origin of Material: Alion Initial Quantity: Unlimited – 20 – 25

In-Service Date: NA

Shelf Life (N/A if not applicable): NA

Expiration Date (N/A if not applicable): NA

Testing Activity	Quantity Used:	Date Used:	Collected By:
SEM	Unlimited	3/2/12	Alion

Attachment 6 – SEM Calibration Grid Information

Calibration Grid MRS-3X4

Scale RIS-11.9 S.E.M. No. 5000X

Calibration Grid _____

Scale _____

Calibration Grid _____

Scale _____

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ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg. 14 of 14

Attachment 7 - Damaged Packages or Samples (N/A this form in table column below if no damage noted)

Sample ID	Date	Description of Damage	Resolution if Required	QA Notification Date
NA	NA	NA	NA	NA

Project Engineer or Designee_____

Date:_____

ALION SCIENCE AND TECHNOLOGY	BWROG ECCS Strainer Bypass Test Report		
	Document No: BWROG-ECCS-TA13-004	Revision: 1	Page: O-114 of O-154

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page: B-7 of B-11

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscope Examinations		
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Page 15 of 15

ATTACHMENT 7

In-House Magnification Reference Standard Verification Checklist

Date:	2/24/12
Project Number:	261-0-7337-005
Project Name:	BWROG SEM
Calibration Reference Standard ID	~~MRS 3~~ MRS 3 2/24/12 RIS-169
Calibration Reference Standard Model Number	MRS-3X4

Any debris that brings the calibration grid into suspect that cannot be removed with gentle air dusting mandates external calibration and cleaning prior to use in Quality Assured work.

Any damage that brings the calibration grid into suspect mandates external calibration and cleaning prior to use in Quality Assured work.

See Across grid 1, 2, 5, 6, 7

Pre-Examination Verification (performed at 10X, 100X and 1,000X)

		Where on Standard?	Removed/Repaired?
Debris	YES (NO)		YES NO
Damage	YES (NO)		YES NO
Deterioration	YES (NO)		YES NO
Disfigurement	(YES) NO	Across Center Appears streak	YES (NO)
External Calibration and Cleaning Required?			(YES) NO

Notes: 1. If measurements are not required at 1,000X or greater then disregard the verification at 1,000X.
2. If measurements are done on SEM then disregard the 10X verification.

Streaking across surface, but most appears coating had been brushed across not evident visual

Post-Examination Verification (performed at 10X, 100X and 1,000X)

		Where on Standard?	Removed/Repaired?
Debris	YES (NO)		YES NO
Damage	YES (NO)		YES NO
Deterioration	YES (NO)		YES NO
Disfigurement	(YES) NO		YES (NO)
External Calibration and Cleaning Required?			(YES) NO

Notes: 1. If measurements are not required at 1,000X or greater then disregard the verification at 1,000X.
2. If measurements are done on SEM then disregard the 10X verification.

Recommend Consulting with Vendor appears only on SEM as a streak.

Store this completed document with the Standard's calibration paperwork when completed.

Verified By Dan Bostelman Dan Bostelman
Print Sign

used cleaned air before putting X to SEM + after

ALION	Control of Materials and Chemicals		
	Document No.: ALION-SPP-LAB-2352-12	Revision: 3	Page: D1 of D1

Attachment D – Specimen Distribution Form

Material/Chemical:	SEM Samples	Amount:	1 Sample
Supplier:	Alion	Alion Lot ID:	C507
Shelf Life/Expiration Date:	N/A	Tracking No.:	
Intended Use:	SEM Analysis		

Destination Plant/Lab	Address	Contact Name, Title	Phone No.
N/A	Jan Bostelman 2751 X Rd Brainard, NE 68626	Jan Bostelman	402-545-3871

Date Transmitted	Sender Name	Signature
1-18-12	J. Poska	Paul Nelson for JP
Date Received	**Recipient Name**	**Signature**
2/24/12	Jan Bostelman	J Bostelman

Receipt Instructions:

Sign, date and retain this attachment until all samples are received, analyzed and returned.

Image lower density areas of each of the three sample areas to observe fiber characteristics especially length.

Storage Instructions:

Store as needed.

Specimen Return Instructions

After all samples have been analyzed, return samples to the

Alion Hydraulics Lab, 30W250 Butterfield Road, Suite 302, Warrenville, IL 60555

Phone 630-929-2214

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ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page: B-9 of B-11

ALION SCIENCE AND TECHNOLOGY	Control of Materials and Chemicals		
	Document No.: ALION-SPP-LAB-2352-12	Revision: 3	Page 01 of 01

Attachment D – Specimen Distribution Form

Material/Chemical:	SEM Samples	Amount:	1 Sample
Supplier:	Alion	Alion Lot ID:	D03
Shelf Life/Expiration Date:	N/A	Tracking No.:	
Intended Use:	SEM Analysis		

Destination Plant/Lab	Address	Contact Name, Title	Phone No.
N/A	Jan Bostelman 2751 X Rd Brainard, NE 68626	Jan Bostelman	402-545-3871

Date Transmitted	Sender Name	Signature
1-18-12	J. Poska	Ron Nellum for JP
Date Received	**Recipient Name**	**Signature**
2/24/12	Jan Bostelman	

Receipt Instructions:

Sign, date and retain this attachment until all samples are received, analyzed and returned.

Image lower density areas of each of the three sample areas to observe fiber characteristics especially length.

Storage Instructions:

Store as needed.

Specimen Return Instructions:

After all samples have been analyzed, return samples to the

Alion Hydraulics Lab, 30W250 Butterfield Road, Suite 302, Warrenville, IL 60555

Phone 630-839-2214

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ALION SCIENCE AND TECHNOLOGY	Control of Materials and Chemicals		
	Document No.: ALION-SPP-LAB-2352-12	Revision: 3	Page D1 of D1

Attachment D – Specimen Distribution Form

Material/Chemical:	SEM Samples	Amount:	1 Sample
Supplier:	Alion	Alion Lot ID:	D17
Shelf Life/Expiration Date:	N/A	Tracking No.:	
Intended Use:	SEM Analysis		

Destination Plant/Lab	Address	Contact Name, Title	Phone No.
N/A	Jan Bosteiman 2751 X Rd Brainard, NE 68625	Jan Bosteiman	402-545-3871

Date Transmitted	Sender Name	Signature
1-18-12	J. Puska	Paul Miller for JP
Date Received	**Recipient Name**	**Signature**
2/24/12	Jan Bosteiman	Jan Bosteiman

Receipt Instructions:

Sign, date and retain this attachment until all samples are received, analyzed and returned.
JM 2/27/2012
Image lower density areas of each of the three sample areas to observe fiber characteristics especially length.

Storage Instructions:

Store as needed.

Specimen Return Instructions:

After all samples have been analyzed, return samples to the
Alion Hydraulics Lab, 30W250 Butterfield Road, Suite 302, Warrenville, IL 60555
Phone 630-939-2214
JPS PM 2/27/2012

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ALION SCIENCE AND TECHNOLOGY	BWROG ECCS Strainer Bypass Test Report		
	Document No: BWROG-ECCS-TA13-004	Revision: 1	Page: O-118 of O-154

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page: B-11 of B-11

ALION SCIENCE AND TECHNOLOGY	Control of Materials and Chemicals		
	Document No.: ALION-SPP-LAB-2352-12	Revision: 3	Page D1 of D1

Attachment D – Specimen Distribution Form

Material/Chemical:	SEM Samples	Amount:	1 Sample
Supplier:	Alion	Alion Lot ID:	S03
Shelf Life/Expiration Date:	N/A	Tracking No.:	
Intended Use:	SEM Analysis		

Destination Plant/Lab	Address	Contact Name, Title	Phone No.
N/A	Jan Bostelman 2751 X Rd Brainard, NE 68626	Jan Bostelman	402-545-3871

Date Transmitted	Sender Name	Signature
1-18-12	J. Poska	Paul Miller for JP
Date Received	**Recipient Name**	**Signature**
1/24/12	Jan Bostelman	Jan Bostelman

Receipt Instructions:

Sign, date and retain this attachment until all samples are received, analyzed and returned.

Image lower density areas of each of the 4 sample areas to observe fiber characteristics especially length. JM 1-27-2012

Storage Instructions:

Store as needed.

Specimen Return Instructions:

After all samples have been analyzed, return samples to the

Alion Hydraulics Lab, 30W250 Butterfield Road, Suite 302, Warrenville, IL 60555

Phone 630-929-2214

313 JM 1/27/2012

Use or disclosure of this document is subject to the restriction on the Cover Sheet.

Use or disclosure of this document is subject to the restriction on the Cover Page

Attachment C: FE-SEM Image Logs

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg 8 of 14

Attachment 1 –

Optical Microscope or (SEM) Image Log

Calibration Grid

Sample ID#	Description	Date	Magnification X	Voltage (kV) (N/A for Optical Microscope) KV	Working Distance (N/A for Optical Microscope) mm	Image File Name
MRS 3X4	Grid	3/2/12	50	15	23	Grid_001
MRS 3X4	Grid	3/2/12	25	15	23	Grid_002
MRS 3X4	Grid	3/2/12	5000	15	23.4	Grid_003
MRS 3X4	Grid	3/2/12	5000	15	23.4	Grid_004
MRS 3X4	Grid	3/2/12	1500	15	23.4	Grid_005
MRS 3X4	Grid	3/2/12	2000	15	23.4	Grid_006
MRS 3X4	Grid	3/2/12	500	15	23.4	Grid_007
MRS 3X4	Grid	3/2/12	40	15	23.3	Grid_008

– Bathman, P.E. 3/2/12

ALION SCIENCE AND TECHNOLOGY	BWROG ECCS Strainer Bypass Test Report		
	Document No: BWROG-ECCS-TA13-004	Revision: 1	Page: O-120 of O-154

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page: C-2 of C-5

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg 8 of 14

Attachment 1 –

Optical Microscope or SEM Image Log

Sample ID#	Description	Date	Magnification X	Voltage (kV) (N/A for Optical Microscope) kV	Working Distance (N/A for Optical Microscope)	Image File Name
CSC7-1	fiber	3/1/12	50	15	16.3	C1_m01
CSC7-1	fiber	3/2/12	50	15	16.3	C1_m02
CSC7-1	fiber	3/2/12	50	15	16.3	C1_m03
CSC7-1	fiber	3/2/12	50	15	16.3	C1_m04
CSC7-1	fiber	3/2/12	25	15	16.3	C1_m05
CSC7-2	fiber	3/1/12	50	15	16.3	C2_m01
CSC7-2	fiber	3/2/12	50	15	16.3	C2_m02
CSC7-2	fiber	3/2/12	50	15	30.9	C2_m03
CSC7-2	fiber	3/2/12	50	15	30.9	C2_m04
CSC7-2	fiber	3/2/12	25	15	30.9	C2_m05
CSC7-3	fiber	3/1/12	50	15	30.9	C3_m01
CSC7-3	fiber	3/2/12	50	15	30.9	C3_m02
CSC7-3	fiber	3/2/12	50	15	30.9	C3_m03
CSC7-3	fiber	3/2/12	50	15	30.9	C3_m04
CSC7-3	fiber	3/2/12	25	15	30.9	C3_m05

cm per pixel 3/2/12

ALION SCIENCE AND TECHNOLOGY	BWROG ECCS Strainer Bypass Test Report		
	Document No: BWROG-ECCS-TA13-004	Revision: 1	Page: O-121 of O-154

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page: C-3 of C-5

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg 8 of 14

Attachment 1 –

Optical Microscope or SEM Image Log

Temp Mat

Sample ID#	Description	Date	Magnification X	Voltage (kV) (N/A for Optical Microscope) KV	Working Distance (N/A for Optical Microscope)	Image File Name
D3-3	fiber	3/2/12	50	15	30.9	D3_m01
D3-3	fiber	3/2/12	50	15	30.9	D3_m02
D3-3	fiber	3/2/12	50	15	30.9	D3_m03
D3-3	fiber	3/2/12	50	15	30.9	D3_m04
D3-3	fiber	3/2/12	25	15	30.9	D3_m05
D3-1	fiber	3/2/12	50	15	36.9	D1_m01
D3-1	fiber	3/2/12	50	15	30.9	D1_m02
D3-1	fiber	3/2/12	50	15	30.9	D1_m03
D3-1	fiber	3/2/12	50	15	30.9	D1_m04
D3-1	fiber	3/2/12	25	15	36.9	D1_m05
D3-2	fiber	3/2/12	50	15	36.9	D2_m01
D3-2	fiber	3/2/12	50	15	30.9	D2_m02
D3-2	fiber	3/2/12	50	15	36.9	D2_m03
D3-2	fiber	3/2/12	50	15	36.9	D2_m04
D3-2	fiber	3/2/12	25	15	30.9	D2_m05

[illegible], P.E. March 2, 2012

ALION SCIENCE AND TECHNOLOGY	BWROG ECCS Strainer Bypass Test Report		
	Document No: BWROG-ECCS-TA13-004	Revision: 1	Page: O-122 of O-154

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page: C-4 of C-5

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg 8 of 14

Attachment 1 –

Optical Microscope or SEM Image Log

Rockwell

Sample ID#	Description	Date	Magnification X	Voltage (kV) (N/A for Optical Microscope) kV	Working Distance (N/A for Optical Microscope)	Image File Name
R17-1	fiber	3/2/12	50	15	23	r1_m01
R17-1	fiber	3/2/12	50	15	23	r1_m02
R17-1	fiber	3/2/12	50	15	23	r1_m03
R17-1	fiber	3/2/12	50	15	23	r1_m04
R17-1	fiber	3/2/12	25	15	23	r1_m05
R17-2	fiber	3/2/12	50	15	23	r2_m01
R17-2	fiber	3/2/12	50	15	23	r2_m02
R17-2	fiber	3/2/12	50	15	23	r2_m03
R17-2	fiber	3/2/12	50	15	23	r2_m04
R17-2	fiber	3/2/12	25	15	23	r2_m05
R17-3	fiber	3/2/12	50	15	23	r3_m01
R17-3	fiber	3/2/12	50	15	23	r3_m02
R17-3	fiber	3/2/12	50	15	23	r3_m03
R17-3	fiber	3/2/12	50	15	23	r3_m04
R17-3	fiber	3/2/12	25	15	23	r3_m05
*						

mr Brittman P.E 3/2/12

* Note the new image photographs were not interpreted still not sure if R17 above correspond to sample R17-3 mounted Rockwell needs visit #3

ALION SCIENCE AND TECHNOLOGY	BWROG ECCS Strainer Bypass Test Report		
	Document No: BWROG-ECCS-TA13-004	Revision: 1	Page: O-123 of O-154

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page: C-5 of C-5

ALION SCIENCE AND TECHNOLOGY	Optical or Scanning Electron Microscopic Examinations			
	Document No: ALION-SPP-LAB-2352-24	Revision: 3	Date: 4/4/06	Pg 8 of 14

Attachment 1 –

Optical Microscope or SEM Image Log

N.Kar

Sample ID#	Description	Date	Magnification X	Voltage (kV) (N/A for Optical Microscope) KV	Working Distance (N/A for Optical Microscope) mm	Image File Name
SC3-1	fiber	3/21/12	50	15	30.9	S1_m01
S03-1	fiber	3/21/12	50	15	30.9	S1_m02
S23-1	fiber	3/21/12	50	15	30.9	S1_m03
S33-1	fiber	3/21/12	50	15	30.9	S1_m04
S63-1	fiber	3/21/12	25	15	30.9	S1_m05
S03-2	fiber	3/21/12	50	15	30.9	S2_m01
S23-2	fiber	3/21/12	50	15	30.9	S2_m02
S33-2	fiber	3/21/12	50	15	30.9	S2_m03
S63-2	fiber	3/21/12	50	15	30.9	S2_m04
S63-2	fiber	3/21/12	25	15	30.9	S2_m05
S03-3	fiber	3/21/12	50	15	23	S3_m01
S23-3	fiber	3/21/12	50	15	23	S3_m02
S63-3	fiber	3/21/12	50	15	23	S3_m03
S33-3	fiber	3/21/12	50	15	23	S3_m04
S63-3	fiber	3/21/12	25	15	23	S3_m05

Jon Boschma 4/2 3/21/12

Attachment D: FE-SEM Measurement Spreadsheets

Image #	#	Segment 1 Length (Pixels)	Segment 2 Length (Pixels)	Segment 3 Length (Pixels)	Segment 4 Length (Pixels)	Segment 5 Length (Pixels)	Segment 6 Length (Pixels)	Segment 7 Length (Pixels)	Segment 8 Length (Pixels)	Segment 9 Length (Pixels)	Segment 10 Length (Pixels)	Total Length (Pixels)	1 Pixel (µm)	Grid Adjusted Length (µm)	Length Category
cl_m01	1	322.2	295.5	55.2								672.9	2.049	1378.9	1000-1500
cl_m01	2	116.4	187	232.2								535.6	2.049	1097.6	1000-1500
cl_m01	3	251.9										251.9	2.049	516.2	500-1000
cl_m01	4	151										151.0	2.049	309.4	<500
cl_m01	5	245.7	60.8									306.5	2.049	628.1	500-1000
cl_m01	6	225.3	135.7	132.0	74	33	36.4	29.8				666.2	2.049	1365.2	1000-1500
cl_m01	7	255.2	47.2	35.5	77.4	74.8	92.1					582.2	2.049	1193.0	1000-1500
cl_m01	8	91.2										91.2	2.049	186.9	<500
cl_m01	9	182	98.2	177.5	19.2	167.3						644.2	2.049	1320.1	1000-1500
cl_m01	10	125.1	87.8									212.9	2.049	436.3	<500
cl_m02	1	164										164.0	2.049	336.1	<500
cl_m02	2	136.7	125.9	61.2	53.5	76.5	157.8	75.7	183.1	121.7	off page	992.1	2.049	2033.0	2000-2500
cl_m02	3	487.8										487.8	2.049	999.6	500-1000
cl_m02	4	239.7	266.3	83.8	38.9							628.7	2.049	1288.3	1000-1500
cl_m02	5	297.7	171.4	140.2	off page							609.3	2.049	1248.6	1000-1500
cl_m02	6	30	245.1	57.6	172.8	92.5	208.7	off page				806.7	2.049	1653.1	1500-2000
cl_m02	7	185.6	73.8	79.2								338.6	2.049	693.9	500-1000
cl_m02	8	161.6	168.2	162.4								492.2	2.049	1008.6	1000-1500
cl_m02	9	78.9										78.9	2.049	161.7	<500
cl_m03	10	98	81	55.5								234.5	2.049	480.5	<500
cl_m03	1	97.1	150.9	70.9								318.9	2.049	653.5	500-1000
cl_m03	2	239.1	165.3	143.6	107.8	157.6	91.7	182	244.6	122.5	off page	1454.2	2.049	2979.9	>2500

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Image #	#	Segment 1 Length (Pixels)	Segment 2 Length (Pixels)	Segment 3 Length (Pixels)	Segment 4 Length (Pixels)	Segment 5 Length (Pixels)	Segment 6 Length (Pixels)	Segment 7 Length (Pixels)	Segment 8 Length (Pixels)	Segment 9 Length (Pixels)	Segment 10 Length (Pixels)	Total Length (Pixels)	1 Pixel (µm)	Grid Adjusted Length (µm)	Length Category
c1_m03	3	197.3	118.7	94.8								410.8	2.049	841.8	500-1000
c1_m03	4	169.1										169.1	2.049	346.5	<500
c1_m03	5	280.7										280.7	2.049	575.2	500-1000
c1_m03	6	115.2	121.2	119.1	160.7	158.9						675.1	2.049	1383.4	1000-1500
c1_m03	7	81.6	245									326.6	2.049	669.3	500-1000
c1_m03	8	93.5	102	133.9	93.9	86.1						509.4	2.049	1043.9	1000-1500
c1_m03	9	93.2	84.2	74.4	107.2	268.9	125	143.8	229.9	85.7	off page	1212.3	2.049	2484.2	2000-2500
c1_m03	10	160.4	43.3	51.1	36.7	36.1						327.6	2.049	671.3	500-1000
c1_m04	1	49.2	90.5	106.5	79.2	107.9	117	220.8	72.9	off page		844.0	2.049	1729.5	1500-2000
c1_m04	2	238.9										238.9	2.049	489.6	<500
c1_m04	3	102.5	125.2	70.6	117.4							415.7	2.049	851.9	500-1000
c1_m04	4	283.2										283.2	2.049	580.3	500-1000
c1_m04	5	78	206.5	354.4								638.9	2.049	1309.2	1000-1500
c1_m04	6	245.2										245.2	2.049	502.5	500-1000
c1_m04	7	64	84.3	24.8								173.1	2.049	354.7	<500
c1_m04	8	153.6	130.6	108.3	49.6	53.8						495.9	2.049	1016.2	1000-1500
c1_m04	9	231.5	406.8	148.6								786.9	2.049	1612.5	1500-2000
c1_m04	10	67.3	130.8									198.1	2.049	405.9	<500
c1_m05	1	131.1	117	164.2	112							524.3	4.107	2153.2	2000-2500
c1_m05	2	310										310.0	4.107	1273.1	1000-1500
c1_m05	3	73.2										73.2	4.107	300.6	<500
c1_m05	4	77.5	83.2	49.6								210.3	4.107	863.7	500-1000
c1_m05	5	129.8	125.8	161.9								417.5	4.107	1714.6	1500-2000

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Image #	#	Segment 1 Length (Pixels)	Segment 2 Length (Pixels)	Segment 3 Length (Pixels)	Segment 4 Length (Pixels)	Segment 5 Length (Pixels)	Segment 6 Length (Pixels)	Segment 7 Length (Pixels)	Segment 8 Length (Pixels)	Segment 9 Length (Pixels)	Segment 10 Length (Pixels)	Total Length (Pixels)	1 Pixel (µm)	Grid Adjusted Length (µm)	Length Category
c1_m05	6	155.3	138.8	66.1								360.2	4.107	1479.3	1000-1500
c1_m05	7	101.2	76.9	11.3								189.4	4.107	777.8	500-1000
c1_m05	8	174.9	240.6	215.3	93.2	84.9	104.2	37.6	off page			950.7	4.107	3904.3	>2500
c1_m05	9	86.9	107.5	73	63.2	20.1						350.7	4.107	1440.3	1000-1500
c1_m05	10	123.8	76.1	98.4	67.7	52.3	69					487.3	4.107	2001.2	2000-2500
c2_m01	1	125.2	164.3	92.2								381.7	2.049	782.2	500-1000
c2_m01	2	99.8	149.3	107.3	95.3	57.4	48.5	7				564.6	2.049	1157.0	1000-1500
c2_m01	3	137.1	107.9	187.7	268.7	120						821.4	2.049	1683.2	1500-2000
c2_m01	4	315.8	15.9									331.7	2.049	679.7	500-1000
c2_m01	5	275	91.9									366.9	2.049	751.9	500-1000
c2_m01	6	136.9	106.3									243.2	2.049	498.4	<500
c2_m01	7	274.1	152.8									426.9	2.049	874.8	500-1000
c2_m01	8	158.1	52.4									210.5	2.049	431.4	<500
c2_m01	9	98.7	135.7	177.6								412.0	2.049	844.3	500-1000
c2_m01	10	277.6										277.6	2.049	568.9	500-1000
c2_m02	1	361	269.3									630.3	2.049	1291.6	1000-1500
c2_m02	2	94	224.8									318.8	2.049	653.3	500-1000
c2_m02	3	150.3	180.5	143.2	94.6	113.9						682.5	2.049	1398.6	1000-1500
c2_m02	4	413.8	126.8									540.6	2.049	1107.8	1000-1500
c2_m02	5	185.2	218	166.9	155.3							725.4	2.049	1486.5	1000-1500
c2_m02	6	340.6	40									380.6	2.049	779.9	500-1000
c2_m02	7	165.2	91.4	140.4	107.9	77.8	77.2	174	off page			833.9	2.049	1708.8	1500-2000
c2_m02	8	372.3										372.3	2.049	762.9	500-1000

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Image #	#	Segment 1 Length (Pixels)	Segment 2 Length (Pixels)	Segment 3 Length (Pixels)	Segment 4 Length (Pixels)	Segment 5 Length (Pixels)	Segment 6 Length (Pixels)	Segment 7 Length (Pixels)	Segment 8 Length (Pixels)	Segment 9 Length (Pixels)	Segment 10 Length (Pixels)	Total Length (Pixels)	1 Pixel (µm)	Grid Adjusted Length (µm)	Length Category
c2_m02	9	113.6	93	20.6								227.2	2.049	465.6	<500
c2_m03	10	140.4	126.5	158.8	181.2							606.9	2.049	1243.7	1000-1500
c2_m03	1	123	148.5	155.5	90.1							517.1	2.049	1059.6	1000-1500
c2_m03	2	89.1	54.6	41.3	226.6	146.7	52.5	43.3				654.1	2.049	1340.4	1000-1500
c2_m03	3	193.8	234.8									428.6	2.049	878.3	500-1000
c2_m03	4	208.6	125.4	200.1								534.1	2.049	1094.5	1000-1500
c2_m03	5	97.4	181.2	69.9	197.1	150.3						695.9	2.049	1426.0	1000-1500
c2_m03	6	171.9	207.9									379.8	2.049	778.3	500-1000
c2_m03	7	113.7	330.2	204.8								648.7	2.049	1329.3	1000-1500
c2_m03	8	156.3	141									297.3	2.049	609.2	500-1000
c2_m03	9	154.7	81.5									236.2	2.049	484.0	<500
c2_m03	10	48.3	64.5	86.7	60.9	77	33.3					370.7	2.049	759.6	500-1000
c2_m04	1	285.8	421.2	318.3	51.5							1076.8	2.049	2206.6	2000-2500
c2_m04	2	260	175.6	110	74.7	108.6						728.9	2.049	1493.7	1000-1500
c2_m04	3	264.7	92.5	32.2	72.1							461.5	2.049	945.7	500-1000
c2_m04	4	258.9	110.4	75.9								445.2	2.049	912.3	500-1000
c2_m04	5	159.1	96.1	55.3	56.6	50.2	60.4	62.2	69.9	33.1		642.9	2.049	1317.4	1000-1500
c2_m04	6	63.9										63.9	2.049	130.9	<500
c2_m04	7	244.7	184.8	41.5								471.0	2.049	965.2	500-1000
c2_m04	8	98.4	215.7	276.5								590.6	2.049	1210.3	1000-1500
c2_m04	9	102	172.7	44.9								319.6	2.049	654.9	500-1000
c2_m04	10	250.7										250.7	2.049	513.7	500-1000
c2_m05	1	91	83.9	32.6								207.5	4.107	852.2	500-1000

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Image #	#	Segment 1 Length (Pixels)	Segment 2 Length (Pixels)	Segment 3 Length (Pixels)	Segment 4 Length (Pixels)	Segment 5 Length (Pixels)	Segment 6 Length (Pixels)	Segment 7 Length (Pixels)	Segment 8 Length (Pixels)	Segment 9 Length (Pixels)	Segment 10 Length (Pixels)	Total Length (Pixels)	1 Pixel (µm)	Grid Adjusted Length (µm)	Length Category
c2_m05	2	172.2	139.8	52.4								364.4	4.107	1496.5	1000-1500
c2_m05	3	277.4										277.4	4.107	1139.2	1000-1500
c2_m05	4	129.7	171.7	26.1								327.5	4.107	1345.0	1000-1500
c2_m05	5	181.5	134.1									315.6	4.107	1296.1	1000-1500
c2_m05	6	116.4	90.6	77.9								284.9	4.107	1170.0	1000-1500
c2_m05	7	117.9	55.9	18.9	34.5							227.2	4.107	933.1	500-1000
c2_m05	8	59.8	168	14.3								242.1	4.107	994.3	500-1000
c2_m05	9	78.2	100.1	38.5	69.6	115.4	76.2					478.0	4.107	1963.1	1500-2000
c2_m05	10	369	132.8									501.8	4.107	2060.8	2000-2500
c3_m01	1	264.8	309.6	276.2								850.6	2.049	1743.0	1500-2000
c3_m01	2	112	116.8	117.2	103.5							449.5	2.049	921.1	500-1000
c3_m01	3	283.8	74.9									358.7	2.049	735.0	500-1000
c3_m01	4	227.3	158.1	255.7	316.6							957.7	2.049	1962.5	1500-2000
c3_m01	5	368.3	132.1									500.4	2.049	1025.4	1000-1500
c3_m01	6	235.2	16.6									251.8	2.049	516.0	500-1000
c3_m01	7	123.1	195.2	83.4	93							494.7	2.049	1013.7	1000-1500
c3_m01	8	274.4	132	46.2								452.6	2.049	927.5	500-1000
c3_m01	9	85.1	67.9	58.2	114.1	117.2	208.4	191.2	245.6	204.3	off page	1292.0	2.049	2647.6	>2500
c3_m01	10	123	87	44	101.6	47.2	89.6					492.4	2.049	1009.0	1000-1500
c3_m02	1	32.6	193	294.3	112.1	6.7						638.7	2.049	1308.8	1000-1500
c3_m02	2	185.0	155.2	130.6								470.8	2.049	964.8	500-1000
c3_m02	3	157.8	71.2	58.7	81	116.2	127.4	40.2				652.5	2.049	1337.1	1000-1500
c3_m02	4	193	119.5									312.5	2.049	640.4	500-1000

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Image #	#	Segment 1 Length (Pixels)	Segment 2 Length (Pixels)	Segment 3 Length (Pixels)	Segment 4 Length (Pixels)	Segment 5 Length (Pixels)	Segment 6 Length (Pixels)	Segment 7 Length (Pixels)	Segment 8 Length (Pixels)	Segment 9 Length (Pixels)	Segment 10 Length (Pixels)	Total Length (Pixels)	1 Pixel (µm)	Grid Adjusted Length (µm)	Length Category
c3_m02	5	125.5	62.9	56.4	65.5	70.7	163.9	55.4				600.3	2.049	1230.1	1000-1500
c3_m02	6	64	78.6	114	52.8	81.3	17.9					408.6	2.049	837.3	500-1000
c3_m02	7	52.4	178.1	39.6	145.3							415.4	2.049	851.2	500-1000
c3_m02	8	230.1										230.1	2.049	471.5	<500
c3_m02	9	184										184.0	2.049	377.1	<500
c3_m03	10	139.5	142.4	224.1	209.3							715.3	2.049	1465.8	1000-1500
c3_m03	1	53.5	118.9	68.4	212.2	138.1						591.1	2.049	1211.3	1000-1500
c3_m03	2	339.6	201	35.2								575.8	2.049	1179.9	1000-1500
c3_m03	3	176.4	127.6									304.0	2.049	623.0	500-1000
c3_m03	4	196.5	81	77.5	232.7	30	43.5	53				714.2	2.049	1463.5	1000-1500
c3_m03	5	167.2	101									268.2	2.049	549.6	500-1000
c3_m03	6	179.4	170.9									350.3	2.049	717.8	500-1000
c3_m03	7	119.9	67.1	239.7	60.4							487.1	2.049	998.2	500-1000
c3_m03	8	213.3	60.8	10.6								284.7	2.049	583.4	500-1000
c3_m03	9	181.6	174.7	158.4								514.7	2.049	1054.7	1000-1500
c3_m03	10	82.7										82.7	2.049	169.5	<500
c3_m04	1	147										147.0	2.049	301.2	<500
c3_m04	2	847.2	off page									847.2	2.049	1736.1	1500-2000
c3_m04	3	167	190.4	136.6	148.7	142.2	off page					784.9	2.049	1608.4	1500-2000
c3_m04	4	406.6	313.3	37.9	off page							757.8	2.049	1552.9	1500-2000
c3_m04	5	227.9	84.1	154	72.2	126.6	307.1	off page				971.9	2.049	1991.6	1500-2000
c3_m04	6	138.9										138.9	2.049	284.6	<500
c3_m04	7	148.9	236	309.1	149	off page						843.0	2.049	1727.5	1500-2000

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ALION SCIENCE AND TECHNOLOGY	BWROG ECCS Strainer Bypass Test Report		
	Document No: BWROG-ECCS-TA13-004	Revision: 1	Page: O-130 of O-154

ALION SCIENCE AND TECHNOLOGY	BWROG Downstream Effects Scanning Electron Microscope Analysis		
	Document No: BWROG-ECCS-TA13-003	Rev: 0	Page: D-7 of D-27

Image #	#	Segment 1 Length (Pixels)	Segment 2 Length (Pixels)	Segment 3 Length (Pixels)	Segment 4 Length (Pixels)	Segment 5 Length (Pixels)	Segment 6 Length (Pixels)	Segment 7 Length (Pixels)	Segment 8 Length (Pixels)	Segment 9 Length (Pixels)	Segment 10 Length (Pixels)	Total Length (Pixels)	1 Pixel (µm)	Grid Adjusted Length (µm)	Length Category
c3_m04	8	231.5	249.1	253.5	81.3							815.4	2.049	1670.9	1500-2000
c3_m04	9	478.8										478.8	2.049	981.2	500-1000
c3_m04	10	296.9	145.8									442.7	2.049	907.2	500-1000
c3_m05	1	184.5	142	293.3								619.8	4.107	2545.4	>2500
c3_m05	2	114	25.5	26.6	62.9	58.2	197.2	65.9	61.6	210.7	39.8	862.4	4.107	3541.7	>2500
c3_m05	3	79.5	151.4	65								295.9	4.107	1215.2	1000-1500
c3_m05	4	58.7	131.5	88.1								278.3	4.107	1142.9	1000-1500
c3_m05	5	132.3	169.8									302.1	4.107	1240.7	1000-1500
c3_m05	6	326.9	141.8									468.7	4.107	1924.9	1500-2000
c3_m05	7	164.1	13	120.8								297.9	4.107	1223.4	1000-1500
c3_m05	8	78.2	101.1	69	78.8	145.9	61.6	35.8				570.4	4.107	2342.5	2000-2500
c3_m05	9	55	120.4	147.7	100.2	83.9	135.7	55.5	off page			698.4	4.107	2868.2	>2500
c3_m05	10	72.6										72.6	4.107	298.2	<500
d1_m01	1	521.7	295.4	off page								817.1	2.049	1674.4	1500-2000
d1_m01	2	682	501.4	off page								1183.4	2.049	2425.0	2000-2500
d1_m01	3	838.5										838.5	2.049	1718.3	1500-2000
d1_m01	4	799.4	off page									799.4	2.049	1638.1	1500-2000
d1_m01	5	558.8	382.2	205.8	off page							1146.8	2.049	2350.0	2000-2500
d1_m01	6	591.3	144.9	off page								736.2	2.049	1508.6	1500-2000
d1_m01	7	567.8	487.5	off page								1055.3	2.049	2162.5	2000-2500
d1_m01	8	192.7	279.4	252								724.1	2.049	1483.8	1000-1500
d1_m01	9	715.4	off page									715.4	2.049	1466.0	1000-1500
d1_m01	10	343.2	373.1									716.3	2.049	1467.8	1000-1500

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