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QS-504 Validation Summary v3
Spore Strip Product Line

Executive Summary

The Spore Strip manufacturing process is validated according to QS-501 *Validation Master Plan for the Mesa Labs, Inc., Bozeman Manufacturing Facility 625 Zoot Way.*

The Spore Strip manufacturing process, under anticipated conditions, will consistently produce product that meets pre-determined specification requirements.

Process Performance Qualification

Process Performance Qualification (PPQ) conducted under Protocol #170710P *Performance Qualification for the Manufacture of Omaha Manufacturing Facility (OMF) Spore Strips.* This PPQ qualifies manufacturing of all OMF Spore Strips catalog numbers at 625 Zoot Way, Bozeman MT 59718. A list of catalog numbers validated under Protocol #170710 is attached to this summary document.

Initial Validation Lots

77-01-1-6100; BATR log spore strips 100/bag, Lot BAS-001
77-01-5-1000NBC; GST/BATR log 5/6 "CONTROL" combined strip 1000/box, Lot DSS-001
77-01-5-1000T; GST/BATR log 5/6 "TEST" combined strip 1000/bag, Lot DSS-002

Additional validation lots to qualify Chemiclave and EO testing per ZT-CAPA-1722 and ZT-CAPA-1723

77-01-3-6100; GST spore strips, Lot GSS-002
77-01-5-1000NBT, combined strip, Lot DSS-003

Rationale for selection of products

Spore strip manufacturing is a three-phase process: inoculation, packaging and qualification. The inoculation phase consists of distributing an aqueous suspension of bacteria onto a roll of paper using the rollstrip inoculation system (INO-101). The paper is allowed to dry and then packaged into glassine envelopes on Spore Strip Packaging machines (SSP-101 and SSP-102). Once packaged, the strips are subjected to qualification testing consisting of population and resistance testing. Depending upon the species of bacteria on the strips they are subjected to steam, EO, and/or dry heat resistance testing. The exposed strips are cultured in growth media and incubated at the appropriate temperature. The resulting data are used to generate the label claim for each lot of strips. Satisfactory completion of the qualification testing results in release of the strips for distribution.

A matrix approach was chosen for validation of the manufacturing process:

- The components used to manufacture these items are representative of the components used to manufacture all variants of Spore Strips.
- The two organisms used for the validation lots, *Bacillus atrophaeus* and *Geobacillus stearothermophilus*, are the only two used to manufacture Spore Strips.
- Three runs were considered sufficient to simulate conditions that will be encountered during routine manufacturing, such as start-up, shut-downs, breaks, and manufacturing over multiple days.

As compared to the manufacturing process prior to transfer to the new facility, there were no changes to the manufacturing process, no changes to specifications, and no changes to components or component suppliers. Procedures were renumbered to align with the quality system, and a number of minor changes occurred to allow for slightly different workflow in the new facility; they otherwise remained unchanged.

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Acceptance criteria and results

Three consecutively manufactured lots meeting the criteria provided below were required to confirm that the Spore Strip manufacturing process, under anticipated conditions, will consistently produce product that meets pre-determined specification requirements.

For the QA final inspection per QSWI-103, the Acceptable Quality Level (AQL) for acceptability of a particular lot's inclusion in this qualification was based on criticality and frequency of the defect. If the lot in question fell within these established limits it was deemed acceptable for use as a validation lot. The defects were divided into two tiers. Defects considered *Critical to Peformance* were assigned an AQL of 99%. Defects considered as having *No Impact to Peformance* were assigned an AQL of 95%. Results are reported below for each validation lot.

77-01-1-6100, Lot BAS-001		
Critical to Performance	**Results**	**Pass/Fail**
Population on assayed strip must be the targeted population log BATR log6	$2.3x10^6$	PASS
Steam D-value must be within the range of 1.5-2.2minutes (if applicable)	Not Applicable	NA
EO D-value must be greater than 2.0minutes when tested in 100% EO	2.8 minutes	PASS
Dry Heat D-value must be within the range of 1.0-3.0minutes	2.1 minutes	PASS
Labeling, specific to product traceability (species, lot number and expiration)	0 labeling errors	PASS
No Impact to Performance	**Results**	**Pass/Fail**
Position of print on glassine or bag/box label	0 printing errors	PASS
Inclusion of C of A in package	0 packaged without a C of A	PASS
Quantity per box/bag (weigh count): 100pk bag: +1/-0	Confirmed by Production to be within acceptable range	PASS

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77-01-5-1000NBC, Lot DSS-001		
Critical to Performance	**Results**	**Pass/Fail**
Population on assayed strip must be the targeted population log BATR log6 / GST log5	(BATR) $2.0x10^6$ (GST) $1.8x10^5$	PASS
Steam D-value must be within the range of 1.5-2.2minutes (if applicable)	1.9 minutes	PASS
EO D-value must be greater than 2.0minutes when tested in 100% EO	2.8 minutes	PASS
Dry Heat D-value must be within the range of 1.0-3.0minutes	2.0 minutes	PASS
Labeling, specific to product traceability (species, lot number and expiration)	0 labeling errors	PASS
No Impact to Performance	**Results**	**Pass/Fail**
Position of print on glassine or bag/box label	0 printing errors	PASS
Inclusion of C of A in package	0 packaged without a C of A	PASS
Quantity per box/bag (weigh count): 1000pk box: +5/-0	Confirmed by Production to be within acceptable range	PASS

77-01-5-1000T, Lot DSS-002		
Critical to Performance	**Results**	**Pass/Fail**
Population on assayed strip must be the targeted population log BATR log6 / GST log5	(BATR) $2.3x10^6$ (GST) $2.6x10^5$	PASS
Steam D-value must be within the range of 1.5-2.2minutes (if applicable)	1.9 minutes	PASS
EO D-value must be greater than 2.0minutes when tested in 100% EO	2.7 minutes	PASS
Dry Heat D-value must be within the range of 1.0-3.0minutes	2.0 minutes	PASS
Labeling, specific to product traceability (species, lot number and expiration)	0 labeling errors	PASS
No Impact to Performance	**Results**	**Pass/Fail**
Position of print on glassine or bag/box label	0 printing errors	PASS
Inclusion of C of A in package	0 packages without a C of A	PASS
Quantity per box/bag (weigh count): 1000pk bag: +5/-0	Confirmed by Production to be within acceptable range	PASS

77-01-3-6100, Lot GSS-002		
Critical to Performance	**Results**	**Pass/Fail**
Chemiclave testing must result in all survive after a zero second exposure	All Survive	PASS
Chemiclave testing must result in all kill after a 10minute exposure	All Kill	PASS

77-01-5-1000NBT, Lot DSS-003		
Critical to Performance	**Results**	**Pass/Fail**
EO D-value must be greater than 2.0minutes when tested in 100% EO	2.4minutes	PASS

Deviations to protocol

There were four deviations to Protocol #170710P.

Deviation Number	Summary	Impact
170710-D-001	Chemiclave testing was not performed on the two lots of combined spore strips, lots DSS-001 and DSS-002 as required by the protocol. Chemiclave testing cannot be performed on these lots because the GST population is only log5 and chemiclave testing requires log6 strips.	The qualification proceeded without the chemiclave testing. Once the first lot of log6 GST strips is manufactured, chemiclave testing will be completed to qualify that testing process and an addendum/revision will be made to the PPQ report. ZT-CAPA-1722
170710-D-002	EO resistance testing was performed and the exposed BIs were incubated at the 10 Evergreen Drive facility because the resistometer at the 625 Zoot facility was not available for use.	A subsequent lot of spore strips will be tested in the EO resistometer at 625 Zoot Way to qualify that testing process and an addendum/revision will be made to the PPQ report. ZT-CAPA-1723
170710-D-003	A total of 138 boxes of item #77-01-5-1000NBC were produced instead of 3 boxes as stated in the protocol.	There is no negative impact to protocol, increasing the quantity of boxes for the PPQ provides a better representation of a production run for this item.
170710-D-004	The protocol implies but does not specifically state that QA/QC will verify the quantity of strips per package. The count verification was performed instead by Production per standard operating procedure AP-301.	No negative impact to protocol. Approved procedures were followed for piece counting and release of the lot.

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Method Verification

The following Compendial Method Verifications were completed as part of this protocol:

- Population assay testing of paper based BI carriers per ISO 11138-1
- Steam resistance testing on paper carriers in glassine per ISO 11138-3
- Dry Heat resistance testing on paper carriers in glassine per ISO 11138-4
- EO resistance testing on paper carriers in glassine per ISO 11138-2.

Equipment Qualification

Equipment Number	Equipment	Qualification document(s)	Protocol Deviations	Conclusion
INO-101	Rollstrip Inoculation Machine	INO101-IOQ-101	None	The rollstrip inoculation machine has been installed successfully. The installation and operation qualification criteria have been met.
STZ-101	Steam Autoclave	STZ101-IOQ-001	None	The Steam Autoclave has been installed successfully. The installation, operation, and performance criteria have been met.
		STZ101-PQ-003	None	
STZ-102	Steam Autoclave	STZ102-IOQ-001	None	The Steam Autoclave has been installed successfully. The installation, operation, and performance criteria have been met.
		STZ102-PQ-001	None	
		STZ102-PQ-004	None	
SSP-101	Spore Strip Packaging Machine	SSP101-IOQ-001	None	The Spore Strip Packaging machine has been installed successfully. The installation and operation qualification criteria have been met.
SSP-102	Spore Strip Packaging Machine	SSP102-IOQ-001	None	The Spore Strip Packaging machine has been installed successfully. The installation and operation qualification criteria have been met.
RES-101	Steam Resistometer	RES101-IOQ-001	None	The steam resistometer has been installed successfully. The installation and operation qualification criteria have been met.

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Equipment Number	Equipment	Qualification document(s)	Protocol Deviations	Conclusion
RES-102	Ethylene Oxide Resistometer	RES102-IOQ-001	D-001: Original protocol referenced a form that was made obsolete prior to execution of the protocol. No impact; the current form was used.	The Ethylene Oxide resistometer has been installed successfully. The installation and operation qualification criteria have been met.
RES-103	Steam Resistometer	RES103-IOQ-001	D-001: the resistometer was only qualified up to 132°C instead of 135°C. No impact to PPQ protocol or product.	The steam resistometer has been installed successfully. The installation and operation qualification criteria have been met.
RES-104	Dry Heat Resistometer	RES104-IOQ-001	None	The dry heat resistometer has been installed successfully. The installation and operation qualification criteria have been met.
RES-105	Harvey Chemiclave	RES105-IOQ-001	None	The Harvey Chemiclave has been installed successfully. The installation and operation qualification criteria have been met.
INC-103	30-35 °C Incubator	INC103-IOQ-001	None	The 30-35°C incubator has been installed successfully. The installation and operation qualification criteria have been met.
INC-105	55-60 °C Incubator	INC105-IOQ-001	None	The 55-60°C incubator has been installed successfully. The installation and operation qualification criteria have been met.
INC-107	58-62 °C Incubator	INC107-IOQ-001	None	The 58-62°C incubator has been installed successfully. The installation and operation qualification criteria have been met.

Utility Qualification

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System Number	Utility	Qualification document(s)	Protocol Deviations	Conclusion
AIR-101	Compressed Air System	AIR101-IOQ-001	None	The Compressed Air System has been installed successfully. The installation and operation qualification criteria have been met.
STM-101	Steam System	STM101-IOQ-001	None	The Steam System has been installed successfully. The installation and operation qualification criteria have been met.
WPU-101	RO/DI Water System	WPU101-IOQ-001	None	The RO/DI Water System has been installed successfully. The installation and operation qualification criteria have been met.
		WPU101-PQ-001	Six deviations, described below. No impact to protocol.	The RO /DI water system meets acceptance criteria. Data confirm that the system generates water that meets or exceeds Type II RO/DI water specifications.

Deviations to WPU101-PQ-001:

- WPU101-PQ-001-D-01 was opened to document that microbial data gathered before 11 Jul 2017 were determined to be invalid, as it was discovered that the filters used for testing were not sterile. No impact to the protocol; the required 30 business days of testing was completed.
- WPU101-PQ-001-D-02 was opened for using expired test strips to record the ozone levels. Data were invalidated. No impact to the protocol; the required 30 business days of testing was completed.
- WPU101-PQ-001-D-03 was opened for having a detectable level of ozone present in the water when ozone wasn't being generated. Data were invalidated. No impact to the protocol; the reason ozone was detected was that Facilities had run the ozone cycle less than 90 minutes before the testing was performed.
- WPU101-PQ-001-D-04 was opened to document that the form used to record data for this study included an action limit for a sampling point before the RO tanks. No action limit should have been set, as this data was being gathered for information only, is not part of the RO system, and was not included in the performance qualification. No impact to the protocol, as all data required for the protocol were gathered and are reported.
- WPU101-PQ-001-D-05 was opened to document that all microbial testing was performed at 10 Evergreen Drive instead of at 625 Zoot Way. No impact to protocol; testing was performed and documented according to procedures and forms identified in the protocol.
- WPU101-PQ-001-D-06 was opened to document that microbial samples were incubated at room temperature instead of in a 20-25 °C incubator as specified in the protocol. No impact to protocol; room temperatures were confirmed to have remained with 20-25 °C for the period of the study.

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Standard Operating Procedures

Document Number	Revision	Title
LP-205	1	Preparation of Spore Dilution for Production
LP-302	2	Resistance Determination of Biological Indicators
LP-305	1	Population Assay of Biological Indicator Products
LP-404	1	Operation of Steam BIERs
LP-417	1	Operation of Ethylene Oxide (EO) BIERs
LP-418	2	Operation of Dry Heat BIERs
LP-420	1	Rollstrip Inoculation System
LP-421	1	Operation of Chemiclave Sterilizer
AP-201	2	Packaging of Product
AP-202	2	Inspection of Biological Indicators and Releasat Media Tubes
AP-301	1	Spore Strip Packager Operation
QSWI-103	1	QA Release of Finished Product Inventory

Training

The operators in the table below completed qualification training on the SOPs identified above during the PPQ.

Operator	Procedure(s)	Status of read-and-understand training on SOPs	Status of qualification training on SOPs
CV	LP-205, LP-302, LP-305, LP-404, LP-417, LP-420	Complete	Complete
BRS	LP-305	Complete	Complete
PS	LP-302, LP-305, LP-404	Complete	Complete
NA	LP-302, LP-305, LP-418	Complete	Complete
AS	LP-418, LP-421	Complete	Complete
NF	AP-201, AP-202, AP-301	Complete	Complete
JS	AP-201, AP-202, AP-301	Complete	Complete
AT	AP-201, AP-202, AP-301	Complete	Complete
GS	AP-201, AP-202, AP-301	Complete	Complete

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Approvals:

Process Owner: _____ Date: 23 Mar 2018
Beth Ridgeway - Director of Production

Process Owner: _____ Date: 25 Mar 2018
Robert Bradley - Director of Production

QA: _____ Date: 23 Mar 2018
Janis Smoke - Director of QA/RA

Attachment:

- List of catalog numbers validated under Protocol #170710

Document Change History

Revision	Changes	Reason for change
1	Original document	N/A
2	Added attachment	Attachment referenced in Process Performance Qualification section but inadvertently omitted from Rev 1
3	Corrected typographical errors in CAPA numbers reported in Deviations to Protocol section. Added data supporting qualification of chemiclave and EO testing not performed in initial qualification.	Typographical errors copied over from 170701R. Additional testing performed per ZT-CAPA-1722 and ZT-CAPA-1723.

Attachment 1
Summary report for PQ170710

Catalog Numbers Validated Under PQ170710

Organism	Catalog Number
Bacillus atrophaeus	1-4100
	1-6100
	1-6100BAG
	1-6500
	1-1000
Organism	**Catalog Number**
Geobacillus stearothermophilus	3-4100
	3-5100
	3-5100BAG
	3-1000
	3-6100
	3-6100BAG
Organism	**Catalog Number**
Bacillus atrophaeus *Geobacillus stearothermophilus*	5-5100T
	5-5100BAG
	5-1000C
	5-1000T
	5-1000NBT
	5-1000NBC