Results of the IEC 61508 Functional Safety Assessment

Project:
4200 Coriolis Flowmeter

Customer:
Micro Motion, Inc.
Emerson
Boulder, CO
USA

Contract No.: Q23/01-183
Report No.: EMM 18-01-017 R002
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Management Summary

The Functional Safety Assessment of the Micro Motion, Inc. 4200 Flowmeter development project, performed by *exida* consisted of the following activities:

- *exida* assessed the development process used by Micro Motion, Inc. through an audit and creation of a detailed safety case against the accredited *exida* certification scheme which includes the relevant requirements of IEC 61508. The assessment was executed using subsets of the IEC 61508 requirements tailored to the work scope of the development team.
- *exida* performed and assessed a detailed Failure Modes, Effects, and Diagnostic Analysis (FMEDA) of the device to document the hardware architecture and failure behavior.
- *exida* reviewed the manufacturing quality system in use at Micro Motion, Inc..

The functional safety assessment was performed to the SIL 3 requirements of IEC 61508:2010. A full IEC 61508 Safety Case was created using the *exida* Safety Case tool, which also was used as the primary audit tool. Hardware and software process requirements and all associated documentation were reviewed. Environmental and validation test reports were reviewed. The user documentation and safety manual also were reviewed.

The results of the Functional Safety Assessment can be summarized by the following statements:

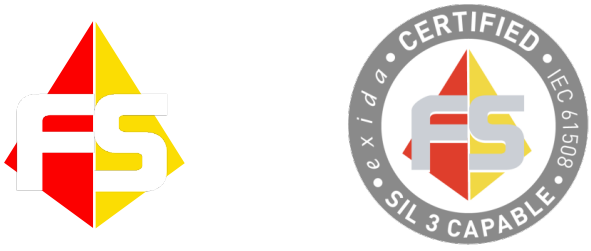
The audited development process, as tailored and implemented by the Micro Motion, Inc. 4200 Flowmeter development project, complies with the relevant safety management requirements of IEC 61508 SIL 3.

The assessment of the FMEDA, done to the requirements of IEC 61508, has shown that the 4200 Flowmeter can be used in a safety related system in a manner where the PFH/PFD_{AVG} is within the allowed range for SIL 2 @HFT = 0 or SIL 3 @HFT = 1, according to table 2 or table 3 of IEC 61508-1.

The assessment of the FMEDA also shows that the 4200 Flowmeter meets the requirements for architectural constraints of an element such that it can be used to implement a SIL 2 safety function (with HFT = 0) or a SIL 3 safety function (with HFT = 1).

This means that the 4200 Flowmeter is capable for use in up to SIL 3 applications when properly designed into a Safety Instrumented Function per the requirements in the Safety Manual and when using the versions specified in section 3.1 of this document.

The manufacturer will be entitled to use the *exida* Functional Safety Logo:



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1 Purpose and Scope

This document shall describe the results of the IEC 61508 functional safety assessment of the

- 4200 Coriolis Flowmeter

by *exida* according to the accredited *exida* certification scheme which includes the requirements of IEC 61508:2010.

The purpose of the assessment was to evaluate the compliance of the 4200 Flowmeter with:

- the technical requirements of IEC 61508-2 and -3 for SIL 3 and the derived product safety properties;

and

- the managerial requirements of IEC 61508-1, -2 and -3 for SIL 3 development processes, procedures and techniques as implemented for the safety-related deliveries;

and

- the relevant requirements of IEC 61508-2 hardware analysis represented by the Failure Mode, Effects and Diagnostic Analysis.

The assessment has been carried out based on the quality procedures and scope definitions of *exida*.

The results of this assessment provide the safety instrumentation engineer with the required failure data per IEC 61508 / IEC 61511 and confidence that sufficient attention has been given to systematic failures during the development process of the device.

1.1 Tools and Methods used for the assessment

This assessment was carried by using the *exida* Safety Case tool. The Safety Case tool contains the *exida* scheme which includes all the relevant requirements of IEC 61508.

For the fulfillment of the objectives, expectations are defined which builds the acceptance level for the assessment. The expectations are reviewed to verify that each single requirement is covered. Because of this methodology, comparable assessments in multiple projects with different assessors are achieved. The arguments for the positive judgment of the assessor are documented within this tool and summarized within this report.

The assessment was planned by *exida* agreed with Micro Motion, Inc. (see [R2]).

All assessment steps were continuously documented by *exida* (see [R1]).

2 Project Management

2.1 *exida*

exida is one of the world's leading accredited Certification Bodies and knowledge companies, specializing in automation system safety and availability with over 500 person-years of cumulative experience in functional safety. Founded by several of the world's top reliability and safety experts from assessment organizations and manufacturers, *exida* is a global company with offices around the world. *exida* offers training, coaching, project-oriented system consulting services, safety lifecycle engineering tools, detailed product assurance, cyber-security and functional safety certification, and a collection of on-line safety and reliability resources. *exida* maintains a comprehensive failure rate and failure mode database on process equipment based on 350 billion hours of field failure data.

2.2 Roles of the parties involved

Micro Motion, Inc.	Manufacturer of the 4200 Coriolis Flowmeter
exida	Performed the hardware assessment [R3]
exida	Performed the Functional Safety Assessment [R1] per the accredited *exida* certification scheme.

Micro Motion, Inc. contracted *exida* with the IEC 61508 Functional Safety Assessment of the above-mentioned devices.

2.3 Standards / Literature used

The services delivered by *exida* were performed based on the following standards / literature.

[N1]	IEC 61508 (Parts 1 – 7): 2010	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems

2.4 Reference documents

Note: Documents revised after the 2020 audit are listed in Section 6, 2023 IEC 61508 Functional Safety Surveillance Audit.

2.4.1 Documentation provided by Micro Motion, Inc.

Doc. ID	Document Description	Project Document Filename	Version	Date
D001	Quality Manual	Flow Measurement Products Quality Manual.pdf	Rev. AG	9/22/2017
D003	Overall Development Process - Prod. Dev.	GWI 318 Product Development and Design Control.docx	Rev. AF	1/1/2018

Doc. ID	Document Description	Project Document Filename	Version	Date
D003b	Overall Development Process - Sustaining Eng.	GWI 33 Sustaining Engineering Stage Gate Process.docx	Rev. F	3/22/2017
D003d	Overall Development Process - Sys. Arch. And Safety Reqs.	LWI 133 Systems Architecture and Safety Requirements Guidelines.docx	Rev. K	4/11/2017
D003e	Overall Development Process - Safety Manual Guideline	LWI 186 Safety Manual Creation Guideline.docx	Rev. F	4/11/2017
D005	Field Failure Reporting Procedure	GWI 235 RMA Evaluation Writing Standard.docx	Rev. F	4/6/2017
D006	Field Return Procedure	LWI 15 Return Material Authorization.docx	Rev. AF	4/14/2017
D007	Manufacturer Qualification Procedure	GWI 380 Supplier Quality Manual.docx	Rev. N	11/8/2017
D008	Part Selection & Corrective Action Procedure	GWI 320 Temporary Deviation Authorization.docx	Rev. U	4/6/2017
D010	Quality Management System (QMS) Documentation Change Procedure	GWI 321 Document Control.docx	Rev. Q	2/12/2018
D012	Non-Conformance Reporting procedure	GWI 47 Non-conforming Material Process and System Identification and Data Collection.docx	Rev. AF	7/12/2018
D016	Action Item List Tracking Procedure	GWI 318 Product Development and Design Control.docx	Rev. AF	1/1/2018
D018	Test Equipment Calibration Procedure	LWI 31 Inspection, Measuring and Test Equipment Calibration.docx	Rev L	2/12/2018
D019	Customer Notification Procedure	GWI 305 Product Safety.docx	Rev. L	12/28/2017
D019b	Customer Tech & Service Bulletins	GWI 03 Technical Bulletins, Service Bulletins and Knowledge Based Articles.docx	Rev. F	3/8/2017

Doc. ID	Document Description	Project Document Filename	Version	Date
D019c	Customer Notification Guideline	GWI 371 Product Notification.docx	Rev. G	Dec.2017
D021	Software Development, Requirements Management, & Configuration Management Process; Software Verification Plan; Coding Standard	LWI 23 Software Development Process.docx	Rev. AE	6/1/2018
D021b	Software Tool Qualification Procedure; List of Design Tools; Tool Qualification Report	Software Tools List and HAZOP.xlsx	1.8	Jul.2019
D023	Modification & Corrective Action Procedure	GWI 336 Design Change Process.docx	Rev. O	3/1/2019
D023b	Impact Analysis Template	GWI 336-A9 SIL Impact Analysis Worksheet.docx	Rev. B	n/a
D023d	Modification Procedure-SIL	SOP_25_SIL_Process.docx	n/a	9/11/2017
D026	FSM Plan or Development Plan	4200 Software Project Plan.doc	Rev. 0.2	3/7/2019
D026b	FSM Plan, Configuration Management & Development Plan, & Skills Matrix	4700 Project Plan.docx	Rev. E	5/17/2018
D033	Training Record and Competencies	SW Team Training.pdf	snapshot	May.2015
D036	ISO 900x Cert or equivalent	Flow Measurement ISO 9001 2015 cert to Dec 2019.pdf	n/a	Expires: Dec.2019
D040	System Safety & Software Safety Requirements Specification, incl. System Architecture Design and Test Traceability	MMI SIL 4200 SASRD.docx	V1.0	Jul. 2018
D040b	Safety Requirements Specification - Cust Reqs.	4700 CRD Final Draft Prior to Gate 2.docx	1	9/27/2016

Doc. ID	Document Description	Project Document Filename	Version	Date
D040c	Safety Requirements Specification - Marketing requirements	4200 2-wire RFS.xlsx	Rev. 0.09	5/10/2018
D040d	Safety & Software Safety Requirements Specification; Requirements Traceability Matrix	4700 SRS.xlsx	Rev. 1.01	6/22/2018
D041	Safety Requirements Review	4200 SRS review.docx	n/a	10/25/17 – 11/9/17
D045	System Architecture Design Specification	EB-xxxx_AA_2_26_2018.docx	AA	Feb.2018
D049	High Level & Detailed Software Design Specification; Module Test Plan	4700 SADD.docx	Rev. 0.03	1/30/2019
D050	SW HAZOP or Criticality Analysis	EMM 16-01-135 R001 V1R2 HAZOP Report 4700.doc	V1R2	Mar.2019
D053	Design Review Record	Elec_Design_Review.pptx	n/a	Mar.2018
D053b	Design Review Record-Process	GWI 91 Product Design Reviews and Design Conformance.docx	N	Apr.2017
D054	Verification Results	4200 Stage Gate 4 - Final.pptx	n/a	Mar.2019
D057	Software Test Coverage Analysis Report	4200 v0.33 Code Coverage Report.xlsx	0.2	11/15/2018
D058b	Code Review Record-example 1	code review CEJZ.docx	n/a	Nov.2017
D058c	Code Review Record-example 2	code review DKXD.docx	n/a	Nov.2017
D060	Coding Standard	C and C++ Coding Standard.docx	J	Jul.2015
D061	Static Code Analyzer Configuration Description	au-exida.lnt	V1.3	6/14/2004
D062	Static Code Analysis Results	lintResults.txt	V0.33	Jul.2019

Doc. ID	Document Description	Project Document Filename	Version	Date
D064b	Module Test Plan - Test Scripts	mao_test.h	1.1	Dec.2017
D065	Module test Plan Review Sample	Software Unit Test Research.docx	n/a	Aug.2015
D066	Module test Results	4200 v0.33 Unit Test Report.log	0.33	Nov.2017
D067	Integration Test Plan ;Validation Test Plan	4200 Test Plan v1.1.docx	1.1	Jan.2018
D069	Validation Test Plan - Gen5	4200_Module_Validation_REVA C_Working.docx	AC	Jul.2019
D069d	Validation Test Plan - Display	4200 Display Validation Test Plan.docx	AA	Mar.2018
D071	Environmental Test Plan	4200 Alpha 2 Reliability Qualification Test Plan Rev 1.0.pdf	1.0	Oct.2018
D071b	Environmental Test Plan	GWI 89 Four Corners Test Procedure.docx	D	Apr.2018
D071c	Environmental Test Plan	GWI 93 Sensor Vibration Testing.docx	D	Apr.2018
D071d	Environmental Test Plan-Vib Elec	GWI 101 Electronics Reliability Vibration Procedure.docx	D	Apr.2018
D073	Name of Change Request Tracking System	3D Experience | ENOVIA Collaboration and Approvals	n/a	n/a
D074	Validation & Integration Test Results	ENG_VAL_4200_ALPHA2_JULY 17.xlsx	AC	Jul.2019
D074b	Validation Test Plan & Results -HART	HART Field Device Test Report_4200_updated.pdf	5	May.2018
D074c	Validation Test Results -SMV AdHoc	4200 SMV Adhoc results v 1.10.xlsx	1.1	Mar.2019
D074d	Validation Test Results - Display	ENG_VAL_4200_DISPLAY_INS TRUTECH.xlsx	AB	Apr.2018
D075	Environmental Test Results	4200 Pilot Reliability Qualification Test Report Rev 1.1.pdf	1.1	Apr.2019
D076	EMC Test Plan & Results	EMC_Report_4200.pdf	n/a	Apr.2019

Doc. ID	Document Description	Project Document Filename	Version	Date
D077	Fault Injection Test Plan & Results	MiMo 18-01-017 R002 V0R1 FIT List 4200 completed.xls	n/a	8/1/2018
D078	Operation / Maintenance Manual	4200INS_MMI-20058013AA.pdf	Rev AA	Apr.2019
D078b	Operation / Config Manual	MM4200_CON_20048166AA.pdf	Rev AA	Apr.2019
D079	Safety Manual	4200SIS_ENG_20049802A.pdf	Rev A	Apr.2019
D079b	Safety Manual - Data Sheet	4200PDS_PS-002153A.pdf	Rev A	Apr.2019

2.4.2 Documentation generated by *exida*

[R1]	EMM 18-01-017 V2R3 61508 Safety Case WB - 4200.xlsm, July.2019	SafetyCase
[R2]	Q18-01-017 4200 MicroMotion Transmitter Certification Proposal.pdf, Feb.2018	Assessment Plan
[R3]	MiMo 18-01-017 R001 V2R2 FMEDA 4200.pdf, July.2019	FMEDA report
[R4]	Micromotion 4200 Site Audit.docx, Mar.2019	Onsite Audit Report

2.5 Assessment Approach

The certification audit was closely driven by requirements of the accredited *exida* certification scheme which includes subsets filtered from IEC 61508.

The assessment was planned by *exida* and agreed with Micro Motion, Inc..

The following IEC 61508 objectives were subject to detailed auditing at Micro Motion, Inc.:

- FSM planning, including
  - Safety Life Cycle definition
  - Scope of the FSM activities
  - Documentation
  - Activities and Responsibilities (Training and competence)

    - Configuration management
    - Tools and languages
- Safety Requirement Specification
- Change and modification management
- Software architecture design process, techniques and documentation
- Hardware architecture design - process, techniques and documentation
- Hardware design / probabilistic modeling
- Hardware and system related V&V activities including documentation, verification
    - Integration and fault insertion test strategy
- Software and system related V&V activities including documentation, verification
- System Validation including hardware and software validation
- Hardware-related operation, installation and maintenance requirements

The project teams, not individuals, were audited.

The onsite audit was done Micro Motion, in Boulder, CO, in August 2018.

3 Product Description

The Micro Motion, Inc. 4200 Coriolis Flowmeter is a two-wire smart device consisting of Coriolis sensors and a microprocessor-based transmitter that provides mass flow measurement of liquids, gases, and slurries with high accuracy. In addition to mass flow, it can also directly measure the average density of the material being measured and monitors the temperature. By use of the density and mass flow measurements, the more typical volumetric flow rate can also be calculated. The primary analog milliamp output, Channel A, must be used for the safety critical variable (mass flow, volume flow or density); all other outputs are considered outside the scope of safety instrumented systems (SIS) usage. A basic version of Smart Meter Verification (SMV) is included and provides a quick assessment of the meter, determining whether the meter has been affected by erosion, corrosion, or other influences affecting meter calibration.

3.1 Hardware and Software Version Numbers

This assessment is applicable to the following hardware and software versions of 4200 Coriolis Flowmeter:

Device	Version
4200 Firmware, Core Processor	1.0 and later
4200 Hardware, Transmitter	AE and later

4 IEC 61508 Functional Safety Assessment Scheme

exida assessed the development process used by Micro Motion, Inc. for this development project against the objectives of the accredited *exida* certification scheme. The results of the assessment are documented in [R1]. All objectives have been successfully considered in the Micro Motion, Inc. development processes for the development.

exida assessed the set of documents against the functional safety management requirements of IEC 61508. An initial evaluation assessment of the development procedures was followed by an evaluation assessment of the project documentation, resulting in final safety case documentation. The safety case demonstrates the fulfillment of the functional safety management requirements of IEC 61508-1 to 3.

The detailed development audit (see [R1]) evaluated the compliance of the processes, procedures and techniques, as implemented for the Micro Motion, Inc. 4200 Coriolis Flowmeter, with IEC 61508. The assessment was executed using the accredited *exida* certification scheme which includes subsets of the IEC 61508 requirements tailored to the work scope of the development team.

The result of the assessment shows that the 4200 Coriolis Flowmeter is capable for use in SIL 3 applications, when properly designed into a Safety Instrumented Function per the requirements in the Safety Manual.

4.1 Product Modifications

The modification process has been successfully assessed and audited, so Micro Motion, Inc. may make modifications to this product as needed.

As part of the accredited *exida* certification scheme a surveillance audit is conducted prior to renewal of the certificate. The modification documentation listed below is submitted as part of the surveillance audit. *exida* will review the decisions made by the competent person in respect to the modifications made.

- List of all anomalies reported
- List of all modifications completed
- Safety impact analysis which shall indicate with respect to the modification:
  - The initiating problem (e.g. results of root cause analysis)
  - The effect on the product / system
  - The elements/components that are subject to the modification
  - The extent of any re-testing
- List of modified documentation
- Regression test plans

5 Results of the IEC 61508 Functional Safety Assessment

exida assessed the development process used by Micro Motion, Inc. during the product development against the objectives of the accredited *exida* certification scheme which includes IEC 61508 parts 1, 2, & 3. The development of the 4200 Coriolis Flowmeter was done per this IEC 61508 SIL 3 compliant development process. The Safety Case was updated with project specific design documents.

5.1 Lifecycle Activities and Fault Avoidance Measures

Micro Motion, Inc. has an IEC 61508 compliant development process as assessed during the IEC 61508 certification. This compliant development process is documented in [D003, D021].

This functional safety assessment evaluated the compliance with IEC 61508 of the processes, procedures and techniques as implemented for the product development. The assessment was executed using the accredited *exida* certification scheme which includes subsets of IEC 61508 requirements tailored to the SIL 3 work scope of the development team. The result of the assessment can be summarized by the following observations:

The audited development process complies with the relevant managerial requirements of IEC 61508 SIL 3.

5.1.1 Functional Safety Management

Objectives

The main objectives of the related IEC 61508 requirements are to:

Structure, in a systematic manner, the phases in the overall safety lifecycle that shall be considered in order to achieve the required functional safety of the E/E/PE safety-related systems.

- Structure, in a systematic manner, the phases in the E/E/PES safety lifecycle that shall be considered in order to achieve the required functional safety of the E/E/PE safety-related systems.
- Specify the management and technical activities during the overall, E/E/PES and software safety lifecycle phases which are necessary for the achievement of the required functional safety of the E/E/PE safety-related systems.
- Specify the responsibilities of the persons, departments and organizations responsible for each overall, E/E/PES and software safety lifecycle phase or for activities within each phase.
- Specify the necessary information to be documented in order that the management of functional safety, verification and the functional safety assessment activities can be effectively performed.
- Document all information relevant to the functional safety of the E/E/PE safety-related systems throughout the E/E/PES safety lifecycle.
- Document key information relevant to the functional safety of the E/E/PE safety-related systems throughout the overall safety lifecycle.
- Specify the necessary information to be documented in order that all phases of the overall E/E/PES and software safety lifecycles can be effectively performed.
- Select a suitable set of tools, for the required safety integrity level, over the whole safety lifecycle which assists verification, validation, assessment and modification.

5.1.2 Safety Lifecycle and FSM Planning

Assessment

The phases in the overall safety lifecycle required to achieve the targeted functional safety integrity level of the product are documented and structured. The management and technical activities performed during the product and software safety lifecycle phases are specified. The responsibilities of the persons, departments, and organizations responsible for each safety lifecycle phase are specified. The necessary documentation for the management of functional safety, verification and the functional safety assessment activities has been specified. The necessary information for all phases of the safety lifecycle to be effectively performed has been documented. A suitable set of tools, for the required safety integrity level, over the whole safety lifecycle which assists verification, validation, assessment, and modification has been selected. Micro Motion, Inc. has a Quality Management System in place and has been ISO 9001 certified. All sub-suppliers have been qualified through a Manufacturer Qualification procedure. All phases of the safety lifecycle have verification steps via phase-gate reviews.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system and new product development processes.

5.1.3 Documentation

Assessment

There is a document management system in place. This system controls how all safety relevant documents are changed, reviewed, and approved. All safety related documentation is electronically generated and stored, making it easy to access and use the documents. Documentation is required to be properly identifiable, indicate the scope of contents, provide format and content to support navigation/readability/organization, such as titles, headings, tables, etc. Documents are required to have a revision index which lists versions of the document along with a description of what changed in that version. Several documents were sampled and found to meet these requirements.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system.

5.1.4 Training and competence recording

Assessment

The Project Plan lists the key people working on the project along with their roles.

Competency requirements have been identified for each role on the project. Individuals have been assigned to each role, considering achieved competencies. Where a competency gap is identified, training has been planned, carried out and documented.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system and internal organizational procedures.

5.1.5 Configuration Management

Assessment

The configuration of the product to be certified is documented including all hardware and software versions that make up the product. For software this includes source code.

Formal configuration control [D021, D026b] is defined and implemented for Change Authorization, Version Control, and Configuration Identification. A documented procedure exists to ensure that only approved items are delivered to customers. Master copies of the software and all associated documentation are kept during the operational lifetime of the released software.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. organizational release procedures, functional safety management system and new product development processes.

5.1.6 Tools (and languages)

Assessment

All tools which support a phase of the software development lifecycle and cannot directly influence the safety-related system during its run time, are documented, including tool name, manufacturer name, version number and a description of the use of the tool on this project [D021b]. This includes validation test tools. All off-line support tools have been classified as either T3 (safety critical), T2 (safety-related), or T1 (interference free). Off-line support tools in classes T2 and T3 have a specification or product manual which clearly defines the behavior of the tool and any instructions or constraints on its use. An assessment has been carried out for T2 and T3 offline support tools, to determine the level of reliance placed on the tools, and the potential failure mechanisms of the tools that may affect the executable software. Where such failure mechanisms have been identified, appropriate mitigation measures have been taken.

Configuration and use information have been documented to ensure consistent use of the tools in configuring and building software. Significant confidence in use data is documented for all T3 tools.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system.

5.2 Safety Requirement Specification

Objectives

The main objectives of the related IEC 61508 requirements are to:

- Specify the requirements for each E/E/PE safety-related system, in terms of the required safety functions and the required safety integrity, in order to achieve the required functional safety.

Assessment

All element safety functions necessary to achieve the required functional safety are specified [D040], including diagnostic functions and any functions required to configure the device (offline). All external interfaces have been carefully specified.

Software safety requirements [D040d] have been created as derived/allocated requirements (from Safety Requirements) and have been made available to the software developers. The SRS has been reviewed in order to verify that the SRS has enough detail such that the required SIL can be achieved during design and implementation and can be assessed.

SRS content is available and sufficient for the duties to be performed. This has been confirmed by the validation testing and assessment.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system.

5.3 Change and modification management

Objectives

The main objectives of the related IEC 61508 requirements are to ensure that the required safety integrity is maintained after corrections, enhancements, or adaptations to the E/E/PE safety-related systems.

Assessment

Modifications are initiated with an Engineering Design Change procedure [D023]. All changes are first reviewed and analyzed for impact before being approved. Measures to verify and validate the change are developed following the normal design process. Modification of the product requires that an Impact Analysis be performed to assess the impact of the modification, including the impact of changes on the Functional Safety of the system and to the software design. The results of Impact Analysis are documented and associated with the change request. Modification records document the reason for the change, a description of the proposed change. All changed engineering artifacts, including tests, documentation, and software, are documented. The required scope of re-verifying and re-validating the change is documented for each change to ensure that the change is fully tested and that other potentially affected functions were not affected. The modification process has been successfully assessed and audited, so Micro Motion, Inc. may make modifications to this product as needed. An impact analysis [D023b] is performed for any change related to functional safety.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system, change management procedures, and sustaining product procedures.

5.4 System Design

Objectives

The objective of the related IEC 61508 requirements of this subclause are to specify the design requirements for each E/E/PE safety-related system, in terms of the subsystems and elements.

Assessment

Product design [D049] has been partitioned into subsystems, and interfaces between subsystems are clearly defined and documented. The Product Architecture Design clearly identifies the SIL capability of all components, including software components, in the design. If a component has a lower SIL capability than that associated with the safety function(s), then sufficient independence between the components has been documented in a Failure Analysis [D050]. The Product

Architecture Design describes that the behavior of the device when a fault is detected is to annunciate the detected fault through the output interface.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system and new product development processes.

5.5 Hardware Design and Verification

Objectives

The main objectives of the related IEC 61508 requirements are to:

- Create E/E/PE safety-related systems conforming to the specification for the E/E/PES safety requirements (comprising the specification for the E/E/PES safety functions requirements and the specification for the E/E/PES safety integrity requirements).
- Ensure that the design and implementation of the E/E/PE safety-related systems meets the specified safety functions and safety integrity requirements.
- Demonstrate, for each phase of the overall, E/E/PES and software safety lifecycles (by review, analysis and/or tests), that the outputs meet in all respects the objectives and requirements specified for the phase.
- Test and evaluate the outputs of a given phase to ensure correctness and consistency with respect to the products and standards provided as input to that phase.
- Integrate and test the E/E/PE safety-related systems.

5.5.1 Hardware architecture design

Assessment

Hardware architecture design [D045] has been partitioned into subsystems, and interfaces between subsystems are defined and documented. Design reviews [D053] are used to discover weak design areas and make them more robust. Measures against environmental stress and over-voltage are incorporated into the design. A FMEDA analyst has reviewed the design and determined that there are measures against physical environmental stresses.

The FSM Plan and development process and guidelines define the required verification activities related to hardware including documentation, verification planning, test strategy and requirements tracking to validation test.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system and new product development processes.

5.5.2 Hardware Design / Probabilistic properties

Assessment

To evaluate the hardware design of the 4200, a Failure Modes, Effects, and Diagnostic Analysis was performed by *exida* for each component in the system. This is documented in [R3]. The FMEDA was verified using Fault Injection Testing as part of the development, see [D77], and as part of the IEC 61508 assessment.

A Failure Modes and Effects Analysis (FMEA) is a systematic way to identify and evaluate the effects of different component failure modes, to determine what could eliminate or reduce the chance of failure, and to document the system in consideration. An FMEDA (Failure Mode Effect and Diagnostic Analysis) is an FMEA extension. It combines standard FMEA techniques with extension to identify online diagnostics techniques and the failure modes relevant to safety instrumented system design. From the FMEDA failure rates are derived for each important failure category.

These results must be considered in combination with PFH/PFD_{AVG} of other devices of a Safety Instrumented Function (SIF) in order to determine suitability for a specific Safety Integrity Level (SIL). The Safety Manual states that the application engineer should calculate the PFH/PFD_{AVG} for each defined safety instrumented function (SIF) to verify the design of that SIF.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system, FMEDA quantitative analysis, and hardware development guidelines and practices.

5.6 Software Design and Verification

Objectives

The main objectives of the related IEC 61508 requirements are to:

- Create a software architecture that fulfils the specified requirements for software safety with respect to the required safety integrity level.
- Review and evaluate the requirements placed on the software by the hardware architecture of the E/E/PE safety-related system, including the significance of E/E/PE hardware/software interactions for safety of the equipment under control.
- Design and implement software that fulfils the specified requirements for software safety with respect to the required safety integrity level, which is analyzable and verifiable, and which is capable of being safely modified.
- To the extent required by the safety integrity level, test and evaluate the outputs from a given software safety lifecycle phase to ensure correctness and consistency with respect to the outputs and standards provided as input to that phase.
- Verify that the requirements for software safety (in terms of the required software safety functions and the software safety integrity) have been achieved.
- Integrate the software onto the target programmable electronic hardware. Combine the software and hardware in the safety-related programmable electronics to ensure their compatibility and to meet the requirements of the intended safety integrity level.

Assessment

The Software Architecture Design [D049] contains a description of the software architecture. The design is partitioned into new, existing and/or reused components and modules, which are identified as such. A software criticality analysis and HAZOP [D050] was performed and the report lists all components along with their criticality and their required Systematic Capability. Common cause failures are identified in the SW HAZOP as failures of one component that could affect an independent component and defensive measures are listed as Safety Measures. Semi-formal design notation was used in the design (e.g., State/Transition diagrams, Sequence Diagrams).

The Software Architecture Design specifies that fault detection is employed to detect software faults. Techniques like program flow monitoring, data flow monitoring and CRCs on serial communications data are used. The resulting behavior of the device due to a detected fault is specified.

Software verification is accomplished through various means. The Software Architecture Design was reviewed. Module tests are created and executed. Structural test coverage [D057] is measured, documented, and verified to ensure all code is tested at least once. All safety related Source Code Modules have been inspected. Sample code review reports [D058] were reviewed to ensure non-conformances are recorded and followed up. Module Test Results [D066] for all safety related modules are documented per the Module Test Verification Plan/Specification. Sample results files were reviewed. Results files indicate whether tests pass or fail. Static code analysis tools and code reviews [D062] are used to ensure that coding rules, documented in the coding standard, are enforced. Integration testing is done by running validation tests in development, using prototype hardware, prior to releasing code to quality assurance for final integration and validation with release candidate hardware.

Test management tools are used to manage the module and/or integration testing process.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system, software development process, and new product development processes.

5.7 Safety Validation

Objectives

The main objectives of the related IEC 61508 requirements are to:

- Ensure that the design and implementation of the E/E/PE safety-related systems meets the specified safety functions and safety integrity requirements.
- Plan the validation of the safety of the E/E/PE safety-related systems.
- Validate that the E/E/PE safety-related systems meet, in all respects, the requirements for safety in terms of the required safety functions and the safety integrity.
- Ensure that the integrated system complies with the specified requirements for software safety at the intended safety integrity level.

Assessment

Validation Tests [D074] exist for each safety requirement (including software safety requirements) as shown by the requirements-to-validation traceability documentation [D040d]. Each test case includes a procedure for the test as well as pass/fail criteria for the test (inputs, outputs and any other acceptance criteria). Validation test results are documented properly. The EMC/Environmental criteria were tested (and passed) [D075, D076] for all claimed product specifications.

Fault injection testing [D077] has been performed on the product as defined in the fault injection test plan. The results have been analyzed and adjustments have been made to the FMEDA based on these results.

Validation testing requires simulation of process inputs and timing between input changes (process simulation). This is done by testing the software in the product hardware and simulating the input signal(s) and other process conditions using test fixtures and test equipment.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system, software development process, and new product development processes.

5.8 Safety Manual

Objectives

The main objectives of the related IEC 61508 requirements are to ensure that the required functional safety of the E/E/PE safety-related systems is maintained during operation and maintenance.

Assessment

The Safety Manual [D079] is provided and identifies and describes (along with the operating/installation manual [D078]) the functions of the product. The functions are clearly described, including a description of the input and output interfaces. The behavior of the product's outputs is clearly described for all scenarios where internal faults are detected, including sufficient information to facilitate the development of an external diagnostics capability (output monitoring).

The Safety Manual gives guidance on recommended periodic (offline) proof test activities for the product, including listing any tools necessary for proof testing. Procedures for maintaining tools and test equipment are listed. All routine maintenance tools and activities required to maintain safety are identified and described in the Safety Manual.

The design includes a write-protect switch to prevent unauthorized (and accidental) modification via the HART interface. The user manual defines what configuration options and methods exist for the product. The safety manual documents procedures required must be used to safely change the device configuration.

Conclusion

The objectives of the standard are fulfilled by the Micro Motion, Inc. functional safety management system and the safety manual.

6 2023 IEC 61508 Functional Safety Surveillance Audit

6.1 Roles of the parties involved

Micro Motion, Inc.	Manufacturer of the 4200 Coriolis Flowmeter
exida	Performed the hardware assessment review
exida	Performed the IEC 61508 Functional Safety Surveillance Audit per the accredited *exida* scheme.

Micro Motion, Inc. contracted *exida* in Jan 2023 to perform the surveillance audit for the above 4200 Coriolis Flowmeter. The surveillance audit was conducted remotely with Micro Motion's facility in Boulder, CO - USA in May 2023.

6.2 Surveillance Methodology

As part of the IEC 61508 functional safety surveillance audit the following aspects have been reviewed:

- Procedure Changes – Changes to relevant procedures since the last audit are reviewed to determine that the modified procedures meet the requirements of the *exida* certification scheme.
- Engineering Changes – The engineering change list is reviewed to determine if any of the changes could affect the safety function of the 4200 Coriolis Flowmeter.
- Impact Analysis – If changes were made to the product design, the impact analysis associated with the change will be reviewed to see that the functional safety requirements for an impact analysis have been met.
- Field History – Shipping and field returns during the certification period will be reviewed to determine if any systematic failures have occurred. If systematic failures have occurred during the certification period, the corrective action that was taken to eliminate the systematic failure(s) will be reviewed to determine that said action followed the approved processes and was effective.
- Safety Manual – The latest version of the safety manual will be reviewed to determine that it meets the IEC 61508 requirements for a safety manual.
- FMEDA Update – If required or requested the FMEDA will be updated. This is typically done if there are changes to the IEC 61508 standard and/or changes to the *exida* failure rate database.
- Evaluate use of the certificate and/or certification mark - Conduct a search of the applicant's web site and document any misuse of the certificate and/or certification mark. Report any misuse of the certificate and/or certification mark to the exida Managing Director.
- Recommendations from Previous Audits – If there are recommendations from the previous audit, these are reviewed to see if the recommendations have been implemented properly.

6.2.1 Documentation provided by Micro Motion, Inc.

[D1]	Flow Measurement Quality Manual.pdf, , Rev AH 3/9/2020	Quality Manual
[D2]	2021x_SOP_25_AA_SIL Process.docx, Rev AA, 24 Nov 2021	Standard Operating Procedure (SOP), Enovia, SIL Process
[D3]	GWI 03 Technical Bulletins, Service Bulletins and Knowledge Based Articles.docx, Rev H, 10 Sept 2020	Flow Measurement Global Work Instruction – GWI 03 Technical Bulletins, Service Bulletins and Knowledge Based Articles
[D4]	GWI 32 Mean Time Between Failure Calculation Procedure.docx, Rev F, 2 Feb 2023	Flow Measurement Global Work Instruction – GWI 32 Mean Time Between Failure Calculation Procedure
[D5]	GWI 33 Sustaining Engineering Stage Gate Process.docx, Rev J, 21 Nov 2022	Flow Measurement Global Work Instruction – GWI 33 Sustaining Engineering Stage Gate Process
[D6]	GWI 47 Non-conforming Material, Process and System Identification and Data Collection.docx, Rev AI, 28 Sept 2022	Flow Measurement Global Work Instruction – GWI 47 Non-conforming Material, Process and System Identification and Data Collection
[D7]	GWI 89 Four Corners Test Procedure.docx, Rev F, 1 Feb 2023	Flow Measurement Global Work Instruction – GWI 89 Four Corners Test Procedure
[D8]	GWI 90 Product Safety Messages.docx, Rev K, 1 Feb 2023	Flow Measurement Global Work Instruction – GWI 90 Product Safety Messages
[D9]	GWI 92 Checklist for Safety.docx, Rev L, 4/28/2022	Global Work Instruction – GWI 92 Checklist for Safety
[D10]	GWI 140 New Product Development Process.docx, Rev C 12/8/22	Flow Measurement Global Work Instruction – GWI 140 New Product Development Process
[D11]	GWI 146 Vibration Procedure.docx, Rev C, 12 Jan 2023	Flow Measurement Global Work Instruction – GWI 146 Vibration Procedure
[D12]	GWI 235 RMA Evaluation Writing Standard.docx, Rev G, 31 Jan 2023	Flow Measurement Global Work Instruction – GWI 235 RMA Evaluation Writing Standard
[D13]	GWI 305 Product Safety.docx, Rev M, 4/5/2021	Flow Measurement Global Work Instruction – GWI 305 Product Safety
[D14]	GWI 320 Global Deviation System.docx, Rev X, 1 Feb 2022	Flow Measurement Global Work Instruction – GWI 320 Global Deviation System
[D15]	GWI 321 Document Control.docx, Rev T, 1 May 2022	Flow Measurement Global Work Instruction – GWI 321 Document Control

[D16]	GWI 336 Design Change Process.docx, Rev Q, 4/16/2021	Flow Measurement Global Work Instruction – GWI 336 Design Change Process
[D17]	GWI 336-A5 SIL Impact Analysis Worksheet.docx, Rev A, 8/5/2020	Flow Measurement Global Work Instruction – GWI 336 SIL Impact Analysis Worksheet
[D18]	GWI 355 Internal Audits.docx, Rev AC, 12 Dec 2022	Flow Measurement Global Work Instruction – GWI 355 Internal Audits
[D19]	GWI 358 Stop Ship Procedure .docx, Rev M, 8/31/2022	Flow Measurement Global Work Instruction – GWI 358 Stop Ship Procedure
[D20]	GWI 371 Product Notification.docx, Rev H, 26 Jan 2023	Flow Measurement Global Work Instruction – GWI 371 Product Notification
[D21]	GWI 380 Supplier Quality Manual.docx, Rev Q, 9 Sept 2022	Flow Measurement Global Work Instruction – GWI 380 Supplier Quality Manual
[D22]	LWI 15 Return Material Authorization.docx, Rev AH, 9 April 2021	Flow Measurement Local Work Instruction – LWI 15 Return Material Authorization
[D23]	LWI 23 Software Development Process.docx, Rev AJ, 3/3/2022	Flow Measurement Local Work Instruction – LWI 23 Software Development Process
[D24]	LWI 31 Inspection, Measuring and Test Equipment Calibration.docx, Rev P, 5/21/2021	Flow Measurement Local Work Instruction – LWI 31 Inspections, Measuring and Test Equipment Calibration
[D25]	LWI 133 Systems Architecture and Safety Requirements Guidelines.docx, Rev M, 4/20/2021	Flow Measurement Local Work Instruction – LWI 133 Systems Architecture and Safety Requirements Guidelines
[D26]	LWI 186 Safety Manual Creation Guideline.docx, Rev H, 2/14/2022	Local Work Instruction – LWI 186 Safety Manual Creation Guideline
[D27]	MVD SOFTWARE REVISION OVERVIEW.pdf, Rev BZ, 12/21/2022	MVD Electronics Firmware Release Overview
[D28]	Flow ISO 9001 cert to 2025.pdf, Expires 28 December 2025	ISO 9001:2015 Quality Management Standard Certificate
[D29]	Rev_Updates_GWI_LWI_Current 2023-03-16.xlsx, 2023-03-16	Revision Updates to GWI and LWI documents
[D30]	Electronics Data Export eStatit V1.xlsx, 1 Oct 2019 – 3 Feb 2023	Electronics Return Data 700 / 800 / 1700 / 2700 / 4200 / 5700
[D31]	Sensors Data Export eStatit V1.xlsx, 1 Oct 2019 – 3 Feb 2023	Sensor Return Data K / LF / T / F-H-R / D / Elite
[D32]	HPC and D Sensors Data V2.xlsx, May 2023	HPC and D Sensor Sales Data
[D33]	WF-18 Comparisons 2018-2023.pptx, May 2023	Sales Data for Elite Sensors, T Sensors, F Sensors, 700 Core, 800 Core, 1700/2700, 4200, 5700

[D34]	Copy of Sensor Shipments FY20 to FY23.xlsx	Sensor Shipment Data, Provided by Emerson MicroMotion, but [D30], [D31], [D32], and [D33] primarily used for FFA
[D35]	Copy of Sensor Returns FY20 to FY23.xlsx	Sensor Return Data, Provided by Emerson MicroMotion, but [D30], [D31], [D32], and [D33] primarily used for FFA
[D36]	PQR 2022-12-21 Charts.pptx	Sales Charts, Provided by Emerson MicroMotion, but [D30], [D31], [D32], and [D33] primarily used for FFA
[D37]	Sales and returns.xlsx	Sales and return data, Provided by Emerson MicroMotion, but [D30], [D31], [D32], and [D33] primarily used for FFA
[D38]	SIL Impact Changes List (New Version).xlsx	Change Numbers and Descriptions for 5700 / 4200 / 1700-2700 / 800 / 700
[D39]	GWI 336-A9 SIL IAWrB 4200v1.90.docx, 15 Dec 2022	SIL Impact Analysis Worksheet, ECR 0053792
[D40]	RE F050PCNG050 4200 SMV coefficients.msg, 15 Dec 2022	Code Review for 4200 V1.9
[D41]	SCR0053792 SMV params update for F050P.docx,	Review Meeting Minutes Form, SCR00053792
[D42]	4200 2-wire RFS Traceability Gate 5 Rev 1.xlsx, Rev 0.22, 4/16/2019	4700 2-Wire Electronics RFS/IRD Revision History
[D43]	4200 SADD.docx, Rev 0.04, 3/8/2023	SPEC, 4700 SADD (Same for 4200), Engineering Specification
[D44]	4700 SRS.xlsx, Rev 1.40, 3/6/2023	4700, 4200, and 824 SRS Engineering Specification
[D45]	EB-20046971_AA07_(SPEC SAFETY DESC SERIES 4200 XMTR).pdf, Rev AA07, 01/25/2019	SPEC, SAFETY DESC, SERIES 4200 XMTR, EB-20046971, Engineering Specification
[D46]	manual-micro-motion-4200-2-wire-transmitter-en-5466238.pdf, Rev AD, October 2022	Micro Motion 4200 2-Wire Transmitter, Installation Manual
[D47]	manual-micro-motion-4200-transmitters-en-5466188.pdf, Rev AE, June 2022	Micro Motion 4200 Transmitters, Configuration and Use Manual
[D48]	safety-manual-micro-motion-4200-coriolis-flowmeter-en-5466198.pdf, Rev AB, August 2021	Coriolis Flow Meter with Micro Motion 4200 2-Wire Transmitters, Safety Manual for Safety Instrumented Systems (SIS)

6.2.2 Surveillance Documentation generated by *exida*

[R5]	MiMo 18-01-017 R001 V3R1 FMEDA 4200	FMEDA report, 4200 Coriolis Flowmeter

[R6]	EMM 18-01-017 V3R0 61508 Safety Case WB - 4200.xlsm	IEC 61508 SafetyCaseWB for 4200 Flowmeter
[R7]	EMM_B V2R0 61508 Safety Case WB - Baseline.xlsm, 22 May 2023	Baseline Safety Case for SC Boulder Process
[R8]	EMM 23-01-183 FFA3 V1R0 - Transmitter 4200.xlsx	Field Failure Analysis for 4200 Flowmeter
[R9]	Prodfails - Further Beak out of numbers 2023_VAM.xlsx, May 2023	Compilation of data from [D30], [D31], [D32], and [D33]
[R10]	EMM_B V2R0 61508 Safety Case WB - Baseline.xlsm, 22 May 2023	Baseline Safety Case for SC Boulder Process
[R11]	EMM 23-01-183 IEC 61508 Surveillance Audit Checklist	Surveillance Audit Checklist

6.3 Surveillance Results

6.3.1 Procedure Changes

Only minor changes have been made to the procedures since the Certification of the 4200 in 2018. Changes were reviewed and were found to be consistent with the requirements of IEC 61508.

6.3.2 Engineering Changes

Lists of Hardware and Software changes since the last audit were reviewed. Each of the changes were judged to be sufficiently evaluated by Micro Motion for functional safety and documented in accordance with Micro Motion's procedures.

6.3.3 Impact Analysis

The SIL Impact Analysis Worksheets for the hardware and software changes were reviewed and found to be adequately documented given the scope of the simple changes made to this mature product.

6.3.4 Field History

Worldwide Shipment and Return information were reviewed for each of the 2 main components of the 4200 flowmeter (the 4200 transmitter and the sensors). For the returns, the WF-18 information was used. The data used was for the 3-year period between October 2019 to January 2023. The calculated actual field failure rate is below the predicted failure rate of the FMEDA.

Management holds regular quality meetings to monitor this as well.

6.3.5 Safety Manual

The updated safety manual (Rev AB) was reviewed and found to be compliant with IEC 61508:2010.

6.3.6 FMEDA Update

The FMEDA was not updated as a part of this Surveillance Audit. The FMEDA report was updated for formatting and some minor changes to boilerplate text.

6.3.7 Evaluate use of certificate and/or certification mark

The Micro Motion, Inc. website was searched and no misleading or misuse of the certification or certification marks was found.

6.3.8 Previous Recommendations

Previous recommendations for improvement were reviewed and were resolved satisfactorily to the requirements of IEC 61508.

6.3.9 Assessed Configurations / Versions

Some sensor models have been added and others removed in the years since the initial audit. The following table lists the current assessed configurations and Hardware/Software versions:

Table 1 Assessed Configurations / Versions

4200 Series	Micro Motion Coriolis Flowmeter with 4200 transmitter
Sensors	Elite (except CMFHC), T, F, H, R, HPC
Hardware	Based on the following schematic revisions (or later) Display, Controller, Rev AD (MMI-20038852) Power, Rev AD (MMI-ES-20045788) 2WCORE, Rev AE (MMI-ES-20046115) Terminal, Rev AE (MMI-ES-20046916)
Software/Firmware (listed versions or later)	4200v1.90

6.4 Surveillance Audit Conclusion

The result of the Surveillance Audit Assessment can be summarized by the following observations:

The Micro Motion, Inc. 4200 Flowmeter continues to meet the relevant requirements of IEC 61508:2010 for SIL 3 in low or high demand applications based on the initial assessment and considering:

- field failure history

- permitted modifications completed on the product

- resolution of past action items

- FMEDA report updates

This conclusion is supported by the updated SafetyCase and certification documents.

7 Terms and Definitions

Fault tolerance	Ability of a functional unit to continue to perform a required function in the presence of faults or errors (IEC 61508-4, 3.6.3)
FIT	Failure In Time ($1x10^{-9}$ failures per hour)
FMEDA	Failure Mode Effect and Diagnostic Analysis
HFT	Hardware Fault Tolerance
Low demand mode	Mode where the demand interval for operation made on a safety-related system is greater than twice the proof test interval.
High demand mode	Mode where the demand interval for operation made on a safety-related system is less than 100x the diagnostic detection/reaction interval, or where the safe state is part of normal operation.
PFD_{AVG}	Average Probability of Failure on Demand
PFH	Probability of dangerous Failure per Hour
SFF	Safe Failure Fraction - Summarizes the fraction of failures, which lead to a safe state and the fraction of failures which will be detected by diagnostic measures and lead to a defined safety action.
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System – Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s).
HART	Highway Addressable Remote Transducer
Type A element	“Non-Complex” element (using discrete components); for details see 7.4.4.1.2 of IEC 61508-2
Type B element	“Complex” element (using complex components such as micro controllers or programmable logic); for details see 7.4.4.1.3 of IEC 61508-2

8 Status of the document

8.1 Liability

exida prepares reports based on methods advocated in International standards. Failure rates are obtained from a collection of industrial databases. *exida* accepts no liability whatsoever for the use of these numbers or for the correctness of the standards on which the general calculation methods are based.

8.2 Version History

Contract Number	Report Number	Revision Notes
Q23/01-183	EMM 18-01-017 R002 V2, R1	Added HPC to Sensor List, removed reviewers comment, VAM, 2-June-2023
Q23/01-183	EMM 18-01-017 R002 V2, R0	2023 Surveillance Audit, VAM, 22-May-2023
Q18/01-017	EMM 18-01-017 R002 V1, R0	Initial report draft; JCY, 17-Jul-2019
Q18/01-017	EMM 18-01-017 R002 V1, R1	Revised after internal review and revised MMI documents; JCY, 18-Jul-2019
Q18/01-017	EMM 18-01-017 R002 V1, R2	Revised after MMI review to correct company name; JCY, 22-Jul-2019

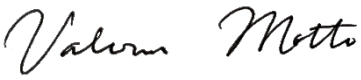
Review: Jonathan Moore, *exida*, 22 May 2023

Status: Released, 22 May 2023

8.3 Future Enhancements

At request of client.

8.4 Release Signatures



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