



Department of Environmental Protection

2600 Blair Stone Road ♦ Tallahassee, Florida 32399-2400

DEP Form: 62-761.900(9)

Form Title: Storage Tank Equipment

Registration Form

Effective Date: July 2019

Incorporated in Rule 62-761.850, F.A.C.

Storage Tank System Equipment Registration Form

Fill out completely

General Information

Company Name: Rosemount Tank Gauging - North America

Contact Name: Lance Berry

Company Address: 6005 Rogerdale Road, MailStop NC136

City, State: Houston, TX Zip: 77072

E-mail: Lance.Berry@emerson.com

Contact Number: 281 988 4000

Product Name: Rosemount 5408 Level Transmitter

Model Number(s): 5408

Product Type: AST radar tank level gauging system

Rule(s) citation that registration is being requested within Chapter 62-761 (UST), and/or 62-762 (AST), Rule 62-762.502, F.A.C., Rule 62-762.702, F.A.C., & Rule 62-851, F.A.C.

F.A.C.: Write a brief description of equipment registration request including product limitations:

The Rosemount 5408 System is a stand-alone 4-20ma single radar gauge for liquid level measurement in bulk aboveground storage tanks. There are no product limitations for regulated substances subject to FDEP Rule 62.762, F.A.C.

Information Checklist (Choose Yes, No, or N/A - Not Applicable):

- | | Yes | No | N/A |
|---|-------------------------------------|-------------------------------------|-------------------------------------|
| 1. Third-party Certification by a Nationally Recognized Testing Laboratory? (Required) | ☒ | ☐ | ☐ |
| 2. Documentation of third-party evaluation that the equipment meets DEP Rules? | ☒ | ☐ | ☐ |
| 3. Documents included about the qualifications of the Nationally Recognized Testing Laboratory? | ☒ | ☐ | ☐ |
| 4. Technical information and drawings included? | ☒ | ☐ | ☐ |
| 5. Installation instructions included? | ☒ | ☐ | ☐ |
| 6. Annual Operability Testing Requirements (Rules 62-761.500, 62-762.501, & 62-762.502 F.A.C.)? | ☒ | ☐ | ☐ |
| 7. Integrity Testing Requirements (Rules 62-761.700, 62-762.701, & 62-762.702, F.A.C.)? | ☐ | ☐ | ☒ |
| 8. Compatible with fuel blends containing >10% ethanol or >20% biodiesel? | ☒ | ☐ | ☐ |
| 9. Has the product been approved or registered in other countries or states? (If so provide list) | ☒ | ☐ | ☐ |
| 10. Any requirements for company-certified installers or trainers? | ☒ | ☐ | ☐ |
| 11. Was this product(s) previously approved or registered by the Department? If yes, EQ _____ | ☐ | ☒ | ☐ |
| 12. Any changes or modifications to the equipment since the last submittal to DEP? | ☐ | ☐ | ☒ |

Document Information: Provide supporting documents indicated as "Yes" above including this form via email to Tanknotify@floridadep.gov, or documents can be sent to FDEP, Division of Waste Management, 2600 Blair Stone Road, MS 4560, Tallahassee, FL 32399.

Write a brief description of equipment installation and performance in the U.S.:

The Rosemount 5408 system is similar in design, materials of construction, and function to the Rosemount 5900 system registered under EQ 840. That system has a successful track record in Florida, the United States, and numerous other countries around the world since 2010.

Equipment Registration Certification:

To the best of my knowledge and belief, all information submitted on this form is true, accurate and complete.

Lance Berry, General Manager

Printed Name and Title

[Signature]
Signature (right click to sign)

8/15/2023
Date

For Department Use Only:

Date Application Received: 09/22/2023

Application complete:

Yes: ☒ No: ☐

EQ- 997

Date of complete or incomplete letter sent: 09/29/2023

Date Equipment Requires Renewal: 09/29/2028

Storage tank system equipment requires renewal every 5 years in accordance with subsection 62-761.850(2), F.A.C.



Equipment Registration for the
5408 and 5408:SIS Radar Gauges
And associated components
to the
Florida Department of Environmental Protection
from
Rosemount Tank Gauging - North America

Submitted by

Marshall T. Mott-Smith, President

Mott-Smith Consulting Group

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August 15, 2023

Amanda Dorsett,
Environmental Administrator
Florida Department of Environmental Protection
Division of Waste Management
Compliance Assistance Program
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Equipment Registration Request for the Rosemount Tank Gauging - North America –
Rosemount 5408 and 5408:SIS Systems

Dear Amanda,

We are submitting an Equipment Registration for the 5408 and 5408:SIS Tank Gauges that are stand-alone 4-20ma single radar gauges from Rosemount Tank Gauging - North America. We would appreciate the expedient processing of this request, and appreciate your consideration in this matter. Please feel free to contact me if you have any questions or if we need to provide additional information.

Best Regards,

A handwritten signature in blue ink that reads "Marshall Tipton Mott-Smith".

Marshall Mott-Smith, President
Mott-Smith Consulting Group, LLC

111 North Calhoun Street

Tallahassee, FL 32301

850.391.9835

www.mott-smithconsulting.com

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FDEP Form 62-761.900(9)

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Contact Information

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1. Overview and Request

This Equipment Registration request is sought in accordance with Florida Administrative Code (F.A.C.) Rule 62-762.851(2), for the Rosemount 5408 System. This includes the Rosemount 5408 and the 5408:SIS Level Transmitters. The system is a stand-alone 4-20ma single radar gauge, and this registration request includes all of the components and system software. The Rosemount 5408 System meets the FDEP's requirements of Chapter 62-762.501, F.A.C., (see attached Third Party Reviews). System manuals, installation instructions and other requirements for the Rosemount 5408 System are contained in the other Attachments listed in this document.

The Rosemount 5408 is a two-wire transmitter for continuous level measurements. It uses fast-sweep Frequency Modulated Continuous Wave technology. The transmitter continuously emits signal sweeps with a constantly varying frequency towards the product surface inside the aboveground storage tank. The transmitter continuously changes the frequency of the transmitted signal, so there is a difference in frequency between the transmitted signals and the reflected signals. The frequency of the reflected signal is subtracted from the frequency of the signal transmitted at that moment, resulting in a low frequency signal that is proportional to the distance to the product surface. This signal is further processed to obtain fast, reliable, and accurate liquid level measurements.

The shape of the tank bottom affects the measurement signal when the product surface is close to the tank bottom. The transmitter has built-in functions that optimize measurement performance for various tank bottom shapes. The Rosemount 5408 and 5408:SIS are accurate for level measurements over a broad range of liquid and solid applications, and are unaffected by changing density, temperature, pressure, pH, and viscosity.

The materials used in the Rosemount 5408 System and its components are impervious, able to withstand deterioration, and have sufficient strength and durability to be in contact regulated substances for the design life of the system. There are no fuel type restrictions for the use of the Rosemount 5408 System. These systems are compatible with gasoline, diesel, ethanol, bio-diesel, and blends of these products. The materials are compatible with the products stored and are not capable of being penetrated by the liquids used in the storage tank system the Rosemount 5408 System is measuring.

These systems are designed for liquid level gauging and overflow protection. They should be installed by experienced and qualified individuals at the discretion of the AST owner and should be installed with DEP Registered Equipment Registration in accordance with Department rules and the manufacturer's specifications in the manuals. Technical drawings of the system are provided in **Attachment V**.

The Emerson Automation Solutions, Rosemount Tank Gauging Division, Rosemount 5408 System website is <https://www.emerson.com/en-us/automation/rosemount>

2. Third Party Approval

The Emerson Automation Solutions, Rosemount Tank Gauging Division, Rosemount 5408 System that the Equipment Registration is being sought for in this request meet the demonstration of equivalent protection and certification as required by DEP Rule 62-762.851(2)(b), F.A.C. The Third-Party Approvals by Exida are provided in **Attachments I & II**, and other international and European approvals and certifications are provided in the Product Certifications document in **Attachment III**.

3. Installation Process and Integrity Testing

There is no company-established requirement for Emerson/Rosemount service technicians to perform the installation or commissioning. Usually, the installation is performed by a local contractor, and Rosemount service technicians do the commissioning unless the customer elects to have their staff complete the work. Rosemount prefers that their service technicians do the start-up since they are experienced and know how to correctly install the system, but there are no specific requirements. Some customers and representatives have factory-trained personnel. Owners using the system should comply with the API 2350 Standard referenced by the Florida Department of Environmental Protection. Installation instructions for the Rosemount 5408 System are contained in **Attachment IV**, and the installation testing requirements are provided in **Attachment VII**.

4. Annual Operability Testing

The requirements for Annual Operability Testing are contained in **Attachment VII**, and there are several options available. However, it is recommended that the Smart Echo Level Test specified in pages 23-25 of the Safety Manual and pages 1-2 of the Proof Testing document, both in **Attachment VII**.

5. General

The Rosemount 5408 System provides equivalent protection to the AST overfill protection requirements specified in current and previous versions of Florida DEP Rule 62-762, F.A.C. The system is constructed with non-corrosive and corrosion-protected materials and have strict quality controls during the manufacturing. The Quality Control specifications are provided in **Attachment VI**. The systems are similar in design and construction to other Rosemount DEP-approved systems that have proven to be able to withstand deterioration from external elements and internal fuel environments since 2010. Preventive Maintenance requirements are listed in **Attachment IX**, and operating requirements are specified in the system Reference Manual (**see Attachment VIII**). However, since the Reference Manual is 214 pages, only the first 40 pages of the manual are contained in this document. The entire manual will be submitted along with this document. The 5408 System complies with industry reference standards contained in API Standard 2350 for Overfill Protection.

Attachment I

Third Party Approval by Exida



Results of the IEC 61508 Functional Safety Assessment

Project:

Rosemount™ 5408 Level Transmitter

Customer:

Rosemount Tank Radar
Sweden

Contract No.: Q19/09-114

Report No.: ROS 15-01-149 R001 V1R3

Version V1, Revision R3, December 5, 2019

Andres Cruz



Management Summary

The Functional Safety Assessment of the Rosemount Tank Radar

- Rosemount 5408 Level Transmitter (4-20mA output version with HART)

development project, performed by *exida* consisted of the following activities:

- *exida* assessed the development process used by Rosemount Tank Radar through an audit and review of a detailed safety case against the *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* reviewed and assessed a detailed Failure Modes, Effects, and Diagnostic Analysis (FMEDA) of the devices to document the hardware architecture and failure behavior.
- *exida* reviewed the manufacturing quality system in use at Rosemount Tank Radar.

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 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 Rosemount Tank Radar for their Rosemount 5408 Level Transmitter 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 Rosemount 5408 Level Transmitter can be used in a high demand safety related system in a manner where the PFH is within the allowed range for up to SIL 3 (HFT = 1) according to table 3 of IEC 61508-1.

The assessment of the FMEDA, done to the requirements of IEC 61508, has shown that the Rosemount 5408 Level Transmitter can be used in a low demand safety related system in a manner where the PFD_{AVG} is within the allowed range for up to SIL 3 (HFT = 1) according to table 2 of IEC 61508-1.

The assessment of the FMEDA also shows that the Rosemount 5408 Level Transmitter 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 Rosemount 5408 Level Transmitter is capable for use in SIL 3 applications in Low or High demand mode 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 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:

- Rosemount 5408 Level Transmitter (4-20mA output version with HART)

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 Rosemount 5408 Level Transmitter with the technical IEC 61508-2 and -3 requirements for SIL 3 and the derived product safety property requirements

and

- the Rosemount 5408 Level Transmitter development processes, procedures and techniques as implemented for the safety-related deliveries with the managerial IEC 61508-1, -2 and -3 requirements for SIL 3.

and

- the Rosemount 5408 Level Transmitter hardware analysis represented by the Failure Mode, Effects and Diagnostic Analysis with the relevant requirements of IEC 61508-2.

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 Rosemount Tank Radar (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 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

Rosemount Tank Radar	Manufacturer of the Rosemount 5408 Level Transmitter
<i>exida</i>	Performed the hardware assessment [R3]
<i>exida</i>	Performed the Functional Safety Assessment [R1] per the accredited <i>exida</i> scheme.

Rosemount Tank Radar 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
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2.4 Reference documents

Note: Documents revised after the 2016 audit are listed in Section 6: 2019 IEC 61508 Functional Safety Surveillance Audit.

2.4.1 Documentation provided by Rosemount Tank Radar

ID	Document	Filename	Version	Date
D001	Quality System Manual	Quality Manual.docx	2	1-Sep-14
D003	Overall Development Process; FSM Process	New Product Development Process 0100-23-306.docx	3	online export
D003b	Overall Development Process - RTR NPPD	RTR_Product_Design_and_Development_Process (0300-19-709).docx	1	Dec.2014
D004	Configuration Management Process	Configuration and Change Management Work Instruction 0100-23-631.docx	2	online export
D004c	Configuration Management Process- Part Number Convention	Part numbering convention 0300-19-505.docx	1	online export



ID	Document	Filename	Version	Date
D004d	Configuration Management Process-Record Retention 1	Rosemount Inc Record Retention Schedule 0200-20-324.docx	3	online export
D004e	Configuration Management Process-Part Number Mgt System	Part number management system user guide 0300-19-506.docx	1	31-Jan-12
D004f	Configuration Management Process-Record Archival, non-SW	Archiving of engineering files_EMA00000M7D.docx	3	21-Feb-13
D004g	Configuration Management Process-Record Retention 2	Principal Record Retention Periods - Sweden 0300-19-532.doc	3	Apr.2010, export
D005	Field Failure Reporting Procedure	0100-23-572 (Customer Feedback Process Description).pdf	2	Dec.2015 export
D005b	Field Failure Evaluation Procedure	0100-23-548 (RMT Failure Analysis Process).pdf	2	online export
D005d	Field Failure Reporting Procedure- RMA handling	RMA Process.pdf	n/a	Mar.2011
D006	Field Return Procedure	RMT Failure Analysis Process (0100-23-548 v2).docx	2	Dec.2015 export
D007	Manufacturer Qualification Procedure	Supplier Approval Process 0300-19-274.docx	1	Jun.2015 export
D007b	Manufacturer Qualification Procedure	Supplier Performance Process 0300-19-276.docx	2	Jun.2015 export
D008	Part Selection Procedure	Production Part Approval Process (PPAP) 0300-19-542.docx	2	Jun.2015 export
D010	Quality Management System (QMS) Dept Documentation Change Procedure	Document management - Department documents 0300-19-417.docx	1	Apr.2015 export
D010b	Quality Management System (QMS) Project Documentation Change Procedure	Document Management - Product Development Projects 0300-19-650.docx	2	Apr.2015 export
D010c	Quality Management System (QMS) Documentation Mgt Change Procedure	Documents and Document management 0300-19-420.docx	9	Apr.2015 export
D012	Non-Conformance Reporting procedure	Registration of non-conforming parts 0300-19-251.docx	2	Apr.2015 export
D013	Corrective Action Procedure	Corrective Action Process (Parts) 0300-19-248.docx	3	Apr.2015 export
D016	Action Item List Tracking Procedure	Design Review Guidelines at RTR.docx	2	25-Oct-12
D019	Customer Notification Procedure	Customer Notification Process Description (0100-23-393 v3).docx	3	Dec.2015 export
D021	Software Development Process; Configuration Management-Embedded SW Dev	GaugeSW-Instr-0008.doc	8	1-Apr-15



ID	Document	Filename	Version	Date
D021c	Software Development Guide Patterns	GaugeSW-Instr-0002 (GSW, General Device SW Design Guidelines).doc	Issue 2	23-May-13
D023	Modification Procedure	Product Change Process (0300-19-534 v1).docx	1	Apr.2016
D023b	Impact Analysis Template	EMA00000LCX_Impact Analysis Template for SIL Approved Products.docx	5	29-Apr-10
D026	FSM Plan or Development Plan; Skills Matrix; Management Review Record; Job Descriptions and Competency Levels	Eagle-0038.docx	2.1	May.2015
D026b	FSM Plan or Development Plan	RTR_Product_Design_and_Development_Process (0300-19-709).docx	1	Apr.2015
D027	Configuration Management Plan	Eagle-0166.docx	3	2-Jun-16
D027b	Configuration Management RACI	Eagle-0404.xlsx	7	10-Oct-16
D029	Verification Plan	Eagle-0110.doc	3	6-Oct-16
D036	ISO 900x Cert or equivalent	RTR ISO 9001 14001 Certificate 2015_2018.pdf	n/a	31-Jul-15
D038	List of Design Tools; Software Tool Qualification Procedure and Report	GaugeSW-0089.docx	1.1	Oct.2016
D040	Safety Requirements Specification	Eagle-Prod_Doc_TH0013 4_0.pdf	4	30-Sep-16
D041	Safety Requirements Review	Eagle-0200.pdf	1.6	24-Sep-15
D043	Software Requirements Specification	Eagle-0114.pdf	4	30-Sep-16
D043b	Software Requirements Specification	Eagle-0174.docx	3	6-Oct-16
D045	System Architecture Design Specification	Eagle-Prod_Doc_TH0012 SAD.pdf	1	12-Dec-14
D045b	System Architecture Design Specification-Safety Concept	Eagle-Prod_Doc_TH0024.pdf	3	18-Dec-15
D045c	System Architecture Design FMEA Review	Eagle-Prod_Doc_TH0022.pdf	2	14-Apr-15
D045d	System Architecture Design Overview	System FMEA 5X08_rev_0a.pptx	0a	Jan.2015
D047	Schematics / Circuit Diagrams	Recorded in FMEDA report [R3] D7000002-814_0L CMH; D7000002-811_01 PMK; D7000002-817_02 TMH; D7000002-823_01 LDT;		30-Sep-16
D049	High Level Software Design Specification	Eagle-Prod_Doc_TH0003.docx	2	6-Oct-16
D049b	High Level Software Design Overview for FMEA	SW Overview 150120.pptx	n/a	Jan.2015



ID	Document	Filename	Version	Date
D050	SW HAZOP or Criticality Analysis-MCU-C	Eagle-0238.xls	1	12-Feb-15
D050b	SW HAZOP or Criticality Analysis-MCU-A	Eagle-0244.xls	3	7-Oct-15
D050c	SW HAZOP or Criticality Analysis-MCU-P	Eagle-0247.xls	3	10-Oct-16
D051	Detailed Software Design Specification; Software Modules List	Eagle-Prod_Doc_TH0007.docx	2	10-Oct-16
D051b	Detailed Software Design -Aout CPU spec	Eagle-Prod_Doc_TH0006.docx	2	10-Oct-16
D053	Design Review Record	Eagle-0180.pdf	1	21-Nov-14
D053b	Design Review Record-MCU-P SW	Eagle-0182.pdf	1	25-Nov-14
D055b	FMEDA Report summary	Eagle-Prod_Doc_TH0119 1_8.efm.xls	1.8	31-Oct-16
D055c	FMEDA Details- Proof test coverage	Eagle-Prod_Doc_TH0167 issue 2.xlsx	2	31-Oct-16
D056	Requirements Traceability Matrix-design	Eagle-Prod_Doc_TH0105.docx	4	7-Oct-16
D056b	Requirements Traceability Matrix-design2	Eagle-Prod_Doc_TH0104.docx	4	7-Oct-16
D056c	Requirements Traceability Matrix- FW V&V	Eagle-0110.doc	3	6-Oct-16
D057	Software Test Coverage Analysis Report	Eagle-Prod_Doc_TH0166.docx	2	6-Oct-16
D057b	Software Test Coverage Analysis Report 2	Eagle-Prod_Doc_TH0170.docx	1	6-Oct-16
D058	Code Review Record; Module test Plan Review Sample	Eagle-0687.pdf	1	30-Sep-16
D059	Fault Injection Test Plan	Eagle-Prod_Doc_TH0115.pdf	7	23-Sep-16
D059b	Fault Injection Test Plan-SW FIT	Eagle-Prod_Doc_TH0114.docx	1	18-Mar-16
D060	Coding Standard-General	GaugeSW-Instr-0022.docx	2	2-Jul-14
D060b	Coding Standard - UML	GaugeSW-Instr-0014.doc	3	15-Mar-11
D060c	Coding Standard - Code Review	GaugeSW-Instr-0011.doc	5	1-Nov-12
D061	Static Code Analyzer Configuration Description	GaugeSW-Instr-0001.doc	6	13-Feb-14
D064	Module Test Plan- SW	Eagle-Prod_Doc_TH0042.docx	2	7-Oct-16
D064b	Module Test Plan- SW	Eagle-Prod_Doc_TH0073.docx	4	Oct.2016



ID	Document	Filename	Version	Date
D066	Module test Results; Integration Test Results; Static Code Analysis Results	Eagle-Prod_Doc_TH0166.docx	2	6-Oct-16
D066b	Module test Results; Integration Test Results; Static Code Analysis Results	Eagle-Prod_Doc_TH0170.docx	1	7-Oct-16
D067	Integration Test Plan	Eagle-Prod_Doc_TH0073.docx	4	Oct.2016
D067b	Integration Test Plan Template	Eagle-Prod_Doc_TH0044.docx	4	Oct.2016
D069	Validation Test Plan; Environmental Test Plan; EMC Test Plan	Eagle-0210.pdf	2	22-Dec-15
D069b	V&V Plan	Eagle-0453.pdf	1.2	30-Sep-16
D070	Validation Test Plan Review	Eagle-0465.pdf	1	21-Dec-15
D074	Validation Test Results; Environmental Test Results	Eagle-0684.pdf	1	30-Sep-16
D076	EMC Test Results	Eagle-0686.pdf	n/a	13-Sep-16
D077	Fault Injection Test Results -HW	Eagle-Prod_Doc_TH0160.pdf	2	25-Sep-16
D077b	Fault Injection Test Results -SW	Eagle-Prod_Doc_TH0163.pdf	1	16-Sep-16
D079	Safety Manual; Operation / Maintenance Manual	5408_RefMan_RevAA.pdf	Rev AA	28-Nov-16
D080	Safety Manual Review	Safety Manual Review.xlsm- form	n/a	Online export
D081	Engineering Change Documentation	Eagle-0069.pdf	5	11-Nov-15
D082	List of Diagnostics for FMEDA	Eagle-0007.pdf	2.3	26-Sep-16
D087	Digital Signature	Eagle-Prod_Doc_TH0048.docx	14.00	6-Oct-16
D088	Impact Analysis Record- example	Raptor-RE-0351.docx	6.00	17-Apr-14
D091	SW Release Notes	Eagle-0651.pdf	1.00	6-Oct-16



2.4.2 Documentation generated by *exida*

[R1]	ROS Eagle V1R2 Safety Case WB-61508 v1.7.2e.xlsm	SafetyCase for the Rosemount 5408 Level Transmitter
[R2]	Q1501149 Eagle CertificationA.pdf; Q1409201 Eagle Certification.pdf	Proposal and Assessment Plan for the Rosemount 5408 Level Transmitter, Rev A
[R3]	ROS 14-09-201 R001 V2R2 FMEDA 5408.pdf, Nov.2016	FMEDA report for the Rosemount 5408 Level Transmitter

2.5 Assessment Approach

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

The assessment was planned by *exida* and agreed with Rosemount Tank Radar.

The following IEC 61508 objectives were subject to detailed auditing at Rosemount Tank Radar:

- FSM planning, including
 - Safety Life Cycle definition
 - Scope of the FSM activities
 - Documentation management
 - 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 / quantitative analysis
- 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 certification onsite audit was done in Linköping, Sweden, in October 2016.

3 Product Description

The Rosemount 5408 Level Transmitter is a non-contact radar level transmitter intended for safety instrumented systems. It has a 4-20 mA analog output as its safety output.

The Rosemount 5408 Level Transmitter provides the following safety functions;

- Measure the distance from the micro-wave unit to a liquid substance in a tank. This function is based on a measurement of the delay time between a transmitted micro-wave and the received echo. A FMCW radar sweep is used for this measurement.
- Optionally derive other measurement variables (for example volume) from the measured distance.
- Calculate and emit a 4-20 mA current based on the selected measurement variable.



3.1 Hardware and Software Version Numbers

This assessment is applicable to the following hardware and software versions of the Rosemount 5408 Level Transmitter:

Table 1 Revisions in Assessment Scope

Rosemount 5408 Level Transmitter	
Hardware	Model 5408F **H* (H = 4-20mA output with HART; * = wildcards based on the order selection)
Software/Firmware	1.A2

The versions in Table 1 were current when this report was released. For updated versions covered under this certification, refer to the Safety Manual which includes the company webpage where the certified versions and compatibility can be checked.



4 IEC 61508 Functional Safety Assessment Scheme

exida assessed the development process used by Rosemount Tank Radar for this development project against the objectives of the *exida* certification scheme. The results of the assessment are documented in [R1]. All objectives have been successfully considered in the Rosemount Tank Radar development processes for the Rosemount 5408 Level Transmitter.

exida assessed the set of documents against the functional safety management requirements of IEC 61508. 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 Rosemount 5408 Level Transmitter, with IEC 61508.

The assessment was executed using the *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 Rosemount 5408 Level Transmitter 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 Rosemount Tank Radar may make modifications to this product as needed. All modifications are subject to review during a surveillance audit.

As part of the *exida* 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 Rosemount Tank Radar during the product development against the objectives of the *exida* certification scheme which includes IEC 61508 parts 1, 2, & 3 [N1]. The development of the Rosemount 5408 Level Transmitter was done per this IEC 61508 SIL 3 compliant process. The Safety Case was updated with project specific design documents.

5.1 Lifecycle Activities and Fault Avoidance Measures

Rosemount Tank Radar has an IEC 61508 compliant development process as assessed during the IEC 61508 certification. This compliant development process is documented in [D003] and [D003b].

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 *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 Manufacturer has been ISO 9001 certified [D036]. All sub-suppliers have been qualified through the Manufacturer Qualification procedure [D007], [D007b].

The functional safety management (FSM) plan [D026] defines the safety lifecycle for this project. This includes a definition of the safety activities and input/output documents to be created for this project. This information is communicated via these documents to the entire development team so that everyone understands the safety plan. The development team is involved in all aspects of the project, including safety activities as applicable, and regular meetings and reviews ensure that all relevant members take part and are informed.

All phases of the safety lifecycle have verification steps described in the FSM plan or a separate verification plan for one or more phases. This plan includes criteria, techniques and tools used in the activities. The verification is carried out against this plan.

The Software Development Procedure [D021] identifies the phases of the software development lifecycle and the inputs/outputs associated with each phase. Any tailoring shall be justified, for example if a modification is required.

Conclusion:

The objectives of the standard are fulfilled by the Rosemount Tank Radar functional safety management system and new product development processes.

5.1.3 Documentation

Assessment

There is a document management system in place [D010], [D010b]. This system controls how all safety relevant documents are changed, reviewed and approved. All safety related documents are required to meet the following requirements:

- Have titles or names indicating scope of the contents
- Have a revision index which lists versions of the document along with a description of what changed in that version
- Documents are searchable electronically

Several documents were sampled and found to meet these requirements.

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar functional safety management system.

5.1.4 Training and competence recording

Assessment



The FSM Plan [D026] lists the key people working on the project along with their roles. A Functional Safety Coordinator is assigned for the project. A competency matrix has been created and includes the following:

- Competency requirements for each role on project.
- List of people who fulfill each role
- List of competencies for each individual matched up to required competencies based on roles that they fill.
- Training planned to fill any competency gaps.

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar functional safety management system and internal organizational procedures.

5.1.5 Configuration Management

Assessment

Formal configuration control is defined and implemented for Change Authorization, Version Control, and Configuration Identification [D004 thru D004g]. 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.

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. Product numbers and versions are well-established.

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar 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 (off-line support tools) are documented, including tool name, manufacturer name, version number, use of the tool on this project [D038]. 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). All 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 are identified, appropriate mitigation measures have been taken.

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar 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. The FSM plan calls for the creation of the SRS [D040]. Software safety requirements [D043] have been created as design requirements (from Safety Requirements). These requirements have been made available to the software developers and have been reviewed by software developers. The results of the review are documented and all action items are tracked through resolution. Specific requirement for start-up and restart procedures (if required) are specified. All system and operator interfaces necessary to achieve the required functional safety are specified. All safety related constraints between the software and hardware have been documented in the Software Safety Requirements or other suitable requirements document.

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar functional safety management system and use of requirements management tools.

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

A Modification Procedure exists that identifies how a modification request is initiated and processed in order to authorize a Product Modification Request (including hardware and software modifications). A Product Modification Request System exists to support this process. 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. The Software Modification Procedure requires that the changed software module is re-verified after the change has been made.

A Modification Procedure requires that an Impact Analysis be performed to assess the impact of the modification, including the impact of changes to the software design (which modules are impacted) and on the Functional Safety of the system. The results of an Impact Analysis are documented. An impact analysis [D023b] is performed for any change related to functional safety.

The modification process has been successfully assessed and audited, so Rosemount Tank Radar may make modifications to this product as needed.

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar 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

System design has been partitioned into subsystems, and interfaces between subsystems are clearly defined and documented. Techniques and measures to achieve SIL3 have been applied during development. The System Architecture Design [D045], [D045b] clearly identifies the SIL of all 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 with an FMEA or software HAZOP [D050 thru D050c]. The System Architecture Design describes that the behavior of the device when a fault is detected is to take an action which will achieve or maintain a safety state.

The System Architecture Design identifies design features (such as Proof Test) that support maintainability and testability. This shows that these qualities have been considered during design and development and have been verified at review time. Maintenance includes possible software changes in the field, if applicable, including maintaining system safety during and after such changes.

An inspection of the system architecture design has been done. Semi-formal methods will be used to document the design. Specific methods used on this project are UML, flowcharts, sequence diagrams, timing diagrams, activity charts, STD.

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar 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.

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 Rosemount Tank Radar functional safety management system and new product development processes.

5.5.2 Hardware Design / Probabilistic properties

Assessment

To evaluate the hardware design of the Rosemount 5408 Level Transmitter, 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 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 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 Rosemount Tank Radar functional safety management system, FMEDA quantitative analysis, and hardware development guidelines and practices.

5.6 Software Design

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.

Assessment

The System Architecture Design contains a description of the software architecture. The design is partitioned into components which are either all new components or treated as new, and fully verified prior to product release. The Software Architecture Design [D049] uses semi-formal methods, such as UML, State Charts / State Transition and Dataflow Diagrams. The Software Architecture Design was reviewed and confirmed that the architecture fulfills the safety requirements. The Software Architecture Design specifies that fault detection techniques are employed to detect software faults. The Software Detailed Design [D051] describes the design features and diagnostics that maintain the safety integrity of data. Any action items to be addressed prior to release were submitted to the action item tracking system and have been resolved.

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar functional safety management system.

5.7 Software Verification

Objectives

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

- 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 results

Design reviews [D053b] are part of the overall software development process. Online collaboration tools are used for reviews. Formal design reviews are held and the results recorded; action items are identified, assigned, and resolved.

A modular approach has been used in the software design. Design has been broken up into functions and methods which are modular and subprograms have a single entry and a single exit.

Static analysis tools [D061] are used; results are reviewed and errors are resolved or explained. Cyclomatic complexity is also measured and recorded in [D066].



Structural test coverage (entry points, statements, branches) of 100 % is documented by a tool or a manual trace of test coverage. An exported example as HTML is included in [D066b]. The coverage metrics are under version control.

Module Test Results [D066] for all safety related modules were produced and documented per the Module Test Verification Plan/Specification. Sample results files were reviewed; unit tests are automated or manual; verification of data is included in tests; result files show the pass/fail output line.

The Traceability Matrix [D056] shows that for each Software Architecture requirement there is one or more corresponding Software Safety Requirement. (backward traceable). The Traceability Matrix also shows that, for each Software Safety Requirement, there are corresponding Software Design Requirements which cover the Software Safety Requirement. (forward traceable).

Conclusion:

The objectives of the standard are fulfilled by the Rosemount Tank Radar functional safety management system, software development process, and new product development processes.

5.8 Safety Validation

Objectives

- 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

One or more test cases, or analysis documents, exist for each safety requirement (including software safety requirements) as shown by the requirements traceability matrix [D056], [D056b]. 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). The test plan includes the procedure used to properly judge that the validation test is successful or not. Dynamic (runtime) analysis/testing is performed in addition to static analysis/testing.

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.

Test cases are created by looking at the product as a black box, meaning that external inputs are applied to the product and outputs are observed. Equivalence classes, input partitioning testing, and boundary value analysis help determine what input values to use.

Test results are documented, including reference to the test case and test plan version being executed. [D074] is a summary of all validation results, either by test, analysis, or Safety Manual entry. Test cases, procedures and details are included in online servers and exported as needed.

The following information is documented in the test results:



- a record of validation activities, permitting validation results to be reproduced and/or retraced;
- the version of the validation plan used to execute the test. (created and modified version history is recorded);
- the safety function associated with each test case. (safety functions indicated in SRS and linked via tools);
- the tools and equipment and calibration data;

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar functional safety management system, software development process, and new product development processes.

5.9 Safety Manual

Objectives

- Develop procedures 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 is provided as a separate section of the Reference Manual [D079], and identifies the safety functions of the product, including a description of the input and output interfaces. When internal faults are detected, their effect on the device output is clearly described. Sufficient information is provided to facilitate the handling of external diagnostics capability (output monitoring by PLC).

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. Routine maintenance tools and activities required to maintain safety are identified and described in the Manual and Appendices. Normal plant and process maintenance procedures are usually enough. Users can add automatic alerts for certain maintenance functions, and other diagnostic alerts can direct troubleshooting activities.

Conclusion

The objectives of the standard are fulfilled by the Rosemount Tank Radar functional safety management system and the safety manual.



6 2019 IEC 61508 Functional Safety Surveillance Audit

6.1 Roles of the parties involved

Rosemount Tank Radar	Manufacturer of the Rosemount 5408 Level Transmitter
<i>exida</i>	Performed the hardware assessment review
<i>exida</i>	Performed the IEC 61508 Functional Safety Surveillance Audit per the accredited <i>exida</i> scheme.

Rosemount Tank Radar contracted *exida* in Oct 2019 to perform the surveillance audit for the above Rosemount 5408 Level Transmitter. The surveillance audit was conducted remotely in Sellersville, PA, USA in November 2019

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 Rosemount 5408 Level Transmitter.
- 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 Rosemount Tank Radar

ID	Document	Filename	Version	Date
D093	Impact Analysis	5408-P-SIS-TB-0003.pdf	2.0	Mar.2017
D094	Verification Module Report	5408-P-SIS-TB-0014.pdf	2.18	8-Mar-17
D097	Verification Module Report	Eagle-0749.pdf	2.15	18-Jan-17
D098	Verification Module Report	Eagle-0799.pdf	2.20	12-Jun-17
D099	HW Test Report	Eagle-Prod_Doc_TH0162.pdf	2.0	16-Jan-17
D100	Impact Analysis	Eagle-Prod_Doc_TH0181.pdf	1.0	8-Mar-17
D101	DVT Test Report	Eagle-Prod_Doc_TH0185.pdf	3	21-Jul-16
D102	Impact Analysis	Eagle-Prod_Doc_TH0186.pdf	1	13-Dec-16
D103	Impact Analysis	Eagle-Prod_Doc_TH0187.pdf	1.0	8-Mar-17
D104	Impact Analysis	Eagle-Prod_Doc_TH0198.pdf	2	11-Jan-17
D105	Impact Analysis	Eagle-Prod_Doc_TH0199.pdf	1	16-Jan-17
D106	Impact Analysis	Eagle-Prod_Doc_TH0200.pdf	3	8-Mar-17
D107	Impact Analysis	Eagle-Prod_Doc_TH0209.pdf	1.0	8-Jun-17
D108	Impact Analysis	Eagle-Prod_Doc_TH0210.pdf	1.1	15-May-17
D109	Impact Analysis	Eagle-Prod_Doc_TH0223.pdf	1.1	16-Jun-17
D110	Impact Analysis	Eagle-Prod_Doc_TH0275.pdf	1.0	18-Oct-19
D111	Impact Analysis	Eagle-Prod_Doc_TH0286.pdf	1.0	18-Mar-19
D112	Device Test Report	Eagle-Prod_Doc_TH0290 (5408 – 1A8 GSW Device Test Report).pdf	1.0	30-Apr-19
D113	HW & GSW CHANGES	ProdApp-0259.pdf	1	25-Sep-19
D114	Field History Report	5408 field return analysis.xlsx		Oct.2019
D115	RFI Resolutions	RE_ 5408 RFI Resolutions.msg		Nov.2019
D116	Software Tool Qualification	D038 GaugeSW-0089.pdf	1.3	3-Feb-17
D117	TH01 SRD	D040 Eagle-Prod_Doc_TH0013 Issue 8 full print.pdf (extract from DOORS)	8.0	6-Sep-19
D118	TH01 SRD	D040 Eagle-Prod_Doc_TH0013 Issue 9.pdf	9.0	26-Sep-19
D120	Firmware Requirement Specification	Eagle-Prod_Doc_TH0298 (5408 - MCU-P FIRMWARE REQUIREMENT SPECIFICATION).pdf (former Eagle-0114)	8.00	Nov.2019
D122	Firmware Requirement Specification	Eagle-Prod_Doc_TH0303 (former Eagle-0174).pdf	4.0	25-Mar-19
D123	Firmware Architecture	D049 Eagle-Prod_Doc_TH0003 Issue 3 (1).pdf	3.0	5-Apr-19
D124	SW Design Specification	D051 Eagle-Prod_Doc_TH0007 Issue 4.pdf	4.0	7-Mar-19



D125	Coding Standard	D060 GaugeSW-Instr-0022 Issue 3.pdf	3.0	25-Sep-19
D126	Device Test Specification	D064 Eagle-Prod_Doc_TH0042 Issue 4.pdf	4.0	16-Oct-19
D127	Device Test Specification	D064b D067 Eagle-Prod_Doc_TH0073 Issue 5.pdf	5.0	1-Apr-19
D128	Reference Manual	D079 00809-0100-4408_RevBE.pdf	BE	June.2019
D130	Coordination Document	D082 Eagle-Prod_Doc_TH0293 (former Eagle-0007).pdf	2.7	25-Mar-19
D131	SW Revision History	D087 Eagle-Prod_Doc_TH0048 Issue 19.pdf	19.0	27-Mar-19
D133	Design Failure Mode & Effects Analysis	D50c Eagle-Prod_Doc_TH0312 (former Eagle-0247).xls		10-Jan-18
D134	Schematics / Circuit Diagrams	(Schematics); see FMEDA folder and report D7000002-811_I03 PMK.pdf; D7000002-814_I03 CMH.pdf; D7000002-817_I02 TMH.pdf; D7000002-823_I01 LDx.pdf;		11/13/2019
D135	FMEDA Report summary	Eagle-Prod_Doc_TH0119 Rev 1.10 2017-02-20 rpc 2019-12-04.xlsx	1.10	Dec.2019
D136	System Control Drawing	Eagle-Prod_Doc_TH0144.pdf	2.1	2/27/2017
D137	SIS Baseline Matrix	Eagle-Prod_Doc_TH0179.xls	7	5/17/2019
D138	SW Release Plan	Eagle-Prod_Doc_TH0203.pdf	1.0	6/14/2017
D139	SRD Update GSW 1A5	Eagle-Prod_Doc_TH0211.pdf	6.0	6/7/2017
D140	Release Report	Eagle-Prod_Doc_TH0214.pdf	1.0	6/12/2017
D141	Engineering Change Documentation	ECR 27225.pdf	n/a	1/29/2018
D142	Detailed Software Design Specification	Eagle-Prod_Doc_TH0095 (SIP Design Spec).pdf	3	11/26/2019
D143	Detailed Software Design Specification	Eagle-Prod_Doc_TH0145 (Echo Design Spec).pdf	3	6/12/2017
D144	Detailed Software Design Specification	Eagle-Prod_Doc_TH0208 (SFE Design Spec).pdf	1	4/28/2017
D145	module test Results	Eagle-Prod_Doc_TH0220 (5408 1A5 - GSW AUTOBUILD DEVICE TEST REPORT).pdf	2	6/13/2017
D146	Device Test Report	Eagle-Prod_Doc_TH0246 (5408 - 1A5B GSW DEVICE TEST REPORT).pdf	1.0	30-Apr-19
D147	Device Test Report	Eagle-0330 (Solids Measurement 5408 DP1 #11).pdf	1.0	30-Apr-19



6.2.2 Surveillance Documentation generated by *exida*

[R4]	ROS 14-09-201 R001 V3R2 FMEDA 5408.pdf	FMEDA report, Rosemount 5408 Level Transmitter
[R5]	ROS 15-01-149 R001 V1R3 IEC 61508 Assessment Report.docx	IEC 61508 Assessment Report, Rosemount Tank Radar (this report)
[R6]	ROS Eagle V2R4 Safety Case WB-61508 v1.7.2e.xlsm	IEC 61508 SafetyCaseWB for Rosemount 5408 Level Transmitter
[R7]	ROS 14-09-201 5408 V1R2 FFA.xlsx	Field Failure Analysis for Rosemount 5408 Level Transmitter
[R8]	Q19-09-114 V1R2 Change Audit_Checklist.xls	Surveillance Audit Change review for Rosemount 5408 Level Transmitter

6.3 Surveillance Results

6.3.1 Procedure Changes

There were no changes to the procedures during the previous certification period.

6.3.2 Engineering Changes

There were some hardware and software design changes to these products from the previous certification period. The documentation for the enhancements were reviewed and all documentation was found to be acceptable.

6.3.3 Impact Analysis

A number of Impact Analyses have been conducted on the Rosemount 5408 Level Transmitter during the certification period; the impact analysis reports were sent to *exida* for review and found satisfactory.

6.3.4 Field History

The field histories of these products were analyzed and found to be consistent with the failure rates predicted by the FMEDA.

6.3.5 Safety Manual

The updated safety manual was reviewed [D128] and found to be compliant with IEC 61508:2010.

6.3.6 FMEDA Update

The FMEDA [D135] was updated as part of this project. The FMEDA report [R4] was updated as part of the recertification.



6.3.7 Evaluate use of certificate and/or certification mark

The Rosemount Tank Radar 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 Recent Product Versions

Table 2 Revisions in Assessment Scope

Rosemount 5408 Level Transmitter	
Hardware	Model 5408F ***H*** (H = 4-20mA output with HART; * = wildcards based on the order selection)
Software/Firmware	1.A8 and higher

The versions in Table 2 were current when this report was released. For updated versions covered under this certification, refer to the Safety Manual which includes the company webpage where the certified versions and compatibility can be checked.

6.4 Surveillance Audit Conclusion

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

The Rosemount 5408 Level Transmitter continues to meet the relevant requirements of IEC 61508:2010 for up to SIL 3 in low or high demand applications based on the initial assessment and considering:

- field failure history
- permitted modifications completed on the product
- FMEDA updates and changes
- resolution of past action items

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 (1×10^{-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
Q19/09-114	ROS 15-01-149 R001 V1R3	Revision due to FMEDA update; 5-Dec-2019, ABC
Q19/09-114	ROS 15-01-149 R001 V1R2	Surveillance Audit Assessment; 2-Dec-2019, ABC
Q15/01-149	ROS 15-01-149 R001 V1R1	Initial Release, revised sect 2.4.1 listing after internal and client review; 9-Dec-2016, JCY

Review: Ted Stewart (*exida*), December 2, 2019

Status: Released, December 5, 2019

8.3 Future Enhancements

At request of client.

8.4 Release Signatures

Andres Cruz, CFSE, Senior Safety Engineer

Ted E. Stewart, CFSP, *exida*CSP
Program Development & Compliance Manager



Part II

Equipment Registration for the
5408 and 5408:SIS Radar Gauges
And associated components
to the
Florida Department of Environmental Protection
from
Rosemount Tank Gauging - North America

Submitted by

Marshall T. Mott-Smith, President

Mott-Smith Consulting Group

111 North Calhoun Street

Tallahassee, FL 32301

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850-391-9835 work

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Attachment II

Third Party Approval by Exida



The manufacturer
may use the mark:



Revision 3.0 December 5, 2019
Surveillance Audit Due
December 4, 2022



ISO/IEC 17065
PRODUCT CERTIFICATION BODY
#1004

Certificate / Certificat Zertifikat / 合格証

ROS 1501149 C001

exida hereby confirms that the:

**Rosemount™ 5408 Level Transmitter
(4-20 mA HART)**

**Rosemount Tank Radar
(an Emerson company)
Sweden**

Has been assessed per the relevant requirements of:

IEC 61508 : 2010 Parts 1-7

and meets requirements providing a level of integrity to:

Systematic Capability: SC 3 (SIL 3 Capable)

Random Capability: Type B Element

SIL 2 @ HFT=0; SIL 3 @ HFT = 1; Route 1_H

**PFD_{avg} and Architecture Constraints
must be verified for each application**

Safety Function:

The Rosemount 5408 Level Transmitter will measure Level within the stated safety accuracy.

Application Restrictions:

The unit must be properly designed into a Safety Instrumented Function per the Safety Manual requirements.



Evaluating Assessor

Certifying Assessor

Rosemount™ 5408
Level Transmitter



80 N Main St
Sellersville, PA 18960

T-002, V5R3

Certificate / Certificat / Zertifikat / 合格証

ROS 1501149 C001

Systematic Capability: SC 3 (SIL 3 Capable)

Random Capability: Type B Element

SIL 2 @ HFT=0; SIL 3 @ HFT = 1; Route 1_H

**PFD_{avg} and Architecture Constraints
must be verified for each application**

Systematic Capability:

The product has met manufacturer design process requirements of Safety Integrity Level (SIL) 3. These are intended to achieve sufficient integrity against systematic errors of design by the manufacturer.

A Safety Instrumented Function (SIF) designed with this product must not be used at a SIL level higher than stated.

Random Capability:

The SIL limit imposed by the Architectural Constraints must be met for each element.

IEC 61508 Failure Rates in FIT*

Device, Route 1 _H	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF
Rosemount™ 5408 Series Level Transmitter (4-20mA HART Non-Contact Radar)	0	260	736	79	92.7%

* FIT = 1 failure / 10⁹ hours

SIL Verification:

The Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) must be verified via a calculation of PFD_{avg} considering redundant architectures, proof test interval, proof test effectiveness, any automatic diagnostics, average repair time and the specific failure rates of all products included in the SIF. Each element must be checked to assure compliance with minimum hardware fault tolerance (HFT) requirements.

The following documents are a mandatory part of certification:

Assessment Report: ROS 15-01-149 R001 V1R3

Safety Manual: #00809-0100-4408, Rev AA and later

Attachment III

Product Certifications

Product Certifications
00825-0200-4408, Rev AT
March 2023

Rosemount™ 5408 and 5408:SIS Level Transmitters

Product Certifications



ROSEMOUNT™



1 Product certifications

Rev 4.49

1.1 European directive and UKCA regulations information

A copy of the EU/UK Declaration of Conformity can be found at the end of this document. The most recent revision of the EU/UK Declaration of Conformity can be found at [Emerson.com/Rosemount](https://www.emerson.com/Rosemount).

1.2 Safety Instrumented Systems (SIS)

SIL 3 Capable: IEC 61508 certified for use in safety instrumented systems up to SIL 3 (Minimum requirement of single use (1oo1) for SIL 2 and redundant use (1oo2) for SIL 3).

1.3 Ordinary location certification

As standard, the transmitter has been examined and tested to determine that the design meets the basic electrical, mechanical, and fire protection requirements by a nationally recognized test laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

1.4 Environmental conditions

Table 1-1: Environmental Conditions (Ordinary Location and Low Voltage Directive (LVD))

Type	Description
Location	Indoor or outdoor use, wet
Maximum altitude	6562 ft. (2000 m)
Ambient temperature	-76 to 158 °F (-60 to 70 °C)
Electrical supply	12-42.2 Vdc (HART®) 9-32 Vdc (Fieldbus)
Mains supply voltage fluctuations	Safe at ±10%
Overvoltage category	II
Pollution degree	2

1.5 Telecommunication compliance

Measurement principle

Frequency Modulated Continuous Wave (FMCW), 26 GHz

Maximum output power

-5 dBm (0.32 mW)

Frequency range

24.05 to 27.0⁽¹⁾ GHz (TLPR)

24.05 to 26.5 GHz (LPR)

LPR (Level Probing Radar) equipment are devices for measurement of level in the open air or in a closed space. Model option "OA". Hardware Version Identification Number (HVIN) is 5408L.

TLPR (Tank Level Probing Radar) equipment are devices for measurement of level in a closed space only (i.e metallic, concrete or reinforced fiberglass tanks, or similar enclosure structures made of comparable attenuating material). Hardware Version Identification Number (HVIN) is 5408T.

1.6 FCC

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC ID K8C5408L (for LPR)

⁽¹⁾ 26.5 GHz in Australia, New Zealand, and Russia.

K8C5408T (for TLPR)

1.7 IC

This device complies with Industry Canada's licence-exempt RSS standard. Operation is subject to the following conditions:

1. This device may not cause interference.
2. This device must accept any interference received, including interference that may cause undesired operation.
3. The installation of the LPR/TLPR device shall be done by trained installers in strict compliance with the manufacturer's instructions.
4. The use of this device is on a "no-interference, no-protection" basis. That is, the user shall accept operations of high-powered radar in the same frequency band which may interfere with or damage this device. However, devices found to interfere with primary licensing operations will be required to be removed at the user's expense.
5. Devices operating under TLPR conditions (i.e. not operating in "Open Air" Mode) shall be installed and operated in a completely enclosed container to prevent RF emissions, which can otherwise interfere with aeronautical navigation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage.
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.
3. L'installation d'un dispositif LPR ou TLPR doit être effectuée par des installateurs qualifiés, en pleine conformité avec les instructions du fabricant.
4. Ce dispositif ne peut être exploité qu'en régime de non-brouillage et de non-protection, c'est-à-dire que l'utilisateur doit accepter que des radars de haute puissance de la même bande de fréquences puissent brouiller ce dispositif ou même l'endommager. D'autre part, les capteurs de niveau qui perturbent une exploitation autorisée par licence de fonctionnement principal doivent être enlevés aux frais de leur utilisateur.

5. Un dispositif visé comme TLPR doit être installé et exploité dans un réservoir entièrement fermé afin de prévenir les rayonnements RF qui pourraient autrement perturber la navigation aéronautique.

Certificate 2827A-5408L (for LPR)
 2827A-5408T (for TLPR)

1.8 Radio Equipment Directive (RED) 2014/53/EU and Radio Equipment Regulations S.I. 2017/1206

This device complies with ETSI EN 302 372 (TLPR), ETSI EN 302 729 (LPR) and EN 62479.

For the receiver test that covers the influence of an interferer signal to the device, the performance criterion has at least the following level of performance according to ETSI TS 103 361 [6].

- Performance criterion: measurement value variation Δd over time during a distance measurement
- Level of performance: $\Delta d \leq \pm 2$ mm

LPR (Level Probing Radar), model code "OA"

Install at a separation distance of >4 km from Radio Astronomy sites, unless a special authorization has been provided by the responsible National regulatory authority (a list of Radio Astronomy sites may be found at www.craf.eu).

Between 4 km to 40 km around any Radio Astronomy site the LPR antenna height shall not exceed 15 m height above ground.

TLPR (Tank Level Probing Radar)

The device must be installed in closed tanks. Install according to requirements in ETSI EN 302 372 (Annex E).

1.9 Installing equipment in North America

The US National Electrical Code® (NEC) and the Canadian Electrical Code (CEC) permit the use of Division marked equipment in Zones and Zone marked equipment in Divisions. The markings must be suitable for the area classification, gas, and temperature class. This information is clearly defined in the respective codes.

1.10 USA

1.10.1 E5 Explosionproof (XP), Dust-Ignitionproof (DIP)

Certificate FM-US FM16US0010X

Standards	FM Class 3600 – 2018; FM Class 3615 – 2018; FM Class 3810 – 2005; ANSI/ISA 60079-0 – 2013; ANSI/UL 60079-1 – 2015; ANSI/UL 60079-26 – 2017; ANSI/ISA 60079-31 – 2015; ANSI/NEMA® 250 – 1991; ANSI/IEC 60529 – 2014, ANSI/ISA 12.27.01:2011
Markings	XP CL I, DIV 1, GRPS A, B, C, D T6...T2 DIP CLII/III, DIV 1, GRPS E, F, G; T6...T3 CL I Zone 0/1 AEx db IIC T6...T2 Ga/Gb Zone 21 AEx tb IIIC T85 °C...T250 °C Db (-40 °C ≤ Ta ≤ +70 °C) ⁽²⁾ ; Type 4X/IP6X SINGLE SEAL

Specific Conditions of Use (X):

1. Flamepath joints are not for repair. Contact the manufacturer.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
5. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP6X and/or Type 4X rating. To maintain the ingress protection ratings, Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for cable entries and blanking plugs. See [Instruction Manual](#) on application requirements.
6. Install per Control drawing D7000002-885.
7. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.

⁽²⁾ Other temperature ranges may apply, see Specific Conditions of Use (X).

8. Display glass shall be positioned in such a way as to minimize the risk of mechanical impact.
9. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Table 1-2: For Divisions:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Division Gas groups:		
T2	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 250 °C
T3	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 195 °C
T4	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 130 °C
T5	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 95 °C
T6	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 80 °C
Division Dust groups:		
T3	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 160 °C
T4	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 130 °C
T5	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 95 °C
T6	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 80 °C

Table 1-3: For Zones:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Zone Gas groups:		
T2	$-50\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-50 °C to 250 °C
T3	$-50\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-50 °C to 195 °C
T4	$-50\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-50 °C to 130 °C
T5	$-50\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-50 °C to 95 °C
T6	$-50\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-50 °C to 80 °C
Zone Dust groups:		
T250°C	$-60\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-60 °C to 250 °C
T200°C	$-60\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-60 °C to 195 °C
T135°C	$-60\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-60 °C to 130 °C
T100°C	$-60\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-60 °C to 95 °C
T85°C	$-60\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-60 °C to 80 °C

1.10.2 I5 Intrinsic Safety (IS), Non-Incendive (NI)

Certificate	FM-US FM16US0010X
Standards	FM Class 3600 – 2018; FM Class 3610 – 2018; FM Class 3611 – 2018; FM Class 3810 – 2005; ANSI/ISA 60079-0 – 2013; ANSI/UL 60079-11 – 2014; ANSI/UL 60079-26 – 2017; ANSI/NEMA® 250 – 1991; ANSI/IEC 60529 – 2014; ANSI/ISA 12.27.01:2011
Markings	IS CL I, II, III DIV 1, GRPS A-G T4...T2 NI CL I, DIV 2, GRPS A-D T4...T2 S CL II, III DIV 2, GRPS E-G T4...T3 CL I Zone 0 AEx ia IIC T4...T2 Ga CL I Zone 0/1 AEx ib IIC T4...T2 Ga/Gb Zone 20 AEx ia IIIC T85°C...T250°C Da -60 (-55) °C $\leq T_a \leq +70\text{ }^{\circ}\text{C}$ When installed per Control Drawing D7000002-885 SINGLE SEAL

Safety parameter	HART®	Fieldbus
Voltage U_i	30 V	30 V
Current I_i	133 mA	300 mA
Power P_i	1.0 W	1.5 W
Capacitance C_i	7.3 nF	1.1 nF
Inductance L_i	0	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Table 1-4: For Divisions:

Temperature class / Maximum surface temperature	Ambient temperature range ⁽¹⁾	Process temperature range ⁽¹⁾
Division Gas groups:		
T2	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T3	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T4	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
Division Dust groups:		
T3	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 160 °C
T4	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
T5	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 95 °C
T6	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 80 °C

(1) -55 °C for Fieldbus; -60 °C for HART

Table 1-5: For Zones:

Temperature class / Maximum surface temperature	Ambient temperature range ⁽¹⁾	Process temperature range ⁽¹⁾
Zone Gas groups:		
T2	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T3	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T4	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
Zone Dust groups:		
T250°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T200°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T135°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
T100°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 95 °C
T85°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 80 °C

(1) -55 °C for Fieldbus; -60 °C for HART

1.10.3 IE FISCO

Certificate	FM-US FM16US0010X
Standards	FM Class 3600 – 2018; FM Class 3610 – 2018; FM Class 3611 – 2018; FM Class 3810 – 2005; ANSI/ISA 60079-0 – 2013; ANSI/UL 60079-11 – 2014; ANSI/UL 60079-26 – 2017; ANSI/NEMA® 250 – 1991; ANSI/IEC 60529 – 2014; ANSI/ISA 12.27.01:2011
Markings	IS CL I, II, III DIV 1, GRPS A-G T4...T2 NI CL I, DIV 2, GRPS A-D T4...T2 S CL II, III DIV 2, GRPS E-G T4...T3 CL I Zone 0 AEx ia IIC T4...T2 Ga CL I Zone 0/1 AEx ib IIC T4...T2 Ga/Gb Zone 20 AEx ia IIIC T85°C...T250°C Da -55 °C ≤ Ta ≤ +70°C When installed per Control Drawing D7000002-885 SINGLE SEAL

Safety parameter	FISCO
Voltage U_i	17.5 V
Current I_i	380 mA
Power P_i	5.32 W
Capacitance C_i	1.1 nF
Inductance L_i	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.

4. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Table 1-6: For Divisions:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Division Gas groups:		
T2	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 250 °C
T3	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 195 °C
T4	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 130 °C
Division Dust groups:		
T3	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 160 °C
T4	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 130 °C
T5	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 95 °C
T6	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 80 °C

Table 1-7: For Zones:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Zone Gas groups:		
T2	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	-55 °C to 250 °C
T3	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	-55 °C to 195 °C
T4	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	-55 °C to 130 °C
Zone Dust groups:		
T250°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	-55 °C to 250 °C
T200°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	-55 °C to 195 °C
T135°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	-55 °C to 130 °C
T100°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	-55 °C to 95 °C
T85°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	-55 °C to 80 °C

1.11 Canada

1.11.1 E6 Explosionproof, Dust-Ignitionproof

Certificate	FM-C FM16CA0011X
Standards	C22.2 NO. 0.4-17:2017, C22.2 NO. 0.5-16:2016, C22.2 No. 25-17:2017, C22.2 No.30-M1986:1986 (R:2016), C22.2 No.94-M91:1991 (R:2011), C22.2 No. 61010-1:2004, CAN/CSA C22.2 No. 60079-0:2015 Ed. 3, C22.2 No. 60079-1:2016 Ed. 3, C22.2 No. 60079-26:2016; CAN/CSA-C22.2 No. 60079-31:2015, C22.2. 60529:2016, ANSI/ISA 12.27.01:2011
Markings	XP CL I, DIV 1, GRPS A-D T6...T2 DIP CLII/III, DIV 1, GRPS E-G; T6...T3 Ex db IIC T6...T3 Gb Ex tb IIIC T85°C...T250°C Db (-40 °C $\leq$ $T_a \leq$ +70 °C) ⁽³⁾ ; Type 4X/IP6X SINGLE SEAL

Specific Conditions of Use (X):

1. Flamepath joints are not for repair. Contact the manufacturer.

⁽³⁾ Other temperature ranges may apply, see Specific Conditions of Use (X).

2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
4. Metric Field Wiring Entries are not allowed for Divisions.
5. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
6. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP6X and/or Type 4X rating. To maintain the ingress protection ratings, Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for cable entries and blanking plugs. See [Instruction Manual](#) on application requirements.
7. Install per Control Drawing D7000002-885.
8. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
9. Display glass shall be positioned in such a way as to minimize the risk of mechanical impact.
10. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Table 1-8: For Divisions:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Division Gas groups:		
T2	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 250 °C
T3	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 195 °C
T4	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 130 °C
T5	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 95 °C
T6	$-40\text{ °C} \leq T_a \leq 70\text{ °C}$	-40 °C to 80 °C
Division Dust groups:		
T3	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 160 °C
T4	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 130 °C
T5	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 95 °C
T6	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 80 °C

Table 1-9: For Zones:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Zone Gas groups:		
T2	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 250 °C
T3	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 195 °C
T4	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 130 °C
T5	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 95 °C
T6	$-50\text{ °C} \leq T_a \leq 70\text{ °C}$	-50 °C to 80 °C
Zone Dust groups:		
T250°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 250 °C
T200°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 195 °C
T135°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 130 °C
T100°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 95 °C
T85°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 80 °C

1.11.2 I6 Intrinsically Safe and Non-Incendive Systems

Certificate	FM-C FM16CA0011X
Standards	C22.2 NO. 0.4-17:2017, C22.2 NO. 0.5-16:2016, C22.2 No. 25-17:2017, C22.2 No.94-M91:1991 (R:2011), C22.2 No. 213-16:2016, C22.2 No. 61010-1:2004, CAN/CSA C22.2 No. 60079-0:2015 Ed. 3, CAN/CSAC22.2 No. 60079-11:2014 Ed. 2, CAN/CSAC22.2 No. 60079-15:2016 Ed.2, C22.2 No. 60079-26:2016, C22.2. 60529:2016, ANSI/ISA 12.27.01:2011
Markings	IS CL I, II, III DIV 1, GRPS A-G T4...T2 NI CL I, DIV 2, GRPS A-D T4...T2 S CL II, III DIV 2, GRPS E-G T4...T3 Ex ia IIC T4...T2 Ga Ex ib IIC T4...T2 Ga/Gb Ex ia IIIC T85°C...T250°C Da -60 (-55) °C ≤ Ta ≤ +70 °C When installed per Control Drawing D7000002-885 SINGLE SEAL

Safety parameter	HART®	Fieldbus
Voltage U _i	30 V	30 V
Current I _i	133 mA	300 mA
Power P _i	1.0 W	1.5 W
Capacitance C _i	7.3 nF	1.1 nF
Inductance L _i	0	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.

3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Table 1-10: For Divisions:

Temperature class / Maximum surface temperature	Ambient temperature range ⁽¹⁾	Process temperature range ⁽¹⁾
Division Gas groups:		
T2	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T3	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T4	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
Division Dust groups:		
T3	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 160 °C
T4	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
T5	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 95 °C
T6	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 80 °C

(1) -55 °C for Fieldbus; -60 °C for HART

Table 1-11: For Zones:

Temperature class / Maximum surface temperature	Ambient temperature range ⁽¹⁾	Process temperature range ⁽¹⁾
Zone Gas groups:		
T2	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T3	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T4	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
Zone Dust groups:		
T250°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T200°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T135°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
T100°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 95 °C
T85°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 80 °C

(1) -55 °C for Fieldbus; -60 °C for HART

1.11.3 IF FISCO

Certificate	FM-C FM16CA0011X
Standards	C22.2 NO. 0.4-17:2017, C22.2 NO. 0.5-16:2016, C22.2 No. 25-17:2017, C22.2 No.94-M91:1991 (R:2011), C22.2 No. 213-16:2016, C22.2 No. 61010-11:2004, CAN/CSA C22.2 No. 60079-0:2015 Ed. 3, CAN/CSAC22.2 No. 60079-11:2014 Ed. 2, CAN/CSAC22.2 No. 60079-15:2016 Ed.2, C22.2 No. 60079-26:2016, C22.2. 60529:2016; ANSI/ISA 12.27.01:2011
Markings	IS CL I, II, III DIV 1, GRPS A-G T4...T2 NI CL I, DIV 2, GRPS A-D T4...T2 S CL II, III DIV 2, GRPS E-G T4...T3 Ex ia IIC T4...T2 Ga Ex ib IIC T4...T2 Ga/Gb Ex ia IIIC T85°C...T250°C Da -55 °C ≤ Ta ≤ +70°C When installed per Control Drawing D7000002-885 SINGLE SEAL

Safety parameter	FISCO
Voltage U_i	17.5 V
Current I_i	380 mA
Power P_i	5.32 W
Capacitance C_i	1.1 nF
Inductance L_i	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between a Zone 0 and Zone 1 area. In this configuration, the process connection is installed in Zone 0, while the transmitter housing is installed in Zone 1. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Table 1-12: For Divisions:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Division Gas groups:		
T2	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 250 °C
T3	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 195 °C
T4	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 130 °C
Division Dust groups:		
T3	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 160 °C
T4	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 130 °C
T5	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 95 °C
T6	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 80 °C

Table 1-13: For Zones:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Zone Gas groups:		
T2	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 250 °C
T3	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 195 °C
T4	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	-55 °C to 130 °C
Zone Dust groups:		
T250°C	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$	-55 °C to 250 °C
T200°C	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$	-55 °C to 195 °C
T135°C	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$	-55 °C to 130 °C
T100°C	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$	-55 °C to 95 °C
T85°C	$-55\text{ }^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$	-55 °C to 80 °C

1.12 Europe

1.12.1 E1 ATEX/UKEX Flameproof

Certificate	FM15ATEX0055X, FM21UKEX0051X
Standards	EN IEC 60079-0:2018, EN 60079-1:2014, EN 60079-26:2015, EN 60079-31:2014, EN 60529+A1+A2:2013
Markings	 II 1/2G Ex db IIC T6...T2 Ga/Gb II 2D Ex tb IIIC T85°C... T250°C Db, IP6X $-60\text{ }^{\circ}\text{C} \leq T_a \leq +70\text{ }^{\circ}\text{C}$

Specific Conditions of Use (X):

1. Flamepath joints are not for repair. Contact the manufacturer.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between EPL Ga and EPL Gb location. In this configuration, the process connection is EPL Ga, while the transmitter housing is EPL Gb. Refer to Control Drawing D7000002-885.
5. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP6X. To maintain the ingress protection ratings, Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for cable entries and blanking plugs. See [Instruction Manual](#) on application requirements.
6. Install per Control Drawing D7000002-885.
7. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
8. Display glass shall be positioned in such a way as to minimize the risk of mechanical impact.
9. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Gas & Dust groups:		
T2 / T250°C	-60 °C ≤ Ta ≤ 70 °C	-60 °C to 250 °C
T3 / T200°C	-60 °C ≤ Ta ≤ 70 °C	-60 °C to 195 °C
T4 / T135°C	-60 °C ≤ Ta ≤ 70 °C	-60 °C to 130 °C
T5 / T100°C	-60 °C ≤ Ta ≤ 70 °C	-60 °C to 95 °C
T6 / T85°C	-60 °C ≤ Ta ≤ 70 °C	-60 °C to 80 °C

1.12.2 I1 ATEX/UKEX Intrinsic Safety

Certificate	FM15ATEX0055X, FM21UKEX0051X
Standards	EN IEC 60079-0:2018, EN 60079-11:2012, EN 60079-26:2015, EN 60529:1991+A1:2000 +A2:2013
Markings	 II 1G Ex ia IIC T4...T2 Ga II 1/2G Ex ib IIC T4...T2 Ga/Gb II 1D Ex ia IIIC T85°C...T250°C Da -60 (-55) °C ≤ Ta ≤ +70°C

Safety parameter	HART®	Fieldbus
Voltage U _i	30 V	30 V
Current I _i	133 mA	300 mA
Power P _i	1.0 W	1.5 W
Capacitance C _i	7.3 nF	1.1 nF
Inductance L _i	0	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.

3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between EPL Ga and EPL Gb location. In this configuration, the process connection is EPL Ga, while the transmitter housing is EPL Gb. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Temperature class / Maximum surface temperature	Ambient temperature range ⁽¹⁾	Process temperature range ⁽¹⁾
Gas groups:		
T2	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T3	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T4	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
Dust groups:		
T250°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T200°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T135°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
T100°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 95 °C
T85°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 80 °C

(1) -55 °C for Fieldbus; -60 °C for HART

1.12.3 IA ATEX/UKEX FISCO

Certificate	FM15ATEX0055X, FM21UKEX0051X
Standards	EN IEC 60079-0:2018, EN 60079-11:2012, EN 60079-26:2015
Markings	 II 1G Ex ia IIC T4...T2 Ga II 1/2G Ex ib IIC T4...T2 Ga/Gb II 1D Ex ia IIIC T85°C...T250°C Da -55°C ≤ Ta ≤ +70°C

Safety parameter	FISCO
Voltage U_i	17.5 V
Current I_i	380 mA
Power P_i	5.32 W
Capacitance C_i	1.1 nF
Inductance L_i	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between EPL Ga and EPL Gb location. In this configuration, the process connection is EPL Ga, while the transmitter housing is EPL Gb. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Gas groups:		
T2	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	$-55\text{ °C to } 250\text{ °C}$
T3	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	$-55\text{ °C to } 195\text{ °C}$
T4	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	$-55\text{ °C to } 130\text{ °C}$
Dust groups:		
T250°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	$-55\text{ °C to } 250\text{ °C}$
T200°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	$-55\text{ °C to } 195\text{ °C}$
T135°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	$-55\text{ °C to } 130\text{ °C}$
T100°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	$-55\text{ °C to } 95\text{ °C}$
T85°C	$-55\text{ °C} \leq T_a \leq 70\text{ °C}$	$-55\text{ °C to } 80\text{ °C}$

1.12.4 N1 ATEX/UKEX Type N: Non-Sparking

Certificate	FM15ATEX0056X, FM21UKEX0052X
Standards	EN IEC 60079-0:2018, EN 60079-15:2010, EN 60529:1991+A1:2000 +A2:2013
Markings	 II 3G Ex nA IIC T4...T2 Gc, IP65 $(-34\text{ °C} \leq T_a \leq +70\text{ °C})$ $V \leq 42.4V, I \leq 23\text{ mA (HART®)}$ $V \leq 32V, I \leq 22\text{ mA (Fieldbus)}$

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP65. To maintain the ingress protection ratings, Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for

cable entries and blanking plugs. See [Instruction Manual](#) on application requirements.

- The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Temperature class	Ambient temperature range	Process temperature range
T2	$-34\text{ °C} \leq T_a \leq 70\text{ °C}$	-34 °C to 250 °C
T3	$-34\text{ °C} \leq T_a \leq 70\text{ °C}$	-34 °C to 195 °C
T4	$-34\text{ °C} \leq T_a \leq 70\text{ °C}$	-34 °C to 130 °C

1.13 International

1.13.1 E7 IECEx Flameproof

Certificate	IECEX FMG15.0033X
Standards	IEC 60079-0:2017, IEC 60079-1:2014; IEC 60079-26:2014, IEC 60079-31:2013
Markings	Ex db IIC T6...T2 Ga/Gb Ex tb IIIC T85°C...T250°C Db IP6X $-60\text{ °C} \leq T_a \leq +70\text{ °C}$

Specific Conditions of Use (X):

- Flamepath joints are not for repair. Contact the manufacturer.
- Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
- Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
- The Transmitter can be installed in the boundary wall between EPL Ga and EPL Gb. In this configuration, the process connection is EPL Ga, while the transmitter housing is EPL Gb. Refer to Control Drawing D7000002-885.
- Cable entries must be used which maintain the ingress protection of the enclosure to at least IP6X. To maintain the ingress protection ratings, Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for

cable entries and blanking plugs. See [Instruction Manual](#) on application requirements.

6. Install per Control Drawing D7000002-885.
7. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
8. Display glass shall be positioned in such a way as to minimize the risk of mechanical impact.
9. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Gas & Dust groups:		
T2 / T250°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 250 °C
T3 / T200°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 195 °C
T4 / T135°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 130 °C
T5 / T100°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 95 °C
T6 / T85°C	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 80 °C

1.13.2 I7 IECEx Intrinsic Safety

Certificate	IECEx FMG15.0033X
Standards	IEC 60079-0:2017, IEC 60079-11:2011, IEC 60079-26:2014, IEC 60529:2013
Markings	Ex ia IIC T4...T2 Ga Ex ib IIC T4...T2 Ga/Gb Ex ia IIIC T85°C...T250°C Da $-60\text{ (-55) °C} \leq T_a \leq +70\text{ °C}$

Safety parameter	HART®	Fieldbus
Voltage U_i	30 V	30 V
Current I_i	133 mA	300 mA
Power P_i	1.0 W	1.5 W
Capacitance C_i	7.3 nF	1.1 nF
Inductance L_i	0	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between EPL Ga and EPL Gb. In this configuration, the process connection is EPL Ga, while the transmitter housing is EPL Gb. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Temperature class / Maximum surface temperature	Ambient temperature range ⁽¹⁾	Process temperature range ⁽¹⁾
Gas groups:		
T2	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T3	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T4	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
Dust groups:		
T250°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T200°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T135°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
T100°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 95 °C
T85°C	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 80 °C

(1) -55 °C for Fieldbus; -60 °C for HART

1.13.3 IG IECEx FISCO

Certificate	IECEx FMG15.0033X
Standards	IEC 60079-0:2017, IEC 60079-11:2011, IEC 60079-26:2014
Markings	Ex ia IIC T4...T2 Ga Ex ib IIC T4...T2 Ga/Gb Ex ia IIIC T85°C...T250°C Da -55°C ≤ Ta ≤ +70°C

Safety parameter	FISCO
Voltage U _i	17.5 V
Current I _i	380 mA
Power P _i	5.32 W
Capacitance C _i	1.1 nF
Inductance L _i	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.

2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. The Transmitter can be installed in the boundary wall between EPL Ga and EPL Gb location. In this configuration, the process connection is EPL Ga, while the transmitter housing is EPL Gb. Refer to Control Drawing D7000002-885.
5. Using the box provided on the nameplate, the User shall permanently mark the type of protection chosen for the specific installation. Once the type of protection has been marked it shall not be changed.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Gas groups:		
T2	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 250 °C
T3	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 195 °C
T4	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 130 °C
Dust groups:		
T250°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 250 °C
T200°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 195 °C
T135°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 130 °C
T100°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 95 °C
T85°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 80 °C

1.13.4 N7 IECEx Type N: Non-Sparking

Certificate	IECEx FMG15.0033X
Standards	IEC 60079-0:2017, IEC 60079-15:2010, IEC 60529:2013
Markings	Ex nA IIC T4...T2 Gc

$(-34\text{ }^{\circ}\text{C} \leq T_a \leq +70\text{ }^{\circ}\text{C})$, IP65
 $V \leq 42.4\text{V}$, $I \leq 23\text{ mA}$ (HART®)
 $V \leq 32\text{V}$, $I \leq 22\text{ mA}$ (Fieldbus)

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test between the circuits and the earth ground. This must be taken into account during installation.
2. Plastic wire-on tag, Plastic part of Process Seal Antenna and Non-standard paint options (paint options other than Rosemount Blue) may cause risk from Electrostatic discharge. Avoid installation that could cause electrostatic build-up, and only clean with a damp cloth.
3. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP65. To maintain the ingress protection ratings, Covers and Sensor Module to be fully tightened and PTFE tape or pipe dope is required for cable entries and blanking plugs. See [Instruction Manual](#) on application requirements.
4. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows:

Temperature class	Ambient temperature range	Process temperature range
T2	$-34\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	$-34\text{ }^{\circ}\text{C}$ to $250\text{ }^{\circ}\text{C}$
T3	$-34\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	$-34\text{ }^{\circ}\text{C}$ to $195\text{ }^{\circ}\text{C}$
T4	$-34\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$	$-34\text{ }^{\circ}\text{C}$ to $130\text{ }^{\circ}\text{C}$

1.14 Brazil

1.14.1 E2 INMETRO Flameproof

Certificate	UL-BR 17.0344X
Standards	ABNT NBR IEC 60079-0:2013, ABNT NBR IEC 60079-1:2016, ABNT NBR IEC 60079-26:2016, ABNT NBR IEC 60079-31:2014
Markings	Ex db IIC T6...T2 Ga/Gb Ex tb III C T85°C...T250°C Db Tamb = $-60\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$; IP6X

Specific Conditions of Use (X):

1. See certificate.

1.14.2 I2 INMETRO Intrinsic Safety

Certificate	UL-BR 17.0344X
Standards	ABNT NBR IEC 60079-0:2013, ABNT NBR IEC 60079-11:2013, ABNT NBR IEC 60079-26:2016, ABNT NBR IEC 60079-31:2014
Markings	Ex ia IIC T4...T2 Ga Ex ib IIC T4...T2 Ga/Gb Ex ia IIIC T85°C...T250°C Da Tamb = -60 (-55) °C to +70 °C

Safety parameter	HART®	Fieldbus
Voltage U_i	30 V	30 V
Current I_i	133 mA	300 mA
Power P_i	1.0 W	1.5 W
Capacitance C_i	7.3 nF	1.1 nF
Inductance L_i	0	0

Specific Conditions of Use (X):

1. See certificate.

1.14.3 IB INMETRO FISCO

Certificate	UL-BR 17.0344X
Standards	ABNT NBR IEC 60079-0:2013, ABNT NBR IEC 60079-11:2013, ABNT NBR IEC 60079-26:2016
Markings	Ex ia IIC T4...T2 Ga Ex ib IIC T4...T2 Ga/Gb Ex ia IIIC T85°C...T250°C Da $-55\text{ °C} \leq T_a \leq +70\text{ °C}$

Safety parameter	FISCO
Voltage U_i	17.5 V
Current I_i	380 mA
Power P_i	5.32 W
Capacitance C_i	1.1 nF
Inductance L_i	0

Specific Conditions of Use (X):

1. See certificate.

1.14.4 N2 INMETRO Type N: Non-Sparking

Certificate	UL-BR 17.0344X
Standards	ABNT NBR IEC 60079-0:2013, ABNT NBR IEC 60079-15:2012
Markings	Ex nA IIC T4...T2 Gc Tamb = -34 °C to +70 °C; IP65 $V \leq 42.4V$, $I \leq 23$ mA (HART®) $V \leq 32V$, $I \leq 22$ mA (Fieldbus)

Specific Conditions of Use (X):

1. See certificate.

1.15 China**1.15.1 E3 Flameproof**

Certificate	NEPSI GYJ22.1835X
Standards	GB/T3836.1,2,4,20,31-2021
Markings	Ex db IIC T6 ~ T2 Ga/Gb Ex tb IIIC T85°C ~ 250°C Db Tamb = -55°C/-60°C to +70°C

Specific Conditions of Use (X):

1. See certificate.

1.15.2 I3 Intrinsic Safety

Certificate	NEPSI GYJ22.1835X
Standards	GB/T3836.1,2,4,20,31-2021

Markings Ex ia IIC T4 ~ T2 Ga
 Ex ib IIC T4 ~ T2 Ga/Gb
 Ex ia IIIC T85°C ~ T250°C Da

Specific Conditions of Use (X):

1. See certificate.

1.15.3 IC FISCO

Certificate NEPSI GYJ22.1835X
Standards B/T3836.1,2,4,20,31-2021
Markings Ex ia IIC T4 ~ T2 Ga
 Ex ib IIC T4 ~ T2 Ga/Gb
 Ex ia IIIC T85°C ~ T250°C Da

Safety parameter	FISCO
Voltage U_i	17.5 V
Current I_i	380 mA
Power P_i	5.32 W
Capacitance C_i	1.1 nF
Inductance L_i	0

Specific Conditions of Use (X):

1. See certificate.

1.16 Technical Regulations Customs Union (EAC)



TR CU 020/2011 "Electromagnetic Compatibility of Technical Products"

TR CU 032/2013 "On safety of equipment and vessels under pressure"

Certificate EAЭC RU C-US.AД07.B.00770-19



TR CU 012/2011 "On safety of equipment intended for use in explosive atmospheres"

1.16.1 EM Technical Regulations Customs Union (EAC) Flameproof

Certificate	EAЭC RU C-SE.A.07.B.01297/20
Standards	GOST 31610.0-2014 (IEC 60079-0:2011), GOST IEC 60079-1-2011, GOST 31610.26-2012 (IEC 60079-26:2006), GOST R IEC 60079-31-2010
Markings	Ga/Gb Ex d IIC T6...T2 X Ex tb IIIC T85°C...T250°C Db X Tamb = -60 °C to +70 °C

Specific Conditions of Use (X):

1. Flamepath joints are not for repair. Contact the manufacturer.
2. The Model 5408 Level Transmitter can accumulate electrostatic charge on the surface of the casing. It is necessary to clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
4. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP65.
5. It is necessary for display to avoid physical impact.
6. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
IIC/ IIIC		
T2/T250	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 250 °C
T3/T200	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 195 °C
T4/T135	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 130 °C
T5/T100	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 100 °C
T6/T85	$-60\text{ °C} \leq T_a \leq 70\text{ °C}$	-60 °C to 85 °C

1.16.2 IM Technical Regulations Customs Union (EAC) Intrinsic Safety

Certificate	EAЭC RU C-SE.AД07.B.01297/20
Standards	GOST 31610.0-2014 (IEC 60079-0:2011), GOST 31610.11-2014 (IEC 60079-11:2011), GOST 31610.26-2012 (IEC 60079-26:2006)
Markings	0Ex ia IIC T4...T2 Ga X Ga/Gb Ex ib IIC T4...T2 X Ex ia IIIC T85°C ...T250°C Da X Tamb = -60 (-55) °C to +70 °C

Safety parameter	HART®	Fieldbus
Voltage U_i	30 V	30 V
Current I_i	133 mA	300 mA
Power P_i	1.0 W	1.5 W
Capacitance C_i	7.3 nF	1.1 nF
Inductance L_i	0	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test. This must be taken into account during installation.
2. The Model 5408 Level Transmitter can accumulate electrostatic charge on the surface of the casing. It is necessary to clean the painted surfaces with a damp cloth.
3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5 °C greater than the maximum specified ambient temperature for location where installed.
4. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP6X.
5. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

Temperature class / Maximum surface temperature	Ambient temperature range ⁽¹⁾	Process temperature range ⁽¹⁾
IIC/ IIIC		
T2/T250	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 250 °C
T3/T200	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 195 °C
T4/T135	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 130 °C
T100	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 100 °C
T85	-60 (-55) °C ≤ Ta ≤ 70 °C	-60 (-55) °C to 85 °C

(1) -55 °C for Fieldbus; -60 °C for HART

1.16.3 IN Technical Regulations Customs Union (EAC), FISCO

Certificate	EAЭC RU C-SE.AД07.B.01297/20
Standards	GOST 31610.0-2014 (IEC 60079-0:2011), GOST 31610.11-2014 (IEC 60079-11:2011), GOST 31610.26-2012 (IEC 60079-26:2006)
Markings	Ex ia IIC T4...T2 Ga Ex ib IIC T4...T2 Ga/Gb Ex ia IIIC T85°C...T250°C Da -55 °C ≤ Ta ≤ +70 °C

Safety parameter	FISCO
Voltage U _i	17.5 V
Current I _i	380 mA
Power P _i	5.32 W
Capacitance C _i	1.1 nF
Inductance L _i	0

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test. This must be taken into account during installation.
2. The Model 5408 Level Transmitter can accumulate electrostatic charge on the surface of the casing. It is necessary to clean the painted surfaces with a damp cloth.

3. Appropriate cable, glands, and plugs need to be suitable for a temperature of 5°C greater than the maximum specified ambient temperature for location where installed.
4. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP6X.
5. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
Gas groups:		
T2	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 250 °C
T3	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 195 °C
T4	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 130 °C
Dust groups:		
T250°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 250 °C
T200°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 195 °C
T135°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 130 °C
T100°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 95 °C
T85°C	-55 °C ≤ Ta ≤ 70 °C	-55 °C to 80 °C

1.16.4 NM Technical Regulations Customs Union (EAC) Non-Sparking

Certificate	EAЭC RU C-SE.AД07.B.01297/20
Standards	GOST 31610.0-2014 (IEC 60079-0:2011), GOST 31610.15-2014/IEC 60079-15:2010
Markings	2Ex nA IIC T4...T2 Gc X Tamb = -34 °C to +70 °C V ≤ 42.4V, I ≤ 23 mA (HART®) V ≤ 32V, I ≤ 22 mA (Fieldbus)

Specific Conditions of Use (X):

1. The Model 5408 Level Transmitter will not pass the 500Vrms dielectric strength test. This must be taken into account during installation.
2. Cable entries must be used which maintain the ingress protection of the enclosure to at least IP65.

3. The applicable temperature class, ambient temperature range and process temperature range of the equipment is as follows;

Temperature class / Maximum surface temperature	Ambient temperature range	Process temperature range
T2	$-34\text{ °C} \leq T_a \leq 70\text{ °C}$	-34 °C to 250 °C
T3	$-34\text{ °C} \leq T_a \leq 70\text{ °C}$	-34 °C to 195 °C
T4	$-34\text{ °C} \leq T_a \leq 70\text{ °C}$	-34 °C to 130 °C

1.17 Japan

1.17.1 E4 Flameproof

Certificate	CML 17JPN1206X
Markings	Ex d IIC T6...T2 Ga/Gb $T_{amb} = -40\text{ °C to }+70\text{ °C}$

Specific Conditions of Use (X):

1. See certificate.

1.17.2 ID FISCO

Certificate	CML 17JPN1206X
Markings	Ex ia IIC T4...T2 Ga Ex ib IIC T4...T2 Ga/Gb Ex ia IIIC T85°C...T250°C Da $-55\text{ °C} \leq T_a \leq +70\text{ °C}$

Safety parameter	FISCO
Voltage U_i	17.5 V
Current I_i	380 mA
Power P_i	5.32 W
Capacitance C_i	1.1 nF
Inductance L_i	0

Specific Conditions of Use (X):

See certificate.

1.18 India

1.18.1 Intrinsic Safety and Flameproof

Certificate PESO P482139/1

1.18.2 IW Intrinsically Safe

Certificate PESO P482139/1

Markings Ex ia IIC T4...T2 Ga
Ex ib IIC T4...T2 Ga/Gb
-55 °C / -60 °C ≤ Ta ≤ +70 °C, IP6X

Safety parameter	HART®	Fieldbus
Voltage U_i	30 V	30 V
Current I_i	133 mA	300 mA
Power P_i	1.0 W	1.5 W
Capacitance C_i	7.3 nF	1.1 nF
Inductance L_i	0	0

Specific Conditions of Use (X):

1. See certificate.

1.18.3 EW Flameproof

Certificate PESO P482139/1

Markings Ex db IIC T6...T2 Ga/Gb
-55 °C / -60 °C ≤ Ta ≤ +70 °C

1.19 Republic of Korea

1.19.1 EP Flameproof

Certificate KTL 17- KAB4O-0652X, 18-KA4BO-0346X, 19-KA4BO-0169X, 19-KA4BO-0170X, 19-KA4BO-0726, 19-KA4BO-0727, 19-KA4BO-0728, 19-KA4BO-0732, 19-KA4BO-0733, 19-KA4BO-073

Markings Ex db IIC T6...T2 Ga/Gb
Ex tb IIIC T85°C...T250°C
Tamb = -60 °C to +70 °C

1.19.2 IP Intrinsic Safety

Certificate	KTL 17-KA4BO-0448X, 17-KA4BO-0654X, 18-KA4BO-0347X, 18-KA4BO-0345X, 19-KA4BO-0729, 19-KA4BO-0730, 19-KA4BO-0731, 19-KA4BO-0752, 19-KA4BO-0736, 19-KA4BO-0737
Markings	Ex ia IIC T4...T2 Ga Ex ib IIC T4...T2 Ga/Gb Tamb = -60 (-55) °C to +70 °C

Safety parameter	HART®	Fieldbus
Voltage U_i	30 V	30 V
Current I_i	133 mA	300 mA
Power P_i	1.0 W	1.5 W
Capacitance C_i	7.3 nF	1.1 nF
Inductance L_i	0	0

Specific Conditions of Use (X):

1. See certificate.

1.20 United Arab Emirates

1.20.1 Flame-proof

Certificate	20-11-28736/Q20-11-001012
Markings	Same as IECEx (E7)

1.20.2 Intrinsic Safety

Certificate	20-11-28736/Q20-11-001012
Markings	Same as IECEx (I7)

1.20.3 FISCO

Certificate	20-11-28736/Q20-11-001012
Markings	Same as IECEx (IG)

1.20.4 Type-N Non Sparking

Certificate	20-11-28736/Q20-11-001012
Markings	Same as IECEx (N7)

1.21 Additional certifications

1.21.1 SBS American Bureau of Shipping (ABS) Type Approval

Certificate	22-2237976-PDA
Intended Use	For use on ABS Classed Vessels and Offshore installations in accordance with ABS rules and International Standards.

Note

Housing material A, Aluminum, is not to be used on open decks.

1.21.2 SBV Bureau Veritas (BV) Type Approval

Certificate	52129/B0 BV
Requirements	Bureau Veritas Rules for the Classification of Steel Ships/Offshore Units. EC Code: 31/41SB for 5408 SST housing 31/41B for 5408 Aluminum housing
Application	Class Notations: AUT-UMS, AUT-CCS, AUT-PORT and AUT-IMS.

1.21.3 SDN Det Norske Veritas Germanischer Lloyd (DNV GL) Type Approval

Certificate	TAA0000230
Intended Use	DNV GL rules for classification – Ships, offshore units, and high speed and light craft.

Table 1-14: Application

Location classes	
Temperature	D
Humidity	B
Vibration	A
EMC	B
Enclosure	C ⁽¹⁾

(1) Enclosure Class B for aluminum housing

1.21.4 SLL Lloyd's Register (LR) Type Approval

Certificate	LR2002529TA-01
Application	Marine applications for use in environmental categories ENV1, ENV 2, ENV 3 and ENV 5 ⁽⁴⁾ as defined in Lloyd's Register's Type Approval System, Test Specification Number 1, May 2018

1.21.5 SRS Russian Maritime Register of Shipping (RS) Type Approval

Certificate	21.10003.262
Rules	Part XV of the Rules for the Classification and Construction of Sea-going Ships, 2020 Part XIV of the Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units (MODU) and Fixed Offshore Platforms of (FOP), 2018 Part IV, section 12 of the Rules for Technical Supervision During Construction of ships and Manufacture of Materials and Products for Ships, 2020

Note

Housing material A, Aluminum, is not to be used on open decks.

1.21.6 QT Safety-certified to IEC 61508:2010 with certificate of FMEDA data

Certificate	exida ROS 15-01-149 C001
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1.21.7 Suitable for intended use

Compliant with NAMUR NE 95:2013, "Basic Principles of Homologation"

1.21.8 U1 Overfill prevention

Certificate	Z-65.16-575
Application	TÜV tested and approved by DIBt for overfill prevention according to the German WHG regulations.

(4) Only housing material "S" (stainless steel) is to be used on open decks.

1.22 Hygienic certificates and approvals

1.22.1 QA 3-A®

Certificate Authorization Number 3626

The following options are conforming to the 3-A Sanitary Standards, Number 74-07 (Sensors and Sensor Fittings and Connections):

Process connection type	C (Tri Clamp)
Process connection size	2, 3, 4
Antenna type	SAA (Process Seal antenna)
Antenna size	2, 3, 4

1.22.2 Other hygienic approvals

The process wetted components of the Process Seal Antenna (antenna type SAA) comply with:

- FDA 21 CFR 110, subpart C and FDA 21 CFR 177.1550
- EC 1935/2004 and EC 10/2011
- TSE/BSE Free
- USP<87>
- USP<88> Class VI

1.22.3 Instructions for hygienic installations

It is the responsibility of the user to ensure that:

1. The materials listed in [Table 1-15](#) and [Table 1-16](#) are suitable for the media and cleaning/sanitizing processes.
2. The installation of the transmitter is drainable and cleanable.
3. The joint/clamping between the transmitter and the nozzle is compatible with the tank pressure and media.
4. For the application suitable cable entry devices are used and with appropriate ingress protection.
5. Any unused cable entries are sealed with suitable plugs to maintain the ingress protection ratings.
6. The product contact surfaces are not scratched.
7. The 3-A specific nozzle height limits are kept to ensure cleanability. See [Reference Manual](#) for nozzle requirements.

1.22.4 Materials of construction

The hygienic approvals and certificates of the transmitter rely upon the following materials used in its construction:

Table 1-15: Product Contact Surfaces

Item	Material
Microwave launcher	PTFE fluoropolymer

Table 1-16: Nonproduct Contact Surfaces

Item	Material
Metal housing	Stainless steel 300 series or aluminium 360, painted with epoxy-polyester or polyurethane
Fasteners and plugs	Stainless steel 300 series
Seals	Nitrile rubber NBR, Ethylene propylene peroxide and FKM fluoroelastomer
Labels	Stainless steel 300 series, metallized polyester, polyester/polycarbonate

1.22.5 Clean-In-Place (CIP)

Withstands cleaning routines up to 194 °F (90 °C)

1.22.6 Steam-In-Place (SIP)

Withstands cleaning routines up to 284 °F (140 °C)

1.23 Pattern approval

Belarus Pattern Approval

Certificate No. 12954

Kazakhstan Pattern Approval

Certificate KazInMetr No. 15466

Russia Pattern Approval

Certificate VNIIMS No. SE.C.29.004.A No 70968

Uzbekistan Pattern Approval

Certificate No. 02.7102

1.24 Installation drawings

Figure 1-1: D7000002-885 - System Control Drawing

SYSTEM CONTROL DRAWING – ROSEMOUNT 5408 SERIES	
(Table of Contents)	
Page 2	- General Information
Page 3	- Intrinsically safe, EPL Ga installation (including description of ENTITY concept)
Page 4	- Intrinsically safe, EPL Gb installation
Page 5	- FISCO, EPL Ga installation (including description of FISCO concept)
Page 6	- FISCO, EPL Gb installation
Page 7	- Flameproof/XP installation
Page 8	- Non-incendive installation
Page 9	- Transmitter with test terminal option (SIS, 4-20 mA)

ISSUE
5

CHANGE ORDER NO.
SME-10408

WEEK
2045

SYSTEM CONTROL DRAWING – ROSEMOUNT 5408 SERIES

GENERAL INFORMATION

1. No revision to drawing without prior FM Approval.

2. Associated apparatus manufacturer's installation drawing must be followed when installing this equipment.

3. Installations in the U.S. should be in accordance with ANSI/ISA RP12.06.01 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the latest edition of the National Electrical Code (ANSI/NFPA 70).

4. Installation in Canada should be in accordance with the latest edition of the C22.1 Canadian Electrical Code, Part 1.

5. Installations in Europe shall comply with the relevant requirements of EN 60079-14 and applicable National regulations.

6. Installations for IECEx certification shall be in accordance with latest editions of the wiring practices for the country of origin.

7. The EPL Ga partition wall is made of stainless steel and a welded fused glass/stainless steel lens.

8. The EPL Ga/Gb separation is invalidated if the transmitter is removed from the antenna connection i.e. there is a risk of flammable gas release and flame entrance. Disconnect power before removing the transmitter.

9. Thread size either 1/2-14 NPT or M20x1.5. Identification of thread size and type (No marking = 1/2-14 NPT).

10. Additional installation requirements are found in the Quick Start Guide (doc no 00825-0100-4408/00825-0300-4408/00825-0500-4408) and the Product Certification Document (doc no 00825-0200-4408).

11. See table below for applicable PTT rating for different antenna types.

12. The bottom of the transmitter is approved as a SINGLE SEAL device according to ANSI/ISA 12.27.01 up to a maximum process pressure of 100 bar and a process temperature range of -76 ... 482 °F (-60 ... 250 °C). Actual process limits depends on antenna type and seal, see table above. Materials of the sealing wall are according to Note 7.

Antenna Type

Operating Temperature and Pressure

Cone Antenna (PTFE seal, CAA)

-15 ... 363 psig (-1 ... 25 bar)
-76 ... 392 °F (-60 ... 200 °C)

Cone Antenna (PTFE seal, CAB)

-15 ... 725 psig (-1 ... 50 bar)
-40 ... 302 °F (-40 ... 150 °C)

Cone Antenna (PTFE seal, CAC)

-15 ... 1450 psig (-1 ... 100 bar)
-40 ... 212 °F (-40 ... 100 °C)

Cone Antenna (PTFE seal, CAD)

-15 ... 44 psig (-1 ... 3 bar)
-76 ... 482 °F (-60 ... 250 °C)

Cone Antenna (PEEK seal, FVMQ, CBF)

-15 ... 754 psig (-1 ... 52 bar)
-76 ... 338 °F (-60 ... 170 °C)

Cone Antenna (PEEK seal, Kalrez, CBK)

-15 ... 754 psig (-1 ... 52 bar)
5 ... 482 °F (-15 ... 250 °C)

Cone Antenna (PEEK seal, Viton, CBV)

-15 ... 754 psig (-1 ... 52 bar)
-22 ... 392 °F (-30 ... 200 °C)

Cone Antenna (PEEK seal, FM, CBM)

-15 ... 754 psig (-1 ... 52 bar)
-13 ... 428 °F (-25 ... 220 °C)

Parabolic Antenna (Swivel Mount, PAS)

-7 ... 43 psig (-0.5 ... 3 bar)
-67 ... 392 °F (-55 ... 200 °C)

Process Seal Antenna (SAA)

Tri Clamp connection:
-15 ... 232 psig (-1 ... 16 bar)
-13 ... 392 °F (-25 ... 200 °C)
Note: -7 ... 232 psig (-0.5 ... 16 bar) for temperatures above 302 °F (150 °C)

2-in. (DN50) and 3-in. (DN80) flanged connections:
-15 ... 363 psig (-1 ... 25 bar)
-76 ... 392 °F (-60 ... 200 °C)
Note: -7 ... 363 psig (-0.5 ... 25 bar) for temperatures above 266 °F (130 °C) / 302 °F (150 °C)⁽¹⁾

4-in. (DN100) flanged connection:
-7 ... 363 psig (-0.5 ... 25 bar)
-76 ... 392 °F (-60 ... 200 °C)

1. 266 °F (130 °C) for 3-in. (DN80); 302 °F (150 °C) for 2-in. (DN50)

EMERSON

PROCESS

5408

ESs-LN 1524

EAP 1525

6

A3

System Control Drawing

Revision

General Information

D7000002-885

2

9

5

FM APPROVED PRODUCT

No revisions to this drawing

without prior Factory Mutual

Approval.

WARNING – Substitution of components may impair Intrinsic Safety.

WARNING – Potential electrostatic charging hazard, wipe with a damp cloth.

WARNING – To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

AVERTISSEMENT – La substitution de composants peut compromettre la sécurité intrinsèque.

AVERTISSEMENT – Risque potentiel de charge électrostatique, essuyer avec un chiffon humide.

AVERTISSEMENT – Ne pas ouvrir en cas de présence d'atmosphère explosive.

CONDUIT THREAD, BOTH SIDES
(see note 9)

1/2-14 NPT

M20x1.5

M20

Product Certifications

47

ENTITY CONCEPT APPROVALS

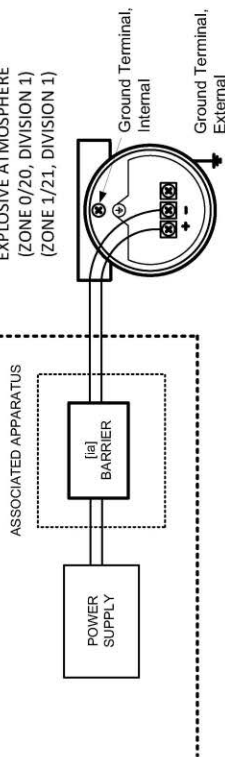
The Entity concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in combination as a system. The approved values of maximum safe input voltage (V_{oc} or V_i) and max. short circuit current (I_{sc} or I_i) and max. power (P_{oc} or P_i) (P_{oc} or $P_i = V_{oc} \times I_{sc}$ or $V_i \times I_i$), for the associated apparatus must be less than or equal to the maximum safe input voltage (V_{is}), maximum safe input current (I_{is}), and maximum safe input power (P_{is}) of the intrinsically safe apparatus. In addition, the approved max. allowable connected capacitance (C_a or C_b) of the associated apparatus must be greater than the sum of the interconnecting cable capacitance and the unspecified internal capacitance (C_u) of the associated apparatus must be greater than the sum of the interconnecting cable capacitance and the unspecified internal inductance (L_u) of the intrinsically safe apparatus.

Notes

1. No revision to drawing without prior FM Approval.
2. The Associated Apparatus must be FM Approved for installations in the U.S.
3. The Associated Apparatus must be Canadian Approved for Installations in Canada.
4. The Associated Apparatus must be ATEX Certified for Installations in Europe.
5. The Associated Apparatus must be IECEx Certified for IECEx installations.
6. Associated apparatus manufacturer's installation drawing must be followed when installing this equipment.
7. Installations in the U.S. should be in accordance with ANSI/ISA RP12.06.01 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the latest edition of the National Electrical Code (ANSI/NFPA 70).
8. Resistance between Intrinsically Safe Ground and earth ground must be less than 1.0 Ohm.
9. Installation in Canada should be in accordance with the latest edition of the C22.1 Canadian Electrical Code, Part 1.
10. Installations in Europe shall comply with the relevant requirements of EN 60079-14 and applicable National regulations.
11. Installations for IECEx certification shall be in accordance with latest editions of the wiring practices for the country of origin.
12. The Entity Concept allows interconnection of associated apparatus and intrinsically safe apparatus with when the following is true:
13. $I_{L1} \leq I_{L2}$ (max), $S \leq P$ (max), $C \leq C_{max}$, $L_1 \leq L_1 + L_{max}$.
14. Different terminal blocks are applicable. See Quick Start Guide (doc no 00825-0100-4408) or 00825-0300-4408/00825-0500-4408) and the Product Certification Document (doc no 00825-0200-4408) for additional installation details.

WARNING – Substitution of components may impair Intrinsic Safety.
WARNING – Potential electrostatic charging hazard, wipe with a damp cloth.
WARNING – To prevent ignition of flammable or combustible atmospheres, do not service in the presence of such atmospheres.
AVERTISSEMENT – La substitution de composants peut compromettre la sécurité intrinsèque.
AVERTISSEMENT – Risque potentiel de charge électrostatique, essuyer avec un chiffon humide.
AVERTISSEMENT – Ne pas ouvrir en cas de présence d'atmosphère explosive ou inflammable.

UNCLASSIFIED LOCATION



See note 13

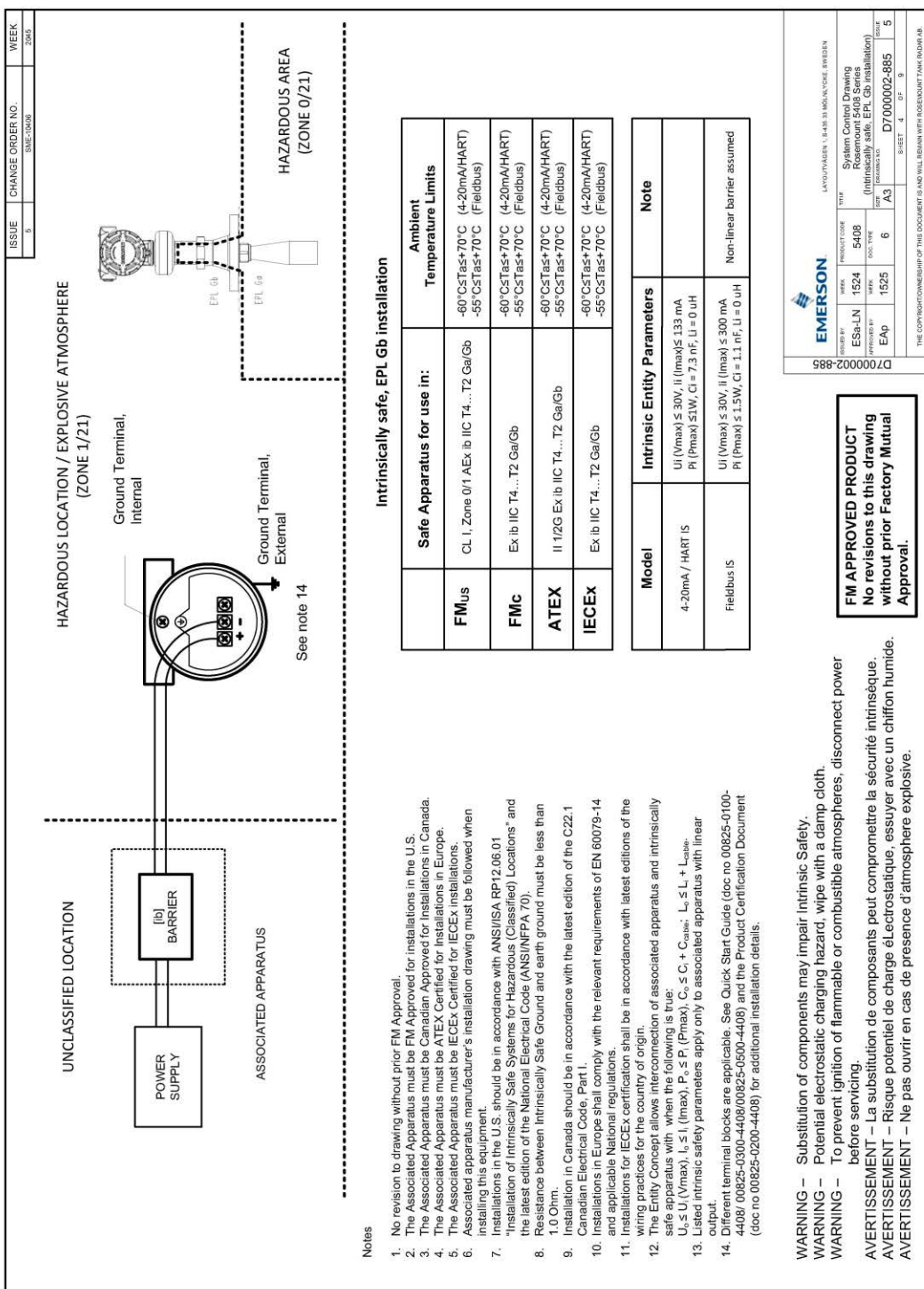
Intrinsically safe, EPL Ga Installation

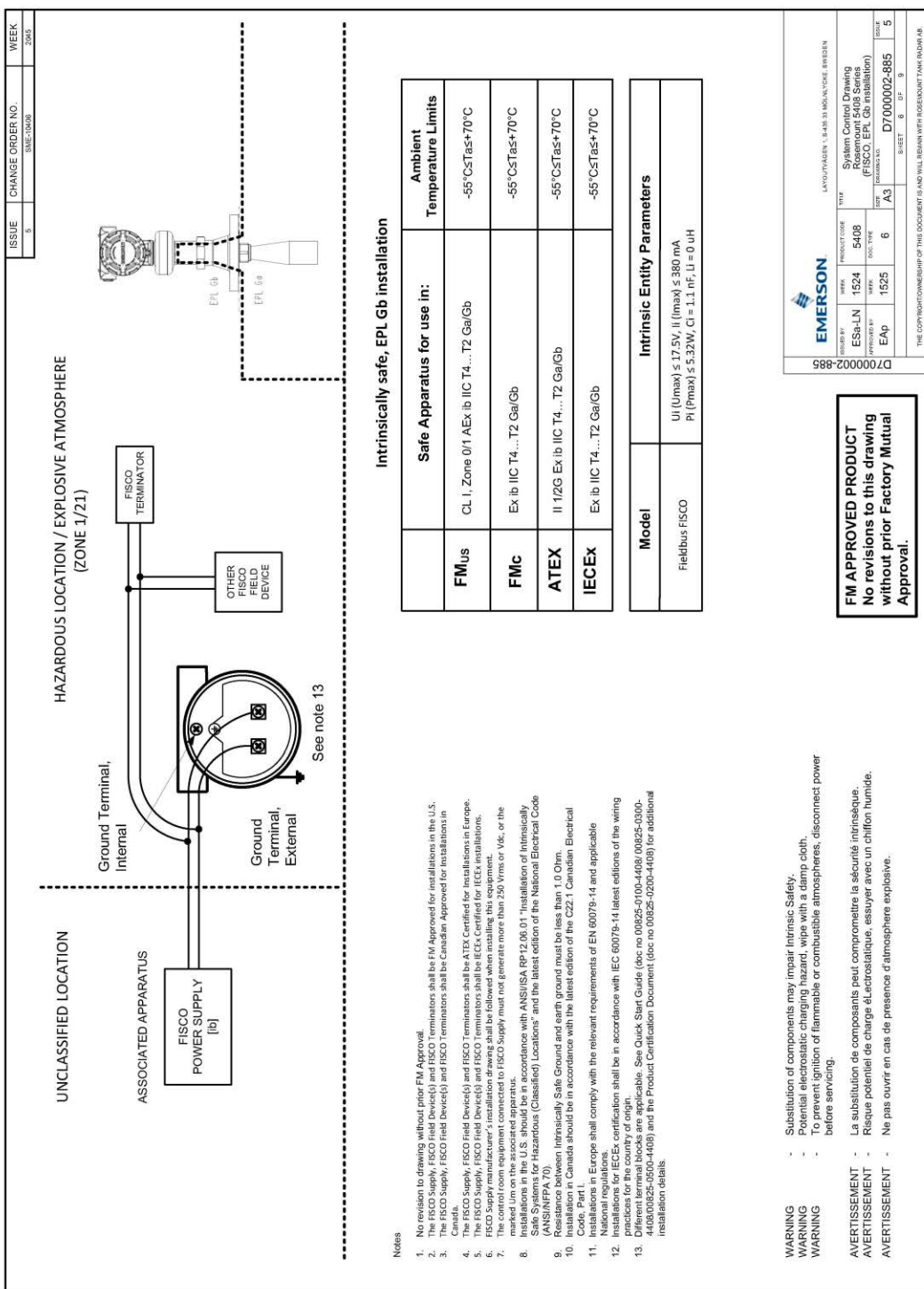
	Safe Apparatus for use in:	Ambient Temperature Limits
FHus	IS Class I, II, III, DIV 1, GP A-G T4...T2 CL I, Zone 0 AEx Ia IIC T4...T2 Ga Zone 20 AEx Ia IIC T85°C...T250°C Da	-60°CStas+70°C (4-20mA/HART) -55°CStas+70°C (Fieldbus)
FMc	IS Class I, II, III, DIV 1, GP A-G T4...T2 Ex Ia IIC T4...T2 Ga Ex Ia IIC T85°C...T260°C Da	-60°CStas+70°C (4-20mA/HART) -55°CStas+70°C (Fieldbus)
ATEX	II 1G Ex Ia IIC T4...T2 Ga II 1D Ex Ia IIC T85°C...T250°C Da	-60°CStas+70°C (4-20mA/HART) -55°CStas+70°C (Fieldbus)
IECEx	Ex Ia IIC T4...T2 Ga Ex Ia IIC T85°C...T250°C Da	-60°CStas+70°C (4-20mA/HART) -55°CStas+70°C (Fieldbus)

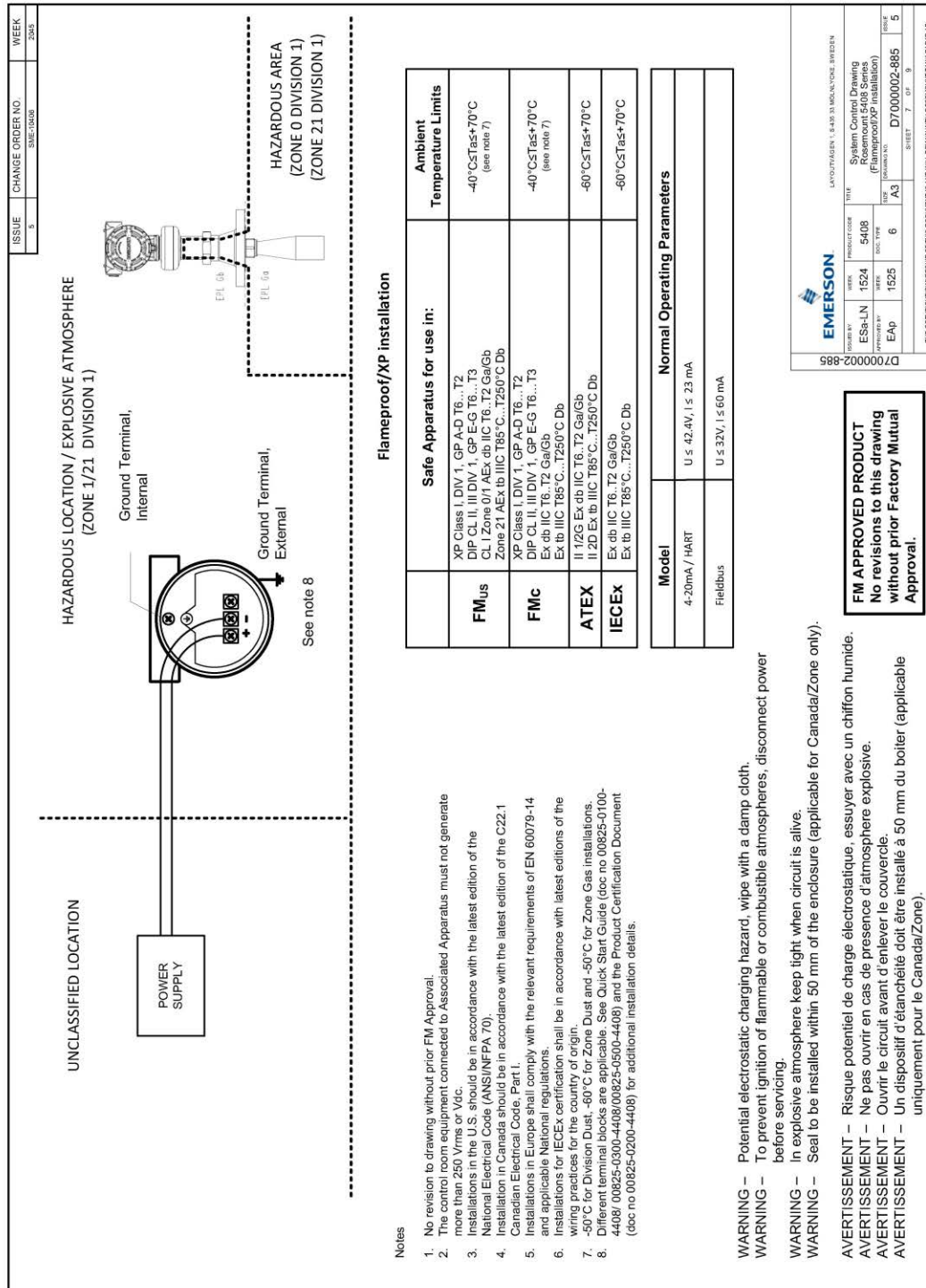
Model	Intrinsic Entity Parameters	Note
4-20mA / HART IS	$U_I (V_{max}) \leq 30V$, $I_I (I_{max}) \leq 133 \text{ mA}$ $P_I (P_{max}) \leq 1W$, $C_I = 7.3 \text{ nF}$, $U_I = 0 \text{ V}$	Non-linear barrier assumed
Fieldbus IS	$U_I (V_{max}) \leq 30V$, $I_I (I_{max}) \leq 300 \text{ mA}$ $P_I (P_{max}) \leq 1.5W$, $C_I = 1.1 \text{ nF}$, $U_I = 0 \text{ V}$	

FM APPROVED PRODUCT
No revisions to this drawing
without prior Factory Mutual
Approval.

 EMERSON		SYSTEM CONTROL DRAWING Roomcontrol 5408 Series (Intrinsically safe, EPT, Cn installation)		LAYOUT/PAGES: 6, 4, 30, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 84	
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UNCLASSIFIED LOCATION

POWER SUPPLY

HAZARDOUS LOCATION / EXPLOSIVE ATMOSPHERE
(ZONE 2 DIVISION 2)

Ground Terminal,
Internal

Ground Terminal,
External

ISSUE 5

CHANGE ORDER NO. SINE-10408

WEEK 2045

Notes

1. No revision to drawing without prior FM Approval.

2. Installations in the U.S. should be in accordance with the latest edition of the National Electrical Code (ANSI/NFPA 70).

3. Installation in Canada should be in accordance with the latest edition of the C22.1 Canadian Electrical Code, Part I.

4. Installations in Europe shall comply with the relevant requirements of EN 60079-14 and applicable National regulations.

5. Installations for IECEX certification shall be in accordance with latest editions of the wiring practices for the country of origin.

6. Different terminal blocks are applicable. See Quick Start Guide (doc no 00825-0100-4408/ 00825-0300-4408/00825-0500-4408) and the Product Certification Document (doc no 00825-0200-4408) for additional installation details.

Non-incendive installation

	Safe Apparatus for use in:	Ambient Temperature Limits
FMUs	NI CL I, DIV 2, GP A-D T4...T2 S CL II, III DIV 2, GP E-G T4...T3	-60°CSt as+70°C
FMC	NI CL I, DIV 2, GP A-D T4...T2 S CL II, III DIV 2, GP E-G T4...T3	-60°CSt as+70°C
ATEX	II 3G Ex Na IIC T4...T2 Gc	-34°CSt as+70°C
IECEX	Ex Na IIC T4...T2 Gc	-34°CSt as+70°C

Model

Maximum operating parameters

4-20mA / HART	U ≤ 42.4V, I ≤ 23 mA
Fieldbus	U ≤ 32V, I ≤ 60 mA

FM APPROVED PRODUCT

No revisions to this drawing without prior Factory Mutual Approval.

WARNING – Do not separate when energized.

WARNING – Substitution of components may impair Intrinsic Safety.

WARNING – Potential electrostatic charging hazard, wipe with a damp cloth.

WARNING – To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

AVERTISSEMENT – Ne pas séparer lorsqu'il est activé.

AVERTISSEMENT – La substitution de composants peut compromettre la sécurité intrinsèque.

AVERTISSEMENT – Risque potentiel de charge électrostatique, essuyer avec un chiffon humide.

D7000002-885

EMERSON

DESIGNED BY ESS-LN

DRAWN BY EAP

REVIEWED BY 1524

DATE 1525

PRODUCT CODE 5408

SYSTEM CONTROL DRAWING (Non-incendive installation)

REVISIONS

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ISSUE

5

CHANGE ORDER NO.

SME-10408

WEEK

2545

SYSTEM CONTROL DRAWING – ROSEMOUNT 5408 SERIES

TRANSMITTERS WITH TEST TERMINAL OPTION

UNCLASSIFIED LOCATION

HAZARDOUS LOCATION /EXPLOSIVE ATMOSPHERE
(ZONE 0/20, DIVISION 1)
(ZONE 1/21, DIVISION 1)

POWER
SUPPLY

IS
BARRIER

TEST
INSTRUMENT

In addition to instructions per Type of Protection, the following applies for the Test Terminal option:

1. In hazardous locations/explosive atmospheres, this test can only be done for intrinsically safe installations.
2. The instrument used for loop current measurement must have correct intrinsically safe type of protection.
3. The combined entity parameters of the transmitter and the test instrument must be compatible with the output parameters of the associated apparatus.
4. The cable/plug must be re-attached to the TEST terminal after completed test.

EMERSON

UNIONPACIFIC 1, 4, 40 13 MONTEVIDEO, SPEDIN

REVISION

DATE

PRODUCT CODE

TEST

ESS-LN

1524

5408

5408

APPROVED BY

DATE

DOC TYPE

TEST

EAp

1525

6

A3

D7000002-885

D7000002-885

9

9

THE COUNTERSIGNATURE OF THIS DOCUMENT IS AND WILL REMAIN WITH ROSEMOUNT TANK PUMP AS

FM APPROVED PRODUCT

No revisions to this drawing

without prior Factory Mutual

Approval.

1.25 EU/UKCA Declaration of Conformity

Figure 1-2: EU/UKCA Declaration of Conformity

Rev. #2	
	Declaration of Conformity  
We, Rosemount Tank Radar AB Layoutvägen 1 S-43533 Mölnlycke Sweden declare under our sole responsibility that the product, Rosemount™ 5408 Level Transmitter manufactured by Rosemount Tank Radar AB Layoutvägen 1 S-43533 Mölnlycke Sweden to which this declaration relates, is in conformity with: 1) the provisions of the European Union Directives, including the latest amendments, as shown in the attached schedule. 2) the relevant statutory requirements of Great Britain, including the latest amendments, as shown in the attached schedule.	
 (signature)	2022-09-02, Mölnlycke (date of issue & place)
Dajana Prastalo (name)	Manager Product Approvals (function)
ATEX Notified Body for EU Type Examination Certificates and Type Examination Certificates: FM Approvals Europe Ltd. [Notified Body Number: 2809] One Georges Quay Plaza Dublin, D02 E440 Ireland ATEX Notified Body for Quality Assurance: DNV GL Presafe AS [Notified Body Number: 2460] Veritasveien 3 1363 Høvik Norway	UKEX Conformity Assessment Body for UKEX Type Examination Certificates: FM Approvals Ltd. [Notified Body Number: 1725] 1 Windsor Dials Berkshire, SL4 1RS United Kingdom UK Notified Body for Quality Assurance: DNV Business Assurance UK Ltd [Notified Body Number: 8501] 4th Floor Vivo Building 30 Stamford Street London, SE1 9LQ United Kingdom

Rev. #2  Declaration of Conformity  	
EMC Electromagnetic Compatibility Directive 2014/30/EU Harmonized Standards: EN 61326-1:2013 ATEX Directive (2014/34/EU) FM15ATEX0055X Intrinsic Safety (HART@4-20mA, Foundation@Fieldbus): Equipment Group II, Category 1G, Ex ia IIC T4...T2 Ga Equipment Group II, Category 1/2G, Ex ib IIC T4...T2 Ga/Gb Equipment Group II, Category 1D, Ex ia IIIC T85°C...T250°C Da Flameproof (Hart@ 4-20mA, Foundation @ Fieldbus): Equipment Group II, Category 1/2G, Ex db IIC T6...T2 Ga/Gb Equipment Group II, Category 2D, Ex tb IIIC T85°C...T250°C Db Harmonized Standards: EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 EN 60079-26:2015 EN 60079-31:2014 EN 60529:1991/A1:2000/A2:2013 FM15ATEX0056X Type of protection N, Non-sparking (Hart@4-20mA, Foundation @ Fieldbus) Equipment Group II, Category 3G, Ex nA IIC T4...T2 Gc Harmonized Standards: EN IEC 60079-0:2018 EN 60079-15:2010 EN 60529:1991/A1:2000/A2:2013 Radio Equipment Directive (RED) (2014/53/EU) Harmonized Standards: ETSI EN 302 372:2016 ETSI EN 302 729:2016 EN 62479: 2010 Low Voltage Directive (2014/35/EU) Harmonized Standards: EN 61010-1:2010/A1:2019/AC:2019-04 RoHS Directive (2011/65/EU) Amended 2015/863 Harmonized Standards: IEC 63000:2018	Electromagnetic Compatibility Regulations 2016 (S.I. 2016/1091) Designated Standards: EN 61326-1:2013 Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016 (S.I. 2016/1107) FM21UKEX0051X Intrinsic Safety (Hart@ 4-20mA, Foundation @ Fieldbus): Equipment Group II, Category 1G, Ex ia IIC T4...T2 Ga Equipment Group II, Category 1/2G, Ex ib IIC T4...T2 Ga/Gb Equipment Group II, Category 1D, Ex ia IIIC T85°C...T250°C Da Flameproof (Hart@ 4-20mA, Foundation @ Fieldbus): Equipment Group II, Category 1/2G, Ex db IIC T6...T2 Ga/Gb Equipment Group II, Category 2D, Ex tb IIIC T85°C...T250°C Db Designated Standards: EN IEC 60079-0:2018 EN 60079-1:2014 EN 60079-11:2012 EN 60079-26:2015 EN 60079-31:2014 EN 60529:1991/A1:2000/A2:2013 FM21UKEX0052X Type of protection N, Non-sparking (Hart@4-20mA, Foundation @ Fieldbus) Equipment Group II, Category 3G, Ex nA IIC T4...T2 Gc Designated Standards: EN IEC 60079-0:2018 EN 60079-15:2010 EN 60529:1991/A1:2000/A2:2013 Radio Equipment Regulations 2017 (S.I. 2017/1206) Designated Standards: EN 302 372:2016 EN 302 729:2016 EN 62479: 2010 Electrical Equipment (Safety) Regulations 2016 (S.I. 2016/1101) Designated Standards: EN 61010-1:2010/A1:2019/AC:2019-04 The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 Designated Standards: IEC 63000:2018

1.26 China RoHS

List of Model Parts with China RoHS Concentration above MCVs
含有China RoHS管控物质超过最大浓度限值的部件型号列表

Part Name 部件名称	Hazardous Substances / 有害物质					
	Lead 铅 (Pb)	Mercury 汞 (Hg)	Cadmium 镉 (Cd)	Hexavalent Chromium 六价铬 (Cr +6)	Polybrominated biphenyls 多溴联苯 (PBB)	Polybrominated diphenyl ethers 多溴联苯醚(PBDE)
Electronics Assembly 电子组件	X	O	O	O	O	O
Housing Assembly 壳体组件	O	O	O	O	O	O

This table is proposed in accordance with the provision of SJ/T11364

本表格系依据SJ/T11364的规定而制作。

O: Indicate that said hazardous substance in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

O: 意为该部件的所有均质材料中该有害物质的含量均低于GB/T 26572所规定的限量要求。

X: Indicate that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.

X: 意为在该部件所使用的的所有均质材料里，至少有一类均质材料中该有害物质的含量高于GB/T 26572所规定的限量要求。



Product Certifications
00825-0200-4408, Rev. AT
March 2023

For more information: [Emerson.com](https://www.emerson.com)

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ROSEMOUNT





Part III

Equipment Registration for the
5408 and 5408:SIS Radar Gauges
And associated components
to the
Florida Department of Environmental Protection
from
Rosemount Tank Gauging - North America

Submitted by

Marshall T. Mott-Smith, President

Mott-Smith Consulting Group

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Tallahassee, FL 32301

marshall@mott-smithconsulting.com

850-391-9835 work

850-591-1434 cell



Attachment IV

Installation Instructions

Rosemount™ 5408 and 5408:SIS Level Transmitters

Cone Antenna



Contents

About this guide.....3

Confirm approval type.....5

Mount the transmitter.....6

Align transmitter head..... 16

Adjust display orientation (optional)..... 18

Prepare the electrical connections.....19

Connect wiring and power up.....26

Configure transmitter using Guided Setup..... 30

Assemble the segmented cone antenna.....32

1 About this guide

This Quick Start Guide provides basic guidelines for the Rosemount 5408 and 5408:SIS Level Transmitters. Refer to the Rosemount 5408 and 5408:SIS with HART® [Reference Manual](#) and Rosemount 5408 with FOUNDATION™ Fieldbus [Reference Manual](#) for more instructions. The manuals and this guide are also available electronically on Emerson.com/Rosemount.

WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

- Make sure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.
- For installations in hazardous locations, the transmitter must be installed according to the Rosemount 5408 and 5408:SIS [Product Certifications](#) document and System Control Drawing (D7000002-885).
- Repair, e.g. substitution of components etc., may jeopardize safety and is under no circumstances allowed.

Explosions could result in death or serious injury.

- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a handheld communicator in an explosive atmosphere, ensure the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- In Explosion-proof/Flameproof and Non-Incendive/Type n installations, do not remove the transmitter covers when power is applied to the unit.
- Both transmitter covers must be fully engaged to meet Explosion-proof/Flameproof requirements.

Electrical shock could cause death or serious injury.

- In Explosion-proof/Flameproof and Non-Incendive/Type n installations, avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.
- Make sure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

⚠ WARNING

Process leaks could result in death or serious injury.

- Make sure that the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

⚠ WARNING**Physical access**

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

⚠ CAUTION

Hot surfaces

The flange and process seal may be hot at high process temperatures. Allow to cool before servicing.



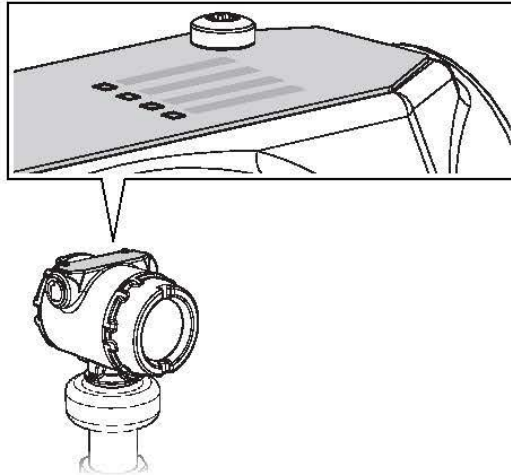
2 Confirm approval type

For hazardous locations transmitters labeled with multiple approval types:

Procedure

Permanently mark the checkbox of the selected approval type(s).

Figure 2-1: Label with Multiple Approval Types



3 Mount the transmitter

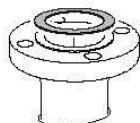
3.1 Flanged version

Prerequisites

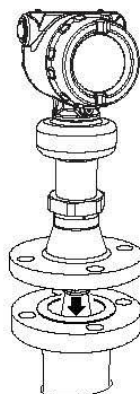
If applicable, assemble the segmented cone antenna (see [Assemble the segmented cone antenna](#)).

Procedure

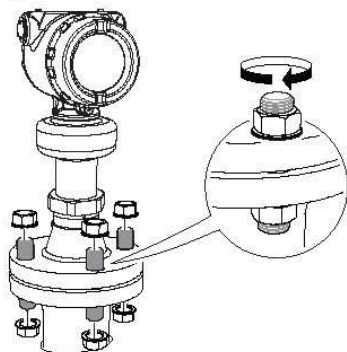
1. Place a suitable gasket on the tank flange.



2. Lower transmitter with antenna and flange into the nozzle.



3. Tighten bolts and nuts with sufficient torque for the flange and gasket choice.



Postrequisites

Align the transmitter head (see [Align transmitter head](#)).

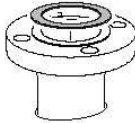
3.2 Flanged version with air purge ring (option code PC1)

Prerequisites

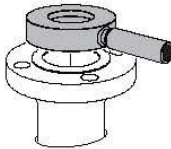
If applicable, assemble the segmented cone antenna (see [Assemble the segmented cone antenna](#)).

Procedure

1. Place a suitable gasket on the tank flange.



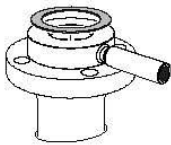
2. Place the purge ring over the gasket.



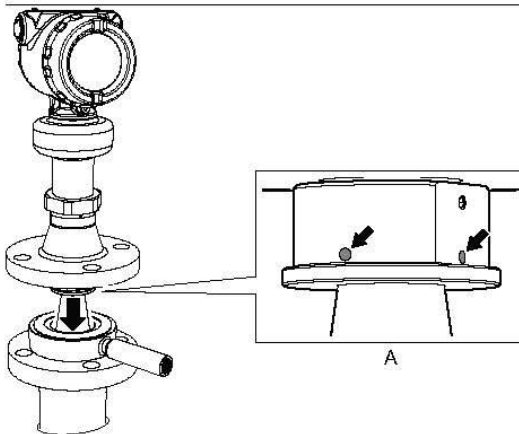
3. Place a suitable gasket over the purge ring.

Note

A minimum gasket thickness of 0.125 in. (3.2 mm) is required for flanges with protective plate design.

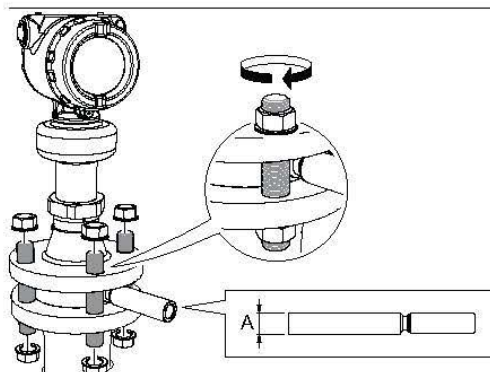


4. Lower transmitter with antenna and flange into the nozzle.



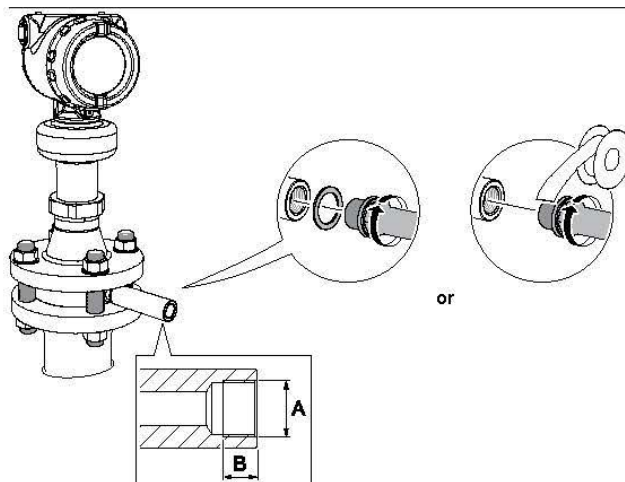
A. Antenna with air purge holes

5. Tighten bolts and nuts with sufficient torque for the flange and gasket choice.



A. 1.0 in. (25.5 mm)

6. Connect the air purging system. Use thread sealant or suitable gasket according to your site procedures.



A. $\frac{3}{8}$ in.

B. 0.4 in. (10 mm)

Table 3-1: Incoming Air Supply Specification

Maximum pressure	Recommended pressure
190 psi (13 bar)	100 to 115 psi (7 to 8 bar)

Postrequisites

Align the transmitter head (see [Align transmitter head](#)).

3.3 Threaded version, antenna diameter smaller than thread diameter

3.3.1 Threaded tank connection

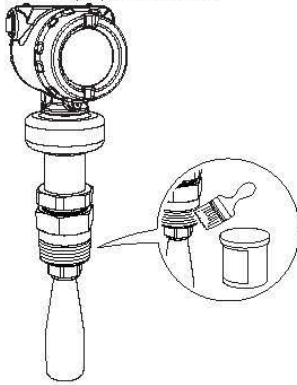
Prerequisites

If applicable, assemble the segmented cone antenna (see [Assemble the segmented cone antenna](#)).

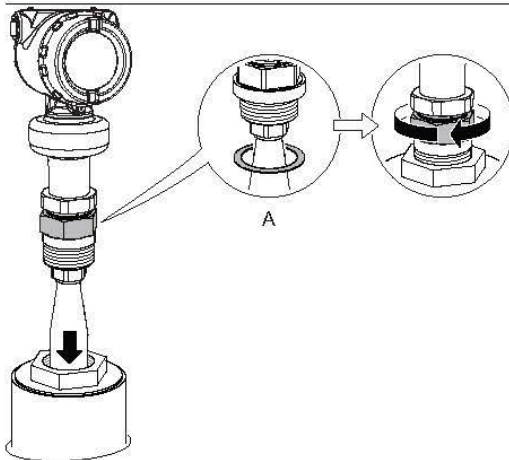
Procedure

1. Apply anti-seize paste or PTFE tape on threads according to your site procedures.

⚠ Gasket may be used as a sealant for adapters with 1½- or 2-in. BSPP (G) threads.



2. Mount the transmitter on the tank.



A. Gasket (for 1½-in. and 2-in. BSPP (G) threads only)

Postrequisites

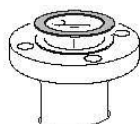
Align the transmitter head (see [Align transmitter head](#)).

3.3.2 Flanged tank connection**Prerequisites**

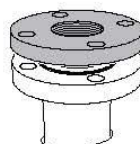
If applicable, assemble the segmented cone antenna (see [Assemble the segmented cone antenna](#)).

Procedure

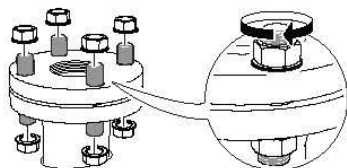
1. Place a suitable gasket on the tank flange.



2. Place the customer supplied flange over the gasket.

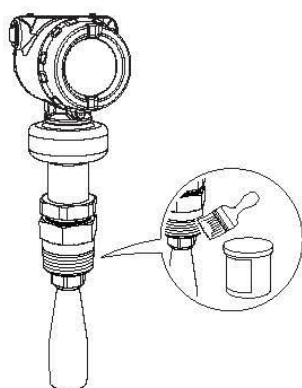


3. Tighten the bolts and nuts with sufficient torque for the flange and gasket choice.

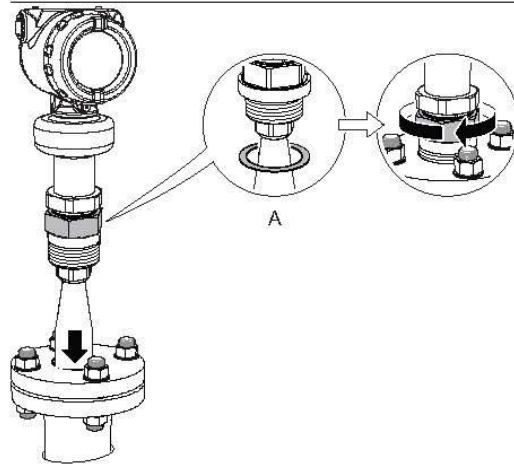


4. Apply anti-seize paste or PTFE tape on threads according to your site procedures.

⚠ Gasket may be used as a sealant for adapters with 1½- or 2-in. BSPP (G) threads.



5. Lower transmitter with antenna into the nozzle.



A. Gasket (for 1½-in. and 2-in. BSPP (G) threads only)

Postrequisites

Align the transmitter head (see [Align transmitter head](#)).

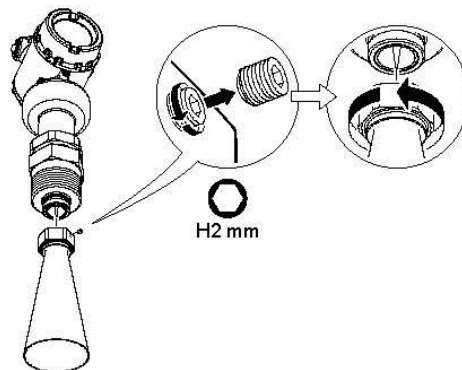
3.4 Threaded version, antenna diameter larger than thread diameter

Prerequisites

If applicable, assemble the segmented cone antenna (see [Assemble the segmented cone antenna](#)).

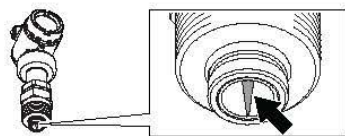
Procedure

1. Unscrew and remove the antenna.



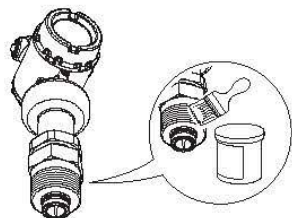
Note

Be careful not to scratch the microwave launcher. The microwave launcher is sensitive to mechanical impacts.

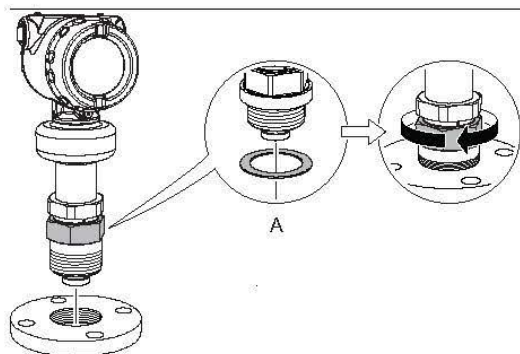


2. Apply anti-seize paste or PTFE tape on threads according to your site procedures.

⚠ Gasket may be used as a sealant for adapters with 1½- or 2-in. BSPP (G) threads.



3. Mount the adapter on the customer supplied flange.

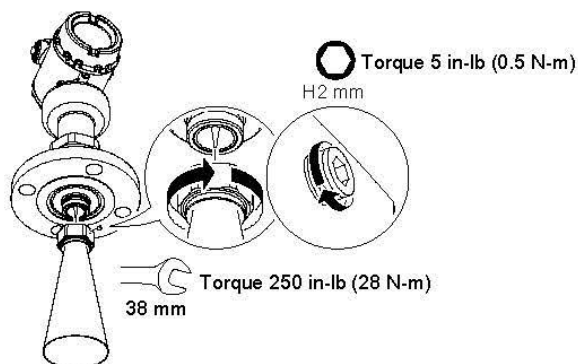


A. Gasket (for 1½-in. and 2-in. BSPP (G) threads only)

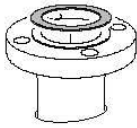
4. Mount the antenna.

Note

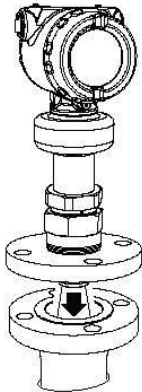
Visually inspect the microwave launcher for damage and dirt.



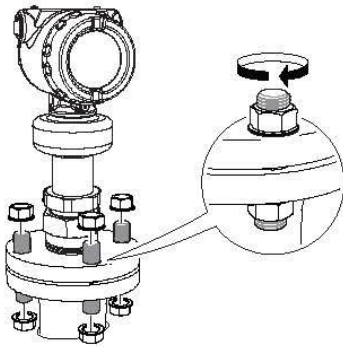
5. Place a suitable gasket on the tank flange.



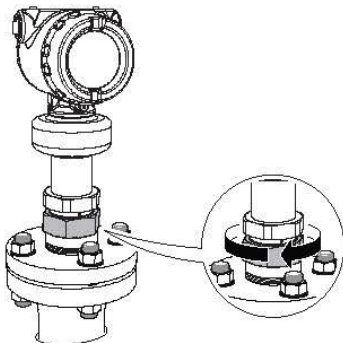
6. Lower transmitter with antenna and flange into the nozzle.



7. Tighten the bolts and nuts with sufficient torque for the flange and gasket choice.



8. Screw the adapter until it is properly tightened.



Postrequisites

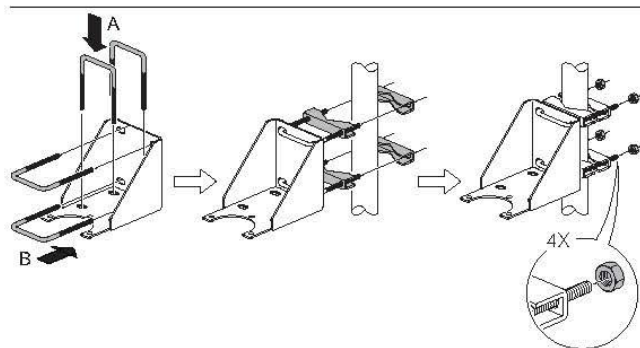
Align the transmitter head (see [Align transmitter head](#)).

3.5 Bracket mounting

Procedure

1. Mount the bracket to the pipe/wall.

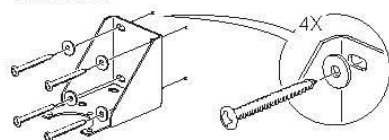
On pipe:



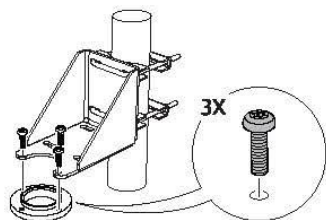
A. Horizontal pipe

B. Vertical pipe

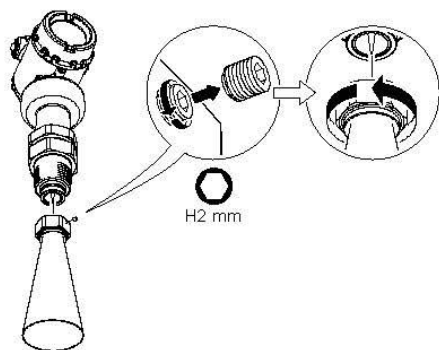
On wall:



2. Mount the holder to the bracket.

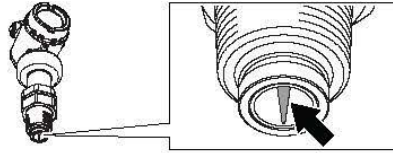


3. Unscrew and remove the antenna.

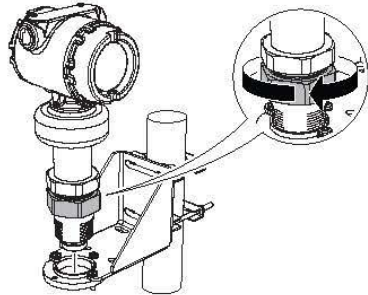


Note

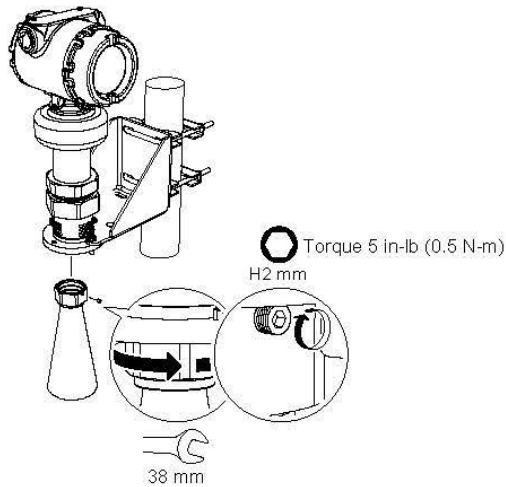
Be careful not to scratch the microwave launcher. The microwave launcher is sensitive to mechanical impacts.



4. Screw the transmitter into the holder.



5. Mount the antenna.

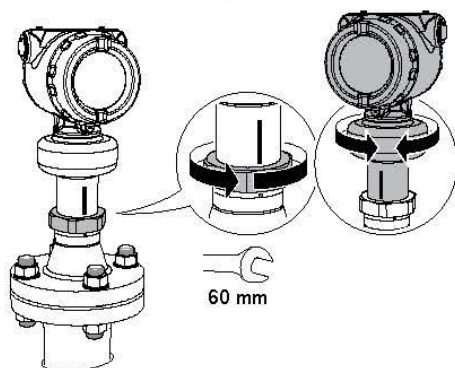
**Postrequisites**

Align the transmitter head (see [Align transmitter head](#)).

4 Align transmitter head

Procedure

1. Loosen the nut slightly and turn the transmitter.



2. Verify the transmitter head is properly aligned.

Option	Description
Open tank	Align the marking on the sensor module toward the tank wall (see Figure 4-1).
Still pipe	Align the external ground screw toward the holes of the still pipe (see Figure 4-2).
Chamber	Align the external ground screw toward the process connections (see Figure 4-3).

3. Tighten the nut.

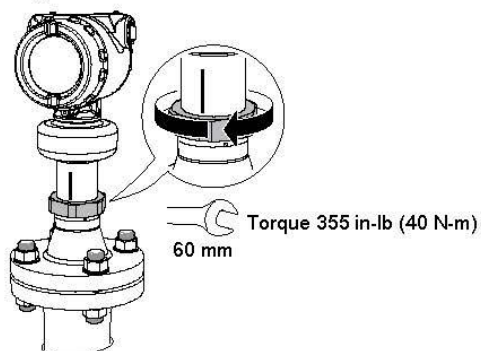
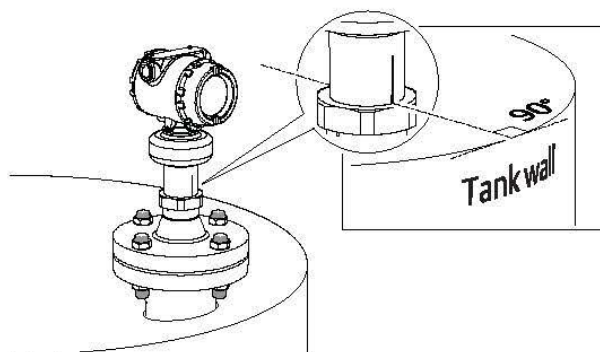
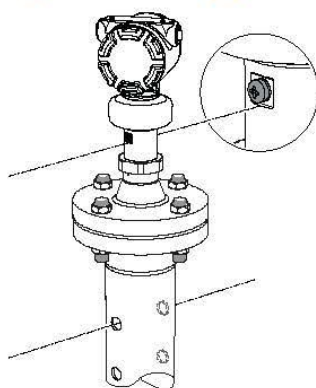
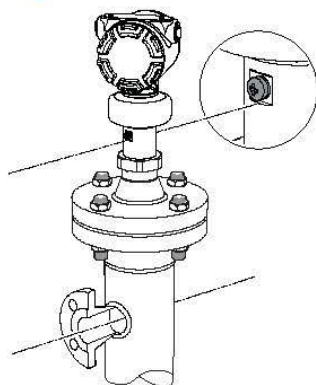


Figure 4-1: Open Tank**Figure 4-2: Still pipe****Figure 4-3: Chamber**

5 Adjust display orientation (optional)

To improve field access to wiring or to better view the optional LCD display:

Prerequisites

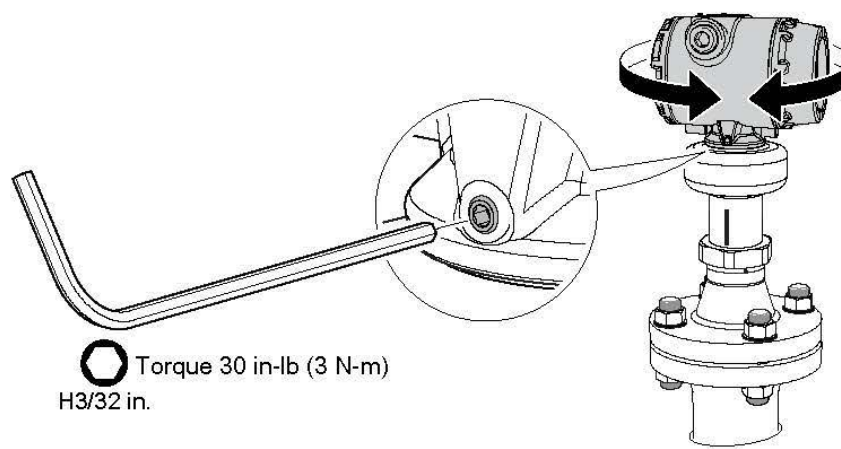
Note

In high vibration applications, the transmitter housing must be fully engaged into the sensor module to meet the vibration test specifications. This is achieved by rotating the transmitter housing clockwise to thread limit.

Procedure

1. Loosen the set screw until the transmitter housing can rotate smoothly.
2. First, rotate the housing clockwise to the desired location. If the desired location cannot be achieved due to thread limit, rotate the housing counterclockwise to the desired location (up to 360° from thread limit).
3. Re-tighten the set screw.

Figure 5-1: Rotate the Transmitter Housing



6 Prepare the electrical connections

6.1 Cable selection

Table 6-1: Recommended Cable Size

Protocol	Wire diameter
4-20 mA/HART®	24-14 AWG
FOUNDATION™ Fieldbus	18 AWG, Fieldbus type A cable

Twisted pairs and shielded wiring are recommended for environments with high EMI (electromagnetic interference).

Use wire rated at least 5 °C above maximum ambient temperature.

Two wires can be safely connected to each terminal screw.

6.2 Cable gland/conduit

For explosion-proof/flameproof installations, only use cable glands or conduit entry devices certified explosion-proof or flameproof.

6.3 Power consumption

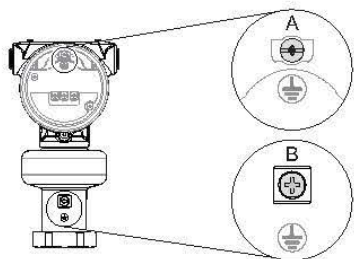
Max. 1 W, current max. 23 mA

6.4 Grounding

Make sure grounding is done according to national and local electrical codes. Failure to do so may impair the protection provided by the equipment.

Transmitter housing

The most effective grounding method is direct connection to earth ground with minimal impedance. There are two grounding screw connections provided (see [Figure 6-1](#)).

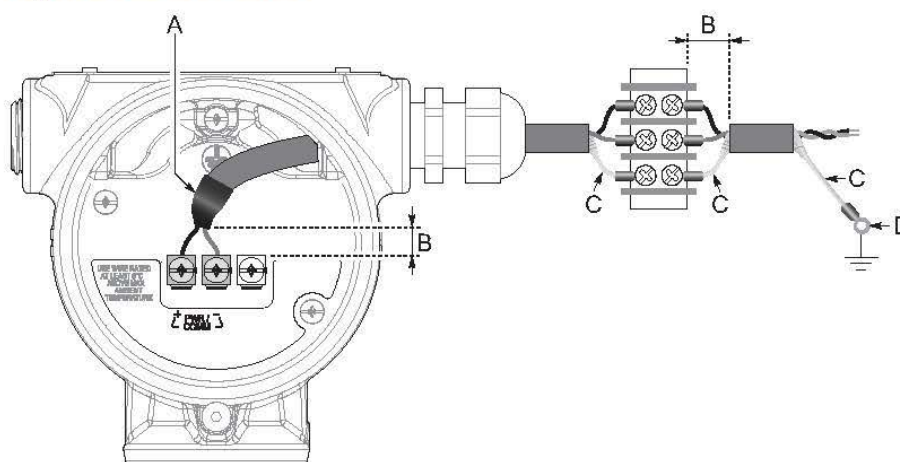
Figure 6-1: Ground Screws

- A. Internal ground screw
B. External ground screw

Signal cable shield grounding

Make sure the instrument cable shield is:

- Trimmed close and insulated from touching the transmitter housing.
- Continuously connected throughout the segment.
- Connected to a good earth ground at the power supply end.

Figure 6-2: Cable Shield

- A. Insulate shield and drain wire
B. Minimize distance
C. Trim shield and insulate exposed drain wire
D. Connect drain wire to the power supply ground

Note

Do not ground the shield and its drain wire at the transmitter. If the cable shield touches the transmitter housing, it can create ground loops and interfere with communications.

6.5 Power supply

4-20 mA/HART®

The transmitter operates on 12-42.4 Vdc (12-30 Vdc in Intrinsically Safe installations) at the transmitter terminals.

FISCO/FOUNDATION™ Fieldbus

The transmitter operates on 9-32 Vdc (9-30 Vdc in Intrinsically Safe installations and 9-17.5 Vdc for FISCO) at the transmitter terminals.

6.6 Signal termination

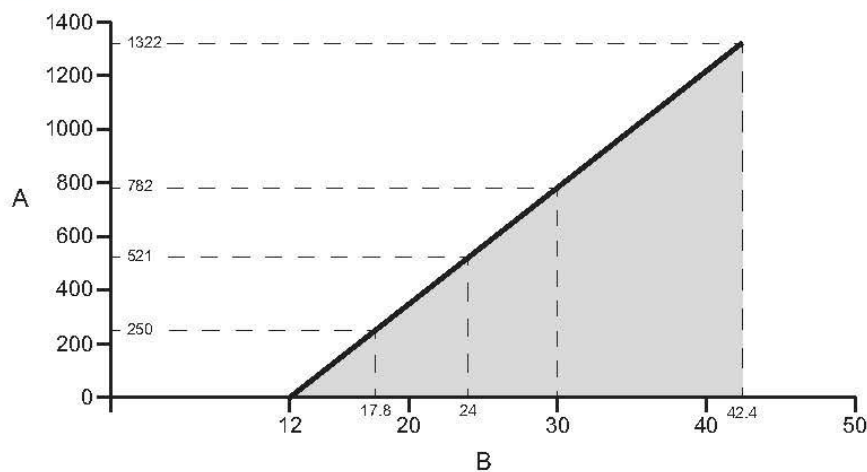
A terminator should be installed at the beginning and end of every Fieldbus segment.

For transmitter with built-in terminator, connect a jumper wire between the "TERMINATE ON" terminals to activate the terminator. Refer to [Cable selection](#) for recommended wire size.

6.7 Load limitations

For HART® communication, a minimum loop resistance of 250 Ω is required. Maximum loop resistance is determined by the voltage level of the external power supply.

Figure 6-3: Load Limits



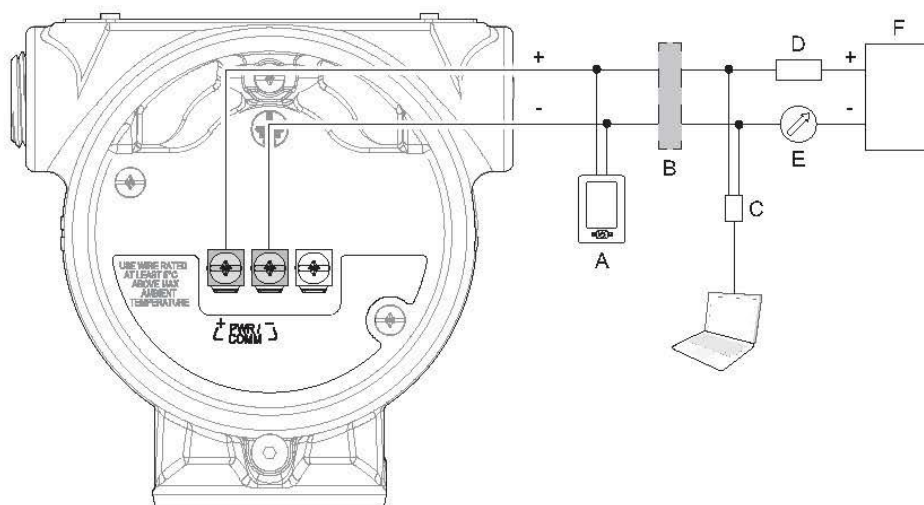
Maximum Loop Resistance = $43.5 * (\text{External Power Supply Voltage} - 12)$

A. Loop Resistance (Ohms)

B. External Power Supply Voltage (Vdc)

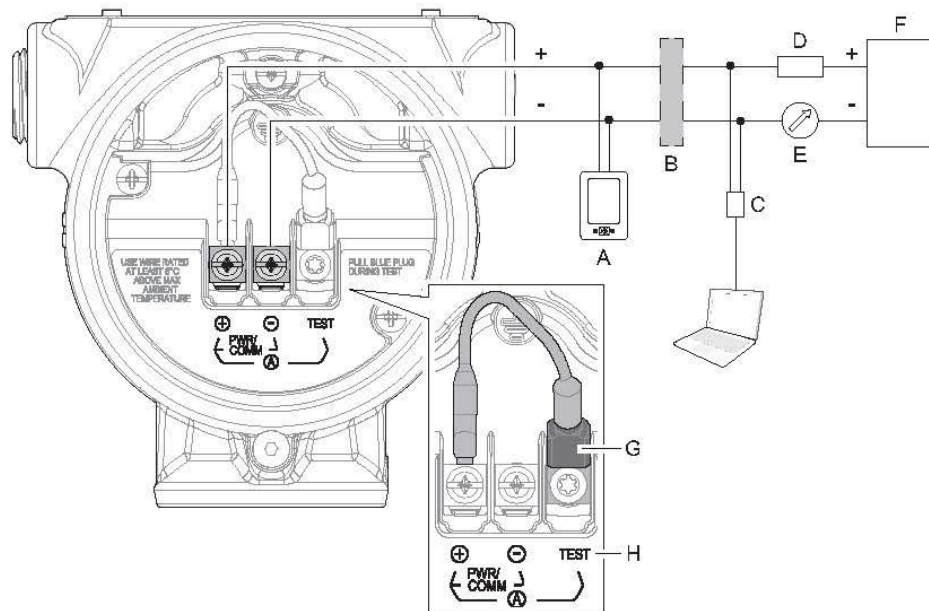
6.8 Wiring diagram

Figure 6-4: 4-20 mA/HART® Communication



- A. Handheld communicator
- B. Approved IS barrier (for Intrinsically Safe installations only)
- C. HART modem
- D. Load resistance ($\geq 250 \Omega$)
- E. Current meter
- F. Power supply

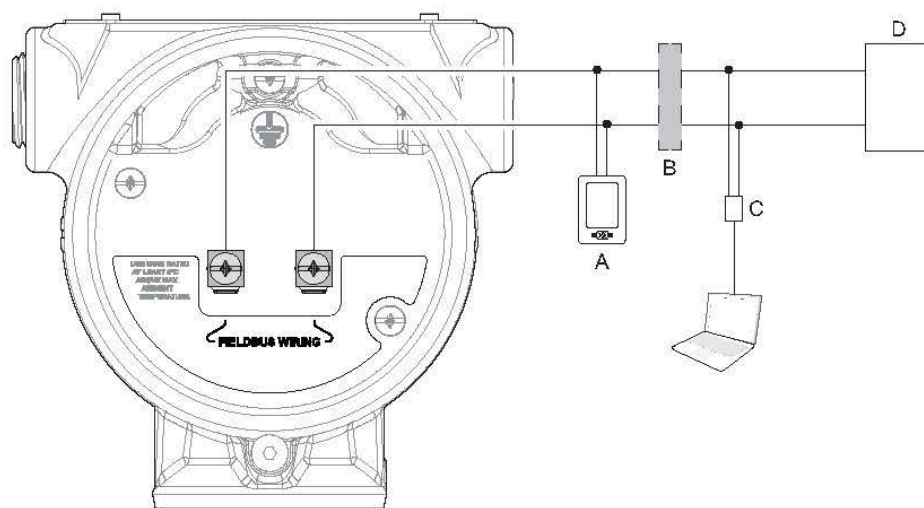
Figure 6-5: 4-20 mA/HART Communication - Terminal Block with TEST Terminal



- A. Handheld communicator
- B. Approved IS barrier (for Intrinsically Safe installations only)
- C. HART modem
- D. Load resistance ($\geq 250 \Omega$)
- E. Current meter
- F. Power supply
- G. Blue plug
- H. TEST terminal

Note

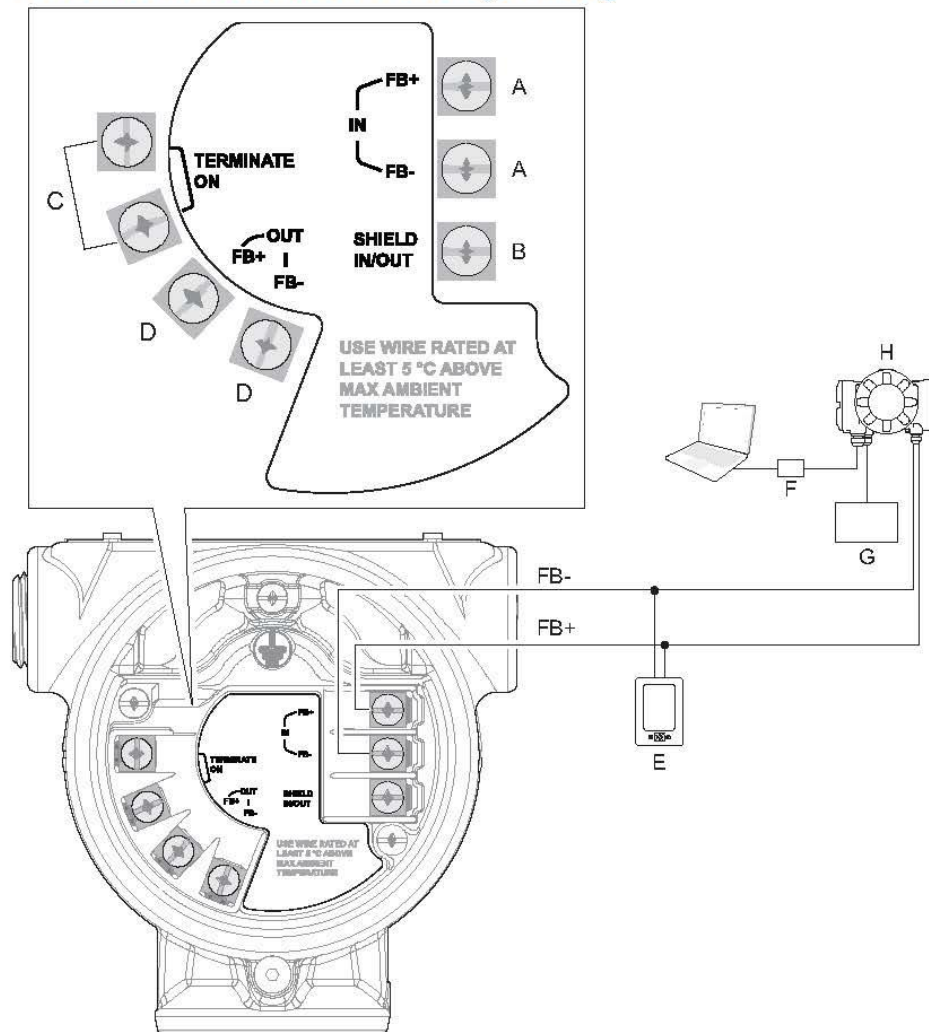
Blue plug must only be disconnected during loop current measurement procedure.

Figure 6-6: FOUNDATION™ Fieldbus

- A. Handheld communicator
- B. Approved IS barrier (for Intrinsically Safe installations only)
- C. FOUNDATION Fieldbus modem
- D. Power supply

The terminals are not polarity sensitive.

Figure 6-7: FOUNDATION Fieldbus - Terminal Block with Built-in Terminator and Connections for Daisy-chaining

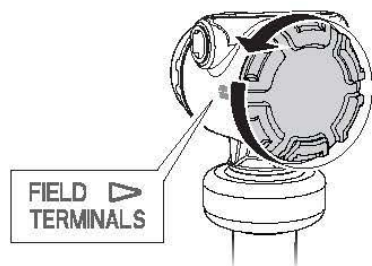


- A. Tankbus
- B. Cable shield (insulate from touching the transmitter housing)
- C. Built-in terminator (connect jumper if last device on the fieldbus segment)
- D. Daisy-chain connection to other devices
- E. Handheld communicator
- F. Fieldbus modem
- G. Power supply
- H. Rosemount™ 2410 Tank Hub

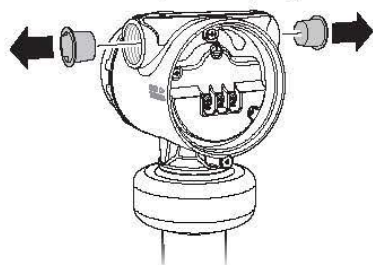
7 Connect wiring and power up

Procedure

1. ⚠ Verify the power supply is disconnected.
2. Remove the cover.

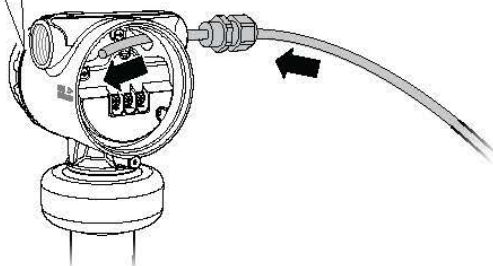
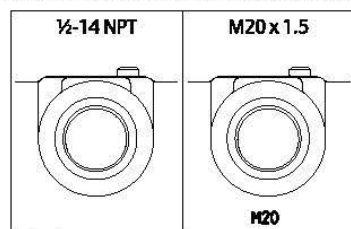


3. Remove the plastic plugs.



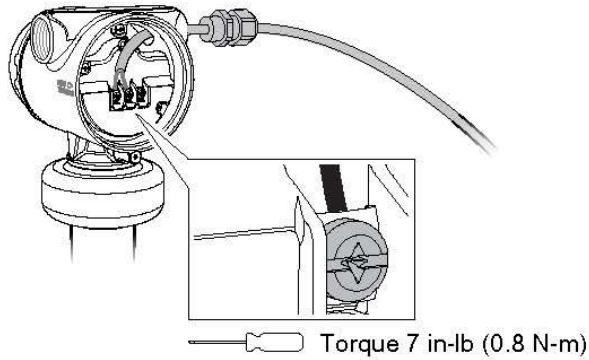
4. Pull the cable through the cable gland/conduit. ⁽¹⁾

Identification of thread size and type:

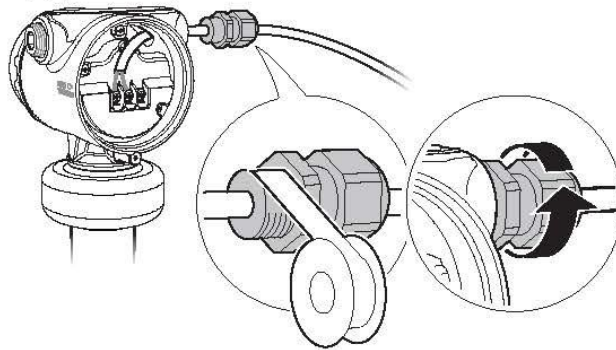


⁽¹⁾ Unless marked, the conduit/cable entries in the transmitter housing use a ½-14 NPT thread form.

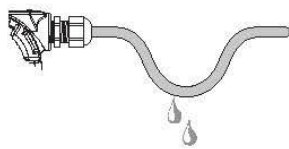
5. Connect the cable wires (see [Wiring diagram](#)).



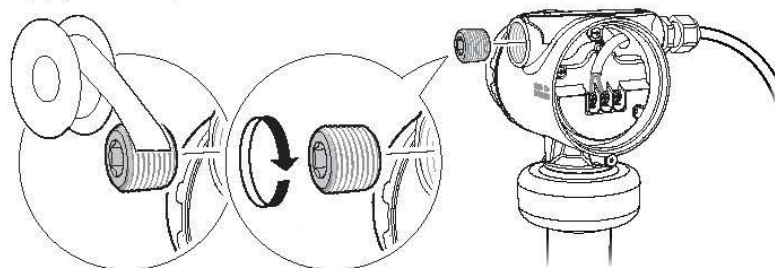
6. Ensure proper grounding (see [Grounding](#)).
7. Tighten the cable gland.
Apply PTFE tape or other sealant to the threads.

**Note**

Make sure to arrange the wiring with a drip loop.

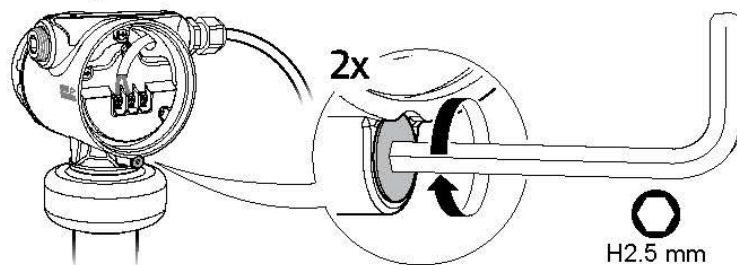


8. Seal any unused ports with the enclosed metal plug.
Apply PTFE tape or other sealant to the threads.



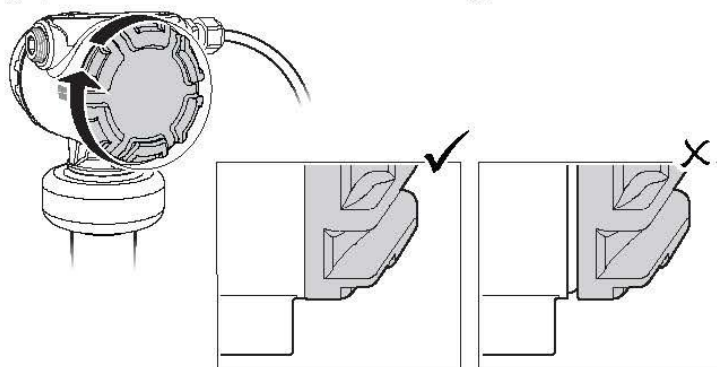
9. Attach and tighten the cover.

- a) Verify the cover jam screw is completely threaded into the housing.



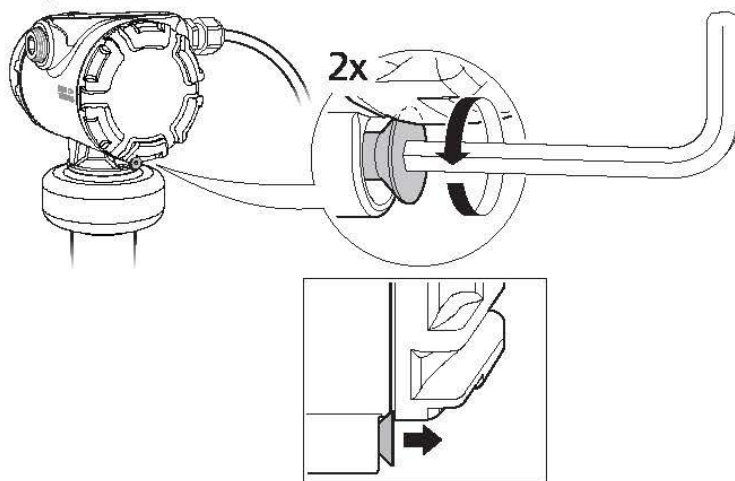
- b) Attach and tighten the cover.

⚠ Make sure the cover is fully engaged. There should be no gap between the cover and the housing.



- c) Turn the jam screw counterclockwise until it contacts the cover.

⚠ Required for explosion-proof/flameproof installations only.



- d) Turn the jam screw an additional $\frac{1}{2}$ turn counterclockwise to secure the cover.
10. Connect the power supply.

Note

It may take up to 15 seconds before the LCD display lights up.

8 Configure transmitter using Guided Setup

8.1 Configuration tools

The transmitter can easily be configured using:

- Rosemount Radar Master Plus (running in the Instrument Inspector™ Application)
- Device Descriptor (DD) based systems, e.g. AMS Device Manager, 475 Field Communicator, AMS Trex™ Device Communicator, and DeltaV™, or any other EDDL or enhanced-EDDL host
- Field Device Integration (FDI) based systems

Rosemount Radar Master Plus is the recommended tool for configuration.

8.2 Rosemount Radar Master Plus

The Instrument Inspector Application or any FDI compliant host is needed to run Rosemount Radar Master Plus.

Instrument Inspector is available at Emerson.com/InstrumentInspector.

8.3 Getting the latest FDI Device Package

The FDI Package or DD is typically installed together with the configuration tool.

The latest FDI Package is available at Emerson.com/RosemountRadarMasterPlus.

The latest DD is available at Emerson.com/DeviceInstallKits.

8.4 Configure using Rosemount Radar Master Plus

The options available in the Guided Setup wizard include all items required for basic operation.

Procedure

1. Start Instrument Inspector Application.



2. In the Instrument Inspector Application window, double-click the device icon.
3. From the Overview screen, select Rosemount Radar Master Plus.



4. Under **Configure**, select **Guided Setup** and follow the on-screen instructions.

8.5 Configure using AMS Device Manager

The options available in the Guided Setup wizard include all items required for basic operation.

Procedure

1. Start AMS Device Manager and connect to the device.
2. Select **Configure** → **Guided Setup**.
3. Select **Basic Setup** and follow the on-screen instructions.

8.6 Configure using handheld communicator

The options available in the Guided Setup wizard include all items required for basic operation.

Procedure

1. Turn on the handheld communicator and connect to the device.
2. Select **Configure** → **Guided Setup**.
3. Select **Basic Setup** and follow the on-screen instructions.

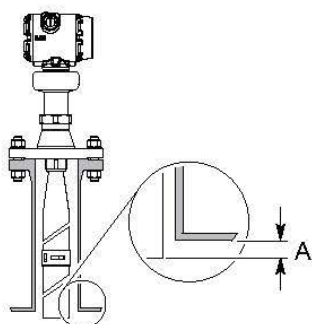
8.7 Learn more

Visit Emerson.com/Rosemount to download the Rosemount 5408 and 5408:SIS with HART® [Reference Manual](#) and Rosemount 5408 with FOUNDATION™ Fieldbus [Reference Manual](#).

9 Assemble the segmented cone antenna

This section applies to the segmented cone antenna (option code S2). Use only one segment; the total antenna length should not exceed 47.2 in. (1200 mm).

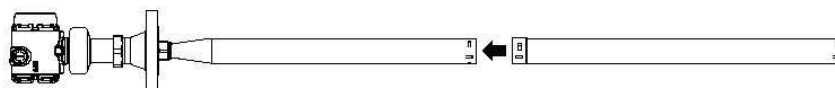
Figure 9-1: Installation Recommendation



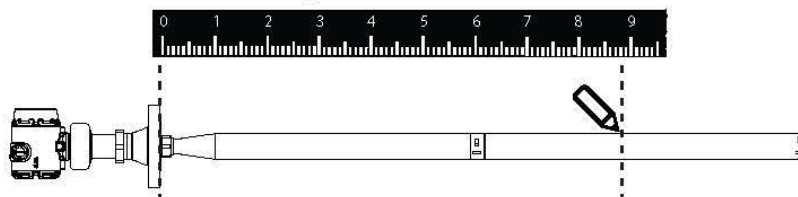
A. Min. 0.4 in. (10 mm)

Procedure

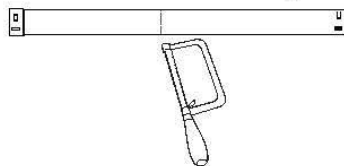
1. Insert the segment into the cone antenna until it bottoms.



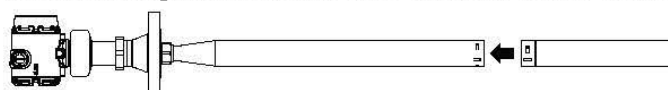
2. Mark where to cut the segment.



3. Remove and cut the segment at the marking.



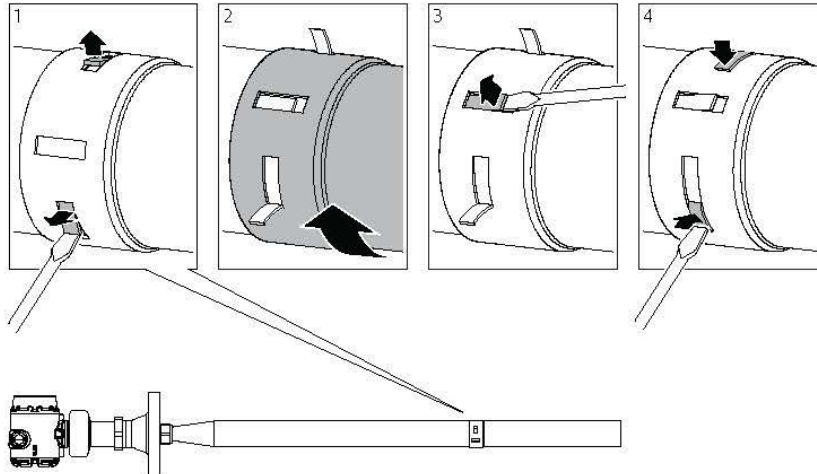
4. Remove any burrs.
5. Insert the segment into the cone antenna until it bottoms.



6. Secure the segment to the antenna.

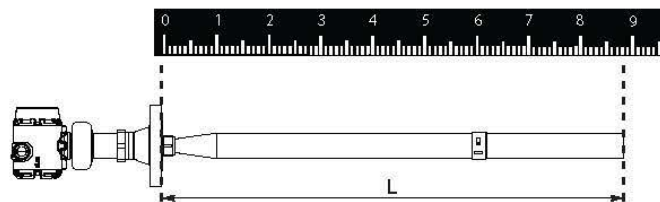
Note

Be careful of sharp edges. Wear protective gloves!



7. Measure the Antenna Extension Length (L).

Antenna Extension Length (L):



8. Update the transmitter configuration to the new Antenna Extension Length (L).
 - Rosemount Radar Master Plus:
 - Under **Configure**, select **Level Setup** → **Antenna**.
 - AMS Device Manager and handheld communicator:
 - Select **Configure** → **Manual Setup** → **Level Setup** → **Antenna**.



Quick Start Guide
00825-0100-4408, Rev. BB
June 2019

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ROSEMOUNT™

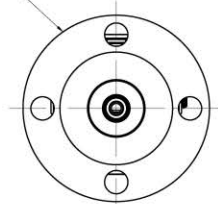
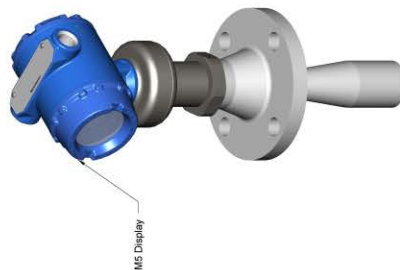
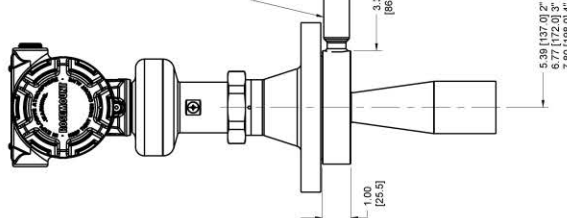
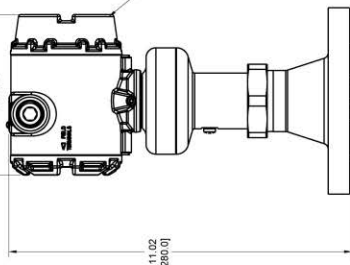
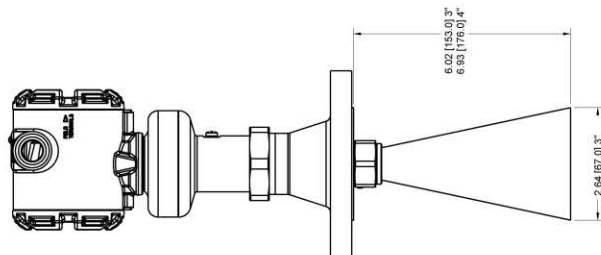
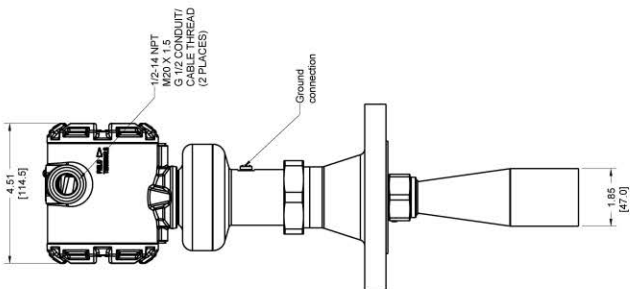
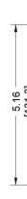


Attachment V

Technical Drawings

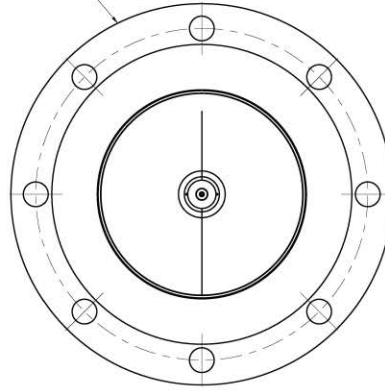
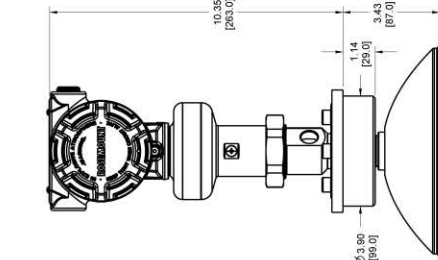
WITH EXTENDED ANTENNA

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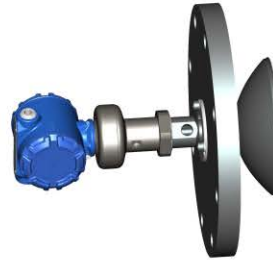


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REFERENCE TO OTHER DRAWINGS PRODUCT SPECIFICATIONS				
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APPROVED BY J. J. METZGER	DATE 3/29/01	DRAWING NO. 05408-7000		

SHOWN WITH PARABOLIC ANTENNA
FLANGE CONNECTION

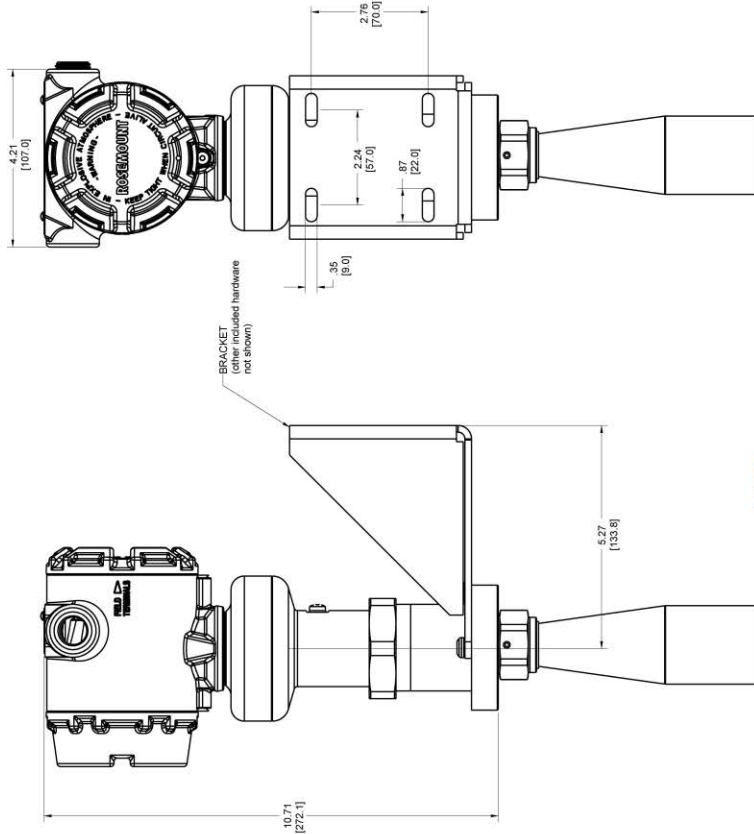
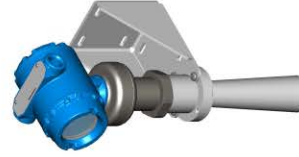
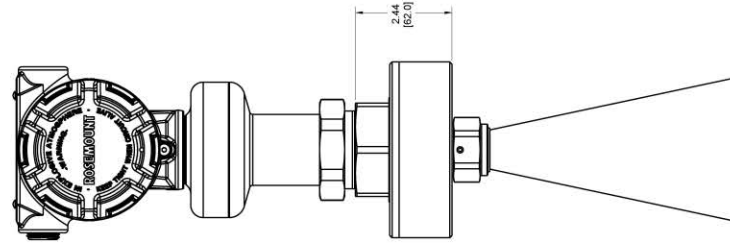


SIZE VARIABLE BY
FLANGE TYPE



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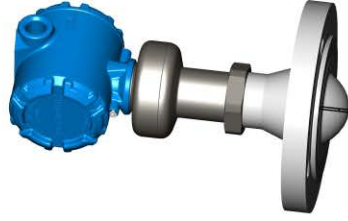
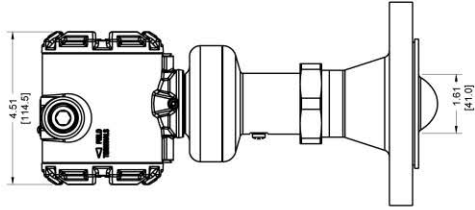
BRACKET MOUNTING



—BRACKET
(other included hardware
not shown)

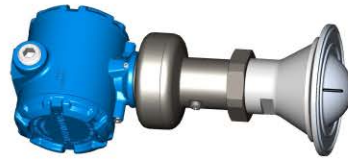
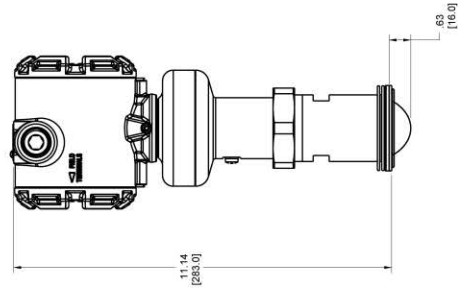
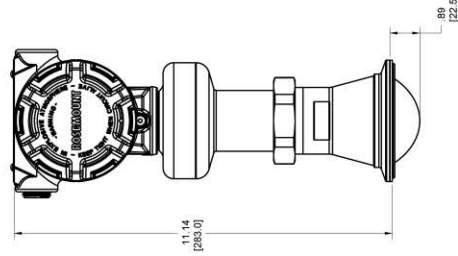
800'S ROSEMOUNT INC.		ROSEMOUNT ENGINEERING		ROSEMOUNT ENGINEERING		ROSEMOUNT ENGINEERING	
UNIT NOTATIONS (INCHES)		UNIT NOTATIONS (INCHES)		UNIT NOTATIONS (INCHES)		UNIT NOTATIONS (INCHES)	
PRODUCT SPECIFICATIONS PRODUCT DATA SHEETS FOR EMERSON ROSEMOUNT CLICK HERE							
EMERSON				ROSEMOUNT 5408 TYPE I DRAWING			
THE				TYPE I DRAWING NO.			
DATE 05-04-08-7000		SIZE D		SCALE 1"=1"		NTS	

PROCESS SEAL CONNECTION

FLANGE TYPE
2"

TRI CLAMP
3"

TRI CLAMP
2"

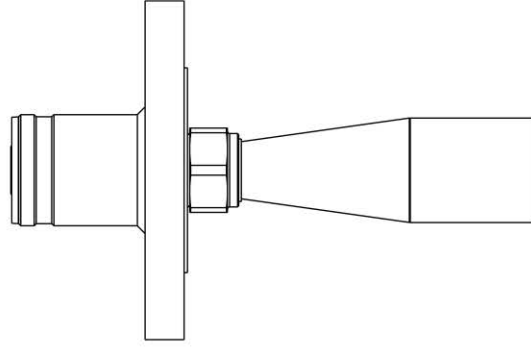
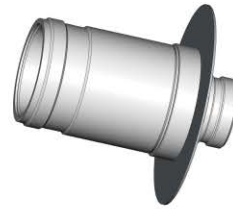
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
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WELDED CONSTRUCTION

SHOWN WITH BACKING
FLANGE AND ANTENNA

SHOWN WITH ANTENNA

3.11
[79.0][illegible]

Attachment VI

Quality Control



MANAGEMENT SYSTEM CERTIFICATE

Certificate no.:
2000-SKM-AQ-029 / 2000-SKM-AE-020

Initial certification date:
09, October, 1992 (9001)
29, December, 1997 (14001)

Valid:
01 August 2021 – 31 July 2024

This is to certify that the management system of
Rosemount Tank Radar AB
Layoutvägen 1, 435 33, MÖLNLYCKE, Sweden
and the sites as mentioned in the appendix accompanying this certificate

has been found to conform to the Management System standards:
ISO 9001:2015/ ISO 14001:2015

This certificate is valid for the following scope:
Design, development and manufacture of systems for level gauging, tank gauging and cargo handling, including equipment approved for installation in Hazardous Locations / Explosive Atmosphere areas.

Place and date:
Solna, 27 May 2021



For the issuing office:
DNV - Business Assurance
Elektrogatan 10, 171 54, Solna, Sweden

Ann-Louise Pätt
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.

ACCREDITED UNIT: DNV GL Business Assurance Sweden AB, Elektrogatan 10, 171 54 Solna, Sweden - TEL: +46 8 587 940 00. www.dnvg1.se/assurance



Certificate no.: 2000-SKM-AQ-029 / 2000-SKM-AE-020
Place and date: Solna, 27 May 2021

Appendix to Certificate

Rosemount Tank Radar AB

Locations included in the certification are as follows:

Site Name	Site Address	Site Scope
Rosemount Tank Radar AB	Layoutvägen 1, 435 33, MÖLNLYCKE, Sweden	Design, development and manufacture of systems for level gauging, tank gauging and cargo handling, including equipment approved for installation in Hazardous Locations / Explosive Atmosphere areas.
Rosemount Tank Radar AB	Låsblecksgatan 9, 589 41, LINKÖPING, Sweden	Design and development of systems for level gauging, tank gauging and cargo handling including equipment approved for installation in Hazardous Locations / Explosive Atmosphere areas.

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.

ACCREDITED UNIT: DNV GL Business Assurance Sweden AB, Elektrogatan 10, 171 54 Solna, Sweden - TEL: +46 8 587 940 00. www.dnvgl.se/assurance

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[Google.com/+RosemountMeasurement](https://google.com/+RosemountMeasurement)

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ROSEMOUNT™





Part IV

Equipment Registration for the
5408 and 5408:SIS Radar Gauges
And associated components
to the
Florida Department of Environmental Protection
from
Rosemount Tank Gauging - North America

Submitted by
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Attachment VII

Safety and Testing

Rosemount™ 5408:SIS Level Transmitter

Non-Contacting Radar



ROSEMOUNT™



NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, ensure you thoroughly understand the contents before installing, using, or maintaining this product.

For technical assistance, contacts are listed below:

Customer Central

Technical support, quoting, and order-related questions.

- United States - 1-800-999-9307 (7:00 am to 7:00 pm CST)
- Asia Pacific- 65 777 8211

North American Response Center

Equipment service needs.

- 1-800-654-7768 (24 hours a day — includes Canada)
- Outside of these areas, contact your local Emerson representative.

⚠ WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

- Ensure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.
- For installations in hazardous locations, the transmitter must be installed according to the Rosemount 5408 and 5408:SIS Product Certifications document and System Control Drawing (D7000002-885).

Explosions could result in death or serious injury.

- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Before connecting a handheld communicator in an explosive atmosphere, ensure the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- In Explosion-proof/Flameproof and Non-Incendive/Type n installations, do not remove the transmitter covers when power is applied to the unit.
- Both transmitter covers must be fully engaged to meet Explosion-proof/Flameproof requirements.

Electrical shock could cause death or serious injury.

- In Explosion-proof/Flameproof and Non-Incendive/Type n installations, avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.
- Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

Process leaks could result in death or serious injury.

- Ensure that the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

Any substitution of non-recognized parts may jeopardize safety. Repair (e.g. substitution of components) may also jeopardize safety and is not allowed under any circumstances.

- Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety. Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson. Any continued use of product that has been damaged or modified without the written authorization is at the customer's sole risk and expense.

▲ WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

▲ CAUTION

Hot surfaces

The flange and process seal may be hot at high process temperatures. Allow to cool before servicing.



▲ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings. For information on Rosemount nuclear-qualified products, contact your local Emerson Sales Representative.

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1 Before you begin

1.1 About this document

This document provides information about how to install, commission, and proof test a Rosemount 5408:SIS Level Transmitter to comply with Safety Instrumented Systems (SIS) requirements.

Note

The following conditions must apply:

- The transmitter has been installed correctly and completely according to the instructions in the Reference Manual and Quick Start Guide.
 - The installation complies with all applicable safety requirements.
 - The operator is trained in local and corporate safety standards.
-

1.2 About this product

The Rosemount 5408:SIS is a two-wire transmitter for continuous level measurements over a broad range of liquids and slurries. The measurement principle is fast-sweep Frequency Modulated Continuous Wave (FMCW).

The Rosemount 5408:SIS can be used as the level sensor in a Basic Process Control System (BPCS) or as a safety device in a safety instrumented system.

1.2.1 Application examples

- Overfill prevention
- Dry-run prevention
- Level range monitoring

1.3 Related documents

You can find all product documentation at [Emerson.com/Rosemount](https://emerson.com/Rosemount).

For more information, see the following documents:

Table 1-1: Related Documentation

Document	Document type
00809-0100-4408	Reference Manual
00813-0100-4408	Product Data Sheet
00825-0100-4408	Quick Start Guide: Cone Antenna
00825-0300-4408	Quick Start Guide: Parabolic Antenna
00825-0500-4408	Quick Start Guide: Process Seal Antenna
00825-0200-4408	Product Certifications

2 Installation and commissioning

2.1 Safety Instrumented System (SIS) certification

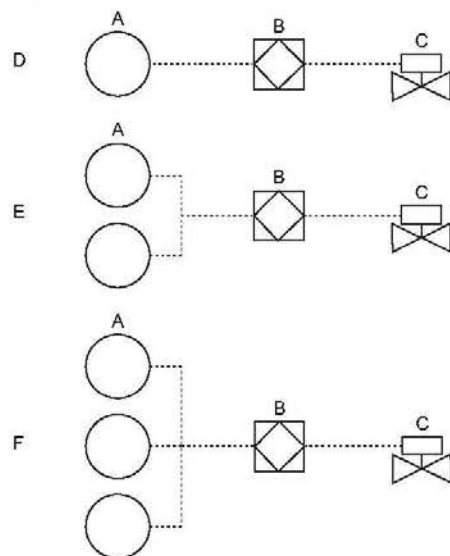
For safety instrumented systems usage, the 4-20 mA analog output is used as the primary safety variable. It is configured to activate the alarm function if an error occurs. If a measured value goes beyond the measurement range, the transmitter enters saturation mode.

The measurement signal used by the logic solver must be the analog 4-20 mA signal proportional to the level or distance (ullage). The HART® protocol can only be used for setup, calibration, and diagnostic purposes, not for safety critical operation.

The Rosemount™ 5408:SIS Level Transmitter is IEC 61508 certified to:

- Low and high demand: Type B element
- SIL 2 for random integrity @ HFT=0
- SIL 3 for random integrity @ HFT=1
- SIL 3 for systematic capability

Figure 2-1: Safety Instrumented Function (SIF) Configuration Examples



- A. Rosemount 5408:SIS Level Transmitter (sensor)
 B. Logic-solver
 C. Actuator
 D. Single use 1oo1 (1-out-of-1) for SIL2 (SIL 2@ HFT=0)
 E. Redundant use 1oo2 for SIL3 (SIL3@ HFT=1)
 F. Redundant use 2oo3 for SIL3 (SIL3@ HFT=1)

2.2 Safety certified identification

All Rosemount 5408SIS Level Transmitters must be identified as safety certified before installing into SIS systems.

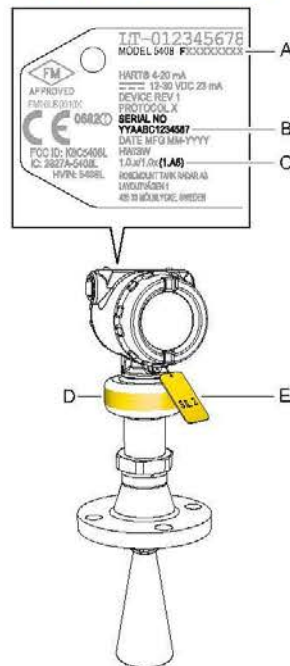
Procedure

1. Verify the transmitter model code starts with "5408F".
2. Verify the software (SW) is 1.A3 or later.

Note

The Smart Echo Level Test requires software version 1.C0 or later.

Figure 2-2: Identification



- A. Model code
- B. Serial number
- C. SW version
- D. Yellow stripe for locating device from distance
- E. Yellow tag for locating device from distance

2.3 Installation

Refer to the Rosemount 5408 and Rosemount 5408:SIS [Reference Manual](#) for installation instructions. No special installation is required in addition to the standard installation practices outlined in this manual.

The loop should be designed so the terminal voltage is within the limits specified in section [Power supply](#).

Check that environmental conditions do not exceed the ratings provided in the Rosemount 5408 and Rosemount 5408:SIS [Product Data Sheet](#).

Note

The Rosemount 5408:SIS Level Transmitter is not safety-rated during maintenance work, configuration changes, multidrop, loop test, proof test, or other activity that affects the safety function. Alternative means should be used to ensure process safety during such activities.

2.3.1 Power supply

The transmitter operates on 12-42.4 Vdc (12-30 Vdc in Intrinsically Safe installations) at the transmitter terminals.

2.4 Configuration

Use a HART-compliant master, such as Rosemount Radar Master Plus, AMS Device Manager, or a handheld communicator, to communicate with and verify configuration of the Rosemount 5408:SIS.

2.4.1 Make sure you are connected to the correct transmitter

Verify that the serial number on the label matches the one in your configuration tool.

Procedure

1. Write down the serial number from the transmitter label.
2. Verify the same serial number in your configuration tool.
 - Rosemount Radar Master Plus:
 - Under **Overview**, select **Device Information** → **Identification**.
 - AMS Device Manager and handheld communicator:
 - Select **Overview** → **Device Information** → **Identification**.

2.4.2 Configure device using Guided Setup

Follow the Guided Setup wizard for transmitter configuration. When configuring parameters not included in the Guided Setup, it may be necessary to do additional verification.

Configure using Rosemount Radar Master Plus

The options available in the Guided Setup wizard include all items required for basic operation.

Procedure

1. Start Instrument Inspector Application.



2. Under *HART*, double-click the device icon.
3. From the *Overview* screen, select **Rosemount Radar Master Plus**.



4. Under *Configure*, select **Guided Setup** and follow the on-screen instructions.

Configure using AMS Device Manager

The options available in the Guided Setup wizard include all items required for basic operation.

Procedure

1. Start AMS Device Manager and connect to the device.
2. Select **Configure** → **Guided Setup**.
3. Select **Basic Setup** and follow the on-screen instructions.

Configure using handheld communicator

The options available in the Guided Setup wizard include all items required for basic operation.

Procedure

1. Turn on the handheld communicator and connect to the device.
2. Select **Configure** → **Guided Setup**.
3. Select **Basic Setup** and follow the on-screen instructions.

2.4.3

Operational mode

There are two Operational Modes to choose from for the Rosemount 5408:SIS: Control/Monitoring and Safety (SIS).

If the transmitter is used as safety device in a Safety Instrumented System, the Operational Mode must be set to Safety (SIS).

Set operational mode using Rosemount Radar Master Plus

The Safety (SIS) operational mode can be activated via the Guided Setup wizard, or as follows:

Prerequisites

When entering the Safety (SIS) operational mode, the analog output will be put into alarm mode until the Safety Mode is enabled.

Procedure

1. Under **Configure**, select **Device Setup** → **Security**.
2. Under **Operational Mode**, select **Change** and follow the on-screen instructions.

Set operational mode using AMS Device Manager and handheld communicator

The Safety (SIS) operational mode can be activated via the Guided Setup wizard, or as follows:

Prerequisites

When entering the Safety (SIS) operational mode, the analog output will be put into alarm mode until the Safety Mode is enabled.

Procedure

1. Select **Configure** → **Manual Setup** → **Device Setup** → **Security**.
2. Under **Safety Instrumented Systems**, select **Change Operational Mode** and follow the on-screen instructions.

2.4.4 Safety mode

When the operational mode is set to Safety (SIS), then the Safety Mode must be enabled for the transmitter to become operational. When Safety Mode is enabled, the transmitter is write protected (with or without a password) to prevent unauthorized changes.

Enable or disable safety mode using Rosemount Radar Master Plus

Procedure

1. Under **Configure**, select **Device Setup** → **Security**.
2. Under **Safety Mode**, select **Change** and follow the on-screen instructions.

Enable or disable safety mode using AMS Device Manager and handheld communicator

Procedure

1. Select **Configure** → **Manual Setup** → **Device Setup** → **Security**.

2. Under **Safety Instrumented Systems**, select **Change Safety Mode** and follow the on-screen instructions.

2.4.5 Alarm and saturation levels

DCS or safety logic solver should be configured to handle both High alarm and Low alarm. In addition, the transmitter must be configured for High or Low alarm.

Note

Note that during startup, the Rosemount 5408:SIS always outputs Low alarm current even if the transmitter is configured for High alarm mode.

Analog signal on alarm

The transmitter automatically and continuously performs self-diagnostic routines. If a failure or a measurement error is detected, the analog signal will be driven offscale to alert the user. High or low failure mode is user-configurable.

Table 2-1: Signal on Alarm

Standard	High	Low
Rosemount standard	≥ 21.75 mA (default)	≤ 3.75 mA (option code C8)
NAMUR NE43	≥ 22.50 mA (option code C4)	≤ 3.6 mA (option code C5)

Analog saturation levels

The transmitter will drive the output to high or low saturation values if measurement goes outside the 4-20 mA range values.

Table 2-2: Saturation Levels

Standard	High	Low
Rosemount standard (default and option code C8)	20.8 mA	3.9 mA
NAMUR NE43 (option code C4 and C5)	20.5 mA	3.8 mA

2.5 Site acceptance

After installation and/or configuration, proper operation of the transmitter (including verification of all configuration changes) must be verified. A site acceptance test is therefore recommended. The proof tests can be used for this.

3 Proof tests

3.1 Overview

The Rosemount 5408: SIS must be tested at regular intervals to reveal faults which are undetected by automatic diagnostics. It is the user's responsibility to choose the type of testing and the frequency of these tests.

Results from periodic proof tests shall be recorded and periodically reviewed. If an error is found in the safety functionality, the device shall be put out of operation and the process shall be kept in a safe state by other measures.

Note

For a valid result, always perform the proof test on the product that will be stored in the tank while the device is in operation.

3.1.1 Suggested proof tests

The following proof tests are suggested:

- (A) 1-point level and analog output verification
- (B) 2-point level and analog output verification
- (C) Analog output verification
- (D) Level deviation monitoring
- (E) Smart echo level test

Table 3-1 can be used as a guidance for selecting the appropriate proof test.

Table 3-1: Suggested Proof Tests

Proof test #	Type	Proof test coverage (%) of DU	Remaining dangerous, undetected failures	Test coverage			Can be performed remotely
				Output circuitry	Measurement electronics	Antenna	
A	Comprehensive	74%	21 FIT	Yes	Yes	Yes	Yes ⁽¹⁾
B	Comprehensive	84%	13 FIT	Yes	Yes	Yes	Yes ⁽¹⁾
C	Partial	35%	51 FIT	Yes	No	No	Yes
D	Partial	62%	30 FIT	No	Yes	No	Yes
E	Partial	40%	47 FIT	Yes	Partially	No	Yes

(1) With the assumption that the BPCS level sensor is used as independent measurement.

3.1.2 Proof test interval

The time intervals for proof testing are defined by the SIL verification calculation (subject to the PFD_{AVG}). The SIL verification calculation is an analytical method to calculate an

appropriate proof test interval for the specific safety function based on equipment's reliability and required risk reduction for the specific SIF.

The proof tests must be performed more frequently than or as frequently as specified in the SIL verification calculation, in order to maintain the required safety integrity of the overall SIF.

3.1.3 Tools required

- HART host/communicator or Rosemount Radar Master Plus
- Current meter
- Safety logic solver
- Independent measuring device (e.g. BPCS level sensor, measuring tape)

3.2 1-point level and analog output verification

3.2.1 Perform 1-point level and analog output verification using Rosemount Radar Master Plus

Prerequisites

WARNING

During the proof test, the transmitter will not output measurement values corresponding to the product surface level. Ensure systems and people relying on measurement values from the transmitter are made aware of the changed conditions. Failure to do so could result in death, serious injury and/or property damage.

Procedure

1. Prior to the test, ensure there are no alarms or warnings present in the transmitter.
 - a) Under **Service Tools**, select **Alerts**.
2. Bypass the process safety function and take appropriate action to avoid a false trip.
3. Simulate 4.00 mA output and verify loop current.
 - a) Under **Service Tools**, select **Simulate**.
 - b) Select **Loop Test**.
 - c) Select **4 mA** and then select **Start**.
 - d) Measure loop current (e.g. reading the safety logic solver or using the TEST terminal).

Note

The inaccuracy of safety logic solver or current meter needs to be considered.

- e) Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).
 - f) Select **Stop** to end loop test.
4. Simulate 20.00 mA output and verify loop current.
- a) Under **Service Tools**, select **Simulate**.
 - b) Select **Loop Test**.
 - c) Select **20 mA** and then select **Start**.
 - d) Measure loop current (e.g. reading the safety logic solver or using the TEST terminal).
 - e) Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).

Note

The inaccuracy of safety logic solver or current meter needs to be considered.

- f) Select **Stop** to end loop test.
5. Perform a one-point level measurement verification of the transmitter in the measuring range. Compare with independent measurement (e.g. the BPCS level sensor).
- a) Under **Overview**, select **All Variables**.
 - b) Verify the current level or distance reading with an independent measurement is within the safety deviation of 2%.

Note

The inaccuracy of the independent measurement needs to be considered.

6. Remove the bypass and otherwise restore normal operation.

Related information

Use the TEST terminal

3.2.2 Perform 1-point level and analog output verification using AMS Device Manager and handheld communicator

Prerequisites

▲ WARNING

During the proof test, the transmitter will not output measurement values corresponding to the product surface level. Ensure systems and people relying on measurement values from the transmitter are made aware of the changed conditions. Failure to do so could result in death, serious injury and/or property damage.

Procedure

1. Prior to the test, ensure there are no alarms or warnings present in the transmitter.
 - a) Select **Service Tools** → **Alerts**.
2. Bypass the process safety function and take appropriate action to avoid a false trip.
3. Simulate 4.00 mA output and verify loop current.
 - a) Select **Service Tools** → **Simulate**.
 - b) Under **Analog Out**, select **Loop test**.
 - c) Select **4mA** and then select **Next** (Enter on Field Communicator).
 - d) Measure loop current (e.g. reading the safety logic solver or using the TEST terminal).
 - e) Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).

Note

The inaccuracy of safety logic solver or current meter needs to be considered.

- f) To end loop test, select **Cancel** (ABORT on handheld communicator).
4. Simulate 20.00 mA output and verify loop current.
 - a) Select **Service Tools** → **Simulate**.
 - b) Under **Analog Out**, select **Loop test**.
 - c) Select **20mA** and then select **Next** (Enter on Field Communicator).
 - d) Measure loop current (e.g. reading the safety logic solver or using the TEST terminal).
 - e) Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).

Note

The inaccuracy of safety logic solver or current meter needs to be considered.

- f) To end loop test, select **Cancel** (**ABORT** on handheld communicator).
- 5. Perform a one-point level measurement verification of the transmitter in the measuring range. Compare with independent measurement (e.g. the BPCS level sensor).
 - a) Select **Service Tools** → **Variables** → **Process**.
 - b) Verify the current level or distance reading with an independent measurement is within the safety deviation of 2%.

Note

The inaccuracy of the independent measurement needs to be considered.

- 6. Remove the bypass and otherwise restore normal operation.

Related information

Use the **TEST** terminal

3.3 2-point level and analog output verification

3.3.1 Perform 2-point level and analog output verification using Rosemount Radar Master Plus

Prerequisites

▲ WARNING

During the proof test, the transmitter will not output measurement values corresponding to the product surface level. Ensure systems and people relying on measurement values from the transmitter are made aware of the changed conditions. Failure to do so could result in death, serious injury and/or property damage.

Procedure

- 1. Prior to the test, ensure there are no alarms or warnings present in the transmitter.
 - a) Under **Service Tools**, select **Alerts**.
- 2. Bypass the process safety function and take appropriate action to avoid a false trip.

3. Simulate 4.00 mA output and verify loop current.
 - a) Under **Service Tools**, select **Simulate**.
 - b) Select **Loop Test**.
 - c) Select **4 mA** and then select **Start**.
 - d) Measure loop current (e.g. reading the safety logic solver or using the TEST terminal).
 - e) Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).

Note

The inaccuracy of safety logic solver or current meter needs to be considered.

- f) Select **Stop** to end loop test.
4. Simulate 20.00 mA output and verify loop current.
 - a) Under **Service Tools**, select **Simulate**.
 - b) Select **Loop Test**.
 - c) Select **20 mA** and then select **Start**.
 - d) Measure loop current (e.g. reading the safety logic solver or using the TEST terminal).
 - e) Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).

Note

The inaccuracy of safety logic solver or current meter needs to be considered.

- f) Select **Stop** to end loop test.
5. Perform a two-point level measurement verification of the transmitter in the measuring range. Compare with independent measurement (e.g. the BPCS level sensor).
 - a) Under **Overview**, select **All Variables**.
 - b) Verify the current level or distance reading with an independent measurement is within the safety deviation of 2%.

Note

The inaccuracy of the independent measurement needs to be considered.

- c) Move the surface in the tank at least 10% of the full measuring span (level 0-100%).
 - d) Repeat 5.a and 5.b for the second point.
6. Remove the bypass and otherwise restore normal operation.

Related information

Use the TEST terminal

3.3.2 Perform 2-point level and analog output verification using AMS Device Manager and handheld communicator

Prerequisites

▲ WARNING

During the proof test, the transmitter will not output measurement values corresponding to the product surface level. Ensure systems and people relying on measurement values from the transmitter are made aware of the changed conditions. Failure to do so could result in death, serious injury and/or property damage.

Procedure

1. Prior to the test, ensure there are no alarms or warnings present in the transmitter.
 - a) Select **Service Tools** → **Alerts**.
2. Bypass the process safety function and take appropriate action to avoid a false trip.
3. Simulate 4.00 mA output and verify loop current.
 - a) Select **Service Tools** → **Simulate**.
 - b) Under **Analog Out**, select **Loop test**.
 - c) Select **4mA** and then select **Next** (Enter on Field Communicator).
 - d) Measure loop current (e.g. reading the safety logic solver or using the TEST terminal).
 - e) Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).

Note

The inaccuracy of safety logic solver or current meter needs to be considered.

- f) To end loop test, select **Cancel** (ABORT on handheld communicator).
4. Simulate 20.00 mA output and verify loop current.
 - a) Select **Service Tools** → **Simulate**.
 - b) Under **Analog Out**, select **Loop test**.
 - c) Select **20mA** and then select **Next** (Enter on Field Communicator).
 - d) Measure loop current (e.g. reading the safety logic solver or using the TEST terminal).

- e) Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).

Note

The inaccuracy of safety logic solver or current meter needs to be considered.

- f) To end loop test, select **Cancel** (**ABORT** on handheld communicator).
5. Perform a two-point level measurement verification of the transmitter in the measuring range. Compare with independent measurement (e.g. the BPCS level sensor).
- a) Select **Service Tools** → **Variables** → **Process**.
 - b) Verify the current level or distance reading with an independent measurement is within the safety deviation of 2%.

Note

The inaccuracy of the independent measurement needs to be considered.

- c) Move the surface in the tank at least 10% of the full measuring span (level 0-100%).
 - d) Repeat 5.a and 5.b for the second point.
6. Remove the bypass and otherwise restore normal operation.

Related information

Use the [TEST](#) terminal

3.4 Analog output verification

Compare HART Primary Variable digital value with analog output reading. Verify that the deviation is within the pass limit.

Procedure

1. Obtain the loop current as a digital value, do one of the following:
 - In Rosemount Radar Master Plus, under **Overview**, select **All Variables** and read the current analog output value.
 - Read HART command 2 or 3 via the host system.
Command 2: Analog output current and Percent of range
Command 3: Device variables (PV, SV, TV, and QV) and Analog output current
2. Obtain the loop current as an analog value (e.g. by using the safety logic solver or using the TEST terminal).
3. Compare the current values.
4. Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).

Note

The inaccuracy of safety logic solver needs to be considered.

Related information

[Use the TEST terminal](#)

3.5 Level deviation monitoring

Use the analog output to obtain level (or distance) reading and compare with an independent level measurement. Verify that the deviation is within the pass limit.

Procedure

1. Obtain the level (or distance) measurement value derived from the analog output (e.g. by checking measurement value in safety logic solver).
2. Obtain the level (or distance) measurement value from an independent level measurement (e.g. the BPCS level sensor).
3. Compare the measurements and verify that the deviation is within the safety deviation of 2%.

3.6 Smart echo level test

The function allows you to test the behavior of the transmitter in a real tank environment without raising the level. During the test, a virtual surface echo is inserted into the radar signal, and the transmitter will output a level corresponding to the echo position.

3.6.1 Configure the smart echo level

Prerequisites

Disable the Safety Mode.

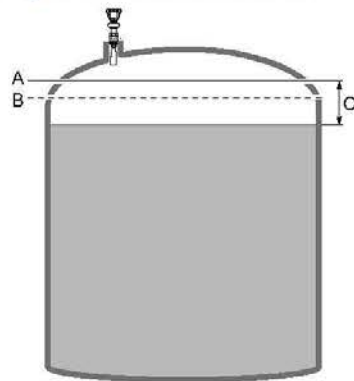
Procedure

1. In Rosemount Radar Master Plus, under **Service Tools**, select **Proof Test**.
2. Select **Configure Smart Echo**.
3. Set the **Smart Echo Level** to a value above the Upper Range Value.

Note

Ensure the product level is at least 1 ft. (30 cm) below the Smart Echo Level.

Figure 3-1: Smart Echo Level



- A. Smart Echo Level
- B. Upper Range Value (100%/20 mA)
- C. Minimum 1 ft. (30 cm)

4. Select **Save**.

Postrequisites

Enable the Safety Mode.

Related information

[Safety mode](#)

3.6.2 Perform a smart echo level test

Simulate a surface echo above the Upper Range Value (i.e. analog out in high saturation) and verify loop current.

Prerequisites

This test is available for transmitters with:

- Device software revision 1.C0 or later
- Option code ET

Prior to and during the test, ensure that:

- The product surface is calm.
- The smart echo level is not closer than 1 ft. (0.3 m) to the liquid surface.
- The tank is not being filled or emptied.

▲ WARNING

During the proof test, the transmitter will not output measurement values corresponding to the product surface level. Ensure systems and people relying on measurement values from the transmitter are made aware of the changed conditions. Failure to do so could result in death, serious injury and/or property damage.

Procedure

1. Ensure there are no alarms or warnings present in the transmitter.
 - a) In Rosemount Radar Master Plus, under **Service Tools**, select **Alerts**.
2. Bypass the process safety function and take appropriate action to avoid a false trip.
3. Perform the Smart Echo Level test.
 - a) Under **Service Tools**, select **Proof Test**.
 - b) Select **Smart Echo Level Test**.
 - c) Select **Start**.
The analog output goes to high saturation.
 - d) Measure loop current (e.g. reading the safety logic solver or using the TEST terminal).
 - e) Verify the current deviation is within the safety deviation of 2% (± 0.32 mA).

Note

The inaccuracy of safety logic solver or current meter needs to be considered.

- f) Select **Stop** to end test mode.
4. Remove the bypass and otherwise restore normal operation.

Related information

Analog saturation levels
Use the TEST terminal

3.7 Use the TEST terminal

Prerequisites

▲ WARNING

Verify that the installation is consistent with the appropriate hazardous locations certifications when the instrument used for loop current measurement is connected.

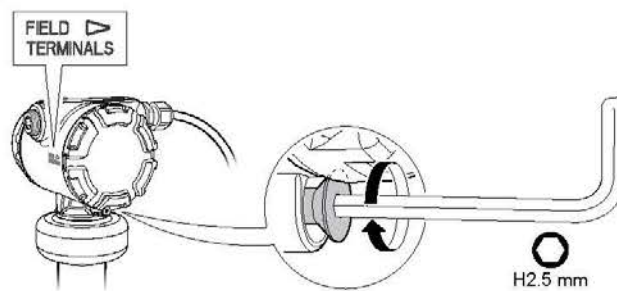
For Explosion-proof/Flameproof and Non-Incendive/Type n installations, the cover must not be opened in an explosive atmosphere.

Note

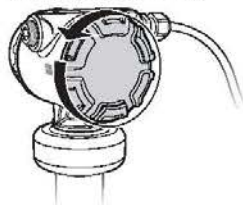
Disconnect the blue plug only during the loop current measurement procedure. To meet the stated EMC specification during normal operation, the blue plug must be plugged in.

Procedure

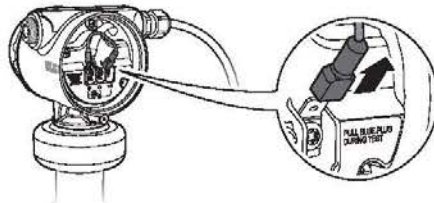
1. Turn the jam screw clockwise until it is completely threaded into the housing.



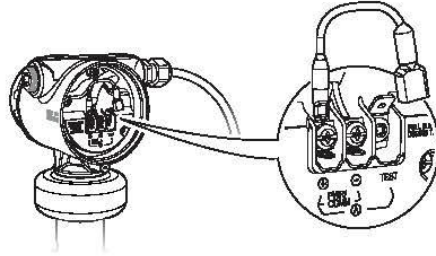
2. Remove the cover.



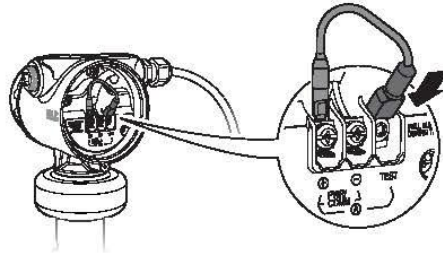
3. Remove the blue plug from the TEST terminal.



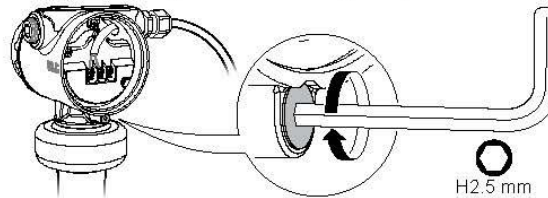
4. Connect the ampere meter leads to the terminals labeled “+” and “TEST”.



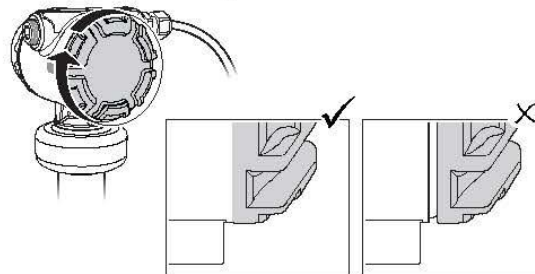
5. Measure the loop current.
6. Attach the blue plug to the TEST terminal.



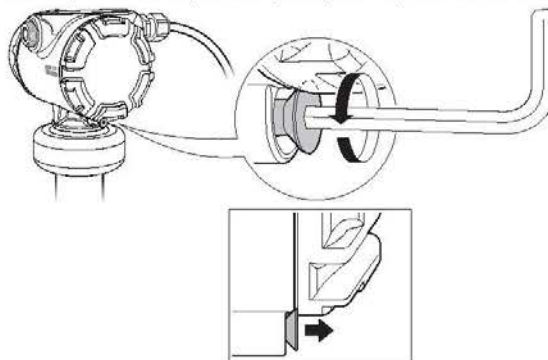
7. Attach and tighten the cover.
a) Verify the cover jam screw is completely threaded into the housing.



- b) Attach and tighten the cover.
⚠ Make sure the cover is fully engaged. There should be no gap between the cover and the housing.



- c) Turn the jam screw counterclockwise until it contacts the cover.
⚠ Required for explosion-proof/flameproof installations only.



- d) Turn the jam screw an additional $\frac{1}{2}$ turn counterclockwise to secure the cover.

4 Operating constraints

4.1 Specifications

The Rosemount 5408:SIS must be operated according to the functional and performance specifications provided in the Rosemount 5408 and Rosemount 5408:SIS [Product Data Sheet](#).

4.1.1 Measuring range

The maximum measuring range is 82 ft. (25 m) for the Rosemount 5408:SIS Level Transmitter in Safety (SIS) mode.

4.1.2 Failure rate data

The [FMEDA report](#) includes failure rate data, assessment details, and assumptions regarding failure rate analysis.

4.1.3 Safety deviation

±2.0% of analog output span

4.1.4 Transmitter response time

- <6 s at damping value 2 s (default)⁽¹⁾
- <2 s at damping value 0 s (minimum)⁽¹⁾

The transmitter response time will be a function of the configured Damping value. Rosemount Radar Master Plus has a built-in function to calculate the transmitter's measurement response time (requires option code EF2).

4.1.5 Diagnostic test interval

<90 min⁽²⁾

4.1.6 Turn-on time

<40 s⁽³⁾

⁽¹⁾ Step response time as per IEC 61298-2.

⁽²⁾ A majority of the self-diagnostic tests are performed once every second and an action (if necessary) is taken in less than 30 seconds (default).

⁽³⁾ Time from when power is applied to the transmitter until performance is within specifications.

4.1.7 Useful lifetime

50 years

- based on worst case component wear-out mechanisms
- not based on wear-out of process wetted materials

4.2 Product repair

The Rosemount 5408:SIS is repairable by major component replacement. All failures detected by the device diagnostics or by the proof test must be reported. Feedback can be submitted electronically at Go.EmersonAutomation.com/Contact-Us (Contact Us).

A Terms and definitions

λ_{DU}	Dangerous Undetected failure rate
λ_{DD}	Dangerous Detected failure rate
λ_{SU}	Safe Undetected failure rate
λ_{SD}	Safe Detected failure rate
Diagnostic test interval	The time from when a dangerous failure/condition occurs until the device has set the safety related output in a safe state (total time required for fault detection and fault reaction).
Element	Term defined by IEC 61508 as "part of a subsystem comprising a single component or any group of components that performs one or more element safety functions"
FIT	Failure In Time per billion hours
FMEDA	Failure Modes, Effects and Diagnostic Analysis
HART® protocol	Highway Addressable Remote Transducer
HFT	Hardware Fault Tolerance
High demand mode	The safety function is only performed on demand, in order to transfer the EUC (Equipment Under Control) into a specified safe state, and where the frequency of demands is greater than one per year (IEC 61508-4).
Low demand mode	The safety function is only performed on demand, in order to transfer the EUC into a specified safe state, and where the frequency of demands is no greater than one per year (IEC 61508-4).
PFD_{AVG}	Average Probability of Failure on Demand
PFH	Probability of dangerous Failure per Hour: the term "probability" is misleading, as IEC 61508 defines a rate.
Proof test coverage factor	The effectiveness of a proof test is described using the coverage factor which specifies the share of detected dangerous undetected failures (λ_{DU}). The coverage factor is an indication of a proof test's effectiveness to detect dangerous undetected faults.
Safety deviation	The maximum allowed deflection of the safety output due to a failure within the device (expressed as a percentage of span). Any failure causing the device output to change less than the Safety Deviation is considered as a "No Effect" failure. All failures causing the device output to change more than the Safety Deviation and with the device output still within the active range (non-alarm state) are considered dangerous failures.

Note

The Safety Deviation is independent of the normal performance specification or any additional application specific measurement error.

SIF	Safety Instrumented Function
SIL	Safety Integrity Level – a discrete level (one out of four) for specifying the safety integrity requirements of the safety instrumented functions to be allocated to the safety instrumented systems. SIL 4 has the highest level of safety integrity, and SIL 1 has the lowest level.
SIS	Safety Instrumented System – an instrumented system used to implement one or more safety instrumented functions. An SIS is composed of any combination of sensors, logic solvers, and final elements.
Systematic capability	A measure (expressed on a scale of SC 1 to SC 4) of the confidence that the systematic safety integrity of an element meets the requirements of the specified SIL, in respect of the specified element safety function, when the element is applied in accordance with the instructions specified in the compliant item safety manual for the element.
Transmitter response time	The time from a step change in the process until transmitter output reaches 90% of its final steady state value (step response time as per IEC 61298-2).
Type B device	Complex device using controllers or programmable logic, as defined by the standard IEC 61508.
Useful lifetime	Reliability engineering term that describes the operational time interval where the failure rate of a device is relatively constant. It is not a term which covers product obsolescence, warranty, or other commercial issues. The useful lifetime is highly dependent on the element itself and its operating conditions (IEC 61508-2).

For more information: www.emerson.com

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ROSEMOUNT™



Proof-testing Rosemount 5408 Level Transmitter

Remote in-situ proof-test for level applications



Smart Echo Level Test

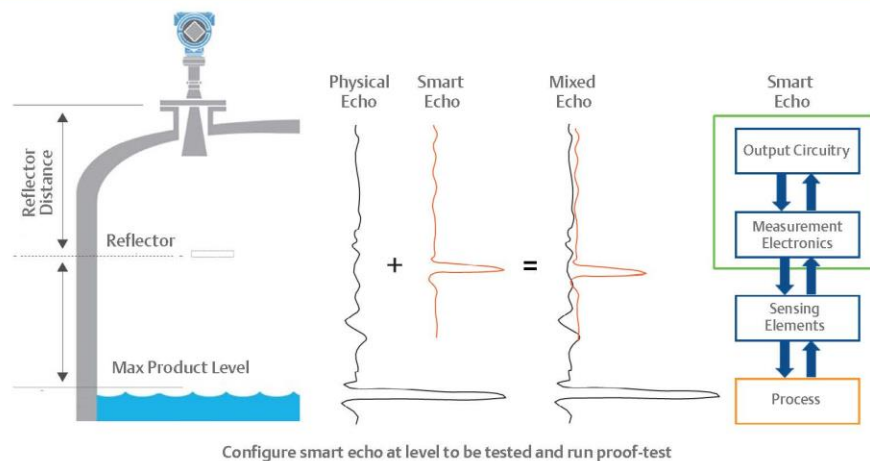
Increase both personnel and process safety by performing high and low level tests in the real tank environment, directly from the control room without the need to raise the actual tank level.

Carrying out a Smart Echo Verification is very easy, simply set a simulated digital echo at a specified level, to test and run proof-tests. The remote, in-situ proof-test works in all installations and for all types of media.



Rosemount™ 5408 Non-contacting Radar SIS Level device with in-situ proof-test capability

Smart Echo Function



Configure smart echo at level to be tested and run proof-test

Smart Echo Verification

- Proof-test ensures correct alarm response
- Level test in a real tank environment
- No need to raise the actual level in the tank
- Works in all installations and for all media
- Use for both high-level and low-level testing

Remote in-situ Proof-test

- Full remote test can be run from control room
- Reduces need for personnel to be in the field
- Available with SIL2 certification

For more information, visit
[Emerson.com/Rosemount5408](https://emerson.com/Rosemount5408)
or contact your local Emerson Sales Representative



Level Applications

Non-contacting continuous level on liquids or solids for monitoring, control or safety

Reactors, Mixers and Blenders	Solid Measurement	Aggressive, Coating or Viscous Media	Safety Applications
			
Challenging applications with varying process conditions, turbulence and high temperatures and pressures.	Unique solids algorithm enables reliable measurement on uneven surfaces with low DC such as solids.	Accurate and reliable level measurement with exotic materials available in tanks with foam, turbulence, condensation and low DC media.	Protection even in turbulent or harsh process conditions and those with rapid level changes. Unique proof testing functionality.

Specifications	
Communication Protocol	Loop-powered 4-20 mA HART®; FOUNDATION™ Fieldbus
Ultra Accuracy	± 0.04 in (±1 mm)
Standard Accuracy	± 0.08 in (±2 mm)
Max Measuring Range	131 ft (40 m)
Min. DC	No minimum
Pressure Rating	1450 psi (100 bar)
Temperature Rating	-76 to +482 °F (-60 to +250 °C)
Power Supply	Loop-powered 4-20 mA HART: 12-42.4 V dc (12-30V dc in Intrinsically Safe installations)
Hazardous Area Approvals	ATEX, IECEx, FM, CSA
Safety Instrumented Systems	IEC 61508 certified to SIL2
Approvals and Certificates	3-A, CRN, WHG, etc.
Antennas	Cone, process seal, parabolic

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Testing the Rosemount™ 5408 Level Transmitter

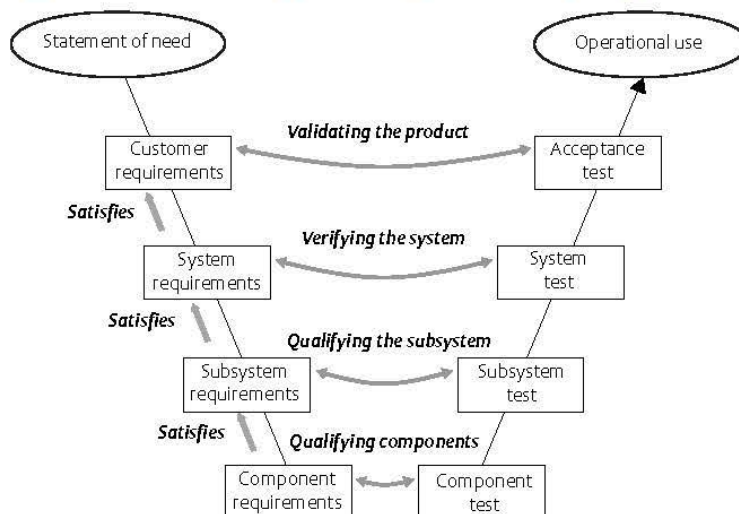
How to know a product will live up to its promises

The non-contacting radar Rosemount 5408 Level Transmitter was developed to meet many challenging expectations and application conditions while being safe, easy to use, and easy to specify. It is built on a power-efficient FMCW (Frequency Modulated Continuous Wave) platform that incorporates the depth of experience gained over five generations of FMCW-based technology. Our customers expect new devices to solve old problems and to be better than previous units. So how can we know that all the challenges are met?

It all goes back to testing. Starting with one little bit at a time, progressing to a subsystem and then the whole product. Lab tests eventually give way to field tests.

While the purpose of this paper is to share some of the final application field testing, it is important to realize that many internal tests are completed before the first field unit is ever shipped. It is a process where the many specifications of the final product are tested at stages where they matter and where changes can be implemented. It gradually grows in complexity from testing component parts to testing a subsystem, such as a board, to testing a system, such as the electronics package, to testing the whole assembled product. It is an iterative process in that if some part fails, a solution is implemented and then re-tested before moving to the next stage.

Figure 1. Product Test Stages Gradually Grow in Complexity



The physical product can be divided into three basic subsystems: wetted parts, electronics, and software. Testing of the whole product can be divided into: performance testing, environmental testing, and usability testing.

Much of the testing can be done in-house (List A: In-house functional and verification testing) while a few tests require an independent lab (List B: External testing). Internal testing allows parameters to be evaluated independently and under controlled conditions.

List A: In-house functional and verification testing

Performance tests

- Accuracy and measurement range
- Low DC
- Pressure and temperature limits
- Power requirements
- Power consumption
- Transient protection
- Vibration
- Startup times at temperature extremes
- Compatibility with Emerson™ host systems (DeltaV™) and a few non-Emerson systems

Measuring performance can be divided into following categories:

- Basic measuring performance in reference condition
- Oil and water applications
- Low DC products (including solids)
- Environmental influence of performance
- Long distance measurements > 30 m

Environmental tests

- Vibration test
- High temperature test
- Corrosion test
- Process temperature de-rating tests
- Process pressure temperature rating
- Pressure regulation tests (per required standards)
- Process temperature impact on microwave performance

Competitive unit comparisons

List B: External testing

- EMC
- HALT (Highly accelerated life testing)
- SIL
- Ingress protection
- Compatibility with non-Emerson host systems

1.0 Usability tests

The main strategy for usability tests are to verify the Reference manual, Quick Start Guide and Safety manual. All configurations shall be made by using Rosemount Radar Master Plus if applicable.

- Installation tests
- Configuration tests
- Ease of use

These lists of tests are a simplification of their complexity. For example, the range and accuracy tests are completed on each type and size of antenna, over the intended range and at the normal, maximum, and minimum temperature limits. Numerous samples are used for each set. Similarly, the tests of the pressure and temperature limits include numerous excursions to both the minimum and maximum extremes of each waveguide and each O-ring with numerous samples. Nitrogen and helium leak tests are included to indicate the maximum possible limits beyond the specification limits.

Many application conditions can be tested individually and in a lab environment. This gives the advantage of isolating single potential application challenges and allows them to be addressed. If testing of these parameters were to be conducted in field testing, then other parameters would potentially influence the results. These include:

- Measurement near bottom
- Influence of polarization orientation
- Near zone measurement
- Measurement in pipes
- Nozzles
- Bridles
- Influence under EMC disturbance
- Mixer
- Interface
- Foam
- Condensation clean/dirty antenna
- Low dielectric constant
- Bracket mounting
- Plastic tank
- Disturbance echo

2.0 Field tests

While there are thousands of possible applications in the industrial world, time and resources do not permit testing of all. Thus, a more practical approach is to identify key parameters that are commonly encountered and to prioritize them. The various field tests of the Rosemount 5408 can be classified into easy, medium, and difficult applications. It is important to thoroughly check key functionality of the device. One function to evaluate is measurement supervision, which is a parallel or supplemental function to the basic level echo analysis. It monitors moving echoes as the level moves past obstacles that could potentially interfere with the actual measurement. Since the unit includes several algorithms to determine its operational performance it is important to evaluate their functionality. These algorithms include how the unit operates near obstacles, near the bottom or top of the tank, during times when signal loss occurs, or when power is lost. All of these evaluations are included in field tests.

Key questions to consider include:

- Is the unit easy to use? Are the pictorial instructions easy to understand? Is the configuration software intuitive?
- Will the Rosemount 5408 electronics work with Rosemount 5402 antennas?
- Does the Rosemount 5408 work better than legacy units?
- Does the Rosemount 5408 work better than competitive units?

Field testing begins when the unit is in an early prototype stage where modifications are expected. These tests often include simpler applications such as storage tanks, sumps, or waste water. Ensuring that the unit physically connects with the customer systems, communication is obtainable, alarms are appropriate, and instructions are easy to follow are all items that can be checked and easily modified during this stage. As the product development evolves, the complexity of the applications increases. An example of this level of testing may include very low dielectric materials such as hydrocarbons, mixing tanks with some small amount of turbulence, longer ranges, and vaporous coating materials such as bitumen.

The last phase of the field testing before production begins includes a more challenging combination of field tests. These would include reactors where turbulence, foam, pressure, and temperature challenges exist, or very long ranges with low dielectric materials, heavy turbulence, vapors, or rapid level changes.

Often, the field tests are done at sites where existing radar units are installed. This allows comparative testing against the legacy products in a field environment and allows the lab tests to be supplemented. In some cases, a different level technology was installed and comparisons were made to that. A summary of the field trials follows here.

3.0 Field test summaries

3.1 Simple but common applications

For a radar unit, an easy application would be a water-based fluid because the dielectric is high and thus the signal reflectivity is high. A Parshall flume and a lime dissolver tank falls into this category.

In the case of the Parshall flume, the range of the unit is short and there is only water to measure although it could be moving rapidly. There could be occasional debris or foam passing beneath the radar. To determine the flow rate through the Parshall flume, the measurement must be within a small accuracy band and responsive to rapid changes. In the test site, the Rosemount 5408 was compared to an existing Rosemount 5402 and performed well.

A slightly more complex but still easy application was found in the lime dissolver tank. In this case, the water contains some acid to help dissolve the lime. The crushed lime particles are suspended in the solution and slowly mixed. The mixing creates a small amount of turbulence, thus adding a slight challenge to the application.

Slightly more difficult, but still considered an easy application was a palm oil tank. The tank was heated to prevent solidification of the oil, which creates some vapors. Like many common fuel oils, palm oil is a low dielectric material (DC 1.8) and the storage vessel was tall –13 m (43 ft.), but the Rosemount 5408 performed as expected.

3.2 A bit more complex

Moving up in complexity are applications that have challenges such as lower dielectric materials, mild turbulence, more internal obstacles, and longer ranges. A field test that met this condition was a paper glue mixing vessel. It was a tall, narrow vessel with some agitation due to mixing. The level was run at a high level and with the agitation, splashing caused the antenna to become coated. The mixing also caused the surface to take on a slight conical shape resulting in an angled surface. The glue was a moderate dielectric material. There were usually some islands of foam present. The challenge here was to track the level during fill and empty cycles without locking on the mixing blades. In this case, performance compared well to the Rosemount 5402 even after the antenna became coated.

An example of a low dielectric material is lube oil. Rather than mixing blades, air is injected into the lube oil creating turbulence. Heating coils are in place for heating. Both items present obstacles that must be managed as the tank fills and empties. The heated lube oil gives off vapors and is moderately turbulent. This application triggered a few premature alarms due to some timing of the echo time-out function. Based on these results, refinements were made to the transmitter firmware to enhance the echo tracking function and to the configuration software to make it more intuitive. With the changes implemented, the unit has performed as it should.

In these earlier tests, there were some cases where the device did not correctly track the level for the whole empty sequence. This allowed some additional refinements to be made for improved tracking when the level nears empty tank conditions. The updates were implemented and verified.

Rapid level changes pose a different sort of challenge. While measuring the level accurately within a few millimeters is not crucial, tracking the target reliably is. An example of this challenge is a wet corn surge bin. In this application, wet corn kernels are deposited in the vessel with a level change rate of about 2 ft./min (0.6 m/min). In this case, the Rosemount 5408 outperformed the previous sonar-based technology and tracked the filling process over the full 26 ft. (8 m) range.

3.3 A new head for an old antenna

Another test challenge was to compare the performance of the Rosemount 5408 to the Rosemount 5402, and to test the ability to use the existing Rosemount 5402 process seal antenna. One example of this test was on a licorice tank. In this case, there are some vapors and there is a mixer blade/scrapper that covers the full diameter of the tank. The Rosemount 5402 with a process seal antenna had been installed previously and it tended to lock on the top of the scraper.

Figure 2. Rosemount 5408 Installed with a Rosemount 5402 Process Seal Antenna



The Rosemount 5408 was installed on the existing process seal antenna. When initially installed, the level surface and the top of the scraper were together. As the level slowly dropped, the Rosemount 5408 initially appeared to lock on the scraper. However, after a few minutes, the level measurement dropped to follow the surface. This was a clear indication that the supervision function had worked. As the level fill and empty cycles continued, the unit tracked the surface movement as if the scraper was not there. The supervision function combined with the configuration software guided set up to register echoes reinforced the ease of use functionality of the Rosemount 5408. Not only did it work well with the Rosemount 5402 process seal antenna, but with its enhanced measurement tracking function, it out-performed the Rosemount 5402.

3.4 A higher level of complexity

A complex application for level measurement devices are reactor vessels. In one test site of a batch reactor, an adhesive product is being produced out of a base material composed of a pine resin with a moderate dielectric of about 6. The vessel is 18 ft. (5.3 m) tall and about 6.5 ft. (2 m) in diameter. Internal objects include multiple tier mixing blades, baffles, heating coils, a ladder, and a nitrogen sparger. The temperature of the reaction is about 554 °F (290 °C) and the pressure ranges from a slight vacuum to a positive pressure. The level application challenges include foam, turbulence, vapors, and changing dielectric as the reaction proceeds.

Figure 3. Internals of a Typical Reactor Vessel

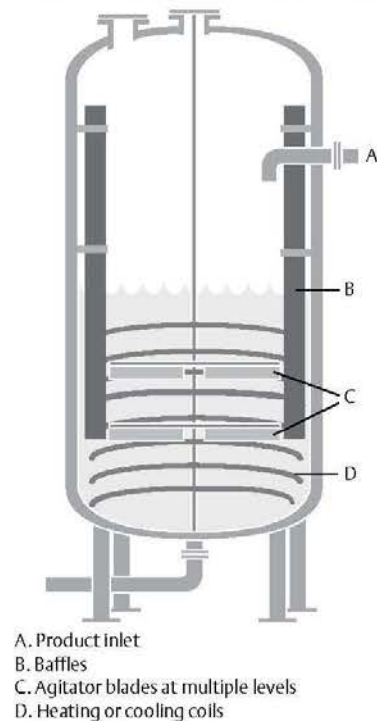


Figure 4. The Internal of the Tested Vessel



An additional challenge in this case was the process connection. Mounting space was very limited. In this case, there is a 2-in. nozzle that is mounted on a flange shared with tank equipment. The previous radar was a traditional 10 GHz unit with a 6-in. antenna that had to be mounted from the inside of the tank with an extension going up into the 2-in. nozzle. For the Rosemount 5408 test, a 2-in. extended cone antenna was mounted directly onto the 2-in. nozzle from the outside of the tank, see [Figure 5](#). The extension was long enough to get past any possible disturbances in the top area of the nozzle.

Figure 5. Rosemount 5408 Mounted on a Flange Intended for Tank Equipment



Figure 6 shows the 6-in. antenna with special extension which was mounted from within the vessel.

Figure 6. Previous 6-in. Antenna with Special Extension



The end of the 2-in. antenna of the Rosemount 5408 is shown in Figure 7. An extended antenna was later added to get the end of antenna past the manhole area.

Figure 7. The End of the 2-in Rosemount 5408 Antenna



The older, traditional 10 GHz unit had been installed for more than 10 years, but with marginal results. At one stage of the reaction where there was heavy turbulence it had difficulties tracking the level. The legacy unit would sometimes stop tracking the level for long periods of time and would be in alarm. In addition, when the reactor was empty, the radar still indicated it was half full. Initial results of the trial Rosemount 5408 showed it tracking for longer periods of time and in alarm much less often. It tracked as the tank emptied and stayed there. It's easy to see why the customer was much happier with the performance of the Rosemount 5408. However, the engineering team saw room for improvement and worked to refine the signal processing of the unit so that it would track the surface consistently. With the final modifications, the Rosemount 5408 now out-performs the previous unit and is providing accurate and reliable results throughout the process.

Another style reactor offers a different challenge. A cyclone reactor is a continuous reactor where fluid is injected from the side and is propelled across the reactor while circulated. With the combination of the injected fluid and the mixer, the surface takes on a whirlpool effect and has a slope estimated to be about 20 to 30 degrees from horizontal. In this case, it is essential that the level is accurate and consistent as fluids into and out of the reactor are based on the level measurement. The process runs under a partial vacuum of about -7 psi or -500 mbars. The most recent measurement used is a pressure-based bubbler system. The challenge for the bubbler system was that it is dependent on a stable system vacuum as well as clean tubing for a good measurement. Five to ten years ago, a competitive radar had been tried but did not work.

The Rosemount 5408 was installed. The operator installed and configured the unit using pictorial instructions and the Rosemount Radar Master Plus guided setup. The unit tracked the surface as the vessel filled and as the process started up. It could maintain the level reading as the surface changed. The customer is now able to use the Rosemount 5408 measurement for their level control.

3.5 Heating things up

The Rosemount 5408 has a high temperature waveguide option. While the internal tests proved that the waveguide could handle the specified temperatures, it can be good to verify that capability in a field site while verifying its measurement performance. An application to meet this test is a sulfur pit in a refinery. Sulfur pits contain molten sulfur and are often maintained at temperatures up to 302 °F (150 °C). In the cooler areas of the pit, condensation can occur to the point where there can be heavy layers of sulfur on the surface. The Rosemount 5408 with a PEEK waveguide cone antenna and Kalrez® O-rings was installed on a short insulated nozzle above the pit. The antenna extended slightly out of the nozzle. This nozzle arrangement stayed hot which helped to minimize build up on the antenna. The unit tracked the level and performed well. However, over a six-month time span, the pit caught fire four times. Each time, the Rosemount 5408 failed due to high temperature at the electronics. Once the fire was controlled and the process returned to normal but before the operators had time to tend to the level measurement, it was noted that the unit was tracking again on the DCS screen. The unit had recovered itself and was operating normally. It was removed for inspection and while there was a charred appearance to the antenna, it was clean enough to function.

3.6 Location, location, location

Plastic tanks are common in the process industry today. They can be simple cost-effective storage tanks for aggressive chemicals or mixing and reaction tanks for smaller batches. Using radar for level measurement is an attractive option since it can be mounted completely outside of the vessel or by using an all-PTFE process seal antenna that eliminates the contact of any metal parts with the process fluid.

In a plastic tank test site, a Rosemount 5402 with a PTFE process seal antenna was installed. The tank has a flat roof with a re-enforced area across the top with a plastic mounting nozzle. There is a small agitator near the bottom of the tank. The tank has a cone-shaped bottom and it was desired to have the level tracked in the cone area. In the application, the water-based fluid was mixed with reactants and an exothermic reaction occurred. This resulted in a lot of condensation on the bottom of the tank roof.

Several mounting variations were tried during the test. This included the plastic mounting nozzle with a PTFE process seal antenna. Other test options included a standard cone antenna at two different locations on the roof, measuring through the plastic roof. The key difference between these two locations was that one had a slight slope to it and the other was located at a very flat portion of the roof.

The Rosemount 5402 had been mounted on the plastic flange and used the PTFE process seal antenna. This position gave the best view of the surface and allowed the level to be tracked. An advantage of the process seal is its cone shape, which allows condensation to drip off its surface. The Rosemount 5402 had tracked level as the tank filled and emptied.

For comparison purposes both Rosemount 5402 and Rosemount 5408 units were installed in each location. With the Rosemount 5402, only the nozzle location yielded good tracking as the tank filled and emptied. The other locations gave very poor results with unreliable tracking.

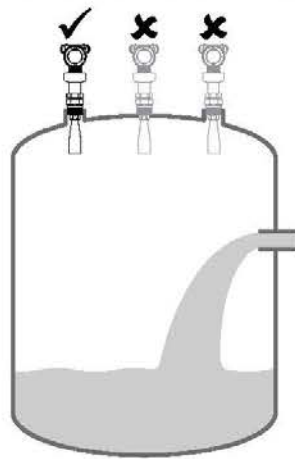
When the Rosemount 5408 was used, results varied considerably with location. The location with the slope had much less condensation and allowed the unit to track the level, but it did not allow it to track level into the cone. The plastic nozzle location offered the best results, and reliable tracking throughout the fill and empty cycle. It maintained a stronger signal throughout the cycle. The location at a very flat portion of the roof had considerable condensation on the bottom of the roof, which created a double bounce. Interestingly though, this unit started to track the correct level once the surface began to move. The supervision function took over when the surface began to move.

Conclusion: install the unit where it can see the surface throughout the whole cycle. The Rosemount 5408 can be used either with a process seal antenna installed in a flange connection or outside the roof installed with a standard cone antenna with a bracket.

When finding an appropriate location on the tank for the transmitter, the conditions of the tank must be carefully considered. Consider the following guidelines when mounting the transmitter:

- For optimal performance, the transmitter should be installed in locations with a clear and unobstructed view of the product surface.
- The transmitter should be mounted with as few internal structures as possible within the signal beam.
- Do not install the transmitter in the center of the tank.
- Do not mount close to or above the inlet stream.

Figure 8. Recommended Mounting Position



3.7 And what about foam?

Foam is a constant source of questions for the radar user. Light foam over a highly reflective material surface may be manageable by many units. As the foam becomes more dense or thick, it becomes more difficult to handle. In the worst case, the foam can absorb the signal and very little is reflected to the transmitter. The other consideration is whether the signal is reflected from the top of the foam or the liquid surface. It can be difficult to know. Often though, the foam will sufficiently attenuate the signal such that very little signal remains for tracking purposes. In these cases, the key is to have a strong enough signal so there is sufficient margin to provide an echo for tracking. In the field testing discussed here, foam has played a part in some of the tests but most notably the batch reactor where it appears during certain stages and the Rosemount 5408 could track during its presence.

One other field test, chosen because of the constant presence of a foam layer, offered another opportunity. In this case, the application was in a filter backwater pit in a refinery. The water was dirty and had a constant, thick layer of foam. The Rosemount 5402 provided marginal results and would occasionally lose the signal. The Rosemount 5408 with its much higher signal amplitude could track the surface reliably despite the constant layer of foam.

3.8 Summary

The Rosemount 5408 has had excellent field test results. It is easy for a user to install with the pictorial guidelines and configuration software is intuitive for the newer user. With results and feedback from the field tests, improvement in both the transmitter software and configuration software were identified and implemented. Its measurement supervision function can ensure that the unit finds and tracks the correct target with minimal user intervention. It can be reliably used with Rosemount 5402 antennas and it out-performs both the 2-wire pulse units and the traditional 4-wire FMCW units.

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ROSEMOUNT™





Part V

Equipment Registration for the
5408 and 5408:SIS Radar Gauges
And associated components
to the
Florida Department of Environmental Protection
from
Rosemount Tank Gauging - North America

Submitted by

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Attachment VIII

Reference Manual

(Only the first 40 pages of the 216-page document included in this Attachment – Copy attached to submittal to FDEP)

Rosemount™ 5408 and 5408:SIS Level Transmitters

Non-Contacting Radar with HART® Protocol



HART 
COMMUNICATION PROTOCOL

ROSEMOUNT™


EMERSON.

Safety messages

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

For technical assistance, contacts are listed below:

Customer Central

Technical support, quoting, and order-related questions.

- United States - 1-800-999-9307 (7:00 am to 7:00 pm CST)
- Asia Pacific- 65 777 8211

North American Response Center

Equipment service needs.

- 1-800-654-7768 (24 hours a day — includes Canada)
- Outside of these areas, contact your local Emerson representative.

▲ WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

Ensure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

For installations in hazardous locations, the transmitter must be installed according to the Rosemount 5408 [Product Certifications](#) document and System Control Drawing.

▲ WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, do not remove the transmitter covers when power is applied to the unit.

Both transmitter covers must be fully engaged to meet Explosion-proof/Flameproof requirements.

▲ WARNING

Electrical shock could cause death or serious injury.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure that the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

⚠ WARNING

Any substitution of non-recognized parts may jeopardize safety. Repair (e.g. substitution of components) may also jeopardize safety and is not allowed under any circumstances.

Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety. Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson. Any continued use of product that has been damaged or modified without the written authorization is at the customer's sole risk and expense.

⚠ WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental in protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Rosemount Sales Representative.

⚠ CAUTION

Hot surfaces

The flange and process seal may be hot at high process temperatures. Allow to cool before servicing.



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1 Introduction

1.1 Using this manual

The sections in this manual provide information on installing, operating, and maintaining the Rosemount™ 5408 and 5408:SIS Level Transmitters – Non-Contacting Radar.

The sections are organized as follows:

[Transmitter overview](#) provides an introduction to theory of operation, a description of the transmitter, information on typical applications, and process characteristics.

[Mechanical installation](#) contains mechanical installation instructions.

[Electrical installation](#) contains electrical installation instructions.

[Configuration](#) provides instructions on configuration of the transmitter.

[Operation](#) contains operation and maintenance techniques.

[Service and troubleshooting](#) provides troubleshooting techniques for the most common operating problems.

[Specifications and reference data](#) supplies reference and specification data, as well as ordering information for spare parts and accessories.

[Configuration parameters](#) provides extended information about the configuration parameters.

1.2 NAMUR NE 53 revision history

The Rosemount 5408 meets the NAMUR recommendation NE 53. [Table 1-1](#) provides the information necessary to ensure you have the correct device driver for your device.

Table 1-1: Identification and Compatibility According to NAMUR NE 53

Release date	Device identification			FDI, DD, and DTM identification		Release note
	NAMUR hardware revision ⁽¹⁾	NAMUR software revision ⁽¹⁾	Device software revision ⁽²⁾	HART [®] universal revision ⁽³⁾	Device revision ⁽⁴⁾	
March-17	1.0.xx	1.0.xx	1.Axx	6	1	Initial release
				7	1	
May-19	1.1.xx	1.1.xx	1.Axx	6	1	Updated design of the cone antenna (PEEK seal) and new device software to support the change
				7	1	
September-21	1.1.xx	1.1.xx	1.Cxx	6	1	Added Smart Echo Level Test functionality
				7	1	

- (1) NAMUR Revision is located on the transmitter label. Differences in level 3 changes, signified above by xx, represent minor product changes as defined per NE53. Compatibility and functionality are preserved and product can be used interchangeably.
- (2) Device software revision is located on the transmitter label, e.g. 1.A3. It can also be found in Rosemount Radar Master Plus (select **Overview** → **Device Information** → **Revisions**).
- (3) HART Revision 6 and 7 can be switched in field. Default HART universal revision from factory is located on the transmitter head label, e.g. PROTOCOL 6.
- (4) Device revision is located on the transmitter label, e.g. DEVICE REV 1.

Related information

[Confirm correct device driver](#)

1.3 Product certifications

See the Rosemount 5408 [Product Certifications](#) document for detailed information on the existing approvals and certifications.

1.4 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislation or regulations.

2 Transmitter overview

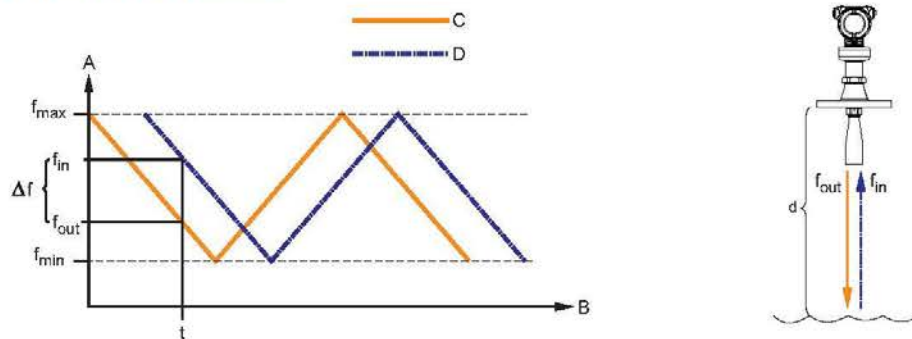
2.1 Measurement principle

The Rosemount 5408 is a two-wire transmitter for continuous level measurements using fast-sweep Frequency Modulated Continuous Wave (FMCW) technology.

The transmitter continuously emits signal sweeps with a constantly varying frequency towards the product surface. Since the transmitter continuously changes the frequency of the transmitted signal, there will be a difference in frequency between the transmitted and the reflected signals (see Figure 2-1).

The frequency of the reflected signal is subtracted from the frequency of the signal transmitted at that moment, resulting in a low frequency signal which is proportional to the distance to the product surface. This signal is further processed to obtain fast, reliable, and highly accurate level measurements.

Figure 2-1: FMCW-method



$\Delta f \sim d = \text{distance}$

- A. Frequency (GHz)
- B. Time (s)
- C. Transmitted signal
- D. Reflected signal

2.2 Process characteristics

2.2.1 Dielectric constant

A key parameter for measurement performance is reflectivity. A high dielectric constant of the media provides better reflection and enables a longer measuring range.

2.2.2 Foam and turbulence

Foaming liquids or turbulence may cause weak and varying surface echo amplitudes. The effects of turbulence are usually minor, but in the most challenging conditions, the

transmitter may be mounted in a still pipe. In addition, measurement performance can be optimized by configuring the appropriate process conditions settings.

Measurement in foamy applications depends largely on the foam properties. When the foam is light and airy, the actual product level is measured. For heavy and dense foam, the transmitter may measure the level of the foam's upper surface.

The Double Surface Handling function allows the user to select if the foam layer or product surface should be used as output.

Related information

[Process conditions](#)

[Double surface handling](#)

2.2.3 Dust

Dust is often present in solids applications, and even if the non-contacting radar is not affected by the dust in the vapor space, dust can be sticky and create a layer on the antenna. If this layer becomes too thick, it may affect the measurement. This is best managed by using air purging.

2.2.4 Solid surface

Solids have some common characteristics which may cause weak and varying surface reflections. The surface is rarely flat or horizontal, the angle of the sloping surface differs during filling and emptying, and the dielectric constant of many solids is fairly low. [Table 2-1](#) presents common characteristics of some solids applications.

The parabolic antenna is ideal for applications with weak surface reflections. A larger diameter concentrates the radar beam and ensures maximum antenna gain. The parabolic antenna comes with a swivel connection that adjusts for angled tank roofs.

Table 2-1: Common Characteristics of Solids Applications

Applications	Common characteristics				
	Particle size			Vapor space	
	Dust or powder	Small (<1 in.)	Larger (>1 in.)	Dust	Steam or condensation
Wood chip bins	Yes	Yes	Yes	Yes	Possible
Grain silo - small kernel grains	Yes	Yes	No	Yes	No
Grain silo - large kernel grains	No	Yes	No	No	No
Lime stone silo	No	Yes	Yes	Possible	No
Cement - raw mill silo	Yes	Yes	No	Yes	No
Cement - finished product silo	Yes	Yes	No	Yes	No
Coal bin	Yes	Yes	Yes	Yes	Yes
Saw dust	Yes	Yes	No	Yes	No
High consistency - pulp stock	No	No	No	No	Yes
Alumina	Yes	Yes	No	Yes	No
Salt	No	Yes	Yes	No	No

2.3 Vessel characteristics

2.3.1 In-tank obstructions

The transmitter should be mounted so that objects such as heating coils, ladders, and agitators are not in the radar signal path. These objects may cause false echoes resulting in reduced measurement performance. However, the transmitter has built-in functions designed to reduce the influence from disturbing objects where such objects cannot be totally avoided.

Vertical and inclined structures cause minimal effect since the radar signal is scattered rather than directed back to the antenna.

2.3.2 Tank shape

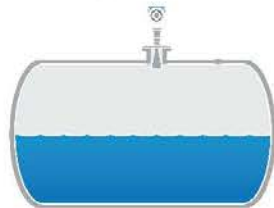
The shape of the tank bottom affects the measurement signal when the product surface is close to the tank bottom. The transmitter has built-in functions which optimize measurement performance for various bottom shapes.

2.4 Application examples

The Rosemount 5408 and 5408:SIS are ideal for level measurements over a broad range of liquid and solids applications. The transmitters are virtually unaffected by changing density, temperature, pressure, media dielectric, pH, and viscosity. Non-contacting radar level is ideal for harsh conditions such as corrosive and sticky media, or when internal tank obstructions are a limiting factor.

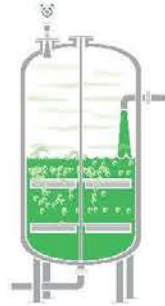
Storage and buffer tanks

The Rosemount 5408 provides accurate and reliable level measurement for both metallic or non-metallic vessels containing almost any liquid (e.g. oil, gas condensate, water, chemicals).



Reactors

The Rosemount 5408 is ideal for the most challenging applications, including reactors where there can be agitation, foaming, and condensation, as well as high temperatures and pressures.



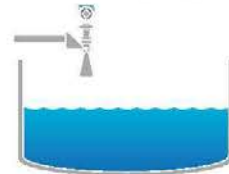
Blenders and mixers

The Rosemount 5408 can help you withstand the rigors of blenders and mixing tanks. Easy to install and commission, it is also unaffected by virtually any fluid property change.



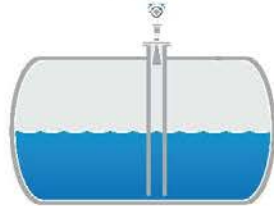
Open atmospheric applications

The Rosemount 5408 measures reliably in open applications, from short range sumps or ponds to long range dams.



Still pipe and chamber installations

The Rosemount 5408 is a great choice for level measurement in tanks with small diameter still pipes. It may also be used in chambers, but guided wave radar is generally the best fit for these applications.



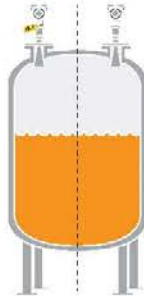
Bulk solids

The Rosemount 5408 is the ideal solution for small- to medium-sized silos with rapid level changes. The narrow beam avoids internal obstructions while still keeping good level measurement.



Safety applications

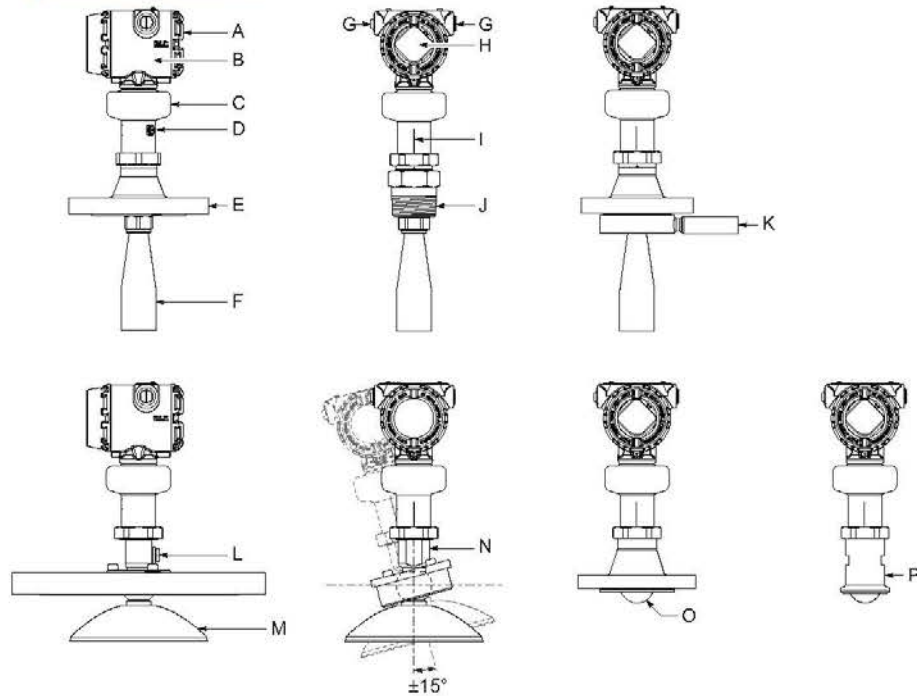
The Rosemount 5408:SIS is the ideal choice for safety functions such as overfill prevention, level deviation monitoring or dry-run prevention.



2.5 Components of the transmitter

Figure 2-2 shows the different components of the transmitter. There are different antenna types and sizes available for various applications.

Figure 2-2: Components



- A. Terminal compartment
- B. Transmitter housing (aluminum or stainless steel)
- C. Sensor module with signal processing electronics
- D. External ground screw
- E. Flanged process connection
- F. Cone antenna
- G. Two cable/conduit entries (½-14 NPT, M20 x 1.5, or G½); Optional adapters: eurofast™ and minifast™
- H. LCD display (optional)
- I. Alignment marker (one per side)
- J. Threaded process connection (NPT or BSPP (G))
- K. Air purge ring (option code PC1 for cone antenna)
- L. Integrated air purge connection
- M. Parabolic antenna
- N. Parabolic antenna with swivel mount
- O. Process seal antenna
- P. Tri Clamp process connection

2.6 System integration

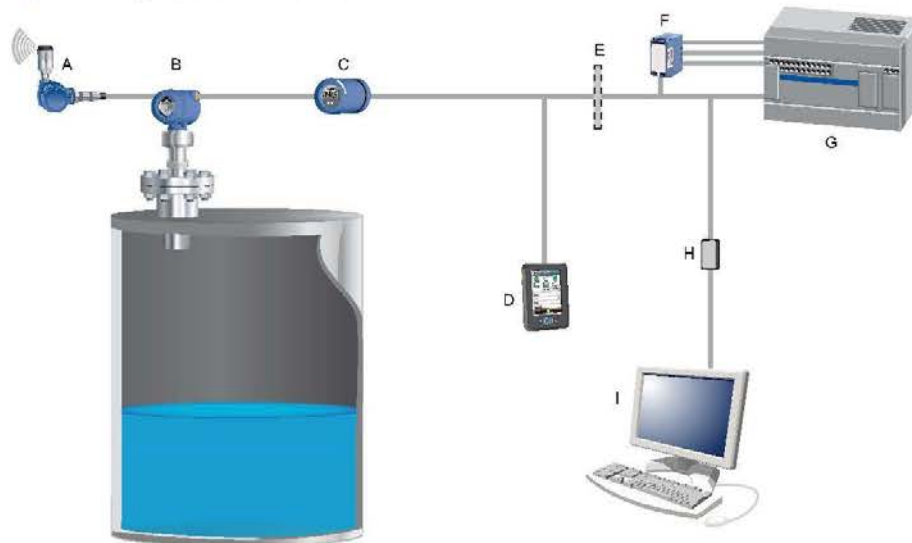
The transmitter is loop-powered, and uses the same two wires for power supply and output signal. The output is a 4-20 mA analog signal superimposed with a digital HART® signal. The transmitter can be configured for either HART Revision 6 or 7. The HART Revision can be switched in field.

By using the optional Rosemount 333 HART Tri-Loop™, the digital HART signal can be converted into three additional 4-20 mA analog signals.

With the HART protocol, multidrop configuration is possible. In this case, communication is restricted to digital, since current is fixed to the 4 mA minimum value.

The transmitter can be combined with the Emerson Wireless 775 THUM™ Adapter to wirelessly communicate HART data with IEC 62591 (*WirelessHART®*) technology. In addition, the transmitter can be connected to a Rosemount 751 Field Signal Indicator, or it can be equipped with an integral display.

Figure 2-3: System Architecture



- A. Emerson Wireless 775 THUM Adapter
- B. Rosemount 5408
- C. Rosemount 751
- D. Handheld communicator
- E. Approved IS barrier (for Intrinsically Safe installations only)
- F. Rosemount 333
- G. Host/DCS system
- H. HART modem
- I. PC with Rosemount Radar Master Plus

The Rosemount 5408 is compliant with NAMUR NE 107 Field Diagnostics for standardized device diagnostic information.

3 Mechanical installation

3.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

Ensure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

For installations in hazardous locations, the transmitter must be installed according to the Rosemount 5408 [Product Certifications](#) document and System Control Drawing.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure that the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

⚠ WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

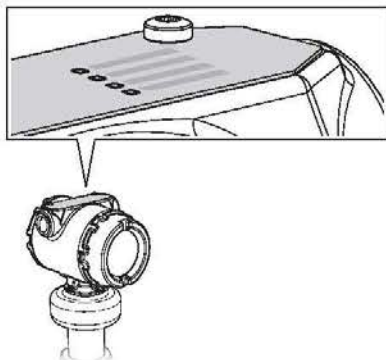
3.2 Confirm approval type

For hazardous locations transmitters labeled with multiple approval types:

Procedure

Permanently mark the checkbox of the selected approval type.

Figure 3-1: Label with Multiple Approval Types



3.3 Installation considerations

Before installing the transmitter, follow recommendations for mounting position, sufficient free space, nozzle requirements, etc.

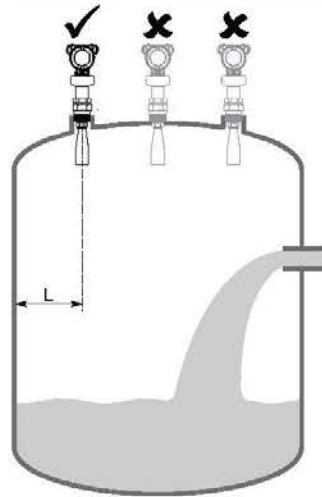
3.3.1 Mounting position

When finding an appropriate location on the tank for the transmitter, the conditions of the tank must be carefully considered.

Consider the following guidelines when mounting the transmitter:

- For optimal performance, the transmitter should be installed in locations with a clear and unobstructed view of the product surface.
- The transmitter should be mounted with as few internal structures as possible within the signal beam.
- Do not install the transmitter in the center of the tank.
- Do not mount close to or above the inlet stream.
- Multiple Rosemount 5408 transmitters can be used in the same tank without interfering with each other.

Figure 3-2: Recommended Mounting Position



3.3.2

Free space requirements

If the transmitter is mounted close to a wall or other tank obstruction such as heating coils and ladders, noise might appear in the measurement signal. See [Table 3-1](#) for recommended clearance.

For easy access to the transmitter, mount it with sufficient service space (see [Table 3-2](#)).

Figure 3-3: Free Space Requirements

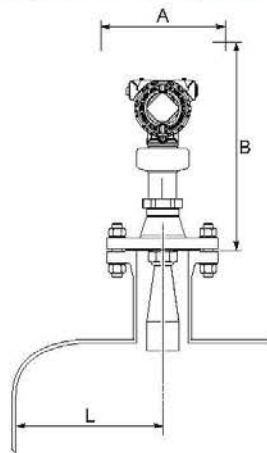


Table 3-1: Distance to Tank Wall (L)

Application	Minimum	Recommended
Liquids	8 in. (200 mm)	$\frac{1}{2}$ of tank radius
Solids	8 in. (200 mm)	$\frac{2}{3}$ of tank radius

Table 3-2: Free Space Requirements

Description	Distance
Service space width (A)	20 in. (500 mm)
Service space height (B)	24 in. (600 mm)

3.3.3 Antenna size

Choose as large antenna diameter as possible. A larger antenna diameter concentrates the radar beam and ensures maximum antenna gain. Increased antenna gain permits greater margin for weak surface echoes.

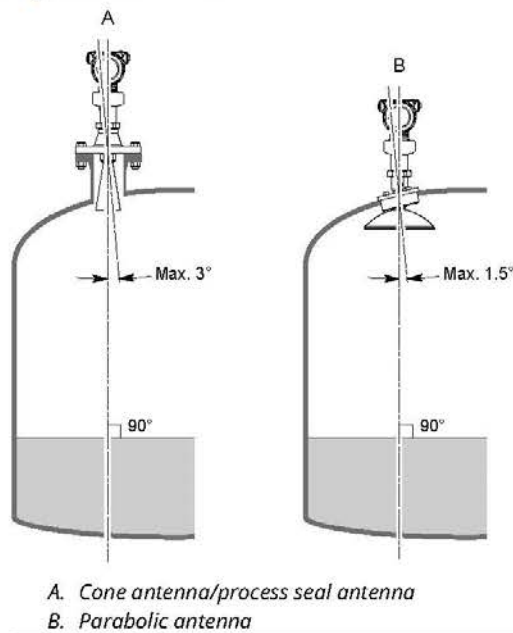
In addition, a larger antenna diameter results in a smaller beam angle and thereby, less interference from any internal structures in the tank.

3.3.4 Antenna inclination

Ensure the antenna is aligned perpendicular to the product surface (see Figure 3-4). The parabolic antenna comes with a swivel connection that adjusts for angled tank roofs.

Note that if the surface echo is weak in solids applications, then a small inclination of the parabolic antenna toward the surface slope may improve the performance.

Figure 3-4: Inclination



3.3.5 Non-metallic tanks

Nearby objects outside the tank may cause disturbing radar echoes. Wherever possible, the transmitter should be positioned so that objects close to the tank are kept outside the signal beam.

3.3.6 Beam width and beam angle

The transmitter should be mounted with as few internal structures as possible within the signal beam. Refer to [Table 3-3](#) for beam angle and [Table 3-4](#) for beam width at different distances.

Figure 3-5: Beam Angle and Beam Width

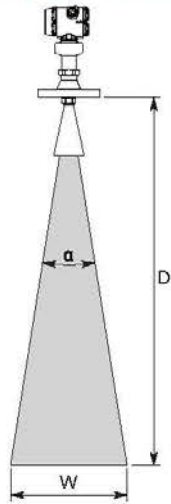


Table 3-3: Beam Angle

Antenna size	Beam angle (α)
1½-in. (DN 40) cone	22°
2-in. (DN50) cone/process seal	18°
3-in. (DN80) cone/process seal	14°
4-in. (DN100) cone/process seal	10°
8-in. (DN200) parabolic	4.5°

Table 3-4: Beam Width, ft. (m)

Distance (D)	Beam width (W)				
	1½-in. cone	2-in. cone/ process seal	3-in. cone/ process seal	4-in. cone/ process seal	Parabolic
16 (5)	6.2 (1.9)	5.2 (1.6)	4.0 (1.2)	2.9 (0.9)	1.3 (0.4)
33 (10)	12.8 (3.9)	10.4 (3.2)	8.1 (2.5)	5.7 (1.8)	2.6 (0.8)
49 (15)	19.0 (5.8)	15.6 (4.8)	12.1 (3.7)	8.6 (2.6)	3.9 (1.2)
66 (20)	25.6 (7.8)	20.8 (6.3)	16.1 (4.9)	11.5 (3.5)	5.2 (1.6)
82 (25)	31.8 (9.7)	26.0 (7.9)	20.1 (6.1)	14.3 (4.4)	6.4 (2.0)
98 (30)	38.4 (11.7)	31.2 (9.5)	24.2 (7.4)	17.2 (5.3)	7.7 (2.4)
131 (40)	51.2 (15.6)	41.6 (12.7)	32.2 (9.8)	23.0 (7.0)	10.3 (3.1)
197 (60)	N/A	N/A	N/A	34.5 (10.5)	15.4 (4.7)
262 (80)	N/A	N/A	N/A	45.9 (14.0)	20.7 (6.3)
328 (100)	N/A	N/A	N/A	57.4 (17.5)	25.9 (7.9)
492 (150)	N/A	N/A	N/A	86.0 (26.2)	38.7 (11.8)

3.3.7

Nozzle requirements

To allow the microwaves to propagate undisturbed, the nozzle dimensions should be kept within the specified limits as given in [Table 3-5](#), [Table 3-6](#), and [Table 3-7](#).

Nozzle requirements for cone antenna

For best performance, the cone antenna should extend at least 0.4 in. (10 mm) below the nozzle. If required, use the extended cone antenna versions (option code S1 or S2).

However, the antenna can be recessed in smooth nozzles up to 4 ft. (1.2 m). Note that if the inside of the nozzle has irregularities (e.g. due to bad welding, rust, or deposit), then use the extend cone antenna.

Figure 3-6: Mounting of the Cone Antenna

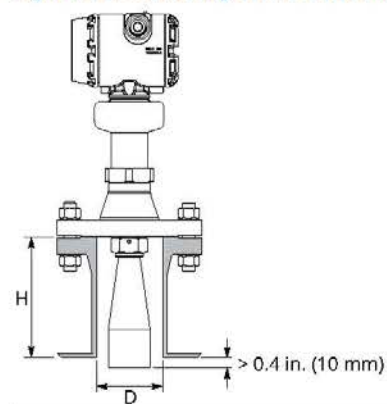


Table 3-5: Nozzle Requirements for Cone Antenna, in Inches (Millimeters)

Antenna size	Minimum nozzle diameter (D) ⁽¹⁾	Recommended maximum nozzle height (H) ⁽²⁾⁽³⁾	
		Antenna	Antenna with air purge ring (code PC1)
1½-in. (DN 40)	1.50 (38.1)	5.59 (142)	N/A
2-in. (DN50)	1.94 (49.3)	5.71 (145)	4.69 (119)
3-in. (DN80)	2.80 (71.0)	5.63 (143)	4.61 (117)
4-in. (DN100)	3.78 (96.0)	6.54 (166)	5.51 (140)

- (1) The antennas are sized to fit within schedule 80 or lower schedules.
(2) The values are valid for cone antennas without antenna extension.
(3) For liquid applications, the cone antenna can be recessed in smooth nozzles up to 4 ft. (1.2 m), but note that the accuracy may be reduced in the region close to the nozzle.

Nozzle requirements for process seal antenna

The antenna can be used on nozzles up to 4 ft. (1.2 m). Disturbing objects inside the nozzle may impact the measurement, and should therefore be avoided.

Figure 3-7: Mounting of the Process Seal Antenna

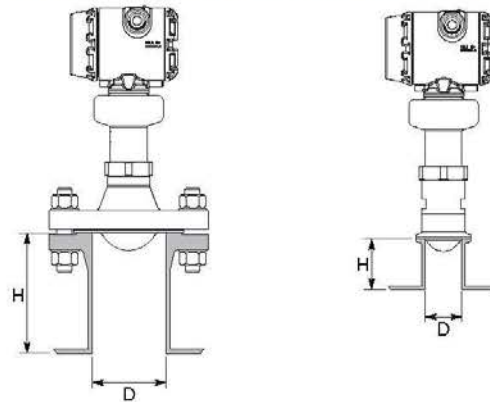


Table 3-6: Nozzle Requirements for Process Seal Antenna

Antenna size	Minimum nozzle diameter (D) ⁽¹⁾	Recommended maximum nozzle height (H) ⁽²⁾
2-in. (DN50)	1.77 in. (45 mm)	4 ft. (1.2 m)
3-in. (DN80)	2.76 in. (70 mm)	4 ft. (1.2 m)
4-in. (DN100)	2.76 in. (70 mm)	4 ft. (1.2 m)

- (1) The antennas are sized to fit within schedule 120 or lower schedules.
(2) For hygienic applications, the nozzle height (H) must not exceed two times the nozzle diameter (D) to ensure cleanability. Maximum nozzle height is 5 in. (127 mm).

Nozzle requirements for parabolic antenna

See Table 3-7 for nozzle height recommendations at different inclination angle.

Figure 3-8: Mounting of the Parabolic Antenna

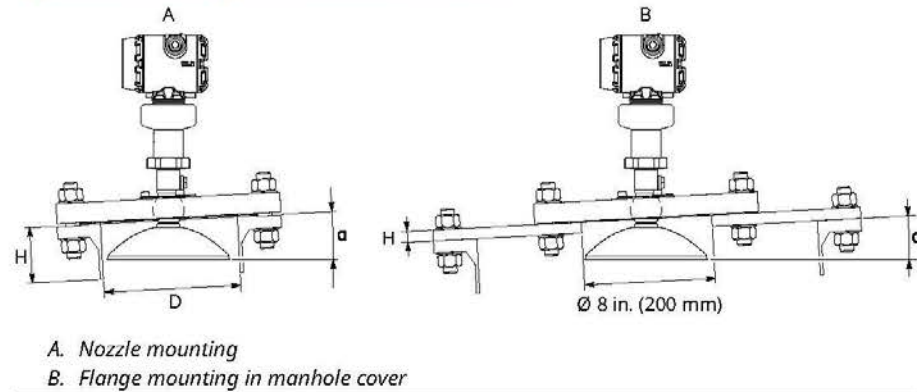


Table 3-7: Nozzle Requirements for Parabolic Antenna, in Inches (Millimeters)

Nozzle size (D)	Inclination angle (α)	Maximum nozzle height (H) ⁽¹⁾
Pipe schedule std, Ø 8 in. (200 mm)	0°	6.1 (155)
	3°	3.4 (85)
	6°	1.6 (40)
	9°	1.2 (30)
	12°	1.0 (25)
	15°	0.6 (15)
Pipe schedule std, Ø10 in. (250 mm)	0°	17.2 (440)
	3°	10.2 (260)
	6°	7.1 (180)
	9°	5.1 (130)
	12°	3.9 (100)
	15°	3.0 (75)

(1) Note that the inside of the nozzle must be smooth (i.e. avoid bad welding, rust, or deposit).

3.3.8 Still pipe/chamber installations

Installation in still pipe/chamber is recommended for tanks where there are excessive foaming or turbulence. Still pipe/chamber may also be used to avoid disturbing objects in the tank.

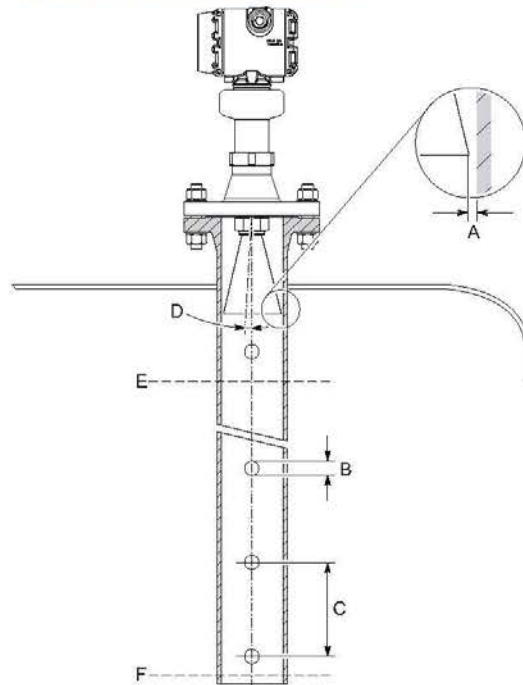
Still pipe

Consider the following still pipe requirements:

- Pipe**
 - Pipes should be an all-metal material.
 - Pipe should have a constant inside diameter.

- The inner surface must be smooth and clear of any rough edges. (Smooth pipe joints are acceptable, but may reduce accuracy.)
 - The end of the pipe must extend beyond the zero level.
- Holes**
- Maximum hole diameter is 1 in. (25 mm).
 - Minimum distance between holes is 6 in. (150 mm).
 - Holes should be drilled on one side only and deburred.
 - Drill one hole above maximum product surface.
- Antenna**
- All cone/process seal antenna sizes can be used for still pipe/chamber installations.
 - The gap between the cone antenna and the still pipe should be maximum 0.2 in. (5 mm)⁽¹⁾. Larger gaps may result in inaccuracies. If required, order a larger antenna and cut on location.

Figure 3-9: Still Pipe Requirements



- A. Maximum 0.2 in. (5 mm)
- B. Maximum 1 in. (25 mm)
- C. Minimum 6 in. (150 mm)
- D. Maximum 1°
- E. Level = 100%
- F. Level = 0%

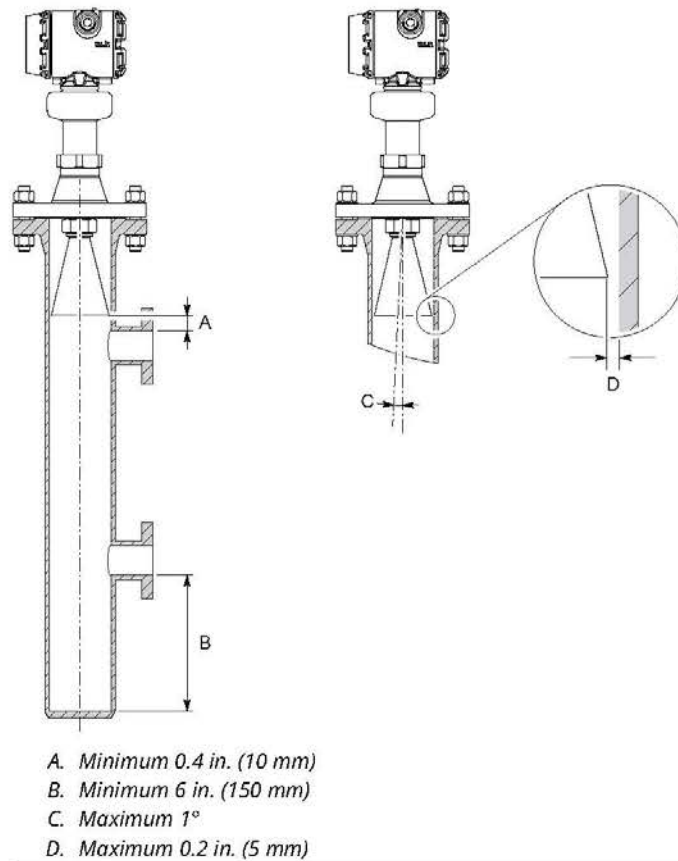
(1) A larger gap is inevitable for the 4-in. cone antenna in pipes with a diameter larger than 4 in.

Chamber

Consider the following chamber requirements:

- Pipes should be an all-metal material.
- Pipe should have a constant inside diameter.
- Inlet pipes should not protrude into the inside of the stand pipe.
- The inner surface must be smooth and clear of any rough edges. (Smooth pipe joints are acceptable, but may reduce accuracy.)
- The gap between the cone antenna and the stand pipe should be maximum 0.2 in. (5 mm)⁽¹⁾. Larger gaps may result in inaccuracies. If required, order a larger antenna and cut on location.

Figure 3-10: Chamber Requirements



Related information

[Best Practices for Using Radar in Still Pipes and Chambers Technical Note](#)

3.3.9 Ball valve installation

The transmitter can be isolated from the process by using a valve:

- Use a full-port ball valve.
- Ensure there is no edge between the ball valve and the nozzle or still pipe, the inside should be smooth.
- Valves can be combined with still pipes.
- The ball valve should have the same inner diameter as the still pipe.

3.3.10 Shipboard installations

Transmitters with aluminum housing are not approved for open deck installations; for use only in engine room, pump room, etc.

For application conditions and limitations refer to the applicable shipboard approval.

3.4 Mounting preparations

3.4.1 Assemble the segmented cone antenna

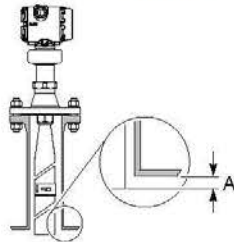
Prerequisites

This section applies to the segmented cone antenna (option code S2). Use only one segment; the total antenna length should not exceed 47.2 in. (1200 mm).

Procedure

1. Determine the antenna length.

Figure 3-11: Installation Recommendation

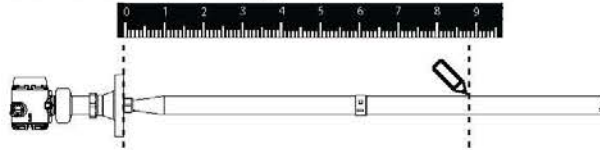


A. Min. 0.4 in. (10 mm)

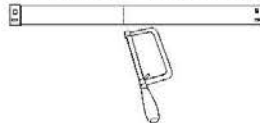
2. Insert the segment into the cone antenna until it bottoms.



3. Mark where to cut the segment.



4. Remove and cut the segment at the marking.



5. Remove any burrs.

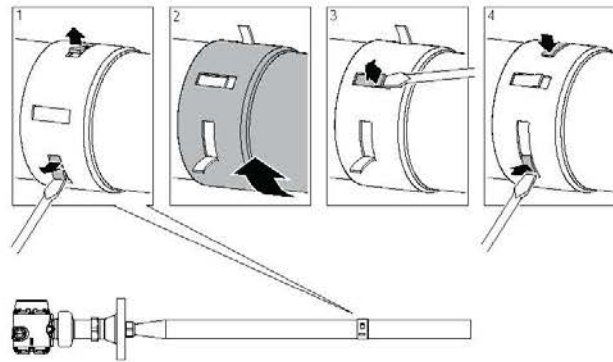
6. Insert the segment into the cone antenna until it bottoms.



7. Secure the segment to the antenna.

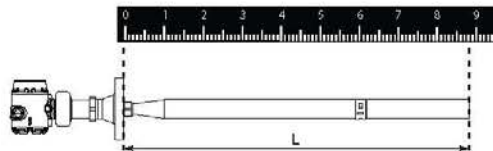
Note

Be careful of sharp edges. Wear protective gloves!



8. Measure the Antenna Extension Length (L).

Antenna Extension Length (L):



9. Update the transmitter configuration to the new Antenna Extension Length (L).
Select **Configure** → **(Manual Setup)** → **Level Setup** → **Antenna**.

3.4.2 Shorten the extended cone antenna

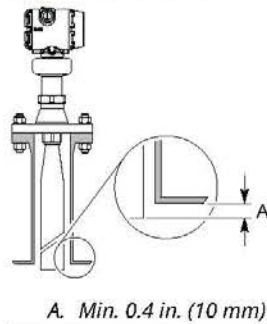
Prerequisites

This section only applies to the extended cone antenna (option code S1).

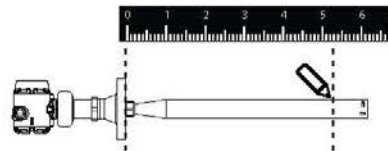
Procedure

1. Determine the antenna length.

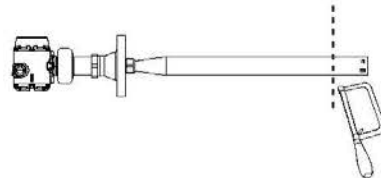
Figure 3-12: Installation Recommendation



2. Mark where to cut the antenna.

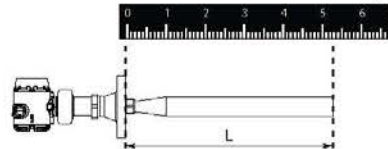


3. Cut the antenna at the marking.



4. Remove any burrs.

5. Measure the Antenna Extension Length (L).



6. Update the transmitter configuration to the new Antenna Extension Length (L).
Select **Configure** → **(Manual Setup)** → **Level Setup** → **Antenna**.

3.4.3 Replace the transmitter head nut

When mounting on a legacy Rosemount 5402 antenna, the transmitter head nut must be changed from size M50 to M52.

Prerequisites

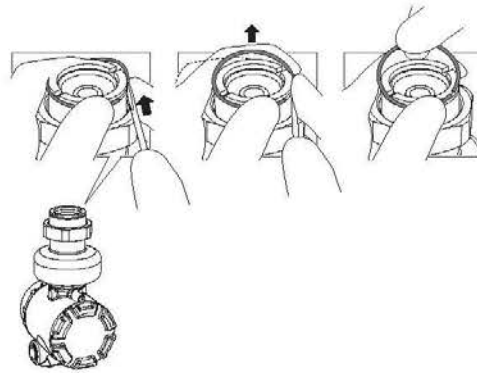
Applies only to transmitters ordered with the option code A1.

Procedure

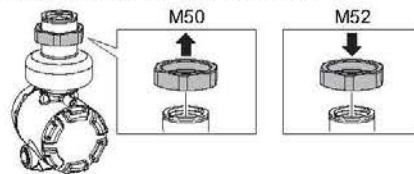
1. Remove the stop ring using a flat head screwdriver.

Tip

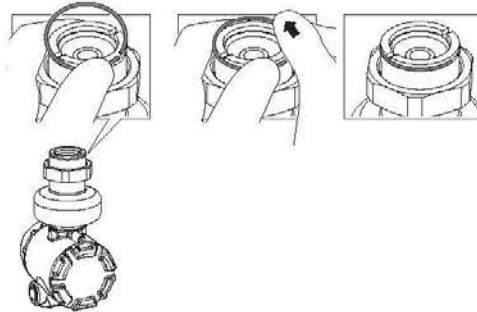
Wear gloves to increase grip when using the tool!



2. Replace the transmitter head nut.



3. Mount the stop ring.
Use the new stop ring supplied with the kit.



Postrequisites

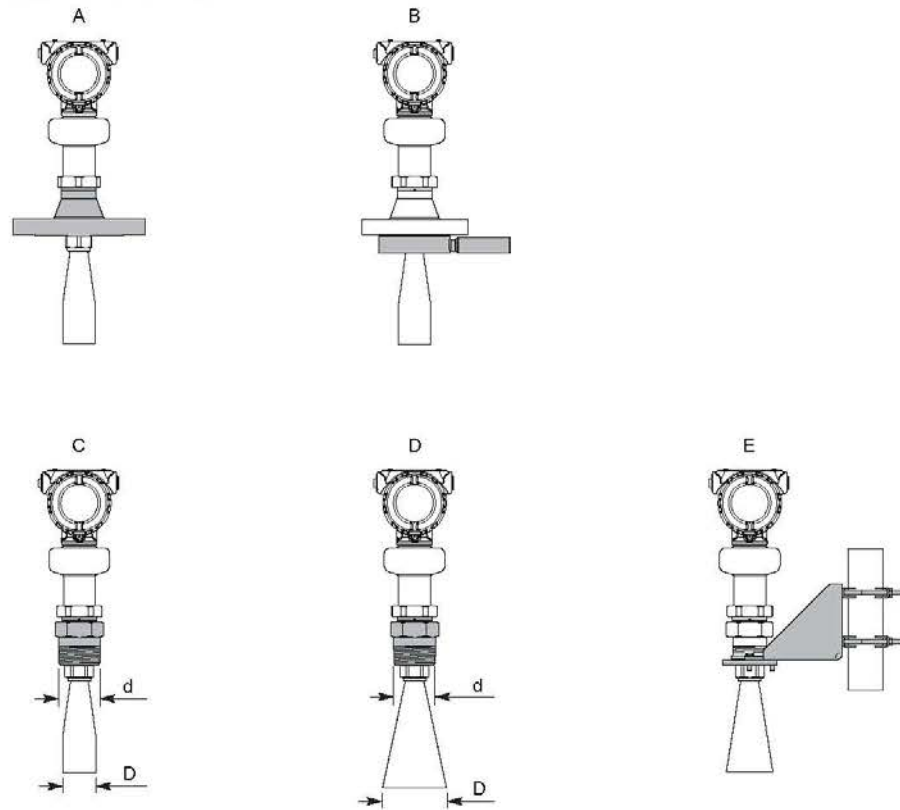
Ensure to set the Antenna Type to Legacy (Rosemount 5402), and then set the User Defined Antenna Options parameters.

Related information
[User defined antenna options](#)

3.5 Mount the cone antenna

3.5.1 Overview

Figure 3-13: Overview

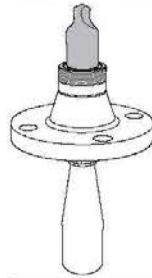


- A. Flanged version (see [page 32](#))
- B. Flanged version with air purge ring (see [page 33](#))
- C. Threaded version, $D < d$ (see [page 35](#))
- D. Threaded version, $D > d$ (see [page 37](#))
- E. Bracket mounting (see [page 40](#))

3.5.2 Protective cap

For spare antennas, keep the protective cap in place until installing the transmitter head. The cap protects the process seal from dust and water.

Figure 3-14: Protective Cap



3.5.3 Flanged version

Prerequisites

If applicable, assemble the segmented cone antenna.

Procedure

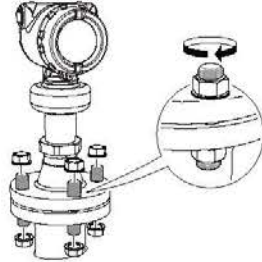
1. Place a suitable gasket on the tank flange.



2. Lower transmitter with antenna and flange into the nozzle.



3. Tighten bolts and nuts with sufficient torque for the flange and gasket choice.



Postrequisites

Align the transmitter head.

Related Information

[Assemble the segmented cone antenna](#)

[Align transmitter head](#)

3.5.4

Flanged version with air purge ring (option code PC1)

Prerequisites

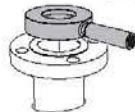
If applicable, assemble the segmented cone antenna.

Procedure

1. Place a suitable gasket on the tank flange.



2. Place the purge ring over the gasket.



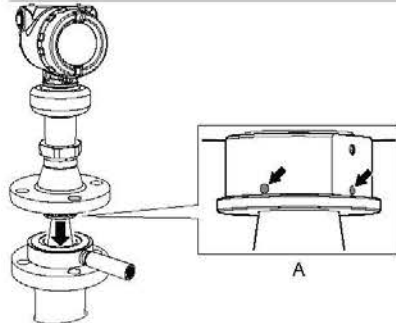
3. Place a suitable gasket over the purge ring.

Note

A minimum gasket thickness of 0.125 in. (3.2 mm) is required for flanges with protective plate design.

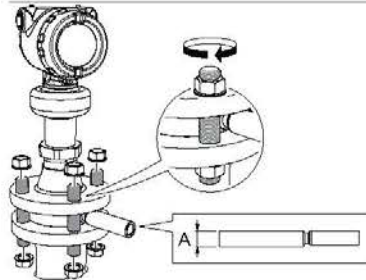


4. Lower transmitter with antenna and flange into the nozzle.



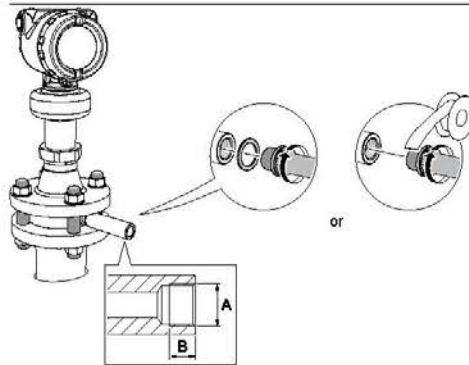
A. Antenna with air purge holes

5. Tighten bolts and nuts with sufficient torque for the flange and gasket choice.



A. 1.0 in. (25.5 mm)

6. Connect the air purging system. Use thread sealant or suitable gasket according to your site procedures.



A. 6 3/8-in.

B. 0.4 in. (10 mm)

Postrequisites

Align the transmitter head.

Related information

Assemble the segmented cone antenna
Align transmitter head
Incoming air supply specification

3.5.5 Threaded version, antenna diameter smaller than thread diameter

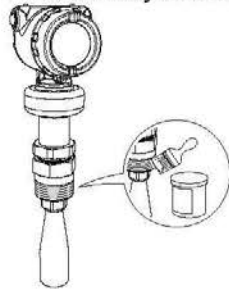
Threaded tank connection

Prerequisites

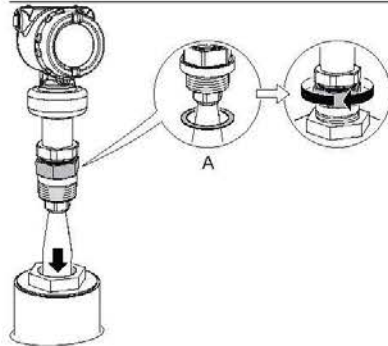
If applicable, assemble the segmented cone antenna.

Procedure

1. Apply anti-seize paste or PTFE tape on threads according to your site procedures.
⚠ Gasket may be used as a sealant for adapters with 1½- or 2-in. BSPP (G) threads.



2. Mount the transmitter on the tank.



A. Gasket (for 1½-in. and 2-in. BSPP (G) threads only)

Postrequisites

Align the transmitter head.

Related information

Assemble the segmented cone antenna
Align transmitter head

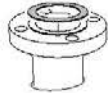
Flanged tank connection

Prerequisites

If applicable, assemble the segmented cone antenna.

Procedure

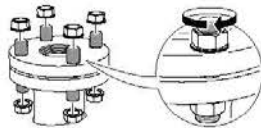
1. Place a suitable gasket on the tank flange.



2. Place the customer supplied flange over the gasket.

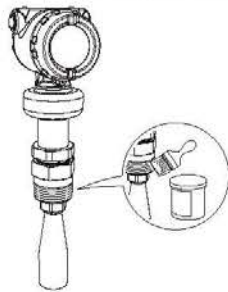


3. Tighten the bolts and nuts with sufficient torque for the flange and gasket choice.

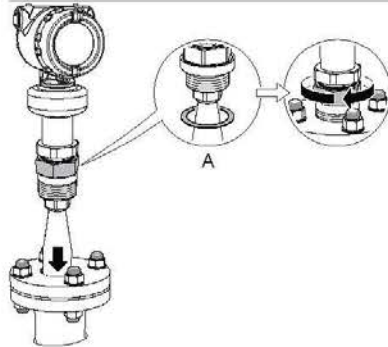


4. Apply anti-seize paste or PTFE tape on threads according to your site procedures.

⚠ Gasket may be used as a sealant for adapters with 1½- or 2-in. BSPP (G) threads.



5. Lower transmitter with antenna into the nozzle.



A. Gasket (for 1½-in. and 2-in. BSPP (G) threads only)

Postrequisites

Align the transmitter head.

Related information

[Assemble the segmented cone antenna](#)

[Align transmitter head](#)

3.5.6

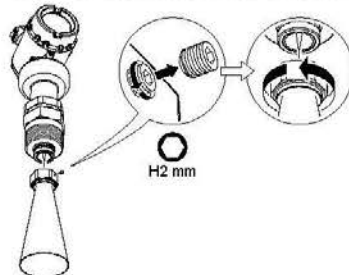
Threaded version, antenna diameter larger than thread diameter

Prerequisites

If applicable, assemble the segmented cone antenna.

Procedure

1. Unscrew and remove the antenna.

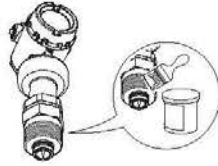


Note

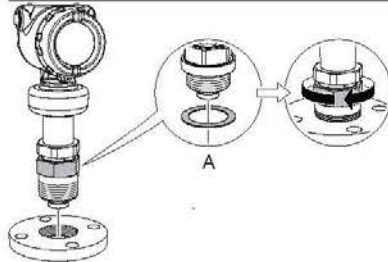
Be careful not to scratch the microwave launcher. The microwave launcher is sensitive to mechanical impacts.



2. Apply anti-seize paste or PTFE tape on threads according to your site procedures.
⚠ Gasket may be used as a sealant for adapters with 1½- or 2-in. BSPP (G) threads.



3. Mount the adapter on the customer supplied flange.

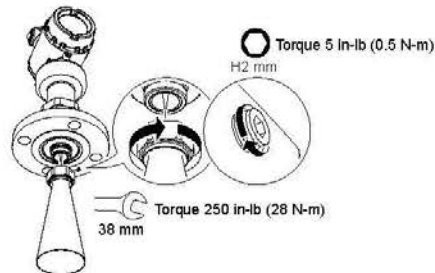


A. Gasket (for 1½-in. and 2-in. BSPP (G) threads only)

4. Mount the antenna.

Note

Visually inspect the microwave launcher for damage and dirt.



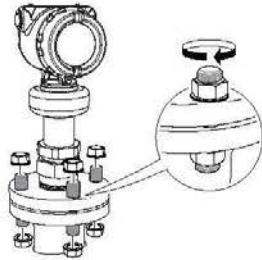
5. Place a suitable gasket on the tank flange.



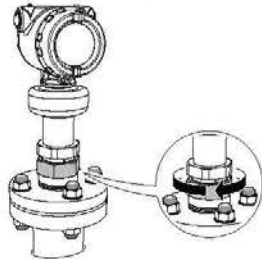
6. Lower transmitter with antenna and flange into the nozzle.



7. Tighten the bolts and nuts with sufficient torque for the flange and gasket choice.



8. Screw the adapter until it is properly tightened.



Postrequisites

Align the transmitter head.

Related information

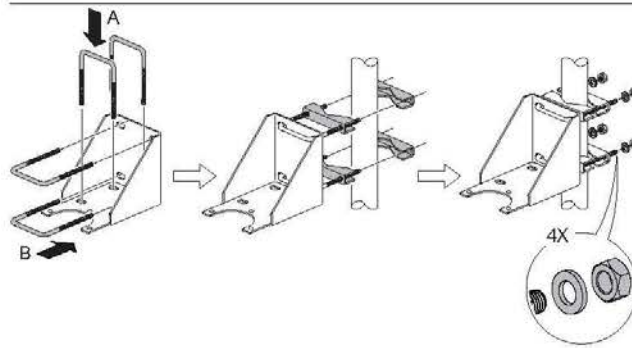
[Assemble the segmented cone antenna](#)

[Align transmitter head](#)

3.5.7 Mount the bracket

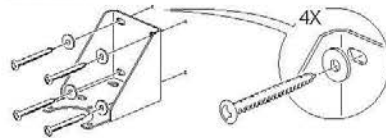
Procedure

1. Mount the bracket to the pipe/wall.
On pipe:

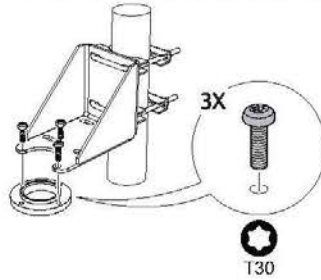


- A. Horizontal pipe
B. Vertical pipe

On wall:



2. Mount the holder to the bracket.



For more information: [Emerson.com](https://www.emerson.com)

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ROSEMOUNT™



Attachment IX

Preventative Maintenance

Rosemount Tank Gauging Preventive Maintenance

No Preventive Maintenance is necessary on Rosemount Tank Gauges; therefore, no instructions or procedures are available/necessary. This is valid for the 5900 and 5408 series. Unlike other gauging equipment, this Radar-based system has no moving parts that would require check-ups, and there are no parts in the system that require re-calibration. The radar electronics work in a temperature-controlled explosion-proof enclosure to ensure a reliable and stable operation.

The statement above refers to equipment maintenance only and does not include applications where preventive maintenance is or could be required in and around the tank itself. Viscous applications like Sulphur and Bitumen (asphalt) are such examples that may require the radar antenna to be cleaned. Typical cleaning cycles are every 12 months or more, depending on the application.

Rosemount Tank Gauging has extensive built-in diagnostic functions. The units have extensive self-test and reference testing made with each measurement to provide a failsafe unit that cannot drift or give false readings.

The radar software is continuously monitoring internal warnings and error flags. If any fault is detected due to a lost measuring signal, software, or hardware fault, the gauge will go into error mode and generate an alarm.

The simple nature of Rosemount Tank Gauge is that it either works correctly with correct approved values or you get an error indication. The software logic is designed to work in process tanks where mixers, heating coils, baffles, vapor, etc., may generate strong disturbing echoes.

Some companies do elect to have preventive maintenance to all their instrumentations and verify the calibration of the gauges on schedule. This varies from plant to plant, yearly, quarterly, or monthly depending on the operation and policies of the site.

Rosemount Tank Gauging System preventative maintenance activities:

Radar Level Gauge & 2410 Tank Hub

- Visual inspection of the installation
- Gauge status check
- Verify and record serial and UI numbers

2240 Temperature Transmitter & MST (Multi-spot temperature sensors)

- Visual inspection of the installation
- Verification of temperature spot readings (if issues are found during gauge status check)

2230 & RDU Local display

- Visual inspection of the installation

**Rosemount Tank
Gauging, N.A.**

Rosemount Tank Gauging, N.A.
6005 Rogerdale Road
Mail Stop NC 136
Houston, TX. 77072
USA

Email
service.rtq.hou@emerson.com

Website
<http://www.rosemount-tq.com>



Rosemount Tank Gauging Preventive Maintenance

- Verification of local readout and communication with gauge

2640 System Hub & FCU Communication Unit

- Visual inspection of the installation
- Verification of configuration and communication
- Inspection of electrical cable connections inside the unit.
- Record serial and UI numbers

TankMaster

- Verify that the system fulfills the minimum TankMaster hardware requirements
- Check of the PC status and available storage space
- Visual status and review of Tank and Inventory data
- Status check of Servers and communication
- Backup of TankMaster system
- Upgrade of TankMaster software to the latest version
- Upgrade of TankMaster WinSetup on service PCs to the latest version

Spare parts

- Inventory of customer onsite spare parts
- Recommendation of changes to quantities based on used parts

Attachment X

Sales Brochure

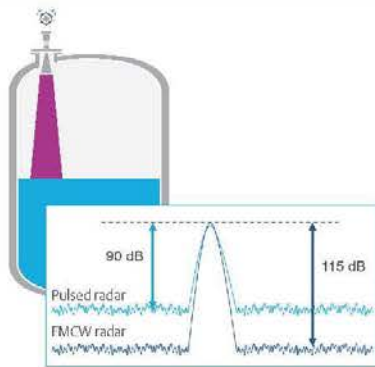
Rosemount™ 5408 Level Transmitter

Next Generation Non-Contacting Radar, Engineered For Ease-Of-Use

Over **40** years of
inventing and redefining radar
level measurement and we
have now taken a giant leap.
The **Rosemount 5408**.
The **best** there is.



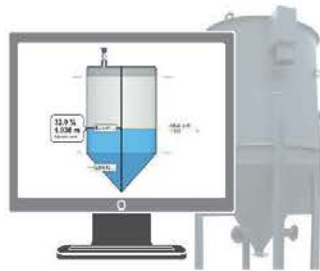
Technology to Redefine Reliability



- FMCW technology provides significantly better signal-to-noise ratio than traditional 2-wire non-contacting radars
 - Better margins provide benefits for all applications - no matter how simple or challenging
- Energy efficient unique radar chip with only 12 Volt lift off
- Immune to intermittent power losses

FMCW technology transmits a continuous signal to maximize surface echo strength and produce a more robust and reliable measurement

Ease-of-Use at Every Touch Point



- Intuitive setup with dynamic and informative graphics to aid inexperienced users
- Pictorial user instructions when you need them, where you need them
- Unique design to eliminate O-ring material selection

Human centered design results in a device that is easy to select, install, and operate for anyone

Dedicated to Safety

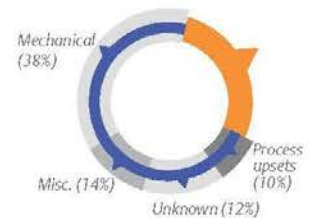


- Early alerts for antenna build-up, weak power supply, or abnormal surface conditions
- Seven days of stored data enables analysis of measurements, alerts and echo profiles
- Remote proof-testing with transmitter in process, without interrupting tank levels

Safety certified (SIL 2) to safeguard your operations with proof-test intervals guaranteed to suit your schedule



Causes of plant incidents



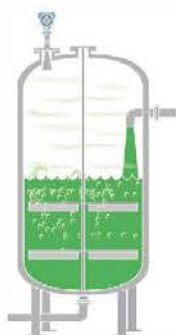
26% Operator error

The Chemical Manufacturers' Association released a report that attributed 26% of incidents to operator error.



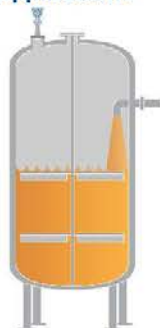
Non-contacting continuous level on liquids or solids for monitoring, control or safety

Reactors, mixers and blenders



Challenging applications with varying process conditions, turbulence and high temperatures and pressures.

Hygienic applications



Process seal antenna with tri-clamp connection are perfect to use in hygienic applications.

Solid Measurement



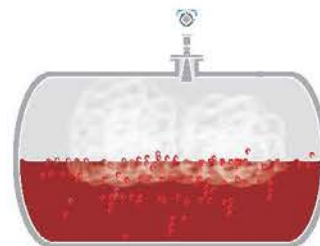
Unique solids algorithm enable reliable measurement on uneven surfaces with low DC such as solids.

Still pipe installations



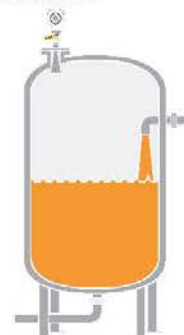
Measurement in still pipes commonly found in turbulent low dielectric fluids or where multiple internal obstacles are present.

Aggressive, coating or viscous media



Accurate and reliable level measurement with exotic materials available in tanks with foam, turbulence, condensation and low DC media.

Safety applications



Protection even in turbulent or harsh process conditions and those with rapid level changes. Unique proof testing functionality.

Specification

Communication protocol	Loop-powered 4-20mA HART; FOUNDATION Fieldbus
Ultra accuracy	± 0.04 in (± 1 mm)
Standard accuracy	± 0.08 in (± 2 mm)
Max measuring range	131 ft (40 m)
Min. DC	No minimum
Pressure rating	1450 psi (100 bar)
Temperature rating	-76 to +482 °F (-60 to +250 °C)
Power supply	Loop-powered 4-20mA HART: 12-42.4V dc (12-30V dc in Intrinsically Safe installations) FOUNDATION Fieldbus: 9-32V dc (9-30V dc in Intrinsically Safe installations and 9-17.5V dc for FISCO)
Hazardous area approvals	ATEX, IECEx, FM, CSA
Safety Instrumented Systems	IEC 61508 certified to SIL 2
Approvals and certificates	3-A, CRN, WHG, etc.
Antennas	Cone, process seal, parabolic

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T (U.S.) 1-800-999-9307
T (International) (952) 906 8888
E RFQ.RMD-RCC@Emerson.com

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 [Twitter.com/Rosemount_News](https://twitter.com/Rosemount_News)

00807-1100-4408 Rev 8A 4/20



Increase Safety with Proven Overfill Prevention Solutions from Emerson™

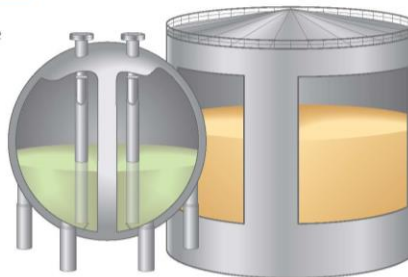
Preventing an
overflow starts with
proven solutions you can
trust.



Certified IEC 61508 Portfolio

Robust overfill prevention systems are essential in process and bulk liquid storage vessels to ensure your plant complies with standards, and risk is reduced.

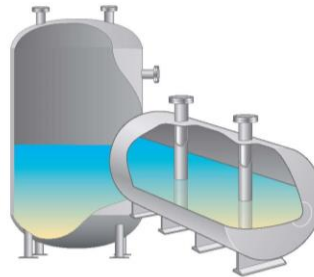
Emerson has the most comprehensive portfolio of safety certified solutions available. Designed for superior reliability and safety certified by a third party, our products support your vision for keeping people and the environment safe.



Flexible Process Plant Solutions

Process vessels come in all shapes and sizes and each application has its own challenges and specific requirements.

Emerson offers point and continuous level technology for reliable overfill prevention in all types of process fluids. Products are simple to configure and install into existing or new SIS loops without adding extra complexity.



Increasing Bulk Storage Safety

The Rosemount™ Tank Gauging system is the simplest way to become API 2350 and IEC 61511 compliant.

The system is scalable to ensure that you can comply with updated standards, today and in the future. Unique 2-in-1 technology enables independent process control and overfill prevention through a single inlet.

Proof-Testing and Diagnostics

Understanding what is happening in your tank is vital. Emerson overfill prevention solutions are equipped with powerful remote diagnostics to keep you informed from the safety of the control room.

Events in the process can be interrogated and devices present actionable alerts and data. Test the integrity of your overfill prevention device in seconds with unique, fully integrated proof-testing solutions.



*“There are **hundreds** of tank spills of hazardous materials **every day**.”*

United States Environmental Protection Agency 2014

Our offering

Emerson supplies both point level detection and continuous level measurement products to provide certified overfill prevention solutions for process and bulk storage applications, and our team of experts can offer further advice and guide you through selecting the best overfill prevention solution.

	Rosemount 2120	Rosemount 2130	Rosemount 2140:SIS	Rosemount 5300	Rosemount 5408:SIS	Rosemount 5900C	Rosemount 5900S
							
	Point detection	Point detection	Point detection	Continuous measurement	Continuous measurement	Continuous measurement bulk storage applications	Continuous measurement bulk storage applications
SIL-rating	SIL 2 certified	SIL 2 certified	SIL 2 certified	SIL 2 certified	SIL 2 certified	SIL 2 certified	SIL 3 certified
SFF	91.1%	95.2%	97.7%	91.5%	92.7%	>90.9%	>99% (2-in-1 option)
λDU (FIT)	24	17.5	13	94	79	193	16 (2-in-1 option)
Proof-test	Local, in-situ	Local, in-situ	Local and remote, in-situ	Remote, in-situ	Remote, in-situ	Remote, in-situ	Remote, in-situ
P/T ratings	-40 to 302 °F (-40 to 150 °C) 1450 psi (100 bar)	-94 to 500 °F (-70 to 260 °C) 1450 psi (100 bar)	-94 to 500 °F (-70 to 260 °C) 1450 psi (100 bar)	-320 to 752 °F (-196 to 400 °C) 5000 psi (Full vacuum) (345 bar)	-76 to 482 °F (-60 to 250 °C) 1450 psi (100 bar)	-40 to 158 °F (-40 to 70 °C)	-40 to 158 °F (-40 to 70 °C)
Description	Simple, cost effective, and flexible overfill prevention suitable for most liquid types.	Flexibility of Rosemount 2120, suitable for more challenging conditions.	Next generation point level overfill prevention with smart diagnostics and remote functionality.	Market leading guided wave radar with state-of-the-art reliability and safety features and powerful built-in diagnostics.	Local memory enables full insight into the last seven days of measurements, alerts, and echo profiles. Immune to intermittent power loss.	For continuous surveillance in bulk storage applications.	1-in-1 and 2-in-1 functionality with custody transfer approvals. 2-in-1 enables combined basic process control and overfill prevention in a single device.

Trust is the basis for everything. Learn more: Emerson.com/OverfillPrevention

Emerson Automation Solutions
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Chanhassen, MN 55317 USA
T (U.S.): 1-800-998-9307
T (International): (952) 906 8888
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00807-0100-4530 Rev. AA 11/17



Attachment XI

FDEP Form 62-761.900(9)



Department of Environmental Protection

2600 Blair Stone Road • Tallahassee, Florida 32399-2400

DEP Form: 62-761.900(9)
Form Title: Storage Tank Equipment
Registration Form
Effective Date: July 2019
Incorporated in Rule 62-761.850, F.A.C.

Storage Tank System Equipment Registration Form

Fill out completely

General Information

Company Name: Rosemount Tank Gauging - North America

Contact Name: Lance Berry

Company Address: 6005 Rogerdale Road, MailStop NC136

City, State: Houston, TX

Zip: 77072

E-mail: Lance.Berry@emerson.com

Contact Number: 281 988 4000

Product Name: Rosemount 5408 Level Transmitter

Model Number(s): 5408

Product Type: AST radar tank level gauging system

Rule(s) citation that registration is being requested within Chapter 62-761 (UST), and/or 62-762 (AST),

Rule 62-762.502, F.A.C.

Rule 62-762.702, F.A.C., & Rule 62-851, F.A.C.

F.A.C.: Write a brief description of equipment registration request including product limitations:

The Rosemount 5408 System is a stand-alone 4-20ma single radar gauge for liquid level measurement in bulk aboveground storage tanks. There are no product limitations for regulated substances subject to FDEP Rule 62.762, F.A.C.

Information Checklist (Choose Yes, No, or N/A - Not Applicable):

	Yes	No	N/A
1. Third-party Certification by a Nationally Recognized Testing Laboratory? (Required)	☒	☐	☐
2. Documentation of third-party evaluation that the equipment meets DEP Rules?	☒	☐	☐
3. Documents included about the qualifications of the Nationally Recognized Testing Laboratory?	☒	☐	☐
4. Technical information and drawings included?	☒	☐	☐
5. Installation instructions included?	☒	☐	☐
6. Annual Operability Testing Requirements (Rules 62-761.500, 62-762.501, & 62-762.502 F.A.C.)?	☒	☐	☐
7. Integrity Testing Requirements (Rules 62-761.700, 62-762.701, & 62-762.702, F.A.C.)?	☐	☐	☒
8. Compatible with fuel blends containing >10% ethanol or >20% biodiesel?	☒	☐	☐
9. Has the product been approved or registered in other countries or states? (If so provide list)	☒	☐	☐
10. Any requirements for company-certified installers or trainers?	☒	☐	☐
11. Was this product(s) previously approved or registered by the Department? If yes, EQ- _____	☐	☒	☐
12. Any changes or modifications to the equipment since the last submittal to DEP?	☐	☐	☒

Document Information: Provide supporting documents indicated as "Yes" above including this form via email to Tanknotify@floridadep.gov, or documents can be sent to FDEP, Division of Waste Management, 2600 Blair Stone Road, MS 4560, Tallahassee, FL 32399.

Write a brief description of equipment installation and performance in the U.S.:

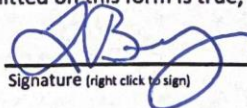
The Rosemount 5408 system is similar in design, materials of construction, and function to the Rosemount 5900 system registered under EQ 840. That system has a successful track record in Florida, the United States, and numerous other countries around the world since 2010.

Equipment Registration Certification:

To the best of my knowledge and belief, all information submitted on this form is true, accurate and complete.

Lance Berry, General Manager

Printed Name and Title


Signature (right click to sign)

8/15/2023
Date

For Department Use Only:

Date Application Received: _____

Application complete:

Yes: ☐ No: ☐

EQ- Date of complete or incomplete letter sent: _____

Date Equipment Requires Renewal:

Storage tank system equipment requires renewal every 5 years in accordance with subsection 62-761.850(2), F.A.C.

Report completed by:

Marshall T. Mott-Smith, President, Mott-Smith Consulting Group, LLC
111 North Calhoun Street
Tallahassee, FL 32301

marshall@mott-smithconsulting.com 850-391-9835 work 850-591-1434 cell www.mott-smithconsulting.com

A Service-Disabled Veteran-Owned Small Business



