



Tender Specification Requirements, ADM Lot

Description of the Performance

ADM Flow Measurement Instruments - Supply, Implement, Manage, Maintain

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1 Introduction

1.1 Purpose of the Tender Specification Requirements

These Tender Specification Requirements ('TSR') describe Rijkswaterstaat's ('RWS's') need to produce reliable discharge and flow velocity data using new ADM Flow Measurement Instruments at existing and new ADM Measurement Sites.

1.2 Structure of the TSR

Chapter 2 'System Definition' contains a description of the ADM Flow Measurement Instruments and the relationship that these Flow Measurement Instruments have with the civil, electrical and telecommunications infrastructure on an ADM Measurement Site. This shows the functional choices that the Contractor must make to be able to supply the requested ADM Flow Measurement Instruments.

Chapter 3 'System Requirements' contains the Performance requirements set for the ADM Flow Measurement Instruments from several perspectives.

This TSR refers to several annexes. These documents form an inseparable part of the Agreement.

1.3 Reading guide

This TSR is best read after the TSG and before the TSP.

The meaning and definition of the terms and abbreviations used in this TSR can be found in **Annex A. 'Glossary Discharge, ADM Lot'** to the Tender Specification.

2 System Definition

2.1 Introduction

This TSR covers the Supply, Implementation, Management and Maintenance of the ADM Flow Measurement Instruments. The purpose of the ADM Flow Instruments is to provide RWS with accurate discharge and flow velocity data at the ADM Measurement Sites in accordance with the specifications.

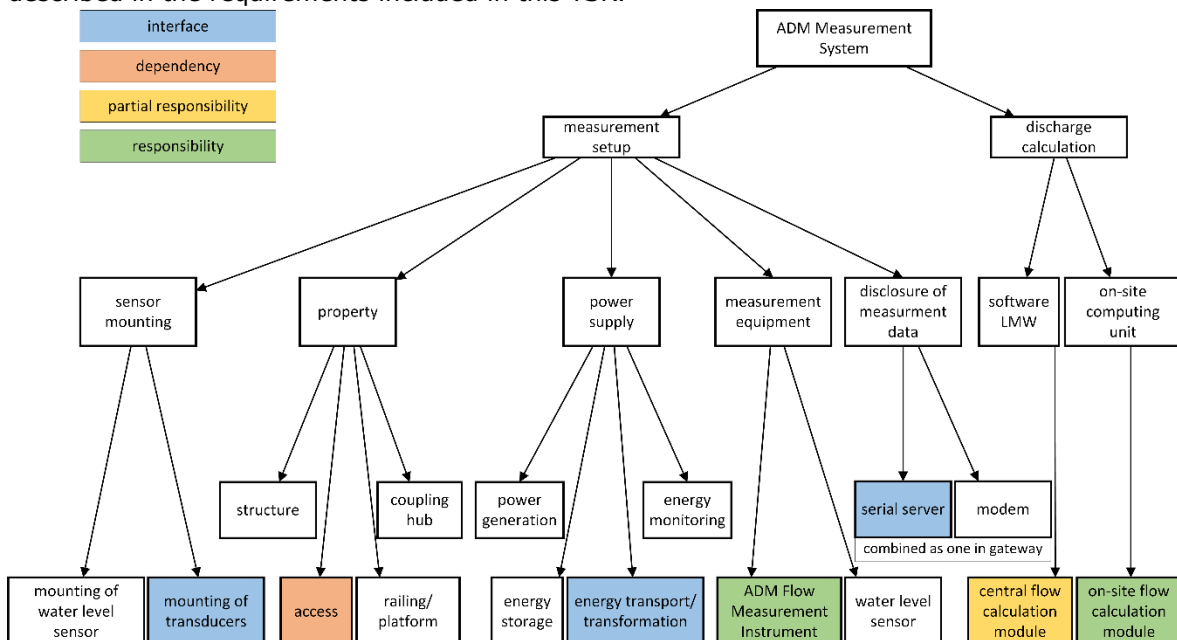
2.2 System Context

2.2.1 System Description

The ADM Flow Measurement Instrument contains the following elements at each ADM Measurement Site:

1. 4 transducers, or a multiple of that if there are several measurement planes;
2. a computing unit;
3. cables between the computing unit and the transducers;
4. transponder (at some ADM Measurement Sites).

Part of the Contract involves the complete renewal of ADM Measurement Sites. To this end, it is important to understand the components that are in Scope for the Contract and the interfaces with the components provided by the Client or by LMW's M&S (Management & Servicing) Contractor. The object tree below illustrates the structure of the complete Measurement System, including the ADM Flow Measurement Instrument at the ADM Measurement Site. For each component, it is specified whether the Contractor bears responsibility (full or partial) for this purpose and whether there are interfaces or dependencies. The exact content of the responsibilities, interfaces and dependencies is described in the requirements included in this TSR.



2.3 Functions of the ADM Flow Measurement Instrument

An ADM Flow Measurement Instrument has the following two main functions:

1. Measuring the flow velocity;
2. Calculating the Discharge from the measured flow velocity and the external data of the water level and bed profile.



3 System Requirements

3.1 Introduction

This chapter describes the functional specifications set for the ADM Flow Measurement Instruments based on the defined requirements.

The requirements for each component are set out in **Chapter 3.2**.

The requirements for each RAMSSHEEP aspect are set out in **Chapter 3.3**. More information on the RAMSSHEEP aspects can be found at <https://www.rijkswaterstaat.nl/zakelijk/zakendoen-met-rijkswaterstaat/werkwijzen/werkwijze-in-gww/sturen-op-prestaties-met-rams>

The requirements resulting from the interface analysis are set out for each interface in **Chapter 3.4**.

The corresponding information for each requirement is provided in accordance with the table below. The identification of the requirements in this chapter is preceded by the prefix 'ADM'.

Each TSR requirement has the following structure.

ADM.xxx	<Requirement title>		
Requirement:	<Requirement text>		
Explanation of requirement:			
Parent requirement(s):	<Requirement ID of parent requirement(s)> <i>Parent requirements specify the origin and thus the background of the requirement.</i>	Child requirement(s):	<Requirement ID of child requirement(s)> <i>Child requirements are derived from the requirement.</i>
V&V method:	<Conditions for the verification(s) and/or validation(s) of this requirement. Verification and/or validation is aimed at meeting/functioning in accordance with the requirement>		

Each requirement specifies the Verification and Validation that must be performed to ensure that the ADM Flow Measurement Instruments meet the relevant requirement. The table below shows how the Verification and Validation must be done for each V&V method.

V&V method	Verification and Validation
Contractor's Analysis	Written substantiation by the Contractor, by means of a technical dossier, that a product or product type meets a requirement. This could be based on evidence or statements from suppliers, calculations and simulations or logical reasoning. The Contractor warrants substantive accuracy; RWS generally tests for plausibility.
RWS's Analysis	Written substantiation by the Client, by means of a technical dossier, that a product or product type meets a requirement. This could be based on evidence or statements from suppliers, calculations and simulations or logical reasoning.
Contractor's Calibration Report	Contractor's report for each ADM Measurement Site describing the conditions under which measurement results are provided by the ADM Flow Measurement Instrument based on evidence from the Client's reference measurements and



	the calculated flow velocity and/or the calculated Discharge based on the measurement results produced by the ADM Flow Measurement Instrument. It contains a description of the formula used and the calibration coefficient values for the flow velocity and/or discharge calculation. The Contractor delivers this calibration report after each calibration.
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3.2 Requirements from the function analysis

3.2.1 General

ADM.001	ADM;General		
Requirement:	Each ADM Flow Measurement Instrument must be supplied, implemented, managed and maintained at the ADM Measurement Sites designated by RWS in such a way that all requirements in the Tender Specification are met.		
Explanation of requirement:			
Parent requirement(s):		Child requirement(s):	
V&V method:	RWS's Analysis		

3.2.2 Measurement Sites for the ADM Flow Measurement Instruments

ADM.010	ADM;RWS_Specifications		
Requirement:	ADM Flow Measurement Instruments must be implemented for discharge and flow velocity measurements at the following seven ADM Measurement Sites: • Bunde (1x measurement plane) • Driel (2x measurement planes) • Genemuiden (1x measurement plane) • Hagestein (2x measurement planes) • Megen (1x measurement plane) • Sint Pieter Noord (2x measurement planes) • Venlo (2x measurement planes). ADM Flow Measurement Instruments must be implemented for flow velocity measurements at the following ADM Measurement Site: • Wieldrecht (1x measurement plane).		
Explanation of requirement:	The ADM Measurement Sites are described in more detail in Annex C. 'Environmental conditions for each Measurement Site' to the Tender Specification. Ten additional Measurement Sites for ADM Flow Measurement Instruments may be added during the term of the Agreement.		
Parent requirement(s):		Child requirement(s):	ADM.020 ADM.040 ADM.041 ADM.042 ADM.043 ADM.044 ADM.200 ADM.210 ADM.220 ADM.230
V&V method:	Contractor's Analysis		



3.2.3 Specifications for the ADM Flow Measurement Instruments

ADM.020	ADM;RWS_Specifications		
Requirement:	The ADM Flow Measurement Instrument must be suitable for the ADM Measurement Sites and comply with the following specifications: • A measurement plane consists of two measurement paths, i.e. a total of four transducers; • It must be possible to supply the ADM Flow Measurement Instrument with both a transducer frequency of 200 kHz and a frequency ≤ 100 kHz (also see Annex C. 'Environmental conditions for each Measurement Site' to the Tender Specification); • It must be possible to install the ADM Flow Measurement Instrument with or without a transponder; • The cables between the computing unit and the transducers must consist of two parts, interrupted by a coupling in what is known as the coupling hub. RWS calls the cable that runs from the computing unit to the coupling hub the 'ground signal cable' and the cable that runs from the coupling hub to the transducer the 'transducer cable'. More information on the locations of the coupling hubs can be found in Annex C. 'Environmental conditions for each Measurement Site' to the Tender Specification; • It must be possible to supply the ADM Flow Measurement Instrument with variable cable lengths to suit the ADM Measurement Sites (also see Annex C. 'Environmental conditions for each Measurement Site' to the Tender Specification); • New ground signal cables must be sheathed/armoured and have a minimum technical service life of 40 years; • New and existing ground signal cables must be connected to transducer cables with watertight couplings; • Various error codes must be visible at the ADM Measurement Site to enable a thorough fault analysis at the ADM Measurement Site.		
Explanation of requirement:	The coupling hub houses the coupling between the ground signal cables and the thinner, more flexible transducer cable. This coupling hub protects against mechanical stress, soil and dirt, but is not watertight. A detachable coupling is desirable, but not mandatory, and must be resistant to the aforementioned environmental conditions at all times.		
Parent requirement(s):	ADM.010	Child requirement(s):	ADM.045
V&V method:	Contractor's Analysis		



3.2.4 Implementation of the ADM Flow Measurement Instruments

ADM.040	ADM;Alignment		
Requirement:	Before Calibration, the Contractor must check the aligned ADM Flow Measurement Instrument at each ADM Measurement Site for correct alignment. If the alignment is incorrect, the instrument must be definitively and properly aligned in cooperation with LMW's M&S Contractor. The Contractor must bring its own hardware and software to perform this alignment.		
Explanation of requirement:	LMW's M&S Contractor attaches the ADM Flow Measurement Instrument to the civil infrastructure at the ADM Measurement Site(s) based on the Contractor's Installation Instruction and initially aligns it.		
Parent requirement(s):	ADM.010	Child requirement(s):	ADM.100
V&V method:	Contractor's Analysis		

ADM.041	ADM;Calibration;Initial		
Requirement:	The ADM Flow Measurement Instrument must be calibrated once during the implementation phase of an ADM Measurement Site such that the discharge and flow velocity measurements can be done with the required accuracy at the ADM Measurement Sites designated by RWS and the generally stated requirements in requirement ADM.100 of this TSR are met under any circumstance. It must be verified that the accuracy of the measurement data of the ADM Flow Measurement Instrument after alignment and calibration meets the requirements in the Tender Specification.		
Explanation of requirement:	For each ADM Measurement Site where discharge and/or flow velocity data is required, the alignment and calibration must be based on the information provided by RWS in Annex C. 'Environmental conditions for each Measurement Site' to the Tender Specification.		
Parent requirement(s):	ADM.010	Child requirement(s):	ADM.100
V&V method:	Contractor's Calibration Report		

ADM.042	ADM;Calibration;Adjustment		
Requirement:	The Contractor must perform a new calibration of the ADM Flow Measurement Instrument if the Client detects a discrepancy.		
Explanation of requirement:	RWS carries out reference measurements on a regular basis. If there is a discrepancy between the Discharge from the ADM Flow Measurement Instrument and the Discharge from the reference measurement, RWS may instruct the Contractor to adjust the calibration. This check occurs no more than once a year.		
Parent requirement(s):	ADM.010	Child requirement(s):	ADM.100
V&V method:	Contractor's Calibration Report		



ADM.043	ADM;Flow_Rate_Calculation_method		
Requirement:	The ADM Flow Measurement Instrument must calculate the Discharge on-site in the computing unit supplied by the Contractor using a method of its choice, in accordance with ISO 6416. A cross-sectionally averaged flow velocity must also be calculated in accordance with ISO6416.		
Explanation of requirement:	The cross-sectionally averaged flow velocity refers to the longitudinal flow velocity averaged over the flow area.		
Parent requirement(s):	ADM.010	Child requirement(s):	
V&V method:	Contractor’s Calibration Report		

ADM.044	ADM;Content_Flow_Rate_message		
Requirement:	The ADM Flow Measurement Instrument must provide flow velocity data for each measurement plane in the longitudinal and transverse direction and provide the Discharge at the ADM Measurement Site to the Gateway, in accordance with the following elements in the message: • Resolution of Discharge; • Frequency of the message; • Discharge value; • Partial discharge for each measurement plane (if available); • Water level; • Current velocities for each measurement plane in the longitudinal and transverse direction; • Cross-sectionally averaged flow velocity; • Error codes where a distinction can at least be made between malfunctions/errors in each of the above parameters.		
Explanation of requirement:			
Parent requirement(s):	ADM.010	Child requirement(s):	ADM.122
V&V method:	Contractor's Calibration Report		

ADM.045	ADM;Quality_Ground_signal_cable		
Requirement:	If the existing ground signal cables of the current ADM Flow Measurement Instrument are reused, the Contractor must provide a measurement and report of the existing ground signal cables at each ADM Measurement Site. The Contractor must demonstrate through an impact analysis that the existing ground signal cables are of such a quality that all the requirements set out in the Tender Specification are met.		
Explanation of requirement:	RWS is prepared to assume the risk itself if the ground signal cable needs to be replaced before the end of the contract term. The Contractor's impact analysis is important to be able to make an informed decision in this regard.		
Parent requirement(s):	ADM.020	Child requirement(s):	
V&V method:	Contractor's Analysis		



3.3 Requirements from the aspect analysis

3.3.1 Reliability

ADM.100	ADM;Accuracy;Current_velocity		
Requirement:	The 10-minute mean value of the flow velocity of each ADM Flow Measurement Instrument must have a minimum accuracy of 10 cm/s and a minimum accuracy of 10 degrees for the current direction at the ADM Measurement Sites.		
Explanation of requirement:	The accuracy of the bed profile provided by RWS is 10 cm at each ADM Measurement Site. This value is given as 1 standard deviation.		
Parent requirement(s):		Child requirement(s):	
V&V method:	RWS's Analysis		

ADM.101	ADM;Accuracy;Flow_Rate		
Requirement:	The 10-minute mean value of the Discharge of each ADM Flow Measurement Instrument must have a minimum accuracy of 10% with a minimum of 1 m ³ /s at the ADM Measurement Sites.		
Explanation of requirement:	The accuracies of the given water level and bed profile are 2.5 cm and 10 cm, respectively, at each ADM Measurement Site. These values are given as 1 standard deviation.		
Parent requirement(s):		Child requirement(s):	
V&V method:	RWS's Analysis		

3.3.2 Availability

No specified requirement(s).

3.3.3 Maintainability

ADM.120	ADM;Maintainability;Preventive		
Requirement:	An ADM Flow Measurement Instrument must be able to undergo periodic preventive maintenance at <u>every</u> ADM Measurement Site by LMW's M&S Contractor based on the Contractor's Maintenance Manual.		
Explanation of req.:			
Parent requirement(s):		Child requirement(s):	
V&V method:	Contractor's Analysis		

ADM.121	ADM;Maintainability;Corrective		
Requirement:	An ADM Flow Measurement Instrument must be constructed in a modular way, so that corrective maintenance is possible at <u>every</u> ADM Measurement Site by LMW's M&S Contractor, including the replacement of standard components, based on the Contractor's Maintenance Manual, or with remote support from the Contractor.		
Explanation of req.:			
Parent requirement(s):		Child requirement(s):	
V&V method:	Contractor's Analysis		



ADM.122	ADM;Maintainability;Error_codes		
Requirement:	Every ADM Flow Measurement Instrument must be able, for the purpose of corrective maintenance, to send several types of error codes in the data message for different faults.		
Explanation of req.:			
Parent requirement(s):	ADM.044	Child requirement(s):	
V&V method:	Contractor's Analysis		

3.3.4 **Safety** (Occupational health and safety)

ADM.130	ADM;Safety		
Requirement:	An ADM Flow Measurement Instrument must operate safely at each ADM Measurement Site for people and the environment in accordance with the applicable occupational health and safety legislation.		
Explanation of req.:			
Parent requirement(s):		Child requirement(s):	
V&V method:	Contractor's Analysis		

3.3.5 **Security** (Environmental safety and security)

ADM.140	ADM;Security.Software_malware-free_delivery		
Requirement:	Every software component of an ADM Flow Measurement Instrument must be delivered tested and free of malware.		
Explanation of req.:			
Parent requirement(s):		Child requirement(s):	
V&V method:	Contractor's Analysis		

3.3.6 **Health**

ADM.150	ADM;Health.Safeguards		
Requirement:	An ADM Flow Measurement Instrument must not endanger the health of people or put the environment at risk.		
Explanation of req.:			
Parent requirement(s):		Child requirement(s):	
V&V method:	Contractor's Analysis		



3.3.7 Economics

ADM.160	ADM;Economy.Service_life		
Requirement:	The Mean Time Between Failures ('MTBF') of each ADM Flow Measurement Instrument must be at least five years with an average technical service life of ten years excluding wear and tear and consumable components or parts.		
Explanation of req.:	This service life may be guaranteed on the basis of replacement components.		
Parent requirement(s):		Child requirement(s):	
V&V method:	Contractor's Analysis		

3.3.8 Ecology

ADM.170	ADM;Sustainability		
Requirement:	Every ADM Flow Measurement Instrument must meet the underlying requirements for sustainability.		
Explanation of req.:			
Parent requirement(s):		Child requirement(s):	ADM.171 ADM.172 ADM.173 ADM.174
V&V method:	Through specific underlying requirements.		

ADM.171	ADM;Sustainability.Components.Repairs		
Requirement:	ADM Flow Measurement Instrument components must be replaced with new materials and/or components only if the current materials and/or components cannot be repaired or are at the end of their service life, provided that the required availability specified in ADM.110 is maintained. Exercising this requirement may not result in undue disadvantages for the Client and/or the Contractor.		
Explanation of requirement:	This requirement applies to every ADM Measurement Site. If and insofar as the Contractor anticipates that using repairable components will or might result in non-compliance with other requirements, these other requirements will prevail.		
Parent requirement(s):	ADM.170	Child requirement(s):	
V&V method:	RWS's Analysis (the Contractor must show the extent to which all used components are repairable. For used components that are not repairable, the Contractor must demonstrate that this is not possible, or would result in undue disadvantages for RWS, the Client, others, the environment, etc.).		



ADM.172	ADM;Sustainability.Components.Reuse		
Requirement:	If ADM Flow Measurement Instrument components are replaced, the materials and/or components to be replaced must be reused as long as the required availability specified in ADM.110 is maintained. Exercising this requirement may not result in undue disadvantages for the Client and/or the Contractor.		
Explanation of requirement:	This requirement applies to every ADM Measurement Site. If and insofar as the Contractor anticipates that reusing components will or might result in non-compliance with other requirements, these other requirements will prevail.		
Parent requirement(s):	ADM.170	Child requirement(s):	
V&V method:	RWS’s Analysis (the Contractor must show the extent to which all used components are reuseable. For used components that are not reusable, the Contractor must demonstrate that this is not possible, or would result in undue disadvantages for RWS, the Client, others, the environment, etc.).		

ADM.173	ADM;Sustainability.Components.Circularity		
Requirement:	As far as possible, ADM Flow Measurement Instrument components must consist of materials and/or components that are recyclable at the end of their service life.		
Explanation of requirement:	This requirement applies to every ADM Measurement Site. If and insofar as the Contractor anticipates that using recycled and/or recyclable components will or might result in non-compliance with other requirements, these other requirements will prevail.		
Parent requirement(s):	ADM.170	Child requirement(s):	
V&V method:	RWS’s Analysis (the Contractor must show the extent to which all used components are recycled and/or recyclable. For used components that are neither recycled nor recyclable, the Contractor must demonstrate that this is not possible, or would result in undue disadvantages for RWS, the Client, others, the environment, etc.).		

ADM.174	ADM;Sustainability.Components.Demountability		
Requirement:	As far as possible, <u>every</u> component of <u>every</u> ADM Flow Measurement Instrument must consist of easily demountable and separable materials and/or components.		
Explanation of requirement:	This requirement applies to every ADM Measurement Site. If and insofar as the Contractor anticipates that using demountable components will or might result in non-compliance with other requirements, these other requirements will prevail.		
Parent requirement(s):	ADM.170	Child requirement(s):	
V&V method:	RWS’s Analysis (the Contractor must show the extent to which all used components are easy to demount and separate. For used components that are not easy to separate or demount, the Contractor must demonstrate that this is not possible, or would result in undue disadvantages for RWS, the Client, others, the environment, etc.).		

3.3.9 Politics

No specified requirement(s).



3.4 Requirements from the Interface Analysis

3.4.1 IT facilities

ADM.200	ADM;IT_facilities		
Requirement:	Each ADM Flow Measurement Instrument must be implemented and connected to the existing IT facilities at the ADM Measurement Sites in such a way that all requirements in the Tender Specification are met.		
Explanation of requirement:	Specifications interface with IT facilities in accordance with the LMW-Next conditions: • At least one of the following digital serial outputs: ◦ RS232 full duplex, no hardware flow control; ◦ RS422 two-wire or four-wire; ◦ RS485 two-wire or four-wire; • Baud rate is between 300 and 115,200 Baud; • Only one instrument is connected per bus (serial port).		
Parent requirement(s):	ADM.010	Child requirement(s):	
V&V method:	Contractor's Analysis		

3.4.2 Power supplies

ADM.210	ADM;Power_supplies		
Requirement:	Each ADM Flow Measurement Instrument must be implemented and connected to the existing power supplies at the ADM Measurement Sites in such a way that all requirements in the Tender Specification are met.		
Explanation of requirement:	Specifications interface with power supplies: • ADM voltage: 230Vac or <50Vdc; • ADM power: not relevant; • After each power interruption, the ADM Flow Measurement Instrument must automatically restart when the power supply is restored, without loss of settings.		
Parent requirement(s):	ADM.010	Child requirement(s):	
V&V method:	Contractor's Analysis		



3.4.3 LMW-Next Protocols

ADM.220	ADM;Protocols_LMW-Next		
Requirement:	Each ADM Flow Measurement Instrument must be implemented and connected to the protocols of the LMW-Next system at the ADM Measurement Sites in such a way that all requirements in the Tender Specification are met.		
Explanation of requirement:	Specifications interface with LMW-Next: - Only the following (polling) communication protocols are permitted in the interface with LMW-Next: - ProfiBUS; - Modbus ASCII/RTU; - ADAM ASCII; - In case the ADM Flow measurement instrument sends the data message on its own initiative, then free flow (no protocol) applies.		
Parent requirement(s):	ADM.010	Child requirement(s):	
V&V method:	Contractor's Analysis		

3.4.4 Water level message

ADM.230	ADM;Water_level_message		
Requirement:	It must be possible to connect a water level gauge with a digital signal to each ADM Flow Measurement Instrument at the ADM Measurement Sites. If necessary, the Contractor must provide and use its own digital-to-analogue converter for this purpose as part of the system described in section 2.2.1.		
Explanation of requirement:	Specifications interface with Gateway: - Frequency of delivery of water level message is 1x per minute; - The water level message is delivered via a digital serial link; - The water level message is constructed according to the RMI protocol; - The RMI message consists of one value of 6 characters. The general form of the message is <LF><RMI message><CR>, with; <LF> = line feed karakter <CR> = carriage return karakter <RMI-bericht> = STDDDD, with: - S = status (' ' or 'A', in which A is for error value) - T = sign (+ or -) - DDDD = measurement value or code for service and management purposes		
Parent requirement(s):	ADM.010	Child requirement(s):	
V&V method:	Contractor's Analysis		