



Rijkswaterstaat
*Ministry of Infrastructure
and Water Management*

Demand Requirements Specification

RWIS

Road Weather Information System for the Netherlands

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1 Introduction

This document is part of the tender documentation and describes the functional and technical requirements of Road Weather Information System (RWIS) measuring stations. The tender for the RWIS measuring stations includes the enclosure, measuring station CPU, sensors, cabling and other accessories required for a complete roadside measuring system. Also included are related services for piece part replacement service, piece part inventory management, customization/development of systems and training/instruction to install and maintain the new RWIS measuring stations.

The tender documentations are covered by three sections of documents:

- **Descriptive document (DD).** The DD contains an introduction as well as key RWS documents with descriptions of the formality around of the procurement and templates for how the registration should be submitted and will be judged. The administrative section also contains the price list that the supplier must fill in. These prices are used for the calculation of the tender price. The DD also contains a general description of definitions and abbreviations.
 - **Demand Process Specification Process (DPS).** The DPS describes the conditions that apply to the procurement; conditions where the system and the Contractor must relate to.
 - **Demand Requirements Specification (DRS, this document)** describes the requirements of the product has to be delivered by the Contractor.
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- Chapter 2 “System definition” contains a description and demarcation of the RWIS measuring stations and its relationship with its environment. This chapter defines the scope and indicates the choices that have been made for the required solution.
 - Chapter 3 “System requirements” contains requirements for RWIS measuring.
 - Chapter 4 “Sensory measurement” brings together the requirements for the sensing modules of the RWIS measuring system.
 - Annex A consists of an overview of relevant standards and references referred to in this document.
 - Annex B describes the three system configurations for which a price must be offered in bidders Financial Offer (see Appendix E: Format Financial Offer).

2 System definition

2.1 RWIS architecture

RWIS measuring stations are part of a chain of systems in an operational process, which has as a general goal to enable safe, reliable and efficient traffic flow on the Dutch main road networks during winter (and extreme weather) conditions.

The project (start) architecture is shown in figure 1.

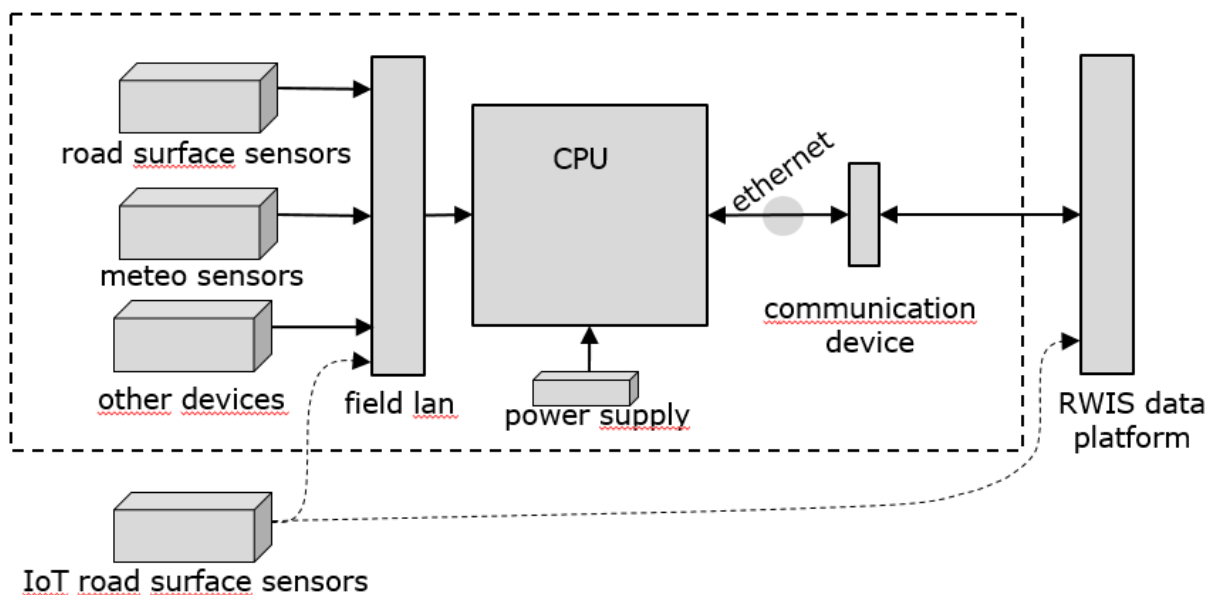


Figure 1: RWIS architecture

Road surface and meteo sensors at the road side are connected with a CPU that forwards data to a central RWIS data platform system using the RWS communication network.

IoT road surface sensors may report their observations over the internet to the RWIS data platform or to a local RWIS measuring station.

2.2 Context description and interfaces

The RWIS measuring stations are mainly positioned along highways, but can also be used on the secondary road network or even on bicycle tracks. Any kind of pavement may be subject of the measurements or observations of RWIS.

The main functionality of RWIS consists of:

- Observe road conditions
- Observe local weather conditions
- Collect traffic data
- Detect special circumstances

All data and observations are collected in the RWS data platform and presented to an operator in order to make an informed decision about taking action like spreading road salt.

RWIS measuring stations mainly consist of the following elements (see figure 2):

- a mast to mount enclosure, sensors and other modules.
- road surface sensors; measure the state of the road surface for parameters like several temperatures, water film thickness, de-icing chemicals, etc.
The sensors are of the embedded and remote type.
- meteo sensors; measure air temperature, humidity and precipitation.
 - Additional and future sensors
- other devices like camera's, future sensors and local interfaces with external (sprinkler) systems.

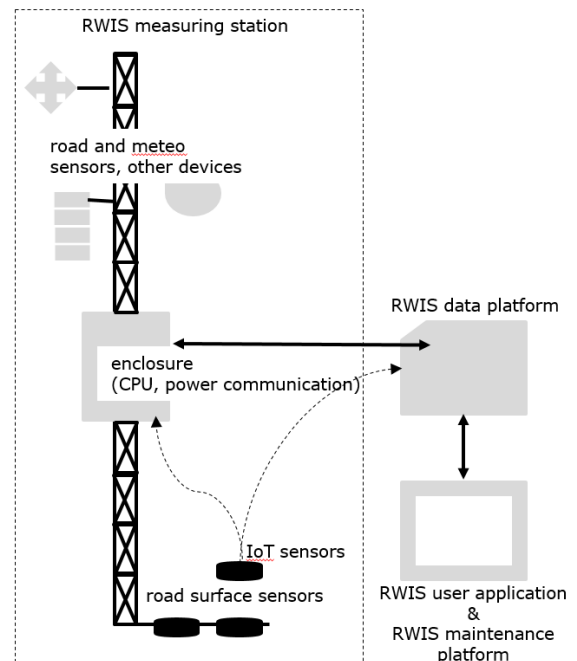


Figure 2: Context RWIS measuring system

Function	Description
RWIS measuring system	This part collects road and weather condition data with several (modular) sensors put into the road surface or placed at the roadside. The measuring system also converts sensor data into relevant values for operational processes, every 5 or 10 minutes. The measuring systems need power supply and network communication.
RWIS data platform	This part of the system chain receives and distributes data and values to other parts of the system chain. In itself is has a function for configuration management ("which measuring stations (composition) are located where?") and monitoring technical/functional availability of the measuring systems ("do measuring stations deliver sensor data and values timely, complete and correct?").
RWIS user application	This part of the chain presents the relevant road and weather information to operators to help them decide whether or not to take actions like spreading road salt and inform road users. The current user application ("Winter-controle") remains operational and needs to be provided with data from the new measuring stations.

Function	Description
RWIS maintenance platform	This part of the chain presents the ability to maintain de RWIS systems. Tooling for diagnostics, configuration and software updates are situated on this platform, which is still evolving. The current user application ("Winter-controle") covers the maintenance demands partly.

Interfaces	Description
Sensor to CPU	Sensors form one whole with the roadside system and communicate with the supplier-supplied CPU with a future-proof protocol.
Camera to CPU	Cameras provide a snapshot on demand. They communicate with the supplier-supplied CPU using a future-proof protocol. Existing cameras: Mobotix Type M10 and M12.
CPU to RWIS data platform	The RWIS data platform is a transparent data layer that acts as an interface between the user and maintenance applications. Communication is based on an open standards and internet protocol. The actual data layer is under construction.
RWIS data platform to user application & maintenance platform	The users and maintenance application communicate with the roadside systems via the RWIS data platform. Currently, the application "Winter Controle" includes this functionality.

2.3 Basic versions of the RWIS measuring stations

The RWIS measuring stations can be divided into three basic versions.

Once the contract has been signed, the exact configuration of each RWIS measuring station will be determined.

The basic versions are:

- **Basic:** Mast with remote sensors
 - Preferably runs on alternative energy, but can also run on mains
 - Without meteo sensors
 - No wired road surface sensors in or under the road surface
- **Standard:** Mast with measuring station, meteo and embedded road sensors, Camera
 - Powered by mains (230V 50Hz)
 - Meteo measurement
 - Sub surface temperature sensor
 - Camera
- **Plus:** Mast with measuring station made up of all components of the basic and standard measuring station, possibly supplemented with additional sensors:
 - Powered by mains (230V 50Hz)
 - Measuring station contains all sensors from the basic and the standard version
 - Measuring station can be supplemented with air quality sensors
 - Measuring station can be supplemented with a visibility sensor
 - Measuring station can be supplemented with a radiation meter
 - Measuring station can be supplemented with anemometers

Annex B describes the three system configurations for which a price must be offered in bidders Financial Offer (see Appendix E: Format Financial Offer).

2.4 Scope

RWIS measuring stations consist of the components shown in figure 3.

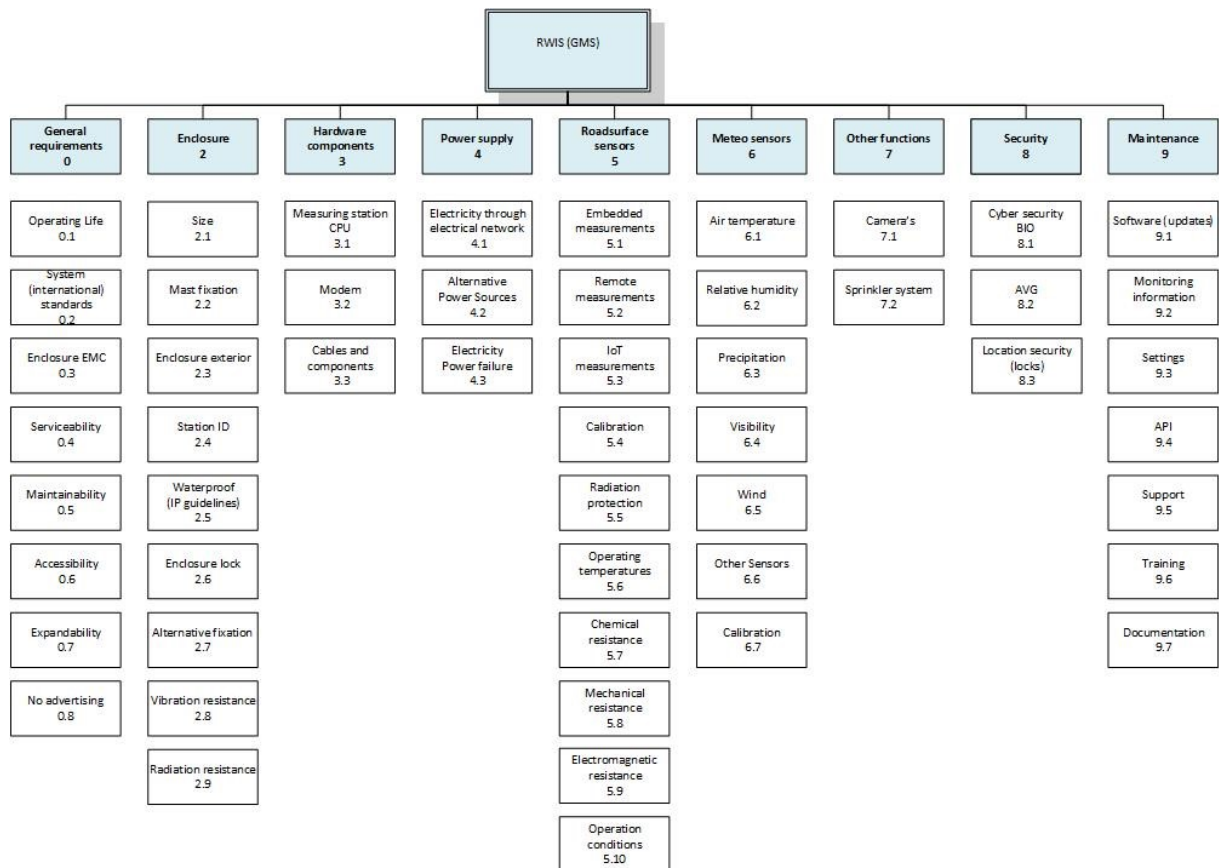


Figure 3: Object tree (OT) RWIS

3 System requirements

3.1 Introduction

This chapter describes the requirements that are set for the RWIS measuring stations. The description must be used by the Contractor as a basis for their product offer, the (financial) conditions, the verification and validation process and the factory acceptance test (FAT) of the RWIS measuring stations.

The identification of the requirements in this chapter is preceded by the prefix "RWIS.X.X.Y" The requirements "X.X" are divided into requirements arising from a function analysis and shown per functional block from figure 2 (object tree) in chapter 2, where "Y" is an optional sequence number in case there is more than one requirement. The corresponding information is given for each requirement in accordance with the table below.

<Req-ID>	<Req Titel>	Validity Period	
Requirement:	<Requirement text>		
Requirement explanations:	<Explanation tekst>		
V&V method FAT:	<Conditions for the verification(s) and/or validation(s) to be performed during the FAT for this requirement>	Priority:	<Must have, Should have, Could have>

For each requirement, the Verification and Validation (V&V) conditions are indicated that must be performed to ensure that the RWIS measuring stations meet the relevant requirements. These V&V methods partly based on **NEN-EN 15518-4:2013**.

The table below shows for each method how the V&V should take place.

V&V method	Verification and validation
Analysis	Written substantiation, in technical file, by the Contractor that a product (-type) meets a requirement. This can be based on evidence or statements from suppliers, calculations and simulations or logical argumentation. The Contractor guarantees the correctness of the content; Rijkswaterstaat generally tests for plausibility. In case of doubt, Rijkswaterstaat can additionally request a test, demonstration or inspection.
Demonstration	Demonstration of an attribute, property or behavior of the product (-type) by the Contractor to Rijkswaterstaat.
Inspection	Assessment of a product property by Rijkswaterstaat, based on sense perception. The Contractor will provide maximum cooperation. In a number of cases, random inspections are foreseen, based on a (not explicit here) consideration of risks and costs.
Test Contractor	Examination of a property or behavior of the product (-type) by the Contractor. The relevant requirement(s), performed test(s), the configuration(s) of the tested product or products, the circumstances and the findings are recorded by the Contractor in a test report, included in the technical file. Insofar as this is not trivial, the Contractor will supplement

	this with an analysis that shows that the findings also apply to other product configurations and circumstances. The Contractor guarantees the correctness of the content; Rijkswaterstaat generally tests for plausibility. In case of doubt, Rijkswaterstaat can additionally request a further analysis, demonstration or inspection.
Test accredited institute (Contractor can also test if accredited)	Examination of a property or behavior of the product (type) by an institute accredited for the subject concerned. See further under `test Contractor`. In addition to the test report, the institute will also endorse any analysis. The Contractor guarantees the correctness of the content; In principle, Rijkswaterstaat does not test this. Where Rijkswaterstaat requests a "Test Contractor", a test from an accredited institute is of course also accepted.
Test RWS	Examination of a property or behavior of the product (type) by Rijkswaterstaat. Rijkswaterstaat will draw up a test report. The Contractor will provide maximum cooperation.

Rijkswaterstaat can delegate V&V components (particularly in the FAT) to the Contractor or, for example, clients. In all cases, the executing party will record the performed checks and findings in writing.

For each requirement a priority is indicated. The table below describes the priorities.

Priority	Description
Must have (M)	Contractor must have this product available as a COTS product from the start of this contract.
Should have (S)	It is desirable that contractor has this product available as a COTS product in the near future.
Could have (C)	It is desirable that contractor has this product available as a COTS product in future.

3.2 General requirements

3.2.1 General requirements

With respect to maintenance of RWIS measuring stations the following requirements are valid.

RWIS.1.1.1	Operating Life	Validity period:	Usage phase
Requirement:	The RWIS measuring system has an operating life of at least 15 years.		
Requirement explanations:	The RWIS system is designed and constructed to operate according to requirements for a period of at least 15 years.		
V&V-method:	Test Contractor	Priority:	M

RWIS.1.1.2	Operating Life: Suitable for environment	Validity period:	Usage phase
Requirement:	The RWIS measuring system has to be suitable for the Dutch operational circumstances and environment. The system must continue to function unimpeded at temperatures between -20 °C to + 45 °C.		
Requirement explanations:	The RWIS measuring system has to be suitable for all conditions and locations along the roadside off all main roads in the Netherlands.		
V&V-method:	Test Contractor	Priority:	M

RWIS.1.1.3	Operating Life: Reliability	Validity period:	Usage phase
Requirement:	The RWIS system should not require maintenance more often than every 6 months. 95% of the observations must be available within 10 minutes after receipt of the sensor signal.		
Requirement explanations:	Components should be reliable with a high MTBF and require very little repairs on location.		
V&V-method:	Test Contractor	Priority:	M

RWIS.1.2.1	System (international) standards for road weather information systems	Validity period:	Realization and Usage phase
Requirement:	It is required that the entire system complies with relevant (international) guidelines and standards. The RWIS system must comply with the following current standards: • CEN/TS 15518-4:2013: Winter maintenance equipment — Road weather information systems — Part 4: Test methods for stationary equipment • ISO 17714, Meteorology — Air temperature measurements — Test methods for comparing the performance of thermometer shields/screens and defining important characteristics		
Requirement explanations:	These directives evolve continuously; The contractor has to take effort to meet the latest requirements.		
V&V-method:	Test accredited institute	Priority:	M

RWIS.1.2.2	System (international) standards: Electrical	Validity period:	Realization and Usage phase
Requirement:	It is required that the entire system complies with relevant (international) guidelines and standards. The RWIS system must comply with the following current standards: • the Low Voltage Directive 2014/35 / EU; • the EMC directive 2014/30 / EU; • NEN1010: Safety provisions for low voltage installations; • NEN 3140 Operation of electrical installations; • Safe switch boxes in accordance with NEN-EN-IEC 61439; • NEN-EN-IEC 62305: Lighting protection. • the harmonic distortion requirements of EN61000-3-2; • the voltage fluctuation requirements of EN61000-3-3. As part of compliance with the EU directives, a CE declaration must be issued and a CE marking must be affixed.		
Requirement explanations:	In the event that there is a dependency on the method of installation, the system supplied must be suitable for an application that meets the specified requirements.		
V&V-method:	Test accredited institute	Priority:	M

RWIS.1.3	EMC; standards, level of immunity and emissions	Validity period:	Realization and Usage phase
Requirement:	The RWIS measuring system must meet the requirements for Electromagnetic Compatibility (EMC) in accordance with the document [NEN-EN-IEC 61000] complete series, whereby the level of Industrial environments must be applied for Immunity and Emission. The following guidelines must be met: - [NEN-EN 50293] for VRIs and roadside stations; - [NEN-EN-IEC 62040-2] for uninterruptible power supplies; - [NEN-EN 55011] for equipment using radio frequency energy.		
Requirement explanations:	The enclosure and the equipment installed within including cabling must comply with the European Community Directive 2014/30 / EU for Electromagnetic Compatibility (EMC) in accordance with: • EMC requirements NEN-EN 50293 for traffic control installations • the emission requirements of NEN-EN 50561-1: 2013 / C1: 2015, Class A / B; • the immunity requirements of NEN-EN 55024: 2010 / A1: 2015;		
V&V-method:	Test accredited institute	Priority:	M

RWIS.1.4	Serviceability	Validity period:	Usage phase
Requirement:	The RWIS measuring system has to be serviceable for a period of at least 15 years.		
Requirement explanations:	The RWIS system has to be is designed and constructed to make it serviceable for a period of at least 15 years. All spare parts, tools and software-versions should be deliverable during this period. In case of EOL or EOS alternative parts must be available.		
V&V-method:	Test Contractor	Priority:	M

RWIS.1.5.1	Maintainability	Validity period:	Usage phase
Requirement:	The RWIS measuring system shall be maintainable at the roadside with the minimum of time and with a minimum of basic hand tools and general-purpose test equipment.		
Requirement explanations:	The RWIS measuring system must support diagnostic monitoring for maintenance purposes to fix issues effectively ("first time right" and "minimal disrupting"). The requirement for special to type tools, jigs or diagnostic test equipment shall be limited to maintenance and repair activities at second or third line.		
V&V-method:	Test Contractor	Priority:	M

RWIS.1.5.2	Maintainability; exchange of data	Validity period:	Usage phase
Requirement:	The RWIS measuring must be able to exchange data with external systems for management and maintenance purposes.		
Requirement explanations:	The RWIS measuring system must support remote diagnostic monitoring for maintenance purposes to fix issues effectively ("first time right" and "minimal disrupting"). Each individual sensor or active component must be distinguishable.		
V&V-method:	Test Contractor	Priority:	M

RWIS.1.6	Accessibility	Validity period:	Usage phase
Requirement:	The RWIS measuring system must be positioned in such a way that all parts are accessible for maintenance work in a safe, non-destructive manner.		
Requirement explanations:			
V&V-method:	Test Contractor	Priority:	M

RWIS.1.7	Expandability	Validity period:	Usage phase
Requirement:	The RWIS measuring system has to be expandable with extra sensors.		
Requirement explanations:	The RWIS system has to be is designed and constructed to make it expandable with extra sensors and features. Once delivered, systems should have 20% capacity for extra sensors and features. These may include also sensors and features which become in future available in the product range of the contractor.		
V&V-method:	Test Contractor	Priority:	M

RWIS.1.8	No advertising nor brand name	Validity period:	Realization phase
Requirement:	It is not allowed to use the system for advertising purposes nor to provide the systems with a road-readable brand name.		
Requirement explanations:	-		
V&V-method:	Inspection	Priority:	M

3.3 Functional requirements

3.3.1 Mounting mast (OT ID: 1)

These requirements concern the supporting structure for components of the RWIS measuring station.

The mast is not part of this tender and is therefore not described in requirements.

3.3.2 Enclosure (OT ID: 2)

These requirements refer to the enclosure (a cabinet mounted to the mast) in which hardware components that are part of the measuring station are housed.

RWIS.2.1	Size	Validity period:	Realization phase
Requirement:	RWIS measuring station includes an enclosure in which hardware components are installed and can be (re)placed. The housing must have passageways for cables to sensors and other devices.		
Requirement explanations:	Hardware components to be installed are a CPU and hardware equipment to connect the measuring station to power and communication network. It is required that these components can be replaced.		
V&V-method:	Inspection	Priority:	M

RWIS.2.2	Enclosure mast fixation	Validity period:	Realization and Usage phase
Requirement:	The enclosure should be mounted on the mounting mast.		
Requirement explanations:	The enclosure must be able to be mounted and removed from the mast without damage or deformation. Appearance and required protection should not be affected by this. For example, by applying easily removable lifting facilities (lifting eyes) at the top, which can be closed water-and molest-resistant after installation.		
V&V-method:	Inspection	Priority:	M

RWIS.2.3.1	Enclosure exterior: material	Validity period:	Realization phase
Requirement:	It is required that the enclosure exterior is made of metal.		
Requirement explanations:	-		
V&V-method:	Analysis	Priority:	M

RWIS.2.3.2	Enclosure exterior: vandalism resistance	Validity period:	Realization and Usage phase
Requirement:	It is required that the enclosure is molest and vandalism resistant.		
Requirement explanations:	It must not be possible to deform or move the enclosure (and its access doors) without using any aids (tools, etc.): the housing must be molest and vandalism-resistant in accordance with resistance class 2 [CSIR 2013, DIN V ENV 1627] C / M3 with burglar resistance of 3 minutes. The exterior of the enclosure must be designed in such a way that the sticking of notes and / or the application of graffiti is prevented as much as possible. The exterior must not be fire sensitive (plastic parts, for example, are therefore not permitted).		
V&V-method:	Analysis	Priority:	M

RWIS.2.3.3	Enclosure exterior: impact and scratch resistance	Validity period:	Realization and Usage phase
Requirement:	It is required that the enclosure is impact and scratch resistant.		
Requirement explanations:	The preservation layer of the housing must be impact and scratch resistant in accordance with class IK07 in accordance with NEN-EN 50102: 1995 / A1: 1998 ("Degrees of protection of electrical equipment enclosures against external mechanical impacts").		
Parent requirement(s):		Child requirement(s):	
V&V-method:	Analysis	Priority:	M

RWIS.2.3.4	Enclosure exterior: preservation layer	Validity period:	Realization and Usage phase
Requirement:	It is required that the enclosure material has a preservation layer.		
Requirement explanations:	The enclosure must be finished on the outside with a preservation layer that is resistant to the local atmospheric conditions. The preservation layer should be maintenance free for at least 15 years. The colour used is RAL7035 unless otherwise agreed.		
V&V-method:	Analysis	Priority:	M

RWIS.2.4	Station ID	Validity period:	Realization and Usage phase
Requirement:	It is required that the enclosure is labelled with its specific station ID.		
Requirement explanations:	All equipment, appliances, cabinets and other relevant parts of the electrical installation should be equipped with a name plate. Name plates must be permanently attached be and remain legible during the technical service life, based on normal usage.		
V&V-method:	Inspection	Priority:	M

RWIS.2.5	Enclosure waterproof guidelines	Validity period:	Realization and Usage phase
Requirement:	It is required that the enclosure comply with waterproof (IP guidelines) requirements.		
Requirement explanations:	The enclosure must have a protection class of at least IP65 according to IEC 60 529 .		
V&V-method:	Analysis	Priority:	M

RWIS.2.6	Measuring station enclosure lock	Validity period:	Realization and Usage phase
Requirement:	It is required that the enclosure can be locked.		
Requirement explanations:	The enclosure must have the possibility to lock it with a EURO Cylinder. See also RWIS.8.3 in regards to location security.		
V&V-method:	Inspection	Priority:	M

RWIS.2.7	Alternative enclosure fixation	Validity period:	Realization and Usage phase
Requirement:	The enclosure should be mounted on a concrete base when a mounting pole is not possible.		
Requirement explanations:	In exceptional cases the enclosure should be mounted on a concrete base. The contractor should have standard solutions for that purpose.		
V&V-method:	Inspection	Priority:	M

RWIS.2.8	Measuring station vibration resistance	Validity period:	Realization and Usage phase
Requirement:	It is required that the assembled enclosure can withstand the operating environment: Surrounding vibrations		
Requirement explanations:	The enclosure, the installed equipment within and the associated cabling must be resistant to vibrations in accordance with RLN00003 version 5. The tests according to RLN00003 version 5 must be carried out under the following conditions: Type of test: Random vibration test Class: 3 / 4M1 Direction: 3 directions Duration: 2 hours per direction Type of test: Square pulse shock test Class: 3 / 4M1 Level: 49 22ms Number: 3x per direction (total 18 shocks) The system must (continue to) function during and after the test. Individual components must be mounted and correctly placed in accordance with the operating instructions.		
V&V-method:	Test accredited institute	Priority:	M

RWIS.2.9	Measuring station enclosure radiation resistance	Validity period:	Realization and Usage phase
Requirement:	It is required that the assembled enclosure can withstand the operating environment: outside temperature and surrounding solar radiation.		
Requirement explanations:	The enclosure must guarantee operational functioning from its components between -20 °C to + 45 °C. The enclosure must thereby be resistant to solar radiation according to IEC 60068 2-5 ; simulated solar radiation (procedure A, temperature class A, test duration: 3 cycles).		
V&V-method:	Analysis	Priority:	M

3.3.3 Hardware components (OT ID: 3)

The enclosure houses different hardware components each with their own requirements.

RWIS.3.1.1	CPU	Validity period:	Realization and Usage phase
Requirement:	Measuring stations have a CPU. This CPU is locally and remotely accessible.		
Requirement explanations:	The CPU has all connections needed to monitor the measurements and health status of the entire roadside measuring system. The RWIS-system shall be maintainable at the roadside with the minimum of basic hand tools and general-purpose test equipment. The requirement for specific tools, jigs or diagnostic test equipment shall be limited to maintenance and repair activities at second or third line.		
V&V-method:	Analysis	Priority:	M

RWIS.3.1.2	GPS location	Validity period:	Realization and Usage phase
Requirement:	It is required that the CPU sends the GPS location position of the measuring system to the RWIS data platform.		
Requirement explanations:	The CPU is able to send a configured GPS location, compliant to the RWIS data platform.		
V&V-method:	Demonstration	Priority:	M

RWIS.3.1.3	System time	Validity period:	Realization and Usage phase
Requirement:	The maximum allowed deviation of the internal clock is 1 s/24 hours. CPU and logging time is synchronized with RWIS data platform.		
Requirement explanations:	The system needs to synchronize its internal clock at least every 24 hours. The deviation should not be more than 1 second in 24 hours.		
V&V-method:	Demonstration	Priority:	M

RWIS.3.1.4	CPU data storage	Validity period:	Realization and Usage phase
Requirement:	It is required that the CPU has data storage to temporarily buffer sensor data when communication to the RWIS data platform is interrupted.		
Requirement explanations:	Measuring station CPU should have sufficient memory capacity to store data as stored every 5 minutes from all sensors for at least 2 weeks. The collected data from the last week should be always available.		
V&V-method:	Demonstration	Priority:	M

RWIS.3.1.5	CPU ready to use	Validity period:	Realization and Usage phase
Requirement:	It is required that the measuring station CPU is ready to use upon delivery		
Requirement explanations:	In case of a defective measuring station CPU, it must be able to be replaced along the roadside. This replacement (hardware and software) has to be completed in less than 20 minutes.		
V&V-method:	Demonstration	Priority:	M

RWIS.3.1.6	CPU is water and dustproof	Validity period:	Realization and Usage phase
Requirement:	It is required that the CPU has an IP44 protection against water and dust		
Requirement explanations:	The RWIS measuring station CPU itself, without measuring cupboards, must be protected with physical protection against moisture or by enclosure, at least IP44. Purpose: This is to manage the risk of exposure to rain or snow when the measuring cabinet door opens.		
V&V-method:	Analysis	Priority:	M

RWIS.3.1.7	CPU memory	Validity period:	Realization and Usage phase
Requirement:	It is required that CPU has a non-volatile memory		
Requirement explanations:	Storage of data on the CPU should be done on non-volatile memory. By non-volatile memory is meant memory that can manage without risk (file system must not be corrupt) the following: - to be made powerless - that data communication is physically or logically interrupted		
V&V-method:	Analysis	Priority:	M

RWIS.3.1.8	CPU password protection	Validity period:	Realization and/or Usage phase
Requirement:	It is required that the measuring station CPU has password protection		
Requirement explanations:	Measuring station CPU should be password-protected. The administration of passwords and rights must be managed via RWIS data platform.		
V&V-method:	Demonstration	Priority:	M

RWIS.3.2.1	Installing Modem	Validity period:	Realization and Usage phase
Requirement:	It is required that a modem adapter can be installed in the enclosure. It concerns a specified modem type delivered by Rijkswaterstaat and installed by the Contractor that places the measuring stations near the roadside.		
Requirement explanations:	An (by Rijkswaterstaat) approved and supplied cellular modem / router can be placed in the enclosure. Current type: Cisco 809G Cellular modem, R809G-LTE-GA-K9, (128x159x29 mm (WxDxH)). This modem is accompanied by a separate power supply type: PWR-IE50W-AC, (50.8x117.5x147.6 mm (WxDxH))		
V&V-method:	Inspection, test Contractor	Priority:	M

RWIS.3.2.2	Modem antenna	Validity period:	Realization and Usage phase
Requirement:	It is required that the modem has a pre-defined antenna		
Requirement explanations:	An external antenna must be able to be placed on the enclosure. Common actual antenna types are CELL 0727 MIMO Omni antenna with gain 7dBi (CL-4G0727MIMO) and MIMO antenna (20-0011COPLL-S3).		
V&V-method:	Analysis	Priority:	M

RWIS.3.3.1	Cable and component labels	Validity period:	Realization and/or Usage phase
Requirement:	Cables, wires, controls, sockets, meters, signal lights and displays should be systematically, clearly and indelibly marked.		
Requirement explanations:	With the aim of being able to carry out unambiguous and smooth maintenance work.		
V&V-method:	Inspection	Priority:	M

RWIS.3.3.2	Cable protection	Validity period:	Realization and/or Usage phase
Requirement:	The enclosure must enable cables to be effectively protected against vandalism.		
Requirement explanations:	During the installation of the system, cables will be finished in a protective structure to prevent vandalism and damage from road works. It is necessary that the cable protection system belonging to the enclosure matches that of the installer.		
V&V-method:	Inspection	Priority:	M

3.3.4 Power Supply (OT ID: 4)

RWIS measuring stations need connection to power supply and – in some compositions – need to generate its own power supply by using solar or wind energy.

RWIS.4.1.1	Power Supply (Electricity network)	Validity period:	Realization and Usage phase
Requirement:	It is required that the electricity received through electrical network		
Requirement explanations:	Most of the measuring stations operate on a 230V 50 Hz +/-10% electrical supply. Some compositions can operate on solar or wind energy. RWS will point out different compositions. Contractor must be able to offer both power supply by a 230V network as well as power on the basis of solar and/or wind energy.		
V&V-method:	Inspection	Priority:	M

RWIS.4.1.2	Power socket(s)	Validity period:	Realization and Usage phase
Requirement:	It is required to have power sockets in the measuring station to connect to power supply.		
Requirement explanations:	A power supply connection (EU socket) is available for the hardware components (CPU, modem/router, other hardware components and equipment for service purposes). There should be at least 2 unswitched 230V wall sockets available for: - the power adapter belonging to the modem/router - tooling of a service engineer. They have to comply to NEN-EN 60204-1; Chapter 15.		
V&V-method:	Inspection	Priority:	M

RWIS.4.2	Alternative Power Sources	Validity period:	Realization and Usage phase
Requirement:	The RWIS measuring system shall be suitable for operation with external DC supplies such as wind turbines, solar panels or alternative power sources.		
Requirement explanations:	Variable external DC power sources such as wind and solar will be equipped with batteries of sufficient capacity to ensure continuous operation between the stated voltage range.		
V&V-method:	Demonstration	Priority:	S

RWIS.4.3	Power Supply failure	Validity period:	Realization and Usage phase
Requirement:	It is required that in case of electricity failure the measuring station will shut down.		
Requirement explanations:	The measuring station can immediately start up autonomously again when the power supply is back. Parts in the measuring station would not become defective or disrupted by power failure.		
V&V-method:	Demonstration	Priority:	M

3.3.5 Roadside Sensory measurement (OT ID: 5)

Sensors must be used to measure road and weather conditions. In this section the sensors are mentioned that relate to measurements for the road surface. RWS distinguishes embedded and remote (roadside) sensors and meteo sensors.

RWIS.5.1.1	Embedded roadside sensory measurement	Validity period:	Realization and Usage phase
Requirement:	It is required to have embedded measurements for the following parameters/values: • Road surface temperature (Priority: must have) • Road subsurface temperature (Priority: must have) • Road surface condition (Priority: must have) • Amount of de-icing agent (Priority: must have) • Water film thickness (Priority: must have) • Freezing point temperature (Priority: should have) • Black ice detection (Priority: should have)		
Requirement explanations:	It must be possible to perform sensorial measurements embedded in the road surface.: The requirements are brought together in Chapter 4.1 and derived from NPR-CEN/TS 15518:2013 and related standards.		
V&V-method:	Analysis	Priority:	M / S

RWIS.5.1.2	Embedded roadside sensory measurement: Additional measuring device	Validity period:	Realization and Usage phase
Requirement:	It is required that an additional temperature probe can be used for additional Road surface temperature measurements		
Requirement explanations:	For accurate measurements all over the year this type of sensor gives comparable data with the historic measurement of the actual GMS-system. The actual sensor is a general purpose probe, produced by TE Connectivity Sensors, MEAS model number 401 and has a resistance of 2252.4 Ohms at 25 °C.		
V&V-method:	Analysis	Priority:	M

RWIS.5.2	Remote roadside sensory measurement	Validity period:	Realization and Usage phase
Requirement:	It is required to have remotely based measurements for the following parameters/values in some of the compositions: • Road surface temperature (Priority: must have) • Road surface condition (Priority: must have) • Ice film thickness (Priority: should have) • Snow layer and water film thickness (Priority: should have) • Black ice detection (Priority: should have)		
Requirement explanations:	It must be possible to perform sensorial measurements embedded in the road surface.: The requirements are brought together in Chapter 4.1 and derived from NPR-CEN/TS 15518:2013 and related standards.		
V&V-method:	Analysis	Priority:	M / S

RWIS.5.3	IoT road temperature and chemical sensor	Validity period:	Realization and Usage phase
Requirement:	It is required to have a IoT sensor to measure road temperature and chemical amount (g/m2).		
Requirement explanations:	NPR-CEN/TS 15518:2013 and related standards. Next parameters should be measured: • Road surface temperature • Road condition • Sub surface temperature • Presence of defrosting agent g/m2		
V&V-method:	Analysis	Priority:	S

RWIS.5.4	Sensory measurement calibration	Validity period:	Usage phase
Requirement:	It is required that all sensors can be calibrated or tuned periodically. The system and its individual sensors should not require more frequent calibration or tuning once every 12 months.		
Requirement explanations:	For meteo-sensors calibration is essential to ensure reliability of the data. Contractor has to indicate the frequency to calibrate the sensors. For other roadside sensors tuning will be necessary to keep them working within the required specifications. Contractor has to indicate the tuning frequency for each sensor. The contractor will describe the calibration or tuning process for each sensor and will specify required method.		
V&V-method:	Analysis	Priority:	M

RWIS.5.5	Radiation protection	Validity period:	Realization and Usage phase
Requirement:	It is required that equipment has radiation protection		
Requirement explanations:	A common radiation protection must be included in the supply of air temperature sensors and humidity. The radiation protection must be designed in such a way that both the sensors must be able to be housed in the radiation protection.		
V&V-method:	Analysis	Priority:	M

RWIS.5.6	Operating temperatures	Validity period:	Usage phase
Requirement:	It is required that sensory equipment can withstand various temperature without loss of service		
Requirement explanations:	1) Sensors embedded in the pavement need to survive surface temperatures from – 40 °C to + 70 °C; 2) Sensory equipment placed in the air need to survive air temperatures from – 40 °C to + 60 °C.		
V&V-method:	Analysis	Priority:	M

RWIS.5.7	Chemical resistance	Validity period:	Usage phase
Requirement:	It is required that equipment has chemical resistance and can withstand chemical attack(s) without loss of service		
Requirement explanations:	All components of the road weather stations must be resistant or protected to chemicals which roads are normally exposed.		
V&V-method:	Analysis	Priority:	M

RWIS.5.8	Mechanical resistance	Validity period:	Usage phase
Requirement:	It is required that equipment has mechanical resistance and can withstand mechanical attack without loss of service		
Requirement explanations:	Sensors and other components embedded in the pavement must withstand regular mechanical stress exerted by all traffic which has to be commonly encountered on site, including rollovers by snow-clearing machines.		
V&V-method:	Analysis	Priority:	M

RWIS.5.9	Electromagnetic resistance	Validity period:	Usage phase
Requirement:	It is required that equipment has electromagnetic resistance and can withstand electromagnetic variance without loss of service		
Requirement explanations:	All components of the road weather information system shall not be affected by conventional environing electro-magnetic conditions. The equipment must fulfil related European EMC standards.		
V&V-method:	Analysis	Priority:	M

RWIS.5.10	Operation conditions	Validity period:	Usage phase
Requirement:	It is required that equipment can operate in different operating conditions without loss of service		
Requirement explanations:	The siting location of RWIS stations with atmospheric sensors alongside the road and the expected data quality due to the environment classification in principle should follow the WMO No. 8 (Annex I.B) guidelines. However, the atmospheric data sensors for road weather information systems should be able to work as best as possible under circumstances which correspond to class 4 or even class 5 of the environmental classification given in WMO No. 8, Annex I.B (CIMO guide, issue 2012, Environmental conditions). Atmospheric parameters for RWIS Stations should be measured in a distance from 1,5 m to 4 m from the road surface shoulder and in a height of 1,5 m to 4 m above road surface level. From these requirements may be waived, if the structural conditions of the road so require (bridges, etc.).		
V&V-method:	Analysis	Priority:	M

3.3.6 Meteo sensory measurement (OT ID: 6)

The RWIS measuring stations must contain sensing measurement to determine general weather characteristics.

RWIS.6.1	Air temperature	Validity period:	Realization and Usage phase
Requirement:	It is required to have an air temperature measuring sensor installed in a radiation shield with the following minimal specifications; - Range: -30 to 50°C - Resolution: 0.1°C - Accuracy: 0.2°C (for range -10 to +10°C) and 0.5°C otherwise - Measuring frequency: at least every 10 seconds - Measurement height 1.5 m		
V&V-method:	Analysis	Priority:	M

RWIS.6.2	Relative humidity	Validity period:	Realization and Usage phase
Requirement:	It is required to have a relative humidity measuring sensor - Range: 5 to 100% - Resolution: 1% RH - Accuracy: 2% at 90% RH - Response time: $t_{90} < 40$ seconds - Measurement height 1.5 m - Dewpoint temperature can be measured in accordance with WMO CIMO Guideline annex 4.b [2018]		
V&V-method:	Analysis	Priority:	M

RWIS.6.3.1	Precipitation	Validity period:	Realization and Usage phase
Requirement:	It is required to be able to detect precipitation - Detection threshold 0.02 mm/h in 1 min - Required output: precipitation detection time in seconds per reporting interval - Measurement height 1.5 m		
V&V-method:	Analysis	Priority:	M

RWIS.6.3.2	Precipitation type	Validity period:	Realization and Usage phase
Requirement:	The system should be able to report the precipitation type - The precipitation types reported shall include at least drizzle, rain, snow, ice pellets/sleet and hail - Freezing/non-freezing rain and drizzle can be determined using the air temperature measurement. Detection of solid and liquid precipitation will have been verified during field evaluations and is determined to result in at least 80% confidence, compared to certified human observers following WMO or ICAO reporting practices. Please report actual confidence level, preferably 95% or higher. - Measurement height 1.75-2.5 m		
V&V-method:	Analysis	Priority:	M

RWIS.6.3.3	Precipitation intensity	Validity period:	Realization and Usage phase
Requirement:	The system should be able to measure the precipitation intensity - Range: between 0,1 mm/h and 200 mm/h - Resolution: 0,1 mm/h - Accuracy: - $\pm 30\%$ of measured value between 0,1 mm/h and 0,5 mm/h - $\pm 20\%$ of measured value between 0,5 mm/h and 5 mm/h - $\pm 40\%$ of measured value above 5 mm/h - The accuracy is given for liquid precipitation, when measured in a 10 min period. - Solid precipitation shall be expressed in terms of the rainfall equivalent.		
V&V-method:	Analysis	Priority:	M

RWIS.6.4	Visibility	Validity period:	Realization and Usage phase
Requirement:	The system should be able to measure visibility - Range: 10 m to 2 km with resolution 10 m, Wish to 10 km (Meteorological Optical Range/MOR) - Accuracy: 10% 10 m to 2 km or 10 km, Wish 5% 10 m to 2 km - Measurement height 1.75-2.5 m		
V&V-method:	Analysis	Priority:	M

RWIS.6.5.1	Wind speed	Validity period:	Realization and Usage phase
Requirement:	Wind speed Measuring range: at least from 0,0 m/s to 35,0 m/s; Resolution: 0,1 m/s; Accuracy: ± 1 m/s (range from 1 m/s to 10 m/s); ± 10 % (otherwise); Starting value: < 1 m/s. The wind speed shall be specified as an average vector over a sliding time interval of 10 min. Gust of wind Measuring range: 0 m/s to 50 m/s; Resolution: 0,1 m/s; Accuracy: ± 1 m/s (range from 1 m/s to 10 m/s); ± 10 % (otherwise); Starting value: < 1 m/s. The gust of wind is measured over 3 seconds rolling average values with at least 4 samples per second. Note: Instruments should work in sub-zero wet conditions.		
V&V-method:	Analysis	Priority:	M

RWIS.6.5.1	Wind direction	Validity period:	Realization and Usage phase
Requirement:	The system should be able measure the wind direction - Range: 0 to 359° - Resolution: 1° - Accuracy: 5° - Starting threshold: ≤ 1 m/s - Measurement height > 2m		
V&V-method:	Analysis	Priority:	M

RWIS.6.6	Other Sensors	Validity period:	Realization and Usage phase
Requirement:	The system could be able to be equipped with other meteorological sensors that provide additional information about the weather and road conditions.		
Requirement explanations:	Additional meteorological parameters other than RWIS 6.1 - 6.5		
V&V-method:	Analysis	Priority:	C

RWIS.6.7.1	Sensor calibration	Validity period:	Usage phase
Requirement:	It is required to be able to calibrate and adjust the meteorological sensors separately at an external location by a third party.		
Requirement explanations:	The current meteorological sensors from the road weather system are calibrated by the KNMI, this practice needs to be able to continue with the future road weather system. Individual sensors should be detachable from the system. The result of the adjustment should be stored in and retrievable from the sensors / system.		
V&V-method:	Analysis	Priority:	M

RWIS.6.7.2	Initial calibration	Validity period:	Usage phase
Requirement:	It is required that the sensors are initially calibrated within specification on delivery.		
Requirement explanations:	When the instruments are delivered it must be possible to immediately use the sensors operationally.		
V&V-method:	Test accredited institute	Priority:	M

3.3.7 Other Functions (OT ID: 7)

RWS has requirements to install camera's, to detect traffic flow and to communicate directly from measuring station with passing vehicles (via wifi-p).

RWIS.7.1.1	Existing camera's	Validity period:	Realization and/or Usage phase
Requirement:	It is required to be able to add existing camera's to the new measuring stations		
Requirement explanations:	It must be possible to connect the existing cameras (Mobotix Models M10 and M12) to the new RWIS measuring station to support visual monitoring. The central GMS application "Winter Control" issues a command to send a snapshot of the camera image.		
V&V-method:	Analysis and test Contractor	Priority:	S

RWIS.7.1.2	New camera's	Validity period:	Realization and/or Usage phase
Requirement:	It is required to be able to add new camera's to be delivered by the Contractor		
Requirement explanations:	It must be possible to connect new cameras to the new RWIS measuring station to support visual monitoring: Mobotix M12 or equivalent.		
V&V-method:	Analysis and test Contractor	Priority:	M

RWIS.7.2	Interface with Sprinkler systems	Validity period:	Realization and/or Usage phase
Requirement:	It must be possible to connect the measuring station to external systems.		
Requirement explanations:	An RWIS roadside system must be able to control an external system on the basis of its own measured values in combination with signals from the RWIS data system. Such an external system can be a sprinkler system or a warning sign. The actual interface is a serial interface. This interface needs to be developed jointly. The design and implementation is based on existing sprinkler configurations and documentation from the current RWIS.		
V&V-method:	Analysis	Priority:	S

3.3.8 Security (OT ID: 8)

With respect to security issues next requirements are made.

RWIS.8.1.1	Cyber security	Validity period:	Usage phase
Requirement:	6.1.2: Information systems involved with the Performance must have been organised with an authorisation model. REMARK: If the Performance consists exclusively of the purchase of information systems, this text should be interpreted as disposing of the functionality of being able to implement the requirement, as standard.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.2	Cyber security	Validity period:	Usage phase
Requirement:	6.2.1: Mobile equipment in use by Staff must save data, related to the Performance, encrypted, in accordance with the classification of these data {4}, by means of cryptographic implementation, where only algorithms and settings are used with the reading 'good', from the latest version of the NCSC document Directives for <i>Transport Layer Security</i> (TLS) {3}.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.3	Cyber security	Validity period:	Usage phase
Requirement:	9.1.2: Information systems involved with the Performance will only contain the functional accounts required for software as standard, or accounts supplied by the prevailing authorisation process		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.4	Cyber security	Validity period:	Usage phase
Requirement:	9.4.1: Accounts on information systems involved with the Performance only have access rights linked to roles allocated via the prevailing authorisation process.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.5	Cyber security	Validity period:	Usage phase
Requirement:	9.4.2: Information systems involved with the Performance have a secured login procedure, in conformity with the <i>Directive for logical access control</i> {6} by Client. NOTE: If the Performance should only consist of the purchase of information systems, this text should be interpreted as disposing of the functionality of being able to implement the requirement, as standard.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.6	Cyber security	Validity period:	Usage phase
Requirement:	9.4.3: Information systems involved with the Performance have password management provisions that force the use of strong passwords, that at least comply with the Policy for password use {1} by Client. NOTE: If the Performance should only consist of the purchase of information systems, this text should be interpreted as disposing of the functionality of being able to implement the requirement, as standard.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.7	Cyber security	Validity period:	Usage phase
Requirement:	11.1.1: Information processing facilities involved with the Performance are physically secured, at least, in accordance with the Directives for physical security {17} by Client.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.8	Cyber security	Validity period:	Usage phase
Requirement:	11.2.1: Information systems involved with the Performance are protected against loss, damage, theft, compromise or interruption, implementing at least the requirements from the <i>Directive for physical security</i> {17} by Client.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.9	Cyber security	Validity period:	Usage phase
Requirement:	12.1.4: Counterparty must have separated development-, test-, production- and, if ordered, educational environments, demonstrably (logically or physically) for all information systems involved with the Performance. Separation implies that all the necessary precautions should be taken to prevent interference between the environments and that the reliability of the production systems is guaranteed. The acceptance and educational environments must be representative for the production environment, to such an extent that the testing or practice results reflect the functionality's behaviour in the production environment.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.10	Cyber security	Validity period:	Usage phase
Requirement:	14.1.1: In the software, which is part of information systems involved with the Performance, at least the measures named in the CIP document <i>Grip on SSD – Security requirements for (web)applications</i> {10} were implemented. NOTE: If the Performance should only consist of the purchase of information systems, this text should be interpreted as disposing of the functionality of being able to implement the requirement, as standard.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.11	Cyber security	Validity period:	Usage phase
Requirement:	14.1.SC-4b: Information systems involved with the Performance that will be installed in the Client's infrastructure must make use of the Client's standard network services {14}. NOTE: If the Performance should only consist of the purchase of information systems, this text should be interpreted as disposing of the functionality of being able to implement the requirement, as standard.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.12	Cyber security	Validity period:	Usage phase
Requirement:	14.2.8a: Information systems involved with the Performance were demonstrably tested on vulnerabilities by means of common testing methods, before being taken into production. In the event of software, the test methods used will at least comprise the <i>OWASP Top-10</i> {13}.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.1.13	Cyber security	Validity period:	Usage phase
Requirement:	14.2.9a: Information systems involved with the Performance must have undergone an acceptance test for all the system requirements stated in this contract, before being taken into production.		
V&V-method:	Test Contractor	Priority:	M

RWIS.8.2	Security AVG	Validity period:	Realization and/or Usage phase
Requirement:	It is required to comply with the AVG (Privacy)		
Requirement explanations:	The contractor meets the requirements set by the client as mentioned in AVG (GDPR legislation).		
V&V-method:	Analysis	Priority:	M

RWIS.8.3	Location security	Validity period:	Realization and/or Usage phase
Requirement:	It is required that each measuring system can physically only be accessed with a key.		
Requirement explanations:	The locking system must comply to the EURO PROFILE 30/10 lock system. RWS will supply the necessary locks.		
V&V-method:		Priority:	M

3.3.9 Maintenance (OT ID: 9)

With respect to maintenance of RWIS measuring stations the following requirements are valid.

RWIS.9.1.1	Software updates	Validity period:	Usage phase
Requirement:	It is required to supply software updates		
Requirement explanations:	Contractor supplies software (updates) for the measuring stations via, for example, a software repository. Deployment of software can be done local and remote and by others than Contractor. Software updates should apply to RWS standards. RWS may refuse specific updates.		
V&V-method:	Test Contractor	Priority:	M

RWIS.9.1.2	Release notes	Validity period:	Usage phase
Requirement:	It is required to supply release notes with the software updates		
Requirement explanations:	Contractor supplies release notes with impact analysis with every software update.		
V&V-method:	Analysis	Priority:	M

RWIS.9.2	Monitoring information	Validity period:	Usage phase
Requirement:	It is required that the monitoring information contains a detailed log file		
Requirement explanations:	The measuring station CPU keeps a log with all occurring incidents / errors. This information can be retrieved via RWIS data platform.		
V&V-method:	Demonstration	Priority:	M

RWIS.9.3	Settings	Validity period:	Usage phase
Requirement:	It is required that the measuring station settings can be checked, changed and backed up.		
Requirement explanations:	The measuring station configuration settings must be accessible for maintenance, monitoring and back up purposes via RWIS data platform.		
V&V-method:	Demonstration	Priority:	M

RWIS.9.4.1	API Interface to RWIS data platform	Validity period:	Usage phase
Requirement:	The API interface has to support all functions of RWIS		
Requirement explanations:	API interface must operate all processes (measurement data, alarms, management, configuration settings, monitoring, software updates identify measuring station, etc.)		
V&V-method:	Demonstration	Priority:	M

RWIS.9.4.2	API Interface to RWIS data platform	Validity period:	Usage phase
Requirement:	The API interface has to be based on international open standards		
Requirement explanations:	The API has to be based on international open standards. RWS demands IETF protocols Https or Coaps; RWS prefers REST above SOAP; The messages that are exchanged in the API interface must be validated, for which message schedules must be supplied by the supplier in the form of XSDs.		
V&V-method:	Demonstration	Priority:	M

RWIS.9.5	Knowledge support	Validity period:	Usage phase
Requirement:	The contractor has to be available for support RWS and its maintenance contractors		
Requirement explanations:	Contractor has to be available too for support and advice. During installation of new RWIS systems contractor should respond substantially within 24 hours, Once installation is completed this term should be within 48 hours, at normal working days.		
V&V-method:	Demonstration	Priority:	M

RWIS.9.6	Training	Validity period:	Usage phase
Requirement:	All parties involved in the management, maintenance and construction of the system must be trained by the contractor, now and in the future.		
Requirement explanations:	All parties involved in the management, maintenance and construction of the system must be able to perform their work professionally and effectively.		
V&V-method:	Demonstration	Priority:	M

RWIS.9.7	Documentation	Validity period:	Usage phase
Requirement:	Good and complete system documentation must be available, in such a way that all parties involved in management, maintenance and construction can carry out their work properly.		
Requirement explanations:	Good and complete system documentation is essential for all parties involved in management, maintenance and construction can carry out their work effectively and properly.		
V&V-method:	Demonstration	Priority:	M

3.4 Interface requirements

3.4.1 Interface requirements

With respect to maintenance of RWIS measuring stations the following requirements are valid.

RWIS.10.1	Internal interface of existing GMS chain	Validity period:	Usage phase
Requirement:	The RWIS system must function as a whole, internally and to the central GMS application "Winter control".		
Requirement explanations:			
V&V-method:	Demonstration	Priority:	M

RWIS.10.2	no disturbance outside road infrastructure system	Validity period:	Usage phase
Requirement:	The RWIS system should not cause any malfunctions in the operation of systems outside the road infrastructure system.		
Requirement explanations:			
V&V-method:	Demonstration	Priority:	M

RWIS.10.3	Connection to adjacent objects and functionalities	Validity period:	Usage phase
Requirement:	The RWIS system must connect to adjacent objects and functionalities in such a way that the cross-system traffic network and environmental functions can be performed without hindrance with the same quality level.		
Requirement explanations:			
V&V-method:	Demonstration	Priority:	M

RWIS.10.4	Different types of pavement	Validity period:	Usage phase
Requirement:	The RWIS system must be suitable for measuring and monitoring types of pavements		
Requirement explanations:	The most commonly used pavement on the Dutch main road network is of the ZOAB type. In addition, DAB, (high strength) concrete.		
V&V-method:	Demonstration	Priority:	M

RWIS.10.5	measuring with continuous traffic flows	Validity period:	Usage phase
Requirement:	The RWIS system must be suitable for taking measurements on roads and pavements, while traffic intensity is 2000 vehicles per hour.		
Requirement explanations:			
V&V-method:	Demonstration	Priority:	M

4 Sensory measurement

This chapter describes respectively the requirements for roadside sensory measurement and for meteo sensory measurement.
The requirements in 4.1 are based on guidelines and standards NPR-CEN/TS 15518:2013 and its successors.

4.1 Roadside sensory measurement

<i>A</i>	Temperature surface Embedded	Measuring range: -30 °C to +60 °C Resolution: 0.1 °C Accuracy: ± 0.2 °C (range from -15.0 °C to +10.0 °C) ± 0.8 °C (otherwise) Response time: 6 min (90% transient)
<i>B</i>	Temperature sub surface (body) Embedded	Measuring range: -25 °C to +60 °C Resolution: 0.1 °C Accuracy: ± 0.3 °C (range from -5.0 °C to +5.0 °C)
<i>C</i>	Temperature surface Embedded IoT sensor	Measuring range: -30 °C to +60 °C Resolution: 0.1 °C Measuring frequency: every 10 minutes Lifetime: 3-5 years (battery) Accuracy: ± 0.2 °C Depth: 0 and 30 cm
<i>D</i>	Temperature (surface) Remote (IR)	Measuring range: -30 °C to +60 °C Resolution: 0.1 °C Accuracy: ± 0.8 °C (range at 0°C, isotherm condition) ± 1.0 °C (range from -5.0 to +5.0°C) ± 2.0 °C (otherwise)
<i>E</i>	Road condition Remote (IR)	Dry: no humidity within the measurement area of the sensor Moist: from 0,015 mm water film thickness Wet: from 0,055 mm water film thickness Ice: whole water surface content frozen. Water equivalent more than 0,015 mm. Snow: dry, packed or wet snow more than 0,015 mm.

Annex A: references

The list below shows the standards that are referred to in the Demand Specification Requirements and that must be used in accordance with the reference. This concerns documents that are mentioned in the requirement tables in the box 'requirement:' or the box 'explanation of requirement:'.

In this requirement document NEN (IEC; ISO) the following standards are quoted:

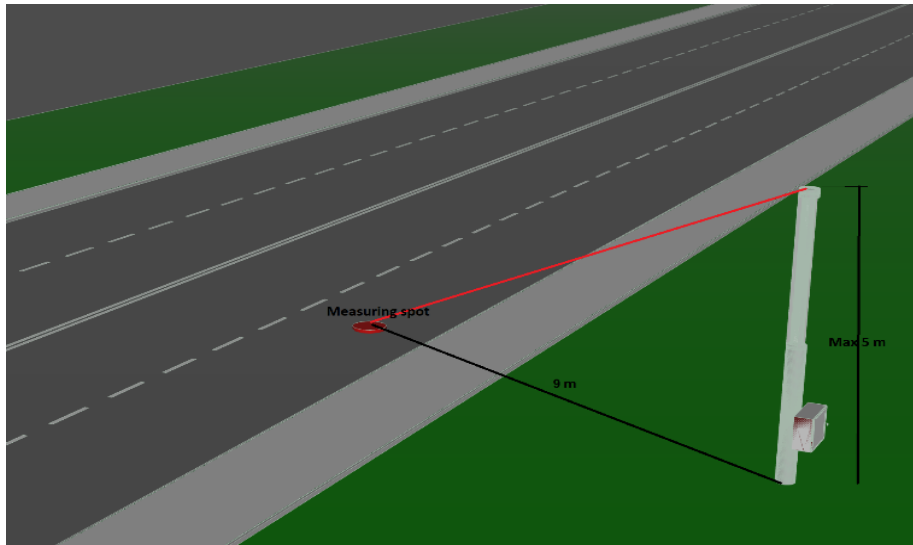
1. NEN-EN 12767:2019 Passive safety of support structures for road equipment. Requirements and test methods
2. NPR-CEN/TS 15518:2013: Winter maintenance equipment - Road weather information systems.
3. Guide to Instruments and Methods of Observation (WMO, 2018)
4. ISO 17714: Meteorology — Air temperature measurements — Test methods for comparing the performance of thermometer shields/screens and defining important characteristics
5. NEN 1010: Elektrische installaties voor laagspanning ; Electrical installations for low-voltage:
6. NEN 3140 : Bedrijfsvoering van elektrische installaties – Laagspanning; Operation of electrical installations - Low voltage
7. NEN- EN 12767: Passieve veiligheid van constructies voor wegwitruising - Eisen en beproevingsmethoden ; Passive safety of support structures for road equipment - Requirements and test methods
8. NEN-EN-IEC 61439: Low-voltage switchgear and controlgear assemblies Zou overeen komen met NEN 3140. Het bestaat uit 7 delen.
9. NEN-EN-IEC 62305: Bliksembeveiliging; Lightning protection
10. NEN-EN 50293: EMC requirements : Verkeersregelinstallaties- Elektromagnetische compatibiliteit; Road traffic signal systems – Electromagnetic compatibility
11. NEN-EN 50561-1: 2013 / C1: 2015, Class A / B: emission requirements
12. NEN-EN 55024: 2010 / A1: 2015; the immunity requirements
13. [CSIR 2013, DIN V ENV 1627]: vandalism-resistant in accordance with resistance class 2: C / M3 with burglar resistance of 3 minutes
14. NEN-EN 50102: 1995 / A1: 1998 : impact and scratch resistant in accordance with class IK07 in accordance with ("Degrees of protection of electrical equipment enclosures against external mechanical impacts"
15. IEC 60529: 2001
16. RLN00003 version 5: resistant to vibrations in accordance.
17. IEC 60068 2-5: resistant to solar radiation according to; simulated solar radiation (procedure A, temperature class A, test duration: 3 cycles).

Annex B: Requested solutions for pricing purposes

Annex B describes the three system configurations for which a price must be offered in bidders Financial Offer (see Appendix E: Format Financial Offer).

1. System "Basic"

Mast with remote sensors

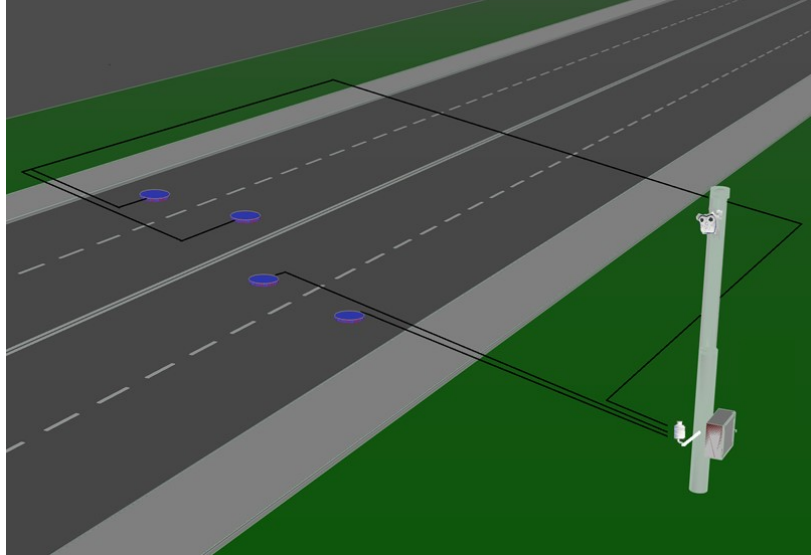


For the financial offer a solution is asked for next situation:

- The system is powered by mains (230V 50Hz).
- Measuring parameters:
 - Road surface temperature
 - Road condition (Wet, moist, dry, slush, snow, ice)
- Pavement type is ZOAB
- Height of the mast is 5 meters
- Distance between mast and measuring spot is 9 meters
- One measuring spot
- Mast, fixation system and general external cabling are excluded
- All additional components needed for an operational period of 10 years are included.

2. System "Standard"

Mast with measuring station, meteo and embedded road sensors, Camera

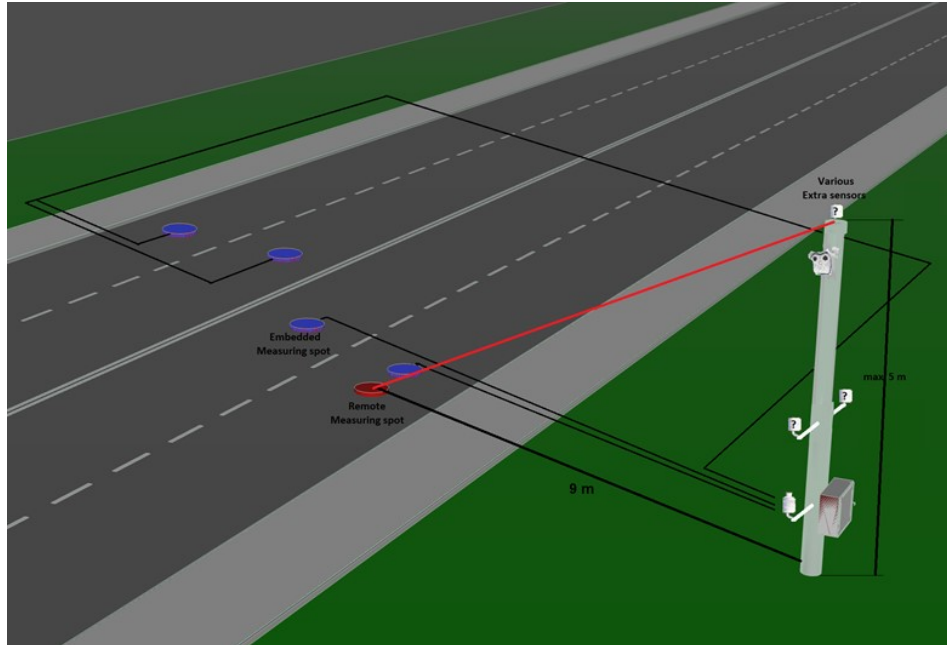


For the financial offer a solution is asked for next situation:

- The system is powered by mains (230V 50Hz).
- Measuring parameters:
 - Meteo measurements
 - Air temperature
 - Relative air humidity
 - Dew point temperature
 - Precipitation Presence / Precipitation Intensity / Precipitation Type
 - Road surface temperature
 - Road condition (Wet, moist, dry, slush, snow, ice)
 - Water film thickness
 - Amount of de-icing agent
 - One camera
- Pavement type is ZOAB
- Height of the mast is 5 meters
- Road (surface) measurements four locations with embedded sensors.
- Mast, fixation system and general external cabling are excluded
- All additional components needed for an operational period of 10 years are included.

3. **System "Plus"**

Mast with measuring station made up of all components of the basic and standard measuring station, possibly supplemented with additional sensors



For the financial offer a solution is asked for next situation:

- The system is powered by mains (230V 50Hz).
- Measuring parameters:
 - Meteo measurements
 - Air temperature
 - Relative air humidity
 - Dew point temperature
 - Precipitation Presence / Precipitation Intensity / Precipitation Type
 - Wind: speed, direction, gust
 - Visibility
 - Road surface temperature
 - Road condition (Wet, moist, dry, slush, snow, ice)
 - Water layer measurements (only for embedded sensors)
 - Amount of de-icing agent (only for embedded sensors)
 - One camera
- Pavement type is ZOAB
- Height of the mast is 5 meters
- Distance between mast and measuring spot is 9 meters
- Road surface measurements on 4 locations with embedded sensors and one location with remote sensors.
- Mast, fixation system and general external cabling are excluded
- All additional components needed for an operational period of 10 years are included.