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BUREAU OF INDIAN STANDARDS
DRAFT FOR COMMENTS ONLY

भारतीय मानक *मसौदा*

सिंचाई तकनीकों — सिंचाई के लिए स्थानीयकृत और दूरस्थ निगरानी और नियंत्रण प्रणाली — परीक्षण
(ISO 21622-2 : 2023, संशोधित)

Draft ***Indian Standard***

IRRIGATION TECHNIQUES — LOCALISED AND REMOTE MONITORING AND CONTROL SYSTEM FOR IRRIGATION — TESTS
(ISO 21622-2 : 2023, MOD)

ICS **65.060.35**

Farm Irrigation and Drainage Systems Sectional Committee, FAD 17	Last date for Comments: **19 February 2025**

FOREWORD

(*Formal clause will be added later*)

Monitoring and Control System for Irrigation is a technology-driven solution designed to enhance the efficiency and management of irrigation processes in agriculture. The system typically involves the integration of sensors, communication devices, and control mechanisms to enable localised as well as remote monitoring and control of irrigation systems. By optimizing irrigation schedules based on real-time data, these systems help in reducing water wastage and promote efficient water use.

The purpose of the evaluation of the controller and local control unit / remote unit is intended to provide an opinion to serve as a guide to determine the overall functionality and operability of the controller and local / remote monitoring system.

This document specifies the tests required to ensure the functionalities for the automated and/or remotely operated irrigation system. This document concerns the local control unit / remote unit of irrigation control systems.

This Indian Standard is a modified adoption of ISO 21622-2 : 2023 'Irrigation techniques — Remote monitoring and control for irrigation — Part 2: Tests' issued by the International Organization for Standardization (ISO), however, the structure of ISO 21622-2 : 2023 has been retained.

The standard has been modified to align with national practices and meet the specific needs of the micro-irrigation industry, aiming to increase its acceptance within the country. The technical modifications include:

a) Definition of local control unit has been added.

b) Considering that local control and monitoring units are commonly used in micro-irrigation systems in India, the term ‘remote unit’ in the ISO standard has been substituted with ‘local control unit/remote unit’.

For the purpose of deciding whether a particular requirement of the standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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IRRIGATION TECHNIQUES — LOCALISED AND REMOTE MONITORING AND CONTROL FOR IRRIGATION — TESTS

1 SCOPE

This document specifies the tests necessary to assess the functionality and robustness of local control units and/or remote units used in irrigation control systems.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
IS/ISO/IEC 17025 : 2017	General requirements for the competence of testing and calibration laboratories (*second revision*)

3 TERMS DEFINITIONS AND SYMBOLS

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1 *Control Centre (CC)* — Place to centralise the communications of all local control unit / remote units

Note 1 to entry — It is usually accompanied by a system for control and monitoring of local as well as remote equipment

3.1.2 *Local Control Unit (LCU)* — Microprocessor-based device that allows control and monitoring of the equipment connected to it through hardwire.

3.1.3 *Remote Unit (RU)* — Microprocessor-based device that allows information to be obtained from an environment and sent remotely to where it can be processed.

3.1.4 *Solenoid Valve* (*SV*) — Controllable element which, after receiving a signal from the local control unit or remote unit, changes its status by allowing or not allowing the passage of water.

3.1.5 *Nominal Pressure (NP)* **—** Working pressure of a hydraulic element

3.1.6 *Water Passage Detector (WPD)* — Element confirming the passage of water through a volumetric valve.

3.1.7 *Limit Switch Detector (LSD)* — Element that ensures that a volumetric valve opens fully.

3.1.8 *Active Pulse Time* (T_{ON}) — Time a pulse emitter is sending an active signal.

3.1.9 *Inactive Pulse Time (T_{OFF})* — Time during which a pulse emitter does not send any signal.

3.2 Symbols

T	time
T_{CNA}	maximum time for the counter to detect opening of SVs
T_{CNC}	maximum time for the counter to detect SV closure
T_{FCA}	maximum time for LSD to detect opening of volumetric valve
T_{FCC}	maximum time for LSD to detect volumetric valve closing
T_{OFF}	inactive pulse time
T_{ON}	active pulse time
T_{PAA}	maximum time for WPD to detect opening of volumetric valve
T_{PAC}	maximum time for WPD to detect volumetric valve closure
V_{MIN}	minimum operating voltage of the local control unit / remote unit
V_{NOM}	nominal operating voltage of the local control unit / remote unit
V_{MAX}	maximum operating voltage of the local control unit / remote unit
V_{OP}	full operating voltage

4 FUNCTUNALITY

4.1 General

The functionality tests detailed in this clause are intended to verify that the data provided by the manufacturers in the questionnaire (*see* Annex A) agree with the data obtained in the laboratory tests detailed in this document.

After each and every functionality test performed, it shall be verified that the local control unit / remote unit is still operational, fulfilling the basic functions, as defined by the manufacturer in the questionnaire (*see* Annex A), by checking it at the nominal voltage (V_{NOM}) of the equipment, unless otherwise stated by the manufacturer.

The manufacturer shall indicate which basic functions the local control unit / remote unit shall maintain, but as a minimum, it shall comply with the following:

a) Counter reading (if available);
b) Solenoid valve actuation (opening and closing);
c) Maintains;
    i) Time;
    ii) Counter readings (if available);
    iii) Programming.

These verifications shall be defined by the manufacturer of the local control unit / remote unit as they depend on the characteristics of the local control unit or remote unit.

Of all the tests indicated in the document, only those that apply shall be carried out, depending on the characteristics of the equipment to be tested [characteristics defined by the manufacturer through the questionnaire (*see* Annex A)].

All tests described in **4** should be conducted by a laboratory conforming to IS/ISO/IEC 17025.

4.1.1 *Acceptance Criteria*

The test shall be considered satisfactory if the variation between the values indicated by the manufacturer and the values obtained in the laboratory tests does not exceed:

a) ± 5 percent of the value indicated by the manufacturer in the questionnaire (*see* Annex A) for the data of :

   Consumption, voltage, current, short-circuit and open-circuit resistance and on the lowest and highest analogue signal value (added to the margin of error described by the manufacturer);

b) ±10 percent of the value indicated by the manufacturer in the questionnaire (*see* Annex A) in:

   Frequency and duration of pulses (to be recorded).

4.2 Power Tests

4.2.1 *Consumption*

4.2.1.1 *Purpose of the test*

The purpose of these tests is to measure the power consumption of the local control unit / remote unit in its different operating modes and compare it with the data provided by the manufacturer. The manufacturer shall provide information on the power used by its equipment, its operating range (nominal, minimum and maximum voltage) and, where applicable, on the built-in protections and alarms.

4.2.1.2 *Preparation*

In order to measure the consumption of the local control unit or remote unit, the part corresponding to the communications module, if available shall be separated, as far as possible, into each of the states in which it may be. The manufacturer shall provide in the questionnaire (*see* Annex A) a definition and a way to enter each of the possible states to enable the measurements to be carried out.

EXAMPLE sleeping, standby, receiving, transmitting.

In all tests in this sub clause, the power consumption shall be measured for each of its power modes. Upon completion of each test, the test sequence shall be performed to verify the correct operation of the local control unit / remote unit.

4.2.1.3 *Test procedure*

4.2.1.3.1 *Consumption at nominal full operating voltage (V_{OP}) in the different operating modes defined by the manufacturer*

a) Power the local control unit / remote unit by connecting an external adjustable power supply to the corresponding power input of the equipment under test.

b) Adjust the power supply until the nominal full operating voltage indicated by the manufacturer in the questionnaire (*see* Annex A) is reached.

c) Measure the power consumption in each of the local control unit/ remote unit's operating modes, as specified by the manufacturer.

4.2.1.3.2 *Power consumption at the minimum full operating voltage (V_{OP}) in the idle operating mode defined by the manufacturer*

a) Power the local control unit / remote unit by connecting an external, adjustable power supply to the corresponding power input.

b) Adjust the power supply until it reaches the minimum full operating voltage specified by the manufacturer

c) Measure the power consumption in the idle operating mode defined by the manufacturer.

4.2.1.3.3 *Consumption at maximum full operating voltage (V_{OP}) in idle mode as defined by the manufacturer*

a) Power the local control unit / remote unit by connecting an external adjustable power supply to the corresponding power input.

b) Adjust the power supply to the maximum operating voltage specified by the manufacturer.

c) Measure the power consumption in the idle operating mode defined by the manufacturer.

4.2.1.4 *Acceptance criteria*

All tests in this sub clause shall be considered satisfactory if the variation between the values indicated by the manufacturer and the values obtained in the laboratory measurement does not exceed ± 5 percent of the consumption specified by the manufacturer in the questionnaire (*see* Annex A).

4.2.2 *Power Loss*

4.2.2.1 *Purpose of the test*

The aim of the group of tests described in this sub clause is to check that the sudden loss of power to the local control unit / remote unit does not lead to a loss of critical values, such as irrigation schedules and counter values.

When power is restored, the local control unit/ remote unit shall continue to operate according to the manufacturer's instructions.

4.2.2.2 *Scheduled irrigation test Case A — Test procedure*

a) Schedule irrigation of sufficient duration (as defined by the manufacturer in their local control unit/ remote unit operating manual) to perform this test.

b) Switch off the power to the local control unit/ remote unit at least 3 min before the irrigation programme starts.

c) Re-power after 1 min, ensuring that there is sufficient time for the local control unit / remote unit to fully reset and become fully operational, before scheduled irrigation begins.

d) Record the actions carried out:

— Execution of irrigation: YES/NO

- YES: record the delay time, if any, execution of the irrigation and the duration of the irrigation.

— Alarm generation: YES/NO

- YES: record the type of alarm.

4.2.2.3 *Scheduled irrigation test Case B — Test procedure*

a) Schedule irrigation of sufficient duration (as defined by the manufacturer in their local control unit/ remote unit operating manual) to perform this test.

b) Remove power to the local control unit/ remote unit at least 1 min before irrigation begins.

c) Re-power 1 min after the programmed start of irrigation.

d) Record the actions carried out:

— Execution of irrigation: YES/NO

- YES: record the delay time, if any, in the execution of the irrigation and the duration of the irrigation.

— Alarm generation: YES/NO

- YES: record the type of alarm.

4.2.2.4 *Scheduled irrigation test Case C — Test procedure*

a) Schedule irrigation of sufficient duration (as defined by the manufacturer in their local control unit/ remote unit operating manual) to perform this test.

b) Switch off the voltage at least 1 min before the scheduled irrigation starts.

c) Re-power at least 1 min after the end of the irrigation time.

d) Record the actions carried out:

— Execution of irrigation: YES/NO

- YES: record the delay time, if any, in the execution of the irrigation and the duration of the Irrigation.

— Alarm generation: YES/NO

- YES: record the type of alarm.

4.2.2.5 *Scheduled irrigation test Case D — Test procedure*

a) Schedule irrigation of sufficient duration (as defined by the manufacturer in their local control unit/ remote unit operating manual) to perform this test.

b) Interrupt power supply after 1 min from the start of the programmed irrigation time.

c) Re-power, 1 min before the scheduled end time.

d) Record the actions carried out:

— Execution of irrigation: YES/NO

- YES: record the delay time, if any, in the execution of the irrigation and the duration of the irrigation.

— Alarm generation: YES/NO

- YES: record the type of alarm.

4.2.2.6 *Scheduled irrigation test Case E — Test procedure*

a) Schedule irrigation of sufficient duration (as defined by the manufacturer in their local control unit/ remote unit operating manual) to perform this test.

b) Interrupt the power supply 1 min before the scheduled irrigation end time.

c) Re-power 1 min after the scheduled end time.

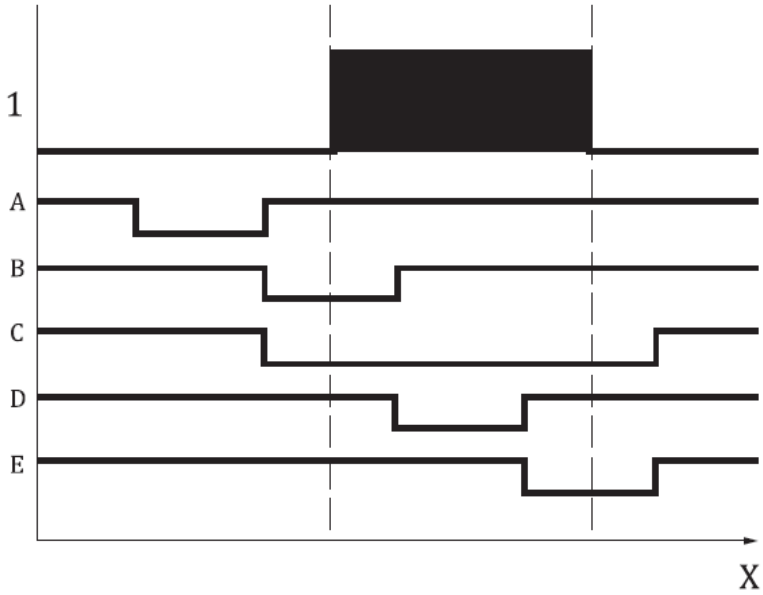
d) Record the actions carried out by the local control unit / remote:

— Execution of irrigation: YES/NO

- YES: record the delay time, if any, in the execution of the irrigation and the duration of the irrigation.

— Alarm generation: YES/NO

- YES: record the type of alarm.



Key

X	time
1	programme
A	case A
B	case B
C	case C
D	case D
E	case E

FIG. 1 SCHEDULED IRRIGATION

4.2.2.7 *Counting pulse test with battery back up*

4.2.2.7.1 *General*

This test shall only be performed if the local control unit / remote unit has a backup power supply for the counter readings.

4.2.2.7.2 *Test procedure*

a) After reading the counter input (X) of the local control unit / remote unit, switch off the power supply for 1 min.

b) During this time, send fifteen pulses spaced 4 s each (unless the manufacturer in the questionnaire (*see* Annex A) indicates a longer time spacing between pulses), to the input of the same counter (X) of the local control unit / remote unit.

c) Check the count performed by the local control unit / remote unit on the abovementioned input.

4.2.2.7.3 *Acceptance criteria*

The test shall be considered successful if the pulse count on all counter inputs is equal to the fifteen pulses sent.

Repeat this test as many times as there are counter inputs to the local control unit / remote unit.

4.2.2.8 *Battery replacement test*

4.2.2.8.1 *Test procedure*

a) Write down the counter value for each of the digital inputs of the local control unit / remote unit.

— For devices that are able to run an irrigation schedule:

— Schedule an irrigation that is not to be run immediately.

b) Disconnect the main battery (ies), for 5 min, following the manufacturer's instructions.

c) Reconnect the main battery (ies), following the manufacturer's instructions.

d) Record the values maintained by the equipment.

4.2.2.8.2 *Acceptance criteria*
If a local control unit / remote unit with battery backup is being tested the values shall be the same as recorded before the loss of power.

If testing a local control unit / remote unit without battery backup the performance of the local control unit / remote unit shall be in accordance with the manufacturer's specifications in the questionnaire (*see* Annex A).

4.3 Solenoid Valve Outputs

4.3.1 *Opening/Closing Solenoid Valves*

4.3.1.1 *Purpose of the test*

The purpose of these tests is to check the behaviour of the local control unit / remote units when acting on the solenoid valve (SV) outputs.

4.3.1.2 *Test procedure*

These tests consist of sending open and close commands through the circuit that triggers the solenoid.

Three types of test shall be simulated.

a) Simulation of solenoid valve with resistors — the test shall be performed by connecting a physical resistor of the Ohms corresponding to that specified by the manufacturer of the local control unit / remote unit.

b) Real unpressurised SV test — the test shall be performed by connecting a commercial SV within the range of voltages and pulse widths specified by the local control unit / remote unit manufacturer to the SV output of the local control unit / remote unit.

c) Test with real solenoid valve and nominal pressure (NP) — the test is performed by connecting a commercial SV to the solenoid valve output of the local control unit / remote unit, which shall be connected, in turn, to a hydraulic circuit.

In all 3 cases, send ten commands (5 openings and 5 closings) to each solenoid valve output of the local control unit / remote unit.

If the local control unit / remote unit can trigger solenoid valves of different voltages, it shall be tested with the most characteristic values of the market, according to the questionnaire (*see* Annex A), by adjusting the parameters in the local control unit / remote unit.

4.3.1.3 *Acceptance criteria*

The test is considered valid when:

a) The 5 openings/closings are confirmed in the manufacturer's control software in all cases;

b) The actuation of the solenoid valve is confirmed in the case of the test without hydraulic pressure;

c) The actuation of the SV is confirmed in the case of the test with a real solenoid valve and at NP, by the passage of water.

In all cases, after the tests have been carried out, the local control unit / remote shall continue to operate as usual.

4.3.2 *Voltage and Current, Simulating SV*

4.3.2.1 *Purpose of the test*

The purpose of these tests is to check the voltage and power consumption values of the local control unit / remote unit when opening and closing solenoid valves (SV).

These tests shall be carried out at the voltages and currents specified by the manufacturer.

4.3.2.2 *Test procedure*

4.3.2.2.1 *Maximum current for SV tripping at nominal operating voltage (V_{OP}) with trip voltage NOT configurable*

a) Power the local control unit / remote unit by connecting an external adjustable power supply to the corresponding power input of the local control unit / remote unit under test.

b) Adjust the power supply until the nominal operating voltage indicated by the manufacturer is reached.

c) Perform solenoid valve opening and closing from the local control unit / remote unit.

d) Measure the tripping voltage and the maximum current (discarding the first 100 ms of the measurement in case of AC solenoid so, the inrush current is not taken into account) delivered by the local control unit / remote unit through the corresponding solenoid valve output. A shunt 100 times smaller than the simulated solenoid valve connected in series shall be used for the measurement.

4.3.2.2.2 *Maximum current for SV tripping at nominal operating voltage with configurable minimum trip voltage*

This test shall only be performed if the local control unit / remote unit has configurable solenoid valve voltage.

a) Power the local control unit / remote unit by connecting an external adjustable power supply to the corresponding power input.

b) Adjust the power supply until the nominal operating voltage indicated by the manufacturer is reached.

c) Set the minimum solenoid valve trip voltage on the local control unit / remote unit.

d) Perform the opening and closing from the local control unit / remote unit.

e) Measure the tripping voltage and the maximum current delivered by the local control unit / remote unit through the corresponding solenoid valve output. For the peak current measurement, a resistor of calculated value shall be connected and measured in a shunt at least 100 times smaller than the simulated SV, connected in series.

4.3.2.2.3 *Maximum current for solenoid valve actuation at nominal operating voltage with configurable maximum tripping voltage*

This test shall only be performed if the local control unit / remote unit has configurable solenoid valve voltage.

a) Power the local control unit / remote unit by connecting an external, adjustable power supply to the corresponding power input.

b) Adjust the power supply until the nominal operating voltage is reached.

c) Set the maximum solenoid valve trip voltage on the local control unit / remote unit. Opening and closing is performed from the local control unit / remote unit.

d) Measure the tripping voltage and the maximum current delivered by the local control unit / remote unit through the corresponding solenoid valve output. For the peak current measurement, a resistance of calculated value shall be connected and measured in a shunt at least 100 times smaller than the simulated solenoid valve, connected in series.

4.3.2.3 *Acceptance criteria*

The test shall be considered successful if the variation between the values indicated by the manufacturer and the values obtained in the laboratory measurement does not exceed ± 5 percent of the value given by the manufacturer in the questionnaire (*see* Annex A) for voltage and consumption data for SV tripping.

4.3.3 *Solenoid valve pulse width duration*

4.3.3.1 *Purpose of the test*

The purpose of these tests is to determine the tripping time of the local control unit / remote unit on the solenoid valves.

4.3.3.2 *Test procedure*

4.3.3.2.1 *Test at nominal operating SV trip voltage with NON-configurable trip time*

a) Set to the full operating voltage specified by the manufacturer, using an adjustable power supply.

b) Send 10 commands (5 openings and 5 closings) to each of the local control unit / remote unit's solenoid actuated outputs. The commands shall be spaced according to the minimum firing time set by each manufacturer.

c) Measure the pulse duration with the help of an oscilloscope, connected to the corresponding SV output of the local control unit / remote unit.

4.3.3.2.2 *Nominal operating solenoid valve trip voltage test with configurable trip time. Minimum trigger time*

This test shall only be performed if the local control unit / remote unit has configurable pulse width duration on solenoid valve actuation.

a) Set the full actuating voltage, with the help of an adjustable power source. Set the operating voltage of the solenoid valve to its nominal value and the pulse duration to the minimum.

b) Send 10 commands (5 openings and 5 closings) to each of the local control unit / remote unit's solenoid actuated outputs. The commands shall be spaced according to the manufacturer's minimum trigger time between pulses.

c) Measure the pulse width duration with the help of an oscilloscope, connected to the corresponding solenoid valve output of the local control unit / remote unit.

4.3.3.2.3 *Nominal operating solenoid valve trip voltage test with configurable trip time — Maximum trigger time*

This test shall only be performed if the local control unit / remote unit has configurable pulse width duration on SV actuation.

a) Set the solenoid valve actuating voltage to its nominal value and the pulse duration to the maximum according to the manufacturer's instructions.

b) Send 10 commands (5 openings and 5 closings) to each of the local control unit / remote unit's solenoid actuated outputs. The commands shall be spaced according to the manufacturer's minimum trigger time between pulses.

c) Measure the pulse width duration with the help of an oscilloscope, connected to the corresponding solenoid valve output of the local control unit / remote unit.

4.3.3.3 *Acceptance criteria*

The test shall be considered successful if the variation between the values indicated by the manufacturer and the values obtained in the laboratory measurement does not exceed:

a) ±5 percent of the value given by the manufacturer in the questionnaire (*see* Annex A) for the maximum tripping times for solenoid valve actuation.

b) 10 requested commands shall be completed correctly.

4.3.4 *Short Circuit and Open Circuit*

4.3.4.1 *Purpose of the test*

The purpose of these tests is to determine the response of the local control unit / remote unit to a short or open circuit.

4.3.4.2 *Short-circuit (overcurrent) detection with NON-configurable alarm level*

4.3.4.2.1 *Test procedure*

This test shall only be performed if the local control unit / remote unit accepts a short circuit on its solenoid valve outputs.

a) Set the solenoid valve actuation voltage to the value indicated by the manufacturer.

b) Connect a calculated resistor, indicated by the manufacturer, to the solenoid valve output, which shall be the value of the solenoid valve resistor for short-circuit detection at the solenoid valve output of the local control unit / remote unit.

c) Send 10 commands (5 open and 5 close) to the solenoid.

4.3.4.2.2 *Acceptance criteria*

Check that one of the following conditions occurs:

a) The manoeuvre does not take place.

b) The local control unit / remote unit detects a short circuit.

Record the condition that has been met with the current data at the output of the local control unit / remote unit, as well as the voltage and resistance.

4.3.4.3 *Short-circuit detection (overcurrent) with configurable alarm level — Configurable minimum tripping voltage*

4.3.4.3.1 *Test procedure*

This test shall only be performed if the local control unit / remote unit accepts a short circuit on its solenoid valve outputs.

This test shall be carried out in the same way as in **4.3.4.2.1**, by setting the local control unit / remote unit to the minimum configurable tripping voltage allowed by the manufacturer.

4.3.4.3.2 *Acceptance criteria*

The test shall be considered successful if one of the following conditions occurs:

a) The manoeuvre does not take place;

b) The local control unit / remote unit detects a short circuit.

4.3.4.4 *Short circuit (overcurrent) detection with configurable alarm level — Maximum trip voltage configurable*

4.3.4.4.1 *Test procedure*

This test shall only be performed if the local control unit / remote unit accepts a short circuit on its solenoid valve outputs.

This test shall be carried out in the same way as in **4.3.4.2.1**, by setting the local control unit / remote unit to the maximum configurable tripping voltage allowed by the manufacturer.

4.3.4.4.2 *Acceptance criteria*
The test shall be considered successful if one of the following conditions occurs:

a) The manoeuvre does not take place;

b) The local control unit / remote unit detects a short circuit.

4.3.4.5 *Open-circuit detection (undercurrent) with NON-configurable alarm level*

4.3.4.5.1 *Test procedure*

This test is only performed if the local control unit / remote unit accepts open circuit on its solenoid valve outputs.

a) Set the trip voltage of SV to the value indicated by the manufacturer.

b) Connect a calculated resistor specified by the manufacturer for the SV resistance value for open circuit detection, and/or output current for open circuit detection to the solenoid valve output of the local control unit / remote unit.

c) Send commands to the solenoid.

4.3.4.5.2 *Acceptance criteria*

Check that one of the following conditions occurs:

a) The manoeuvre does not take place;

b) The local control unit / remote unit detects a short circuit.

Record the condition that has been met with the current data at the output of the local control unit / remote unit, as well as the parallel voltage and resistance.

4.3.4.6 *Open circuit detection (undercurrent) with configurable alarm level — Configurable minimum tripping voltage*

4.3.4.6.1 *Test procedure*

This test shall only be performed if the local control unit / remote unit accepts open circuit on its solenoid valve outputs.

This test shall be carried out in the same way as in **4.3.4.5.1** by setting the local control unit / remote unit to the minimum configurable tripping voltage allowed by the manufacturer.

4.3.4.6.2 *Acceptance criteria*

The test shall be considered valid if one of the following conditions occurs:

a) The manoeuvre does not take place;

b) The local control unit / remote unit detects a short circuit.

4.3.4.7 *Open circuit detection (undercurrent) with configurable alarm level — Maximum trip voltage configurable*

4.3.4.7.1 *Test procedure*

This test shall only be performed if the local control unit / remote unit accepts open circuit on its solenoid valve outputs.

This test shall be carried out in the same way as in **4.3.4.6.1**, by setting the local control unit / remote unit to the minimum configurable tripping voltage allowed by the manufacturer.

4.3.4.7.2 *Acceptance criteria*
The test shall be considered successful if one of the following conditions occurs:

a) The manoeuvre does not take place;

b) The local control unit / remote unit detects a short circuit.

4.3.5 *Local Control Unit / Remote Unit Operation with Real Solenoids*

4.3.5.1 *Maximum current for typical market SV actuation*

4.3.5.1.1 *Test procedure*

The test shall be performed for each of the SV actuating voltages supported by the local control unit / remote unit, and indicated in the questionnaire (*see* Annex A) by the manufacturer.

a) If the local control unit / remote unit allows it, set the appropriate voltage for each model of solenoid valve commonly available on the market, and connect the solenoids to the outputs.

b) Send 10 commands (5 openings and 5 closings) to each of the solenoids. The commands shall be spaced according to the minimum trip time allowed by the solenoid valve hydraulics (if the minimum trip time allowed by the local control unit / remote unit is less than the minimum trip time allowed by the solenoid valve hydraulics, the former shall be the conditioning time for the test).

c) Record voltage and current data as well as the results of the manoeuvres.

4.3.5.1.2 *Acceptance criteria*

The test shall be considered successful if the variation between the values indicated by the manufacturer and the values obtained in the laboratory measurement does not exceed:

a) ± 5 percent of the value given by the manufacturer in the questionnaire (*see* Annex A) for SV performance consumptions;
b) 10 requested commands shall be completed correctly.

4.3.5.2 *Simultaneous programming and manoeuvring test*

4.3.5.2.1 *Test procedure*

a) If the local control unit / remote unit allows it, connect a solenoid of the same characteristics to each of the solenoid valve outputs of the local control unit / remote unit.
b) Make a schedule for each SV, so that they are triggered at exactly the same time, in order to verify whether they are triggered simultaneously or sequentially and with what time interval between them.

c) Check how the local control unit / remote unit performs. There are four scenarios:
   i) Solenoid valves open simultaneously;
   ii) Solenoid valves open sequentially;
   iii) Solenoid valves do not open;
   iv) A smaller number of solenoid valves than programmed is opened.

4.3.5.2.2 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit carries out the 10 requested commands correctly. Noting the times and delays in the opening of the solenoid valves.

4.3.6 *Association of Sensors with Solenoid Valve Outputs*

4.3.6.1 *Event test associating solenoid valve with limit switch detector (LSD)*

4.3.6.1.1 *Test procedure*

a) If the local control unit / remote unit allows it, associate a solenoid valve output with an LSD connected to a digital input. There shall be a T_{FCA} time to confirm opening and a T_{FCC} time to confirm closing.
b) Check that the times supplied by the manufacturer in the questionnaire (*see* Annex A) agree with those obtained in the test.

Additionally, if the local control unit / remote unit supports event generation, the test shall confirm its receptions, taking into account the minimum event generation time, since the sensor is activated. These data shall be provided by the manufacturer in the questionnaire (*see* Annex A).

4.3.6.1.1.1 *When opening the solenoid valve*

Send irrigation commands to the corresponding solenoid valve output, and check which of the following conditions are met:

a) The action is confirmed;
b) The action is confirmed and the event is generated;
c) The action is not confirmed.

4.3.6.1.1.2 *When closing the solenoid valve*

Send irrigation commands to the corresponding solenoid valve output, and check which of the following conditions are met:

a) The action is confirmed;
b) The action is confirmed and the event is generated;
c) The action is not confirmed.

4.3.6.1.2 *Acceptance criteria*

a) If the manufacturer indicates that the solenoid valve can be associated with LSD but does not generate an event, the test shall be passed if action is confirmed.

b) If the manufacturer indicates that the solenoid valve can be associated with LSD and also generates an event, the test shall be passed if the action is confirmed and the event is generated.

4.3.6.2 *Event test associating SV with WPD*

4.3.6.2.1 *Test procedure*

a) If the local control unit / remote unit allows it, configure to associate a solenoid valve output with a water passage detector (WPD) connected to a digital input. There shall be a T_{PAA} time to confirm opening and a T_{PAC} time to confirm closing.
b) Check that the times supplied by the manufacturer in the questionnaire (*see* Annex A) agree with those obtained in the test.

4.3.6.2.2 *Acceptance criteria*

a) If the manufacturer indicates that the solenoid valve can be associated with WPD but does not generate an event, the test shall be passed if the action is confirmed.
b) If the manufacturer indicates that SV can be associated with WPD and also generates an event, the test shall be passed if the action is confirmed and the event is generated.

4.3.6.3 *Event test associating SV with counter*

4.3.6.3.1 *Test procedure*

a) Configure the local control unit / remote unit to associate a solenoid valve output with a counter. There shall be a time to confirm the opening T_{CNA} and a time to confirm the closing T_{CNC}.
b) Check that the times supplied by the manufacturer in the questionnaire (*see* Annex A) agree with those obtained in the test.

4.3.6.3.2 *Acceptance criteria*

a) If the manufacturer indicates that the solenoid valve can be associated with a counter, but not generate an event, the test shall be passed if the action is confirmed.
b) If the manufacturer indicates that the solenoid valve can be associated with a counter and also generates an event, the test shall be passed if the action is confirmed and the event is generated.

4.4 Counter Entries

4.4.1 *Sensor power supply*

4.4.1.1 *General*

This test is performed to verify whether the local control unit / remote unit constantly powers the counter sensor or runs sampling periods. The manufacturer shall provide the following counter input electrical parameters, in the following power modes:

a) Electric current when the contact is closed;
b) Open circuit voltage in the event of open contact.

For a local control unit / remote unit running sampling periods, two additional parameters are required:

a) Active pulse time (T_{ON});
b) Inactive pulse time (T_{OFF}).

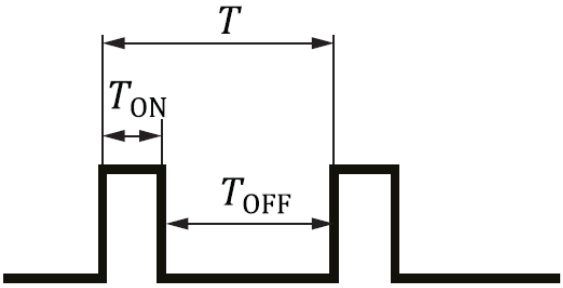


FIG. 2 PULSE TIME

4.4.1.2 *Test procedure*

Connect an oscilloscope to any of the inputs of the counter to determine these times and with the aid of a measuring device to measure the voltages and currents specified for the test.

4.4.1.3 *Acceptance criteria*

The test shall be considered successful if the variation between the values indicated by the manufacturer and the values obtained in the laboratory measurement does not exceed ± 5 percent of the value given by the manufacturer in the questionnaire (*see* Annex A) for the voltages, currents and times T_{ON} and T_{OFF}.

4.4.2 *Flow Calculation*

4.4.2.1 *Purpose of the test*

The purpose of this test is to verify the ability of the local control unit / remote unit to calculate the flow rate, using counter pulses. The purpose of the test is to confirm that the local control unit / remote unit:

a) Calculates instantaneous flow rate;
b) Generates minimum (low) flow and maximum (high) flow alarms.

4.4.2.2 *Test procedure*

a) Send a set of pulses, not less than 50 pulses, of fixed frequency to the local control unit / remote unit for 5 min. The flow rate shall be calculated by establishing a relationship between pulse and volume. The volume recorded during the test and its duration shall define the flow rate (volume/time ratio).
b) Compare the value recorded by the local control unit / remote unit with that calculated from the ratio of pulses generated and the duration of the test.

4.4.2.3 *Acceptance criteria*

The test shall be considered successful if the maximum permissible difference between the value indicated by the local control unit / remote equipment and the calculated value shall not exceed ± 5 percent.

4.4.3 *High flow alarm*

4.4.3.1 *Test procedure*

Generate pulses at a frequency greater than 5 % of the maximum flow rate set in the local control unit / remote unit.

4.4.3.2 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit shall generate a high flow alarm.

4.4.4 *Low Flow Alarm*

4.4.4.1 *Test procedure*

Generate pulses at a frequency of less than 5 % of the minimum flow rate set in the local control unit / remote unit to generate the low flow alarm.

4.4.4.2 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit generates a low flow alarm.

4.4.5 *Hardware Pulse Filtering — Maximum Pulse Rate and Minimum Pulse Width*

4.4.5.1 *General*

This test should be performed to determine the ability of the local control unit / remote unit to filter counter pulses through Hardware. Two parameters define a counter pulse:

a) Maximum frequency between pulses.

b) Minimum pulse width.

4.4.5.2 *Test procedure*

Generate a minimum group of 50 pulses on the counter input, within the range in which the local control unit / remote unit is able to detect them. This pulse train shall be defined by the maximum frequency and minimum width indicated by the manufacturer in the questionnaire (*see* Annex A).

a) The maximum tested frequency shall be 20 % lower than the theoretical maximum frequency.

b) The minimum pulse width tested shall be 20 % greater than the theoretical pulse width.

4.4.5.3 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit counts the same number of pulses sent at both cases, **4.4.5.2 a)** and **4.4.5.2 b)**.

4.4.6 *Maximum Frequency Between Pulses*

4.4.6.1 *Test procedure*

a) Increase the frequency using the pulse width provided by the manufacturer, until the local control unit / remote unit stops detecting pulses in the counter.
b) Record the frequency at which the local control unit / remote unit stops recording a pulse of the generated pulses.

4.4.6.2 *Acceptance criteria*

The test shall be considered successful if the frequency values since the local control unit / remote unit stops detecting pulses are ± 1 percent of the maximum frequency between pulses specified in the questionnaire (*see* Annex A).

4.4.7 *Minimum Frequency Between Pulses*

4.4.7.1 *Test procedure*

a) Reduce the pulse width, using the frequency provided by the manufacturer until the local control unit / remote unit stops detecting counter pulses.

b) Record the minimum pulse width below which the local control unit / remote unit does not detect pulses. The minimum pulse width is reached when the local control unit / remote unit loses its first pulse.

4.4.7.2 *Acceptance criteria*

The test shall be considered successful if the frequency values since the local control unit / remote unit stops detecting pulses are ± 1 percent of the minimum frequency between pulses as specified in the questionnaire (*see* Annex A).

4.4.8 *Pulse Filtering by Software with Fixed Time*

4.4.8.1 *Test procedure*

a) Generate a certain number of pulses, at least 50, at the counter input with a time between them longer than the time indicated by the manufacturer in the questionnaire (*see* Annex A) (pulse filtering).

b) Check that all pulses are detected, without loss of any.

c) Decrease the time between pulses below that specified by the manufacturer.

d) Check that the local control unit / remote unit is not receiving the pulses.

4.4.8.2 *Acceptance criteria*

The test shall be considered successful if the values since the local control unit / remote unit stops detecting pulses are ± 1 percent of the minimum time between pulses specified in the questionnaire (*see* Annex A).

4.4.9 *Software Pulse Filtering with Configurable Time*

4.4.9.1 *Purpose of the test*

The purpose of this test is to determine the ability of the local control unit / remote unit to filter counter pulses through software. Two parameters define this type of filtering:

a) Minimum time between pulses;

b) Maximum time between pulses.

4.4.9.2 *Test procedure*

Generate a minimum group of 50 pulses on the counter input, within the range in which the local control unit / remote unit is able to detect them. This pulse train shall be defined by the minimum and maximum time between pulses indicated by the manufacturer in the questionnaire (*see* Annex A).

a) The minimum time between pulses shall be 20 percent less than the specified minimum time between pulses.

b) The maximum time between pulses shall be 20 percent longer than the specified maximum time between pulses.

4.4.9.3 *Acceptance criteria*

The test shall be considered successful if the values of time since the local control unit / remote unit stops detecting pulses are:

a) ± 1 percent of the minimum time between pulses specified in the questionnaire (*see* Annex A);

b) ± 1 percent of the maximum time between pulses specified in the questionnaire (*see* Annex A).

4.4.10 *Minimum time between pulses*

4.4.10.1 *Test procedure*

a) Generate a minimum set of 50 pulses at the counter input. The time between pulses shall be at least 20 % longer than the minimum time between pulses indicated by the manufacturer in the questionnaire (Annex A).

b) Verify that all pulses are detected, without any loss.

c) After this, reduce the time between pulses by 1 s below the minimum specified by the manufacturer.

d) Verify that the local control unit / remote unit stops registering pulses.

4.4.10.2 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit stops detecting pulses with ± 1 s of the minimum time between pulses specified in the questionnaire (*see* Annex A).

4.4.11 *Maximum time between pulses*

4.4.11.1 *Test procedure*

a) Generate a minimum set of 50 pulses at the counter input. The time between pulses shall be at least 20 percent less than the maximum time between pulses indicated by the manufacturer in the questionnaire (*see* Annex A).

b) Verify that all pulses are detected, without any loss.

c) Increase the time between pulses by 1 s above the maximum specified by the manufacturer.

d) Verify that the local control unit / remote unit stops registering pulses.

4.4.11.2 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit stops detecting pulses with ± 1 s of the maximum time between pulses specified in the questionnaire (*see* Annex A).

4.4.12 *"Open Contact" Test*

4.4.12.1 *Purpose of the test*

The purpose of this test is to determine the minimum voltage that the local control unit / remote unit requires at the counter input to detect pulses.

The voltage shall be measured at the counter input.

4.4.12.2 *Test procedure*

a) Connect a variable resistor (at its minimum value) in parallel with a pulse generator or a relay, preferably of the reed type.

b) Increase the resistance until the local control unit / remote unit starts detecting pulses, waiting 1 min between each value.

c) Note the value of the resistance and the voltage at the moment when the local control unit / remote unit starts to detect the pulses.

d) Compare these values with the parameters declared as open contact parameters by the manufacturer in the questionnaire (*see* Annex A).

4.4.12.3 *Acceptance criteria*

The test shall be considered successful if the variation between the values indicated by the manufacturer and the values obtained in the laboratory measurement does not exceed ± 5 percent of the voltage and resistance values specified by the manufacturer in the questionnaire (*see* Annex A).

4.4.13 *"Closed contact" test*

4.4.13.1 *Purpose of the test*

The purpose of this test is to determine the maximum voltage that the local control unit / remote unit requires at the counter input to detect pulses.

The voltage shall be measured at the counter input.

4.4.13.2 *Test procedure*

a) Connect a variable resistor (at its maximum value) in series with a pulse generator or a relay, preferably of the reed type.

b) Decrease the resistance until the local control unit / remote unit starts detecting pulses, waiting 1 min between each value.

c) Note the value of the resistance and the voltage at the moment when the RU starts to detect pulses.

d) Compare the data obtained with the short-circuit parameters declared by the manufacturer in the questionnaire (*see* Annex A).

4.4.13.3 *Acceptance criteria*

The test shall be considered successful if the variation between the values indicated by the manufacturer and the values obtained in the laboratory measurement does not exceed ± 5 percent of those specified by the manufacturer in the questionnaire (*see* Annex A).

4.4.14 *Random Pulse Counting Test*

4.4.14.1 *Purpose of the test*

The purpose of this test is to verify the correct allocation of pulses in local control unit / remote units with more than one counter input.

If the local control unit / remote unit has four (4) or fewer counter inputs, all of them shall be tested simultaneously. If the local control unit / remote unit has more than four (4) counter inputs, four (4) of them, selected at random, shall be tested.

4.4.14.2 *Test procedure*

a) Connect a pulse generator to each of the counting inputs of the local control unit / remote unit.

b) Randomly generate pulses (within the limits found in the previous tests, both time between pulses and pulse width) for 10 min.

c) Record the pulse value register for each counter input.

d) Compare this value with the pulses recorded by each generator.

4.4.14.3 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit counts 100 percent of the pulses sent.

4.4.15 *Concurrent Pulse Count Test*

4.4.15.1 *Purpose of the test*

The purpose of this test is to verify the correct allocation of pulses in local control unit / remote units with more than one counter input.

If the local control unit / remote unit has four (4) or fewer counter inputs, all of them shall be tested simultaneously. If the local control unit / remote unit has more than four (4) counter inputs, four (4) of them, selected at random, shall be tested.

4.4.15.2 *Test procedure*

a) Connect a pulse generator to each counter input of the local control unit / remote unit.

b) Generate pulses simultaneously at the maximum frequency for 5 min. The maximum frequency value shall be a value between the value defined by the manufacturer and the results obtained in **4.4.8** to **4.4.13**.

c) Record the value of the pulses for each counter input

d) Compare this value with the pulses recorded by each generator.

4.4.15.3 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit counts 100 percent of the pulses sent on all counter inputs.

4.4.16 *Counter Events and Alarms*

NOTE — The objective of this test is to verify the generation of all events and alarms allowed by the system.

4.4.16.1 *Overflow alarm*

4.4.16.1.1 *General*

This event shall be triggered if the counter reading exceeds its limit.

4.4.16.1.2 *Test procedure*

a) If the local control unit / remote unit allows it, set to the maximum value of the overflow.
b) Generate 1 additional pulse from the maximum specified by the manufacturer.
c) Check whether it generates an alarm.

4.4.16.1.3 *Acceptance criteria*

The test shall be considered successful if any additional pulse beyond the maximum value generates an alarm.

4.4.16.2 *Flow limit*

4.4.16.2.1 *General*

This event shall be generated when a pre-configured value for the counter input to the local control unit / remote unit is exceeded.

4.4.16.2.2 *Test procedure*

a) Pre-set a value in the counter input of the local control unit / remote unit, above the value already pre-set for that input.
b) Generate pulses for 3 min with the help of a generator.
c) Check that when the pre-configured value is exceeded, the local control unit / remote equipment generates an event indicating this.

4.4.16.2.3 *Acceptance criteria*

The test shall be considered successful if it generates an alarm when generating values exceeding the pre-set limit flow rate.

4.5 Analogue Inputs

4.5.1 *General*

This set of tests shall be performed on local control unit / remote units supporting analogue signal sensors. The manufacturer shall provide in the questionnaire (*see* Annex A) the specifications of the analogue inputs available on the local control unit / remote unit:

a) Signal type (electrical current input signal or voltage input signal);
b) Signal range;
c) Resolution expressed in bits;
d) Total error expressed as a percentage;
e) Input wiring.

For all tests, an analogue signal generator shall be connected to the analogue input under test.

4.5.2 *Measurement Accuracy*

4.5.2.1 *General*

The purpose of these tests is to verify the measurement accuracy of the local control unit / remote unit's analogue inputs specified by the manufacturer. If the local control unit / remote unit, during normal operation, performs any kind of compensation or error correction, measurements shall be made with this function activated.

4.5.2.2 *Impact of the power supply on the measurements*

4.5.2.2.1 *Test procedure*

The procedure to be followed is as follows.

a) Establish the relationship between the minimum value of the signal and the magnitude it represents.
b) Perform the same process for the maximum value of the signal.
c) Establish the expected magnitude values for ten (10) different signal values between the minimum and maximum values, assuming linearity of the signal.
d) Calculate, taking into account the input resolution and its theoretical total error:
    i) The minimum and maximum signal determined as [Signal Range]/ [Resolution].
    ii) The minimum and maximum magnitude represented by this minimum/maximum signal and determined as [Magnitude Range]/ [Resolution].

e) Generate, using the analogue signal simulator, the discrete set of ten (10) signal values established for point 3, including the limit values specified by the manufacturer in the questionnaire (*see* Annex A), and the magnitude corresponding to each of them.
f) Note the values recorded by the local control unit / remote equipment.
g) Compare these values with those generated.

4.5.2.2.2 *Acceptance criteria*

The test shall be considered successful in the case that there is no difference of ± 5 percent between the generated value and the read value.

4.5.2.3 *Impact of the power supply on the measurements*

4.5.2.3.1 *General*

The purpose of this test set is to determine the behaviour of the analogue input at the limits of the local control unit / remote unit's power supply. The result should match the result obtained in test **4.5.2.2**.

4.5.2.3.2 *Low power supply from the local control unit / remote unit*

4.5.2.3.2.1 *Test procedure*

a) Power the local control unit / remote unit with the V_{MIN}. Perform the test using the same discrete values as used in test **4.5.2.2** (minimum and maximum values).
b) Verify that its accuracy does not change.
c) Record all values in a table.

4.5.2.3.2.2 *Acceptance criteria*

The test shall be considered successful in the case that there is no difference of ± 5 percent between the generated value and the read value.

4.5.2.3.3 *High power supply from the local control unit / remote unit*

4.5.2.3.3.1 *Test procedure*

a) The local control unit / remote unit shall be powered by the V_{MAX}. Perform the test using the same discrete values as used in test **4.5.2.2** (minimum and maximum values)
b) Verify that its accuracy does not change.
c) Record all values in a table.

4.5.2.3.3.2 *Acceptance criteria*

The test shall be considered successful if there is no difference of ± 5 percent between the generated value and the read value.

4.5.3 *Events and Alarms Generated by the Analogue Input*

4.5.3.1 *Out-of-range measurements*

4.5.3.1.1 *Purpose of the test*

The purpose of this test suite is to verify whether the local control unit / remote unit generates events when a measured value is outside the analogue input range.

4.5.3.1.2 *Value lower than the minimum measurable value (Lower threshold)*

4.5.3.1.2.1 *Test procedure*

a) Generate a signal 10 percent above the minimum value that the local control unit / remote unit is capable of measuring.
b) Take samples by progressively decreasing the value in steps of 0.1 mA, with the aid of an analogue generator, until the measurable range is exceeded.
c) Annotate the value of the analogue signal below the minimum measurable by the local control unit / remote unit with the events generated by the local control unit / remote unit.
d) Take samples by increasing the value progressively in steps of 0.1 mA, until it returns to the measurable range
e) Record the signal values that generate a new event.

4.5.3.1.2.2 *Acceptance criteria*

The test shall be considered successful if an event/alarm is generated once the minimum measurable value has been exceeded.

4.5.3.1.3 *Value higher than the maximum measurable (Higher threshold)*

4.5.3.1.3.1 *Test procedure*

a) Generate a signal 10 percent below the maximum value that the local control unit / remote unit is capable of measuring

b) Take samples by increasing the value progressively in steps of 0.1 mA, with the aid of an analogue generator, until the measurable range is exceeded.

c) Annotate the value of the analogue signal above the maximum measurable by the local control unit / remote unit with the events generated by the local control unit / remote unit.

d) Take samples by progressively decreasing the value in steps of 0.1 mA until it returns to the measurable range.

e) Record the values that generate a new event.

4.5.3.1.3.2 *Acceptance criteria*

The test shall be considered successful if an event/alarm is generated once the maximum measurable value has been exceeded.

4.5.3.2 *Measurements outside a consigned interval*

4.5.3.2.1 *General*

The purpose of this test suite is to verify whether the local control unit / remote unit generates events when a set signal threshold has been reached. For testing purposes, the thresholds shall be configured in the local control unit / remote equipment.

4.5.3.2.2 *Value below an interval*

4.5.3.2.2.1 *Test procedure*

a) Generate a signal 10 percent above the start of the interval.

b) Sample by decreasing the value progressively in steps of 0.1 mA until the starting value of the interval is exceeded.

c) Note the values and events generated.

d) Take more samples by increasing the value until the interval is re-entered.

e) Record the values that generate a new event.

4.5.3.2.2.2 *Acceptance criteria*

The test shall be considered successful if an event/alarm is generated after the minimum measurable value has been exceeded.

4.5.3.2.3 *Value above an interval*

4.5.3.2.3.1 *Test procedure*

a) Generate a signal of 10 percent below the end of the interval.

b) Take samples by increasing the value progressively in steps of 0.1 mA until the starting value of the interval is exceeded.

c) Note the values and events generated.

d) Take further samples by decreasing the value until you get back into the interval.

e) Record the values that generate a new event.

4.5.3.2.3.2 *Acceptance criteria*

The test shall be considered successful if an event/alarm is generated after the maximum measurable value has been exceeded.

4.5.3.3 *Sensor power supply*

4.5.3.3.1 *General*

This set of tests shall be performed if the manufacturer confirms in the questionnaire (*see* Annex A) that the local control unit / remote unit can supply power to as many analogue sensors as it can support. The questionnaire (*see* Annex A) shall include the supply voltage provided by the local control unit / remote unit.

If this supply voltage is configurable, the tests shall also be performed with the maximum and minimum supply voltage.

4.5.3.3.2 *No consumption*

4.5.3.3.2.1 *Test procedure*

a) Set the local control unit / remote unit to the minimum sensor supply voltage.

b) Measure the voltage provided by the local control unit / remote unit on its analogue output when the analogue sensor is not connected

c) Compare the data obtained with the value provided by the manufacturer in the questionnaire (see Annex A).

4.5.3.3.2.2 *Acceptance criteria*

The test shall be considered successful if there is not a difference of ± 5 percent between the voltage value generated and the value read.

4.5.3.3.3 *Maximum consumption*

4.5.3.3.3.1 *Test procedure*

a) Set the local control unit / remote unit to the maximum supply voltage of the sensor.

b) Measure the voltage provided by the local control unit / remote unit on its analogue output at the maximum consumption of the sensor.

c) Compare the data obtained with the value provided by the manufacturer in the questionnaire (Annex A).

4.5.3.3.3.2 *Acceptance criteria*

The test shall be considered successful if there is not a difference of ± 5 percent between the voltage value generated and the value read.

4.5.3.4 *Analogue input short circuit test*

4.5.3.4.1 *Test procedure*

a) Short-circuit the analogue input, which shall last at least 30 s.

b) Verify that the local control unit / remote unit is still operational and fully functional.

c) Perform a new measurement on the analogue input. The local control unit / remote unit shall behave in the same way as in point **4.5.1**.

4.5.3.4.2 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit has not been affected by the generation of the short circuit and is still operational and fully functional.

4.6 Other Inputs and Outputs

4.6.1 *Purpose of the Test*

The purpose of these tests is to check the functionality of all inputs and outputs other than those detailed above that the local control unit / remote unit has.

These tests listed in **4.6** are reference examples, as each local control unit / remote unit shall have its own specific signals with its own characteristics, and each shall be tested according to the instructions provided by the manufacturer in the questionnaire (*see* Annex A).

4.6.2 *External Signals*

4.6.2.1 *General*

External signals are those that are connected to the local control unit / remote unit via cables and therefore shall be tolerant to tampering and wiring errors.

4.6.2.2 *Wiring interactions*

4.6.2.2.1 *Purpose of the test*

The purpose of these tests is to find out whether errors or falsification of measurements due to interference occur in the event two or more external devices share the same cable harness.

4.6.2.2.2 *Test procedure*

a) Connect two or more devices by means of a simulated multi-pair cable.

b) Check the correct functioning of all of them.

c) Perform one test for each possible pair of elements: Valve + Counter, Valve + Analogue and Analogue + Counter.

d) Generate counter pulses and valve actuations. It is expected that there shall be no unwanted interactions.

a) NOTE —In the event the remote unit has analogue sensors, their interactions shall also be checked as follows:

e) Connect two devices or signal generators using multiple cables from the same hose.

f) Perform a test for each possible pair of devices. Each device shall perform its typical functions. The basic test shall be performed with solenoid valve and counter. If the local control unit / remote unit supports analogue sensors, the interactions between them shall also be checked:

i) Solenoid valve and counter signal simulator

ii) Analogue signal simulator and analogue solenoid valve or sensor.

iii) Analogue signal counter and simulator or analogue sensor.

4.6.2.2.3 *Acceptance criteria*

The test shall be considered successful if, when performing the interactions between inputs and outputs, none of the inputs and outputs act differently from their normal operation.

4.6.2.3 *Digital inputs*

4.6.2.3.1 *Purpose of the test*

The purpose of this test is to verify the operation of the digital inputs of the general purpose local control unit / remote unit.

4.6.2.3.2 *Test procedure*

a) Connect a device or signal generator to the digital input being tested.

b) Force or simulate the two possible states of the digital input to check if the local control unit / remote equipment generates any alarm or event.

c) Note the status and the event recorded.

The manufacturer shall provide the digital input data necessary to run the test assembly.

4.6.2.3.3 *Acceptance criteria*

The test shall be considered successful when upon the generation of signals at the digital inputs, an event is recorded at the local control unit / remote unit.

4.6.2.4 *Analogue outputs*

4.6.2.4.1 *Purpose of the test*

The purpose of this test is to verify the performance of the general purpose analogue outputs of the local control unit / remote unit.

4.6.2.4.2 *Test procedure*

a) Connect a device capable of measuring the analogue signal generated by the local control unit / remote unit to the analogue output being tested.

b) Note the status and the event recorded.

The manufacturer shall provide the digital input data necessary to run the test assembly.

4.6.2.4.3 *Acceptance criteria*

The test shall be considered successful when the values generated by the local control unit / remote unit do not differ ± 5 percent from the expected value.

4.6.3 *Internal Signals*

4.6.3.1 *Voltage measurement*

4.6.3.1.1 *Purpose of the test*

All local control unit / remote units shall be capable of internally measuring the voltages of their associated devices, such as battery, backup battery, solar panel, solenoid valve trigger capacitor or other.

The purpose of this test is to verify that the local control unit / remote unit provides all these data.

4.6.3.1.2 *Test procedure*

Compare the voltage data provided by the local control unit / remote unit of its associated devices with the direct measurement of these parameters.

4.6.3.1.3 *Acceptance criteria*

The test shall be considered successful if the values measured by the local control unit / remote and those measured directly have a difference of not more than ± 5 percent.

4.6.3.2 *Integrated sensors*

4.6.3.2.1 *General*

The local control unit / remote unit may have integrated sensors for environmental conditions (temperature, humidity, etc.).

*E*xample Temperature sensors.

4.6.3.2.2 *Test procedure*

This test may be skipped for sensors having authorized test results complying with the acceptance criteria in **4.6.3.2.2**.

With the help of a climatic chamber, regulate a certain temperature and humidity. Verify that the local control unit / remote correctly measures these values.

4.6.3.2.3 *Acceptance criteria*

The test shall be considered successful if the values measured by the local control unit / remote and the actual values have a difference of not more than ± 5 percent.

4.7 Operating Logic

4.7.1 *General*

This test suite shall be performed on local control unit / remote units supporting local control logics. The manufacturer shall provide in the questionnaire (*see* Annex A) the specifications of the control logics available in the local control unit / remote unit.

The minimum tests that shall be able to be performed on a local control unit / remote unit are:

- Safety lockout test due to low supply voltage;
- Low pressure lockout safety test;
- Safety overflow (flow) lockout test.

Monitor SV output to perform these safety lockout tests

4.7.2 *Low Supply Voltage Safety Interlock (Lockout) Test*

4.7.2.1 *Purpose of the test*

The purpose of this test is to verify the ability of the local control unit / remote unit to automatically shut down the SV when it detects a low level of power supply.

4.7.2.2 *Test procedure*

a) With the solenoid valves in the open state, reduce the supply voltage until the local control unit / remote unit detects that it has reached its minimum operating voltage level.

b) Check the behaviour of the local control unit / remote unit.

4.7.2.3 *Acceptance criteria*

The test shall be considered successful when all active solenoid valves have been closed and the corresponding alarm is generated.

4.7.3 *Low-pressure safety lockout test*

4.7.3.1 *Purpose of the test*

The purpose of this test is to verify the ability of the local control unit / remote unit to automatically close the solenoid valves when it detects a signal level below a set threshold in an analogue input. This operating logic is normally implemented by means of a pressure signal.

4.7.3.2 *Test procedure*

a) Define the threshold that triggers the execution of the operating logic. The threshold shall be common to all SV outputs.

b) Once the threshold has been set, with the solenoid valves in the open state and a signal generator connected to an analogue input, reduce the signal value until one of the following situations occurs:

   i) The local control unit / remote unit closes all solenoid valves and generates the corresponding event (low pressure alarm).

   ii) The pressure reaches zero without executing the safety interlock.

c) Record the threshold value, the generated signal and the obtained behaviour.

4.7.3.3 *Acceptance criteria*

The test shall be considered successful when all active solenoid valves have been closed and the corresponding alarm is generated.

4.7.4 *Excess Flow (Flow Rate) Safety Shutdown Test*

4.7.4.1 *Purpose of the test*

The purpose of this test is to verify the ability of the local control unit / remote unit to automatically close the solenoid valve when it detects that a set threshold has been reached. This operating logic is normally executed using the flow calculation functionality, so this test shall be applicable to local control unit / remote units that support this functionality (*see* **4.4.2**).

4.7.4.2 *Test procedure*

a) Set the threshold that triggers the execution of the operating logic. In this case, each SV output shall have its own threshold set.

b) Once these thresholds have been established, with the solenoid valves in the open state and a signal generator connected to the counter input associated with each of them, simulate with the signal generators, the spaced pulses for a time corresponding to a normal flow rate, within the maximum limits stipulated by the manufacturer.

c) When the local control unit / remote unit detects the initial flow rate, start generating, at one of the counter inputs, an excessive flow rate, higher than the threshold set in the local control unit / remote unit as excess flow, until one of the following situations occurs:

   i) The local control unit / remote unit closes the associated solenoid valve and generates the corresponding event (excess flow alarm). The rest of the solenoid valves, with a normal flow in their counter entry do not close.

   ii) The maximum flow threshold has been exceeded by 25 percent without executing the safety interlock.

   NOTE — Only in the first case (a) the safety interlock due to excess flow is verified.

d) Record the threshold values, the normal and excess flow generated and the behaviour obtained.

4.7.4.3 *Acceptance criteria*

The test shall be considered successful when the local control unit / remote unit closes the solenoid valve corresponding to the excess flow and generates an alarm.

Solenoid valves with normal flow shall remain open.

5 ROBUSTNESS

All tests described in **5** should be conducted by a laboratory conforming to ISO/IEC 17025.

5.1 Environmental conditions

5.1.1 *General*

The local control unit / remote unit (RU) shall be able to operate within the full temperature and humidity range specified by the manufacturer in the questionnaire (Annex A).
Before performing this group of tests, the following actions shall be carried out.

a) Introduce all the components required by the local control unit / remote unit to execute its functionalities inside a climatic chamber.

b) Check that there is correct communication inside the climatic chamber. If not, install the necessary elements (e.g. antennas or cables) to ensure correct communication with the local control unit / remote unit inside.

c) Programme the climate chamber to achieve the minimum and maximum air temperature and humidity levels as specified by the manufacturer.

d) Perform the tests for each of the following three (3) combinations of the climatic chamber:

   — First group: minimum temperature and maximum air humidity;

   — Second group: 25 °C maximum air temperature and humidity; and

   — Third group: maximum temperature and maximum air humidity.

e) Once these conditions are reached, keep the local control unit / remote equipment inside the climatic chamber for at least 30 min before the execution of the tests.

NOTE — In parallel, another local control unit / remote unit shall be placed outside the climatic chamber as a verifier. This second local control unit / remote unit shall be used to compare the functionality with the equipment inside the climatic chamber.

f) Check all the specific functions of the local control unit / remote unit that may be altered due to extreme environmental conditions, such as, for example:

— battery charge regulation;

— short circuit or open circuit alarms; or

— Pulse filtering.

The tests to be carried out for each combination of the climatic chamber are detailed in **5.1.2**, **5.1.3** and **5.1.4**.

5.1.2 *Solenoid valve actuation (SV)*

5.1.2.1 *Purpose of the test*

The purpose of the test is to verify the opening and closing actions of the local control unit / remote unit's SV outputs at the nominal, minimum and maximum temperature defined by the manufacturer in the questionnaire (*see* Annex A).

5.1.2.2 *Test procedure*

a) Send ten (10) watering programmes at the minimum and maximum operating temperature of the local control unit / remote unit as specified by the manufacturer.

b) Monitor the tested SV output.

5.1.2.3 *Acceptance criteria*

The test shall be considered successful when the local control unit / remote unit's outputs shall exactly match the number of irrigation programmes sent. This procedure shall be repeated for each of the local control unit / remote unit's SV outputs.

5.1.3 *Counter pulses*

5.1.3.1 *Purpose of the test*

The purpose of this test is to verify the performance of the local control unit / remote unit's counter input. Its configuration shall conform to the manufacturer's specifications used in test **4.2.1**.

5.1.3.2 *Test procedure*

a) Generate 10 000 counter pulses.

b) Monitor the corresponding counter input of the local control unit / remote.

c) Record the number of pulses the counter reads.

d) Check that this number coincides with the pulses generated.

This procedure shall be repeated for each of the local control unit / remote units counter inputs.

5.1.3.3 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit is able to count 100 percent of the pulses sent.

5.1.4 *Analogue Readout*

5.1.4.1 *Test purpose*

The purpose of this test is to verify the performance of the analogue input.

5.1.4.2 *Test procedure*

a) Generate analogue signal values corresponding to 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of the allowable range of the analogue input under test.

b) Wait 2 min between each local control unit / remote unit's read signal stabilisation time value.

c) Record and compare the values recorded by the local control unit / remote unit and the expected values, both obtained in the test given in **4.4.1**.

5.1.4.3 *Acceptance criteria*

The test shall be considered successful when there is no more than ± 5 percent difference between the expected values and the obtained values.

This procedure shall be repeated for each of the analogue inputs of the local control unit / remote unit.

5.2 Power supply

5.2.1 *Polarity Reversal in Main Power Supply*

5.2.1.1 *Test procedure*

This test shall only be performed when the manufacturer confirms in the questionnaire (*see* Annex A) that the local control unit / remote unit supports polarity reversal.

a) Reverse the polarity of the local control unit / remote unit's power cables.

b) Maintain polarity reversal for 1 min.

c) Restore the correct supply.

5.2.1.2 *Acceptance criteria*

The local control unit / remote unit shall still be fully operational after reset for the test to pass.

5.2.2 *Short-circuit at the SV solenoid valve output*

5.2.2.1 *General*

This test shall only be carried out when the manufacturer confirms in the questionnaire (*see* Annex A) that the local control unit / remote unit supports short circuits in the SV output. Depending on whether the SV output is two-wire or three-wire, it shall be performed as follows:

a) Two-wire SV output:

Short-circuit the two output terminals.

b) Three-wire SV output:

Short-circuit the three output terminals

5.2.2.2 *Test procedure*

a) To produce this short-circuit, make a jumper with a cable with a minimum cross-section of 1,5 mm connecting the two/three terminals of the SV output to be tested.

b) Perform five (5) openings and five (5) closings on each SV output. Record any incidents.

c) Correctly connect the outputs of the SV to verify that both maintain their function.

This procedure shall be repeated on all SV outputs of the local control unit / remote unit.

5.2.2.3 *Acceptance criteria*

The test shall be considered successful when all the SV outputs of the local control unit / remote unit are functioning correctly after the test has been carried out.

5.3 Accidental Wiring Errors on Inputs and Outputs

5.3.1 *Purpose of the test*

5.3.1.1 *General*

The purpose of this test is to verify the behaviour of the local control unit / remote unit when an accidental wiring error occurs. The RU and any of its inputs and outputs should not be permanently damaged. The manufacturer shall identify which of the local control unit / remote unit's inputs and outputs shall withstand a wiring error.

To run the possible combinations of the test, simulate the following wiring errors.

5.3.1.2 *Connection of counter input to SV output*

5.3.1.2.1 *Test procedure*

a) Wire from SV output to counter input.

b) Execute an opening and closing of the SV.

c) Restore normal wiring.

d) Check whether the counter input and SV output remain operational.

5.3.1.2.2 *Acceptance criteria*

The test shall be considered successful when both the counter inputs and the tested SV outputs are operational after the test has been carried out.

5.3.1.3 *Analogue input with SV output*

5.3.1.3.1 *Test procedure*

a) Connect the SV output to the analogue input.

b) Execute an opening and closing of the SV.

c) Restore normal wiring.

d) Check if the analogue input and SV output remain operational when normal wiring is restored.

5.3.1.3.2 *Acceptance criteria*

The test shall be considered successful when both the analogue inputs and the SV outputs are operational after the test has been carried out.

5.3.1.4 *Analogue input with counter input*

5.3.1.4.1 *Test procedure*

a) Connect the counter input to the analogue input.

b) Execute an analogue input reading.

c) Restore normal wiring.

d) Check if the analogue input and counter input remain operational when normal wiring is restored.

5.3.1.4.2 *Acceptance criteria*

The test shall be considered successful when both the analogue inputs and the counter inputs are operational after the test has been carried out.

5.4 Analogue Input

5.4.1 *Overvoltage (Analogue Voltage Input)*

5.4.1.1 *Test procedure*

a) Generate an overvoltage of twice the maximum value of the signal voltage for at least 1 min.

b) Record the value obtained from the measurement as well as whether the local control unit / remote device has generated an event.

c) Generate a signal within the expected range.

d) Check that the local control unit / remote unit maintains the behaviour obtained in **4.5.**

5.4.1.2 *Acceptance criteria*

The test shall be considered successful when the analogue inputs are still working as in **4.5.**

5.4.2 *Overcurrent (Analogue Input by Current)*

5.4.2.1 *Test procedure*

a) Calculate a resistor that generates a current draw twice the maximum reading that the analogue input can make.

b) Connect the resistor to the analogue input.

c) A measurement is taken.

d) Record the value obtained from the measurement as well as whether the local control unit / remote device has generated an event.

e) Remove the previously calculated resistance.
f) The expected range.
g) Check that the local control unit / remote unit maintains the behaviour obtained in **4.5.**

5.4.2.2 *Acceptance criteria*

The test shall be considered successful when the analogue inputs are still working as in **4.5**.

5.4.3 *Short Circuit*

5.4.3.1 *General*

The short-circuit behaviour of the analogue inputs shall be verified in the following test. This test applies only when the input is an analogue voltage input.

5.4.3.2 *Short-circuit between the three analogue input terminals*

5.4.3.2.1 *Test procedure*

a) Once the connection has been made and maintained for at least 1 min, record the value obtained from the measurement, as well as whether the local control unit / remote equipment has generated an event.

b) Reconnect the wiring correctly.

c) Generate a signal within the range specified by the manufacturer in the questionnaire (*see* Annex A).

d) Check that the local control unit / remote unit maintains the behaviour obtained in test **4.3.4**.

5.4.3.2.2 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit maintains the behaviour and results obtained in test **4.3.4**.

This next test applies only when the input is an analogue current input.

5.4.3.3 *Short-circuit between the two analogue input terminals*

5.4.3.3.1 *Test procedure*

a) Once the connection has been made and maintained for at least one 1 min, record the value obtained from the measurement, as well as whether the local control unit / remote equipment has generated an event.

b) Correctly reconnect the wiring.

c) Generate a signal within the range specified by the manufacturer in the questionnaire (*see* Annex A).

d) Check that the local control unit / remote unit maintains the behaviour obtained in **4.5**.

5.4.3.3.2 *Acceptance criteria*

The test shall be considered successful if the local control unit / remote unit maintains the behaviour and results obtained in **4.5**.

5.5 Communications

5.5.1 *Antenna Short Circuit Test*

5.5.1.1 *Test procedure*

This test applies only to local control unit / remote units that have a radio communication system.

a) Disconnect and short-circuit the radio antenna for at least 1 min.

b) Any incident detected shall be logged.

c) Check that when you reconnect the radio antenna by removing the short circuit, the communication system still responds.

5.5.1.2 *Acceptance criteria*

The test shall be considered successful when several commands are sent to the local control unit / remote unit any that involve communication with the local control unit / remote unit, and the local control unit / remote unit communicates without having been affected by the performance of the test.

5.5.2 *Antenna Open Circuit Test*

5.5.2.1 *Test procedure*

This test applies only to local control unit / remote units that have a radio communication system.

a) Disconnect the radio antenna for at least 1 min.

b) Register any incident detected.

c) Check that when the radio antenna is reconnected, the communication system still responds.

5.5.2.2 *Acceptance criteria*

The test shall be considered successful when several commands are sent to the local control unit / remote unit any that involve communication with the local control unit / remote unit, and the local control unit / remote unit communicates without having been affected by the performance of the test.

5.6 Long-Term Behaviour

5.6.1 *Purpose of the Test*

The purpose of this test is to obtain reliability results on the local control unit / remote equipment after intensive use and within the maximum levels allowed by the manufacturer.

5.6.2 *Test Procedure*

Reliability testing shall be performed at room temperature with a local control unit / remote unit, powered from an adjustable power supply and with the SV output being monitored.

a) Perform a primary test (counter reading and solenoid valve actuation (opening and closing) to verify the correct operation of the scheme.

b) Perform ten (10) cycles of openings and closings.

c) Read the value of the counter stored by the local control unit / remote unit.
d) Verify that the value of the counter matches the value of a digital counter connected in parallel to the digital input used, so that it records the number of operations performed by the local control unit / remote unit.
e) Calculate the number of valve actuations that the local control unit / remote should perform over its lifetime using as parameters:

— Two daily openings and two daily closings of each valve.

— The useful life of the system specified by the manufacturer. (If this data is not known, it shall be calculated for 10 years, i.e. 14 400 operations per valve, estimating four operations per day, 2 openings and 2 closings).

f) Start the pulse series (calculated from the above data) at the fastest possible speed.

g) Record the number of operations performed and counter readings stored in the local control unit / remote unit.

5.6.3 *Acceptance Criteria*

The test shall be considered successful if the triggers recorded by the SV input and those of the SV pulse counter do not differ by more than 0.05 percent.

ANNEX A

(*Informative*)

QUESTIONNAIRE FOR TESTING IRRIGATION CONTROL SYSTEMS INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

A-1 GENERAL CONSIDERATIONS

The objective of this Annex is to give an example of how the questionnaire provided to the manufacturer can be to know the characteristics and functionalities of the equipment.

A-2 SYSTEM SPECIFICATIONS

A-2.1 Manufacturer

System Name

Version: Model:

Type: ☐ Online ☐ Hybrid ☐ Offline

A.2.2 Basic Functions of the System

☐ Open and close valves by direct command	
☐ Schedule an irrigation by start time and duration	
☐ Schedule an irrigation by start time and end time	
☐ Schedule an irrigation by duration and end time	
☐ Schedule an irrigation by volume	
☐ Schedule an irrigation by start time, maximum duration and maximum volume	
☐ Schedule a periodic irrigation (e.g.: every day from 6 to 8 hours)	
☐ Capable of periodic programming.	Nº of levels
[E.g.: "From July 1 to August 31 (level 1), Monday, Wednesday and Friday (level 2), Watering from 8 to 10 and from 20 to 22 hours (level 3)"]	
☐ Configure the pulse trigger valve	
☐ Pre-define types of valve (e.g.: 6 v and 40 ms, 18 v and 100 ms, etc.)	
☐ Assign an administrative name to a valve (hydrant)	
☐ Assign a serial number to a valve	
☐ Associate a valve with a meter	
☐ Associate multiple valves with the same meter.	How many?

☐ Immediately read a meter
☐ Immediately upload information to a meter
☐ Configure the volume / pulse meter
☐ Predefine meter types (e.g.: 0.1 m^3/pulse, 1 m^3/pulse)
☐ Assign an administrative name to a meter
☐ Assign a serial number to a meter
☐ Read analogue input
☐ Configure the power supply of the analogue input sensor
☐ Convert the analogue input signal to engineering units (MPa, litres/sec)
☐ Assign an administrative name to an analogue input
☐ Write analogue output

A-2.3 Basic Functions that the Local Control Unit / Remote Unit Allows after Performing a Test, Defined in the Functionality or Robustness Protocol, at Rated Voltage

☐ Water meter reading

☐ Solenoid performance

☐ Analog input reading

☐ Bidirectional communication

The local control unit / remote unit keeps:

☐ The real time clock (RTC)

☐ Water meter values

☐ The irrigations schedule

NOTE — In case that, after performing some of the tests describe on this document, at normal voltage, the local control unit / remote unit does not perform any of the basic functions, the manufacturers shall indicate which test is and which of the functions it fails to perform.

A-2.4 Specific Elements of the System

In the control centre:

In the field:

Intermediate elements:

Comments

A-3 SPECIFICATIONS OF THE LOCAL CONTROL UNIT / REMOTE UNIT

A.3.1 Model

Version:

Type:

Firmware:

NOTE — The manufacturer shall explain the operation of the control equipment outside the range provided.

A.3.2 Local Control Unit / Remote Unit Operating Environment

	Minimum	**Maximum**	**Unit**
Total operating temperature			
Relative humidity (RH)			

A-3.3 Useful Life of the Local Control Unit / Remote Unit

Number of useful years of the local control unit / remote unit, estimating four performances per day:

A-3.4 Power sources

☐ **Primary batteries**	Number	Type	Function
(Batteries)	Number	Type	Function

Does the local control unit / remote unit support polarity reversal in the power supply?	**Consumption**

☐ **Secondary batteries** Number Type Function

(Rechargeable) Number Type Function

Does the local control unit / remote unit support polarity reversal in the power supply?	**Consumption**

☐ **Backup battery**

Functionality:

- ☐ Storage of meter values
- ☐ Storage of irrigation schedules
- ☐ Measuring counter pulses when the main power of the local control unit / remote unit is interrupted

Other (Define which):

- ☐ **Other kind of battery**

Number	Type	Function
Number	Type	Function

Does the local control unit / remote unit support polarity reversal in the power supply?	**Consumption**

A-3.5 Other specifications

Which auxiliary elements are required at each local control unit / remote unit terminal (solar panels, masts, etc.)?

Specify:

Which additional items are required for complete installation (electricity supply, administrative licences, prefabricated cabins, towers, etc.)?

Specify:

Define the operation of the local control unit / remote unit for each of the cases listed in point 4.1 Power tests of the Functionality tests, as described in this document

- **Case A:**
- **Case B:**
- **Case C:**
- **Case D:**
- **Case E:**

Comments:

A-3.6 Inputs/Outputs

A-3.6.1 *External Signals*

No. of SV outputs ☐	expandable up to ☐	in modules of ☐
No. of meter inputs ☐	expandable up to ☐	in modules of ☐
No. of digital outputs of general purpose		

(differing of SV outputs) ☐	expandable up to ☐	in modules of ☐
No. of digital inputs of general purpose	Event generated ☐ Yes ☐ No Type:	
(differing of meter inputs) ☐	expandable up to ☐	in modules of ☐
Event generated ☐ Yes ☐ No Type:		
No. of analogue outputs ☐	expandable up to ☐	in modules of ☐
Event generated ☐ Yes ☐ No Type:		
No. of analogue inputs ☐	expandable up to ☐	in modules of ☐
Event generated ☐ Yes ☐ No Type:		

Added features in the remote unit		
Can the firmware be reprogrammed from a local control unit / remote unit site?	☐ Yes	☐ No
Can the firmware of all of the local control unit / remote units be reprogrammed at the same time?	☐ Yes	☐ No
How long does it take to change the firmware in the equipment?	☐ s	
Does the local control unit / remote unit have an indicator light to indicate that it is operating?	☐ Yes	☐ No
Is it possible to debug from a local control unit / remote unit site?	☐ Yes	☐ No
Does the local control unit / remote unit perform a self-test when starting?	☐ Yes	☐ No
Has the local control unit / remote unit local intelligence?	☐ Yes	☐ No

A-3.6.2 *Internal Signals*

Voltage measurement:

Rated voltage ☐

Solar panel ☐

Backup battery ☐

Solenoid trip capacitor ☐

Others ☐

Sensors integrated in the local control unit / remote unit

Temperate ☐

Humidity ☐

Others (define which) ☐

Consumption connected since

Abr.	Components of the local control unit / remote unit.	Minimum	Rated	Maximum	No.
V_{OP}	Supply voltage for total operation				

Consumption at V_{OP} minimum (mA)	NA	Minimum	Rated	Maximum	No.
Consumption in standby mode					

Consumption at V_{OP} Maximum (mA)	NA	Minimum	Rated	Maximum	No.
Consumption in standby mode					

Consumption at V_{OP} rated (mA)	NA	Minimum	Rated	Maximum	No.
Consumption in standby mode					
Consumption in active mode					
Consumption communicating					
Consumption when activating valve					
Consumption when measuring analogy input					
Consumption when counting pulses					
The manufacturer shall provide information about the operation of the local control unit / remote unit outside the specified ranges. **Comments:**					

A-3.7 Solenoid Valve Output

Connection	Load capacitor	Maximum current in SV
☐ 2-Wire (latch)	☐ No	
☐ 3-Wire common positive	☐ Yes, of ____ uF	____ A
☐ 3-Wire common negative		

A-3.7.1 *Configurable Actuation Voltage*

☐	V_{NOM}	I_{MAX}	A
☐	V_{MIN}	I_{MAX}	A
	V_{MAX}	I_{MAX}	A
	V_{RAT}	I_{MAX}	A
☐ Allows to schedule irrigation and simultaneous manoeuvring of SV outputs			
Maximum time between manoeuvres			

A-3.7.2 *Configurable Actual Time*

☐	T_{NOM}		
☐	T_{MIN}	T_{MAX}	T_{NOM}
Minimum operating time between pulses			

Short circuit enabled		**Resistance in the SV output for short circuit detection**	**Output current for short circuit detection**
☐ No	☐ Yes		

Short circuit enabled		**Resistance in the SV output for open circuit detection**	**Output current for open circuit detection**
☐ No	☐ Yes		

Can be associated with			**Open event generated**		**Closing event generated**	
Water Meter	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes
WFS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes
EPS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes

Minimum time for generation of the corresponding event, since the sensor is activated	
☐ TFWO (Maximum time for the WFS to detect opening)	
☐ TFWC (Maximum time for the WFS to detect closure)	
☐ TEPO (Maximum time for the EPS to detect opening)	
☐ TEPC (Maximum time for the EPS to detect closure)	
☐ TSVO (Maximum time for water meter to detect opening)	
☐ TSVC (Maximum time for water meter to detect closure)	
☐ TWMF (Maximum time between WM pulses to be considered as a flow)	

Comments

A-3.7.3 *Operating Logic*

☐ Security lock test due to low power supply

☐ Security lock test due to low pressure

☐ Security lock test due to excessive flow

A-3.8 Water Meter input

A-3.8.1 *Water Meter Input Characteristics*

Connection ☐ 2-Wire free contact ☐ other

A-3.8.2 *Sensor Power Supply*

☐ Always

☐ During the sample ☐ T_{ON}

☐ T_{OFF}

Flow calculated		**Alarm generated Flow high**		**Alarm generated Flow low**		**Configurable level**		**Minimum flow**	**Maximum flow**	**Steps**
☐ **No**	☐ **Yes**	☐ **No**	☐ **Yes**	☐ **No**	☐ **Yes**	☐ **No**	☐ **Yes**			

A-3.8.3 Pulse filter

☐ Hardware	Maximum frequency

	Minimum pulse width ☐
☐ Software	Time between pulses
	☐ Fixed
	☐ Configurable from to steps ☐ to ☐ steps ☐

A-3.8.4 *During the Measurement*

a) Current in a closed contact		☐ Fixed
(Mustimeter's Internal resistance to intensity of =< 1 Ohm)		
☐ Configurable from ☐	to ☐	steps ☐
b) Voltage in open circuit		☐ Fixed
(Mustimeter's Internal resistance to intensity of =<1 Ohm)		
☐ Configurable from ☐	to ☐	steps ☐
c) "Open contact" is understood:		
☐ If the voltage is greater than a value		☐ Fixed
☐ Configurable from ☐	to ☐	steps ☐
☐ If the current is less than a value		☐ Fixed
☐ Configurable from ☐	to ☐	steps ☐
d) "Closed contact" is understood:		
☐ If the voltage is less than a value		☐ Fixed
☐ Configurable from ☐	to ☐	steps ☐
☐ If the current is greater than a value		☐ Fixed
☐ Configurable from ☐	to ☐	steps ☐
Does the local control unit / remote unit accept concurrent pulses count in all counter inputs?	☐ No	☐ Yes
Does the local control unit / remote unit accept random pulses count in the counter inputs?	☐ No	☐ Yes
Does the local control unit / remote unit generate an event by quota limit overstepped?	☐ No	☐ Yes

A-3.9 Analogue Input

A-3.9.1 *Analogue Input Characteristics*

Connection	☐ 2-Wires		
Type	☐ Current from ☐ to ☐		
☐ Voltage from ☐ to ☐			
☐ Other			
Specify:			
Resolution	value ☐	☐ bits	☐ digits
Total error	less than or equal to ☐ percent		

Connection	☐ 3-Wires		
Type	☐ Current from ☐ to ☐		
☐ Voltage from ☐ to ☐			
☐ Other			
Specify:			
Resolution	value ☐	☐ bits	☐ digits
Total error	less than or equal to ☐ percent		

A-3.9.2 *Measures Out of Range*

Describe the operation of the local control unit / remote unit when:

a) Value less than the measurable minimum (Lower threshold)

b) Value greater than the measurable maximum (Higher threshold)
The local control unit / remote unit allows to define a consigned interval ☐ No ☐ Yes
Sends alarms ☐ No ☐ Yes

A-3.9.3 *Behaviour of the Local Control Unit / Remote Unit when Subjected to Extreme Values*

— ***V*OP minimum:**

Take real measurement with minimum value of the sensor ☐ No ☐ Yes

Take real measurement with maximum value of the sensor ☐ No ☐ Yes

— ***V*OP maximum:**

Take real measurement with minimum value of the sensor ☐ No ☐ Yes

Take real measurement with maximum value of the sensor ☐ No ☐ Yes

A-3.9.4 *Sensor Power Supply*

Sensor power supply	☐ No	☐ Always	☐ Before the sample

Power voltage of the sensor	☐ Fixed ☐ ☐ Sw ☐ Hw
	☐ Configurable since ☐ to ☐ steps ☐
Time before taking the sample	☐ Fixed ☐ ☐ Sw ☐ Hw
	☐ Configurable since ☐ to ☐ steps ☐
Short circuit is enabled in the power output of the sensor	☐ No
☐ Yes? Alarm generated?	

Voltage provided by the local control unit / remote unit to the sensor when there is no consumption by said sensor ☐

Voltage provided by the local control unit / remote unit to the sensor when the consumption by said sensor is the maximum specified ☐

Short Circuit Permitted		**Alarm generated**		**Configurable level**		**Minimum**	**Maximum**	**Steps**
☐ **No**	☐ **Yes**	☐ **No**	☐ **Yes**	☐ **Yes**	☐ **No**			

It can be programmable to take regular samples

☐ No				
☐ Yes	How often?	from	to	steps

Does it store the data?

No	
Yes	— Number of samples
	— With a date? Yes No

Does it generate an alarm?

☐ No

☐ Yes, type:

Comments

A-3.10 Other Outputs and Inputs

A.3.10.1 *External Signals*

The local control unit / remote unit allows using a single cable hose to connect SV and meter, without interferences occurring between solenoid output and water meter input
No ☐ Yes ☐

The local control unit / remote unit allows using a single cable hose to connect SV and analogue input, without interferences occurring between solenoid output and analogue input
No ☐ Yes ☐

The local control unit / remote unit allows using a single cable hose to connect water meter and analogue input, without interferences occurring between values of both sensors
No ☐ Yes ☐

A-3.11 Type of Communication

A.3.11.1 *General Considerations*

Explain in which part(s) of the system this applies.

> NOTE — If one system has more than one type of communication (for example GPRS between the control centre and the hub, and by cable from the hub to the local control unit / remote unit), complete as many pages as number of communications to describe each one of them.

A-3.11.2 *Physical Medium Environment*

☐ **Wire** ☐ with protocol ☐ proprietor ☐ standard

Maximum number of units that can connect to the same segment of cable:

Maximum length of a cable segment (m):

Is the communication cable galvanic ally isolated from the solenoid cable and the meter, etc. (hydraulic elements)?

☐ No

☐ Yes

Specify:

> Which construction requirements does the local control unit / remote unit terminal have (valve boxes, ground spikes, etc.)?

Specify:

☐ **Radio**

with telephone operator

GSM ☐ GPRS ☐ UMTS ☐ WiMAX ☐ Other ☐

Without telephone operator and with protocol:

proprietor:	☐	UHF433	☐	UHF868	☐ Other
standard	☐	ZigBee	☐	Wi-Fi	☐ Other

Frequency	☐ Fixed	☐ Configurable	-	steps
TX power	☐ Fixed	☐ Configurable	-	steps
Speed	☐ Fixed	☐ Configurable	-	steps

Accepts short circuit on the antenna connector during communicating ☐ No ☐ Yes

Accepts open circuit on the antenna connector by communicating ☐ No ☐ Yes

Recommended specifications before installing a facility via radio:

Recommended maximum distance for a radio link meters

If a local control, unit / remote unit can function as a router for others (multi-hopping):

Each hop increases the delay in communication (s)

How does the function of communication repeaters affect the dimensioning of the power supply of the local control unit / remote units?

Is it advisable to install some element of protection against intense electric fields of low frequency approximately the antenna? ☐ No ☐ Yes, explain

A-3.11.3 *Network architecture*

☐ Master-Slave (Poll) ☐ Peer2Peer (Events)

A-3.11.4 *Network Topography*

☐ Bus ☐ Star ☐ Tree ☐ Mesh ☐ Mixed,

Is the quality of the link measured?	☐ No	☐ Yes, explain
Are there various possible routes?	☐ No	☐ Yes, explain:
Is there a priority channel?	☐ No	☐ Yes, explain:
Can the network be auto-configured? (Do new elements added in the field connect automatically?)	☐ No	☐ Yes, explain:
Is encryption enabled?	☐ No	☐ Yes, explain:
Is an administrative license required?	☐ No	☐ Yes, explain: