Cycling Speed and Cadence Service (CSCS)

Bluetooth® Test Specification

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- **Group Prepared by** BTI
- **Feedback Email** bti-main@bluetooth.org
- **Abstract**

This document defines test structures and procedures for conformance test of products implementing the Cycling Speed and Cadence Service Specification.
Revision History

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1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and Test Cases (TC) to test the Bluetooth Cycling Speed and Cadence Service Specification.

The objective of this test specification is to provide a basis for interoperability tests for Bluetooth devices giving a high probability of air interface interoperability between different manufacturers' Bluetooth devices.
2 References, Definitions, and Abbreviations

2.1 References
This Bluetooth document incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter.

[1] Bluetooth Test Strategy and Terminology Overview
[2] Bluetooth Core Specification, Version 4.0 or later
[3] Cycling Speed and Cadence Service Specification v1.0

2.2 Definitions
For the purpose of this Bluetooth document, the definitions from [1] and [2] apply.

2.3 Abbreviations
For the purpose of this Bluetooth document, the definitions from [1] and [2] apply.
3 Test Suite Structure (TSS)

3.1 Overview

The Cycling Speed and Cadence Service requires the presence of GAP, SM (LE), SDP (BR/EDR), and GATT. This is illustrated in Figure 3.1.

![Cycling Speed and Cadence Service Test Model](image)

*Figure 3.1: Cycling Speed and Cadence Service Test Model*

3.2 Test Strategy

The test objectives are to verify functionality of the Cycling Speed and Cadence Service within a Bluetooth Host and enable interoperability between Bluetooth Hosts on different devices. The testing approach is to cover mandatory and optional requirements in the service specification and to match these to the support of the IUT as described in the ICS Proforma.

The test equipment shall provide an implementation of the Radio Controller and the parts of the Host needed to perform the test cases defined in the Cycling Speed and Cadence Service Test Specification. For some test cases, it is necessary to stimulate the IUT from an Upper Tester. In practice, this could be implemented as a special test interface, an MMI, or another interface supported by the IUT.

The Cycling Speed and Cadence test suite contains Valid Behavior (BV) tests complemented with Invalid Behavior (BI) tests where required. The test coverage mirrored in the test suite
structure is the result of a process that started with catalogued specification requirements that were logically grouped and assessed for testability enabling coverage in defined test cases.

The test suite structure is a tree with the first level representing the protocol groups.

### 3.3 Test Groups

The following test groups have been defined.

#### 3.3.1 Service Definition

Verify the service definition.

#### 3.3.2 Characteristic Declaration

Verify the presence and contents of characteristic declarations.

#### 3.3.3 Characteristic Descriptors

Verify the presence and contents of characteristic descriptors.

#### 3.3.4 Characteristic Read

Verify characteristics which support reading can be read. Verify the format and value of characteristic values.

#### 3.3.5 Characteristic Write

Verify characteristics which support writing can be written.

#### 3.3.6 Configure Notification

Verify characteristics can be configured for notification.

#### 3.3.7 Configure Indication

Verify characteristics can be configured for indication.

#### 3.3.8 Characteristic Notification

Verify characteristics which support notification can be notified.

#### 3.3.9 Characteristic Indication

Verify characteristics which support indication can be indicated.
4 Test Cases

4.1 Introduction

4.1.1 Test Case Identification Conventions

Test cases shall be assigned unique identifiers per the conventions in [1]. The convention used here is <spec abbreviation>/<IUT role>/<class>/<xx>-<nn>-<y>.

Test group abbreviations for “class,” “feature,” “function,” “sub-function” or “capability” (as applicable to this test specification) are defined in Table 4.1.

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<tr>
<th>Identifier Abbreviation</th>
<th>Class Identifier &lt;class&gt;</th>
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<tr>
<td>CSCS</td>
<td>Cycling Speed and Cadence Service</td>
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<td>SEN</td>
<td>Sensor Role</td>
</tr>
<tr>
<td>SD</td>
<td>Service Definition</td>
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<td>DEC</td>
<td>Characteristic Declaration</td>
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<td>DES</td>
<td>Characteristic Descriptors</td>
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<td>CR</td>
<td>Characteristic Read</td>
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<td>CW</td>
<td>Characteristic Write</td>
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<td>CON</td>
<td>Configure Indication or Notification</td>
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<td>CN</td>
<td>Characteristic Notification</td>
</tr>
<tr>
<td>SPS</td>
<td>Service Procedure – Set Cumulative Value</td>
</tr>
<tr>
<td>SPU</td>
<td>Service Procedure – Update Sensor Location</td>
</tr>
<tr>
<td>SPL</td>
<td>Service Procedure – Request Supported Sensor Locations</td>
</tr>
<tr>
<td>SPE</td>
<td>Service Procedure – Error Handling</td>
</tr>
</tbody>
</table>

*Table 4.1: Cycling Speed and Cadence Service TC Class Naming Convention*

4.1.2 Conformance

When conformance is claimed, all capabilities indicated as mandatory for this Specification shall be supported in the specified manner (process-mandatory). This also applies for all optional and conditional capabilities for which support is indicated. All mandatory capabilities, and optional and conditional capabilities for which support is indicated, are subject to verification as part of the Bluetooth certification program.

The Bluetooth Qualification Program may employ tests to verify implementation robustness. The level of implementation robustness that is verified varies from one Specification to another and may be revised for cause based on interoperability issues found in the market.

Such tests may verify:

* That claimed capabilities may be used in any order and any number of repetitions that is not excluded by the Specification, OR
• That capabilities enabled by the implementations are sustained over durations expected by the use case, OR

• That the implementation gracefully handles any quantity of data expected by the use case, OR

• That in cases where more than one valid interpretation of the Specification exist, the implementation complies with at least one interpretation and gracefully handles other interpretations OR

• That the implementation is immune to attempted security exploits.

A single execution of each of the required tests is required in order to constitute a pass verdict. However, it is noted that in order to provide a foundation for interoperability, it is necessary that a qualified implementation consistently and repeatedly pass any of the applicable tests.

In any case, where a member finds an issue with the Test Plan Generator, the Test Case as described in the Test Specification, or with the Test System utilized, the Member is required to notify the responsible party via an errata request such that the issue may be addressed.

4.1.3 Pass/Fail Verdict Conventions
Each test case has an Expected Outcome section, which outlines all the detailed pass criteria conditions that shall be met by the IUT to merit a Pass Verdict.

The convention in this test specification is that, unless there is a specific set of fail conditions outlined in the test case, the IUT fails the test case as soon as one of the pass criteria conditions cannot be met and in case this occurs the outcome of the test shall be the Fail Verdict.

4.2 Setup Preambles
The procedures defined in this section are provided for information, as they are used by test equipment in achieving the initial conditions in certain tests.

4.2.1 ATT Bearer on LE Transport
Follow the preamble procedure described in [5] section 4.2.1.2 with the IUT operating in the Peripheral role.

4.2.2 ATT Bearer on BR/EDR Transport
Follow the preamble procedure described in [5] section 4.2.1.1.

4.2.3 SC Control Point
Follow the preamble procedure to enable the IUT for use with the SC Control Point.

1. Establish an ATT Bearer connection between the Lower Tester and IUT as described in section 4.2.1 if using an LE transport or 4.2.2 if using a BR/EDR transport.
2. The handle of the CSC Measurement characteristic, CSC Feature characteristic, Sensor Location and SC Control Point characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

3. The handle of the Client Characteristic Configuration descriptor of the CSC Measurement characteristic and SC Control Point characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

4. If the Lower Tester and IUT were not previously bonded, perform a bonding procedure. If previously bonded, re-enable encryption.

5. The IUT configures the SC Control Point characteristic for indications, and if the test case requires notifications of the CSC Measurement characteristic, the IUT configures the CSC Measurement characteristic for notifications. These configurations may occur in any order.

4.3 Service Definition

Verify the service definition.

4.3.1 CSCS/SEN/SD/BV-01-C [Service Definition over LE]

- Test Purpose
  
  Verify the IUT has an instantiation of the Cycling Speed and Cadence Service as either a primary service or a secondary service. This test case only applies when using the LE transport.

- Reference
  
  [3] 2

- Initial Condition
  
  Establish an ATT Bearer connection between the Lower Tester and IUT as described in section 4.2.1.

- Test Procedure
  
  1. The Lower Tester sends an ATT_Find_By_Type_Value_Request (0x0001, 0xFFFF) to the IUT, with type set to «Primary Service» and Value set to «Cycling Speed and Cadence Service». Verify one attribute handle range is returned, containing the starting handle and the ending handle of the service definition.

  2. If no instances of Cycling Speed and Cadence Service as a primary service are found, the Lower Tester performs the find included services procedure by sending an ATT_Read_By_Type_Request (0x0001, 0xFFFF) to the IUT, with type set to «Include».
Verify one attribute handle range is returned, containing the starting handle and the ending handle of the service definition.

• Expected Outcome

Pass verdict

One attribute handle range is returned (either as a primary service or a secondary service), containing the starting handle and the ending handle of the service definition. The Attribute Type in that service declaration is either «Primary Service» or «Secondary Service».

4.3.2 CSCS/SEN/SD/BV-02-C [SDP Record]

Verify the SDP Record for the Cycling Speed and Cadence Service. This test case only applies when using the BR/EDR transport.

• Reference

[3] 4

• Initial Condition

An ACL connection over BR/EDR is established between the Lower Tester and IUT.

• Test Procedure

1. The Lower Tester establishes an SDP connection to the IUT.
2. The Lower Tester sends SDP requests to retrieve all attributes of the SDP record for the Cycling Speed and Cadence Service.

- Expected Outcome

   **Pass verdict**
   The SDP record for the service is found.
   All attributes which are mandatory for the service are present in the SDP record.
   The values of all attributes in the SDP record meet the requirements of the service.
   The GATT Start Handle and GATT End Handle parameters in the SDP record match the start handle and end handle of the service.

4.4 **Characteristic Declaration**

- Test Purpose

  This test group contains test cases to verify that the characteristic property field of the characteristic declaration meets the requirements of the service. The verification is performed one property at a time, as enumerated in the test cases in Table 4.2 below, using this generic test procedure.

- Reference

  [3]

- Initial Condition

  The handle range of the service has been previously discovered by the Lower Tester in test case CSCS/SEN/SD/BV-01-C [Service Definition over LE] or CSCS/SEN/SD/BV-02-C [SDP Record].

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.

- Test Procedure

  The following test procedure applies to the test cases listed in Table 4.2:

  1. Discover all characteristics of the service by executing the test procedure of GATT test case GATT/SR/GAD/BV-04-C [Discover All Characteristics of a Service - from server] or GATT/SR/GAD/BV-05-C [Discover Characteristics by UUID - from server] in [4].

  2. For a discovered characteristic that is listed in Table 4.2, verify the characteristic properties field of the characteristic declaration meets the requirements of the service.

- Expected Outcome
The following pass and fail verdicts apply to the test cases listed in Table 4.2:

**Pass verdict**

The characteristic is discovered and the characteristic properties field of the characteristic declaration meets the requirements of the service.

### Characteristic Declaration Test Cases

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Characteristic Properties Value (Requirements)</th>
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<tr>
<td>4.4.1 CSCS SEN/DEC/BV-01-C [Characteristic Declaration – CSC Measurement]</td>
<td>0x10 ([3] Table 3.1)</td>
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<tr>
<td>4.4.2 CSCS SEN/DEC/BV-02-C [Characteristic Declaration – CSC Feature]</td>
<td>0x02 ([3] Table 3.1)</td>
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<tr>
<td>4.4.3 CSCS SEN/DEC/BV-03-C [Characteristic Declaration – Sensor Location]</td>
<td>0x02 ([3] Table 3.1)</td>
</tr>
<tr>
<td>4.4.4 CSCS SEN/DEC/BV-04-C [Characteristic Declaration – SC Control Point]</td>
<td>0x28 ([3] Table 3.1)</td>
</tr>
</tbody>
</table>

*Table 4.2: Characteristic Declaration Test Cases*

### 4.5 Characteristic Descriptors

- **Test Purpose**

  This test group contains test cases to verify that the characteristic descriptors meet the requirements of the service. The verification is done one descriptor at the time, as enumerated in the test cases in Table 4.3, using this generic test procedure.

- **Reference**

  [3] 3.1.2.1

- **Initial Condition**

  The handle range of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.

- **Test Procedure**

  The following test procedure applies to the test cases listed in Table 4.3:
1. Discover all characteristic descriptors of the characteristic by executing the test procedure of GATT test case GATT/SR/GAD/BV-06-C [Discover All Characteristic Descriptors - from server] in [4] using the handle range of the characteristic. The IUT returns at least one handle-UUID pair.

2. If the UUID in a handle-UUID pair is for a characteristic descriptor referenced in a test case below, read the characteristic descriptor by executing the test procedure of GATT test case GATT/SR/GAR/BV-06-C [Read Characteristic Descriptors - from server server] in [4].

3. Verify the value of the characteristic descriptor meets the requirements of the service.

   - Expected Outcome

The following pass and fail verdicts apply to the test cases listed in Table 4.3:

   Pass verdict

   The characteristic descriptor is discovered, the characteristic descriptor is read, and the value of the characteristic descriptor meets the requirements of the service.

<table>
<thead>
<tr>
<th>Characteristic Descriptor Test Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Case</td>
</tr>
<tr>
<td>4.5.1 CSCS/SEN/DES/BV-01-C [CSC Measurement - Client Characteristic Configuration Descriptor]</td>
</tr>
<tr>
<td>4.5.2 CSCS/SEN/DES/BV-02-C [SC Control Point - Client Characteristic Configuration Descriptor]</td>
</tr>
</tbody>
</table>

Table 4.3: Characteristic Descriptor Test Cases

4.6 Characteristic Read

   - Test Purpose

This test group contains test cases to read and verify that the characteristic values required by the service are compliant. The verification is done one value at a time, as enumerated in the test cases in Table 4.4, using this generic test procedure.

   - Reference

[3] 3.2.1

   - Initial Condition

The handle range of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.
If the IUT requires a bonding procedure then perform a bonding procedure.

Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.

If IUT permissions for the characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Test Procedure

The following test procedure applies to the test cases listed in Table 4.4:

1. Read the characteristic value by executing the test procedure of GATT test case GATT/SR/GAR/BV-01-C [Read Characteristic Value - from Server] in [4].

2. Verify the characteristic value meets the requirements of the service.

- Expected Outcome

The following pass and fail verdicts apply to the test cases listed in Table 4.4:

Pass verdict

The characteristic is successfully read and the characteristic value meets the requirements of the service.

### Characteristic Read Value Test Cases

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.6.1 CSCS/SEN/CR/BV-01-C [Characteristic Read – CSC Feature]</td>
<td>2 octets with RFU bits set to 0. ([3] 3.2.1)</td>
</tr>
<tr>
<td>4.6.2 CSCS/SEN/CR/BV-02-C [Characteristic Read – Sensor Location]</td>
<td>1 octet with value other than RFU range. ([3] 3.3.1)</td>
</tr>
</tbody>
</table>

*Table 4.4: Characteristic Read Value Test Cases*

### 4.7 Configure Indication and Notification

- Test Purpose

This test group contains test cases to verify compliant operation in response to enable and disable characteristic indication or notification. The verification is done one value at a time, as enumerated in the test cases in Table 4.5, using this generic test procedure.

- Reference

[3] 3.1.2, 3.4.5

- Initial Condition
The handle range of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.4 or is known to the Lower Tester by other means.

The handle of the Client Characteristic Configuration descriptor of each characteristic referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.5 or is known to the Lower Tester by other means.

If the IUT requires a bonding procedure then perform a bonding procedure.

Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.

If IUT permissions for the characteristic require a specific security mode or security level, establish a connection meeting those requirements.

• **Test Procedure**

The following test procedure applies to the test cases listed in Table 4.5:

1. Disable indication or notification by writing value 0x0000 to the client characteristic configuration descriptor of the characteristic using the test procedure of GATT test case GATT/SR/GAW/BV-08-C [Write Characteristic Descriptors – from Server] in [4].

2. If the test case is for notification, enable notification by writing value 0x0001 to the client characteristic configuration descriptor of the characteristic.

3. Otherwise, if the test case is for indication, enable indication by writing value 0x0002 to the client characteristic configuration descriptor of the characteristic.

4. The Lower Tester reads the value of the client characteristic configuration descriptor.

• **Expected Outcome**

The following pass and fail verdicts apply to the test cases listed in Table 4.5:

**Pass verdict**

The characteristic descriptor is successfully written and the value returned when read is consistent with the value written.

---

**Configure Indication and Notification Test Cases**
<table>
<thead>
<tr>
<th>Test Case</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.7.1 CSCS/SEN/CON/BV-01-C [Configure Notification - CSC Measurement]</td>
<td>0x01 ([3] 3.1.2.1)</td>
</tr>
<tr>
<td>4.7.2 CSCS/SEN/CON/BV-02-C [Configure Indication - SC Control Point]</td>
<td>0x02 ([3] 3.4.5.1)</td>
</tr>
</tbody>
</table>

**Table 4.5: Configure Indication and Notification Test Cases**

4.8 **Characteristic Notification**

This test group contains test cases to verify compliant operation when the IUT sends notifications of characteristic values.

4.8.1 **CSCS/SEN/CN/BV-01-C [CSC Measurement Notifications – Wheel Revolution Data]**

- **Test Purpose**
  
  Verify the IUT can send notifications of the CSC Measurement characteristic that include Wheel Revolution Data.

- **Reference**
  
  [3] 3.1

- **Initial Condition**
  
  If the IUT requires a bonding procedure then perform a bonding procedure.
  
  The CSC Measurement characteristic is configured for notification.
  
  If desired, establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.
  
  If IUT permissions for the CSC Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- **Test Procedure**
  
  1. Perform an action on the IUT that will induce it, once connected, to send notifications of the CSC Measurement characteristic with Wheel Revolution Data.
  
  2. A connection is established between the Lower Tester and IUT meeting the security requirements of the IUT, if not already done so prior to step 1.
  
  3. The Lower Tester receives an ATT_Handle_Value_Notification from the IUT containing the CSC Measurement characteristic handle and value.
  
  4. Verify the characteristic value meets the requirements of the service.
5. Repeat steps 3-4 until the Lower Tester receives one or more additional notifications.

6. The Lower Tester configures the CSC Measurement characteristic to disable notifications.

7. Repeat steps 1-2 with notifications disabled.

8. Verify the Lower Tester does not receive an ATT_Handle_Value_Notification from the IUT containing the CSC Measurement characteristic.

• Expected Outcome

   **Pass verdict**
   
   The IUT sends more than one notification of the CSC Measurement characteristic.
   
   The CSC Measurement characteristic contains a Flags field, a Cumulative Wheel Revolutions field and a Last Wheel Event Time field.
   
   The value of each field of the characteristic meets the requirements of the service.
   
   The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.
   
   The IUT stops sending notifications of the CSC Measurement characteristic after the Lower Tester configures the characteristic to disable notifications.
   
   In all cases, ensure that the RFU bits of the flags field are set to zero.

4.8.2 CSCS/SEN/CN/BV-02-C [CSC Measurement Notifications – Forward Wheel Revolution Data]

• Test Purpose

   Verify the IUT can send notifications of the CSC Measurement characteristic that include Cumulative Wheel Revolutions and Last Wheel Event Time values when the wheel is rotated in the forward direction.

• Reference

   [3] 3.1

• Initial Condition

   If the IUT requires a bonding procedure then perform a bonding procedure.
   
   The CSC Measurement characteristic is configured for notification.
   
   If desired, establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.
If IUT permissions for the CSC Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- **Test Procedure**

  1. Perform an action on the IUT that will induce it, once connected, to send notifications of the CSC Measurement characteristic along with Cumulative Wheel Revolutions and Last Wheel Event Time values when the wheel is rotated in the forward direction.

  2. A connection is established between the Lower Tester and IUT meeting the security requirements of the IUT, if not already done so prior to step 1.

  3. The Lower Tester reads the CSC Feature characteristic (e.g., by executing test case CSCS/SEN/CR/BV-01-C [Characteristic Read – CSC Feature] or by other means).

  4. The Lower Tester receives one or more ATT_Handle_Value_Notifications from the IUT containing the CSC Measurement characteristic handle and value along with Cumulative Wheel Revolutions and Last Wheel Event Time values.

  5. Verify the characteristic value meet the requirements of the service.

- **Expected Outcome**

  **Pass verdict**

  The IUT sends one or more notifications of the CSC Measurement characteristic and at least one includes the Cumulative Wheel Revolutions and Last Wheel Event Time values with the appropriate flag set in the Flags field.

  The value of the characteristic meets the requirements of the service.

  The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

  In all cases, ensure that the RFU bits of the flags field are set to zero.

### 4.8.3 CSCS/SEN/CN/BV-03-C [CSC Measurement Notifications – Reverse Wheel Revolution Data]

- **Test Purpose**

  Verify that when an IUT supports the ability for the Cumulative Wheel Revolutions that can count in reverse (i.e., when the wheel is rotated in the reverse direction), it does not decrement below zero.

- **Reference**

  [3] 3.1.1.2

- **Initial Condition**
If the IUT requires a bonding procedure then perform a bonding procedure.

The CSC Measurement characteristic is configured for notification.

If desired, establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.

If IUT permissions for the CSC Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.

• Test Procedure

1. Perform an action to set the value of the Cumulative Wheel Revolutions to a value near zero (e.g. set to 0x00000005 using the procedure in CSCS/SEN/SPS/BV-01-C [Set Cumulative Value - Set to zero]).

2. Perform an action on the IUT that will induce it, once connected, to send notifications of the CSC Measurement characteristic along with Cumulative Wheel Revolutions and Last Wheel Event Time values when the wheel is rotated in the reverse direction.

3. A connection is established between the Lower Tester and IUT meeting the security requirements of the IUT, if not already done so prior to step 1.

4. The Lower Tester reads the CSC Feature characteristic (e.g. by executing test case CSCS/SEN/CR/BV-01-C [Characteristic Read – CSC Feature] or by other means).

5. Perform an action on the IUT that will induce it to count down a number of times greater than the value set in step 1.

6. The Lower Tester receives one or more ATT_Handle_Value_Notifications from the IUT containing the CSC Measurement characteristic handle and value along with Cumulative Wheel Revolutions and Last Wheel Event Time values.

7. Verify the characteristics value meet the requirements of the service.

• Expected Outcome

Pass verdict

The IUT sends one or more notifications of the CSC Measurement characteristic and at least one includes the Cumulative Wheel Revolutions and Last Wheel Event Time values with the appropriate flag set in the Flags field.

The value of the characteristic meets the requirements of the service.

The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

The value of the Cumulative Wheel Revolutions field reverses and ends at a count of 0x00000000 and does not roll over.

In all cases, ensure that the RFU bits of the flags field are set to zero.
4.8.4 CSCS/SEN/CN/BV-04-C [CSC Measurement Notifications – Crank Revolution Data]

• Test Purpose

Verify the IUT can send notifications of the CSC Measurement characteristic that include Cumulative Crank Revolutions and Last Crank Event Time values.

• Reference

[3] 3.1

• Initial Condition

If the IUT requires a bonding procedure then perform a bonding procedure.

The CSC Measurement characteristic is configured for notification.

If desired, establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 if using an LE transport or Section 4.2.2 if using a BR/EDR transport.

If IUT permissions for the CSC Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.

• Test Procedure

1. Perform an action on the IUT that will induce it, once connected, to send notifications of the CSC Measurement characteristic along with Cumulative Crank Revolutions and Last Crank Event Time values.

2. A connection is established between the Lower Tester and IUT meeting the security requirements of the IUT, if not already done so prior to step 1.

3. The Lower Tester receives one or more ATT_Handle_Value_Notifications from the IUT containing the CSC Measurement characteristic handle and value along with Cumulative Crank Revolutions and Last Crank Event Time values.

4. Verify the characteristic value meets the requirements of the service.

• Expected Outcome

Pass verdict

The IUT sends one or more notifications of the CSC Measurement characteristic and at least one includes the Cumulative Crank Revolutions and Last Crank Event Time values with the appropriate flag set in the Flags field.

The value of the characteristic meets the requirements of the service.

The value of the Crank Revolution Data Supported bit of the CSC Feature characteristic is set to 1.
In all cases, ensure that the RFU bits of the flags field are set to zero.

4.9 Service Procedure – Set Cumulative Value

This test group contains test cases to verify compliant operation when the Lower Tester uses SC Control Point Set Cumulative Value procedure.

4.9.1 CSCS/SEN/SPS/BV-01-C [Set Cumulative Value - Set to zero]

• Test Purpose

Verify the IUT can perform the Set Cumulative Value procedure to set a zero value to the Cumulative Wheel Revolutions.

• Reference

[3] 3.4.2.1

• Initial Condition

Perform the preamble described in Section 4.2.3.

The value of Cumulative Wheel Revolutions in the IUT is not set to a known non-zero value.

• Test Procedure

1. A connection is established between the Lower Tester and IUT.

2. The IUT sends one or more notifications of the CSC Measurement characteristic.

3. The Lower Tester writes the Set Cumulative Value Op Code (0x01) to the SC Control Point with a Parameter Value of 0x00000000.

4. The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x01) followed by the Response Value for 'success' (0x01) without Response Parameter.

5. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.

6. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.

7. Verify the characteristic value meets the requirements of the service.

• Expected Outcome

Pass verdict

The IUT sends one or more notifications of the CSC Measurement characteristic with the Cumulative Wheel Revolutions field set to a non-zero value.
The IUT sends one indication of the SC Control Point characteristic with the Response Code Op Code containing a valid Parameter Value.

After setting the value to zero, the IUT sends the next notification of the CSC Measurement characteristic with the Cumulative Wheel Revolutions field set to 0 (or slightly higher in case of movement).

The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

### 4.9.2 CSCS/SEN/SPS/BV-02-C [Set Cumulative Value - Set to non-zero]

- **Test Purpose**

  Verify the IUT can perform the Set Cumulative Value procedure to set a non-zero value to Cumulative Wheel Revolutions.

- **Reference**

  [3] 3.4.2.1

- **Initial Condition**

  Perform the preamble described in Section 4.2.3.

  The value of Cumulative Wheel Revolutions in the IUT is not set to a known non-zero value.

- **Test Procedure**

  1. A connection is established between the Lower Tester and IUT.

  2. The IUT sends one or more notifications of the CSC Measurement characteristic.

  3. The Lower Tester writes the Set Cumulative Value Op Code (0x01) to the SC Control Point with a Parameter Value other than 0x00000000 and different from the initial value.

  4. The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x01) followed by the Response Value for 'success' (0x01) without Response Parameter.

  5. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.

  6. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.

  7. Verify the characteristic value meets the requirements of the service.

- **Expected Outcome**

  Pass verdict
The IUT sends one or more notifications of the CSC Measurement characteristic with the Cumulative Wheel Revolutions field set to a non-zero value.

The IUT sends one indication of the SC Control Point characteristic with the Response Code Op Code containing a valid Parameter Value.

After setting the value to a non-zero value, the IUT sends the next notification of the CSC Measurement characteristic with the Cumulative Wheel Revolutions field set to the specified value (or slightly higher in case of movement).

The value of the Wheel Revolution Data Supported bit of the CSC Feature characteristic is set to 1.

### 4.10 Service Procedure – Request Supported Sensor Locations

This test group contains test cases to verify compliant operation when the Lower Tester uses SC Control Point Request Supported Sensor Locations procedure.

#### 4.10.1 CSCS/SEN/SPL/BV-01-C [Request Supported Sensor Locations]

- **Test Purpose**
  
  Verify the IUT can perform the Request Supported Sensor Location procedure.

- **Reference**
  
  [3] 3.4.2.4

- **Initial Condition**
  
  Perform the preamble described in Section 4.2.3.

- **Test Procedure**

  1. A connection is established between the Lower Tester and IUT.
  2. The Lower Tester writes the Request Supported Sensor Locations Op Code (0x04) to the SC Control Point without any Parameter Value.
  3. The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x04) followed by the Response Value for 'success' (0x01) followed with the list of the supported sensor locations.
  4. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.
  5. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  6. Verify the characteristic value meets the requirements of the service.
• Expected Outcome

Pass verdict
The IUT sends one indication of the SC Control Point characteristic with the Response Code Op Code containing a valid Parameter Value.
The value of the Multiple Sensor Locations Supported bit of the CSC Feature characteristic is set to 1.

4.11 Service Procedure – Update Sensor Location
This test group contains test cases to verify compliant operation when the Lower Tester uses SC Control Point Update Sensor Location procedure.

4.11.1 CSCS/SEN/SPU/BV-01-C [Update Sensor Location]
• Test Purpose
Verify the IUT can perform the Update Sensor Location procedure.

• Reference
[3] 3.4.2.3

• Initial Condition
Perform the preamble described in Section 4.2.3.

• Test Procedure
1. A connection is established between the Lower Tester and IUT.
2. The Lower Tester reads the Sensor Location characteristic to determine the present value.
3. For each supported Sensor Location value (known by executing CSCS/SEN/SPL/BV-01-C [Request Supported Sensor Locations] or by other means), perform the following:
   - The Lower Tester writes the Update Sensor Location Op Code (0x03) to the SC Control Point with a Parameter Value set to another supported sensor location (e.g. by executing test case CSCS/SEN/SPL/BV-01-C [Request Supported Sensor Locations] or by other means).
   - The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x03) followed by the Response Value for 'success' (0x01) without Response Parameter.
   - The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.
- The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
- Verify the characteristic value meets the requirements of the service.
- The Lower Tester reads the Sensor Location characteristic and verifies the characteristic value meets the requirements of the service.

• Expected Outcome

Pass verdict
For each supported Sensor Location value, verify the following:
- The IUT sends one indication of the SC Control Point characteristic with the Response Code Op Code containing a valid Parameter Value.
- The Sensor Location value is set to the value written as a Parameter to the SC Control Point.

The value of the Multiple Sensor Locations Supported bit of the CSC Feature characteristic is set to 1.

4.12 Service Procedure – General Error Handling
This test group contains test cases to verify compliant operation when the Lower Tester uses SC Control Point procedure and an error results.


• Test Purpose
Verify that the IUT responds appropriately when a Client writes an unsupported Op Code to the SC Control Point.

• Reference
[3] 3.4.3

• Initial Condition
Perform the preamble described in Section 4.2.3.

• Test Procedure
1. A connection is established between the Lower Tester and IUT.
2. The Lower Tester writes an Op Code Value of 0x00 to the SC Control Point without Parameter Value.
3. Verify the IUT response meets the requirements of the service.
4. The Lower Tester writes an Op Code value from the Reserved for Future Use range other than 0x00 to the SC Control Point without Parameter Value.

5. Verify the IUT response meets the requirements of the service.

- Expected Outcome

**Pass verdict**

For both cases, the IUT sends a Write Response followed by an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (i.e. 0x00 for step 2 and the RFU value written for step 4) followed by the Response Value for ‘Op Code not supported’ (0x02) and without Response Parameter.

4.12.2 CSCS/SEN/SPE/BI-02-C [Invalid Parameter]

- Test Purpose

Verify that the IUT responds appropriately when a Client writes a supported Op Code followed by an invalid Parameter Value to the SC Control Point.

- Reference

[3] 3.4.3

- Initial Condition

Perform the preamble described in Section 4.2.3.

- Test Procedure

1. A connection is established between the Lower Tester and IUT.
2. The Lower Tester writes the Update Sensor Location Op Code (0x03) to the SC Control Point with a Parameter Value set to a sensor location from the RFU range.
3. Verify the IUT response meets the requirements of the service.

- Expected Outcome

**Pass verdict**

The IUT sends a Write Response followed by an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing Request Op Code (0x03) followed by the Response Value for ‘Invalid Parameter’ (0x03) and without Response Parameter.
4.12.3 CSCS/SEN/SPE/BI-03-C [Client Characteristic Configuration Descriptor Improperly Configured]

- **Test Purpose**
  Verify that the IUT responds appropriately when a Client attempts to perform an SC Control Point procedure with a Client Characteristic Configuration descriptor that is improperly configured.

- **Reference**
  [3] 1.6, 3.4.3

- **Initial Condition**
  Perform the preamble described in Section 4.2.3.

- **Test Procedure**
  1. A connection is established between the Lower Tester and IUT.
  2. The Lower Tester resets to 0 the Client Characteristic Configuration descriptor of the SC Control Point characteristic.
  3. The Lower Tester writes a valid Op Code to the SC Control Point.
  4. Verify the IUT response meets the requirements of the service.

- **Expected Outcome**
  **Pass verdict**
  The IUT rejects the Write Request by sending an Error Response with an Attribute Protocol Application Error Code set to Client Characteristic Configuration Descriptor Improperly Configured (0x81).

4.12.4 CSCS/SEN/SPE/BI-04-C [Procedure Already in Progress]

- **Test Purpose**
  Verify that the IUT responds appropriately when a Client attempts to perform an SC Control Point procedure when a procedure is already in progress.

- **Reference**
  [3] 1.6, 3.4.3

- **Initial Condition**
  Perform the preamble described in Section 4.2.3.

- **Test Procedure**
1. A connection is established between the Lower Tester and IUT.

2. The Lower Tester sets to 1 the Client Characteristic Configuration descriptor of the SC Control Point characteristic.

3. The Lower Tester writes a valid Op Code (e.g. by executing test case CSCS/SEN/SPL/BV-01-C [Request Supported Sensor Locations] or by other means) to the SC Control Point without Parameter Value.

4. The Lower Tester receives one Indication of the SC Control Point to acknowledge the first request. The Lower Tester does not send any Confirmation to acknowledge this Indication.

5. The Lower Tester sends five consecutive write requests all with valid Op Codes to the SC Control Point without Parameter Value.

6. There are two alternatives (a or b):
   a) The Lower Tester receives an Error Response with an Attribute Protocol Application Error Code set to Procedure Already In Progress (0X80).
   b) The Lower Tester receives five indications of the SC Control Point to acknowledge each request sent by the Lower Tester in Step 5.

7. Verify the IUT response(s) meet the requirements of the service.
   • Expected Outcome
     Pass verdict
     The IUT acknowledges the first write request with appropriate Response Value.
     The IUT successfully performs one of the following alternatives (a or b):
     a. Rejects a Write Request in Step 5 by sending an Error Response with an Attribute Protocol Application Error Code set to Procedure Already In Progress (0x80).
     b. Acknowledges all five write requests with appropriate Response Values.

4.12.5 CSCS/SEN/SPE/BI-05-C [SC Control Point Procedure Timeout]
   • Test Purpose
     Verify that the IUT stops sending indications related to the operation after an ATT Transaction Timeout.
   • Reference
     [3] 3.4.4
   • Initial Condition
Perform the preamble described in Section 4.2.3.

- Test Procedure

1. A connection is established between the Lower Tester and IUT.

2. The Lower Tester sends write request for any of the supported Op Codes supported by the IUT (Set Cumulative Value or Update Sensor Location or Request Supported Sensor Locations) to the SC Control Point using an appropriate Parameter for the Op Code.

3. The IUT sends an indication of the SC Control Point characteristic with the Response Code Op Code (0x10), a Parameter Value representing the Request Op Code (0x01 or 0x03 or 0x04) followed by the Response Value for 'success' (0x01) without Response Parameter or followed with the list of the supported sensor locations (if Request Supported Sensor Locations)

4. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the SC Control Point characteristic handle and value.

5. The Lower Tester receives the indication but does not send a handle/value confirmation for an ATT Transaction Timeout plus several seconds.

6. After the ATT Transaction Timeout, the IUT does not send any further notifications and considers the procedure to have failed.

- Expected Outcome

Pass verdict

The IUT stops sending any further notifications after the ATT Transaction Timeout.

The IUT returns to a stable state and may disconnect based on implementation.
# 5 Test Case Mapping

The Test Case Mapping Table (TCMT) maps test cases to specific capabilities in the ICS.

The columns for the TCMT are defined as follows:

- **Item**: contains an y/x reference, where y corresponds to the table number and x corresponds to the feature number as defined in the ICS Proforma Cycling Speed and Cadence Service (CSCS) [4]. If the item is defined with Protocol, Profile or Service abbreviation before y/x, the table and feature number referenced are defined in the abbreviated ICS proforma document.

- **Feature**: recommended to be the primary feature defined in the ICS being tested or may be the test case name.

- **Test Case(s)**: the applicable test case identifiers required for Bluetooth Qualification if the corresponding y/x references defined in the Item column are supported.

- **Test Case Applicable**: may be used to note if a test is required based on the supported features.

For purpose and structure of the ICS/IXIT proforma and instructions for completing the ICS/IXIT proforma refer to the Bluetooth ICS and IXIT proforma document.

<table>
<thead>
<tr>
<th>Item</th>
<th>Feature</th>
<th>Test Case(s)</th>
<th>Test Case Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCS 1/2 and CSCS 3/1</td>
<td>Cycling Speed and Cadence Service - Service Definition over LE</td>
<td>CSCS/SEN/SD/BV-01-C</td>
<td></td>
</tr>
<tr>
<td>CSCS 1/1 and CSCS 3/1</td>
<td>Cycling Speed and Cadence Service - SDP Record</td>
<td>CSCS/SEN/SD/BV-02-C</td>
<td></td>
</tr>
<tr>
<td>CSCS 3/2</td>
<td>CSC Measurement Characteristic</td>
<td>CSCS/SEN/DEC/BV-01-C CSCS/SEN/DES/BV-01-C CSCS/SEN/CON/BV-01-C</td>
<td></td>
</tr>
<tr>
<td>CSCS 2/1</td>
<td>Wheel Revolution Data fields of CSC Measurement Characteristic</td>
<td>CSCS/SEN/CN/BV-01-C</td>
<td></td>
</tr>
<tr>
<td>CSCS 2/1</td>
<td>Wheel Revolution Data fields of CSC Measurement Characteristic (Forward)</td>
<td>CSCS/SEN/CN/BV-02-C</td>
<td></td>
</tr>
<tr>
<td>CSCS 3/5</td>
<td>Wheel Revolution Data fields of CSC Measurement Characteristic (Reverse)</td>
<td>CSCS/SEN/CN/BV-03-C</td>
<td></td>
</tr>
<tr>
<td>CSCS 2/2</td>
<td>Crank Revolution Data fields of CSC Measurement Characteristic</td>
<td>CSCS/SEN/CN/BV-04-C</td>
<td></td>
</tr>
<tr>
<td>CSCS 3/6</td>
<td>CSC Feature Characteristic</td>
<td>CSCS/SEN/DEC/BV-02-C CSCS/SEN/CR/BV-01-C</td>
<td></td>
</tr>
<tr>
<td>CSCS 3/7</td>
<td>Sensor Location Characteristic</td>
<td>CSCS/SEN/DEC/BV-03-C CSCS/SEN/CR/BV-02-C</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Feature</td>
<td>Test Case(s)</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>CSCS 3/8</td>
<td>SC Control Point Characteristic</td>
<td>CSCS/SEN/SD/BV-01-C</td>
<td></td>
</tr>
</tbody>
</table>
|  |  | CSCS/SEN/DEC/BV-04-C  
|  |  | CSCS/SEN/DES/BV-02-C  
|  |  | CSCS/SEN/CON/BV-02-C  
|  |  | CSCS/SEN/SPE/BI-01-C  
|  |  | CSCS/SEN/SPE/BI-03-C  
|  |  | CSCS/SEN/SPE/BI-04-C  
|  |  | CSCS/SEN/SPE/BI-05-C  |
| CSCS 2/1 | Wheel Revolution Data Supported | CSCS/SEN/SPS/BV-01-C |
| CSCS 2/1 and CSCS 3/10 | Wheel Revolution Data Supported - Set Cumulative Value Procedure – Set to non-zero | CSCS/SEN/SPS/BV-02-C |
| CSCS 2/3 | Multiple Sensor Locations Supported | CSCS/SEN/SPL/BV-01-C  
|  |  | CSCS/SEN/SPU/BV-01-C  
|  |  | CSCS/SEN/SPE/BI-02-C  |

*Table 5.1: Test Case Mapping*