

# ScooterMotorRequirements

Author(s): John Doe  
Published on: 11-May-2023

Overall mark	
Notes	6 informational requirements 15 functional requirements.  Requirement links included.  Sections 3, 4, 5 and 6 should be defined as container requirements in the editor.

Requirement correctness per feature: Good, regular, bad.

## Table of Contents

Chapter 1: Requirement Set: ScooterMotorRequirements .....	2
1 Standard test contidions .....	3
2 Size .....	3
3 Motor Ratings .....	4
3.1 Maximum Torque.....	4
3.2 Nominal Torque .....	5
3.3 Maximum Speed .....	6
3.4 Maximum Power .....	7
3.5 Nominal Voltage.....	8
4 Security and comfort.....	8
4.1 Cogging torque.....	9
4.2 Braking .....	9
4.3 Shut down .....	10
4.4 Shock immunity.....	11
4.5 Noise level.....	12
4.6 Balancing .....	12
5 Performance.....	13
5.1 Throttle response.....	13
5.2 Power delivery .....	14
5.3 Efficiency .....	15
5.4 Temperature range .....	15
6 Direction.....	16

## Chapter 1: Requirement Set: ScooterMotorRequirements

---

### Description

### Implementation Status

Total: 15, Implemented: 0, Justified: 0, None: 15

### Verification Status

Total: 15, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 15

**Change Information** No change issue detected.

## 1 Standard test conditions

**Requirement Type** Informational

**ID** #6









### Description

The standard test conditions for the electric scooter shall be in a smooth road with a maximum gradient of 5% and a load of 90 kg (not including the scooter's weight).

**Change Information** No change issue detected.

### Links

Artifact: ScooterMotorRequirements.slreqx

Linked Item	Link Type
 <a href="#">Maximum Torque</a>	⇒ Related to
 <a href="#">Nominal Torque</a>	⇒ Related to
 <a href="#">Maximum Speed</a>	⇒ Related to
 <a href="#">Maximum Power</a>	⇒ Related to
 <a href="#">Cogging torque</a>	⇒ Related to
 <a href="#">Throttle response</a>	⇒ Related to
 <a href="#">Power delivery</a>	⇒ Related to
 <a href="#">Efficiency</a>	⇒ Related to

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	The word smooth is ambiguous. Specify friction conditions.							

## 2 Size

**Requirement Type** Informational

**ID** #4

## Description

The motor shall fit on a 10 inch diameter inflatable wheel.

**Change Information** No change issue detected.

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments								

## 3 Motor Ratings

**Requirement Type** Functional

**ID** #7

## Description

**Change Information** No change issue detected.

## Implementation Status

Total: 6, Implemented: 0, Justified: 0, None: 6

## Verification Status

Total: 6, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 6

## 3.1 Maximum Torque

**Requirement Type** Functional

**ID** #1

## Description

The motor shall have a maximum torque output of 10 Nm under standard test conditions.


## Rationale

The maximum torque required in the whole route is 7.2 Nm, so a maximum torque of 10 Nm has been established.

**Change Information** No change issue detected.

## Links

Artifact: ScooterMotorRequirements.slreqx

Linked Item	Link Type
 <a href="#">Standard test contidions</a>	← Related to

## Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

## Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	It should be specified whether for the whole test or only for a limited time.							

## 3.2 Nominal Torque

**Requirement Type** Functional

**ID** #5


## Description

The motor shall have a nominal torque output of 1 Nm under standard test conditions.

**Change Information** No change issue detected.

## Links

Artifact: ScooterMotorRequirements.slreqx

Linked Item	Link Type
 <a href="#">Standard test contidions</a>	← Related to

## Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

## Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments								

## 3.3 Maximum Speed

**Requirement Type** Functional

**ID** #2



### Description

The motor shall have a top speed of 530 rpm under standard test conditions.

**Change Information** No change issue detected.

### Links

Artifact: ScooterMotorRequirements.slreqx

Linked Item	Link Type
 <a href="#">Standard test contidions</a>	← Related to
 <a href="#">Noise level</a>	⇒ Related to

## Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

## Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	It should be specified whether for the whole test or only for a limited time.							

### 3.4 Maximum Power

**Requirement Type** Functional

**ID** #3


#### Description

The motor shall have a maximum power output of 500 W under standard test conditions.

**Change Information** No change issue detected.

#### Links

Artifact: ScooterMotorRequirements.slreqx

Linked Item	Link Type
 <a href="#">Standard test contidions</a>	← Related to

#### Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

#### Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	It should be specified whether for the whole test or only for a limited time.							



### 3.5 Nominal Voltage

**Requirement Type** Functional

**ID** #24

#### Description

The motor shall have a nominal voltage of 24 V.

**Change Information** No change issue detected.

#### Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

#### Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments								

### 4 Security and comfort

**Requirement Type** Functional

**ID** #9

#### Description

**Change Information** No change issue detected.

#### Implementation Status

Total: 4, Implemented: 0, Justified: 0, None: 4

#### Verification Status

Total: 4, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 4

## 4.1 Cogging torque

**Requirement Type** Functional

**ID** #10


### Description

The motor shall have a maximum cogging torque of 8 % under standard conditions.

**Change Information** No change issue detected.

### Links

Artifact: ScooterMotorRequirements.slreqx

Linked Item	Link Type
 <a href="#">Standard test contidions</a>	← Related to

### Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

### Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	The reference for the 8% should be specified							

## 4.2 Braking

**Requirement Type** Functional

**ID** #11

### Description

The motor shall have a braking system that can bring the scooter to a stop within 5 meters when traveling at a speed of 25 km/h.

**Change Information** No change issue detected.

### Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

### Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	It leaves different options open. A mechanical brake integrated in the motor, regenerative braking...							

## 4.3 Shut down

**Requirement Type** Functional

**ID** #12

### Description

The motor shall have a temperature sensor and shall shut down automatically if the temperature exceeds 80 °C.

**Change Information** No change issue detected.

### Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

### Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	<p>Which temperature should be specified: stator, rotor...</p> <p>There should be two requirements:</p> <ul style="list-style-type: none"> <li>- One specifying the protection of the motor at 80 °C.</li> <li>- One specifying that the temperature shall be measured with a sensor.</li> </ul> <p>In this way the work may be divided more easily. A hardware engineer may be responsible for the installation and measurements of the sensor. The control engineer for the programming of the protection.</p> <p>The requirement about the protection does not limit any solution and someone could suggest an estimator.</p>							

## 4.4 Shock immunity

**Requirement Type** Informational

**ID** #13

### Description

The motor shall have a robust design that can withstand a drop test from a height of 1 meter without damage.

**Change Information** No change issue detected.

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	More information about how the drop test is performed could be included. A standard could be mentioned.							

## 4.5 Noise level

**Requirement Type** Informational

**ID** #14


### Description

The motor noise level shall be less than 70 dB at a distance of 1 meter while travelling at it's maximum speed.

**Change Information** No change issue detected.

### Links

Artifact: ScooterMotorRequirements.sreqx

Linked Item	Link Type
 <a href="#">Maximum Speed</a>	← Related to

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments								

## 4.6 Balancing

**Requirement Type** Informational

**ID** #22

### Description

The motor and the 10 inch inflatable tires shall be dynamically balanced.

**Change Information** No change issue detected.

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.

				or other kind of mistakes.				
Comments	What does dynamically balanced mean?							

## 5 Performance

**Requirement Type** Functional

**ID** #15

**Description**

**Change Information** No change issue detected.

**Implementation Status**

Total: 4, Implemented: 0, Justified: 0, None: 4

**Verification Status**

Total: 4, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 4

### 5.1 Throttle response

**Requirement Type** Functional

**ID** #17


**Description**

The motor shall have a response time of less than 100 ms when the throttle is applied under standard conditions.

**Change Information** No change issue detected.

**Links**

Artifact: ScooterMotorRequirements.slreqx

Linked Item	Link Type
 <a href="#">Standard test contidions</a>	← Related to

**Implementation Status**

Total: 1, Implemented: 0, Justified: 0, None: 1

## Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	The tester needs to know when the response time starts and finishes.							

## 5.2 Power delivery

**Requirement Type** Functional

**ID** #18


### Description

The motor shall have a maximum power ripple of 5 % in it's whole speed range under standard test conditons to achieve a smooth and consistent power delivery.

**Change Information** No change issue detected.

### Links

Artifact: ScooterMotorRequirements.slreqx

Linked Item	Link Type
 <a href="#">Standard test contidions</a>	← Related to

## Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

## Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.

Comments	The requirement should specify how to measure the power ripple and where to measure it.							

### 5.3 Efficiency

**Requirement Type** Functional

**ID** #19


#### Description

The motor efficiency shall be at least 80 % under standard test conditions.

**Change Information** No change issue detected.

#### Links

Artifact: ScooterMotorRequirements.slreqx

Linked Item	Link Type
 <a href="#">Standard test contidions</a>	← Related to

#### Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

#### Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments								

### 5.4 Temperature range

**Requirement Type** Informational

**ID** #20



## Description

The motor shall be able to operate in temperatures ranging from -10 °C to 50 °C.

**Change Information** No change issue detected.

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments	Standard test conditions should be mentioned. This requirement leaves open the option for a degraded operation mode at extreme temperatures.							

## 6 Direction

**Requirement Type** Functional

**ID** #21

## Description

The motor shall be able to operate in both forward and reverse directions.

**Change Information** No change issue detected.

## Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

## Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

	Feasible	Verifiable	Unambiguous	Clear	Atomic	Legal	Abstract	Complete
Compliance	Technically possible (cost and schedule).	Each statement can be tested. There is a feasible procedure to do so.	Each statement is precise, there are no ambiguities. There is only one interpretation.	Each statement can be understood. There are not spelling or other kind of mistakes.	The requirement defines a single traceable element.	Does not make you break any law.	Does not specify a certain solution	It contains all the information to understand it.
Comments								