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Maximum assistance factor for cycles designed to pedal

Motorcycle Working Group
23/09/2015

L1e vehicle classification

co-decision text - Annex I

Category	Category name	Common classification criteria
L1e	Light two-wheel powered vehicle	(4) two wheels and powered by a propulsion as listed under Article 4(3) and (5) engine capacity ≤ 50 cm^3 if a PI internal combustion engine forms part of the vehicle's propulsion configuration and (6) maximum design vehicle speed ≤ 45 km/h and (7) maximum continuous rated or net power ([1]) ≤ 4 000 W and (8) maximum mass = technically permissible mass declared by the manufacturer and
Sub-categories	Subcategory name	Supplemental sub-classification criteria
L1e-A	Powered cycle	(9) cycles designed to pedal equipped with an auxiliary propulsion with the primary aim to aid pedalling and (10) output of auxiliary propulsion is cut off at a vehicle speed ≤ 25 km/h and (11) maximum continuous rated or net power ([1]) ≤ 1 000 W and (12) a powered three- or four-wheel cycle complying with supplemental specific sub-classification criteria (9) to (11) is classified as being technically equivalent to a two-wheel L1e-A vehicle.
L1e-B	Two-wheel moped	(9) any other vehicle of the L1e category that cannot be classified according to the criteria (9) to (12) of a L1e-A vehicle.

L1e vehicle classification - summarized

	L1e-A classification criteria	L1e-B classification criteria	
cycle designed to pedal	*Yes*	***Yes***	***No***
maximum assistance speed	*≤ 25 km/h*	*≤ 45 km/h*	*≤ 45 km/h*
maximum continuous rated power	*≤ 1000 W*	*≤ 4000 W*	*≤ 4000 W*
maximum assistance factor	*n/a*	*≤ 4*	*n/a*

L1e vehicle classification - summarized

According to co-decision text, Annex I:
Vehicle classification

	L1e-A classification criteria	L1e-B classification criteria	
cycle designed to pedal	*Yes*	***Yes***	***No***
maximum assistance speed	*≤ 25 km/h*	*≤ 45 km/h*	*≤ 45 km/h*
maximum continuous rated power	*≤ 1000 W*	*≤ 4000 W*	*≤ 4000 W*
maximum assistance factor	*n/a*	*≤ 4*	*n/a*

According to RVFSR, Annex XIX
Requirements regarding vehicle structure integrity

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L1e vehicle classification - summarized

According to RVFSR, Annex XIX
Requirements regarding vehicle structure integrity

1.1.2. *Cycles designed to pedal of vehicle category L1e-B shall have a mass in running order* ***≤ 35 kg*** *and shall be fitted with* ***pedals*** *enabling the vehicle to be propelled solely by the rider's muscular leg power. The vehicle shall feature* ***adjustable rider positioning*** *in order to enhance the ergonomic posture of the rider for pedalling. The auxiliary propulsion power shall be added to the* ***driver's pedal power*** *and shall be less than or equal to* ***four times the actual pedal power****.*

On a glance

According to classification in co-decision text:

	≤ 1000W, ≤ 25 km/h	≤ 4000W, ≤ 45 km/h
AF < 4	L1e	L1e
AF > 4	L1e	L1e

On a glance

According to co-decision text + RVSFR:

	≤ 1000W, ≤ 25 km/h	≤ 4000W, ≤ 45 km/h
AF < 4	L1e	L1e
AF > 4	L1e	L3e

Cycles designed to pedal?

Category	Category name	
L1e	Light two-wheel powered vehicle	(4) two wheels and powered by a propulsion a (5) engine capacity ≤ 50 cm³ if a PI internal co (6) maximum design vehicle speed ≤ 45 km/h (7) maximum continuous rated or net power ((8) maximum mass = technically permissible m
Sub-categories	Subcategory name	
L1e-A	Powered cycle	(9) cycles designed to pedal equipped with an (10) output of auxiliary propulsion is cut off at (11) maximum continuous rated or net power ((12) a powered three- or four-wheel cycle comply equivalent to a two-wheel L1e-A vehicle.
L1e-B	Two-wheel moped	(9) any other vehicle of the L1e category that

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Cycles designed to pedal?

Category	Category name	
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L1e-A	Powered cycle	(9) cycles designed to pedal equipped with an (10) output of auxiliary propulsion is cut off at (11) maximum continuous rated or net power ((12) a powered three- or four-wheel cycle comply equivalent to a two-wheel L1e-A vehicle.
L1e-B	Two-wheel moped	(9) any other vehicle of the L1e category that

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A tale of 4 vehicles…

1

2

3

4

A tale of 4 vehicles…

1

2

3

4

	vehicle 1	vehicle 2	vehicle 3	vehicle 4
cycle designed to pedal	Yes	Yes	**No**	Yes

A tale of 4 vehicles…

1

2

3

4

	vehicle 1	vehicle 2	vehicle 3	vehicle 4
cycle designed to pedal	Yes	Yes	No	Yes
maximum assistance speed	**25 km/h**	45 km/h	45 km/h	45 km/h

A tale of 4 vehicles…

1

2

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4

	vehicle 1	vehicle 2	vehicle 3	vehicle 4
cycle designed to pedal	Yes	Yes	No	Yes
maximum assistance speed	25 km/h	45 km/h	45 km/h	45 km/h
maximum continuous rated power	1000 W	**500 W**	3000 W	**500 W**

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A tale of 4 vehicles…

1

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4

	vehicle 1	vehicle 2	vehicle 3	vehicle 4
cycle designed to pedal	Yes	Yes	No	Yes
maximum assistance speed	25 km/h	45 km/h	45 km/h	45 km/h
maximum continuous rated power	1000 W	500 W	3000 W	500 W
maximum assistance factor	**6**	3	n/a	**6**

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A tale of 4 vehicles…

1

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4

	vehicle 1	vehicle 2	vehicle 3	vehicle 4
cycle designed to pedal	Yes	Yes	No	Yes
maximum assistance speed	25 km/h	45 km/h	45 km/h	45 km/h
maximum continuous rated power	1000 W	500 W	3000 W	500 W
maximum assistance factor	6	3	n/a	6
classification	**?**	**?**	**?**	**?**

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A tale of 4 vehicles…

1

	vehicle 1
cycle designed to pedal	Yes
maximum assistance speed	25 km/h
maximum continuous rated power	1000 W
maximum assistance factor	6

A tale of 4 vehicles…

1

	vehicle 1	L1e-A classification criteria	OK?
cycle designed to pedal	Yes	*Yes*	
maximum assistance speed	25 km/h	*≤ 25 km/h*	
maximum continuous rated power	1000 W	*≤ 1000 W*	
maximum assistance factor	6	*n/a*	

A tale of 4 vehicles…

1

	vehicle 1	L1e-A classification criteria	OK?
cycle designed to pedal	Yes	*Yes*	☑
maximum assistance speed	25 km/h	*≤ 25 km/h*	☑
maximum continuous rated power	1000 W	*≤ 1000 W*	☑
maximum assistance factor	6	*n/a*	n/a

A tale of 4 vehicles…

1

➔ **Vehicle 1 is a L1e-A vehicle!**

	vehicle 1	L1e-A classification criteria	OK?
cycle designed to pedal	Yes	*Yes*	☑
maximum assistance speed	25 km/h	*≤ 25 km/h*	☑
maximum continuous rated power	1000 W	*≤ 1000 W*	☑
maximum assistance factor	6	*n/a*	n/a

L1e vehicle classification

Category	Category name	Common classification criteria
L1e	Light two-wheel powered vehicle	(4) two wheels and powered by a propulsion as listed under Article 4(3) and (5) engine capacity ≤ 50 cm^3 if a PI internal combustion engine forms part of the vehicle's propulsion configuration and (6) maximum design vehicle speed ≤ 45 km/h and (7) maximum continuous rated or net power ([1]) ≤ 4 000 W and (8) maximum mass = technically permissible mass declared by the manufacturer and
Sub-categories	Subcategory name	Supplemental sub-classification criteria
L1e-A	Powered cycle	(9) cycles designed to pedal equipped with an auxiliary propulsion with the primary aim to aid pedalling and (10) output of auxiliary propulsion is cut off at a vehicle speed ≤ 25 km/h and (11) maximum continuous rated or net power ([1]) ≤ 1 000 W and (12) a powered three- or four-wheel cycle complying with supplemental specific sub-classification criteria (9) to (11) is classified as being technically equivalent to a two-wheel L1e-A vehicle.
L1e-B	Two-wheel moped	(9) any other vehicle of the L1e category that cannot be classified according to the criteria (9) to (12) of a L1e-A vehicle.

L1e-A: Powered cycle

- No maximum assistance factor defined (RVFSR, annex XIX)
  !**But subject to test!** (REPPR, Annex X, appendix 4)

A tale of 4 vehicles…

1

2

3

4

	vehicle 1	vehicle 2	vehicle 3	vehicle 4
cycle designed to pedal	Yes	Yes	No	Yes
maximum assistance speed	25 km/h	45 km/h	45 km/h	45 km/h
maximum continuous rated power	1000 W	500 W	3000 W	500 W
maximum assistance factor	6	3	n/a	6
classification	**L1e-A**	**?**	**?**	**?**

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A tale of 4 vehicles…

2

	vehicle 2
cycle designed to pedal	Yes
maximum assistance speed	45 km/h
maximum continuous rated power	500 W
maximum assistance factor	3

A tale of 4 vehicles…

2

	vehicle 2	L1e-B classification criteria	OK?
cycle designed to pedal	Yes	*Yes/No*	
maximum assistance speed	45 km/h	*≤ 45 km/h*	
maximum continuous rated power	500 W	*≤ 4000 W*	
maximum assistance factor	3		

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A tale of 4 vehicles…

2

	vehicle 2	L1e-B classification criteria	OK?
cycle designed to pedal	Yes	*Yes/No*	
maximum assistance speed	45 km/h	*≤ 45 km/h*	
maximum continuous rated power	500 W	*≤ 4000 W*	
maximum assistance factor	3	*≤ 4*	

RVFSR

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A tale of 4 vehicles…

2

	vehicle 2	L1e-B classification criteria	OK?
cycle designed to pedal	Yes	*Yes/No*	☑
maximum assistance speed	45 km/h	*≤ 45 km/h*	☑
maximum continuous rated power	500 W	*≤ 4000 W*	☑
maximum assistance factor	3	*≤ 4*	☑

A tale of 4 vehicles…

2

➔ **Vehicle 2 is a L1e-B vehicle!**

	vehicle 2	L1e-B classification criteria	OK?
cycle designed to pedal	Yes	*Yes/No*	☑
maximum assistance speed	45 km/h	*≤ 45 km/h*	☑
maximum continuous rated power	500 W	*≤ 4000 W*	☑
maximum assistance factor	3	*≤ 4*	☑

A tale of 4 vehicles…

1

2

3

4

	vehicle 1	vehicle 2	vehicle 3	vehicle 4
cycle designed to pedal	Yes	Yes	No	Yes
maximum assistance speed	25 km/h	45 km/h	45 km/h	45 km/h
maximum continuous rated power	1000 W	500 W	3000 W	500 W
maximum assistance factor	6	3	n/a	6
classification	**L1e-A**	**L1e-B**	**?**	**?**

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A tale of 4 vehicles…

3

	vehicle 3
cycle designed to pedal	No
maximum assistance speed	45 km/h
maximum continuous rated power	3000 W
maximum assistance factor	n/a

A tale of 4 vehicles…

3

	vehicle 3	L1e-B classification criteria	OK?
cycle designed to pedal	No	*Yes/No*	
maximum assistance speed	45 km/h	*≤ 45 km/h*	
maximum continuous rated power	3000 W	*≤ 4000 W*	
maximum assistance factor	n/a		

A tale of 4 vehicles…

3

	vehicle 3	L1e-B classification criteria	OK?
cycle designed to pedal	No	*Yes/No*	
maximum assistance speed	45 km/h	*≤ 45 km/h*	
maximum continuous rated power	3000 W	*≤ 4000 W*	
maximum assistance factor	n/a	*n/a*	

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A tale of 4 vehicles…

3

	vehicle 3	L1e-B classification criteria	OK?
cycle designed to pedal	No	*Yes/No*	☑
maximum assistance speed	45 km/h	*≤ 45 km/h*	☑
maximum continuous rated power	3000 W	*≤ 4000 W*	☑
maximum assistance factor	n/a	*n/a*	n/a

A tale of 4 vehicles…

Vehicle 3 is a L1e-B vehicle! ←

3

	vehicle 3	L1e-B classification criteria	OK?
cycle designed to pedal	No	*Yes/No*	☑
maximum assistance speed	45 km/h	*≤ 45 km/h*	☑
maximum continuous rated power	3000 W	*≤ 4000 W*	☑
maximum assistance factor	n/a	*n/a*	n/a

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A tale of 4 vehicles…

1

2

3

4

	vehicle 1	vehicle 2	vehicle 3	vehicle 4
cycle designed to pedal	Yes	Yes	No	Yes
maximum assistance speed	25 km/h	45 km/h	45 km/h	45 km/h
maximum continuous rated power	1000 W	500 W	3000 W	500 W
maximum assistance factor	6	3	n/a	6
classification	**L1e-A**	**L1e-B**	**L1e-B**	**?**

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A tale of 4 vehicles…

	vehicle 4
cycle designed to pedal	Yes
maximum assistance speed	45 km/h
maximum continuous rated power	500 W
maximum assistance factor	6

A tale of 4 vehicles…

	vehicle 4	L1e-B classification criteria	OK?
cycle designed to pedal	Yes	*Yes/No*	
maximum assistance speed	45 km/h	*≤ 45 km/h*	
maximum continuous rated power	500 W	*≤ 4000 W*	
maximum assistance factor	6		

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A tale of 4 vehicles…

	vehicle 4	L1e-B classification criteria	OK?
cycle designed to pedal	Yes	*Yes/No*	
maximum assistance speed	45 km/h	*≤ 45 km/h*	
maximum continuous rated power	500 W	*≤ 4000 W*	
maximum assistance factor	6	*≤ 4*	

RVFSR

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A tale of 4 vehicles…

	vehicle 4	L1e-B classification criteria	OK?
cycle designed to pedal	Yes	*Yes/No*	☑
maximum assistance speed	45 km/h	*≤ 45 km/h*	☑
maximum continuous rated power	500 W	*≤ 4000 W*	☑
maximum assistance factor	6	*≤ 4*	☒

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A tale of 4 vehicles…

➔ **Vehicle 4 is not a L1e vehicle!**

	vehicle 4	L1e-B classification criteria	OK?
cycle designed to pedal	Yes	*Yes/No*	☑
maximum assistance speed	45 km/h	*≤ 45 km/h*	☑
maximum continuous rated power	500 W	*≤ 4000 W*	☑
maximum assistance factor	6	*≤ 4*	☒

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A tale of 4 vehicles…

4

Vehicle 4 is not a L1e vehicle

because the vehicle exceeds the maximum assistance factor, RVFSR requirement

According to co-decision text article 4.4(a)

"As regards the classification of L-category vehicles in paragraph 2, a vehicle that does not come under a certain category because it exceeds at least one of the criteria stipulated for that category falls into the next category whose criteria it meets."

(a) category L1e with its subcategories L1e-A and L1e-B and category L3e with its subcategories L3e-A1, L3e-A2 and L3e-A3;

➔ Vehicle 4 is a L3e-A1 vehicle!

A tale of 4 vehicles…

1

2

3

4

	vehicle 1	vehicle 2	vehicle 3	vehicle 4
cycle designed to pedal	Yes	Yes	No	Yes
maximum assistance speed	25 km/h	45 km/h	45 km/h	45 km/h
maximum continuous rated power	1000 W	500 W	3000 W	500 W
maximum assistance factor	6	3	n/a	6
classification	**L1e-A**	**L1e-B**	**L1e-B**	**L3e-A1?**

A tale of 4 vehicles…

4

➔ **Both vehicles above are L3e-A1 vehicles!**

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A tale of 4 vehicles…

Vehicle 4 = L3e-A1 vehicle?
Is this right?

- L3e-A1 vehicle class is not adapted to this kind of vehicles

- These vehicles are currently available on the market. There is no statistical nor scientific evidence that they are more dangerous than their L1e-B counterparts with factor 4!

A tale of 4 vehicles…

Vehicle 4 = L3e-A1 vehicle?
Is this right?

- L3e-A1 vehicle class is not adapted to this kind of vehicles

- These vehicles are currently available on the market. There is no statistical nor scientific evidence that they are more dangerous than their L1e-B counterparts with factor 4!

➔ **Creation of legal bottlenecks!**

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A tale of 4 vehicles…

Vehicle 4 = L3e-A1 vehicle?
Is this right?

- L3e-A1 vehicle class is not adapted to this kind of vehicles

- These vehicles are currently available on the market. There is no statistical nor scientific evidence that they are more dangerous than their L1e-B counterparts with factor 4!

→ Creation of legal bottlenecks

➔ This situation is caused by the interpretation that maximum assistance factor is a requirement in the scope of article 4.4 *(co-decision text)*

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A tale of 4 vehicles…

?

?

?

?

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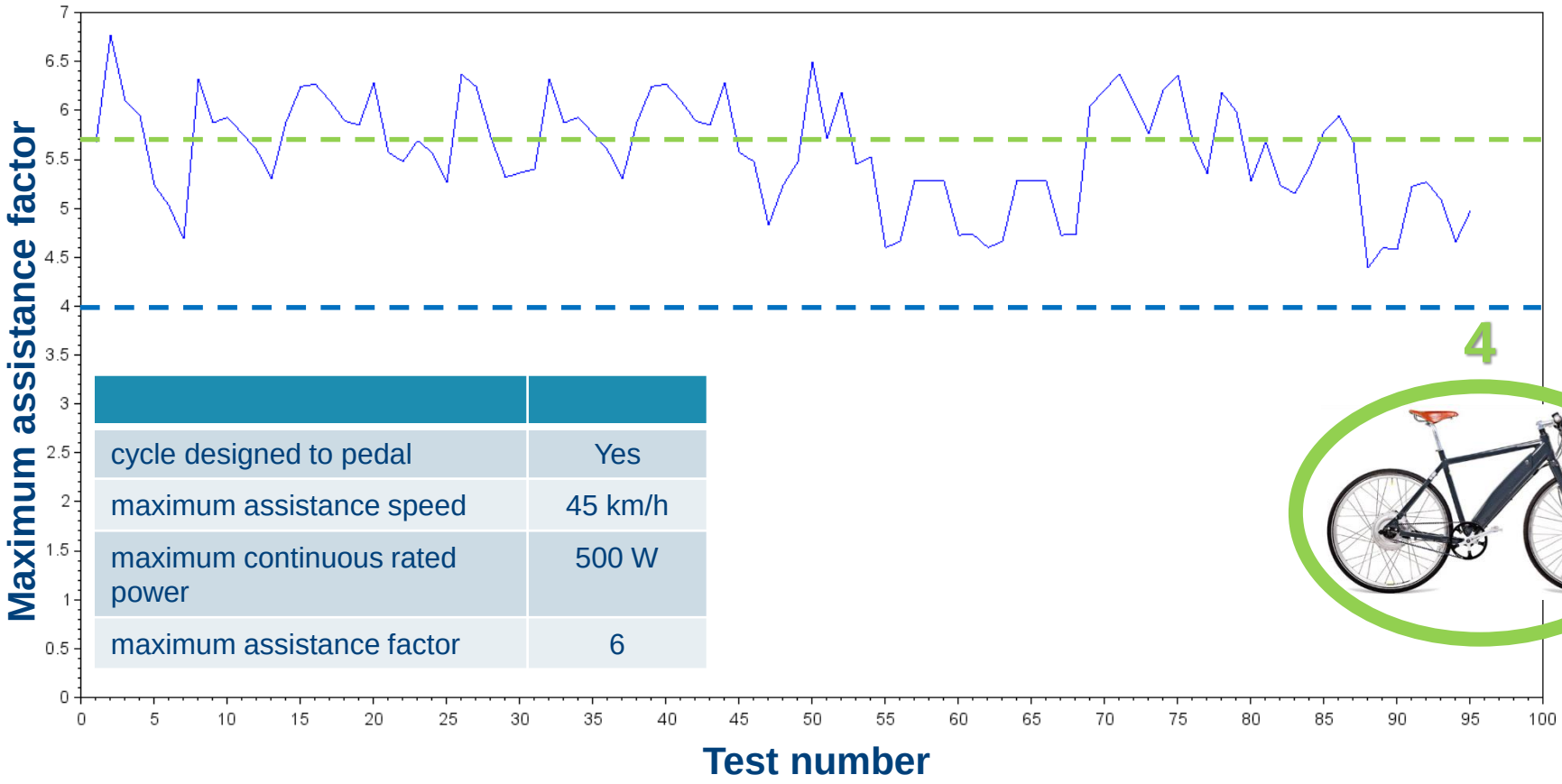
Measured maximum assistance factor



cycle designed to pedal	Yes
maximum assistance speed	45 km/h
maximum continuous rated power	500 W
maximum assistance factor	6

4

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Comments on maximum assistance factor

C1: No technology neutrality!

- favouring fully motor powered vehicles over partly human powered vehicles

  ➔ In contradiction with EU objectives as regards:
  - Emission reduction
  - Active mobility
  - Modal shift from cars to light electric mobility

- favouring torque sensors
- Throttle ⇔ designed to pedal?

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Comments on maximum assistance factor

C2: Link between maximum assistance factor and safety?

According to co-decision text, Annex I:
Vehicle classification

	L1e-A classification criteria	L1e-B classification criteria	
cycle designed to pedal	*Yes*	*Yes*	*No*
maximum assistance speed	*≤ 25 km/h*	*≤ 45 km/h*	*≤ 45 km/h*
maximum continuous rated power	*≤ 1000 W*	*≤ 4000 W*	*≤ 4000 W*
maximum assistance factor	*n/a*	*≤ 4*	*n/a*

According to RVFSR, Annex XIX
Requirements regarding vehicle structure integrity

Comments on maximum assistance factor

C2: Link between maximum assistance factor and safety?

According to co-decision text, Annex I:
Vehicle classification

	L1e-A classification criteria	L1e-B classification criteria	
cycle designed to pedal	*Yes*	*Yes*	*No*
maximum assistance speed	*≤ 25 km/h*	*≤ 45 km/h*	*≤ 45 km/h*
maximum continuous rated power	*≤ 1000 W*	*≤ 4000 W*	*≤ 4000 W*
maximum assistance factor	*n/a*	*≤ 4*	*n/a*

According to RVFSR, Annex XIX
Requirements regarding vehicle structure integrity

Comments on maximum assistance factor

C2: Link between maximum assistance factor and safety?

According to RVFSR, Annex XIX
Requirements regarding vehicle structure integrity

Why do vehicles designed to pedal need a maximum assistance factor to guarantee vehicle structure integrity?

Designed to pedal

Not designed to pedal

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Comments on maximum assistance factor

C2: Link between maximum assistance factor and safety?

COMMISSION DELEGATED REGULATION (EU) No 3/2014

of 24 October 2013

supplementing Regulation (EU) No 168/2013 of the European Parliament and of the Council with regard to vehicle functional safety requirements for the approval of two- or three-wheel vehicles and quadricycles

(11) The limitation to 'four' of the ratio of auxiliary propulsion power and actual pedal power for cycles designed to pedal set out in Annex XIX should be subject to further scientific research and assessment. Upon availability of scientific data and statistics on vehicles placed on the market, the ratio 'four' referred to above may be revisited in a future revision of this Regulation.

Important that there **is** a **scientific evidence** to support a possible restriction of the assistance factor, because of the **confusion and legal bottlenecks**

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Comments on maximum assistance factor

C3: Maximum assistance factor of four causes fickle vehicle

- discriminates weaker riders
- weather influence:
  - *4Bft headwind speed:* $100W_{human} + 400W_{motor}$ ➔ **25km/h**
- geographical influence:
  - *6% slope:* $100W_{human} + 400W_{motor}$ ➔ **22km/h**

Comments on maximum assistance factor

C4: Control strategy?

A crucial safety aspect such as control strategy is not taken into account

Comments on maximum assistance factor

C5: Perceived as unjust by European bike manufacturers

Vehicles designed to pedal are limited to an assistance factor four, but don't enjoy less restrictive regulations:

If designed to pedal:

- extra tests for frames and front forks (RVFSR, Annex XIX)
- extra tests for propulsion unit performance requirements (peak power, maximum motor power, maximum assistance factor… (REPPR Annex X))

- Exempted from the electric range test *(REPR, annex VII)*

Consequences of the current regulations

Designed to pedal
500 W
30 kg
45 km/h
Assistance factor < 4

Not designed to pedal
500 W
30 kg
45 km/h

Designed to pedal
500 W
30 kg
45 km/h
Assistance factor > 4

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Consequences of the current regulations

Designed to pedal
500 W
30 kg
45 km/h
Assistance factor < 4

L1e-B
Tests for frames
and front fork

Not designed to pedal
500 W
30 kg
45 km/h

L1e-B
No tests for frames
and front fork

Designed to pedal
500 W
30 kg
45 km/h
Assistance factor > 4

L3e-A1?

Conclusions

- A maximum assistance factor is not technology neutral *(propulsion, sensors..)*
- There is no scientifically established link between assistance factor and safety
- Maximum assistance factor of four causes fickle vehicles
- Control strategy is not taken into account
- Perceived as unjust by European bike manufacturers

Conclusions

- *“L1e-B cycles”,* designed to pedal with an assistance factor > 4 are available on the market. Apparently, they should be classified as L3e vehicles, which causes great confusion

- This vehicle classification complicates (unharmonised) conditions for using the vehicles.

- The maximum assistance factor is not required for L1e-A, but they are subject to the test.

- Legal bottlenecks hamper market development

Solution proposals

- Review interpretation Article 4.4.: confirmation assistance factor is outside article scope, classification of cycles designed to pedal > factor 4 as L1e-B

- Correction wording in RVFSR-Annex XIX so that the test method for measuring factor 4 in REPPR, Annex X, Appendix 4 only applies to L1e-B and not to L1e-A

- Further research into the need of a maximum assistance factor to ensure vehicle safety as well as research into other possible technical requirements/solutions to ensure safe vehicles in anticipation of future regulation revision

Thank you for your attention!

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