

Regulatory framework for tricycles, quadricycles and small passenger cars: Opportunities and challenges for small electric vehicles

A case study in the European Union

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Summary

This paper analyzes and compares definitions, technical requirements (safety, environment, maximum masses, maximum dimensions) and driving licence requirements of tricycles, quadricycles and cars (EU directive 2007/46 and EU regulations 2006/126 and 2013/168).

The main conclusion: Safer vehicles could be offered to drivers younger than 18 years, and holders of driving licences for low-speed and small vehicles in general.

Recommendations on possible modifications of the EU regulatory framework are included at the end of the paper.

Keywords: tricycle, car, driver, safety, regulation

1. Small cars versus quadricycles, where do they come from ?

In the EU as well as in some other jurisdictions, a limited number of vehicles types are offered that look like passenger cars, but are actually certified as quadricycles. On the other hand, some car manufacturers offer really very small passenger cars, with similar dimensions than these quadricycles.



Figure 1: Both Daimler Smart Fortwo and Toyota iQ, comply with the full package of EU safety regulations (category M1 in EU Directive 2007/46)

Daimler's "Smart Fortwo" and Toyota's "iQ" both have a maximum length slightly below 3 meters, whilst they both have been certified as an M1 vehicle, M1 being the designation in the EU and UN-ECE regulatory system for passenger cars.

M1 and other categories of larger vehicles (trucks, vans, buses ..) are defined by EU Directive 2007/46. The Directive also defines a package of safety and environmental requirements. Vehicles need to comply with all of these standards in order to get market access.



Figure 2: In the EU, small and large M1 vehicles up to 9 seats comply with the same safety and environment regulations

On the other hand, for example French manufacturer Ligier produces a number of small vehicles with a top speed limited at 45 kph, certified according to the requirements of category L6, the so-called light quadricycle. Another French company, Aixam, produces some light quadricycle models as well as heavy quadricycle models.



Figure 3: light quadricycle (L6) Ligier JS50 and heavy quadricycle (L7) Aixam Crossover GT

Maximum and minimum masses, dimensions, seat numbers and maximum power of L-class vehicles are regulated by EU Regulation 2013/168 (L class) and EU Directive 2007/46 (M1). An overview is given in table 1.

Since there are no minimum limits, apart from the minimum top speed of 25 kph and minimum seat number of 1 for the M1, it is a valid observation that in terms of external dimensions and shape, overlaps between vehicle classes are possible.

For example, a small M1, with an overall vehicle length of not more than 3 meters, could have the same dimensions as an L6 class vehicle. And an M1 with an overall length of not more than 4 meters could have the same dimensions as an L7.

	L6	L7	M1
maximum vehicle length (meters)	6	3.7 / 4	12
minimum vehicle length (meters)	none	None	none
maximum vehicle weight (kg)	425	450	3500
minimum vehicle weight (kg)	none	None	none
maximum number of seats	2	4 / 2	9
minimum number of seats	1	1	1
maximum top speed (kph)	45	90 / none	none
maximum engine power (kW)	6	15	none

Table 1: Maximum mass, vehicle length, number of seats, top speed (Note: for M1 the maximum applies to the technically permissible maximum laden mass, whilst for L6 and L7 the “mass in running order” is used in the Regulation)

At first sight, it should not be excluded that one and the same vehicle type can be certified, for example, as both M1 and L7, or as M1 and L6. The Daimler Smart and Toyota IQ could be considered for such an operation, and somewhat larger passenger cars (up to 4 meters) could be considered.

A justification for the latter: L6 is restricted to a length of 3 meter, but its three-wheeled counterpart, the L2 “light tricycle”, is subject to a maximum length of 4 meters. So, for reasons of coherence, a maximum length of 4 meters seems justified also for the four wheeled variant.

Such an approach might have several advantages.

The M1 vehicle platform could be used for an L7 or L6 vehicle. Even if some of the safety equipment required to comply with the M1 safety requirements would be removed in the L7 and or L6 version, the basic structure would ensure compliance with protection standards in case of frontal and lateral impact.

It is possible, however, that the maximum vehicle weights of only 425 / 450 kg (not including propulsion batteries) for the L6 /L7 class could obstruct the development of L6/L7 class vehicles.

Electrification has the most energy saving potential for small vehicles (given that ICE efficiency decreases from 15 kW downwards), such a situation would therefore be beneficial for electrification. Also, by increasing the number of vehicle types derived from the same platform, the business case for small M1 EVs would improve.

One example of a vehicle certified as M1 as well as L7 is the electric Tazzari Zero (Figure 4), with a maximum weight close to 450 kg.

But would it be possible to have another version of the Zero certified in the L6 category ? This would allow the vehicle to be driven with driving license AM. This observation calls into question the difference in maximum mass between L6 (425 kg) and L7 (450 kg).



Figure 4: The Tazzari Zero exists both as an L7 and an M1 variant

The last example I would like to mention is the Colibri car (Figure 5), announced by a young German company, Innovative Mobility Automobiles (IMA). It is a fully electric one-seater with a top speed of 120 kph and a full M1 certification. With a maximum weight of 560 kg including batteries, the weight without batteries is expected to be more than 450 kg, which is a challenge for the L6/L7 certification.



Figure 5: IMA Colibri electric one-seater with full passenger car safety and highway capability, expected to hit the German market in 2016

2. What about safety ?

EU Regulation 2013/168 (L class) and EU Directive 2007/46 (M1) also define key environment and safety standards for the respective classes.

Table 2 outlines some of the compulsory key safety standards.

A comparison of both regulations shows that the passenger car is subject to a much larger regulatory package.

	L6	L7	M1
Brakes mandatory	yes	Yes	Yes
Lighting mandatory	yes	Yes	Yes
ABS braking mandatory	no	Yes	Yes
ESP braking mandatory	no	No	Yes
Seatbelts mandatory	Yes	Yes	Yes
Rear view mirrors mandatory	Yes	Yes	Yes
Pedestrian protection compliance mandatory	No	No	Yes
Side impact compliance mandatory	No	No	Yes
Front impact compliance mandatory	No	No	Yes

Table 2: Comparison of some key safety standards for categories M1, L6 and L7

Protection in case of a frontal or lateral crash, using biomechanical dummies applies to cars, not to quadricycles. Same story for pedestrian protection, ESP braking and many other issues.

Different certification classes for small vehicles build on the same architecture would open up new opportunities to market small EVs, considering that it is in very small vehicles that electric propulsion has the biggest advantage over ICEs.

3. Driving licence and driving age: An additional argument

Driving license regulation 2006/126 defines minimum driving ages for M and L class vehicles (see table 3).

Vehicle class	M1	L6	L7
Licence	B	AM	B/B1
Minimum age (EU recommendation)	18	16	18
Minimum age (member-state choice)	18	14-18	16-18

Table 3: Driving license and minimum driving age per vehicle class (Note: Driving licence can be introduced at National level the choice of the Member-States. Each Member-State can choose the minimum age between 16 years and 18 years. For the mandatory licence AM, Member-States can choose the introduction date between 14 years and 18 years).

The information in tables 2 and 3 seems to indicate that some potentially less safe vehicle types are allowed to be driven at a lower age than their potentially safer M1 counterparts with similar dimensions, but higher weight.

This consideration of age reinforces the earlier conclusion that M1-based low speed vehicles could be offered in restricted versions to drivers younger than 18 and to other drivers with a restricted driving license.

4. Proposal: Modify EU driving licence directive or modify maximum weight in the L6 and L7 category definitions

The latter could be achieved in either or both of the following ways:

- 1) Increase maximum mass for L6 and L7, e.g. till 1000 kg
- 2) Expand the scope of driving licenses AM and B1 by adding M1 vehicles with similar dimensional, speed and power limitations (but not the same mass limitations)

A further step could be the increase of the maximum length of the L6 from 3 to 4 meters. The justification is that maximum length of the light tricycle, the L2, is 4 meters (EU 2003/168).

Most car manufacturers offer a small car with a maximum length less than 4 meters. So the latter amendment would open the possibility to offer low-speed variants of mainstream small M1 vehicles. Since for low power needs, say from 4 kW till 15 kW, the efficiency of electrical propulsion is far better than the efficiency of an ICE, this would improve the business case for small electric M1 vehicles.

5. Topics for further research

Further in-depth analysis should quantify road-safety benefits, and environment and energy saving potential of such an analysis.

Further analysis can be done on different vehicle classes in other jurisdictions as well as three-wheeled vehicles. One possibility is that a world-wide class of small electric passenger cars, with full passenger car safety, available in different variants with various restrictions, intended for various ages and driving licences, will be defined one day.

References

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Luc Vinckx holds a masters degree in mechanical engineering from the Catholic University of Leuven (1982). For the last 25 years, he was active in various jobs in the car industry, dealing with vehicle regulations, safety and environment aspects, and public affairs. His former employers include FEBIAC, the Belgian federation of the car industry and General Motors Brussels Office. From 2007 till 2009, he served as the chairperson of the technical committee of OICA, the worldwide association of the car manufacturers, representing the car, truck and bus industry in WP.29, the “World Forum for Harmonization of Vehicle Regulations” of the United Nations (Geneva, Brussels). Since the beginning of 2016, he runs his own consulting company, “Elephant Consult” (Brussels, Belgium), focussing on EU and UN regulatory affairs and association management.