Proposal for a new supplement to the 02 and 03 series of amendments to UN Regulation No. 154

The text reproduced below was prepared by the experts from Sweden. This document proposes amendments to Section 3.4 of Annex B8 in UN ECE Regulation 154 to include the possibility to use driver robots during pure electric vehicle range and electric energy consumption tests.

Since the test procedure can be performed by either a driver, or an operator, one option is to perform the test procedure with a driver robot as the operator.

The proposal is to allow the possibility to use a driver robot as the operator in the test procedure to determine pure electric range, and electric energy consumption. One key criteria is that the robot will have to act as a human driver and the request for acceleration and deceleration will have to come from an external source, vehicle speed from the test cell equipment. It shall not be allowed to drive the vehicle through the vehicle internal ECUs, the vehicle speed request shall come from an external source outside the vehicle.

The intention is to enable efficient and correct tests related to pure electric range and electric energy consumption test procedures. It should be possible to use both a mechanical robot and a virtual robot, however always to perform the test replicating a human driver.

Correlation tests between a human driver and the driver robot will have to be demonstrated to the approval authority to show that the robot acts as a human driver.

I. Proposal

Add new paragraph to the end of Section 3.4.1 in Annex B8

On request by the manufacturer and approved by the type approval authority the test can be operated by a virtual or mechanical robot. The robot shall be an external device that replicates a human driver. The type approval authority may request the manufacturer to demonstrate that the robot acts as a human driver.

II. Justification

The procedure to determine the pure electric range and the electric energy consumption is presented in table A8/3 of Annex B8. The procedure is either to perform consecutive Type I test procedures, or a shortened Type I test procedure where two dynamic segments are combined with two constant speed segments.

The complete pure electric range demonstration is very time consuming (usually more, or lot more, than 6 hours), and one driver will not be able to run the complete procedure without taking one or more breaks. The test procedure as defined in section 3.4.4 of Annex B8 allows one or more shorter breaks during the test procedure. However, a mistake by the driver, does not manage to follow the vehicle speed trace or exceeding the maximum driver break time will disqualify the test. As a result the test procedure will have to be re-started with conditioning of the test vehicle and REESS.

Improved and/or new technology with improved pure electric range will result in even longer time for a complete pure electric range test. As a result the consequences by failing the test procedure boundaries will have an even more negative impact on the total time to complete the test procedure.

The procedure can be performed by either a driver, or an operator. One option with regards to an operator is to perform the test procedure with driver robots. Where it is important that the robot acts as a human driver.

A human driver is using the accelerator pedal to request acceleration, and the brake pedal to request deceleration. In addition, the vehicle speed trace to be followed by the driver during test sequence is presented to the driver on a screen in front of the vehicle. Information with regards to vehicle speed serves as the information for the driver to either accelerate, or decelerate the vehicle in order to accurately follow the speed trace. The request for acceleration, or deceleration is made through actuators, the

accelerator pedal and brake pedal, where the pedal position signals are sent to a vehicle ECU. The ECU then request a specific torque and engine speed based on the received information from the accelerator or brake pedal position signals.

For a robot to act as a human driver it is important to secure that the robot receives input for decisions, the vehicle speed information, to request acceleration or deceleration from outside the vehicle. Since the human driver is using the vehicle speed trace as the major information to decide if to request acceleration or deceleration, it is appropriate to have the vehicle speed information as the main input also for a robot.

There are solutions available to provide the vehicle speed to either a physical robot, or a virtual robot as presented below:

1. Mechanical robot

   A mechanical robot is a hardware installed in a vehicle with actuators connected to acceleration pedal, brake pedal, gear selection, etc. The robot shall use the vehicle speed signal information from the test cell as the primary input with the purpose to follow the vehicle speed trace.

2. Virtual robot.

   A virtual robot is an external tool utilizing external information to request accelerator pedal position and brake pedal position in order to follow the vehicle speed trace. The virtual robot shall act as a mechanical robot, however without the mechanical hardware as the connection to the vehicle. It shall not be allowed to drive the vehicle through the vehicle internal interface. All request with regards to start of the test, actual requested vehicle speed, etc. shall be requested outside the vehicle. The external tool shall provide a request similar as an accelerator pedal, and brake pedal. The internal vehicle control system shall treat the accelerator pedal position signal, and a brake position signal in the same way regardless if it is a human or robot driving the vehicle.

In addition, for autonomous vehicles there will not necessarily be actuators to be used by a human driver, and hence external signals will be required to perform tests.