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Submitted by the expert from OICA

UN Regulation No. 140 modification proposal

GRVA-14, September 26-30, 2022

BACKGROUND :
EXPLANATION OF THE SITUATION

Requirements for Sine with Dwell test of oversteer intervention and responsiveness

9.9.4. The steering amplitude of the final run in each series is the greater of 6.5 A or 270 degrees, provided the calculated magnitude of 6.5 A is less than or equal to 300 degrees. If any 0.5 A increment, up to 6.5 A, is greater than 300 degrees, the steering amplitude of the final run shall be 300 degrees.

Note: "A" is the steering wheel angle in degrees that produces a steady state lateral acceleration […] of 0.3g for the test vehicle. […]
(para. 9.6.1.)

Case of a vehicle with a direct steering gear ratio

- The Steering wheel angle A = 21°
- The final run will be : 6.5 x 21 ° = 136.5°
- But according to the regulation test procedure, the sine with dwell series of tests needs to be conducted until 270° even if higher than 136.5°
- 270° of steering wheel angle leads to ca. 13 times A, i.e. a very high steering wheel angle for such vehicle
- The steering robot needs a huge mechanical power to reach this very high steering wheel angle in 0.7 Hz
- A conventional steering robot (already more powerful than required by the regulation) can only go to ca. 241.5° (i.e. 11.5 A)
- Vehicle behaviour remains unchanged beyond 140° steering wheel angle (limit of adhesion) → going to 270° does not give more information

AMENDMENT PROPOSAL

- Purpose
  - Make the certification manoeuver feasible with conventional steering robot (similar to recommendation per paragraph. 8.3.5) for vehicles with direct steering gear ratio
  - Maintain the robustness of this manoeuvre (ensure that ESC is efficient and safe whatever the driver does)
- Principle: limit the robot power demand
  - A human driver may deliver high torque at low steering wheel speed, but can't deliver high torque at high steering wheel speed
  - Limiting the mechanical power (torque x anglular speed) demand seems reasonable and sufficiently representative of human capabilities
  - 1200 W is very hard for a human, and represents the limit for usual conventional steering robot:

– § 8.3.5 specifies to use a steering robot capable of 40 to 60 N m, up to 1200°/s

– 60 x 1200 x π/180 = 1256 W

- For information,
  - 270° amplitude at 0.7 Hz means 1188 °/s maximum steering wheel angular speed
  - This kind of steering robot is already very powerful compared to human capabilities

Proposal

- Paragraph 9.9.4, amend to read:

"9.9.4. The steering amplitude of the final run in each series is the greater of 6.5 A or 270 degrees, provided the calculated magnitude of 6.5 A is less than or equal to 300 degrees. If any 0.5 A increment, up to 6.5 A, is greater than 300 degrees, the steering amplitude of the final run shall be 300 degrees.

If the above calculated steering amplitude of the final run is greater than the maximum operable steering wheel angle determined by design of the steering system, the final angle amplitude for the series test shall be greater than 98 per cent of the maximum operable angle.

If the execution of the steering maneuver needs a steering robot mechanical power of more than 1200 W, the first amplitude above 1200 W of steering robot mechanical power may be used as the final steering amplitude."

Thank you