Road load setting procedure for LowTemp test

12 December 2019

Report to the LowTemp TF

Road load setting procedure for LowTemp test

What was the need to have this discussion with RLD experts?

- Type VI test procedure in UN R83 is intended to only check pollutant emissions; road load has a secondary effect
- LowTemp test is also intended for CO_2, EC and range; road load has a direct effect on these parameters
- Procedure for setting the dyno in UN R83 is not sufficiently clear
- No decision taken yet in LowTemp TF on transfer of road load to dyno

⇨ Purpose for the LowTemp test is to set a representative road load for a low temperature condition, and to develop a clear procedure

UN R83 Type VI test

- Not clear where the 10% reduction in coastdown times is based on
- Text can be interpreted to:
  - set the increased road load at 23°C and apply this dyno setting to the test at -7°C
  - use the increased road load as a target setting at -7°C
- These approaches lead to different results.

⇨ Road load increase is connected to the dyno setting procedure

2.2. Chassis dynamometer

2.2.1. The requirements of Appendix 1 to Annex 4a to this Regulation apply. The dynamometer shall be adjusted to simulate the operation of a vehicle on the road at 266 K (-7 °C). Such adjustment may be based on a determination of the road load force profile at 266 K (-7 °C). Alternatively the driving resistance determined according to Appendix 7 to Annex 4a to this Regulation may be adjusted for a 10 per cent decrease of the coast-down time. The Technical Service may approve the use of other methods of determining the driving resistance.

Suggested approach by EC (similar to ATCT method)

1. Set the chassis dynamometer at 23°C, record the dyno settings
2. Soak the vehicle to -7 °C
3. Apply the dyno settings and increase the C coefficient by 10% of f_2 to correct for the air density

No need to correct f_0 as the increase of rolling resistance due to the low temperature is implicitly included

Evaluation of suggested approach

1. Method is pragmatic and reduces test-burden:
   no additional chassis dyno setting required at -7 °C
2. Influence of low temperature on rolling resistance (f_0) is accounted for
3. Requirements: same test cell, test tyres and tyre pressure on the test vehicle

→ This is approach was proposed by EC, and was agreed as most promising option by the road load experts

Current status and next steps

- OICA and UTAC have expressed their support for the proposed approach by EC
- Japan has a scrutiny reservation until December 12th (JAMA meeting)
- A draft text proposal is being prepared, based on the text for the ATCT test in EU-WLTP (2nd act)
- Some further discussions might be needed to conclude on the details of the dyno setting procedure (same test cell, tyres and tyre pressure)

Back-up slides

Alternative methods

There are three possible methods:

A. Measure road load at -7 °C and use this as target setting
B. Apply a correction to the road load and set the dyno at -7°C (target setting) - this method is allowed for the Type VI test in UN R83
C. Apply a correction to the road load, set the dyno at 23°C, and use this as a dyno setting for the test at -7°C

The corrections in B and C will be different, as the temperature effect on rolling resistance should be considered for B, but is implicitly included in C

Possible approach for method B

Correction formula in par. 4.5.5 for road load determination by coastdown:

$$F^* = \left((f_0(1 - K_1) - w_1) + f_1 v\right) \times \left(1 + K_0(T - 20)\right) + K_2 f_2 v^2$$

$$K_0 = 8.6 \times 10^{-3}\ °C^{-1}$$

Correction 20 to -7 °C:
f_0 and f_1 increase by 23.2%

$$K_2 = \frac{T}{293\ K} \times \frac{100\ kPa}{P}$$

Correction 20 to -7 °C:
f_2 increase by 10.2%

Correction of road load at the Low Temperature test:

$$F_{LowTemp} = 1.23 \cdot f_0 + 1.23 \cdot f_1 + 1.10 \cdot f_2$$

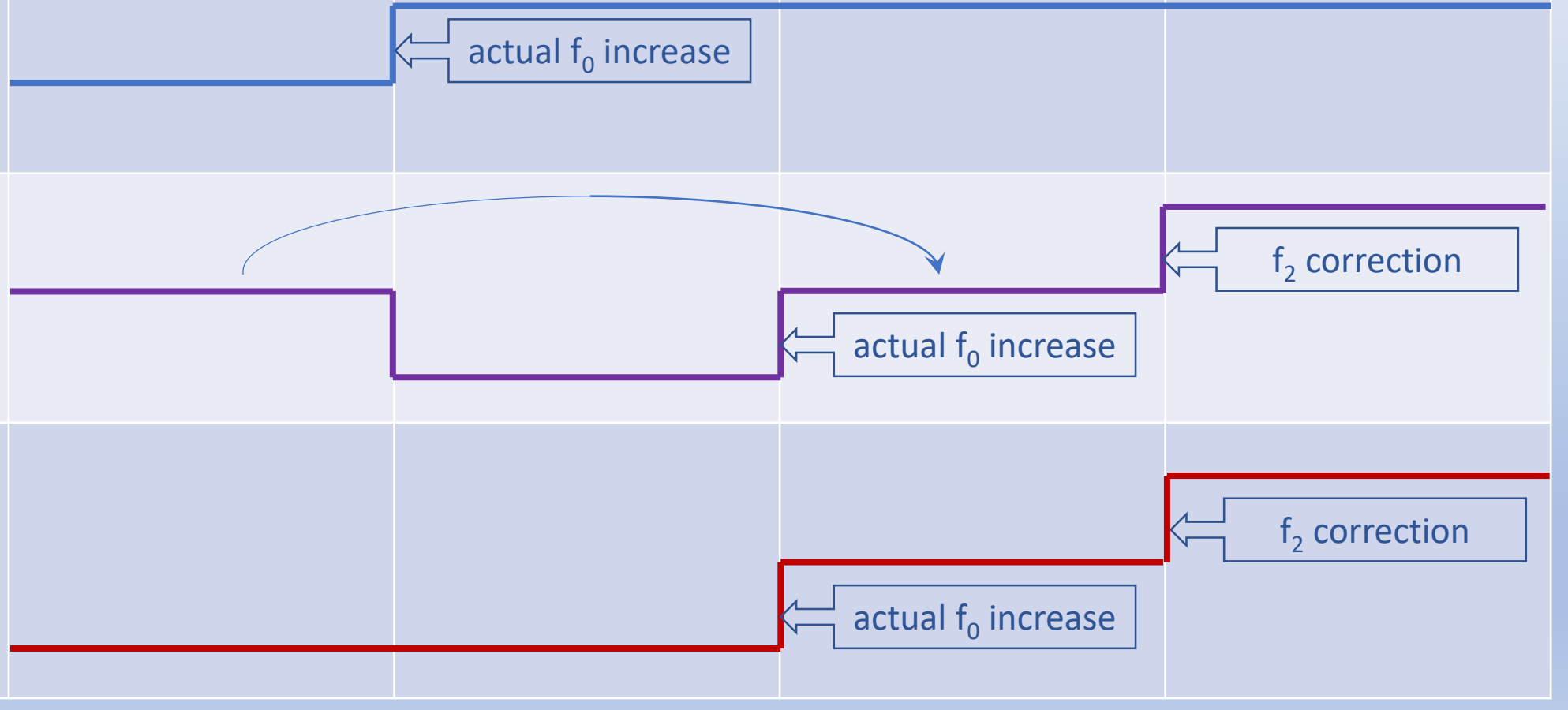
Possible approach for method B

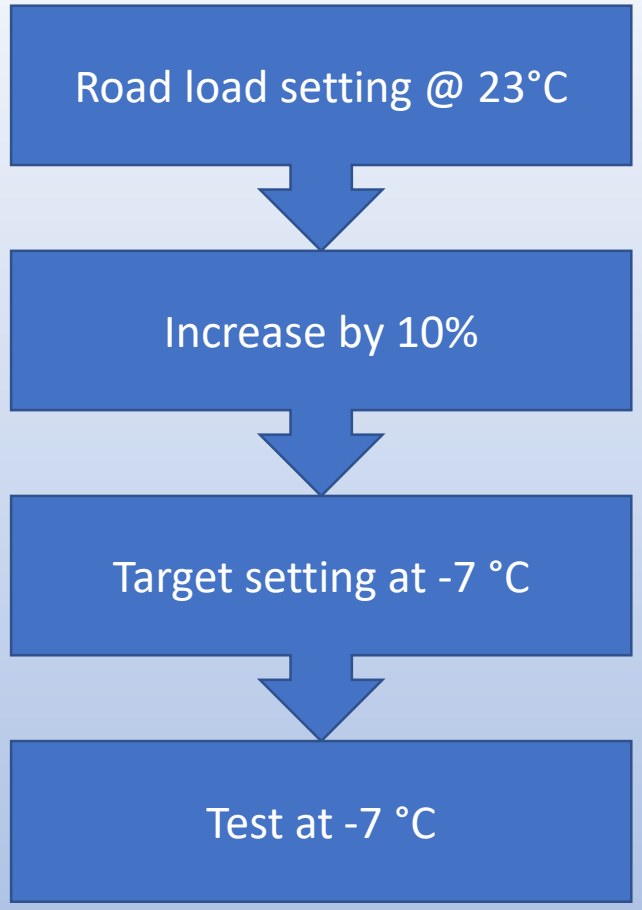
- Correction formula is intended to make relatively small temperature corrections (normal window: 5 - 40 °C, can be extended to 1 – 45 °C).
- Correction of f_0 is empirical: no guarantee that the correction is accurate and if temperature effect behaves linear over a 27 °C difference

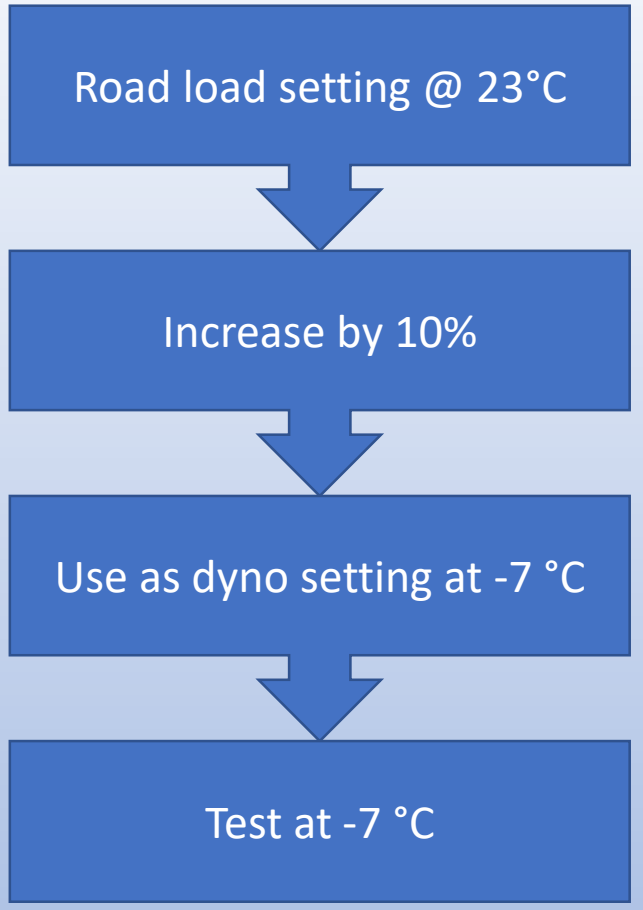
Correction of road load at the Low Temperature test:

$$F_{LowTemp} = 1.23 \cdot f_0 + 1.23 \cdot f_1 + 1.10 \cdot f_2$$

Based on road load determined @ 20 °C	Target CD setting @ 23 °C test	Target CD setting @ -7 °C test	Dyno CD setting @ -7 °C test	Increase C coefficient by 10% of f_2 @ -7 °C test Acc. to METHOD C
Road load of vehicle on dyno (X)				
Road load setting of the dyno (Y)				
Total road load (experienced by vehicle on the dyno: Z = X + Y)				







Influence of temperature on f_0 is neglected, 10% increase is insufficient

Influence of temperature on f_0 is implicitly included (similar to ATCT procedure)

Based on road load determined @ 20 °C	Target CD setting @ 23 °C test	Target CD setting @ -7 °C test	Increase A and B coefficient by 1.23 @ -7 °C test	Increase C coefficient by 10% of f_2 @ -7 °C test Acc. to METHOD B
Road load of vehicle on dyno (X)				
Road load setting of the dyno (Y)				
Total road load (experienced by vehicle on the dyno: Z = X + Y)