

Annex 5 to
D4.3.4 Calculation of contact stress

Determination of the effective rail inclination of the VAS WET #1 test

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1. A short introduction to the VAS test rig

The Voestalpine test rig, as shown in figure 1, has applied vertical load N on the wheel axle and lateral force Q on the rail (figure 2). The wheel rolls over the rail in the direction T . The nominal rail inclination is 1:40, see figure 3. For detailed information of the test, please see [1, 2].

2. Determination of the effective rail inclination

Because of the load the wheel is bent so that the effective rail inclination deviated from its nominal value for the Wet 1 test. The effective rail inclination is calculated as follows:

- The nominal inclination is $1:40 = 1.432^\circ$
- The wheel bending is 1.11° . For its determination please see section 3 below.

So that the effective inclination is $0.322^\circ = 1:172$, see figure 4.



Figure 1, the VAS test rig

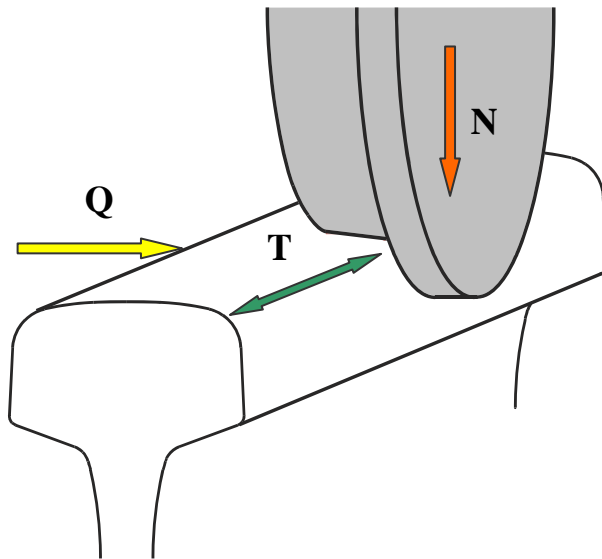


Figure 2, the vertical load N , lateral load Q and the relative motion direction T

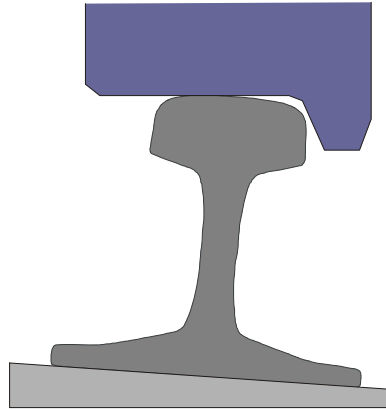


Figure 3, nominal rail inclination is 1:40

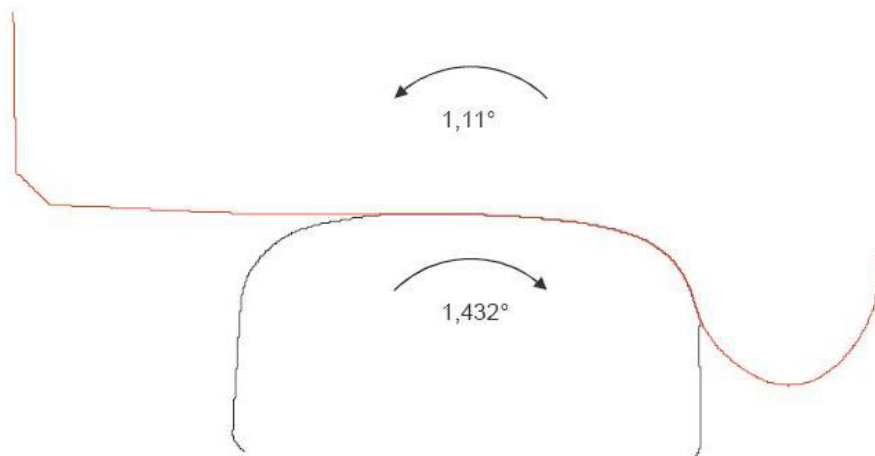


Figure 4, wheel bending and the nominal rail inclination

3. Determination of the wheel bending

The wheel bending was determined as follows:

The test rig is equipped with displacement sensors:

- Vertical displacement of the wheel.
- Lateral displacement of the rail.
- Lateral displacement of the wheel.

What cannot be directly measured is the rotation or tilting of the wheel as a consequence of the lateral force.

In order to calculate this,

- First wheel and rail measurements are aligned within the MiniProf Software 4.2 to a straight (no inclination) orientated reference (cad-drawing) profile.
- Then the aligned profiles are exported for each measurement (e.g. 0, 2,000 cycles, 5,000 cycles ... 100,000 cycles) to Corel draw.
- Then the rail inclination is adjusted according to the test set-up.
- At the beginning of each test, a calibration of the displacement sensors is done. According to this calibration file the "zero" measurements are brought into contact.
- The same is now done with the 100,000 measurements corrected with the recorded displacement sensor readings at 100,000 cycles.
- Then the width of the contact band after 100,000 cycles is measured at the rail, and the contact band is marked on the 100k profile drawing in Corel.
- Then the wheel is rotated and moved in lateral and vertical position (by hand) until it perfectly fits to the width of the contact band on the rail.
- According to this rotation angle and the displacement sensor readings all the other measurements are aligned to each other.

4. References

- [1] D4.3.1-F2-TESTING_MATRIX_DEFINITION.DOC, Initial Definition of Conditions for Testing Matrix of Rail Steels and Welds, available in KMS of InnoTrack
- [2] D4.3.3 Results of first test rig measurements, available in KMS of InnoTrack