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INNOTRACK

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Thematic Priority 6: Sustainable Development, Global Change and Ecosystems

D4.5.2 – Target Profiles

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Glossary

Abbreviation/acronym	Description
AHC	Anti Head Check
AHCC	Anti Head Check Corrective
AHCP	Anti Head Check Preventative
HC	Head Check
HR	High Rail

1. Executive Summary

WP4.5 summarized first the present grinding strategies and specifications of the represented IMs (see deliverable D4.5.1). The second step was to collect all the target profiles for grinding work used by them and to compare their shape and application in order to prepare guidelines for an optimized use.

Besides the standard target profiles for grinding, which are usually the as-rolled profiles, specific profiles to combat gauge corner fatigue are applied. They are described in this document.

2. Introduction

Four infrastructure managers participate in this work-group. Contributions from two of the remaining four IMs participating in the other work packages could be implemented. Further input came from two rail manufacturers and one rail grinding contractor. 24 different target profiles have been compared to each other. The collected target profiles are based on similar considerations (lowering contact stresses to reduce HC, low equivalent conicity et al.), however they vary depending on local/national conditions. The profiles have been classified as standard grinding profiles, profiles for specific purposes and anti head check profiles.

3. Comparison of Target Profile for Anti-Headcheck Grinding

24 different target profiles for grinding have been collected. A detailed comparison one by one allowed classifying these profiles in several categories:

3.1 Standard grinding profiles

These profiles are specified when grinding to correct the longitudinal profile of the rails (e.g. elimination of short pitch corrugation and short waves). These profiles are identical to the profiles of the initial installed as-rolled profiles. The IMs represented in WP 4.5 use the following profiles with the inclination mentioned as well:

- SNCF – 60E1 1:20
- DB AG – 60E2 1:40
- ProRail – 54E1 1:40

These profiles provide essentially the same contact conditions. A radial deviation of $\pm$ 0.2 mm could be assumed as neglible, since it is in the order of grinding tolerances. See for example the comparison of 60E1 1:20 with 60E2 1:40 in Figure 1 and Figure 2. The shift of the reference point only slightly affects the results.

The same profiles with a different inclination are also common. The Profile 60E2 is used by NR (Network Rail) with the higher inclination of 1:20. Banverket (Sweden) uses 60E1 and 50E3 profiles at 1:30, with the intention to apply generally 60E1 1:30 for all grinding work.

ÖBB (Austria) uses a modified 60E1 profile 1:40 as target for all grinding work (close to 60E2).

3.2 Specific grinding profiles

For special applications different target profiles are in use, such as asymmetric profiles to reduce lateral wear of high rails in sharp curves and gauge widening profiles to lower the equivalent conicity.

Banverket uses for the ore line (“Malmbanan”) 2 specific profiles (MB 1, MB 3), which have been developed in order to accommodate hollow worn wheels.

ÖBB (Austria) has developed two specific - more convex - profiles (so-called “Ballige Schiene”) to assure low equivalent conicity and reduce gauge corner fatigue simultaneously.

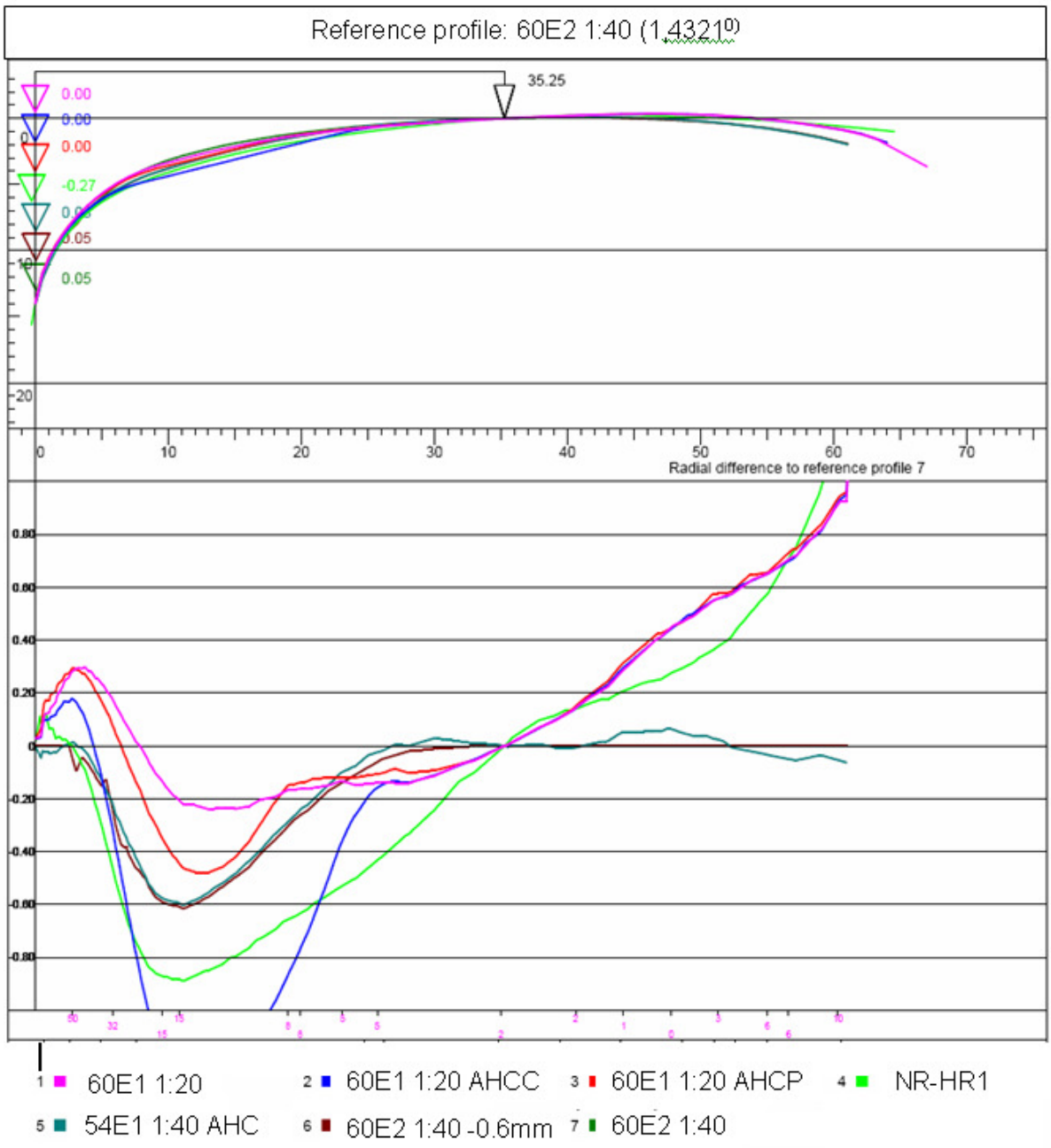
SNCF have specified different target profiles for grinding related to rail size (head width), basically they all provide the same contact conditions as the 60E1 1:20 and the related Anti-headcheck-profiles.

3.3 Anti-headcheck-profiles

In order to control RCF on the high rails in shallow curves five specific target profiles can be grouped together. They are characterized by specifically grinding more metal off the gauge corner in order to assure lower contact stresses:

- 54E1 AHC (ProRail)
- 60E2 –0.6 (DB AG); while the designation “-0.6” describes the undercutting of the initial profile at the gauge corner.
- 60E1 AHCC (SNCF); **A**nti **H**ead **C**heck Profile for **C**orrective purposes
- 60E1 AHCP (SNCF); **A**nti **H**ead **C**heck Profile for **P**reventative purposes
- HR1 (Network Rail)

The difference between the two Anti Head Check Profiles of SNCF is the more undercutting at the gauge shoulder for the corrective profile AHCC compared to the preventive profile AHCP (see also Figure 1 and Figure 2).



These profiles are applied in head check sensitive areas, usually on the high rails in curves.

Figure 1: Profile comparison I – The reference profile is the 60E2 1:40 (No 7) and the reference points are the railhead centre 1.4321°- tangent & 14 mm below at gauge; The radial difference to the reference profile is given beneath.

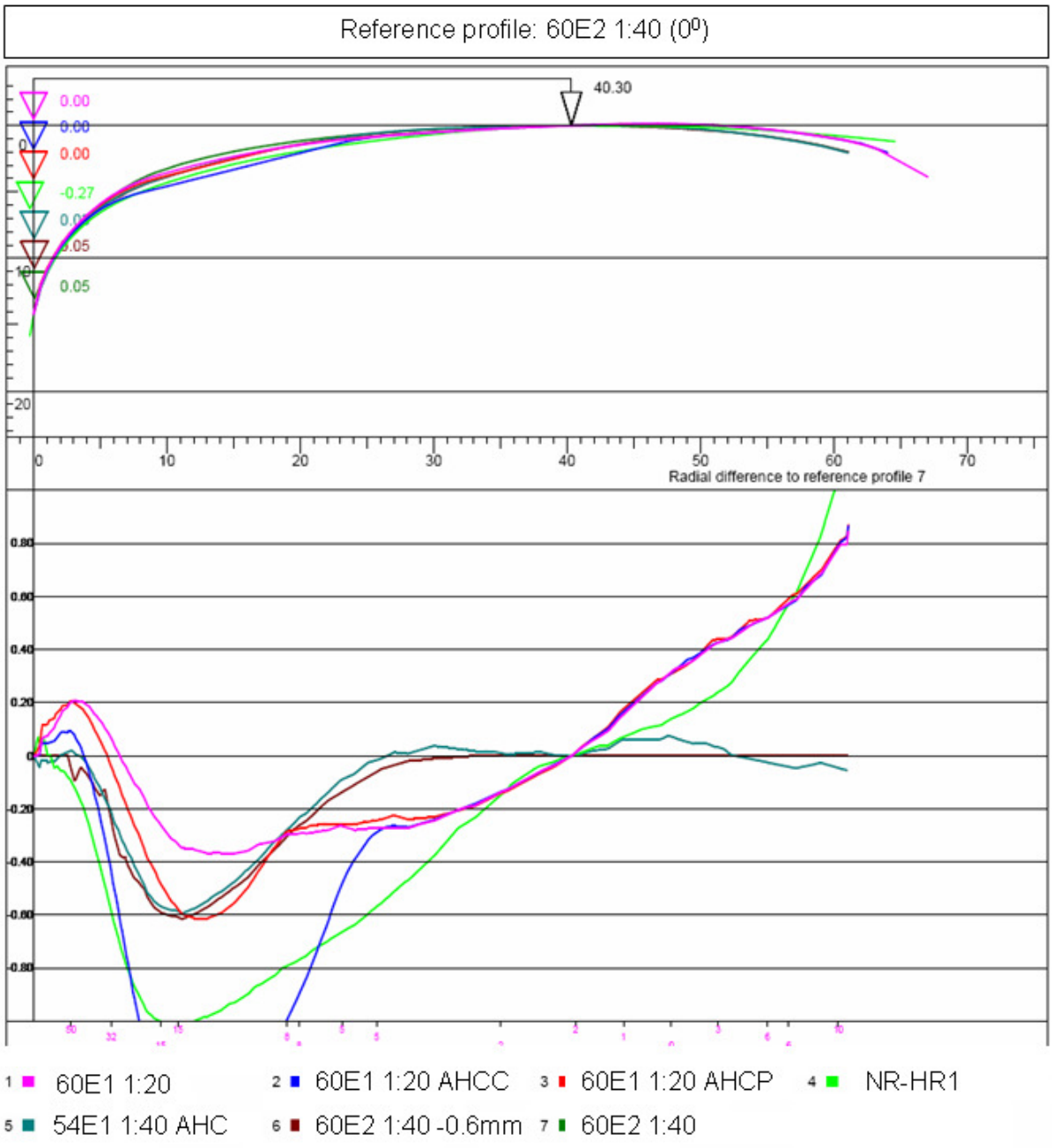


Figure 2: Profile comparison II – The reference profile is the 60E2 1:40 (No 7) and the reference points are the railhead centre 0°- tangent & 14 mm below at gauge; The radial difference to the reference profile is given beneath.

3.3.1 Comparison Anti-headcheck-profiles to Standard profile

- The HR1 – profile provides a consistently lower shape from the centre to gauge and a higher one from centre to field.
- The 60E1 AHCC – profile has a distinguished lower zone at the gauge shoulder.
- The 60E1 AHCP – profiles, the 54E1 AHC – profiles and the 60E2 –0.6 have similar shapes at the gauge shoulder and corner, the latter two provide virtually identical contact conditions because of the differing head-width (Figure 1 and Figure 2).

3.3.2 Grinding requirements

The profiles 54E1 AHC (ProRail), 60E1 AHCP (SNCF) and 60E2 –0.6 (DB AG) require a maximum of 0.6 mm metal removal at the gauge. These profiles combine moderate crack removal and moderate gauge corner relief in a way to minimize metal removal requirements. With heavy-duty grinders such work can be achieved in a one-pass regime, which would be ideal for cyclical maintenance grinding work.

The other profiles require more metal removal for the first application. If maintained in appropriate cycles, metal removal can be adjusted for a one-pass regime as well.

4. Conclusions

Whereas the basic principle of gauge corner relief is generally accepted the target profiles used at present differ considerably.

Preferably cyclic maintenance grinding (limited metal removal requirements) should be executed applying profiles with moderate gauge corner relief (preventive profile).

In case of more severe fatigue considerable gauge corner undercutting is recommended (corrective profile).

It could not be clarified, whether complete headcheck removal should be aimed at generally (lack of work capacity and budget) or whether partial crack removal would be sufficient. This needs to be followed using now available recording techniques (eddy-current).

The preventive anti-headcheck profiles provide rather similar contact conditions. Due to the fact that contact conditions depend on rolling stock (wheel profiles, bogie stiffness etc) and line conditions, the IMs consider it not appropriate to propose a uniform anti-headcheck profile for general use.

Standardisation of these profiles should however be aimed at. That would involve wheel-rail contact experts from both sides (track and vehicle), as running stability (equivalent conicity), derailment risk (wheel climbing) and fatigue issues need to be addressed.

The mentioned profiles should at least serve as guideline for respective target profiles. By applying them, gauge corner fatigue is reduced and respective maintenance cost as well. Thus, their use should be recommended European wide.