Corrugation Study

KELTRACK Trackside Transit

Evaluation of KELTRACK™ Trackside Friction Modifier on Rail Corrugation Mitigation at Merseyrail, Liverpool, UK.

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Issue Date: 30th September, 2009.
KELTRACK Corrugation Study:

Customer: Merseyrail.

Date: December 2007 – June 2009.
Locations: Moorfields Curve, Lime Street and Central Station.
Vehicles: British Rail DMU Type 157 & 158.
Train Consist: 3 Cars, 6 Bogies.

Merseyrail have experienced an ongoing corrugation problem at a number of locations on their system, but particularly on the loop beneath the city between Moorfields and Central Stations. The following the report summaries the data collected following the application of KELTRACK Friction Modifier.

System Details:
Merseyrail operates the commuter service in and around Liverpool and the wider Merseyside area; the system has 3 lines, and operates 7 days a week for approximately 18 hours a day.

Figure 1: Diagram showing Merseyrail service.
Figure 2: Typical Merseyrail Service Vehicle

**Curve & Track Details:**

Moorfields Curve: Radius 225m Cant 50mm

Start of curve transition: 0m 880y  
Start of curve: 0m 957y  
End of curve: 0m 1425y  
End of transition: 0m 1520y

Lime Street Curve: Radius 210m Cant 65mm

Start of curve transition: 1m 311y  
Start of curve: 1m 339y  
End of curve: 1m 950y  
End of transition: 1m 978y

The track is of slab construction, raised on concrete pads with 113lb flat bottomed rail.
Moorfield Curve.

The PIV was installed immediately after the station platform on the tangent section of track prior to the start of the transition of the curve, KELTRACK was applied to the low rail only with a setting of 0.25 seconds every 16 axles, – The track had been re-laid a few weeks prior to the installation of the unit. - There is gauge face grease being applied to the high rail from hydraulic units.

Corrugation growth was monitored following the application of KELTRACK once per month following a short period after the installation. The measurements were taken at chainage markers 46, 51, 56, 61, and 66, five consecutive measurements were taken from each marker.

The original / baseline corrugation measurement was taken from a section of rail which had been removed prior to the PIV installation.

It can be seen that the corrugation growth has remained consistently low since the application of KELTRACK.

Figure 3: Results of Corrugation Measurements on Moorfield Curve, KELTRACK application.
**Lime Street / Central Station Curve.**

The PIV was installed on the tangent section of track prior to the start of the transition of the curve approximately 200m from the end of the station platform, KELTRACK was applied to the low rail only with a setting of 0.25 seconds every 16 axles. – The track had been re-laid a few weeks prior to the installation of the unit, - There is gauge face grease being applied to the high rail from hydraulic units.

Corrugation growth was monitored following the application of KELTRACK once per month following a short period after the installation. The measurements were taken at chainage markers 102, 107, 112, 117, and 122, five consecutive measurements were taken from each marker.

The original / baseline corrugation measurement was taken from a section of rail which had been removed prior to the PIV installation.

It can be seen that the corrugation growth has remained consistently low since the application of KELTRACK.

![Figure4: Results of Corrugation Measurements on Lime Street / Central Station, KELTRACK application.](image)
Measurement Equipment

Esveld RAILPROF
The RAILPROF is a tool for accurately measuring longitudinal rail geometry. The unit is lightweight (6 kg for RAILPROF 1000) and easily portable. The casing is constructed of robust high tech materials developed in space technology. The RAILPROF measures both vertical and lateral rail geometry without making mechanical contact. There are two sensors located inside the housing and driven by a step motor. The latter is responsible for the results being not influenced by the operator. Over a length of 1000mm a measurement is taken every 5mm. Each measurement is shown in the display, graphically or in number form. The data is stored on a standard PCMCIA memory card that can be read by a PC. The operation of the machine is carried out on a touch pad on the upper surface of the equipment.

The Esveld RailProf placed on the rail during measurement.

RAILPROF contains a built-in PC compatible processor, due to which a flexible data processing and programming is realized, easily facilitating user required modifications of the standard functions. A measured rail profile can be split up in short waves (corrugation), and trend (lining rail ends for welding). Condensed information, such as versine and grinding index (the amount of metal to be removed), is calculated and displayed.
Diagram of the measurement capabilities of the RailProf.

The profile is defined as a deviation from a straight line connecting the first and last measurement points. Other parameters displayed are long (trend) and short wavelengths. The trend in every point is the mean value over a length of 10cm on either side. The positive and negative versines are the highest and lowest points of the trend. The positive and negative slopes are the steepest ascending and descending points of the trend. The short waves are the difference between the profile and the trend. The average amplitude is based on the short waves. It is the average of the maxima minus the average of the minima. The average wavelength is twice the average distance between (ascending and descending) zero crossings.