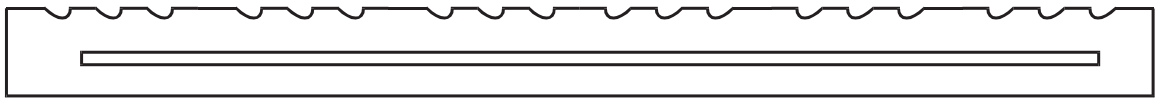
STRENGTH OF GANTRAIL CRANE RAIL PAD

INTRODUCTION

Gantrail supply two types of elastomeric crane rail support pad. Mark VII pad is made from vulcanised nitrile rubber and is reinforced with a continuous steel strip. It is used under the full length of the crane rail. Mark II pad is made from solid Ethylene Vinyl Acetate (EVA) material. It fits between the crane rail and individual soleplates. These are typically mounted on a concrete support structure.

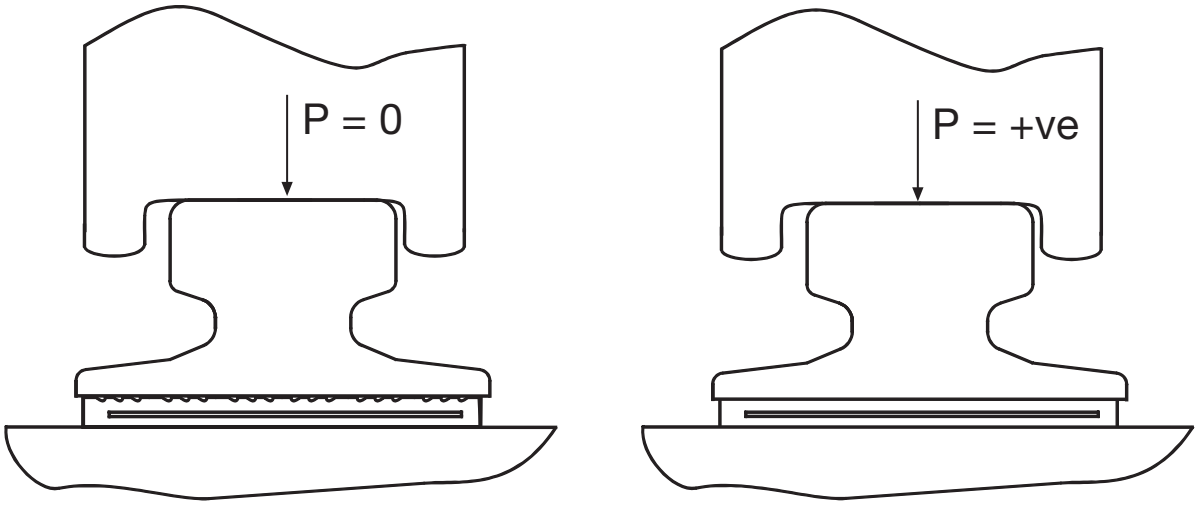
CHARACTERISTICS OF THE PAD

The Mark VII pad has a grooved or fluted top surface. This is shown in the figure below.



The idea of this is to give the pad an initial softness to cushion the wheel loads and impacts and to allow the pad to fill hollows in the top surface of the girder formed by welding distortion and the like. When the pad has been compressed the grooves fill as the rubber flows elastically into the voids they form. This is shown in the figure below. This ensures that for heavy wheel loads the pad is not excessively compressed and the rail is not able to bend to a degree where it may fail.

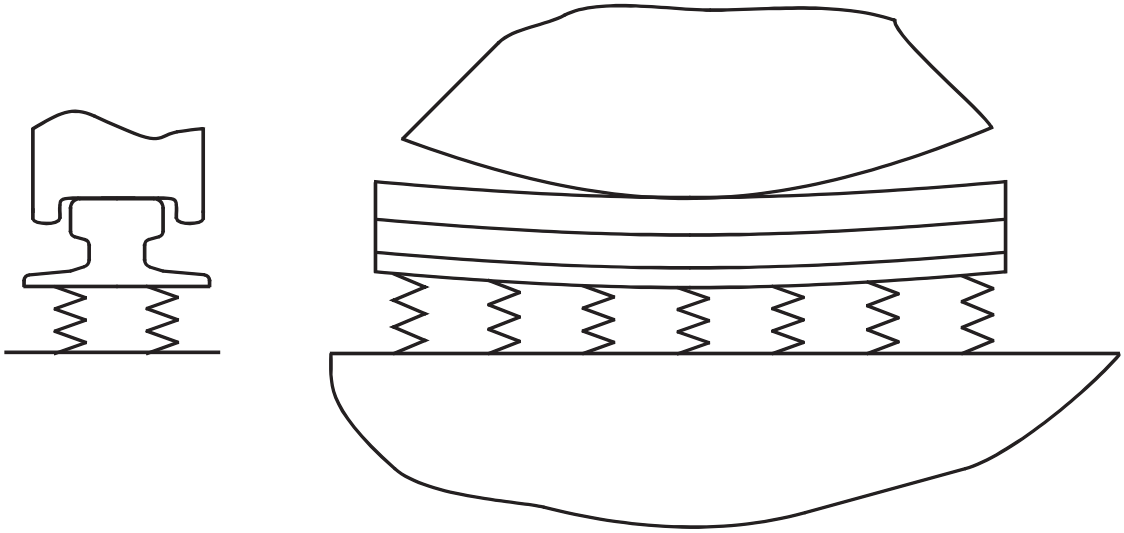
The solid Mark II pad is made of a harder material and is not normally used in such heavy applications. Thus it also ensures that the rail is not over stressed.



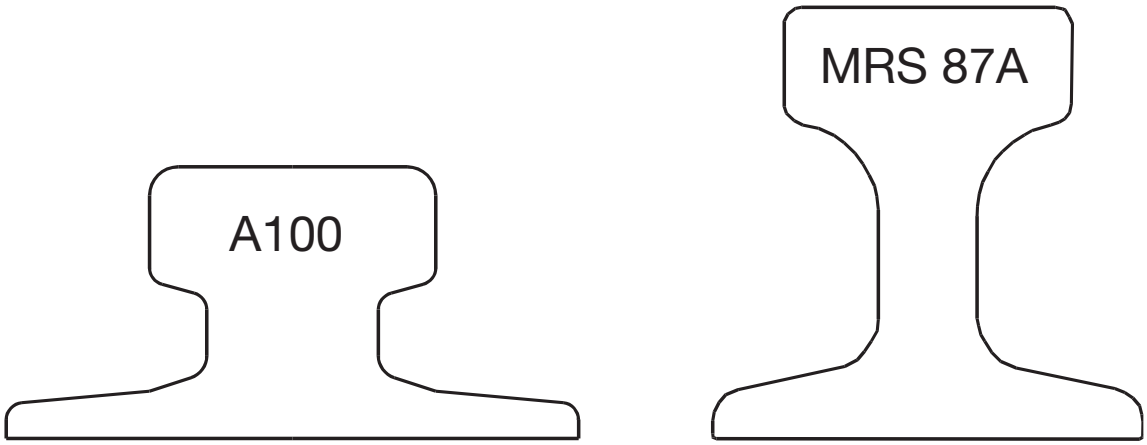
ANALYSIS

The interaction between the crane wheel, rail, pad and the support structure require a complex analysis. The rail acts as a beam and it is supported on an elastic foundation.

The situation is made difficult to analyse because the elasticity of the support is not linear i.e. the resistance of the pad is not proportional to the compressive deflection. The diagram below indicates the type of analysis that is required. A series of springs (the pad) supports the rail. Again, this is a simplification as more than one wheel may be influencing the rail.



To further complicate the practical application of pad, crane rails come in a range of sizes and shapes. The figure below shows two rails that have substantially the same head width. Thus they would be expected to be able to carry the same wheel loads. However, the squatter rail A100 has only about a third of the bending resistance of the taller rail.



Complex calculations that have been performed show the actual stress levels on the pad of between 5 and 10N/mm^2.

It is sometimes practice to carry out crude calculations to determine the pressure below the rail. Consider as an example the two rails shown above and consider the load to be carried on the area projected from the rail wheel interface at 45º Consider a 50 tonne wheel load. This is high for both rails.

	A100	MRS 87A
Height mm	95	152.4
Foot width mm	200	152.4
Stressed area below rail mm^2	38000	46451
Pad stress N/mm^2	12.9	10.6

PAD STRENGTH TESTS

The complex analysis must not prevent Gantrail from understanding the degree of safety in using the pad. Thus Gantrail have had tests performed to determine the ultimate strength of the Mark VII and the Mark II pads in artificial conditions. Samples of each type of pad were tested in compression between pairs of steel blocks. The blocks were chosen as 150mm square, 105mm square and 75mm square. These both have area ratios of approximately 2:1. A UK Government recognised laboratory completed the tests. The results were as follows:

Mark VII Pad Tests

- 150 x 150mm sample

No failure with 2000kN load
Average stress without failure 88.9N/mm^2

- 105 x 105mm sample

Minimum load for three samples 937kN
Average failure stress 94.6N/mm^2

- 75 x 75mm sample

Minimum load for three samples 608kN
Average failure stress 112N/mm^2

Mark II Pad Tests

- 150 x 150mm sample

No failure with 2000kN load
Stress without failure 88.9N/mm^2

- 105 x 105mm sample

Failure load for one sample 1340kN
Stress 121.5N/mm^2

- 75 x 75mm sample

Failure load for one sample 550kN
Stress 97.8N/mm^2

SAFETY FACTOR

The safety factor for pad strength is the failure stress divided by the expected maximum stress.

There is no failure stress below 85N/mm^2 and Gantrail believe the actual stress in operation will not excess 15N/mm^2 in any case. Thus there should be a safety factor of in excess of five times in every application.