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# METRO TRACK EQUIPMENT

Revision : 02  
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Page n° : 1  
Total Pages : 11

TS-DFMA-L10-E

**TECHNICAL SPECIFICATION + QAP  
ELASTIC MAT  
CDM – DFMA – L10/RR**

## TECHNICAL SPECIFICATION Including QAP

### SUPPLY OF ELASTIC MATS

## CDM-DFMA-L10/RR

### 2 layers





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Page n° : 2  
Total Pages : 11

TS-DFMA-L10-E

## TECHNICAL SPECIFICATION + QAP ELASTIC MAT CDM – DFMA – L10/RR

## 1 **GENERAL:**

### 1.1 **Scope**

The present specification is intended to define the conditions that must be satisfied by the « surface resilient mat treatment + lateral isolation » system, all part of a track vibration isolation system called DFMA. This system is a solution based on the principle of a concrete floating trackbed on continuous resilient mats. The performance of this solution depends essentially on the characteristics of the floating part (static mass in relation to the dynamic mass), the stiffness of the ground, and the stiffness of the resilient mat.

The component materials of the CDM-DFMA system (description according to this technical specification) are:

- Resilient surface mat
- Lateral isolation

Depending on the stiffness of the foundation, this track isolation system ensures an insertion loss of -20dBV with respect to the predominant excitation (40 to 125 Hz) present in the classic non-isolated trackbed with only simple rubber grooved railpads (7 mm thick) laying on concrete trackbed foundation. The rail deflection under the static loads (with train at stop) may not be higher than 3 mm.

The resilient mats used in the DFMA trackbed isolation system are made of resin-bonded rubber granules (CDM-RR range).

Typical load window:

- The permanent load  $g$  (approx. 310 mm RC) = approx. 10 kPa (0.010 MPa);
- The dynamic load: metro max. 140 kN axle load representing approx. 15 kPa;
- Thus, the load window  $\sigma$  for the resilient mat is  $0.010 \text{ MPa} < \sigma < 0.025 - 0.03 \text{ MPa}$ ;

### 1.2 **Fabrication**

The resilient mats CDM-DFMA-L10/RR are manufactured in the factories RBSI, Z.I. de la Tuilerie F.57385 Tétting-sur-Nied, France (part of CDM group), by moulding manufacturing technology with a mix of high quality rubber granules (typically resulting from the grinding of post-consumer tyres from cars, trucks and rolling stock) with adequate granulometry and resins + additive. The raw material batch formulation is owned by CDM and gives origin to a resin bonded rubber product being called CDM-43.





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Mod. Date : 20/11/08

Page n° : 3  
Total Pages : 11

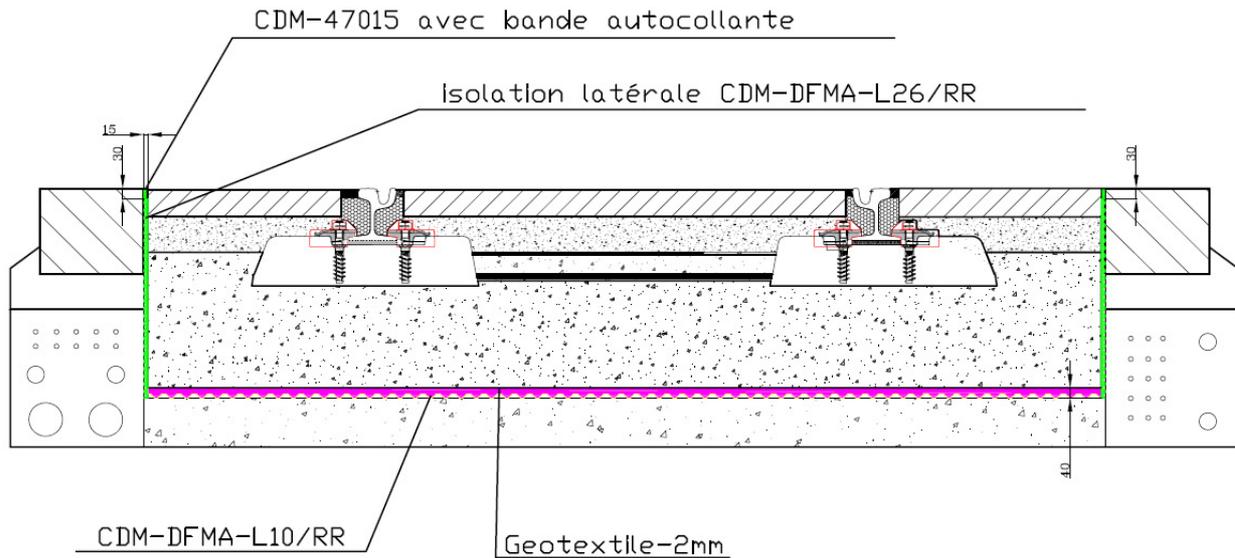
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## TECHNICAL SPECIFICATION + QAP ELASTIC MAT CDM – DFMA – L10/RR

The rubber granules are also manufactured in the RBSI factories, ALIAPUR certified (see [www.aliapur.fr](http://www.aliapur.fr)) as revalorisation of post-consumer tyres. Thus the CDM-group controls the quality during the complete production chain.

### 1.3 Drawing:

As an example, a drawing is shown of a typical cross section for track isolation with an elastic mat type CDM-DFMA-L10/RR installed in 2 layers CDM-43020/10mm.



### 1.4 Rules of QAP

The applicable management rules are described in the general QAP of CDM homologated ISO-9001:2000 / IQNET BE-00 1550a valid until 22/02/2010. Documentation is available on demand.





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Page n° : 4  
Total Pages : 11

TS-DFMA-L10-E

## TECHNICAL SPECIFICATION + QAP ELASTIC MAT CDM – DFMA – L10/RR

### **1.5 Specific organisation for the project realisation**

#### 1.5.1 CDM – Head Quarters:

- Managing director: Mr. Patrick Carels
- Financial director: Mr. Pieter Demuyne
- QA responsible: Mr. Yos Blustain
- Responsible follow-up / customer contact: Mr. Vincent Brasseur
- Responsible invoicing: Mr. Dieter Jacobs
- Responsible lab: Mr. Bram Veelhaver

#### 1.5.2 RBSI – production of granules and mats

- Director: Mr. Olivier Prud'homme

### **1.6 Available equipment for production and testing**

1.6.1 RBSI: grinding mill line for used tyres, hydraulic presses, mixers, production moulds and crushers.

1.6.2 CDM: laboratory with hydraulic INSTRON press + cantilever testing system (CTS) for creep tests.





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Page n° : 5  
 Total Pages : 11

TS-DFMA-L10-E

## TECHNICAL SPECIFICATION + QAP ELASTIC MAT CDM – DFMA – L10/RR

## 2 GENERAL PROVISIONS

### 2.1 General descriptions and production conditions

2.1.1 General characteristics of the resilient material used for the mat CDM-DFMA-L10/RR:

Description		Unit	Resilient mat
Material			RR (High quality resin-bonded rubber)
Type			CDM-DFMA-L10/RR (2 layers – horizontal part)
			CDM-DFMA-L20/RR (1 layer – vertical part)
Density – DIN et ISO 845		kg/m <sup>3</sup>	710 +/- 50
Static load range		MPa	<0.3
Maximum total load		MPa	0.6
Maximum occasional load		MPa	3.0
Colour			Black
Dimensions	Thickness	mm	1 layer : 20/10 (DFMA-L20)
			2 layers : 40=2*20/10 (DFMA-L10)
Rolls	Length x width	mm	12500 x 800, manufactured in single layer (other dim. are available on demand)
Temperature range		°C	-10 / +100
Static E-module - DIN 53513		MPa	1.5 – 3.0
Dynamic E-module - DIN 53513		MPa	4.0 – 9.0
Static G-module - DIN 53513		MPa	0.3
Dynamic G-module - DIN 53513		MPa	0.6
Compression set - 50% / 70H RT – DIN and ISO 1856		%	< 10 %





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Page n° : 6  
 Total Pages : 11

TS-DFMA-L10-E

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$k_{stat}$ (0.02 MPa)	MN/m <sup>3</sup>	DFMA-L10 : 10 ± 20%
$k_{dyn}$ (10 Hz – 0.02MPa +/- 20%)	MN/m <sup>3</sup>	DFMA-L10 : < 20

### 2.1.2 General description of geotextile NW-26:

Description	Unit	Geotextile NW-26
Weight	g/m <sup>2</sup>	335
Tensile strength M – EN ISO 10319	kN/m	26
Tensile strength T – EN ISO 10319	kN/m	26
Elongation at break M – EN ISO 10319	%	50
Elongation at break T – EN ISO 10319	%	55
Water permeability – EN ISO 11058	mm/s	65

### 2.2 Tolerances on dimensions:

- length : +10 / - 5 mm.
- width : +5 / -0 mm.
- thickness : +/- 2 mm.

### 2.3 Marking:

Normally, the mats are not marked. On special demand a marking can be introduced.

### 2.4 Traceability of the products

The mats are put on a pallet, which is marked with a sequential number linked with the order number (= P.xxxx/yy/zz,...xxxx = order n°, yy = shipment n°, zz = pallet n° within the shipment).





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Revision : 02  
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Page n° : 7  
Total Pages : 11

TS-DFMA-L10-E

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## 3 PERFORMANCE AND FACTORY IDENTIFICATION CHARACTERISTICS

Tests and reports are provided by the supplier.

### 3.1 Performance characteristics - laboratory tests or tests by an organization approved by the Project superintendent:

#### 3.1.1 Static stiffness:

In exploitation conditions, the system is submitted to a permanent load of approx. 10 kPa, the rolling stock (max. 140 kN axle load) imposes a local dynamic load of approx. 15 kPa. The static stiffness is to be measured @ 20°C +/- 3°C in a hydraulic press between two stiff flat plates. The sample (300x300 mm) is subjected to 3 cycles load-unload from 0 to 2.7 kN @ 2.7 kN/min. The duration between 2 cycles is 30 seconds. The stress-strain curve is measured during the 3rd cycle. The tangent static stiffness is to be measured between 0.9 kN and 2.7 kN:

$$K_{\text{stat-tan}} > 8 \text{ MN/m}^3$$

#### 3.1.2 Dynamic stiffness: is to be measured in the same press and on the same sample as the one used in 3.1.1. Oscillation at 1.8 kN +/- 20% at 10 Hz:

$$K_{\text{dyn-10Hz}} < 20 \text{ MN/m}^3$$

#### 3.1.3 Creep under constant load (according to ISO-8013):

- During 168h the sample (100x100 mm) is loaded by a charge, equivalent to the permanent load, of 0.02 MPa. 30 minutes after creep tests, the ratios  $(k_{\text{dyn-10Hz}})_{\text{after creep}} / (k_{\text{dyn-10Hz}})_{\text{before creep}}$  and  $(k_{\text{stat-tan}})_{\text{after creep}} / (k_{\text{stat-tan}})_{\text{before creep}}$  must be <1.25.
- Creep rate < 0.5 mm / decade of time expressed in minutes.
- Recuperation of the sample 30 min. after 168h creep at 0.02 MPa should be > 95% of the initial height.

#### 3.1.4 Fatigue test: after having measured $k_{\text{dyn-10Hz}}$ and $k_{\text{stat-tan}}$ the sample is submitted to $2.5 \times 10^6$ cycles between 0.01 and 0.04 MPa at a frequency of 3 Hz. 1 hour (MAX 24 hours) after the fatigue test, again $k_{\text{dyn-10Hz}}$ and $k_{\text{stat-tan}}$ are measured. The ratios $(k_{\text{dyn-10Hz}})_{\text{after fatigue}} / (k_{\text{dyn-10Hz}})_{\text{before fatigue}}$ and $(k_{\text{stat-tan}})_{\text{after fatigue}} / (k_{\text{stat-tan}})_{\text{before fatigue}}$ must be <1.25.





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Page n° : 8  
Total Pages : 11

TS-DFMA-L10-E

### TECHNICAL SPECIFICATION + QAP ELASTIC MAT CDM – DFMA – L10/RR

#### **3.2 Quality Control after manufacture – Quality plan:**

3 samples per full truck (approximately 2000m<sup>2</sup> CDM-DFMA-43020/10mm) have to be tested according to the procedures 3.1.1 and 3.1.2.

#### **4 DELIVERY AND CONDITIONS OF STORAGE:**

The mats (800 mm wide in rolls or sheets following specific project demands) will be provided on pallet equipped with a sheet of protection. The conditioning is adapted to the order according to the quantities required by the project.

The pallets cannot be superimposed, nor to be loaded by additional weights and cannot be subjected to extreme climatic conditions. At the time of the unloading of the pallets, care is to be taken not to drop or give violent shocks to the pallets.

These pallets are provided on building site unloaded from the truck. So we advise the customer to check the aspect of the pallets before unloading (swing of the pallets, abnormal slip of materials, tearing of the protection sheet ...). Eventual anomalies must be announced on the delivery note presented by the transporter.





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Page n° : 9  
Total Pages : 11

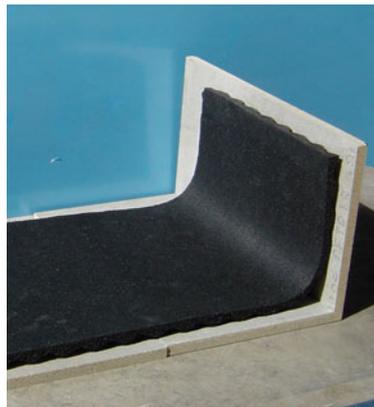
TS-DFMA-L10-E

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## 5 INSTALLATION OF THE SYSTEM

The installation of the system depends essentially from the specific project details. As an example of an installation of a double-layered elastic mat with single layered lateral isolation, the sequential steps for the installation of the system could be the following:

- after having concreted the excavation, a first layer of the mat is installed on the invert and against the vertical upstands, with the wavy side towards the bottom (the length of the mats can be adapted to the width of the trackbed)



- the second layer of DFMA-L10/RR (for the horizontal part) is placed on the first one with the wavy side downwards, shifted in the longitudinal direction, to avoid superimposing the joints





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Mod. Date : 20/11/08

Page n° : 10  
Total Pages : 11

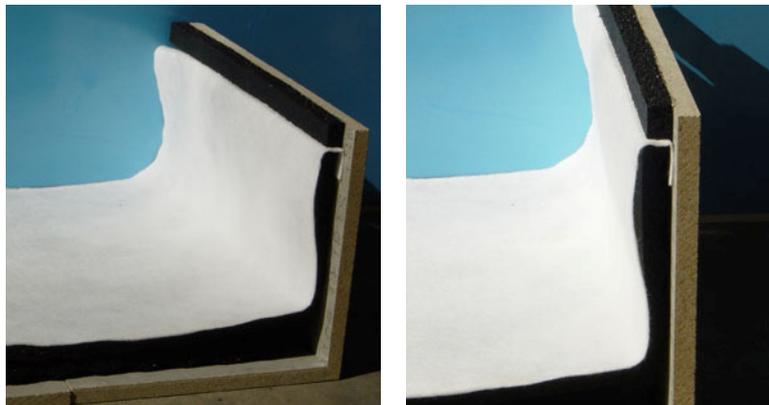
TS-DFMA-L10-E

### TECHNICAL SPECIFICATION + QAP ELASTIC MAT CDM – DFMA – L10/RR

- in order to limit the deflection in the zones of levelled crossings, a strip with increased stiffness in CDM-43040 is installed
- a geotextile protection layer is put on the mat (with covering joints, min. 100mm)



- on top of the lateral isolation, a resilient strip in CDM-47020 (width 50mm, thickness 20 mm, with self-adhesive side) is stuck on the concrete to assure the impenetrability of the joint on the surface



- the concrete is poured up to the specified thickness

## 6 **MAINTENANCE:**

After the pouring of the concrete, the floating floor does not require any specific maintenance.



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Page n° : 11  
Total Pages : 11

TS-DFMA-L10-E

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## **7 GUARANTEES AND ENGAGEMENTS OF THE SUPPLIER :**

The mats are guaranteed against all defects ascribable to manufacture or constitutive material for a period of 10 years after the delivery. This guarantee does not cover the deterioration resulting from abnormal installation or use or their exposure in an accidental way with a chemical agent dissuaded from use such as solvents (tri-chlorethylene, acetone, acetic anhydride, cyclohexanol).

The mechanical characteristics of the system were selected in such a way that, under the usual installation conditions, vibration isolation  $> -20$  dBV is obtained in the frequency band beyond 63 Hz, compared to the traditional installation on concrete sleepers embedded in concrete with grooved rubber pads (9 mm), under rigid foundation conditions. This will be confirmed by the realization of the in situ tests described in chapter 8.

In order to safeguard the system effectiveness, the supplier of the mats commits himself ensuring technical assistance to the design and construction team:

- The presence at building site meetings referring to the installation of the mats, if necessary.
- The implementation of a quality plan.
- A technical assistance related to the installation and the use of the mats within the project.

## **8 IN SITU PERFORMANCE CONTROL TESTS:**

The tests are organised by the supplier of the track system. They are to be done by an independent consultant, specialised in track vibration measurements, proposed by the supplier of the DFMA system and approved by the project superintendent.

The performance control will be executed according to the following procedure:

- a sensor A (vertical acceleration) is fixed on the floating trackbed as close as possible to the rail
- a sensor B (vertical acceleration) is fixed outside the floating trackbed at 3 m from the axle of the nearest track
- the transfer function between A to B under excitation (vertical direction) on the rail with impact hammer or excitation machine is measured in 1/3 octaves. If necessary a correction for the effect of the foundation stiffness will be taken into account.
- the attenuation of A to B is given by the amplitude of this transfer function. This attenuation should be  $> -20$  dBv for the 63, 80, 100 and 125 Hz. 1/3 octave bands.

