

OFFICIAL



# Control Period 7 (CP7) Variable Usage Charge (VUC)

Process and policy for the proposal and consent of new rates

Version 2

26 July 2024

## Contents

1	Introduction .....	4
	Document Audience .....	4
	The Variable Usage Charge (VUC) .....	4
	Circumstances for calculating a new VUC .....	4
	Timescales for requesting a new VUC rate .....	5
2	Process for calculating and agreeing a new VUC rate .....	7
	Step one – requesting a new rate .....	8
	Step two – calculating a new rate .....	8
	Step three – submitting a new rate to ORR .....	8
	Step four – ORR determination .....	9
	Step five – TABS implementation .....	9
	Step six – publication of the new rate .....	10
3	The Default VUC Rate .....	11
4	Modified vehicles .....	13
5	Averaging vehicle characteristics .....	14
6	Articulated trains .....	16
7	Freight services using passenger vehicles .....	17
	Ride Force Count Suspension Factor .....	17
8	Heritage Trains .....	18
9	VUC pro formas .....	19
	Passenger pro forma .....	19
	Freight pro forma .....	20
10	CP7 VUC Calculators & Ready Reckoner .....	21
	Official CP7 VUC Calculator .....	21
	Unofficial CP7 VUC Calculator .....	21
	Ready Reckoners .....	21
11	Using the Official CP7 VUC Calculator .....	22
	Importing vehicle characteristics .....	22
	Passenger vehicles .....	23
	Vehicle type .....	24
	Existing vehicle .....	24
	New vehicle name .....	25
	Price base .....	25
	Motor / trailer .....	25
	Locomotive / coach or multiple unit .....	25
	Number of axles .....	26
	Vehicle weight .....	26
	Total number of seats .....	26
	Unsprung mass .....	26

Maximum speed.....	27
Route-based maximum speed.....	27
User calculated operating speed .....	28
Curving class .....	28
User-defined TGamma .....	29
Calculating the VUC rate .....	29
Exporting and saving the results.....	31
Freight vehicles .....	31
Vehicle type .....	31
Existing vehicle .....	32
New vehicle name.....	32
Price base .....	32
Locomotive / wagon .....	32
Load condition.....	33
Number of axles.....	33
Vehicle weight.....	33
Unsprung mass.....	33
Curving class .....	34
User-defined TGamma .....	34
Suspension band .....	34
Ride Force Count (RFC) suspension (discount) factor.....	35
Freight commodity .....	36
Calculating the VUC rate .....	36
Exporting and saving the results.....	37
Testing trains .....	37
12 Help with new VUC rates .....	38
13 Version Control .....	39
14 Appendix 1 – VUC rate proposal letter .....	40
15 Appendix 2 – VUC calculation methodology for articulated units .....	41
A.01 Methodology.....	41
A.02 New vehicle calculations .....	43
<b>1. Class 755/4</b> .....	43
<b>2. Class 755/3</b> .....	44
<b>3. Class 745/0</b> .....	45
<b>4. Class 745/1</b> .....	47
End .....	48

## 1 Introduction

- 1.1 The purpose of this document is to set out the process and information required for the calculation and approval of new Variable Usage Charge (VUC) rates in Control Period 7 (CP7). A new VUC rate is one which is not on the CP7 Track Usage Price List published on 20 December 2023 and available on our website [here](#). This price list is shown in 2023/24 prices, however, updated versions of the price list reflecting the impact of inflation are also provided on our website [here](#).
- 1.2 This document also details how to complete the VUC pro forma and the CP7 VUC calculators, which are excel based tools, available to interested stakeholders<sup>1</sup> to calculate new VUC rates for CP7.
- 1.3 Hyperlinks to individual documents are provided wherever possible, but all the documents can be downloaded manually from Network Rail's main CP7 Access Charges website [here](#).
- 1.4 This document has been endorsed by ORR.

### Document Audience

- 1.5 This document has been created for anyone who is interested in the process regarding the calculation and approval of VUC rates for new or modified vehicles. Interested parties may include train operating companies (passenger, freight, open access and heritage train operators), vehicle owners, vehicle manufacturers, the Office of Rail and Road (ORR), Department for Transport, Transport for Wales, Transport Scotland.

### The Variable Usage Charge (VUC)

- 1.6 The VUC is one of a range of track access charges payable by train operators to Network Rail for use of its infrastructure. The charge allows Network Rail to recover its efficient maintenance and renewal costs that vary with traffic levels (e.g. track 'wear and tear' costs).
- 1.7 The charge is designed to be cost reflective and as a result, 'track friendly' vehicles which cause less 'wear and tear' to the network, are subject to lower VUC rates than vehicles which are more damaging. Theoretically, levying the charge should mean that, from a 'wear and tear' perspective, Network Rail is not disincentivised from accommodating additional traffic (i.e. it is recompensed for the 'wear and tear' resulting from more trains on the network).

### Circumstances for calculating a new VUC

- 1.8 A new VUC rate can **only** be calculated in the following circumstances:

---

<sup>1</sup> The tool is made available so that interested stakeholders can understand the likely outputs from the process but the completion of **the official VUC calculation** will be undertaken by Network Rail's Regulatory Economics Team.

- a) Where a vehicle type due to begin operating on the network is not on the CP7 Track Usage Price List;
- b) Where a vehicle type already operating<sup>2</sup> on the network is not on the CP7 Track Usage Price List;
- c) Where a vehicle type has been modified<sup>3</sup> following the publication of the CP7 Track Usage Price List on 20 December 2023 and as a result, the vehicle characteristics (discussed in Section 11) which determine the VUC rate, have changed; or
- d) Where the operating weight (laden) of a freight wagon has been changed due to the removal of any Heavy Axle Weight (HAW) dispensations that Network Rail has in effect at the start of CP7.

1.9 Otherwise, the Track Usage Price List published on 20 December 2023 will apply for the whole of CP7 and only adjusted annually for inflation.

**1.10 The Track Usage Price List cannot be re-opened during the control period, even if errors are subsequently identified.**

### Timescales for requesting a new VUC rate

- 1.11 To help ensure that an appropriate VUC rate is available from the date that the relevant vehicle begins operating on the network (including testing), we suggest that as soon as the necessary vehicle characteristics are available, the operator initiates the process set out in Section 2. Required vehicle characteristics are discussed in more detail in Section 11 for passenger and freight vehicles.
- 1.12 As discussed in more detail in Section 3, if a new VUC rate does not receive consent from ORR prior to the new or modified vehicle running on the network, Network Rail will apply the temporary 'high' Default VUC Rate for new vehicles, or the existing VUC rate in the case of modified vehicles, until such time that the new VUC rate is consented to. Once the new VUC rate has been approved by ORR, any difference between this rate and the Default VUC Rate or an existing rate if the new rate is a for a modified vehicle, will be calculated and refunded / charged<sup>4</sup> to the train operator.
- 1.13 For new vehicles, many of the vehicle characteristics necessary to calculate a new VUC rate are likely to form part of the overall suite of information prepared prior to establishing route compatibility. Therefore, because it's more efficient to identify both sets of data at the same time, we would encourage all parties involved in the vehicle compatibility process to be mindful of the need to identify the vehicle

---

<sup>2</sup> In these circumstances the Default VUC rate would be levied against any vehicle mileage incurred prior to the approval of a new VUC rate.

<sup>3</sup> See Section 4 for what constitutes a vehicle modification.

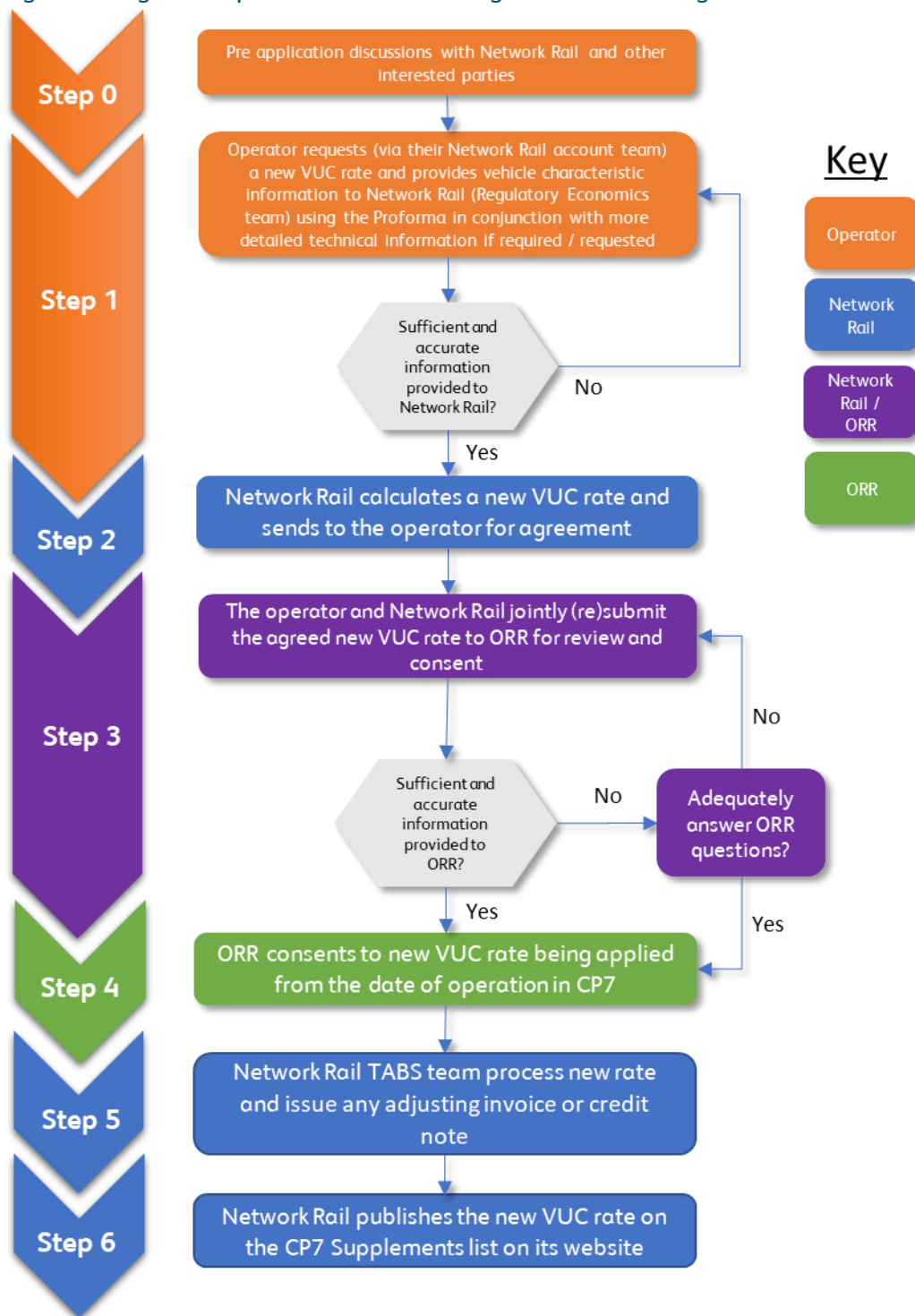
<sup>4</sup> Refunds / additional charges are limited to the control period in which the consent for the new VUC rate is applicable i.e CP7 only.

characteristics used for charging purposes and, if possible, share it with the relevant train operator as early as possible.

## 2 Process for calculating and agreeing a new VUC rate

2.1 The high-level process for calculating and agreeing new VUC rates is set out in Figure 1 below. Indicative timescales for the whole process are approximately 3 months, provided accurate and complete data is provided in the first instance.

Figure 1: High-level process for calculating and determining new a VUC rate.



## Step one – requesting a new rate

- 2.2 The pro formas setting out the vehicle characteristics that the operator needs to provide to Network Rail to calculate a new VUC rate are available on Network Rail's website [here](#) for passenger operators and [here](#) for freight operators. This information is also set out in sections 9 for passenger and freight vehicles respectively.
- 2.3 The completed vehicle characteristics pro forma should be sent by the operator to the Network Rail customer team. If the pro forma contains incomplete or conflicting information, then this may delay the application. The customer team will then share the pro forma with the Network Rail Regulatory Economics team who will calculate the VUC rate.
- 2.4 Requests for a new VUC rate and the provision of vehicle characteristics should be made in writing (email is acceptable). Network Rail also has the option to propose a new VUC rate if it considers this to be appropriate.

## Step two – calculating a new rate

- 2.5 The operator may wish to use the Official CP7 VUC Calculator to calculate the new VUC rate itself and provide this information to Network Rail, alongside the provision of the vehicle characteristic information in a pro forma. In this situation, this would serve as a reference to speed up the process of agreeing the rate. **Network Rail would still retain the full responsibility for calculating the rate.**
- 2.6 The Official CP7 VUC Calculator can be downloaded from our website [here](#), further guidance in relation to using the calculator is provided, below. This is a link to the 'Official' version of the CP7 VUC calculator, which only allows VUC rates to be calculated in 2023/24 prices. This official version is used to calculate rates for submission to ORR. The Unofficial CP7 VUC Calculator, which allows VUC rates to be calculated in current prices, is also available on our website. However, this is provided for information only.
- 2.7 The new VUC rate calculated by the Network Rail will be sent to the operator via the relevant Network Rail customer team for agreement.

## Step three – submitting a new rate to ORR

- 2.8 If Network Rail and the operator agree the new VUC rate, a joint submission should be made to ORR in writing requesting that it consents to this new rate. Template letters exist for both passenger and freight applications and should be used for the submission (further information and links to the template letters are provided in Appendix 1). Network Rail's customer team, with support from other Network Rail colleagues as required, should work with the train operator to populate the template letter before submitting it to ORR. The following supporting documentation should also be submitted to ORR by email:
  - a) Completed pro forma;



- b) Vehicle characteristics;
- c) Outputs from the Official CP7 VUC Calculator (appended to the letter);
- d) Evidence of any averaging of vehicle characteristics;
- e) Evidence of commodity operating weights (freight only and if applicable);
- f) Outputs from Ride Force Count calculations (freight only and if applicable);  
and
- g) any other relevant information.

2.9 If Network Rail and the operator agree an appropriate VUC rate, including the appropriate supporting information as described in paragraph 2.8, generally, this will result in the VUC rate being consented to by ORR in a timelier manner than when both parties are unable to reach agreement, or if supporting information is missing. Therefore, it is in both parties' interest to work collaboratively to agree a new VUC rate.

2.10 If Network Rail and the operator fail to agree a new VUC rate, either party has the option to refer the issue to ORR for determination as detailed in the Track Access Contract.

#### **Step four – ORR determination**

2.11 Any request for ORR's consent to a supplement should be accompanied by information demonstrating that the proposed rates have been calculated correctly, in accordance with established processes. Where there is anything unusual about a proposal, ORR will expect the request to be accompanied by sufficient background explanation and supporting information to reach an informed decision.

2.12 If ORR does not initially consent to the VUC submitted by Network Rail and the operator, it may be necessary to provide additional supporting information and / or make a new joint submission, as required by ORR.

#### **Step five – TABS implementation**

2.13 Following ORR consent for the new VUC rate in 2023/24 prices, the new rate will be indexed accordingly and uploaded to TABS.

2.14 If the vehicle type has not yet begun running on the network, it will pay the new VUC rate consented to by ORR from the date of operation in CP7 and no re-charge will be required.

2.15 Where a new VUC rate has been calculated to reflect a vehicle modification, the operator should provide its Network Rail customer team with a schedule setting out the date it expects each vehicle to be modified. This should allow the new VUC rate to be applied to individual vehicles as they are modified. If it becomes apparent that the modification date of a vehicle will vary from that set out in the schedule

provided to Network Rail, it is the operator's responsibility to inform Network Rail so that this can be appropriately reflected in charges.

### **Step six – publication of the new rate**

2.16 Following ORR's consent to a new VUC rate, Network Rail will publish on its website within 28 days, details of the new VUC rate alongside other new CP7 rates.

### 3 The Default VUC Rate

- 3.1 If a new vehicle type begins operating on Network Rail infrastructure prior to a new VUC rate being consented to by ORR, Network Rail will charge that vehicle type at the Default VUC Rate. The passenger Default VUC Rate for CP7 is set at the highest equivalent vehicle rate<sup>5</sup> published on the CP7 Track Usage Price List.
- 3.2 Similarly, the Default VUC Rate for freight vehicles will be set at the highest equivalent vehicle rate<sup>6</sup>, on the published CP7 Track Usage Price List, for locomotives and wagons (Laden and Tare).
- 3.3 The Default VUC Rates for both freight and passenger operators were introduced, initially in CP6, to serve as an incentive to encourage the operator to apply for a new VUC rate for new vehicles in a timely manner. While a rebate is the most likely scenario following a period of being charged using the Default VUC Rate, it's possible that any new VUC rate could be higher than the Default VUC Rate. Network Rail will issue an adjusting invoice or credit note in relation to any money due / owed within 28 days of ORR consenting to the new VUC rate.
- 3.4 Table 1 and Table 2 show the Default VUC Rates published for CP7 in 2023/24 prices. The Default VUC Rates are indexed annually in line with the corresponding Track Access Contracts.

Table 1: Default Passenger Variable Usage Charge (VUC) rates for CP7.

	VUC rate
Vehicle classification	Pence per vehicle mile (2023/24 prices)
Locomotive	127.05
Multiple unit (motor)	60.44
Multiple unit (trailer)	28.23
Coach	23.45

<sup>5</sup> i.e. the highest equivalent vehicle rate for either a loco, multiple unit or coach.

<sup>6</sup> i.e. the highest equivalent vehicle rate for either a loco, or wagon for year 5 of the control period.

Table 2: Default Freight Variable Usage Charge (VUC) rates for CP7.

	VUC rate
Vehicle Classification	£ per kgtm (2023/24 prices)
Locomotive	11.6379
Wagon (laden)	7.7070
Wagon (tare)	4.0809

## 4 Modified vehicles

- 4.1 A new VUC rate may be required to reflect a modification to an existing vehicle which materially changes the vehicle characteristics. In these circumstances, the existing VUC rate will apply until such time as the new VUC rate has been consented to by ORR.
- 4.2 The operator should provide Network Rail with a schedule setting out the date each vehicle will be / has been modified. This will allow the new VUC Rate to be applied to individual vehicles as they are modified to ensure billing is accurate.
- 4.3 Examples of when a vehicle type would be considered 'modified' are listed below:
- a) Where a modification triggers a subclass in the vehicle type;
  - b) The removal or addition of equipment that materially alters the tare weight of the vehicle;
  - c) Adding or removing seats;
  - d) The addition of HALL bushes; and / or
  - e) A physical change that alters the maximum operating speed of the vehicle.
- 4.4 Train refurbishments usually don't meet the threshold to trigger the requirement for a new VUC rate.
- 4.5 If a modification to the vehicle type does not trigger an official subclass designation, then because Network Rail's Track Access Billing System (TABS) cannot contain two different prices for the same class of vehicle, it may be necessary to provide the vehicle type with a different designation on Network Rail's price list to differentiate the modified vehicle from non-modified vehicles of the same class run by other operators.
- 4.6 If, after discussions, Network Rail believes the modifications to a vehicle type **do not** materially alter the vehicle characteristics, then the operator shall be entitled to refer the matter to ORR for determination.

## 5 Averaging vehicle characteristics

- 5.1 New trains are more commonly being commissioned as ‘fixed formations’ and comprise a variety of different vehicles all with their own characteristics. Where appropriate to do so, Network Rail’s preference is to average vehicle characteristics so that we limit the number of new VUC rates that need to be calculated for any given train.
- 5.2 For example, the class 800 comes in a fixed 5-car formation as shown in Figure 2 below.

Figure 2: Fixed formation of a class 800.



- 5.3 The vehicle characteristics for this unit, for example, may look something like those contained in Table 3 below.

Table 3: Example vehicle characteristics of a fixed formation unit.

Vehicle	DTPS	Me	Me	Me	DPTF
Tare mass (t)	48.01	51.073	51.31	51.711	51.30
No. of seats	56	88	88	76	18 (+2 w/c)
No. of axles	4	4	4	4	4
Unsprung mass (kg/axle)	1,485	1,605	1,605	1,605	1,485
Max. speed (mph)	125	125	125	125	125
Motor / Trailer	T	M	M	M	T

- 5.4 In this instance, we observe that while the vehicle characteristics are similar, no two columns of data are the same, and it might be appropriate to average the values for the motor and trailer vehicles respectively, giving us two VUC rates as opposed to five individual ones.
- 5.5 In some circumstances, it might be applicable to use a weighted average, if for example, a new class of train comes in multiple fixed unit formations.
- 5.6 While Network Rail will seek to be as consistent as possible in its approach to applying averaging methodologies, it should be noted that this may not always be possible due to the wide range of scenarios which can be encountered. Therefore, each new VUC rate will be dealt with on a case-by-case basis.

- 5.7 Where an averaging methodology has been jointly agreed between Network Rail and the operator, it should be clearly explained, including a table of values, and included as an appendix to the template VUC proposal letter<sup>7</sup> being submitted to ORR so that its decision can be made based on all the evidence.
- 5.8 If Network Rail and the operator disagree on the most appropriate form of averaging, or indeed disagree on the need for averaging at all, then the operator shall be entitled to refer the matter to ORR for determination.

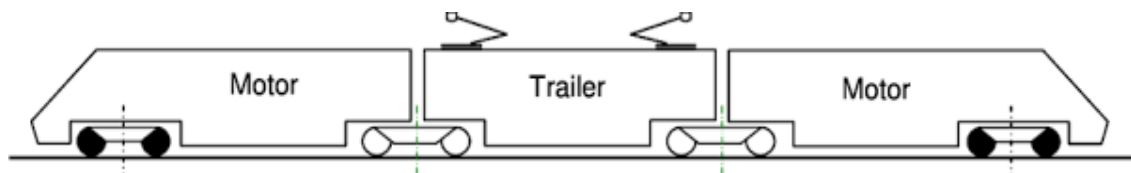
---

<sup>7</sup> Detailed in Appendix 1 to this document.

## 6 Articulated trains

- 6.1 In order to populate the VUC pro forma detailed in Section 9 and use the VUC calculator correctly (Section 11), agreed or proposed vehicle characteristics are required. To be able to set the VUC rate there must be an individual rate<sup>8</sup> for each vehicle as seen by the billing system (TABS). This means that a rate needs to be determined for each vehicle body in a multiple unit.
- 6.2 In the case of articulated trains, where some of the bogies in a unit will be shared between two adjacent vehicles (see Figure 3 below), some apportioning of different sections of vehicles needs to be applied to different bogies to calculate proxy characteristics that can be used to calculate a reflective VUC rate using the VUC calculator.

Figure 3: Example of articulated train bogies for illustration.



- 6.3 An approved methodology for calculating proxy vehicle characteristics for articulated trains is contained in Appendix 2. Any operator requesting a new VUC rate for an articulated train should read Appendix 2 prior to submitting a pro forma to Network Rail. Alternatively, they should contact their customer account team for more information or arrange a meeting with Network Rail's Regulatory Economics / Technical Authority representatives.
- 6.4 **Please note** that operators applying for a new VUC rate for an articulated train are encouraged to calculate bespoke TGamma values (paragraph 11.30 and 11.50 for passenger and freight respectively) rather than using an existing curving class (paragraph 11.29 and 11.49 respectively). Due to the nuances of apportioning the vehicle, the number of axles may not correlate with the generic passenger curving classes in the calculator. A bespoke curving class will produce a more cost reflective VUC rate.
- 6.5 If Network Rail and the operator disagree on the most appropriate vehicle characteristics for an articulated train, then the operator shall be entitled to refer the matter to ORR for determination.

<sup>8</sup> See section 5 for more information on when averaging vehicle characteristics might be appropriate.



## 7 Freight services using passenger vehicles

- 7.1 Where a freight operator is using either, a re-purposed passenger vehicle or a vehicle whose design is based on a passenger vehicle to carry a commodity, due to systems limitations, when the train is being consisted, there may be no option to differentiate the state of the vehicle, i.e. whether it's laden or tare. In this scenario, the train will be consisted as 'tare'.
- 7.2 To ensure that the correct VUC rate is calculated to reflect the weight of the commodity the train is carrying, Network Rail will calculate a single 'tare' VUC rate based on the **average operating weight** of the vehicle(s) (**tare weight + average load weight**). The average operating weight should be calculated using a representative and proportionate data set and agreed between Network Rail and the operator.
- 7.3 The **average operating weight** will then be adjusted down to reflect the percentage of journeys that are truly tare i.e. where the vehicle is not carrying any cargo. Again, the percentage of journeys which are truly tare should be calculated using a representative and proportionate data set and agreed between Network Rail and the operator.
- 7.4 The **traffic-adjusted average load per vehicle (in tonnes)** will be calculated using the equation below:

$$\begin{aligned} \text{Traffic adjusted average load per vehicle (tonnes)} = \\ \text{percentage of total traffic that is loaded (i. e. not empty)} \\ \times \text{average weight of load per vehicle (tonnes)} \end{aligned}$$

- 7.5 The **traffic-adjusted average load per vehicle** is added to the true tare weight of the vehicle to generate the **average operating weight for the vehicle**. The freight VUC rate is then calculated using the **average operating weight for the vehicle**.
- 7.6 Both the tare and laden VUC rates will be published as the same rate. This will mitigate against a default rate being applied in any instances where the state of the vehicle has been manually altered in error.

### Ride Force Count Suspension Factor

- 7.7 For freight vehicles, there is a range of 'suspension (discount) factors' applicable according to the vehicle's suspension design, whereas passenger vehicles use one of only two values for the 'Track Ct factor' depending on whether the vehicle is a locomotive or coach/MU. A factor of 0.89 is applied for a coach/MU.
- 7.8 Because we need to calculate the VUC rate using the Official CP7 VUC Calculator for freight, the 'Track Ct factor' of 0.89 needs to be manually entered. See sections 11.54 to 11.56 for further details on how to do this.

## 8 Heritage Trains

- 8.1 Heritage train operators, North Yorkshire Moors Railway (NYMR) and the West Coast Railway Jacobite (Jacobite) services are subject to bespoke VUC rates set out in their respective sections of the CP7 Track Usage Price List.
- 8.2 If, during CP7, one of these operators starts operating a different type of rolling stock for which there is not already a rate published in the relevant section of the Track Usage Price List, the operator should contact Network Rail's Regulatory Economics team (see section 12) directly to calculate a new bespoke rate. These will be calculated on a case-by-case basis and will still require ORR consent.

## 9 VUC pro formas

- 9.1 The first step in the application of a new VUC rate is the completion, by the operator<sup>9</sup>, of a vehicle characteristic pro forma which sets out the vehicle characteristics that Network Rail needs to calculate the new VUC rate. There are two pro formas available for use by operators – a passenger pro forma and a freight pro forma. Both pro formas contain an introductory tab and glossary to guide the completion of the form are available to download from Network Rail’s website through the links below:
- a) Passenger pro forma [link](#); and
  - b) Freight pro forma [link](#).
- 9.2 Once complete, the operator sends the pro forma to Network Rail (via the customer account team) to review. If Network Rail agrees with the vehicle characteristics provided in the pro forma, it will then proceed to Step two of the application process (see section 2 ) and calculate the new VUC rate. However, if Network Rail and the operator cannot agree on the vehicle characteristics contained in the pro forma, then the operator shall be entitled to refer the matter to ORR for determination.
- 9.3 A detailed explanation of the different vehicle characteristics required for both passenger and freight can be found in section 11.**

### Passenger pro forma

- 9.4 The passenger vehicle characteristics pro forma provides the opportunity to supply vehicle characteristics for up to four vehicles / units in one form. If more than four units are required, the operator will need to complete two or more forms.
- 9.5 The vehicle characteristics required by the operator in the passenger pro forma are as follows:
- a) Vehicle class/name;
  - b) Vehicle code;
  - c) Vehicle type (locomotive, coach or Multiple Unit, and whether it is a motor or trailer);
  - d) Tare weight (tonnes);
  - e) Operating weight (tonnes, for modified vehicles);
  - f) Number of seats in the vehicle;
  - g) Maximum speed of the vehicle (mph);

---

<sup>9</sup> Operators often seek input from train manufacturers or suppliers, as interested parties / technical experts, to complete the pro forma.

- h) Route-based maximum speed OR average operating speed (mph)<sup>10</sup>;
- i) Number of axles;
- j) Unsprung mass (kg per axle); and
- k) Curving class.

9.6 The operator may apply for a new curving class, based on a set of user-defined TGamma values. There is an additional TGamma form within the pro forma that may be completed where required. See paragraph 11.30 for more details on the user-defined TGamma values.

9.7 The form also provides a space in which the operator may provide additional contextual commentary against the vehicle characteristics in the completed pro forma.

### Freight pro forma

9.8 The freight vehicle characteristics pro forma provides the opportunity to supply vehicle characteristics for a vehicle in the tare state, laden state, or both, in one form. The vehicle characteristics required by the operator in the freight pro forma are as follows:

- a) Vehicle class/name;
- b) Vehicle type (locomotive, wagon or Multiple Unit);
- c) Tare weight (tonnes, required if applying for tare or both);
- d) Operating weight (tonnes, required if applying for laden or both);
- e) Number of axles;
- f) Unsprung mass (kg per axle);
- g) Suspension type OR Ride Force Count (RFC) suspension (discount) factor; and
- h) Curving class.

9.9 The operator may apply for a new curving class, based on a set of user-defined TGamma values. There is an additional TGamma form within the pro forma that may be completed where required. See paragraph 11.50 for more details on the user-defined TGamma values.

9.10 The form also provides a space in which the operator may provide additional commentary against the vehicle characteristics in the completed pro forma.

---

<sup>10</sup> Only required if not using the operating speed derived from the maximum speed of the vehicle.

## 10 CP7 VUC Calculators & Ready Reckoner

### Official CP7 VUC Calculator

- 10.1 To calculate VUC rates that are not on the CP7 price list, as published on 20 December 2023 and indexed annually thereafter, we have developed the Official CP7 VUC Calculator. This is an excel spreadsheet-based tool which, when input with agreed / proposed vehicle characteristics, will calculate a new VUC rate, in 2023/24 prices, using the same methodology that underpins the published price list. This proposed rate can then be submitted to ORR for consent before it can be added to the CP7 Supplements Price List and input into the Track Access Billing System.
- 10.2 Operators can use the Official CP7 VUC Calculator to gain an understanding of a likely new VUC rate but, for audit and assurance purposes, Network Rail will calculate the new VUC rate that will be submitted to ORR, using the Official CP7 VUC Calculator with the agreed vehicle characteristics contained in the corresponding pro forma.
- 10.3 The Official CP7 VUC Calculator is available on our website [here](#).

### Unofficial CP7 VUC Calculator

- 10.4 An Unofficial version of the CP7 VUC Calculator which allows VUC rates to be calculated in current prices is also available on our website, however, this is provided for information only.

### Ready Reckoners

- 10.5 VUC 'Ready Reckoners' are also available on our website, which we have developed to help operators and train manufacturers test the effect of different vehicle characteristics / variables on the VUC rate. The passenger and freight VUC Ready Reckoners are provided for information only.

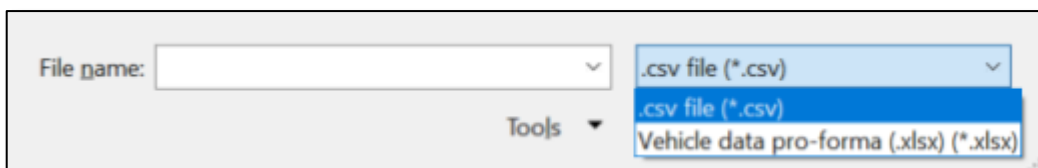
## 11 Using the Official CP7 VUC Calculator

11.1 The Official CP7 VUC calculator is used to calculate new passenger and freight VUC rates during CP7. It replicates the calculations<sup>11</sup> made in the CP7 VUC model used to recalibrate existing vehicle's VUC rates but does so on a case-by-case basis. As previously stated, where the operator and Network Rail agree on the vehicle characteristics being proposed for the new VUC rate, **Network Rail will calculate the new VUC rate for submission to ORR**, using the Official CP7 VUC Calculator. However, operators may wish to use either the Official VUC calculator or the Unofficial VUC Calculator themselves, at any point in the process, to gain an understanding of a likely new VUC rate being sought for a new or modified vehicle. The operator's calculation of the VUC can be submitted to Network Rail with the vehicle characteristics pro forma as supporting evidence.

### Importing vehicle characteristics

- 11.2 Previously, all vehicle characteristics had to be entered into the VUC calculators manually and this is still an option and explained from paragraph 11.6 for passenger VUCs and paragraph 11.35 for freight VUCs.
- 11.3 However, a new feature of the CP7 VUC Calculators is the ability to import vehicle characteristics directly from the pro forma<sup>12</sup>. This works for both passenger and freight vehicle characteristics. This feature is designed to be more user friendly and reduce scope for inputting errors. To import vehicle characteristics, click on the '**Import vehicle data**' button shown at the bottom of Figure 6. The Windows File Explorer window will open. At the bottom of the window, choose the '**Vehicle data pro-forma**' file extension format from the drop-down window on the right-hand side (shown in Figure 4) and then navigate to the saved location of the pro forma file as normal and click open.

Figure 4 – Choosing file extension for importing vehicle characteristics.

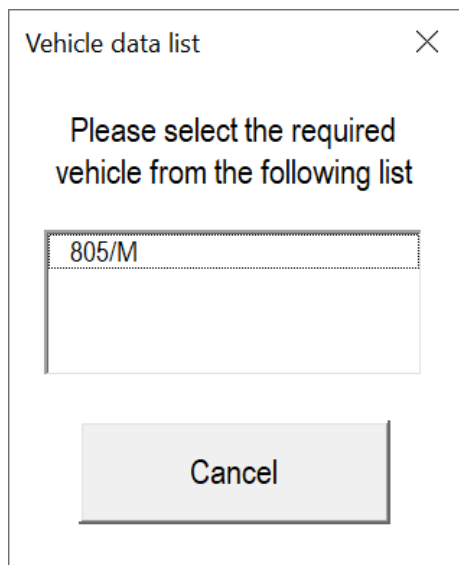


11.4 The next prompt will be to choose the vehicle being imported from the '**Vehicle data list**' window that appears (Figure 5). If more than one set of vehicle characteristics are contained in the pro forma, these will be shown in the list. Click on the required vehicle in the window. If the pro forma contains '**User-defined TGamma values**', then this window will automatically appear pre-populated. Click '**Done**'.

<sup>11</sup> Including phasing-in / capping policy in the case of freight vehicles.

<sup>12</sup> Or from previously exported vehicle characteristics (see paragraph 11.34).

Figure 5 – Vehicle data list.



Vehicle data list

Please select the required vehicle from the following list

805/M

Cancel

11.5 With the vehicle characteristics now imported from the pro forma, you can now calculate the VUC rate by clicking the '**Calculate VUC Rate**' button and follow the further steps laid out from paragraph 11.32 for passenger VUCs, and 11.58 for freight VUCs.

### Passenger vehicles

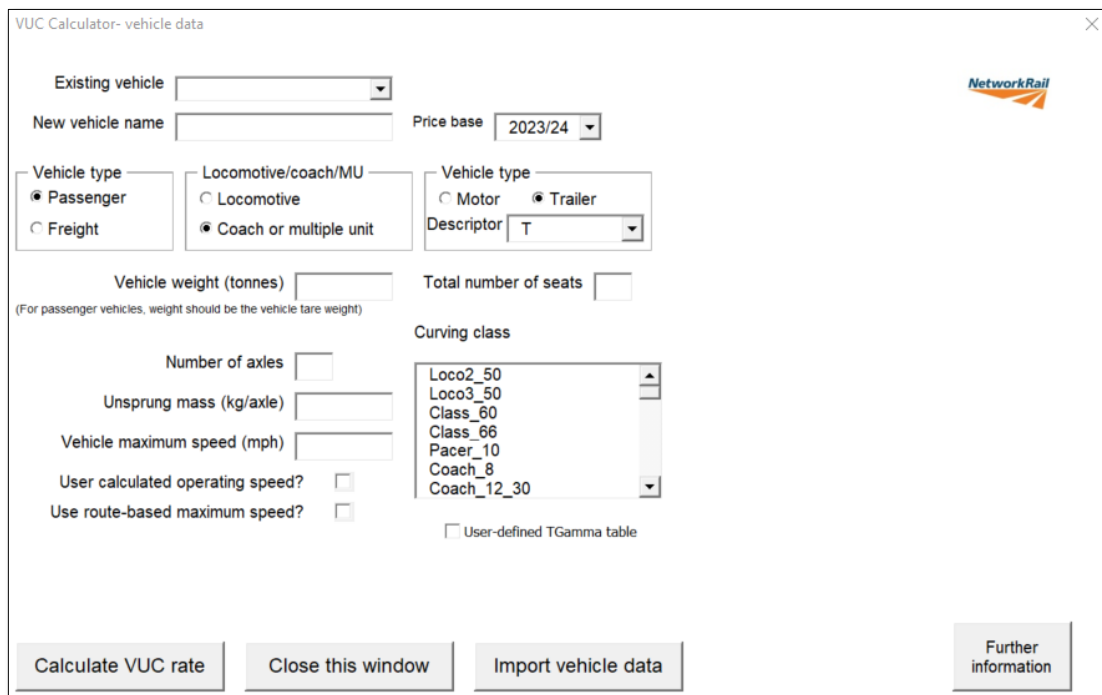
11.6 The following section explains how to use the CP7 VUC calculators<sup>13</sup> in detail to calculate new passenger VUC rates and the policy surrounding the vehicle characteristics which are used in the process.

11.7 Once the VUC calculator is opened in Excel, the window as shown in Figure 6 below should open automatically. This is the vehicle characteristics input screen.

---

<sup>13</sup> These apply to both the Official and Unofficial CP7 VUC calculators.

Figure 6 – VUC calculator passenger input screen.



## Vehicle type

11.8 Prior to calculating a passenger VUC rate, ensure that the ‘**Passenger**’ option is selected in the ‘**Vehicle type**’ box, so that the appropriate input fields are displayed.

## Existing vehicle

11.9 If you wish to calculate a VUC rate based on a vehicle type included on the CP7 VUC Track Usage Price List, it is possible to automatically populate all the input fields by selecting the existing vehicle type from the drop-down list. The vehicle characteristics can then be updated as required. This option would most likely be used when calculating a new VUC rate for a modified vehicle. **For the avoidance of doubt, the only parameters that should be changed are those that have changed directly because of the modification.** For example, if due to the modification the vehicle weight has changed then this is the only parameter that should be changed in the calculator. Please note that if an existing passenger coach or multiple unit is selected the ‘Total number of seats’ field will display a zero value. However, this is not because the vehicle is assumed to have zero seats, rather the weight associated with passenger loading (which is derived from the number of seats that the vehicle has) is already incorporated in the ‘**Vehicle weight**’ value for those vehicles on the published CP7 price list.

11.10 For the avoidance of doubt, where a vehicle has been modified a new vehicle subclass should be created, rather than a revised calculation of the original rate based on the new weighted average vehicle characteristics across the relevant fleet.



### New vehicle name

11.11 If a vehicle type is not selected from the existing vehicle drop down box, the name of the vehicle should be input into this field so that it is clear to which vehicle type the new rate would apply. Generally, passenger vehicles use the following naming convention:

- a) **Locomotive:** XX/X (e.g. 43/0);
- b) **Multiple Unit Motor:** XXX/M (e.g. 139/M);
- c) **Multiple Unit Trailer:** XXX/T (e.g. 315/T); or
- d) **Coach:** X (e.g. 1 for a Mk1 coach).

### Price base

11.12 The 'Price base' drop-down box should be used to select an appropriate price base. VUC rates increase annually for inflation and this functionality in the Unofficial CP7 VUC Calculator allows you to see the applicable VUC rate in either the current or previous years. However, new VUC rates being submitted to ORR for consent **must be submitted in the same contractual price base used for PR23, i.e. 2023/24 prices**. Therefore, the Official CP7 VUC Calculator only has the 2023/24 price base option.

### Motor / trailer

11.13 The appropriate option should be selected confirming for multiple units whether the vehicle is a motor or trailer vehicle. This selection does not impact the level of the VUC rate but clarifies whether the proposed rate will apply to the motor or trailer vehicle. Where vehicle characteristics differ substantially, there is the option of having more than one VUC rate for multiple unit motor / trailer vehicles within a vehicle class. For example, instead of having a single average rate for all Class 390 motor vehicles (a '390/M' rate), the operator may choose to have separate rates for the different variants of motor vehicle (e.g. a '390/M DMS' rate and a '390/M MS' rate), which should result in the same overall charge as the average motor rate.

11.14 If stakeholders wish to take advantage of this option, they can use the 'Descriptor' dropdown box to select the relevant motor or trailer descriptor, if available. The dropdown list includes a range of commonly used motor / trailer descriptors; however, the list is not meant to be exhaustive. If the required descriptor is not available, it can be manually entered in the 'New vehicle name' field.

11.15 However, it's Network Rail's preference to simplify VUC rates where possible and appropriate to do so, in agreement with the operator, as detailed in Section 5 - Averaging vehicle characteristics.

### Locomotive / coach or multiple unit

11.16 The appropriate option should be selected confirming whether the vehicle is a locomotive, coach or multiple unit.

## Number of axles

11.17 The number of axles that the vehicle has should be entered. Together with the vehicle weight, this value is used to calculate the average axle load of the vehicle. For articulated trains this is not straightforward, and users should refer to Appendix 2 detailing the methodology for calculating the vehicle characteristics of articulated trains for guidance or approach Network Rail's Regulatory Economics team for assistance.

## Vehicle weight

11.18 The weight of the vehicle in tonnes should be entered. This should be the tare weight of the vehicle in serviceable condition (i.e. the weight of the vehicle with no passengers). Where multiple variants of a vehicle type exist (and will be subject to the same new VUC rate) a weighted average of the vehicle weight should be calculated based on a typical train set formation. As noted, if an existing passenger coach or multiple unit is selected, this value will include passenger loading and the '**Total number of seats**' field will display a zero value.

## Total number of seats

11.19 The **total number** of passenger seats<sup>14</sup> in the vehicle should be entered here. Where multiple variants of a vehicle type exist that will be subject to the same new VUC rate, a weighted average of the number of seats should be calculated based on a typical train set formation (fractions of a seat are permissible). One wheelchair space should be counted as one seat.

11.20 For multiple units and coaches the VUC is calculated by using the weight of the vehicle with 50% of seats full (assuming 75kg per passenger). The calculator will therefore take the total number of seats entered, multiply it by 75kg and multiply by 50%, before adding it to the tare weight to determine the total vehicle weight for the VUC calculation.

11.21 As noted, if an existing passenger coach or multiple unit is selected, this field will display a zero value. This is not because the vehicle is assumed to have zero seats, rather the weight associated with passenger loading is included in the '**Vehicle weight**' value.

## Unsprung mass

11.22 The unsprung mass per axle should be entered into this field in kilograms. The unsprung mass is determined as the mass of equipment which is not separated from the track by the primary suspension and a proportion of any mass that is partially separated from the track by the primary suspension (e.g. bogie trailing arms and traction linkages). Therefore, the unsprung mass comprises the masses of the wheelset, axleboxes, brake gear, any axle-mounted gearbox or final drive, and any other equipment which may be mounted on the wheelset or axleboxes. If the unsprung mass is not the same for every axle, then it is permissible to take an

---

<sup>14</sup> For sleeper services, sleeping berths should be counted as seats.

average for that vehicle. For determining the unsprung mass of the wheelset, it is acceptable to calculate its mass with the wheel diameter halfway between the new and fully worn diameter.

### Maximum speed

11.23 The maximum speed of the vehicle type should be entered in miles per hour. If the ‘**user calculated**’ operating speed field is left blank, this maximum speed value will be converted into an ‘operating’ speed to be used for charging purposes using the standard formula<sup>15</sup>. The operating speed of a vehicle is a representative ‘average’ speed at which the vehicle type typically travels on the network and is used for charging purposes. The majority of vehicle operating speeds are calculated formulaically based on the vehicle’s maximum speed. The maximum speed entered should be the lowest of:

- a) the maximum speed specified when the vehicle type was built, if this continues to be a physical constraint which the vehicle type cannot exceed; or
- b) the maximum speed specified by the operator, assuming this is a physical constraint which the vehicle type cannot exceed.

11.24 For the avoidance of doubt, by physical constraint we mean a vehicle-based constraint which limits the maximum speed of the vehicle, irrespective of where it operates on the GB rail network.

### Route-based maximum speed

11.25 As an alternative to ‘**maximum speed**’, operators have the option, where circumstances permit, of opting for a ‘**Route-based maximum speed**’ where the speed is based on the maximum line speed of the routes over which a vehicle operates, rather than the maximum speed that the vehicle is capable of. Where different passenger operators operate the same vehicle class on different routes and are limited to different maximum line speeds, there is the option of having two (or more) separate VUC rates for the relevant vehicle class. Operators may wish to take advantage of this option if the maximum speed of the vehicle class that they operate exceeds the maximum line speed over the routes that the operator runs.

11.26 To enter a route-based maximum speed the user should tick the route-based maximum speed box and enter the relevant line speed value - the maximum line speed across all the routes over which it operates, this includes diversionary routes and routes used for empty coaching stock moves. If a route-based maximum speed is entered in this field this value will be used to calculate the vehicle operating speed using the standard formula, instead of the maximum speed described, above. This option is only available for new vehicles which are not on the original CP7 Track Usage Price List – it is not possible to re-open CP7 VUC rates which have already been determined (even if there are changes to line speeds during the control

---

<sup>15</sup> Operating speed =  $0.021 \times \text{Max. speed}^{1.71}$ . (e.g.  $55\text{mph} = 0.021 \times (100\text{mph})^{1.71}$ ).

period). To make this proposal workable we will need to apply the following charging principles:

- a) Each operator is only allowed one VUC rate per vehicle class because our billing system is not sophisticated enough to apply different rates when the same vehicle runs on different parts of the network.
- b) Where vehicles are loaned between train operators the obligation is on operators to inform us, otherwise the 'parent' rate would continue to apply. This is because our billing system attaches rates to vehicles, not operators.
- c) If vehicles were to be redeployed or cascaded to a different part of the network, with a different maximum line speed, again the onus is on operators to inform us otherwise the 'parent' rate would continue to apply.
- d) Where an operator has requested a lower VUC rate which reflects the maximum line speed on the relevant route, and that line speed is subsequently increased, it would be necessary to calculate an updated VUC rate for that vehicle class. This new rate would apply from the date that the line speed was increased.

### User calculated operating speed

11.27 If an operator considers that the standard formula (see footnote 8) used to estimate a vehicle's operating speed, based on either its maximum speed or the route-based line speed, gives rise to a result that is not a reasonable estimate of the vehicle's true operating speed it has the option to calculate an operating speed based on the published timetable. If an operating speed based on the timetable is entered into the user calculated operating speed field, this value will be used in the VUC calculation rather than the operating speed derived from the vehicle's maximum speed or the route-based maximum speed.

11.28 When calculating an operating speed based on the timetable, the operator should take a weighted average of the relevant journeys and exclude stopping time at stations. **If an operator wishes to use an operating speed based on its analysis of the timetable it should provide enough supporting information to Network Rail / ORR to demonstrate that this speed is appropriate.**

### Curving class

11.29 The specified '**Curving class**' is a way of categorising vehicles according to the rail surface damage (wear and rolling contact fatigue) that they generate. Operators have the option to calculate a bespoke curving class (see '**User-defined TGamma**', below). However, they also have the option to select the most appropriate generic curving class from the existing list in the calculator. If a generic curving class is selected from the list in the calculator, it is not necessary to complete the user-defined TGamma fields. The generic passenger curving classes in the calculator typically use the following naming convention "Coach\_XX\_YY", where "XX" is the primary yaw stiffness (in MNm/rad) and "YY" is the weight in tonnes. To determine

the nearest curving class for a vehicle both the primary yaw stiffness and vehicle weight should be rounded up.

### User-defined TGamma

11.30 Rather than specify one of the existing generic curving classes included in the calculator, there is an option to manually input bespoke TGamma values determined from vehicle dynamics modelling over a specified range of curves. To use these values, the '**User-defined TGamma table**' box should be selected and TGamma values for each axle and curve radii entered. This option supersedes the generic curving classes from the list provided in the calculator. Using TGamma values derived from vehicle dynamics modelling will result in a more cost-reflective VUC rate.

11.31 A guidance note can be downloaded from our website [here](#) setting out the process for conducting the vehicle dynamics modelling. Network Rail are happy to assist with this modelling should the operator require support.


### Calculating the VUC rate

11.32 Once the relevant vehicle characteristics set out in paragraphs 11.8 - 11.31 have been entered, the user should click the '**Calculate VUC rate**' button and a new passenger VUC rate, along with the vehicle characteristics used to underpin the calculation, will be calculated and displayed as shown in Figure 7 below.

Figure 7 – Example VUC calculator passenger output screen<sup>16</sup>.

**Official CP7 VUC Calculator** Passenger **Passenger vehicles**

*V8c: March 2024*



Vehicle data	
Vehicle name/class	805/M (Motor)
Vehicle type	Coach or Multiple Unit
Number of axles	4
Speed (max, mph)	125
Route speed (max, mph)	
Speed (operating, mph)	80.90 (Calculated)
Tare weight (t)	52.37 Seats 76
Operating weight (t)	55.22
Unsprung mass (kg)	1485
Curving class	User defined
Ct factor	0.89

Calculate another vehicle VUC rate

Export/save results

Calculated VUC		
2023/24 prices		
VUC	21.42	3.8784
	p/vm	£/kGTM
<b>VUC Breakdown</b>		
Track	12.57	2.2755
Structures	4.41	0.7981
Signals (variable)	0.36	0.0653
Signals (fixed)	0.28	0.0506
Surface damage	3.80	0.6889

User specified TGamma value for surface damage calculation				
	Axle			
Radius	1	2	3	4
200	249	33.1	214.9	62.9
400	110.3	7.5	92.8	15.2
600	63.3	5.6	61.7	12.5
800	40.1	3.9	32.6	6.5
1000	23.6	3.1	18.8	5.3
1200	14.3	2.8	11.4	4.2
1400	9.8	2.1	8	3
1800	5.7	1.2	4.7	1.7
2200	3.8	0.8	3.2	1.7
2600	2.8	1.1	2.3	1.3
3000	2.1	0.9	1.8	1.1
4000	1.3	0.8	1.1	0.9
6000	0.7	0.6	0.7	0.6
8000	0.6	0.5	0.6	0.6
10000	0.5	0.5	0.5	0.5

11.33 The calculated VUC rate is expressed in both pence per vehicle mile (p/vm) and £ per 1,000 gross tonne mile (£/kGTM). When submitting new passenger VUC rates to ORR for consent, it is the rate calculated in p/vm that should be submitted for **passenger vehicles**. This reflects how rates are shown in the passenger section of

<sup>16</sup> Please note that the vehicle characteristics used in this example are for illustrative purposes only and do not reflect the actual characteristics for this vehicle.

the Track Usage Price List. The equivalent rate shown in £/kGTM is not relevant to passenger operators, it is only applicable to freight operators who run passenger vehicles (e.g. for testing purposes). The VUC rates shown in both p/vm and £/kGTM are broken down by asset type for information only.

### Exporting and saving the results

11.34 A copy of the output screen should be appended to the submission to ORR (template letters discussed in more detailed in Appendix 1). The CP7 VUC Calculators now have the ability to export and save the results by clicking on the ‘**Export / save results**’ button. This will save both a pdf version and an excel output of the results (as a .csv file). These files will be saved to the same location as the CP7 VUC Calculator has been saved.

### Freight vehicles

11.35 The following section explains how to use the CP7 VUC calculators in detail to calculate new freight VUC rates and the policy surrounding the vehicle characteristics which are used in the process.

11.36 Once the VUC calculator is opened in Excel, the window as shown in Figure 8 below should open automatically. This is the vehicle characteristics input screen.

Figure 8 – Example VUC calculator freight input screen.

### Vehicle type

11.37 Prior to calculating a freight VUC rate, ensure that the ‘**Freight**’ option is selected in the ‘**Vehicle type**’ box, so that the appropriate input fields are displayed.

## Existing vehicle

- 11.38 If you wish to calculate a VUC rate for a vehicle type included on the CP7 VUC price list, it is possible to automatically populate all of the input fields by selecting an existing vehicle type and commodity from this drop-down list. To determine the VUC for an existing vehicle which has been modified it is possible to select the existing vehicle from this list and then change the appropriate parameters. **For the avoidance of doubt, the only parameters that should be changed are those that have changed directly because of the modification.** For example, if due to the modification the vehicle weight has changed then this is the only parameter that should be changed in the calculator.
- 11.39 For the avoidance of doubt, where a vehicle has been modified a new vehicle sub-class should be created, rather than a revised calculation of the original rate based on the new weighted average vehicle characteristics across the relevant fleet.

## New vehicle name

- 11.40 The name of the vehicle should be entered so that it is clear to which vehicle type the new rate will apply. Generally, freight vehicles use the following naming convention:
- Locomotive:** XX/X (e.g. 66/0);
  - Wagon (laden):** XXXX (L) (e.g. FRAA (L));
  - Tare Wagon (tare):** XXXX (T) (e.g. FRAA (T)); or
  - Coach:** X (e.g. 1 for a Mk1 coach).

Please note that if operators submit applications for freight wagons in the format XXX-X they will be renamed accordingly, removing the dash.

## Price base

- 11.41 The 'Price base' drop-down box should be used to select an appropriate price base. VUC rates increase annually for inflation and this functionality in the Unofficial CP7 VUC Calculator allows you to see the applicable VUC rate in either the current or previous years. However, new VUC rates being submitted to the ORR for consent **must be submitted in the same contractual price base used for PR23, i.e. 2023/24 prices.** Therefore, the Official CP7 VUC calculator only has the 2023/24 price base option.

## Locomotive / wagon

- 11.42 The 'Locomotive / wagon' option should be selected accordingly. If the locomotive option is selected the load condition and suspension band boxes will



disappear and be automatically populated by the model (a locomotive will always operate in a tare condition and attract a locomotive suspension band).

### Load condition

11.43 The '**Load condition**' option should be selected to confirm whether the rate being calculated will **apply** when the wagon is tare or laden. If both a tare and laden rate is required, the calculation process should be performed twice with appropriate input data. As noted above, this box will disappear if the locomotive option is selected.

### Number of axles

11.44 The '**Number of axles**' that the vehicle has should be input. Together with the '**Vehicle weight**' this value is used to calculate the average axle load of the vehicle.

### Vehicle weight

11.45 The '**Vehicle weight**', i.e. the operating weight of the vehicle, in tonnes, should be entered. The operating weight is the weight at which the vehicle will typically operate and thus could be less than the gross laden weight of a wagon. Ideally, for laden wagons, only one commodity should be requested / selected at a time. This produces the most cost reflective VUC rates and reduces the chance of over or under recovery. However, if the operator feels that the operating weights for more than one commodity are comparable, then more than one type can be selected and an average operating weight across the different commodities should be entered. The operator must provide evidence supporting the operating weight of the vehicle. This **evidence must be based on a proportionate sample** and should clearly articulate and include any calculations and assumptions used to calculate the operating weight.

11.46 Network Rail retains the right to reject applications using an average operating weight for more than one commodity if it feels that the average weight is likely to vary materially across the commodities.

11.47 If Network Rail and the operator fail to agree on operating weights, then the operator shall be entitled to refer the matter to ORR for determination.

### Unsprung mass

11.48 The '**Unsprung mass**' per axle should be entered in kilograms. The unsprung mass is determined as the mass of equipment which is not separated from the track by the primary suspension and a proportion of any mass that is partially separated from the track by the primary suspension (e.g. bogie trailing arms and traction linkages). Therefore, the unsprung mass comprises the masses of the wheelset, axleboxes, brake gear, and any other equipment which may be mounted on the wheelset or axleboxes. If the unsprung mass is not the same for every axle then it is permissible to take an average for that vehicle. For determining the unsprung mass of the wheelset it is acceptable to calculate its mass with the wheel diameter halfway between the new and fully worn diameters.

## Curving class

11.49 The specified '**Curving class**' is a way of categorising vehicles according to the rail surface damage (wear and rolling contact fatigue) that they generate. Operators have the option to calculate a bespoke curving class (see '**User-defined TGamma table**', below). However, there is also the option to select the most appropriate generic curving class from the existing list in the calculator. If a generic curving class is selected from the list in the calculator, it is not necessary to complete the '**User-defined TGamma**' fields. The generic freight curving classes in the calculator are based on the vehicle's suspension type (e.g. "Y25\_loaded" or "Y25\_empty").

## User-defined TGamma

11.50 Rather than specify one of the existing generic curving classes included in the calculator, there is an option to manually input bespoke TGamma values determined from vehicle dynamics modelling over a specified range of curves. To use these values, the '**User-defined TGamma table**' box should be selected and TGamma values for each axle and curve radii entered. This option supersedes the generic curving classes from the list provided in the calculator. Using TGamma values derived from vehicle dynamics modelling will result in a more cost-reflective VUC rate.

11.51 A guidance note can be downloaded from our website [here](#) setting out the process for conducting the vehicle dynamics modelling. Network Rail would also be happy to assist with this modelling if the operator considers that this would be help.

## Suspension band

11.52 The '**Suspension band**' reflects the suspension / bogie type of the wagon. Wagons with 'track friendly' suspensions / bogies will pay a lower VUC than wagons with those that impose higher forces on the track, all other things being equal. Only freight wagons registered in the Rolling Stock Library (RSL) prior to 1 April 2014, and not on the CP7 price list, have the option to select one of the existing suspension bands in the VUC calculator (0 – 7 from the drop-down list). For all other wagons, this part of the VUC calculation has been replaced by the Ride Force Count (RFC) methodology, described at paragraph 11.54.

11.53 Table 4 shows the relationship between the chosen Suspension band (Column 1) for a vehicle type and its corresponding suspension factor.

Table 4 – Suspension bands and corresponding suspension factor.

Suspension band	Vehicle type (long format)	Vehicle type (short format)	Suspension factor
0	Loco	Loco	1.000
1	4-wheel wagon - pedestal type suspension	2axle-1	1.098

Suspension band	Vehicle type (long format)	Vehicle type (short format)	Suspension factor
2	4-wheel wagon - leaf springs, friction damped	2axle-2	1.058
3	Bogie wagon - 3-piece bogie	3piece	1.018
4	Bogie wagon - enhanced 3-piece bogie e.g. “swing motion”, and parabolic 4-wheel wagon	NACO	0.978
5	Basic bogie wagon - primary springs, e.g. Y25	Y25-1	0.938
6	Bogie wagon - enhanced primary springs (low track force bogies, TF25, “axle motion” (like HV primary sprung bogies))	Y25-2	0.898
7	Bogie wagon - enhanced primary springs and steering	Steering	0.858
8	Loco	Loco	1.000

### Ride Force Count (RFC) suspension (discount) factor

- 11.54 The ‘Discount factor from Ride Force Count (RFC) calculation’ should be entered if a ‘Suspension band’ does **not** apply. The RFC is a metric developed in CP4 to provide a quantitative assessment of the ‘track friendliness’ of a wagon’s suspension / bogie type, following vehicle dynamics modelling. The methodology for estimating a freight wagon’s RFC value and the associated suspension (discount) factor is set out in a user guide available from our website [here](#).
- 11.55 The RFCpro software is required in order to calculate the RFC value from the results of vehicle dynamics modelling and can be downloaded from our website [here](#) along with the ‘Guide to calculating Ride Force Count April 2019’ RFCPro guidance document.
- 11.56 If the VUC rate being applied for by the freight operator (excluding hauling passenger stock for testing purposes) is for either, a re-purposed passenger vehicle or a vehicle whose design is based on a passenger vehicle, the RFC suspension (discount) factor should be set equal to 0.89 in the ‘Discount factor from Ride Force Count (RFC) calculation’ box in the VUC calculator and/or in the ‘RFC suspension factor’ input in the freight vehicle pro forma. In these instances, the suspension type should not be filled in.

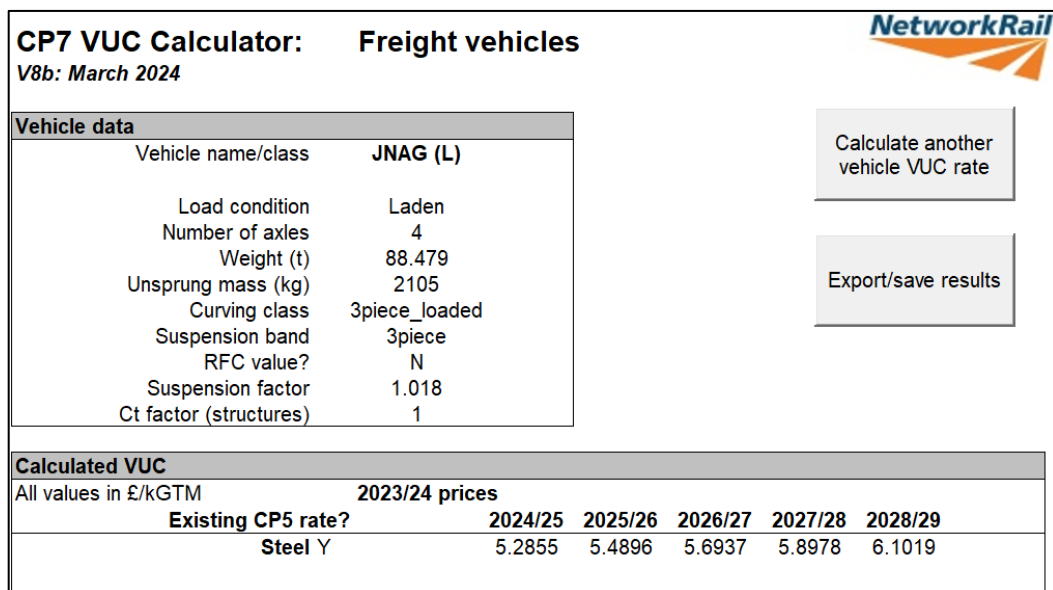
### Freight commodity

11.57 The commodity (or commodities) that require a VUC rate and for which the vehicle parameters that have been entered are applicable, should be selected from the ‘**Freight commodities**’ section. Multiple commodities can be selected where appropriate, for example a commonly used locomotive. However, if a vehicle can carry a range of commodities, and the laden weight of the vehicle varies materially for different commodities, then a separate calculation for each vehicle weight and pertinent commodity should be performed to calculate an appropriate VUC rate for each commodity.

### Calculating the VUC rate

11.58 Once the relevant vehicle characteristics set out in paragraphs 11.37 – 11.54 have been entered, the user should click the ‘**Calculate VUC rate**’ button and a new freight VUC rate, along with the vehicle characteristics used to underpin the calculation, will be calculated and displayed as shown in Figure 9 below.

Figure 9 – VUC calculator freight output screen.



Vehicle data	
Vehicle name/class	JNAG (L)
Load condition	Laden
Number of axles	4
Weight (t)	88.479
Unsprung mass (kg)	2105
Curving class	3piece_loaded
Suspension band	3piece
RFC value?	N
Suspension factor	1.018
Ct factor (structures)	1

Calculated VUC	
All values in £/kGTM	
	2023/24 prices
Existing CP5 rate?	2024/25 2025/26 2026/27 2027/28 2028/29
Steel Y	5.2855 5.4896 5.6937 5.8978 6.1019

11.59 The output screen shows:

- a) the new VUC rate(s) is calculated in £/kGTM and for each year of the control period to reflect the ORR’s determination to phase-in VUC rates for freight operators; and
- b) the vehicle characteristics used to underpin the VUC rates.

11.60 The “Existing CP6 rate?” flag on the output screen (see in Figure 7), above, next to the commodity type) indicates whether a VUC rate existed in CP6 for this vehicle/commodity combination. Where a “Y” is displayed in this field it indicates that a CP6 rate did exist for this vehicle/commodity combination and, therefore, the

vehicle characteristics underpinning the rate that has been calculated are the same as those underpinning the rate on the published price list. Therefore, one would expect the rate that has been calculated to be consistent with that set out on the published price list. If an “N” is displayed in this field, it indicates that a VUC rate did not exist for this vehicle/commodity combination in CP6.

### Exporting and saving the results

11.61 A copy of the output screen should be appended to the submission to ORR (template submission letters discussed in more detail in Appendix 1). The CP7 VUC Calculators now have the ability to export and save the results by clicking on the ‘**Export / save results**’ button. This will save both a pdf version and an excel output of the results (as a .csv file). These files will be saved to the same location as the CP7 VUC Calculator has been saved.

### Testing trains

11.62 If a freight operator runs a train designed for passenger use (e.g. for testing purposes) the VUC rate should be calculated using the passenger charging methodology, rather than the freight charging methodology. This means calculating the rate using the passenger part of the VUC calculator as described from paragraph 11.8. However, in this situation, the rate submitted to ORR for consent should be the rate expressed in £/kGTM on the passenger output sheet (not the rate expressed in p/vm which is normally used for passenger operators). The rate expressed in £/kGTM is equivalent to the rate expressed in p/vm and consistent with how VUC rates are shown in the freight section of the Track Usage Price List. Both freight and passenger VUC rates are initially calculated in £/kGTM, with the passenger p/vm rate calculated using a simple conversion.

## 12 Help with new VUC rates

12.1 We appreciate that there are many vehicle characteristics of a technical / engineering nature required to calculate a new VUC rate. We are happy to discuss any aspect of this document, or the process more generally with stakeholders. Please see Table 5 below which should guide you to the correct person in Network Rail to assist.

Table 5 – Network Rail contact details.

Contact name	Area of expertise	Contact details
<b>Track Access Billing Team</b>	Billing enquiries, inputting new rates, processing new bills.	<a href="mailto:TrackAccessBilling-Manchester@networkrail.co.uk">TrackAccessBilling-Manchester@networkrail.co.uk</a>
<b>Mark Burstow</b> Principal Vehicle Track Dynamics Engineer	Engineering and technical questions	<a href="mailto:mark.burstow@networkrail.co.uk">mark.burstow@networkrail.co.uk</a>
<b>Nicholas Prag</b> Regulatory Economics Manager	Calculation of new charges, policy and periodic review questions	<a href="mailto:nicholas.prag@networkrail.co.uk">nicholas.prag@networkrail.co.uk</a> 07515 625 961

## 13 Version Control

- 13.1 The date this document was published and its version number are shown on the cover page. This document is intended to be a 'living' document and updated from time to time so that it includes additional guidance, where appropriate, based on the industry's experience of the VUC rate calculation and approval process in CP7.
- 13.2 Table 6 below will be updated as required and detail the changes made with each iteration of this policy document.

Table 6 – Version control.

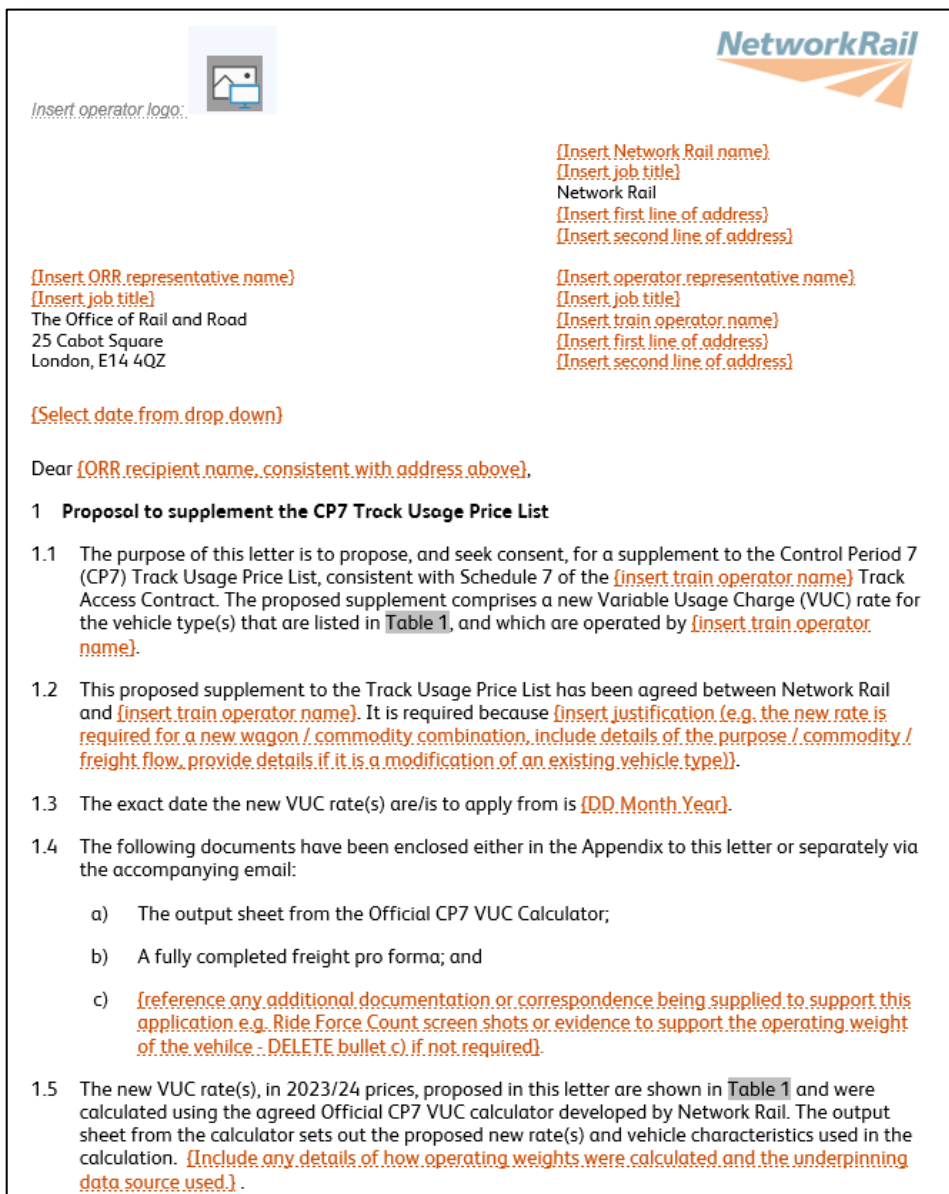
Version number	Description of change	Date of version
1	Original CP7 version	08 April 2024
2	Updates to reflect policy for freight services using passenger trains for transporting commodities plus other minor updates.	26 July 2024


## 14 Appendix 1 – VUC rate proposal letter

14.1 Once the new VUC rate has been calculated and agreed between Network Rail and the operator, a joint submission should be made in writing to the ORR requesting consent of this new rate. Separate template submission letters for freight and passenger applications can be downloaded from our website [here](#). The red text provides instruction and indicates the sections that need to be completed. Simply click anywhere on the red text and start typing. The template can be changed if required but it has been developed to make it easier for users to complete.

14.2 A screen shot of the first page of the freight template letter is shown in Figure 10 below.

Figure 10 – Screenshot of template new VUC letter to ORR



*Insert operator logo:* 

*Insert Network Rail name*  
*Insert job title*  
 Network Rail  
*Insert first line of address*  
*Insert second line of address*

*Insert ORR representative name*  
*Insert job title*  
 The Office of Rail and Road  
 25 Cabot Square  
 London, E14 4QZ

*Insert operator representative name*  
*Insert job title*  
*Insert train operator name*  
*Insert first line of address*  
*Insert second line of address*

*[Select date from drop down]*

Dear *[ORR recipient name, consistent with address above]*,

**1 Proposal to supplement the CP7 Track Usage Price List**

1.1 The purpose of this letter is to propose, and seek consent, for a supplement to the Control Period 7 (CP7) Track Usage Price List, consistent with Schedule 7 of the *[insert train operator name]* Track Access Contract. The proposed supplement comprises a new Variable Usage Charge (VUC) rate for the vehicle type(s) that are listed in **Table 1**, and which are operated by *[insert train operator name]*.

1.2 This proposed supplement to the Track Usage Price List has been agreed between Network Rail and *[insert train operator name]*. It is required because *[insert justification (e.g. the new rate is required for a new wagon / commodity combination, include details of the purpose / commodity / freight flow, provide details if it is a modification of an existing vehicle type)]*.

1.3 The exact date the new VUC rate(s) are/is to apply from is *[DD Month Year]*.

1.4 The following documents have been enclosed either in the Appendix to this letter or separately via the accompanying email:

- The output sheet from the Official CP7 VUC Calculator;
- A fully completed freight pro forma; and
- [reference any additional documentation or correspondence being supplied to support this application e.g. Ride Force Count screen shots or evidence to support the operating weight of the vehicle - DELETE bullet c) if not required]*.

1.5 The new VUC rate(s), in 2023/24 prices, proposed in this letter are shown in **Table 1** and were calculated using the agreed Official CP7 VUC calculator developed by Network Rail. The output sheet from the calculator sets out the proposed new rate(s) and vehicle characteristics used in the calculation. *[Include any details of how operating weights were calculated and the underpinning data source used.]*



## 15 Appendix 2 – VUC calculation methodology for articulated units

**Dr Mark Burstow**  
**Principal Vehicle Track Dynamics Engineer**

### A.01 Methodology

These guidelines follow from those applied for determining the VUC rate for the Class 373 Eurostar (from 'Eurostar VUC v3.pdf', August 2013), which was the first train with articulated bogie designs for which a VUC rate was required.

To be able to set the VUC for a multiple unit there must be an individual rate for each vehicle as seen by the billing system (TABS). This means that a rate needs to be determined for each vehicle body in a multiple unit.

In the case of articulated trains, where some of the bogies in a unit will be shared between two adjacent vehicles, some apportioning of different sections of vehicles needs to be applied to different bogies. For example, where a motor vehicle has a motor bogie at one end and an articulated trailer bogie at the other, the motor vehicle can be considered to consist of the mass carried by the motor bogie, and the portion of the mass of that vehicle which is carried by the trailer bogie can be added to the mass of the trailer vehicles and its bogies. The average mass of a motor 'vehicle' and the average mass of a trailer 'vehicle' can then be determined.

The average number of axles within each vehicle type will also need to be determined: the number of axles over which the total mass of that vehicle type is carried. Within the VUC calculator it is permissible to have a 'non-integer' number of axles in a vehicle. Although this does not make the vehicle look realistic as a stand-alone vehicle, it is permissible so that the total number of axles in a train can be correctly apportioned.

The unsprung mass specified in the VUC calculation is the unsprung mass for a single axle. This mass should not, therefore, be changed when the average number of axles in a vehicle is calculated.

To simplify the VUC where possible, the minimum number of vehicle rates should be used. Ideally, this will result in a multiple unit consisting of rates set for one motor and (possibly) one trailer vehicle. However, if there are significant differences between the characteristics of different vehicles of the same type (for example, some trailer bogies within a unit may have a significantly different axleload or unsprung mass from some others) it is possible to generate 2 different VUCs for different (for example) trailer vehicles. (The non-linearity in the relationship between axleload and infrastructure wear and tear, and therefore cost, means that averaging data over too wide a range will not be cost-reflective).

The pre-determined list of curving classes is described by a combination of the primary yaw stiffness for each axle and the vehicle mass (e.g. 'Coach\_16\_40' applies to a vehicle with a primary yaw stiffness of up to 16 MNm/rad and a mass of up to 40 t). If the curving class is to be selected from the pre-determined list of curving classes then the

vehicle mass element of the curving class applies to the vehicle as if it had 4 axles (i.e. the vehicle has an axleload one quarter of that referred to in the name of the curving class). For example, if a particular vehicle has an average mass of 25 t and an average of 2.5 axles (because some of the bogies are articulated), and therefore a 10 t axleload, the curving class used should be that for a 40 t 4-axle vehicle (which would also have a 10 t axleload).

So, overall:

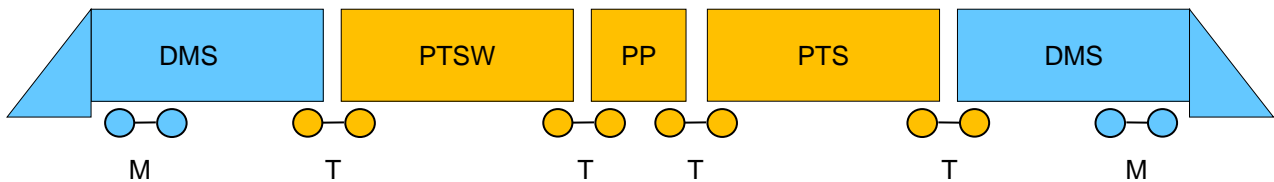
- A VUC rate needs to be set for each vehicle body in a multiple unit;
- The total number of axles for each vehicle in the VUC calculator should equal the total number of axles in the train;
- The total mass specified for each vehicle in the VUC calculator should equal the total mass of the train;
- When calculating averages for each vehicle it is permissible to have a 'non-integer' number of axles for each vehicle;
- The curving class selected for the vehicle must be the one that would be appropriate if the same axleload were carried on a 4-axle vehicle.

A.02 New vehicle calculations

1. Class 755/4

Basic vehicle data, supplied by Stadler in documents 190415\_Stadler BMU4 Methodology.pdf and 129869 Class 755-4, BMU4-R.pdf.

Vehicle	DMS		PTSW		PP		PTS		DMS			
Bogie	1 (M)		2 (T)		3 (T)		4 (T)		5 (T)		6 (M)	
Axles	2		2		2		2		2		2	
Axleload (t)	14.851	14.869	12.252	12.353	14.33	14.47	13.736	13.87	11.307	11.43	14.691	14.957
Seats	16		60		8		22		72		24	
Tip-up seats	12		2		5		4		0		4	
Unsprung mass (kg)	1956	1956	1359	1359	1359	1359	1359	1359	1359	1359	1956	1956
Curving class	HB_60		HB_50		HB_50		HB_50		HB_50		HB_60	



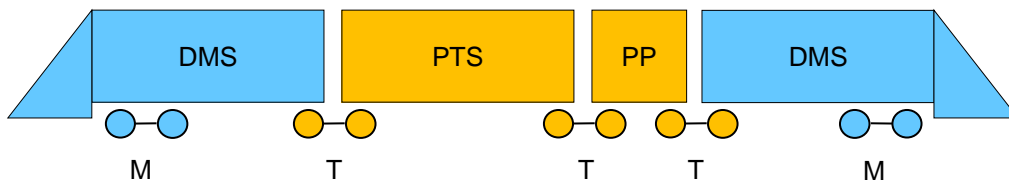
Data converted to 5-vehicles

Vehicle	DMS M	PTSW T	PP T	PTS T	DMS M	Total
Av. Axles	2	2.67			2	12
Average Vehicle mass (t)	29.684	34.583			29.684	163.117
Av. Seats (incl. tip-up)	28	58			28	230
Unsprung mass (kg)	1956	1359			1956	
Curving class	HB_60	HB_50			HB_50	
Notes	Average of bogie 1 and bogie 6	Average = sum of bogies 2 to 5, divided over 3-vehicles			Average of bogie 1 and bogie 6	
VUC (p/vm) 2017/18 prices	9.37	8.99	8.99	8.99	9.37	45.71

## 2. Class 755/3

Basic vehicle data, supplied by Stadler in documents 210127\_Stadler BMU3 Methodology+NR.pptx.

Vehicle	DMS		PTS		PP		DMS			
Bogie	1 (M)		2 (T)		3 (T)		4 (T)			
Axles	2		2		2		2			
Axleload (t)	14.720	14.746	12.079	12.107	12.184	12.210	12.776	12.971	14.556	14.811
Seats	16		60		8		36		24	
Tip-up seats	12		2		5		0		4	
Unsprung mass (kg)	1956	1956	1359	1359	1359	1359	1359	1359	1956	1956
Curving class	HB_60		HB_50		HB_50		HB_50		HB_60	



Data converted to 4-vehicles

Vehicle	DMS M	PTS T	PP T	DMS M	Total
Av. Axles	2	3		2	10
Average Vehicle mass (t)	29.417	37.164		29.417	133.162
Av. Seats (incl. tip-up)	28	56		28	168
Unsprung mass (kg)	1956	1359		1956	
Curving class	HB_60	HB_50		HB_60	
Notes	Average of bogie 1 and bogie 5	Average = sum of bogies 2 to 4, divided over 2-vehicles		Average of bogie 1 and bogie 5	
VUC (p/vm) 2017/18 prices	9.20	8.99	8.99	9.20	36.38

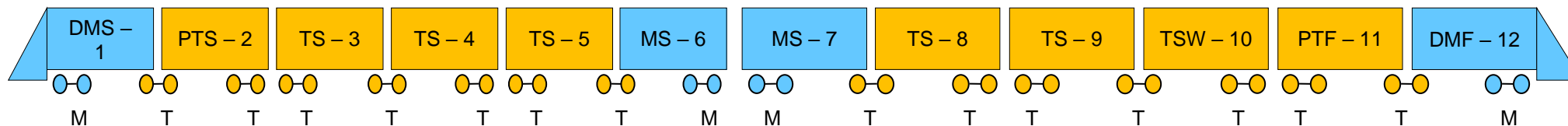


### 3. Class 745/0

Basic vehicle data, supplied by Stadler in documents *191010\_Stadler EMU IC Methodology.pdf*.

Vehicle	DMS - 1		PTS - 2				TS - 3		TS - 4		TS - 5				MS - 6			
Bogie	1 (M)		2 (T)		3 (T)		4 (T)		5 (T)		6 (T)		7 (T)		8 (T)		9 (M)	
Axles	2		2		2		2		2		2		2		2		2	
Axleload (t)	14.915	14.800	11.560	11.533	9.063	9.080	8.548	8.550	9.835	9.820	8.465	8.490	8.480	8.478	11.680	11.690	12.880	12.908
Seats	22		62		44		42		64		42		44		68		16	
Tip-up seats	4		4		0		0		8		0		0		4		4	
Unsprung mass (kg)	1956	1956	1359	1359	1353	1353	1353	1353	1359	1359	1353	1353	1353	1353	1359	1359	1956	1956
Curving class	HB_60		HB_50		HB_40		HB_40		HB_40		HB_40		HB_40		HB_50		HB_60	

Vehicle	MS - 7		TS - 8				TS - 9		TSW - 10		PTF - 11				DMF - 12			
Bogie	10 (M)		11 (T)		12 (T)		13 (T)		14 (T)		15 (T)		16 (T)		17 (T)		18 (M)	
Axles	2		2		2		2		2		2		2		2		2	
Axleload (t)	12.995	12.975	11.695	11.678	8.495	8.513	8.433	8.428	9.958	9.928	8.533	8.578	9.120	9.115	11.618	11.638	14.813	14.945
Seats	16		68		44		42		34		16		29		34		17	
Tip-up seats	4		4		0		0		18		3		0		0		0	
Unsprung mass (kg)	1956	1956	1359	1359	1353	1353	1353	1353	1359	1359	1353	1353	1353	1353	1359	1359	1956	1956
Curving class	HB_60		HB_50		HB_40		HB_40		HB_40		HB_40		HB_40		HB_50		HB_60	





Data converted to 12 vehicles (4 Motor, 8 Trailer)

Vehicle	DMS M	PTS T	TS T	TS T	TS T	MS M	MS M	TS T	TS T	TSW T	PTF T	DMF M	Total
Av. Axles	2	3.5				2		3.5				2	36
Average Vehicle mass (t)	27.808	33.875				27.808		33.875				27.808	382.3
Av. Seats (incl. tip-up)	21	84				21		84				21	756
Unsprung mass (kg)	1956	1356				1956		1356				1956	
Curving class	HB_60	HB_40				HB_60		HB_40				HB_60	
Notes	Average of bogies 1, 9, 10 and 18	Average = sum of bogies 2 to 8 and 11 to 17, divided over 8-vehicles				Average of bogies 1, 9, 10 and 18		Average = sum of bogies 2 to 8 and 11 to 17, divided over 8-vehicle				Average of bogies 1, 9, 10 and 18	
VUC (p/vm) 2017/18 prices	8.13	7.26	7.26	7.26	7.26	8.13	8.13	7.26	7.26	7.26	7.26	8.13	90.60

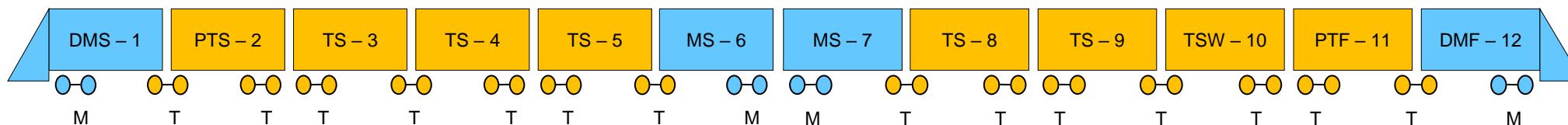
4. Class 745/1

Basic vehicle data, supplied by Stadler in documents 20210127\_Stadler EMU AIR Methodology\_NR.pptx.

Vehicle	DMS - 1		PTS - 2		TS - 3		TS - 4		TS - 5		MS - 6							
Bogie	1 (M)		2 (T)		3 (T)		4 (T)		5 (T)		8 (T)		9 (M)					
Axles	2		2		2		2		2		2		2					
Axleload (t)	14.298	14.260	11.435	11.395	8.758	8.763	8.413	8.388	10.108	10.118	8.348	8.353	8.550	8.518	11.488	11.508	13.418	13.440
Seats	12		62		42		40		48		40		42		66		16	
Tip-up seats	6		0		0		0		16		0		0		0		0	
Unsprung mass (kg)	1956	1956	1359	1359	1353	1353	1353	1353	1359	1359	1353	1353	1353	1353	1359	1359	1956	1956
Curving class	HB_60		HB_50		HB_40		HB_40		HB_40		HB_40		HB_40		HB_50		HB_60	

Vehicle	MS - 7		TS - 8		TS - 9		TSW - 10		PTF - 11		DMF - 12							
Bogie	10 (M)		11 (T)		12 (T)		13 (T)		14 (T)		15 (T)		16 (T)		17 (T)		18 (M)	
Axles	2		2		2		2		2		2		2		2		2	
Axleload (t)	12.818	12.800	11.538	11.528	8.398	8.405	8.330	8.308	9.793	9.765	8.398	8.413	8.950	8.938	11.335	11.363	14.713	14.835
Seats	16		66		42		40		34		40		42		62		12	
Tip-up seats	0		0		0		0		14		3		0		0		6	
Unsprung mass (kg)	1956	1956	1359	1359	1353	1353	1353	1353	1359	1359	1353	1353	1353	1353	1359	1359	1956	1956
Curving class	HB_60		HB_50		HB_40		HB_40		HB_40		HB_40		HB_40		HB_50		HB_60	

Data converted to 12 vehicles (4 Motor, 8 Trailer)



## Data converted to 12 vehicles (4 Motor, 8 Trailer)

Vehicle	DMS M	PTS T	TS T	TS T	TS T	MS M	MS M	TS T	TS T	TSW T	PTF T	DMF M	Total
Av. Axles	2	3.5				2		3.5				2	36
Average Vehicle mass (t)	27.646	33.451				27.646		33.451				27.646	378.2
Av. Seats (incl. tip-up)	17	87				17		87				17	764
Unsprung mass (kg)	1956	1356				1956		1356				1956	
Curving class	HB_60	HB_40				HB_60		HB_40				HB_60	
Notes	Average of bogies 1, 9, 10 and 18	Average = sum of bogies 2 to 8 and 11 to 17, divided over 8-vehicles				Average of bogies 1, 9, 10 and 18		Average = sum of bogies 2 to 8 and 11 to 17, divided over 8-vehicle				Average of bogies 1, 9, 10 and 18	
VUC (p/vm) 2017/18 prices	7.96	7.17	7.17	7.17	7.17	7.96	7.96	7.17	7.17	7.17	7.17	7.96	89.20

End