



Development of an approach for estimating the pollutant emissions from road transport at a street level

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Michel André, Nadine Adra, Catherine Fantozzi. Development of an approach for estimating the pollutant emissions from road transport at a street level. INRETS-LTE 0628, Ifsttar. 2006. <hal-04618498>

HAL Id: hal-04618498

<https://hal.science/hal-04618498v1>

Submitted on 20 Jun 2024

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**INSTITUT NATIONAL DE RECHERCHE
SUR LES TRANSPORTS ET LEUR SECURITE**

*Michel ANDRÉ,
Catherine FANTOZZI,
Nadine ADRA*

*Development of an approach for
estimating the pollutant emissions
from road transport at a street level*

*ARTEMIS - Assessment and reliability of transport
emission models and inventory systems*

*Report INRETS-LTE 0628
July 2006*



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- *Project funded by the European Commission within the 5th Framework Research Programme*
- *DG TREN Contract N° 1999-RD.10429* *(ref INRETS: C00-23)*

COST346 Action: Emissions and fuel consumption from heavy duty vehicles

*Report INRETS-LTE 0628
July 2006*

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Acknowledgements : these works were possible thanks to :

- *the financial support by the European Commission*
- *the support of INFRAS (Switzerland), VTI (Sweden), University of Lund (Sweden), who contributed to these works and more generally of the partners from the ARTEMIS research project and from the COST346 research action.*

Fiche bibliographique

1 UR (1er auteur) LTE, Laboratoire Transports et Environnement		2 Projet n°		3 Rapport INRETS n° <i>Report INRETS-LTE 0628</i>	
4 Titre: Development of an approach for estimating the pollutant emissions from road transport at a street level					
5 Sous-titre				6 Langue E	
7 Auteur(s) Michel ANDRÉ, Catherine FANTOZZI, Nadine ADRA				8 Rattachement ext.	
9 Nom adresse financeur, co-éditeur				10 N° contrats, conv.	
				11 Date de publication July 2006	
12 Remarques					
13 Résumé L'estimation des émissions de polluant du transport routier est nécessaire à l'échelle locale pour des inventaires détaillés et études d'impact. Dans le cadre des projets ARTEMIS et COST346, une approche a été élaborée pour cette échelle. Ceci implique la définition d'une structure en « situations de trafic » (configuration routière et condition de trafic). Cette structure est envisagée à partir de l'analyse des pratiques européennes. Elle s'appuie principalement sur la fonction (transit, distribution, accès) et la hiérarchisation des réseaux mise en œuvre pour gérer le trafic. Les caractéristiques routières (nombre de voies, vitesse limite, etc.) sont analysées et intégrées dans le schéma. La différenciation urbain / rural repose sur le concept d'entité fonctionnelle urbaine, qui génère et gère le trafic selon son organisation. On propose une définition des conditions de trafic en 4 classes (du trafic congestionné au trafic fluide), ainsi qu'une prise en compte qualitative de la topographie et sinuosité routière. A côté de ces aspects structurels, orientés délibérément vers les utilisateurs potentiels des outils d'estimation des émissions, l'approche nécessite également des facteurs d'émissions appropriés et des données de « conduite » (vitesses, distribution du kilométrage selon les situations de trafic). Un recueil de données existantes de vitesse des voitures particulières est organisé, ainsi qu'une expérimentation spécifique. Ces données sont analysées et affectées aux différentes situations de trafic. Parallèlement on développe une approche de calcul des émissions des voitures à partir des données d'émissions de la base de données ARTEMIS, qui sont au préalable analysées selon 15 conditions types de conduite. Cette cartographie des émissions et conditions de circulation est utilisée comme base pour calculer les émissions d'une situation de trafic, par une combinaison linéaire entre la courbe de vitesse représentative de cette situation et les conditions types les plus proches (proximité en terme de cinématiques). On récapitule les principes et hypothèses de l'approche, décrit l'élaboration du schéma en situations de trafic et le processus qui a permis d'affecter des courbes de vitesse à chaque situation. On décrit finalement le processus de calcul des émissions de polluants des voitures particulières et la mise en œuvre de l'approche quant à la distribution du kilométrage pour l'estimation des émissions à une échelle nationale. Cette approche, rigoureuse quant à son élaboration, nécessite une validation entre les catégories de véhicules. Les jeux de données de vitesse représentatives de chacune des situations en sont certainement le point faible, et il conviendra de les améliorer (recueil de données).					
14 Mots clés Réseau routier, trafic, vitesse, véhicule routier, voitures, émissions de polluant, estimation, modélisation			15 Diffusion libre		
16 Nombre de pages 153 pages	17 Prix — — — — F	18 Confidentiel jusqu'au		19 Bibliographie oui	

ISBN: INRETS/RR/06-536-ENG

Publication data form

1 UR (1st author) Transport and Environment Laboratory		2 Project n°		3 INRETS report n° <i>Report INRETS-LTE 0628</i>	
4 Title: Development of an approach for estimating the pollutant emissions from road transport at a street level					
5 Subtitle				6 Language E	
7 Author(s) Michel ANDRÉ, Catherine FANTOZZI, Nadine ADRA				8 Affiliation	
9 Sponsor, co-editor, name and address				10 Contract, conv. n°	
				11 Publication date July 2006	
12 Notes					
13 Summary The estimation of the pollutant emissions from the road transport is needed at low spatial scale to enable detailed inventories or impact studies. In the frame of the ARTEMIS and COST346 European research projects, a modelling approach was designed for this scale. This implies the definition a structure in “Traffic Situations” (road configurations and traffic conditions). This structure was built-up through the analysis of the European practices of traffic and transport management. It relies on the road function (through-traffic, distribution, access) and on the road network hierarchical organisation, usually implemented to manage the traffic and transport. The road characteristics (number of lanes, speed limit, etc.) were also analysed and considered as complementary parameters. The urban / rural definition relies on the concept of Urban Functional Entity (i.e. the entity that generates and manages the traffic according to its own functioning and activities). A definition of the traffic conditions into 4 classes was also elaborated as well as a qualitative taking into account of the road topography (gradient) and sinuosity. Apart from these structural aspects, deliberately oriented to the potential users of the emission estimation tools, the approach requires appropriated emissions and driving related data (speeds and mileage distribution according to the traffic situations). A collection of the existing car speed data was conducted as well as a specific experimentation (instrumented cars). These data were analysed and affected to the different traffic situations. In parallel, an approach for the estimation of the car pollutant emissions was built-up. That approach relied on the ARTEMIS emissions database. The emissions data were analysed as regards 15 reference tests patterns. The resulting emission cartography is used as a basis to compute the emissions for a given traffic situation, through a linear combination between its representative speed curve and the closest test patterns (the proximity being defined in term of kinematic). We recapitulate the principles and assumptions of the traffic situation approach. We describe then the elaboration of the traffic situation scheme and the process that was conducted to collect and affect the representative speed curves to each traffic situation. We highlight then the cars emission calculation process and the implementation of the whole approach with respect to the mileage distribution for an estimation at a national level. The overall approach although rigorous with respect to its elaboration requires a validation between the vehicle categories. The speed datasets (for each traffic situation) are certainly the weak point and should be improved through data collection.					
14 Key Words Road network, traffic condition, speed, road vehicle, passenger cars, pollutant emission estimation, modelling			15 Distribution statement free		
16 Nb of pages 153 pages	17 Price — — — — F	18 Declassification date	19 Bibliography yes		

ISBN: INRETS/RR/06-536-ENG

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Introduction

More and more, the estimation of the pollutant emissions from the road transport is needed at a low spatial scale (i.e. in one street, as a function of the traffic conditions), to enable detailed inventories or impact studies. Indeed pollutant emissions are generally quite sensitive to different "traffic situations", as the encountered driving conditions that govern to a large extent the emissions significantly vary. Furthermore the emission problem varies from the both points of view of the traffic conditions and of the population exposure according to the spatial context (urban areas with exposed population, rural areas, etc.). The existing emission estimation tools were however not always ready, nor designed for such a low scale usage. In the previous European approaches for estimating the pollutant emissions (COPERT / MEET¹ / COST319², Hickman et al. 1999, Joumard et al. 1999), we had the trivial structure in urban, rural and motorway traffic situations. This structure was considered in certain application cases as "not detailed enough". A more detailed structure was envisaged in the Handbook approach (Switzerland - Keller et al. 1995, Germany, Austria) that considered the traffic situation as a combination of road and traffic parameters.

In the frame of ARTEMIS³ and of COST346⁴ projects, which intended at renewing the European emission estimation tools, it was quite early considered that an approach at a sufficiently low scale (i.e. at the street level) was necessary and requested by the users. Such an approach was called a "traffic situation approach".

However, such an approach has different implications that are not so easy to handle:

- It is first necessary to develop a structure in traffic situations. Furthermore, this structure should be coherent and have a common meaning across the different countries, and the different users. Such a structure should be preferably close to the existing ones that are usually implemented by the transport or traffic engineers.
- It is then necessary to be able to estimate the pollutant emissions for each of these newly defined traffic situations. The simplest way would rely on a characterization of the driving conditions encountered within the traffic situations, and on mathematical links between pollutant emissions and driving characteristics. However, such links are not so obvious up

¹ MEET: Methodologies for estimating the emission from transport. Project funded by the European Commission within the 5th Framework Research Programme, DG TREN.

² COST319: Transport and pollutant emissions. COST action. European Cooperation in the Field of Scientific and Technical Research.

³ ARTEMIS: Assessment and reliability of transport emission models and inventory systems. Project funded by the European Commission within the 5th Framework Research Programme, DG TREN.

⁴ COST346: Emissions and Fuel Consumption from Heavy Duty Vehicles. European Cooperation in the Field of Scientific and Technical Research.

to now. Apart from a simple dependency between emission and average speed, no clear relation implying other kinematic parameters has been established.

- Furthermore, such a detailed structure should imply certainly a large need of data (driving data for each of the situations and distribution of the mileage for a real application), that is not necessarily available today and that can hardly be measured within the frame of the Artemis project.
- Finally we should also consider the implication of such approach as regards the outputs (that should be discrete while they were continuous with a function of the speed) and the easiness or difficulty to implement it from the user side (need of input data, etc.).

Preliminary works have been conducted (Poize 2002, André et al., 2002), which examined first the modelling approach, structure and implications, and the user point of view. A draft structure into traffic situations was then elaborated, relying on the current classifications of roads and traffic in Europe. The road function appeared as a crucial parameters for defining traffic situations. These works were followed by several discussions and debates, and by numerous exchanges and comments around this question. However, the resulting scheme (COST346 Traffic situation scheme, Keller et al. 2003) was finally uncompleted as regards certain parameters (sinuosity, gradient, etc.) and not definitive regarding the road configuration.

Important works have then been undertaken that have enable first:

- The confirmation of the principles of a traffic situation scheme based on the road function and characteristics, through complementary investigations and contacts with traffic engineers,
- The definitive setting-up of a satisfying structure,
- The investigation on the complementary parameters (traffic conditions, sinuosity, gradient, speed limits) considering the actual data and practices throughout Europe.

Apart from these “structural” aspects, deliberately oriented to the actual transport and traffic related practices and to the potential users of the emissions estimation tools, the approach requires appropriate emissions and driving related data. A whole approach of estimating the emissions for each traffic situation has been thus designed. In parallel, a synthesis of the speed information and statistics throughout Europe was conducted, and a collection of the available data (speed versus time recording) was initiated in order to get the data needed by the approach.

For the passenger cars, an emissions estimation approach was developed using the properties of the Artemis driving cycles (André, 2004), i.e. their construction and structure in sub-cycles, according to representative driving patterns.

In this report, we recapitulate first the principles and assumptions behind the traffic situation approach. We describe then the elaboration of the traffic situation scheme in the following of the preliminary works. We examine then the process to collect and affect the representative speed curves to each traffic situations. We describe and highlight the process of emission calculation in the case of the passenger cars. We finally examine how the mileage distribution can be estimated in a practical case such as a national estimation.

1. A traffic situation approach to estimate emissions – implications and initial works

The need of emission estimation at a quite low level of definition (i.e. in one street) is mainly justified for local impact study as well as for macroscopic studies that start from a street-by-street basis (for instance the studies based on a road network knowledge and on a traffic simulation model). We examine hereafter the various difficulties and implications of such an approach.

In a simplified way, we could say that a traffic situation approach requires:

- the setting-up of a pertinent structure in traffic situations,
- the characterisation / description of these traffic situations as regards the parameters influencing the pollutant emissions,
- the detailed knowledge of the emissions as a function of these parameters and at this level,
- furthermore, as the emissions are calculated by crossing specific emissions with traffic volumes ($E=e*T$), it is necessary to be able to quantify the traffic volume as regards the different traffic situations.

Depending on the pertinence of the structure in traffic situations and of its level of detail, and also on the availability of data at this level of detail, we can see that a traffic situation approach is not obvious a priori.

The definition of the traffic situations should be pertinent. Firstly, traffic situations should be defined according to what the potential users know (road characteristics, traffic indicator, etc.). Secondly traffic situations should be pertinent as regards their known impact on the emissions: Defining traffic situations that have no impact on the emissions would be useless. If the impact is real but not known, the situation is not better.

At this stage, we can say that the only known parameters characterising a situation in the street and its pollutant emissions seems to be the driving speed on one hand, the traffic volume and composition on the other hand.

The traffic situation approach implies also that emissions are known at this level, and / or that we are able to link the emission to the specific conditions or surrounding aspects that characterize a street and that may have an impact on the emissions. Such an approach is then not disconnected from the way we measure or estimate the emissions.

To associate emissions to a given traffic situation – and as emissions measurement generally do not exist at this level –, we have to consider different types of emission modelling approaches.

Today, several models provide instantaneous emission values at each second of a speed versus time curve whereas other models express the emissions over a whole speed curve according to its average speed. The traffic situation approach should be compatible with these approaches.

1.1. Modelling approach

The traffic situation estimation approach can be seen as shown in Figure 1. We have on one side a set of traffic situations (TS), defined according to a user point of view. On the other side we have the emissions as they were measured. In general, emissions are measured on pre-defined driving cycles and sub-cycles, having a certain link of representativity with the actual driving conditions. These cycles / sub-cycles are generally not so numerous, because of the experimental costs. These cycles are those used to measure the emissions on a chassis dynamometer, and consequently, emissions factors are directly associated. The objective is then to calculate the emissions for the traffic situations as a function of the emissions measured on the driving cycles.

This is typically the case for the passenger cars, 2-wheelers and light duty vehicles, particularly within the Artemis project. For these vehicle categories, we should then establish a link between the traffic situations and the driving cycles or sub-cycles. Combinations can be envisaged, as well as various type of model (speed dependency, etc.). This requires then the identification of the pertinent kinematic parameters, that would characterize both the traffic situations and the driving cycles, and for which an emission dependency could be established taking into account the available data.

For the heavy-duty vehicles and in the frame of Artemis, the situation is quite different, as emissions factors are not directly measured on a chassis dynamometer, but envisaged through a model (based on engine emission maps and transient corrections). This model is applied on input data, that are driving cycles or patterns, including the speed profile and other driving and operating conditions such as the road gradient and curvature, the vehicle load, the gearbox use, and possibly additional loads such as the engine auxiliaries or the vehicle equipments.

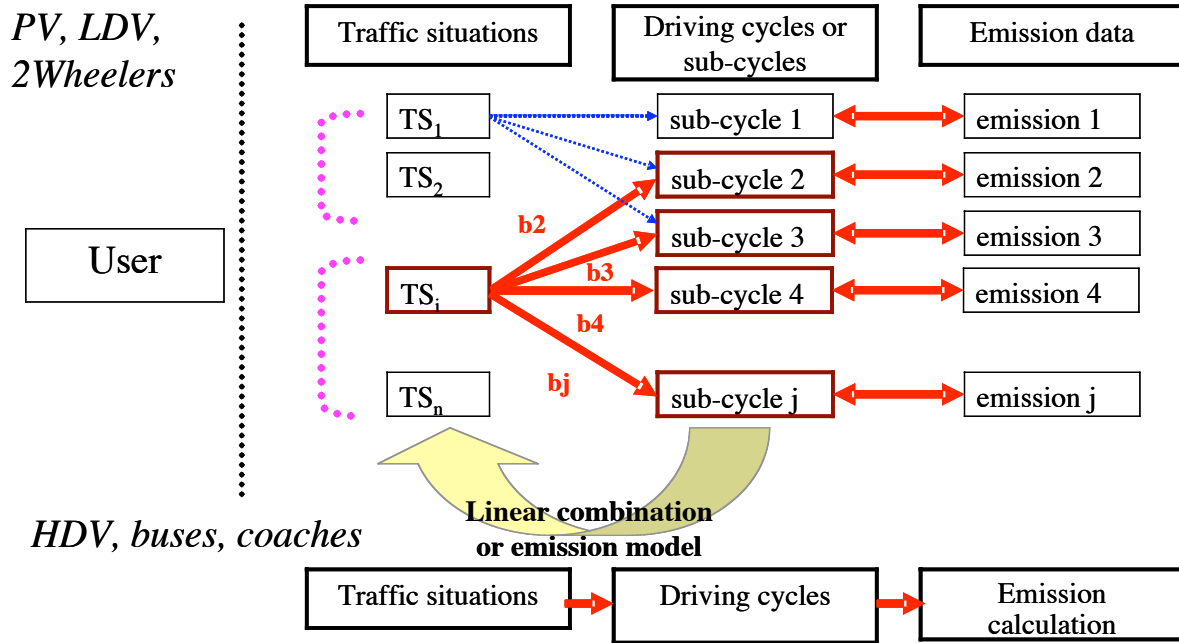


Figure 1: A possible modelling approach (André et al. 2002)

1.1.1. Difficulties

The above approach implies the following difficulties:

- the defining of a common and pertinent structure in traffic situations,
- the identification of pertinent kinematic parameters and the defining of the links between traffic situations and cycles / sub-cycles,
- the coherency of the approach and of the definitions of the traffic situations for each of the road transport vehicles category (PC, HDV, 2W)
- the knowledge of the traffic mileage distribution according to the above TS,
- a detailed knowledge of the driving patterns corresponding to each of the TS.

1.1.2. Implications from a user side

Furthermore, we have to consider the way by which the user would be able to intervene in this modelling approach, for a particular case study or application. We could envisage different options:

- The normal case would be that the user chooses a Traffic Situation amongst those proposed. We have then a discrete modelling that could account some tenths (or hundred) traffic situations. However, that could be not fully satisfying or "accurate enough". Indeed, the step between 2 traffic situations could be quite large if, for instance the same road configuration can be approached with 2 speed limits differing by 10 km/h, or with 2 qualitative conditions such as congested or free-flow traffic. In fact, the emissions estimation intends often at estimating slight changes around a given situation (a slight change in the average traffic speed due to a modification of the traffic management, etc.). The traffic situation approach would imply no change at all in the emission estimation for such limited evolution.

- One can imagine the user choosing amongst the proposed traffic situations, but also and acting directly on the cycles / sub-cycles and on their combination to compute the emissions. In that case, he would combine directly – possibly with some limitations - the basic emission factors to estimate the emissions for a given situation. Such an approach could even become continuous. Apart from the very high complexity to implement such an approach, it seems hardly feasible and acceptable as we could doubt on the ability of the user to combine these basic emissions factors in a pertinent way.
- The ideal solution would be that we offer to the user something like integration parameters (speed limit, average speed, traffic flow, etc.), associated to each of the traffic situations, and the user would have the possibility to adjust these parameters to his case. Once again such an approach is too complicated at this stage, as it would be necessary to develop a continuous dependency between these parameters and the detailed kinematic parameters (speed curve for example) and also to build-up robust emissions models as a function of these continuous parameters, which seems hardly feasible today.

Finally, we have also to consider that the Artemis emission estimation tool will succeed to existing tools (such as COPERT or the Handbook tools), and from this point of view a certain continuity is required. COPERT was a speed based continuous model. It would certainly be necessary to associate a continuous approach to the traffic situation approach, which is a discrete one. Furthermore these 2 approaches should be coherent between them.

1.2. Traffic situations and emissions parameters

Emission estimation tools should consider the parameters which characterize the traffic situation on one hand, and which have a significant influence on the emission estimation on the other hand.

1.2.1. Road characteristics

From the review conducted by (Poize, 2002), it appeared that road classifications generally distinguish urban and rural situations and address various objectives (safety, road management, numbering, etc.). Functional classifications are predominant and consider the road function (access / distribution / through). Others road parameters are often described or associated with the classification:

- type of area, number of lanes,
- speed limit,
- junctions (how they are managed, round about, traffic light, priority rules),
- parking areas (how they are organised),
- transport modes (vehicles authorized).

According to the countries, specificities can be noted: mountain area, severe climatic conditions, etc.

As far as these road classifications exist, it seems pertinent to consider them before defining traffic situations for emissions estimation, because:

- Their functional aspect implies that they have a direct implication on the traffic itself (speed, traffic flow and composition).
- The descriptive parameters generally associated with these classifications seem to correspond quite well to those that would be required to compute estimation.
- These classifications are known and used by potential users of emission estimation (transport / traffic planners and managers).
- Complementary field data (traffic flow or volume, information on "speed", etc.) could likely be available with such classification and would be also very useful for the emission estimation.

1.2.2. Emission parameters

Apart from the road characteristics, a traffic situation should be characterised by complementary parameters that influence the pollutant emissions: the traffic condition or traffic-flow level, the gradient, the climatic conditions, etc.

Figure 2 highlights as an example the various parameters that interact with the pollutant emissions, and their links. Road characteristics and type of area determine to a large extent the road function. That function influences the flow level and traffic composition. These last ones can be strongly altered by the time period (peak hours, holidays) or by the temporal climatic conditions. However, the resulting flow level, which takes into account the road characteristics and complementary parameters such as gradient and curvature, determines in the main the speed patterns (speed profile, stops, accelerations). This speed profile, together with the associated operating and usage conditions are the main factors of the emissions (also depending on the vehicles characteristics and on the fleet composition).

Such a flowchart – although not perfect - highlights the main parameters that should be considered as input parameters. It also shows the pertinence of considering a functional road classification that would determine to a large extent the traffic flow. Gradient and sinuosity – as they are very local parameters – are considered as complementary parameters.

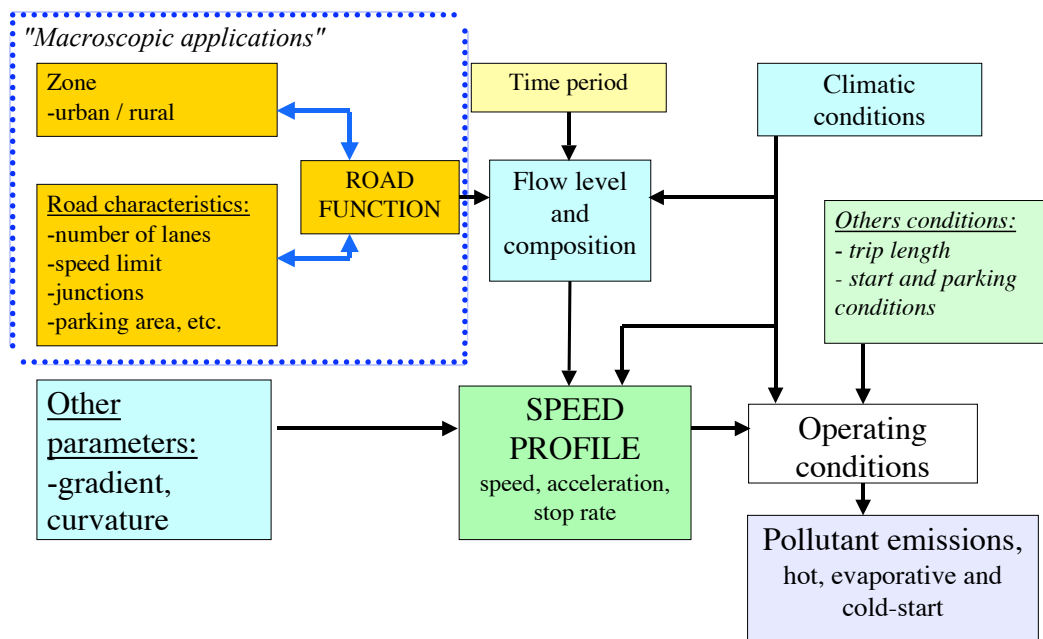


Figure 2: Parameters characterising a traffic situation and links with the resulting pollutant emissions (André et al. 2002)

This flowchart enabled also a ranking of the different parameters that could be considered according to the application scale. For large scale estimation (national, regional), the description through the type of area (urban, rural) and the road classification (associated with mean values average speed or speed limits, etc.) should be sufficient, as in all the cases, it won't be possible to describe more accurately the whole road network (with respect to traffic flow, gradient, curvature, etc.).

For local / punctual applications, we could think that the taking into account of the following parameters should be necessary:

- Road classification and type of area (urban / rural). For a given road type, ranges of the various characteristics parameters could be proposed as representative (speed limit, number of lanes, etc.), but could be adjusted by the user according to his case study,
- Traffic level should be defined, due to its strong impact on speed profile (in a qualitative way: congested, unsteady, steady flow, etc.) or continuously (number of veh/h/lane),
- Gradient and curvature should be taken into account due to their high effect on emissions for heavy duty vehicles,
- Climatic conditions are probably of less importance: although having a significant effect, they could hardly be considered in most studies, due to their variable character and to the associated uncertainties on the emissions,
- The operating conditions (trip length, load conditions, start and parking) should also be considered, but these ones could hardly be considered in that framework.

1.3. Initial works

1.3.1. A scheme based on the existing functional road classifications

As a part of the Artemis works, Poize (Poize, 2002) set down most of the methodological aspects raised up by the traffic situation approach. This work also enabled the elaboration and proposal of a first road classification. That was based on a systematic review of about fifteen road classifications from US, UK, NL, D, FIN, I, SP, S, CH, F. Some similarities were observed, even if there are differences in category names. Generally, we have urban and rural classifications. These classifications can have various objectives (safety, road numbering, etc.), but functional classifications are predominant. Three main road functions are considered: access / distribution / through (transit).

However, each country can use different definitions and different terms to describe the same or similar road types. For example, the United Kingdom distinguished urban (or built-up) roads and rural (or non-built-up) roads but this definition did not rely on buildings but on speed limits. In the Netherlands, rural roads are defined by their function as part of a Sustainable Safety approach.

This initial review of the existing road classifications - mainly functional - and the analysis of their descriptive parameters had enable the emergence of a classification proposed as a base structure for the emissions estimation. It included urban and rural road classifications (Table 1 and Table 2, Poize, 2002, André et al. 2002).

Category	Speed limit (km/h)	Other characteristics
Highways, roads of national importance	90-120	- mostly motorways, more than 2x2 carriageways, - grade separated junctions, - specific parking areas, no cycles/mopeds/pedestrians
Expressways / roads through built-up areas	90-110	- quick exchanges, more than 2x2 carriageways, - specific parking areas
Distribution roads	50	- more than 2x1 carriageways, - eventual parking areas, traffic lights at junctions, - eventual buses
Inter-district roads	50	- less than 3 lanes, - eventual parking areas
District and local roads	< 50 km/h	- inside a district, at best 3x1 carriageways, - priority rule at junctions, - parking areas, pedestrian and cycles

Table 1: Classification of the urban roads (Poize 2002; André et al. 2002)

Category	Speed limit (km/h)	Other characteristics
Motorway and national main network	100-130	- mostly motorways, more than 2x2 carriageways, - grade separated junctions, - specific parking areas, no cycles/mopeds/pedestrians
<i>of which : national / regional, trunk, main roads</i>		<i>non motorways</i>
Distributor roads	≈ 80	- at best 2x2 carriageways, - specific parking areas, roundabouts
Local and access roads	50	- low speed limit, access to properties - at best 2x1 carriageways, - pedestrians and cycles

Table 2: Classification of the rural roads (Poize 2002; André et al. 2002)

We shall note that this structure did not distinguish the main roads (national, trunk, main roads) as a specific category but included them in the “motorway” group. We note also that this classification introduced several terms which were not well defined, e.g. for motorway / highway / expressway. Many information related to junctions, number of lanes, speed limit, parking area and cyclists, pedestrians and mopeds, were given as these parameters appeared to be important as regards the road configuration and type.

A parameter describing the junctions (density of junctions) was also envisaged to characterize the urban context. The wide of lane was also suggested as complementary parameter (Poize, N., 2002) as it is often used or associated with other road characteristics to define the road function and to “regulate” the speed.

1.3.2. Associated and additional parameters

Furthermore, the previous work proposed also additional parameters (speed limits, etc.) to describe the above road classification and practical suggestions as regards the taking into account of the traffic flow, gradient, sinuosity, etc. The speed limit and the flow level are amongst the parameters for which it can be possible to associate a range or a probable value (Table 3 and Table 4) and that could be adjusted by the user.

The speed limits were proposed as discrete values corresponding to the existing European limits. The traffic condition was proposed as a continuous variable (traffic flow per lane, traffic density) or in 3 classes (such as steady flow / free-flowing, unsteady flow / dense traffic, congested flow / stop and go), which remained to be defined.

Road gradient and curvature were envisaged as continuous parameters (to be defined, i.e. % of gradient, sinuosity in absolute degree per km, etc.) providing that these parameters should be pertinent for the users, or in two or three levels. However, such simplification does not reduce the need of pertinence for the definition of these parameters (i.e. we cannot simply state low/medium/high road curvature, it is also necessary that such a definition can be quantified or has a meaning for the user). It was also proposed to neglect gradient and curvature in a certain

number of cases, for which these parameters can have a low impact on driving patterns: in urban areas, where the driving patterns are more determined by the junctions, and for local roads for which the gradient should also have a limited incidence.

However, these parameters, as well as their definition required further investigations for their integration into the emission estimation approach.

Category	Speed limit (km/h)	Flow level (veh/h/lane)	Curvature	Gradient
• Highways, roads of national importance	90-120	1800-2000	no	low / medium / high
• Expressways / roads through built-up areas	90-110	1200	no	low / medium / high
• Distribution roads	50	1600-2000 ⁵ 800-1500	no	low / medium / high
• Inter-district roads	50	300-700	no	low / medium / high
• District and local roads	< 50 km/h	30 <100	no	low / medium / high

Table 3: Urban roads classification and associated parameters (Poize 2002; André et al. 2002)

Category	Speed limit (km/h)	Flow level (veh/h/lane)	Curvature	Gradient
• Motorways	100-130	1800-2000	low / medium	low / medium / high
• of which national / regional, trunk, main roads				
• Distributor roads a) access /distribution to the higher level b) link between poles	≈ 80	1600-2000 800-1500	low / medium / high	low / medium / high
• Local and access roads	50	<100	low / medium / high	low / medium / high

Table 4: Rural roads classification and associated parameters (Poize 2002; André et al. 2002)

1.3.3. Attempt of refinement of the Traffic Situation Scheme

The previous Traffic Situation Scheme was discussed within COST346/ARTEMIS (Keller et al. 2003) and that led to a second version (Table 6), highlighting more accurately the different characteristics of each road type.

The main differences with the previous classification were the following:

⁵ This subdivision is proposed by similitude with rural distribution roads but its definition (and opportunity) requires a validation

- An attempt to get a parallel between urban and rural roads. However, the use of common terms for both rural and urban roads could introduce a certain confusion between the road definition and their functional role. Typically, the urban roads are classified according to their function (transit, distribution, inter- or within district, etc.) and a rural motorway is not always comparable with an urban motorway.
- A certain confusion resulted from the definition of the “local roads” (which include also access and collector roads), while “residential roads” were introduced as a separated category.
- A “Flow characteristics” information was introduced, that could however induce a confusion with the traffic related parameters (level of service or traffic condition).
- The range of the speed limits was extended to cover the speeds recorded in the different European countries (Table 5).
- Configurations as regards the number of lanes and the junctions were deepened and clarified.
- A definition of urban / rural was proposed as follows: “Urban” was defined as a built-up area and concerned then small towns or villages where a well-defined settlement area can be distinguished. “Rural” concerned thus “any area that was not urban”.

However and despite the notable progress in its elaboration through large discussion and agreement between the involved partners, this second traffic situation scheme remained uncompleted as several definitions were missing or imperfect and as several parameters were not set-up (traffic conditions, gradient, sinuosity, etc.).

Area	Road type	Range of speed limit (km/h)									
Urban	Motorway	130	120	113*	110	100	97*	90	80	70	60
	Expressway / major artery	113*	110	100	97*	90	80	70	60		
	Medium/high capacity road (minor artery / distributor / connector)	97	80	70	60	50	48*				
	Local road / access road / collector road	50	48*								
	Residential road	50	48*	30							
Rural	Motorway	> 130**	130	120	113*	110	100	97*			
	Expressway / major artery	113*	110	100	97*	90	80	70			
	Medium/high capacity road (minor artery / distributor / connector)	97	80	70	60	50	48*				
	Local road / access road / collector road	50	48*								

Table 5: Range of speed limit proposed by (Keller et al, 2003)

*: UK speed limits: 70 mph = 113 km/h; 60 mph = 97 km/h; 30 mph = 48 km/h

** : Speed limit on German motorway for passenger cars

Area	ID	Category	Function	Characteristics						
				Speed limit (km/h)	Number of lanes	Junctions	Parking area	Cyclists, pedestrians, mopeds	Flow characteristics	Bus stop
Urban	A_urb	Motorway	Traffic movement primary consideration, no property access	60-130	At least 2*2	Grade separated	Specific	Prohibited	Free flow (grade separated)	None
	B_urb	Expressway / major artery	High speed roads that is not a motorway, traffic movement primary consideration; property access in remote areas	60-113*	At least 2*1	Quick, not grade separated	Specific	Pedestrians prohibited or side walks on both sides, cyclists prohibited or separate bicycle lane	Uninterrupted accept at signals and crosswalks	Apart from road
	C_urb	Medium/high capacity road (minor artery / distributor / connector)	Traffic movement primary consideration, some property access in remote areas	48*-97*	At least 2*1 or 1*2	Traffic lights or round about	Separate, close to road	side walks on both sides, cyclists on street or separate bicycle lane	Uninterrupted accept at signals and crosswalks	Separate bus stop at road side
	D_urb	Local road / access road / collector road	Traffic movement and property access of equal importance	48*/50	2*1 or 1*2	Traffic lights, round about or priority rule	Road side parking (US: curb side)	side walks on both sides, cyclists on street	Interrupted flow	Separate bus stop or on street
	E_urb	Residential road	Inside a district, property access, primary function	30-50	At best 2*1	Mostly priority rule	On street	Side walk on one or both, or no side walk, cyclists on street	Interrupted flow	On street
Rural	A_rur	Motorway	Traffic movement primary consideration, no property access	97*->130	At least 2*2	Grade separated	Specific	Prohibited	Free flow (grade separated)	None
	B_rur	Expressway / major artery	High speed roads that is not a motorway, traffic movement primary consideration; property access in remote areas	70-113*	At least 2*1	Quick, not grade separated	Specific	Pedestrians prohibited or side walks on both sides, cyclists prohibited or separate bicycle lane	Uninterrupted accept at signals and crosswalks	Apart from road
	C_rur	Medium/high capacity road (minor artery / distributor / connector)	Traffic movement primary consideration, some property access in remote areas	48*-97*	At least 2*1 or 1*2	Traffic lights or round about	Separate, close to road	side walks on both sides, cyclists on street or separate bicycle lane	Uninterrupted accept at signals and crosswalks	Separate bus stop at road side
	D_rur	Local road / access road / collector road	Traffic movement and property access of equal importance	48*/50	2*1 or 1*2	Traffic lights, round about or priority rule	Road side parking (US: curb side)	side walks on both sides, cyclists on street	Interrupted flow	Separate bus stop or on street

*: UK speed limits: 70 mph = 113 km/h; 60 mph = 97 km/h; 30mph = 48 km/h

Table 6: Road classification and characteristics proposed in (Keller et al. 2003)

1.4. Conclusions

The development of a traffic situation approach for the estimation of the pollutant emission from the road transport implies the definition of such traffic situations (traffic situation scheme), the building-up of the emission modelling approach itself and the parameters to be considered, and finally the taking into account of the users point of view (input data, outputs).

Most of these aspects have been approached in (Poize 2002, André et al. 2002). These preliminary works have enabled a review of the existing road classifications and the setting-up of a first structure, based mainly on the functional aspects. Traffic situations should certainly be approached from a traffic engineering point of view. Discussions and refinements have enable a certain improvement of this initial traffic situation scheme, that remained – at this stage – uncompleted and not fully validated. Complementary parameters (traffic conditions, gradient, sinuosity, etc.) have not been fully defined in the frame of these preliminary works.

The actual status of the traffic situation scheme suggests the following issues:

- It is necessary to clarify the urban / rural aspects,
- The road classification should be re-examined, and one should take care to preserve the initial concepts when defining / adjusting the traffic situations,
- The complementary parameters (traffic conditions, gradient, sinuosity, etc.) should be investigated.

2. Definition of a Traffic Situation Scheme

The definition of the traffic situations should necessarily include:

- the definition of the area: urban, rural,
- the definition of the road and of its physical characteristics,
- the definition of the traffic conditions.

We examine in this section these different aspects.

The initial works undertaken in COST346 and Artemis are taken as a starting point. The urban / rural definition and road classification are re-examined, while attempting to clarify the terminology. The complementary aspects are then investigated, namely the traffic conditions (often – but also improperly - called Level of Service), the road sinuosity and gradient which had not been defined so far, as well as the speed limits to consider. That chapter enables finally the setting-up of a full traffic situation scheme.

2.1. Urban definition

Most of the existing European road classifications (Poize, 2002) distinguish the urban and rural roads. A French classification in (Grand Lyon, 2000) separates urban and rural road types because roads have a different role in each area, even if they are based on a similar structure. Important differences can also be observed between road uses and their characteristics (The Countryside Agency, 2004). This supposes however a clear definition of urban and rural.

Urban / rural distinction was often subject to debate and indeed hundreds of national definitions are reported by (UN, 2001). This question is not new and numerous attempts of harmonisation have been done by international institutions to report international statistics and comparisons (urbanization, etc.). The simple criteria of a built-up zone (as envisaged in the previous chapter and by Keller et al., 2003) seems generally insufficient to define urban. The concepts of “urban” and “rural” can be defined in a variety of ways (EPSON, 2004), as demonstrated by the numerous international works on that subject.

2.1.1. A high diversity of urban / rural definitions

Hundreds of definitions of rural and urban areas were reported by the United Nations (UN, 2001), highlighting well the difficulty of that topic.

In most countries, a town is identified by an administrative status, depending on national criteria. The urban or rural status – as well as the criteria to establish it –, are thus subject to a

governmental decision, and can change with the time period. More often the status is subject to criteria regarding the population size of the local administrative area or population agglomerations identified by field studies. However the level of population can vary from some hundreds of people (in Peru, Uganda) to more than 10,000 (Italy, Senegal). Other countries consider the population density (Canada).

In some countries, urban is defined as a built-up zone made up of adjacent buildings forming a whole such that no building is more than 200 metres away from the next nearest building (Le Gléau et al. 1997). Several countries have no definition for the urban area. In others countries, disparities between basic gridding patterns and chosen thresholds limit the scope of international comparisons, which are a hundred year old idea.

Roughly, two main and complementary approaches can define a town. The first one focuses on the economic relations between the urban core and its environment and defines the “sphere of influence” of a town. The second defines towns in terms of building density. International comparisons are always difficult taking into account the large range of definitions.

2.1.2. Urban and rural typologies

The OECD distinguishes between three different types of regions on the basis of the proportion of population living in rural municipalities (Spiezia, 2003). The first identifies rural communities according to their population density. A community is defined as rural if its population density is below 150 inhabitants per square kilometre. The second classifies regions according to the percentage of population living in rural communities. Thus, a region is classified as:

- Predominantly rural, if more than 50% of its population lives in rural communities,
- Predominantly urban, if less than 15% of the population lives in rural communities,
- Intermediate, if the population living in rural communities is between 15 and 50%.

The corresponding European Union (EU) approach is based on the degree of urbanisation, so EU regions are classified into three different types:

1. Densely populated areas, which have a population of more than 50,000 inhabitants living in contiguous local authority units with a population density of more than 500 inhabitants per km².

2. Intermediate areas, which comprise local authority units with population densities of 100 inhabitants per km² each. The total population of the zone should be more than 50,000 inhabitants, or alternatively, it can be contiguous to a densely populated area.

3. Sparsely populated zones which comprise all the non-densely populated and non intermediate EU areas.

Ballas examines alternative methodologies to build a typology for rural areas in Europe (Ballas et al. 2003). The two main attributes characterizing the European rural regions are a relatively low population densities and a significant role of the agriculture in the local economy. It is noteworthy that population density has been traditionally used for the definitions of rural

areas in Europe. In particular, at the NUTS5 level rural areas are defined by EUROSTAT (Eurostat, 2004) as those with a population density of less than 100 inhabitants per km². It appears that the criterion of population density is not sufficient for a robust classification between urban and rural regions, e.g. low population densities are not always associated with rural populations. As European rural areas are extremely diverse, they cannot be easily defined on the basis of a single criteria.

2.1.3. Urban and rural definition proposal

In the following of the mentioned recent international works, we propose to adopt a “functional” or at least “morphological” oriented definition, i.e. which considers functional entities (Functional Urban Area, FUA) such as an agglomeration or urban area. Such approaches are used in France (INSEE classification, see Figure 3), Belgium and probably in several other European countries. A certain consensus seems also achieved in a larger European context (SPESP, 2000: Study Programme on European Spatial Planning, EPSON, 2004: European Spatial Planning Observatory Network, Urban Audit: Eurostat Project, see below).

The idea seems pertinent as the city, the traffic and the road network and hierarchy are generally managed at this scale (and by the relevant authorities), and also because the commuting and the mobility on one side and traffic conditions and speeds on the other side are to a large extent and primarily linked to these structural aspects. Finally, the urban / rural definitions should be in coherence with the urban and rural road schemes defined later.

According to SPESP study, a European Functional Urban Area (EFUA) is defined by:

1. *a contiguous core of urban units (built-up area according to the United Nation definition), accounting for at least 5000 jobs,*
2. *urban units from which people commuting to work in the core exceed 40% of the active labour force of each units*
3. *urban units where commuting from the area defined by the previous 1 and 2 exceeds 40% of the jobs of the unit in question.*
4. *the remaining local units are considered as rural.*

The INSEE French approach is quite similar and considers:

- *the **urban area** as a homogenous built-up area composed by a group of villages and/or towns, with one **urban centre** (offering at least 5000 jobs) and rural or urban units (periurban belt) with at least 40% of its resident and employed population working in the urban centre or in the surrounding rural and urban units.*
- *A **rural area** (or predominantly rural area) consisting in small urban units and rural communities, which do not belong to the predominantly urban area (urban centres, periurban belts and multi-polarised villages and towns). This area is huge and represents 70% of the total surface area.*

With:

- *an **urban unit** being a continuous built-up area (settlements or building that are not more than 200 m apart), composed of a or a set of village(s) or town(s), and having at least 2000 inhabitants (more than half of them living in this built-up area)*
- *the villages or towns or territory units that do not belong to an urban unit are rural.*

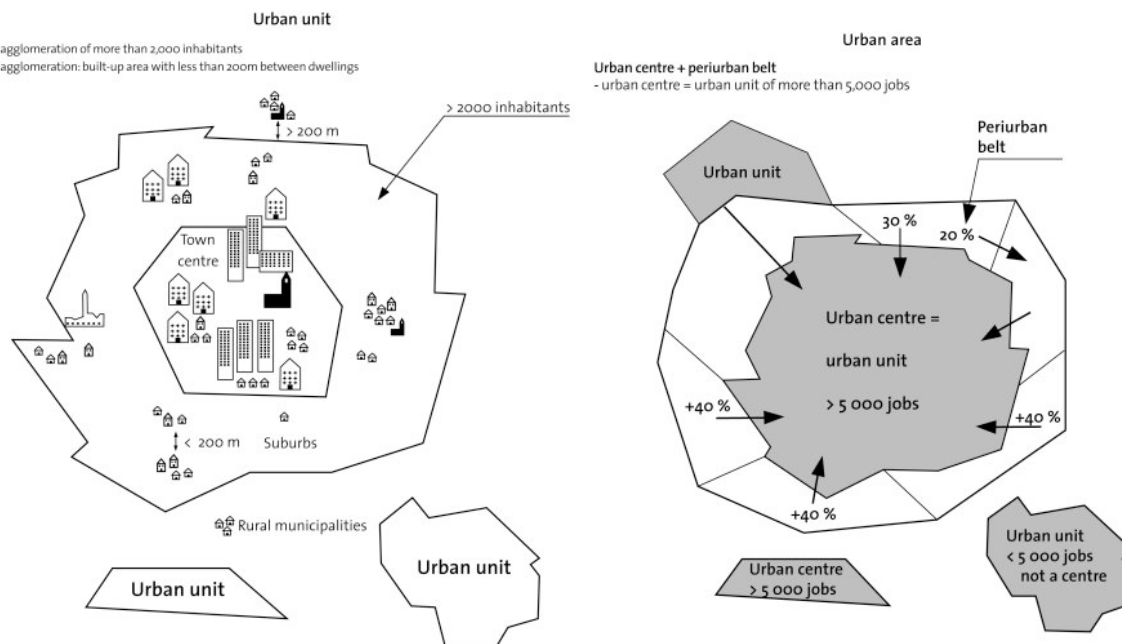


Figure 3: Schematic definition of the urban unit and urban area, according to INSEE in France (from <http://www.institutveoliaenvironnement.org>) – The figures in % express the share of people commuting to work

The main implication of these definitions is that:

- villages and small towns that are isolated in a rural context are considered as rural (Figure 4),
- there can be villages and even rural territories within an urban area, and these ones are indeed mainly dependent on the city and crossed by the urban traffic.

The notion of CBD (Central Building District) proposed by Ericsson (Ericsson, 2000) refers likely to the idea of a city core or urban centre in the previous definitions, or also to the notions of historical and business city centres. This term designs the town centre, which is composed mainly of inter-districts roads and local roads. The CBD has a highest intersection density. Driving in the CBD might induce higher levels of emissions per kilometre. Such areas obviously could differ of the urban area in term of morphology (geometrical design, streets, junctions' density, etc.) and consequently also in term of driving conditions.

However, to avoid a too complex classification within tools that are designed mainly for macroscopic scales (regional, national), it was proposed not to introduce a complementary division of the urban area into more detailed zone-types. Furthermore the difference of driving conditions within these areas (compared to the other urban area) could be managed by different time frequencies of the different driving conditions such as congested, dense, free-flow, etc.

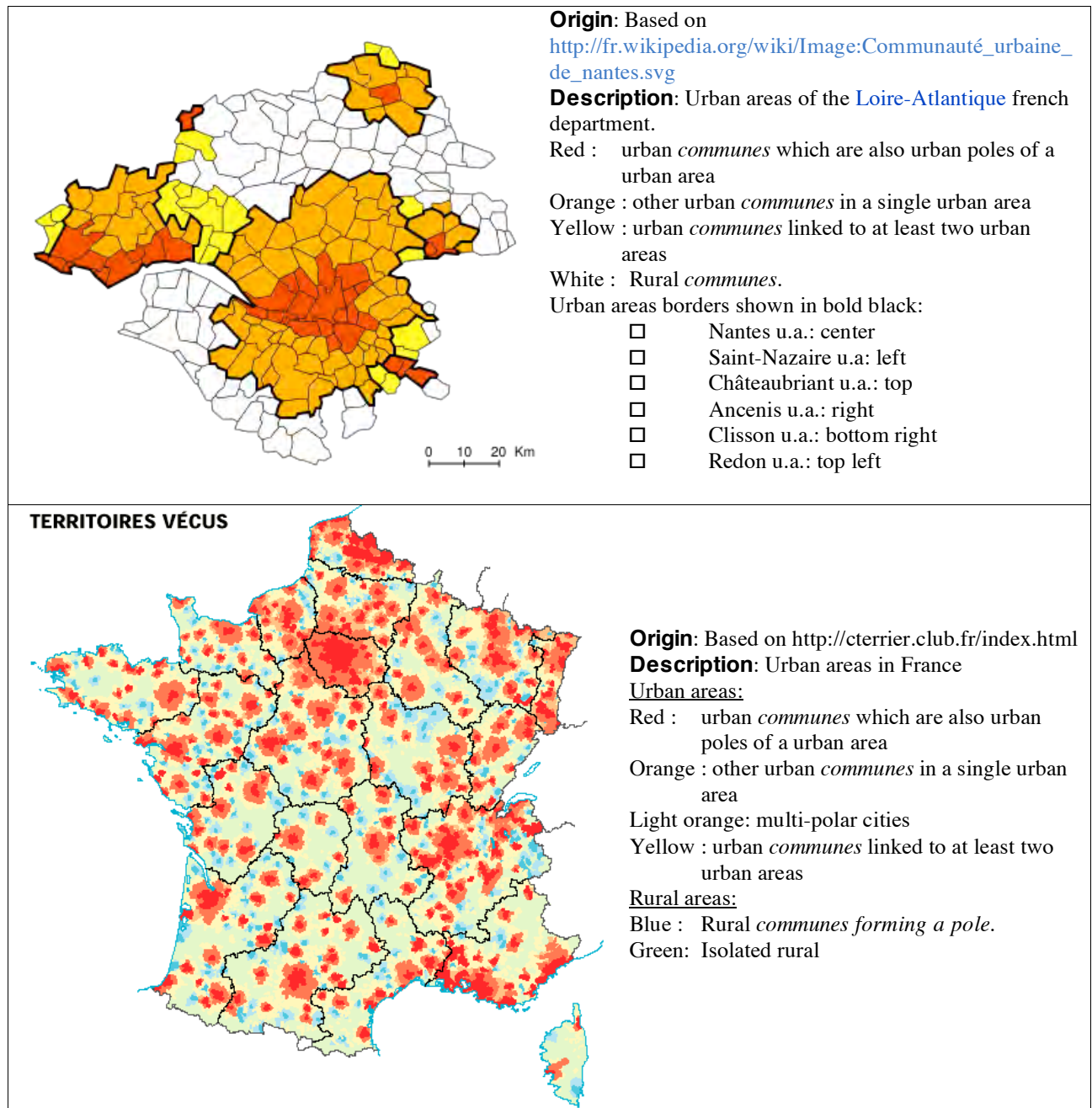


Figure 4: Illustration of the zoning into urban functional areas – Case of Loire-Atlantique in France (top) and case of France (bottom)

2.2. Road classification

Apart from the urban / rural distinction, it seems that road classifications rely on several principles: the hierarchical and functional organisation of the road network, the road geometry and function (with respect to its different users, pedestrian, cars, buses, etc.) and the speed limit.

For our purpose, a road classification should follow closely the actual practices in Europe (even if these ones can be quite heterogeneous) to be understandable by a large variety of emission model users.

Furthermore, the definitions and terms used should avoid any confusion. From this point of view, the American terms – which are often used and which rely on different practices should be avoided when possible. Indeed, they can be source of confusion as highlighted in Annex 1 for the motorway related terms.

In that section, we highlight the concept of road network hierarchy and analyse the road characteristics and function. On the basis of the previous works we finally proposed a road classification for the emission estimation in ARTEMIS.

2.2.1. Road network hierarchy

More and more, the road networks are managed according to hierarchical and functional principles with an attempt to identify and separate the long distance, transit, high capacity and generally at high speed traffic from the access, local, low speed traffic, with a lot of interactions with vulnerable users (pedestrian, bicycle, etc.) and a lot of access. Between these two extremes, intermediate levels of distribution are considered (Figure 6). Obviously, the road configuration and characteristics are adapted to such functions.

That hierarchical organisation is well analysed in (ARTISTS, 2004) and it is highlighted in Figure 5.

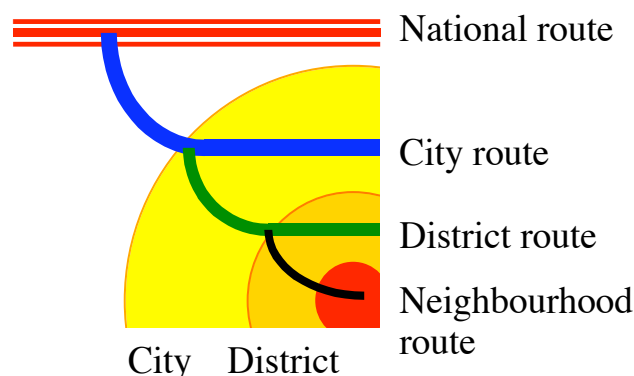


Figure 5: Hierarchisation of the road network (Artists, 2004)

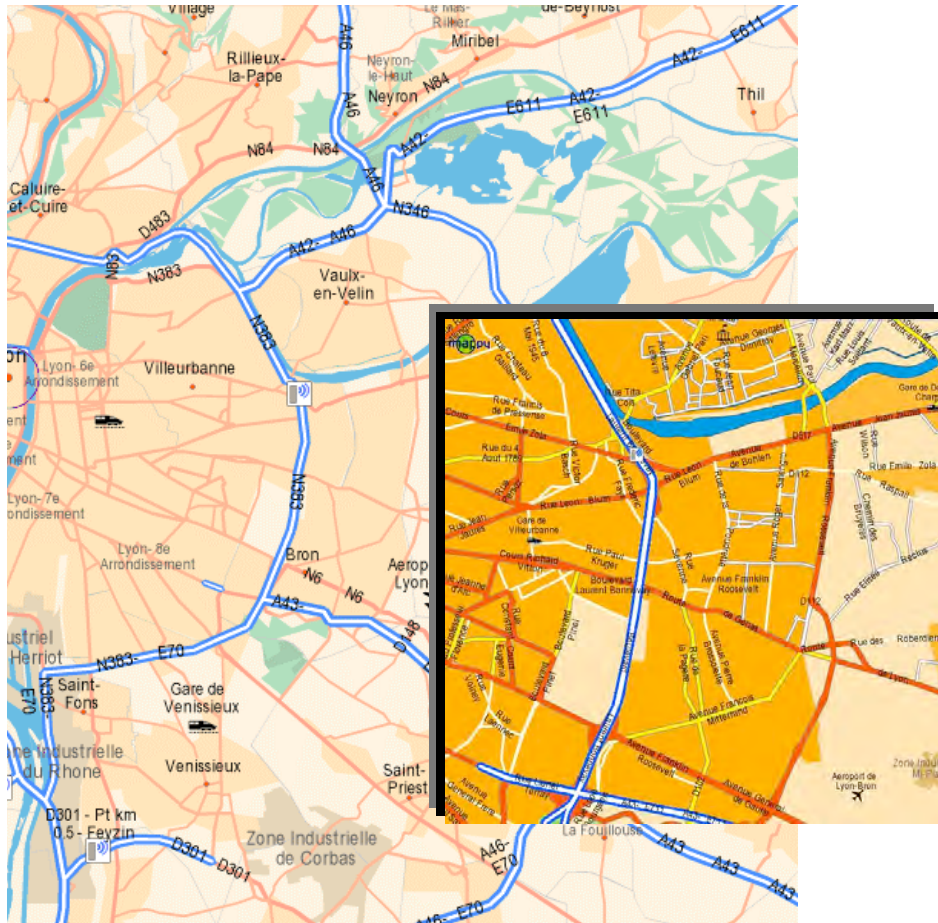
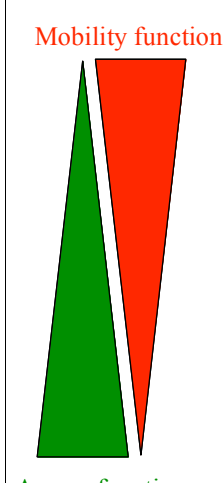


Figure 6: Typical structure of a road network

In the following we highlight these principles through their implementation by French authorities with quite differing points of view. First, the CERTU proposes a French classification into 3 main levels (the first one being then subdivided) for the urban roads (Table 7). This urban road classification puts forward the following characteristics:

- The notions of mobility and access functions and their opposition appear, e.g. a road with a high mobility function has a low access function and vice versa. It is a simplified approach of the road function. Level 1 groups together major roads of urban area, with a high mobility level and high speeds. Levels 2 and 3 are managed at lower speed zone (30 or 50 km/h) because of their high access function and then the frequent interactions (with pedestrian, bicycles, etc.).
- The number of junctions is considered as an important criteria and allows classifying the different road types.
- The width of lane is also used to characterize a road and even to manage the traffic. Indeed, this one can influence vehicles speed without necessarily modifying the traffic.

	Level	Road type	Function	Speed limit (km/h)	Pedestrians, cyclists, mopeds
	1	VCA (Motorway)	Motorway if transit is favoured. Express urban road of type A, with interchange.	(130) – 110/90 – “70”	Prohibited
		VCR (High speed road)	Road 90 km/h, major road 70 km/h or express urban road of type U. Few junctions and rare grade separated.	(90) – 70 – “50”	Cyclists and mopeds on a specific lane
		VCM (controlled or “mastered” traffic)	Major road 50 km/h, artery. Junctions (traffic lights, round about, priority rules).	(70) – 50	Authorized
	2	VCC (Calmed traffic)	Road 50 km/h, classic road.	50 – 30	Authorized
	3	VCL (Low speed road)	Road 30 km/h, avenue	30 – 10	Authorized

(): Speed which must be justified.

“70”: Speed objective, actually researched.

“50”: speed objective difficult to attempt, particularly in off peak periods.

Table 7: Urban roads classification (CERTU)

Hierarchical movement	Level	Network level (PC, 2W)	Speed limit (km/h)	Cyclists, pedestrians, mopeds	Junctions	Intersection density
National and regional levels	5	National and regional networks	130–110	Prohibited	Access road, interchange, grade separated	Less than 10 kilometres
Urban area network	4	National, trunk roads, major artery, (inner / outer) ring road	90–70	Prohibited		
Distribution network and connection between “towns”	3	Distribution roads	70–50	Cycle track, pedestrians on walk side	Round about, traffic lights	
Interdistricts network	2	Inter-district roads	50	Cycle track, pedestrians on walk side	Priority rule	
Local and districts networks	1	Local and district roads, residential roads	50–30	Pedestrians on the walk side, cycles and mopeds on the street.	Priority rule	

Table 8: Hierarchical classification in urban proposed by Le Grand Lyon (Grand Lyon, 2000)

The number of junctions allows also differentiating an urban motorway from a ring road. An urban motorway can have input/output every 1000m, whereas a high speed urban road has it every 350 m.

The hierarchical road network proposed by Le Grand Lyon is based on the vehicles movement (Table 8). Five levels are defined: level 1 corresponds to the lowest level, i.e. local roads. The level increases with the volume of movement (i.e. level 5 corresponds to motorway). Such scheme is also envisaged to manage the public and non-road transports (rail) with a similar coherency (Grand Lyon, 2000).

The type of junction allows defining a distance between crossroads or interchanges in keeping with the range network. The “adhesion” (i.e. intensity of the interaction between the traffic and the road surroundings) is used to distinguish each road type. The adhesion of levels 4 and 5, characterized mainly by the distance between interchanges, is then inversely proportional to the

considered level.

This hierarchical organization is easily understandable by model's users because it corresponds to the real road use. It presents also the main advantage of being an overall approach based on the spatial organization of the activities and of the exchanges.

This road classification has a different issue than the CERTU classification, which was more oriented to the building-up and design of the roads. The discussion underlined also that the traffic flow, which is often used for road classification, is not always the most pertinent parameter.

2.2.2. Road discriminating parameters

According to discussion with the French organisms and in the following of the previous work (Poize, 2002), it appears that the following parameters are amongst the most discriminating ones to differentiate and characterize the roads:

- The **road function** is a major parameter (it can be more important than the road type) to classify a road. The road function is well defined by (Grand Lyon, 2000).
- **Pedestrians, cycles and mopeds**: Authorization and interdiction are strictly managed according to the road type.
- The **type of junction** is an important geometric characteristic which allows distinguishing a road at motorway characteristic or not (i.e. a motorway roads have a grade separated junctions).
- The **density of junctions** or intersection density (number of junctions per km or intervals between each intersection) is a main characteristic of road classification as it characterizes the urban (or rural) context and influences the interactions between vehicles and also their speed. This parameter was already strongly suggested in (Ericsson, 2000), which proposed a scale to characterize the urban situations (Table 9) and demonstrated that a high intersection density decreased speed systematically on local and main streets.

Variable	Interval used
Intersection density	< 50 m
	50-100 m
	100-200 m
	> 200 m

Table 9: Intersection density in urban area (Ericsson, 2000)

- The **width of lane**, which influences vehicles speed and is also set in this aim. For example, drivers must slow down on local roads if the lane is not wide enough.
- the **grade-separation** which can be associated with several road types and certainly induces a difference in the driving conditions.

Finally, the speed limit is often considered to complete the road classification. (Poize, 2002) has shown that urban speed limits are quite harmonized throughout Europe: No variability is noted between vehicle categories, and the speed limit is generally around 50 km/h (30

mph in the UK) in the majority of European countries.

Rural speed limits are less homogenous. We note in particular:

- In Finland, speed limits are different in winter and in summer.
- Different speeds for vehicles on rural roads of different qualities.
- Lower speed limits for caravans without specific brakes (in Norway).
- Specific speed limits for the heavy duty vehicles according to their weights.

2.2.3. Road classification proposal

2.2.3.1. Detailed characteristics

The previous consideration and the issues from the previous works (Poize, N., 2002, André et. Al. 2002) led us to propose a road classification (given in Table 10 and Table 11), which was based primarily:

- on the road function (through-traffic, distribution, access, and often a mix),
- on the road network hierarchy or hierachisation which is more and more used to assume these functions and manage the traffic in a satisfying way,
- on the road characteristics linked to these functions (lane wide, parking, junctions type and density), and in particular on the distinction between motorway and normal road for a same function, because this implies a significant difference in driving patterns.

The main differences with the previous proposal relies on a closer adjustment with the existing and in-use classification (F, UK) and on a strong interaction with traffic specialists to establish the structure, define the terms and adjust the characteristics according to the practices. We note in particular:

- Five levels of urban roads are used. The levels 5 and 4 are separated in two cases, according to motorway characteristics or no.
- The geometric characteristics are given in detail and an indicative intersections density is provided as an order of magnitude (i.e. 1km means 1 or a few km, etc.).

The indicated characteristics recapitulated in are indicative and correspond to the general case. Obviously, local specificities and exceptions can occur, but it seems unrealistic to take any particularity into account in our framework.

We should finally notice that a specific case of road configuration was added to that classification: the “semi-motorway”, which is a particular configuration of a motorway – mainly implemented in Sweden - with an alternation of road segments of 2 to 3 kilometres and having successively 1 or 2 lanes in each way. In the following that case will be either specifically identified (5s) or considered as part of the rural motorway (5).

Main function	Comments	Level	Characteristics	Speed limit (km/h)	Number of lanes and geometry		Junction type and density (order of magnitude of distance between junctions)		Parking	Pedestrians, cycles, mopeds	Bus circulation and stops
Through-traffic – Primary distributor – National and regional network	High-speed or major road through an urban area. Concerns Regional or national traffic	5a	Motorway	110–130	At least 2*2, separate road ways	Wide	Always grade separated	Low (10 km)	Specific area	Always prohibited	Authorized, no bus stops
		5b	Not motorway (trunk road)	80–90/97*	At least 2*1, separate road ways or no	Wide	Grade separated	Low	Specific area	Prohibited	Authorized, no bus stops
Primary distributor – Agglomeration network, city primary roads	High-speed or major roads through the urban area, major arterials. Quick exchanges at the city scale	4a	Motorway (ring road)	80–113*	At least 2*2, separate road ways or no	Wide	Always grade separated	High (1 km)	Specific area	Always prohibited	Authorized, no bus stops
		4b	Not motorway (trunk road)	48*/50–90/97*	At least 2*1, separate road ways or no	Wide	Grade separated, roundabout, traffic lights	High	Specific area or on road side	Prohibited or on pavement, and cycle lane	Authorized, separate stops or on road side
Districts distributors	Connection between districts or poles and access to/from primary distributors	3	road	48*/50 – 70	At least 2*1 or 1*2, separate road ways or no, (perhaps 1*1 when one way road)	Lanes can be narrowed to limit the speed	Traffic lights, roundabout or grade separated	High	On road side	Pavement, cycles and mopeds on road or on a specific lane	Authorized, possibly on a specific lane, separate stops or on road side
Local distributors – Inner exchange and local traffic	Connection between communities and within districts. Access to/from district distributors – Neighbourhood traffic	2	road	50/48*	At least 2*1 or 1*1 lane if one way road	Narrow lanes	Traffic lights, priority rule or roundabout	High	On road side	Pavement, cycles and mopeds on road or on a specific lane	Authorized, possibly on a specific lane, separate stops or on road side
Access roads – Local traffic.	Access to housing and business places.	1	road, cul-de-sac, side road	5–10–30–50/48*	At best 2*1 or 1*2 lanes	Narrow lanes	Mostly priority rule, traffic lights and small roundabout	High (100 m)	On road side or on the street	Pavement, cycles and mopeds on road	Authorized, stops on road side

Table 10: Urban road classification

Main function	Comments	Level	Characteristics	Speed limit (km/h)	Number of lanes and geometry		Junction type and density (order of magnitude of distance between junctions)		Parking	Pedestrians, cycles, mopeds	Bus circulation and stops
Through and distribution traffic – National and regional network	High speed or major road through the rural area. Concerns Regional or national traffic	5	Motorway	110– >130	At least 2*2, separate road ways	Wide	Always grade separated	Low (20 km)	Specific area	Always prohibited	Authorized, no bus stop
		5s	Semi-motorway (1)		(1)						
	Road network in the rural area, connecting villages, towns	4	Not motorway (trunk road)	70–113*	At least 2*1, separate road ways or no	Wide	Roundabout, traffic lights, or grade separated	Low (5 km)	Specific area or on road side	Prohibited or on pavement, and cycle lane	Authorized, separate stops or on road side
Distributors	Connection between villages/towns and access to/from national/regional network	3	Road	48*/50 – 90/97*	At least 2*1 or 1*2, separate road ways or no	Lanes can be narrowed to limit the speed	Traffic lights, roundabout, priority rule	High	On road side	Pavement, cycles and mopeds on road or on a specific lane	Authorized, separate stops or on road side
Local distributors – Inner exchange and local traffic	Roads through villages, and occasional access to properties such as farms	2	Road	50/48*, 70	At least 2*1 or 1*1 lane if one way road	Narrow	Roundabout, priority rule or traffic lights	High	On road side	Pavement, cycles and mopeds on road	Authorized, stops on road side or on road
Access roads – Local traffic.	Access to properties, residential roads	1	Road, cul-de-sac, side road	≤ 50/48*	At best 2*1 lanes	Narrow	Priority rule	–	On the street	Pavement, cycles and mopeds on road	No

Table 11: Rural road classification

(1): the “semi-motorway” is a particular case of the rural motorway. It presents an alternation of road segments (distance of 2-3 km), with 2 lanes in one way and 1 lane in the opposite way.

2.2.3.2. Name convention and pictures

To name in a convenient way the resulting road classes, it was proposed to use the underlined terms. An indicative proposal was provided in Table 12. Language corrections proposed by TRL have been added.

A set of illustrative pictures is proposed in Annex 9. Such photos should help model's user in the understanding of the current definitions.

	Level	Short Name for the appellation	<i>Corrections suggested by TRL</i>
Urban	5a	National / regional motorway	
	5b	National / regional trunk road	
	4a	City or urban motorway	
	4b	City primary road, major arterial	
	3	Districts distributor, inter district road	
	2	Local distributor, neighbourhood road	<i>Local distributor</i>
	1	Access road	<i>Local access</i>
Rural	5	National / regional motorway	
	<i>of which:</i>		
	5s	<i>Semi-motorway</i>	
	4	National / regional trunk road	
	3	Distributor, inter village road	
	2	Local distributor, through village road	
	1	Access road	

Table 12: Urban and Rural road classification – Name convention

2.2.3.3. Speed limits

The inventory of the in-use speed limits in Europe led to a quite large number of figures for each of the previously defined road categories (Table 13). For simplification, the English speed limits have been approached by equivalent cases (as the impact of such simplification on the emissions should be low and very likely below the inaccuracy). Although the speed limit can vary between 5 and 50 km/h for the residential roads (local roads, access roads) in urban area, due to the marginal aspect of such very low speeds (with respect to the traffic volume in particular), a limited range was considered (30 and 50 km/h).

That proposal – resulting mainly from the review and compilation of documents related to the European practices – was discussed, and suggestions of extension were agreed. These extensions are shown in Table 14. They consist mainly in the extension of the minimal speed limit for nearly each of the road category and several increase of the upper limit, as such cases were considered as probable throughout Europe.

We should however keep in mind that such extension should increase the complexity of the

traffic situation scheme, and furthermore the difficulty to get speed data corresponding to an increasing number of cases.

Area	Level	Road type	Range of speed limit (km/h)				
Urban	5a	National/Regional motorway	130	120	113*/110		
	5b	National/Regional trunk road	97*/90	80			
	4a	City or urban motorway	113*/110	100	97*/90	80	
	4b	City primary roads, major arterials	97*/90	80	70	60/64*	50/48*
	3	Districts distributor, inter districts roads	70	60/64*	50/48*		
	2	Local distributors, neighbourhood roads	50/48*				
	1	Access roads	50/48*	40	30		
Rural	5	National/Regional motorway	> 130	130	120	113*/110	
	4	National/Regional trunk road	113*/110	100	97*/90	80	70
	3	Distributors, inter villages roads	97*/90	80	70	60/64*	50/48*
	2	Local distributors, through village roads	70	60/64*	50/48*		
	1	Access roads	< 50/48*				

*: UK speed limits: 70 mph = 113 km/h; 64 mph = 103 km/h,
60 mph = 97 km/h; 30 mph = 48 km/h

**: Speed limit on German motorway for PC

Table 13: Range of speed limits for the ARTEMIS road classification

Level and road category		Initial range (km/h)	Extended range
5a	Urban – National / regional motorway	110 – 130	80 – 130
5b	Urban – National / regional trunk or main road	80 – 90	70 – 100
4a	Urban – City or urban motorway	80 – 110	60 – 110
4b	Urban – City primary road, major arterial	50 – 90	50 – 90
3	Urban – Districts distributor, inter district road	50 – 70	50 – 80
2	Urban – Local distributor, neighbourhood road	50 –	50 – 60
1	Urban – Access road	30 – 50	30 – 50
5	Rural – National / regional motorway	110 – 150	80 – 150
4	Rural – National / regional trunk or main road	70 – 110	60 – 110
3	Rural – Distributor, inter village road	50 – 90	50 – 100
2	Rural – Local distributor, through village road	50 – 70	50 – 80
1	Rural – Access road	50 –	30 – 50

Table 14: Speed limits: extension envisaged

2.3. Traffic condition or traffic-flow level

We analyse hereafter the taking into account of the traffic conditions, or traffic levels (or Level of Service) which is probably the main parameter influencing the pollutant emissions through the driving conditions. In this aim, we review different ways to describe this parameter.

2.3.1. Different ways to consider the flow level

In the above, the flow level appears to be a main parameter describing the traffic situations. Various ways can be envisaged to describe it. In the Swiss Handbook (Keller et al. 1995), we had the 3 levels "free-flowing, dense and stop and go". In others traffic related works, we find an other classification in "steady flow, unsteady flow and congested", that could correspond to a more realistic approach (or more user-oriented) and that is based on speed versus traffic flow chart such as the one illustrated in Figure 7.

	Traffic condition 1	Traffic condition 2	Traffic condition 3
Swiss Handbook approach:	Free-flowing	Dense traffic	Stop & go
"Certu" flow levels:	Steady flow (high average speed)	Unsteady flow (variable speed)	Congested flow (very low speed)

Table 1: Two ways for characterising the traffic flow (Poize, 2002)

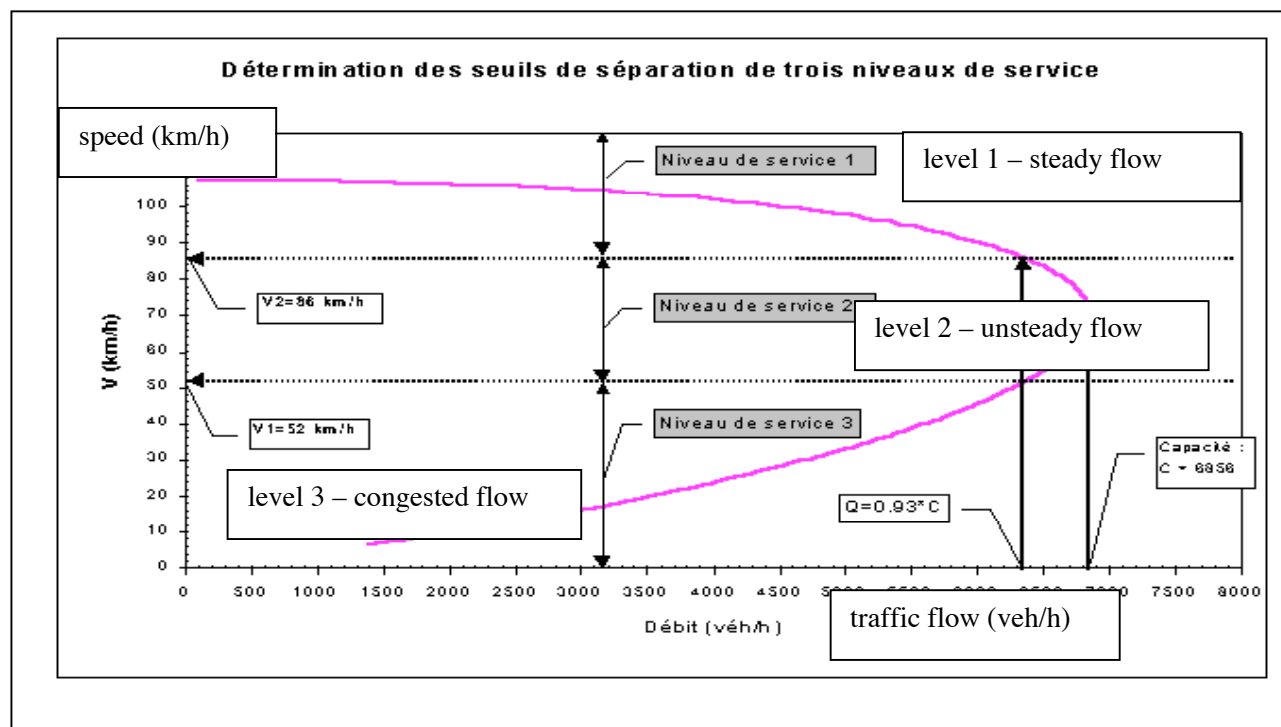


Figure 7: A scheme in 3 different levels of service, described in speed and traffic flow

2.3.1.1. HCM definition

According to the US Highway Capacity Manual (HCM, 2000), the Level of Service (LOS) is: “a qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience”.

The US Highway Capacity Manual defines six levels (A to F), with different definitions for different road categories. LOS A represents the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions (Table 15).

This definition is very detailed and would enable a sufficiently strict and well-documented definition of the traffic conditions. Furthermore that definition is well known and used by the traffic engineers and implemented for the design of the roads.

Level of Service	Description
A	Completely free flowing conditions. The operation of vehicles is virtually not affected by the presence of other vehicles. Minor disruptions to flow are easily absorbed without a change in travel speed
B	Free flow, although the presence of other vehicles becomes noticeable. Average speeds are the same as in LOS A, but drivers have slightly less freedom to maneuver. Minor disruptions are still easily absorbed, although local deterioration in LOS will be more obvious.
C	The influence of traffic density on operations becomes marked. The ability to maneuver within the traffic stream is clearly affected by other vehicles. The travel speed reduce somewhat. Minor disruptions can cause serious local deterioration in service, and queues will form behind any significant traffic disruption.
D	The ability to maneuver is severely restricted due to traffic congestion. Travel speed is reduced by the increasing volume. Only minor disruptions can be absorbed without extensive queues forming and the service deteriorating.
E	It represents operations at or near capacity, an unstable level. Vehicles are operating with the minimum spacing for maintaining uniform flow. Disruptions cannot be dissipated readily, often causing queues to form and service deterioration to LOS F. For the majority of multilane highways with FFS between 70 to 100 km/h, passenger car mean speeds at capacity range from 68 to 88 km/h but are highly variable and unpredictable.
F	It represents forced or breakdown flow. It occurs either when vehicles arrive at a rate greater than the rate at which they are discharged or when the forecast demand exceeds the computed capacity of a planned facility. Although operations at these points appear to be at capacity, queues form behind these breakdowns. Operations within queues are highly unstable, with vehicles experiencing brief periods of movements followed by stoppages. Travel speeds within queues are generally less than 48 km/h/ Note that the term LOS F may be used to characterize both the point of the breakdown and the operating condition within the queue.

Table 15: Definition of LOS for multilane highways (HCM, 2000)

2.3.1.2. CERTU proposition

Traffic flow data and road capacity are generally associated with the road type as illustrated in (Table 16). Trucks and tractors are accounted, considering equivalence (according to CERTU, one truck or tractor is equivalent to 2.8 cars). Levels of Services can thus be defined in relation with these indicators.

Road type	Flow of service (veh/h/lane)	Capacity (veh/h/lane)
VCA connection (motorway)	1500	1800
VCA urban (motorway)	1800 – 2000 (updating in progress)	2200 – 2400 (updating in progress)
VCR inter urban (High speed road)	600	800
VCR urban (High speed road)	1000	1400
VCM (“Mastered” traffic)	800 – 1000	1000 – 1200

Table 16: Data of flow and capacity for road of level 1 proposed by the CERTU (Lhuillier, 2004)

Four Levels of Service are so defined for the main urban roads (level 1) by CERTU (Table 17), establishing also equivalence with the HCM levels.

LOS 1 is a mix of LOS A and B from HCM, LOS 2 is a mix of LOS C and D from HCM. Such classification could be more practical than the quite complex HCM definition. Speed and traffic-flow measurements conducted on many roads (CERTU, 1999) enabled to set-up the thresholds for discrimination of the fourth Level of Service levels. These thresholds were respectively at 90 percent and 75 percent of road capacity.

Level of Service	Description	LOS Equivalent in the HCM
1	Free flowing conditions. Constant speed	A and B
2	Free flowing / heavy traffic conditions. Constant speed	C and D
3	Heavy flow, highly unstable beginning of congestion. Speed not very high but always constant.	E
4	Heavily congested flow, stop and go/ gridlock. Speed not constant.	F

Table 17: LOS on motorway proposed by the CERTU (Lhuillier, 2004)

2.3.2. Comparison of traffic condition schemes

Table 18 compares different schemes in traffic conditions. In fact, it appears that the existing classifications and the resulting “scales” of congestion are not really coherent. It appears also that the level F of the HCM (HCM, 2000), or the equivalent in other classifications (with ranges of speed in the order of 50% of the free speed and vehicle density about 30 veh/km/lane, i.e. 1 vehicle every 30 m) seems quite far from what we call stop-and-go (stop-and-go driving cycles identified in Artemis have speed level of less than 10 km/h). It is maybe not surprising as far as such classification is rather established for the design of road (i.e. to assume a certain traffic volume in satisfying conditions and not to manage the possibly resulting congestion).

Switzerland	Certu (F)	Finland (Finra, 2000)	TNO (comments)	US, HCM (PIARC 1999)	Certu (2004)
Free-flowing	Steady flow, high speed (86–110 km/h)	Free flowing	2e: Speed >120 km/h, independent of traffic volume	A: Free flow, low traffic and high speed (> 90 km/h)	Free flowing conditions, constant speed (LOS A–B)
			2c–2d: 75–120 km/h traffic flow < 1000 veh/lane/h	B: Reasonably free flow but speed begins to be hampered by the traffic (80 – 90 km/h)	
Dense	Unsteady flow, variable speed (52–86 km/h)	Heavy traffic	2a–2b: 75–120 km/h traffic flow > 1000 veh/lane/h	C: Steady flow but most drivers are tempered in the freedom of choice of their own speed (70 – 80 km/h)	Free flowing, heavy traffic conditions, constant speed (LOS C–D)
			1c: 40–75 km/h	D: Nearing unsteady flow. Drivers have little choice of their own speed (60–70 km/h)	
	Congested flow, very low speed (< 52 km/h)	Slow traffic	1b: 25–40 km/h	E: Unsteady flow, sometimes short stops (<60 km/h)	Heavy flow, highly unstable, congested traffic, low but constant speed (LOS E)
			1a: 1aa+1ab (0–25 km/h)	F: Unacceptable congestion (<48 km/h)	
			- 1ab: 10–25 km/h		
Stop and Go		Queuing traffic	- 1aa: Speed < 10 km/h; stop and go		Heavily congested flow, stop and go or gridlock, very low and variable speed
		Stationary traffic			

Table 18: Different structures in traffic conditions or Level of Service (and range of speeds when examples are associated)

2.3.3. Traffic condition definition – proposal for ARTEMIS

Three levels were initially proposed such as:

- Free-flowing, dense, stop-and-go (Poize, N., 2002),
- Steady flow (high speed), unsteady flow (variable speed), congested flow (low speed) (André et al. 2002).

From that basis, we have discussed also the possibility of using the existing classifications such as the Level of Service (Highway Capacity Manual), and consequently to associate related indicators such as the vehicle flow or density. A 4th level was also suggested, as such level should enable us identifying clearly the stop and go from the saturated flow.

With a certain coherence with the recent French works on that topic, it was thus proposed to consider 4 levels of service or traffic conditions in the Artemis project and tools (Table 19) as follows :

- Clearly the **stop-and-go** situation (also queuing traffic) as this case is quite easy to deal with: driving cycles exist already for urban and motorway, and in term of driving patterns, this situation is probably quite similar for all the urban road categories on one side, and for all the main rural road and motorways on the other sides. Such condition should correspond to speed below or in the range of 10 km/h.
- The **free-flowing condition**, enlarged (as in the French Certu proposal, Lhuillier, 2004) to the free-flow with some traffic interaction (i.e. an average speed which would range between 85-100% of the free speed - or possibly higher). That condition

corresponds roughly to the HCM levels of service A and B.

- The free-flowing with **heavy traffic**, with constraint constant speed (in the range 65-85% of the free speed) and corresponding to the HCM LOS C-D,
- The **unsteady flow**, quite **saturated traffic** (HCM LOS E and even worst), variable speed with possible stops (speed in the range of 30 to 60% of the free speed).

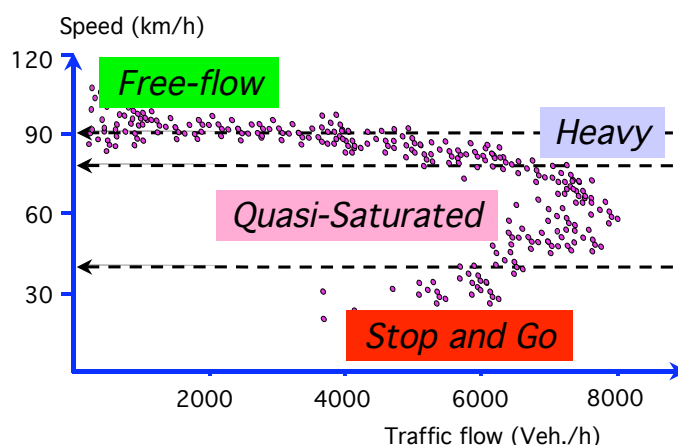


Figure 8: Four levels of service according to speed and traffic capacity (Lhuillier 2004)

Traffic condition and description		Indicative speed range (km/h)	
		110 km/h motorway	50 km/h road
1	Free-flow conditions, low and steady traffic flow. Constant and quite high speed.	90 – 120	45 – 60
2	Free flowing with heavy traffic . Constraint but quite constant speed.	70 – 90	30 – 45
3	Heavy and unsteady flow quite saturated traffic . Variable intermediate speeds, with possible stops.	30 – 70	15 – 30
4	Stop and go . Heavily congested flow, stop and go or gridlock. Variable and low speed and stops.	5 – 30	5 – 15

Table 19: Traffic conditions proposed for ARTEMIS and illustrative speed range for 2 contrasted cases

Such a scheme follows roughly the CERTU assumption and proposal for a classification into 4 levels of traffic flows (Figure 8).

For the urban area, the 4 traffic conditions should be considered for each road configuration. We can however envisage a simplification into 2 levels (free-flowing and heavy flow or congested) for the local distributors, and even in one single case for access roads.

In rural area, the 4 levels should be considered for the 2 or 3 upper road configuration. Local distributors and access road can be considered with one average free-flowing traffic.

We suggest also associating indicative figures of traffic flow (veh/h/lane or veh/h) to each combination of road configuration and traffic condition. Such data can be derived from existing

measurements (Table 20).

Urban road category (or level)	Data in urban area by the CERTU (Lhuillier, 2004)		Data in urban and peri-urban area (André, 2002)	
	Flow of service (veh/h/lane)	Capacity (veh/h/lane)	Urban area Flow of service (veh/h/lane)	Peri-urban area Flow of service (veh/h.lane)
5	1800 – 2000 (updating in progress)	2200 – 2400 (updating in progress)	1800 – 2000	1800 – 2000
4	600 – 1000	800 – 1400	1200	1600 – 2000
3	800 – 1000	1000 – 1200	800 – 2000	800 – 1500
2			300 – 700	< 100
1			30 – < 100	< 100

Table 20: Urban traffic flow and capacity data measured by CERTU and proposed by André, 2002

Indicative average speeds were also estimated for each speed limit (on the basis of the previous assumption regarding speed and traffic flow level). These figures were however estimated independently of the road category and that simplification could limit their validity. These figures are recapitulated in Table 21. We assume by that way that a free-flow traffic could have an average speed ranging from 111 and 130 km/h when the speed limit is 130 km/h and an average speed of 60-70 km/h when the limit is 70 km/h. On the other hand, the stop and go speeds would be in the range of 30 km/h on a high speed road, below 20 km/h on a 70 km/h road, and below 15 km/h when the speed limit is below 50 km/h.

Speed Limit (km/h)	Traffic condition (level of service)							
	Free-flow traffic		Heavy traffic		Near-saturated		Stop and go	
130	111	130	85	111	39	85	≤ 39	
120	102	120	78	102	36	78	≤ 36	
110	94	110	72	94	33	72	≤ 33	
100	85	100	65	85	30	65	≤ 30	
90	77	90	59	77	27	59	≤ 27	
80	68	80	52	68	24	52	≤ 24	
70	60	70	46	60	21	46	≤ 21	
60	51	60	39	51	18	39	≤ 18	
50	43	50	33	43	15	33	≤ 15	
40	34	40	26	34	12	26	≤ 12	
30	26	30	20	26	9	20	≤ 9	
<i>Suggested interval (% of speed limit)</i>	<i>85%</i>	<i>100%</i>	<i>65%</i>	<i>85%</i>	<i>30%</i>	<i>65%</i>	<i>< 30%</i>	

Table 21: Indicative average speeds according to the speed limit and within 4 different traffic conditions.

2.4. Sinuosity and Gradient

Apart from the general definition of the roads, 2 complementary parameters require to be considered: the road gradient due to its strong incidence on emissions or fuel consumption (particularly for the heavy vehicles), and the sinuosity that influences strongly the driving conditions in rural area (occurrence of deceleration and acceleration). These 2 parameters are linked as sinuosity is generally observed in mountainous area, and as strong gradients imply a high sinuosity (André et al. 2005).

Initially, (Keller, M. & al., 2003) proposed a quantitative approach in considering gradient classes both with signs (e.g. -6%, -4%, -2%, 0%, +2%; +4%, +6%) for meso-scale model, and without signs (e.g. $\pm 0\%$, $\pm 2\%$, $\pm 4\%$, $\pm 6\%$) for macro-scale application. However, such proposition should be pertinent only for very local application, for which the detailed gradient can be associated with the road links. It was also proposed to neglect sinuosity in urban, because the curvature had a low impact on speed (compared to the incidence of the junctions, congestion and other urban parameters, etc.) and therefore on pollutant emissions in urban area. In a similar way, the sinuosity should be taken into account for main roads and motorways in rural areas, and can be neglected on local / access roads.

For national or regional estimation, (André et al. 2002) proposed rather a qualitative approach (i.e. non-sinuuous or straight road and sinuous, flat, hilly, mountainous) possibly associated with macroscopic quantitative indicators (sum of successive angle changes per kilometre in radians/km, sum of changes in height in m/km⁶). Indeed the gradient, (signed or not, i.e. +4% or $\pm 4\%$) is not satisfying except when it is applied at a very local scale (one road short section). Due to the high variability of the local gradient (see below and Figure 9), its use at a larger scale (one trip, one itinerary or a part of a road network) would have no real meaning.

Bjorketun proposed indicators describing sinuosity (sum of successive angle changes per kilometre in radians/km, in 3 classes (Table 22) and gradient (sum of changes in height in m/km, in 3 classes) and analysed the Swedish roads as regards these classes (Bjorketun, 2003). The alignment measurements obtained from the National Road Administration Information Bureau were used to classify the road links in three groups, with respect to sinuosity and gradient.

Sinuosity / gradient	< 10 meters/km	10-30 meters/km	≥ 30 meters/km
< 0,5 radians/km	24	15	<u>0.3</u>
0,5-1,25 radians/km	16	28	<u>0.8</u>
$\geq 1,25$ radians/km	4	12	1.4

Table 22: Sinuosity and gradient classes to describe the Swedish roads (Bjorketun, U., 2003) and distribution of the roads (in % of km) and possible simplification

⁶ Furthermore, it seems that such indicators are used by the World Bank, (i.e. Rise and Fall for gradient and Average Degree of Curvature) to express road geometry statistics

From the Swedish analysis, we can also observe that sinuosity and gradient are to a certain extent linked: high gradient means sinuous (except on motorway). We could thus simplify the question in 3 or 4 cases such as :

- 1 (F): flat and non-sinuous (or slightly sinuous, without a strong incidence on the speed), recapitulating the 4 green cells, bold italic,
- 2 (R): hilly straight roads (long ramp on main roads and motorways only, 2 italic underlined cells),
- 3 (H): hilly and sinuous (2 bold blue cells),
- 4 (M): mountainous and strongly sinuous (pink, bold underlined cell).

However, such classification – based only on the Swedish data, with rather flat relief - should be adapted for other European countries, or areas such as the Alps, etc.

To complete these elements, INRETS has thus monitored specifically a vehicle equipped with a GPS and speed sensor, on 3 itineraries through the Alps and one in a hilly area near Lyon (see Annex 3). The recorded data (Figure 9) highlighted well the high variability of the gradient over short distance, and then underlined the above remark on the difficulty to deal with gradient at a local scale. Others illustrations are also provided in Annex 1

One should note that the calculation of the sinuosity and the gradient indicators from the GPS were not immediate and required on one hand an integration over a 100 m travelled distance (to get consistent figures) and on the other hand a filtering due to the mask and echo / reflection effects that can be encountered in a mountain area. The resulting figures in (Table 23) were quite consistent with the above classification. However the Alps typical situation showed figures that were significantly higher than the upper limit of the Swedish proposal (45-66 m/km and 1.5-2 radians/km). Thus, it should be preferable to extent the previous classification to typical cases such as the Alps situation, providing that driving data and emission correction exist for these situations.

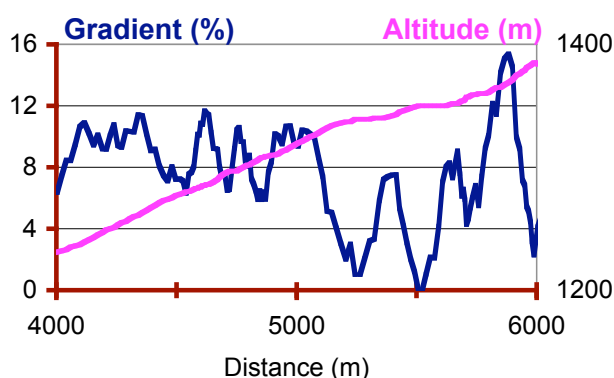


Figure 9: Variability of the gradient measured over a 2 km uphill trip (experimental data recorded in the Alps)

Trip	Identi- fication	Rise & Fall (m/km)	Angle (radians/km)	Distance travelled (m)	Height difference (m)	Average gradient (%)	Average gradient (m/km)
D213 – Barrage – 2-Alpes	100001	60	1,94	8607	519	6,0	60
	100010	67	1,95	8584	564	6,6	66
N85 (hilly)	00101	14	1,10	11870	139	1,2	12
	00110	14	1,02	11575	140	1,2	12
Bourg d'Oisans – Barrage	100011	26	1,39	13170	232	1,8	18
	100111	34	1,48	13136	322	2,5	25
La Grave – Monetier	100101	48	1,47	23096	557	2,4	24
	100110	46	1,46	23173	555	2,4	24

Table 23: Sinuosity and gradient indicators measured in the Alps and in a hilly area near Lyon

A discussion around these elements was conducted in the frame of COST346. This led to the proposal of considering a 5th category (Flat and sinuous, for which the sinuosity can have an influence on the speed). The final proposal is then shown in Table 24. That complementary category was however not taken into account during the Artemis work (speed data collection and affectation to the different traffic situations). We have then a certain distorsion between that structure and the data.

1	Flat and non-sinuous	Low sinuosity without influence on the speed
2	<i>Flat and sinuous</i>	<i>Sinuosity with influence on the speed</i>
3	Hilly straight roads	Long ramp on main roads and motorways
4	Hilly and sinuous,	
5	Mountainous and strongly sinuous	of which the Alps are a particular case

Table 24: Gradient and sinuosity typology

COST346 concluded also on a complementary approach, using local gradient (from –10 % to + 10%). The two approaches (area-wide: flat / hilly / mountainous / and local by gradient) should thus be implemented in the Artemis tools.

However, for very local estimation, the possibility to consider local gradient remains a challenge, as it would require a large quantity of data (driving data for each step of gradient).

2.5. ARTEMIS Traffic Situation Scheme – Overall form

The previous assumptions and the different structures and parameters that have been retained (i.e. areas and roads classification, traffic conditions, sinuosity and gradient), result in a quite complex Traffic Situation Scheme, which is recapitulated hereafter.

Furthermore, complementary “traffic situations” are proposed to enable an easiest application of the traffic situation approach. These complementary situations did not results from the previous process of elaboration but were directly adapted from the Artemis driving cycles.

2.5.1. General form of the traffic situation scheme

A reasonable scheme (shown in Table 25) included already 269 cases, without considering the extension for the speed limits (mentioned in Table 14). That was already significantly higher than in the previous proposals (Chapter 1). The following simplifications were already implemented in that scheme:

- The English speed limits have been approached by equivalent European speed limits (low impact on emissions),
- Only 4 qualitative categories were retained combining sinuosity and gradient,
- Sinuosity and gradient were neglected in urban and on local rural roads,
- The taking into account of the traffic conditions was limited to 2 or even 1 cases for the local and access roads.

After discussion, a slight adjustment was agreed, which consisted in considering at 4 traffic conditions in most cases and 3 conditions (free-flow, saturated and stop and go) instead of 1 or 2 for the previously mentioned local and access cases. That led to an increase by 30 complementary traffic situations.

Furthermore, the extension with respects to complementary speed limits (as envisaged previously, see Table 14) led to a considerable increase of the number of traffic situations (up to 480) as shown in Table 26.

			Sinuosity/Gradient				Level of Service				Total
Area	Road level and categorie	Speed limit (km/h)	Flat, non-sinuous	Hilly straight road	Hilly, sinuous	Mountainous, sinuous	Free-flow	Heavy traffic	Saturated traffic	Stop and go	Total
Urban	5a National / regional motorway	130 120 113*/110					✓	✓	✓	✓	12
	5b National / regional trunk road	97*/90 80					✓	✓	✓	✓	8
	4a City or urban motorway	113*/110 100 97*/90 80					✓	✓	✓	✓	16
	4b City primary road, major arterial	97*/90 80 70 60/64* 50/48*					✓	✓	✓	✓	20
	3 Districts distributor, inter district road	70 60/64* 50/48*					✓	✓	✓	✓	12
	2 Local distributor	50/48*					✓			✓	2
	1 Local access	50/48* 40 30					✓			✓	6
Rural	5 National / regional motorway	> 130 130 120 113*/110	✓	✓	✓	✓	✓	✓	✓	✓	64
	4 National / regional trunk road	113*/110 100 97*/90 80 70	✓	✓	✓	✓	✓	✓	✓	✓	80
	3 Distributor, inter village road	97*/90 80 70 60/64* 50/48*	✓		✓	✓	✓			✓	30
	2 Local distributor, through village road	70 60/64* 50/48*	✓		✓	✓	✓			✓	18
	1 Access road	< 50/48*					✓				1
total										269	

*: UK speed limit: 70 mph = 113 km/h, 64 mph = 103 km/h, 60 mph = 97 km/h, 30 mph = 48 km/h

Table 25: Artemis proposal for a Traffic Situations Scheme per road category

			Sinuosity/Gradient				Level of Service				Total
Area	Road level and categorie	Speed limit (km/h)	Flat, non-sinuous	Hilly straight road	Hilly, sinuous	Mountainous, sinuous	Free-flow	Heavy traffic	Saturated traffic	Stop and go	Total
Urban	5a National / regional motorway	130 120 113/110					✓	✓	✓	✓	12
	5b National / regional trunk road	100 97/90 80					✓	✓	✓	✓	12
	4a City or urban motorway	130 120 113/110 100 97/90 80 70 60/64					✓	✓	✓	✓	32
	4b City primary road, major arterial	100 97/90 80 70 60/64 50/48					✓	✓	✓	✓	24
	3 Districts distributor, inter district	100 97/90 80 70 60/64 50/48					✓	✓	✓	✓	24
	2 Local distributor	80 70 60/64 50/48					✓		✓	✓	12
	1 Local access	50/48 40 30					✓		✓	✓	9
Rural	5 National / regional motorway	> 130 130 120 113/110 100 97/90 80 70 60/64	✓	✓	✓	✓	✓	✓	✓	✓	144
	4 National / regional trunk road	113/110 100 97/90 80 70 60/64 50/48	✓	✓	✓	✓	✓	✓	✓	✓	112
	3 Distributor, inter village road	100 97/90 80 70 60/64 50/48	✓		✓	✓	✓		✓	✓	54
	2 Local distributor, through village r	80 70 60/64 50/48	✓		✓	✓	✓		✓	✓	36
	1 Access road	50/48 40 30					✓		✓	✓	9
total										480	

Table 26: Artemis Traffic Situations Scheme: Adjustment and extension to complementary speed limits

Furthermore, one should note that the presented scheme does neither include the taking into account of specific situations (such as the Alps or the semi-motorways for instance) nor the combination of the individual traffic situation with local gradient (from -10% to +10%, by step of 2%).

However, several simplifications were envisaged to reduce this complexity (i.e. the large need of driving data associated to each of the traffic situations), as follows:

- In the above scheme, we can limit the number of stop and go cases (the minimum being 2 distinct cases for urban and rural) and apply the retained cases to all the other situations. In that way, a maximum of 80 cases from the 269 cases scheme, or 128 cases for the 480-scheme can be easily solved with respect to the driving data requirement.

- We can also assume similarities of the heavy traffic conditions, in urban area for a certain number of cases (which are close with respect to speed limit), and the same kind of assumption can be done for rural conditions.
- Urban 5a and 5b (National / regional motorway and trunk road) situations are similar to Rural 5 and 4. On the same way, and rural 2 and 1 (local and access roads) can be assimilated to urban 2 and 1 (in all about 19-25 cases can thus be simplified).
- It is not necessary to consider simultaneously strong gradient and sinuosity and congested conditions, particularly in rural area, as this situation should be extremely rare.

However, these simplifications remained obviously linked to the ability to provide speed data behind all these configurations.

Complementary remarks:

- The decrease of the traffic situation number (by assimilation of similar road categories, etc.) could have been another way to limit the complexity of the traffic scheme. Such a solution is not pertinent as the scheme was elaborated from a user or at least from a traffic engineering point of view. It is rather preferable to preserve the scheme (with its operational character) and to manage links between cases that would be comparable from our point of view. Typically, the possible groupings of 5a and 4a (motorway in an urban area and urban motorway) and of 5b and 4b (national main road and urban main road in an urban area) are not pertinent as these road categories differ significantly according to the area (inter-junction distance, traffic, etc.).
- *urban / rural* and *urban / rural / motorway coherency*: In the previous methods and tools (MEET, COPERT) the emissions were estimated according to a “*urban / rural / motorway*” scheme, while a discrimination in urban / rural and road categories is proposed here. Fortunately, the traffic situation scheme is sufficiently disaggregated to enable both estimations (and thus continuity with the ancient estimations) providing that the mileage distribution is known.

2.5.2. Complementary “traffic situations”

It was proposed to consider the Artemis cycles and sub-cycles (for the passenger cars) as well as other relevant test cycles as complementary and particular “traffic situations”, although these driving conditions do not follow the previous way of defining traffic situations. Indeed, their use should enable an easiest application of a “traffic situation approach”, as these cycles are already associated with speed versus time curves, with a distribution with respect to the total travelled mileage, and also with measured pollutants emissions.

These particular traffic situations constitute thus a special case, which should enable thus the most direct and easiest application for an emission estimation, providing that we can analyse a case study with respect to these particular situations.

These specific cases include the Artemis cycles and sub-cycles for passenger cars, as well as particular cycles or combination of cycles identified Chapter 5, section 5.1. In theory, any

driving cycle can be considered, for any vehicle category.

2.6. Conclusion

The definition of traffic situations was the object of consequent work, of a large review of the European practices and of long discussion within the ARTEMIS and COST346 projects and also with traffic engineers.

The urban / rural definition was proposed in the following of the numerous international works and recommendations on that topic. Furthermore the notion of urban functional entity seemed particularly pertinent as the traffic is mainly generated and managed at such a scale.

Detailed urban and rural road classifications were defined following the in-use functional classification and the hierarchical road network management. These definitions should be relatively coherent with the European practices in traffic management.

A proposal regarding the traffic conditions definition into 4 classes was also elaborated. A qualitative taking into account of the road topography (gradient) and sinuosity was proposed.

The resulting traffic situation scheme is relatively complex but it relies on rigorous bases. It should constitute the basic structure for the elaboration of an emission estimation approach at a local scale. The next steps should consist in acquiring the necessary data for that structure (i.e. speed data for each traffic situation) and in building-up a method for calculating the emissions at that level.

3. Speed statistics for European countries

An accurate and detailed knowledge of the actual driving speeds is fundamental for emission estimations and inventories. In fact, emissions can be affected by 30% by the quality of the driving speed data (André et al., 2000).

Varied information is available through measurements, surveys and modelling. However, it is often limited to average speed values. Speed distribution and speed profiles (or speed x acceleration matrices) can be obtained from instrumented vehicles but the data are often heterogeneous and not compatible with the degree of detail that would be needed

In this section, we give an overview of the speed data obtained from different sources e.g. European projects, national studies, etc., and we highlight the difficulties to obtain detailed speed data. We note that the road types used in this report are generally the names from the related references and not according to the classification and definition discussed earlier.

Due to the need of detailed speed information for the traffic situation approach (i.e. speed versus time curves), this chapter does not provide directly applicable data or results, but should be seen rather as a source of information or a guide for the application of speed or speed ranges according to various factors and contexts. Complementary results were also reported in (Poize, 2002). The next chapter will be dedicated to the provision of speed data applicable for the traffic situation approach.

3.1. European projects

3.1.1. MASTER project

The task of the MASTER project was to provide recommendations for speed management strategies and policies, and develop guidelines for the development of innovative speed management tools. As a part of this project a questionnaire survey was conducted in order to collect information on speed levels on European roads. This study shows that actual speeds are measured in many European countries, even if the results are usually not published and are difficult to obtain and compare. Systematic data collection does not, however, cover speed data in different road surface conditions, traffic densities, visibility, weather conditions, etc. Those data are only collected for specific experimental purposes (Draskoczy et al. 1997).

Actual speeds are in a high percentage over the speed limit in most of the European countries, especially in low speed urban areas and on motorways. Actual speed data also indicate that although the introduction of lower speed limit can reduce speeds, speeds can start to increase

soon after a short transitory period (MASTER, 1998).

The survey shows that there is a lack of data on actual speeds by road category. Systematic data collection is not carried out in many European countries, and different indicators are used for speed measurements. The most comprehensive data were obtained from the UK. Some data were obtained from Austria, Portugal, Finland, Netherlands, Israel and Sweden (see Table 27).

Country	Time period	Vehicle type	Road type
Austria	1996	PC	Built-up area, rural main road and motorway
Finland	1995	All vehicles	Rural roads
Netherlands	1996	All vehicles, slow vehicles, bicycles	Two lane rural roads

Table 27:: Example of speed data from the MASTER project

3.1.2. MEET project

The available statistics from different European countries provide a high number of reference values for passenger cars and duty vehicles by broad categories and highlight the influence of numerous factors on speed (road characteristics, weather conditions, time-period, gradient, etc). The significant variations in the speed according to the day-time, to the areas of a city, and the wide spread of the values for a given situation raise the question of using a single average value rather than a distribution and its impact on emission estimation (André et al., 1999).

A network and traffic assignment model based on Swedish data has been used to estimate speed as a function of vehicle types, road configuration (urban or rural roads, motorway, junction density) and traffic flows. Such a tool allows the estimation of local speeds even for a whole network. The proposed figures and the speed measurements - corresponding to a road and traffic classification in Switzerland and Germany -, provide a large set of reference data for cars and duty vehicles.

A survey of traffic related data has been carried out in Europe in the frame of the COST319 action and of the MEET research project. This survey has allowed the characterisation of the statistics and has revealed a lack of data on experienced speeds with a satisfying level of description. There are various but partial statistics in some countries. The various types and sources of speed information were described by (André M. & al., 2000) as presented in Table 28.

Type of data	Speed estimation for : Cities / Countries	Type of information (road types, areas, time periods)	Vehicle categories
Local measurements	France, Great-Britain	By road types (rural area) – mean values over large periods	Passenger cars, heavy vehicles
Vehicle instrumentation in cities	London (UK), Thessaloniki (Gr), Graz (Austria), Amiens and Niort (F)	By types of streets, urban area – peak and off-peak hours – weekdays	Passenger cars
Large scale vehicle instrumentation	France, Germany, Great-Britain and Greece	Urban and rural areas – all time periods	Passenger cars
Large scale speeds measurement	Switzerland, Germany	Urban and rural – as a function of typical situations in terms of road type and traffic level	Passenger cars, heavy vehicles
Travel surveys	France	Urban area – by city sizes, by origin – destination – weekdays – peak, off- peak hours	Passenger cars
	France, Switzerland, Sweden	National average speed estimation	Passenger cars
Network and traffic assignment models	(Sweden data) – applied to a range of road and traffic conditions	By road types, urban and rural – as a function of traffic level	Passenger cars, heavy vehicles

Table 28: Data sources used for speed estimation (André et al., 2000)

Table 29 summarises the various passenger car speed estimations.

Sources of the estimation of the speed experienced by passenger cars	Overall average speed (km/h)
National Travel Survey (1981–82, 1993–94), France	34 to 37
National Travel Survey, Switzerland, 1994	42
National Travel Survey, Sweden, passenger cars (1995, 1996, 1997)	37 to 38
Passenger cars instrumentation –European research projects – in all of which Greece – France – UK – Germany	41 32 – 37 – 43 – 50
Passenger cars instrumentation 1983, 1989 in France	38 – 40
Light duty vehicles 1994 in France	37
Speed and traffic volume figures for Switzerland, 1990	49
European reference data for emissions inventory	
• Austria, Denmark, Finland, Germany, Luxembourg, Portugal, Spain,	51 to 58
• Belgium, France, Greece, Ireland, Italy, The Netherlands, Sweden, UK	40 to 47

Table 29: Comparison of national average speed estimations for light vehicles (André et al. 2000)

3.2. National data

3.2.1. Great Britain

3.2.1.1. National statistics

Table 30 gives the average speed of 4 wheel petrol cars by month and length of trip stage for 1999/2000 (The Stationery Office, 2001).

	Miles per hour/miles per gallon/percentage												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
Under 1 mile	6	6	6	7	6	7	6	6	6	6	6	6	6
1 to under 2 miles	11	10	10	11	11	11	11	11	11	11	10	10	11
2 to under 5 miles	15	15	15	15	15	16	15	16	15	15	15	15	15
5 to under 10 miles	21	20	21	21	21	21	21	21	21	21	21	20	21
10 to under 25 miles	29	28	29	29	28	29	27	29	29	28	28	28	28
25 to under 50 miles	37	35	36	36	38	37	36	37	38	37	36	37	37
50 to under 100 miles	44	44	44	45	44	42	40	43	43	43	44	45	43
100 miles and over	53	53	52	52	49	50	50	49	51	50	46	50	50
All lengths	25	25	25	26	26	26	25	27	26	26	25	25	26
Petrol consumption (miles per gallon)	29	29	29	30	30	31	32	31	30	30	30	29	30
Percentage of car distance travelled on long trip stages (50 miles or more)	21	23	20	24	22	25	25	27	26	25	20	23	24

Table 30: Average speed of 4 wheel petrol cars by month of year and length of trip stage: 1992/2000, GB

Traffic speeds and traffic levels were monitored in Great Britain at about 180 sites using automatic traffic counters (Transport UK, 2004). These are generally situated away from junctions, hills or sharp bends, at locations where traffic is likely to be free flowing and not near speed cameras. Distinction is made between ‘built-up’ (roads to which a 48 km/h⁷ mph or 64 km/h⁸ limit applies) and ‘non-built-up’ roads (other roads).

Non built-up roads

Percentage of cars exceeding the speed limit, by time of day

On motorways and single carriageway roads, the percentage exceeding the speed limit was highest at night and lowest during the peak periods. However on dual carriageways average speeds were highest between 6am and 7am and between 6pm and 7pm.

Weekday and weekend comparisons

There is evidence that speeds increase slightly at the weekend when traffic flows are lower and the proportion of heavy vehicles is much smaller. The proportion of vehicles exceeding the speed limit also generally shows an increase at weekends. For cars and LGVs this was most marked on motorways.

Built-up roads

Average car speeds by time of day

Although the automatic traffic detectors are generally located at places where the traffic is likely to be free flowing, some sites may have been affected by congestion during part of the day. In general, car speeds and the percentage exceeding the speed limit were slightly lower during the morning peak period when the traffic flow was heaviest and highest in early morning or late evening when traffic was lightest. On 50 km/h roads average car speeds varied at different times of the day between 50 km/h and 55 mph and on 65 km/h roads between 55 km/h and 65 km/h. At both speed limits the lowest average speeds occurred between 0800-0900.

⁷ 30 mph

⁸ 40 mph

Weekday and weekend comparisons

Average vehicle speeds were slightly higher at the weekend and a greater proportion of drivers exceeded the speed limit. This repeats the pattern shown by the results for non-built-up roads, reflecting the lower traffic volumes at the weekend.

Vehicle type	Road type	Average speed (km/h)	
		Weekday	Weekend
Cars	Motorway	114	117
	Dual carriage way	111	113
	Single carriage way	76	79
LGVs	Motorway	111	116
	Dual carriage way	109	111
	Single carriage way	76	79
Buses/coaches	Motorway	93	97
	Dual carriage way	92	95
	Single carriage way	71	74
Rigid $\frac{3}{4}$ axle	Motorway	85	87
	Dual carriage way	84	85
	Single carriage way	68	69
Articulated	Motorway	87	87
	Dual carriage way	85	85
	Single carriage way	71	74

Table 31: Vehicle speeds on non built-up roads by road type and vehicle type, Great Britain

Vehicle type	Road type (speed limit)	Average speed (km/h)	
		Weekday	Weekend
Cars	50 km/h	50	51
	65 km/h	58	60
LGVs	50 km/h	50	51
	65 km/h	58	61
Motorcycles	50 km/h	48	51
	65 km/h	60	63
Rigid $\frac{3}{4}$ axle	50 km/h	48	50
	65 km/h	56	60

Table 32: Vehicle speeds on built-up roads by road type and vehicle type, Great Britain

3.2.1.2. TRAMAQ project

The TRAMAQ (TRAffic Management and Air Quality) suite of projects was commissioned by the CLT Division of the Department for Transport in 1998. The overall aim of the research programme was to provide local authorities with technical advice and guidance to better understand the effects of traffic management on air quality in urban areas (see TRAMAQ 2006). Within this programme TRL Limited (TRL) was commissioned to undertake a study to assemble a database of vehicle operation profiles. This database was assembled using profiles for a range of vehicles (car, LGV, HGV and bus) and a range of traffic management schemes, which were used to develop traffic management specific drive cycles (TRAMAQ, 2006).

In total seven different types of traffic management were chosen: Bus lanes, Cycle lanes, Traffic calming - speed humps, Traffic calming – other, Mini roundabouts, One-way systems and Urban Traffic Control. Three control drive cycles were also developed using stretches of road with no traffic management present. These were urban congested, urban non-congested and suburban cycles. The speed traces of the 40 TRAMAQ drive cycles are given in a detailed report (Green et al. 2004). Figure 10 and Figure 11 show examples of speed data for control urban congested.

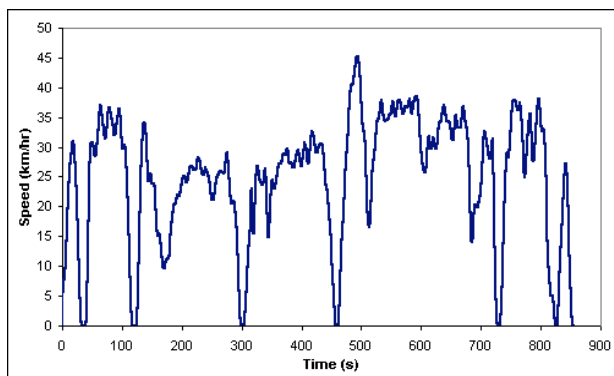


Figure 10: Cars-control urban congested

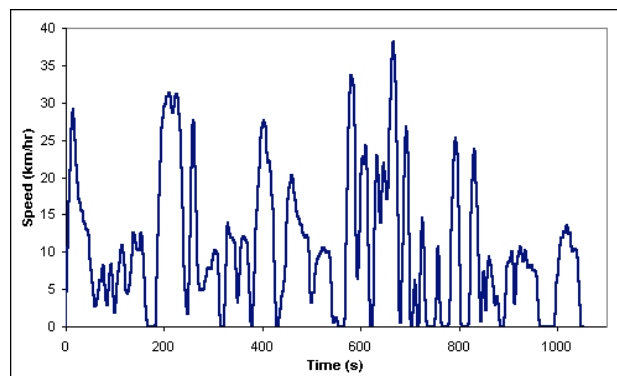


Figure 11: Bus-control urban congested

3.2.1.3. Review

A lot of studies provide speed data for passenger cars (PC), buses, coaches, motorcycles (2W) and HDV on different road types for a range of years. We present in Table 33 all studies available and detail the type of data available, for which vehicle types and on which road type.

Source	Time period	Vehicle type	Road type	Type of data
Department of the Environment Transport and the Regions	1993, 1999 and 2000	PC, buses and coaches	Motorways, single and dual carriageways	Not specify
TRANSTAT	1995 – 1997, 1998– 2003	PC, 2W, buses/coaches, HDV rigid (2, 3 and 4 axles) and articulated (4 and 5 or more axles)	Motorways, single and dual carriageways Built-up and non built-up area	Automatic traffic counters, situated away from junctions, hills or sharp bends, at location where traffic is likely to be free flowing

Table 33: Review of available speed data in Great Britain

3.2.2. France

3.2.2.1. National interdepartmental observatory for road safety

The French National interdepartmental observatory for road safety ONISR (ONISR, 2005, Observatoire national interministériel de sécurité routière) provides speed data for passenger cars, motorcycles and HDV on different road types from 1996 to 2000. This data is obtained on straight and plane roads, without disturbed traffic, no junctions, within 1 km upstream and 1 km downstream by surveys or radars (according to the road type). We give in Table 34 an example of average speeds in 2000.

Road type	Average speed (km/h)					Motor-cycles
	Passenger cars (day)	Passenger cars (night)	HDV 2 axles	HDV 3 axles	HDV 4 axles or more	
Motorway	127	121	95	88	90	132
Ring road	110	117	87	83	86	118
National road 2x2 lanes	112	–	95	88	89	121
National road 2–3 lanes	89	96	80	79	80	103
Departmental road	95	–	84	87	86	97
Distribution road (–5000 residents)	62	65	57	61	60	69

Table 34: Average speed in 2000 for France

3.2.2.2. INRETS

In a study of the vehicle fleet statistics, (André, 1999) underlines the lack of information on the vehicle fleet and its use in France and suggests representative vehicle speeds for different road and vehicle types (see Table 35). These mean values are then distributed into the different vehicle sizes.

Vehicle type	Average speed by road type (km/h)		
	Urban	Rural	Motorway
Passenger cars	23	56	108
Moped (<50 cc)	23	30	–
Motorcycle and moped (>50cc)	30	70	90
LDV	23	56	108
HDV	20	50	80
Buses	18	40	70
coaches	20	50	80

Table 35: Proposal of average speed by road type for vehicles in France (André, 1999)

3.2.2.3. Review

A lot of studies provide speed data for passenger cars (PC), motorcycles (2W) and LDV on different road types for a range of years. We present in Table 36 all studies available and detail the type of data available, for which vehicle types and on which road type.

3.2.3. Spain

In an estimation of pollutant emissions by road traffic in Spain, Burón (Burón, et al, 2004) provides average speeds for different types of vehicles during the period 1988 – 1999 (Table 37). These data for each type of vehicle are available in three driving conditions: urban, rural and highway. These data are required in order to estimate consumption and emission factors, which eventually lead to the emission estimation.

The weak point of this study is that only one value for each type of vehicle of the different driving conditions is given for the time period.

Source	Time period	Vehicle type	Road type	Type of data
ONISR	1991–1995	PC, 2W, HDV (2, 3, 4 or more axles)	Highway, major artery, distribution and local road	straight and plane road, without disturbed traffic, no junctions, within 1 km upstream and 1km downstream.
	1996–2000	PC, 2W, HDV (2, 3 and four or more axles)	Highway, major artery, distribution and local road	Or with stationary sensors
	1999–2003	HDV (2, 3 and four or more axles)	Highway, major artery, distribution and local road	On road, straight line and plane
	1998–2002	2W	Rural and urban roads	With stationary sensors
	1986–1998	PC	8 types of roads	Not specify
	1999–2002	HDV (2, 3, 4 or more axles)	5 types of roads	
ISL/DSCR	1990–1999	2W	Highway, major artery, distribution and local road	On road, straight line and plane
Internet (2004)	2001– 2002	PC	Highway, major artery, distribution and local road	Not specify
Internet (2004)	1988 to 2002	PC	Highway	Not specify
Les Dossiers du Net (2004)	2000	Not specify	Major artery, distribution and other roads	Not specify

Table 36: Review of available speed data in France

Country	Time period	Vehicle type	Road type
Spain	1998–1999	PC, Vans, trucks and lorries, buses and 2 wheelers (different cylinders)	Urban, rural and highway

Table 37: Review of available speed data in Spain

3.3. Conclusion

This chapter has enabled us to review a large (but non-exhaustive) range of sources related to speed information. Unfortunately that information is often disparate, heterogeneous with respect to the methods, and not directly applicable to the traffic situation approach. It constitutes however a good basis for estimating realistic speeds in different contexts and their variation according to various factors such as the time-period, the places, the vehicle categories, the road characteristics, the traffic conditions, etc.

Complementary speed data could be elaborated using a network and traffic flow model as it was already implemented in (André et al., 1999). Indeed, such model allows considering several parameters (area, road type, speed limits, number of lanes, junctions density and traffic flow level and composition, etc.) and enables the estimation of average speeds (and other traffic related variables) for the different vehicles categories, within different road configurations and traffic conditions.

4. Speed data and traffic situations

The previous chapters have enabled the elaboration of a traffic situations scheme, which was defined according to the area (urban/rural), the road category (governed by the hierarchical and functional organisation of the road network) and characteristics of which the speed limit, the gradient and sinuosity, and finally the traffic condition or level of service (from stop and go to free-flow traffic).

The approach for estimating the pollutant emissions at such a level (i.e. a traffic situation or a the street level) relies first on the definition of that traffic situation scheme, and then on the ability to compute the emission for each situation. It will be seen later that the approaches envisaged to compute the emissions for the different vehicle categories (cars, heavy vehicles, 2-wheelers) require the knowledge of the detailed speed data (or even speed versus time curve) for each traffic situation.

In that chapter, we manage that aspect for the passenger cars, while the other vehicle categories were dealt with as part of other works reported in (Sturm et al, 2006) for the heavy duty vehicles), and in (Elst et al. 2006) for the motorized 2 wheelers.

We first report on a data collection process aiming at collecting the car driving data, which were already available throughout Europe and from the ARTEMIS or COST346 partners. A specific experimentation was also conducted in France to record specific driving data.

The collected speed curves are then carefully analysed in particular with respect to coherency between the recording and the traffic situation or context in which it was recorded. On that basis pertinent curves are identified.

An assignment process is then conducted to affect a speed curve to a traffic situation when possible, and to design assumptions and mechanisms of affectation when no speed curve was available. The resulting scheme is then analysed and compared to those corresponding to the other vehicle categories.

4.1. Collection of the existing speed data

A process of collection of the available speed data was initiated. The aim was to collect this data, providing that it was well documented with respect to the information characterizing a traffic situation. Indeed, such a background information should be known if we intend to affect a speed curve to a given traffic situation. A detailed questionnaire (cf. Annex 2) was the elaborated and sent to all the Artemis and COST346 partners, as well as to institutions known for their activity in that field.

4.2. Urban, rural and mountainous speeds through specific experimentation

In parallel, INRETS started a specific experimentation to monitor 2 cars in a certain number of cases clearly identified by the traffic situation scheme. These cases included in particular urban and rural roads of the different categories and also rural roads in hilly and mountainous areas. Methodological elements are given in Annex 3. In all 65 journeys were recorded, providing a limited but interesting basis – as it was well controlled – for affecting speed to different traffic situations.

The specificity of the hilly and mountainous driving is well illustrated in Figure 12, which compares similar road categories on flat, hilly and mountainous areas. As observed, the mountainous speeds are strongly affected by the sinuosity (frequent deceleration and acceleration). The road geometry (lane width) could also explain a part of that difference. Lower speed levels are then recorded.

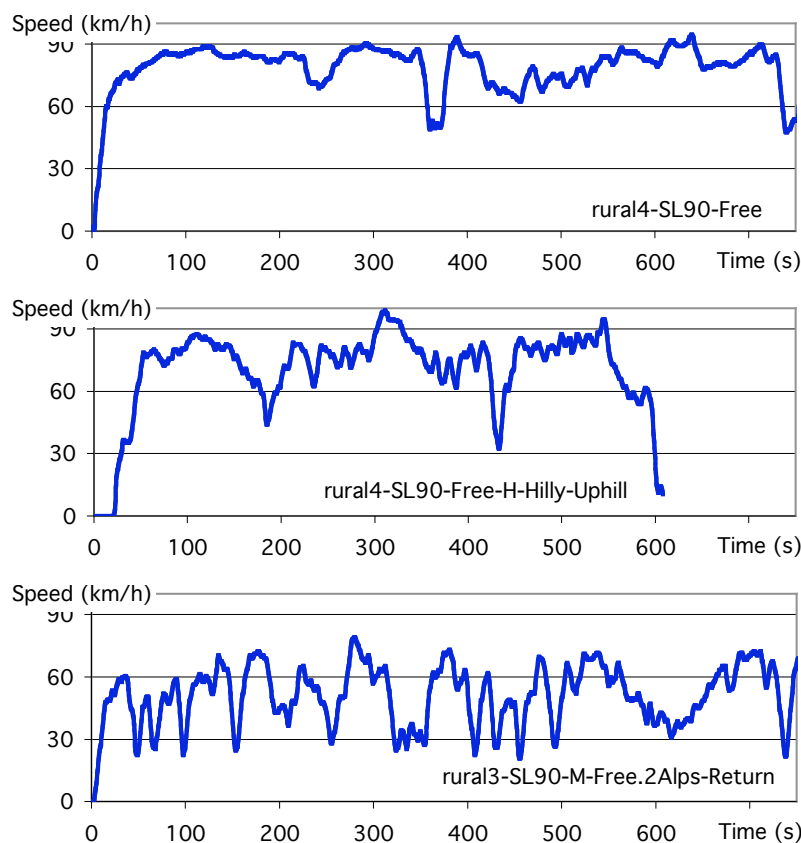


Figure 12: typical speeds on flat (top), hilly (middle) and mountainous (bottom) roads (speed limit 90 km/h) in free-flow traffic

4.3. Speed recorded on semi- and unlimited-motorways

Data was specifically measured in Sweden on semi-motorways with different speed limits. That data was dedicated for characterizing the corresponding traffic situations. Figure 13 shows

typical speeds recorded on such semi-motorway and compare them with speed recorded on a classical motorway. Others curves are shown in Annex 8. The speed profiles are significantly affected by the structure in road segments (alternation of 1 or 2 lanes per way). That certainly limits the possibility of using speed, which would have been recorded on a classical motorway for such a particular roads (and vice-versa).

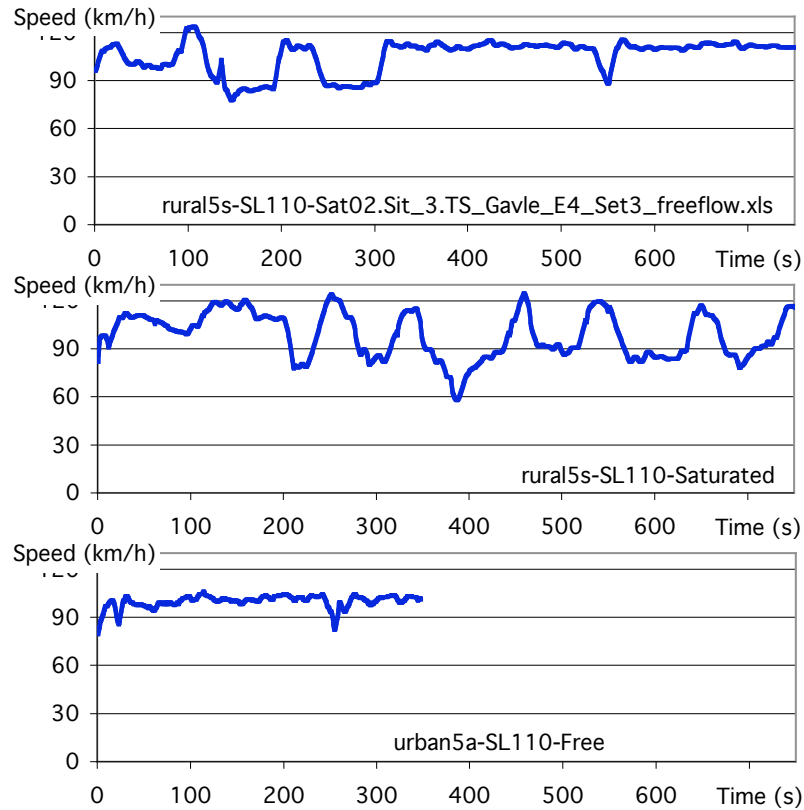


Figure 13: typical speed on a semi-motorway, speed limit 110 km/h, in free-flow (top) and saturated (middle) traffic, and speed measured on a classical motorway (bottom)

Concerning the unlimited motorway (mainly in Germany), the modem-Hyzem data base was used to extract typical data recorded on such roads. Three speed curves were then extracted, with average speeds of about 150 km/h (Figure 14), 170 and 180 km/h (these curves are provided in Annex 8). Indeed, such speeds were actually experienced on German unlimited motorways.

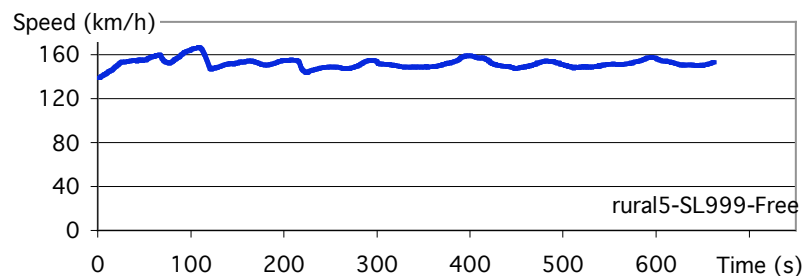


Figure 14: typical speed on a unlimited motorway (average speed ≈ 150 km/h, free-flow traffic assumed)

4.4. Complementary data

As mentioned earlier, existing driving cycles (Artemis cycles and sub-cycles for cars) were envisaged as particular traffic situations. Their speed curves are thus considered.

4.5. Status of the data collection

Table 38 provides a synthesis of the data collection. That represents a very large quantity of data on the actual driving in “controlled conditions”, by opposition to the data recorded in “uncontrolled conditions” such as the modem-Hyzem or the various experimentations for which the driving places were not known. These last data were thus not considered within that framework because they would not enable us providing speed data for well-identified traffic situations.

Source	Location	Road type / area	Remark
VITO	Belgium	Urban, Rural, Freeway	Light Duty Vehicles – several recordings
Lund (WP1040)	Budapest, Malmo, Napoli	Urban, city centre	Large dataset, no “direct” information on the driving context. Cars.
TUV-Essen	Germany		Light duty vehicles. No information on the context. Access database
INFRAS	Switzerland	Urban, Rural, Motorways	32 driving patterns of which very specific conditions (acceleration from / to a city, etc.). Insufficient background information associated with the data. Access database.
(VTI, MTC)	Sweden	Urban, freeway	Several driving cycles (cars).
VTI	Sweden	Urban, motorway	Four driving cycles (cars).
VTI	Sweden	Semi-motorway	20 recorded and well-documented trips (cars).
OSCAR (TRL)	Athens, London, Helsinki, Madrid	City	A lot of data. Traffic condition information through the vehicle density (cars).
TNO	Netherlands	Urban mainly	A lot of data. Indicative information on the driving condition. Access database (cars).
INRETS	France	Urban, rural, hilly, mountain	Some recordings per TS. Indicative information on the traffic condition. Cars.
INRETS	Germany	Unlimited motorway	High speeds extracted from the modem-Hyzem database. Cars.
INRETS	Europe	Urban, rural, motorway	Artemis cycles and sub-cycles, as well as other reference driving cycles (cars).

Table 38: Status of the data collection

We should first underline the specific difficulty of the exercise which should consist in affecting these speed data to traffic situations. Indeed, the existing speed data were recorded in places or within conditions, which often had nothing or few to see with the criteria of our traffic situation scheme. We are unfortunately in the situation that we have defined a traffic situation scheme and we have to use available data, which was recorded independently of this scheme. We can thus only assume correspondence between the background information behind a speed data and the traffic situation criteria.

A fastidious work was conducted to inventory all that data and the related information. That is

illustrated in Annex 2, where detailed information is provided for samples of some tenths of speed curves from the different experimentations.

However a large quantity of data was (to a great extent) useless at least in a short time-period, because the background information was insufficient to affect the speed data to a given traffic situation. Most often, the information on the traffic condition was not available or not directly available.

That led us to use mainly the data from the OSCAR research project (cars in urban area and more specifically in 4 big European cities, see OSCAR, 2006), the TNO data (cars in the Netherlands) and the INRETS dataset (see the previous section). In all, more than 1500 speed curves were usable and have been edited for analysis.

Despite their high richness, it was not possible to use the data recorded in ARTEMIS (WP1040 task, Ericsson et al. 2005) in Sweden, Naples and Budapest, because their interpretation with respect to the traffic conditions and urban context (road type, speed limit) would have requested a very important effort.

On the other hand, very few data was available for rural and nearly no data for the hilly or mountainous situations (except those which were specifically recorded by INRETS for that purpose). As these particular traffic situations should be finally insufficiently covered, it could be pertinent to consider them separately (as “specific situations” such as “hilly”, “mountainous”, etc.) without a declination of the other road characteristics (speed limit, lane number) and traffic conditions (stop and go to free-flow).

4.6. Other vehicle categories

The data collection was mainly (but not only) dedicated to the cars data. Although some rare data were provided for the light duty vehicles, these last ones were not considered in the following. Due to that lack of data, an assumption of equivalence with the cars could be envisaged (same speeds experienced). The emission estimation should however rely on specific data and approach.

With respect to the motorized 2-wheelers and to the heavy- duty vehicles (including buses and coaches), full sets of speed data were elaborated by TUV Essen, attempting to follow when possible the actual Traffic situation scheme. The differences in the approaches, in the method, and in the available dataset could lead to problems of coherency between the vehicles categories.

For HDV, it was considered as necessary to have a particular gradient approach, considering local characteristics (+4% ascend, etc.). The implementation of such an approach was not possible for passenger cars due to a total lack of corresponding speed data. However, one should notice that the taking into account of the gradient on the passenger cars emission is also not obvious.

4.7. Speed data analyses and affectation

An attempt to cover all the traffic situations with the available and documented speed data was conducted. A first and simple principle was adopted, which consisted in affecting a speed data according to the only background information (i.e. area, road type, speed limit, and traffic condition). Indeed none specific analysis would have enabled the affectation of a speed profile to a traffic situation, according only to its kinematic characteristics. There are too many unknown information (road type, speed limit, sinuosity and gradient, traffic condition).

All the speed curves that were sufficiently described were then affected to the corresponding situations (implying sometimes complementary assumptions). These speed curves were then processed and a large range of kinematic parameters were computed, of which the average speed, the stops duration and frequency, the accelerations, etc.. When several data corresponded to the same situation, they were compared. The distribution of kinematic parameters enabled the setting-up of expected figures (range of probable speeds, of stop duration, etc.) and the selection of the most pertinent curve. Furthermore, the different situations and the different data set were compared and that enabled a certain validation of the choices.

The Annex 5 highlights that selection and also the high variability observed between several observations for a given traffic situation. From that selection, we note a quite large number of data for stop and go, a good coverage of urban and the limited number of rural data.

The high variability observed for a given traffic situation (and through that variability the low significance of the background information associated with the speed measurements) is also shown in Table 39, in which ranges of variation observed for several traffic situations are provided. Indeed, we can record speeds varying by a factor 2 for free traffic, and observe a high overlapping of the different traffic conditions.

That also raises up the problem of the reliability of providing an objective advice on the driving conditions when we are in the traffic as – in several cases – the information seemed false (significant incoherency between the speed limit and the speeds experienced, incoherency between the traffic condition and the kinematic parameters, i.e. very low stop rates while the traffic was declared as stop and go, etc.).

	Road type	Speed limit (km/h)	Traffic condition	Nb. of observations	Aver. speed (km/h) Min.- Max.	Max. speed (km/h) Min.- Max.	Stop duration (%) Min. - Max.	Stop frequency (1/km) Min. - Max.
Urban	Primary roads (4b)	80	Free	7	42 – 80	79 – 97	0 – 11	0 – 0.6
			Heavy	5	65 – 77	87 – 95	–	–
			Stop & go	3	9 – 27	40 – 74	11 – 25	0.5 – 8.5
	Urban motorway (4a)	80	Free	3	79 – 99	86 – 105	–	–
			Heavy	13	72 – 99	81 – 103	–	–
	District distributor (3)	50	Free	14	15 – 52	46 – 97	(0,6) 5 – 34	0.4 – 5.2
			Heavy	12	16 – 42	48 – 71	7 – 36	0.5 – 3.9
			Saturated	14	10 – 26	42 – 68	22 – 49	1 – 8.6
			Stop & go	5	6 – 19	30 – 47	29 – 48	2 – 12

Table 39: Variability observed for multiple observations of a same traffic situation

Despite these difficulties and incoherencies, the selection process enabled us to retain coherent speed curves and to affect them to given traffic situations. The retained speed curves are listed in Annex 6. Their kinematic parameters are provided in Annex 7. However the number of cases covered was finally relatively low, as a lack of speed data was recorded for a large number of traffic situations. The coverage through the selected curves is shown Figure 15 (that figure however does not concern cases with gradient).

IDArea	Area	IDRoadType	Roadtype	IDLOS	LOS	FirstOfDVehCat	13-30	14-40	15-50	16-60	17-70	18-80	19-90	20-100	21-110	22-120	23-130	24->130
1 Rural		10 Motorway		1 Freeflow	1							A	A	A	A	A	122	152
1 Rural		10 Motorway		2 Heavy	1							A	A	A	A	A	A	A
1 Rural		10 Motorway		3 Saturated	1							A	A	A	A	A	A	A
1 Rural		10 Motorway		4 Stop+go	1							A	A	A	A	A	A	A
1 Rural		12 Semi-Motorway		1 Freeflow	1								95		110			
1 Rural		12 Semi-Motorway		2 Heavy	1								87		101			
1 Rural		12 Semi-Motorway		3 Saturated	1								71		A			
1 Rural		12 Semi-Motorway		4 Stop+go	1										A			
1 Rural		20 TrunkRoad		1 Freeflow	1					A	68	A	80	A	A			
1 Rural		20 TrunkRoad		2 Heavy	1					A	A	A	A	A	A			
1 Rural		20 TrunkRoad		3 Saturated	1					A	A	A	A	A	A			
1 Rural		20 TrunkRoad		4 Stop+go	1					A	A	A	A	A	A			
1 Rural		30 Distributor		1 Freeflow	1				49	A	A	A	A	A	A			
1 Rural		30 Distributor		2 Heavy	1				A	A	A	A	A	A	A			
1 Rural		30 Distributor		3 Saturated	1				A	A	A	A	A	A	A			
1 Rural		30 Distributor		4 Stop+go	1				A	A	A	A	A	A	A			
1 Rural		31 Distributor-sinuous		1 Freeflow	1				A	A	A	A	A	A	A			
1 Rural		31 Distributor-sinuous		2 Heavy	1				A	A	A	A	A	A	A			
1 Rural		31 Distributor-sinuous		3 Saturated	1				A	A	A	A	A	A	A			
1 Rural		31 Distributor-sinuous		4 Stop+go	1				A	A	A	A	A	A	A			
1 Rural		40 Local		1 Freeflow	1				A	A	A	A						
1 Rural		40 Local		2 Heavy	1				A	A	A	A						
1 Rural		40 Local		3 Saturated	1				A	A	A	A						
1 Rural		40 Local		4 Stop+go	1				A	A	A	A						
1 Rural		41 Local-sinuous		1 Freeflow	1				A	A	A	A						
1 Rural		41 Local-sinuous		2 Heavy	1				A	A	A	A						
1 Rural		41 Local-sinuous		3 Saturated	1				A	A	A	A						
1 Rural		41 Local-sinuous		4 Stop+go	1				A	A	A	A						
1 Rural		50 Access		1 Freeflow	1		A	A	A									
1 Rural		50 Access		2 Heavy	1		A	A	A									
1 Rural		50 Access		3 Saturated	1		A	A	A									
1 Rural		50 Access		4 Stop+go	1		A	A	A									
2 Urban		10 Motorwa-Nat.		1 Freeflow	1							A	A	A	100	A	118	
2 Urban		10 Motorwa-Nat.		2 Heavy	1							A	A	A	90	A	A	
2 Urban		10 Motorwa-Nat.		3 Saturated	1							A	A	A	A	A	A	
2 Urban		10 Motorwa-Nat.		4 Stop+go	1							A	A	A	26	A	A	
2 Urban		11 Motorway-City		1 Freeflow	1					A	A		76	94	A			
2 Urban		11 Motorway-City		2 Heavy	1					A	A	72		74	A			
2 Urban		11 Motorway-City		3 Saturated	1					A	A	A	A	A	A			
2 Urban		11 Motorway-City		4 Stop+go	1					A	A	A	A	A	A			
2 Urban		20 TrunkRoad-Nat.		1 Freeflow	1						A	A	A	A	A	A		
2 Urban		20 TrunkRoad-Nat.		2 Heavy	1						A	A	A	A	A	A		
2 Urban		20 TrunkRoad-Nat.		3 Saturated	1						A	A	A	A	A	A		
2 Urban		20 TrunkRoad-Nat.		4 Stop+go	1						A	A	A	A	A	A		
2 Urban		21 TrunkRoad-City		1 Freeflow	1				44	63	A	74	A					
2 Urban		21 TrunkRoad-City		2 Heavy	1				36	51	A	65	A					
2 Urban		21 TrunkRoad-City		3 Saturated	1				17	30	A	A	A					
2 Urban		21 TrunkRoad-City		4 Stop+go	1				A	23	A	A	A					
2 Urban		30 Distributor		1 Freeflow	1				45	53	64	A						
2 Urban		30 Distributor		2 Heavy	1				38	40	50	A						
2 Urban		30 Distributor		3 Saturated	1				24	28	31	A						
2 Urban		30 Distributor		4 Stop+go	1				13	19	19	A						
2 Urban		40 Local		1 Freeflow	1				40	A								
2 Urban		40 Local		2 Heavy	1				A	A								
2 Urban		40 Local		3 Saturated	1				20	A								
2 Urban		40 Local		4 Stop+go	1				A	A								
2 Urban		50 Access		1 Freeflow	1		20	33	37									
2 Urban		50 Access		2 Heavy	1		A	A	A									
2 Urban		50 Access		3 Saturated	1		13	14	26									
2 Urban		50 Access		4 Stop+go	1		11	12	A									

Figure 15: Average speed of the original speed curves and their affectation to the traffic situations scheme (sinuosity partially covered, gradient not taken into account). The red cells (49 cases) indicate the available data, the A yellow cells require affectation of speed data.

Two typical cases of traffic situation are highlighted Figure 16. The other curves are reported in Annex 8. We observe that certain curves can be very short and that limits likely their representativity. When possible, several curves were added or combined together to increase the validity, but that was not always feasible due to the lack of data.

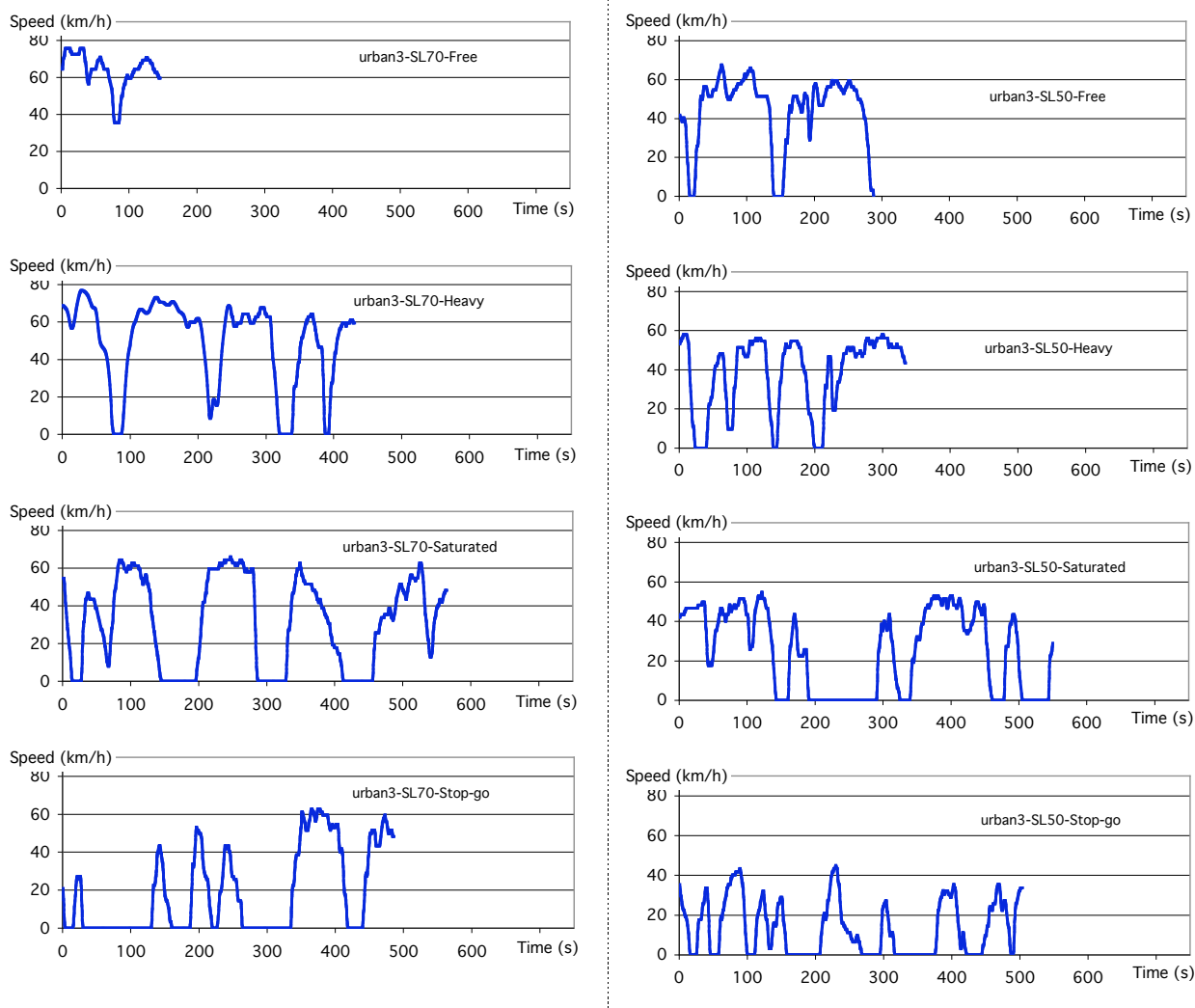


Figure 16: Original speed curves corresponding to two traffic situations: urban distributors, speed limit 70 km/h (left) and 50 km/h (right), traffic condition varying from free-flow (top) to stop and go (bottom).

4.8. Speed adjustments and re-affectation

The previous status (the less questionable) is largely insufficient to allow the traffic situation approach. Mechanisms of re-affectations (using an existing speed curve for similar situations) were thus implemented to complete the traffic situation scheme. Transformations had also been envisaged (for instance to “translate” a free-flow speed on a 130 km/h motorway into a free-flow speed on a 120 km/h motorway). Such transformations were finally not implemented.

4.8.1. Analysis of the individual original speed curves

4.8.1.1. Stop and go

Several speed curves were available for stop and go that had different average speed level and presented a high variability. The urban data are shown in Figure 17 and their variability with respect to speed and stop parameters is shown in Figure 18.

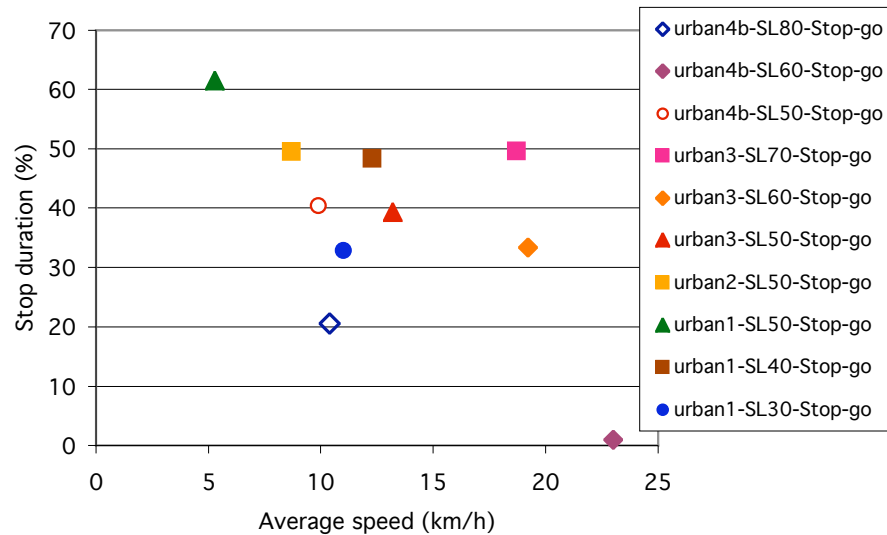


Figure 17: Speed recordings related to urban stop and go

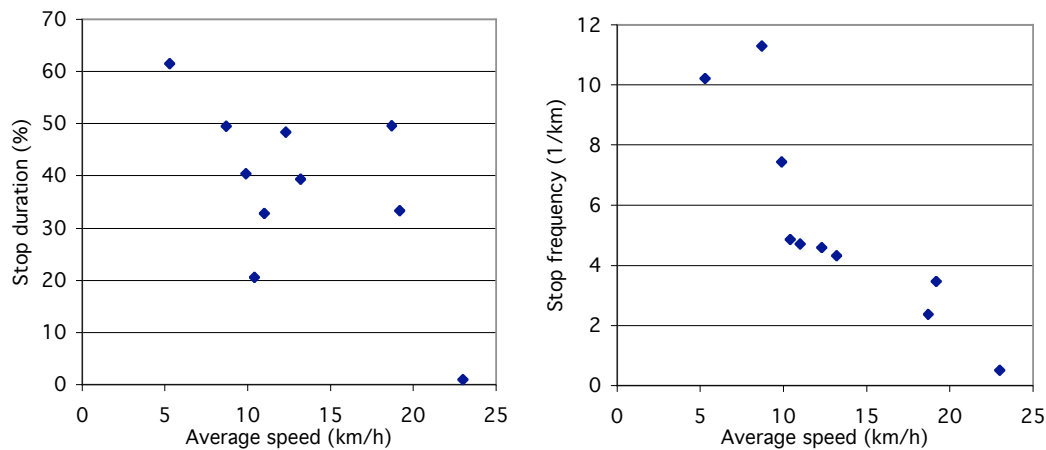


Figure 18: Variability of the speed recordings related to urban stop and go (as regards the average speed and the stop duration and frequency)

The correlation between the stop-go average speed and the road speed limit were then analysed by area (urban/rural) to retain coherent curves. That led us to select stop and go curves with speed increasing with the speed limits, and stop-go with low stop rate / frequency on (urban/rural) motorways and trunk roads. The slowest acceptable stop and go was then recorded at 11 km/h, while the quickest was recorded at 26 km/h.

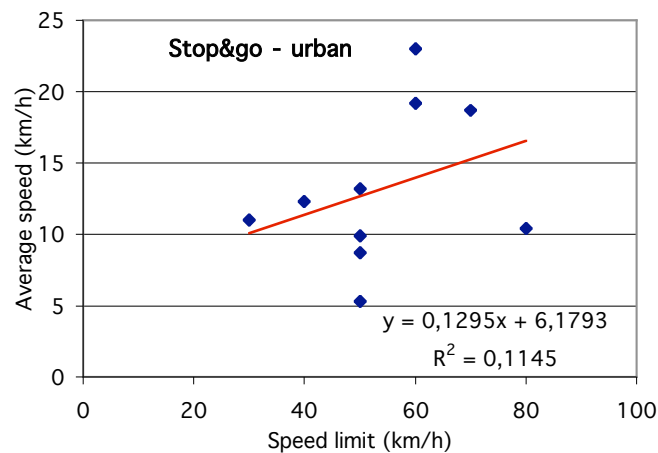


Figure 19: Correlation between the average speed and the speed limit in congested traffic

4.8.1.2. Other traffic conditions

Similar analyses were done to select coherent saturated conditions. Furthermore, as we have only speed-curves corresponding to saturated conditions up to 70 km/h of speed limit, the speed curve corresponding to this speed limit should be applied to all the situations with higher speed limits.

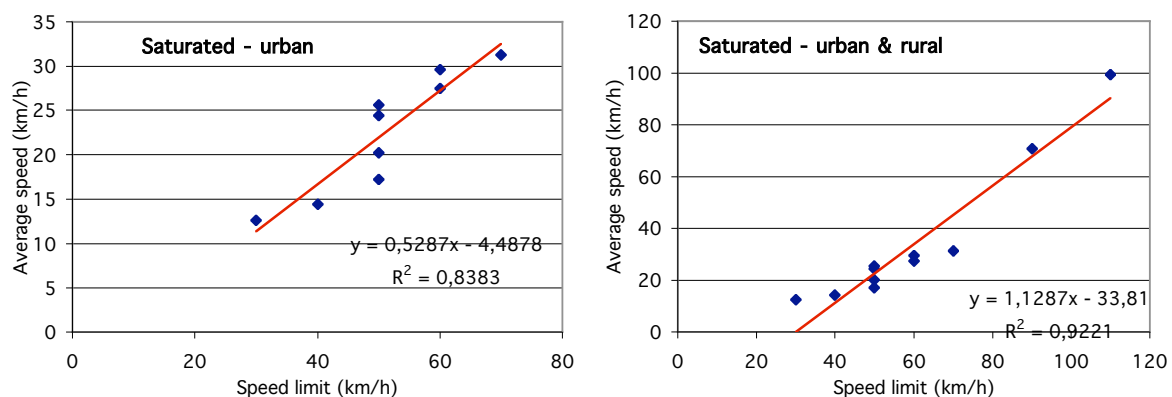


Figure 20: Correlation between the average speed and the speed limit in saturated traffic (left: urban data – right: urban and rural data)

Similar analyses were also conducted for free-flow and heavy traffic that demonstrated quite good correlations. Generally we observe different correlations between urban and rural data as previously. However, that conclusion is limited by the low number of data.

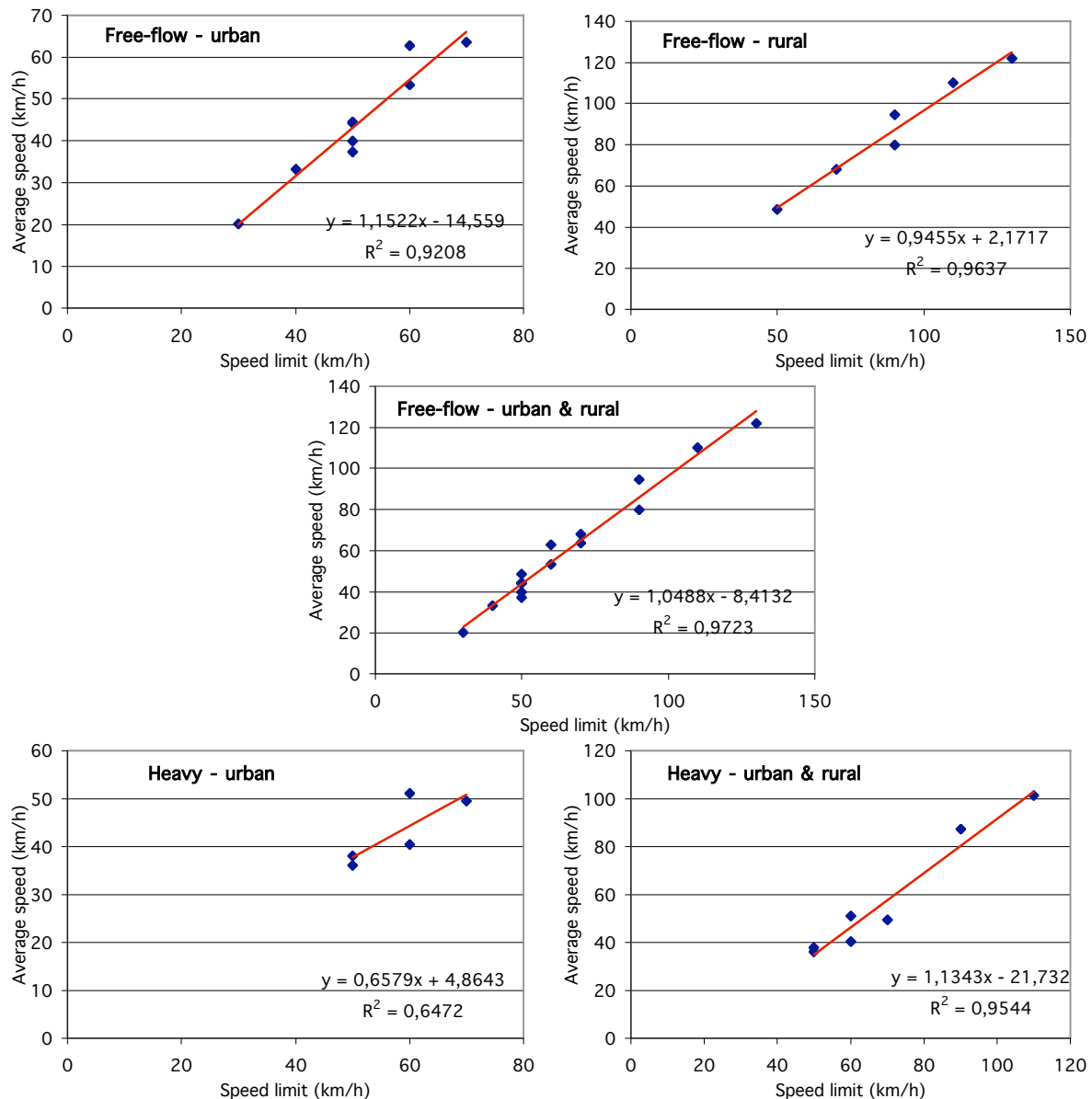


Figure 21: Correlation between the average speed and the speed limit in free-flow (top) and heavy (bottom) traffic

4.8.1.3. Complementary analyses

Average and maximum speeds (as well as stop number, duration, acceleration) have been analysed as a function of the area (urban/rural), the road category and the traffic conditions. That has help to design principles of affectation of the original speed curves for the cases no data are available (see next section). Further light investigations should be conducted on that topic, to possibly establish simple criteria that would enable discriminating the speed curves as a function of speed limits, area, road category, and traffic conditions. With such criteria, it could be envisaged to extract representative speed curves from the existing database (modem-Hyzem, etc.), which do not contain background information on the driving places and conditions. However such approach is not ready at all.

To increase the number of original speed curves, the initial databases could also be re-

examined and analysed. Indeed, the background information regarding the Swiss data is actually missing but could be retrieved. The Artemis WP1040 data should also be re-analysed as the exact itineraries were known in detail.

4.8.2. Rules/principles of the affectation of the original speed curves to traffic situations

To get a coherent set of data, despite the low number of original speed curves, the following rules of affectations have been applied:

- A Free-flow curve was only applied to other situations with the same speed limit.
- Affectation of a speed curve should preserve the traffic condition. It is not possible to affect Heavy traffic data for Free-flow, or Saturated data for Heavy or Stop-go for Saturated, etc. Indeed, even if the average speed can be similar, each traffic condition presents very specific characters as it can be shown through the corresponding kinematic parameters (accelerations, stops, etc. see Annex 7) or through the speed curves (Annex 8).
- A curve for given condition and speed limit may be applied – when necessary – to the closest speed limits (+ and – 10 km/h).
- When no original data exist, Urban Access, Local and Distributor were used for the rural corresponding cases.
- For Access urban and rural cases – for which the Heavy condition was not initially considered because of less importance – the Heavy condition was assumed to be equivalent to the Free-flow, when no data was available.
- Swedish semi-motorway: due to the very specific character of these cases, the speed curves were not used for other road categories and reciprocally. The Stop-go was however taken from a normal urban motorway (no data measured on the semi-motorway).
- When no data exists for the higher speed limits, the last available Stop-go (resp. Saturated) curve was applied for all the upper speed limits. By this way, the 26 km/h stop and go was applied to all speed limits higher than 110 km/h. The 31 km/h Saturated case (observed at 70 km/h) was applied for all the speed limits exceeding 70. In fact a Saturated speed in the order of 40-60 km/h should be expected for the highest speed limits.
- With respect to sinuosity and gradient, only “Free-flow” speed recordings were available. The corresponding “Flat” cases were thus used. However to take into account the decrease of the speed due to the sinuosity / gradient, the Free-flow cases were taken equivalent to the “Heavy Flat” cases (Sinuous Free-flow and Heavy are then equal). These assumptions have been implemented for all the sinuous / Hilly cases of the qualitative gradient-sinuosity scheme in 4 classes. The Hilly cases were also used for the flat-sinuosity cases.

Cell-Content = Average_Speed (Original and affected data)																			
IDArea	Area	IDRoadTy pe	Roadtype	IDLOS	LOS	FirstO fIDVe hCat	13-30	14-40	15-50	16-60	17-70	18-80	19-90	20- 100	21- 110	22- 120	23- 130	24- >130	
1	Rural	10	Motorway	1	Freeflow	1						74	80	94	100	118	122	152	
1	Rural	10	Motorway	2	Heavy	1						72	72	74	90	90	90	90	
1	Rural	10	Motorway	3	Saturated	1						31	31	31	31	31	31	31	
1	Rural	10	Motorway	4	Stop+go	1						23	23	26	26	26	26	26	
1	Rural	12	Semi-Motorway	1	Freeflow	1							95		110				
1	Rural	12	Semi-Motorway	2	Heavy	1							87		101				
1	Rural	12	Semi-Motorway	3	Saturated	1							71		71				
1	Rural	12	Semi-Motorway	4	Stop+go								23		26				
1	Rural	20	TrunkRoad	1	Freeflow	1				63	68	74	80	94	100				
1	Rural	20	TrunkRoad	2	Heavy	1				51	50	65	72	74	90				
1	Rural	20	TrunkRoad	3	Saturated	1				30	31	31	31	31	31				
1	Rural	20	TrunkRoad	4	Stop+go	1				23	23	23	23	26	26				
1	Rural	30	Distributor	1	Freeflow	1			49	53	68	74	80	94					
1	Rural	30	Distributor	2	Heavy				38	40	50	65	72	74					
1	Rural	30	Distributor	3	Saturated	1			24	28	31	31	31	31					
1	Rural	30	Distributor	4	Stop+go	1			13	19	19	19	23	26					
1	Rural	31	Distributor-sinuuous	1	Freeflow				38	40	50	65	65	74					
1	Rural	31	Distributor-sinuuous	2	Heavy				38	40	50	65	65	74					
1	Rural	31	Distributor-sinuuous	3	Saturated				24	28	31	31	31	31					
1	Rural	31	Distributor-sinuuous	4	Stop+go				13	19	19	19	23	26					
1	Rural	40	Local	1	Freeflow	1			40	53	64	74							
1	Rural	40	Local	2	Heavy				38	40	50	65							
1	Rural	40	Local	3	Saturated	1			20	28	31	31							
1	Rural	40	Local	4	Stop+go	1			13	19	19	19							
1	Rural	41	Local-sinuuous	1	Freeflow				38	40	50	65							
1	Rural	41	Local-sinuuous	2	Heavy				38	40	50	65							
1	Rural	41	Local-sinuuous	3	Saturated				20	28	31	31							
1	Rural	41	Local-sinuuous	4	Stop+go				13	19	19	19							
1	Rural	50	Access	1	Freeflow	1	20	33	37										
1	Rural	50	Access	2	Heavy		20	33	37										
1	Rural	50	Access	3	Saturated	1	13	14	26										
1	Rural	50	Access	4	Stop+go		11	12	13										
2	Urban	10	Motorwa-Nat.	1	Freeflow	1						74	76	94	100	118	118		
2	Urban	10	Motorwa-Nat.	2	Heavy	1						72	72	74	90	90	90		
2	Urban	10	Motorwa-Nat.	3	Saturated	1						31	31	31	31	31	31		
2	Urban	10	Motorwa-Nat.	4	Stop+go	1						23	23	26	26	26	26		
2	Urban	11	Motorway-City	1	Freeflow	1				63	64	74	76	94	100				
2	Urban	11	Motorway-City	2	Heavy	1				51	50	72	72	74	90				
2	Urban	11	Motorway-City	3	Saturated	1				30	31	31	31	31	31				
2	Urban	11	Motorway-City	4	Stop+go	1				23	23	23	23	26	26				
2	Urban	20	TrunkRoad-Nat.	1	Freeflow	1						64	74	76	94	100			
2	Urban	20	TrunkRoad-Nat.	2	Heavy	1						50	65	65	74	90			
2	Urban	20	TrunkRoad-Nat.	3	Saturated	1						31	31	31	31	31			
2	Urban	20	TrunkRoad-Nat.	4	Stop+go	1						23	23	23	26	26			
2	Urban	21	TrunkRoad-City	1	Freeflow	1			44	63	64	74	76						
2	Urban	21	TrunkRoad-City	2	Heavy	1			36	51	50	65	65						
2	Urban	21	TrunkRoad-City	3	Saturated	1			17	30	31	31	31						
2	Urban	21	TrunkRoad-City	4	Stop+go	1			13	23	23	23	23						
2	Urban	30	Distributor	1	Freeflow	1			45	53	64	74							
2	Urban	30	Distributor	2	Heavy	1			38	40	50	65							
2	Urban	30	Distributor	3	Saturated	1			24	28	31	31							
2	Urban	30	Distributor	4	Stop+go	1			13	19	19	19							
2	Urban	40	Local	1	Freeflow	1			40	53									
2	Urban	40	Local	2	Heavy				38	40									
2	Urban	40	Local	3	Saturated	1			20	28									
2	Urban	40	Local	4	Stop+go	1			13	19									
2	Urban	50	Access	1	Freeflow	1	20	33	37										
2	Urban	50	Access	2	Heavy		20	33	37										
2	Urban	50	Access	3	Saturated		13	14	26										
2	Urban	50	Access	4	Stop+go	1	11	12	13										

Figure 22: Re-affectation to the original speed curves to the traffic situations scheme (sinuosity and gradient cases not shown here, except for rural distributors and local roads). Bold underlined figures are original data. Others are affected data.

- Ramp cases (from the qualitative gradient-sinuosity scheme, i.e.: not sinuous but gradient): As few data existed, the corresponding “Flat” cases were used. It was thus assumed that there was no decrease of the speed due to the ramp. That assumption has been implemented for all the Ramp cases of the gradient-sinuosity scheme.
- Mountainous cases (from the qualitative gradient-sinuosity scheme, i.e.: sinuous and strong gradient): several “Mountainous – Free-flow” speed recordings were available and used for the corresponding speed limits and for the closest speed limits (+ - 10 km/h). These curves were also taken for both the Free-flow and Heavy conditions. For the other cases, the “Flat” cases were used, while applying the Heavy cases to the Free-flow conditions to take into account of the decrease of the speed due to the sinuosity / gradient. These assumptions have been implemented for all the Mountainous cases of the gradient-sinuosity scheme.

These rules enabled us the elaboration of the traffic scheme, which is partially illustrated in Figure 22 (sinuosity and gradient cases very partially shown in that table).

4.9. Coherency with the other vehicle categories

A complete data set – in terms of average speeds and for the different vehicles categories - is provided in Annex 9 (for passenger cars, heavy-duty vehicles, buses and 2Wheelers). The comparison of these tables reveals a certain number of “incoherencies”, resulting likely from the available speed data and from the method to extract and affect the speed curves.

As a matter of example, there were about 30 cases for which the HDV speed was higher than the car speed in the same traffic situation. The factor between the 2 speeds was of 1.20 at least. There were also 50 cases for which the two-wheelers speed was lower (by a factor 0,8) than the car speed.

We should also observe that the urban bus speeds were likely taken from heavy-duty or coach data. Such simplification (which was necessary due to the lack of data) is quite unrealistic as the bus driving behaviour is very specific. By the same way, the use of speed recorded on normal motorway and their application to the semi-motorways is really questionable.

However, it is difficult to improve the current dataset to decrease the incoherencies number. Except if mistakes were recorded in the assumptions to process the car speed data, the passenger car data set can hardly be improved. The quality and assumptions underlying the data for the other vehicles categories are also not questionable here. It is also not possible to assess the relative validity of the datasets, and it would totally unrealistic to affect driving data from one vehicle category (i.e. heavy-duty vehicles, busses, cars, etc.) to another one.

Consequently, we can neither conclude regarding the observed gaps, nor “correct” arbitrarily one or the other of the data.

That demonstrates however the weakness of the approach at the time being, due mainly to a lack of consistent data on driving behaviour within well-identified traffic situations.

Further investigations are then strongly needed in that aim, with complementary data

collection (existing speed data which were recorded on-board urban bus cycles, light duty vehicles, 2-wheelers, etc. should be useful) and complementary experimentation to record data for the situations for which no data exists. When possible, such experimentation should be applied for the different vehicles categories, using a common method.

4.10. Conclusion

A complete exercise was achieved, which enabled us to affect speed curves to the different traffic situations. That exercise relies on the collection of the existing driving data, as well as on numerous assumptions to compensate both the insufficient information associated with that data and also the lack of data for a very high number of cases.

The resulting dataset makes the traffic situation approach possible (providing that emission calculation approaches are developed). However the low quantity of speed data, its probable low quality (background information not always reliable, data collected independently of the current traffic situation criteria, etc.) and the numerous incoherencies observed between the vehicles categories highlight the weakness of the dataset, which should be also the main weakness of the whole emission estimation approach.

Complementary work is thus strongly needed on that topic and speed data collection is highly required to ensure the validity of the approach.

However, that weakness of the speed dataset also raises up the question of the information to the users. It is not only question of filling in tables with data: the users should also be aware of the quality of that data. The idea of a “quotation” of the data (valid / hypothetical) could help.

Specific situations (driving in the Alps, semi-motorways, certain driving cycles etc), for which data was available (even if only available for certain vehicle categories), have also been identified through that process. It should be worth that such situations are available in the Artemis tools, as they could be useful for very specific estimations.

5. Cars emissions estimation approach

The approaches for estimating the vehicles emissions at the traffic situation level are reported in (Rexeis et al. 2005 and Sturm et al. 2006) for the heavy-duty vehicles and in (Elst et al. 2006) for the two-wheelers. Up to now, the light duty vehicles have not been dealt with. In that chapter we recapitulate the approach developed for the passenger cars.

5.1. Cars emissions data

A detailed information on that topic can be found in (André et al. 2006). Here, we recapitulate the main aspects, which are used then for the emission estimation approach.

The estimation of the pollutant emission for the detailed previous road configurations and traffic conditions required measurements that enable an accurate and discriminating analysis of the emissions as regards driving conditions.

Based on a large database of the actual driving in Europe, the Artemis driving cycles for passenger cars were designed to describe the “space” of the actual driving conditions in their diversity (Artemis-WP300 – light vehicles emissions). Twelve typical driving patterns were identified from the analysis of the detailed speed and acceleration, and 14 representative sub-cycles were built-up within 3 driving cycles (André, 2004, Figure 23). These test cycles enabled then the measurement of the emissions according to 12 patterns characterizing the European driving, allowing then a detailed analysis of the emissions as regards kinematic parameters.

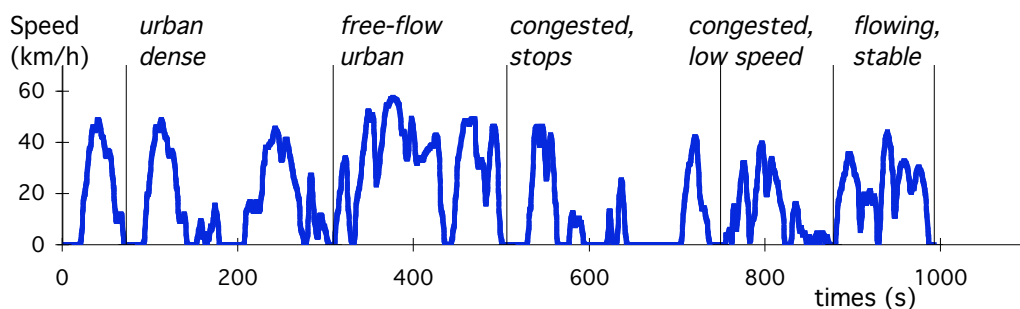


Figure 23: The ARTEMIS urban driving cycle and its structure in driving conditions

However, the emissions data collected in Artemis concerned also a large range of non-Artemis driving cycles. The analysis and classification of these cycles according to a similar process (2-dimensional distribution of instant speed and acceleration) enabled then the definition of 15 “test driving patterns” (adding a severe stop-and-go and a very stable motorway driving in the range of 120 km/h which were not covered by the Artemis cycles, André et al. 2006).

This cartography was also the results of a compromise to get sufficient level of detail in the driving patterns description, while preserving a good quality of the emissions estimation through a sufficient number of emission data for each of the 15 points and for the different categories of passenger cars (by fuel type and by emission regulation standard).

We have thus defined a “cartography” in 15 test driving conditions that constitutes a detailed description of the European actual driving (Figure 28, and Table 40), and for which car emissions were computed from the whole Artemis emission database (Figure 25).

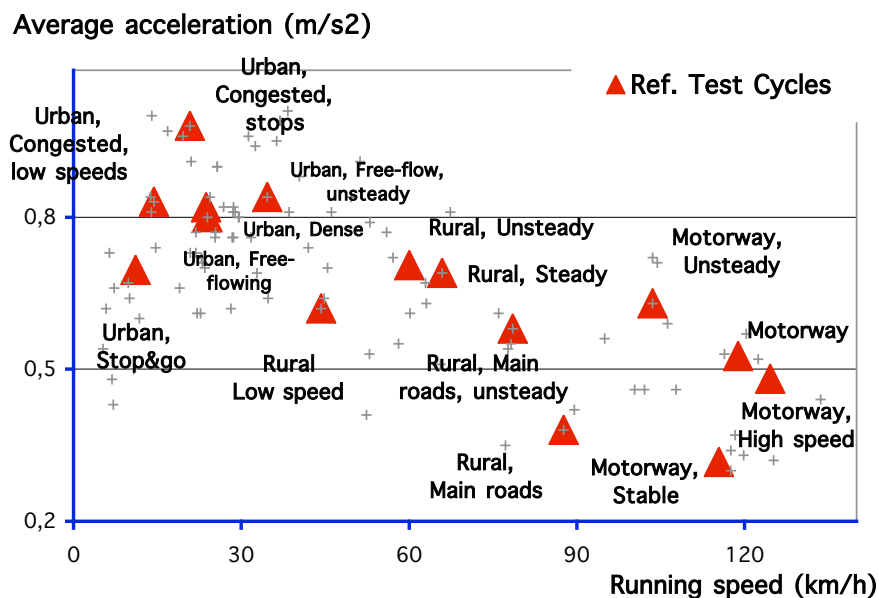


Figure 24: Test cycle variability and reference test patterns determined by automatic clustering, as regards speed and acceleration

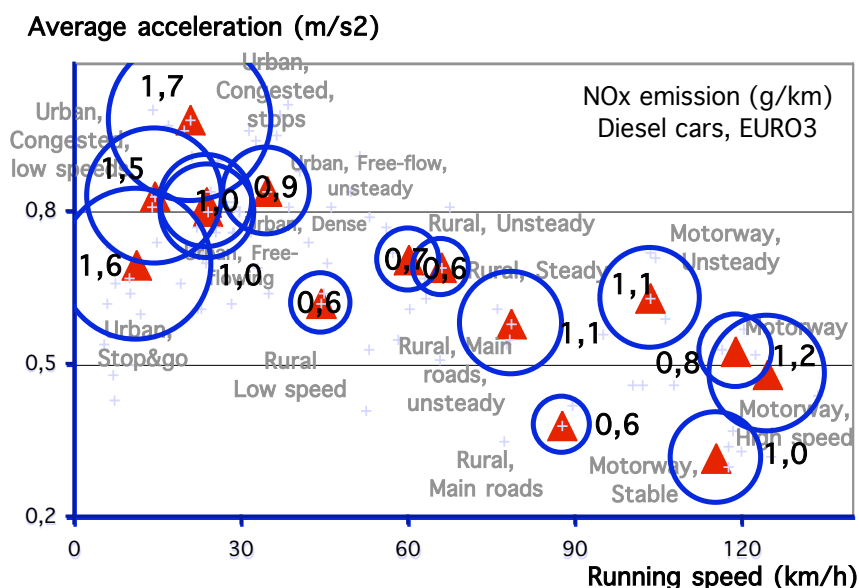


Figure 25: Variation of the pollutant emissions (NOx emission from Diesel Cars EURO3) according to the 15 test driving patterns

Test pattern number	Characteristics	Reference test cycle(s)	Average speed (km/h)	Average Positive acceleration (m/s ²)	Stop duration (%)	Stop/km	Steady / Unsteady driving
7 Urban	Stop&go	OSCAR.H1, H2 & H3,TRL.WSL_CongestedTraffic	7,1	0,70	35,4	16,3	1
3 Urban	Congested, stops	Artemis.urban_3	8,7	0,98	58,2	10,2	2
2 Urban	Congested, low speeds	Artemis.urban_4	11,7	0,83	18,6	16,7	2
1 Urban	Dense	Artemis.urban, Artemis.urban_1	16,9	0,82	28,7	5,2	1
4 Urban	Free-flowing	Artemis.urban_5	21,5	0,80	10,3	4,3	1
5 Urban	Free-flow, unsteady	Artemis.urban_2	31,6	0,84	8,5	2,3	2
6 Rural	Low speed	Artemis.rural_3	43,1	0,62	2,7	0,5	1
11 Rural	Unsteady	Artemis.rural, Artemis.rural_1	58,0	0,71	3,4	0,3	2
9 Rural	Steady	Artemis.rural_2	65,9	0,69	0,0	0,0	1
10 Rural	Main roads, unsteady	Artemis.rural_4	78,5	0,58	0,0	0,0	2
8 Rural	Main roads	Artemis.rural_5	87,6	0,38	0,0	0,0	1
14 Motorway	Unsteady	Artemis.motorway_150_2	103,5	0,63	0,0	0,0	2
15 Motorway	Stable	EMPA.BAB, modemHyzem.motorway, TRL.MotorwayM113	115,3	0,32	0,1	0,0	1
13 Motorway		Artemis.motorway_130, Artemis.motorway_150_1	118,8	0,53	0,0	0,0	1
12 Motorway	High speed	Artemis.motorway_150, Artemis.motorway_150_3 & 150_4	124,6	0,48	0,0	0,0	2

Table 40: Reference test patterns definition and characteristics, and corresponding test cycles (André et al 2006) – Speed curves are provided in Annex 8.

5.2. Dynamic approach of the emissions

The previous cartography of the driving cycles offers a good mapping of the driving conditions as regards the average speed level but also as regards the acceleration dimension, i.e. the dynamic of the traffic conditions. Indeed, we clearly identify two classes of driving along the speed scale, i.e. the stable or normal driving with low acceleration and stop frequencies on one side, and the unsteady driving on the opposite.

Such a dynamic dimension within the emission reference data should be particularly useful for the detailed estimation required at the traffic situation level. Indeed, for certain pollutants (NO_x and CO₂) and vehicle categories, the influence of this dynamic dimension appears clearly as shown in Figure 26.

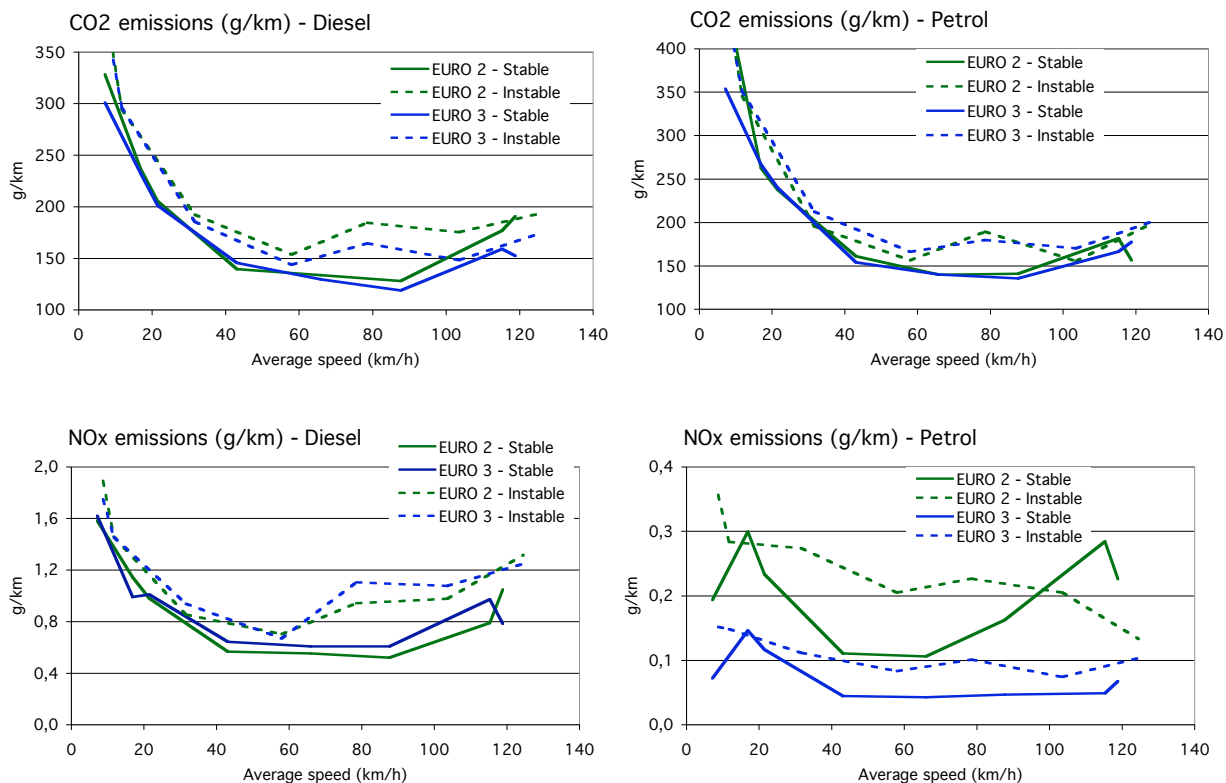


Figure 26: Dynamic influence on the CO2 and NOx pollutant emissions.

5.3. Emission estimation

The previously developed emission cartography is particularly appropriated to compute emission for the different traffic situations, as the structure enables already the analysis at a relatively microscopic scale. The idea is then to “link” a given traffic situation as a function of the different sub-cycles for which emissions are known.

In that aim, the representative speed curves were analysed together with the test cycles as regards their speed and acceleration distribution. Binary Correspondences Analysis enabled to transform the time distribution into factorial coordinates (orthonormal axes system) and to compute thus and easily distances between a speed curve (i.e a traffic situation) and the test cycles. It should be noted that it was exactly the same method that was implemented to characterize the driving patterns, to build-up the Artemis driving cycles, and also to constitute the reference test patterns.

The distances between a traffic situation (represented by its speed curve) and the test cycles, enable thus identifying the closest test patterns and to consider the traffic situation as a linear combination proportional to the proximity – in term of kinematic – to the test patterns. We realise then a projection on the plan (when 3 reference points are selected), on the line (with 2 points), or on a hyper-plan (4 or 5 points) determined by the reference points. We got always an interpolation process, and never an extrapolation (Figure 27). We determine then a set of coefficients for each traffic situation (Figure 28 and Annex 10).

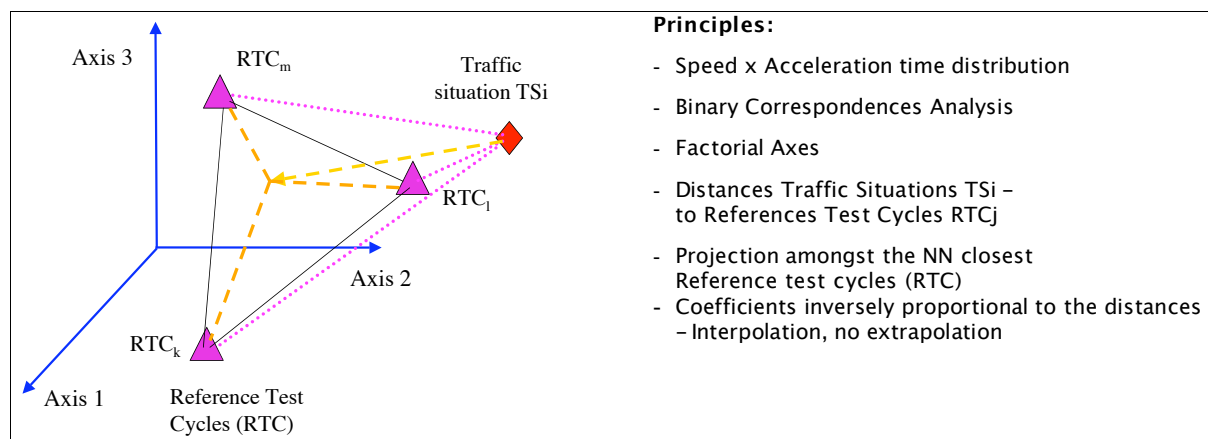


Figure 27: Positioning of a traffic situation as regards the reference test cycles

ID	SpeedCurve	Name of the curve (shortened here)	Area	Road Category	Speed limit (km/h)	Gradient, sinuosity	Traffic condition	Identification	Number of coefficients	Reference test patterns														
										1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
										Urban, Dense	Urban, Congested, low speeds	Urban, Congested, stops	Urban, Free-flowing	Urban, Free-flow, unsteady	Rural, Low speed	Urban, Stop&go	Rural, Main roads	Rural, Steady	Rural, Main roads, unsteady	Rural, Unsteady	Motorway, High speed	Motorway,	Motorway, Unsteady	Motorway, Steady
40	rural5	Rural	Nat./reg. motorway	130	Flat	Free-flow	110131	1														1,00		
88	rural5	Rural	Nat./reg. motorway	150	Flat	Free-flow	110141	1													1,00			
74	rural5	Rural	Semi-motorway	110	Flat	Free-flow	112111	1																1,00
67	rural5	Rural	Semi-motorway	110	Flat	Heavy traffic	112112	3										0,11	0,19	0,11				0,7
68	rural5	Rural	Semi-motorway	110	Flat	Saturated	112113	4									0,18					0,27		0,3
43	rural4	Rural	Nat./reg. trunk road	70	Flat	Free-flow	120071	1										1,00						
41	rural4	Rural	Nat./reg. trunk road	90	Flat	Free-flow	120091	2									0,75			0,25				
42	rural4	Rural	Nat./reg. trunk road	90	Hilly	Free-flow	120091	2										0,60		0,40				
46	rural3	Rural	Distributor	50	Flat	Free-flow	130051	1							1,00									
45	rural3	Rural	Distributor	70	Mountain	Free-flow	130071	2										0,20		0,80				
44	rural3	Rural	Distributor	90	Mountain	Free-flow	130091	1									1,00							
2	urban5	Urban	Nat./reg. motorway	110	Flat	Free-flow	210111	3									0,17		0,12					0,7
3	urban5	Urban	Nat./reg. motorway	110	Flat	Heavy traffic	210112	2									0,52		0,48					
4	urban5	Urban	Nat./reg. motorway	110	Flat	Stop and go	210114	3	0,25	0,37		0,38												
8	urban4	Urban	Urban motorway	80	Flat	Heavy traffic	211082	1										1,00						
7	urban4	Urban	Urban motorway	90	Flat	Free-flow	211091	2									0,47			0,53				
5	urban4	Urban	Urban motorway	100	Flat	Free-flow	211101	4									0,55		0,21	0,11				0,1
6	urban4	Urban	Urban motorway	100	Flat	Heavy traffic	211102	3									0,23		0,50	0,27				
16	urban4	Urban	City primary road	50	Flat	Free-flow	221051	1							1,00									
17	urban4	Urban	City primary road	50	Flat	Heavy traffic	221052	3	0,15					0,66										
18	urban4	Urban	City primary road	50	Flat	Saturated	221053	3	0,38	0,35						0,28				0,20				
19	urban4	Urban	City primary road	50	Flat	Stop and go	221054	3	0,44		0,11					0,45								
28	urban3	Urban	Districts distributor	50	Flat	Free-flow	230051	2						0,26	0,74									
29	urban3	Urban	Districts distributor	50	Flat	Heavy traffic	230052	2						0,32	0,68									
30	urban3	Urban	Districts distributor	50	Flat	Saturated	230053	3	0,45		0,17			0,38										
31	urban3	Urban	Districts distributor	50	Flat	Stop and go	230054	2	0,71		0,29													
32	urban2	Urban	Local distributor	50	Flat	Free-flow	240051	2						0,79	0,21									
47	urban2	Urban	Local distributor	50	Flat	Saturated	240053	2	0,88			0,12												
33	urban2	Urban	Local distributor	50	Flat	Stop and go	240054	2	0,27		0,73													
34	urban1	Urban	Local access	50	Flat	Free-flow	250051	3				0,26	0,55	0,19										
48	urban1	Urban	Local access	50	Flat	Saturated	250053	1				1,00												
35	urban1	Urban	Local access	50	Flat	Stop and go	250054	2			0,82				0,18									

Figure 28: Examples of coefficients for a set of traffic situations

These coefficients are then used to compute their emissions. As a matter of example, the emission from the free-flow motorway traffic situation, speed limit 130 km/h is directly computed from the test pattern 13 (Motorway), while the 150 km/h is taken from the 12th pattern (Motorway high speeds). However one should note that any motorway speed curve with a speed higher than 125 km/h should result in the same emission (no extrapolation).

For most of the situations, the emissions result from the combination of several test patterns (1 to 5).

Figure 28 highlights well the difference between urban and motorway stop and go. Indeed, the stop and go driving on a motorway (in urban area) is expressed as a combination of “Urban dense”, “Urban congested, low speeds” and “Urban, free-flowing”, while the stop and go recorded on a city primary road is rather expressed by a combination of “Urban dense”, “Urban

congested, stops” and “Urban, stop & go”.

We obtain thus a way to compute the emissions at the street level by combination of the reference emissions factors. Figure 29 highlights the results of that calculation and the strong incidence of the traffic condition on the emissions.

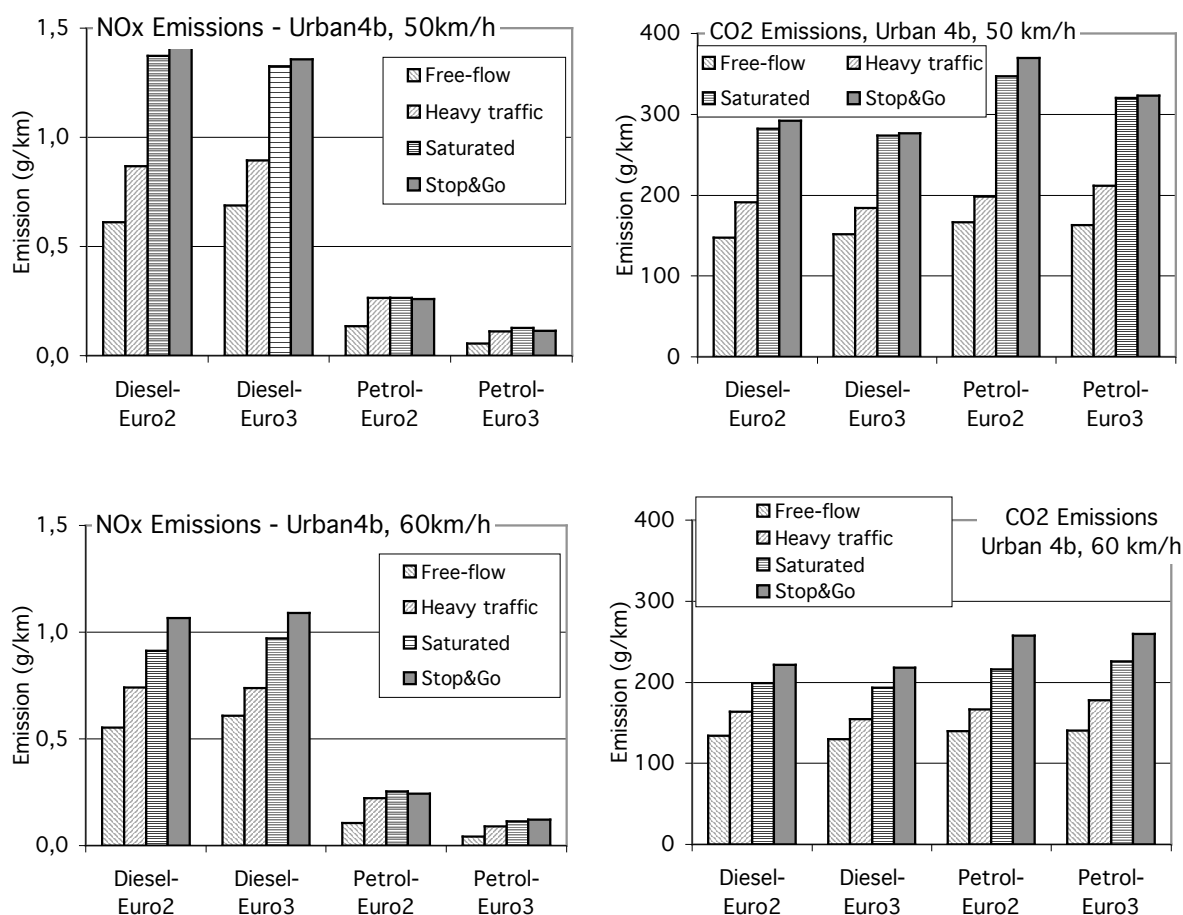


Figure 29: NOx (left) and CO2 (right) emissions estimation from the traffic situation approach, for EURO 2 and EURO 3 cars (Diesel and Petrol) driven on a urban trunk road (4b), speed limit 50 km/h (top) and 60 km/h (bottom), within 4 traffic conditions

5.4. Conclusion

An approach was designed for the calculation of the cars pollutant emissions at the level of a traffic situation. This approach relies on the Artemis emission database, which was analysed and harmonized with respect to test cycles. A classification into 15 test patterns was defined in that aim. This typology constitutes a good coverage of the actual driving conditions, including the dynamic dimension. It was used as a basis for the computation of the emissions for any traffic situation. For that, a traffic situation is represented through a representative speed curve. This speed curves is analysed as regards its proximity in term of kinematic to the 15 test patterns. A simple linear combination of the closest test patterns is then realized and enables us the determination of the emission of the traffic situation.

The combination of traffic situations with their respective weight in term of mileage should then enable the estimation of the pollutant emissions from the vehicles driven on a road network, at a local, regional or national level.

Complementary remarks:

It should be noted that other approaches have been proposed in Artemis, such as an emission modelling based on several kinematic parameters (reported in André et al. 2006) or the VERSITS emission model by TNO, NL. Unfortunately, these approaches were not ready for an implementation in Artemis.

For light duty vehicles and 2-wheelers a similar approach – based on a linear combination of test cycles - should be conceivable as well.

For heavy duty vehicles, the traffic situation emissions are computed through an instantaneous model (based on engine emission maps and transient corrections), using the speed curves (and other parameters such as road gradient and curvature, vehicle load, etc.) as input data.

6. Implementation of the traffic situation approach

The purpose of this chapter is not to provide a guideline for the implementation of the traffic situation approach. Such guideline should be rather associated with the ARTEMIS tools. We consider here the task of distributing the mileage into the various traffic situations. Indeed, the selection of the traffic situations corresponding to a given case study, and the attribution of a relative travelled mileage are the main tasks let to the user.

The highly sophisticated traffic situation scheme that was previously elaborated implies a difficult estimation of the mileage distribution for the various vehicle categories as regards the different traffic situations. The advantage of a traffic situations scheme derived from existing road classifications and traffic practices is that possibly estimations of traffic could be available from the traffic engineering.

6.1. A real case study: Sweden

A first real case of application is reported in (Larsson et al, 2006). The authors proposed method and assumptions for the elaboration of the traffic data required for the estimation of the Sweden road transport emission using the traffic situation approach. The authors set up successively the mileage share between urban and rural and the mileage distribution as regards the different road categories, using road and traffic databases and statistics. They identified also the most common traffic situations in Sweden (10 situations representing 80% of the total traffic).

The most critical point was the estimation of the stop-and-go driving. The analysis of the hourly traffic flows enabled the assessment of the mileage distribution according to the traffic condition (Table 41). This table suggests that the stop and go and even the heavy and saturated traffics are very marginal situations (0.05, 2 and 3% respectively).

Traffic condition	% of mileage – estimation
Free-flow	94,4
Heavy traffic	3,4
Saturated traffic	2,1
Stop and go	0,05

Table 41: Estimation of the mileage distribution with respect to traffic conditions in Sweden (Larsson et al. 2006).

6.2. General case

For a national (or even regional) application, and in the following of the Swedish case study, we would recommend setting up high level assumptions (based on national statistics) and then a disintegration of these assumptions to the lowest levels. Typically, the urban / rural mileage distribution should be estimated. The mileage distribution according to the road types (within urban and rural area) should be estimated using the relevant traffic statistics.

For each road type, the most probable speed limits should be known, allowing an estimation of the distance travelled on each road category and speed limit.

Distributions of the mileage as regards the traffic conditions should be estimated at this level (i.e. per road category and speed limit). Complementary assumptions can help for such estimation: the stop-and go is likely very low or even null (on a yearly basis) on rural and local or access roads. The overall stop and go driving could be estimated from large database such as the modem-Hyzem database or from various measurements of the congestion (total queue lengths, etc.).

Furthermore, the compilation of the mileage distribution and of the average speeds for each traffic situation enables us to estimate the average speeds at different levels: overall speed, urban and rural overall speeds, speeds within different traffic conditions and speed limits. The resulting figures should help in validating the mileage distribution assumptions.

Such a process can be highlighted as follows:

1. We suppose a share of the mileage between urban (40% of the total) and rural (60%).
2. We assume a distribution as regards the different road categories as shown in Table 42.

Area			% of mileage
Rural			60
Urban			40
Area	Code	Road category	% of mileage
Rural	5	Nat./reg. motorway	20
	4	Nat./reg. trunk road	35
	3	Distributor	20
	2	Local distributor	15
	1	Access road	10
	<i>All</i>		<i>100</i>
Urban	5a	Nat./reg. motorway	7
	5b	Nat./reg. trunk road	8
	4a	Urban motorway	15
	4b	City primary road	20
	3	Districts distributor	25
	2	Local distributor	15
	1	Local access	10
	<i>All</i>		<i>100</i>

Table 42: High-level assumptions with respect to the mileage distribution (Case study)

3. We attempt now a distribution as regards the different speed limits for each road categories as well as a share within the different traffic conditions as shown in Table 43

				Speed limit (km/h)												Traffic condition					
Area	Code	Road category	% of mileage	30	40	50	60	70	80	90	100	110	120	130	>130	All speed limits	Free-flow	Heavy traffic	Saturated	Stop and go	All conditions
Rural	5	Nat./reg. motorway	20							5		15		80		100	70	15	10	5	100
	4	Nat./reg. trunk road	35					15		70		15				100	70	15	10	5	100
	3	Distributor	20			30	20	40		10						100	70	15	10	5	100
	2	Local distributor	15	0		60	25	15								100	80	15	5	0	100
	1	Access road	10	25		75										100	90	10		0	100
All			100	2,5	22,5	7,8	15,5		27,5		8,3		16,0		100	73,5	14,5	8,3	3,8	100	
Urban	5a	Nat./reg. motorway	7							5		15		80		100	50	25	15	10	100
	5b	Nat./reg. trunk road	8					15		30		55		0		100	50	25	15	10	100
	4a	Urban motorway	15					15		70		15				100	40	25	20	15	100
	4b	City primary road	20			60	15	25								100	40	25	20	15	100
	3	Districts distributor	25			70	25	5								100	40	25	20	15	100
	2	Local distributor	15	0		85	15	0								100	50	25	15	10	100
	1	Local access	10	30		70										100	60	20	15	5	100
	All			100	3,0	49,3	11,5	9,7		13,3		7,7		5,6		100	45,0	24,5	18,0	12,5	100
Urban and rural				2,7	33,2	9,3	13,2		21,8		8,0		11,8		100	62,1	18,5	12,2	7,3	100	

Table 43: Mileage distribution assumptions with respect to speed limits and traffic conditions (Case study)

				Speed limit (km/h)												Traffic condition					
Area	Code	Road category	% of mileage	30	40	50	60	70	80	90	100	110	120	130	>130	All speed limits	Free-flow	Heavy traffic	Saturated	Stop and go	All conditions
Rural	5	Nat./reg. motorway	12	0	0	0	0	0	0	0,6	0	1,8	0	9,6	0	12,0	8,4	1,8	1,2	0,6	12,0
	4	Nat./reg. trunk road	21	0	0	0	0	3,2	0	15	0	3,2	0	0	0	21,0	14,7	3,2	2,1	1,1	21,0
	3	Distributor	12	0	0	3,6	2,4	4,8	0	1,2	0	0	0	0	0	12,0	8,4	1,8	1,2	0,6	12,0
	2	Local distributor	9	0	0	5,4	2,3	1,4	0	0	0	0	0	0	0	9,0	7,2	1,4	0,5	0,0	9,0
	1	Access road	6	1,5	0	4,5	0	0	0	0	0	0	0	0	0	6,0	5,4	0,6	0,0	0,0	6,0
All			60	1,5	13,5	4,7	9,3	16,5	5,0	9,6	60,0										
Urban	5a	Nat./reg. motorway	2,8	0	0	0	0	0	0	0,1	0	0,4	0	2,2	0	2,8	1,4	0,7	0,4	0,3	2,8
	5b	Nat./reg. trunk road	3,2	0	0	0	0	0,5	0	1	0	1,8	0	0	0	3,2	1,6	0,8	0,5	0,3	3,2
	4a	Urban motorway	6	0	0	0	0	0,9	0	4,2	0	0,9	0	0	0	6,0	2,4	1,5	1,2	0,9	6,0
	4b	City primary road	8	0	0	4,8	1,2	2	0	0	0	0	0	0	0	8,0	3,2	2,0	1,6	1,2	8,0
	3	Districts distributor	10	0	0	7	2,5	0,5	0	0	0	0	0	0	0	10,0	4,0	2,5	2,0	1,5	10,0
	2	Local distributor	6	0	0	5,1	0,9	0	0	0	0	0	0	0	0	6,0	3,0	1,5	0,9	0,6	6,0
	1	Local access	4	1,2	0	2,8	0	0	0	0	0	0	0	0	0	4,0	2,4	0,8	0,6	0,2	4,0
All			40	1,2	19,7	4,6	3,9	5,3	3,1	2,2	40,0										
Urban and rural				2,7	33,2	9,3	13,2	21,8	8,0	11,8	100,0										

Table 44: Resulting mileage distribution with respect to area, road categories, speed limits and traffic conditions (Case study)

- At that stage, we can easily compute the relative distances corresponding to each case (road category x speed limit and road category x traffic condition, Table 44).
- For simplification, we have assumed here, that the distribution into the 4 traffic conditions is common for all speed limits of a road category (i.e. Nat. / reg. motorway a 90, 110 and 130 km/h speed limit should record the same traffic conditions, i.e. 70% free-flow, 15% heavy, 10% saturated and 5% stop and go). That assumption could obviously be abandoned as far as we had more detailed information. That step enables us to estimate the distribution per detailed low-level situation (i.e. road category x speed limit x traffic condition).
- The combination of the detailed mileage distribution and the corresponding traffic situation average speeds enables us the estimation of speeds as shown in Table 45.

This last table (which combines the road categories) provides useful information for validation and comparison with other statistics, and finally to adjust the above assumptions:

- The resulting overall speed (43 km/h) is quite coherent with current estimations (maybe a bit high for France),

- The overall urban (including motorway in urban area) and rural speed should be compared to other macroscopic estimations (several big cities record their average speeds),
- Average speeds recorded for a given speed limit could be compared to roadside measurements, etc.

Area	Traffic condition	% of mileage	Speed limit (km/h)												All speed limits
			30	40	50	60	70	80	90	100	110	120	130	>130	
Urban	Free-flow	18,0	20		42	55	64		76		100		118		49
	Heavy traffic	9,8	20		37	43	50		71		90		90		45
	Saturated	7,2	13		21	28	31		31		31		31		24
	Stop and go	5,0	11		13	20	22		23		26		26		17
	All conditions	40,0	18		28	37	41		47		58		64		34
Rural	Free-flow	44,1	20		41	53	67		80		100		122		60
	Heavy traffic	8,7	20		38	40	50		72		90		90		55
	Saturated	5,0			22	28	31		31		31		31		30
	Stop and go	2,3			13	19	20		23		26		26		22
	All conditions	60,0	20		38	46	53		62		72		80		52
Urban and rural	Free-flow	62,1	20		41	54	67		79		100		122		57
	Heavy traffic	18,5	20		38	42	50		71		90		90		49
	Saturated	12,2	13		21	28	31		31		31		31		26
	Stop and go	7,3	11		13	20	21		23		26		26		18
	All conditions	100,0	19		32	41	49		57		66		76		43

Table 45: Estimation of the average speeds resulting from the compilation of the mileage distribution and of the traffic situation average speeds (Case study)

6.3. Simplified approach

The previous exercise is quite complex and requires certainly a good knowledge of the traffic statistics, if these ones are available with such a level of detail.

It is however possible to build-up an estimation using a simplified approach based on the Artemis cycles and sub-cycles. Indeed, for their development a typology of the European driving conditions was built-up, using the modem-Hyzem database, which was recorded on 80 instrumented private cars driven in real-world conditions. We obtained thus a declination of the European driving conditions in 12 classes (Table 46). Three Artemis cycles (urban, rural-road and motorway) were then derived from this typology, and structured in sub-cycles corresponding to the different driving patterns. The 3 resulting cycles and 14 sub-cycles (2 driving patterns are represented by 2 cycles) can be considered as particular traffic situations with their respective speeds and characteristics, and with their mileage share as estimated from the modem-Hyzem database (Table 47). Thus, we can directly obtain a “European” emission estimation from the use of the emissions measured on the Artemis cycles / sub-cycles. Adjustments of the mileage distribution are obviously possible and could enable managing specific cases, providing that we are able to build-up the specific assumptions underlying such cases.

At a later stage, it can be envisaged to derive a similar approach relying on the set of 15 reference test patterns mentioned in Chapter 5, section 5.1., but the mileage distribution is more difficult to establish. That would enable a more accurate or detailed taking into account of the

traffic situations, as 3 complementary test patterns were identified.

Classes of driving conditions and their description			% of total mileage	running speed (km/h)	average speed (km/h)	stop duration (in %)	stop rate (1/km)	aver. positive acceleration (m/s ²)
1	congested urban	high stop duration	3.7	25.9	10.2	60.8	3.9	0.87
2			5.9	23.6	15.9	32.7	3.0	0.81
3		low steady speeds	2.4	16.5	13.2	19.5	3.4	0.67
4	free-flow urban		5.1	28.0	26.1	6.7	0.97	0.65
5		unsteady speeds	12.2	35.6	32.3	9.1	0.98	0.81
6	secondary roads	unsteady speeds	10.8	52.2	48.8	6.6	0.41	0.75
7			8.8	45.5	43.8	3.7	0.39	0.63
8		steady speeds	7.2	65.0	64.0	1.5	0.15	0.55
9	main roads	unsteady speeds	11.8	75.0	72.5	3.3	0.15	0.67
11			6.2	86.1	85.7	0.4	0.04	0.48
10	motorways	unsteady speeds	10.4	115.6	114.9	0.7	0.03	0.53
12			15.6	123.8	123.7	0.1	0.01	0.40

Table 46: Twelve driving patterns representative of European driving, obtained by automatic clustering of speed profiles described by the distribution of the instantaneous speed and acceleration. Data recorded on-board private vehicles in actual use (André, 1997)

Driving cycle or sub-cycle and driving pattern		Absolute weight (%)	Cycles and sub-cycles relative weights (%)
Artemis Urban cycle			29.2
Sub-cycle urban 1	(DP 2: Urban dense)	5.9	20,1
Sub-cycle urban 2	(DP 5: Free-flowing urban, unsteady)	12.2	41,6
Sub-cycle urban 3	(DP 1: Congested urban, stops)	3.7	12,6
Sub-cycle urban 4	(DP 3: Congested urban, low speed)	2.4	8,3
Sub-cycle urban 5	(DP 4: Free-flowing urban)	5.1	17,3
Artemis Road cycle			44.9
Sub-cycle road 1	(DP 6: Secondary roads, unsteady)	10.8	24,1
Sub-cycle road 2	(DP 8: Secondary roads, steady speed)	7.2	16,0
Sub-cycle road 3	(DP 7: Secondary roads)	8.8	19,7
Sub-cycle road 4	(DP 9: Main roads, unsteady speed)	11.8	26,3
Sub-cycle road 5	(DP 11: Main roads)	6.2	13,9
Artemis Motorway cycle			25.9
Sub-cycle motorway 1	(DP 12a: Motorway)	9.3	36,0
Sub-cycle motorway 2	(DP 10a: Motorway, unsteady speed)	6.0	23,2
Sub-cycle motorway 3	(DP 12b: Motorway)	6.2	24,0
Sub-cycle motorway 4	(DP 10b: Motorway, unsteady speed)	4.4	16,8
Artemis Motorway130 cycle			25.9
Sub-cycle motorway 1	(DP 12a: Motorway)	9.5	36,6
Sub-cycle motorway 2	(DP 10a: Motorway, unsteady speed)	6.3	24,4
Sub-cycle motorway 3	(DP 12b: Motorway)	6.1	23,4
Sub-cycle motorway 4	(DP 10b: Motorway, unsteady speed)	4.0	15,6

Table 47: Weighing of the ARTEMIS sub-cycles and cycles(André, 2004b)

Conclusions

The estimation of the road transport pollutant emissions at a low special scale (i.e. street level) being necessary for detailed inventories or impact studies, a whole approach has been designed for such scale within the framework of the ARTEMIS and COST346 research projects. That implied the definition of “Traffic Situations” (road configurations and traffic conditions), the building-up of appropriate emission data and emission calculation approaches and required driving related data (speeds and mileage distribution according to the traffic situations). Preliminary works (Poize 2002, André et al. 2002, Keller et al. 2003) had already enabled a first approach of most of the methodological aspects.

In the following of these works, a whole traffic situation scheme has been exhaustively defined and agreed. This structure was built-up through the analysis of the European practices of traffic and transport management. It relies on the road function (through-traffic, distribution, access) and on the road network hierarchical organisation, usually implemented to manage the traffic and transport. The road characteristics (number of lanes, speed limit, etc.) were also analysed and considered as complementary parameters. The urban / rural definition relies on the concept of Urban Functional Entity (i.e. the entity that generates and manages the traffic according to its own functioning and activities). A definition of the traffic conditions into 4 classes was also elaborated as well as a qualitative taking into account of the road topography (gradient) and sinuosity.

These structural / definition aspects were deliberately oriented to the potential users of the emission. The search for similarity with in-use definitions should make easier both the application of the approach and the collection of the required traffic-related input data. A set of pictures is associated to the road classification. It will concern the road configuration only and not the traffic conditions as these ones are difficult to express in a static way (photography).

The resulting traffic situation scheme is relatively complex but relies on rigorous bases. It constitutes the basic structure for the elaboration of an emission estimation approach at a local scale.

A large review of the speed data from different sources e.g. European projects, national studies, etc. has been conducted. The related information, although not directly applicable to the traffic situation approach, constitutes a good basis for estimating realistic speeds in different contexts and their variation according to various factors (time-period, places, vehicle categories, road characteristics, traffic conditions, etc.).

The traffic situation approach requires detailed speed data (speed versus time curve) for each traffic situation. For the cars, a data collection process aiming at collecting the existing driving data was conducted as well as a specific experimentation with instrumented cars in France to

record driving data for specific situations (hilly, mountainous, etc.). The collected speed curves were carefully analysed and affected to traffic situations when possible. That process implied the elaboration of numerous assumptions and mechanisms of affectation to compensate the lack of data for a high number of cases.

A complete exercise was thus achieved and the resulting dataset makes the traffic situation approach possible. Similar exercises were conducted for heavy-duty vehicles and motorized 2-wheelers. However the low quantity of speed data for the different vehicle categories, its probable limited quality and the incoherencies observed between the vehicles categories (cars, lorries, buses, 2-wheelers) highlight the weakness of the dataset, which should be also the main weakness of the whole emission estimation approach. One should note the particular difficulty of that exercise, which consisted in using speed data that was already recorded and thus independently of the traffic situation scheme adopted here. Finally, this weakness raises up the question of the information to the users, who should be fully advised on the quality of the data. A “quotation” of the data (valid / hypothetical) could help.

Complementary work is thus strongly needed on that topic and speed data collection is highly required to ensure the validity of the approach.

Specific approaches for estimating the vehicles emissions at the traffic situation level have been developed for the heavy-duty vehicles (Rexeis et al. 2005) and or the two-wheelers (Elst et al. 2006). Up to now, the light duty vehicles have not been dealt with.

For the passenger cars, a new approach was designed for the calculation of the cars pollutant emissions at the level of a traffic situation. This approach relies on the Artemis emission database, which was analysed and harmonized with respect to test cycles. A typology into 15 test patterns was defined, which offers a good coverage of the actual driving conditions including the dynamic dimension. It was used as a basis for the computation of the emissions for any traffic situation. For that, a traffic situation is represented through a representative speed curve. This speed curves is analysed as regards its proximity in term of kinematic to the 15 test patterns. A simple linear combination of the closest test patterns is then realized and enables us the determination of the emission of the traffic situation.

The implementation of the traffic situation approach was discussed with respect to the difficult task of distributing the mileage amongst the numerous traffic situations. General recommendations on that topic were then proposed.

Finally, a comprehensive approach was designed for estimating the pollutant emissions from the road vehicles at a street level, including the definition of the traffic situations, the building-up of the emission approaches and the elaboration of the speed related data.

The lack of speed data and the limited reliability of the derived datasets are certainly the main weakness of the traffic situation approach, which should be implemented with precaution and preferably for local applications. However, the whole approach is operational and ready for implementation as well as for adjustments and integration of new data.

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Acronyms

CETE: Centre d'Etudes Techniques de l'Equipement (French Institute for technical study of the Country and town planning)

CERTU: Centre d'Etudes sur les Réseaux de Transports et l'Urbanisme (French Institute for technical study of Transport Networks and Town Planning)

FINRA: Finland National Road Administration

INSEE: Institut National des Statistiques et des Sciences Economiques (French National Institute for Statistics and Economic Studies)

OECD: Organisation for Economic Cooperation and Development

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Annex 1. Terminology and American terms - Motorway

Several American terms are sometimes used in European countries but their definition and use seem sometimes unclear or incoherent. We recapitulate then some definitions hereafter:

Expressway (US): urban or peri-urban motorway

Beltway (US): ring road

Highway: great road, national road

Superhighway: generic term to design a motorway. They are divided in interstate highway (between one state to another), freeways (free), toll roads (not free) and expressways (see before)

Distributor and access road : roads having access to properties

Collector road : collect traffic from local road

The expressway definition corresponds to “an urban motorway” but can also be considered like a beltway. An urban motorway is a motorway through an urban area, which has a lot of connection with this one, while a motorway built-up through an urban area may have few or no connection with it. In Hungary, expressway gathers motorway and motor route, which are in rural or built-up area. The term expressway seems not used in the Netherlands, where different types of motorway exist in rural area, even with traffic light or roundabout at junctions.

The term highway gathers the roads like interstate highway, freeway, and motorway. In general, a highway is multilane, traffic in each direction (grade separation) and pedestrians prohibited. In HCM (HCM, 2000), highway does not include motorway, which is called freeway.

These definitions show the confusion introduced by the US terms. Several conditions (number of lanes, grade separated junctions, separated roadways) must be gathered so that a road should be defined as a motorway. The difference between a freeway and an expressway seems to be the presence or not of grade separated junctions.

Table 48: Comparison between freeway and expressway

Road	Similarity	Difference
Freeway	Multilane of traffic in each direction, great speed, double way circulation	Grade separated junctions, grade separated roadways (barrier or strip of land),
Expressway		Junctions can exist but they are minimized (internet site, 2004; Keller, 2003), not grade separated roadways but they can be separated (with a small median strip) (CERTU)

This leads us to propose to use exclusively the term motorway concerning the roads with motorway characteristics. The urban road category like major artery, trunk road, can have grade or not grade separated junctions but can also be or not grade separated roadways.

Annex 2. Collection of the existing speed data

A2.1. Requested background information and speed data

HOW TO PROVIDE THE NECESSARY BACKGROUND INFORMATION THAT CHARACTERIZES THE TRAFFIC SITUATIONS			
The second column gives examples of answer			
You can duplicate the columns for a series of traffic situations			
Information needed	Examples of answer (several examples are given to illustrate the way you can answer)	Your answer (1)	Your answer (2)
Traffic situation name (you can provide a clear name corresponding to what you mean)	<i>traffic_situation_1</i>		
Vehicles concerned:			
Vehicle category	<i>Passenger Car (PC), Urban bus, etc. select in the list or type directly</i>		
Detailed or complementary information	<i>Articulated truck, minibuss, articulated bus,</i>		
Engine size (Passenger cars, 2-Wheelers)	<i>1,4 liters, 50 cm³</i>		
Vehicle weight (Light and heavy goods vehicles, bus, coach)	<i>3.5 tons, 12 tons</i>		
Traffic situation:			
Area (urban / rural)	<i>urban, rural, suburban, city centre</i>		
Road type or definition	<i>motorway</i>		
Road configuration			
Number of lanes	<i>2 lanes x 2 ways (total 4 lanes)</i>		
Speed limit	<i>30 km/h, 30 mph</i>		
- Complementary information regarding the road / street			
Mountainous or plain character, gradient	<i>plain or flat, hilly, mountainous, uphill, downhill, 3%, -6% slope, etc.</i>		
Sinuosity	<i>straight road, sinuous, very sinuous, etc.</i>		
Traffic conditions when the data was recorded	<i>congested, free-flow, strong disturbances, 1200 vehicles/lane, etc.</i>		
Mileage represented by this traffic situation (in % of total mileage)	<i>7% (of the total mileage of the concerned vehicle category), 10% of urban mileage, etc. even a rough estimation can be useful</i>		
Comments or description when the above information is difficult to answer			
	<i>This data was recorded in urban area with a car in the traffic flow, using various streets with a limit of 50 km/h and also arteries, etc...</i>		

Vehicle categories
Passenger Car (PC)
motorized 2 wheeler (2W)
Light Duty Vehicle (LDV)
Lorry, truck (Heavy goods vehicles)
Urban Bus
Coach or interurban bus
Other: please type directly in the cell

Requested background information and speed data (cont.)

HOW TO PROVIDE SPEED VERSUS TIME CURVES FOR A SERIES OF TRAFFIC SITUATIONS (EXAMPLE) In case a speed curve has a different time basis, please introduce a new time column (eg "Traffic_Situations_4")							
Name identifying the traffic situation	Traffic Situation_1		Traffic Situation_2	Traffic Situation_3	Traffic Situation_4		Traffic Situation_5
time (s)	speed (km/h)	speed (km/h)	speed (km/h)	time (s)	speed (km/h)	time (s)	speed (km/h)
1	0			0,5	0	1	
2	0			1	0	2	
3	0			1,5	0	3	
4	2			2	2	4	
5	5			2,5	5	5	
6	7			3	7	6	
...	...			3,5 ...	...	...	...
				...			

A2.2. Detailed collected information (samples)

Nber	Identifiers					Vehicle characteristics					Road characteristics		Road configuration					Traffic conditions				Commen ts % Other comments	Traffic Situation	
	Origine	Location, city, country	Extracted data file	Trip code	Other	Vehicle category	Detailed information	Engine size	Vehicle weight	Other	Area (urban/rural)	Road type or definition	To no. of lanes	Speed limit (km/h)	Characteristics (junctions, bus lanes, parking, bus stop, pedestrian, etc)	Mountainous or plain character, gradient	Sinusity	Unit	Value	Tr density (vehicles/km)	Mean Tr density per serie			
1	TRL	Athens	Link A01_1 all patterns.xls	3000		PC					urban		3	50	Bus lane (1), traffic lights (7) per km			Total traffic fld	546	49				u2-V50
2	TRL	Athens	Link A01_1 all patterns.xls	3001		PC					urban		3	50	Bus lane (1), traffic lights (7)			Total traffic fld	546	35				u2-V50
3	TRL	Athens	Link A01_1 all patterns.xls	3002		PC					urban		3	50	Bus lane (1), traffic lights (7)			Total traffic fld	546	44				u2-V50
4	TRL	Athens	Link A01_1 all patterns.xls	3003		PC					urban		3	50	Bus lane (1), traffic lights (7)			Total traffic fld	614	34				u2-V50
5	TRL	Athens	Link A01_1 all patterns.xls	3004		PC					urban		3	50	Bus lane (1), traffic lights (7)			Total traffic fld	614	58				u2-V50
122	TRL	Athens	Link A02_2 all patterns.xls	3121		PC					urban		3	60	Bus lane (0) traffic lights(1,5)			Total traffic fld	567	10				u4b-V60
123	TRL	Athens	Link A02_2 all patterns.xls	3122		PC					urban		3	60	Bus lane (0) traffic lights(1,5)			Total traffic fld	567	8				u4b-V60
124	TRL	Athens	Link A02_2 all patterns.xls	3123		PC					urban		3	60	Bus lane (0) traffic lights(1,5)			Total traffic fld	567	12				u4b-V60
125	TRL	Athens	Link A02_2 all patterns.xls	3124		PC					urban		3	60	Bus lane (0) traffic lights(1,5)			Total traffic fld	567	11				u4b-V60
126	TRL	Athens	Link A02_2 all patterns.xls	3125		PC					urban		3	60	Bus lane (0) traffic lights(1,5)			Total traffic fld	567	13				u4b-V60
338	TRL	Helsinki	Link H01 all patterns.xls	2000		PC					urban		2	80	Bus lane (0) traffic lights(0)				852	14				u4b-V80
339	TRL	Helsinki	Link H01 all patterns.xls	2001		PC					urban		2	80	Bus lane (0) traffic lights(0)				852	14				u4b-V80
340	TRL	Helsinki	Link H01 all patterns.xls	2002		PC					urban		2	80	Bus lane (0) traffic lights(0)				996	41				u4b-V80
341	TRL	Helsinki	Link H01 all patterns.xls	2003		PC					urban		2	80	Bus lane (0) traffic lights(0)				1480	22				u4b-V80
342	TRL	Helsinki	Link H01 all patterns.xls	2004		PC					urban		2	80	Bus lane (0) traffic lights(0)				1456	20				u4b-V80
668	TRL	Helsinki	Link H07 all patterns.xls	2331		PC					urban		2	40	Bus lane (0) traffic lights(7,5)				372	11				u1/2-V40
669	TRL	Helsinki	Link H07 all patterns.xls	2332		PC					urban		2	40	Bus lane (0) traffic lights(7,5)				267	9				u1/2-V40
670	TRL	Helsinki	Link H07 all patterns.xls	2333		PC					urban		2	40	Bus lane (0) traffic lights(7,5)				265	10				u1/2-V40
671	TRL	Helsinki	Link H07 all patterns.xls	2334		PC					urban		2	40	Bus lane (0) traffic lights(7,5)				265	11				u1/2-V40
783	TRL	London	Link L01 all patterns.xls	1011		PC					urban		3	48	Bus lane (1) traffic lights(7,5)				386	24				u2-V50
784	TRL	London	Link L01 all patterns.xls	1012		PC					urban		3	48	Bus lane (1) traffic lights(7,5)				386	37				u2-V50
785	TRL	London	Link L01 all patterns.xls	1013		PC					urban		3	48	Bus lane (1) traffic lights(7,5)				367	29				u2-V50
786	TRL	London	Link L01 all patterns.xls	1014		PC					urban		3	48	Bus lane (1) traffic lights(7,5)				366	23				u2-V50
787	TRL	London	Link L01 all patterns.xls	1015		PC					urban		3	48	Bus lane (1) traffic lights(7,5)				348	23				u2-V50
793	TRL	London	Link L01 all patterns.xls	1021		PC					urban		3	48	Bus lane (1) traffic lights(7,5)				379	54				u2-V50
923	TRL	London	Link L04 all patterns.xls	1141		PC					urban		3	48	Bus lane (1) traffic lights(8)				306	38				u2-V50
924	TRL	London	Link L04 all patterns.xls	1142		PC					urban		3	48	Bus lane (1) traffic lights(8)				306	35				u2-V50
925	TRL	London	Link L04 all patterns.xls	1143		PC					urban		3	48	Bus lane (1) traffic lights(8)				323	28				u2-V50
926	TRL	London	Link L04 all patterns.xls	1144		PC					urban		3	48	Bus lane (1) traffic lights(8)				335	41				u2-V50
927	TRL	London	Link L04 all patterns.xls	1145		PC					urban		3	48	Bus lane (1) traffic lights(8)				357	36				u2-V50
965	TRL	Madrid	Link M01 to M05 all patterns.xls	4000	M01	PC					urban		3	50	Bus lane (1)				524	20				u2/3-V50
966	TRL	Madrid	Link M01 to M05 all patterns.xls	4001	M01	PC					urban		3	50	Bus lane (1)									u2/3-V50
967	TRL	Madrid	Link M01 to M05 all patterns.xls	4002	M01	PC					urban		3	50	Bus lane (1)				571	40				u2/3-V50
968	TRL	Madrid	Link M01 to M05 all patterns.xls	4003	M01	PC					urban		3	50	Bus lane (1)				590	45				u2/3-V50
969	TRL	Madrid	Link M01 to M05 all patterns.xls	4004	M01	PC					urban		3	50	Bus lane (1)				627	68				u2/3-V50
1056	TRL	Madrid	Link M11 to M14 all patterns.xls	4091	M13a	PC					urban		4/5	50	Bus lane (1)				967	31				u4b-V50
1057	TRL	Madrid	Link M11 to M14 all patterns.xls	4092	M13a	PC					urban		4/5	50	Bus lane (1)				525	9				u4b-V50
1058	TRL	Madrid	Link M11 to M14 all patterns.xls	4093	M13b	PC					urban		4/5	50	Bus lane (1)				591	40				u4b-V50
1059	TRL	Madrid	Link M11 to M14 all patterns.xls	4094	M13b	PC					urban		4/5	50	Bus lane (1)				780	46				u4b-V50
1060	TRL	Madrid	Link M11 to M14 all patterns.xls	4095	M13b	PC					urban		4/5	50	Bus lane (1)				577	30				u4b-V50
1146	TRL	Madrid	Link M26 to M30 all patterns.xls	4181	M26	PC					urban		6	50	Bus lane (1)				498	13				u4b-V50
1147	TRL	Madrid	Link M26 to M30 all patterns.xls	4182	M26	PC					urban		6	50	Bus lane (1)				361	10				u4b-V50
1148	TRL	Madrid	Link M26 to M30 all patterns.xls	4183	M26	PC					urban		6	50	Bus lane (1)				325	8				u4b-V50
1149	TRL	Madrid	Link M26 to M30 all patterns.xls	4184	M27	PC					urban		6	50	Bus lane (1)				859	30				u4b-V50
1150	TRL	Madrid	Link M26 to M30 all patterns.xls	4185	M27	PC					urban		6	50	Bus lane (1)				925	40				u4b-V50

Development of an approach for estimating the pollutant emissions from road transport at a street level

Nber	Identifiers					Vehicle characteristics					Road characteristics		Road configuration				Traffic conditions		Comments	Traffic Situation				
	Origine	Location, city, country	Extracted data file	Trip code	Other	Vehicle category	Detailed information	Engine size	Vehicle weight	Other	Area (urban/rural)	Road type or definition	Tot no. of lanes	Speed limit (km/h)	Characteristics (junctions, bus lanes, parking, bus stop, pedestrian, etc)	Mountainous or plain character, gradient	Sinuosity	Unit			Value	Tr density (vehicles/km)	Mean Tr density per serie	Mileage represented by the TS %
#####	LUND	Malmö	TrafficSituations_Speed_arteria			PC	Toyota corolla	81 kW, 1	1300 kg		urban	street arteria travelled in both directions	1x1	50		flat							zeros at	u3-V50
#####	LUND	Budapest	TrafficSituations_Speed_arteria			PC		suzuki swift			urban	street arteria travelled in both directions	2x2	50									zeros at	u3 ou u4b
#####	LUND	Malmö and napoli	TrafficSituations_Speed_main			PC		small-average sized car			urban	local street in resi	1x1	50									zeros at	u2 -V50
#####	LUND	Malmö	TrafficSituations_Speed_main			PC	Toyota corolla	81 kW, 1	1300 kg		urban	main street in resi	1x1	30									zeros at	u1-V30
#####	LUND	Napoli	TrafficSituations_Speed_main			PC		small-average sized car			urban	main street in indu	1x1	50									zeros at	u2-V50
#####	LUND	Budapest, Malmö and napoli	TrafficSituations_Speed_main			PC		small-average sized car			urban	main street in indu	1x1	50									zeros at	u2-V50
#####	LUND	Budapest and napoli	TrafficSituations_Speed_main			PC		small-average sized car			city ce	main street in cbd	2x2	50									zeros at	u2 ou u3-V
#####	LUND	Malmö and napoli	TrafficSituations_Speed_main			PC		small-average sized car			city ce	main street in cbd	1x1	50									zeros at	u2-V50
#####	LUND	Budapest & Malmö	TrafficSituations_Speed_main			PC		small-average sized car			city ce	main street in cbd	1x1	50									zeros at	u1-V50
#####	LUND	Budapest	TrafficSituations_Speed_local			PC		suzuki swift			urban	local street in resi	1x1	50									zeros at	u1-V50
#####	LUND	Budapest, Malmö and napoli	TrafficSituations_Speed_local			PC		small-average sized car			urban	local street in resi	1x1	50									zeros at	u1-V50
#####	LUND	Malmö	TrafficSituations_Speed_local			PC	Toyota corolla	81 kW, 1	1300 kg		urban	local street in resi	1x1	30									zeros at	u1-V30
#####	LUND	Budapest	TrafficSituations_Speed_local			PC		suzuki swift			urban	local street in resi	1x1	50									zeros at	u1-V50
#####	LUND	Budapest, Malmö and napoli	TrafficSituations_Speed_local			PC		small-average sized car			urban	local street in indu	1x1	50									zeros at	u1-V50
#####	LUND	Budapest, Malmö and napoli	TrafficSituations_Speed_local			PC		small-average sized car			city ce	local street in cbd	1x1	50									zeros at	u1-V50
#####	LUND	Napoli	TrafficSituations_Speed_arteria			PC					urban	arterial travelled in	3x3	80									zeros at	u4b-V80
#####	LUND	Napoli	TrafficSituations_Speed_arteria			PC					urban	arterial travelled in	2x2	80									zeros at	u4b-V80
#####	LUND	Budapest	TrafficSituations_Speed_arteria			PC		suzuki swift			urban	arterial travelled in	3x3	60									zeros at	u4b-V60
#####	LUND	Budapest	TrafficSituations_Speed_arteria			PC		suzuki swift			urban	several arterials tr	2x2	50									zeros at	u3-V50
#####	LUND	Malmö	TrafficSituations_Speed_arteria			PC	Toyota corolla	81 kW, 1	1300 kg		urban	3 arterials travel	2x2	50		flat							zeros at	u3-V50
#####	LUND	Budapest	TrafficSituations_Speed_arteria			PC		suzuki swift			urban	arterial travelled in	3x3	60									zeros at	u4b-V60
#####	VITO	Mol/Belgium	Vito Citroën Jumper City cycle	City_1		LDV	Citroen jumper	2,5 D	2500 kg		urban	in the city of Mol, District and lo	Map available			flat								
#####	VITO	Mol/Belgium	Vito Citroën Jumper City cycle	City_2		LDV	Citroen jumper	2,5 D	2500 kg		urban	in the city of Mol, District and lo	Map available			flat								
#####	VITO	Belgium	Vito Citroën Jumper Motorway	Frew_1		LDV	Citroen jumper	2,5 D	2500 kg		rural	Motorway	2x2	<120	Map available	flat								
#####	VITO	Belgium	Vito Citroën Jumper Motorway	Frew_2		LDV	Citroen jumper	2,5 D	2500 kg		rural	Motorway	2x2	<120	Map available	flat								
#####	VITO	Belgium	Vito Citroën Jumper Motorway	Frew_8		LDV	Citroen jumper	2,5 D	2500 kg		rural	Motorway	2x2	<120	Map available	flat								
#####	VITO	Belgium	Vito Citroën Jumper Rural cyc	Rural_1		LDV	Citroen jumper	2,5 D	2500 kg		Rural	distribution roads	<3 lan	<90	Map available	flat								
#####	VITO	Belgium	Vito Citroën Jumper Rural cyc	Rural_2		LDV	Citroen jumper	2,5 D	2500 kg		Rural	distribution roads	<3 lan	<90	Map available	flat								
1246	VTI	Sweden	drivcycl.doc	V1	Based on	PC	Volvo 940 5 gears				urban	motorway in urban	2-3 in	70		avoid gradients more tha in 2%								
1247	VTI	Sweden	drivcycl.doc	V2	Based on	PC	Volvo 940 5 gears				urban	motorway in urban	2-3 in	70		avoid gradients more tha in 2%								
1248	VTI	Sweden	drivcycl.doc	V3	Based on	PC	Volvo 940 5 gears				urban	motorway in urban	2-3 in	70		avoid gradients more tha in 2%								
1249	VTI	Sweden	drivcycl.doc	V4	Based on	PC	Volvo 940 5 gears				urban	motorway in urban	2-3 in	70		avoid gradients more tha in 2%								
1250	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	800	Per segr	PC							80-100											Recorded in 1992,
1251	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	801	Per segr	PC							80	1-3 lanes										Recorded in 1992,
1252	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	802	Per segr	PC							60-80	1-3 lanes										Recorded in 1992,
1253	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	803	Per segr	PC							80-120	2-3 lanes										Recorded in 1992,
1254	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	804	Per segr	PC							120	2-3 lanes										Recorded in 1992,
1255	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	805	Per segr	PC							100-120	2-3 lanes										Recorded in 1992,
1256	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	806	Per segr	PC							120	2-3 lanes										Recorded in 1992,
1257	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	807	Per segr	PC							100-120	2-3 lanes										Recorded in 1992,
1258	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	808	Per segr	PC							80-100											Recorded in 1992,
1259	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	809	Per segr	PC							120											Recorded in 1992,
1260	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	810	Per segr	PC							80-120											Recorded in 1992,
1261	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	811	Per segr	PC							80-120	2-3 lanes										Recorded in 1992,
1262	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	812	Per segr	PC									acceleration phase after crossings, with priority									Recorded in 1992,
1263	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	813	Per segr	PC									acceleration phase after crossings, with priority									Recorded in 1992,
1264	INFR	Switzerland	CH_DrivingCyclesPC_2004-11	814	Per segr	PC									acceleration phase after settlements									Recorded in 1992,

Nbr	Identifiers					Vehicle characteristics					Road characteristics		Road configuration					Traffic conditions				Comments		Traffic Situation	
	Origine	Location, city, country	Extracted data file	Trip code	Other	Vehicle category	Detailed information	Engine size	Vehicle weight	Other	Area (urban/rural)	Road type or definition	Tot no. of lanes	Speed limit (km/h)	Characteristics (junctions, bus lanes, parking, bus stop, pedestrian, etc)	Mountainous or plain character, gradient	Smoothly	Unit	Value	Tr density (vehicles/km)	Mean Tr density per serie	Mileage represented by the TS %	Other comments	Suggested Traffic situation	
1282	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission M5, s	motorway		80						medium interactions					u4a-V80-2
1283	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission M5, s	motorway		80						free flowing					u4a-V80-1
1284	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission urban	main street		50						free flowing					u3-V50-1
1285	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission urban	main street		50						medium interactions					u3-V50-2
1286	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission urban	main street		30						free flowing					u3-V30-1
1287	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission urban	main street		50						Stop & go					u3-V50-4
1288	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission urban	Residential		30						Stop & go					u1-V30-4
1289	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission urban	Residential		30						free flowing					u1-V30-2
1290	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission urban	Residential		50						free flowing					u1-V50-2
1291	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission urban	centre		30						free flowing					u1-V30-2
1292	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Ford M	different	PC	Ford Mondeo wagon gasoline	81 kW		Transmission urban	centre		50						medium interactions					u1-V50-2
1327	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission urban	Arteries		30						Stop & go					u2 ou u3?
1328	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission urban	Arteries		50						medium interactions					u2 ou u3?
1329	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission urban	Arteries		50						free flowing					u2 ou u3?
1330	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission urban	Arteries		70						medium interactions					u3 ou u4b
1331	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission urban	Arteries		70						free flowing					u3 ou u4b
1332	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission urban	Arteries		80						free flowing					u4b-V80-1
1333	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission urban	Arteries		80						medium interactions					u4b-V80-2
1334	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission Rural	Arteries		80						free flowing					u4b-V80-1
1335	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission Rural	main street		50						free flowing					u2 ou u3?
1336	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Peuge	different	PC	Peugeot 307	66 kW		Transmission Rural	main street		80						free flowing					u2 ou u3?
1337	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Alfa R	different	PC	Alfa Spider	110 kW		Transmission M5, s	Motorway													u4a ou u5
1338	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Alfa R	different	PC	Alfa Spider	110 kW		Transmission urban														
1339	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Alfa R	different	PC	Alfa Spider	110 kW		Transmission rural														
1340	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Opel V	different	PC	Opel Vectra	55 kW		Transmission M5, s	Motorway													u4a ou u5
1341	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Opel V	different	PC	Opel Vectra	55 kW		Transmission urban														
1342	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Opel V	different	PC	Opel Vectra	55 kW		Transmission rural														
1348	TNO	Netherlands	A300 - TNO -Real-World data.k	tbl	Opel V	different	PC	Opel Vectra	92 kW		Transmission rural														
1358	INRE	France	Essai_00000.xls				PC				rural	motorway	2 x 2	130		flat	no		free flowing						r5-V130-F
1359	INRE	France	Essai_00001.xls				PC				rural	motorway	2 x 2	130		flat	no		free flowing						r5-V130-F
1360	INRE	France	Essai_00011.xls				PC				rural	trunk road (4)	2 x 1	70 - 90	7 priority rule	flat	no		free flowing						r4-V70-90
1361	INRE	France	Essai_00100.xls				PC				rural	trunk road (4)	2 x 1	70 - 90	13 priority rule	flat	no		free flowing						r4-V70-90
1362	INRE	France	Essai_00101.xls				PC				rural	trunk road (4)	2 x 1	90	1 roundabout, 9 priority rule, 3 ped	hill	yes		free flowing						r4-V90-H
1363	INRE	France	Essai_00110.xls				PC				rural	trunk road (4)	2 x 1	90	1 roundabout, 5 priority rule, 3 ped	hill	yes		free flowing						r4-V90-H
1364	INRE	France	Essai_00111.xls				PC				urbain	motorway (4/5)	2 x 2	110		flat	no		very heavy flow						u5a-V110
1365	INRE	France	Essai_01000.xls				PC				urbain	motorway (4/5)	2 x 2	110		flat	no		dense traffic						u5a-V110
1366	INRE	France	Essai_01001.xls				PC				rural	trunk road (4)	2 x 1	90-70	3 roundabout, 7 priority rule, 10 pe	flat	no		free flowing						r4-V90-70
1367	INRE	France	Essai_01010.xls				PC				rural	trunk road (4)	3 x 1	90-70	3 roundabout, 7 priority rule, 11 pe	flat	no		free flowing						r4-V90-70
1368	INRE	France	Essai_01011.xls				PC				urbain	motorway (4/5)	2 x 2	110		flat	no		free flowing						u5a-V110
1386	INRE	France	Essai_100001.xls				PC				rural	distribution road	2x1	90	12 pedestrian	mount	yes		free flowing						r3-V90-M
1387	INRE	France	Essai_100010.xls				PC				rural	distribution road	2x1	90	12 pedestrian	mount	yes		free flowing						r3-V90-M
1388	INRE	France	Essai_100011.xls				PC				rural	distribution road	2x1	90	5 priority rule	mount	yes		free flowing						r3-V90-M
1389	INRE	France	Essai_100101.xls				PC				rural	distribution road	2x1	50-70	4 priority rule	mount	yes		free flowing						r3-V90-M
1390	INRE	France	Essai_100110.xls				PC				rural	distribution road	2x1	50-70	1 priority rule	mount	yes		free flowing						r3-V90-M
1391	INRE	France	Essai_100111.xls				PC				rural	distribution road	2x1	90	1 priority rule	mount	yes		free flowing						r3-V90-M
1423																									
1424	VTI	Sweden	V=ster=s_E18_situation_1.xls				PC				Rural	semimotorway	2+1	90	2+1 lanes	flat	straight		Heavy con	1325 v/h, degree of sat	Platoon				r4-90-1
1425	VTI	Sweden	V=ster=s_E18_situation_2.xls				PC				Rural	semimotorway	2+1	90	2+1 lanes	flat	straight		Some con	1540 v/h, degree of sat	Platoon				r4-90-1
1426	VTI	Sweden	V=ster=s_E18_situation_3.xls				PC				Rural	semimotorway	2+1	90	2+1 lanes	flat	straight		Traffic bre	1500 v/h directional flow	Platoon				r4-90-1 ou
1430	VTI	Sweden	G=vle_G_E4_situation_1.xls				PC				Rural	semimotorway	2+1	110	2+1 lanes, 14 m width	flat	straight		Some con	640 v/h directional flow	Platoon				r4-110-1
1431	VTI	Sweden	G=vle_G_E4_situation_2.xls				PC				Rural	semimotorway	2+1	110	2+1 lanes, 14 m width	flat	straight		Much con	1325 v/h directional flow	Platoon				r4-110-1
1432	VTI	Sweden	G=vle_G_E4_situation_3.xls				PC				Rural	semimotorway	2+1	110	2+1 lanes, 14 m width	flat	straight		Congestio	1010 v/h directional flow	Platoon				r4-110-1
1433	VTI	Sweden	G=vle_G_E4_situation_4.xls				PC				Rural	semimotorway	2+1	110	2+1 lanes, 14 m width	flat	straight		Congestio	850 v/h directional flow	Platoon				r4-110-1

Annex 3. Speed data from an experimentation in France

A3.1. Context

In Artemis, traffic situations have been defined as regards a road configuration and traffic conditions. These traffic situations should be the basic elements for determination of the pollutant emissions. This approach requires speed versus time curves for each of the pre-defined traffic situations. A data collection has been started to get the existing data from different partners. However, these data were likely recorded in conditions which were not exactly those addressed by the traffic situations scheme. In parallel, we envisage an experimentation to cover a certain number of situations.

A3.2. Method

Traffic situations to be covered are specified as shown in the hereafter table. A preliminary identification of local site is done, using road maps. Portions of roads are chosen. A in-situ refinement enables possible improvements of the determination. Generally, we search for sections which would be long enough (minimum 3 min. of driving or 1 km, maximum : 10-20 min., 4-20 km) but relatively homogeneous.

On each road section that was retained, the start and end points are clearly set-up. Number and type of intersections (priority rule, round-about, traffic light, separated lanes on motorway, etc.) are noted as well as the encountered speed limits.

Two cars (Peugeot 306 and Renault Laguna) are instrumented with a data logger and sensors to record the vehicle speed, engine speed, GPS (to record latitude, longitude, altitude) and logical information (in particular to indicate the start and the end of the recording, and to add a specific code to each run). The car will be driven on the different road sections and different time-periods, and following a strict protocol. The car is driven in both ways within low traffic first. Others runs should be attempted later possibly under heavier traffic or even in congestion.

The driver should follow the traffic or one particular car, without constraints and quite freely.

For each run, a sheet of information recapitulates the background information.

A3.3. Traffic situations to be covered and pre-determination of sites

Rural	Motorway, 130 km/h	Motorway Lyon Genève, from La Valbonne to Ambérieux
	National road	N84-N75 : La Valbonne (Meximieux) Ambérieux or Lagnieux
	- flat	N7 : Reventin – Le péage de Roussillon
	- hilly	N85, Bessenay, les Halles
	- mountainous	Bourg-d'oisan – Barrage du Chambon (2 ways) La Grave – Le Monetier (2 ways)
	Départementale (secondary roads)	Montée des 2 Alpes (2 ways)
	- mountainous	
	- sinuous	Surroundings from Bessenay
	- flat	D124 from La Valbonne, D65, to be adjusted in situ
	Local / access roads	Access to a hamlet or a farmhouse (at least 1 km)
Urban	Motorway, 130 km/h	Motorway going accross the agglomeration of Bourgoin (2 ways)
	Urban motorway	Ring from Vaulx-en-Velin to Chassieu (far ring) Ring Villeurbanne – Bron Genas (close ring)
	Main artery	Axis North – South, 2 ways, Perrache to Croix-Rousse Tunnel Cours Émile Zola (Cusset to Charpennes)
	Other artery	Avenue de Saxe, Gambetta
	Distributor, minor artery	Rue Edouard Herriot Other in Bron and suburbs
	Inter-districts	Bron, avenue du 8 mai, Avenue Camille Rousset ?
	Local roads	Resident areas (30 km/h et 50 km/h) Small street in Bron (crossing Place de l'église, Avenue Camille Rousset, etc.)

This preliminary determination was however re-discussed with local authorities as the urban street determination was finally not so obvious.

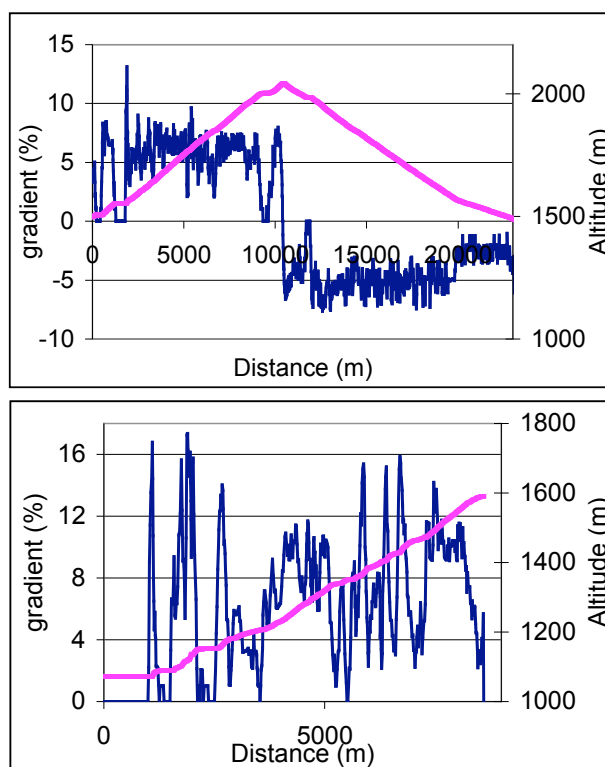
A3.4. Recorded journeys

Code	Date	Time	Driver	Place	Code	Road configuration	Speed limit	Traffic conditions	Gradient	Sinuosity	Traffic lights	Roundabout	Stop	Priority rule	Pedestrian passage
00000	15/11/04	14:54	Pas	Autoroute		2 x2	130	free	plain	no					
00001	15/11/04	15:06	Pas	Autoroute		2 x2	130	free	plain	no					
00011	18/11/04	10:20	Pat	Nationale 84+75		2 x 1	70 - 90	free	plain	no			7		
00100	18/11/04	10:35	Pat	Nationale 84+75		2 x 1	70 - 90	free	plain	no			13		
00101	18/11/04	14:27	Pas	Nationale 85		2 x 1	90	free	hilly	yes		1	9		3
00110	18/11/04	14:42	Pas	Nationale 85		2 x 1	90	free	hilly	yes		1	5		3
00111	18/11/04	18:25	Mic	Rocade est		2 x 2	110	perturbed	plain	no					
01000	19/11/04	7:30	Mic	Rocade est		2 x 2	110	dense	plain	no					
01001	19/11/04	10:12	Pas	Nationale 7		2 x 1	90-70-50	free	plain	no		3	7		10
01010	19/11/04	10:27	Pas	Nationale 7		3 x 1	90-70-50	free	plain	no		3	7		11
01011	22/11/04	9:22	Pat	Rocade est		2 x 2	110	free	plain	no					
01100	22/11/04	9:32	Pat	Rocade est		2 x 2	110	dense	plain	no					
01111	23/11/04	10:02	Pas	Cours Emile Zola		2 x 2	50	dense	plain	no	13		1		4
10000	23/11/04	9:50	Pas	Cours Emile Zola		2 x 2	50	dense	plain	no	15		3		2
10001	23/11/04	10:23	Pas	Camille Rousset		2 x 1	50	free	plain	no	3		4		5
10010	23/11/04	10:31	Pas	Camille Rousset		3 x 1	50	free	plain	no	3		2		5
10011	23/11/04	14:16	Pas	Rue Saxe		3	50	dense	plain	no	18		3		0
10100	23/11/04	14:50	Pas	Rue Garibaldi		3	50	free	plain	no	12		1		1
10101	23/11/04	15:15	Pas	Périphérique		2 x3	90	free	plain	no					
10110	23/11/04	15:28	Pas	Périphérique		3 x3	90	free	plain	no					
10111	24/11/04	9:37	Pas	Pagère		2 x1 1	50	free	plain	no			4		6
11000	24/11/04	9:48	Pas	Ferdinand Buisson		1 2x1	30 - 50	free	plain	no	1		2		8
11001	24/11/04	14:16	Pas	N>S Perrache Tunnel		2x3	50	dense	plain	no	9				
11010	24/11/04	14:25	Pas	N<S Tunnel Perrache		2x3	50	dense	plain	no	16		5		0
11011	24/11/04	14:49	Pas	Bd Europe S>N		2x2	70	free	plain	no	7				
11100	24/11/04	14:56	Pas	Bd Europe N>S		2x2	70	free	plain	no	6				0
11101	24/11/04	15:09	Pas	7 Chemins Villeurbanne		2x2	50	free	plain	no	16		4		5
11110	24/11/04	15:19	Pas	Villeurbanne 7 Chemins		2x2	50	free	plain	no	16		4		5
100001	25/11/04	11:09	Pas	D213 Barrage 2Alpes		2x1	90	free	mountain	yes					12
100010	25/11/04	11:23	Pas	D213 2Alpes Barrage		2x1	90	free	mountain	yes					12
100011	25/11/04	10:51	Pas	Bourg D'Oisans > Barrage		2x1	90	free	mountain	yes			5		
100101	25/11/04	11:51	Pas	La Grave > Monetier		2x1	50-70-90	free	mountain	yes			4		
100110	25/11/04	12:17	Pas	Monetier > La Grave		2x1	50-70-90	free	mountain	yes			1		
100111	25/11/04	13:15	Pas	Barrage > Bourg D'Oisans		2x1	90	free	mountain	yes			1		
101001	30/11/04	15:56	Pas	Youri Gagarine mit>genas		2 x1	50	free	plain	no	1		2	1	2
101010	30/11/04	15:51	Pas	Youri gagarine genas>mit		2 x1	50	free	plain	no	1		1	1	2
101011	1/12/04	9:55	Pas	Rue Créqui		1	50	free	plain	no	14		16	1	5
101100	1/12/04	9:41	Pas	Rue Duguesclin		1	50	free	plain	no	9		18	2	3
101101	1/12/04	10:34	Pas	Bellecours. Terreau. Bell		1	30	pereturbé	plain	no	12	1	11		11
101110	30/11/04	15:45	Pas	Boutasse Zac chène		2 x1	50	free	plain	no	7		2		4
101111	30/11/04	15:38	Pas	Zac chène Boutasse		2 x1	50	free	plain	no	8		5		
110000	30/11/04	15:14	Pas	Autoroute Bourgoin		2 x2	130	free	plain	no					
110001	30/11/04	15:24	Pas	Autoroute. Bourgoin		2 x2	130	free	plain	no					
110010	1/12/04	14:24	Pas	Bellecours. Terreau. Bell		1	30	pereturbé	plain	no	12	1	11		11
110011	1/12/04	15:18	Pas	Rue Lacouture marn>genas		2 x1	50	free	plain	no	1		2		1
110100	1/12/04	15:22	Pas	Rue Lacouture genas>marn		2 x 1	50	free	plain	no	1		1		4
110101	2/12/04		Pas	Rue du Dupeuble		2 x 1	50	free	plain	no	1				1
110110	2/12/04	10:19	Pas	Rue du Dupeuble		2 x 1	50	free	plain	no					1
110111	2/12/04	17:20	Rob	7 Chemins Villeurbanne		2 x2	50	tres chargé	plain	no	16		4		5
111000	2/12/04	17:57	Rob	Rue Saxe		3	50	dense	plain	no	18		3		0
111001	2/12/04	18:11	Rob	Rue Garibaldi		3	50	free	plain	no	12		1		1
111010	2/12/04	18:40	Rob	Villeurbanne 7 Chemins		2 x 2	50	free	plain	no	16		4		5
111011	3/12/04	7:58	Rob	7 Chemins Villeurbanne		2 x 2	50	mi dense	plain	no	16		4		5
111100	3/12/04	8:25	Rob	Rue Saxe		3	50	dense	plain	no	18		3		0
111101	6/12/04	17:19	Rob	N<S Tunnel Perrache		2x3	50	dense	plain	no	9				
111110	6/12/04	17:34	Rob	N>S Perrache Tunnel		2x3	50	dense	plain	no	16		5		0
111111	6/12/04	17:54	Rob	Rue Créqui		1	50	free	plain	no	14		16	1	5
1000000	9/12/04	17:24	Pas	Nationale 7		2 x 1	90-70-50	free	plain	no		3	7		10
1000001	10/12/04	7:40	Pas	Nationale 7		3 x 1	90-70-50	free	plain	no		3	7		11
1000010	13/12/04	17:35	Rob	Cours Emile Zola	new	2 x 2	50	dense	plain	no	13		1		4
1000011	13/12/04	17:52	Rob	Cours Emile Zola	new	2 x 2	50	free	plain	no	15		3		2
1000100	13/12/04	18:05	Rob	Villeurbanne 7 Chemins	new	2x2	50	mi dense	plain	no	16		4		5
1000101	14/12/04	7:45	Rob	7 Chemins Villeurbanne	new	2x2	50	mi dense	plain	no	16		4		5
1000110	14/12/04	8:20	Rob	Rue Créqui	new	1	50	mi dense	plain	no	14		16	1	5
1001011	14/12/04	8:35	Rob	Rue Duguesclin	new	1	50	mi dense	plain	no	9		18	2	3

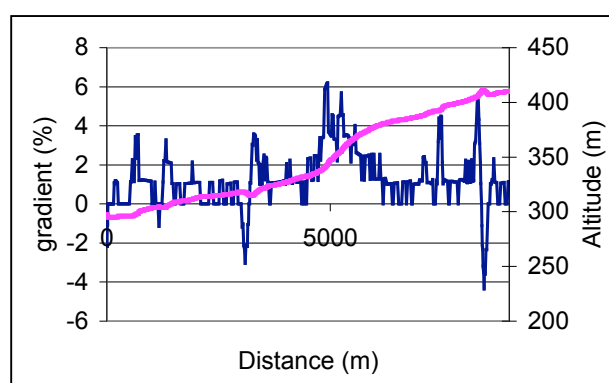
Annex 4. Sinuosity and gradient indicators measured in the Alps and in a hilly area near Lyon

A4.1. Three typical hilly and mountainous trips

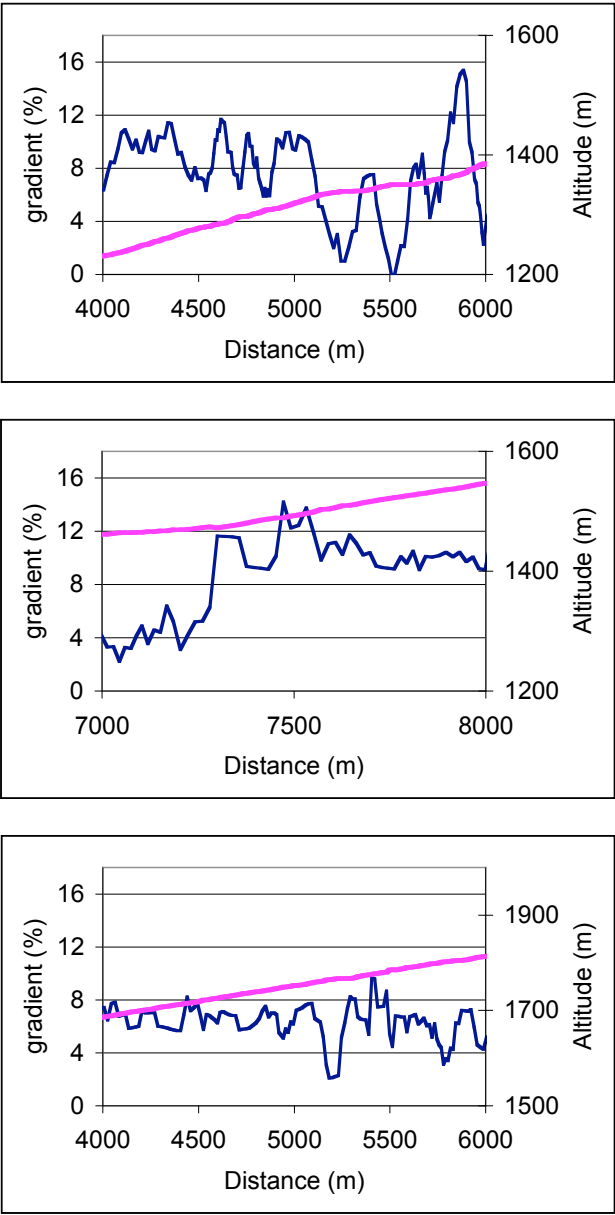
- *In the Alps:*



- *In a hilly area:*



A4.2. Local variability of the gradient



Annex 5. Selection process

Speed curve number and type	Comment	distance (m)	Average speed (km/h)	Max. speed (km/h)	Average positive acceleration n (m/s ²)	Running speed (km/h)	Stop duration (%)	Stop / km	Acceleration n / km	Traffic condition	Speed Limit	Sinusity Gradient
urban5a-SL130-Free.5	attention, rural 4 and 5 grouped 2 and 3 grouped	19302	123.4	129	0.52	123.4	0.0	0.00	0.10	1	130	F
urban5a-SL130-Free.4		17757	120.6	129	0.47	120.6	0.0	0.00	0.45	1	130	F
urban5a-SL130-Free.3		11626	117.6	124	0.34	117.6	0.0	0.00	0.26	1	130	F
urban5a-SL130-Free.2		11560	119.2	131	0.51	119.2	0.0	0.00	0.87	1	130	F
urban5a-SL110-Free.6	ok	9654	99.9	106	0.58	99.9	0.0	0.00	0.41	1	110	F
urban5a-SL110-Free.7	ok	9696	90.2	119	0.59	90.2	0.0	0.00	1.65	2	110	F
urban5a-SL140-Dense.10	non-dense	10800	97.7	111	0.54	97.7	0.0	0.00	0.83	3	110	F
urban5a-SL140-Dense.8	non-dense	5270	95.3	107	0.49	95.3	0.0	0.00	1.14	3	110	F
urban5a-SL140-Dense.8		10831	39.7	107	0.53	40.2	1.3	0.46	4.15	3	110	F
urban5a-SL110-Stop-go.11	ok	5546	25.5	76	0.53	25.9	1.7	0.90	6.85	4	110	F
urban4a-SL100-Free.13	ok	9372	93.7	109	0.58	93.7	0.0	0.00	0.75	1	100	F
urban4a-SL100-Free.12	ok - heavy (non free)	1825	73.8	104	1.09	73.8	0.0	0.00	1.64	1	100	F
urban4a-SL100-Heavy.14	non-heavy	7679	92.1	109	0.57	92.1	0.0	0.00	0.91	2	100	F
urban5b-SL90-Free.20		12760	81.7	95	0.57	81.7	0.0	0.00	0.71	1	90	F
urban5b-SL90-Free.19	19 and 20 grouped	12396	77.9	93	0.73	77.9	0.0	0.00	1.05	1	90	F
urban4a-SL90-Free.18		3624	77.2	89	0.74	77.2	0.0	0.00	1.66	1	90	F
urban4a-SL90-Free.17	17 and 18 grouped	3820	73.5	88	0.55	73.5	0.0	0.00	1.67	1	90	F
rural4-SL90-H-Free.16		11575	65.4	88	0.58	65.5	0.2	0.09	2.68	1	90	H
rural4-SL90-H-Free.15		11870	70.3	99	0.61	72.8	3.5	0.08	2.44	1	90	H
rural3-SL90-M-Heavy.24		13136	64.6	96	0.60	64.6	0.0	0.00	3.27	2	90	M
rural3-SL90-M-Heavy.23		13170	56.4	96	0.61	61.8	8.8	0.15	2.73	2	90	M
rural3-SL90-M-Heavy.22		8584	51.1	73	0.76	51.1	0.0	0.00	4.89	2	90	M
rural3-SL90-M-Heavy.21		8607	50.3	79	0.75	50.5	0.3	0.12	5.81	2	90	M
urban4b-SL80-Free.34		2906	56.6	79	0.72	58.5	3.2	0.34	2.06	1	80	F
urban4b-SL80-Free.33		847	76.3	89	0.80	76.3	0.0	0.00	1.18	1	80	F
urban4b-SL80-Free.32		1062	76.5	79	-99999.00	76.5	0.0	0.00	0.00	1	80	F
urban4b-SL80-Free.31		7096	41.5	84	0.75	46.7	11.2	0.56	3.81	1	80	F
urban4b-SL80-Free.30		1983	72.8	85	0.78	72.8	0.0	0.00	1.01	1	80	F
urban4b-SL80-Free.29		1988	80.4	97	0.88	80.4	0.0	0.00	1.01	1	80	F
urban4b-SL80-Free.28	28 and 30 grouped	1964	74.4	84	0.86	74.4	0.0	0.00	1.02	1	80	F
urban4a-SL80-Free.27		2632	79.0	87	-99999.00	79.0	0.0	0.00	0.00	1	80	F
urban4a-SL80-Free.26	26 and 27 grouped	2667	80.0	86	-99999.00	80.0	0.0	0.00	0.00	1	80	F
urban4a-SL80-Free.25		5507	99.1	105	0.32	99.1	0.0	0.00	0.18	1	80	F
urban4b-SL80-Heavy.52	ok	5412	64.9	94	0.55	64.9	0.0	0.00	1.29	2	80	F
urban4b-SL80-Heavy.51		2900	77.9	95	0.62	77.9	0.0	0.00	0.34	2	80	F
urban4b-SL80-Heavy.50		1961	75.1	87	0.81	75.1	0.0	0.00	1.02	2	80	F
urban4b-SL80-Heavy.49		1969	77.1	90	0.81	77.1	0.0	0.00	1.02	2	80	F
urban4b-SL80-Heavy.48		1966	76.9	95	0.78	76.9	0.0	0.00	1.02	2	80	F
urban4a-SL80-Heavy.47		2797	76.3	81	-99999.00	76.3	0.0	0.00	0.00	2	80	F
urban4a-SL80-Heavy.46		2625	78.1	86	0.34	78.1	0.0	0.00	0.76	2	80	F
urban4a-SL80-Heavy.45		2930	72.7	78	0.39	72.7	0.0	0.00	0.68	2	80	F
urban4a-SL80-Heavy.44		2531	75.9	81	-99999.00	75.9	0.0	0.00	0.00	2	80	F
urban4a-SL80-Heavy.43		2536	83.0	94	-99999.00	83.0	0.0	0.00	0.00	2	80	F
urban4a-SL80-Heavy.42		2071	74.5	78	-99999.00	74.5	0.0	0.00	0.00	2	80	F
urban4a-SL80-Heavy.41		5156	97.7	101	0.34	97.7	0.0	0.00	0.39	2	80	F
urban4a-SL80-Heavy.40		3314	79.5	85	0.33	79.5	0.0	0.00	0.30	2	80	F
urban4a-SL80-Heavy.39	39 and 45 grouped - High speed	3548	71.0	78	0.35	71.0	0.0	0.00	0.85	2	80	F
urban4a-SL80-Heavy.38		3089	74.1	83	0.38	74.1	0.0	0.00	0.65	2	80	F
urban4a-SL80-Heavy.37		3782	76.1	85	0.45	76.1	0.0	0.00	0.26	2	80	F
urban4a-SL80-Heavy.36		2831	76.1	92	-99999.00	76.1	0.0	0.00	0.00	2	80	F
urban4a-SL80-Heavy.35		10978	98.8	103	0.34	98.8	0.0	0.00	0.09	2	80	F
urban4b-SL80-Stop-go.55		2299	13.6	60	0.66	15.8	14.1	1.30	5.22	4	80	F
urban4b-SL80-Stop-go.54		1998	27.4	74	0.76	30.7	10.7	0.50	5.03	4	80	F
urban4b-SL80-Stop-go.53	53, 55 grouped	1877	8.7	40	0.57	11.6	24.8	8.52	5.33	4	80	F
urban4b-SL70-Free.64		12760	81.7	95	0.57	81.7	0.0	0.00	0.71	1	70	F
urban4b-SL70-Free.63		12396	77.9	93	0.73	77.9	0.0	0.00	1.05	1	70	F
urban3-SL70-Free.62	heavy	4957	57.6	91	0.87	57.6	0.0	0.00	1.61	1	70	F
urban3-SL70-Free.61	heavy	938	56.3	72	1.13	56.3	0.0	0.00	2.13	1	70	F
urban3-SL70-Free.60	ok - free	2578	63.6	76	0.60	63.6	0.0	0.00	1.55	1	70	F
urban3-SL70-Free.59	heavy	2551	57.8	85	1.04	59.2	2.5	0.39	2.74	1	70	F
urban3-SL70-Free.58	heavy	2546	58.4	84	0.91	59.9	2.5	0.39	1.96	1	70	F
urban3-SL70-Free.67	heavy	2542	48.9	72	0.82	48.9	0.0	0.00	3.15	1	70	F
urban3-SL70-Free.66	dense	2400	37.2	71	0.94	50.5	26.3	1.67	2.50	1	70	F
urban3-SL70-Heavy.70		3696	53.2	77	0.78	55.9	4.8	0.27	2.16	2	70	F
urban3-SL70-Heavy.69	69, 70 grouped	2575	45.9	68	0.89	52.4	12.4	0.78	2.72	2	70	F
urban3-SL70-Heavy.68		2535	39.8	72	0.98	44.3	10.0	0.79	4.34	2	70	F
urban3-SL70-Heavy.67		2541	38.6	85	0.87	46.7	17.3	0.79	5.12	2	70	F
rural3-SL70-M-Heavy.66		23173	62.8	85	0.54	62.8	0.0	0.00	2.89	2	70	M
rural3-SL70-M-Heavy.65		23096	63.0	91	0.61	63.0	0.0	0.00	2.99	2	70	M
urban3-SL70-Dense.75		2589	34.7	69	0.98	45.9	24.5	0.77	2.70	3	70	F
urban3-SL70-Dense.74	74, 75 grouped	2588	30.0	64	0.77	41.4	27.7	0.77	3.86	3	70	F
urban3-SL70-Dense.73		2548	29.3	85	0.94	51.0	42.5	1.18	4.71	3	70	F
urban3-SL70-Dense.72		2545	27.3	76	0.95	42.6	35.8	1.57	5.11	3	70	F
urban3-SL70-Dense.71		2531	30.0	77	0.89	47.4	36.8	0.79	5.53	3	70	F
urban3-SL70-Stop-go.76	ok	2521	18.7	63	1.04	37.0	49.6	2.38	5.95	4	70	F
urban4b-SL60-Free.82		642	60.8	64	0.70	60.8	0.0	0.00	1.56	1	60	F
urban4b-SL60-Free.81		625	60.8	64	0.45	60.8	0.0	0.00	0.00	1	60	F
urban4b-SL60-Free.80	ok - 80,81,82 grouped	638	58.9	69	0.70	58.9	0.0	0.00	1.57	1	60	F
urban3-SL60-Free.79	ok	1187	53.4	67	0.68	53.4	0.0	0.00	5.05	1	60	F
urban3-SL60-Free.78	ok - heavy (non free)	1178	40.4	62	0.59	41.6	2.9	0.85	3.40	1	60	F
urban3-SL60-Free.77	ok - dense	1189	37.5	52	0.75	40.0	6.1	0.84	5.05	1	60	F
urban4b-SL60-Heavy.93		634	23.0	39	0.81	23.8	3.0	1.58	7.89	2	60	F
urban4b-SL60-Heavy.92		619	23.5	50	0.73	24.2	3.2	1.62	3.23	2	60	F
urban4b-SL60-Heavy.91		658	59.3	77	0.72	59.3	0.0	0.00	1.52	2	60	F
urban4b-SL60-Heavy.90		642	59.3	63		59.3	0.0	0.00	0.00	2	60	F
urban4b-SL60-Heavy.89	ok	653	51.1	68	0.74	52.2	2.2	1.53	1.53	2	60	F
urban4b-SL60-Heavy.88		652	57.3	69	0.45	57.3	0.0	0.00	3.07	2	60	F
urban3-SL60-Heavy.87		1136	31.2	68	1.34	47.6	34.4	2.64	3.52	2	60	F
urban3-SL60-Heavy.86		1185	30.9	52	0.71	33.9	8.7	0.84	6.75	2	60	F
urban3-SL60-Heavy.85		1165	29.5	56	0.79	37.8	21.8	1.72	4.29	2	60	F
urban3-SL60-Heavy.84		1164	27.9	59	0.92	34.1	18.0	2.58	6.87	2	60	F
urban3-SL60-Heavy.83		1192	31.3	62	1.02	37.6	16.8	1.68	4.19	2	60	F
urban4b-SL60-Dense.100		624	43.2	55	0.59	43.2	0.0	0.00	4.80	3	60	F
urban4b-SL60-Dense.99		616	46.2	60	0.65	46.2	0.0	0.00	4.87	3	60	F
urban4b-SL60-Dense.98		649	30.7	42	0.45	30.7	0.0	0.00	3.08	3	60	F
urban4b-SL60-Dense.97	ok - 97,98 grouped	639	29.9	50	0.77	35.9	16.9	1.57	4.70	3	60	F
urban3-SL60-Dense.96		1177	28.1	63	0.84	34.7	19.2	1.70	5.10	3	60	F
urban3-SL60-Dense.95		1181	24.2	45	0.70	31.3	22.7	1.69	7.62	3	60	F
urban3-SL60-Dense.94	ok - 94,95,96 grouped	1169	30.0	64	0.73	35.7	15.7	2.57	4.28	3	60	F
urban4b-SL60-Stop-go.104	ok	1974	23.0	52	0.68	23.2	1.0	0.51	10.13	4	60	F
urban3-SL60-Stop-go.103		1123	20.5	53	0.90	28.7	28.4	3.56	8.02	4	60	F
urban3-SL60-Stop-go.102		1163	20.8	64	0.88	30.5	31.8	3.44	6.88	4	60	F
urban3-SL60-Stop-go.101	ok	1151	19.2	61	0.92	28.8	33.3	3.47	9.55	4	60	F
urban4b-SL60-Free.124		654	36.8	64	1.12	39.3	6.2	3.06	3.06	1	50	F
urban4b-SL60-Free.123		982	15.6	56	0.90							

Speed curve number and type	Comment	distance (m)	Average speed (km/h)	Max. speed (km/h)	Average positive acceleration (m/s ²)	Running speed (km/h)	Stop duration (%)	Stop / km	Acceleration / km	Traffic condition	Speed Limit	Sinuosity Gradient
urban3-SL50-Free-118		2304	51.5	97	0.97	51.8	0.6	0.43	4.34	1	50	F
urban3-SL50-Free-117		4896	26.9	61	0.92	39.2	31.4	1.02	5.11	1	50	F
urban3-SL50-Free-116		7714	26.7	71	0.75	40.5	34.0	0.39	3.37	1	50	F
urban3-SL50-Free-115		1875	29.1	69	1.07	40.9	28.9	1.07	6.40	1	50	F
urban3-SL50-Free-114		1898	47.1	68	0.89	49.5	4.8	0.53	2.11	1	50	F
urban3-SL50-Free-113	ok -113,114 grouped	1860	41.6	60	0.89	45.9	9.3	1.08	4.30	1	50	F
urban3-SL50-Free-112		1859	30.4	63	1.02	43.7	30.5	1.08	4.30	1	50	F
urban3-SL50-Free-111		1871	32.5	63	0.97	40.1	18.8	1.60	3.74	1	50	F
urban3-SL50-Free-110		2800	22.9	47	0.78	29.4	22.0	1.79	6.79	1	50	F
urban3-SL50-Free-109		2399	25.9	51	0.62	30.2	14.1	2.08	7.50	1	50	F
urban3-SL50-Free-108		1568	25.7	53	0.81	30.4	15.5	1.91	8.93	1	50	F
urban3-SL50-Free-107		1767	32.6	61	0.77	36.1	9.7	1.13	5.09	1	50	F
urban3-SL50-Free-106		2229	28.2	63	0.70	38.4	26.7	1.35	3.14	1	50	F
urban3-SL50-Free-105		1724	15.3	46	0.72	22.5	32.0	5.22	6.96	1	50	F
urban4b-SL50-Heavy-163		610	14.8	37	0.72	15.6	4.7	4.92	14.75	2	50	F
urban4b-SL50-Heavy-162		685	25.7	40	0.67	26.5	3.1	2.92	7.30	2	50	F
urban4b-SL50-Heavy-161		579	25.1	45	0.86	29.8	15.7	3.45	10.36	2	50	F
urban4b-SL50-Heavy-160		1212	16.1	47	0.76	22.1	27.3	2.48	9.90	2	50	F
urban4b-SL50-Heavy-159		1221	16.4	45	0.79	24.8	34.0	2.46	7.37	2	50	F
urban3-SL50-Heavy-158		9266	25.3	67	0.91	37.7	32.8	1.62	4.32	2	50	F
urban3-SL50-Heavy-157		4380	33.9	64	0.87	47.9	29.2	0.91	1.60	2	50	F
urban3-SL50-Heavy-156		3822	16.3	48	0.78	25.3	35.5	2.62	9.16	2	50	F
urban3-SL50-Heavy-155		1880	31.5	63	0.91	40.8	22.8	1.60	2.66	2	50	F
urban3-SL50-Heavy-154		1879	42.8	71	1.02	46.6	8.2	1.06	3.73	2	50	F
urban3-SL50-Heavy-153		1875	40.2	69	0.98	44.4	9.5	1.07	4.27	2	50	F
urban3-SL50-Heavy-152	152,151 grouped	1884	33.2	58	1.04	39.4	15.7	1.59	4.25	2	50	F
urban3-SL50-Heavy-151		1878	41.2	58	0.89	44.5	7.3	0.53	2.13	2	50	F
urban3-SL50-Heavy-150		1879	37.2	64	0.85	42.3	12.1	1.06	3.73	2	50	F
urban3-SL50-Heavy-149		1878	33.5	60	0.99	40.7	17.8	1.07	4.26	2	50	F
urban3-SL50-Heavy-148		2825	17.7	56	0.79	24.6	27.9	3.89	8.14	2	50	F
urban3-SL50-Heavy-147		2868	18.6	53	0.78	25.1	25.9	3.83	6.62	2	50	F
urban2-SL50-Heavy-146		7297	29.2	62	0.86	34.5	15.4	1.23	7.54	2	50	F
urban2-SL50-Heavy-145		1220	14.6	61	0.85	21.9	33.0	4.10	9.83	2	50	F
urban2-SL50-Heavy-144	ok - dense	1684	20.2	53	0.71	26.9	25.0	2.37	4.75	2	50	F
urban2-SL50-Heavy-143		826	35.8	56	0.88	39.1	8.4	1.21	6.06	2	50	F
urban2-SL50-Heavy-142	ok - free+ - 141,142 grouped	795	39.7	68	0.78	39.7	0.0	0.00	6.29	2	50	F
urban2-SL50-Heavy-141		937	40.2	56	0.67	40.2	0.0	0.00	6.40	2	50	F
urban2-SL50-Heavy-140		1256	34.8	48	0.69	35.3	1.5	0.80	4.78	2	50	F
urban2-SL50-Heavy-139		1368	35.7	46	0.71	35.7	0.0	0.00	5.85	2	50	F
urban2-SL50-Heavy-138		869	24.3	52	0.95	27.5	11.6	2.30	9.20	2	50	F
urban2-SL50-Heavy-137		896	29.6	53	0.80	35.0	15.6	1.12	7.82	2	50	F
urban1-SL50-Heavy-136		3730	18.7	41	0.61	18.8	0.4	0.27	11.26	2	50	F
urban1-SL50-Heavy-135		2770	21.6	38	0.60	22.1	2.2	0.72	10.11	2	50	F
urban1-SL50-Heavy-134		702	33.7	47	0.60	33.7	0.0	0.00	4.27	2	50	F
urban1-SL50-Heavy-133		3151	18.9	61	0.78	26.8	29.5	2.22	8.25	2	50	F
urban1-SL50-Heavy-132	ok - free+ - 131,132 grouped	773	36.6	47	0.51	36.6	0.0	0.00	3.88	2	50	F
urban1-SL50-Heavy-131		359	30.7	48	0.84	31.5	2.4	2.79	2.79	2	50	F
urban1-SL50-Heavy-130		2134	12.6	37	0.69	17.2	26.6	2.81	13.59	2	50	F
urban1-SL50-Heavy-129		2574	15.1	43	0.77	19.8	23.5	3.89	10.88	2	50	F
urban1-SL50-Heavy-128	ok - dense	933	25.6	36	0.69	26.0	1.5	1.07	6.43	2	50	F
urban1-SL50-Heavy-164		0,NaN	0.0	0	0.00	NaN	NaN	NaN	999.00	2	50	F
urban1-SL50-Heavy-127		2463	12.1	45	0.84	17.5	30.7	10.96	13.40	2	50	F
rural3-SL50-M-Heavy-126		25026	67.6	1338	1.83	67.6	0.0	0.00	2.76	2	50	M
rural3-SL50-M-Heavy-125		23096	63.0	91	0.61	63.0	0.0	0.00	2.99	2	50	M
urban4b-SL50-Dense-181		843	14.5	43	0.83	21.1	31.1	7.12	8.30	3	50	F
urban4b-SL50-Dense-180		1547	12.3	48	0.95	21.8	43.6	4.53	10.34	3	50	F
urban4b-SL50-Dense-179	ok	999	17.2	85	0.75	22.8	24.4	4.00	8.00	3	50	F
urban3-SL50-Dense-178	ok - 178,177 grouped	1889	23.0	55	0.94	38.2	39.9	1.06	3.71	3	50	F
urban3-SL50-Dense-177		1871	26.1	53	0.80	36.4	28.3	1.60	7.48	3	50	F
urban3-SL50-Dense-176		1872	26.2	56	0.89	34.6	24.1	1.60	5.34	3	50	F
urban3-SL50-Dense-175		1892	20.5	60	1.07	40.3	49.1	1.59	3.17	3	50	F
urban3-SL50-Dense-174		1887	20.8	63	0.98	33.8	38.3	2.12	6.89	3	50	F
urban3-SL50-Dense-173		2527	19.9	57	0.72	30.7	35.1	1.98	5.94	3	50	F
urban3-SL50-Dense-172		2084	13.1	48	0.68	19.0	31.1	8.64	6.24	3	50	F
urban3-SL50-Dense-171		2805	19.3	57	0.85	28.1	31.2	3.92	8.56	3	50	F
urban3-SL50-Dense-170		2085	11.8	43	0.73	19.1	38.1	5.76	10.55	3	50	F
urban3-SL50-Dense-169		2564	22.9	68	0.74	29.3	21.8	1.17	7.02	3	50	F
urban3-SL50-Dense-168		2065	13.3	52	0.80	21.6	38.4	3.87	9.69	3	50	F
urban3-SL50-Dense-167		1869	10.3	42	0.79	18.1	43.4	8.56	9.09	3	50	F
urban3-SL50-Dense-166		2123	16.5	51	0.77	23.3	29.2	3.77	8.95	3	50	F
urban3-SL50-Dense-165		2054	15.6	48	0.83	23.2	32.6	5.35	10.22	3	50	F
urban4b-SL50-Stop-go-198	ok - 196,197,198 grouped	848	8.3	37	0.91	12.5	33.7	9.43	9.43	4	50	F
urban4b-SL50-Stop-go-197		756	10.4	50	0.63	16.7	37.5	5.29	9.26	4	50	F
urban4b-SL50-Stop-go-196		1167	11.5	45	0.88	21.9	47.4	6.86	11.14	4	50	F
urban4b-SL50-Stop-go-195		1399	5.9	52	0.87	14.2	58.6	16.44	7.15	4	50	F
urban3-SL50-Stop-go-194		916	9.2	30	0.73	14.2	35.6	8.73	7.64	4	50	F
urban3-SL50-Stop-go-193		2605	11.0	47	0.56	15.5	28.6	4.22	6.14	4	50	F
urban3-SL50-Stop-go-192		565	6.2	35	0.68	11.9	48.2	12.39	5.31	4	50	F
urban3-SL50-Stop-go-191		1850	18.9	47	0.88	27.4	31.0	2.16	8.65	4	50	F
urban3-SL50-Stop-go-190	ok	1852	13.2	45	0.77	21.8	39.3	4.32	8.10	4	50	F
urban2-SL50-Stop-go-189		824	9.3	39	0.96	16.9	45.0	10.92	16.99	4	50	F
urban2-SL50-Stop-go-188		854	6.1	32	1.11	13.4	54.6	12.88	14.06	4	50	F
urban2-SL50-Stop-go-187	ok - 185,186,187 grouped	929	9.7	47	1.14	19.8	51.2	7.53	10.76	4	50	F
urban2-SL50-Stop-go-186		886	9.6	48	1.08	18.3	47.7	9.03	14.67	4	50	F
urban2-SL50-Stop-go-185		835	8.8	52	0.95	16.0	44.9	14.37	16.77	4	50	F
urban1-SL50-Stop-go-184		385	4.6	34	0.69	9.4	51.2	18.20	7.80	4	50	F
urban1-SL50-Stop-go-183	ok - 182,183 grouped	609	6.1	25	0.61	9.8	37.8	14.79	4.93	4	50	F
urban1-SL50-Stop-go-182		1057	4.9	46	0.87	17.7	72.4	8.52	9.46	4	50	F
urban1-SL40-Heavy-204		613	37.4	47	0.74	37.4	0.0	0.00	6.52	2	40	F
urban1-SL40-Heavy-203	ok - free+, 199,201,202,203 grouped	665	26.9	43	0.72	29.9	10.1	1.50	4.51	2	40	F
urban1-SL40-Heavy-202		662	36.7	45	0.79	36.7	0.0	0.00	1.51	2	40	F
urban1-SL40-Heavy-201		545	32.7	64	0.80	32.7	0.0	0.00	11.00	2	40	F
urban1-SL40-Heavy-200		654	31.0	47	0.76	31.0	0.0	0.00	6.12	2	40	F
urban1-SL40-Heavy-199		666	28.6	47	0.92	34.8	17.9	3.00	4.50	2	40	F
urban1-SL40-Stop-go-208	ok - dense, 205,207,208 grouped	670	15.0	43	0.94	26.5	43.5	4.48	8.96	4	40	F
urban1-SL40-Stop-go-207		502	16.9	55	0.80	34.1	50.5	1.99	7.96	4	40	F
urban1-SL40-Stop-go-206	ok	653	12.3	39	0.83	23.8	48.4	4.59	7.65	4	40	F
urban1-SL40-Stop-go-205		669	20.8	47	0.91	33.4	37.9	1.50	5.98	4	40	F
urban1-SL30-Heavy-246		3842	19.3	45	0.56	19.8	2.2	0.78	6.77	2	30	F
urban1-SL30-Heavy-245		5881	16.0	50	0.51	16.1	0.5	0.17	5.44	2	30	F
urban1-SL30-Heavy-244		2793	17.5	38	0.59	17.8	1.9	0.36	7.16	2	30	F
urban1-SL30-Heavy-213	ok - free+	4733	20.2	43	0.61	20.3	0.4	0.21	8.87	2	30	F
urban1-SL30-Heavy-242		5041	19.4	53	0.65	21.6	11.1	1.79	8.33	2	30	F
urban1-SL30-Heavy-241		473	1.2	40	0.79	21.3	94.3	6.34	8.46	2	30	F
urban1-SL30-Heavy-210	ok - stop&go	2125	11.0	38	0.77	16.4	32.8	4.71	12.70	2	30	F
urban1-SL30-Heavy-209	ok - dense	2134	12.6	37	0.69	17.2	26.6	2.				

Annex 6. Retained speed curves

ID	SpeedCurve_FullName	Characteristics of the traffic situation		Speed limit (km/h)	Gradient, sinuosity	Traffic condition	Identification	ID/CYL	Comments on the Speed Curve
		Area	Road category						
1	urban5a-SL130-Free.def.INRETS.110000-110001	Urban	Nat./reg. motorway	130	Flat	Free-flow	210131	1	France
2	urban5a-SL110-Free.def.INRETS.01011	Urban	Nat./reg. motorway	110	Flat	Free-flow	210111	2	France
3	urban5a-SL110-Heavy.def.INRETS.00111	Urban	Nat./reg. motorway	110	Flat	Heavy traffic	210112	3	France
4	urban5a-SL110-Stop-go.def.INRETS.01000	Urban	Nat./reg. motorway	110	Flat	Stop and go	210114	40	France
5	urban4a-SL100-Free.def.TNO.FordM.L81863-82222	Urban	Urban motorway	100	Flat	Free-flow	211101	4	The Netherlands
6	urban4a-SL100-Heavy.def.TNO.FordM.L51349-51438	Urban	Urban motorway	100	Flat	Heavy traffic	211102	5	The Netherlands
7	urban4a-SL90-Free.def.INRETS.10101-10110	Urban	Urban motorway	90	Flat	Free-flow	211091	6	France
8	urban4a-SL80-Heavy.def.TNO.P307.L72665-72809.FordM.L567-746	Urban	Urban motorway	80	Flat	Heavy traffic	211082	7	The Netherlands
9	urban4b-SL80-Free.def.OSCAR.Hels.Link01.2033.2032	Urban	City primary road	80	Flat	Free-flow	221081	8	Helsinki
10	urban4b-SL80-Heavy.def.TNO.FordM.L81563-81862	Urban	City primary road	80	Flat	Heavy traffic	221082	9	The Netherlands
11	urban4b-SL80-Stop-go.def.OSCAR.Hels.LinkH01.2015	Urban	City primary road	80	Flat	Stop and go	221084	41	Helsinki
12	urban4b-SL60-Free.def.OSCAR.Ath.LinkA02_2.3140-3137-3139	Urban	City primary road	60	Flat	Free-flow	221061	10	Athens
13	urban4b-SL60-Heavy.def.OSCAR.Ath.LinkA02_2.3125	Urban	City primary road	60	Flat	Heavy traffic	221062	11	Athens
14	urban4b-SL60-Saturated.def.OSCAR.Ath.LinkA02_2.3108-3110	Urban	City primary road	60	Flat	Saturated	221063	12	Helsinki
15	urban4b-SL60-Stop-go.def.OSCAR.Hels.LinkH02.2077	Urban	City primary road	60	Flat	Stop and go	221064	42	Helsinki
16	urban4b-SL50-Free.def.OSCAR.Mad.LinkM26toM30.4183	Urban	City primary road	50	Flat	Free-flow	221051	13	Madrid
17	urban4b-SL50-Heavy.def.OSCAR.Mad.LinkM21toM25.4172-4178	Urban	City primary road	50	Flat	Heavy traffic	221052	14	Madrid
18	urban4b-SL50-Saturated.def.OSCAR.Mad.LinkM11toM14.4089	Urban	City primary road	50	Flat	Saturated	221053	15	Madrid
19	urban4b-SL50-Stop-go.def.OSCAR.Mad.LinkM31toM41.4221-4099-4186	Urban	City primary road	50	Flat	Stop and go	221054	43	Helsinki
20	urban3-SL70-Free.def.OSCAR.Hels.LinkH04.2204	Urban	Districts distributor	70	Flat	Free-flow	230071	16	Helsinki
21	urban3-SL70-Heavy.def.TNO.FordM.L83120-83369-OSCAR.Hels.LinkH04.2194	Urban	Districts distributor	70	Flat	Heavy traffic	230072	17	The Netherlands and Helsinki
22	urban3-SL70-Saturated.def.OSCAR.Hels.LinkH04.2176-2162	Urban	Districts distributor	70	Flat	Saturated	230073	18	Helsinki
23	urban3-SL70-Stop-go.def.OSCAR.Hels.LinkH03.2135	Urban	Districts distributor	70	Flat	Stop and go	230074	19	Helsinki
24	urban3-SL60-Free.def.OSCAR.Lond.LinkL02.1057	Urban	Districts distributor	60	Flat	Free-flow	230061	20	London
25	urban3-SL60-Heavy.def.OSCAR.Lond.LinkL02.1050	Urban	Districts distributor	60	Flat	Heavy traffic	230062	21	London
26	urban3-SL60-Saturated.def.OSCAR.Lond.LinkL02.1068-1031-1059	Urban	Districts distributor	60	Flat	Saturated	230063	22	London
27	urban3-SL60-Stop-go.def.OSCAR.Lond.LinkL02.1062	Urban	Districts distributor	60	Flat	Stop and go	230064	23	London
28	urban3-SL50-Free.def.OSCAR.Hels.LinkH06.2314-2313	Urban	Districts distributor	50	Flat	Free-flow	230051	24	Helsinki
29	urban3-SL50-Heavy.def.OSCAR.Hels.LinkH06.2311-2310	Urban	Districts distributor	50	Flat	Heavy traffic	230052	25	Helsinki
30	urban3-SL50-Saturated.def.OSCAR.Hels.LinkH06.2324-2304	Urban	Districts distributor	50	Flat	Saturated	230053	26	Helsinki
31	urban3-SL50-Stop-go.def.OSCAR.Hels.LinkH06.2271	Urban	Districts distributor	50	Flat	Stop and go	230054	27	Helsinki
32	urban2-SL50-Free.def.OSCAR.Ath.LinkA01_2.3058-3056	Urban	Local distributor	50	Flat	Free-flow	240051	28	Athens
33	urban2-SL50-Stop-go.def.OSCAR.Ath.LinkA01_1.3024-3022-3021	Urban	Local distributor	50	Flat	Stop and go	240054	30	Athens
34	urban1-SL50-Free.def.INRETS.110110-TNO.FordM.L123582-123657	Urban	Local access	50	Flat	Free-flow	250051	31	France and The Netherlands
35	urban1-SL50-Stop-go.def.TNO.FordM.L70485-70844-L164259-165038	Urban	Local access	50	Flat	Stop and go	250054	33	The Netherlands
36	urban1-SL40-Free.def.OSCAR.Hels.LinkH07.2333-2354-2355-2344	Urban	Local access	40	Flat	Free-flow	250041	34	Helsinki
37	urban1-SL40-Stop-go.def.OSCAR.Hels.LinkH07.2376	Urban	Local access	40	Flat	Stop and go	250044	36	Helsinki
38	urban1-SL30-Free.def.TNO.FordM.L97001-97843	Urban	Local access	30	Flat	Free-flow	250031	37	The Netherlands
39	urban1-SL30-Stop-go.def.INRETS.110010	Urban	Local access	30	Flat	Stop and go	250034	39	France
40	rural5-SL130-Free.def.INRETS.00000-00001	Rural	Nat./reg. motorway	130	Flat	Free-flow	110131	44	France
41	rural4-SL90-Free.def.INRETS.00011-00100	Rural	Nat./reg. trunk road	90	Flat	Free-flow	120091	45	France
42	rural4-SL90-H-Free.def.INRETS.N89.00110-00101	Rural	Nat./reg. trunk road	90	Hilly	Free-flow	120091	48	France (N89)
43	rural4-SL70-Free.def.INRETS.N7-1010-70	Rural	Nat./reg. trunk road	70	Flat	Free-flow	120071	49	France (N7)
44	rural3-SL90-M-Free.def.INRETS.Bourgoisans-D.100111.90C	Rural	Distributor	90	Mountainou	Free-flow	130091	58	The Alps (Bourg-Oisans)
45	rural3-SL70-M-Free.def.INRETS.Bourgoisans-D.100111.70C	Rural	Distributor	70	Mountainou	Free-flow	130071	59	The Alps (Bourg-Oisans)
46	rural3-SL50-Free.def.INRETS.N7-1010-50	Rural	Distributor	50	Flat	Free-flow	130051	50	France (N7)
47	urban2-SL50-Saturated.def.TNO.FordM.L54589-54888	Urban	Local distributor	50	Flat	Saturated	240053	29	The Netherlands
48	urban1-SL50-Saturated.def.INRETS.101001	Urban	Local access	50	Flat	Saturated	250053	32	France
49	urban1-SL40-Saturated.def.OSCAR.Hels.LinkH08.2398-2433.LinkH07.2352	Urban	Local access	40	Flat	Saturated	250043	35	Helsinki
50	urban1-SL30-Saturated.def.INRETS.101101	Urban	Local access	30	Flat	Saturated	250033	38	France

Development of an approach for estimating the pollutant emissions from road transport at a street level

ID	SpeedCurve_FullName	Characteristics of the traffic situation		Speed limit (km/h)	Gradient, sinuosity	Traffic condition	Identification	ID/CYCL	Comments on the Speed Curve
		Area	Road category						
51	rural4-SL90-H-Free.sup.INRETS.N89-M.00101	Rural	Nat./reg. trunk road	90	Hilly	Free-flow	120091	46	Trip in a hilly area - heterogeneous gradient, but roughly uphill
52	rural4-SL90-H-Free.sup.INRETS.N89-D.00110	Rural	Nat./reg. trunk road	90	Hilly	Free-flow	120091	47	Trip in a hilly area - heterogeneous gradient, but roughly downhill
53	rural3-SL90-M-Free.sup.INRETS.2alps-M.100001	Rural	Distributor	90	Mountainou	Free-flow	130091	51	Severe trip in the Alps - Uphill
54	rural3-SL90-M-Free.sup.INRETS.2alps-D.100010	Rural	Distributor	90	Mountainou	Free-flow	130091	52	Severe trip in the Alps - Downhill
55	rural3-SL90-M-Free.sup.INRETS.Bourgoisans-D.100111	Rural	Distributor	90	Mountainou	Free-flow	130091	56	Trip in the Alps - Heterogeneous gradient, downhill
56	rural3-SL90-M-Free.sup.INRETS.Bourgoisans-M.100011	Rural	Distributor	90	Mountainou	Free-flow	130091	57	Trip in the Alps - Heterogeneous gradient, uphill
57	rural3-SL90-70-50-M-Free.sup.INRETS.LaGrave2.100110	Rural	Distributor	90	Mountainou	Free-flow	130091	61	Trip in the Alps - Heterogeneous gradient, uphill and downhill
58	rural3-SL90-70-50-M-Free.C.INRETS.LaGrave2_M.100110	Rural	Distributor	90	Mountainou	Free-flow	130091	62	Trip in the Alps - Heterogeneous gradient, uphill
59	rural3-SL90-70-50-M-Free.C.INRETS.LaGrave2_D.100110	Rural	Distributor	90	Mountainou	Free-flow	130091	63	Trip in the Alps - Heterogeneous gradient, downhill
60	rural3-SL90-70-50-M-Free.G.INRETS.LaGrave1-2.100101-100110	Rural	Distributor	90	Mountainou	Free-flow	130091	65	Trip in the Alps - Heterogeneous gradient
61	rural3-SL90-M-Free.def.INRETS.2alps-M.100001-D.100010	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	53	Severe trip in the Alps - Uphill and return
62	rural3-SL90-M-Free.C.INRETS.Bourgoisans-M.100011.90	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	54	Trip in the Alps - Heterogeneous gradient, but uphill
63	rural3-SL70-M-Free.C.INRETS.Bourgoisans-M.100011.70	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	55	Trip in the Alps - Heterogeneous gradient, but uphill
64	rural3-SL90-M-Free.def.INRETS.Bourgoisans-D.100111-M.100011	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	60	Trip in the Alps - Heterogeneous gradient, uphill and return
65	rural3-SL90-M-Free.C.INRETS.LaGrave2.100110.90	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	64	Trip in the Alps - Heterogeneous gradient
66	rural3-SL70-M-Free.C.INRETS.LaGrave2.100110.70	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	66	Trip in the Alps - Heterogeneous gradient
67	rural5s-SL110-Heavy.Sit_1.TS_Gavle_E4_Set1.xls	Rural	Semi-motorway	110	Flat	Heavy traffic	112112	67	Semi-motorway in Sweden; Alternance of segments with 1 and 2 lanes, every 2-3 km - The traffic condition (free/heavy/dense) may have a different meaning than on a normal road
68	rural5s-SL110-Saturated.Sit_2.TS_Gavle_E4_Set1.xls	Rural	Semi-motorway	110	Flat	Saturated	112113	68	
74	rural5s-SL110-Free.Sit_4.TS_Gavle_E4_Set3_freeflow.xls	Rural	Semi-motorway	110	Flat	Free-flow	112111	74	
75	rural5s-SL90-Heavy.Sit_1.TS_Vasteras_E18_Set2.xls	Rural	Semi-motorway	90	Flat	Heavy traffic	112092	75	
77	rural5s-SL90-Saturated.Sit_3.TS_Vasteras_E18_Set2.xls	Rural	Semi-motorway	90	Flat	Saturated	112093	77	
84	rural5s-SL90-Free.Sit_4.TS_Vasteras_E18_Set4_mflow.xls	Rural	Semi-motorway	90	Flat	Free-flow	112091	84	Speed recorded on a non-limited motorway; average speed around 170 km/h
87	rural5-SL999-Free.TS170.golf4_2.bin.045	Rural	Nat./reg. motorway	150	Flat	Free-flow	110141	87	
88	rural5-SL999-Free.TS150.a1002_2.bin.026	Rural	Nat./reg. motorway	150	Flat	Free-flow	110141	88	
89	rural5-SL999-Free.TS180.a1003_3.bin.019	Rural	Nat./reg. motorway	150	Flat	Free-flow	110141	89	Speed recorded on a non-limited motorway; average speed around 180 km/h
1002	TS_Artemis.urban	Urban	Districts distributor	50	Flat	Heavy traffic	#VALEUR!	1002	ARTEMIS Cycles and sub-cycles derived from in actual use driving data - F/FRG/UK/GR data
1003	TS_Artemis.urban_1	Urban	Districts distributor	50	Flat	Saturated	#VALEUR!	1003	
1004	TS_Artemis.urban_2	Urban	Districts distributor	50	Flat	Saturated	#VALEUR!	1004	
1005	TS_Artemis.urban_3	Urban	Districts distributor	50	Flat	Stop and go	#VALEUR!	1005	
1006	TS_Artemis.urban_4	Urban	Districts distributor	50	Flat	Stop and go	#VALEUR!	1006	
1007	TS_Artemis.urban_5	Urban	Districts distributor	50	Flat	Heavy traffic	#VALEUR!	1007	
1009	TS_Artemis.road	Rural	Distributor	90	Flat	Heavy traffic	#VALEUR!	1009	
1010	TS_Artemis.road_1	Rural	Distributor	90	Flat	Heavy traffic	#VALEUR!	1010	
1011	TS_Artemis.road_2	Rural	Distributor	90	Flat	Heavy traffic	#VALEUR!	1011	
1012	TS_Artemis.road_3	Rural	Distributor	90	Flat	Heavy traffic	#VALEUR!	1012	
1013	TS_Artemis.road_4	Rural	Distributor	90	Flat	Heavy traffic	#VALEUR!	1013	
1014	TS_Artemis.road_5	Rural	Nat./reg. trunk road	90	Flat	Heavy traffic	#VALEUR!	1014	
1016	TS_Artemis.motorway	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#VALEUR!	1016	
1017	TS_Artemis.motorway_1	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#VALEUR!	1017	
1018	TS_Artemis.motorway_2	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#VALEUR!	1018	
1019	TS_Artemis.motorway_3	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#VALEUR!	1019	
1020	TS_Artemis.motorway_4	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#VALEUR!	1020	
1022	TS_Artemis.motorway130	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#VALEUR!	1022	
1023	TS_Artemis.motorway130_3	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#VALEUR!	1023	
1024	TS_Artemis.motorway130_4	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#VALEUR!	1024	
1025	TS_Artemis.URM150	Rural	#N/A	0	Flat	Heavy traffic	#VALEUR!	1025	
1026	TS_Artemis.URM130	Rural	#N/A	0	Flat	Heavy traffic	#VALEUR!	1026	

Annex 7. Kinematic parameters from the retained speed curves

IDSpeedCurve	SpeedCurve_FullName	Characteristics of the traffic situation										number of accel per km	strong_acc_number_per_km	max_speed (km/h)
		Area	Road category	Speed limit (km/h)	Gradient, sinuosity	Traffic condition	Identification	speed (km/h)	run_speed (m/s ²)	acc_mean_value (m/s ²)	stop_rel_duration (%)	stop_number_per_km		
40	rural5-SL130-Free.def.INRETS	Rural	110	130	0	0	110131	122	122	0,46	0	0,0	0,2	129
87	rural5-SL999-Free.TS170.go	Rural	110	150	0	0	110141	170	170	0,39	0	0,0	0,2	185
88	rural5-SL999-Free.TS150.a1c	Rural	110	150	0	0	110141	152	152	0,00	0	0,0	0,0	167
89	rural5-SL999-Free.TS180.a1c	Rural	110	150	0	0	110141	178	178	0,38	0	0,0	0,2	195
75	rural5s-SL90-Heavy.Sit_1.TS	Rural	112	90	0	0	112092	87	87	0,41	0	0,0	0,7	99
77	rural5s-SL90-Saturated.Sit_3	Rural	112	90	0	0	112093	71	71	0,51	0	0,0	1,2	98
84	rural5s-SL90-Free.Sit_4.TS_1	Rural	112	90	0	0	112091	95	95	0,46	0	0,0	0,2	100
67	rural5s-SL110-Heavy.Sit_1.TS	Rural	112	110	0	0	112112	101	101	0,43	0	0,0	0,6	115
77	rural5s-SL90-Saturated.Sit_3	Rural	112	110	0	0	112113	71	71	0,51	0	0,0	1,2	98
74	rural5s-SL110-Free.Sit_4.TS	Rural	112	110	0	0	112111	110	110	0,00	0	0,0	0,0	114
43	rural4-SL70-Free.def.INRETS	Rural	120	70	0	0	120071	68	68	0,48	0	0,0	0,5	77
41	rural4-SL90-Free.def.INRETS	Rural	120	90	0	0	120091	80	80	0,67	0	0,0	0,9	95
46	rural3-SL50-Free.def.INRETS	Rural	130	50	0	0	130051	49	49	0,49	0	0,0	2,0	65
2	urban5a-SL110-Free.def.INRE	Urban	210	110	0	0	210111	100	100	0,58	0	0,0	0,4	106
3	urban5a-SL110-Heavy.def.INRE	Urban	210	110	0	0	210112	90	90	0,59	0	0,0	1,7	119
4	urban5a-SL110-Stop-go.def.INRE	Urban	210	110	0	0	210114	26	26	0,53	2	0,9	6,9	76
1	urban5a-SL130-Free.def.INRE	Urban	210	130	0	0	210131	118	118	0,48	0	0,0	0,6	131
8	urban4a-SL80-Heavy.def.TNO	Urban	211	80	0	0	211082	72	72	0,37	0	0,0	0,7	78
7	urban4a-SL90-Free.def.INRETS	Urban	211	90	0	0	211091	76	76	0,61	0	0,0	1,6	89
5	urban4a-SL100-Free.def.TNO	Urban	211	100	0	0	211101	94	94	0,58	0	0,0	0,8	109
6	urban4a-SL100-Heavy.def.TNO	Urban	211	100	0	0	211102	74	74	1,09	0	0,0	1,6	104
16	urban4b-SL50-Free.def.OSCAR	Urban	221	50	0	0	221051	44	44	0,70	0	0,0	3,0	55
17	urban4b-SL50-Heavy.def.OSCAR	Urban	221	50	0	0	221052	36	40	0,88	11	1,0	5,2	74
18	urban4b-SL50-Saturated.def.OSCAR	Urban	221	50	0	0	221053	17	23	0,75	24	4,0	8,0	85
31	urban3-SL50-Stop-go.def.OSCAR	Urban	221	50	0	0	221054	13	22	0,77	39	4,3	8,1	45
12	urban4b-SL60-Free.def.OSCAR	Urban	221	60	0	0	221061	63	63	0,45	0	0,0	0,8	69
13	urban4b-SL60-Heavy.def.OSCAR	Urban	221	60	0	0	221062	51	52	0,74	2	1,5	1,5	68
14	urban4b-SL60-Saturated.def.OSCAR	Urban	221	60	0	0	221063	30	33	0,64	10	1,0	4,8	50
15	urban4b-SL60-Stop-go.def.OSCAR	Urban	221	60	0	0	221064	23	23	0,68	1	0,5	10,1	52
9	urban4b-SL80-Free.def.OSCAR	Urban	221	80	0	0	221081	74	74	0,79	0	0,0	0,8	85
10	urban4b-SL80-Heavy.def.TNO	Urban	221	80	0	0	221082	65	65	0,55	0	0,0	1,3	94
15	urban4b-SL60-Stop-go.def.OSCAR	Urban	221	80	0	0	221084	23	23	0,68	1	0,5	10,1	52
28	urban3-SL50-Free.def.OSCAR	Urban	230	50	0	0	230051	45	48	0,93	8	0,8	3,1	68
29	urban3-SL50-Heavy.def.OSCAR	Urban	230	50	0	0	230052	38	43	0,98	11	0,9	3,1	58
30	urban3-SL50-Saturated.def.OSCAR	Urban	230	50	0	0	230053	24	37	0,86	35	1,3	5,4	55
31	urban3-SL50-Stop-go.def.OSCAR	Urban	230	50	0	0	230054	13	22	0,77	39	4,3	8,1	45
24	urban3-SL60-Free.def.OSCAR	Urban	230	60	0	0	230061	53	53	0,68	0	0,0	5,1	67
25	urban3-SL60-Heavy.def.OSCAR	Urban	230	60	0	0	230062	40	42	0,59	3	0,9	3,4	62
26	urban3-SL60-Saturated.def.OSCAR	Urban	230	60	0	0	230063	28	34	0,78	20	2,1	5,2	64
27	urban3-SL60-Stop-go.def.OSCAR	Urban	230	60	0	0	230064	19	29	0,92	33	3,5	9,6	61
20	urban3-SL70-Free.def.OSCAR	Urban	230	70	0	0	230071	64	64	0,60	0	0,0	1,6	76
21	urban3-SL70-Heavy.def.TNO	Urban	230	70	0	0	230072	50	54	0,83	9	0,5	2,4	77

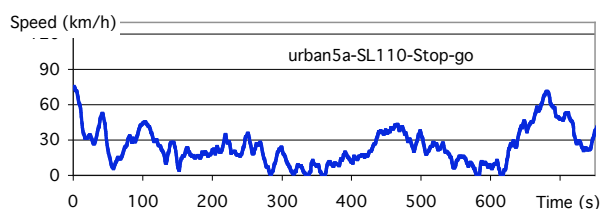
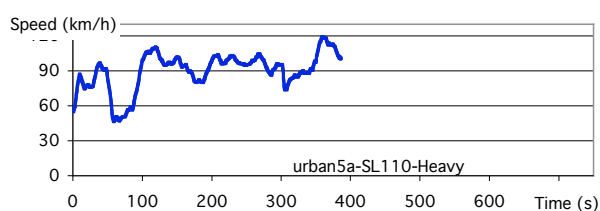
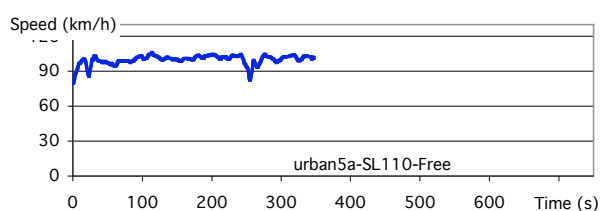
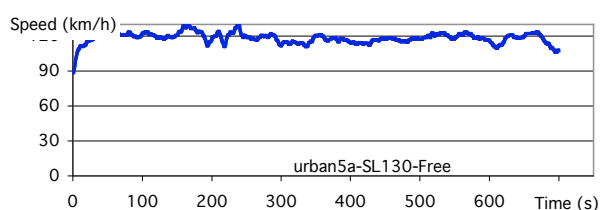
Development of an approach for estimating the pollutant emissions from road transport at a street level

ID	SpeedCurve_FullName	Area	Characteristics of the traffic situation				Traffic condition	Identification	speed (km/h)	run_speed (m/s2)	acc_mean_value (m/s2)	stop_rel_duration (%)	stop_number_per_km	number of accel per km	strong_acc_number_per_km	max_speed (km/h)
			Road category	Speed limit (km/h)	Gradient, sinuosity											
22	urban3-SL70-Saturated.def.OS	Urban		230	70	0	0	230073	31	43	0,89	27	0,8	3,3	1,0	66
23	urban3-SL70-Stop-go.def.OS	Urban		230	70	0	0	230074	19	37	1,04	50	2,4	6,0	3,6	63
32	urban2-SL50-Free.def.OSCAR	Urban		240	50	0	0	240051	40	40	0,74	0	0,0	5,5	1,2	68
31	urban3-SL50-Stop-go.def.OS	Urban		240	50	0	0	240054	13	22	0,77	39	4,3	8,1	1,6	45
47	urban2-SL50-Saturated.def.TI	Urban		240	50	0	0	240053	20	27	0,71	25	2,4	4,8	1,2	53
38	urban1-SL30-Free.def.TNO.Fo	Urban		250	30	0	0	250031	20	20	0,61	0	0,2	8,9	0,2	43
39	urban1-SL30-Stop-go.def.INR	Urban		250	30	0	0	250034	11	16	0,77	33	4,7	12,7	2,4	38
50	urban1-SL30-Saturated.def.INR	Urban		250	30	0	0	250033	13	17	0,69	27	2,8	13,6	1,4	37
36	urban1-SL40-Free.def.OSCAR	Urban		250	40	0	0	250041	33	36	0,85	8	1,2	5,9	1,8	64
37	urban1-SL40-Stop-go.def.OS	Urban		250	40	0	0	250044	12	24	0,83	48	4,6	7,7	1,5	39
49	urban1-SL40-Saturated.def.O	Urban		250	40	0	0	250043	14	29	0,91	51	3,8	9,9	3,0	52
34	urban1-SL50-Free.def.INRETS	Urban		250	50	0	0	250051	37	37	0,63	0	0,0	3,0	0,0	48
31	urban3-SL50-Stop-go.def.OS	Urban		250	50	0	0	250054	13	22	0,77	39	4,3	8,1	1,6	45
48	urban1-SL50-Saturated.def.IN	Urban		250	50	0	0	250053	26	26	0,69	2	1,1	6,4	1,1	36
42	rural4-SL90-H-Free.def.INRETS	Rural		120	90	0	0	120091	65	66	0,58	0	0,1	2,7	0,1	88
51	rural4-SL90-H-Free.sup.INRETS	Rural		120	90	0	0	120091	70	73	0,61	4	0,1	2,4	0,3	99
52	rural4-SL90-H-Free.sup.INRETS	Rural		120	90	0	0	120091	68	69	0,60	2	0,1	2,6	0,2	99
45	rural3-SL70-M-Free.def.INRETS	Rural		130	70	0	0	130071	59	59	0,62	0	0,0	4,3	0,1	79
44	rural3-SL90-M-Free.def.INRETS	Rural		130	90	0	0	130091	84	84	0,47	0	0,0	1,0	0,0	96
53	rural3-SL90-M-Free.sup.INRETS	Rural		130	90	0	0	130091	50	51	0,75	0	0,1	5,8	1,2	79
54	rural3-SL90-M-Free.sup.INRETS	Rural		130	90	0	0	130091	51	51	0,76	0	0,0	4,9	0,9	73
55	rural3-SL90-M-Free.sup.INRETS	Rural		130	90	0	0	130091	65	65	0,60	0	0,0	3,3	0,1	96
56	rural3-SL90-M-Free.sup.INRETS	Rural		130	90	0	0	130091	56	62	0,61	9	0,2	2,7	0,1	96
57	rural3-SL90-70-50-M-Free.sup	Rural		130	90	0	0	130091	63	63	0,54	0	0,0	2,9	0,1	85
58	rural3-SL90-70-50-M-Free.C.I	Rural		130	90	0	0	130091	70	70	0,49	0	0,0	2,7	0,0	85
59	rural3-SL90-70-50-M-Free.C.I	Rural		130	90	0	0	130091	56	56	0,58	0	0,0	3,2	0,2	80
60	rural3-SL90-70-50-M-Free.G.I	Rural		130	90	0	0	130091	63	63	0,58	0	0,0	3,0	0,1	91
1002	TS_Artemis.urban	Urban		230	50	0	0	#####	18	24	0,84	28	4,9	8,1	2,7	58
1003	TS_Artemis.urban_1	Urban		230	50	0	0	#####	15	22	0,77	30	5,9	7,9	1,0	49
1004	TS_Artemis.urban_2	Urban		230	50	0	0	#####	32	35	0,84	9	2,3	5,2	1,7	58
1005	TS_Artemis.urban_3	Urban		230	50	0	0	#####	9	21	0,98	58	10,2	6,8	5,1	46
1006	TS_Artemis.urban_4	Urban		230	50	0	0	#####	12	14	0,83	19	16,7	16,7	4,8	40
1007	TS_Artemis.urban_5	Urban		230	50	0	0	#####	22	24	0,80	10	4,3	11,5	4,3	44
1009	TS_Artemis.road	Rural		130	90	0	0	#####	61	63	0,67	2	0,2	2,2	0,3	112
1010	TS_Artemis.road_1	Rural		130	90	0	0	#####	50	53	0,79	6	0,6	5,1	0,9	77
1011	TS_Artemis.road_2	Rural		130	90	0	0	#####	66	66	0,69	0	0,0	0,6	0,0	84
1012	TS_Artemis.road_3	Rural		130	90	0	0	#####	43	44	0,62	3	0,5	3,6	0,5	69
1013	TS_Artemis.road_4	Rural		130	90	0	0	#####	79	79	0,58	0	0,0	1,3	0,0	112
1014	TS_Artemis.road_5	Rural		120	90	0	0	#####	88	88	0,38	0	0,0	0,5	0,0	104
1016	TS_Artemis.motorway	Rural		110	130	0	0	#####	120	120	0,57	0	0,0	0,6	0,0	150
1017	TS_Artemis.motorway_1	Rural		110	130	0	0	#####	122	122	0,52	0	0,0	0,1	0,0	132
1018	TS_Artemis.motorway_2	Rural		110	130	0	0	#####	104	104	0,63	0	0,0	1,8	0,2	128
1019	TS_Artemis.motorway_3	Rural		110	130	0	0	#####	125	125	0,32	0	0,0	0,3	0,0	148
1020	TS_Artemis.motorway_4	Rural		110	130	0	0	#####	134	134	0,44	0	0,0	0,5	0,0	150
1022	TS_Artemis.motorway130	Rural		110	130	0	0	#####	116	116	0,53	0	0,0	0,6	0,0	132
1023	TS_Artemis.motorway130_3	Rural		110	130	0	0	#####	118	118	0,34	0	0,0	0,3	0,0	130
1024	TS_Artemis.motorway130_4	Rural		110	130	0	0	#####	120	120	0,33	0	0,0	0,8	0,0	130
1025	TS_Artemis.URM150	Rural	#N/A	0	0	0	0	#####	59	66	0,73	11	0,6	2,2	0,4	150
1026	TS_Artemis.URM130	Rural	#N/A	0	0	0	0	#####	58	65	0,72	11	0,6	2,3	0,4	132

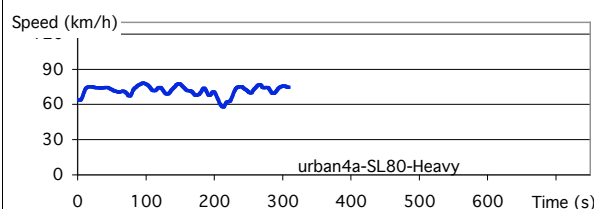
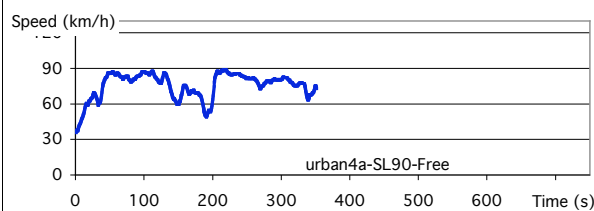
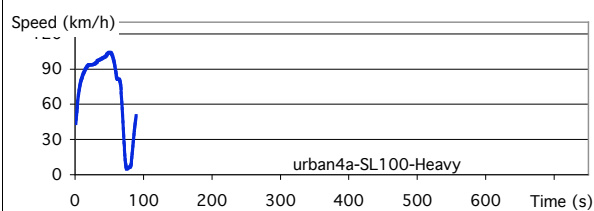
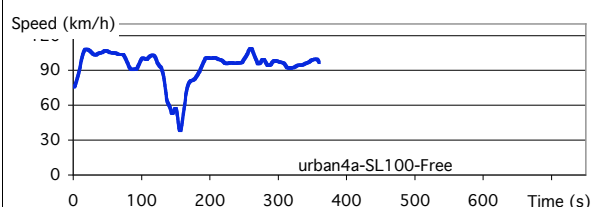
Annex 8. Speed curves

A8.1. Urban speed curves (flat area)

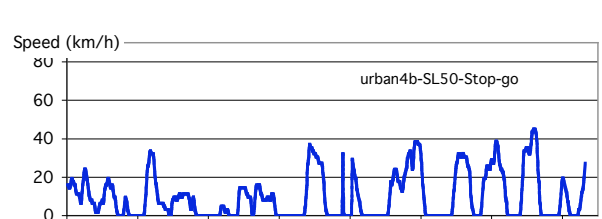
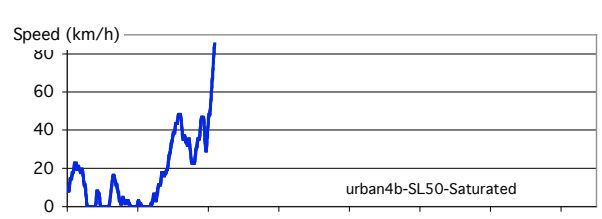
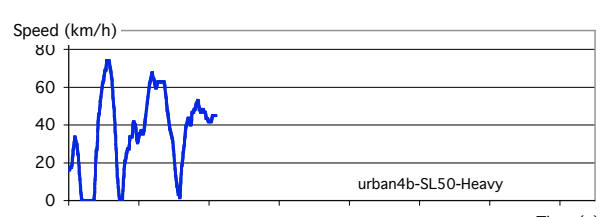
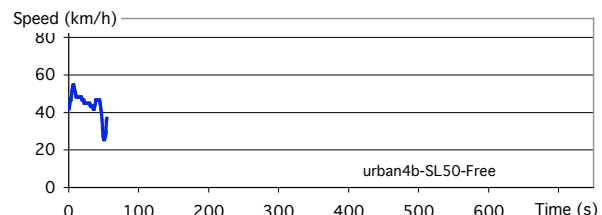
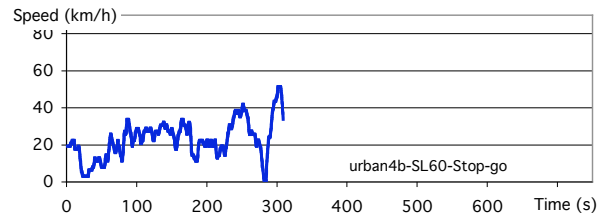
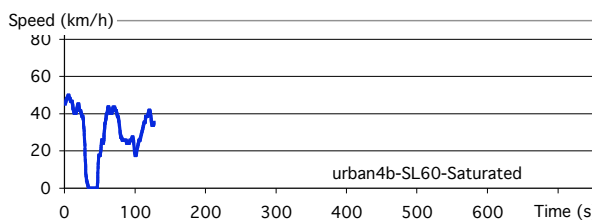
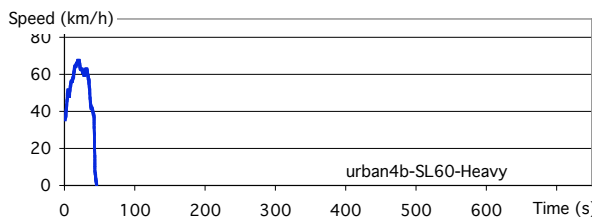
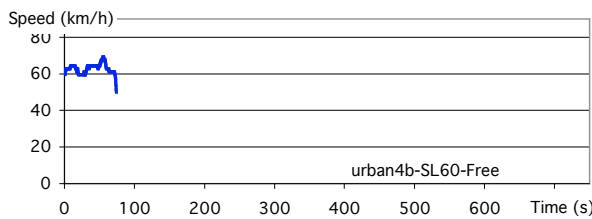
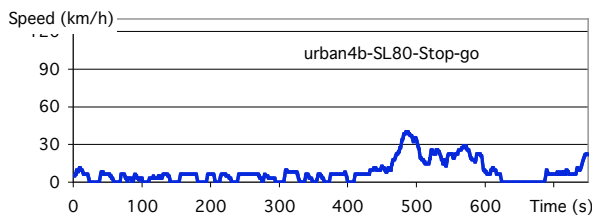
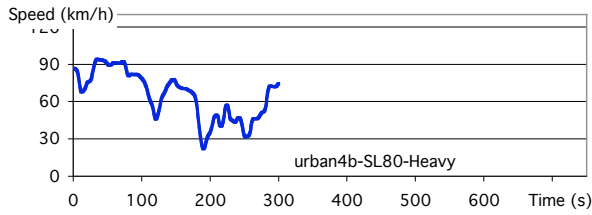
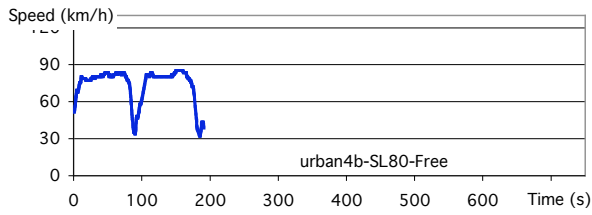
Urban 5a (National / regional motorway) and 5b (National / regional trunk road)



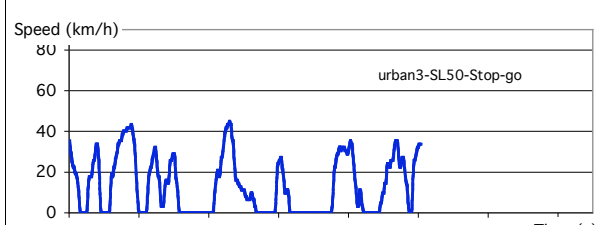
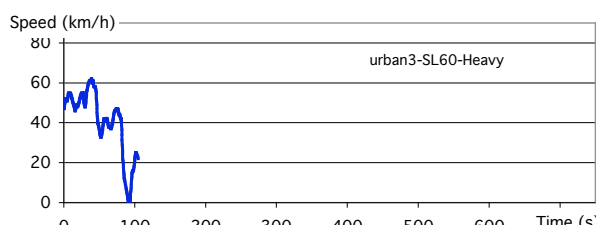
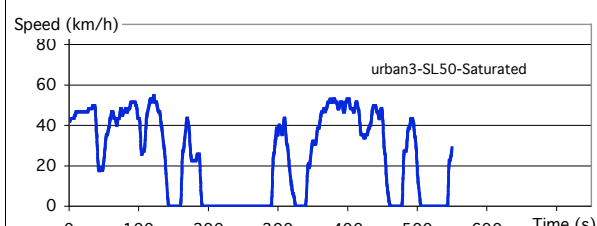
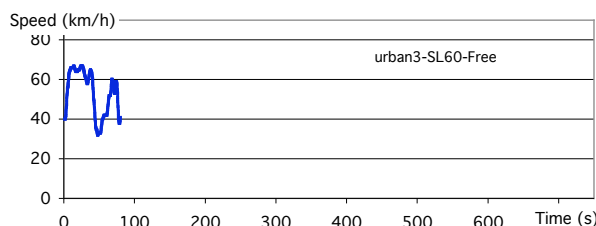
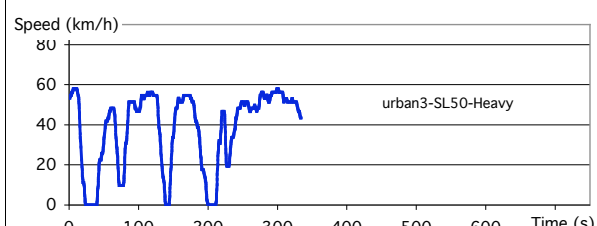
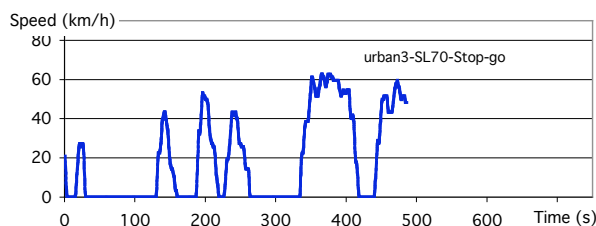
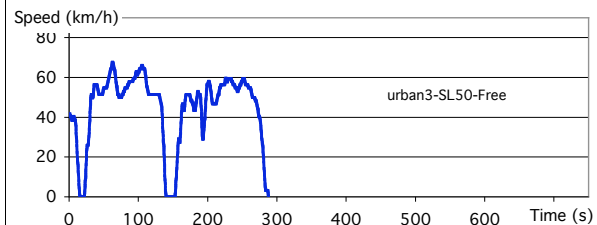
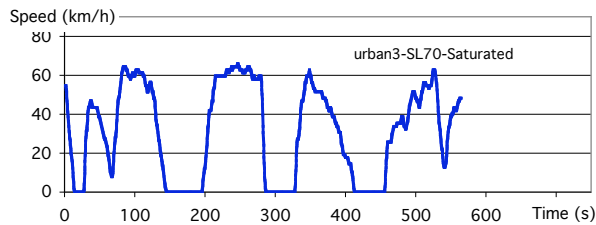
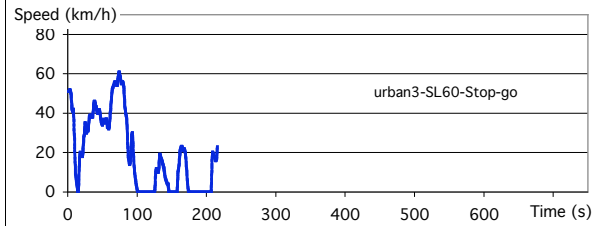
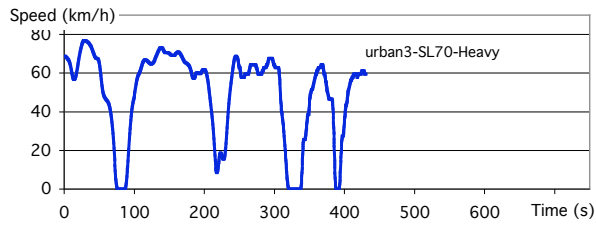
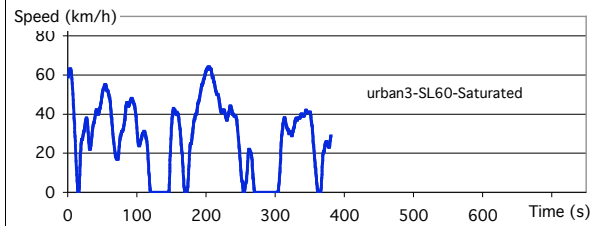
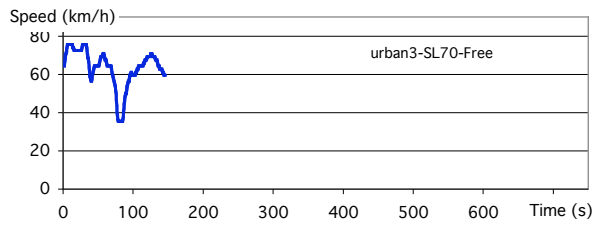
Urban 4a (City or urban motorway)



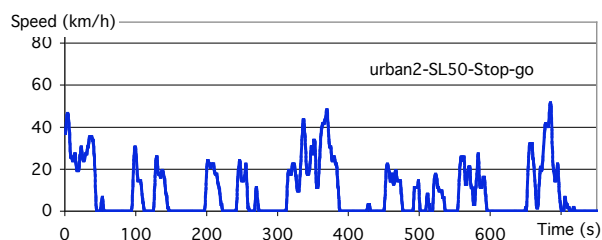
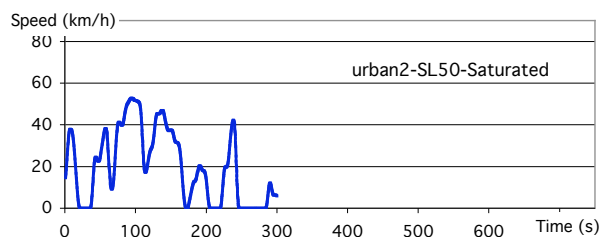
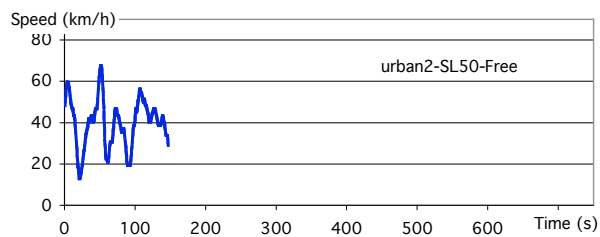
Urban 4b (City primary roads, major arterials)



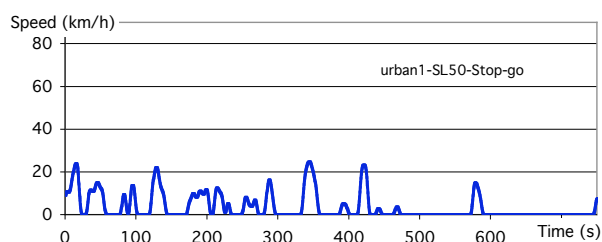
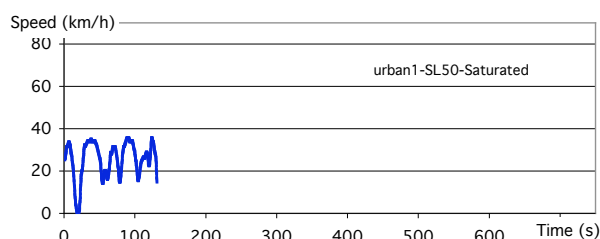
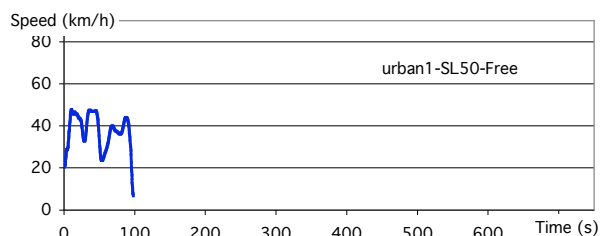
Urban 3 (District distributor, inter district road)



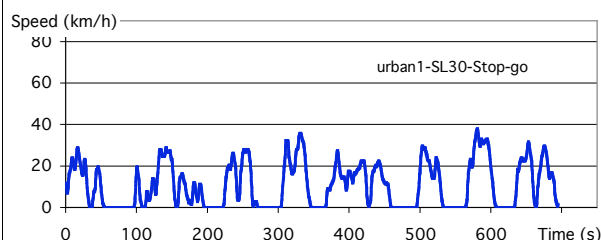
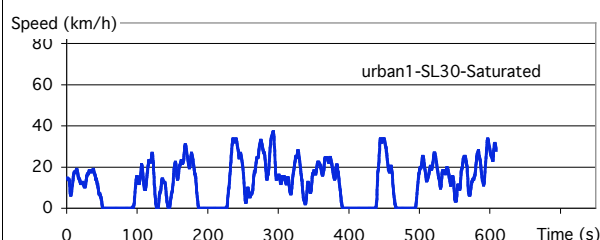
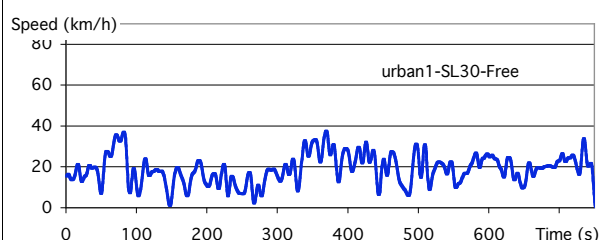
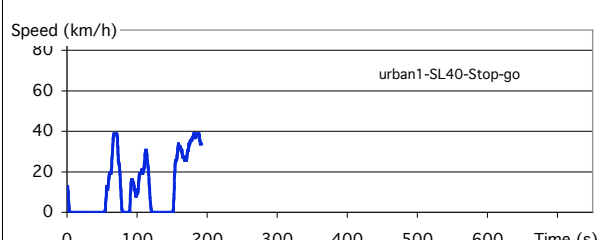
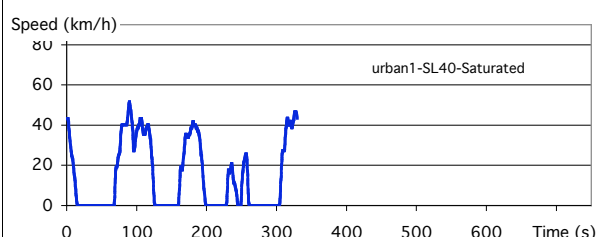
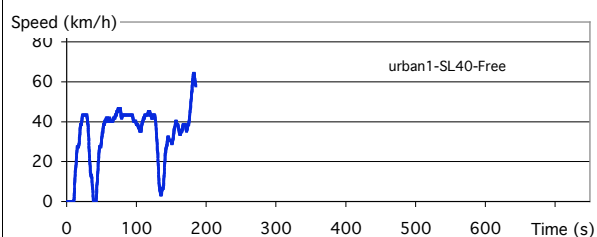
Urban 2 (Local distributor)



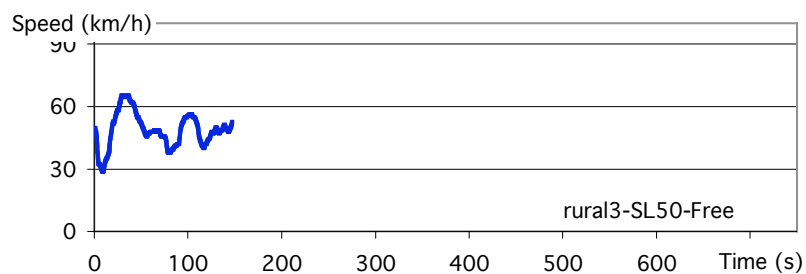
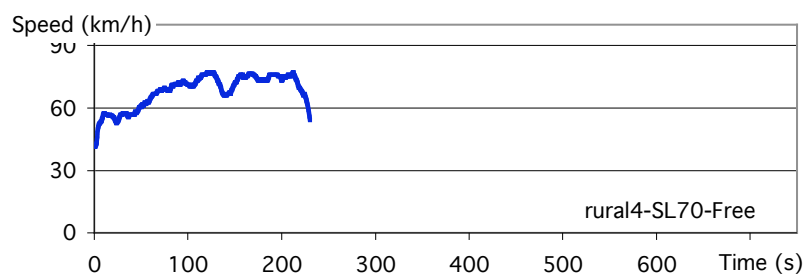
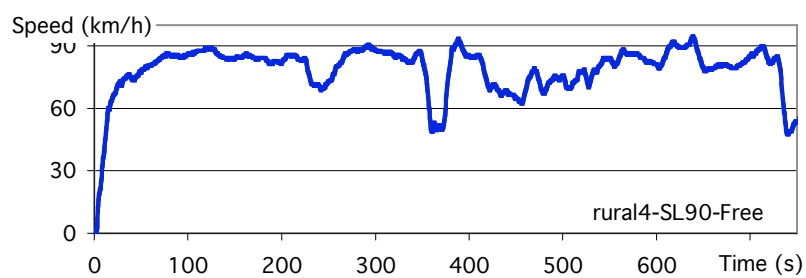
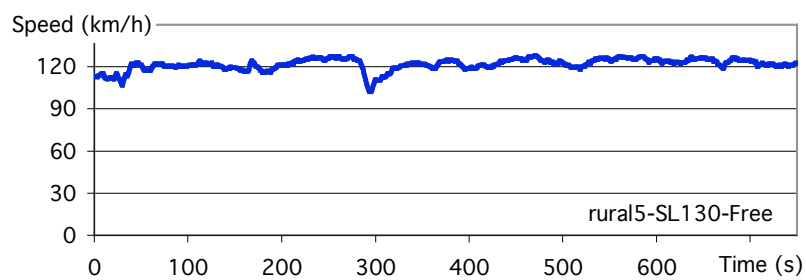
Urban 1 (Local access)



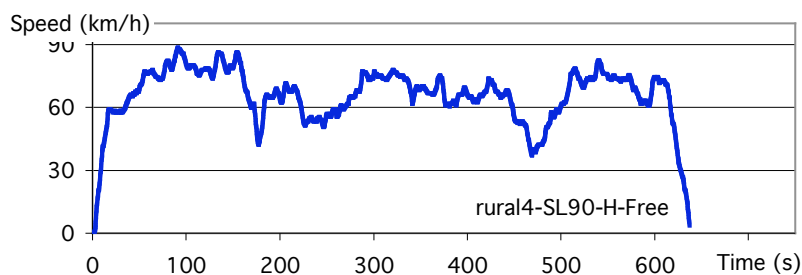
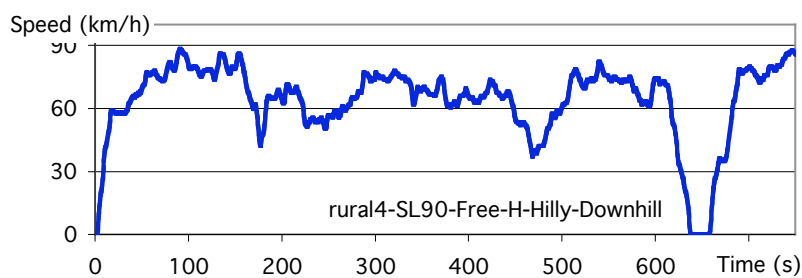
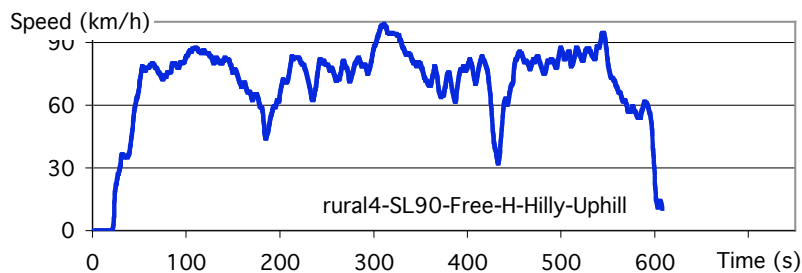
Urban 1 (Local access) (cont.)



A8.2. Rural speed curves (flat area)

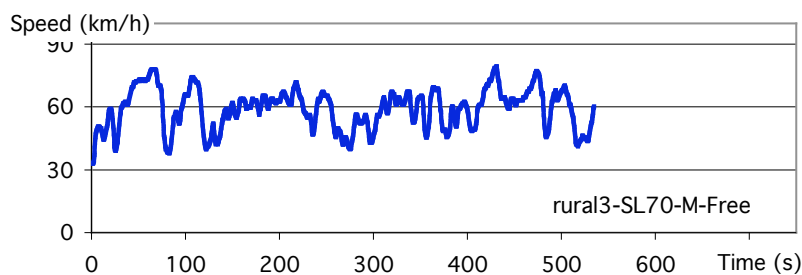
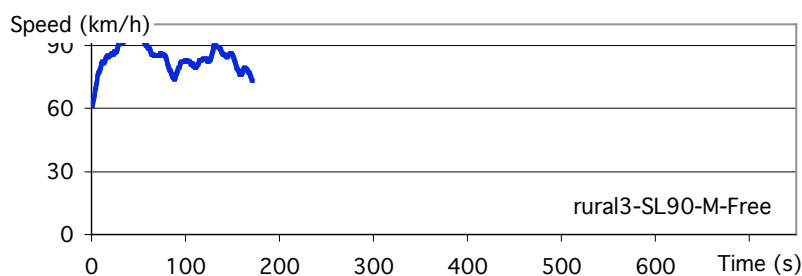


A8.3. Rural speed curves (Hilly area)

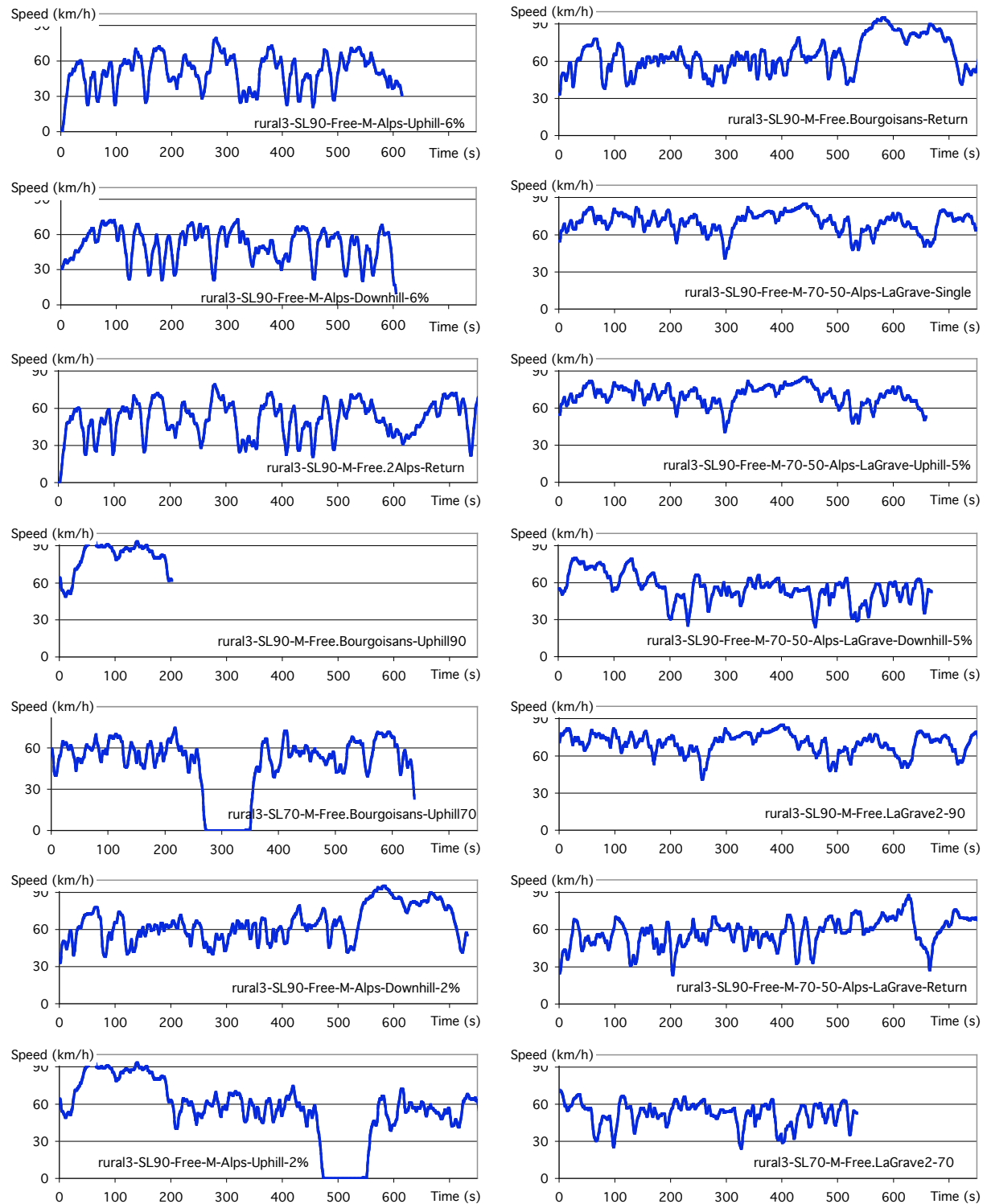


A8.4. Rural speed curves (Mountainous area)

Two retained curves

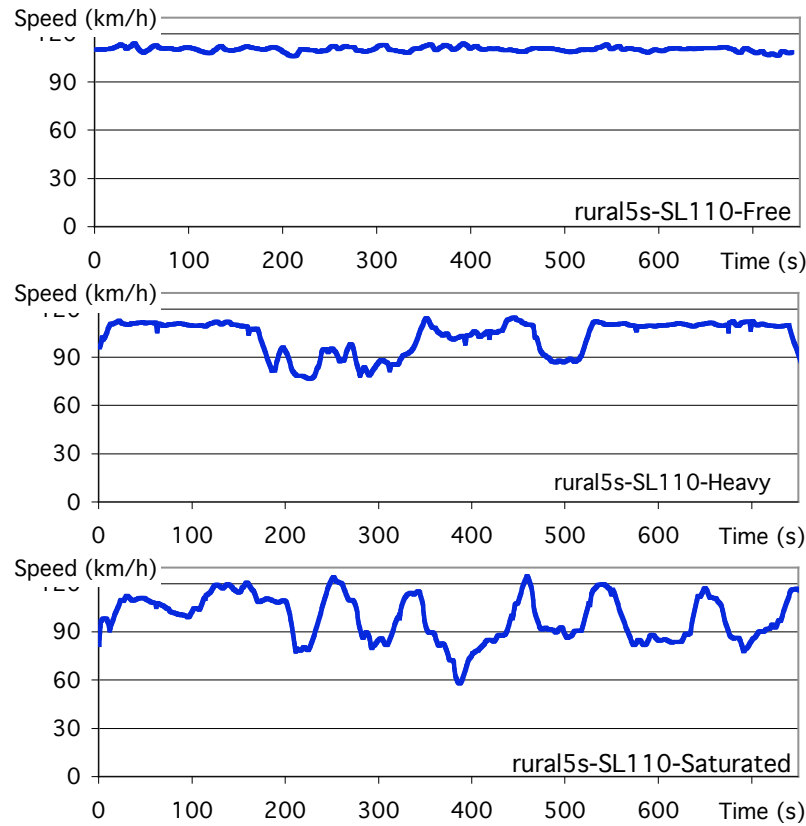


Complementary curves (mountainous area)

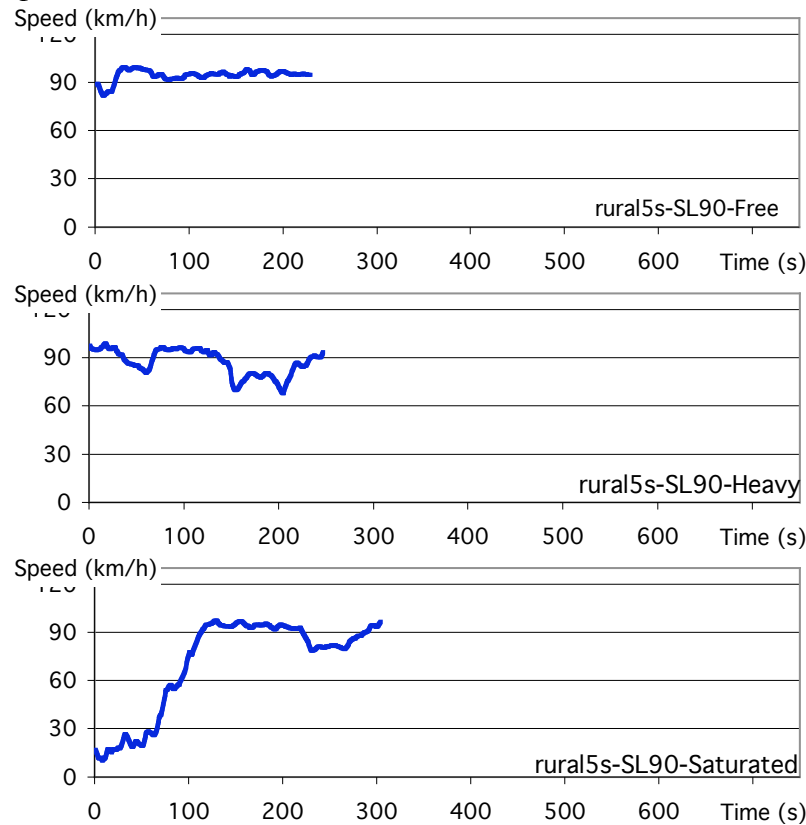


A8.5. Swedish semi-motorways

Speed limit 110 km/h

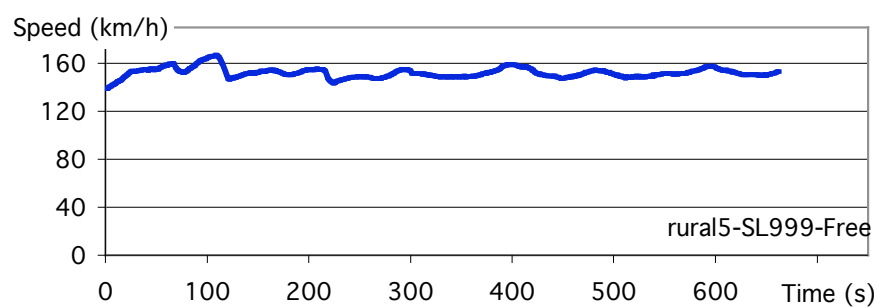


Speed limit 90 km/h

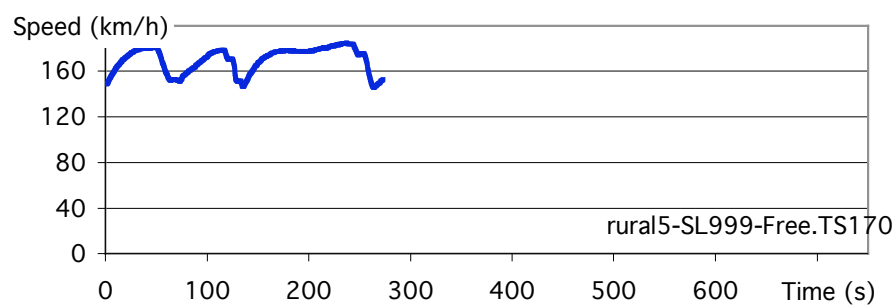


A8.6. Unlimited motorways

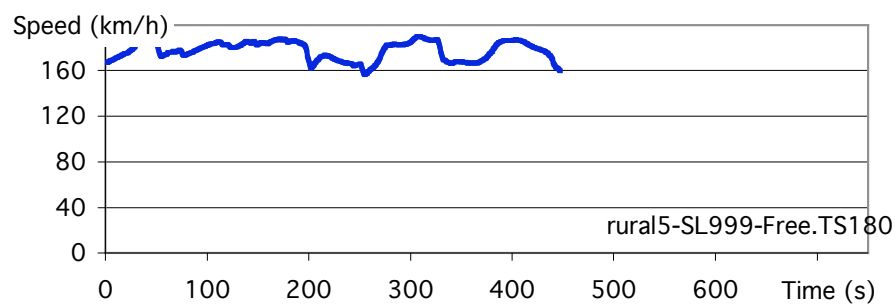
At about 150 km/h (retained curve)



At about 170 km/h

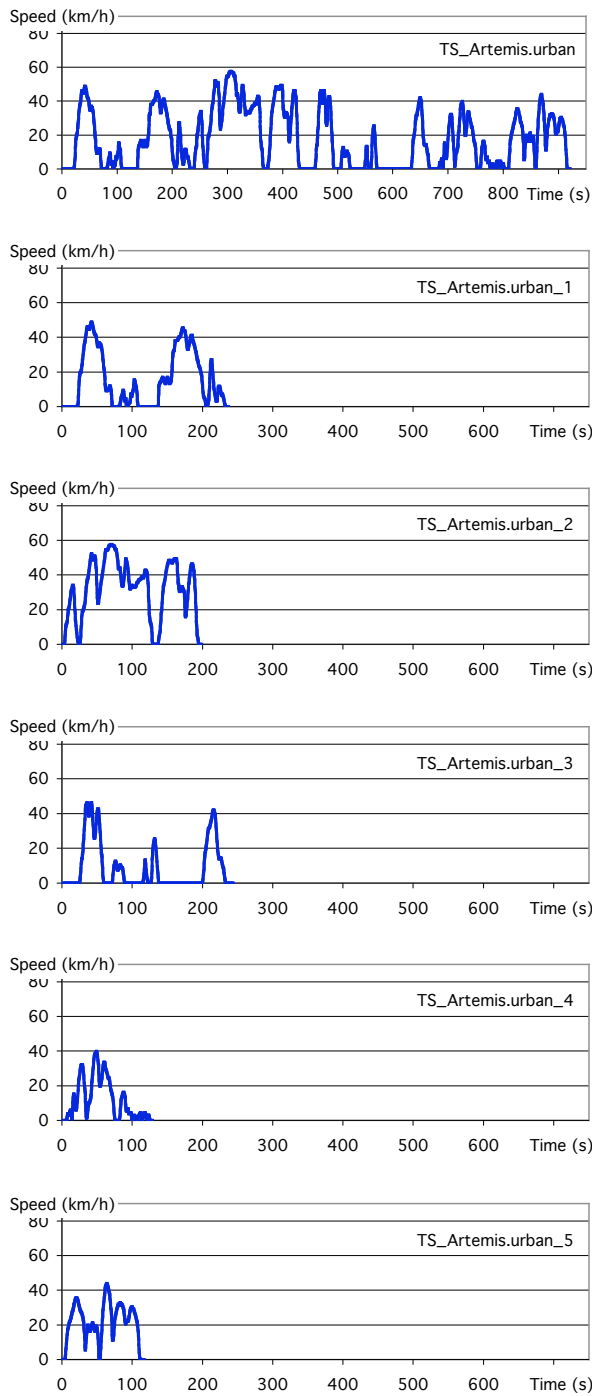


At about 180 km/h

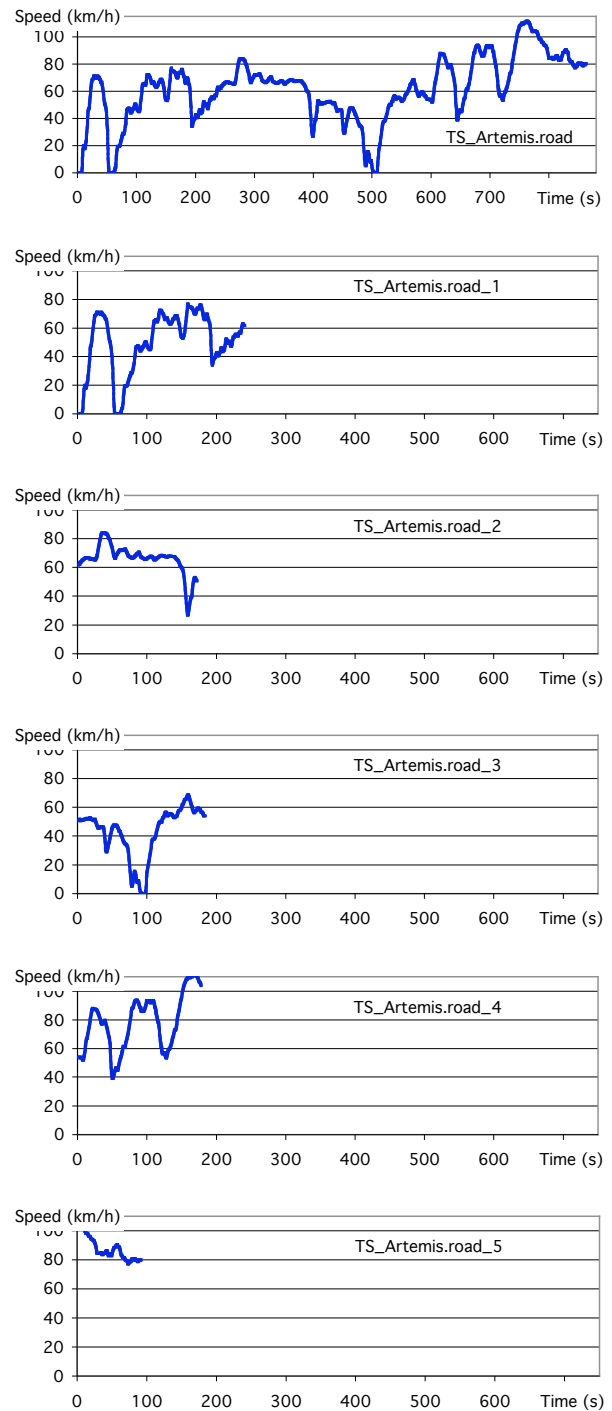


A8.7. Particular traffic situations: the Artemis cycles and sub-cycles

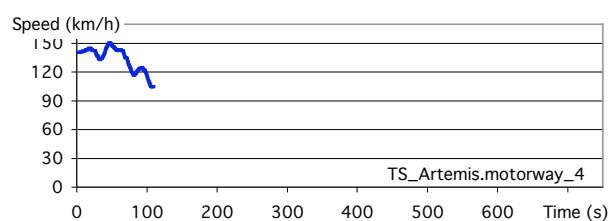
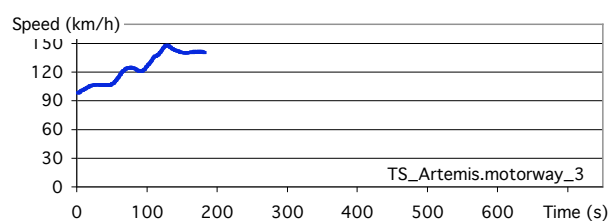
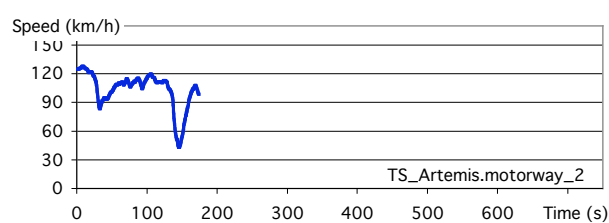
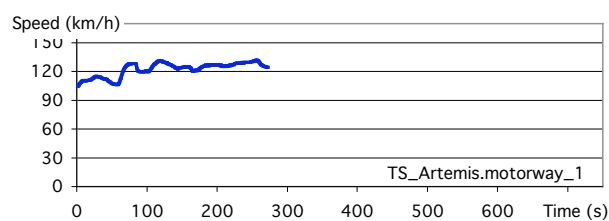
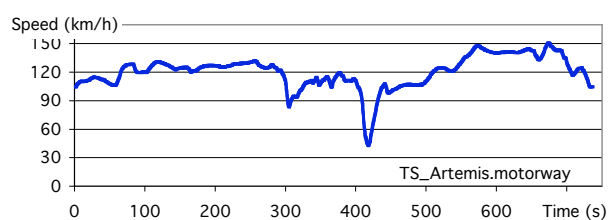
Artemis urban cycle / sub-cycles



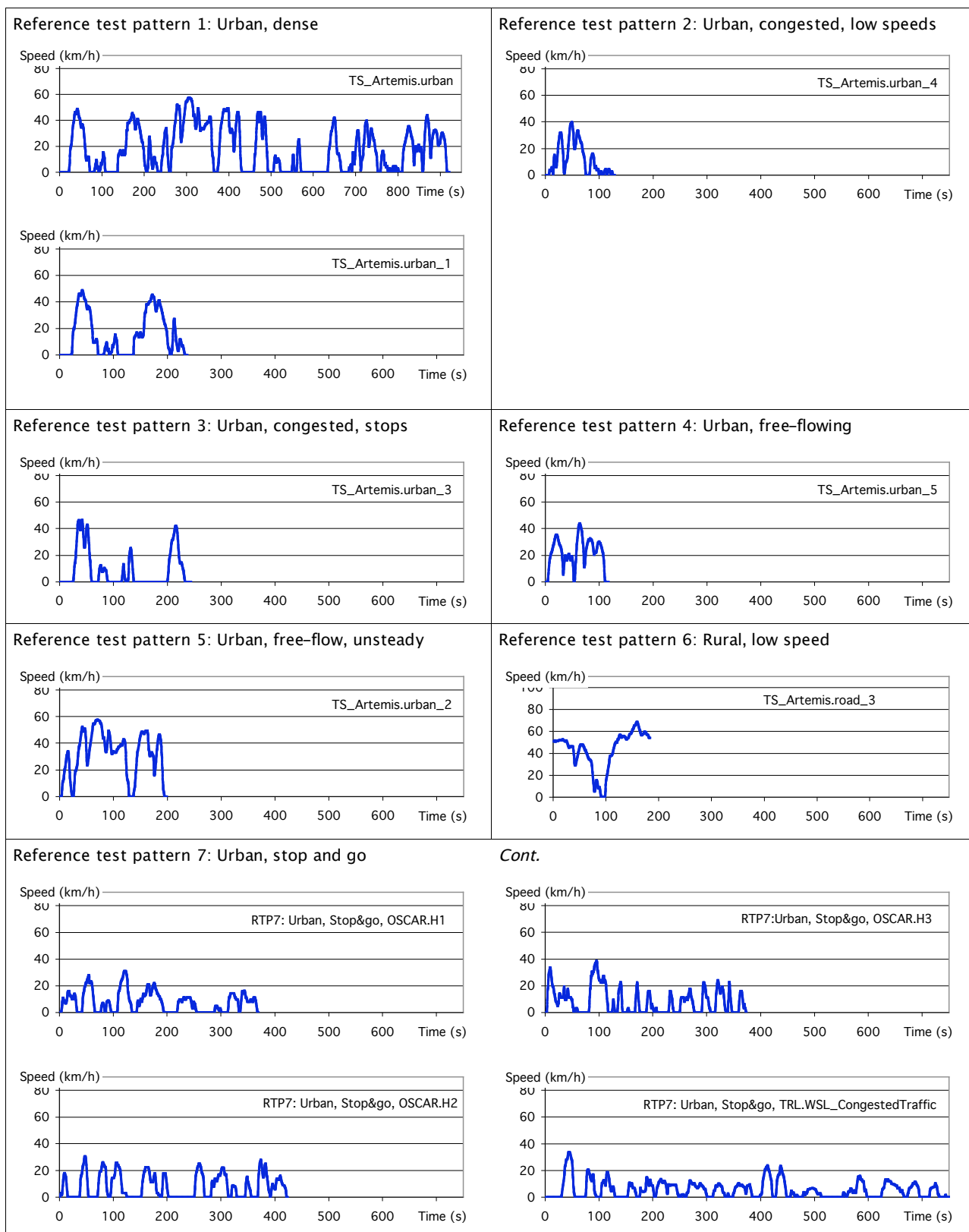
Artemis rural-road cycle / sub-cycles



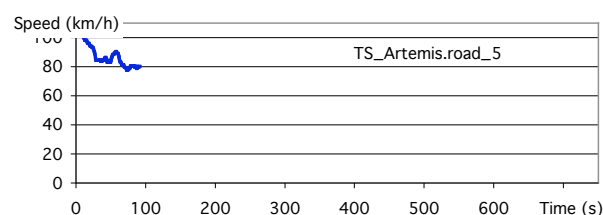
Artemis motorway cycle / sub-cycles



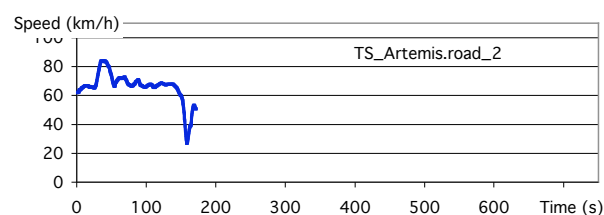
A8.8. Particular traffic situations: 15 reference test patterns



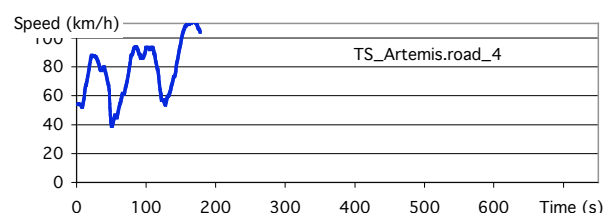
Reference test pattern 8: Rural, main road



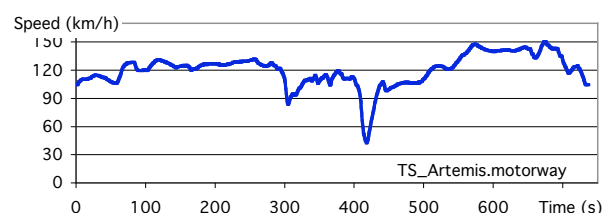
Reference test pattern 9: Rural, steady



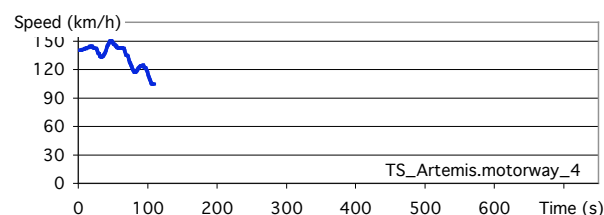
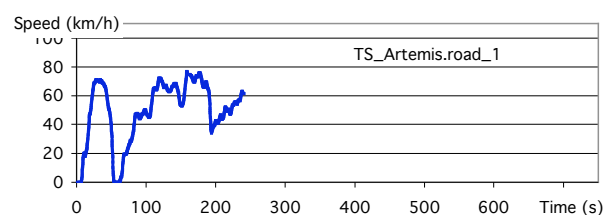
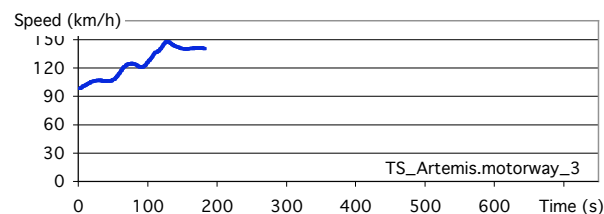
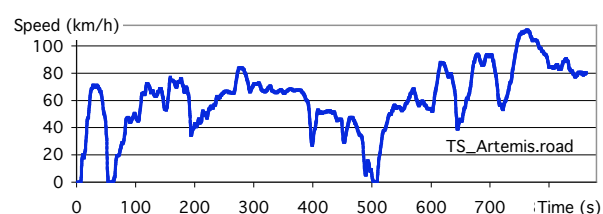
Reference test pattern 10: Rural, main road, unsteady



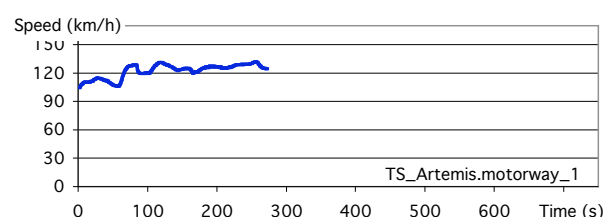
Reference test pattern 12: Motorway, high speed



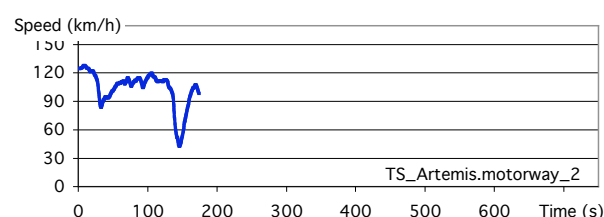
Reference test pattern 11: Rural, unsteady



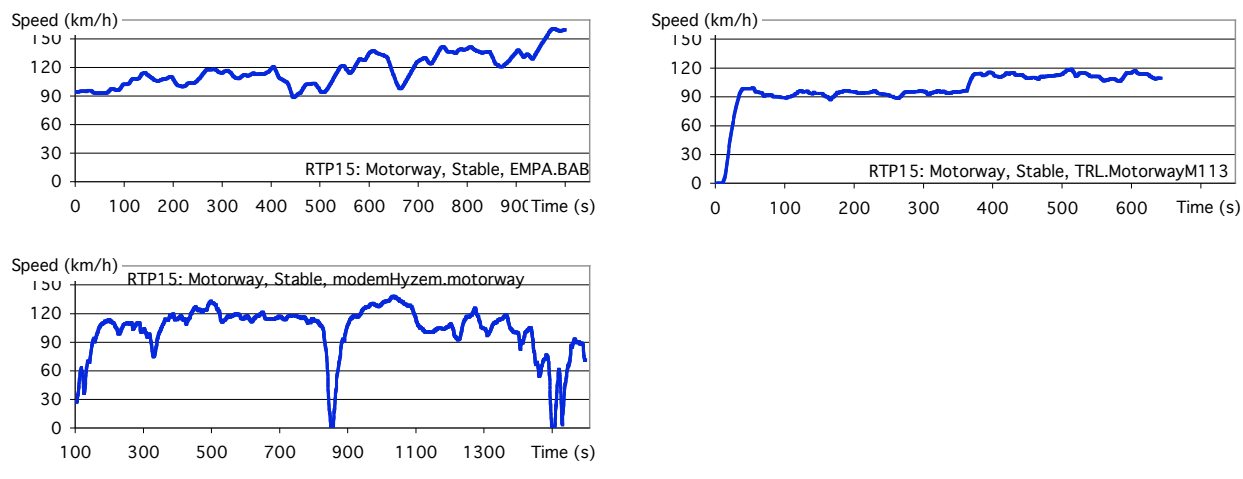
Reference test pattern 13: Motorway



Reference test pattern 14: Motorway, unsteady



Reference test pattern15: Motorway, stable



Annex 9. Traffic situations and speed data

A9.1. Passenger cars

Cars					Average_Speed (km/h)												
IDArea	Area	IDRoad	Roadtype	IDLOS	Traffic condition	Speed limit (km/h)											
						30	40	50	60	70	80	90	100	110	120	130	>130
1	Rural	10	Motorway	1	Freeflow						74	80	94	100	118	122	152
1	Rural	10	Motorway	2	Heavy						72	72	74	90	90	90	90
1	Rural	10	Motorway	3	Saturated						31	31	31	31	31	31	31
1	Rural	10	Motorway	4	Stop+go						23	23	26	26	26	26	26
1	Rural	12	Semi-Motorway	1	Freeflow						95			110			
1	Rural	12	Semi-Motorway	2	Heavy						87			101			
1	Rural	12	Semi-Motorway	3	Saturated						71			71			
1	Rural	12	Semi-Motorway	4	Stop+go						23			26			
1	Rural	20	TrunkRoad	1	Freeflow				63	68	74	80	94	100			
1	Rural	20	TrunkRoad	2	Heavy				51	50	65	72	74	90			
1	Rural	20	TrunkRoad	3	Saturated				30	31	31	31	31	31			
1	Rural	20	TrunkRoad	4	Stop+go				23	23	23	23	26	26			
1	Rural	30	Distributor	1	Freeflow				49	53	68	74	80	94			
1	Rural	30	Distributor	2	Heavy				38	40	50	65	72	74			
1	Rural	30	Distributor	3	Saturated				24	28	31	31	31	31			
1	Rural	30	Distributor	4	Stop+go				13	19	19	19	23	26			
1	Rural	31	Distributor-sinuuous	1	Freeflow				38	40	50	65	65	74			
1	Rural	31	Distributor-sinuuous	2	Heavy				38	40	50	65	65	74			
1	Rural	31	Distributor-sinuuous	3	Saturated				24	28	31	31	31	31			
1	Rural	31	Distributor-sinuuous	4	Stop+go				13	19	19	19	23	26			
1	Rural	40	Local	1	Freeflow				40	53	64	74					
1	Rural	40	Local	2	Heavy				38	40	50	65					
1	Rural	40	Local	3	Saturated				20	28	31	31					
1	Rural	40	Local	4	Stop+go				13	19	19	19					
1	Rural	41	Local-sinuuous	1	Freeflow				38	40	50	65					
1	Rural	41	Local-sinuuous	2	Heavy				38	40	50	65					
1	Rural	41	Local-sinuuous	3	Saturated				20	28	31	31					
1	Rural	41	Local-sinuuous	4	Stop+go				13	19	19	19					
1	Rural	50	Access	1	Freeflow	20	33	37									
1	Rural	50	Access	2	Heavy	20	33	37									
1	Rural	50	Access	3	Saturated	13	14	26									
1	Rural	50	Access	4	Stop+go	11	12	13									
2	Urban	10	Motorwa-Nat.	1	Freeflow						74	76	94	100	118	118	
2	Urban	10	Motorwa-Nat.	2	Heavy						72	72	74	90	90	90	
2	Urban	10	Motorwa-Nat.	3	Saturated						31	31	31	31	31	31	
2	Urban	10	Motorwa-Nat.	4	Stop+go						23	23	26	26	26	26	
2	Urban	11	Motorway-City	1	Freeflow				63	64	74	76	94	100			
2	Urban	11	Motorway-City	2	Heavy				51	50	72	72	74	90			
2	Urban	11	Motorway-City	3	Saturated				30	31	31	31	31	31			
2	Urban	11	Motorway-City	4	Stop+go				23	23	23	23	26	26			
2	Urban	20	TrunkRoad-Nat.	1	Freeflow					64	74	76	94	100			
2	Urban	20	TrunkRoad-Nat.	2	Heavy					50	65	65	74	90			
2	Urban	20	TrunkRoad-Nat.	3	Saturated					31	31	31	31	31			
2	Urban	20	TrunkRoad-Nat.	4	Stop+go					23	23	23	26	26			
2	Urban	21	TrunkRoad-City	1	Freeflow				44	63	64	74	76				
2	Urban	21	TrunkRoad-City	2	Heavy				36	51	50	65	65				
2	Urban	21	TrunkRoad-City	3	Saturated				17	30	31	31	31				
2	Urban	21	TrunkRoad-City	4	Stop+go				13	23	23	23	23				
2	Urban	30	Distributor	1	Freeflow				45	53	64	74					
2	Urban	30	Distributor	2	Heavy				38	40	50	65					
2	Urban	30	Distributor	3	Saturated				24	28	31	31					
2	Urban	30	Distributor	4	Stop+go				13	19	19	19					
2	Urban	40	Local	1	Freeflow				40	53							
2	Urban	40	Local	2	Heavy				38	40							
2	Urban	40	Local	3	Saturated				20	28							
2	Urban	40	Local	4	Stop+go				13	19							
2	Urban	50	Access	1	Freeflow	20	33	37									
2	Urban	50	Access	2	Heavy	20	33	37									
2	Urban	50	Access	3	Saturated	13	14	26									
2	Urban	50	Access	4	Stop+go	11	12	13									

A9.2. Heavy duty vehicles

Heavy-duty vehicles / Trucks														Average_Speed (km/h)			
						Speed limit (km/h)											
IDArea	Area	IDRoad	Roadtype	IDLOS	Traffic condition	30	40	50	60	70	80	90	100	110	120	130	>130
1	Rural	10	Motorway	1	Freeflow						80	80	80	86	86	86	86
1	Rural	10	Motorway	2	Heavy						75	75	75	80	80	80	80
1	Rural	10	Motorway	3	Saturated						50	50	50	50	50	50	50
1	Rural	10	Motorway	4	Stop+go						8	8	8	8	8	8	8
1	Rural	12	Semi-Motorway	1	Freeflow							80		86			
1	Rural	12	Semi-Motorway	2	Heavy							75		80			
1	Rural	12	Semi-Motorway	3	Saturated							50		50			
1	Rural	12	Semi-Motorway	4	Stop+go							8		8			
1	Rural	20	TrunkRoad	1	Freeflow				56	65	75	75	75	75			
1	Rural	20	TrunkRoad	2	Heavy				48	59	66	66	66	66			
1	Rural	20	TrunkRoad	3	Saturated				30	29	46	46	46	46			
1	Rural	20	TrunkRoad	4	Stop+go				8	8	8	8	8	8			
1	Rural	30	Distributor	1	Freeflow			40	48	59	70	70	70				
1	Rural	30	Distributor	2	Heavy			33	43	55	66	66	66				
1	Rural	30	Distributor	3	Saturated			27	30	29	39	39	39				
1	Rural	30	Distributor	4	Stop+go			8	8	8	8	8	8				
1	Rural	31	Distributor-sinuuous	1	Freeflow			34	42	56	65	65	65				
1	Rural	31	Distributor-sinuuous	2	Heavy			30	39	49	60	60	60				
1	Rural	31	Distributor-sinuuous	3	Saturated			20	22	22	34	34	34				
1	Rural	31	Distributor-sinuuous	4	Stop+go			8	8	8	8	8	8				
1	Rural	40	Local	1	Freeflow			34	42	56	65						
1	Rural	40	Local	2	Heavy			31	39	51	60						
1	Rural	40	Local	3	Saturated			22	25	25	34						
1	Rural	40	Local	4	Stop+go			8	8	8	8						
1	Rural	41	Local-sinuuous	1	Freeflow			30	40	49	59						
1	Rural	41	Local-sinuuous	2	Heavy			27	33	45	56						
1	Rural	41	Local-sinuuous	3	Saturated			21	22	22	27						
1	Rural	41	Local-sinuuous	4	Stop+go			8	8	8	8						
1	Rural	50	Access	1	Freeflow	26	32	39									
1	Rural	50	Access	2	Heavy	20	25	29									
1	Rural	50	Access	3	Saturated	20	25	29									
1	Rural	50	Access	4	Stop+go	8	8	8									
2	Urban	10	Motorwa-Nat.	1	Freeflow						75	75	75	75	75	75	
2	Urban	10	Motorwa-Nat.	2	Heavy						66	66	66	66	66	66	
2	Urban	10	Motorwa-Nat.	3	Saturated						45	45	45	45	45	45	
2	Urban	10	Motorwa-Nat.	4	Stop+go						8	8	8	8	8	8	
2	Urban	11	Motorway-City	1	Freeflow				54	66	75	75	75	75			
2	Urban	11	Motorway-City	2	Heavy				49	60	66	66	66	66			
2	Urban	11	Motorway-City	3	Saturated				31	29	45	45	45	45			
2	Urban	11	Motorway-City	4	Stop+go				8	8	8	8	8	8			
2	Urban	20	TrunkRoad-Nat.	1	Freeflow					56	65	65	65	75			
2	Urban	20	TrunkRoad-Nat.	2	Heavy					50	60	60	60	66			
2	Urban	20	TrunkRoad-Nat.	3	Saturated					22	35	35	35	46			
2	Urban	20	TrunkRoad-Nat.	4	Stop+go					8	8	8	8	8			
2	Urban	21	TrunkRoad-City	1	Freeflow			35	43	56	65	65					
2	Urban	21	TrunkRoad-City	2	Heavy			29	41	50	60	60					
2	Urban	21	TrunkRoad-City	3	Saturated			17	22	22	35	35					
2	Urban	21	TrunkRoad-City	4	Stop+go			8	8	8	8	8					
2	Urban	30	Distributor	1	Freeflow			33	40	48	59						
2	Urban	30	Distributor	2	Heavy			26	36	45	55						
2	Urban	30	Distributor	3	Saturated			17	22	22	27						
2	Urban	30	Distributor	4	Stop+go			8	8	8	8						
2	Urban	40	Local	1	Freeflow			30	42								
2	Urban	40	Local	2	Heavy			22	39								
2	Urban	40	Local	3	Saturated			17	25								
2	Urban	40	Local	4	Stop+go			8	8								
2	Urban	50	Access	1	Freeflow	26	32	39									
2	Urban	50	Access	2	Heavy	20	25	29									
2	Urban	50	Access	3	Saturated	20	25	29									
2	Urban	50	Access	4	Stop+go	8	8	8									

A9.3. Busses

Busses																		Average_Speed (km/h)				
						Speed limit (km/h)																
IDArea	Area	IDRoad	Roadtype	IDLOS	Traffic condition	30	40	50	60	70	80	90	100	110	120	130	>130					
1	Rural	10	Motorway	1	Freeflow																	
1	Rural	10	Motorway	2	Heavy																	
1	Rural	10	Motorway	3	Saturated																	
1	Rural	10	Motorway	4	Stop+go																	
1	Rural	12	Semi-Motorway	1	Freeflow																	
1	Rural	12	Semi-Motorway	2	Heavy																	
1	Rural	12	Semi-Motorway	3	Saturated																	
1	Rural	12	Semi-Motorway	4	Stop+go																	
1	Rural	20	TrunkRoad	1	Freeflow				56	65	75	75	75	75								
1	Rural	20	TrunkRoad	2	Heavy				48	59	66	66	66	66								
1	Rural	20	TrunkRoad	3	Saturated				30	29	46	46	46	46								
1	Rural	20	TrunkRoad	4	Stop+go				8	8	8	8	8	8								
1	Rural	30	Distributor	1	Freeflow			40	48	59	70	70	70									
1	Rural	30	Distributor	2	Heavy			33	43	55	66	66	66									
1	Rural	30	Distributor	3	Saturated			27	30	29	39	39	39									
1	Rural	30	Distributor	4	Stop+go			8	8	8	8	8	8									
1	Rural	31	Distributor-sinuuous	1	Freeflow			34	42	56	65	65	65									
1	Rural	31	Distributor-sinuuous	2	Heavy			30	39	49	60	60	60									
1	Rural	31	Distributor-sinuuous	3	Saturated			20	22	22	34	34	34									
1	Rural	31	Distributor-sinuuous	4	Stop+go			8	8	8	8	8	8									
1	Rural	40	Local	1	Freeflow			34	42	56	65											
1	Rural	40	Local	2	Heavy			31	39	51	60											
1	Rural	40	Local	3	Saturated			22	25	25	34											
1	Rural	40	Local	4	Stop+go			8	8	8	8											
1	Rural	41	Local-sinuuous	1	Freeflow			30	40	49	59											
1	Rural	41	Local-sinuuous	2	Heavy			27	33	45	56											
1	Rural	41	Local-sinuuous	3	Saturated			21	22	22	27											
1	Rural	41	Local-sinuuous	4	Stop+go			8	8	8	8											
1	Rural	50	Access	1	Freeflow	26	32	39														
1	Rural	50	Access	2	Heavy	20	25	29														
1	Rural	50	Access	3	Saturated	17	17	17														
1	Rural	50	Access	4	Stop+go	8	8	8														
2	Urban	10	Motorwa-Nat.	1	Freeflow																	
2	Urban	10	Motorwa-Nat.	2	Heavy																	
2	Urban	10	Motorwa-Nat.	3	Saturated																	
2	Urban	10	Motorwa-Nat.	4	Stop+go																	
2	Urban	11	Motorway-City	1	Freeflow																	
2	Urban	11	Motorway-City	2	Heavy																	
2	Urban	11	Motorway-City	3	Saturated																	
2	Urban	11	Motorway-City	4	Stop+go																	
2	Urban	20	TrunkRoad-Nat.	1	Freeflow					56	65	65	65	65								
2	Urban	20	TrunkRoad-Nat.	2	Heavy					50	60	60	60	60								
2	Urban	20	TrunkRoad-Nat.	3	Saturated					22	35	35	35	35								
2	Urban	20	TrunkRoad-Nat.	4	Stop+go					8	8	8	8	8								
2	Urban	21	TrunkRoad-City	1	Freeflow				35	43	56	65	65									
2	Urban	21	TrunkRoad-City	2	Heavy				29	41	50	60	60									
2	Urban	21	TrunkRoad-City	3	Saturated				17	22	22	35	35									
2	Urban	21	TrunkRoad-City	4	Stop+go				8	8	8	8	8									
2	Urban	30	Distributor	1	Freeflow				33	40	48	59										
2	Urban	30	Distributor	2	Heavy				26	36	45	55										
2	Urban	30	Distributor	3	Saturated				17	22	22	27										
2	Urban	30	Distributor	4	Stop+go				8	8	8	8										
2	Urban	40	Local	1	Freeflow				30	40												
2	Urban	40	Local	2	Heavy				22	36												
2	Urban	40	Local	3	Saturated				17	22												
2	Urban	40	Local	4	Stop+go				8	8												
2	Urban	50	Access	1	Freeflow	26	32	39														
2	Urban	50	Access	2	Heavy	20	25	29														
2	Urban	50	Access	3	Saturated	17	17	17														
2	Urban	50	Access	4	Stop+go	8	8	8														

A9.4. Motorcycles

Motorcycles											Average_Speed (km/h)								
						Speed limit (km/h)													
IDArea	Area	IDRoad	Roadtype	IDLOS	Traffic condition	30	40	50	60	70	80	90	100	110	120	130	>130		
1	Rural	10	Motorway	1	Freeflow						89	99	109	119	129	130	130		
1	Rural	10	Motorway	2	Heavy						84	89	99	109	119	126	126		
1	Rural	10	Motorway	3	Saturated						59	69	79	79	79	79	79		
1	Rural	10	Motorway	4	Stop+go						16	16	16	16	16	16	16		
1	Rural	12	Semi-Motorway	1	Freeflow							99		119					
1	Rural	12	Semi-Motorway	2	Heavy							89		109					
1	Rural	12	Semi-Motorway	3	Saturated							69		79					
1	Rural	12	Semi-Motorway	4	Stop+go							16		16					
1	Rural	20	TrunkRoad	1	Freeflow				66	75	85	97	107	117					
1	Rural	20	TrunkRoad	2	Heavy				57	70	74	84	94	104					
1	Rural	20	TrunkRoad	3	Saturated				39	46	60	68	69	79					
1	Rural	20	TrunkRoad	4	Stop+go				16	16	16	16	16	16					
1	Rural	30	Distributor	1	Freeflow			52	62	72	82	92	102						
1	Rural	30	Distributor	2	Heavy			46	56	66	76	86	96						
1	Rural	30	Distributor	3	Saturated			37	42	42	51	61	71						
1	Rural	30	Distributor	4	Stop+go			15	15	15	15	15	15						
1	Rural	31	Distributor-sinuuous	1	Freeflow			45	55	65	75	85	95						
1	Rural	31	Distributor-sinuuous	2	Heavy			40	49	58	69	89	99						
1	Rural	31	Distributor-sinuuous	3	Saturated			31	31	39	47	57	67						
1	Rural	31	Distributor-sinuuous	4	Stop+go			15	15	15	15	15	15						
1	Rural	40	Local	1	Freeflow			52	62	72	82								
1	Rural	40	Local	2	Heavy			46	56	66	76								
1	Rural	40	Local	3	Saturated			37	42	42	51								
1	Rural	40	Local	4	Stop+go			15	15	15	15								
1	Rural	41	Local-sinuuous	1	Freeflow			45	55	65	75								
1	Rural	41	Local-sinuuous	2	Heavy			40	49	58	69								
1	Rural	41	Local-sinuuous	3	Saturated			31	31	39	47								
1	Rural	41	Local-sinuuous	4	Stop+go			15	15	15	15								
1	Rural	50	Access	1	Freeflow	42	43	45											
1	Rural	50	Access	2	Heavy	34	36	37											
1	Rural	50	Access	3	Saturated	24	24	24											
1	Rural	50	Access	4	Stop+go	16	16	16											
2	Urban	10	Motorwa-Nat.	1	Freeflow						86	96	106	116	126	130			
2	Urban	10	Motorwa-Nat.	2	Heavy						77	87	97	107	116	124			
2	Urban	10	Motorwa-Nat.	3	Saturated						59	69	79	79	79	79			
2	Urban	10	Motorwa-Nat.	4	Stop+go						15	15	15	15	15	15			
2	Urban	11	Motorway-City	1	Freeflow				69	83	86	96	106	116					
2	Urban	11	Motorway-City	2	Heavy				64	74	77	87	97	107					
2	Urban	11	Motorway-City	3	Saturated				50	50	59	69	79	79					
2	Urban	11	Motorway-City	4	Stop+go				15	15	15	15	15	15					
2	Urban	20	TrunkRoad-Nat.	1	Freeflow					69	83	94	104	117					
2	Urban	20	TrunkRoad-Nat.	2	Heavy					64	74	84	93	104					
2	Urban	20	TrunkRoad-Nat.	3	Saturated					50	50	60	70	79					
2	Urban	20	TrunkRoad-Nat.	4	Stop+go					15	15	15	15	16					
2	Urban	21	TrunkRoad-City	1	Freeflow			55	65	75	83	94							
2	Urban	21	TrunkRoad-City	2	Heavy			47	56	66	74	84							
2	Urban	21	TrunkRoad-City	3	Saturated			32	35	42	50	60							
2	Urban	21	TrunkRoad-City	4	Stop+go			16	16	16	15	15							
2	Urban	30	Distributor	1	Freeflow			46	55	65	75								
2	Urban	30	Distributor	2	Heavy			37	47	56	66								
2	Urban	30	Distributor	3	Saturated			29	32	35	42								
2	Urban	30	Distributor	4	Stop+go			16	16	16	16								
2	Urban	40	Local	1	Freeflow			45	55										
2	Urban	40	Local	2	Heavy			37	47										
2	Urban	40	Local	3	Saturated			24	32										
2	Urban	40	Local	4	Stop+go			16	16										
2	Urban	50	Access	1	Freeflow	35	42	49											
2	Urban	50	Access	2	Heavy	28	34	41											
2	Urban	50	Access	3	Saturated	24	24	24											
2	Urban	50	Access	4	Stop+go	16	16	16											

Annex 10. Coefficients for the emission computation

								Reference test patterns																
ID	SpeedCurve	Name of the curve (shortened here)	Area	Road Category	Speed limit (km/h)	Gradient, sinuosity	Traffic condition	Identification	Number of coefficients	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
										Urban, Dense	Urban, Congested, low speeds	Urban, Congested, stops	Urban, Free-flowing	Urban, Free-flow, unsteady	Rural, Low speed	Urban, Stop&go	Rural, Main roads	Rural, Steady	Rural, Main roads, unsteady	Rural, Unsteady	Motorway, High speed	Motorway,	Motorway, Unsteady	Motorway, Stable
40	rural5-SL130-Free.d	Rural	Nat./reg. motorway	130	Flat	Free-flow	110131	1														1,00		
87	rural5-SL999-Free.T	Rural	Nat./reg. motorway	150	Flat	Free-flow	110141	1													1,00			
88	rural5-SL999-Free.T	Rural	Nat./reg. motorway	150	Flat	Free-flow	110141	1													1,00			
89	rural5-SL999-Free.T	Rural	Nat./reg. motorway	150	Flat	Free-flow	110141	1													1,00			
84	rural5s-SL90-Free.Si	Rural	Semi-motorway	90	Flat	Free-flow	112091	1									1,00							
75	rural5s-SL90-Heavy	Rural	Semi-motorway	90	Flat	Heavy traffic	112092	2									0,84			0,16				
77	rural5s-SL90-Saturat	Rural	Semi-motorway	90	Flat	Saturated	112093	2									0,68			0,32				
74	rural5s-SL110-Free.S	Rural	Semi-motorway	110	Flat	Free-flow	112111	1																1,00
67	rural5s-SL110-Heavy	Rural	Semi-motorway	110	Flat	Heavy traffic	112112	3											0,11	0,11				0,79
68	rural5s-SL110-Satur	Rural	Semi-motorway	110	Flat	Saturated	112113	4									0,18		0,19				0,27	0,37
43	rural4-SL70-Free.def	Rural	Nat./reg. trunk road	70	Flat	Free-flow	120071	1										1,00						
41	rural4-SL90-Free.def	Rural	Nat./reg. trunk road	90	Flat	Free-flow	120091	2									0,75			0,25				
51	rural4-SL90-H-Free.s	Rural	Nat./reg. trunk road	90	Hilly	Free-flow	120091	2											0,34	0,66				
52	rural4-SL90-H-Free.s	Rural	Nat./reg. trunk road	90	Hilly	Free-flow	120091	2										0,25		0,75				
42	rural4-SL90-H-Free.d	Rural	Nat./reg. trunk road	90	Hilly	Free-flow	120091	2									0,60			0,40				
46	rural3-SL50-Free.def	Rural	Distributor	50	Flat	Free-flow	130051	1							1,00									
45	rural3-SL70-M-Free.d	Rural	Distributor	70	Mountain	Free-flow	130071	2										0,20		0,80				
53	rural3-SL90-M-Free.s	Rural	Distributor	90	Mountain	Free-flow	130091	2						0,42						0,58				
54	rural3-SL90-M-Free.s	Rural	Distributor	90	Mountain	Free-flow	130091	2						0,39						0,61				
55	rural3-SL90-M-Free.s	Rural	Distributor	90	Mountain	Free-flow	130091	1												1,00				
56	rural3-SL90-M-Free.s	Rural	Distributor	90	Mountain	Free-flow	130091	2						0,17						0,83				
44	rural3-SL90-M-Free.d	Rural	Distributor	90	Mountain	Free-flow	130091	1								1,00								
57	rural3-SL90-70-50-M	Rural	Distributor	90	Mountain	Free-flow	130091	2										0,18		0,82				
58	rural3-SL90-70-50-M	Rural	Distributor	90	Mountain	Free-flow	130091	2										0,78		0,22				
59	rural3-SL90-70-50-M	Rural	Distributor	90	Mountain	Free-flow	130091	2							0,42					0,58				
60	rural3-SL90-70-50-M	Rural	Distributor	90	Mountain	Free-flow	130091	2										0,13		0,87				
2	urban5a-SL110-Free	Urban	Nat./reg. motorway	110	Flat	Free-flow	210111	3									0,17		0,12					0,72
3	urban5a-SL110-Hea	Urban	Nat./reg. motorway	110	Flat	Heavy traffic	210112	2									0,52		0,48					
4	urban5a-SL110-Stop	Urban	Nat./reg. motorway	110	Flat	Stop and go	210114	3	0,25	0,37		0,38												
1	urban5a-SL130-Free	Urban	Nat./reg. motorway	130	Flat	Free-flow	210131	2													0,32			0,68
8	urban4a-SL80-Heavy	Urban	Urban motorway	80	Flat	Heavy traffic	211082	1										1,00						
7	urban4a-SL90-Free.d	Urban	Urban motorway	90	Flat	Free-flow	211091	2									0,47			0,53				
5	urban4a-SL100-Free	Urban	Urban motorway	100	Flat	Free-flow	211101	4									0,55		0,21	0,11				0,13
6	urban4a-SL100-Hea	Urban	Urban motorway	100	Flat	Heavy traffic	211102	3									0,23		0,50	0,27				

ID	SpeedCurve	Name of the curve (shortened here)	Area	Road Category	Speed limit (km/h)	Gradient, sinuosity	Traffic condition	Identification	Reference test patterns															
									Number of coefficients	Urban, Dense	Urban, Congested, low speeds	Urban, Congested, stops	Urban, Free-flowing	Urban, Free-flow, unsteady	Rural, Low speed	Urban, Stop&go	Rural, Main roads	Rural, Steady	Rural, Main roads, unsteady	Rural, Unsteady	Motorway, High speed	Motorway,	Motorway, Unsteady	Motorway, Stable
16	urban4b-SL50-Free	Urban	City primary road	50	Flat	Free-flow	221051	1						1,00										
17	urban4b-SL50-Heavy	Urban	City primary road	50	Flat	Heavy traffic	221052	3	0,15					0,66						0,20				
18	urban4b-SL50-Satur	Urban	City primary road	50	Flat	Saturated	221053	3	0,38	0,35						0,28								
19	urban4b-SL50-Stop	Urban	City primary road	50	Flat	Stop and go	221054	3	0,44		0,11					0,45								
12	urban4b-SL60-Free	Urban	City primary road	60	Flat	Free-flow	221061	1									1,00							
13	urban4b-SL60-Heavy	Urban	City primary road	60	Flat	Heavy traffic	221062	2						0,25						0,75				
14	urban4b-SL60-Satur	Urban	City primary road	60	Flat	Saturated	221063	2					0,47	0,53										
15	urban4b-SL60-Stop	Urban	City primary road	60	Flat	Stop and go	221064	2		0,18			0,82											
9	urban4b-SL80-Free	Urban	City primary road	80	Flat	Free-flow	221081	3									0,64		0,14	0,22				
10	urban4b-SL80-Heavy	Urban	City primary road	80	Flat	Heavy traffic	221082	2						0,14						0,86				
11	urban4b-SL80-Stop	Urban	City primary road	80	Flat	Stop and go	221084	2					0,22			0,78								
28	urban3-SL50-Free	Urban	Districts distributor	50	Flat	Free-flow	230051	2						0,26	0,74									
29	urban3-SL50-Heavy	Urban	Districts distributor	50	Flat	Heavy traffic	230052	2						0,32	0,68									
30	urban3-SL50-Satur	Urban	Districts distributor	50	Flat	Saturated	230053	3	0,45		0,17			0,38										
31	urban3-SL50-Stop	Urban	Districts distributor	50	Flat	Stop and go	230054	2	0,71		0,29													
24	urban3-SL60-Free	Urban	Districts distributor	60	Flat	Free-flow	230061	2						0,26						0,74				
25	urban3-SL60-Heavy	Urban	Districts distributor	60	Flat	Heavy traffic	230062	2						0,37	0,64									
26	urban3-SL60-Satur	Urban	Districts distributor	60	Flat	Saturated	230063	2	0,33					0,68										
27	urban3-SL60-Stop	Urban	Districts distributor	60	Flat	Stop and go	230064	2	0,89		0,11													
20	urban3-SL70-Free	Urban	Districts distributor	70	Flat	Free-flow	230071	2										0,70		0,30				
21	urban3-SL70-Heavy	Urban	Districts distributor	70	Flat	Heavy traffic	230072	2										0,19		0,82				
22	urban3-SL70-Satur	Urban	Districts distributor	70	Flat	Saturated	230073	2	0,51					0,49										
23	urban3-SL70-Stop	Urban	Districts distributor	70	Flat	Stop and go	230074	2	0,29		0,71													
32	urban2-SL50-Free	Urban	Local distributor	50	Flat	Free-flow	240051	2						0,79	0,21									
47	urban2-SL50-Satur	Urban	Local distributor	50	Flat	Saturated	240053	2	0,88				0,12											
33	urban2-SL50-Stop	Urban	Local distributor	50	Flat	Stop and go	240054	2	0,27		0,73													
38	urban1-SL30-Free	Urban	Local access	30	Flat	Free-flow	250031	2			0,43		0,57											
50	urban1-SL30-Satur	Urban	Local access	30	Flat	Saturated	250033	2	0,25	0,75														
39	urban1-SL30-Stop	Urban	Local access	30	Flat	Stop and go	250034	2	0,57	0,43														
36	urban1-SL40-Free	Urban	Local access	40	Flat	Free-flow	250041	2						0,44	0,57									
49	urban1-SL40-Satur	Urban	Local access	40	Flat	Saturated	250043	2	0,25		0,75													
37	urban1-SL40-Stop	Urban	Local access	40	Flat	Stop and go	250044	2	0,46		0,55													
34	urban1-SL50-Free	Urban	Local access	50	Flat	Free-flow	250051	3					0,26	0,55	0,19									
48	urban1-SL50-Satur	Urban	Local access	50	Flat	Saturated	250053	1					1,00											
35	urban1-SL50-Stop	Urban	Local access	50	Flat	Stop and go	250054	2			0,82					0,18								

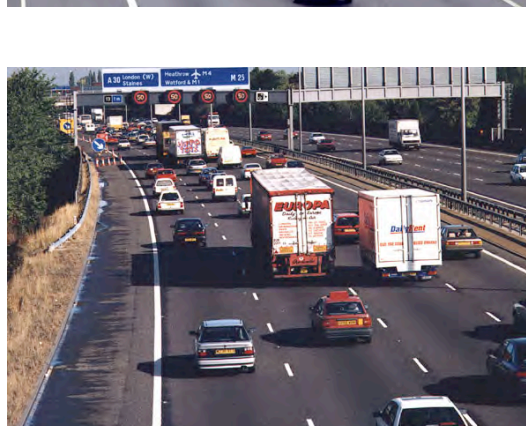
ID	SpeedCurve	Name of the curve (shortened here)	Area	Road Category	Speed limit (km/h)	Gradient, sinuosity	Traffic condition	Identification	Reference test patterns															
									Number of coefficients	Urban, Dense	Urban, Congested, low speeds	Urban, Congested, stops	Urban, Free-flowing	Urban, Free-flow, unsteady	Rural, Low speed	Urban, Stop&go	Rural, Main roads	Rural, Steady	Rural, Main roads, unsteady	Rural, Unsteady	Motorway, High speed	Motorway,	Motorway, Unsteady	Motorway, Stable
1002	TS_Artemis.urban	Urban	Districts distributor	50	Flat	Heavy traffic	#####	1	1,00															
1003	TS_Artemis.urban_1	Urban	Districts distributor	50	Flat	Saturated	#####	2	0,83	0,18														
1004	TS_Artemis.urban_2	Urban	Districts distributor	50	Flat	Saturated	#####	1						1,00										
1005	TS_Artemis.urban_3	Urban	Districts distributor	50	Flat	Stop and go	#####	1				1,00												
1006	TS_Artemis.urban_4	Urban	Districts distributor	50	Flat	Stop and go	#####	1		1,00														
1007	TS_Artemis.urban_5	Urban	Districts distributor	50	Flat	Heavy traffic	#####	1					1,00											
1009	TS_Artemis.road	Rural	Distributor	90	Flat	Heavy traffic	#####	1											1,00					
1010	TS_Artemis.road_1	Rural	Distributor	90	Flat	Heavy traffic	#####	1											1,00					
1011	TS_Artemis.road_2	Rural	Distributor	90	Flat	Heavy traffic	#####	1										1,00						
1012	TS_Artemis.road_3	Rural	Distributor	90	Flat	Heavy traffic	#####	1						1,00										
1013	TS_Artemis.road_4	Rural	Distributor	90	Flat	Heavy traffic	#####	1											1,00					
1014	TS_Artemis.road_5	Rural	Nat./reg. trunk road	90	Flat	Heavy traffic	#####	1								1,00								
1016	TS_Artemis.motorwa	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#####	2												0,66	0,34			
1017	TS_Artemis.motorwa	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#####	1													1,00			
1018	TS_Artemis.motorwa	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#####	1														1,00		
1019	TS_Artemis.motorwa	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#####	1												1,00				
1020	TS_Artemis.motorwa	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#####	1												1,00				
1022	TS_Artemis.motorwa	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#####	1													1,00			
1023	TS_Artemis.motorwa	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#####	2													0,86			0,14
1024	TS_Artemis.motorwa	Rural	Nat./reg. motorway	130	Flat	Heavy traffic	#####	4												0,15	0,39	0,19	0,27	

Annex 11. Illustrative photographs

Rural 5: National / regional motorway



Motorway (2x3)

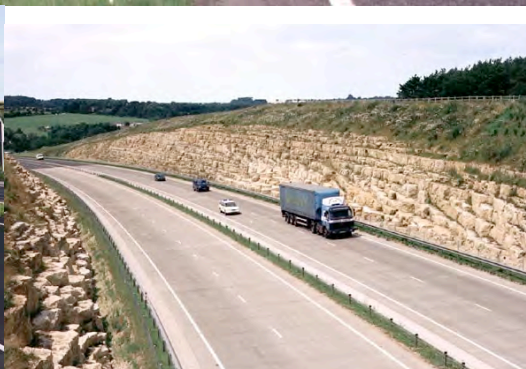


Motorway (2x4)
(can be also Urban
5a: National /
regional motorway
in an urban area,
strategic network)

Rural 4: National / regional trunk road



2x1 A-road



2x2 trunk road



Rural 3: Distributor, inter-village road



Rural minor road
(2x1)

Rural 2: Local distributor, through-village road



(2x1) road

Rural 1: Access road



Rural minor road
(1x1)

Urban 5a: National / regional motorway in an urban area (strategic network)



Speed limit:
110 to 130 km/h
2*3 lanes
Grade separated
junctions,
Grade separated
road ways ,
Street lighting,
Capacity around
2000 vehicles per
lane per hour.



Speed limit:
110 to 130 km/h
2*2 lanes
Grade separated
junctions,
Grade separated
road ways
No lighting
Capacity around
1800 vehicles per
lane per hour



Motorway (2x4)
(can be also Rural
5:National /
regional motorway
in an urban area,
strategic network)

Urban 5b: National/regional trunk road (strategic network)



N74, Belgium

Urban 4a: Urban motorway (city scale network)



Speed limit:
90 to 110 km/h
2*5 lanes (left)
2*2 lanes (right)
Grade separated
junctions,
Grade separated
road ways with
trees
Street lighting
Capacity around
1800 vehicles per
lane per hour



4a (could be also
5a National /
regional motorway
through an urban
area)



(Rural/urban)
motorway (2x2
with bus lane) – It
is a motorway M6
in the approach of
London

Urban 4b: City primary road, major arterial (city scale network)



Speed limit:
90 to 110 km/h
2*2 lanes
Junction not
grade-separated,
Grade-separated
road ways
Street lighting
Capacity around
1500 vehicles per
lane per hour



4b – trunk road



4b urban trunk
road, major arterial

(Left: could be
also an Urban 3
road category)



Other illustrations

Urban 3: District distributor, inter-district road



Speed limit:
50 km/h
2*2 lanes (left)
2*1 lanes (right)
Grade separated
road ways
Sidewalks
Parking area on
road side
Capacity around
800 vehicles per
lane per hour



Speed limit:
50 to 70 km/h
2*2 lanes
Sidewalk
Grade separated
road ways (right)
No parking
Capacity around
1000 vehicles per
lane per hour



Speed limit:
50 km/h
1*2 lanes in one
way
Sidewalks
Parking area on
road side
Specific cycles
lane
Bus lane
Capacity around
800 vehicles per
lane per hour

Urban 3: District distributor, inter-district road (cont.)



Other illustrations

Urban 2: Local distributor



Speed limit:
30 to 50 km/h
Capacity maximum
600 vehicles per
hour
One way road
Parking area on
road side
Sidewalks



Speed limit:
50 km/h
Capacity maximum
in vehicles per
hour:
- Left: 800
- Right: 2000
2*1 lanes
Parking area on
road side
Sidewalks



Speed limit:
50 km/h
Capacity maximum
1600 vehicles per
hour
2*1 lanes (road
ways separated
with a mark)
Parking on road
side
Sidewalks



With traffic
calming

Urban 2: Local distributor (cont.)



in fact a trunk
road (A-road)



Other illustrations

Urban 1: Access road



Speed limit:
30 km/h
Capacity around
300 vehicles per
hour
One way road
Parking on road side
Sidewalks



Speed limit 50
km/h
Capacity around
700 vehicles per
hour
2*1 lanes
- Left: No parking
area, sidewalks,
cycles on a
specific lane
- Middle: Parking on
road side,,
sidewalks
- Right: No marks,
parking on road
side



Residential roads
(2x1)



With traffic calming

Urban 1: Access road (cont.)



Others illustrations