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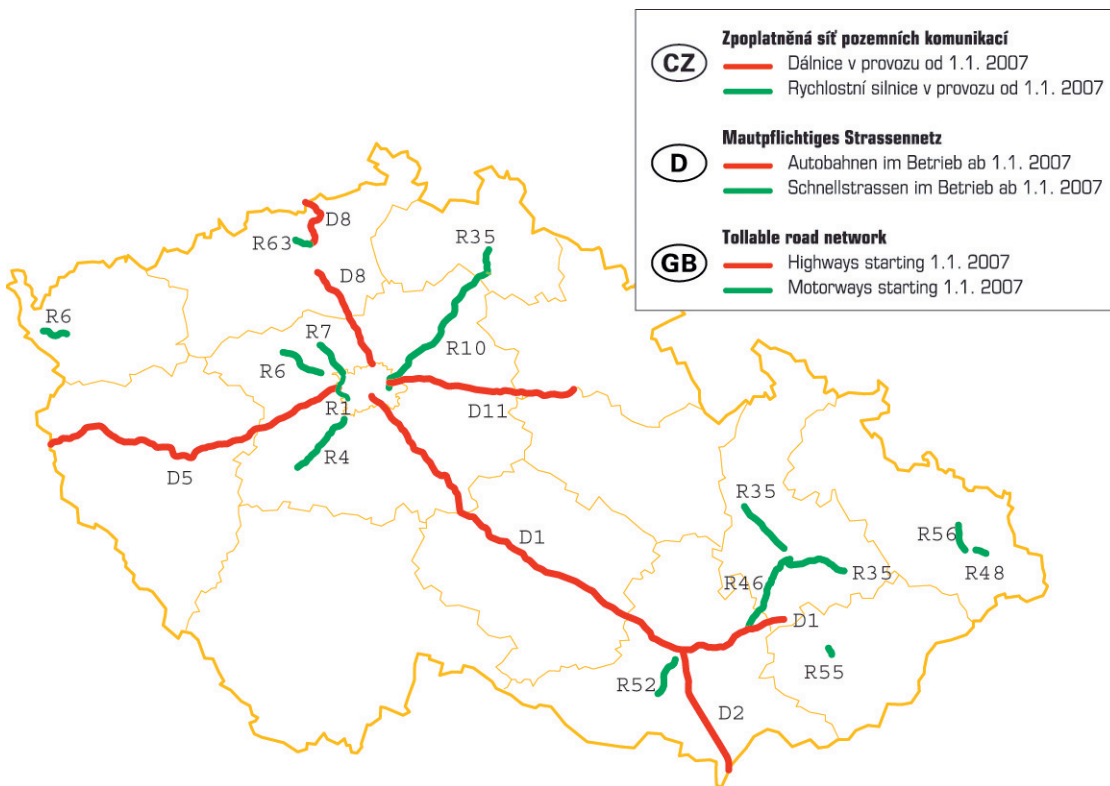
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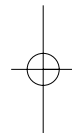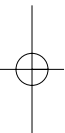
IMPRINT

Layout: Markus Frühwirth, Bohmann-Verlag
Printing Shop: AV+Astoria Druckzentrum

Cover Picture: Kapsch/Premid

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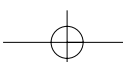
Charts for calculating toll costs for trucks in the combined shipment and less-than-truckload sector in the Czech Republic

Vienna, January 2007

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1. Background

The Czech Republic introduced a kilometre-based road toll system for heavy trucks on highways, selected motorways as well as selected first rank roads marked with "M"-design on 1st of January 2007. In principal, all vehicles with an overall weight of at least 12 tons are subject to the kilometre-based road toll system. The amount of the fee per kilometre is dependent on the number of axles and the emission standard of the vehicle.

It is planned to extend the toll road network to further medial road categories subject to lower toll fee on 1st July 2007. Due to the microwave-technology employed this intention is very ambitious and so hardly foreseeable. Should these basic changes take place, the toll chart and the distance zone table will be adapted.

The relevant legal foundations for the road toll system are[1]:
- Highway Ordinance Law No 13/97 Sb
- Regulation act CR No 484/2006 Sb from 10/18/2006
- Announcement MD CR No 527/2006 Sb

The amount of the toll fees are as follows:

Number of axles (vehicle and trailer)	Emission standard EURO 0, 1, 2	Emission standard EURO 3, 4, 5, EEV
2-axles	2,30 (0,08)	1,70 (0,06)
3-axles	3,70 (0,13)	2,90 (0,10)
4-axles and more	5,40 (0,19)	4,20 (0,15)

Chart 1: Toll fees in CZK (EUR) / km, Exchange rate: CZK/EUR: 28,3417   Status: 01.01.2007

The kilometre road toll fee[2] has the character of a distance tax. For this reason it is justified to display the additional costs separately and to charge the customer with the proportionate fee. The road toll fee will lead to an increase in transportation costs by up to 20 %. Due to relatively low margins for transport services it is of vital importance for transportation companies to pass on the additional toll costs to the customer.

1 The legal documents can be seen on the homepage of the Czech toll system operator, see www.premid.cz
2 The authors avoid naming the system as "road pricing", because "road pricing" is a price differentiation including local as well as time criterions which is not given in the Czech Republic.

2. Existing toll charts for calculation

Until now the University of Pardubice (Dopravnì fakulta Jana Pernera) has published toll charts for charging customers.[3]

Besides the fact that a lot of non-cited parallels to the report by Kummer (2005) can be found in the introduction chapter, this report has some fundamental weaknesses and problematical premises:

- The premise that only vehicles with 4 and more axles are used is far from reality. Especially in the combined shipment sector, a lot of vehicles with two or three axles can be found.
- The premise that the percentage of EURO 2 vehicles amounts to 80 %, was based on a survey of 6 companies. The sample is much to low. It would be better to calculate with EURO 3 if only to promote modern and environmentally friendly vehicles.
- Despite the mention of indirect toll costs, neither these costs nor hub-surcharges or deadhead mileages were considered at all.
- The distance chart is related to overall kilometres and assumed that 75 % of the journey between two zones was on toll roads. This premise is very problematic because the real share of tolled kilometres against total kilometres travelled can fluctuate greatly. In some regions there are no toll roads, so customers should not be charged toll fees.
- Formula (4) is not correct, as variable M (weight of consignment) is part of the denominator but should instead form part of the numerator.

As a result this chart has limited use. Deficits in methodology and partly wrong assumptions reduce the quality very strongly.
The following table remedies these deficits. Average values were used for calculation. The charts are appropriate to charging customers with the correct toll costs. A comparison of toll cost values with the chart of University of Pardubice is difficult because of different classes for distance zones and weight.

3 See Cempírek, V.; Kampf, R.; Čáp, I. and Morkus, J. (without date): Rate making methodology for road goods traffic in the territory of the Czech Republic after the introduction of the electronic toll. University of Pardubice, Dopravnì fakulta Jana Pernera.
4 See Kummer (2005) Charts for calculating costs of road toll for trucks in the combined shipment and less-than-truckload sector in Germany (Tabellen zur Berechnung der Kosten der deutschen Lkw-Maut im Spediteurssammelgut- und Teilladungsverkehr), Bohmann-Verlag, Wien.

3. Costs of the road toll fee in the Czech Republic

3.1. Classification of road toll costs

The road toll fee leads to a direct and to an indirect increase in transportation costs.

Direct toll costs are costs resulting directly from the payment of the charge.
They are mainly influenced by the following factors:
- transport distance,
- transport weight,
- capacity utilization of the tolled vehicle,
- deadhead mileage and
- share of kilometres on tolled roads out of total kilometres for the vehicle.

Indirect toll costs are costs arising for logistics service providers and shippers, which are not direct toll costs but are closely related to the charging process. They can be separated as follows:
- pre-financing costs,
- costs resulting from bad debt-losses,
- administration costs (i.e. invoicing costs),
- supervisory costs for tolls
- transaction costs (one-time negotiations with customers, suppliers, permanent fees)

Direct toll costs have until now been the focus of discussions about charging in practice. Indeed, this kind of costs seems to be the predominant part of toll costs. Nevertheless companies are also faced with indirect costs which are not negligible. They have to be considered when ascertaining transportation costs and calculation of prices.

3.2. Description of toll charts

To ascertain the proportionate consignment-based toll costs in the Czech combined shipment and less-than-truckload-sector, a two-stage procedure makes sense.

The first step comprises the determination of the relevant distance zone on the basis of the distance zone table for a special destination. Ascertaining proportionate toll costs are the subject of the second step. They can be identified in the toll depending on the relevant weight or volume of the consignment.
The attached distance zone table ascertains the distance zone on the basis of the zip codes of the sender and the addressee. In total 121 zones were formed. The amount of kilometres on the tolled roads (status: 1st January 2007) between source and destination are the base for the distance zone table. The distance zone table consists of 12 distance zones (0 – 11). The lower distance zones 0 - 4 are more exact than the others. As a result local and regional transports are modelled in a more accurate way, so the calculation is fair.
The allocation of a special connection to a certain distance zone is based on the tolled distance between the economic centres of both zip codes. The determination of economic centres was supported by a geographic information system (GIS).

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The tolled distance was ascertained on the basis of the official distance table published by the Czech toll operator through an IT-supported calculation algorithm. A second, independent distance table was used for validating the distances. In this way the possibility of using the non-tolled road network was also taken into consideration. Transports with both origin and destination within the Czech Republic going through foreign countries (i.e. Poland) are admitted, if the transportation time was much shorter in comparison with pure intrastate transport within the Czech Republic. Transports within a zip code region get the distance zone 0 or 1, depending on the size of the zip zone and the length of tolled roads.

There are in some cases differences between the economic centre of zip codes regions and the location of border crossings to the neighbour countries. This fact has to be considered for international transports or transit. That is why additional columns / rows were added to the distance zone table and have to be used for transports to the border crossings. Chart 2 shows the allocation of border crossings to zip codes:

Countries	Name of border crossing	Zip code in distance table
CZ-PL	**Chotěbuz (R48)** - Cieszyn (1)	73701
CZ-PL	**Bohumín (R58)** - Chalupki (78)	70030
CZ-PL	**Sudice (R467)** - Pietraszyn (916)	74601
CZ-PL	**Krnov (R45)** - Pietrowice (38)	79201
CZ-PL	**Mikulovice (R44)** - Glucholazy (40)	79003
CZ-PL	**Dolní Lipka (R43)** - Boboszów (33)	56204
CZ-PL	**Náchod (R33)** - Kudowa Slone (8)	54701
CZ-PL	**Královec (R16)** - Lubawka (5)	54101
CZ-PL	**Harrachov (R10)** - Jakuszyce (3)	46602
CZ-SK	**Břeclav (D2)** - Brodské (D2)	SK1
CZ-SK	**Hodonín (R55)** - Holíč	69501
CZ-SK	**Strání (R54)** - Moravské Lieskové (54)	68601
CZ-SK	**Starý Hrozenkov (R50)** - Drietoma (50)	68601
CZ-SK	**Brumov-Bylnice (R57)** - Horné Srnie (57)	76005
CZ-SK	**Střelná (R49)** - Lysá pod Makytou (49)	76005
CZ-SK	**Bílá** - Bumbálka (R35) - Makov (18)	SK2
CZ-SK	**Bílá (R56)** - Klokočov (484)	SK2
CZ-SK	**Mosty u Jablunkova (R11)** - Svrčinovec	73701
CZ-AT	**Dolní Dvořiště (R3)** - Wullowitz (B310)	38101
CZ-AT	**České Velenice** - Gmünd-Böhmzeil	37701
CZ-AT	**Halámky (R24)** - Neu-Nagelberg (B2)	37701
CZ-AT	**Nová Bystřice (R128)** - Grametten (B5)	37701
CZ-AT	**Hatě (R38)** - Kleinhaugsdorf (B303)	66902
CZ-AT	**Mikulov (R52)** - Drasenhofen (B7)	AT1
CZ-DE	**Hradec nad Nisou (R35)** - Zittau (B96/99)	46005
CZ-DE	**Rumburk (R9)** - Neugersdorf	DE1
CZ-DE	**Dolni Zleb (R62)** - Schöna (B172)	40502
CZ-DE	**Krasny Les (R248/D8)** - Breitenau (A17)	DE2
CZ-DE	**Cínovec (R8)** - Zinnwald/Cinvald (B170)	41503
CZ-DE	**Hora Sv. Šebestiána (R7)** - Reitzenhain (B174)	43001
CZ-DE	**Boži Dar (R25)** - Oberwiesenthal (B95)	36004
CZ-DE	**Vojtanov (R21)** - Schönberg/Krásná hora (B92)	35002
CZ-DE	**Aš (R64)** - Selb	35002
CZ-DE	**Pomezí nad Ohří (R6)** - Schirnding (B303)	35002
CZ-DE	**Svatý Kříž (R214)** - Waldsassen/Valdsasy (B299)	35002
CZ-DE	**Broumov** - Mähring	35301
CZ-DE	**Rozvadov (D5)** - Waidhaus (A6)	DE3
CZ-DE	**Folmava (R26)** - Furth im Wald/Brod nad Lesy (B20)	34401
CZ-DE	**Železná Ruda (R27)** - Bayerisch Eisenstein (B11)	33901
CZ-DE	**Strážný (R4)** - Philippsreut (B12)	38301

Chart 2: Zip codes of important Czech border crossings

A mix of vehicles with 2 axles, 3 axles as well as 4 or more axles was assumed as a reference vehicle for determining the value in the toll charts. For calculation only vehicles with emission standard Euro 3 or higher were selected as a reference vehicle for determining the value in the toll charts. This can be justified by the fact that most vehicles covering heavy goods transport belong to this emission category now or will do in the near future. Furthermore we assume that it is neither in the interest of the freight industry nor the transportation company to employ out-dated fleets. Using older, less environmentally friendly vehicles leads to higher toll costs which cannot be covered fully by these proposed toll charts.

The exact amount of toll costs is mainly influenced by both the transport distance and the transport weight / volume. As a result these distance-weight charts or distance-volume charts can be used for finding out proportionate toll costs.

Two distance-weight charts and one distance-volume chart were developed:

Distance-weight charts:
- Toll cost chart for consignments up to 2,000 kg (combined shipment)
- Toll cost chart for consignments over 2,000 kg (less-than-truckload)

Distance-volume chart:
- Toll cost chart for consignments over 2 load metres (less-than-truckload)

The weight-based and the volume-based degree of capacity-utilization depend on factors such as the structure of the goods to be transported, consignor regulations, the kind of packaging used or the regions in question. In addition to this, capacity-utilization is subject to seasonal fluctuations. Industry-specific average values were used to calculate the chart values. The weight-based capacity-utilization for consignments up to 2,000 kg is assumed to be lower than for consignments over 2,001 kg. Capacity utilization for the combined shipment sector is calculated on the basis of a chargeable weight of 8,000 kg. The reason for the low value for capacity-utilization is the high variety of cargo in terms of size or package. The volume-based capacity-utilization is in many cases much higher than the weight-based one in the combined shipment sector.

For consignments between 2,001 kg - 11,000 kg a weight-based capacity-utilization of 12,000 kg is assumed. Consignments between 11,001 kg - 15,000 kg have a variable weight-based capacity-utilization between 12,500 kg and 14,750 kg. For consignment over 15,001 kg full capacity-utilization is presumed because full-truck load-transports are dominant for these cases.

The production system in the combined shipment sector differs from the less-than-truckload-segment. In the latter case direct transport connections between shipper and consignee are usual. Hub-and-spoke-systems are typical for the combined shipment sector. Depots are used for consolidation and hubs are needed for relations with low volumes. This results in longer routes for the same distance between shipper and consignee. Consequently the model generates a depot / hub – surcharge for consignments up to 2 tons. In the toll chart for combined shipments it can be seen that in Zone 0 for consignments under 2,000 kg proportionate toll charges are incurred, whereas toll charges are not levied on part-load consignments where no toll road is used.

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In order to smooth the transition between consignments up to 2,000 kg and those over 2,001 kg, a continuous increase of weight-based capacity-utilization between 1,500 kg - 4,500 kg (see Chart 3) is assumed.
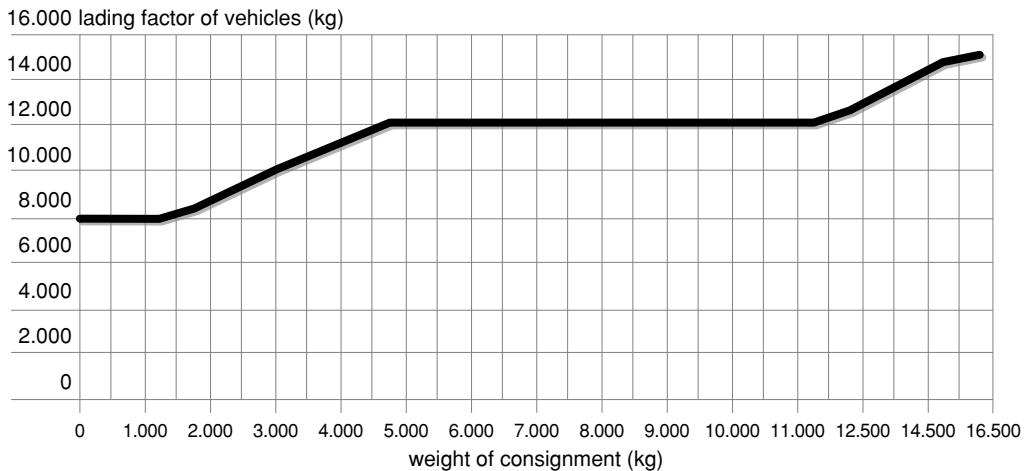

Chart 3: Progression of weight-based capacity-utilization   Status: 01.01.2007

The distance-volume-table assumes an average volume-based capacity-utilization of 10 load metres. When calculating proportional toll costs, deadhead mileages also have to be considered. It is not always possible to acquire freight for backhaul due to the lack of transport flow pairing. In the case of no return cargo, it will only be legitimate to charge the customer with the toll costs for the backhaul, if the forwarder uses all possibilities for generating return cargo without success. A wide variety of efforts on the part of forwarders to reduce deadhead mileages (i.e. establishing cooperations with other forwarders) leads to a relatively low degree of deadhead mileages. The driven deadhead mileages increase subproportionally with higher distances.

That is why a deadhead mileage multiple is used dependent on the distance (see Chart 4).
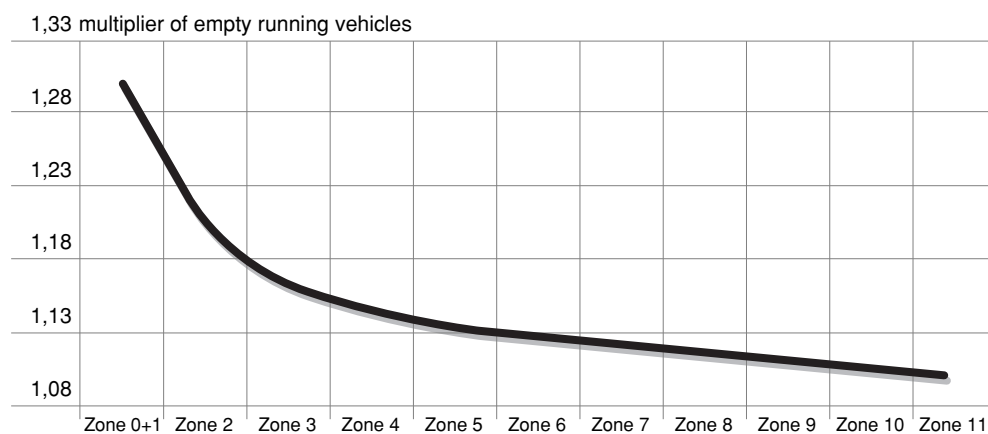

Chart 4: Multiplier of empty running vehicles   Status: 01.01.2007

3.3. Estimation of indirect costs

In the following we discuss an estimation concerning the amount of indirect costs in the Czech Republic, since real experience is not yet available.

3.3.1. Pre-financing costs

To be able to charge tolls it is necessary to configure vehicles with on-board units called Premid. The fee is booked automatically when a toll bridge is passed. In general, the user can select from two kinds of booking procedures, pre-pay procedure or post-pay variant. The pre-pay variant demands payment before using the tolled road. When driving on the tolled road, the toll fee is debited continuously. In the post-pay variant, payment occurs at regular intervals after driving on the tolled road. The charging period is 15 or alternatively 30 days and the date of payment is 15, 30 or 60 days.

It can be assumed that forwarders prefer the post-pay variant because of the shorter pre-financing period. In the toll charts a value of 1% of the toll fee is set for pre-financing costs.

3.3.2. Costs for bad debt-losses

The toll fee represents a claim against the shipper – in the same way that the transportation company / forwarder's fee does. However, Premid has a claim against the registered owner of the vehicle and not against the shipper. In the case that the transportation company / forwarder's claims against the shipper cannot be collected, additional costs will arise. These costs depend on the average loss rate. If an insurance policy is taken out to protect against bad debts, additional costs in terms of the insurance premium have to be borne. Furthermore additional administration processes are necessary, for example notifying the insurance company about losses resulting from bad debts. The average loss rate is listed as 0.3 % in the toll charts.

3.3.3. Costs for administration

Toll fees lead to additional costs for administration. They include invoicing costs to the shipper, where a separate disclosure of proportionate toll costs is required. In particular an accurate assessment of toll costs is not negligible in the combined shipment sector.

3.3.4. Costs for toll-controlling

Supervising invoices (in the form of a detailed report) from the toll system operator makes sense. Especially in the initial phase, the system will be vulnerable to teething troubles which could lead to anomalous amounts being invoiced.

Basically three kinds of failures could occur:

- Double bookings

Double bookings may arise because of technology-based registration failures (i.e. traffic jams).

- Incorrect booking

Incorrect booking includes cases of invoices with an anomalous invoice amount which were not caused by twice bookings. Examples are false axle categories or wrong emission standards for the tolled vehicle.

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- Missing booking

A missing booking occurs in cases in which there is no booking even though the tolled road was used. Causes could lie in defect on-board units.

Supervising booking procedures without adequate software support is only possible with a great deal of time and effort due to the huge number of bookings.

3.3.5. Transaction costs

The new toll system requires a lot of information. It is necessary for users to negotiate with customers or suppliers (i.e. software companies). Many of these transaction costs occur only once. In addition to this transaction costs are difficult to measure. Charging customers directly with transaction costs is unusual. For these reasons transaction costs were not calculated.

3.3.6. Total indirect toll costs

Breaking the above discussed indirect costs components down into consignment-based and kilometre-based cost components makes sense for activity-based cost considerations. The average consignment-based cost components were calculated and were included in the toll charts as kilometre- and weight-independent fixed costs. They amount CKZ 1.96 per consignment (exception: less-than-truckload without tolled routes). The kilometre- and weight-dependent indirect costs were assigned with a rate of 5.8 % of direct toll costs.

4. Using toll cost charts (with examples)

Using the toll tables for calculating proportionate toll costs requires a two-step procedure. Necessary input variables from the user-side are the consignment's chargeable weight or the respective number of load meters as well the sender and destination zip codes.

The first step comprises the determination of the correct distance zone for the consignment in the distance zone table. The zip code zones are shown in the first column and first row of the distance zone table.
The distance zone is needed for the toll cost chart used in the second step. The appropriate chargeable weight or load meter respectively in the column and the distance zone in the row must be selected for the consignment in the relevant distance-weight charts or distance-volume chart. Then the specific toll costs for the consignment can be read from the relevant toll cost chart.

Example 1:
A consignment with a chargeable weight of 1,250 kg needs to be transported from 779 00 Olomouc to 671 81 Znojmo.
At first the intersection of the rows "77000 and 78399" as well as column "66900 and 67399" has to be found (alternatively it could be found in the row "66900 and 67399" and in the column "77000 and 78399"). The result is distance zone 4. In the second step the proportionate toll costs are ascertained using the distance-weight chart up to 2,000 kg, row 1,201 kg – 1,300 kg and column zone 4. The proportionate toll costs for this consignment amounts to CZK 64.20.

Example 2
A consignment with a volume of 7.5 load meters needs to be transported from 793 12 Horni Benesov to Germany, using the border crossing near Rozvadov (CZ - DE) on the motorway D5.
The first step is the determination of the correct zip code in the distance zone table for the border crossing Rozvadov (D5) – Waidhaus (A6), see Chart 2. The result is zip code DE3. Then the intersection has to be found for rows / columns "79200 and 79599" (Horni Benesov) and DE3. This relates to distance zone 11. The distance-volume chart shows, that the intersection between row 7 – 7.99 load metres and distance zone 11 leads to toll costs for this consignment amounting to CZK 1,301.30.

5. Electronic versions of the toll charts

The Kummer-charts for Austria, Germany and Czech Republic are also electronically available. The toll charts, distance zone tables as well as a simple piece of software for all three countries can be ordered on the internet, see www.kummer-tabelle.de.

6. Toll charts

The toll tables are a simple and efficient instrument in the combined shipment and less-than-truckload sector for charging customers with additional toll costs.

The calculation of toll costs is based on the number of kilometres driven on toll roads and determines the proportionate toll costs for a consignment considering average grades of capacity utilization, deadhead mileages and indirect toll costs. For small consignments (up to 2,000 kg) a surcharge is added, since this kind of consignment regularly flows through a hub-system. The proposed proportionate toll costs do not contain a costing-based entrepreneurial profit (profit margin).
For calculating toll costs in the truck-load sector an ascertainment of real costs is recommended considering deadhead mileages and indirect toll costs.
The calculated toll costs in the toll charts are based on average values. In particular cases the real proportionate toll costs for a link can differ from the value coming from the toll table.