



EUROPEAN COMMISSION
DIRECTORATE GENERAL II
ECONOMIC AND FINANCIAL AFFAIRS
Economy of the Euro zone and the Union

Brussels,
DGII/C-4-SP(99)

II/ 28/99-EN

“Wer den Pfennig nicht ehrt,
ist des Thalers nicht wert.”

(German proverb)

THE INTRODUCTION OF THE EURO AND THE ROUNDING OF CURRENCY AMOUNTS

(UPDATE FEBRUARY 1999)

An earlier version of this page was published under the same title as Number 22 of the series Euro Papers in March 1998. The hypothetical calculations in conversion rates in the examples of the earlier version have been replaced in this update by the definite conversion rates as applicable from 1 January 1999. Besides, the present text compares in more detail conversion of national currency unit amounts by triangulation and by using implicit bilateral rates.

Table of Contents

1. SUMMARY AND MAIN CONCLUSIONS	4
2. INTRODUCTION	6
3. THE PROVISIONS ON ROUNDING IN THE LEGAL FRAMEWORK OF THE EURO	7
3.1. The legal status of the euro	7
3.2. The rules on conversion rates and rounding in Council regulation (EC) No 1103/97	7
3.3. Use of the conversion rates	8
3.4. Conversions between the euro unit and the national currency units	8
3.5. Conversions between national currency units	9
3.6. The applicability of the rounding rules according to Article 5	10
4. TYPES OF ROUNDING ISSUES	11
4.1. Horizontal rounding issues	11
4.1.1. Rounding differences resulting from conversions and reconversions into the initial currency unit	11
4.1.2. Conversion of sums and products of monetary amounts	14
4.1.2.1. The handling of sums of monetary amounts in the retail sector	15
4.1.2.2. Other cases	17
4.1.3. Relation between national rounding rules and the rounding rules of the regulation	18
4.2. Specific rounding problems	18
4.2.1. The display of prices of low value goods	18
4.2.2. Conversion of small amounts	19
4.2.3. Redenomination of debt	20
4.2.4. Implicit bilateral rates between the national currency units	21
4.2.5. Conversions between NCUs and third currencies	22
4.2.6. Conversion of thresholds and tables	23
4.2.6.1. Transitional period	23
4.2.6.2. After the transitional period	24
Annex 1: Conversion rates between the euro and the national currencies	25
Annex 2: Rounding provisions in the legal framework	26
Annex 3: Currency codes and definition of sub-units of EU-currencies	29
Annex 4: The use of bilateral rates	30

1. SUMMARY AND MAIN CONCLUSIONS

The rounding rules laid down in the legal framework of the euro are an integral part of the monetary law of the euro area. The legal equality of the euro unit and the national currency units is based on their application and the application of the conversion rates. The basic rules laid down in the Council Regulation (EC) No 1103/97¹ are:

- the conversion rates are adopted as one euro expressed in terms of each of the national currencies of the participating Member States. They are adopted with six significant figures. These rates shall not be rounded or truncated when making conversions. As a consequence, inverse rates must not be used.
- Bilateral rates between national currency units are not defined. However the regulation prescribes an algorithm for converting an amount from one national currency unit to another; alternative methods are allowed, provided that they lead to the same result.
- Amounts converted into the euro unit shall be rounded up or down to the nearest cent. Amounts converted into national currency units shall be rounded to the nearest sub-unit or in the absence of a sub-unit (as with the Peseta) to the nearest unit or, according to national law or practice, to a multiple or fraction of the sub-unit (e.g. Belgian Franc) or unit (like the Italian Lira) of the national currency unit. In all cases the amount shall be rounded up if the application of the conversion rate gives a result which is exactly half-way.

Besides these Community rules, national practices and market conventions will continue to play an important role in ensuring that the inaccuracies, which rounding inevitably implies, will be managed in a transparent and equitable manner.

According to the analysis of the Commission services, there are a few areas where further clarification of the rounding rules might be useful in the context of conversions involving the euro unit and the national currency units. The analysis of these issues has led the Commission services to the following conclusions:

- * Monetary amounts which have been converted into the euro unit and which have to be paid are to be rounded to the nearest cent. Monetary amounts to be accounted for might be held with more than two decimals. For such amounts, rounding to the nearest cent is the largest rounding inaccuracy tolerated by the legal framework (see point 3.6.).
- * In order to deal with discrepancies which might occur in case of conversions and reconversions, Member States might reflect if it would be useful to define by law under which conditions a debt is discharged (See point 4.1.1.).
- * Given that payment systems will provide solutions to avoid the conversion/reconversion problem, bank clients should give the payment order in the unit in which the debt is denominated. Conversions should, whenever possible, be left to the banking sector.

¹ Council Regulation (EC) No 1103/97 of 17 June 1997 on certain provisions relating to the introduction of the euro, O. J. No L 162 of 19.6.1997

- * Rounding discrepancies may arise between the sum of a string of converted amounts and the result which one obtains by converting the total of the original amounts. An appropriate solution depends on individual circumstances. National authorities or business associations might consider setting standards to define which of the amounts (individual amount, sums) is the one deemed relevant for conversion and consecutive rounding (see point 4.1.2).
- * Retailers should determine the “lead unit” (national currency unit or euro unit) in which prices are set and amounts to be paid are calculated. The display of prices in the other unit would be for information purposes only (see point 4.1.2.1).
- * Prices which have been converted from a national currency unit to the euro unit will in general have to be rounded to the nearest cent. Nevertheless, for prices which are displayed with a particular high level of accuracy in the national currency unit, a similar accuracy should be used when they are displayed in the euro unit. Member States might reflect if it may be useful to issue recommendations to this end (see point 4.2.1).
- * For conversions between national currency units, the algorithm defined in Article 4 (4) of Regulation 1103/97 should be used. Simulations suggest that it is practically excluded to find implicit bilateral rates which always produce the same result as the algorithm. The use of bilateral rates should therefore be avoided (see point 4.2.4).
- * Thresholds and tables used to categorise monetary amounts should be set up in one “lead unit”. Public administrations and enterprises should check during the transitional period if further action is necessary in order to avoid inconsistencies which might follow from the redenomination which takes place on 1 January 2002 (see point 4.2.6).

2. INTRODUCTION

Rounding of currency amounts is a widespread phenomenon in currency matters. Even in a mono-currency environment rounding is often unavoidable, e.g. in the calculation of interests or fees.

Rounding has so far not been at the forefront of public interest and has rarely been the subject of formal rules laid down in legislation; economic operators have themselves dealt with the issue. A large variety of market conventions and national practices exist, laying down rounding rules for different national and international financial markets.

Questions related to rounding also have to be tackled in the context of the introduction of the euro. National practices and market conventions will continue to play an important role in this respect. Nonetheless, rounding acquires a new quality in the changeover to the euro because monetary amounts expressed in the euro unit or a national currency unit (NCU) are converted into each other not by using a market-determined exchange rate, but by applying a legally fixed conversion rate.

Generally, rounding inaccuracies which may occur in conversions between the euro unit and the national currency units, despite a correct application of the rounding rules, will be so small that they will be economically insignificant. However, they may have significant legal or technical consequences in some cases. Such rounding effects may occur during the transitional period, when NCUs and the euro unit exist side by side, and after the end of this period when the national currency units cease to be defined as sub-units of the euro.

In a separate issue of the Euro Papers, the Commission services have presented their views on a wide range of questions from citizens, companies and business associations on the legal framework of the euro². This earlier document addressed some particular rounding questions, notably in the context of the redenomination of bonds. Rounding issues are also dealt with in a document of the Commission services on the preparation of the changeover in financial information systems³.

The purpose of the present document is to respond in a systematic manner to the various questions on rounding which the Commission services have received since the adoption of the Council regulation on certain provisions relating to the introduction of the euro in June 1997.⁴ To this end it tries to clarify the interpretation of the rounding provisions in the legal framework of the euro and to give guidance on technical aspects of rounding.

The views expressed in this document are preliminary considerations by members of the staff of the European Commission⁵. It should be read under the twin provisos that the

² The legal framework for the euro – Questions and answers on the euro regulations, Euro Papers No. 10, December 1997

³ Preparing Financial Information Systems for the euro, Euro Papers No. 11, January 1998

⁴ Council Regulation (EC) No 1103/97 of 17 June 1997 on certain provisions relating to the introduction of the euro, O. J. No L 162 of 19.6.1997

⁵ The paper has benefited from input from members of the staff of the European Monetary Institute.

interpretation of legislation is in the final instance for the courts to decide and that the interpretations given do not represent an official opinion of the Commission as such. It should be recalled that the two regulations which form the legal framework for the use of the euro are not the product of the Commission, but the legislator, i.e. the Council.

3. THE PROVISIONS ON ROUNDING IN THE LEGAL FRAMEWORK OF THE EURO⁶

3.1. The legal status of the euro

Since 1 January 1999, the euro is the single currency of the participating Member States (Article 2 of Council regulation 974/98 on the introduction of the euro)⁷. On that date, the euro has substituted for the currencies of the participating Member States according to the conversion rates which have been adopted by the Council in a regulation on 31 December 1998⁸. The currency unit is one euro. The euro is divided into 100 cent. Once national coins are withdrawn, one cent will be the coin with the lowest value; this will also be the lowest sub-unit with which monetary obligations can be settled in legal tender. That is why the legislator has foreseen that monetary amounts to be paid or accounted for have to be rounded to the nearest cent.

Until the end of 2001, the euro will also be divided into national currency units (NCU) according to the conversion rates.

Because of the legal equivalence of the euro unit and the national currency units, conversions of monetary amounts between a national currency unit and the euro unit have to be distinguished from foreign exchange transactions, where different currencies are exchanged at rates which have been agreed by the parties.

3.2. The rules on conversion rates and rounding in Council regulation (EC) No 1103/97

The rounding rules for conversions between the euro unit and the national currency units are laid down in Articles 4 and 5 of Council regulation (EC) No 1103/97. Apart from the form which the conversion rates will take (Article 4 (1)), these articles comprise two categories of provisions: those on the use of the conversion rates (Article 4 (2) to Article 4 (4) and those on how monetary amounts which result from the application of the conversion rate have to be rounded (Article 5).

The rounding provisions apply exclusively to conversions from national currency units to the euro unit or vice-versa, and between national currency units. They form part of the monetary law (*lex monetae*) of the Member States which will adopt the euro. They do not interfere with any rounding rules or practices in other areas which may be of relevance

⁶ Extracts from the euro regulations can be found in Annex. A more thorough description of the legal framework can be found in: The legal framework for the use of the euro, Euro Papers, No. 4, September 1997 and in: The legal framework for the euro – Questions and answers of the euro regulations, *supra*

⁷ O.J. No L 139 of 11.5.1998

⁸ Council Regulation (EC) No 2866/98 of 31 December 1998 on the conversion rates between the euro and the currencies of the Member States adopting the euro, O.J. No L 359 of 31.12.1998

for the computation of monetary amounts, but which are not intrinsically related to the conversion operation per se.

Likewise, rounding procedures in a mono-currency environment are not governed by the Council regulation, e.g. in the calculation of interests or fees. In these cases, market conventions or national practices will continue to apply. Foreign exchange operations against a third currency are only covered as far as a conversion between a national currency unit and the euro is involved (see point 4.2.5).

3.3. Use of the conversion rates

In accordance with Article 4 (1) of the regulation, the conversion rates have been defined as one euro expressed in terms of each of the national currencies of the participating Member States (see annex 1). The rates have been adopted with six significant figures, e.g. 1 EUR = 40.3399 BEF.

Wherever these conversion rates are used, they will have to be applied exactly, i.e. with six significant figures; no rounding or truncating of the conversion rates is allowed (Article 4(2)).

Taking the conversion rate between the euro and the Irish Punt of 1 EUR = 0.787564 IEP, it would not be allowed

- to round this rate when making conversions to 1 EUR = 0.8 IEP, 0.79 IEP, or 0.788 IEP, etc.
- or to cut off one or more decimals: 1 EUR = 0.7 IEP, 0.78 IEP, etc.

3.4. Conversions between the euro unit and the national currency units (EUR → NCU or NCU → EUR)

Only the conversion rates may be used for conversions from the euro unit into a national currency unit (NCU) and vice versa. This means that in case of a conversion EUR→NCU, the euro amount will have to be multiplied by the conversion rate. Correspondingly, the conversion NCU→EUR will require the division of the NCU amount by the conversion rate.

It is not permissible to calculate in a first step the inverse rate expressed in decimals and subsequently to multiply the NCU amount by the inverse rate (Article 4 (3)) because inverse rates necessarily imply rounding of the rates. The use of inverse rates could lead to large rounding differences when converting big amounts.

Take the conversion rate for the Dutch Guilder which is 1 EUR = 2.20371 NLG. The inverse rate, rounded to an equal number of significant figures, would be 1 NLG = 0.453780 EUR. The conversion of an amount of 1 million Dutch Guilders according to the correct method would give:

$$1,000,000 \text{ NLG} = \frac{1,000,000}{2.20371} \text{ EUR} = 453,780.22 \text{ EUR}$$

The use of the inverse rate would result in:

$$1,000,000 \text{ NLG} = 1,000,000 \times 0.453780 \text{ EUR} = 453,780.00 \text{ EUR}$$

In this example, the difference due to the rounding of the inverse conversion rate amounts to 0.22 EUR.

The rules for rounding of monetary amounts which result from a conversion are laid down in Article 5. In general, monetary amounts to be paid or accounted for which are converted into the euro unit have to be rounded to the nearest cent. Results of a conversion that are exactly half-way shall be rounded up, i.e. an amount of EUR 2.345 would have to be rounded to EUR 2.35.

BEF → EUR	$100 \text{ BEF} / 40.3399 \Rightarrow 2.4789352477... \text{ EUR} \Rightarrow 2.48 \text{ EUR}$
-----------	--

1 EUR = 40.3399 BEF

With respect to rounding of national currency units, the rules respect the diversity of the situations in the Member States. Amounts converted into a national currency unit shall be rounded, when they are paid or accounted for, to the nearest sub-unit, or in absence of a sub-unit to the nearest unit, or according to national law or practice to a multiple or fraction of the sub-unit or unit of the national currency. The result of a conversion into DEM for example is to be rounded to the nearest Pfennig, the sub-unit of the DEM. In the case of the BEF, a sub-unit does exist (centime), but amounts resulting from a conversion into BEF are in general to be rounded to the nearest BEF as this corresponds to national practice.

EUR → BEF	$100 \text{ EUR} * 40.3399 \Rightarrow 4033,99 \text{ BEF} \Rightarrow 4034 \text{ BEF}$
-----------	--

1 EUR = 40.3399 BEF

3.5. Conversions between national currency units

(NCU → NCU)

The Council has not fixed any bilateral rates between national currency units. The reason is that a grid of bilateral rates would include minor inconsistencies. Such inconsistencies also exist in the present parity grid of the exchange rate mechanism of the European Monetary System. In the case of the ERM parity grid, these inconsistencies do not really matter, because the central rates are not used for carrying out transactions. In the case of the conversion rates, such inconsistencies would open up the possibility of systematic profit making through conversion operations.

Instead of fixing bilateral rates, the Council has set the following rule for converting amounts from one national currency unit into another (Article 4 (4)): the initial amount expressed in a national currency unit first has to be converted into the euro unit; in a second step, the euro unit amount has to be converted into the target national currency unit. The intermediate result in euro may be rounded to not less than three decimals.

The following example shows a conversion between Austrian Schilling and German Mark:

ATS → DEM	1000 ATS / 13.7603	⇒ 72.67283416...EUR	⇒ 72.673 EUR
	⇒ 72.673 EUR * 1.95583	⇒ 142.13603359 DEM	⇒ 142.14 DEM

1 EUR = 13.7603 ATS
1 EUR = 1.95583 DEM

The regulation imposes a minimum accuracy for the intermediate result. More decimals than three may be used for the intermediate result in euro, possibly leading to small differences in the final result (see point 4.2.4).

Other algorithms (e.g. implicit bilateral rates) may be used provided that they produce the same results as the algorithm prescribed in Article 4 (4).

3.6. The applicability of the rounding rules according to Article 5

The rules of Article 5 apply after a conversion, i.e. after a multiplication or division of the initial currency amount by the conversion rate. They are of no relevance for any other operations (see point 3.2 above).

Furthermore, they apply to monetary amounts “to be paid or accounted for”. Any operations or computations which precede the establishment of such amounts are outside the scope of Article 5 and depend on the terms of the contractual relationship and on the law which is applicable.

“Monetary amounts to be paid” cover all forms of monetary obligations. Such amounts are to be rounded to the nearest cent (when converted from a national currency unit) or to the appropriate fraction or multiple of the national currency unit (when converted from the euro unit). Rounding after a conversion will not only have to take place when a payment is executed (at this moment it would for technical reasons be unavoidable to round) but beforehand when a monetary amount is computed (either by the debtor, the creditor or a third party) and recorded with the intention to indicate the amount which finally has “to be paid”.

All other monetary amounts fall in the second category, i.e. “amounts to be accounted for”, like amounts at which tangible assets are valued, amounts in legislative provisions, sales offers. In principle, the rounding rules of Article 5 also apply to this category, which means that amounts converted into the euro unit are to be rounded to the nearest cent. However, this rule has to be understood as a minimum standard of accuracy defined by the EC legislator; it is the highest rounding inaccuracy tolerated by the euro regulations. This reasoning is reflected in Recital 11 of the same regulation, which points to rounding practices, conventions or national provisions providing a higher degree of accuracy for intermediate computations. Intermediate computations cover all those steps where the converted amount does not in itself constitute a monetary obligation, but is an element in a sequence of acts which may lead up to the establishment of a monetary obligation.

In certain cases, it may indeed be desirable to round converted amounts with a higher degree of accuracy than at the cent level. A case in question are sales offers at prices which are expressed with a fraction of the smallest sub-unit of a national currency unit, like petrol prices per litre or gas prices per m³. Dual displaying of a euro price with a fraction of a cent (to ensure a similar degree of accuracy) would be compatible with Article 5 provided that national rules would allow for it.

4. TYPES OF ROUNDING ISSUES

The rounding issues discussed below are split up into two groups. The first group includes rounding problems that are of a more horizontal nature whereas the rounding issues that concern only specific areas are discussed in the second part of this chapter.

4.1. Horizontal rounding issues

4.1.1. Rounding differences resulting from conversions and reconversions into the initial currency unit

Conversions and reconversions of monetary amounts may occur in various instances, in particular in payment systems where several financial intermediaries are engaged in the processing of payments and where accounts to be credited/debited are held in different denominations.

The fact that Article 4 (3) of the regulation stipulates that the conversion rates shall be used for conversions either way between the euro unit and the national currency units already greatly limits possible rounding differences. Nevertheless, they are not excluded altogether. This is due to the fact that the value of the smallest unit of a given national currency unit is not equal to the value of the smallest euro unit, the cent. For most Member States, the sub-unit cent has a higher value than the smallest national unit, in which payments in legal tender can be made.

The maximum difference between the amount resulting from a conversion/reconversion and the original amount depends on two factors: the rounding rule and the conversion rate. Consequently, the maximum difference due to rounding is independent from the amount of the transaction.

Given the rule of the Council regulation that half-way results are rounded up, the maximum rounding difference (max RD) in the intermediate result amounts to plus/minus half of the smallest unit of the intermediate currency.

For conversion chains from a national currency unit into the euro unit and back to the national currency unit, the absolute maximum difference between the original amount and the result from the conversion chain ($|Dx|$) would be:

$$|Dx| = \max RD \times CR \quad \text{with } \max RD = 0.005 \text{ EUR}$$

and CR = conversion rate.

Take the example of a conversion of 100 PTE into EUR and reconversion into PTE:

PTE → EUR → PTE	250 PTE / 200.482 ⇒ 1.2469947... EUR ⇒ 1.25 EUR
	1.25 EUR * 200.482 ⇒ 250.6025 PTE ⇒ 251 PTE

1 EUR = 200.482 PTE

In this example, a conversion from PTE to EUR and back again introduces an error of 1 PTE. This is because both 250 PTE and 251 PTE convert to 1.25 EUR, whereas the conversion of 1.25 EUR leads to 251 PTE. For a NCU where the value of the smallest sub-unit is much smaller than the cent, there will be several monetary amounts in NCU which convert to the same EUR value. In the case of the PTE there are in general two amounts in PTE which convert to the same EUR amount:

PTE ⇒ EUR	
1	⇒ 0.00
2	⇒ 0.01
3	
4	⇒ 0.02
5	
6	⇒ 0.03
7	
8	⇒ 0.04

For conversion chains from the euro into a national currency and back to the euro the maximum difference would be:

$$|Dx| = \frac{\max RD}{CR}$$

with $\max RD$ = half of smallest NCU

and CR = fixed conversion rate.

The following example shows a conversion of a euro amount into Irish Punt and a subsequent reconversion into the euro.

EUR → IEP	1459.00 EUR * 0.787564 ⇒ 1149,05587... IEP ⇒ 1149.06 IEP
→ EUR	1149.06 IEP / 0.787564 ⇒ 1459.005236 EUR ⇒ 1459.01 EUR

1 EUR = 0.787564 IEP

The following table shows the maximum rounding differences (rounded to the next sub-unit or unit) resulting from reconversions for the currencies of the Member States which have adopted the euro.

	Conversion rates (1 EUR = x NCU)	[Smallest national currency unit]	Maximum rounding differences	
			Conversion: NCU – EUR – NCU [NCU]	conversion: EUR - NCU - EUR [EUR]
BEF/LUF	40.3399	1.00	0.00	0.01
DEM	1.95583	0.01	0.01	0.00
ESP	166.386	1.00	1.00	0.00
FRF	6.55957	0.01	0.03	0.00
IEP	0.787564	0.01	0.00	0.01
ITL	1936.27	1.00	10.00	0.00
NLG	2.20371	0.01	0.01	0.00
ATS	13.7603	0.01	0.07	0.00
PTE	200.482	1.00	1.00	0.00
FIM	5.94573	0.01	0.03	0.00

It appears that only in the cases of the Irish Punt and the Belgian/ Luxembourg Franc rounding differences may arise from a conversion from the euro unit into the national currency units and back to the euro unit, as the smallest units of these currencies have a higher value than the cent. Consequently, rounding differences cannot occur from a conversion and subsequent reconversion of an amount initially expressed in one of these three national currency units.

Double conversions may theoretically occur within the banking system when payment systems are working in another currency unit than the currency unit of the payment order and the unit of the account of the creditor. However, it can be expected that payment systems will be capable to avoid differences from double conversions inside the system: payment systems may either store besides the converted amount the initial amount or they may store besides the converted amount the initial currency unit and a rounding coefficient. Rounding differences can also be avoided if systems work in the unit whose sub-unit has the lowest intrinsic value.

However, even if payment systems offer solutions, rounding differences can still occur when conversions are made outside the system, e.g. when a bank client converts an amount to be paid on his own. Take the example of a customer who has to pay an invoice, say in Spanish Pesetas, but wishes to pay in the euro unit and therefore converts the amount into the euro unit on his own initiative. The euro amount of the payment order will then be transferred by his bank to the creditor's bank which reconverts the euro amount into Spanish Pesetas. In this case, a discrepancy of 0.83 Pesetas (rounded to 1 ESP) at maximum may occur.

The debtor, who has made “unnecessarily” (unnecessary, because it was assumed that the payment system offers the possibility to make conversions) the conversion on his own

has, in the absence of specific national legislation or an agreement with his counterpart, to bear the risk of not discharging the debt, even if he has properly applied the conversion rates and the rounding rules. It goes without saying that the debtor also has to bear the legal consequences of any incorrect application of the conversion rates or rounding rules.

In order to avoid rounding inaccuracies resulting from conversions and reconversions, banks should advise their clients to give the payment order in the denomination of the invoice. Bank clients should be made aware that they should not make conversions during the transitional period on their own, but – whenever available - leave it to the banking sector to make the necessary conversions.

However, for large companies it might be advantageous or even inevitable to make the necessary conversions on their own, for example because they forward their payment orders electronically to their bank, and the data transmission formats only allow the use of one currency unit. Banks may advise these customers how the conversions should be made.

The situation would be different in case of rounding inaccuracies which occur inside payment systems. Even though such inaccuracies are unlikely to occur in domestic payments, they may be of relevance for cross-border payments. If the payment systems involved fail to offer a solution which excludes differences from double conversions, it might be that a difference arises between the amount debited to the account of the debtor and the amount (expressed in the same unit) which the creditor will receive on his account.

In such cases, it may be argued that the creditor's consent to be paid by credit transfer can be interpreted as implying the acceptance of possible rounding differences because of dual conversions inside the payment system. Accordingly, the creditor would have to accept rounding differences which occur despite the correct application of the conversion rates and the rounding rules.

A way to tackle the conversion/reconversion problem is to reflect on whether it may be useful to define by national law under what conditions a debt is discharged. National legislation could provide, for example, that a debt is discharged in the case of a double conversion if the conversion and rounding rules are adhered to as specified in Council Regulation (EC) No 1103/97. In this case, the limited rounding differences from conversions back and forth would have to be accepted by the contracting parties. In some Member States, e.g. France and Belgium, legislation has been passed to this end.

4.1.2. Conversion of sums and products of monetary amounts

The problem of conversion of sums arises in many instances, e.g. when prices and sums to be paid are indicated in two currency units in a shop, when a string of credit transfers is initiated or when a bond issue is redenominated (see 4.2.3.).

The sum of a series of converted amounts only exceptionally exactly matches the conversion of the total of the original amounts. Take the following example:

	FIM	EUR
Item 1	1000	168,19
Item 2	1000	168,19
Item 3	1000	168,19
Item 4	1000	168,19
Item 5	1000	168,19
Item 6	1000	168,19
Total	<u>6000</u>	<u>1009.14</u>
	↓	
	EUR →	1009.13

1 EUR = 5.94573 FIM

Adding up the individual amounts converted to EUR leads to a total of 1009.14 EUR. Conversion of the total of the items expressed in FIM leads to:

$6000 \text{ FIM} / 5.94573 \Rightarrow 1009.13 \text{ EUR}$,

i.e. to a total which differs by 1 cent from the total of the converted EUR amounts.

The total maximum rounding difference equals to half of the smallest currency unit to which the amounts are converted multiplied with the number of items to be converted. Thus, the rounding error theoretically may increase with an increasing number of amounts to be converted.

In practice, in many cases the total rounding difference will be limited as the rounding differences for the individual amounts will vary randomly upwards and downwards and thus partly cancel out. In other cases, however, these rounding differences may systematically accumulate, e.g. a string of operations which all have the same amount.

There may be different solutions required to deal with this kind of rounding problem depending on the circumstances.

4.1.2.1. The handling of sums of monetary amounts in the retail sector

If dual prices are displayed on a till receipts item by item, the sum of all counter-values may be different from the counter-value of the total amount (see below). In order to avoid these discrepancies retailers should determine and indicate a “lead unit” for the shop, i.e. the unit in which the prices are set which serve as the basis for the calculation of the amount the client eventually has to pay. The “lead unit” has to be distinguished from the units accepted for payment or the units in which prices are displayed.

The definition of a “lead unit” would neither prevent retailers from accepting payments in another unit nor from displaying prices in another unit for information purposes. It would simply mean that prices expressed in other units would not be used for calculating the amount to be paid; this calculation would have to take place on the basis of the “lead unit”.

During the transitional period, most retailers will probably define the national currency unit as the “lead unit”, whereas after E-day (1 January 2002) the “lead unit” would have to be the set in the euro unit. Other retailers might want to change the “lead unit” already during the transitional period.

Example: Sales slip with “lead price” in FIM

	EUR <i>(for information)</i>	FIM
1 snow- shovel	36.83	219
5 m wire	2.52	15
Paint	9.08	54
1 brush	9.75	58
1 palm	31.45	187
20 kg garden peat	38.85	231
1 screw-driver	14.30	85
20 m tape	6.39	38
Total		FIM 887 ↓ EUR 149.18

1 EUR = 5.94573 FIM

In the above example, the shop should clearly indicate (on shelves, receipts, etc.) that the “lead unit” is the FIM and therefore only the individual FIM amounts are relevant for the calculation of the total amount to be paid, whereas the EUR prices for each item are only indicative. Unless otherwise stated, the retailer would not be obliged to accept euro for payment.

If retailers want to give customers the possibility to make payments in both currency units, they would have to convert the amount to be paid from the lead unit into the other unit. In the example mentioned above, the retailer would have to indicate on the sales slip the total amount to be paid in FIM (887 FIM) and to convert this amount to EUR (149.18 EUR) by using the conversion rates and rounding to the nearest cent.

It has to be noted that the amount of 149.18 EUR differs slightly from the sum of the individual items expressed in EUR which would add up to 149.17 EUR. The definition of a lead unit and the indication of prices in the other unit for information purposes only avoids rounding differences especially in those cases where prices are set per unit of consumption (petrol prices at the petrol station, prices of public utilities like electricity, water, etc.). In those cases the conversion and rounding of the individual unit price would lead to an accumulation of large rounding differences.

4.1.2.2. Other cases

In other areas it might be more appropriate to convert and round the individual items instead of the totals. This would for example be the case for payment systems, like the German one, where each individual payment is expressed in two different units in all stages of the payment process. In such a system, it would be inappropriate to convert and round totals, e.g. in the case of a string of credit transfers.

In some cases a solution might be more difficult to find, e.g. when entities are transacting on a regular basis with each other. Taking up the example used in section 4.1.2., consider that enterprise A has delivered six lots of goods to enterprise B at different times, each lot valued at 1000 FIM. If enterprise B makes a single payment of 6000 FIM or the equivalent of 1009.13 EUR to the account of enterprise A, which has recorded the sales individually in EUR and expects a payment of 1009.14, there would be a mismatch of 1 cent. This mismatch may cause problems in particular in electronic accounting systems which match transactions only on the basis of their amounts. If no other criteria are used for matching payments and claims, an accounting system might not be able to identify that enterprise B has settled its debt.

Moreover such mismatches make it necessary to allocate the differences (1 cent) in the example mentioned above to a special account for rounding differences. Otherwise the accounting systems may indicate that an amount of 1 cent is still outstanding and may initiate the sending of a reminder⁹.

An appropriate solution might depend on the interpretation of the will of the parties whether several transactions are to be considered as individual contracts with separate payment obligations or whether each individual “position” forms only part of an (internal) calculation of the final sum to be paid. In the first case individual amounts are to be converted and rounded while in the latter the finally invoiced amounts will be relevant. Similarly, situations may arise where invoiced final prices are not paid for directly but put into a current account kept between the parties. In such a case it would be the net balance drawn at regular intervals that has to be paid according to the agreement (for example at the end of each year) and therefore the conversion of the periodic net balance would be the appropriate solution.

In order to tackle the problem, national authorities or business associations might consider to elaborate standards which define which of the amounts (individual, sums, or even periodic balances) are the ones deemed relevant for conversion and consecutive rounding. Both, the choice of converting individual amounts and of converting sums can provide for a consistent treatment of rounding problems at the national level and thereby enhance accuracy in a wider sense for conversion operations.

Different solutions to ensure consistency have already been developed on the national level in the context of payment systems. In France, a working group consisting of representatives of the public as well as the private sector has suggested to convert, wherever possible, only final results and not the single monetary amounts. The same recommendation is given in Belgium by the working group on conversion and rounding

⁹ For possible solutions, see: Preparing Financial Information Systems for the Euro, European Commission, Euro Papers, No. 11, January 1998

issues, representing the public sector and the banking sector. In Germany, banking associations have agreed always to convert in domestic payment systems the individual monetary amounts and not the sums.

4.1.3. Relation between national rounding rules and the rounding rules of the regulation

The rounding rules contained in Council Regulation (EC) No 1103/97 are part of the monetary law of the euro area. They are applicable to conversions involving the national currency units and the euro unit. Steps which precede or follow this kind of conversion operations are not covered by the rounding rules. The monetary amounts to be converted and the computation thereof depend on contractual, legislative and other provisions which have their origin outside the realm of monetary law. (see point 3.2.)

Take the example of a national tax law authorising tax payers to round monetary amounts in their tax declaration to the next unit (instead of sub-unit). This possibility will continue to be available for taxpayers who have to declare an amount which is the result of a conversion between a national currency unit and the euro unit.

Let's assume the tax declaration has to be made in DEM and the income to be declared is EUR 35,715.47. The amount in EUR would have to be converted as follows (i.e. the initial amount should not be rounded before the conversion to the nearest euro):

EUR → DEM	35715.47 EUR *1.95583 ⇒ 69853.3876... DEM ⇒ 69853.39 DEM
-----------	--

1 EUR = 1,95583 DEM

In accordance with national tax law, it would still be permissible to declare this amount in DEM as:

69,853.- DEM

4.2. Specific rounding problems

4.2.1. The display of prices of low value goods

This section deals with the dual display of prices, i.e. the display of a price in a national currency unit and in the euro unit. It was argued in section 4.1.2.1 that in dual price displays, the retailer should define a “lead unit” for the shop in which prices and sums to be paid are set. The display of prices in the other unit would only serve information purposes.

The indication of a price both in the national currency unit and the euro unit has to respect the conversion rate and the rounding rules. This means that prices which have been converted from a national currency unit into the euro unit will in general have to be rounded to the nearest cent.

In some cases rounding of the counter-value to the nearest cent would however be inappropriate, for example when prices are indicated with a degree of accuracy which is higher than the smallest currency unit in use (petrol prices, price per unit of consumption of gas, electricity, water, etc.).

Take the following example of a conversion of a price per litre of petrol:

price in BEF	Conversion into EUR	Price in EUR rounded to the nearest cent	Price in EUR rounded to 3 decimals
32.9 BEF	$32.9 / 40.3399 = 0.815569\dots$ EUR	0.82 EUR	0.816 EUR

1 EUR = 40.3399 BEF

Rounding the converted price to the nearest cent would in this case be inappropriate as it would imply that the price in euro units is displayed with a lower degree of accuracy than the price expressed in national currency units. This would somehow mean to give misleading information to the customer. Achieving a similar degree of accuracy would require to use more than two decimals for the converted amount in EUR. The rounding rules of Article 5 do not stand in the way of expressing a price in euro with more than 2 decimals. As shown in section 3.6, rounding to the nearest cent has to be understood as a minimum standard of accuracy for conversions of prices into the euro unit.

Generally, for prices which are displayed with a high level of accuracy in the national currency unit, a similar level of accuracy should be used when they are displayed in the euro unit. For the Belgian Franc, the Belgian “Commissariat général à l’euro” recommends to use at least two more decimals for the converted euro amount compared to the initial amount in BEF. Following this recommendation in the example above, a similar level of accuracy would be maintained if the price in euro would be stated with 3 decimals, that is 0.816 EUR.

The number of decimals required in order to maintain a similar level of accuracy varies between Member States and depends on the value of the national currency units. National authorities or associations might consider it useful to give indications what a similar level of accuracy means.

4.2.2. Conversion of small amounts

A similar problem arises for the conversion of amounts which are relatively small. Take the example of a fictive inventory:

	Amount in PTE	Amount in EUR	Amount in EUR (rounded to 2 decimals)	Rounding-discrepancy
Item A	5	0.024939...	0.02	- 20 %
Item B	10	0.049879...	0.05	+ 0.2 %
Item C	43	0.214483...	0.21	- 2,1 %

1 EUR = 200.482 PTE

Rounding to the nearest cent for each individual item may lead in the case of small amounts to large rounding inaccuracies. These could be avoided if the value attributed to such items would be expressed with more than two decimals, or if such items are accounted for together with items of the same nature, e.g. 100 pieces of item A may be valued at 500 PTE.

For the example given above, one additional decimal for the EUR amounts would reduce the discrepancies significantly:

	Amount in PTE	Amount in EUR	Amount in EUR (rounded to 3 decimals)	Rounding-discrepancy
Item A	5	0.024939...	0.025	+ 0.2 %
Item B	10	0.049879...	0.050	+ 0.2 %
Item C	43	0.214483...	0.214	- 0.2 %

4.2.3. Redenomination of debt

The rounding issues related to the conversion of bonds belongs to the category of “conversion of strings with identical amounts” (see 4.1.2.)¹⁰. Article 14 of Council Regulation 974/98 explicitly confirms that the rounding rules laid down in Council Regulation (EC) No 1103/97 apply to the redenomination of existing legal instruments which will take place at the end of the transitional period. A redenomination which takes place beforehand under Article 8 (4), will have to follow the same rules. In this context it is important to recall that redenomination in the sense of Article 1 of the draft regulation on the introduction of the euro only means changing the unit in which the amount of outstanding debt is stated from a national currency unit to the euro unit. It does not cover the renominalisation of bonds.

Rounding to the nearest cent must not necessarily take place after the conversion of a bond. In a first logical step, the nominal value after redenomination is its face value (expressed in national currency units) divided by the conversion rate. This value is an unrounded amount expressed in the euro unit.

A rounding to the nearest cent will only have to take place for the amount to be paid. Rounding to the nearest cent would have to take place either for each minimum nominal amount (this would arguably be the case if the debtor has an obligation to pay bond by bond) or for the aggregated amount of bonds held by each investor (if the obligation to pay concerns the aggregated amount of each individual holding or the whole issue). As set out in section 4.1.2, it depends on the contract which of the amounts in question will be considered as the ones legally relevant for conversion and rounding.

Remaining minor rounding inaccuracies at the issuer’s level might nevertheless oblige an issuer to realise profits or losses in his accounting because of the rounding. Such remaining rounding inaccuracies should not be considered as being a change to the economic value of a monetary obligation or claim.

¹⁰ Suggestions how to carry out the redenomination of bonds or shares have been put forward in “The Impact of the Introduction of the Euro on Capital Markets”, Euro Papers No. 3, July 1997

4.2.4. Implicit bilateral rates between the national currency units¹¹

The use of inverse conversion rates is explicitly prohibited by Article 4 (3) of Council Regulation (EC) No 1103/97 in order to eliminate one important source of rounding inaccuracies. Rounding is usually unavoidable when fixing several rates. Thus inverse rates would be inconsistent with the conversion rates fixed against the euro.

A similar reasoning applies to the fixing of bilateral rates between two different national currency units. The regulation therefore prescribes an algorithm for conversions from one national currency unit to another national currency unit (triangulation method, see point 3.5). As this algorithm allows rounding for the intermediate result to not less than three decimals, there is a range of possible outcomes from this method.

Take the conversion rates for the FRF (1 EUR = 6.55957 FRF) and for the DEM (1 EUR = 1.95583 DEM). A conversion of DEM 100 would lead, depending on the numbers of decimals used for the intermediate result to the following amount in FRF:

Decimals	DEM	EUR	FRF
3	100	51.129	335.38
4	100	51.1292	335.39

An implicit bilateral rate which is used instead of the algorithm prescribed in Article 4 (4) must produce one of the results which are possible under the algorithm.

The size of rounding differences resulting from the use of bilateral rates instead of applying the prescribed triangulation method depends not only upon the number of significant figures adopted for the bilateral rate but also upon the amounts converted and the specific conversion rates adopted. Differences between the results obtained by triangulation and those obtained by application of bilateral rates tend to be very small when a bilateral rate with a high number of decimals is chosen and if the converted amount is relatively small. But even for small amounts and using a high number of significant figures, the use of a bilateral rate may produce results that do not fall within the range of possible results from the triangulation method.

Economic agents should be aware that bilateral rates do not always manage to produce exactly the same result as the triangulation method even for relatively small amounts. The tables shown in Annex 4 indicate the maximum amounts up to which the application of implicit bilateral rates and triangulation lead to exactly the same result. Depending on the number of significant figures used for the implicit bilateral rates, these amounts are relatively small.

¹¹ Implicit bilateral rates, derived from the conversion rates, have to be distinguished from the bilateral rates, which have been announced in May 1998. Due to rounding problems, these two sets of rates are not exactly the same.

If deviations from the result prescribed by the triangulation method occur, the legal risk of not discharging a debt or not fulfilling other obligations stays with the party that uses a bilateral rate instead of the algorithm. They have to be aware that the use of bilateral rates may create technical and legal problems¹². The algorithm should therefore always be implemented and the use of bilateral rates in calculations should be avoided.

The euro regulations do not prohibit on the other hand the display of bilateral rates for information purposes, e.g. to make it easier for clients to make an “approximate” conversion on their own. Banks, enterprises or public authorities may consider to publish such rates. Nevertheless, it should be made clear in these cases that bilateral rates are displayed for information only and that the application of these rates does not necessarily result in the correct counter-value of an amount expressed in a national currency unit when converted into another national currency unit.

4.2.5. Conversions between NCUs and third currencies

The conversion between the euro and third currencies, e.g. the US \$, is outside the scope of the rounding rules set by Council Regulation (EC) No 1103/97. The accuracy to be applied to these exchange rates as well as the rounding rules are left to the contract under which the exchange takes place, market conventions or practices.

However, conversions between national currency units and third currencies may include a conversion between the euro and the national currency unit as it is unlikely that rates between national currency units and third currencies will still be available throughout the third stage. For these conversions between the national currency unit and the euro unit the rounding rules of Articles 4 and 5 of Council Regulation (EC) No 1103/97 will apply.

It is useful to distinguish two cases: a conversion from a national currency unit to a third currency and the inverse transaction. Take first the example of a conversion from USD to NLG. The USD amount would first be converted into a euro amount by application of a USD/EUR exchange rate. The intermediate euro amount would then be converted into a NLG amount by using the conversion rate. It is only to this last operation that the rounding rules as laid down in Article 5 of Council Regulation (EC) No 1103/97 are applicable.

Article 5 is not of relevance in the case of a conversion from NLG into USD. A NLG amount would first have to be converted into the euro unit by applying the conversion rate. The intermediate euro amount resulting from this operation would not have to be rounded to the nearest cent because this amount will only be part of an intermediate computation. The intermediate euro amount would then be converted into a USD amount by using the EUR/USD exchange rate. This final step of calculating the USD amount is not covered by the Council regulation.

¹² In some instances, there might be a possibility to avoid these legal risks. Enterprises might choose to use different bilateral rates for the same two currency units depending on the nature of the transaction. They might use one bilateral rate for the conversion of amounts which they owe to another party and another bilateral rate for amounts which they have to get from third party, each time applying a bilateral rate which leaves their counterpart as good or better of as with the application of the algorithm. An enterprise considering such a solution would have to compare the costs involved by adapting IT-systems to the algorithm with the extra-costs (of a technical and financial nature) caused by the use of different bilateral rates.

4.2.6. Conversion of thresholds and tables

The conversion of thresholds or tables referring to monetary amounts may lead to inconsistencies of different nature. These inconsistencies are not limited to tables which are included in legislative provisions, e.g. brackets in law. Enterprises or other entities may face this kind of problem if they use groups of monetary amounts to make listings, rankings etc.

On the one hand the application of the conversion rates and rounding rules may lead to gaps between neighbouring brackets if the smallest unit of the NCU has a higher value than the smallest euro unit, the cent. On the other hand, for a NCU whose smallest unit has a lower value than one euro cent, the converted threshold may no longer distinctively delimit the bracket.

Example 1

BEF	≤ 1000	1001 – 2000	2001 – 3000	> 3000
EUR	≤ 24.79	24.81 – 49.58	49.60 - 74.37	> 74.37

1 EUR = 40.3399 BEF

In example 1, the conversion produces small gaps. An amount of 49.59 Euro would fall in between the defined brackets.

Example 2

FRF	≤ 1000	1000.01 - 2000.00	2000.01 – 3000.00	> 3000
EUR	≤ 152.45	152.45 – 304.90	304.90 – 457.35	> 457.35

1 EUR = 6.55957 FRF

In example 2, overlaps are created by the conversion into euro. It is not determined for example whether an amount of 304.90 EUR falls into the second or the third bracket.

4.2.6.1. Transitional period

During the transitional period, where amounts expressed in the national currency unit as well as in the euro unit will have to be classified, there is a relatively easy solution to avoid inconsistencies. It consists of not defining such tables or brackets in both units (NCU/euro unit) but only in one “lead unit” in which all amounts to be classified are to be converted. Leaving such tables during the transitional period in their original denomination (NCU) and converting all amounts to this NCU would give enterprises or public authorities some time to devise solutions for the conversion of the tables which will in any event be necessary at the end of the transitional period.

Take the example of a tax bracket which is defined in a law as 2000 FRF. During the transitional period, this threshold continues to be part of a consistent set of tax brackets in FRF. If an income in EUR has to be declared during the transitional period, the amount of the income would have to be converted into FRF in order to determine the tax amount to

be paid. An income of 304.90 EUR (= 2000.01FRF) would thus be above the threshold and an income of 304.89 EUR (= 1999.95 FRF) would fall below this threshold.

The rounding rules of Article 5 are applicable to the necessary conversions between the national currency unit and the euro unit. In the context of legislative provisions or operations with public authorities, the term “amounts to be accounted for” covers the declaration to the public authorities (e.g. in tax declarations, registration forms etc...) of monetary amounts which are the result of conversions between national currency units and the euro unit as well as monetary amounts appearing in legislative provisions at the end of the transitional period (see also 4.2.6.2.). That means when a rounding takes place at the cent level or at the level of the sub-unit or unit of the national currency unit, it has to take place to the nearest unit.

It should be recalled that anyway during the transitional period the denominations of legal instruments (including laws) existing on the date of substitution of the national currency by the euro are not automatically changed into the euro unit (Article 7 of Council regulation 974/98).

4.2.6.2. After the transitional period

The situation is somewhat different after the end of the transitional period, when the national currency units have lost their status as sub-units of the euro. The option of maintaining the national currency unit as the “lead unit” is not available after the end of the transitional period since the national currency units will no longer exist.

Article 14 of the Council regulation 974/98 stipulates that references to national currency units, which exist in legal instruments at the end of the transitional period will have to be read as references to the euro unit according to the conversion rates. All monetary amounts in laws, contracts and other legal instruments will then by automatic operation of law have been “redenominated” into the euro unit¹³.

“Reading” a monetary amount in a legislative provision (tax brackets, fees, etc.) which is still expressed in a national currency unit after 2001 means the following: division of the amount by the conversion rate, and rounding the euro amount to the nearest cent.

In the example given above, the conversion of the tax bracket (2000 FRF) has to be read as a rounded amount of 304.90 EUR as opposed to an unrounded amount of 2000/6.55957 FRF, which in this case would be slightly lower.

Therefore, in the absence of national rules, the “redenomination” of monetary amounts contained in legislative provisions (tax brackets, fees, allowances...) at the end of the transitional period does not only have to include the application of the conversion rates but also the application of the rounding rules, including the rounding to the nearest cent. It would indeed be confusing for private economic agents if all references to national currency units in existing laws or other legal instruments would have to be read as unrounded figures expressed in the euro unit.

¹³ A physical re-writing of the amounts is not necessary.

As shown above, this “redenomination” of monetary amounts at the end of the transitional period which includes rounding may lead to inconsistencies (gaps, overlaps). There are several ways to avoid such inconsistencies. In the examples given above, inconsistencies could be avoided if the upper threshold for each bracket and the lower threshold of the following bracket were defined with the same amount in the national currency unit using the relations “equal or lower than, higher than”. For example 1 this solution would produce the following groups:

BEF	$X \leq 1000$	$1000 < X \leq 2000$	$2000 < X \leq 3000$	$X > 3000$
EUR	$X \leq 24.79$	$24.79 < X \leq 49.58$	$49.58 < X \leq 74.37$	$X > 74.37$

This kind of threshold definition may already be used in many legal instruments today. Where this is the case, one can rely on the conversion and rounding rules as defined in Council Regulation (EC) No 1103/97. Where this is not the case, a revision of the legal instrument possibly before the end of the transitional period might prove necessary in order to ensure consistency.

Another option to achieve consistency of the brackets after conversion into the euro is to convert only the upper limit of each bracket and to derive the lower limit of the following bracket by adding one euro cent. For example 2 such a solution might be:

FRF	≤ 1000	$1000.01 - 2000.00$		$2000.01 - 3000.00$		> 3000
	$1000/6.55957$	$152.45 + 0.01$	$2000/6.55957$	$304.90+0.01$	$3000/6.55957$	$457.35+0.01$
EUR	≤ 152.45	$152.46 - 304.90$		$304.91 - 457.35$		> 457.36

Again, the implementation of this solution would, for brackets contained in legislative provisions, necessitate further legislative action; this is because the new lower limits expressed in the euro unit do not correspond to the amounts in FRF according to the conversion and rounding rules. A direct application of the conversion rates and the rounding rules would not achieve the desired result.

Annex 1: Conversion rates as defined in Council Regulation (EC) No 2866/98 of 31 December 1998 on the conversion rates between the euro and the currencies of the Member States adopting the euro¹⁴

Article 1

The irrevocably fixed conversion rates between the euro and the currencies of the Member States adopting the euro are:

1 euro	=	40.3399	Belgian francs
	=	1.95583	German marks
	=	166.386	Spanish pesetas
	=	6.55957	French francs
	=	0.787564	Irish pounds
	=	1936.27	Italian lire
	=	40.3399	Luxembourg francs
	=	2.20371	Dutch guilders
	=	13.7603	Austrian schillings
	=	200.482	Portuguese escudos
	=	5.94573	Finnish marks

¹⁴ O.J. No L 359 of 31.12.1998

Annex 2: Rounding provisions in the legal framework

Extracts from Council Regulation (EC) No 1103/97 of 17 June 1997 on certain provisions relating to the introduction of the euro¹⁵

Recitals

....

- (10) Whereas the Council, when acting in accordance with the first sentence of Article 109l (4) of the Treaty, shall define the conversion rates of the euro in terms of each of the national currencies of the participating Member States; whereas these conversion rates should be used for any conversion between the euro and the national currency units or between the national currency units; whereas for any conversion between national currency units, a fixed algorithm should define the result; whereas the use of inverse rates for conversion would imply rounding of rates and could result in significant inaccuracies, notably if large amounts are involved;
- (11) Whereas the introduction of the euro requires the rounding of monetary amounts; whereas an early indication of rules for rounding is necessary in the course of the operation of the common market and to allow a timely preparation and a smooth transition to Economic and Monetary Union; whereas these rules do not affect any rounding practice, convention or national provisions providing a higher degree of accuracy for intermediate computations;
- (12) Whereas, in order to achieve a high degree of accuracy in conversion operations, the conversion rates should be defined with six significant figures; whereas a rate with six significant figures means a rate which, counted from the left and starting by the first non-zero figure, has six figures,

....

Article 1

....

- ‘conversion rates’ shall mean the irrevocably fixed conversion rates which the Council adopts in accordance with the first sentence of Article 109l (4) of the Treaty,
- ‘national currency units’ shall mean the units of the currencies of participating Member States, as those units are defined on the day before the start of the third stage of Economic and Monetary Union,

¹⁵ O. J. No L 162 of 19.6.1997

- ‘euro unit’ shall mean the unit of the single currency as defined in the Regulation on the introduction of the euro which will enter into force at the starting date of the third stage of Economic and Monetary Union..

.

.

Article 4

1. The conversion rates shall be adopted as one euro expressed in terms of each of the national currencies of the participating Member States. They shall be adopted with six significant figures.
2. The conversion rates shall not be rounded or truncated when making conversions.
3. The conversion rates shall be used for conversions either way between the euro unit and the national currency units. Inverse rates derived from the conversion rates shall not be used.
4. Monetary amounts to be converted from one national currency unit into another shall first be converted into a monetary amount expressed in the euro unit, which amount may be rounded to not less than three decimals and shall then be converted into the other national currency unit. No alternative method of calculation may be used unless it produces the same results.

Article 5

Monetary amounts to be paid or accounted for when a rounding takes place after a conversion into the euro unit pursuant to Article 4 shall be rounded up or down to the nearest cent. Monetary amounts to be paid or accounted for which are converted into a national currency unit shall be rounded up or down to the nearest sub-unit or in the absence of a sub-unit to the nearest unit, or according to national law or practice to a multiple or fraction of the sub-unit or unit of the national currency unit. If the application of the conversion rate gives a result which is exactly half-way, the sum shall be rounded up.

....

Extracts from Council Regulation (EC) No 974/98 of 3 May 1998 on the introduction of the euro¹⁶

Article 1

....

- "conversion rate" shall mean the irrevocably fixed conversion rate adopted for the currency of each participating Member State by the Council according to the first sentence of Article 109l(4) of the Treaty;

¹⁶ O.J. No L 139 of 11.5.1998

- "euro unit" shall mean the currency unit as referred to in the second sentence of Article 2;
- "national currency units" shall mean the units of the currencies of participating Member States, as those units are defined on the day before the start of the third stage of Economic and Monetary Union;
- "transitional period" shall mean the period beginning on 1 January 1999 and ending on 31 December 2001;
- "redenominate" shall mean changing the unit in which the amount of outstanding debt is stated from a national currency unit to the euro unit, as defined in Article 2, but which does not have through the act of redenomination the effect of altering any other term of the debt, this being a matter subject to relevant national law.

Article 2

As from 1 January 1999 the currency of the participating Member States shall be the euro. The currency unit shall be one euro. One euro shall be divided into one hundred cent.

Article 3

The euro shall be substituted for the currency of each participating Member State at the conversion rate.

.
.
.

Article 6

1. The euro shall also be divided into the national currency units according to the conversion rates. Any subdivision thereof shall be maintained. Subject to the provisions of this Regulation the monetary law of the participating Member States shall continue to apply.

Article 7

The substitution of the euro for the currency of each participating Member State shall not in itself have the effect of altering the denomination of legal instruments in existence on the date of substitution.

....

.
.
.

Article 14

Where in legal instruments existing at the end of the transitional period reference is made to the national currency units, these references shall be read as references to the euro unit according to the respective conversion rates. The rounding rules laid down in Regulation (EC) No 1103/97 shall apply.

Annex 3: Currency codes and definition of sub-units of EU-currencies

Currency	Alphabetic code	Minimum multiples of units or sub-unit in use for scriptural payments	Smallest coin in circulation and still produced
Belgian/Luxembourg franc	BEF / LUF	1 franc	50 centimes*
German mark	DEM	1 Pfennig*	1 Pfennig*
Spanish peseta	ESP	1 peseta	1 peseta
French franc	FFR	1 centime*	5 centimes*
Irish punt	IEP	1 penny*	1 penny*
Italian lira	ITL	1 lira	50 lire
Dutch guilder	NLG	1 cent*	5 cent*
Austrian schilling	ATS	1 Groschen*	10 Groschen
Portuguese escudo	PTE	1 escudo	1 escudo
Finnish mark	FIM	1 penni	10 penni*
Euro	EUR	1 cent*	1 cent*

* Decimal sub-unit of the main unit

Annex 4: The use of bilateral rates

Table 1: Amounts up to which the application of bilateral rates with 6 significant figures leads to the same result as triangulation

		Converted from				
		BEF/LUX	DEM	ESP	FRF	IEP
to	BEF/LUX		51.31	1919	115.36	53.63
	DEM	431		1096	84.96	43.94
	ESP	3125	66.14		58.83	10.33
	FRF	442	13.23	2368		11.74
	IEP	8986	81.11	3543	47.59	
	ITL	448	100.13	480	10.68	1.86
	NLG	1843	51.00	506	74.42	14.43
	ATS	1275	25.18	919	11.5	4.81
	PTE	2600	25.34	3149	50.23	9.53
	FIM	549	59.11	1020	56.68	59.36

		Converted from				
		ITL	NLG	ATS	PTE	FIM
to	BEF/LUX	42982	26.84	276.8	2551	72.58
	DEM	50098	198.82	44.56	1329	354.5
	ESP	79359	14.91	15.91	11703	69.19
	FRF	3767	18.58	47.85	3789	33.94
	IEP	29096	137.98	625.05	4842	34.68
	ITL		141.64	31.22	1182	27.76
	NLG	6725		49.35	1385	40.96
	ATS	10815	13.24		1645	13.4
	PTE	4688	78.16	53.08		61.84
	FIM	1795	10.77	32.24	1793	

Note: The tables above show the amounts up to which the application of a bilateral rate with 6 significant figures leads to exactly the same result as the triangulation method. For example, in the case of a conversion from DEM to BEF, there is no deviation between the two methods for amounts up to 51.31 DEM. The application of a bilateral rate would not produce the correct result when converting an amount of 51.32 DEM. This is the first occurrence of a difference; there exist higher amounts which again lead to the same result as the use of the triangulation method.

Table 2

Amounts up to which the application of bilateral rates with 8 significant figures leads to the same result as triangulation

		Converted from				
		BEF/LUX	DEM	ESP	FRF	IEP
to	BEF/LUX		512.73	34260	3409.3	328.79
	DEM	26845		75077	1240.43	638.53
	ESP	162048	1354.24		1163.84	999.09
	FRF	4511	290.66	16530		398.32
	IEP	4309	654.55	27695	1265.78	
	ITL	12940	344.91	5698	426.66	36.34
	NLG	30191	258.04	17291	804.67	1519.69
	ATS	7380	299.88	26383	234.94	78.14
	PTE	17013	321.57	37450	643.36	304.62
	FIM	3868	286.34	364096	298.4	310.27
		ITL	NLG	ATS	PTE	FIM
to	BEF/LUX	171235	554.06	1645.67	86367	2336.65
	DEM	397845	10465.79	2347.5	95452	1046.04
	ESP	209498	1971.94	383.02	315413	552.75
	FRF	222326	431.03	533.31	29714	336.05
	IEP	422342	875.96	16745.22	71837	546.16
	ITL		179.61	632.14	39781	200.07
	NLG	49137		457.78	35889	569.32
	ATS	148411	504.00		98594	107.35
	PTE	61632	857.53	1299.58		1500.48
	FIM	69802	72.47	3985.37	28308	

See note to Table 1