Risk-Based-Margining

eurex clearing

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Abstract

This document details the methodology of Risk-Based Margining (RBM), which is Eurex Clearing's risk methodology for bond and equity transactions including repos and securities lending transactions as well as Exchange-Traded Funds (ETFs) and cash positions. The document contains several stylized examples showing the calculation steps behind Current Liquidating Margin (CLM; backwards-looking) and Additional Margin (AM; forwards-looking).

List of abbreviations

Term	Meaning
AI	Accrued interest
AM	Additional margin
CIR	Cash interest rate
CLM	Current liquidating margin
CLV	Current liquidating value
CLVC	Current liquidating value cash
CLVS	Current liquidating value security
CNP	Cash net position
CP	Cash position size
EWMA	Exponentially-weighted moving average
FHS	Full historical simulation
D	Down
DCP	Days since last coupon payment
DUSD	Days until settlement
DUTS	Days until notional settlement
LP	Last price on day T
LV	Liquidating value
MP	Margin Parameter
MP^{min}	Minimum value of margin parameter
MV	Position market value
NV	Nominal value
P	Equity market price
PnL	Profit and loss
R	Interest rate

Term	Meaning
RAIRU	Risk adapted market interest rate up
RAIRD	Risk adapted market interest rate - down
$S_{i,t}(T, 0)$	Value of security i on day t under the base scenario
SD	Settlement date
SP	Daily settlement price
SSP	Standard settlement period
STK	Number of equities
t'	Standard settlement period for a standard spot transaction
T	Number of calendar days between payment- and valuation date
T	Time to maturity of instrument i
T_{min}	Minimum time to maturity
TD	Trade date
TP	Trade Price
U	Up
VaR	Value-at-Risk
X	Security position
γ	Offset factor
ΔLV	Change in liquidating value
Δr_i	Security-specific basis point shift to the yield curve
$\Delta r_{ccy,\tau}$	Interest rate risk component of yield shift
$\Delta cs_{\gamma,\rho,ccy}$	Credit spread risk component of yield shift
$\Delta liq_{i,j,\rho}$	Liquidity risk component of yield shift
ρ	Correlation coefficient

1 Introduction

Eurex Clearing AG acts as the central counterparty and guarantees the fulfilment of all transactions in futures and options on Eurex as well as for other trading solutions such as EurexOTC Clear (interest rate swaps) and Eurex Repo (market for repurchase agreements).

This document details the methodology of Risk-Based Margining (RBM), which is Eurex Clearing's risk methodology for bond and equity transactions including repos and securities lending transactions as well as Exchange-Traded Funds (ETFs) and cash positions.[1]

In RBM, backwards-looking margin is called Cash Liquidating Margin (CLM) whereas forward-looking margin is called Additional Margin (AM). Additional margin is always essentially calculated as the product of the price of the security today multiplied by a so-called Margin Parameter (MP), which captures potential price fluctuation at the 99th percentile. However, RBM uses different models for the margin parameter depending on asset class.

Section 2 introduces the concepts of margin class and margin group, which are ways of grouping positions with similar underlyings and allow (partial) netting of opposite risks. The price as of the valuation date of a security or cash position is called the Current Liquidating Value (CLV), and from this value the general principles behind netting are demonstrated for CLM and AM.

Section 3 presents the margin parameter methodology for equity transactions and the section concludes with a detailed example.

Section 4 describes the bond methodology including a detailed example.

Finally, section 5 briefly describes Securities Financing Transactions (SFTs).

[1] Eurex Clearing's risk methodology Prisma is used for exchange-traded derivatives such as futures and options as well as for OTC interest rate and inflation derivatives. For more details cf. Eurex Clearing Prisma.

2 General Concepts

2.1 Netting

Positions are divided into cash and security legs, both of which can be processed either on gross or net basis, since transaction management for CCP eligible securities supports gross settlement handling. The security position represents the quantity of securities to be delivered or received, whereas the cash position describes the payable amount defined at execution time. Furthermore, corporate actions such as creation of subscription rights or payments of dividends can result in cash and/or security positions relevant for the margining process.

Positions marked for gross processing are not subject to settlement netting and must be considered independently, i.e. long and short positions do not compensate each other. From the CCP point of view they form either a security gross long or security gross short position.

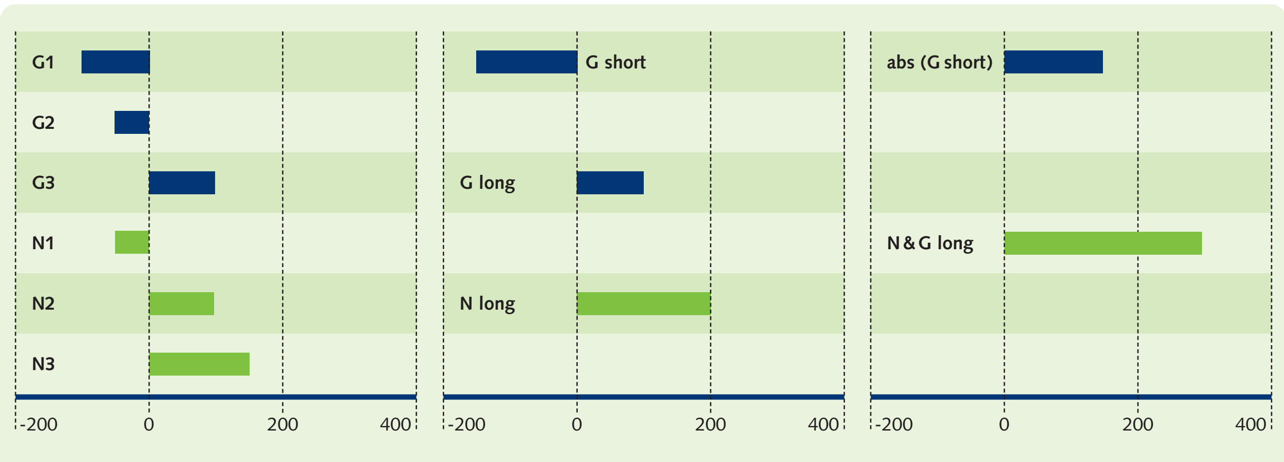
Net positions, on the other hand, can compensate each other so that totals of security positions and totals of payable amounts are aggregated. Net positions are constructed separately for the cash and security legs by grouping by currency, margin class, ISIN, and contractual settlement date. The result is one security and one cash net position either long or short.

Position aggregation and handling of net and gross positions is illustrated in Figure 1. The portfolio contains six positions[2], with long positions identified by positive numbers and short positions by negative numbers. The initial portfolio is shown in the box on the left, with gross positions in blue (G1–G3) and net positions in green (N1–N3).

The box in the middle of Figure 1 shows the first level of aggregation. All net positions are added, resulting in a single long or short position, in this case a net long position. For gross positions, all long positions are added to a single long position, and similarly for all gross short positions. The result is a single gross short position and a single gross long position.

The graph on the right shows the final step of the aggregation. The net position is added to the gross long position, resulting in a final single long position. This position and the remaining gross short position is input to the calculation of margin figures.

Figure 1: Gross and net aggregation



[2] Note that this example illustrates the general concept of gross and net positions, as the actual calculation does involve the trade prices summing up to the CLVs on the cash and security sides. The concept of CLV is defined in section 2.3 and detailed examples are found in section 3.3 for equities and section 4.3 for bonds.

2.2 Margin Classes and Margin Groups

A trade will depend on an underlying, either an equity or a bond. Based on the underlying, the RBM methodology groups positions in margin classes. For instance, if a company has issued several types of equity, positions on these equities can end up in the same margin class. Positions classified within the same margin class are subject to offsets/netting, allowing equal but opposite risks to cancel. Notice that currency is defined on margin class level.

Margin classes can be, but are not necessarily, further consolidated into margin groups. A margin group is a set of margin classes whose associated underlying instruments have proven to be significantly correlated and where the correlation is meaningful from an economic point of view. For example, state bonds belongs to the same margin group. In some cases, partial netting is allowed for product IDs related to the same margin group. First, pairwise correlations ρ_{30} and ρ_{250} between products assigned to margin classes within the same margin group are calculated based on data from the previous 30 and 250 business days, respectively. An offsetting effect between products of two margin classes within the same margin group is only granted if $\min(\rho_{30}, \rho_{250}) \geq 0.5$.

The details of netting at margin class and margin group level for the forward-looking margin are described in detail in sections 2.4–2.5.

2.3 Current Liquidating Value

The Current Liquidating Value (CLV) is the value of a cash or security position discounted from settlement date to the current valuation date (see Table 1).

A simple spot market transaction, for example a long security position (positive MV), results in a corresponding short cash position (negative CP). Following the above definition, the resulting $CLV_{Security}$ is negative and CLV_{Cash} is positive. As the security needs to be delivered to the holder of the long position after the settlement period, the value of $CLV_{Security}$ reflects the claim of the holder of the long position as it reduces the margin requirement due to the negative sign. On the other hand, the positive value of CLV_{Cash} reflects the future obligation of the holder of the long position, which needs to be covered with a margin, resulting in a margin debit.

In order to protect the CCP against shifts in market rates, the formula for CLV_{Cash} is based on conservative assumptions. The rate used to discount positive cash positions (RAIRD) is below market rates, thereby overstating the value of the expected cash receipt to the CCP. The rate used to discount negative cash positions (RAIRU) is above market rates, thereby understating the cost of the cash flow to the CCP.[3] The market rate shift leading to RAIRU and RAIRD is currently set by Eurex Clearing to ±100 bp, but may be revised at the discretion of the CCP.

Table 1: CLV calculation for cash and security positions

Client security position	Cash	Security
Long	$CLV_{Cash} = \dfrac{-CP}{1 + RAIRD \times \dfrac{t}{365}}$	$CLV_{Security} = \dfrac{-MV}{1 + r \times \dfrac{t'}{365}}$
Short	$CLV_{Cash} = \dfrac{-CP}{1 + RAIRU \times \dfrac{t}{365}}$	

Where:

CP	size of the cash position (CP is negative if the client is short on the cash leg and is positive if the client is long)
RAIRU, RAIRD	Risk adapted market interest rate up and down to provide protection of the CCP against changes in interest rates
t	number of calendar days between payment- and valuation date
MV	market value of the position equal to the payable amount. For equities $MV = X \times P$ while $MV = X \times (P + AI)$ for bonds
X	security position (negative for client short and positive for client long)
P	market price of the equity
AI	amount of accrued interest
r	interest rate relevant for the time period from the valuation date to the payment date
t'	standard settlement period for a standard spot transaction

[3] As the expression for $CLV_{Security}$ does not distinguish between discount rates for long and short positions, same-size long and short security positions will offset each other. However, due to the differences in discounting for long and short cash positions, the values of CLV_{Cash} do not sum to zero for otherwise identical long and short positions.

2.4 Current Liquidating Margin

The backward-looking margin for both security and cash positions is called Current Liquidating Margin (CLM). CLM covers losses that would occur if positions were closed out today. The basis for the CLM calculation is the current liquidating value, which is calculated individually for cash and security legs of positions as outlined in the previous subsection.

The difference between the current market price and the trade price determines whether a member receives a CLM margin credit or debit from a position. A long position leads to margin credit if the current market price is higher than the price at which the trade was made and a margin debit in case the current market price is lower than the trade price. The situation is reversed for short positions.

In order to calculate CLM, the CLVs of a security and cash position are added resulting in CLM for a position. The lowest calculation level is per settlement date within a margin class. The current liquidating margin for an aggregated net position in a margin class equals

$$CLM_{NET} = CLV_{cash,\,net} + CLV_{Security,\,net}$$

Note that the CLM_{NET} can also result in a negative value resulting in margin credit for the respective account. As already stated, for every gross position the CLM is calculated separately, as no netting is permissible. The gross position is only considered if it results in a margin requirement. Therefore CLM for a gross position in the margin class is calculated as

$$CLM_{GROSS} = \max\left(CLV_{Cash,\,gross} + CLV_{Security,\,gross},\, 0\right)$$

CLM of a margin class k equals the sum of the CLMs of all gross positions and aggregated net positions in the respective margin class, i. e.:

$$CLM^{k} = \sum CLM^{k}_{NET} + \sum CLM^{k}_{GROSS}$$

2.5 Additional Margin

Additional Margin (AM) is the forward-looking margin, which covers losses on a pre-defined confidence level. It is the difference between the worst case liquidating value resulting out of the projection for the given confidence level and the current price. A central concept is the Margin Parameter (MP), which, when applied to the current market price, gives a conservative estimate of the price at confidence level 1% and 99% (covering short and long positions, respectively). The parameter is calibrated at product level from the distribution of profit-and-loss (PnL) scenarios based on historical market data movements with respect to the assumed holding period. The calculation of the margin parameter is described for equities in section 3 and for bonds in section 4.[4]

Relevant margin measures and their methodologies (described in detail in coming sections) are summarised in Table 2 below.

Table 2: Margin Models

	CLM	AM			
		Volatility-based	Bond Model	GC Pooling	Manual Override
Equity					
ETF					
Bonds, Special Repos, Sec lending					
GC Pooling Repos					
Cash positions					

[4] ETF margin parameters are either given by expert judgment or from a volatility-based model as for equities and will therefore not be discussed further.

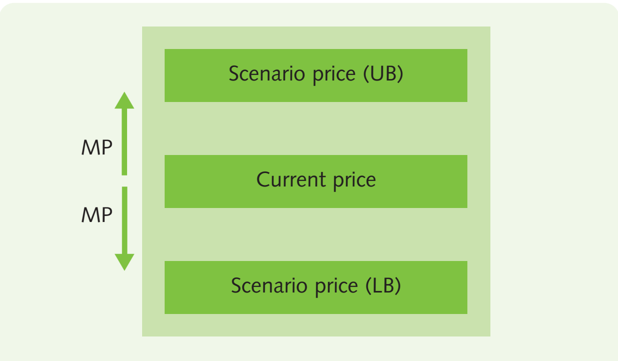
2.5.1 Calculation of Worst-Case Scenario Exposures

Though additional margin is well-defined on security level, the lowest calculation level is margin class level, i.e. positions of several instruments based on the same underlying is margined together. However, for the spot market the majority of margin classes consist of a single security for which a calculation on margin class level will not differ to a security level calculation.

This process provides capital efficiency, offsetting similar but opposing positions leading to considerably less margin requirement on account level than if the sum of all margin requirements for each individual position had to be provided separately.

To obtain AM on margin class level, the first step is to calculate the worst case scenario exposures. Several input variables need to be defined for this calculation. First, the concept of risk array is introduced. A risk array consists of all projected scenario exposures and the current price. Figure 2 illustrates the simple case for a single security margin class.

Figure 2: Risk array for a margin class consisting of a single security



If the margin class contains one security, the risk array construction is straightforward. Take as example a bond margin class consisting of a single security. The risk array will consist of the three elements upper bound and lower bound security prices calculated using the margin parameter and the current price of the bond. Additional margin is determined from the loss side of the two projected bounds depending on the position size within the respective portfolio.

2.5.2 Additional Margin for a Margin Class

For margin classes containing a single security the risk array is simple, consisting of the boundaries and the settlement price as discussed in the previous subsection. For spot market products, AM is only calculated for security positions, as the cash side already reflects a forward-looking component within the CLM calculation. Recall from section 2.1 the calculation of net and gross positions. The potential result was either one position on the long or short side, or two positions on both sides in case of existing gross positions in different directions.

For a positions rp and scenario i associated with a margin class k, the following liquidating values $\Delta LV_i^{k,rp}$ are calculated[5]:

Table 3: ΔLV (liquidating value) for securities

	Risk Position-Short
i: Up	$LV_{UB}^{k,rp-short}\left(X_{short}\right) - CLV^{k,rp-short}\left(X_{short}, P\right)$
i: Down	$LV_{LB}^{k,rp-short}\left(X_{short}\right) - CLV^{k,rp-short}\left(X_{short}, P\right)$

Where:
- X equals the quantity of securities (negative for a member short position).
- P is the settlement price.
- UB upper bound
- LB lower bound

An identical calculation is performed for a long position where $X_{long} > 0$.

The following ΔLVs are used per security position rp in the margin class k:

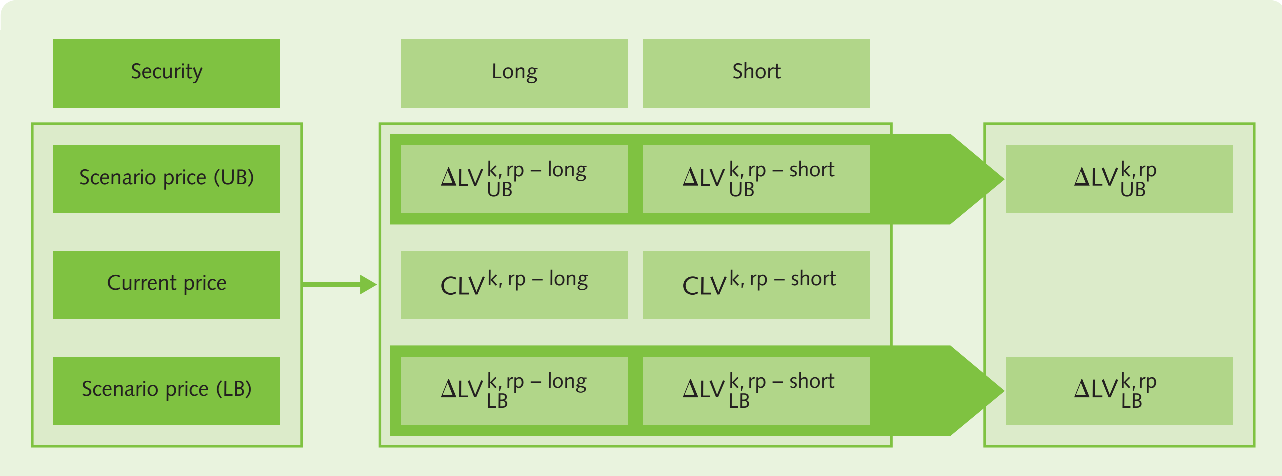
$$\Delta LV_{UB}^{k,rp} = \max\left(\Delta LV_{UB}^{k,rp-short}, \Delta LV_{UB}^{k,rp-long}\right)$$

$$\Delta LV_{LB}^{k,rp} = \max\left(\Delta LV_{LB}^{k,rp-short}, \Delta LV_{LB}^{k,rp-long}\right)$$

Figure 3 illustrates the above outlined calculation for long and short security positions. The largest difference between the scenario liquidation values for long and short position compared to CLV is determining the two respective scenarios.

[5] Omitting for clarity that CLV for bonds also depends on accrued interest.

Figure 3: Calculating ΔLV for a security margin class



If margin class k contains multiple securities, the $\Delta LV_i^{k,rp}$ are aggregated for the two scenarios up and down. The larger of the two scenario values is defined to be the additional margin of the margin class, if the margin class is not assigned to a margin group.

2.5.3 Additional Margin for a Margin Group

RBM allows partial forward-looking risk netting of positions in different margin classes if these margin classes belong to the same margin group.

Additional margin on margin group level is determined by an overall worst-case scenario. Depending on the net position in a margin class, the underlying upshift scenarios might result in AM debit or credit. Remember that for each margin class k, worst-case price-up and price-down scenarios were calculated:

- Prices Up: ΔLV_u^k
- Prices Down: ΔLV_d^k

All scenario profits which result in margin credit on margin class level are adjusted with an offset factor γ, between 0 and 1. Offset factors greater than zero are allowed in case of significant and reliable correlations between the securities that are driving the margin classes. Offset-adjusted scenario values are defined for margin class k as:

$$\Delta LV_i^{k,adj} = \begin{cases} \Delta LV_i^k & \text{if } \Delta LV_i^k \geq 0 \\ \gamma \times \Delta LV_i^k & \text{if } \Delta LV_i^k < 0 \end{cases}, \quad i = u,d$$

Table 4 demonstrates aggregation in case of a margin group consisting of three margin classes.

Table 4: Aggregated margin group ΔLV

Level	Up	Down
MC1	$\Delta LV_u^{1,adj}$	$\Delta LV_d^{1,adj}$
MC2	$\Delta LV_u^{2,adj}$	$\Delta LV_d^{2,adj}$
MC3	$\Delta LV_u^{3,adj}$	$\Delta LV_d^{3,adj}$
MG	$\sum_k \Delta LV_u^{k,adj}$	$\sum_k \Delta LV_d^{k,adj}$

Given the aggregated scenario values of the margin group, additional margin for the margin group is defined as:

$$AM_{MG} = \max_{p=u,d} \left(\sum_k \Delta LV_p^{k,adj} \right)$$

Risk figures for individual margin classes are evaluated in a single currency. Therefore, currency differences must be taken into account during aggregation from margin class to margin group level. Margin class scenario PnLs are converted to reporting currency using adjusted exchange rates, i.e. FX rates to which a haircut has been applied. Given the converted scenario values, the relevant worst-case scenario is determined as described above The result of this process is margin group impact-adjusted additional margin on margin class level per currency.

3 Equities

3.1 Equities

A transaction in spot equities is an exchange of securities for cash. An investor with a long equity position acquires a specific number of shares of a certain security at a specific point in time (standard settlement period) for a specific amount (delivery versus payment). At settlement, the short position receives the agreed-upon price and is required to deliver the security.

The lowest level of aggregation for equities is the position per ISIN.

3.2 Margin Parameter

A volatility-based model is used for the margin parameter for equities. Risk factor EWMA (Exponentially-Weighted Moving Average) volatilities from 30 days and 250 days lookback periods, respectively, are calculated daily. The maximum of these volatilities is scaled to the 99th percentile. The result is floored by a minimum value to limit procyclicality. This minimum value is calculated as the 99th percentile of a time series of absolute log returns with a look-back period of 10Y. Finally, a multiplicative liquidity add-on is applied to the margin parameter to account for illiquidity.

3.3 Example

This example serves as a demonstration for the determination of positions. For this reason, only trades of one trading participant in one security are considered.

All trades that are not marked for gross processing are accumulated and result in an (aggregated) net position either long or short. Trades that are marked for gross processing individually represent a position. Positions are split into a security side and a cash side. Additionally in this example, a positive (negative) sign next to the number of shares means that the respective member receives (delivers) equities. A positive (negative) sign in front of the payable amount means that the respective member receives (pays) cash payments.

Table 5: Sample parameters for example of equity risk calculation

Parameter name	Abbreviation	Value
Equity ISIN	-	DE0005810055 Deutsche Börse AG
Margin parameter	MP	10%
Cash interest rate	CIR	5%
Risk adapted interest rate – up	RAIRU	6%
Risk adapted interest rate – down	RAIRD	4%
Standard settlement period	SSP	2
Days until settlement	DUSD	2
Daily settlement price	SP	EUR 39.10

Table 6: Sample equity portfolio

Trade ID	Trade buy/sell	Processing method	Number of shares	Trading price (EUR)	Payable amount (EUR)
1	Buy	Net	+200	42.10	−8,420.00
2	Buy	Net	+100	43.20	−4,320.00
3	Sell	Net	−50	40.65	+2,032.50
4	Buy	Gross	+100	38.80	−3,880.00
5	Sell	Gross	−50	38.00	+1,900.00
6	Sell	Gross	−100	41.00	+4,100.00

In this example, the aggregation of net positions amounts to:

Table 7: Aggregation of equity portfolio – net positions

Trade ID	Number of shares	Trading price (EUR)	Payable amount (EUR)
1	+200	42.10	−8,420.00
2	+100	43.20	−4,320.00
3	−50	40.65	+ 2,032.50
Security long and cash short aggregated net position	**+250**		**−10,707.50**

Positions marked for gross processing amount to:

Table 8: Aggregation of equity portfolio – gross positions

Trade ID	Number of shares	Trading price (EUR)	Payable amount (EUR)
4	+100	38.80	−3,880.00
Security long and cash short gross position 1	**+100**		**−3,880.00**
5	−50	38.00	+1,900.00
Security short and cash long gross position 2	**−50**		**+1,900.00**
6	−100	41.00	+4,100.00
Security short and cash long gross position 3	**−100**		**+4,100.00**

Now, CLVs are calculated for the aggregated net position and the gross positions. Denoting by STK the number of equities and by CNP the cash net position, CLV is determined by the expressions

$$CLV_{equity} = \frac{STK \times SP}{\left(1 + CIR \times \frac{SSP}{365}\right)}$$

$$CLV_{cash}^{(short)} = \frac{CNP}{\left(1 + RAIRD \times \frac{DUS}{365}\right)}$$

$$CLV_{cash}^{(long)} = \frac{CNP}{\left(1 + RAIRU \times \frac{DUS}{365}\right)}$$

Table 9: Current Liquidating Values (CLV) and Current Liquidating Margin (CLM) for sample equity portfolio

Security Long / Cash Short (EUR)		Security Short / Cash Long (EUR)	
Current Liquidating Margin			
Net position (trades 1–3)		Net position (trade 5)	
CLV security: –250 × 39.10 / (1 + (5% × 2/365))	–9,772.32	CLV security: –(–50) × 39.10 / (1 + (5% × 2/365)	1,954.46
CLV cash: –(–10,707.50) / (1 + (4% × 2/365))	10,705.15	CLV cash: –1,900.00 / (1 + (6% × 2/365))	–1,899.38
CLM	932.83	CLM	55.09
Gross position 1 (trade 4)		Gross position 3 (trade 6)	
CLV security: –100 × 39.10 / (1 + (5% × 2/365))	–3,908.93	CLV security: –(–100) × 39.10 / (1 + (5% × 2/365))	3,908.93
CLV cash: –(–3,880.00) / (1 + (4% × 2/365))	3,879.15	CLV cash: –4,100.00 / (1 + (6% × 2/365)	–4,098.65
CLM	–29.78	CLM	–189.72
Current Liquidating Margin (EUR)		**Unadjusted Margin**	**Adjusted Margin**
For the net risk position (trades 1–3)		932.83	932.83
For the gross risk position 1 (trade 4)		–29.78	0.00
For the gross risk position 2 (trade 5)		55.09	55.09
For the gross risk position 3 (trade 6)		–189.72	0.00
Current Liquidating Margin (EUR)			**987.92**

Total CLM is the sum of all positive margin values (margin debit). Negative margin values (margin credit) are floored at zero. In this example, the margin credits of the gross positions 1 and 3, resulting from trade 4 and 6, do not offset any margin debits within the CLM.

The first step in the calculation of additional margin is to determine the sum of the long and short security positions (gross positions and the aggregated net position). Aggregated long net position and the corresponding security long (or short) gross positions are grouped as follows:

Table 10: Grouping gross and net positions

	Number of Equities		Number of Equities
Security long and cash short aggregated net position	+250	Security short and cash long gross position 2	–50
Security long and cash short gross position 1	+100	Security short and cash long gross position 3	–100
Total security long position and cash short position	**+350**	**Total security short position and cash long position**	**–150**

The ΔLV is now calculated for the resulting positions. Consider the price shifted up and down, respectively, by the margin parameter:

$$PU = SP \times (1 + MP)$$
$$PD = SP \times (1 - MP)$$

The current liquidating value is:

$$CLV = \frac{-STK \times SP}{\left(1 + CIR \times \frac{SSP}{365}\right)}$$

Similarly, liquidating values in the up and down scenarios are:

$$LVU = \frac{-STK \times PU}{\left(1 + CIR \times \frac{SSP}{365}\right)}$$

$$LVD = \frac{-STK \times PD}{\left(1 + CIR \times \frac{SSP}{365}\right)}$$

From this:

$$\Delta LVU = LVU - CLV$$
$$\Delta LVD = LVD - CLV$$

Table 11: Additional margin for sample equity portfolio

Security long position and cash short position		Security short position and cash long position	
Additional Margin			
Maximum Price – Up PU = 39.10 × (1 + 0.1)	43.01	Maximum Price – Up PU = 39.10 × (1 + 0.1)	43.01
Maximum Price – Down PD = 39.10 × (1 – 0.1)	35.19	Maximum Price – Down PD = 39.10 × (1 – 0.1)	35.19
Liquidating Value – Up –350 × 43.01 / (1 + (5% × 2/365))	–15,049.38	Liquidating Value – Up –(–150) × 43.01 / (1 + (5% × 2/365))	6,449.73
Liquidating Value – Down –350 × 35.19 / (1 + (5% × 2/365))	–12,313.13	Liquidating Value – Down –(–150) × 35.19 / (1 + (5% × 2/365))	5,277.05
CLV –350 × 39.10 / (1 + (5% × 2/365))	–13,681.25	CLV –(–150) × 39.10 / (1 + (5% × 2/365))	5,863.39
ΔLVU = LVU – CLV ΔLVD = LVD – CLV	–1,368.13 1,368.13	ΔLVU = LVU – CLV ΔLVD = LVD – CLV	586.34 –586.34

Additional margin is set to the maximum of the ΔLVU and ΔLVD; in this example, AM = EUR 1,368.13. Finally, the total margin requirement is determined as the sum of additional margin and current liquidating margin.

Table 12: Total margin for sample equity portfolio

Total Margin	
Current Liquidating Margin	987.92
Additional Margin	1,368.13
Total Margin	2,356.05

4 Bonds

4.1 Bonds

A transaction in bonds is the exchange of fixed income securities for cash. The buyer acquires the par value of a specific bond at a specific point in time for a specific amount. At settlement, the seller receives the sales price from the buyer and is required to deliver the bond. In addition to the sales price, the buyer is required to pay the accrued interest on the bonds from last coupon payment up to settlement date.

Similar to equities, bond trades are separated into cash and security positions for margining purposes. For example, a bond trade to deliver EUR 100,000 nominal bonds to the CCP against a payment of EUR 99,950 from the clearing house on a certain date would be treated as two separate positions as follows:

- Short position: Bond position with nominal EUR 100,000
- Long position: Cash position of EUR 99,500

Transaction management for gross positions is described in section 2.1.

4.2 Margin Parameter

Single security margin parameters are defined at security level as:

$$MP_{i,t} = \max\left(MP^{min}_{\gamma,\rho,CCY}, \left(\frac{S_{i,t}(\max(T, T_{min}), \Delta r_i(\tau))}{S_{i,t}(T,0)} - 1\right)\right)$$

where

$S_{i,t}(T,0)$	Value of security i on day t under the base scenario
Δr_i	Security-specific basis point shift to the yield curve
$MP^{min}_{\gamma,\rho,CCY}$	Minimum value of margin parameter
T	Time to maturity of instrument i
T_{min}	Minimum time to maturity

Since bonds that are very close to maturity will exhibit unreasonably small margin parameters, the minimum time to maturity has been introduced to ensure a stable margin parameter floor.

Bond shifts are security specific and depend on instrument characteristics (currency, tenor, credit cluster, rating, liquidity cluster). Shifts are obtained by combining three key components:

$$\Delta r_i = \Delta r_{CCY,\tau} + \Delta cs_{\gamma,\rho,CCY} + \Delta liq_{i,j,\rho}$$

with

$\Delta r_{CCY,\tau} \geq 0$	Interest rate yield shift for currency CCY and tenor τ
$\Delta cs_{\gamma,\rho,CCY} \geq 0$	Credit spread yield shift for credit cluster γ (rating ρ for Credit Sector Model) and currency CCY
$\Delta liq_{i,j,\rho} \geq 0$	Liquidity Adjustment-driven yield shift of security i within liquidity cluster j and rating ρ

Yield shifts are applied to current yield curve levels and a re-valuation of securities is performed to compute the actual margin parameter.

The interest rate and credit components of the yield shift are determined by applying a multi-component model to the bond risk factors. The model is a Full Historical Simulation (FHS) Value-at-Risk (VaR) model with a 3Y lookback period with VaR taken at the 99th percentile. Furthermore, the model is subject to an anti-procyclicality measure (10Y unfiltered VaR acting as a floor to limit procyclicality) as well as model add-ons. The liquidity component is based on a product and market characteristics.

Finally, ECB bond haircuts are used for GC pooling repos.

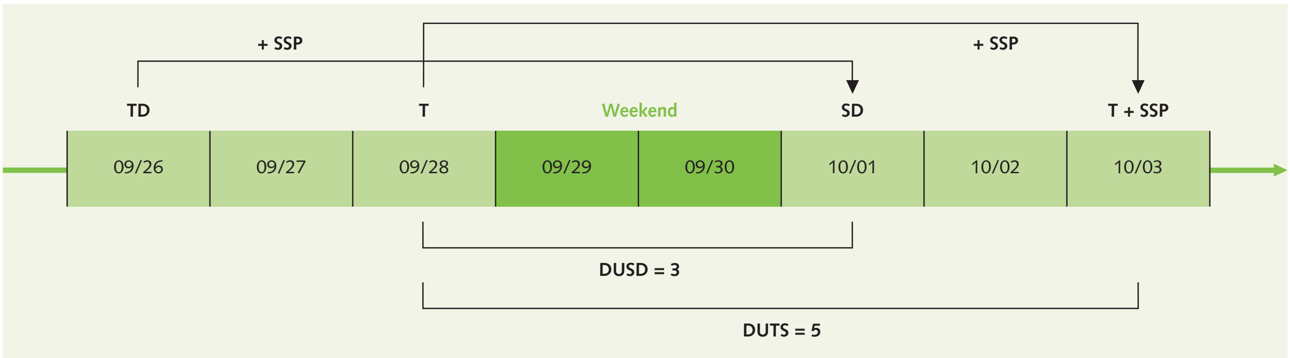
4.3 Example

This is an example in which a bond is sold and margin is calculated from the point of view of buyer and seller. Table 13 below contains bond and margin parameters whereas Table 14 shows the relationships between the dates that are relevant for the margin calculation.

Table 13: Sample parameters for example of bond risk calculation

Parameter name	Abbreviation	Value
Bond ISIN	-	DE0001141349
Coupon	C	4.250%
Margin class	-	DE40
Margin parameter	MP	0.750%
Trade date	TD	09/26/2001
Day of assessment	T	09/28/2001
Settlement date	SD	10/01/2001
Notional settlement date (T + SSP)	T+SSP	10/03/2001
Nominal value	NV	5,000,000
Trade price	TP	101.355
Last price on day T	LP	101.540
Accrued interest	AI	2.643%
Cash interest rate	CIR	3.120%
Risk adapted interest rate – up	RAIRU	4.120%
Risk adapted interest rate – down	RAIRD	2.120%
Standard settlement period	SSP	3
Days until settlement	DUSD	3
Days until notional settlement	DUTS	5
Days since last coupon payment	DCP	225

Table 14: Bond dates relationships



The Cash Net Position, CNP, is the amount due from the buyer at date SD:

$$CNP = \frac{NV}{100}\left(TP + 100 \times C \times \frac{DCP}{365}\right)$$

The present value of the cash (C) net position is the Current Liquidating Value, or CLVC. The values in the up and down scenarios are denoted CLVCU and CLVCD, respectively:

$$CLVCD = \frac{CNP}{1 + RAIRD \times \frac{DUSD}{365}}$$

$$CLVCU = \frac{CNP}{1 + RAIRU \times \frac{DUSD}{365}}$$

On the security (S) side, the Current Liquidating Value, CLVS, is the notional present value of a notional CNP due T+3 in case Eurex Clearing must organise a buy-in on day T:

$$CLVS = \frac{NV}{100} \times \frac{LP + 100 \times AI}{1 + CIR \times \frac{DUTS}{365}}$$

Current Liquidating Margin is calculated as:

$$CLM \text{ (bond buyer)} = CLVCD - CLVS$$
$$CLM \text{ (bond seller)} = - CLVCU + CLVS$$

Finally, additional margin AM is calculated from MP as:

$$AM = MP \times \frac{NV}{100} \times LP \times \frac{1}{1 + CIR \times \frac{DUTS}{365}}$$

Table 15 contains the details of the margin calculation and the resulting margin figures.

Table 15: Margin calculation for sample bond trade

Buyer of the bonds	Value (EUR)	Seller of the bonds	Value (EUR)
Current Net Position			
CNP 5,000,000/100 × (101.355 + (100 × 0.425 × 225 / 365))	5,198,743.15	CNP 5,000,000/100 × (101.355 + (100 × 0.425 × 225 / 365))	5,198,743.15
Current Liquidating Margin			
CLVCD (Cash): 5,198,743.15 / 1.0001742	5,197,837.45	CLVCU (Cash): –5,198,743.15 / 1.0003386	5,196,983.30
CLVS (Bond): –50,000.00 × 104.1384915	–5,206,924.57	CLVS (Bond): 50,000.00 × 104.1384915	5,206,924.57
CLM	–9,087.13	**CLM**	9,941.28
Additional Margin			
50,000 × 0.7612247	38,061.23	50,000 × 0.7612247	38,061.23
Total Margin			
Current Liquidating Margin Additional Margin	–9,087.13 38,061.23	Current Liquidating Margin Additional Margin	9,941.28 38,061.23
Total Margin	28,974.10	Total Margin	48,002.51

5 Securities Financing Transactions

The methodology described in previous chapters is used in the risk assessment of Securities Financing Transactions (SFTs). Below is briefly described the types of SFTs that are relevant for RBM.

A repo transaction is the sale of a security (front leg) for cash with the simultaneous agreement to repurchase the security (term leg). In return for payment of a specific amount, the buyer receives the agreed number (par value) of a specified bond that will be re-sold at an agreed-upon future point in time at a specific price plus accrued interest (delivery versus payment). Given the agreed repurchase, a repo transaction is simply a temporary exchange of bonds for cash between two parties.

From the point of view of margining, there is no difference between standard cash market transactions and repo trades. The traded instruments are equal and the only difference is that a repo consists of two legs with opposite directions. On the trade date, a repo transaction is split into two separate bond trades, one for the front leg and one for the term leg. At settlement of the front leg, the credit amount (cash) is transferred from the cash provider to the cash taker while the security is transferred in the opposite direction, creating cash and security position. At settlement of the term leg, the principal amount plus interest at the repo rate is transferred as a cash position and the bond is exchanged back, resulting in a security position in RBM. Cash payments adjusting for the coupon payments between the two repo legs are creating additional cash positions with settlement date equal to the coupon date for the related bond position.

RBM distinguishes between two repo markets:

Specific Repo Market ("Special repos"): Repos traded on securities or on specific securities chosen out of these collateral baskets.

GC Pooling Market: GC Pooling is repo trading on predefined security baskets. The securities are selected from the collateral pool of the cash taker. In contrast to a normal repo, it is the value of the claim amount, i.e. the cash leg, which is agreed upon and collateral is reallocated to reflect changes in its valuation.

In a securities lending trade the lender transfers securities to the borrower in exchange of collateral in the form of cash or non-cash (other securities). The borrower is obliged to return the securities to the lender at maturity and has to pay a fee for the transaction.

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