London SPAN Version 4
Margin Specification Changes

Version 1.0

10th March 2001

Contents

1 Introduction

London SPAN Version 4 is an upgrade from Version 3, also known as LME SPAN.

This document contains the full revised margin algorithm specification, highlighting the changes from version 3 to Version 4. In summary, the changes are as follows:

- Strategy Spread Charge Method – A new step in the interprompt spread charge calculation
- Intercontract Spread Method 1 – This method has now been replaced
- Multi-Tier Intercontract Spread Credit Method – A multi-tier version of the original intercontract spread method (method 1)

Note that we aim to remove Intercontract Spread Method 2 as soon as is practicable.

Changes are highlighted throughout this document in ***bold italics***.

2 London SPAN Calculation Overview

In order to calculate SPAN margins, the following steps should be followed where applicable:

2.1 Receive Risk Arrays

- One array for each futures contract expiry in each contract in its original currency
- One discounted array for each forward contract prompt date in each contract in its original currency
- One array for each call at each strike for each expiry in each contract in its original currency
- One array for each put at each strike for each expiry in each contract in its original currency

2.2 Receive parameters

- Interprompt and intercontract tier definitions
- Interprompt spread charge rates and spreading priorities
- Prompt date charge rates
- Short option minimum rates
- Intercontract spreads
- Intercontract spread priorities
- Intercontract spread credit rates
- Delta ratios for all contracts in all spreads
- Foreign exchange (FX) spot rates
- Spot FX rate adjustment percentage

2.3 Calculate Scanning Risk

a) Select a combined contract where the portfolio has positions

b) Select a contract currency where the portfolio has positions

c) Calculate total loss values for this currency

d) Repeat steps b) and c) until all currencies have been processed

e) Calculate total losses for this combined contract in the margin currency[1]

f) Calculate scanning risk for the combined contract

2.4 Calculate Interprompt Spread and Prompt Date Charges

a) Total prompt date net deltas

b) Select the strategy spread type that has the highest priority, where applicable

c) Form all possible spreads of this type

d) Calculate Spread Charge for this spread type

e) Repeat steps b) to d) for all remaining strategy spreads

f) Calculate total remaining delta for all interprompt tiers

g) Select the multi-tier spread type that has the highest priority, where applicable

h) Form all possible spreads of this type

i) Calculate Spread Charge for this spread type

j) Repeat steps g) to i) for all remaining multi-tier spreads

k) Calculate total Interprompt Spread Charge for the combined commodity

l) Calculate prompt date charges for each prompt date

m) Calculate total Prompt Date Charges for the combined contract

2.5 Calculate Combined Contract Risk

- Combined Contract Risk = Scanning Risk + total Interprompt Spread Charge + total Prompt Date Charge

2.6 Calculate Intercontract Spread Credits, where applicable

For combined contracts as defined by the Contract Group:

a) Select the intercontract spread type that has the highest priority

[1] Margin currency refers to the currency specified by LCH in the parameter files as the currency in which margin calculations for combined contracts are performed. This is generally the same as the contract currency. Where they differ, currency conversion is to be performed.

b) Form all possible spreads of this type

c) Calculate the Spread Credit for this spread type

d) Repeat steps a) to c) for all allowable spreads. Work from the highest priority to the lowest priority

e) Intercontract Spread Credit = Sum of Spread Credits of all Spreads for the combined contract within the margin currency

2.7 Calculate Combined Contract Risk where there are intercontract spreads

For the combined contracts selected in step 2.6 within the Contract Group:

a) Combined Contract Risk = Combined Contract Risk in margin currency - total Intercontract Spread Credit in margin currency

b) If Combined Contract Risk is less than zero, then:
Combined Contract Risk = 0

2.8 Calculate Short Option Minimum Charge

For each combined contract:

a) Count the number of short option positions (i.e. number of short lots) within each contract within the combined contract

b) Multiply this number by the Short Option Minimum Rate for the combined contract in the margin currency. The result is the Combined Contract Short Option Minimum Charge, which is compared to the Combined Contract Risk as detailed below.

2.9 Calculate Combined Contract Initial Margin

For each combined contract after intercontract spreads have been deducted i.e. as in step 2.6:

a) Compare Combined Contract Risk to Short Option Minimum Charge. Select the larger value. **Do not add the values together**

b) Combined Contract Initial Margin = Result in step a).

2.10 Repeat steps 2.3 to 2.9 for all Combined Contracts within the portfolio

2.11 Calculate Portfolio Initial Margin:

Portfolio Initial Margin = Sum of Combined Contract Initial Margins in the margin currency.

3 London SPAN Version 4 Concepts

3.1 Risk Arrays

Risk arrays and scanning risk are the heart of SPAN. Each option, future and forward contract has its own risk array. Each risk array is recalculated every day. Risk arrays contain value losses in ticks and deltas. All risk arrays have the same general structure.

The value losses of a risk array summarise how an option, future or forward contract reacts to various scenarios of changing market conditions. Each value shows one long contract's price change in ticks from the previous closing price.

To construct these scenarios, SPAN changes the price of the underlying contract[2] and implied volatility over given ranges for "n" days forward (where n = 1 for example). Risk arrays for futures and forward contracts have the same structure as options' risk arrays. The forward contract value losses are discounted to present value by applying discount factors derived from fixed interest rates for the currency of the forward contract. **Option on forward risk arrays are not discounted if they are premium-paid up front.**

LCH, after consultation with the exchange sets scanning ranges and volatility shifts to cover changes in underlying futures and forward prices and implied volatilities. Scanning ranges are set by combined contract in the margin currency and converted to the other currencies. Volatility ranges can be specified by prompt date for a combined contract and may have independent up and down shifts.

The composite delta is used in interprompt and prompt date additional charges, and in intercontract spread credits.

3.2 Combined Contracts and Contract Codes

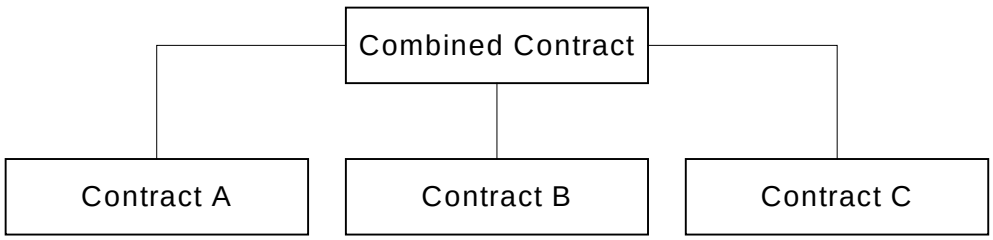
The purpose of the combined contract code is to indicate that there can be multiple contract codes which refer to the same underlying contract and which are treated as one for the purpose of margin calculations.

For each combined contract code, any number of individual contract codes and generic contract types (future/option) can be specified as belonging to the combined contract. Examples of this grouping are:

- A futures contract, and options on that future
- Multiple currency variants of LME metals forwards
- Equity options, Universal Stock Futures and the underlying stock
- American and European style FTSE 100 options
- FTSE 100 Futures and Mini-Futures

[2] For example, futures contract price at the relevant prompt date.

The combined contract concept is illustrated below:



3.3 Interprompt and Intercontract Tiers

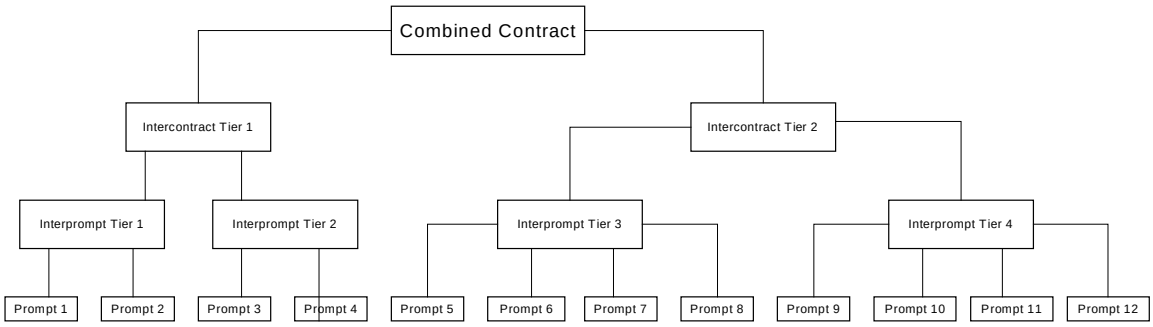
London SPAN Version 3 (LME SPAN) introduced the concept of "tiers" of prompt dates in order to implement a flexible approach to the calculation of interprompt and prompt date spread charges. ***London SPAN Version 4 extends this concept with the introduction of a tiered approach to the calculation of intercontract spread credits.***

The tiering of contracts is organised as a simple hierarchy:

a) Each interprompt tier is composed of one or more futures or forwards prompts, and

b) Each intercontract tier is composed of one or more whole interprompt tiers.

This tier structure is illustrated below:



4 Scanning Risk

4.1 Loss Values

Scanning risk is SPAN's most basic portfolio risk calculation. It is a worst-case portfolio loss i.e. it cannot ever be a portfolio gain.

The following example calculates the scanning risk for a portfolio with positions in one combined contract in US Dollars.

For this combined contract:

a) Select the arrays where this portfolio has positions. Ignore the arrays where this portfolio does not have positions.

b) Multiply each value on each selected array by the corresponding position (i.e. number of lots), tick value and lot size. This step yields 16 different value losses. Round these to the nearest currency unit as defined by the rounding definitions below.

> For long forwards, long calls and long puts, multiply by a positive position size. For short forwards, short calls and short puts, multiply by a negative position size.
>
> e.g.: If a position is long 2 calls, multiply by +2
> If a position is short 2 calls, multiply by -2

c) For each scenario, add across value losses. This step yields 16 different total losses. Ignore any differences between prompt dates or expiries.

d) Scanning risk equals the largest total loss for the contract.

e) If all the total losses are negative (i.e. they are all gains, which may occur in certain exceptional portfolios) then the scanning risk is set to zero.

Notes of Arithmetic:

a) A negative times a positive yields a negative. A negative times a negative yields a positive.

b) Subtracting a negative is the same as adding a positive.

c) Any positive is larger than any negative. Zero is larger than any negative. -1 is larger than -2, -2 is larger than -3, and so on.

4.2 Rounding Definitions

SPAN uses the rounding principle that **any values are rounded as soon as they are converted to a currency**. For example in "2. Scanning Risk" above, when value losses in ticks are expressed as scenario value losses in currency units, rounding is applied to each value loss. Later sections on Interprompt and Prompt Date Charges, and on Intercontract Spreading, will describe how position delta values are multiplied by rates to give charges: again as soon as a value in a currency is obtained, rounding is applied even if a series of such values are added to generate a total.

The rounding rules are obtained from the currency exponent for a given currency code. The level of rounding is defined by calculating the value of 10 to the power of the currency exponent:

Contract Currency Code	Currency Exponent	Rounding Level	Description of Rounding
USD	0	$10^0 = 1$	nearest currency unit
GBP	0	$10^0 = 1$	nearest currency unit
EUR	0	$10^0 = 1$	nearest currency unit
JPY	2	$10^2 = 100$	nearest hundred currency units

4.3 Intercurrency Risk

SPAN allows forwards, futures and options contracts based on the same underlying but in different currencies to be treated as a single portfolio. The initial margin will then be calculated in the margin currency. The offset of risk arrays across currencies reduces overall portfolio risk where appropriate.

The 16 total losses for a combined contract may be calculated in any of the currencies in which contracts are traded on the exchange. For example, LME metals are traded in US Dollars, Sterling, Euros and Japanese Yen. LCH and the exchange will designate which is the margin currency used for LCH margins.

LCH in consultation with the exchange determines adjustment percentages that are applied to spot currency exchange rates to allow for their potential to change.

4.3.1 LME Forwards

For a given combined contract, SPAN uses the total losses based on discounted[3] forwards risk arrays and undiscounted options risk arrays for contracts within the combined contract, together with adjusted SPOT foreign exchange rates, to derive total losses in the margin currency for each combined contract.

4.3.2 Total Losses in the Margin Currency

Total losses for a combined contract are calculated in the margin currency, which is currently designated by LCH in consultation with the exchange. For LME contracts this is US Dollars.

4.3.3 Scanning Ranges for Contracts not in the Margin Currency

Contracts having the same combined contract code require a consistent scanning range to produce risk arrays. The scanning range will be set by LCH in consultation with the exchange for a combined contract in the margin currency. Scanning ranges in the other currencies are necessary as intermediate stages of calculation. They are derived from the margin currency scanning range by using appropriate currency exchange rates for each day.

4.3.4 Steps Required to Produce the Scanning Risk in the Margin Currency

Within a combined contract:

[3] Options risk arrays do not need discounting as options' premiums are paid "up front".

4.3.4.1 Convert total losses for separate contracts to the margin currency

a) Calculate the separate total losses for the positions in contracts in the different currencies e.g. four sets of 16 total loss scenarios, for CAD, CAS, CAM and CAY.

b) Multiply the Sterling total losses by the Sterling/Dollar upwards adjusted spot currency exchange rate ("FX rate") to convert each total loss to US Dollars at the higher rate.

c) Multiply the Sterling total losses by the Sterling/Dollar downwards adjusted FX rate to convert each total loss to US Dollars at the lower rate[4].

d) Repeat steps C and D for the Euro and Japanese Yen total losses using Euro/Dollar and Yen/Dollar FX Rates.

4.3.4.2 Produce the margin currency total losses for the combined contract

a) Select the two sets of total losses e.g. for CAS, which have been converted to US Dollars by multiplying by the upwards and downwards adjusted FX Rates.

b) Compare the total losses in the two sets scenario by scenario, and select the algebraically larger of each scenario to form a new set of total losses for scenarios 1 to 16 which are worst cases i.e. largest losses and smallest gains.

   For example for scenario one, if 10 is compared to -10 then 10 is selected; for scenario two, if -10 is compared to -20 then -10 is selected; for scenario three, if 10 is compared to 20 then 20 is selected, and so on. This defines the total losses for a Sterling contract e.g. CAS, converted to Dollars.

c) Repeat this process for the remaining non-dollar currencies e.g. CAM and CAY, to define their total losses in US Dollars. There will now exist three new sets of total losses, e.g. for CAS, CAM and CAY, expressed in the margin currency, in addition to the original total losses for CAD.

d) Select the original total losses e.g. for CAD

e) Add the four sets of total losses together to produce one set for the combined contract: the margin currency total losses which have been produced from "worst case" FX Rates.

f) These are the combined contract total losses from which the scanning risk is selected.

[4] There will now be two sets of total losses for Sterling, converted to US Dollars at higher and lower FX rates.

4.4 Combined Commodity Scanning Risk

Where a combined contract incorporates multiple currency contracts section 4.3 yields 16 total loss values. The total loss values for single currency contracts are obtained from section 4.1.

a) Scan the 16 total losses yielded by section 4.1 or 4.3 as appropriate.

b) Scanning risk for the combined contract in the margin currency equals the largest total loss.

4.5 Position Delta

Position deltas are used for the various interprompt, prompt date and intercontract spread calculations described later in this document. They are derived in a similar manner to loss values, in that positions are multiplied by a "composite delta" that is supplied with the 16 risk arrays for each series. They are therefore often calculated at the same time as scanning risk, and retained for later.

4.5.1 Standard Calculation

Position delta is calculated for each series where the portfolio has positions, and is accumulated by prompt date, as follows:

- Calculate the net position delta at each prompt date for a combined contract.

  a) Select a prompt date where this portfolio has positions. Ignore the prompt dates where this portfolio does not have positions.

  b) Within this prompt date, select the arrays where this portfolio has positions. Ignore the arrays where this portfolio does not have positions.

  c) Multiply the composite delta value on each selected array by the corresponding position (i.e. number of lots) and lot size, and divide by the delta divisor for the contract.

  For long futures, long calls, and long puts, multiply by a positive position. For short futures, short calls, and short puts, multiply by a negative position.

  Example: If a position is long 2 calls, multiply by +2
  If a position is short 2 calls, multiply by -2.

  d) Add across position delta values resulting from step c above within this prompt date to find the net position delta for the prompt date.

  e) Repeat steps a) to d) for each prompt date.

  f) Repeat the above for all other contracts in the combined contract where the portfolio has positions accumulating a single net position delta for each prompt date.

Explanatory Notes:

a) Netting Across Contracts in Different Currencies

For a combined contract delta positions at different prompt dates are netted across the contracts in different currencies to produce a net position delta at each prompt date for the combined contract. The Strategy Spread System is then applied to these netted deltas and the charges are calculated using rates in the margin currency.

b) For convenience the term "position delta" which refers to composite delta multiplied by net position, is referred to simply as the "net delta" when this would not cause confusion.

Note:

This standard calculation is to be used for futures, forwards, and any options that are associated with a single underlying prompt date. Traded Average Price Options (TAPOs) are a special case, and are processed in accordance with the instructions in section 9.1.

4.6 Intercontract Tier Risk

Previous versions of London SPAN required total loss values and total position delta values to be retained for use in Intercontract Spread Credit calculations. With the introduction of multi-tier intercontract spreads in version 4, these values are required per tier. This may best be achieved by retaining total losses and delta for each intercontract tier during the calculation of scanning risk.

Where a combined commodity incorporates multiple currency contracts, the intercurrency risk algorithm defined in section 4.3 should also be applied to the total losses for each intercontract tier.

5 Interprompt Spread and Prompt Date Charges

SPAN scanning risk assumes that futures and forward prices move by identical amounts across all prompt dates i.e. ignoring spread risk.

Since forward price moves do not correlate perfectly across prompt dates, value gains at one prompt date do not exactly offset value losses in another. Portfolios can therefore face considerable interprompt spread risk.

SPAN calculates an interprompt spread charge to cover this risk. SPAN first finds how many interprompt spreads were implicitly formed during scanning and then applies a charge for each spread. Wherever possible, SPAN minimises the spread charge.

London SPAN version 4 performs two forms of interprompt spread calculation:

a) Strategy Spreads

b) Multi-Tier Interprompt Spreads

Strategy spreads are used to identify delta-neutral combinations of positions such as butterflies and condors. Because of the lower risk associated with these strategies, SPAN generally applies a lower charge to them than to other Interprompt spreads. Where they are used, strategy spreads are always performed before any multi-tier Interprompt spreads, and identified strategies are excluded from the latter.

The steps involved in the calculation of interprompt spread and prompt date charges is:

a) Calculate net position delta for each prompt date (described in section 4.5)

b) Identify strategy spreads for the combined contract, and calculate strategy spread charges

c) Accumulate remaining (unspread) position delta for interprompt tiers

d) Identify interprompt spreads for the combined contract, and calculate interprompt spread charges

e) Calculate prompt date charges

f) Accumulate remaining (unspread) position delta for intercontract tiers

5.1 Strategy Spreads

London SPAN version 4 uses two strategy spread charge methods. These are:

- ***Method 1: No extra charge is needed.***
- ***Method 10: Calculate Strategy Spread Charges***

For one portfolio's positions in a combined contract:

Use the strategy spread charge method code to determine which method applies to this combined contract. LCH and the exchange provide this parameter.

See the following pages for detailed description of the spread method.

5.1.1 Strategy Spread Charge: Method 1

For this combined contract:

The Strategy Spread Rate is zero

Strategy Spread Charge = 0.

5.1.2 Strategy Spread Charge: Method 10

5.1.2.1 Read Required Strategy Spreads and Charge Rates from the Risk Parameter File

The combined contract records in the Risk Parameter file will define any required strategy spreads.

The following data elements will be defined for each spread:

- ***the required spread number or priority***
- ***the charge rate per spread formed***
- ***the total number of legs in the spread***

The following data elements will be defined for each leg of the spread:

- ***the prompt date***
- ***the delta ratio***
- ***the market-side indicator ('A' or 'B')***

5.1.2.2 Establish the spread direction

Each spread is processed in order of priority.

The first step is to establish where there is net position delta available for the first leg of the spread. If there is, i.e. the net position delta for the prompt date is not zero, then the spread direction is established:

The market side of the leg is related to the sign of the position delta (positive [long] or negative [short]). For all remaining legs, the position delta must have the same sign for the same market side, and the opposite sign for the opposite market side. For example:

- ***If the market side of the leg is "A" and the position delta is positive (long), then positions must be long in the remaining legs where the market side is "A", and short where the market side is "B".***
- ***If the market side of the leg is "A" and the position delta is negative (short), then positions must be short in the remaining legs where the market side is "A", and long where the market side is "B".***

5.1.2.3 Establish number of spreads required

The next step is to pass through all legs of the spread (there may be two or more) to establish the amount of delta that can be spread overall.

The leg with the smallest absolute delta, given the appropriate market side, determines the amount of delta to be spread. For example in this condor:

	Net Position Delta	*Delta Ratio*	*Market Side*	*Spreads*
Leg 1	*Long 10*	*1*	*A*	*10*
Leg 2	*Short 6*	*1*	*B*	*6*
Leg 3	*Short 7*	*1*	*B*	*7*
Leg 4	*Long 5*	*1*	*A*	*5*

The maximum number of spreads available for this strategy is 5.

The total delta in each case should be divided by the delta ratio before calculating the number of spread units. For example, in this butterfly:

	Net Position Delta	*Delta Ratio*	*Market Side*	*Spreads*
Leg 1	*Long 10*	*1*	*A*	*10*
Leg 2	*Short 10*	*2*	*B*	*5*
Leg 3	*Long 10*	*1*	*A*	*10*

The number of spreads is only 5 because leg 2 requires 2 deltas for each spread.

5.1.2.4 Recalculate Delta for the Prompt Date

The next step is to calculate the spread delta and the delta remaining for each prompt date involved in the spread. The spread amount ascertained above should be multiplied by the delta spread ratio to give the spread amount for the prompt date. This should be subtracted from the total delta remaining for the prompt date.

The above should be performed for each leg of the spread.

5.1.2.5 Calculate Strategy Spread Charge

The next step is to determine the strategy spread charge for the spread. This is done as follows:

- ***Multiply the total number of spreads for this required spread by the strategy charge rate for the spread, giving the total strategy spread charge for this required spread.***

5.2 Accumulate Interprompt Tier Delta

Following the calculation of strategy spreads by either method, the remaining (unspread) delta is carried forward for interprompt spread calculations.

The following step is required to accumulate interprompt tier delta:

a) For each tier of prompt dates, calculate the sum of remaining long position delta, and the sum of remaining short delta. This produces the "gross remaining delta" i.e. total long and total short.

5.3 Multi-Tier Interprompt Spreads

London SPAN version 4 uses two interprompt spread charge methods. These are:

- Method 1: No extra charge is needed.
- Method 10: Calculate Multi-Tier Interprompt Spread Charges

For one portfolio's positions in a combined contract:

Use the interprompt spread charge method code to determine which method applies to this combined contract. LCH and the exchange provide this parameter.

See the following pages for detailed description of the spread method.

5.3.1 Interprompt Spread Charge: Method 1

For this combined contract:

The Inter-month Spread Rate is zero

Inter-month Spread Charge = 0.

5.3.2 Interprompt Spread Charge: Method 10

5.3.2.1 Read Required Inter-prompt Spreads and Charge Rates from the Risk Parameter File

The combined contract record on the Risk Parameter file will give a list of tiers; it will also define any **required spreads** within and between the tiers. Each spread will consist of two or more **spread legs**.

The following data elements will be defined for each spread:

- the required spread number
- the charge rate per spread formed
- the total number of legs in the spread

The following data elements will be defined for each leg of the spread:

- the tier number
- the delta ratio
- the market-side indicator ('A' or 'B')

There may be spreads within tiers as well as spreads between tiers. The order of spreading is supplied in parameter files, there being no algorithmic requirement to perform particular spreads first.

5.3.2.2 Long-side/Short-side

For the following 3 steps, the processing is performed twice; once assuming Market Side A to be long, and once assuming it to be short. This way, the same algorithm will cater for both long v. short and short v. long spreads.

5.3.2.3 Establish number of spreads required

The first step is to pass through all legs of the spread (there may be two or more) to establish the amount of delta that needs to be spread overall.

The leg with the smallest absolute delta, given the appropriate market side, determines the amount of delta to be spread. For example:

	Total Delta	Market Side
Leg 1	Long 10,Short 5	A
Leg 2	Long 20, Short 15	B

If market-side 'A' is long, the number of spreads will be 10 (the smaller of 10 and 15).
If market-side 'A' is short, the number of spreads will be 5 (the smaller of 5 and 20).

The total delta in each case should be divided by the delta spread ratio before calculating the number of spread units (an example is included later which explains this).

5.3.2.4 Recalculate Delta for the Tier

The next step is to calculate the spread delta and the delta remaining for each tier involved in the spread. The spread amount ascertained above should be multiplied by the delta spread ratio to give the spread amount for the tier. This should be subtracted from the total delta remaining for the tier.

The above should be performed for each leg of the spread.

5.3.2.5 Recalculate Delta for the Prompts

The next step is to apportion each tier's spread delta across the prompts, and to establish the remaining unspread delta for each prompt.

The prompt dates are processed sequentially. The amount of delta that can be apportioned to a prompt date is the smaller (in absolute terms) of; the unspread delta for the prompt date, and the tier's spread delta.

Again, this is done for each leg of the spread.

5.3.2.6 Calculate Inter-prompt Spread Charge

The next step is to determine the inter-prompt spread charge for the spread. This is done as follows:

- Multiply the total number of spreads for this required spread by the inter-prompt charge rate for the spread, giving the total inter-prompt charge for this required spread.

When all spreads have been processed, the Total Interprompt Spread Charge is the sum of all Strategy Spread charges and Interprompt Spread charges for the compbined contract.

5.4 Prompt Date Charges

If futures or forwards prices for particular prompt dates are subject to higher volatility than usual (e.g. when a forward is an "illiquid prompt date", or is in backwardation), then a prompt date charge may be calculated because of the additional risk.

SPAN uses two prompt date charge methods. These are:

- Method 1: No extra charge is needed.
- Method 10: Calculate Prompt Date Charges

For one portfolio's positions in one combined contract:

- Use the prompt date method code to determine which method applies to this contract. LCH and the exchange determine when a charge is appropriate. The parameter files provide the charges applicable to each prompt date; they also include charge selection per prompt date by the sign of the prompt date's net delta. The parameter files control whether prompt date charges will apply to a prompt date's net delta only if it is long, or only if it is short, or either long or short.

5.4.1 Prompt Date Charge: Method 1

For this combined contract:

No extra charge is needed.

Prompt Date Charge = 0.

5.4.2 Prompt Date Charge: Method 10

Once the total inter-prompt spread charge has been determined, if the prompt date charge method code is '10', prompt date charges should be calculated as follows:

- The SPAN Risk Parameter file specifies two charge rates on the Spot Month Charge Details combined contract record for certain prompt dates. These are:

  Prompt date charge rate for spreads
  Prompt date charge rate for outrights

- These rates should be applied to the spread amount, or the outright i.e. unspread amount, for each prompt date, to give the Prompt Date Charge.

- The prompt charge for spreads and the prompt charge for outrights are summed across all prompts to give the total prompt month charge.

5.5 Accumulate Net Intercontract Tier Delta

Following the calculation of strategy spreads, interprompt spreads and prompt date charges, the remaining (unspread) delta is carried forward for intercontract spread calculations. Each intercontract tier is composed of one or more contiguous interprompt tiers. The intercontract tier definitions are provided in the risk parameter file.

The following step is required to accumulate intercontract tier delta:

a) For each intercontract tier, ascertain the sum of remaining net position delta in its constituent interprompt tiers. Add both positive and negative deltas together to produce a net value.

6 Intercontract Spread Credits

SPAN offers credits for allowable intercontract spreads. These credits recognise cases where offsetting positions in related contracts reduce overall portfolio risk. These spread credits will therefore reduce the amount of margin required.

London SPAN version 4 enables the intercontract spreads to be targeted at specific intercontract tiers in each combined contract. An example of this tiered approach is a spread between the front months of the Three-month Euribor and the front months of the Short Sterling (inter yield curve correlations).

The LCH and the exchange determine spread priorities and sets the spread credit rates. SPAN uses the spread priorities to form the most favourable spreads first. Different spreads save different fractions of the total outright margins. For example spreads that save the largest fractions get the highest priority. Spreads that save the smallest fractions get the lowest priority.

SPAN uses two intercontract spread credit methods. These are:

- Method 2: Scanning Risk Spread Credits. Note that these are unchanged from their specification in London SPAN Version 2 and have been excluded from this document[5].
- Method 10: Multi-Tier Intercontract Spread Credits

The following steps calculate the Intercontract Spread Credit for one portfolio's positions in related contracts using Method 10:

Note:

The Method 10 calculation is identical to that for Method 1. The only difference is that it is performed on an intercontract tier basis.

Each intercontract tier in Method 10 is treated in the same manner as a combined contract in Method 1.

[5] It is LCH's intention to discontinue use of this method in the short term. A date for this has not yet been set.

a) Determine the Weighted Futures Price Risk for each intercontract tier within each combined contract

b) Determine the available delta for each intercontract tier within each combined contract

c) Form spreads between net long and net short positions

d) Calculate intercontract spread credit

6.1 Determine the Weighted Futures Price Risk for Each Tier

6.1.1 Futures Price Risk

As an approximation:

Scanning Risk = Future Price Risk + Volatility Risk + Time Risk

Since SPAN intercontract spreads are based on deltas and reactions to futures price changes, these spreads adjust only the Futures Price Risk. Delta values and the resulting spreads do not directly relate either to Volatility Risk or to Time Risk.

SPAN intercontract spreads do not adjust either Volatility Risk or Time Risk.

a) Select an intercontract tier in the group. Select this intercontract tier only if it is part of one or more allowable intercontract spreads.

b) Calculate Time Risk for this intercontract tier using the intercontract tier risk totals determined in section 0. Add this tier's Total Loss for scenario 1 and its Total Loss for scenario 2. Divide the sum by 2 and round to the nearest integer. The result is this combined contract's Time Risk.

Use the Total Loss values from this tier's Scanning Risk calculations.

Total Loss scenarios 1 and 2 show portfolio losses in one tier when:

- *Volatility moves up and down*
- *Time passes*
- *The future price remains unchanged.*

Since the futures price remains unchanged, there is no Futures Price Risk. Averaging the losses for these two scenarios averages out Volatility Risk, leaving only Time Risk.

Example:

Assume these Intercontract Tier A Total Loss values:

Scenario 1:	*-640*
Scenario 2:	*+680*
	+40

Time Risk for Intercontract Tier A = +40 / 2 = +20

Note: That Time Risk could be a negative value eg., if scenario 1 = +640, scenario 2 = -680.

c) *Identify the Scanning Risk scenario and its paired scenario.*

Identify the array scenario where this tier faces the largest Total Loss. This largest Total Loss is exclusive to this intercontract tier and is not the total that became the combined contract's Scanning Risk.

Use this table to identify the Paired Scenario:

If Scanning Risk is Scenario:	The Paired Scenario is:
1	2
2	1
3	4
4	3
5	6
6	5
7	8
8	7
9	10
10	9
11	12
12	11
13	14
14	13
15	15 (not 16)
16	16 (not 15)

d) Add this intercontract tier's Scanning Risk and the Total Loss for the Paired Scenario. Divide the sum by 2 and round to the nearest integer.

e) Subtract this intercontract tier's Time Risk value from the result in step d).

The result is this intercontract tier's Futures Price Risk. If Futures Price Risk is less than zero, set Futures Price Risk equal to zero.

Scanning Risk shows the worst Total Loss over the range of futures price moves and volatility moves for a given futures price move and volatility move over one day.

The Scanning Risk Scenario reflects:

- *A given volatility move in one direction*
- *A given futures price move*
- *One day passing.*

The Paired Scenario reflects:

- *The same volatility move in the opposite direction*
- *The same futures price move*
- *The same one day passing.*

Averaging the losses for the Scanning Risk Scenario and the Paired Scenario averages Volatility Risk. Subtracting Time Risk leaves Futures price Risk.

Example:

Assume these values for Intercontract Tier A:

Scanning Risk:	*1760*
Paired Scenario Total Loss:	*1120*
Time Risk:	*20*
Futures price Risk for Intercontract Tier A	*= ((1760 + 1120)/2) - 20 = 1420*

Note: that a negative Time Risk would add on e.g., -(-20) becomes +20.

f) Repeat steps A to E for each intercontract tier in the group.

6.1.2 Weighted Futures Price Risk

a) Select a intercontract tier within this group that forms intercontract spreads for this portfolio.

b) Divide this intercontract tier's Futures Price Risk by the absolute value of its total net delta and round to whole currency units. Use the full delta value for that tier, as calculated in section 0. The result is the Weighted Futures Price Risk for this intercontract tier.

c) Repeat steps a) and b) for each intercontract tier that forms intercontract spreads for this portfolio.

Examples:

For this portfolio, SPAN uses Intercontract Tier A delta to form intercontract spreads:

Futures price Risk for Intercontract Tier A	=	*1420*
Absolute value of net delta	=	*3.33*
Weighted Futures price Risk = 1420/3.33	=	*426*

For this portfolio, SPAN uses Intercontract Tier B delta to form intercontract spreads:

Assuming the value for Futures price Risk:

Futures price Risk for Intercontract Tier B	=	*1380*
Absolute value of net delta	=	*16.32*
Weighted Futures price Risk = 1380/16.32	=	*85*

6.2 Determine Intercontract Delta Available for Spreads

a) Select a intercontract tier within this group that forms intercontract spreads for this portfolio.

b) Set the available delta to be the net delta remaining from any intracontract spread calculations. This is described in section 5.5.

> *Note that the delta used in spread calculations is not the total delta for the tier that is used to determine Weighted Futures Price Risk.*

6.3 Form Spreads between Net Long and Net Short Positions

a) Identify the highest priority spread. The LCH and exchange define the allowable spreads and set their priorities.

b) Identify the spread credit rate for this spread, and the following parameters for each leg:

- *Intercontract Tier*
- *Market side - In each case, market side A delta spreads against market side B delta.*
- *Delta Ratio - The Delta ratio shows how much delta a given combined contract must contribute to form one spread of a given type. In most cases, the ratio is one.*

The LCH and exchange provide all the above parameters.

c) Use the available delta to form as many spreads of this type as possible. For each intercontract tier in the spread, divide the available delta by its delta ratio. Truncate the result to 4 decimal places. The number of spreads is the smallest of the results for each intercontract tier.

d) For each tier in this spread type, calculate the spread credit:

Multiply the number of spreads by the spread credit rate, the delta ratio and the Weighted Futures Price Risk for the intercontract tier (determined in section 6.1.2).

This produces the spread credit for each combined contract and this spread type.

e) Remove the delta used for this spread type from the pool of available delta for each tier. The delta used is the number of spreads multiplied by the delta spread ratio. Note that the original available delta, i.e. the intercontract tier's net delta, must have been retained for further use.

f) Repeat steps b to e for the remaining allowable spreads in this group. Work through the allowable spreads, going from the highest priority to the lowest priority. Stop once no more spreads are possible.

6.4 Calculate the Intercontract Spread Credit for Each Combined Contract

a)Add the Spread Credits calculated in section 6.3 by combined contract for all spread types. These yield the Spread Credits for each combined contract.

Example:

For the same portfolio:

Select the Intercontract Tier B - Intercontract Tier C spread

Assume that the Spread Credit Rate for the Intercontract Tier B - Intercontract Tier C spread is 75%.
Assume that the Delta Ratio for Intercontract Tier B in this spread is 1.
Assume that the Delta Ratio for Intercontract Tier C in this spread is 2.

Weighted Futures price Risk for Intercontract Tier B = 395
Number of Intercontract Tier B - Intercontract Tier C spreads = 6.12

Spread Credit for Intercontract Tier B in this spread = 75% x 395 x 1 x 6.12
= 1813

Weighted Futures price Risk for Intercontract Tier C = 85
Number of Intercontract Tier B - Intercontract Tier C spreads = 6.12

Spread Credit for Intercontract Tier C in this spread = 75% x 85 x 2 x 6.12
= 780

For the same portfolio:

Select the Intercontract Tier A - Intercontract Tier B spread

Assume that the Spread Credit Rate for the Intercontract Tier A - Intercontract Tier B spread is 81%.

Assume that the Delta Ratio for Intercontract Tier A in this spread is 1.
Assume that the Delta Ratio for Intercontract Tier B in this spread is 2.

Weighted Futures Price Risk for Intercontract Tier A = 426
Number of Intercontract Tier A - Intercontract Tier B spreads = 2.04

Spread Credit for Intercontract Tier A in this spread = 81% x 426 x 1 x 2.04
= 704

Weighted Futures Price Risk for Intercontract Tier B = 85
Number of Intercontract Tier A - Intercontract Tier B spreads = 2.04

Spread Credit for Intercontract Tier B in this spread = 81% x 85 x 2 x 2.04
= 281

Total Intercontract Spread Credits:

Intercontract Tier C:
Intercontract Tier B Spread against Intercontract Tier C
Intercontract Spread Credit for Intercontract Tier C = 780

Intercontract Tier A:
Intercontract Tier A Spread against Intercontract Tier B
Intercontract Spread Credit for Intercontract Tier A = 704

Intercontract Tier B:
Intercontract Tier B Spread against Intercontract Tier C
Intercontract Spread Credit for Intercontract Tier B = 1813
Intercontract Tier A Spread against Intercontract Tier B
Intercontract Spread Credit for Intercontract Tier B = 281
Total Intercontract Spread Credit for Intercontract Tier B = 2094

The intercontract spreads so formed are deducted from the appropriate combined contracts' scanning risks as described in earlier sections.

7 Short Option Minimum Charge

SPAN requires a minimum charge for each option in the portfolio. This charge sets an absolute minimum for a combined contract Initial Margin to cover residual short option risk that may appear nowhere else in the calculations.

The short option minimum charge is calculated by first summing the number of short call and short put net lots in all options in all contracts within the combined contract. The total number of short option lots for the combined contract is then multiplied by the short option minimum charge rate for the combined contract, which will be in the Margin Currency.

8 Inital Margin Calculation

INITIAL MARGIN FOR THE COMBINED CONTRACT = the greater of:

SCANNING RISK

plus

TOTAL INTERPROMPT CHARGE

plus

TOTAL PROMPT DATE CHARGE

minus

TOTAL INTERCONTRACT CREDIT

or

SHORT OPTION MINUMUM CHARGE

9 Non-Standard Product Handling

9.1 Position Delta and Traded Average Price Options (TAPOs)

Position delta relating to a prompt date is used within the interprompt spread charge and prompt date charge calculations. Position delta is calculated from forwards positions and discount factors, and from options positions and deltas. TAPOS however are not options upon a single forward contract with a specific prompt date, but are options on an average forward price. TAPOS position delta relating to a particular expiry (as calculated above) must be apportioned to designated dates in order to perform interprompt and prompt date charge calculations.

The apportionment of position delta will be performed according to the expiry groups supplied in the risk arrays. A parameter specified by LCH and the EXCHANGE will derive the expiry groups in the risk array records. Each expiry group is a particular date, and margin calculations are performed by dividing the delta for the TAPO expiry equally among the expiry groups; where there is only one expiry group, all the delta is allocated to it. The sum of the allocated deltas across the expiry groups must equal the total TAPO delta for that expiry and to avoid rounding error the delta allocated to the last expiry group will contain any rounding difference.

9.1.1 Expiry Group Derivation Method 1

This defines a single expiry group for a given TAPO expiry, to equal the 3rd Wednesday prompt date which falls within the TAPO expiry month, except when the current close of business falls within a TAPO expiry month. In this case expiry groups are designated as available prompt dates within the remainder of the TAPO expiry month, according to Method 3 below.

9.1.2 Expiry Group Derivation Method 2

Expiry groups are derived as for Method 1 to equal the 3rd Wednesday prompt date which falls within the TAPO expiry month, except when the TAPO expiry month falls totally within three months less 2 business days of the current date. When the TAPO month is within this period, the expiry groups are designated as prompt dates within the TAPO expiry month, according to Method 3 below.

9.1.3 Expiry Group Derivation Method 3

Expiry groups are derived to equal LME prompt dates within a given TAPO expiry month. For the purposes of identifying prompt dates, the period of time utilised will encompass prompt dates starting 2 business days from the first fixing day in the TAPO expiry month and ending 2 business days after the last fixing day in the TAPO expiry month.

If the current close of business is part of the way through a TAPO expiry month, the period of time utilised will encompass prompt dates starting 2 business days from the close of business date and ending 2 business days after the last fixing day in the TAPO expiry month.

As an example, for a March 1996 TAPO, if the current close of business is Friday 8th March, the first available prompt date for designation as an expiry group is Tuesday 12th March and the last prompt date is Tuesday 2nd April, as the last fixing date is Friday 29th March.

9.1.4 Expiry Group Derivation Method 4

Expiry groups are designated as business dates, rather than prompt dates, within the TAPO expiry month. For the purposes of identifying business dates, the period of time utilised will encompass business dates starting 2 business days from the first fixing day in the TAPO expiry month and ending 2 business days after the last fixing day in the TAPO expiry month.

If the current close of business is part of the way through the TAPO expiry month, the period of time utilised will encompass business dates starting 2 business days from the close of business date and ending 2 business days after the last fixing day in the TAPO expiry month.

For example, for a March 1996 TAPO, if the current close of business is Friday 8th March, the first available business date for allocation is Tuesday 12th March and the last business date is Tuesday 2nd April, as the last fixing date is Friday 29th March.