model should also take into account the market characteristics, for example, delivery dates and the scope provided to traders to close out positions.

D. Quantitative Standards

1. A bank may use one of a number of generally accepted measurement techniques including, for example, an internal model based on variance-covariance matrices, historical simulations, or Monte Carlo simulations so long as the model employed captures all the material market risks.[19] The following minimum standards apply for purposes of using an internal model for calculating market risk capital requirements:

a. Value-at-risk must be calculated on a daily basis using a 99th percentile, one-tailed confidence interval[20] and the holding period must be ten trading days. For positions that display linear price characteristics, a bank may use value-at-risk numbers calculated according to shorter holding periods scaled up to ten days by the square root of time.[21]

b. Value-at-risk must be calculated using an observation period of at least one year to measure historical changes in rates and prices.

c. A bank must update its historical rates and prices at least once every three months and must reassess them whenever market conditions change materially.

2. A bank may use discretion in recognizing empirical correlations within each market risk factor category.[22] However, empirical correlations among risk categories are not recognized. The value-at-risk measure for each risk category must be added together on a simple sum basis to determine the aggregate value-at-risk amount.

3. A bank's models must accurately capture the unique risks associated with options within each of the market risk factor categories. The following minimum criteria apply to the measurement of options risk:

a. A bank's internal model must capture the non-linear price characteristics of option positions using an options pricing technique. The bank must apply a minimum ten-day holding period to option positions or positions that display option-like characteristics. Banks may not scale-up the daily value-at-risk numbers by the square root of time.

b. A bank's internal model must capture the volatilities of the rates and prices (that is, the vega) underlying option positions and a bank should measure the volatilities of the underlying instruments broken down by different option maturities.

4. The accuracy of a bank's internal model will be reviewed periodically by the Federal Reserve. Such review, during which, when appropriate, the Federal Reserve may take into consideration reports and opinions generated by external auditors or qualified consultants, will include, at a minimum:

a. Verification that the internal validation processes described in section III.B.2. of this Appendix E are operating in a satisfactory manner;

b. Affirmation that the formulae used in the calculation process and for the pricing of options and other complex instruments, are validated by a qualified unit of the bank, which in all cases must be independent from the trading areas;

c. Confirmation that the structure of the internal model is adequate with respect to the bank's activities and geographical coverage;

d. Confirmation that the results of the bank's back-testing of its internal measurement system (that is, comparing value-at-risk estimates with actual profits and losses) are being used effectively to monitor reliability of the model's estimates over time; and

e. Affirmation that, for regulatory capital purposes, the model processes all relevant data and that the modeling procedures conform with the parameters and specifications set forth in this appendix E.

IV. The Standardized Approach

A. Debt Instruments

1. *Specific Risk*. a. The capital requirement for specific risk is based on the identity of the obligor and, in the case of corporate securities, on the credit rating and maturity of the instrument. The specific risk capital requirement is calculated by weighting the current market value of each individual position, whether long or short, by the appropriate category factor as set forth below and summing the weighted values. In measuring specific risk, the bank may offset and exclude from its calculations any matched positions in the *identical* issue (including positions in derivatives). Even if the issuer is the same, no offsetting is permitted between different issues since differences in coupon rates, liquidity, call features, etc., mean that prices may diverge in the short run. The categories and factors are:

Category	Remaining maturity (contractual)	Factor (In percent)
Government	N/A	0.00
Qualifying	6 months or less	0.25
	6 to 12 months	1.00
	Over 12 months	1.60
Other	N/A	8.00

b. The *government* category includes all forms of debt instruments of central governments of the OECD-based group of countries[23] including bonds, Treasury bills and other short-term instruments, as well as local currency instruments of non-OECD central governments to the extent that the bank has liabilities booked in that currency.

c. The *qualifying* category includes securities of U.S. government-sponsored agencies, general obligation securities issued by states and other political subdivisions of the OECD-based group of countries, multilateral development banks, and debt instruments issued by U.S. depository institutions or OECD-banks that do not qualify as capital of the issuing institution.[24] It also includes other securities, including revenue securities issued by states and other political subdivisions of the OECD-based group of countries, that are rated investment-grade by at least two nationally recognized credit rating services, or rated investment-grade by one nationally recognized credit rating agency and not less than investment-grade by any other credit rating agency, or, with the exception of securities issued by U.S. firms and subject to review by the Federal Reserve, unrated but deemed to be of comparable investment quality by the reporting bank *and* the issuer has securities listed on a recognized stock exchange.

d. The *other* category includes debt securities not qualifying as government or qualifying securities. This would include non-OECD central government securities that do not meet the criteria for the government or qualifying categories. This category also includes instruments that qualify as capital issued by other banking organizations.

e. The Federal Reserve will consider the extent of a bank's position in non-investment grade instruments (sometimes referred to as high yield debt). If those holdings are not well-diversified or otherwise represent a material position to the institution, the Federal Reserve may prevent a bank from offsetting positions in these instruments with other positions in qualifying instruments that may be offset when calculating its general market risk requirement. In addition, the Board may impose a specific risk capital requirement as high as 16.0 percent.

2. *General Market Risk*. a. A bank may measure its exposure to general market risk using, on a continuous basis, either the

rate risk is the risk of a change in the cost of carrying forward positions and options. Basis risk is the risk that the relationship between the prices of similar commodities changes over time.

[19] In a variance/covariance approach, the change in value of the portfolio is calculated by combining the risk factor sensitivities of the individual positions—derived from valuation models—with a variance/covariance matrix based on risk factor volatilities and correlations. A bank using this approach would calculate the volatilities and correlations of the risk factors on the basis of the holding period and the observation period. A bank using a historical simulation would calculate the hypothetical change in value of the current portfolio in the light of historical movements in risk factors. This calculation would be done for each of the defined holding periods over a given historical measurement horizon to arrive at a range of simulated profits and losses. A bank using a Monte Carlo technique would consider historical movements to determine the probability of particular price and rate changes.

[20] A one-tailed confidence interval of 99 percent means that there is a 1 percent probability based on historical experience that the combination of positions in a bank's portfolio would result in a loss higher than the measured value-at-risk.

[21] This transformation entails multiplying a bank's value-at-risk by the square root of the ratio of the required holding period (ten days) to the holding period embodied in the value-at-risk figure. For example, the value-at-risk calculated according to a one-day holding period would be scaled-up by the ''square root of time'' by multiplying the value-at-risk by 3.16 (the square root of the ratio of a ten-day holding period to a one-day holding period).

[22] While a bank has flexibility to use correlations, the Federal Reserve must be satisfied that there is integrity in the bank's process for calculating correlations.

[23] The OECD-based group of countries is defined in section III.B.1. of appendix A of this part.

[24] U.S. government-sponsored agencies, multilateral development banks, and OECD banks are defined in section III.C.2. of appendix A of this part.