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# **THE USE OF STRESS TESTS AS PART OF RISK MANAGEMENT**

Guide for asset management companies

**amf-france.org**

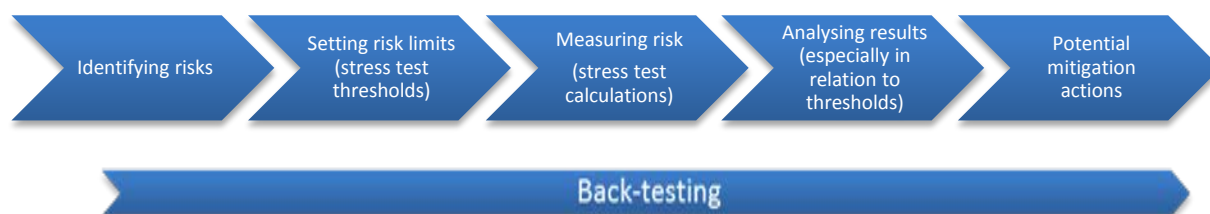
## INTRODUCTION

The aim of this instructive guide is to present an overview of the stress test practices of French asset management companies (AMCs). Its target audience is primarily AMCs that manage undertakings for collective investment in transferable securities (UCITS) or alternative investment funds (AIFs), or that provide a third-party portfolio management investment service, but it may also be of use to investment services providers that provide the same service. The examples shown herein are not applicable simultaneously and to all funds/portfolios, but AMCs may be able to use them depending on what type of funds they manage and the strategies they have implemented. As an example, our simulations for investment mandates focus on market risk.

Two years after the measures brought about by the alternative investment fund managers directive (AIFMD) came into effect, the AMF met with AMCs of different sizes and from different sectors in order to establish an overview of their stress test practices. In so doing, the AMF was able to analyse the conditions under which stress tests are implemented and then used, and how they fit in with procedures for managing market, liquidity and counterparty risk. We found that all the AMCs we met with use stress tests, but that they use different test scenarios and models, making comparison difficult.

### Guide overview:

Stress tests are part of the overall risk management policy, as specified in particular by the UCITS<sup>1</sup> and AIFM<sup>2</sup> directives, and they may be implemented using the same approach:



<sup>1</sup> Article 51 of Directive 2009/65/EC of the European Parliament and of the Council of 13 July 2009 (the "UCITS Directive"), and articles 38 and 40 of Commission Directive 2010/43/EU of 1 July 2010

<sup>2</sup> Articles 15 and 16 of Directive 2011/61/EU of the European Parliament and of the Council of 8 June 2011 (the "AIFM Directive"), and articles 45 and 48 of Commission Delegated Regulation (EU) 231/2013 supplementing the AIFM Directive

This guide includes examples of market, liquidity and counterparty stress tests. The scenarios must be adapted to the specific characteristics of each fund and portfolio and updated regularly.

AMCs should aim to replicate some of the good practice presented herein, including the implementation of:

- liquidity stress tests for each fund simulating concurrent problems in the fund's assets and liabilities;
- aggregate liquidity stress tests for several funds managed by a single AMC, particularly where market capacity is limited;
- a stress test policy that defines alert thresholds and procedures in the event that such an alert is triggered, as well as how the stress tests results are conveyed within the AMC;
- redemption scenarios based on the exploitation of all available liability data and, ideally, an investor behaviour model; and
- stress tests that correspond to the various stages in a fund's life, from creation to liquidation via ongoing risk management.

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## 1. OBJECTIVE AND SCOPE OF STRESS TESTS

### 1.1. WHAT ARE STRESS TESTS AND WHAT DO THEY AIM TO ACHIEVE?

In order to manage and monitor their business risks, AMCs implement a risk management policy that enables them to verify and measure at any given moment the risks associated with their positions and how these affect the overall risk profile of the portfolios. This involves the AMCs **performing periodic stress tests in order to address risks that might adversely impact the collective investment schemes or individual portfolios** they manage<sup>3</sup>.

A stress test **simulates extreme or unfavourable, yet plausible, economic and financial conditions in order to study the consequences** on both the performance of a collective investment undertaking or investment mandate and its ability to honour redemption requests, even at a discounted net asset value.

Primarily, stress tests are **tools that help to analyse the strength of the strategies that have been put in place**. They provide periodic scenario analyse in order to address risks arising from potential changes in market conditions that might adversely impact the portfolios managed. During normal periods, the stress test identifies the weaknesses of an investment strategy and helps AMCs to prepare themselves operationally for a crisis; during crisis periods, the stress test helps to direct crisis management and resolution strategy. In such a way, stress tests can serve as risk management and decision-making tools both when a fund is created and throughout its life.

### 1.2. STRESS TESTS ARE PART OF THE PERMANENT RISK MANAGEMENT FUNCTION

As part of its risk management strategy, in compliance with article 313-53-7 (II) and article 318-40 of the AMF's General Regulation and AMF Position-Recommendation DOC-2014-06<sup>4</sup>, the investment services provider shall establish and implement, among other things:

- 1) **risk mapping**, taking account of the risks of each position of the collective investment undertaking or individual portfolio it manages, and the interaction between those individual risks;
- 2) **relevant risk indicators** and a system of risk limits that is consistent with the risk profile of the collective investment undertaking or individual portfolio under its management;
- 3) **an alert mechanism** to prevent and detect any breaches of the limits, and remedial procedures in the event of any actual or anticipated breaches of the limits.

It updates them regularly to ensure they are relevant and effective.

**Stress tests are part of risk management and may be implemented using the same approach.**

The implementation of stress tests first requires the asset management company to identify the risks associated with investing in the financial assets that it manages or to which it wishes to become exposed, and more generally with the risk profile of the fund or portfolio.

<sup>3</sup> For AMCs that manage UCITS or AIFs and are governed by Book III, Title I of the AMF's General Regulation, article 313-53-7 (II) c) of the AMF's General Regulation. For AMCs that manage AIFs and are governed by Book III, Title I of the AMF's General Regulation, point 2 of article 318-41 provides for a similar requirement to perform appropriate stress tests and articles 318-43 and 318-46 require compliance with the relevant articles of the Commission Delegated Regulation of 19 December 2012 (implementing the AIFM Directive).

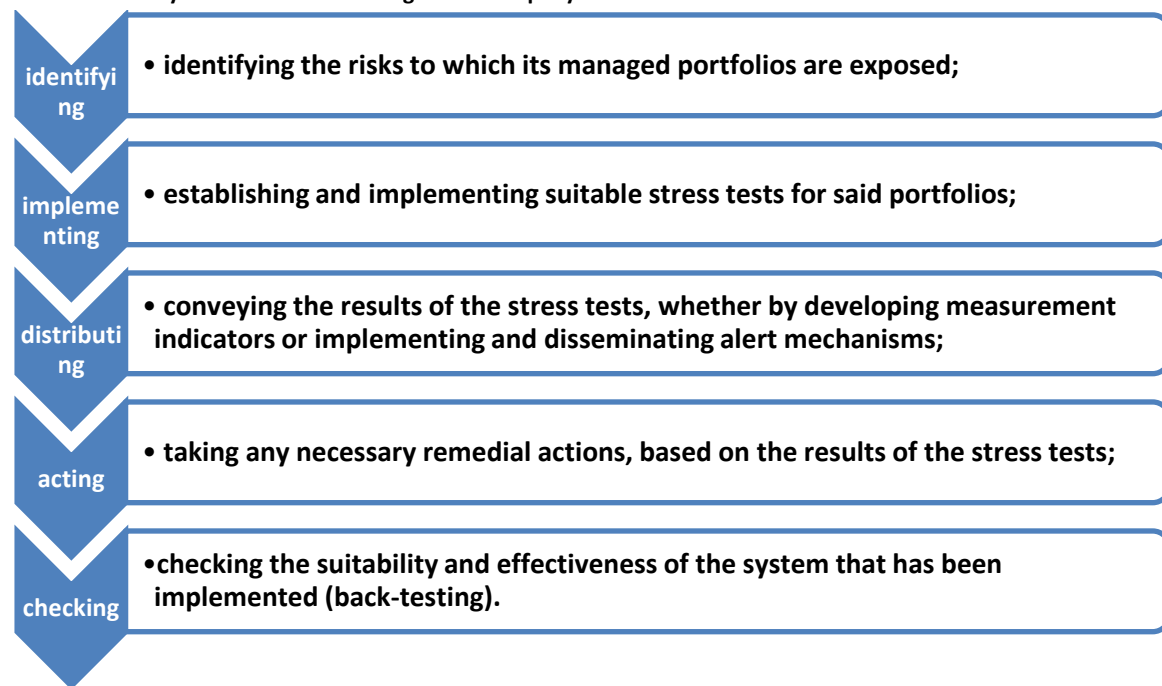
<sup>4</sup> Guide to the organisation of the risk management system within asset management companies

Based on this risk mapping, the implementation of a stress test involves defining scenarios that represent the risks then introducing a regular schedule for calculating the impact of these scenarios on one or more portfolios. Once the scenarios are in place, their results are calculated periodically and used by the risk management teams and/or the fund or portfolio managers as a decision-making tool in order to detect anomalies (thanks to predefined alert thresholds) and monitor extreme risk.

Lastly, the results of the stress tests should be conveyed within the asset management company, in particular to executive and decision-making bodies, so that any corrective measures can be taken.

The aim of stress tests is to improve risk analysis by dedicated teams or senior managers, and to highlight the limits of management strategies. In particular, they flag up conditions that might lead to extreme scenarios, and then their possible consequences, highlighting any risks that have not been taken into account by the investment team.

The stress test system of an asset management company therefore consists of:



## 2. IDENTIFYING RISKS AND ESTABLISHING STRESS TEST SCENARIOS

Work on constructing stress test models begins by using a mapping process to identify risk.

Identifying risk is part of the **risk management policy** which, in compliance with article 313-53-5 (II) of the AMF's General Regulation, *"shall comprise such procedures as are necessary to enable the management company to assess for each collective investment scheme [...] or individual portfolio it manages the exposure of that collective investment scheme [...] or individual portfolio to market, liquidity and counterparty risks, and the exposure of the collective investment schemes [...] or individual portfolios to all other risks, including operational risks, which may be material for each collective investment scheme [...] or individual portfolio it manages."*<sup>5</sup>

<sup>5</sup> See also article 318-40 of the AMF's General Regulation.



AMCs tend to distinguish **market stress tests**, which simulate the impact of turbulence on one or several markets on the fund's net asset value, from **liquidity stress tests**, which simulate the impact of a high volume of redemption requests on the fund's liabilities (possibly during a period of low market liquidity). Stress tests that simulate the **default of a counterparty** or the materialisation of an **operational risk** may also be pertinent, to the extent that these risks can be quantified and materialise in the form of quantitative indicators.

More specifically, the risk factors used for stress tests must include extreme risk factors, such as the full or partial erosion of liquidity of certain assets, that occur only in stressed periods. It is also crucial to reconsider how these risk factors interact. Stressed periods often manifest themselves in greater correlation between certain risk variables (greater impact of exogenous variables) or, to a lesser extent, in distortion of the sensitivities of a certain number of positions that an asset management company may have in its portfolio. As such, rather than just rigidly simulating traditional risk factors, stress test scenarios should aim to **expand the risk analysis scope by including more risk factors and interactions**.

This section of the guide contains a certain number of paths and illustrative examples with regard to identifying risk and then establishing scenarios, firstly for market, liquidity and counterparty risks, then for aggregate risk across several funds and finally for particular fund categories such as illiquid asset classes and index funds.

## 2.1. MARKET RISKS

Market risk<sup>6</sup> is the risk of loss for the collective investment scheme or the individual portfolio resulting from fluctuation in the market value of positions in the portfolio attributable to changes in market variables such as interest rates, foreign exchange rates, equity and commodity prices, or an issuer's creditworthiness. These risks may be independent of each other or correlated, depending on the financial instruments within the fund's asset base.

<sup>6</sup> Article 313-53-3 of the AMF's General Regulation.

### 2.1.1. Identifying risks

The way in which market risk is mapped should be adapted to the instruments and strategy implemented by the fund.

#### **Example of identifying risks associated with the instruments used during fund management:**

Instruments	Associated risk factors	Risk indicators
<b>Forex products:</b> <ul style="list-style-type: none"> <li>• Forex spots</li> <li>• Forex forwards</li> <li>• Forex derivatives</li> <li>• Forex swaps</li> </ul>	Foreign exchange risk Volatility risk Liquidity risk Counterparty risk	<ul style="list-style-type: none"> <li>• Exposure</li> <li>• Volatility</li> <li>• VaR</li> <li>• CVaR,</li> <li>• Sensitivity / Greeks</li> <li>• Leverage</li> </ul>
<b>Equity products:</b> <ul style="list-style-type: none"> <li>• European large caps</li> <li>• International mid and small caps</li> <li>• Equity/index derivatives</li> <li>• Equity UCITS</li> </ul>	Equity risk Foreign exchange risk Volatility risk Liquidity risk Counterparty risk Geopolitical risk	<ul style="list-style-type: none"> <li>• Exposure</li> <li>• Volatility</li> <li>• VaR</li> <li>• CVaR,</li> <li>• Sensitivity / Greeks</li> <li>• Leverage</li> <li>• Country risk score</li> </ul>
<b>Fixed income products:</b> <ul style="list-style-type: none"> <li>• Corporate and interbank loans</li> <li>• Sovereign debt (fixed/variable rate)</li> <li>• Corporate debt (fixed/variable rate)</li> <li>• Securities lending</li> <li>• Repos/reverse repos</li> <li>• Interest rate derivatives (interest rate swaps / interest rate futures / forward rate agreements)</li> <li>• Fixed income UCITS or AIFs (money market UCITS)</li> <li>• Bond UCITS or AIFs</li> </ul>	Interest rate risk Repo rate risk Credit risk Volatility risk Liquidity risk Counterparty risk Geopolitical risk	<ul style="list-style-type: none"> <li>• Exposure</li> <li>• Volatility</li> <li>• VaR</li> <li>• CVaR</li> <li>• Sensitivity / Greeks</li> <li>• Repo rate sensitivity</li> <li>• Leverage</li> <li>• Country risk score</li> </ul>
<b>Commodity products</b> <ul style="list-style-type: none"> <li>• Commodity futures index options</li> </ul>	Commodity risk Volatility risk Liquidity risk Counterparty risk Geopolitical risk	<ul style="list-style-type: none"> <li>• Exposure</li> <li>• Volatility</li> <li>• VaR</li> <li>• CVaR</li> <li>• Sensitivity / Greeks</li> <li>• Leverage</li> <li>• Country risk score</li> </ul>



<p>Credit derivatives</p> <ul style="list-style-type: none"> <li>• Credit default swaps (CDSs)</li> <li>• Credit linked notes (CLNs)</li> <li>• Credit Default Swaption</li> </ul>	<p>Interest rate risk</p> <p>Credit risk</p> <p>Volatility risk</p> <p>Liquidity risk</p> <p>Geopolitical risk</p>	<ul style="list-style-type: none"> <li>• Exposure</li> <li>• Volatility</li> <li>• VaR</li> <li>• CVaR</li> <li>• Sensitivity / Greeks</li> <li>• Leverage</li> <li>• Country risk score</li> </ul>
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### 2.1.2. Defining market stress test scenarios

Once the risk factors have been identified, the AMC should set about defining the stress test scenarios.

The simplest approach is to model the parameters of previous crises and deduce the impact they would have had on the fund (**historical scenario**). This approach can obviously lead to questions about the fund's ability to deal with future crises. Clearly, there is nothing to suggest that future crises will be similar to previous ones. Moreover, it is difficult to precisely replicate past crises because data (for example in terms of the historic correlation of risk factors) are often incomplete, particularly going back more than a decade, and may produce very different scenarios.

Alternatively, **hypothetical scenarios** involve anticipating a crisis by imagining its parameters. These scenarios, often based on historical scenarios, should be relatively realistic and are sometimes formulated with the help of fund managers, whose expertise complements the purely statistical approach.

By way of example, here are some commonly used scenarios:

- **Historical scenarios:** junk bonds in 1989, subprime mortgages in 2008, the Greek crisis in 2009 and the Chinese stock market crash in 2015. These scenarios can have independent or correlated shocks depending on the model.
- **Credit-linked scenarios:** widening of spreads, credit crunch<sup>7</sup>, flight to quality<sup>8</sup>.
- **Single-factor or multi-factor scenarios**
  - uncorrelated (fixed income, equity, real estate, counterparty, commodities, forex, volatility, correlation, etc.).
  - correlated: a particular shock may spread to all risk factors, depending on the correlation table in question.
- **Hypothetical scenarios** based on economic shocks, particularly risk by country or business segment (e.g. bankruptcy of a sovereign state or crash in an industrial sector). This type of scenario requires the creation of a dashboard of all changed risk factors, a correlation matrix and a choice of financial behaviour model.
- **Probable scenarios** based on implied volatility.
- **Fund strategy-specific scenarios**, where there is little influence from previous scenarios and real sensitivity to traditional risk factors is hard to calculate. This can be the case for a long/short investment strategy.

Stress scenarios can take very different forms. It is advisable to use as varied scenarios as possible provided they are relevant to the funds or individual portfolios in question.

<sup>7</sup> Significant and sudden contraction of credit.

<sup>8</sup> During a stock market crisis, significant flows of capital to safe (and generally more liquid) investments. The price of financial assets affected by credit risk falls sharply because it is harder for borrowers to get financing, and even if they succeed, they have to pay a higher rate of interest.

**Good practice:**

- 1) Use highly varied scenarios based on rare hypotheses developed by fund managers. For example, a long/short fund may be particularly sensitive to market movements that were not taken into account by historical stress tests. Hypothetical scenario creation can highlight correlations or sensitivities that were not taken into account by historical scenarios.
- 2) Vary the time windows for historical scenarios in order to process as many scenarios as possible and avoid getting stress test results that depend overly on an arbitrary time window (e.g. one period with low interest rates and another with higher rates).

When a fund's strategy refers to a benchmark index, it may be advisable to perform stress tests on the index and compare the results with the stress tests performed on the fund.

**Methods to avoid:**

- 1) Using scenarios from a past period which, following a sustained spell of stability, no longer contains examples of extreme events. For example, if an AMC uses a five-year track record for volatility, it is possible that all major volatility peaks occurred before the start of that period, which changes the interest of the scenario considerably.
- 2) Using scenarios that are too old and are not updated regularly. For example, it may no longer be relevant to use a matrix of correlation between country risk factors and equities that has not been updated regularly, particularly if a company changes the location of its registered office or expands into new markets.

## 2.2. LIQUIDITY RISK

Liquidity risk<sup>9</sup> is the risk that a position in the portfolio cannot be sold, liquidated or closed out at limited cost in an adequately short time frame and that the ability of the collective investment scheme to comply at any time with the third paragraph of articles L. 214-7 or L. 214-24-29 or articles L. 214-8 or L. 214-24-34 of the French Monetary and Financial Code, or the ability of the investment services provider to liquidate positions in an individual portfolio in accordance with the contractual requirements of the portfolio management mandate, is thereby compromised.

It is very hard to measure liquidity risk using a single measure because it may result from: (i) significant redemptions; (ii) illiquid assets; or (iii) a combination of the two.

### 2.2.1. Significant redemptions

First of all, a liquidity stress test includes **a simulation of redemptions**. This simulation can be calibrated based on stability analysis of the liabilities, which itself depends on the type of investor (institutional, retail, private bank, etc.) and the concentration of the liabilities.

**Understanding and analysing the fund's liabilities is essential to identifying the risks faced by the AMC.**

The particular characteristics of the liabilities and any cyclical changes to redemptions need to be taken into account when establishing redemption scenarios. There are many ways to simulate liabilities and redemptions. In this section of the guide, **we will look at four examples of redemption scenarios**, but these scenario types can be combined to simulate redemptions from a fund and are not exhaustive.

<sup>9</sup> Article 313-53-3 of the AMF's General Regulation.

### Examples of significant redemption scenarios:

- A. **Redemptions of a percentage of the liabilities (typically between 20% and 50%)** defined based on the frequency of calculating the net asset value, any redemption notice period and the type of investors

**Example:**

**Estimating the percentage of redemption requests that the fund is able to honour based on the liabilities subject to redemption requests.**

For the purpose of this example, we assume that the fund will liquidate positions under normal market conditions and with no major distortion of portfolio allocation, and that a maximum of 20% of the daily average volume can be sold on the underlying market.

Fund	AuM (€m)	Redemption scenarios	10% redemptions	20% redemptions	30% redemptions	40% redemptions	50% redemptions
AMF equity Europe	1353	Ability to honour (as a percentage of redemptions)	100%	99.5%	98.9%	97.9%	96.9%
		Ability to honour (as a percentage of assets)	10%	19.90%	29.67%	39.16%	48.45%
AMF equity France	350	Ability to honour (as a percentage of redemptions)	92.2%	83.4%	78.3%	73.4%	68.7%
		Ability to honour (as a percentage of assets)	9.22%	16.68%	23.49%	29.36%	34.35%

In this example, we can see that the fund AMF actions France is far more sensitive to redemption risk: even if only 10% of liabilities are subject to redemption requests, the fund is able to honour only 92.2% of requests, i.e. 9.22% of the portfolio, under the assumptions used.

This means that if 10% of the fund's liabilities are subject to redemption requests, the AMC will have to sell at a loss or reduce the portfolio's average liquidity by distorting its allocation, which threatens the principle of fair treatment of investors<sup>10</sup>. The assumptions we have used do not seem extreme, because more than 10% of liabilities may be subject to redemption requests when asset liquidity is also worse and the fund may not be able to liquidate up to 20% of the average daily volume.

The liquidation of positions with no major distortion of portfolio allocation is also a conservative assumption. In the example, the AMF actions France fund can liquidate only 9.22% of the portfolio if 10% of liabilities are subject to redemption requests (because at least one of the assets cannot be liquidated at 10%). The following solutions would be possible: i) creating a side pocket<sup>11</sup> for the asset with insufficient liquidity; ii) selling more than 10% of one of the least liquid assets to adjust the portfolio's average liquidity; or iii) failing to honour the redemption requests (by applying redemption caps or gates, for example). The scenarios presented in these examples are based on the use of side pockets or a slight distortion of portfolio liquidity.

B. **Redemption of units by the largest unitholder(s)**

Rather than defining an arbitrary redemption percentage like in the previous scenario, we can use information about a fund's investors to refine the stress test. Specifically, the scenario involving redemption of units by the largest unitholders should be calibrated based on the concentration of the fund's liabilities and the

<sup>10</sup> Throughout this guide, the term "fund investors" should be taken as including the shareholders of a SICAV.

<sup>11</sup> If the sale of assets is not in the interests of the UCI's unit- or shareholders, they can be transferred to a side pocket AIF under the terms of articles L. 214-8-7, L. 214-7-4, L. 214-24-41 and L. 214-24-33 of the French Monetary and Financial Code.

relationships between the AMC and the fund's primary unitholders (i.e. is it a long-term, equity-based relationship or are the investors deemed to be volatile?).

- C. **Redemptions equal to historical redemptions** in a group of similar (geographically or in terms of fund type) funds or across all the funds managed by the AMC

Liability-side stress scenarios can also be based on historical redemptions from the same fund, from all the AMC's funds or from other similar funds.

However, the largest redemptions witnessed in the past are not necessarily a reliable indicator of the worst redemptions that may occur in the future, and it is therefore advisable to also use a more extreme scenario based on one of the two previous approaches.

- D. **Redemptions based on an investor behaviour model**, in accordance with the breakdown of liabilities by investor category.

This type of scenario simulates the behaviour of each type of investor and establishes a simulation based on the composition of the fund's liabilities.

**Example of investor classification and simulation of their behaviour (the figures shown are not real):**

Investor type	Record redemptions for this investor type			Stressed redemptions for this investor category
	Over one day	Over one week	Over one month	
Large institutionals	25%	75%	100%	75%
Investment fund	20%	65%	100%	65%
Small institutionals	10%	25%	40%	25%
Private banking network	15%	40%	75%	40%
Retail investor with distributor A	5%	10%	20%	10%
Retail investor with distributor B	7%	15%	20%	15%

Implementing such a simulation requires assumptions to be made about the behaviour of each investor type, based in part on historical redemptions (just like in the previous kind of stress test). In the example above, the AMC has noted that the retail investors who invested through distributor A are historically slower to exit in the event of difficulty (see the maximum redemptions observed in one day and in one week), but that they exhibit the same behaviour over one month as retail investors who invested through distributor B<sup>12</sup>.

The stress scenario used in this example (stressed redemption) is based on hypothetical redemptions over one week. This fictitious example demonstrates a possible classification that AMCs can use based on the data available to them as regards liabilities and investor behaviour.

Historical redemption data should enable the fund redemption scenarios to be more accurately calibrated.

<sup>12</sup> Any differences in investor behaviour based on the distributor are often attributable to the different locations of the investors (e.g. different tax regimes in different countries) or the different types of non-professional investors.

AMCs are advised to take into account all the information at their disposal about the liabilities of the funds they manage; they should take all possible steps to model investor behaviour and create the best possible redemption scenarios.

**Note:**

The ownership limits applicable to institutional investors may, in certain cases, pose a specific risk of **snowballing redemptions** in certain funds with insufficiently diversified liabilities. In effect, if several investors are invested up to their ownership limit, the exit of one investor may cause others to reach their ownership limit and also be obliged to redeem their units. Understanding of this type of constraint can enhance the liability modelling process.

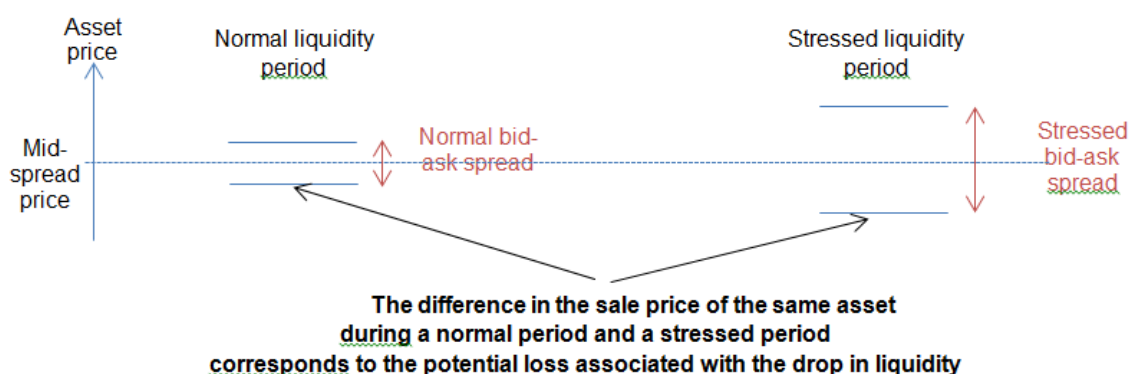
### 2.2.2. Liquidity risk on the asset side

Liquidity stress tests should also take account of the liquidity of portfolio assets. Although the liquidity of an asset is extremely subjective, there are several methods of monitoring the ability to sell assets without having a major effect on the price.

A non-exhaustive list of ways to measure asset liquidity is provided below to assist AMCs, which should above all adapt them to their funds' portfolios and understand their limitations.

#### Example 1 of asset liquidity measure - Loss incurred following an increase in the bid-ask spread.

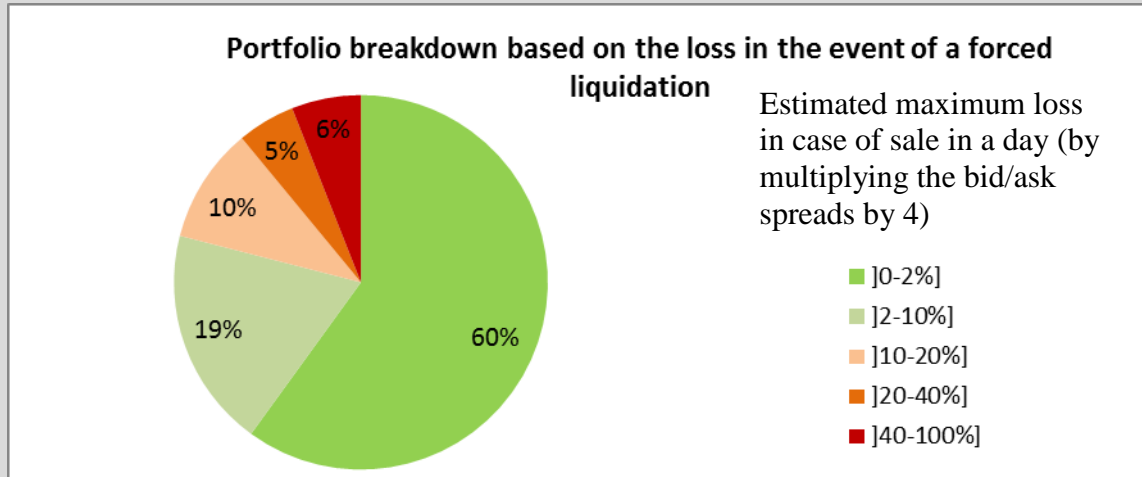
If an asset becomes less liquid, the gap between the "bid" and the "ask" (the purchase and sale prices generally proposed by the market-makers) tends to increase, partly because the risk taken by the market-makers is greater. Therefore, when a fund sells assets in stressed conditions, it will do so at a lower bid price than it would have obtained under normal liquidity conditions.



This loss is usually calculated on the basis of multiplying normal bid-ask spreads by three or four during a stressed period. On the other hand, this method is based on the premise that assets can always be sold immediately with a possible discount, which is no longer the case in an exceptional crisis with no buyer. This loss may not be relevant for illiquid assets.

**Example: Estimate of loss arising from illiquid assets**

**Classification of a European bond fund's assets based on the potential loss upon same-day liquidation.**



According to this estimate of the loss incurred in the event of a forced liquidation, the fund may lose between 5% (optimistic scenario based on the minimum loss for each range<sup>13</sup>) and 13% (conservative scenario based on the maximum loss for the range<sup>14</sup>) if it were forced to liquidate all its assets on the same day.

In some specific cases, this estimate may not be accurate because in the event of a serious liquidity crisis, it would likely be impossible to sell large volumes of certain bonds.

**Example 2 of asset liquidity measure - Maximum liquidation possible in a single day**

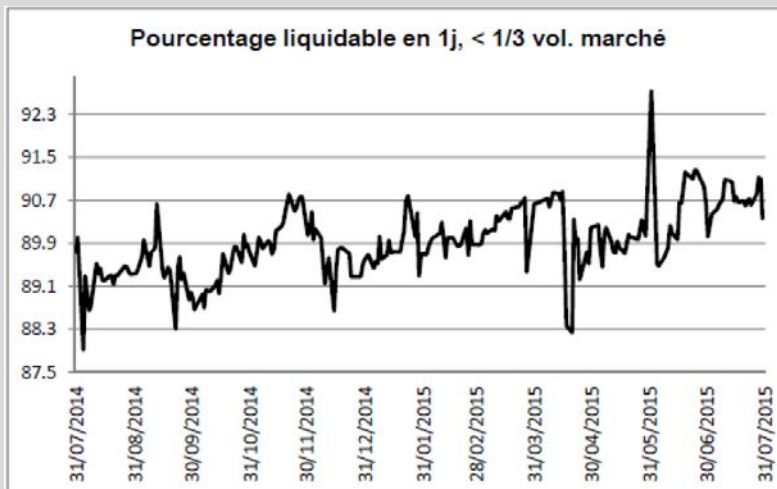
This method relies on analysing daily trades on the markets underlying each portfolio asset type, but these are currently published only for US bonds and equities. For any given asset, a calculation is made of the maximum share of the volumes exchanged on the underlying market that the AMC believes can be liquidated (typically 10% or 20% for equities). By estimating this maximum amount for each portfolio asset, the daily liquidity of a portfolio can be worked out.

For narrow markets (e.g. small caps), it would be helpful if this estimate of a fund's ability to sell out of its positions would take into account the other funds managed by the AMC, which may simultaneously be subject to the same redemption requests but cannot simultaneously liquidate the same assets at 20% of the market volume. If an AMC manages several funds invested in the same security, the maximum amount of this security that can be liquidated should include all the securities held by the funds it manages.

<sup>13</sup>  $60\% \times 0 + 19\% \times 2\% + 10\% \times 10\% + 5\% \times 20\% + 6\% \times 40\% = 4.78\%$  loss.

<sup>14</sup>  $60\% \times 2\% + 19\% \times 10\% + 10\% \times 20\% + 5\% \times 40\% + 6\% \times 100\% = 13.10\%$  loss.

**Example of an equity fund's ability to liquidate its portfolio in a single day, assuming it can sell at 30% of the market volume on that day:**



In this example of a fund consisting of 50 listed shares, we consider the average volume exchanged every day for each security in the portfolio, then we assume that 30% of this volume can be sold in a single day. Based on an analysis of each portfolio security, we can calculate the percentage of assets across the entire portfolio that can be liquidated in a single day.

This work is carried out every day on the basis of the new volumes exchanged, which is how we arrive at the data shown in the chart above. The daily changes on the graph, which represent the changes in volumes exchanged on the underlying markets, are not decisive, but the long-term trend of the graph provides an indication as to the liquidity of the portfolio.

In view of the assumptions used in this example (30% liquidation of the volume exchanged daily on the underlying markets), it would appear as though the fund can sell between 88% and 92% of its assets in a single day

**As the variety of the examples shows, the uncertainty surrounding the liquidity of an asset encourages AMCs to exercise caution and imagine several different scenarios.**

It is difficult to estimate the ability to sell an asset, and this ability will probably be considerably less during a liquidity crisis than under normal conditions. More generally, the volumes exchanged on a market are not always a good indicator of the liquidity of an asset because some assets are held by long-term investors and are therefore exchanged only occasionally.

**Example of a large-cap equity fund:**

Estimate of the share of assets that can be liquidated if we assume that a maximum of X% of the daily volume exchanged on the market can be sold (and with no portfolio allocation constraints).

		Percentage that can be liquidated in a single day			
Fund	AuM (€m)	Hypothesis 1 1% of the daily volume	Hypothesis 2 5% of the daily volume	Hypothesis 3 10% of the daily volume	Hypothesis 4 30% of the daily volume
AMF actions France	350	9%	45 %	91%	100%

For the purpose of this example, we assume that the average volume exchanged daily and weighted by portfolio composition over one year is €3.2 billion. If we assume that the fund can liquidate 1% of the daily volume, it can therefore sell €32 million of assets, or 9% of its portfolio.

For an equity fund investing in large caps, the markets can be considered fairly transparent and the daily exchange volume and changes thereto can therefore be reliably determined. However, this method is much less reliable for smaller markets (see the example below) and over-the-counter (OTC) markets, where trust between operators can easily be eroded.

**Example 3 of asset liquidity measure - Estimate of liquidation time frame based on breaking down<sup>15</sup> fund assets by liquidity (bucketing)**

This method uses a breakdown by liquidity buckets to estimate the time needed to sell under normal conditions. It is similar to the previous method, but measures the total liquidation time rather than the volume that can be liquidated.

It makes a distinction between the portfolio's estimated liquidation time frame with a constant liquidity profile and with the most liquid assets sold first.

**Example of a small-cap fund:**

Let us take the example of an equity fund that has invested €15 million in mid-tier firms (known as ETIs in France), most of which are listed on Compartment C of Euronext (market capitalisation of less than €150 million) and on Alternext. The fund has a portfolio of companies with an average capitalisation of €75m.

We will assume that for the stressed scenario, 25% of the average daily volume exchanged can be sold.

Example of fund's five main holdings:

Name of stock	% of assets	Capitalisation (€m)	Daily volume exchanged (€k)	Amount that can be liquidated assuming redemptions of 25% of the daily volume (€k)	Number of days to liquidated the holding
A	6%	300	800	200	5
B	5.3%	205	4000	1000	1
C	4.5%	105	450	112	6
D	4.1%	70	50	12.5	49
E	3.3%	85	100	25	20

<sup>15</sup> This involves breaking down data into categories.



By applying the same method as the one used in the table above, we can classify the assets by the time required to fully liquidate the holding.

However, this assumption appears optimistic in the event of a liquidity crisis because:

- the exchange volume is likely to be well below average during a liquidity crisis;
- if the exchange volume remains close to the average, other players will also want to sell. Specifically, if five funds hold shares in company B, they cannot possibly all sell 25%, in accordance with the assumption made. This will make a significant dent in the volume of the assets that the fund will be able to sell, and therefore also the redemption requests it can honour.

The following factors may affect the liquidity of the holding during a crisis:

- the portion of the free float<sup>16</sup> of the listed company;
- the type of investors in the target companies.

More generally, the exchange volume is an uncertain indicator, and it is useful to compare the exchanged volumes with those of other stocks in the same segment or with a similar market capitalisation.

The above list of ways in which liquidity can be measured shows that many different approaches are possible. Whatever the method or methods chosen by the AMC to estimate the liquidity of its assets, it must also be aware of the limitations. In view of the difficulties involved in measuring liquidity, it is at least equally important to analyse changes in liquidity as the absolute value, and it is preferable to use several **liquidity measurement models, at least one of which** should make provision for it being impossible to sell certain assets.

### 2.2.3. Combined asset and liability liquidity risk

There are three separate elements of liquidity risk management: liquidity risk on the asset side, liquidity risk on the liability side (portfolio liquidity and investor behaviour) and combined asset and liability liquidity risk (the fund's ability to meet its redemption obligations).

#### Example of a short-term money market fund

Money market funds need to be dealt with specially because of their size and the significant levels of redemption requests they have to honour.

Let us take the example of a money market fund with €15 billion under management, whose three largest investors account for 25% of net assets. The fund has 10% of highly liquid assets or deposits. In addition, 15% of its assets under management are held by very stable investors.

The table below estimates the potential losses incurred by the money market fund in the event of redemptions or market stress (credit or interest rate shocks).

<sup>16</sup> Portion of shares that can actually be traded on the stock exchange.

	Three largest investors (25%)							Very stable investors (15%)		
Redemptions	0% redemptions	10% redemptions	20% redemptions	30% redemptions	40% redemptions	50% redemptions	60% redemptions	70% redemptions	80% redemptions	90% redemptions
Initial portfolio			2 bps	3bps	5bps	6bps	8bps	9bps	11bps	12bps
First scenario	7bps	9bps	13bps	18bps	24bps	32bps	45bps	66bps	110bps	236bps
Second scenario	3 bps	4bps	6bps	9bps	12 bps	16bps	21bps	28bps	38bps	85bps
WAL (days)	105	117	131	149	169	192	219	249	290	320
<p><b>First scenario: credit premium shock of 25 bps</b>  <b>Second scenario: interest rate shock of 25 bps</b></p> <p>This stress test shows that a redemption by the three largest investors (25% of net assets) would push the weighted average life (WAL) beyond the 120-day regulatory threshold (for a short-term money market fund) and cause the portfolio to lose in the region of 2-3 bps under normal conditions. The same level of cumulative redemptions with a 25 bps rise in interest rates would cause a loss of around 13-18 bps.</p>										

It is useful for **liquidity stress test scenarios to combine a liability shock** (significant redemptions or margin calls) and an asset shock because it is likely that investors will make significant redemption requests during stressed market periods.

### Multicriteria approach to evaluating the combined asset and liquidity liability of a fund:

One way of simulating a combined asset and liability shock is to use a multicriteria approach, which measures changes in a fund's liquidity risk over time.

This method involves calculating a daily score for each fund, based on two elements:

- an evaluation of asset liquidity with an asset score (stressed bid-ask spread to simulate daily exchanged volume or liquidation cost);
- a liability score estimating investor stability, based on distribution and concentration by investor type.

The final result can be used to classify the different funds managed by the AMC based on their sensitivity to liquidity risk and to monitor instances of considerable variation for the same fund.

**Example of multicriteria approach to asset-liability balance under stressed conditions:**

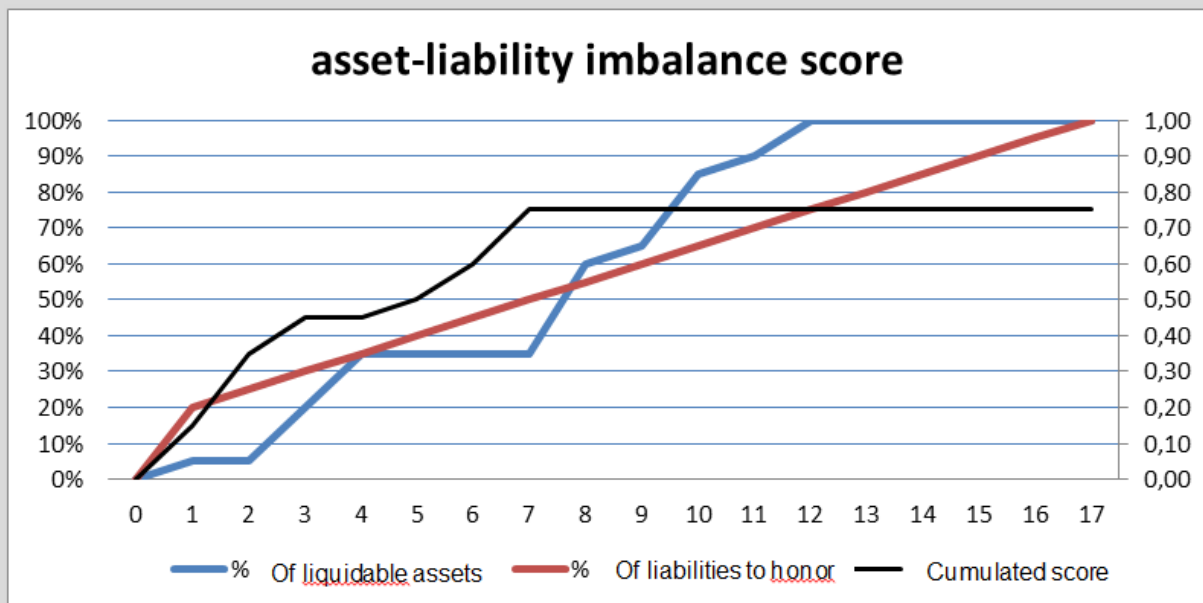
In this approach, the score is the sum over one year (250 days) of estimated daily cash deficits (expressed as a percentage of net assets). The cash deficit (or redemption requests that are not honoured) is calculated every day as the difference between the maximum possible redemption requests and the amount generated by the liquidation of assets.

$$score = \sum_{250 \text{ days}} \text{cash deficits}$$

$$score = \frac{1}{\text{net assets}} \sum_{250 \text{ days}} [\text{redemption requests}_{day} - \text{assets to be liquidated}_{day}]$$

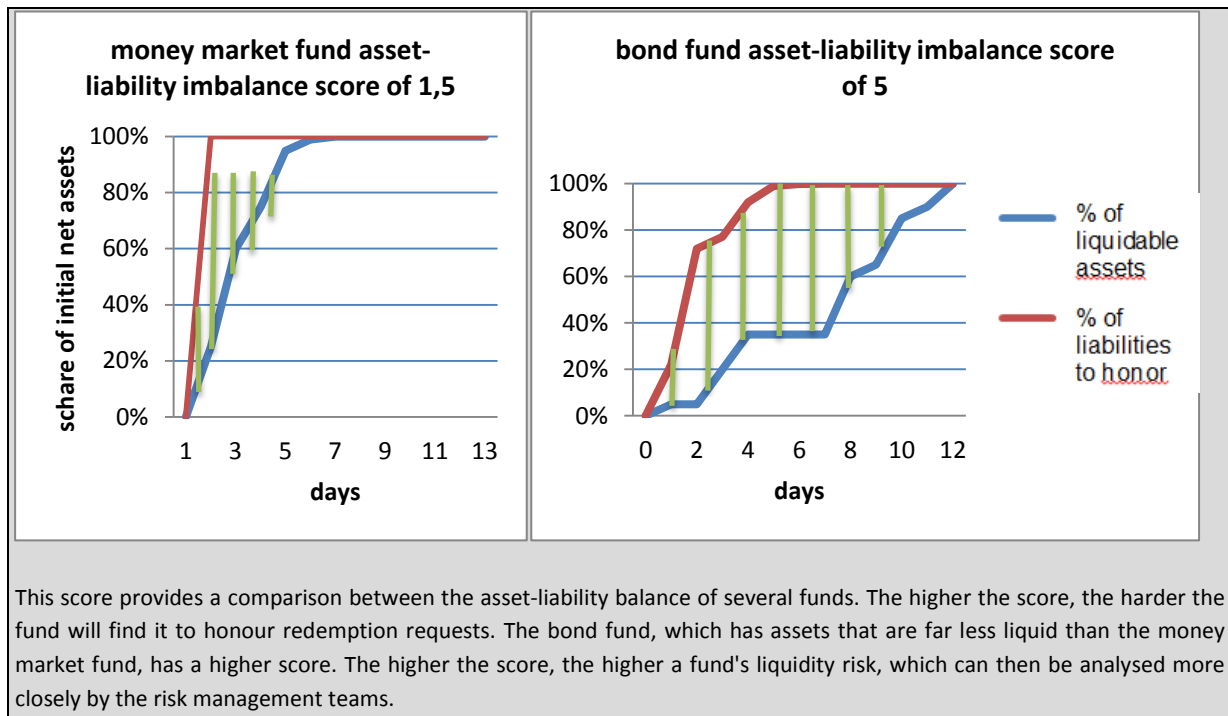
This means that the score is a measure of the gap between the redemption requests and the ability, estimated under stressed conditions, to sell the assets.

In this example, the score varies from 0 (perfect asset-liability balance) to 250 (the worst possible situation in which redemptions are equal to total net assets and the assets are impossible to sell).



In the graph above, which shows redemption requests in red and the cumulative percentage of liquid assets in blue, **the score is the area marked with green lines, i.e. the difference between the redemption requests and the result of asset sales.**

Let us look at two specific examples of a money market fund and a bond fund:



### 2.3. COUNTERPARTY AND COLLATERAL RISK.

Counterparty risk<sup>17</sup> is the risk of loss for the collective investment scheme or the individual portfolio from the fact that the counterparty to the transaction or to a contract may default on its obligations prior to the final settlement of the transaction's cash flow.

It can be useful to simulate the default of one or more counterparties in certain stress test scenarios, including by combining this risk with liquidity and market risk.

For example, a fund that receives bonds as collateral can simulate the forced sale of 40% of the nominal value of the collateral received in a portfolio, at an identical discount to the one applied in the stress tests carried out on bond funds.

These stress tests can improve the calibration of the business continuity plan (for example by replacing the counterparty or other types of operational solutions) or measure certain specific risks associated with the assets received as collateral.

<sup>17</sup> Article 313-53-3 of the AMF's General Regulation.

Paragraph 37 of AMF Position DOC-2013-06 on ETFs and other UCITS issues<sup>18</sup> deals specifically with the liquidity risk associated with collateral:

*"A UCITS receiving collateral for at least 30% of its assets should have an appropriate stress testing policy in place to ensure regular stress tests are carried out under normal and exceptional liquidity, in order that the UCITS can evaluate the liquidity risk associated with the collateral. At the very least, the stress testing policy should make provision for:*

- a) the design of stress test scenario analysis including calibration, certification and sensitivity analysis;*
- b) an empirical approach to impact assessment, including back-testing of liquidity risk estimates;*
- c) reporting frequency and limit/loss tolerance threshold/s; and*
- d) mitigation actions to reduce loss including haircut policy and gap risk protection."*

## 2.4. AGGREGATE LIQUIDITY STRESS TESTS FOR ALL FUNDS MANAGED BY AN AMC

The liquidity stress test scenarios implemented for each fund may also take into account how the funds interact with the other funds managed by the AMC. Creating aggregate stress test scenarios for all funds managed by the AMC therefore provides a consolidated picture of how certain scenarios will affect a range of funds.

With regard to these scenarios, it may be useful when defining the stress parameters to remember that if a crisis affects an entire market or asset class, other operators are also likely to be in a selling position and it will therefore be harder to sell than in normal conditions.

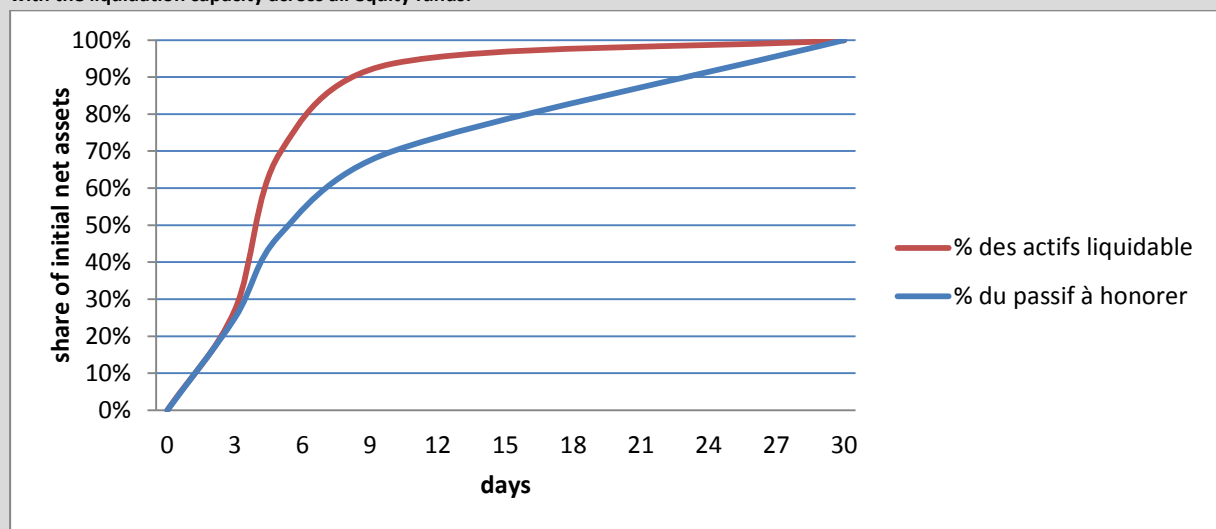
In particular, if it is felt that a market has limited capacity (in the case of small caps, for example), it might be useful to take into account, for example, the total volume of assets held by all an AMC's funds in a particular position, and the potential impact of several portfolios selling out of said position at the same time during a liquidity crisis.

<sup>18</sup> Which itself is based on ESMA's guidelines on ETFs and other UCITS issues (ESMA/2014/937FR).

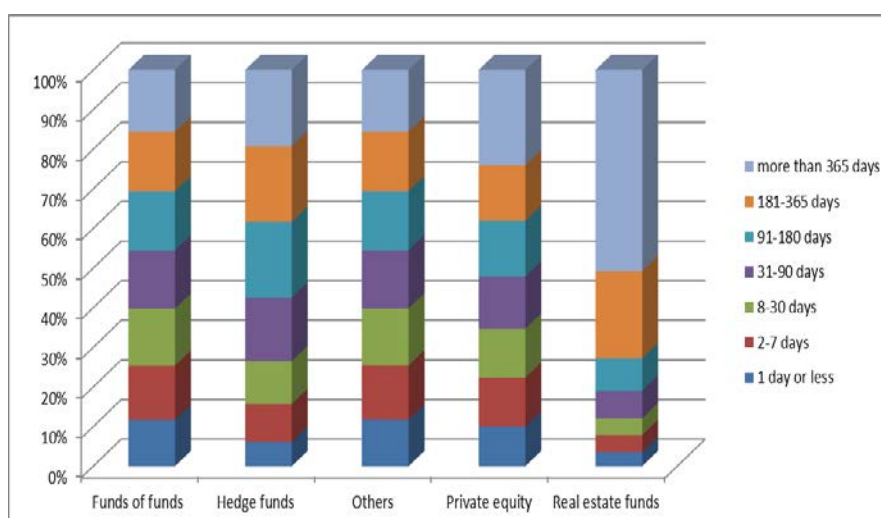
**Example: Summary of the securities held across all an AMC's equity portfolios**

Estimated liquidation time frame (days)	0 – 3	3-5	5 - 10	10 – 30	> 30
Share of net assets of all the AMC's funds	27.18%	42.42%	24.05%	6.22%	0.14%

In this example, it is supposed that 30% of the AMC's equity fund units are held by stable investors and that the three biggest investors cumulatively hold 25% across all funds. It is possible to simulate redemption requests across all the AMC's funds and compare them with the liquidation capacity across all equity funds:



Equally, aggregating all funds by liquidity bucket provides an overview of the liquidity of all funds by asset class. This is the method the AMF uses to aggregate some of the data it receives in accordance with the AIFM Directive ("AIFM Reporting"):



Source: AIFM Reporting (December 2015), calculation by the AMF

For narrow markets, it would seem appear sensible to **implement liquidity stress test scenarios that simultaneously affect several funds managed by an AMC rather than each individual AIF or UCITS**. This better takes into account the interaction between the different funds managed and integrates the AMC's reputational risk into the fund redemption simulations. In particular, if it is felt that a market has limited capacity to absorb asset sales, it is helpful, for liquidity stress tests, to consider redemptions across several of the funds managed by an AMC rather than dealing with each fund separately.

## 2.5. THE PARTICULAR CASE OF CERTAIN ASSET CLASSES

### Stress tests on illiquid or closed-end assets

#### Liquidity stress tests

For AMCs authorised under the AIFM Directive, article 318-44 of the AMF's General Regulation states that liquidity stress tests (tests conducted under normal and exceptional liquidity conditions for the purpose of assessing the liquidity risk of the AIFs) are compulsory for open-ended funds and leveraged closed-ended funds.

Although stress tests are less crucial for certain types of unleveraged closed-ended funds, particularly if no mitigation action can be taken, **liquidity stress tests may be helpful for funds that may experience redemptions in exceptional circumstances, particularly where non-professional investors are concerned**.

Moreover, stress tests can also be a useful tool in preparing for the **liquidation of a fund**.

**For closed-ended funds**, liquidity stress tests are useful in preparing for liquidation (if the assets have to be liquidated within a certain time frame) or whenever the fund expects premature exits caused by exceptional events such as death or incapacity.

#### Market stress tests

According to article 45 of Commission Delegated Regulation (EU) 231/2013 of 19 December 2012, AMCs should conduct "periodic appropriate stress tests and scenario analyses to address risks arising from potential changes in market conditions that might adversely impact the AIF". **This market stress test requirement applies to all AIFs, including closed-end and illiquid funds<sup>19</sup>**. Nevertheless, stress test conditions should be assessed differently depending on the fund type, whether it is open- or closed-ended, and its life cycle.

In particular, market stress tests on assets with little or no liquidity are useful **at the time of the investment choice** or significant management actions.

**For closed-ended funds**, market stress tests should be implemented and used at key stages in a fund's life (creation, merger, liquidation, etc.).

### Stress tests on property funds

Unlisted real estate is an illiquid asset class that requires long-term investment.

#### Market risk stress tests

Market stress tests can be used on a real estate asset prior to an investment or a significant management action, but also during the investment's lifetime in order to assess the possibility of a sale.

Market stress tests can also be carried out in order to anticipate movements that might, for example, prompt the underlying assets to be sold (the duration of the sale may be a problem in the event of significant redemptions) or the borrowing conditions to be renegotiated.

<sup>19</sup> Pursuant to article 313-53-7 (II) of the AMF's General Regulation, companies that manage sub-threshold AIFs and have chosen not to apply the AIFM Directive must also conduct stress tests where appropriate.

By way of example, here are a few market risk factors that can be stressed for a given real estate asset:

- Real estate price in the asset's market segment;
- Rental indicators (rent amounts, vacancy rates, unpaid rent, etc.);
- Configuration and technical indicators, e.g. amounts for scheduled and unscheduled works to be carried out, which are crucial in determining value.

Traditionally, the value of a fund's unlisted real estate assets is subjected to shock assumptions by geographical sector, with the specific risks of each asset not taken into account.

This may be supplemented by an interest rate curve shock, particularly if the assets are financed externally with no hedging of interest rate risk, or by an exchange rate shock if there are foreign-currency assets with no hedging of exchange rate risk.

The shock to the value of unlisted real estate assets may be associated with a shock to the value of any financial assets held by the fund.

#### **Liquidity risk stress tests**

Liquidity risk arises from the risk of premature sale or delays to the sale.

Stress tests are designed based mainly on the liquidity profile of each fund's liabilities, i.e. the methods used to repay capital and debt as well as the type of investors.

In particular, it should be remembered that certain funds are extremely illiquid but have a limited lifetime (professional real estate collective investment schemes, or OPPCIs) while others offer liquidity only on a secondary market (real estate investment trusts, or SCPIs)<sup>20</sup>.

Leverage is an important factor in fund liquidity management because loans generally have to be repaid via the sale of the assets they have financed, unless a new loan is taken out<sup>21</sup>. The stress test scenarios must take account of the fundamental liquidity characteristics of loans, i.e. the updated loan-to-value (LTV) ratio, the maturity date, the interest rate and the updated compliance with covenants.

Just like for the other fund types, it is important to have scenarios that combine several risk factors. In particular, a reduction in the value of assets often goes hand in hand with significant redemption requests and/or loan acceleration.

#### **Private equity funds**

Private equity actors do not perform many stress tests during the life of a fund because of the closed-end nature of the funds. As mentioned above, it is still useful to put liquidity stress tests in place if a fund is not totally closed-end, particularly in the case of funds available to non-professional investors, and when the fund is liquidated (if the liquidation has to take place over a fixed period).

<sup>20</sup> Open-ended SCPIs are eligible for redemption on the primary market, but only up to the number of units subscribed over the same period.

<sup>21</sup> New loans are included in stress test scenarios only if the fund explicitly benefits from a credit line it can draw down on in a stressed period.



## Exchange-traded funds (ETFs)

Market stress tests are of limited use to ETFs with a systematic, non-discretionary strategy and for which few corrective measures can be implemented.

Having said that, depending on the setup, ETFs can have a counterparty risk and implementing specific stress tests can allow AMC's to plan solutions or mitigating measures in the event of a default or any other major event resulting in a split between the ETF and its counterparty or counterparties.

With regard to liquidity risk, certain ETFs can experience replication difficulties if the underlying market becomes illiquid, meaning that it is a good idea to implement liquidity stress tests that combine assets and liabilities. Since ETFs are known as being highly liquid, they are particularly vulnerable to significant redemptions during a liquidity crisis, which means that using particularly extreme stress test scenarios is merited.

On the liability side, it is particularly useful to simulate the extreme scenario whereby authorised participants (APs) no longer lead the secondary market and investors directly request redemption at the net asset value.

To summarise, stress tests for ETFs can simulate, among other things:

- Severe asset and liability liquidity shocks;
- Counterparty defaults;
- Bankruptcy of authorised participants or market makers.

## 2.6. THE SPECIFIC CASE OF INDIVIDUAL MANAGEMENT MANDATES

For individual portfolios, asset liquidity must be aligned with the investor's objectives but liquidity risk is not the same as for a UCI, because there is no requirement to treat investors equally should the portfolio's liquidity be distorted. As such, management mandate stress tests often focus on the portfolio's market risks.

In addition, it is acceptable to use stress tests that are common to several portfolios for groups of mandates.

## 2.7. CONCLUSIONS ON THE IMPLEMENTATION OF STRESS TESTS

### Stress tests designed specifically for the strategy of each fund

Article 411-79 of the AMF's General Regulation states that, for funds that measure their global exposure using the value at risk (VaR) model, AMC's should implement "2° A rigorous and comprehensive stress-testing programme adjusted to the risk profile of the CIS that can be used to simulate the behaviour of the CIS under stress." Equally, for AIFs managed by an AMC that has been authorised under the AIFM Directive, in compliance with article 318-41, the AMC shall "2° Ensure that the risks associated with each investment position of the AIF and their overall effect on the AIF's portfolio can be properly identified, measured, managed and monitored on an ongoing basis, including through the use of appropriate stress testing procedures." More specifically, article 422-58 of the AMF's General Regulation states that "the asset management company shall install [...] 2° A set of stress tests that are stringent, complete and appropriate to the risk profile of the retail investment fund capable of simulating how the retail investment fund behaves in crisis situations."

In order for the stress tests to be appropriate, AMC's should establish **fund-specific stress tests** if the strategies, underlying assets or other factors to which the collective investment schemes that they manage are exposed are not sufficiently taken into account by the traditional stress test scenarios or those common to other funds.

Implementing stress tests only for certain model portfolios and not for each fund would appear to be questionable practice if these model portfolios are not similar to the actual portfolios. On the other hand, it is acceptable to use stress tests that are common to several portfolios as long as the portfolios are identical.

It also **unwise to implement a large number of generalised stress tests applicable to all the funds that an AMC manages**. AMCs typically have between 10 and 50 stress tests that they apply regularly to each fund. Using a large number of stress tests makes it hard to analyse their results and therefore makes them less effective.

### Regularly updated stress test scenarios

In compliance with article 313-53-6 of the AMF's General Regulation, the permanent risk management function periodically reviews the risk management policy and ensures it remains in line with the AMC's business and with market and product changes<sup>22</sup>.

This obligation also applies to the stress-testing policy that features within the risk management policy:

- **Stress test parameters (correlations, redemption levels, estimates of liquidation time frame for each asset class, etc.)** should be updated periodically, **particularly in the case of liquidity stress tests** because an asset's liquidity characteristics can change a lot over time. The stress-testing policy should specify which parameters should be updated regularly and which should be updated as market conditions change.
- Stress tests are **calculated and analysed at appropriate intervals based on the programme of activity (complexity of the strategies, complexity of the underlying assets, frequency of the net asset value calculation, etc.)**.

**Stress tests can be based on services from external providers provided the AMC has the internal expertise required to verify the service provision.**

**Stress tests supplied by external providers**, including data providers, can be used only if the permanent risk management function understands the simulation models used. In compliance with article 4 of AMF Instruction DOC-2012-01 on the outsourcing of risk management activities, the AMC should have the necessary expertise and resources to verify the stress test calculations, even if these calculations are performed by an external services provider or using software supplied by such a provider.

## 3. THE USE OF STRESS TESTS

### 3.1. USING STRESS TESTS FOR THE INVESTMENT STRATEGY, CREATION OR LIQUIDATION OF A FUND.

Stress tests can be used at the different stages of a fund's life from creation to liquidation, via the investment decisions made to manage it during its lifetime. Specifically, AMF Instruction DOC-2011-15 on the calculation of global exposure states that the "results of these tests should be [...] taken into consideration when making any investment decisions".

AMCs should take liquidity risks into account as soon as a fund's size is calculated. When a fund is created, stress tests can therefore be used **to define the main parameters of the fund** (how often net asset value is calculated, frequency of possible redemptions, critical mass or hard cap).

<sup>22</sup> Equally, for management companies governed by Title I bis of Book III of the AMF's General Regulation for their AIFM business, article 318-41 of said General Regulation states that the AMC shall at least:  
"1° Implement an appropriate, documented and regularly updated due diligence process when investing on behalf of the AIF, according to the investment strategy, objectives and risk profile of the AIF;"

For example, if a company wishes to create a fund eligible for the PEA-PME scheme (a share savings plan aimed at financing SMEs), when it calculates the size of the fund it should take into consideration the limited market depth and the other funds already present on the market.

**Example: implementation of stress tests across the lifetime of a high-yield global bond fund.**

When the fund is created, the asset management company's risk management function assesses the liquidity profile on both the asset and liability sides.

The asset target is €1 billion. In view of the credit risk and the liquidity of high-yield bonds, it may be decided that:

- redemptions can take place on a weekly basis;
- the fund will retain a minimum of 5% of liquid assets at any moment (corresponding to the 95th percentile of monthly outflows observed as a share of AuM);
- the fund's assets under management will be capped at €1 billion.

If an institutional investor invests €150 million, the risk management function establishes a specific stress test simulating the exit of this investor. It also sets up an alert for when this investor's holding exceeds 20% of the fund's liabilities.

A specific procedure for liquidity crisis management (including the operational measures to be implemented) is prepared in case of redemption requests of more than 20%.

During the fund's lifetime:

- liquidity stress tests are conducted on a weekly basis;
- the parameters of these liquidity stress tests (asset liquidity and redemption scenarios) are reviewed at least once every three months following consultation with fund managers, traders and sales personnel;
- in the event of reduced liquidity on a market, stress tests can be conducted more frequently, for example on a daily basis;
- any redemptions exceeding 0.5% of net assets will be communicated immediately to the risk management team, who will decide whether to update the stress test scenarios;
- if the fund reaches its target of €1 billion, the AMC should assess whether to close the fund to new investment, modify the frequency of net asset value calculations or introduce special liquidity management measures tools such as swing pricing or a five-day notice period.

**During a fund's lifetime**, stress tests can be used, in the event of a change in strategy, to monitor changes in risk and make any necessary changes to the portfolio, or when specific investment decisions need to be made in such a way as to measure both the market risk of an investment and how it will affect portfolio liquidity.

**Ahead of the liquidation of a fund**, stress tests can be used to establish several stressed scenarios and get a clearer picture of liquidity risk in order to inform investors and manage their exit as efficiently as possible.

### **3.2. ENSURING STRESS TESTS ARE CONDUCTED THROUGHOUT THE AMC IN ORDER TO IMPROVE RISK MONITORING**

In accordance with article 313-53-4 (III)<sup>23</sup> of the AMF's General Regulation, "the permanent risk management function shall [...] provide regular reports to the board of directors and, where it exists, the supervisory function, on:

- i) the consistency between the current levels of risk incurred by each managed collective investment scheme or individual portfolio and the risk profile agreed for that collective investment scheme or portfolio;
- ii) the compliance of each managed collective investment scheme or individual portfolio with relevant risk limit systems;

<sup>23</sup> See also article 39 of Commission Delegated Regulation 231/2013 for AMCs authorised under the AIFM Directive.

iii) the adequacy and effectiveness of the risk management process, indicating in particular whether appropriate remedial measures have been taken in the event of any deficiencies”

**The results and analysis of the stress tests should be available at all times and conveyed to all necessary decision-making and hierarchical levels in an appropriate format and as often as required.** In particular, the permanent risk management function’s regular report to the board of directors or executives must contain an overview of the main results of the stress tests. Stress tests show whether risk levels are consistent with the objectives and thresholds that have been set.

When presenting to executive and risk management committees, many asset management companies display the results of stress tests in a summary table known as a dashboard, which groups together the different stress tests for the main funds or the funds with particular difficulties.

In addition, the risk management teams submit a report to financial managers when a set of tests have been devised to assess changes in risk with a view to adjusting portfolio positions, where asset liquidity allows.

Stress tests are increasingly part of the strategic decisions of certain AMCs, which engage in good practice by including them in their governance, commercial or interdepartmental communications policies.

However, communicating the results of stress tests to investors (excluding in the case of a dedicated fund) may be misleading because the investors do not have all the details of the models used and, in particular, all the assumptions used to understand the result. It can therefore be risky for an investor to compare the stress tests performed on different funds.

### 3.3. IMPLEMENTATION OF STRESS TEST THRESHOLDS AND DISCLOSURE WHEN THESE THRESHOLDS ARE BREACHED

It is important to present stress tests clearly and broadly in order to successfully transmit information within the AMC. Alert thresholds on the results of certain stress tests can ensure that the risk management team, executives and fund managers are alerted more quickly.

In compliance with article 313-53-7 (II) d)<sup>24</sup> of the AMF's General Regulation, the asset management company shall “establish, implement and maintain a documented system of internal limits concerning the measures used to manage and control the relevant risks for [each UCITS or AIF]”.

As such, the risk management policy may define **alert thresholds** for the results of regular stress tests. The risk management policy lays down **the procedures to be implemented in the event that a stress test alert threshold is breached**, in particular the discussions within the management team and the risks that may prompt remedial measures to be implemented at portfolio level.

- If stress tests show a considerably higher liquidity risk than expected, the AMC should assess whether to amend its strategy or use exceptional preventative liquidity management techniques (limiting or suspending redemptions), if allowed by the fund’s regulations or bylaws.
- If stress tests flag up a particular vulnerability to certain market conditions, the AMC should assess whether to take measures that will enable the current investment objective to be retained.

<sup>24</sup> see also article 42 of Commission Delegated Regulation (EU) 231/2013 of 19 December 2012 for AMCs governed by the AIFM Directive.

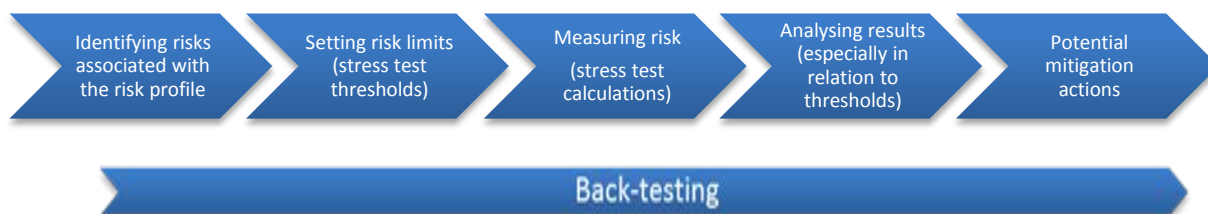
The reports on compliance and risk control, which are sent to the senior managers on a regular basis (at least once a year), in compliance with article 313-7 of the AMF's General Regulation, may provide a summary of breaches of stress test thresholds and remedial measures taken.

Note: If regular analysis of the stress test results for all an AMC's funds is difficult because of the sheer number of funds, the AMC should **select a list of funds that represent the strategies put in place and then analyse those funds carefully**. This system of selecting certain funds for more in-depth analysis **does not however negate the need for conducting stress tests on the other funds and the use of an automatic monitoring tool for funds that are not analysed regularly**. In addition, it is helpful for funds with specific risks (CPPI funds, formula-based funds, regulatory VaR funds, guarantee funds, funds with complex underlying assets, etc.) to be specially monitored.

#### 4. ORGANISING STRESS TESTS AS PART OF THE RISK MANAGEMENT SYSTEM

**Stress tests are part of the risk management system.** They provide a global analysis of the impact of shocks on indicators, positions (individual or cumulative) and portfolios, taking account of any compensation or leverage effects.

**The stress testing policy is an integral part of the permanent risk management function. This function ensures that stress tests are carried out regularly in both normal and exceptional liquidity conditions. It includes an appropriate and documented stress testing policy that identifies the risks to which the collective investment schemes or individual portfolios that the AMC manages are, or could be, exposed, and then makes provision for back-testing.**



At the very least, the stress testing policy should make provision for<sup>25</sup>:

- a) the design of stress test scenario analysis including calibration, certification and sensitivity analysis;
- b) an empirical approach to impact assessment, including back-testing of liquidity risk estimates;
- c) reporting frequency and limit/loss tolerance threshold/s; and
- d) mitigation actions to reduce loss including haircut policy and gap risk protection.

The list of stress test scenarios, the models used, how often the results are calculated and analysed, and how they are conveyed should be set out in the risk management policy or in a specific stress testing policy. This policy should be tailored to the company's business and reviewed and approved periodically by the senior managers, who make sure it is effective.

<sup>25</sup> AMF Position DOC-2013-06 on ETFs and other UCITS issues states that a UCITS receiving collateral for at least 30% of its assets should have an appropriate stress testing policy in place, but the content of the crisis management policy can be transferred to the management of other funds or mandates.

**Good practice:**

It is helpful to dedicate a chapter of the risk management policy to stress tests in order to:

- document and file the methodologies (scenarios, assumptions and results<sup>26</sup>);
- document the reasons behind these scenarios.

#### 4.1. INDEPENDENCE, PERMANENCE, CONTROL AND CONFLICT-OF-INTEREST MANAGEMENT

- ✓ Independence and permanence:

The management of stress tests, which is part of the broader risk management framework, must be permanently operational and independent of the operational units, under the same conditions as risk management.

- ✓ Conflict-of-interest management:

AMCs should establish and maintain policies, procedures and measures that are suitable for dealing with conflicts of interest and enabling the risk controller to implement a reliable stress testing system. In particular, when the stress test systems are being implemented, management or external operators may provide a certain number of parameters and a certain amount of information. A conflict of interests traditionally occurs when a liquidity estimate is made on the basis of the fund manager's observations of volumes exchanged on the market.

#### 4.2. CONTROL

Pursuant to articles 313-53-4<sup>27</sup> and 313-53-7 of the AMF's General Regulation or article 39 of Commission Delegated Regulation (EU) 231/2013 of 19 December 2012, **the permanent risk management function** implements the risk management procedures and validates the risks measurement techniques that are defined in these procedures. As such:

- 1° It **checks that the theoretical basis** is relevant and that the assumptions made are appropriate for the characteristics of the investment and the management strategy in place;
- 2° It **ensures that the parameters used are reliable**, robust and suited to the management strategies in place and to the market behaviour, and that the market data used are accurate;
- 3° It **approves the scope of validity and the limits of each technique** or tool used to measure risk, particularly with regard to the specific characteristics of the management strategy in place and the assets employed, and to particular market situations;
- 4° It **ensures the proper digital implementation** of each risk measurement tool or technique.

With regard to stress tests, the permanent risk management function should verify that:

- the choice of stress test models is based on prior analysis;
- the scope and scenarios are relevant;

<sup>26</sup> AMF Instruction DOC-2011-15 on the calculation of global exposure states that the "results of these tests should be filed".

<sup>27</sup> "III. - The permanent risk management function shall:

a) implement the risk management policy and procedures;  
b) ensure compliance with the collective investment schemes referred to in Article 311-1 A or individual portfolios [sic] risk limit system, including statutory limits concerning global exposure and counterparty risk in accordance with Articles 411-71-1 to 411-83 or Articles 422-50 to 422-63;

- the models used have been subjected to upstream testing;
- the performance of these models is subjected to back-testing;
- the parameters used are reliable, robust and suited to the management strategies in place, and the market data used are accurate (with no conflict of interest)

It ensures the proper digital implementation of each risk measurement tool or technique.

## ANNEXES :

### RELEVANT TEXTS MENTIONED IN THE GUIDE:

Articles 411-73, 411-73 and 318-40 to 318-44 of the AMF's General Regulation.

Articles 313-1, 313-2, 313-7, 313-53-3, 313-53-4, 313-53-7 and 313-60 of the AMF's General Regulation.

Position-Recommendation DOC-2014-06, Position DOC-2013-06, Instruction DOC-2012-01

## REGULATORY ENVIRONMENT FOR STRESS TESTS

### EUROPEAN DIRECTIVES

**Article 40, paragraph 2 of Commission Directive 2010/43/UE implementing Directive 2009/65/EC (the UCITS Directive) states that<sup>28</sup>:**

"[...] Member States shall require management companies to take the following actions for each UCITS they manage:  
[...]

b) conduct, where appropriate, periodic back-tests in order to review the validity of risk measurement arrangements which include model-based forecasts and estimates;

c) conduct, where appropriate, periodic stress tests and scenario analyses to address risks arising from potential changes in market conditions that might adversely impact the UCITS

[...]

Member States shall ensure that management companies employ an appropriate liquidity risk management process in order to ensure that each UCITS they manage is able to comply at any time with Article 84(1) of Directive 2009/65/EC [article 84: "A UCITS shall repurchase or redeem its units at the request of any unit-holder. ..."].

Where appropriate, management companies shall conduct stress tests which enable assessment of the liquidity risk of the UCITS under exceptional circumstances."

**Similarly, article 15, paragraph 3 and article 16, paragraph 1 of Directive 2011/61/EU (the AIFM Directive) state that:**

#### **Article 15**

##### Managing risks

##### 3. AIFMs shall at least

[...]

(b) ensure that the risks associated with each investment position of the AIF and their overall effect on the AIF's portfolio can be properly identified, measured, managed and monitored on an ongoing basis, including through the use of appropriate stress testing procedures; [...]

#### **Article 16**

##### "Liquidity management

1. AIFMs shall, for each AIF that they manage which is not an unleveraged closed end AIF, employ an appropriate liquidity management system and adopt procedures which enable them to monitor the liquidity risk of the AIF and to ensure that the liquidity profile of the investments of the AIF complies with its underlying obligations.

<sup>28</sup> Issued in execution of article 51 of Directive 2009/65/EC of the European Parliament and of the Council of 13 July 2009



AIFMs shall regularly conduct stress tests, under normal and exceptional liquidity conditions, which enable them to assess the liquidity risk of the AIFs and monitor the liquidity risk of the AIFs accordingly.”

**Supplemented by Commission Delegated Regulation (EU) No 231/2013**

**Article 40**

Risk management policy

1. An AIFM shall establish, implement and maintain an adequate and documented risk management policy which identifies all the relevant risks to which the AIFs it manages are or may be exposed.
2. The risk management policy shall comprise such procedures as are necessary to enable the AIFM to assess for each AIF it manages the exposure of that AIF to market, liquidity and counterparty risks, and the exposure of the AIF to all other relevant risks, including operational risks, which may be material for each AIF it manages.
3. The AIFM shall address at least the following elements in the risk management policy:
  - a) the techniques, tools and arrangements that enable it to comply with Article 45;
  - b) the techniques, tools and arrangements that enable liquidity risk of the AIF to be assessed and monitored under normal and exceptional liquidity conditions including through the use of regularly conducted stress tests in accordance with Article 48;
  - c) the allocation of responsibilities within the AIFM pertaining to risk management;
  - d) the limits set in accordance with Article 44 of this Regulation and a justification of how these are aligned with the risk profile of the AIF disclosed to investors in accordance with Article 23(4)(c) of Directive 2011/61/EU;
  - e) the terms, contents, frequency and addressees of reporting by the permanent risk management function referred to in Article 39.
4. The risk management policy shall include a description of the safeguards referred to in Article 43, in particular:
  - a) the nature of the potential conflicts of interest;
  - b) the remedial measures put in place;
  - c) the reasons why these measures should be reasonably expected to result in independent performance of the risk management function;
  - d) how the AIFM expects to ensure that the safeguards are consistently effective.
5. The risk management policy referred to in paragraph 1 shall be appropriate to the nature, scale and complexity of the business of the AIFM and of the AIF it manages.

**Article 45, point 3 :**

“[...] the AIFM shall take the following actions for each AIF it manages:

[...]

- b) conduct periodic back-tests in order to review the validity of risk measurement arrangements which include model-based forecasts and estimates;
- c) conduct, periodic appropriate stress tests and scenario analyses to address risks arising from potential changes in market conditions that might adversely impact the AIF;”

## AMF'S GENERAL REGULATION

### For UCITS

#### Article 313-53-7 of the AMF's General Regulation

I. - Investment services providers shall adopt adequate and effective arrangements, processes and techniques in order to:

a) measure and manage at any time the risks which the collective investment schemes referred to in Article 311-1 A and individual portfolios they manage are or might be exposed to;

b) ensure compliance with limits applicable to collective investment schemes referred to in Article 311-1 A concerning global exposure and counterparty risk, in accordance with Articles 411-72 and 411-73 or 422-51 and 422-52 and Articles 411-82 to 411-83 or 422-61 to 422-63.

Those arrangements, processes and techniques shall be proportionate to the nature, scale and complexity of the business of the investment services providers and of the collective investment schemes referred to in Article 311-1 A and individual portfolio they manage and be consistent with the risk profile of these collective investment schemes and individual portfolios.

II. - For the purposes of I, investment services providers shall take the following actions for each collective investment scheme referred to in Article 311-1 A or individual portfolio they manage:

a) put in place such risk measurement arrangements, processes and techniques as are necessary to ensure that the risks of taken positions and their contribution to the overall risk profile are accurately measured on the basis of sound and reliable data and that the risk measurement arrangements, processes and techniques are adequately documented;

b) conduct, where appropriate, periodic back-tests in order to review the validity of risk measurement arrangements which include model-based forecasts and estimates;

**c) conduct, where appropriate, periodic stress tests and scenario analyses to address risks arising from potential changes in market conditions that might adversely impact the collective investment schemes referred to in Article 311-1 A or individual portfolios they manage;**

**d) establish, implement and maintain a documented system of internal limits concerning the measures used to manage and control the relevant risks for** each collective investment scheme referred to in Article 311-1 A or individual portfolio taking into account all risks which may be material to the collective investment scheme referred to in Article 311-1 A or individual portfolio as referred to in Article 313-53-3 and ensuring consistency with the risk-profile of the collective investment schemes referred to in Article 311-1 A or individual portfolios;

e) ensure that the current level of risk complies with the risk limit system as set out in d) for each collective investment scheme referred to in Article 311-1 A or individual portfolio;

f) establish, implement and maintain adequate procedures that, in the event of actual or anticipated breaches to the risk limit system of the collective investment scheme referred to in Article 311-1 A or individual portfolio, result in timely remedial actions in the best interests of unit holders or shareholders or principals.

III. - Investment services providers shall use an appropriate liquidity risk management process for each collective investment scheme referred to in Article 311-1 A and individual portfolio they manage.

This procedure shall enable them in particular to ensure that all the collective investment schemes referred to in Article 311-1 A they manage comply at all times with the requirement set out in the third paragraph of

Articles L. 214-7 or L. 214-24-29 or Articles L. 214-8 or L. 214-24-34 of the Monetary and Financial Code or investment services providers' ability to liquidate positions in an individual portfolio in accordance with the contractual obligations in the investment mandate.

**Where appropriate, investment services provider companies shall conduct stress tests which enable assessment of the liquidity risk of the collective investment schemes referred to in Article 311-1 A under exceptional circumstances.**

IV. - Investment services providers shall ensure that for each collective investment scheme referred to in Article 311-1 A they manage the liquidity profile of the investments of the collective investment scheme referred to in Article 311-1 A is appropriate to the redemption policy laid down in the fund rules or the instruments of incorporation or the prospectus.

#### **Article 411-73**

[...]

The VaR approach is supplemented by a stress-testing programme.

#### **Article 411-79**

The management company shall establish:

- 1° A programme for back-testing the model's calculations using historical data to check the precision and performance of the VaR model;
- 2° A rigorous and comprehensive stress-testing programme adjusted to the risk profile of the CIS that can be used to simulate the behaviour of the CIS under stress.
- 3° Where required by the risk profile and investment strategy, risk management tools and methods suited to the scheme's risk profile and investment strategy may be used to supplement the programmes referred to in 1° and 2°.

#### **AMF Position DOC-2013-06 on ETFs and other UCITS issues**

37. A UCITS receiving collateral for at least 30% of its assets should have an appropriate stress testing policy in place to ensure regular stress tests are carried out under normal and exceptional liquidity, in order that the UCITS can evaluate the liquidity risk associated with the collateral. At the very least, the stress testing policy should make provision for:

- a) the design of stress test scenario analysis including calibration, certification and sensitivity analysis;
- b) an empirical approach to impact assessment, including back-testing of liquidity risk estimates;
- c) reporting frequency and limit/loss tolerance threshold/s; and
- d) mitigation actions to reduce loss including haircut policy and gap risk protection.

#### **For AMCs authorised under the AIFM Directive**

#### **Article 318-40**

The asset management company shall implement adequate risk management systems in order to identify, measure, manage and monitor appropriately all risks relevant to each AIF investment strategy and to which each AIF is or may be exposed.

In particular, the asset management company shall not make exclusive or mechanical use of credit ratings issued by credit ratings agencies within the meaning of Article 3, Paragraph 1, point b of Regulation (EC) n°

1060/2009 of the European Parliament and Council of 16 September 2009 on credit ratings agencies, to assess the creditworthiness of AIF assets.

The asset management company examines the risk management systems, at appropriate intervals and at least once a year, and adapts them if necessary.

#### **Article 318-41**

Asset management companies shall at least:

1° Implement an appropriate, documented and regularly updated due diligence process when investing on behalf of the AIF, according to the investment strategy, objectives and risk profile of the AIF;

**2° Ensure that the risks associated with each investment position of the AIF and their overall effect on the AIF's portfolio can be properly identified, measured, managed and monitored on an ongoing basis, including through the use of appropriate stress testing procedures;**

3° Ensure that the risk profile of the AIF shall correspond to the size, portfolio structure and investment strategies and objectives of the AIF as laid down in the AIF rules or instruments of incorporation, prospectus and offering documents

### **Section 12 - Liquidity Management**

#### **Article 318-44**

Asset management companies shall, for each AIF that they manage which is not an unleveraged closed-end AIF, employ an appropriate liquidity management system and adopt procedures which enable them to monitor the liquidity risk of the AIF and to ensure that the liquidity profile of the investments of the AIF complies with its underlying obligations.

**Asset management companies shall regularly conduct stress tests, under normal and exceptional liquidity conditions, which enable them to assess the liquidity risk of the AIFs and monitor the liquidity risk of the AIFs accordingly.**

#### **Article 318-45**

Asset management companies shall ensure that, for each AIF that they manage, the investment strategy, liquidity profile and redemption policy are consistent.

#### **Article 318-46**

The asset management company shall comply with Articles 46 to 49 of Commission Delegated Regulation (EU) n° 231/2013 of 19 December 2012.

#### **Article 422-58**

The asset management company shall install:

1° An ex-post control mechanism for calculations using the model on previous data, in order to monitor the accuracy and performance of the value at risk model;

2° A set of stress tests that are stringent, complete and appropriate to the risk profile of the retail investment fund, capable of simulating how the retail investment fund behaves in crisis situations.

3° Where required by the risk profile and investment strategy, risk management tools and methods appropriate to the risk profile and investment strategy of the retail investment fund, in addition to the resources specified in 1° and 2°.