

Euro banknotes – training material



Objectives of the training material

Objectives

At the end of this module, the goal is for the trainees to be able to identify the:

- series and denominations of euro banknotes,
- main characteristics of euro banknotes,
- security features of euro banknotes,
- to check and validate the fitness of a euro banknote sorted,
- to identify the rules, criteria and conditions for the exchange of damaged genuine euro banknotes,
- the rules, criteria and conditions for exchanging damaged euro banknotes and neutralised banknotes (IBNS).





Euro banknotes are issued by euro area national central banks following the authorisation by the European Central Bank, and are legal tender in all countries of the Eurosystem.

There are two series of euro banknotes in circulation: the first series issues in 2002, comprising seven denominations (€5, €10, €20, €50, €100, €200 and €500), and the Europa series (ES2) gradually issued as of 2013, which has the same denominations apart from €500.

The €500 banknote was not included in the Europa series and as of 27 April 2019 is no longer being issued.

Banknotes of the first series including the €500 banknote retain their value and are legal tender, thereby continuing to be a valid means of payment, and therefore do not need to be exchanged.

SIZE, COLOR AND THEME

Visually, the euro banknote denominations are distinguished through their:

- Size: The higher the value, the larger the banknote.
- Colour: There is a specific colour for each denomination.
- Theme: Euro banknotes take the theme of "ages and styles", and reproduce architectural styles from seven periods of European cultural history.

The second series of euro banknotes is called "Europa" because the notes contain a portrait of Europa, a figure from Greek mythology. It adds a human touch to the notes and, of course, is the origin of the name of our continent.



Euro banknotes exhibit elements common to all the denominations.

In the Europa series, these features have been revised, taking into consideration the countries that joined the European Union after the launch of the first banknote series.

The common elements are:

- The European flag
- Signature of the President of the European Central Bank: Each banknote bears the signature of one of the Presidents of the European Central Bank. Notes with different signatures are therefore in circulation. The signatures are those of Willem F. Duisenberg, Jean-Claude Trichet, Mario Draghi or Christine Lagarde, the current President.





Initials of the BCE: Following the enlargement of the European Union, the number of linguistic variants on Europa series banknotes has increased from five to nine (€5, €10 and €20 banknotes) and ten (€50, €100 and €200 banknotes).





The word euro: Euro banknotes of the first series feature the word 'euro' in the Latin and Greek alphabets (EURO and EYPΩ respectively). In the Europa series, with Bulgaria joining the European Union in 2007, the word 'euro' now also appears in the Cyrillic alphabet (EBPO).



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Serial number

The serial number is a unique identifier for the banknote, and is printed twice on the back: in black on the upper right-hand side and in the dominant colour of the denomination in the lower left-hand side.

- First series: The number consists of 12 characters: one letter and 11 digits, where the letter relates to the country responsible for producing the banknote.
- Europa series: The horizontal number comprises two letters and ten digits, and the vertical number comprises the last six digits of the horizontal number. The first letter of the serial number identifies the printing works. The second letter has no particular meaning; it simply makes more serial numbers possible.
- Under ultraviolet light, the horizontal serial number appears in red.





Security features - Authentification

a) Feel

b) Look

Tilt

Authenication with technical aids



Security feature - Feel

- The touch and sound of genuine banknote paper is very characteristic.
- Especially professional cash handlers can often recognise counterfeits by just touching them.





Security feature - Feel

Relief

Intaglio printing gives a special structure to the printing image which you can feel with your fingers.

When looking flat over the surface of a banknote towards a light source, one can see the structure of the intaglio image.

On the front of the first series, to the left of the large value numeral, there is a field consisting of vertical lines. The structure can be checked very easily by running a fingernail over this field. On the Europa series, the tactile lines are on the edge.







Watermark

On the notes of the first series, the watermark shows a repetition of the architectural motif.









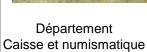






The Europa series also repeats the architectural motif, but the focus is on the same Europa portrait throughout.











Watermark

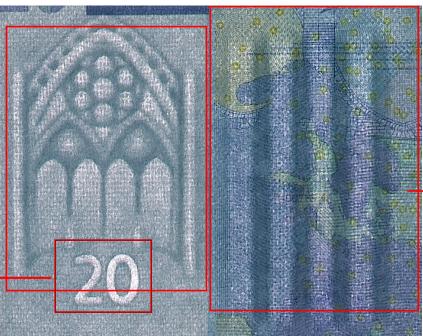
Euro banknotes of the first series have three different watermarks, those of the Europa series two (the electrotype watermark is missing).

A genuine multitone watermark has both, areas that are lighter and areas that are darker than the surroundings.

The lines are never sharp. The transitions between light and dark are soft.

Multitone Watermark





Barcode Watermark



Watermark

Normally, one expects a watermark to be checked in transmitted light. However, you can also view it against a dark background and you will notice that those parts of the image that appear light against the light then look dark.







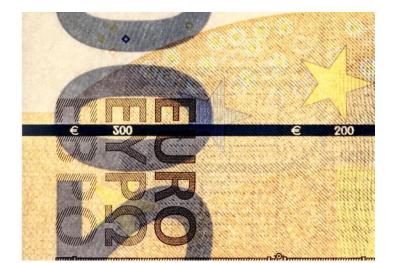
Security thread

The security thread is embedded in the paper. In transmitted light you can read the denomination on it.

There is a small difference between the notes of the first and second series. On the first series the word EURO is written out in full.



On the Europa series, you will only find the value numeral and the €-logo.

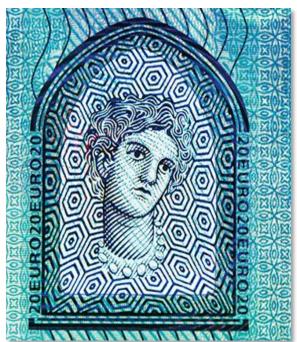




Hologram strip

In the hologram strip of the denominations from €20 of the second series there is a new security feature : the window.

In the backlight you can see the portrait of Europa.













Emerald number



€5, €10, €20 and €50

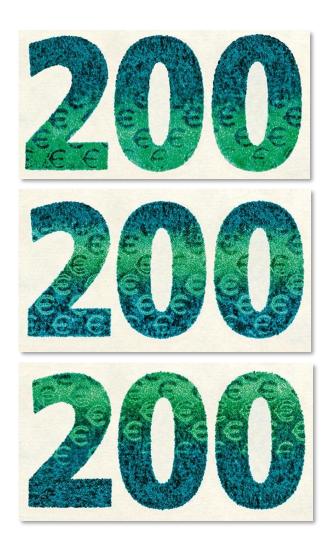
When tilted, the colour changes from emerald green to dark blue and a light crossbar moves from top to bottom.



Emerald number

ES2 €100 and €200

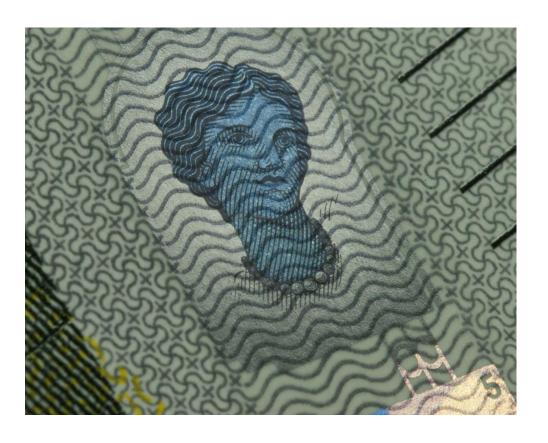
When tilted, the colour changes from emerald green to dark blue and a light crossbar moves from top to bottom and the €-logo becomes visible.





Foil stripe

The low denominations of €5 and €10 of the new series have a fitted (registered) foil strip containing a portrait of Europa and the note's architectural motif.



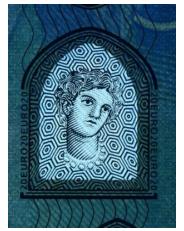


Foil stripe

The remaining denominations also have a fitted foil strip. It is wider and contains the new window.

The window combines three features: On the front, in incident light, you see the value numeral surrounded by contour lines that show different rainbow colours when tilted. In the transmitted light, the portrait appears and on the back there is a pattern of repeating value numbers that also shimmer in rainbow colours.









Satelite hologramm

The €100 and €200 banknotes of the Europe series also have the satellite hologram: at the top of the silver stripe, the satellite hologram shows euro (€) symbols orbiting the number. The euro (€) symbols become clearer under

direct light.







Iridescent stripe

On the reverse of the low denominations of the first series and on all denominations of the second series, the iridescent stripe becomes visible when tilted.











Iridescent stripe

Reverse side





Authentication with technical aids: Ultra-violet light



Under a UV lamp, the paper does not emit bright light. The fibres embedded in the paper of the first series of banknotes stand out in red, blue and green. The EU flag appears in green and the stars in orange. The signature of the President of the ECB is in green. The large stars and small circles printed in the centre glow orange.





Small fibres in three different colours, embedded in the paper thickness of the Europe series banknotes, stand out. The stars of the European Union flag, the small circles and the large stars appear yellow. Several other parts also emit yellow light.

Under a special UV lamp (UV-C), on the front side of the banknote the small circles in the centre of the banknote emit yellow light, and the large stars and several other parts glow orange. The euro symbol (€) also appears.

Authentication with technical aids: Ultra-violet light



Genuine banknote paper remains dark under UV light. Some parts of the printed image glow in green, red or orange.



Authentication with technical aid: Ultra-violet light



On the reverse the map of Europe and the bridge fluoresce in shades of yellow or green (different colours depending on denomination).



Authentication with technical aid: Fluorescent fibres

Invisible to the naked eye, the fluorescent fibres become visible when the note is exposed to ultraviolet light. They are placed in the paper at random.

Under ultraviolet light, their colour varies according to the euro banknote series.

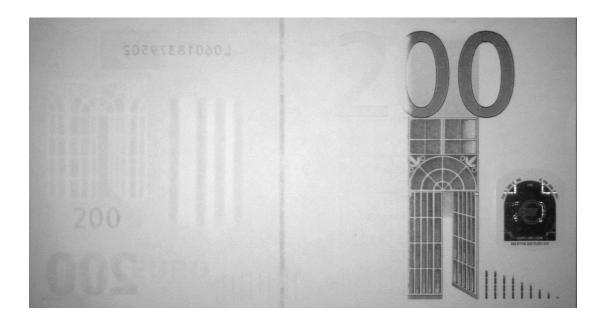


Europa series: Each fluorescent fibre has three colours.

First series: Each fluorescent fibre is all one colour: green, blue or red.



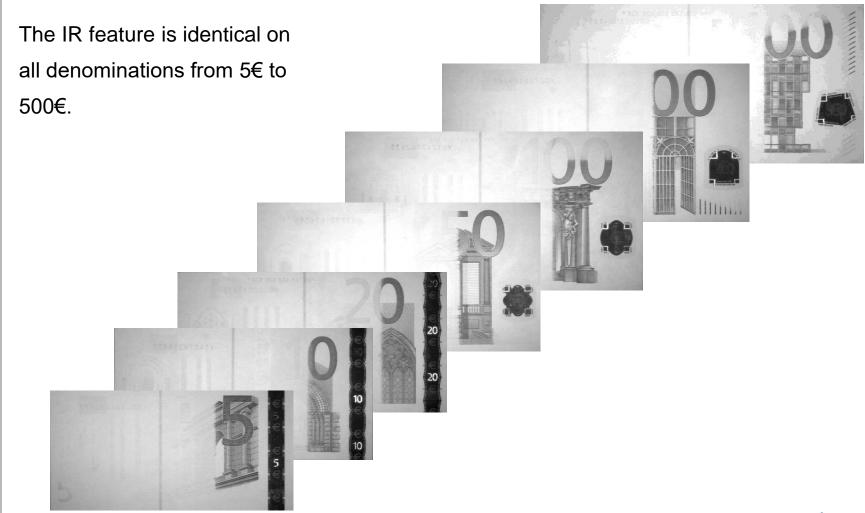
Authentication with technical aid: Infra-red



Viewed with an IR camera the image on the front of the Euro banknotes disappears, except for the right hand side of the architectural motif. There is a sharp vertical split running through the image.

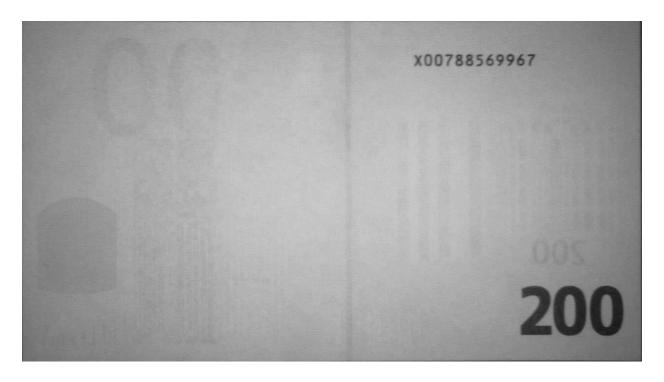


Authentication with technical aid: Infra-red





Authentication with technical aid: Infra-red

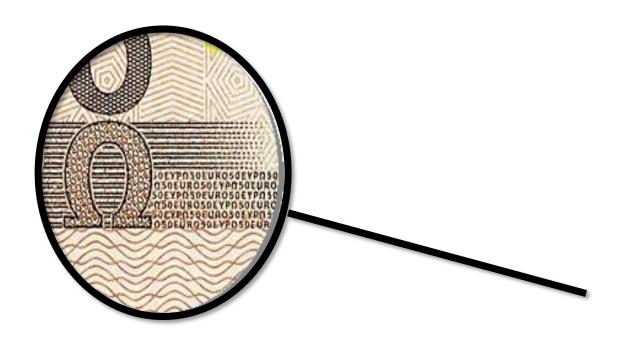


The reverse side IR image of genuine Euro notes is completely transparent. Only the upper serial number and (on the higher denominations) the emerald number is dark.



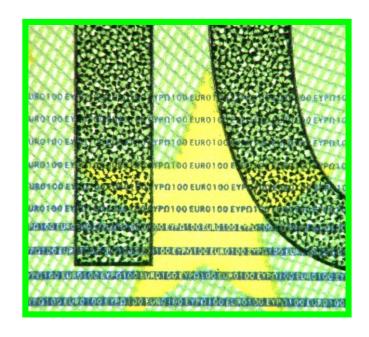
Authentication with technical aids: microlettering

Microletters legible with the aid of a magnifying glass





Authentication with technical aids: microlettering

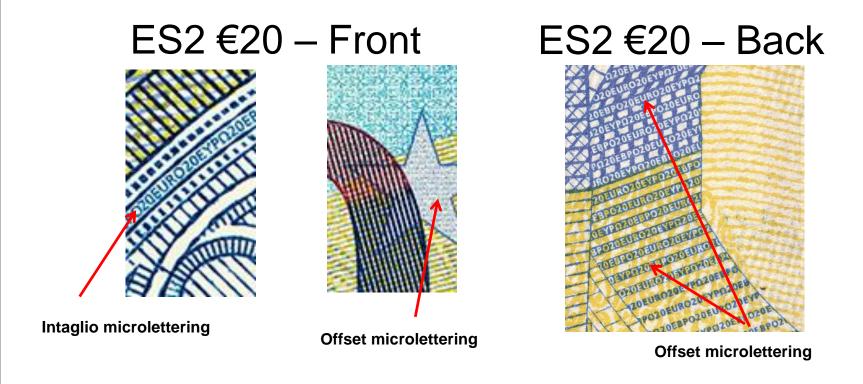


The very small letters are usually beyond the resolution of colour copiers and desktop printers.



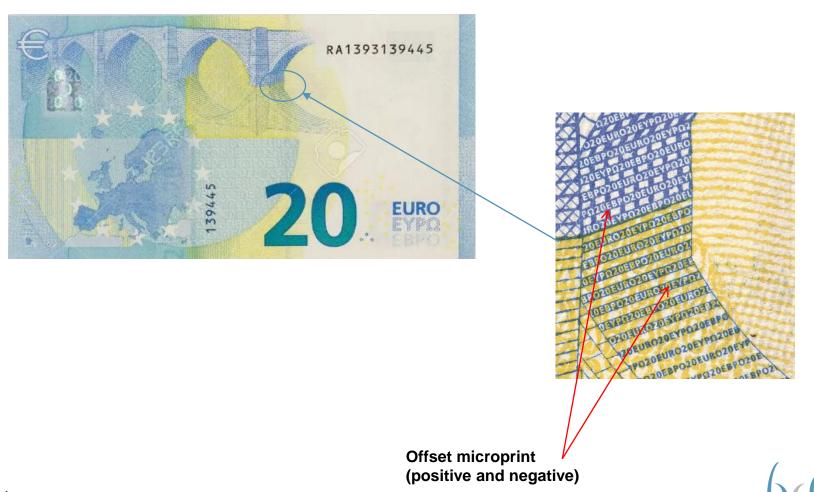
Microlettering

Some areas of the banknote feature a series of tiny letters. This microprint can be read with the aid of a magnifying glass. The letters are sharp, not blurred.





Microlettering



Comparison: genuine vs counterfeit

Watermark – genuine







Most fake watermarks are too sharp and there are no areas that are lighter than the surroundings. Watermark imitations are a very common attempt to upgrade a counterfeit. They appear on more than 75% of the counterfeits. Most of the imitations are of a very limited quality.



Comparison: genuine vs counterfeit

Emerald number – genuine

Emerald number (OVI®) – counterfeit





Sometimes the Emerald number is printed with metallic inks or foils to give an impression similar to the metallic purple on the genuine banknote. Such imitations may be quite deceptive when viewed straight on.



Comparison: genuine vs counterfeit

Emerald number - genuine

Emerald number – counterfeit



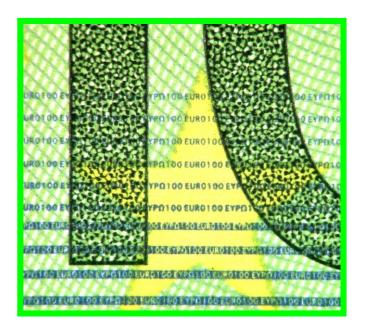


The typical colour shift is not visible when the banknote is tilted.

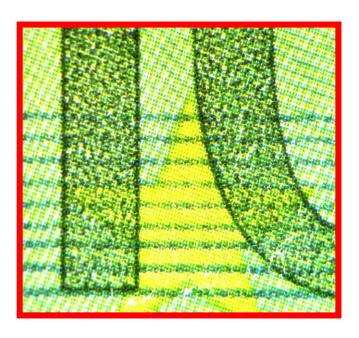


Comparison : genuine vs counterfeit

Microlettering – genuine



Microlettering – counterfeit



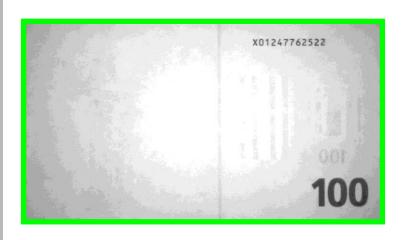
The very small letters are usually beyond the resolution of colour copiers and desktop printers. Reproductions are blurred and unreadable.



Comparison: genuine vs counterfeit

Infra-Red feature – genuine

Infra-Red feature - counterfeit





Often counterfeits look very much the same on the reverse side! When checking the IR feature you should always refer to the front image.



The Eurosystem has defined rules, quality criteria and minimum standards with regard to fitness, aimed at withdrawing from circulation all euro banknotes that are damaged or worn. Twelve quality criteria have been identified and acceptance criteria or minimum standards have been defined for each of them. The acceptance criteria determine the fitness of a banknote for recirculation, and thus enable the sorting and separation of banknotes that are fit for circulation from those that are unfit.

https://www.ecb.europa.eu/euro/cashprof/cashhand/recycling/html/fitness.en.html

In the recirculation of euro banknotes, the quality (fitness for use) can be checked in two different ways:

- 1. Automated Sorting
- 2. Manual Sorting



Quality criteria





Quality criteria





Manual sorting

The recirculation of banknotes is mainly performed by banknote handling machines. Consequently, in terms of fitness and compared with automated sorting, the proportion of banknotes sorted manually is small.

In manual sorting, all twelve quality criteria are mandatory, since the human eye can detect all of them. If a banknote has defects or imperfections in any of the security features, it must be considered unfit for circulation.



Sorting systems

In automated sorting the quality criteria, which are often also termed quality defects, can be split into three categories: **optical** (soiling, de-inking and staining), **mechanical** (folded corner, tear, hole, mutilation, repair and fold) and **non-mandatory** (limpness, crumpled and graffiti).

In the case of **non-mandatory** quality criteria, the sorting machine is not strictly required to separate banknotes with these defects, as most machines today are not equipped with sensors to detect them reliably.

For recirculation, checking the quality criteria complying with the minimum standards is critical to ensure the fitness of euro banknotes in circulation within the Eurosystem. Verifying the good performance of automated sorting/recirculation machines for euro banknotes is extremely important.



Basic concept

Automated sorting uses **four basic concepts**:

Banknotes fit for recirculation

Genuine banknotes in good condition – i.e. those that comply with the minimum fitness standards.

Banknotes that are unfit to return to circulation

Genuine banknotes that do not comply with the minimum fitness standards.

False fit rate

This is the percentage of unfit banknotes present in a sample of fit banknotes, in accordance with the stipulated minimum fitness standards.

False unfit rate

This is the percentage of fit banknotes present in a sample of unfit banknotes, in accordance with the stipulated minimum fitness standards.

TAKE NOTE

In order to ensure the fitness of banknotes in circulation, the Eurosystem has stipulated that the false fit rate must not exceed 5%.

Tools

Ruler

Very useful for measuring the size of certain parameters.

Template

Models depicting certain fitness parameters in terms of size and at the maximum acceptable threshold. The template is placed on top of a banknote to ascertain whether the parameter threshold has been exceeded.

D-65 Light Table

Examining a banknote on a light table ensures uniform lighting conditions at the workstation and eliminates shadows created by folds/wrinkles on the banknote.



Soil

Soiling is the most frequent and the most subjective quality criteria for determining the fitness of a banknote.

A banknote is considered soiled when the soil is evenly distributed across its entire surface, both front and back, with a uniform tonality that is usually yellowish. Such banknotes are often also limp and/or slightly crumpled.

Soil increases the optical density of banknotes and reduces their reflectance, enabling it to be measured by optical sensors in the banknote handling machines.



Stain

A stain is a localised concentration of dirt and its detection by sorting equipment depends directly on its size, colour, contrast and location on the banknote.

Minimum standard for automated sorting

A banknote with a stain covering at least 9 mm by 9 mm in the non-printed area or 15 mm by 15 mm in the printed area is unfit to be put back into circulation.

Manual sorting

In manual sorting, a banknote with an apparent stain must be considered unfit for circulation regardless of the stain's colour, location or size.



Stain

Example Unfit Banknotes - Automated Sorting





Example Fit Banknotes - Automated Sorting









Graffiti

Graffiti is constituted by graphical alterations made deliberately to the surface of the banknote, such as handwritten numbers, letters, drawings, stamps, stickers, etc.

Minimum standard for automated sorting

A banknote with graffiti can be considered fit to be put back into circulation by automated sorting (there is no minimum standard).

Manual sorting

In manual sorting, a banknote with graffiti must always be considered unfit to be put back into circulation





De-inking

When a banknote is washed or treated with harsh chemical or physical agents, it can lose its colour to a greater or lesser extent, with a visible lack of ink, termed de-inking. These euro banknotes can be identified by image detectors, authenticity validation or ultraviolet light in the sorting machine.

Minimum standard for automated sorting

This is a mandatory quality criteria and banknotes de-inked by the means mentioned above must be considered unfit for circulation.

Manual sorting

In manual sorting, a de-inked banknote must also be always considered unfit for circulation.





Limpness

Limpness in a banknote is caused by deterioration of the rigidity of the banknote paper, which becomes apparent by a marked lack of stiffness.

Minimum standard for automated sorting

There is no mandatory fitness minimum standard for limpness. Limpness is usually associated with soiling so that limp banknotes are often classified as unfit because of soiling by the sorting machine.

Manual sorting

In manual sorting, a limp banknote must always be considered as unfit for circulation.





Tear

A tear is cut on one of the edges of the banknote surface that may be either "open" or "closed".

Minimum standard for automated sorting

Euro banknotes with an open tear larger than specified in the table below must be considered unfit for circulation.

| Orientation of the tear | Width (mm) | Length (mm) | |
|-------------------------|------------|-------------|-----|
| Vertical | | 4 | 8 |
| Horizontal | | 4 | 15 |
| Diagonal | | 4 | 18* |

^{*} The length of the tear is measured by drawing a straight line from the peak of the tear to the edge of the banknote where the tear begins (rectangular projection), rather than measuring the length of the tear itself.

In manual sorting, any banknote with a tear, whether open or closed, regardless of size and location, should be considered unfit for circulation.



Hole

Banknotes with holes have one or more visible perforations.

Minimum Standard for Automated Sorting

In automated sorting a banknote with a hole must be considered unfit for circulation if the area of the hole is greater than 10 mm².

Manual sorting

For manual sorting, a banknote with a hole must always be considered unfit for circulation regardless of its size.

Example Fit Banknote (size of the hole at the acceptable threshold) - Automated Sorting



Example Unfit Banknote where the area of the hole is greater than 10 mm²– Automated Sorting





Mutilation

A mutilated banknote has missing parts, horizontally or vertically, along at least one edge.

Minimum Standard for Automated Sorting

Euro banknotes with lengths reduced by 6 mm or widths reduced by 5 mm, or more, must be considered unfit. All measurements relate to differences recorded in comparison with the original size of the euro banknote.

Manual sorting

For manual sorting, the reduction in comparison with the original size is irrelevant and all mutilated banknotes must be considered unfit for circulation.



Repaired

A repaired euro banknote is created by joining parts of euro banknote(s) together, e.g. by using tape or glue.

Minimum Standard for Automated Sorting

If tape covers an area greater than 400 mm2 (10 mm by 40 mm) and is more than 50 µm (microns) thick, it should be detected by the sorting machine and the banknote must be considered unfit to be put back into circulation.

Manual sorting

In manual sorting, a composed banknote must always be considered unfit for circulation, regardless of the location and size of the tape.

TAKE NOTE

Banknotes that arouse suspicions because they have different (first series) or noncomplementary (Europa series) numbers, must undergo a more detailed analysis and must be sent to the national central bank for replacement.







Fold

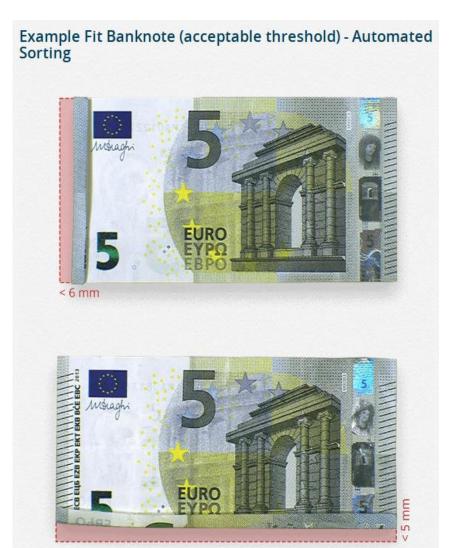
A folded euro banknote, due to the fold, has a reduction on its original length or width and an area where the thickness has increased.

Minimum Standard for Automated Sorting

Due to technical limitations, only folds fulfilling the criteria laid down for mutilated banknotes can be detected. Euro banknotes with lengths reduced by 6 mm or widths reduced by 5 mm, or more, must be considered unfit for circulation.

Manual sorting

In manual sorting, the fold must be unfolded, if possible, and if the banknote has no other defect that renders it unfit, it must be considered fit for circulation.





Crumpled

A banknote is said to be crumpled when it has multiple random wrinkles distributed across its entire surface.

Minimum Standard for Automated Sorting

Crumpled euro banknotes can normally be identified by their reduced level of reflectance or stiffness.

However, for automated sorting, there are no minimum standard and this quality criteria is not mandatory.

Manual sorting

In manual sorting, any crumpled banknote must be considered unfit for circulation.





Folded corner

A folded corner is when the banknote has a fold on at least one corner.

Minimum Standard for Automated Sorting

For a banknote with a folded corner to be considered unfit in automated sorting, it must meet two criteria: the length of the fold's smaller edge is greater than 10 mm and the total area of the fold is greater than 130 mm2. If at least one of these conditions is not met, the banknote is considered fit for circulation.

Manual sorting

In manual sorting, the corner must be unfolded, if possible, and if the banknote has no other defect it should be considered fit to remain in circulation.









Daily wear and tear can lead to a deterioration in euro banknotes. Some may be damaged or even mutilated and no longer meet the prerequisites for remaining in circulation.

The holders of damaged or mutilated banknotes can have them exchanged for banknotes of equal or equivalent value under the conditions laid down in the Decision of the ECB of 19 April 2013 on the denominations, specifications, reproduction, exchange and withdrawal of euro banknotes (recast), (ECB/2013/10), (2013/211/EU), published in the Official Journal of the European Union on 30 April 2013.





Exchange of banknotes

The exchange of damaged or mutilated genuine euro banknotes is possible if:

More than 50% of a euro banknote is presented, or 50% or less of a euro banknote is presented, if the applicant proves that the missing parts have been destroyed.

The part of the original euro banknote that needs to be presented in order to qualify for exchange is subject to minimum measurement requirements expressed as a percentage of the surface area of the original euro banknote before it was damaged, in order to prevent the distortion of measurements.





Conditions

Under the terms of Article 3(3) of Decision ECB/2013/10, and without prejudice to the above, the exchange of damaged or mutilated genuine banknotes must meet the following additional conditions:

The NCBs will exchange the mutilated or damaged euro banknotes if they either know or have sufficient reason to believe that the applicant is bona fide, or if the applicant can prove themselves to be bona fide. Otherwise, they shall refuse to exchange euro banknotes that have been intentionally mutilated or damaged and shall withhold them in order to avoid their return into circulation or to prevent the applicant from presenting them to another NCB for exchange.

Where an NCB knows or has sufficient reason to believe that a criminal offence has been committed, it shall refuse to exchange the mutilated or damaged euro banknotes and shall withhold them, against acknowledgement of receipt, as evidence to be presented to the competent authorities to initiate or to support an ongoing criminal investigation. Unless otherwise decided by the competent authorities, the euro banknotes shall be returned to the applicant at the end of the investigation and can be exchanged thereafter.



Conditions

TAKE NOTE

Euro banknotes which are damaged to only a minor degree, for example by having annotations, numbers, or brief sentences inscribed on them, will in principle not be considered to be intentionally damaged banknotes.



Intelligent banknote neutralisation systems

Intelligent banknote neutralisation systems (IBNS) are protective devices installed, for example, in cash dispensers (ATMs), cash safes or in cash-in-transit devices that mark or partially destroy banknotes following an attempted robbery or theft; they are designed to protect the banknotes during transportation and distribution against unauthorised access.

The purpose of an IBNS is to make stolen banknotes practically worthless and hinder, or even prevent, their use as a means of payment. The damages may also serve to increase the chances of capturing the criminal.

The use of intelligent banknote neutralisation systems is a preventive measure, designed to ensure that criminals do not profit from crimes committed on cash dispensers (ATMs), cash safes or cash-in-transit devices. This reduces the risk for banks, professional cash handlers and retailers of becoming victims of crime.



Intelligent banknote neutralisation systems





Technologies used

IBNS can use different technologies, for example, ink-staining, singeing, or glue, among others, to make banknotes unusable.

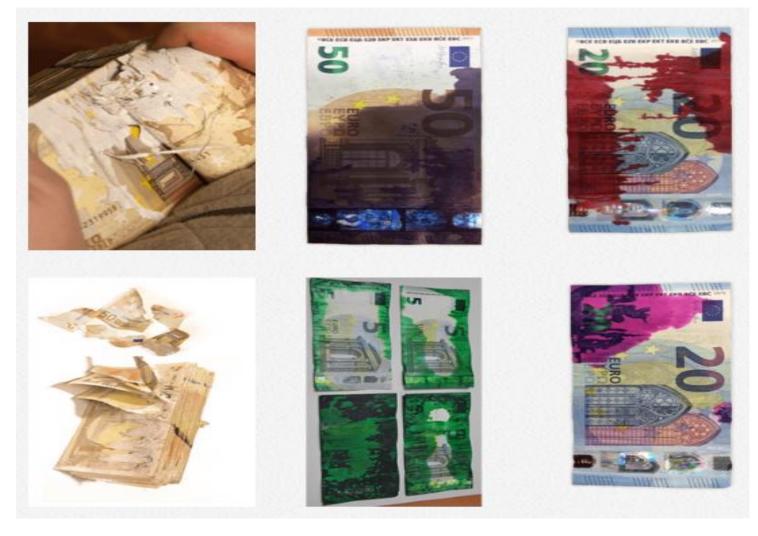
The most common colours of security inks used in IBNS are violet, green, blue, red and black.

When a banknote is stained by an IBNS, the security ink used by the system soaks into the banknote paper, leaving traces which are normally more pronounced on the edges of the banknote. The banknotes are heavily and permanently stained, and the ink usually flows from the edges towards the centre of the banknote, leaving a characteristic pattern.

In intelligent banknote neutralisation systems that use glue, the notes are fused together into a block, permanently and irreversibly. A banknote cannot be peeled off the block without tearing it into small pieces.



Technologies used





Neutralised banknotes

A neutralised banknote is very likely to be a stolen banknote, and the ink stains on it may be from the activation of intelligent banknote neutralisation systems.

The ink usually flows from the edges towards the inner part of the banknotes and leaves a characteristic pattern, designed to prevent their acceptance by the public and arouse suspicion that the person offering the banknotes is not their rightful owner.

The public must not accept banknotes that are ink-stained, bleached, bear suspicious stains, or that appear to have been washed to remove ink, and should ask for another banknote instead (sometimes criminals try to remove the security ink by washing or bleaching the banknotes).

When manually checking cash and detecting neutralised banknotes, cash handlers must retain these banknotes and ask, in line with national legislation, for information concerning its origin and the details of the holder. They must then complete a corresponding form and send it to the competent authorities (national central bank) for further investigations. If warranted, the police will be involved for subsequent criminal investigations.



Neutralised banknotes

TAKE NOTE

In principle, a banknote neutralised by an intelligent banknote neutralisation system will not be exchanged or credited.

A banknote damaged by an IBNS can only be exchanged for its original owner, who is the victim of the crime, or by his or her appointed representative.



Questions?

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Department Currency and Numimsatics
Section Currency Handling Control
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L-2983 Luxembourg

Email: cash-recirculation@bcl.lu

