



Monetary Authority of Singapore

GENERAL INFORMATION ON POLYMER NOTES



January 2006

INTRODUCTION

From the experience in several countries, polymer notes are more durable, resistant to soiling and cost-effective. Together with the favourable feedback from the public, banks and note handling machine operators on the \$10 polymer notes issued in May 2004, MAS has decided to issue \$2 polymer notes in Jan 2006. This guide, which is arranged in an easy Question-and-Answer format, provides general information on polymer notes and raises the awareness of the new material.

- 1) How are polymer notes produced? 3**
- 2) What are the key properties of polymer notes? 3**
- 3) How are the \$2 polymer notes printed? 4**
- 4) What are the security features unique to polymer notes? 5**
- 5) What are the other security features found on the notes? 6**

1) How are polymer notes produced?

Polymer notes are printed on a specialized polypropylene plastic that is derived from petroleum, and this material is not available commercially for security control purposes. The material starts as a clear plastic film, which is produced using unique patented production processes. The clear film is coated with multiple layers of materials, on which the features of the notes can then be printed. During the coating process an extensive range of security features are incorporated.

The polypropylene film is processed into polymer notes through the following steps:

- a) Opacifying: Layers of ink are applied to each side of the note, except for areas that are deliberately left clear for the windows
- b) Sheeting: The opacified substrate is cut into sheets suitable for feeding into the printing press
- c) Printing:
 - *Offset-* Prints the background colours and images
 - *Intaglio-* Prints a heavy ink layer of the main and secondary design features to give a tactile or raised print feeling
 - *Letterpress-* Prints the serial number

At the end of the production process, the notes are coated with a protective varnish that provides a resilient and non-porous surface to the notes.

2) What are the key properties of polymer notes?

The key properties are:

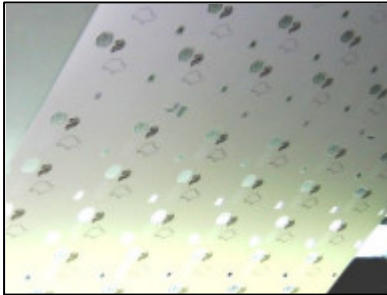
- a) Non-porous: They do not absorb moisture (e.g. oils, sweat, humidity, liquids, dirt, mould and grime, etc) and thus do not stain or accumulate dirt as easily. There is also a lower propensity for bacterial growth.
- b) Non-fibrous: They do not break-down physically with repeated folding.
- c) Sturdy: They are more difficult to initiate a tear compared to paper notes.
- d) Temperature: They remain robust and there is no effect at temperatures between -40°C and 120°C in laboratory trials and in note usage situations. For temperatures above 120°C, they will begin to shrink slightly, and will eventually melt at significantly higher temperatures.

3) How are the \$2 polymer notes printed?



Step 1: Raw Materials

Propylene is first derived from petroleum through separation and distillation methods, and it is then polymerised and pelletised.



Step 2: Substrate Production

The polypropylene plastic is subsequently processed into a thin film, opacified, coated with various layers and some security features are incorporated at this stage.



Step 3: Preparation of Sheets

The polymer substrate is cut into sheets suitable for feeding into the traditional currency printing presses.



Step 4: Printing

The traditional offset, intaglio and letterpress printing processes are applied on the sheets, to give the background colours, tactility (i.e. raised feeling) and serial numbers respectively.



Step 5: Quality Control

After the sheets have been printed at various stages, they are examined for possible defects as part of the quality control process.



Step 6: Cutting and Verification

The sheets are then cut into single notes and inspected on a separate machine in a further verification process. Individual notes are automatically removed and destroyed if they fall below certain standards.



Step 7: Packaging

The single notes are then bundled and packed into cartons, and delivered to MAS.

4) What are the security features unique to polymer notes?

On the \$2 note (as well as the \$10 polymer note), the security features unique to polymer are:



Complex Clear Window

A see-through window with a multi-tonal image of the Singapore Arms.



Embossed Clear Window

A clear window embossed with the denomination numeral, with repetitive patterns of the numeral on the top and bottom.



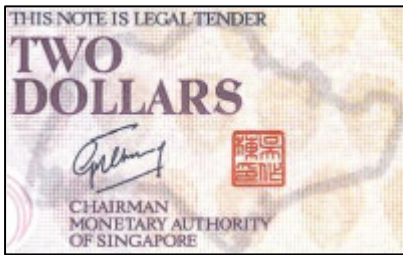
Singapore Lion Symbol with Hidden Image

A stylized gold patch in the shape of the Singapore Lion Symbol with the image of the Singapore Arms appearing when the note is viewed at varying angles.



Shadow Image

A watermark-like image of President Yusof bin Ishak is visible when viewed with transmitted light.

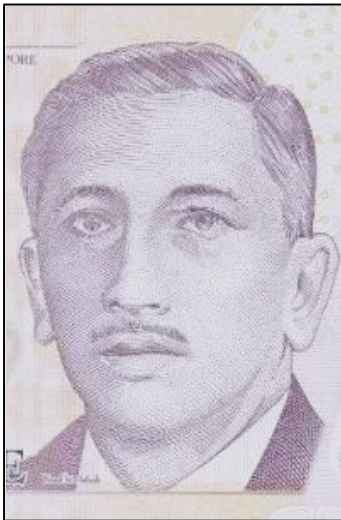


Security Thread

A security thread in the shape of the Singapore island.

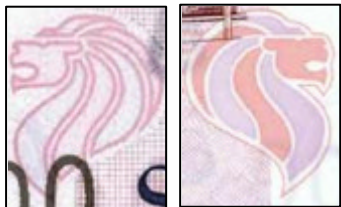
5) What are the other security features found on the notes?

The other security features on notes are:



Engraved Portrait

The portrait dominates the front of the note, and it is engraved with fine lines and printed in intaglio (i.e. raised) to give an embossed feel and provide a tactility effect.



Perfect Registration

The Singapore Lion symbol is printed with the same image on the front and back of the note, and when the note is held up to light, the two images register perfectly.



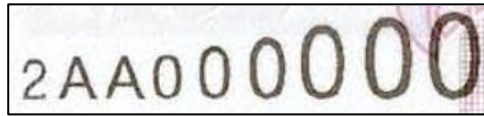
Micro-Printing

The micro-text "Monetary Authority of Singapore" can be seen with the aid of a magnifying glass.



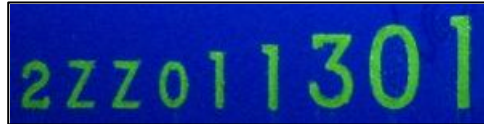
Lithographic Prints

The background on both sides of the notes is printed by the lithographic process. The smooth, rainbow-colored and anti-photographic background makes camera counterfeiting and photographic separation difficult.



Asymmetrical Serial Numbers

This style for the vertical and horizontal serial numbers has progressively larger digits in adjacent positions. The serial numbers also glow under ultra-violet light.



Line Structures

Next to the vertical serial number are line structures that will give distortions when photo-copied.



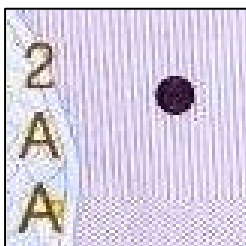
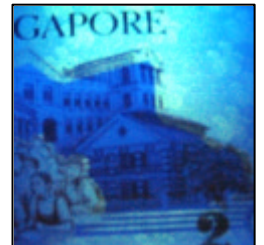
Invisible Feature

This feature is invisible under ordinary light, but glows brightly under ultra-violet light to show the denomination numeral.



Fluorescent Ink

The seal of the MAS Chairman is printed with fluorescent ink, and it will glow under ultra-violet light. The feature also appears on the back of the note as well.



Braille Code

The note has Braille code printed in heavy intaglio ink on the front top right-hand corner. Visually handicapped users can recognise the note denomination by touch of this code.



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