

# COLOUR PERSONALISATION FOR POLYCARBONATE IDENTITY DOCUMENTS

## Why Colour Is the Choice for Your Next Document

Whitepaper

**TOPPAN**  
TOPPAN Security

# SHAPING THE NEW STANDARD FOR LASER PERSONALISATION

Colour shapes how we interpret information, recognise authenticity, and detect inconsistencies. It helps us assess danger and understand our surroundings. Yet despite colour's proven role in enhancing recognition and preventing deception, many government-issued identity documents still use monochrome portraits. As verification environments grow more demanding and fraud techniques advance, restoring secure, high-fidelity colour becomes essential to protecting identities and strengthening trust, used across all verification processes.

Recent statistics from Interpol indicate that document fraud cases have increased by 35% over the past five years, with counterfeit identity documents facilitating everything from illegal immigration to terrorist activities. The economic impact extends far beyond direct fraud losses, encompassing increased verification costs, administrative burdens, and the erosion of public trust in government-issued credentials. The portrait remains the central element of document inspection, and its importance is increasing as officers face growing pressure to verify identities quickly and accurately in environments with rising traveller volumes and more sophisticated fraud attempts. Growing security concerns have encouraged the shift toward laser engraving as a more secure option. However, its technical limitations in colour reproduction have led to a considered compromise between security, visual clarity.

There have been several attempts to bring back colour to portrait personalisation. All the methods have their own drawbacks. We will explore laser colour technology on polycarbonate documents and why it is the answer for governments around the world.

# OVERVIEW OF PERSONALISATION TECHNOLOGIES

When selecting personalisation technology for identity documents, government agencies must evaluate multiple printing/engraving methods based on security, durability, cost, and operational requirements. The three primary technologies, colour laser, greyscale, and inkjet printing, each offer distinct advantages and limitations for identity document applications.

## GREYSCALE LASER TECHNOLOGY



**Greyscale personalisation** offers proven security benefits with simplified operational requirements, making it suitable for applications where colour elements are not essential.

**Technical Characteristics:** Greyscale laser systems use focused laser energy to create permanent black personalisation within polycarbonate documents.

**Security Advantages:** Greyscale personalisation provides excellent resistance to tampering, as the personalisation is embedded subsurface within the layers of the polycarbonate.

The technology supports various security features including microtext, complex patterns, and variable data elements. Whilst lacking the authentication layers of colour systems, monochrome laser personalisation still offers substantial security improvements over surface-applied methods.

**Quality and Durability:** Monochrome laser systems produce crisp, high-contrast text and images with excellent edge definition. The permanent integration ensures long-term stability without degradation. However, the aesthetic appeal is limited compared to colour alternatives, and photograph reproduction lacks the quality law enforcement and citizens expect from modern identity documents. It reduces visual clarity because colour tones influence how the portrait appears, much like the photograph stored on the chip and the facial features verified by border officers much like the colour photograph.

**Operational Considerations:** Greyscale laser systems require lower initial investment and simpler maintenance compared to laser colour alternatives. Operator training requirements are reduced. Environmental control needs are less stringent, though still important for consistent quality output.

## **GREYSCALE LASER WITH SURFACE-APPLIED COLOUR**

This personalisation process combines greyscale laser engraving with surface-applied colour printing to introduce colour elements into polycarbonate identity documents.

This approach has been adopted as an intermediate step where colour portraits are desired but fully integrated colour laser technology is not yet implemented.

**Technical Characteristics:** Greyscale laser engraving technology is utilized to embed personalised data beneath the surface of the polycarbonate substrate, resulting in permanent, tamper-evident monochromatic information. Colour detail, most notably those associated with the portrait, is applied to the document surface through a separate printing process, such as inkjet printing.

In these configurations, the laser engraving and colour printing processes operate independently. As a result, colour information is not integrated into the substrate structure but remains a surface-level addition.

**Security Limitations:** While the greyscale laser component provides strong resistance to tampering, the surface-applied colour elements inherit the same security limitations as all surface printing methods. Colour portraits can be altered, removed, or degraded using mechanical, chemical, or environmental techniques without necessarily affecting the embedded laser data.

This creates a two-tier security profile, where foundational personalisation benefits from substrate integration, but the most visually prominent element, the colour portrait, remains the least secure. From an authentication perspective, this represents a structural weakness, as document inspectors cannot easily distinguish if the surface inkjet matches the laser engraving under it or if it has been entirely covered in a fraudulent attempt to replace the portrait.

**Quality and Durability:** Hybrid solutions can initially deliver acceptable colour image quality. However, surface-applied colour typically requires protective laminate or varnish layers to improve durability.

These additional layers reduce overall image sharpness and limit visual assessment of potential tampering.

Over the document lifecycle, surface-applied colour is susceptible to fading, scratching, and wear, while laser-engraved elements preserve their clarity and integrity. This uneven ageing can lead to inconsistent visual and tactile characteristics across the document, complicating inspection and long-term validation.

**Operational Considerations:** Hybrid systems offer moderate investment requirements compared to fully integrated colour laser solutions. However, they introduce additional production steps, quality assurance complexity, and ongoing material dependencies. Environmental conditions and consumable variability can also impact colour consistency.

As security requirements evolve, hybrid approaches are increasingly regarded as transitional solutions, rather than long-term platforms for high-security identity documents.

## COLOUR LASER TECHNOLOGY

**Colour laser personalisation** represents the most advanced option for identity document production.

**Technical Characteristics:** Colour laser personalisation systems embed images into the document by using precisely controlled laser energy which results in content that becomes an integral part of the document's structure rather than simply being printed on its surface.

**Security Advantages:** The integration of colour elements creates multiple authentication layers that are extremely difficult to replicate. Tampering attempts result in immediate visible damage to the document, as the colour elements cannot be removed without destroying the substrate.

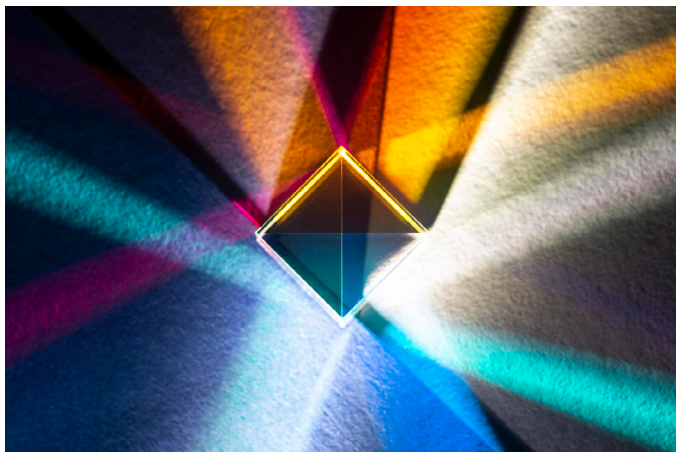
**Quality and Durability:** Colour laser personalisation produces exceptional image quality with sharp detail reproduction and consistent colour accuracy. The embedded nature of the personalisation ensures long-term durability, with no fading, peeling, or surface wear typical of traditional printing methods. Documents maintain their appearance and security features throughout their intended lifespan.

**Operational Considerations:** Colour laser requires higher initial investment costs due to system sophistication and reactive material integration into the document body.

Environmental controls are critical for maintaining consistent output quality, and ongoing maintenance costs are higher due to system sophistication.



# FROM A QUALITY PERSPECTIVE, THIS HYBRID APPROACH ALSO PRESENTS CHALLENGES



The inkjet colour requires protective layers to improve durability, but these layers reduce overall image quality and create a visible distinction between the laser-engraved areas and surface-printed regions. Laser engraving is covered by an inkjet layer, which prevents a clear assessment of whether the image has been tampered with. This limitation is frequently cited by law enforcement and security specialists as a major drawback; often ranking as their least favoured option for that specific reason, even before considering durability concerns.

The document exhibits different tactile properties and visual characteristics across its surface, creating an inconsistent user experience.

Furthermore, the surface-applied colour elements remain susceptible to fading, scratching, and environmental degradation over the document's lifespan, whilst the laser-engraved monochrome elements maintain their integrity.

This creates documents that age unevenly, with colour photographs deteriorating whilst text and security features remain pristine; a situation that can complicate long-term verification and may necessitate earlier document replacement.

## COMPARATIVE ANALYSIS

### Security Ranking:

1. **Colour laser** (highest security)
2. **Greyscale laser with inkjet surface** (mixed security profile with vulnerable colour elements)
3. **Greyscale** (excellent tamper-evidence with substrate integration)

### Quality Ranking:

1. **Colour laser** (superior image quality and aesthetic appeal)
2. **Greyscale laser with inkjet surface** (inconsistent quality with surface vulnerabilities)
3. **Greyscale** (excellent text quality, limited aesthetic options)

For high-security identity documents requiring maximum fraud resistance and citizen satisfaction, colour laser personalisation represents the optimal choice. The technology provides unmatched security benefits whilst meeting contemporary expectations for document quality and appearance.

# VERIFICATION BENEFITS OF COLOUR PORTRAIT INTEGRATION



The implementation of colour portrait photography in identity documents fundamentally transforms the verification process, providing border control officers, law enforcement personnel, and document verification staff with significantly enhanced authentication capabilities.

## Security

Furthermore, colour portraits integrated through laser personalisation technology are virtually impossible to substitute or alter without causing obvious damage to the document substrate, providing verification officers with immediate confidence in the photograph's authenticity. The psychological impact of colour photography also contributes to verification effectiveness, as the enhanced realism and professional appearance of colour portraits make subtle alterations more apparent to trained personnel, whilst simultaneously increasing the document holder's confidence in presenting their credential for inspection.

## Visual Fidelity

Unlike traditional greyscale photographs, colour portraits preserve crucial identifying characteristics such as skin tone variations,

natural eye colour ranging from subtle hazel patterns to distinctive heterochromia, and hair colour gradations including natural highlights, grey streaking, or auburn undertones that appear identical in monochrome images. The enhanced detail resolution available through colour laser personalisation technology captures subtle facial characteristics including distinctive birthmarks with colour variations, and natural freckling patterns that would be completely invisible in black and white.

Additionally, colour portraits reveal important distinguishing features such as the natural reddish tint of eyebrows that may appear darker in hair colour, subtle colour differences in facial hair including ginger beards on individuals with brown hair, and the natural flush variations in lip colour that can serve as secondary identification markers. This improved visual fidelity enables verification personnel to conduct more confident and accurate identity confirmations, particularly in challenging lighting conditions or when examining documents that have experienced normal wear and handling.

## HOW CAN YOU MOVE TO A COLOUR PORTRAIT?

Governments have continually modernised their identity documents, from handwritten entries to machine-readable formats, from laminated photos to integrated polymers, and from surface printing to laser engraving. Each transition seemed challenging at the time, yet each became the norm as security needs evolved.

The move to colour personalisation follows the same pattern. As threats grow and inspection environments become more demanding, upgrading from greyscale engraving to colour is a natural and expected step in document evolution.

A phased approach remains the most effective way forward. Reviewing current systems, running controlled pilot programmes, and working closely with experienced technology partners ensures a smooth transition.

As with past upgrades, each stage builds confidence, strengthens security, and aligns national documents with modern expectations.

## CONCLUSION

Colour laser technology represents a transformative technology for government identity document programmes, offering significant security enhancements whilst improving citizen experience and operational efficiency. The technology's ability to create tamper-evident, high-quality personalised documents addresses critical security needs whilst supporting modernisation objectives.

Successful implementation requires careful planning, appropriate investment in infrastructure and training, and partnership with experienced technology providers. However, the long-term benefits in terms of security enhancement, cost reduction, and citizen satisfaction make strategic imperative for forward-thinking government identity document programmes.

Colour laser technology will become increasingly accessible to government agencies of all sizes, making it an essential consideration for any identity document modernisation initiative.





Copyright © 2026 TOPPAN Security All rights reserved.

