

Can registration errors on a printing press cause color shifts? What can be the root causes for those registration errors? And what do ISO standards say about registration errors?

Yes, **registration errors on a printing press absolutely cause color shifts** (also called **color misregistration**).¹

This happens because the final color in process printing (CMYK) is created by microscopically overlapping four separate color layers. If these layers are misaligned, the intended overlap pattern (like the rosette pattern of halftone dots) is disrupted.

- **Visual Defects:** Misalignment creates visible defects like blurring, a fuzzy appearance, or a "halo" or shadow effect around images and text.²
- **Color Shift:** In areas where two or more colors should precisely overlap to form a composite color (e.g., Cyan and Yellow overlap to make Green), misregistration changes the ratio and geometry of the ink coverage, resulting in an observable shift in the final average color.

● Root Causes of Registration Errors

Registration errors typically fall into three main categories: mechanical, material, and operational.³

1. Mechanical Instability and Wear⁴

These issues relate to the physical condition and setup of the press:

- **Worn or Damaged Gears/Bearings:** Loose or worn gears cause inconsistent movement of the print cylinders, leading to cyclical or intermittent registration variations, often called "barring" or "gear marking."⁵
- **Cylinder Runout or Wobble:** If the printing or impression cylinders are not rotating on a perfectly concentric axis due to damage or bearing wear, the contact point for the plate/blanket shifts, causing alignment errors.⁶
- **Plate/Sleeve Mounting Errors:** Incorrectly or inexact mounting the printing plate or sleeve to the cylinder can cause an immediate, consistent offset error.⁷
- **Cylinder Not Locked Tightly:** A print cylinder that is not properly secured can "walk" or shift laterally during the run.

2. Substrate and Tension Issues

These relate to the printing material and how it is handled:

- **Web Tension Fluctuation (Roll-fed Presses):** Incorrect or inconsistent tension control stretches or relaxes the substrate (paper or film) as it moves through the press.⁸ This change in material length or width causes subsequent color stations to print in the wrong position relative to the previous colors (**longitudinal** and **lateral** misregistration).
- **Substrate Instability:** Materials like paper and film can **expand or contract** due to changes in **temperature or humidity**, especially as they pass through inter-station drying units.⁹ This physical change in the material's size between printing units causes the subsequent print layers to fall out of register.
- **Wandering Web:** Lateral movement of the substrate across the press (a "wandering web") if the web guide system malfunctions or is incorrectly set up.¹⁰

3. Operational and Prepress Errors

These relate to human setup and upstream processes:

- **Inaccurate Prepress Trapping:** While not a "cause" of registration error, insufficient **trapping** (the slight overlap between adjacent colors) makes a slight registration error much more visible.¹¹

- **Incorrect Image Positioning:** The original printing plate/file may have been prepared with the image slightly misaligned, resulting in a constant registration error.

ISO Standards on Registration Errors

The International Organization for Standardization (ISO) addresses registration accuracy within its suite of graphic technology standards, most notably **ISO 12647**, which covers process control for printing.¹²

The standard defines expected **color-to-color register tolerances** for various printing methods. While the specific numerical tolerance varies based on the printing process and the screening frequency (LPI), the key principle is:

- **ISO 12647-2 (Sheetfed and Web Offset):** Defines parameters for print production.¹³ One common reference point often cited for high-quality offset printing on commercial paper is that the average of color register centers **should not exceed 0.10 mm** (100 micrometers) as the largest deviation between any two printed colors.
- **ISO 12647-6 (Flexography):** This standard often ties the register tolerance to the print line screen (LPI), suggesting that the required accuracy is tighter (smaller tolerance) for finer screen rulings.¹⁴ A general guideline might specify that the tolerance shall be within a certain fraction of the halftone dot size.

These standards serve as benchmarks, allowing printers to:

1. **Guarantee Quality:** Demonstrate that their print output consistently falls within an internationally recognized tolerance range.
2. **Define Trapping:** Use the expected registration tolerance of their press to determine the minimum required **trapping width** in prepress.¹⁵ If the press has a maximum potential misregistration of $\$X\%$, the trap must be at least $\$X\%$ to prevent white gaps.