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Color Contrast Best Practices

Ensuring readable and accessible color combinations

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Color Contrast Best Practices

Color contrast is essential for making text and interactive elements readable for everyone, including users with low vision, color blindness, and those viewing content in bright sunlight or on low-quality displays.

WCAG Contrast Requirements

Level AA (Minimum Standard)

- **Normal text** (≤ 18 pt regular or ≤ 14 pt bold): **4.5:1 contrast ratio**
- **Large text** (> 18 pt regular or > 14 pt bold): **3:1 contrast ratio**
- **UI components and graphical objects**: **3:1 contrast ratio**

Level AAA (Enhanced Standard)

- **Normal text**: **7:1 contrast ratio**
- **Large text**: **4.5:1 contrast ratio**

Contrast Ratio Formula

The WCAG contrast ratio is calculated using the relative luminance of the foreground and background colors:

$$\text{Contrast Ratio} = (L1 + 0.05) / (L2 + 0.05)$$

Where:

- **L1** = Luminance of lighter color
- **L2** = Luminance of darker color

Common Contrast Failures

✖ Poor Contrast Examples

Text Color	Background	Ratio	Status
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#999999 (gray)	#FFFFFF (white)	2.8:1	✗ Fails AA
#FF6B6B (light red)	#FFFFFF (white)	2.9:1	✗ Fails AA
#4ECDC4 (cyan)	#FFFFFF (white)	2.5:1	✗ Fails AA
#F7B731 (yellow)	#FFFFFF (white)	1.7:1	✗ Fails AA

✓ **Good Contrast Examples**

Text Color	Background	Ratio	Status
#2C3E50 (dark blue)	#FFFFFF (white)	12.6:1	✓ Passes AAA
#E74C3C (red)	#FFFFFF (white)	5.1:1	✓ Passes AA
#27AE60 (green)	#FFFFFF (white)	5.0:1	✓ Passes AA
#3498DB (blue)	#FFFFFF (white)	4.6:1	✓ Passes AA

Design System Tokenization

Recommended Approach

Create color tokens with built-in contrast compliance:

```
:root {
  /* Primary colors with guaranteed contrast */
  --color-primary: #2563EB;      /* 4.6:1 on white */
  --color-primary-dark: #1E40AF; /* 8.2:1 on white */

  /* Text colors */
  --color-text-primary: #1F2937; /* 15.8:1 on white */
  --color-text-secondary: #4B5563; /* 7.0:1 on white */
  --color-text-muted: #6B7280; /* 4.5:1 on white (minimum) */

  /* Background colors */
  --color-bg-primary: #FFFFFF;
```

```
--color-bg-secondary: #F9FAFB;
--color-bg-tertiary: #F3F4F6;

/* Semantic colors */
--color-success: #10B981;           /* 4.6:1 on white */
--color-warning: #F59E0B;           /* 2.9:1 on white (needs da
--color-error: #EF4444;             /* 4.6:1 on white */
--color-info: #3B82F6;              /* 4.5:1 on white */
}
```

Contrast Testing in Design Tools

Figma/Adobe XD Plugins:

- Stark (WCAG contrast checker)
- Contrast (real-time contrast testing)
- A11y (comprehensive accessibility)

Browser DevTools:

- Chrome DevTools Lighthouse
- Firefox Accessibility Inspector
- Safari Web Inspector

Dark Mode Considerations

Dark mode requires separate contrast calculations:

Dark Mode Best Practices

- **Background:** Use near-black (#0F172A, #1E293B) instead of pure black
- **Text:** Use light gray (#F1F5F9, #E2E8F0) instead of pure white
- **Accent colors:** May need adjustment for dark backgrounds

Example Dark Mode Palette

```
[data-theme="dark"] {
  --color-bg-primary: #0F172A;
  --color-bg-secondary: #1E293B;
  --color-text-primary: #F1F5F9; /* 15.8:1 on dark */
  --color-text-secondary: #CBD5E1; /* 10.2:1 on dark */
  --color-primary: #60A5FA; /* Adjusted for dark bg */
}
```

Interactive Elements

Buttons and Links

Minimum Requirements:

- Text must meet 4.5:1 contrast ratio
- Focus indicators must meet 3:1 contrast ratio
- Hover states should maintain or improve contrast

Example Button Styles:

State	Background	Text	Ratio	Status
Default	#2563EB	#FFFFFF	4.6:1	✅ AA
Hover	#1D4ED8	#FFFFFF	5.8:1	✅ AA
Focus	#2563EB	#FFFFFF	4.6:1	✅ AA
Disabled	#E5E7EB	#9CA3AF	2.3:1	❌ Fails

Form Inputs

Requirements:

- Input borders: 3:1 contrast ratio
- Labels: 4.5:1 contrast ratio
- Placeholder text: 4.5:1 contrast ratio
- Error messages: 4.5:1 contrast ratio

Testing Tools

Automated Testing

- **axe DevTools:** Browser extension with contrast checking
- **Lighthouse:** Built into Chrome DevTools
- **WAVE:** Web accessibility evaluation tool
- **Contrast Checker:** Online tool (webaim.org/resources/contrastchecker)

Manual Testing

- **Browser zoom:** Test at 200% and 400%
- **Different displays:** Test on various monitors
- **Brightness levels:** Test in different lighting conditions
- **Color blindness simulators:** Chrome DevTools, Color Oracle

Common Mistakes to Avoid

Don't

- Use light gray text on white backgrounds
- Rely solely on color to convey information
- Use low-contrast colors for error messages
- Assume "close enough" contrast ratios
- Ignore contrast in dark mode

Do

- Test contrast ratios with automated tools
- Use semantic color tokens in design systems
- Provide alternative indicators beyond color
- Test in various viewing conditions
- Document contrast requirements for designers

Quick Reference

Minimum Contrast Ratios

Element Type	WCAG AA	WCAG AAA
Normal text	4.5:1	7:1
Large text	3:1	4.5:1
UI components	3:1	3:1
Focus indicators	3:1	3:1

Large Text Definition

- **Regular weight:** >18pt (24px)
- **Bold weight:** >14pt (18.5px)

Implementation Checklist

- ☐ Design system includes contrast-compliant color tokens
- ☐ All text meets WCAG AA contrast requirements
- ☐ Interactive elements have sufficient contrast
- ☐ Dark mode palette tested for contrast
- ☐ Automated contrast testing in CI/CD pipeline
- ☐ Manual testing performed on multiple displays
- ☐ Color-blind users tested the interface
- ☐ Documentation includes contrast requirements

Resources

- **WCAG 2.2 Contrast Requirements:**
<https://www.w3.org/WAI/WCAG22/Understanding/contrast-minimum>
- **Contrast Ratio Calculator:** <https://webaim.org/resources/contrastchecker/>
- **Color Contrast Analyzer:** <https://www.tpgi.com/color-contrast-checker/>
- **Contrast Plugin for Figma:**
<https://www.figma.com/community/plugin/748533339900865323/Stark>