

## **Coding with Compassion – Giving Everyone Access to The Power to Know™**

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### **ABSTRACT**

Accessibility means making electronic information and technologies usable by people with disabilities. Many people with disabilities use special assistive technologies, such as screen readers or screen magnifiers, to make the information usable. U.S. legislation, an aging population, and increased reliance on the web combine to make accessible web content a business best practice. To not only comply with U.S. law, but also to make the software usable by a broader range of people, SAS has worked to enable coders to make their SAS output available to assistive technologies. Beyond the legal requirements, most SAS coders and their organizations would simply want to do the right thing in terms of accessibility if they knew how. By specifying some simple options in SAS, you can start down the path to accessible output. In this paper, we offer specific SAS coding tips and demonstrate the value of different options in ODS and SAS/GRAPH output. We emphasize SAS 9 features, such as the SAS/GRAPH accessibility option to generate accessible Java graphs and the use of the HTML destination for ODS, to ensure that you generate the most accessible output possible. You will gain a better understanding of your organization's legal and social responsibility for accessible web content and learn how to make your SAS output accessible to everyone.

### **INTRODUCTION**

Section 508 of the American Disabilities Act (ADA) mandates that when the U.S. Federal Government purchases electronic information and technology (EIT), the information and data access provided to its employees with disabilities must be comparable to the access provided to employees without disabilities. In addition, the U.S. Federal Government must provide information and data access to members of the public with disabilities comparable to the access provided to members of the public without disabilities. Section 508 applies to any web-based information, desktop- and web-based applications, technical support, and product or service documentation. As the leading employer of persons with disabilities in the United States, the Federal Government needs Section 508-compliant EIT in order to meet terms of the Americans with Disabilities Act (ADA). Under the ADA, employers of fifteen or more persons must make "reasonable accommodations" to provide "equal access" to facilities and information for its employees with disabilities. It is this aspect of the ADA that extends Section 508 from the Public Sector market into all U.S. market sectors. In recent high-profile civil litigation, the ADA has been extended to apply to private industry web sites as well. Section 508 extends to federally funded programs and public universities. Moreover, many state and municipal governments and international bodies increasingly require compliance with accessibility standards.

### **WHAT IS ACCESSIBLE CONTENT**

Accessible web content means web material that is usable by people with disabilities. People who are blind or have extreme low vision may rely on a screen reader to read content aloud. Any graphics or charts must include alternative, readable text descriptions to be useful to them. Site visitors who are color blind may set their displays to show images only high contrast; thus graphics or text with insufficient foreground to background contrast are indecipherable. People with vision impairments may need to set the font in their web browser to a larger size to make text legible; accessible content inherits these user settings. People who are deaf or hard of hearing may need captions or transcripts viewable to get value from online video or training. People with dexterity impairments, for whom using a mouse is difficult or impossible, may navigate web pages using keystrokes or special devices such as a mouth or head pointer.

### **WHY PRODUCE ACCESSIBLE CONTENT**

In addition to the legal incentives, organizations find compelling social and financial incentives for delivering accessible web content. By making web content accessible, organizations can improve the usability of their web sites for all users. By applying web development techniques to render content accessible, content providers widen the audience of potential users to include people with disabilities, those who use assistive technologies, as well as the growing segment of older computer users. The market for accessible content is wider than many realize as evidenced by research.

In a 2003 study commissioned by Microsoft Corporation, Forrester Research found that more than half of computer users 18-64 are likely to benefit from accessibility options that built into products (such as options that change font size and color) and assistive technologies (the specialty hardware and software such as screen readers and voice-recognition products). The study concluded:

57 percent of working-age computer users in the U.S. between the ages of 18 and 64 (more than 74 million Americans) could benefit from accessible technology because of mild-to-severe vision, hearing, dexterity, speech,

and cognitive difficulties and impairments that interfere with their ability to perform routine tasks – including their use of computers. Of the 74.2 million U.S. computer users who could benefit from accessible technology, 51.6 million have mild impairments and 22.6 million have more severe impairments. Another 56.2 million are unlikely to benefit from accessible technology because they experience either no difficulties or only minimal impairments. (Microsoft 2004)

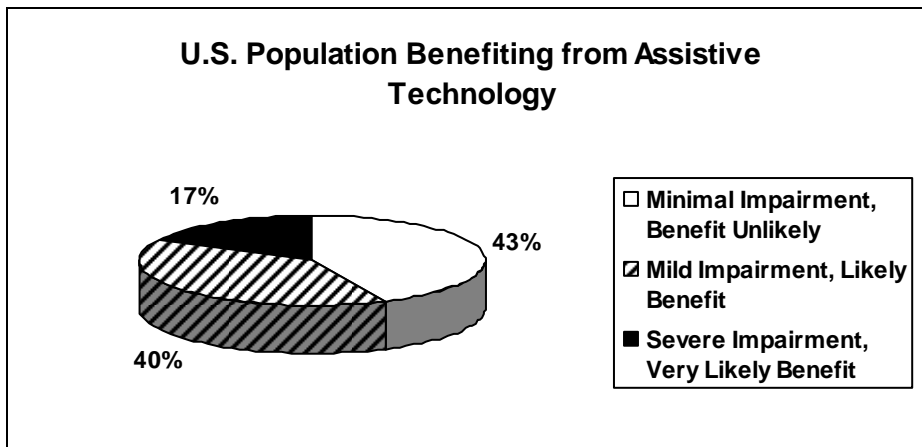


Figure 1. Percentage of U.S. Population Likely or Very Likely to Benefit from Use of Assistive Technology

From the Institute’s own usability research, SAS has found that accommodations for accessibility often contribute to overall ease-of-use. When coded to platform and industry standards for interaction, software operates in a predictable and intuitive fashion. SAS recognizes that universal design and accessibility contribute to usability and customer satisfaction. Techniques of accessible development promote content that is easier to maintain. In addition, these methods may improve searchability and efficiency. See the W3C Web Accessibility Initiative’s discussion of the auxiliary benefits of accessible web content. (Arch et al. 2002).

Organizations that provide services to people with disabilities may find delivering those services via the web to be cost effective. Making that content accessible increases the success for their constituents. As web distribution has become standard for public information, the need to ensure equal access to the information for people who have disabilities becomes paramount. The aging workforce in the U.S. also puts pressure on organizations to provide accessible content on their internal web browser-based content.

Key demographic trends combine to make accessible software a necessity in all market sectors. As the average life expectancy has risen, people are staying in the workforce longer. The U.S. Bureau of Labor projects that the number of civilians, age 55 and older, in the workforce will increase by nearly 50% from 2002 to 2012. This percentage is up from 12% in 1992. A global survey of economically active populations which was conducted by the International Labor Organization (ILO) shows comparable growth projections through 2010. (“Universal Design” 2005).

The incidence of one or more disabilities that impair computer use increases with age. The aging process diminishes visual and audio acuity and decreases manual dexterity. Firms need accessible web content to accommodate aging customers as well as aging employees. To meet the emerging needs of older customers and employees, firms must provide web content that is compatible with assistive technologies. With accumulated years of domain knowledge, experienced staff members are valuable resources to their employers. Companies can protect their investment in employees by delivering accessible content to help these employees maintain their productivity despite age-related impairments.

### HISTORY OF ACCESSIBLE CONTENT FROM SAS

With version 9, SAS enhanced the ODS HTML tag set to include accessible coding and to target the HTML 4.01 specification by default (version 8 used HTML 3.2). SAS/Graph, beginning with version 8, included a GACCESSIBLE macro. With the GACCESSIBLE macro, you could produce a chart or graph with alternative text, available to screen readers. You could also activate a link to a tabular view of the data. The table data could then be read by a screen reader. In version 9, SAS extended the enhancements. For accessible graphs, one need only specify `GOPTION ACCESSIBLE` in the output.

### CURRENT STATE OF ACCESSIBLE CONTENT FROM SAS

The code and output for this paper was generated using Base SAS and SAS/GRAPH software, Version 9.1.3 of the SAS System for Windows. We used PROC TABULATE and PROC REPORT to create simple tables in the ODS HTML and PDF destinations. The tables were built using few (procedure and ODS) options to ensure that the output we created was not

altered beyond the “out of the box” output that SAS intended. Regular tables produced from table templates, with non-complex structures, have good accessibility. Our review relies on ODS HTML output from version 9.1.3 because in this release of SAS, the default ODS HTML output uses the HTML 4.01 specification.

## TESTING OUTPUT

We checked the HTML output by using a combination of free, online accessibility checkers/validators and common assistive technologies.

To evaluate code validity, we used WebXact™ ([webxact.watchfire.com](http://webxact.watchfire.com)), Cynthia Says™ ([www.cynthiasays.com](http://www.cynthiasays.com)), and the W3C HTML Validator ([validator.w3.org/](http://validator.w3.org/)). The accessibility of HTML Output was tested against W3C Priority 1, 2, and 3 standards as well as Section 508.

Color contrast and difference were tested using Juicy Studio's Online Color Contrast Analyzer ([juicystudio.com/services/colourcontrast.php](http://juicystudio.com/services/colourcontrast.php)). This analyzer allows a user to enter two color codes (foreground and background) and then it analyzes the color and brightness contrast using algorithms specified by the W3C.

To test the output for screen reader users, we used Job Access for Windows (JAWS®) screen reader ([www.freedomscientific.com/fs\\_products/software\\_jaws.asp](http://www.freedomscientific.com/fs_products/software_jaws.asp)) from Freedom Scientific®. This tool is the market-leading screen reader and the tool used by the Federal Government to validate accessibility compliance. An evaluation version of JAWS is available for download. Although fully-functioning, the evaluation version operates for only 40 minutes before requiring a reboot.

## ACCESSIBILITY OF HTML TABLES

Generally, HTML table output from SAS did well in our accessibility review. Both TABULATE and REPORT output passed W3C Priority 1 and 2 Checkpoints and all section 508 guidelines. The output from both PROC TABULATE and PROC REPORT read well in a screen reader. PROC TABULATE included the proper use of table header tags with appropriate row or column scope attributes (`<th scope="...">`). PROC REPORT, however, did not use consistently use table header tags. It used the `<th>` tags for the column headers, but not for the row headers. In a simple table with only one level of headers, the screen reader assumption that the left-most row and top-most column are the headers works well. However, PROC REPORT output with multiple row or column header levels would likely produce confusion in a screen reader. This means that if you need to display a table with multiple levels of row headers, the most compliant output will come from PROC TABULATE. For a single level of row headers, PROC REPORT is not technically correct, but it likely will still function well in most screen readers.

Both TABULATE and REPORT used summary tags for the table, but unfortunately this summary tag simply stated the name of the procedure, which is not very helpful to the end user who is interested in determining the content of the table. Currently it is not possible to change the summary tag for an HTML table.

## ACCESSIBILITY OF PDF TABLES

The news was not as good for PDF table output. The output was not a “tagged” PDF document. Tags in Acrobat PDF documents lend the document structure, much the way headers and styles work in Word, and assist screen readers in navigating a document.

Although the SAS output was untagged (meaning unstructured), it was however rendered as text and a screen reader was able to read it aloud. In the PROC TABULATE report, the table was recognized as such and the program was able to associate the appropriate headers with the data cells. In the PROC REPORT output however, the screen reader did not recognize the output as a table and the user could only hear the data in a linear fashion and the headers were not associated with table cells. As mentioned above with HTML output, this likely comes from the different ways TABULATE and REPORT generate output. This again means, to get the most accessible output, PROC TABULATE is preferred to PROC REPORT.

In general, these results were not surprising as PDF documents are notorious for their accessibility challenges. Because of these challenges, it is best that you provide output in a format other than PDF. Both Section 508 and W3C recommend that a text alternative be available if the other form cannot be made accessible. Given the ease with which SAS users can direct their output to multiple ODS destinations by simply adding a few lines of code to send output to PDF and an additional ODS destination like HTML or RTF, this requirement should be easy to comply with.

## IMAGES

SAS/GRAPH software output can be a wide variety of graphs, maps, or plots. One key element here is that they are all images rather than text. For images to be available to those using a screen reader, accessibility standards require that there be an alternate description of the image. This is true regardless of your document type (HTML, PDF, RTF). It is easy to imagine the alternate text, or alt text, for something like a company logo or a photo of a smiling child. However, SAS output is often very data-rich and thus cannot be easily described in alt text. In this case the alt text should describe what the display is “Pie chart of sales by region”. In order to give everyone access to the data and information in your table, you need to provide

more information. There are a few ways this can be accomplished, in some cases through SAS options and in others through using the drill down or ODS HTML capacity of SAS. Most static (unchanging) images will be created using a GIF, JPG, or PNG driver. Dynamic images are likely created in SAS using the ACTIVEEX, ACTXIMG, JAVA, or JAVAIMG device drivers. These drivers allow developers to offer the end user an exciting ability to change and explore a graph. How then, can those using screen readers still get to your data without being able to physically see or manipulate your graph? In 9.1.3 SAS has provided an ACCESSIBLE GOPTION. When this GOPTION is specified, SAS creates an invisible link to an accessible text version of the data underlying the graph. When someone using a screen reader views a page containing an accessible graphic, the link is announced. The user can then activate the link and the screen reader displays and reads the tabular version. For an example, see Appendix B: Sample Accessible SAS Graph on page 11.

## GENERAL DESIGN TIPS FOR ACCESSIBILITY

Even though SAS output was, for the most part, accessible, this does not mean that as coders we can assume any SAS output will automatically be accessible and usable by anyone. We still are responsible for making sure our output is as clear and useful as possible. Two areas to consider are the design of the table and in the choice of colors used. There have been several past presentations at various SAS User Group conferences focusing specifically on good design as it relates to SAS Output (*Gilmore, WUSS 12* and *Bessler, SUGI 28* among others). In addition many general resources exist for guidance on general web design, accessibility, and information design (see Appendix A – Annotated Bibliography on page 8).

**TABLE DESIGN.** As with any output we generate to be shared with end users, we need to make sure that the output table or figure conveys the information clearly and makes our intended point(s) without unnecessary complexity and confusion. Again, while this may have specific benefits for users with cognitive disabilities, clear design also helps all users. The less any user has to work to understand the information, the better it is.

In general, the goal is to create a table that can stand alone out of context and convey enough information to the reader to explain what the data is and how it is presented. One key part of this is writing useful and informative titles. Table (and figure) titles should stand on their own – acronyms explained, the data described, and the type of analysis clarified. For example, compared to “Injury Deaths” as a title “Number of Injury Deaths among California Residents in 2004” is much more descriptive and can stand alone out of the context of the presentation or report.

In the table itself, avoid unnecessary nesting of headers and sub-headers. Sometimes it may be clearer to present two tables in sequence rather than incorporate many data points into a single table. In addition, for accessibility, it is much easier for a screen reader to handle a single row or column header rather than many nested headers. In PROC TABULATE, use the KEYLABEL statement to suppress the display of the header row that repeats the statistic being presented. By default, the statistic being presented (n, sum, percent, etc) is included in the table title and thus the repetition in the table itself is unnecessary. To suppress the line, simply use the statement `KEYLABEL keyword=' '`; where *keyword* is your statistic and the value is simply empty quotes.

**COLOR CONTRAST.** The default ODS style template uses a combination of light and medium grays with black and blue text fonts. It does provide an appropriately large font for easy readability and simple gridlines to allow the readers’ eyes to read across or down with ease. However, the template’s combination of grays is dull and the gray/blue combination reduces the contrast between the foreground and background.

[Guideline 2.2](#) of the [Web Content Accessibility Guidelines 1.0](#) requires that foreground and background colour combinations provide sufficient contrast when viewed by someone having colour deficits, or when viewed on a black and white screen. Two colours provide good colour visibility if the brightness difference and the colour difference between the two colours are greater than a set range [determined by the W3C’s algorithm].

Testing the contrast of the blue row and column headers against the gray background revealed that according to the W3C algorithm, the default style does not offer sufficient color contrast. To address this issue, use a custom style in your table that provides sufficient contrast between the text and the background. This does not have to mean all black and white and you can still even keep different backgrounds between your row and column headers and the data cells. The figures below compare a sample table generated in the Default style template (Figure 2) with one created with the “EGDefault” style (Figure 3). A comparison of the colors used for the row and column headers of each table reveals that there is not sufficient contrast between the foreground and background colors in the Default style. The EGDefault style does provide sufficient contrast per the algorithm.

*This Style is  
Styles.Default*

Obs	A	B	C
1	1	2	3
2	4	5	6
3	7	8	9
4	10	11	12
5	13	14	15

*This Style is  
Styles.EGDefault*

Obs	A	B	C
1	1	2	3
2	4	5	6
3	7	8	9
4	10	11	12
5	13	14	15

Figure 2. Sample output in ODS Default style template

Figure 3. Sample output in ODS EGDefault style template

Table 1. Comparison of color contrast between ODS Default and EGDefault styles.

	ODS Default	EGDefault
Foreground color code	#0033AA	#004477
Background color code	#B0B0B0	#EFE5E0
Brightness Difference * (Threshold is 125)	126 (barely sufficient)	177
Color Difference * (Threshold is 500)	307 (not sufficient)	505

Note: SAS has developed a high-contrast option for ODS that will be available in version 9.2. Efforts are underway to make it available for use with 9.1.3 through a tech support download. To receive notification when it becomes available, send email to Lisa Pappas at SAS ([lisa.pappas@sas.com](mailto:lisa.pappas@sas.com)).

## HOW TO PRODUCE AN ACCESSIBLE CHART IN SAS

The World Wide Web brought visual content to an already lively text-based Internet. However, the addition of visuals excluded blind and many visually impaired users. Accessibility of visual content such as charts can be achieved by providing text equivalents, descriptions, and long descriptions. SAS/GRAPH supports a range of options to achieve accessibility. To demonstrate, let's look at an example chart. In the sections that follow, we discuss in detail how to use each of the techniques that are demonstrated in the graph. When generated and viewed in a browser, you can hover your mouse over the various areas to see the html alt text, or if you have a browser tool that supports screen-reading, you can actually use that to hear the graph as a blind user would.

- To view sample output, see Appendix C: Sample Accessible SAS Graph with D-Link on page 12.
- To view the full code used to produce the sample, see Appendix D: SAS Code Used to Generate Accessible Graph with dLink on page 13.

## CHART TITLES AND FOOTNOTES

By default, when using ODS html and `device=gif`, SAS/GRAPH "draws" titles as part of the graph; these would not be read by screen reading software. Instead, use the ODS `'nogtitle'` option to cause the titles to be brought outside of the graph and coded into the html as an html `'<title>'` that text readers can easily read. (Note: Prior to v9.1, `nogtitle` titles were encoded into the html as html tables rather than html titles). Here is an example of an ODS html statement that uses the `nogtitle` option:

```
ODS HTML path=odsout body="somename.htm" nogtitle;
```

Footnotes work similarly to titles, except you use the ODS `'nogfootnote'` option to control the footnotes.

## GRAPHICAL ELEMENTS

The graphical elements are the pieces that represent the data values: in a bar chart, the bars; in a pie chart, pie slices; in a map, the areas (such as states in the US map); in a scatter or line plot, the markers. Most SAS/GRAPH PROC steps support the `html=` option, so you can encode html alternative text for each of the graphical elements. You can either hard-code the alt text, or dynamically generate it in a data step so that it is generated from (or based on) the data values when you run the SAS code. The following example shows how to combine several variables together to use as the alt text:

```
data work.a; set work.a;
  length myhtmlvar $300;
  myhtmlvar=
  'alt='|| quote(
    ' Age '||trim(left(put(agegroup,agefmt.)))||
    ' = '|| trim(left(put(pct,percent6.0)))||
    ' of '|| trim(left(fipname1(stfips(state))))||' population '||
    ' ')||' ';
run;
```

In addition to providing accessible text, this feature also enables you to add extra information to a chart without cluttering the graphics area with text labels.

## ANNOTATIONS

You can include alt text with the annotation that is overlaid on a chart through the `html=` support for annotated labels, symbols, bars, and polygons. Available since v7.01, support was added in v9 for alt text in annotated images, pies, etc.

The syntax is the same as the syntax of the `html=` variable used in the SAS/GRAPH PROCs, but in the `annotate` data set the variable must be named `html`. The following code snippet shows annotation of a gif image and associated html alt text with that image:

```
data work.logoanno;
  length function style $ 8 html $ 300;
  xsys='3'; ysys='3'; hsys='3'; when='a';
  function='move'; x=65; y=80; output;
  function='image'; style='fit'; x=100; y=95; imgpath='aconly.gif';
  html='alt="American Community Survey logo"
  href="http://www.census.gov/acs/www/index.html"';
  output;
run;
```

## ENTIRE CHART

With images on the web, it is common practice to have an 'alt' description of the entire graph. SAS/GRAPH supports this with the `des=` option. Using this option, you can specify brief descriptive text to describe the entire graph. Starting in v9.1, SAS/GRAPH produces a default description of the charts. The default one uses the names of the variables being plotted; to override this default description, specify `des='{your text}'`, or you can eliminate it by using `des=''`. For example:

```
des="Graph of the Age Distribution of People"
```

## BOOKMARKS

Another useful place for short descriptive text to describe the entire chart is as the bookmark label. You can control this through SAS using the ODS `title=` option. Assistive technologies access this text, and it also provides a textual description for your browser when you bookmark the graph. You can place the ODS (`title=`) option immediately after the `body=`, as shown:

```
ODS HTML path=odsout body="somename.htm"
(title="Bar Chart of Age Distribution of people in NC")
nogtitle;
```

## DESCRIPTIVE LINK

For visual material that merits a longer description, you can include a `dLink`, or descriptive link, in the graph. A `dLink` links to a textual description (longer than the image's `alt=` or bookmark label) of the graph. Typically, the `dLink` is placed in an inconspicuous location to not distract people who do not need it. Sometimes, its text color is the same color as the background, so that only assistive technologies announce it.

To create a `dLink` in SAS, you can implement the link using an annotated text label or a footnote with text `'dLink'` and a link

to the textual description, as shown:

```
footnote2 justify=r
link=http://www.census.gov/acs/www/Products/Profiles/Single/2002/ACS/Narrative/040/NP04000
US37.htm
"dLink" ;
```

## CONCLUSIONS

As developers of code that produces web-based output, we want that data to be useful to and usable by as many of our users as possible. From our research and experience, we have learned that accessible content is generally more usable by all users, not just those with disabilities. SAS supports our efforts by building accessible output methods into ODS and SAS GRAPH into version 9. The PDF output is adequate, but the HTML is highly accessible with minimal effort.

As our society's reliance on the Internet for information has increased, so has the need to deliver that public information in a way usable by all people. While legislation requires that publicly funded web content meet accessibility standards, compassion for the disadvantaged should motivate us to make all web content accessible. As the workforce in America continues to age, the web user with age-induced disabilities that we help may well be the person in the mirror.

## REFERENCES

- "Accessible Technology in Computing—Examining Awareness, Use, and Future Potential". 2003. A Research Report commissioned by Microsoft Corporation and conducted by Forrester Research, Inc. Available: [www.microsoft.com/enable/research/phase2.aspx](http://www.microsoft.com/enable/research/phase2.aspx).
- "Laws and Standards." Web Accessibility In Mind (WebAIM). Available: [www.webaim.org/coordination/law/](http://www.webaim.org/coordination/law/).
- "The Market for Accessible Technology—The Wide Range of Abilities and Its Impact on Computer Use". 2003. A Research Report commissioned by Microsoft Corporation and conducted by Forrester Research, Inc. Available: [www.microsoft.com/enable/research/phase1.aspx](http://www.microsoft.com/enable/research/phase1.aspx).
- Arch, Andrew and Chuck Letourneau, with Worldwide Web Consortium (W3C) Web Accessibility Initiative (WAI) Education and Outreach Working Group (EOWG) members. March 2002. "Auxiliary Benefits of Accessible Web Design." [www.w3.org/WAI/bcase/benefits.html](http://www.w3.org/WAI/bcase/benefits.html).
- Barrington, Linda. November 10, 2004. "Demographic Trends and the Aging Workforce." Presented at "Maximizing Your Workforce: Employees Over 50 in Today's Economy." Wharton Impact Conference hosted by the American Association of Retired Persons' (AARP's) Global Aging Program and the Wharton School's Center for Human Resources, in collaboration with the Boettner Center for Pensions and Retirement Research. Philadelphia, PA Available: [www.aarp.org/international-events/Articles/a2004-09-27-wharton-11-04.html](http://www.aarp.org/international-events/Articles/a2004-09-27-wharton-11-04.html).
- Bessler, LeRoy. "Web Communication Effectiveness: Design and Methods to Get the Best Out of ODS, SAS®, and SAS/GRAPH®." *Proceedings of the 28<sup>th</sup> Annual SAS Users Group International (SUGI 28)*. 2003, SUGI. Available: [www2.sas.com/proceedings/sugi28/130-28.pdf](http://www2.sas.com/proceedings/sugi28/130-28.pdf).
- Coyne, Kara, and Jakob Nielsen. *Web Usability for Senior Citizens: Design Guidelines Based on Usability Studies with People Age 65 and Older*. April 2002. Nielsen Norman Group Report. Available: [www.nngroup.com/reports/accessibility/testing/](http://www.nngroup.com/reports/accessibility/testing/).
- Deloitte Research. "It's 2008: Do You Know Where Your Talent Is? Why Acquisition and Retention Strategies Don't Work." March 4, 2005. Available: [www.deloitte.com/dtt/cda/doc/content/US\\_TalentMgmtPOV\\_2.11.05.pdf](http://www.deloitte.com/dtt/cda/doc/content/US_TalentMgmtPOV_2.11.05.pdf).
- Gilmore, Jodi. "Design Principles for Online Information: Readability, Usability, and Accessibility." *Proceedings of the Western Users of SAS Software 12<sup>th</sup> Annual Conference*. 2003, WUSS.
- Information Technology Industry Council. May 6, 2004. "Voluntary Product Accessibility Template, v1.2". Available: [www.itic.org/reports/508/vpat.html](http://www.itic.org/reports/508/vpat.html).
- International Labor Office – Bureau of Statistics. Economically Active Population Estimates and Projections: 1950-2010. Available: [laborsta.ilo.org/](http://laborsta.ilo.org/).
- Lemon, Jez. *Juicy Studio Contrast Analyzer*. Available: [juicystudio.com/services/colourcontrast.php#contrast](http://juicystudio.com/services/colourcontrast.php#contrast). Juicy Studio: 2002-2005.

Microsoft Press Release. Feb. 2, 2004. "New Research Study Shows 57 Percent of Adult Computer Users Can Benefit From Accessible Technology." Available: [www.microsoft.com/presspass/features/2004/feb04/02-02aging.asp](http://www.microsoft.com/presspass/features/2004/feb04/02-02aging.asp)

SAS Institute. April 2005. *Universal Design: A Commitment to Accessible Software from SAS Institute*. Available: [www.sas.com/govedu/accessibility\\_white\\_paper\\_040505.pdf](http://www.sas.com/govedu/accessibility_white_paper_040505.pdf).

U.S. Bureau of Labor Statistics. February 11, 2004. "Civilian labor force by age, sex, race, and Hispanic origin, 1992, 2002, and projected 2012 numbers in thousands". Available: [www.bls.gov/news.release/ecopro.t06.htm](http://www.bls.gov/news.release/ecopro.t06.htm).

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## APPENDIX A: ANNOTATED BIBLIOGRAPHY

The following list is not exhaustive. We offer these as resources that we have found helpful in our efforts to provide accessible web-based content. For SAS accessibility resources, visit [www.sas.com/accessibility](http://www.sas.com/accessibility).

### ACCESSIBILITY STANDARDS AND GUIDELINES

*Issues for Statistical Agencies: Implementing Section 508 on Agency Web Sites* – A white paper that outlines the issues facing Federal Agencies that present statistical data in trying to conform to Section 508 and provides recommendations by sector to help resolve these problems. [workshops.fedstats.gov](http://workshops.fedstats.gov)

Summary of State Accessibility Compliance – compiled by the Information Technology Technical Assistance and Training Center (ITTATC), funded by the National Institute on Disability and Rehabilitation Research (NIDRR). [www.ittatc.org/laws/state.php](http://www.ittatc.org/laws/state.php)

United States Federal Section 508. [www.section508.gov](http://www.section508.gov)

Worldwide Web Consortium (W3C) Web Accessibility Initiative (WAI) – Provides Web accessibility guidelines cited in many state and international procurement requirements. [www.w3.org/WAI](http://www.w3.org/WAI)

### ACCESSIBILITY DESIGN AND BACKGROUND

*Building Accessible Web Sites* by Joe Clark ([www.joeclark.org](http://www.joeclark.org), ISBN 0-7357-1150-X)

*Constructing Accessible Web Sites* by Jim Thatcher ([jimthatcher.com](http://jimthatcher.com), ISBN 1590591488) – A good reference book and a website with various accessibility-related articles including a comparison of W3C WAI standards and Section 508.

*The Visual Display of Quantitative Information*. Edward Tufte. ([www.tufte.com](http://www.tufte.com), ISBN 0961392142). An excellent book on how to graphically display complex information.

*Web Accessibility for People with Disabilities* by Mike Paciello. CMP Books: Lawrence, Kansas, 2000. (ISBN 10929629-08-7) – Provides a thorough introduction to legal requirements, policies, standards, and guidelines. Covers the lifecycle of web content from design through development, testing, and validation.

WebAIM – A nonprofit WebAIM is a non-profit organization within the Center for Persons with Disabilities at Utah State University, WebAIM is a great resource for learning how to implement accessibility on the web. [www.webaim.org](http://www.webaim.org)

### ASSISTIVE TECHNOLOGIES

#### For Blind Users

*Someone who is blind requires a screen reader to use a computer. A screen reader makes information on the screen available as synthesized speech or a refreshable Braille display.*

Ai Squared ZoomText Magnifier with Screen Reader. The combined magnifier reader is helpful for low vision users who want to switch to a screen reader in extended sessions to avoid eyestrain. [www.aisquared.com/index.cfm](http://www.aisquared.com/index.cfm)

Freedom Scientific's Job Action for Windows, commonly known as JAWS. [www.freedomscientific.com/fs\\_products/software\\_jaws.asp](http://www.freedomscientific.com/fs_products/software_jaws.asp)

IBM's Home Page Reader – Originally limited to browser-based content, HPR version 3.04 adds support for the Microsoft Windows desktop, Flash, and Acrobat documents. Not as expensive as some screen readers, this is a viable option for many personal and small-business users. HPR offers significant low vision customizations, giving it a broader user base. Its paned display, showing the content above and the linearized text below, is helpful for users with learning disabilities. [www-3.ibm.com/able/solution\\_offerings/hpr.html](http://www-3.ibm.com/able/solution_offerings/hpr.html)

#### For People with Vision Impairments

*People with impaired vision use a screen magnifier to zoom portions of the screen, particularly to distinguish data details.*

Ai Squared ZoomText Magnifier. [www.aisquared.com/index.cfm](http://www.aisquared.com/index.cfm)

Freedom Scientific's MAGic. [www.freedomscientific.com/fs\\_products/software\\_magic.asp](http://www.freedomscientific.com/fs_products/software_magic.asp)

### **For People with Dexterity Disabilities**

*When people experience difficulty using a mouse or keyboard, a voice-input system can enable them to operate a computer.*

ScanSoft Dragon Naturally Speaking takes voice input (versus mouse or keyboard input) to control applications and manage the desktop. There is a considerable learning curve, as you train the software to your voice.

[www.scansoft.com/naturallyspeaking/](http://www.scansoft.com/naturallyspeaking/)

### **ONLINE TOOLS FOR ACCESSIBILITY EVALUATION**

CynthiaSays - Interactive web content accessibility check against Section 508 standards and the WCAG guidelines. The online test only validates one page at a time, but a commercial version is available - The HiSoftware Cynthia Says portal is a joint Education and Outreach project of ICDRI, The Internet Society Disability and Special Needs Chapter and HiSoftware Corporation. [www.cynthiasays.com](http://www.cynthiasays.com)

Juicy Studios - Collection of tools including a color contrast analyzer, reading level checker, and a complex table analyzer. Some are Mozilla Firefox extensions; others are online tools. [juicystudio.com/services.php](http://juicystudio.com/services.php)

VIS Desktop – Simulator that manipulates the images on the Windows desktop to show the effects of visual impairments such as colorblindness or macular degeneration among others. [slappy.cs.uiuc.edu/cs492/Group2/vis/index.php](http://slappy.cs.uiuc.edu/cs492/Group2/vis/index.php)

Vischeck - Simulates what an image or web page might look like to a user who is color blind. [www.vischeck.com/vischeck](http://www.vischeck.com/vischeck)

WebXact - Free online service that lets you test single pages of web content for quality, accessibility, and privacy issues - [webxact.watchfire.com](http://webxact.watchfire.com)

### **BROWSER ADD-INS**

Fangs Screen Reader Emulator – A Mozilla Firefox extension that creates a textual representation of a web page similar to how the page would be read by a modern screen reader. This is a simple way to roughly simulate a screen reader without having to learn to operate one. [www.standards-schmandards.com/index.php?show/fangs](http://www.standards-schmandards.com/index.php?show/fangs)

Web Accessibility Toolbar – A free toolbar from the Accessible Information Solutions Team at the National Information and Library Service, Australia for Microsoft Internet Explorer. You examine a page in your web browser for a variety of accessibility and quality issues. [www.nils.org.au/ais/web/resources/toolbar](http://www.nils.org.au/ais/web/resources/toolbar)

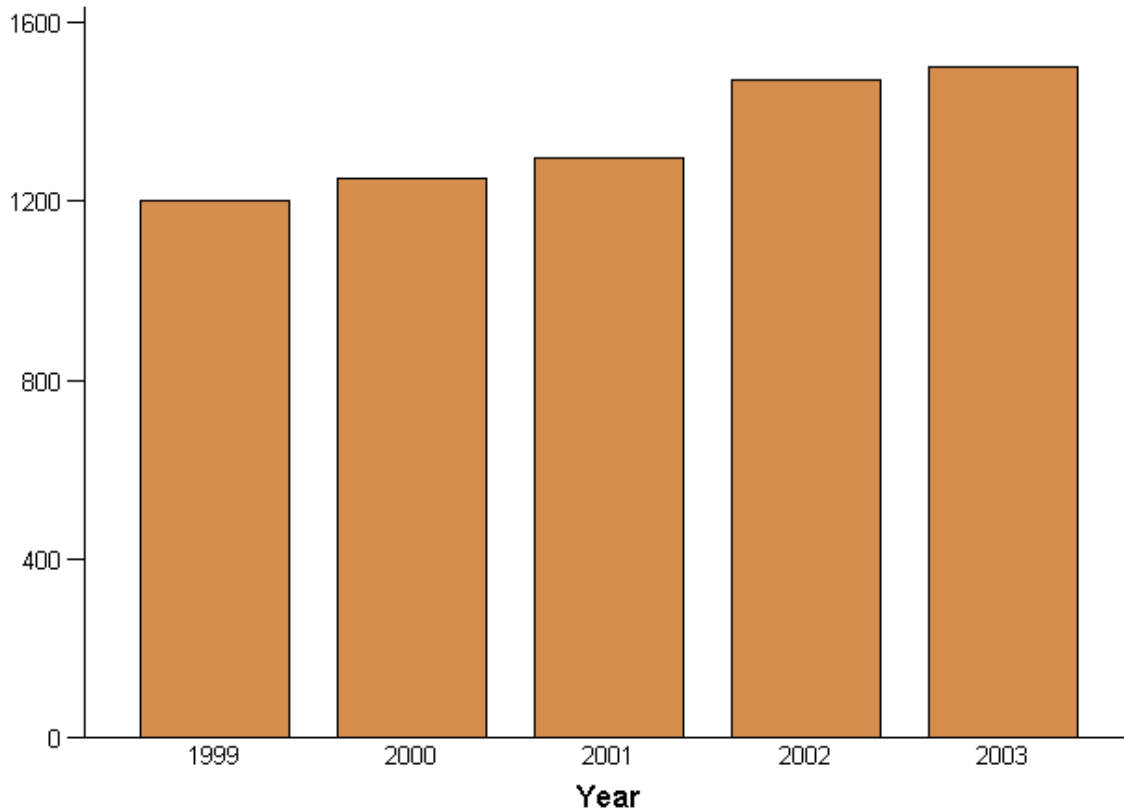
Web Developer toolbar – A Mozilla Firefox extension that adds a menu and toolbar with useful web developer tools for reviewing the accessibility of a site. [chrispederick.com/work/firefox/webdeveloper](http://chrispederick.com/work/firefox/webdeveloper)

**APPENDIX B: SAMPLE ACCESSIBLE SAS GRAPH**

Figure 4. SAS Graph produced with GOPTION ACCESSIBLE, with accessible table view expanded

**Number of Fatal Falls by Year**  
**California Residents, 1999 - 2003**  
*actxing Device Driver, EGDefault style, ACCESSIBLE GOPTION is active*

**Number of Fatal Falls**



This graph is a vertical bar chart of 'Year', with a frequency value.

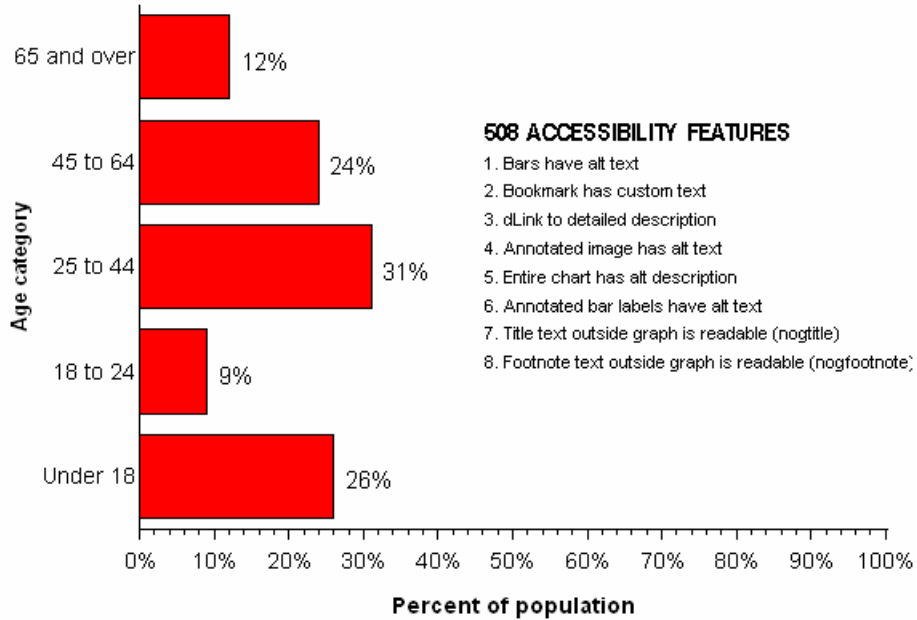
The following table contains the data from the graph:

Year	frequency value
1999	1201
2000	1251
2001	1299
2002	1472
2003	1501

**APPENDIX C: SAMPLE ACCESSIBLE SAS GRAPH WITH D-LINK**

Sample provided by Robert Allison of SAS.

The Age Distribution of People in North Carolina in 2002



Source: American Community Survey, 2002

[dLink](#)

Here are the values in tabular form

State	Age category	Percent of population
NC	65 and over	12%
NC	45 to 64	24%
NC	25 to 44	31%
NC	18 to 24	9%
NC	Under 18	26%

## APPENDIX D: SAS CODE USED TO GENERATE ACCESSIBLE GRAPH WITH DLINK

Sample code provided by Robert Allison of SAS.

```
%let name=blind;

filename odsout '.';

/* Imitating a population bar chart from the US Census website:
http://www.census.gov/acs/www/Products/Profiles/Single/2002/ACS/Narrative/040/NP04000US37.htm
Adding 508/accessible text, to show how to add such text programmatically
using sas. Note that this example adds *many* pieces of text (some redundant);
use only the ones beneficial in your situation.
*/

/* Using a user-defined format, to assign numeric values to the age groups
...and have the bars sorted/ordered by that numeric value rather than alphabetically
*/

proc format;
  value agefmt
    0='65 and over'
    1='45 to 64'
    2='25 to 44'
    3='18 to 24'
    4='Under 18'
  ;
run;

/* Read in the data */
data work.a;
format pct percent6.0;
format agegroup agefmt.;
label agegroup='Age category';
label pct='Percent of population';
input state $ 1-2 agegroup pct;
cards;
NC 0 .12
NC 1 .24
NC 2 .31
NC 3 .09
NC 4 .26
;
run;

/* ***** 1. - Bars have alt text *****
Creating a variable that contains an 'alt' tag to use with the
...html= option of proc gchart. When the person viewing the
graph mouses over the bars, they will see this alt text; a screen reader
reads the alt text aloud.
*/

data work.a; set work.a;
length myhtmlvar $300;
myhtmlvar=
'title='|| quote(
  ' Age '||trim(left(put(agegroup,agefmt.)))||
  ' = '|| trim(left(put(pct,percent6.0)))||
  ' of '|| trim(left(fipnamel(stfips(state))))||' population '||
  ' '||' ';
run;

/* ***** 6. Annotated bar labels have alt text. *****
Create an annotate data set, to annotate the % number labels at
the end of each bar. Adding simple alt text to each one, containing
...just the % number -- you could add more text or a href drilldown if desired
. In annotate, the variable containing the alt & href *must* be called 'html'.
*/
```

```

data labelanno; set work.a;
length html $300;
html='title=||quote( trim(left(put(pct,percent6.0))) );
when='a'; function='label'; position='6';
xsys = '2'; ysys = '2'; size=1.4;
x=pct+.015; midpoint=agegroup; text =trim(left(put(pct,percent6.0))); color = 'black';
output;
run;

/* ***** 4. Annotated image with alt text *****
html variable on an annotated image. This allows you to have alt text
and href drilldowns. Remember, in the annotate data set the variable
*must* be called 'html'.
*/

/* Annotate the ACS logo, and add some alt text and a drilldown to the ACS home page */

data work.logoanno;
length function style $ 8 html $ 300;
xsys='3'; ysys='3'; hsys='3'; when='a';
/* identify 2 diagonal corners, and image will go between them */
function='move'; x=65; y=80; output;
function='image'; style='fit'; x=100; y=95; imgpath='acsonly.gif';
html='title="American Community Survey logo"
href="http://www.census.gov/acs/www/index.html"';
output;
run;

GOPTIONS DEVICE=gif;
/* ***** 2. Bookmark has custom text done in the "ods html" statement.
The (title= ) immediately follows the body=. Text displays in title bar
...of the browser window and is the title when you bookmark the
page. This text is readable by screen readers.
*/

ODS LISTING CLOSE;
ODS HTML path=odsout body="&name..htm"
(title="Bar Chart of Age Distribution of people in NC")
style=minimal
/* ***** 7. Title text outside graph is readable *****
By using the 'nogtitle' ODS option, the title is scripted in the html,
so the screen readers can read the title.
*/
nogtitle
/* ***** 8. Footnote text outside graph is readable *****
Similar to 'nogtitle', use 'nogfootnote' for the footnote.
*/
nogfootnote
;

goptions border;
goptions hsize=6in vsize=5in;
goptions ftext="arial" htext=3pct;
title c=black h=.2in "The Age Distribution of People in North Carolina in 2002";
footnote c=black h=.2in "Source: American Community Survey, 2002";
/* ***** 3. dLink to detailed description *****
A 'dLink' on the page provides a link to a textual
description of the graphical output. The dLink target page
...can be output programmatically produced with a proc print,
proc tabulate, proc summary, etc ... or it could simply
be a text page written by a human (such as that case here.
Optionally, you could put a link= in the title at the top of the page.)
*/
footnote2 justify=r
link="http://www.census.gov/acs/www/Products/Profiles/Single/2002/ACS/Narrative/040/NP04000US
37.htm" "dLink";
pattern1 v=s c=red;

```

```

/* force axis to show 0-100% */
axis1 order=(0 to 1 by .1) label=(font="arial/bold");
axis2 label=(font="arial/bold" a=90);
proc gchart data=work.a anno=work.logoanno;
note move=(106,33.0) font=swissb height=2.6pct color=black
"508 ACCESSIBILITY FEATURES";
note move=(106,31.5) font="arial" height=2.6pct color=black
'1. Bars have alt text';
note move=(106,30.0) font="arial" height=2.6pct color=black
'2. Bookmark has custom text';
note move=(106,28.5) font="arial" height=2.6pct color=black
'3. dLink to detailed description';
note move=(106,27.0) font="arial" height=2.6pct color=black
'4. Annotated image has alt text';
note move=(106,25.5) font="arial" height=2.6pct color=black
'5. Entire chart has alt description';
note move=(106,24.0) font="arial" height=2.6pct color=black
'6. Annotated bar labels have alt text';
note move=(106,22.5) font="arial" height=2.6pct color=black
'7. Title text outside graph is readable (nogtitle)';
note move=(106,21.0) font="arial" height=2.6pct color=black
'8. Footnote text outside graph is readable (nogfootnote)';
hbar agegroup /
sumvar=pct
/*
sum
sumlabel=none
*/
/* Instead of using the automatic bar labels, I'm annotating labels.
to place them exactly and give them title= text
*/
nostats anno=labelanno
noframe
discrete
raxis=axis1
maxis=axis2
outline=black
html=myhtmlvar
/* ***** 5. Entire chart has alt description *****
The default alt description for the whole chart is very generic,
and doesn't really tell you what the chart is about. Override the
default and specifying custom text in the short des= field.
*/
des="Graph of the Age Distribution of People"
name="&name";
run;

title c=black h=.2in "Here are the values in tabular form";
footnote;

proc print data=work.a noobs label;
var state agegroup pct;
run;
quit;

ODS HTML CLOSE;
ODS LISTING;

```