OPEN PROCESS INTEGRATION DATA FORMATS & DIGITAL WORKFLOW ISSUES

by Patrice M. Dunn, President, DTI

Anyone who has recently attended the industry's trade shows knows that, where digital technology is concerned, we as an industry have a lot of stuff. We have computers -- some call these platforms. Computer speed today is often measured in things called MIPS -- Million Instructions Per Second -- which is a benchmark for how many instructions a computer can process in one second. Computers also have Random Access Memory (RAM) and Read Only Memory (ROM). We have Local Area Networks (LANs), Wide Area Networks (WANs), T-1 satellite links, Raster Image Processors (RIPs), Desktop Publishing (DTP) systems, Reduced Instruction Set Computer (RISC) chips, Very Large Scale Integrated (VLSI) chips, color hardcopy (CHC) devices, Direct Digital Color Proofing (DDCP) devices, Charged Couple Device (CCD) scanners, PhotoMultiplier Tube (PMT) scanners, Computer to Plate (CTP) devices, Computer to Cylinder (CTC) engravers, and Digital Presses.

This is certainly a far cry from where we were twenty or so years ago when, if one were to attend a Print, or a DRUPA, or an NAA (nee., ANPA) show, then one might perhaps see three laser-exposure computer-to-plate (CTP) devices -- yes, they existed back then -- and only a handful of primarily text-based, vector data, black-and-white, workstations.

Yes, things have changed. Yes, we as an industry, certainly have a lot of stuff.

Today we hear an awful lot about the computer revolution in the graphic arts. I'm rather fond of something that Dr. Leo Beiser -- a gentleman often credited with being the father of laser scanning -- once said: "If you watch it, then it's evolution, and if you don't watch it, then it's revolution." [1]

[1] Beiser, Leo, *A Scanner with No Beam Wobble for Quality Color Separation*, Lasers in Graphics/Electronic Design in Print conference proceedings, 1990, Vol. II, pp. 239.

As such, I am not really in a position to agree with those who proclaim that we, as an industry, are engaged in a revolution. Rather the process that we seem to be engaged in --which is the industrial transformation of our workflows and process flows from conventional means to electronic, and more specifically digital, means -- is really more subtle and complex than mere revolution. No, we as an industry are engaged in an evolution; an evolution that will ultimately result in graphic arts workflows and process flows that are 100% electronic. The only question is the kind of shape we, as an industry, will be in as we struggle through this monumental transition. Nonetheless I believe that this transition is as inevitable as evolution itself. Or, to quote Jim Mikol, Director of Creative Services, Kraft Foods: "Digital advertising -- or more generally, digital printing -- is not only very real, it is where the entire print industry, of which advertising is only a small part, is headed." Kraft Foods is, of course, one of the world's larger users of various printing services.

The problem, of course, is that when one is engaged in the thick of evolution it can seem to be somewhat random, aimless, pointless, and otherwise unpleasant. Rather a bit of a mess. But if we step back for a moment we can, together, perhaps ascertain that there really has been some logical method to the apparent madness.

At the risk of over simplifying I would like to quickly review the 20 or so years of evolutionary progress that has been made in the graphic arts industry towards the goal of 100%, total digital, workflows and process flows.

I have split this quick review into four periods for the sake of convenience and as something of an assistance in seeing the forest from the trees. This, despite the fact that evolution rarely accommodates itself to this sort of delineation.

Evolutionary Trends -- The 1970's

Let me start with a basic premise: If one is to successfully integrate a total digital process then one must have all of the relevant points in that process equipped with some form of digital technology.

We, as an industry, did not yet have that in the 1970's.

Some printing environments, predominately newspapers, were using the early computer-to-plate systems; or platesetters, as we call them today. These platesetters had RIPs front ending them. These were the first RIPs to be used in the graphic arts industry.

These systems were designed to output in black-and-white because newspapers had not yet ventured into color. Thus the CTP plate technology was also geared towards black-and-white reproduction requirements.

Within newspaper environments, of course, the concept creation -- with the exception of the display advertising -- prepress production, and printing, is all vertically integrated within one company. Some of these companies even own their own typefaces. It was this industrial structure attribute that assisted with the relatively early adoption of digital technology within the newspaper market.

A similar comment can be made for check printing and the business forms printing business, or niche markets, as they are sometimes called.

Unlike newspapers, however, the business forms and check printing markets have been successful in going 100% digital. Some of these companies have had 100% digital workflows and process flows for well over a decade.

Why? Let's review some of the basic technical requirements and industrial structure issues: The work performed by these organizations is principally black-and-white with some spot color; it features a comparatively limited number of typefaces used in the production process, and for the most part, one finds a vertically integrated business environment (i.e., all, or most, of the process functions are completed within one company).

Newspapers were poised on the edge of going 100% computer-to-plate -- at least on the editorial and classified advertising side of things -- during the early 1980's. Even with this, however, there remained the issue of how to efficiently integrate the advertising into the digital process flow. Nonetheless the basic technology was in place to accommodate a substantive portion of the process.

Then newspapers went into color in a big way -- and it was back to the drawing board for the computer-to-plate, and plate materials, vendors.

The prepress segment of the graphic arts industry was bifurcated into two functional, and typically also business, groupings: The color trade shop which, in the 1970's had photomultiplier (PMT), or drum, scanner technology -- available from companies such as Hell (before it was Linotype-Hell), Crosfield (before it was Fuji Photo Film/Crosfield), and Dainippon Screen, (a.k.a., DS and/or Screen depending on which division you are dealing with in which part of the world). The type tradeshop, of course, had typesetters upon which sat whatever type library was available from the typesetter vendor (e.g., Monotype, Linotype, and/or Compugraphics -- which today is Agfa -- were the major players in the western language milieu. ShaKen dominated the Japanese type market and, to a lesser extent, still does today).

The concept creation segment of the industry -- i.e., advertising agencies, design firms, etc. -- had yet to enter the "digital" game in any substantial manner. That made sense at the time, as there wasn't much stuff available for them.

Evolutionary Trends -- 1980 to 1985

A substantive portion of the "digital action" was focused in the prepress segment of the market during the early 1980's -- particularly in regards to the digital automation of color prepress work -- or in the area of the image processing of raster color picture data. The first color electronic prepress system (CEPS) -- the Scitex Response system -- was introduced at the GEC international graphic arts show in Milan, Italy, in 1979.

An interesting sub-point here: In 1979 the color scanners were all of an integrated function (e.g., input and output tied together on the same scanner) design. There weren't yet any "split-apart scanners" -- that which today we think of as a color scanner, which provides the input function, and a film recorder, which provides the output function where film is used. It is this which perhaps explains the unique line interleaved attribute of the Scitex native language

Both "split apart scanners", and other CEPS, were introduced to, and adopted by, the graphic arts market throughout the 1980's and into the early 1990's.

Pagination systems -- principally black-and-white -- were also introduced and met with market acceptance.

The early CEPS, typesetters, and pagination systems, were based on the mini-computer which, we must remember, was the standard platform of the time.

There were some early forays into basing production systems on the micro-computer during this period -- but these were principally for the vector data, black-and-white, functions in the process. It also took several years to refine the technology to the point where the results were of a quality level acceptable to the graphic arts industry. This, in addition to the necessary negotiations with the major type vendors to unbundle their font libraries from their own typesetters and allow them to be imported to that which was later to be termed desktop publishing systems.

Evolutionary Trends -- 1985 to 1990

Desktop Publishing (DTP) -- or micro-computer based systems -- took off in the concept creation segment of the graphic arts industry during the period of 1985 through the early 1990's. Thus another segment of the graphic arts industry

started to go "digital." It also substantially displaced both the typesetter and pagination system installed base. As this occurred the bottom basically dropped out of the black-and-white photopaper market as plain paper laser printer output began to be increasingly used in the process.

Initially these systems handled black-and-white vector data functions such as page layout, typesetting, and vector graphic illustrations. The ability to handle raster data, principally in the form of low resolution monotone picture data, was added. Then came spot color. Then came low resolution color picture data.

Workflows evolved in which fully composed pages were being RIPped directly to imagesetters -- with film output being sent to press. Workflows also evolved whereby data from the DTP systems were fed into the CEPS -- though owing to the proprietary nature of both the DTP applications software and the native CEPS languages, this has been a somewhat cumbersome, painful, and expensive, process.

The minicomputer-based typesetters still in use through this period, have now been pretty well decommissioned. The same can be said for the mini-based pagination systems -- except, of course, for a couple of niche markets.

CCD scanners began to compete with the PMT scanners for market share in the 4-color prepress production segment of the market. Lower cost, and often less color sensitive, CCD scanners also began to proliferate within the concept creation segment of the industry.

The minicomputer-based CEPS were still dominant in the area of image processing for raster color picture data -- owing to the data intensive nature of this part of the process.

Evolutionary Trends -- 1990 to 1995

The good news is that, by 1995, just about everyone involved with the graphic arts process had digital stuff. The bad news, from a workflow and process flow perspective, is that just about everyone involved with the graphic arts process had digital stuff.

Color "digital presses" -- high-speed, principally electrophotographic-based, output devices hit the market with promises of "near graphic arts quality." Meanwhile, conventional presses develop into digital/conventional hybrids. Terms like "On-Demand Printing", and "Short-Run Color Printing" begin to be heard.

The minicomputer based CEPS give way to a more open systems approach based on a multiplicity of special function workstations, input devices, and output devices, integrated together on something of a "super-server."

True Direct Digital Color Proofing (DDCP) devices hit the market. These are devices possessive of a reasonably high degree of stability, color calibration, and color characterization precision, to serve as useful color control tools -- which, of course, is the basic function of color proofing.

Platesetters and plate materials, at various run-lengths, capable of handling color, match up and are presented to the market.

Computers, and computer components such as memory, get "smaller, faster, cheaper". Always, "smaller, faster, cheaper". This is nothing new -- it has been going on since the inception of the computer industry *(figure 1)*.

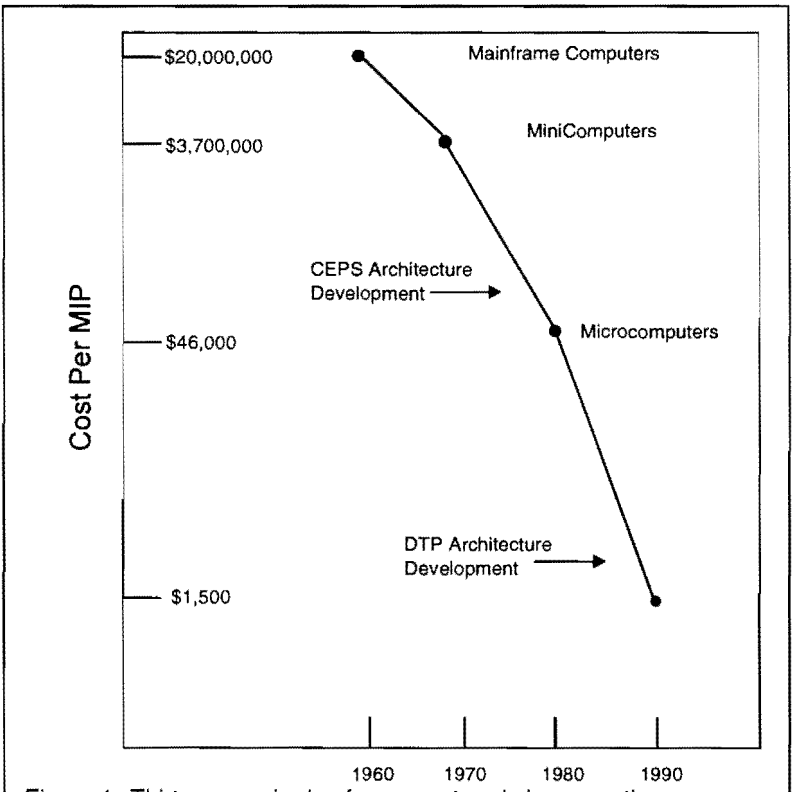

Figure 1: Thirty year price/performance trends in computing power as measured in million instructions per second (MIPS).

Data is flying all over the place. The problem is that it all too often seems to have UFO status -- leading to an undue number of files that have trouble landing and, as a result, crash and burn.

This is rough on business.

Terms like pre-flighting, digital workflows, workflows, data management, and process flows come in vogue.

Digital transport mechanisms -- everything from floppies to Magneto-Optical Disks (MODs), and "on-line" transports ranging from 56 kilo-bits per second (56kb/sec) phone lines up through T-1 satellite links begin to get laid down in earnest.

Everybody now seems to have digital stuff. Everyone is "automated". But the process of flowing and controlling volumes of data through the industrial structure -- from concept creation through to the printing press -- is a bit of a mess.

From Automation to Integration

Let's go back to my initial premise which was: "If one is to successfully integrate a total digital process then one must have all of the relevant points in that process equipped with some form of digital technology."

It would appear that during the past 20 years we, as an industry, have succeeded in getting most, if not all, of the relevant points in the process equipped with some form of digital technology. It just seems that perhaps along the way the function, if not the concept, of process integration kind of dropped into a black-hole.

Process integration -- what is process integration? It is the mechanism by which one integrates, into a whole, an entire process -- such as flowing and controlling volumes of data from concept creation through to the printing press or some alternative form of ultimate output.

How does one do digital process integration in an industry such as the graphic arts?

Another premise: Computers can only emulate known, defined, processes. If a process is not well known, or well defined, then one can throw all the automation technology in the world at it and all that will result is a fast mess.

How does one do digital process integration in an industry such as the graphic arts? Well, how did we, as an industry, integrate our process prior to moving 100% digital?

Did you notice that little word "film" on all of those evolutionary process flow models?

Film as a Standard

> "Film has long served as a standard exchange format within the graphic arts industry. It is easily transportable, it allows for multi- company production to be undertaken on one job; archiving and storage of film are now mature procedures; continuous tone (CT) or halftone (HT) formats are readily available; it's changeable, and it's physical. In order to be ultimately successful, digital standards for the graphic arts industry must emulate the attributes of film."[2]

With this understanding, the DDAP (Digital Distribution of Advertising for Publications) Association set out to define the process -- some might say the industrial structure -- that required integrative emulation.[3]

The basic process flow model, matched to digital transport mechanism bandwidth requirements, is outlined in the *DDAP Advertising and Publishing Digital Highway - Basic Process Flows & Bandwidth Requirements* map.

The DDAP Association also began to work closely with the accredited standards development committees on both a national and international basis.

As a result, substantive progress has been made toward the goal of achieving open process integration and, as a subset, sensible, productive, workflows and process flows are being achieved.

---

[2] Wagner, Patrice M. & S. Thomas Dunn, *The Issue of Standards for Electronic Prepress*, The Technical Association of the Graphic Arts (TAGA), 1985 TAGA Conference.

[3] *The DDAP User Requirement Specification, Ver. 3.2.*, The Digital Distribution of Advertising for Publications (DDAP) – A practical guide to the core concepts, user requirements, and basic tools of open process integration, The DDAP Association, 1995, pp. 39-51.

Easily Transportable Data Formats

The first of the "film emulation" attributes needed to move "all digital" is having and using data formats that are easily transportable across the multiplicity of systems and devices used throughout the graphic arts process.

This is being achieved today via the accredited *International Standards Organization (ISO) 12639 TIFF/IT-P1* graphic arts data interchange standard. [4]

For more details on this standard I refer those of you who like bits, bytes, numbers, and computer code, to the ISO 12639 document available from the International Standards Organization. For those of you who prefer a somewhat less technical approach I refer you to the article contained in the DDAP Association's TIFF/IT-P1 Starter Kit, entitled: *The TIFF/IT-P1 Standard for Phase I DDAP.*[5]

Figures 2a, 2b, and 2c, show the status of TIFF/IT-P1 implementations as of April, 1997.

For workflows that tend to be exclusively DTP based, Adobe's PostScript page description language (PDL) is, of course, often used. However, for large volume production operations -- particularly those that run on fairly precise deadlines -- there is some concern regarding the relative unpredictability of the RIPping times that occur right in front of the platesetter, gravure engraver, and/or digital press.[6]

That is just one of the reasons why international graphic arts organizations such as the DDAP Association, SICOGIF, TAGA Italia, and others, have endorsed the use of the ISO 12639 TIFF/IT-P1 standard for data interchange.

Though of course it should be evident that some form of reasonable interoperability needs to exist between the DTP and CEPS environments. This is critical to achieving the goal of open process integration.

---

[4] *ISO 12639, Graphic technology -- Prepress digital data exchange -- Tag image file format for image technology (TIFF/IT),* September, 26, 1996.

[5] Dunn, Patrice M., *The TIFF/IT-P1 Standard for Phase I DDAP*, TIFF/IT-P1 Starter Kit, Published by the DDAP Association, 1996, pp. 1 - 5.

[6] Hedgecock, Peter, *Where Are We Going?*, The DDAP Reporter, Winter 1997 edition, pp. 12 - 13.

TIFF/IT-P1 Products
April, 1997

Company	Product Name/Type	Approximate Pricing*
4-Sight	ISDN based network	
Ad Graphics Group Europe (Rorke Data)		
Adobe Systems	Encapsulated within PDF (ANSI CGATS Version)	
Agfa (Xeikon)	Chromapress digital press	
Archetype, Inc.	MediaBank database management system	$5,000 - $200,000 depending on configuration
ArtQuest	1. Crescendo Server/RIP 2. TIFF Box Module	
Barco Graphics	1. TIFF-IT CT Input i/f 2. TIFF-IT LW Input 3. TIFF-IT CT Output 4. TIFF-IT LW Output	
Contex Prepress Systems	1. Professional 2. RIP 'n' Strip 3. Eclipse 4. Contex File Exchange	
CORAY	Newscaster	
Cortron Corp.	Cortron Image RIP	
CREO	1. Platemaster front end 2. CEPSLink (Software)	$100 K* $18,000

Figure 2a: ISO CD 12639 (TIFF/IT-P1) Standard Product Implementations and Their Status

Source: The DDAP Association, based on information supplied by the vendor.

TIFF/IT-P1 Products
April, 1997

Company	Product Name/Type	Approximate Pricing*
DDAP Association	1. TIFF/IT-P1 Photoshop Plug in 2. TIFF/IT-P1 PreFlight 3. TIFF/IT-P1 Verify	Free $98 $3,000
Dalim		
DynaLab/Rampage	DynaRIP	
Eastman Kodak Co.	1. Approval Classic w/ Shira Option 2. Approval PS w/CEPS-to-PS 3. DCP9000 (Desktop Proofer) 4. Photo CD (CT Only)	
Essential Technical Services, Inc.	1. Native File Exchanger 2. NATEX Photoshop Plug-in 3. PS-RIP	$5,000 $1,500 $2,500 to $12,000
Fuji Photo Film Co.	Celix 4000 Crosfield RIP Celix 8000 Crosfield RIP Celix 8000 CTP Crosfield RIP	
Harlequin	ScriptWorks RIP	
Heidelberg	QuickMaster DI	
Imation Enterprises, Inc.	1. Rainbow 2715 2. Rainbow 2720 3. Rainbow 2730 4. Rainbow 4700	$ 9,995 $18,500 $18.500 $79,995
Komori	Lithrone automated press	
Konica	Performik	

Figure 2b: ISO CD 12639 (TIFF/IT-P1) Standard Product Implementations and Their Status

Source: The DDAP Association, based on information supplied by the vendor.

TIFF/IT-P1 Products
April, 1997

Company	Product Name	Approximate Pricing*
Linotype-Hell	1. DaVinci Power 4.5 2. DaVinci Sprint 4.5 3. LinoServer SciPath 1.50 4. LinoServer CtP Path 1.10 5. LinoServer TIFF/IT Print	
Monet, Inc.	Telecomm & Image Management (TIM) System	
NetCo Communication Co.	WAM!NET Digital Delivery System	
Optronics	Aurora Platesetter	
Sakata Inx	1. Trapeze 2. Flight Simulator	$34,000 $ 1,400
Scitex	1. SciNet Span Pro - NUBUS 2. SciNet Span Pro - PCI	$4,000 $4,000
Screen	1. Tiger V. 3.0 software 2. TaigaSpace system	
Shira Computers	1. Image Server 2. Gravure Server 3. Offset Server 4. TIFF/IT Stream 5. Print Server	
SpringTek, Ltd.	Spring Board	
Total Integration	Ad Check	$ 995

Figure 2c: ISO CD 12639 (TIFF/IT-P1) Standard Product Implementations and Their Status

Source: The DDAP Association, based on information supplied by the vendor.

Regrettably, there seems to be a developing perception in the market that, per usual, the CEPS and the desktop worlds are going off in different directions. But such is not the case.

Adobe Systems, Incorporated has been an active member within the American National Standards Institute Committee for Graphic Arts Technologies Standards Subcommittee 6 (ANSI CGATS/SC6), which was initially founded to respond to the *DDAP Association's User Requirement Specifications* for open process integration.

CGATS/SC6 is in the process of developing a "use" standard based on a modified *Portable Document Format (PDF)* from Adobe Systems, Incorporated.

Key attributes of this "Professional PDF" are:[7]

- ❑ Fonts included in the PDF to assure rendering with the exact same font and font metrics.

- ❑ Raster data accommodated by incorporating or calling external files, including the ISO 12639 TIFF/IT-P1 standard.

- ❑ Data to be exchanged will include single colors or CMYK process colors with colorimetric characterization data to assure correct color renderings.

It should be noted that the technical discussions to provide for this form of interoperability between the different systems (i.e., DTP, which is principally a vector data or computer graphic environment, and CEPS which is principally a raster data or image processing environment) are currently in process within the ANSI CGATS/SC6 committee. The fruits of these discussions have yet to be embodied in products brought to market.

---

[7] Dunn, Patrice M., *PDF & TIFF/IT-P1 - Towards an Integrated Relationship*, TIFF/IT-P1 Starter Kit, published by the DDAP Association, 1996, pp. 27 - 31.

References

Adobe Systems, Inc., *Portable Document Format (PDF) Reference Manual, Ver. 1.2*, November 27, 1996.

American National Standards Institute (ANSI), *ANSI IT8.7/1, Graphic technology - Color transmission target for input scanner calibration*, 1993.

Ibid., ANSI IT8.7/2, *Graphic technology - Color reflection target for input scanner calibration*, 1993.

Ibid., *ANSI IT8.7/3, Graphic technology - Input data for characterization of 4-color process printing*, 1993.

Ibid., *ANSI CGATS.4, Graphic technology - Graphic arts reflection densitometry measurements - Terminology, equations, image elements and procedures*, 1993.

Ibid., *CGATS.5, Graphic technology - Spectral measurement and colorimetric computation for graphic arts images*, 1993.

American Society for Testing and Materials (ASTM), *ASTM Standards on Color and Appearance Measurement*, PCN: 03-512083-14, First Edition, 1984.

The Digital Distribution of Advertising for Publications (DDAP) Association, *TIFF/IT-P1 Starter Kit*, 1996.

Ibid., *Typeface Issues in Electronic Intermedia Publishing (EIP) -- Particularly as these effect the Digital Distribution of Advertising for Publications (DDAP)*, 1996.

Ibid., *DDAP -- A practical guide to the core concepts, user requirements, and basic tools of open process integration*, 1995.

Ibid., *Advertising and Publishing Digital Highway -- Basic Process Flow & Bandwidth Requirements*, 1995.

Ibid., *A Discussion Forum for the Applications and Workflows of ISO 12639 TIFF/IT-P1 and Phase I DDAP*, 1995.

Ibid., *Color Picture Data Compression Testing*, 1992.

Ibid., *Direct Digital Color Proofing (DDCP) Repeatability Testing*, 1992.

Ibid., *The DDAP User Requirement Specification, Ver. 1.0*, 1992.

Dunn, S. Thomas, David McDowell, et. al., *Industry Roundtable on Color Calibration, Communication, and Control*, The Lasers in Graphics/Electronic Design in Print conference proceedings, Vol. I, 1989, pp. 277 - 307.

Dunn, Dr. S. Thomas & Patrice M. Dunn, *Telecommunications Technology for the Graphic Arts*, The Lasers in Graphics/Electronic Design in Print conference preceedings, 1991, pp. 85 - 89.

Dunn Technology, Inc. (DTI)., *Characterizing and Calibrating Color Scanners with ANSI IT8.7/1 Targets*, 1992.

Ibid., *Independent Data Compression Tests, Methodology, and Results*, 1991.

Ibid., *Digital Press and EIP Issues for Short-Run, High Quality, Color Printing*, 1991.

Ibid., *Digital Data Exchange Standards (DDES) for the Graphic Arts Industry*, 1989.

Ibid., Process Flow & Control Issues, Telecommunications, and Data Compression Techniques for Digital Color Newsphoto Wire Services, 1987.

Ibid., Workflow & Process Integration Issues and Technologies Needed to Enable Color Computer-to-Plate and Computer-to-Gravure Cylinder, 1986.

The Graphic Arts Technical Foundation (GATF), *The Lithographers Manual*, eighth edition, 1988.

International Standards Organization (ISO), *ISO 12639, Graphic Technology -- Prepress digital data exchange -- Tag image file format for image technology (TIFF/IT)*, September 26, 1996.

Luckiesh, M., *Color and its Applications*, D. Van Nostrand Co., 1915.

Rao, Narahari, Curtis J. Hujphreys, and D.H. Rank, *Wavelength Standards in the Infrared*, Academic Press, 1966.

Raven, Francis H., *Automatic Control Engineering*, McGraw-Hill Book Co., Inc., 1961.

Ross, Monte, *Laser Applications*, Vol. II, Academic Press, A subsidiary of Harcourt Brace Jovanovich, Publishers, 1974.

Sorum, C.H., *Introduction to Semimicro Qualitative Analysis*, Prentice-hall, Inc., Second Edition, 1953.

SWOP, Inc., *Specifications for Web Offset Publications* (SWOP), 1993 edition.

Van Wylen, Gordon J., *Thermodynamics*, John Wiley & Sons, Inc., 1963.

Warner, Frank M., and Matther McNeary, *Applied Descriptive Geometry*, McGraw-Hill Book Co., Inc., 1959.