

**UNITED STATES DISTRICT COURT
DISTRICT OF _____**

IN RE: MDL LITIGATION

**Case No. 1:23-md-04567 (ABC)(DEF)
MDL NO. 0001**

THIS DOCUMENT RELATES TO: ALL CASES

DECLARATION OF CRAIG BALL

CRAIG BALL, hereby declares under penalty of perjury as follows:

1. I, Craig Ball, am over the age of eighteen years and competent and qualified to make this declaration. I have been retained as a consultant for Defendants in this action. I am fully familiar with the facts contained herein based upon my personal knowledge.
2. I am an attorney in good standing, licensed in the State of Texas and hold multiple professional certifications in computer forensics, data recovery and electronic discovery. I've published extensively on these disciplines with my work cited as authoritative by courts throughout the nation. I serve as a consultant and a court-appointed special master in computer forensics and e-discovery, and have previously been designated as an expert witness in my fields on numerous occasions and appointed by courts to serve as a neutral master in electronically stored evidence in forty-plus cases. I've lectured on electronic evidence all over the world, producing more than two thousand published paper and presentations. I own and operate the Law Offices of Craig D. Ball, P.C. based in Austin, Texas. I also serve on the law faculties of the University of Texas in Austin, Texas and Tulane University in New Orleans, Louisiana, where I teach law school courses on electronic evidence and digital discovery. I am an academic, but my opinions are informed by almost forty years in my disciplines, thirty years as first-chair trial counsel and over twenty years of service as a neutral Special Master in Electronically Stored Evidence. I limit my practice to matters involving digital evidence and discovery.
3. I supply a true and correct copy of my C.V. as Exhibit A to this Declaration.
4. I provide this Declaration in support of Defendants' previously submitted proposed version of the Parties' ESI Order and to rebut comments made in the Declaration of Jane Doe Submitted in Support of Plaintiff's Proposed ESI Protocol, February 30, 2020, ("Doe Declaration").

Times Have Changed, but Plaintiff's Proposed ESI Protocol is Mired in the Past

5. In pre-digital times, discovery was conducted using hard copy paper documents, and the cost and burden of marshaling paper was more-or-less the same for all sides. Deliberately making productions more difficult to

use—by, *e.g.*, removing and shuffling pages, separating attachments from transmittals or producing illegible copies—was understood to be dirty pool.

6. I practiced trial law in both the paper and digital era, and I've spent the last four decades researching, using, writing about and teaching electronic evidence and e-discovery.
7. In a world of paper evidence, converting electronic information to static TIFF images made sense. In today's world of electronically stored information, it makes no sense to convert electronic formats to TIFF images considering the information that's lost and the severe burden and added expense so-called TIFF+ productions impose on requesting parties.
8. TIFF+ productions like those advocated by Plaintiff are an antiquated, expensive legacy of a pre-digital era dominated by paper records. Black and white TIFF images were superior *only* to paper records; today, static image productions visit severe hardships on parties doing electronic discovery—hardships serving to make discovery more costly and less useful in speedily reaching the facts needed for just resolution.
9. The profound question before the Court is whether evidence produced in discovery may be deliberately degraded to deny requesting parties substantially the same economies- and ease-of-use enjoyed by producing parties.
10. I speak of "parties," not law firms, because our system of civil discovery does not cognize systematic deconstruction of evidence and the stripping of non-privileged content by lawyers seeking a leg up in litigation. In the interests of integrity and economy, forms of production should faithfully reflect the forms of the evidence *as the parties and witnesses use and acknowledge them*. This is particularly true when static forms of production tilt the playing field in unjust and wasteful ways.
11. If we consider the evidence from the point of view of the parties and the issues at bar, these are the facts:
 - a. In the ordinary course of business, Plaintiff uses electronically stored information in native forms.
 - b. Plaintiff uses native forms because they are the most efficient, functional and complete forms.
 - c. Native forms are most efficient because they store data compactly without sacrificing content.
 - d. Native forms are most functional because they perform all tasks users require of electronic files.
 - e. Native files are most complete because they hold all content, including color, structure, and metadata.
12. I can attest that Plaintiff uses native forms because the form in which Plaintiff's software routinely creates and stores ESI is, by definition, its native form. As a certified computer forensic examiner, I don't need to examine Plaintiff's systems to know that it stores and uses Microsoft Word documents in native forms. *All* Word users do. I needn't speculate as to the native form of Plaintiff's e-mail because there are only a handful of e-mail formats in common use and all of them adhere to a common format that TIFF images cannot replicate. If they did not hew to the native format, Plaintiff's messages could not traverse the Internet.

Plaintiff's Proposal Creates Asymmetry in Access to Evidence, and Unnecessary Cost

13. Under Plaintiff's proposal, Plaintiff will collect e-mail messages and Word documents from its employees. It will collect the e-mail in portable native formats from its e-mail systems and collect the Word documents in the .DOCX (and .DOC) formats native to Microsoft Word.
14. Under Plaintiff's proposal, when Plaintiff's lawyers select what they deem responsive, their e-discovery service provider (vendor) will generate a set of black-and-white letter-size TIFF images of the native items. All color features will be eliminated. Static TIFF images are not electronically searchable unlike the native forms of the evidence, so the vendor must create additional files to hold as much of the text from the native evidence as the vendor can extract or as much text as the vendor can glean from the image using optical recognition (OCR) software. For e-mail and Word documents, extraction is more common than OCR.
15. Because the conversion of native evidence to TIFF images under Plaintiff's proposal strips away all the native file's metadata, the vendor must attempt to salvage select metadata and stow it in files termed "load files." The native evidence is now in three or more pieces: an unsearchable image or images, a file with collected or replicated text and a file with metadata. The latter two are the "plus" in a TIFF+ production.
16. Still more files are needed to serve as assembly instructions pointing to the disparate shards of data used to fashion a crude, colorless facsimile of the original evidence. This reassembly requires an e-discovery "review platform." The text files are then indexed by the review platform to recreate a level of searchability reminiscent of the inherent, easy searchability of the native evidence.
17. Thus, Plaintiff seeks to produce a "kit" obliging the defendants to assemble a model of the real evidence, though that model will neither look like nor work like the original evidence and will be missing pieces.

Plaintiffs' Proposal Reduces Burden and Equalizes Access to Evidence

18. At the outset, it must be understood that the form of the evidence the Plaintiff seeks to produce is not the form used by the parties or familiar to the witnesses. Plaintiff seek to produce a degraded, incomplete, and bloated form that makes discovery prohibitively costly for the defendants and corrupts searchability.
19. The defendants don't want TIFF images of the evidence and have requested Plaintiff produce the evidence in its native forms. The defendants don't ask that Plaintiff produce *both* native forms and TIFF images, as that would be duplicative and wasteful. Producing just the native form is sufficient and puts the parties on a level footing.
20. The plaintiff's proposal unduly complicates discovery by converting some evidence to TIFF images (Mail, Word Documents) while supplying other evidence in native forms (Spreadsheets, PowerPoints). An advantage of supplying native forms is that native forms can be readily converted to other forms such that any party wanting TIFF images can generate TIFFs from native forms, though the converse isn't true. TIFF

images cannot be converted to native files. Native forms are not only less costly to load and host, but they're also the most flexible and utile forms.

21. If native is appropriate for PowerPoints and Excel Spreadsheets, why isn't it good enough for everything? Plaintiff would likely respond that PowerPoints and spreadsheets don't lend themselves to production as TIFFs, but in fact, PowerPoint presentations, Excel spreadsheets and Word documents all derive from the same Microsoft Office "family" of file formats. All are Zip-compressed files formatted in Extensible Markup Language (XML). The ability to process native PPTX and XLSX documents in the Plaintiff's discovery workflow establishes that there is no impediment to processing Word DOCX items in the same workflow, so as to be produced more economically in the same manner as its sibling Office formats. There are huge advantages to supplying DOCX Word documents in their native formats, particularly lower cost, proper juxtaposition of comments and tracked changes, native support of color and OLE (Object Linked and Embedded) content and inherent searchability.
22. Again, parties don't use TIFF images; only lawyers do, and none of the justifications for their use hold water in 2020. The parties use *native* forms in all their day-to-day business. The parties do not convert Word documents or email messages to TIFF images. They work with the native files for the simple reason that, when you try to convert the three-dimensional, multihued data of word-processed documents to two-dimensional, black-and-white forms, you sacrifice information, corrupt content and visit needless expense and burden on an opponent. Indeed, it is that last impact that often drives efforts to produce TIFF images instead of the authentic, original, *native* evidence.
23. The optimum form in which to produce evidence in discovery is the form most faithful to the evidence as the parties encountered it; that is, the form that best preserves the integrity of the evidence vis-à-vis the events and transactions on which it bears. Certainly, there are times when we must settle for a color photo of a victim so as not to not produce the corpse; but absent rare and compelling cause, we must strive to ensure the most complete and faithful forms are produced.

Plaintiff's Claimed Advantages for TIFF Productions Are Illusory

24. Plaintiff suggests that, if Defendants receive the evidence in the same form as Plaintiff uses it, Defense counsel will mishandle the evidence to deface its contents or will email persons counsel is ethically bound not to contact. The Plaintiff posits that TIFF images cannot be altered or misused by those determined to break the rules, as if an unethical attorney couldn't edit a TIFF or pluck an address from a TIFF image and abuse it.
25. When used in conjunction with all industry-standard review tools, the text in a native file is as static as that of any TIFF image. Review tools guard against alteration by emulating native views of the evidence without opening files in native applications. By contrast, if I load a TIFF image in a drawing program, I can change it, including altering its Bates numbering. Likewise, if I load a PowerPoint presentation into PowerPoint, I

can change it. *There is nothing static about data if one is intent upon altering it.* Competent e-discovery workflows, purpose-built tools and our duties of professional responsibility augur against intentional and fraudulent alteration of evidence. TIFF images and native files are both composed of ones and zeroes. Either can be changed; but for both, there are effective means to detect and deter fraudulent and negligent handling.

26. For native forms to be altered in e-discovery, they must first be exported from the Defendant's e-discovery review tool and then opened in a native application. If the "risk" is that defense counsel will intentionally load evidence into programs to alter the evidence, then "static" TIFF images pose a greater risk of alteration than native forms because TIFFs are just black and white pictures and can be readily changed in any of the countless drawing and editing programs found on Windows and Mac computers, even using PowerPoint. ESI is only numbers, and numbers are easily changed.
27. For an e-mail in native form to facilitate a "reply-all" event or trigger a read receipt or calendar item, the message must first be exported and then opened in a compatible e-mail client program. The best indication why this is not a material risk is the fact that it doesn't routinely happen to Plaintiff's counsel, who use the same small universe of discovery tools and have the same ability to export items into native applications. That a long-ago lawyer was once so foolish as to load evidence into Outlook for review and seek to reply to other people's e-mail is not a cross every lawyer should bear. Once more, modern review tools employ native file viewers that allow native forms, *including e-mail messages*, to be viewed without need of native applications.
28. In measuring the claimed risk, I point to the dearth of motions for sanctions on these grounds and the absence of a single reported decision where it was alleged that counsel improperly e-mailed anyone because they were supplied native forms in discovery. Fertile minds can imagine a parade of horrors and there are risks of perfidy or error in anything; but the risks put forward here are more speculative than real. If the touted risks materialize, the Court has ample authority to deter and punish misconduct. Until then, the benefits and cost savings of native production *are* real and substantial.

Native Productions Support Bates Numbering with Nothing Lost and Much Gained

29. Now that nearly all written evidence items are blocks of data—files on disks and records in databases—the printed page is not an efficient or economical way to unitize electronically stored information (ESI). As well, enumeration of ESI by page numbers based upon conversion to a static image format is like measuring and delivering water as ice cubes or steam. You can do it, but you really shouldn't. Unitization should be based on the native form (*e.g.*, gallons), not the occasional altered form (cubes or cubic feet) until and unless the change of form is necessitated by the usage. The same logic holds true for ESI.
30. For items produced in discovery, the unitization that makes most sense is the native unitization, *files*. Word processed documents, presentations, spreadsheets, email, photos, videos and sound recordings all manifest as files in the ordinary course. We store them as files, collect them as files, process and enumerate them as files

and hash them as files for deduplication and authentication. It only stands to reason that we should produce and Bates number electronic evidence as files.

31. Parties “emboss” Bates numbers on files in the same way that parties identify files in the ordinary course. That is, they name each file produced or withheld to reflect its Bates number. It’s a flexible method that comports with the longstanding practice of naming images of printed pages to mirror the Bates numbers embossed on those pages. Bates numbers can be prepended to file names, appended to them or simply replace the filename (as the original filename is *always* produced in an accompanying load file). Nothing is lost and, because filenames aren’t stored inside files, changing a file’s name in this way doesn’t alter the file’s content or hash value. Native production doesn’t end the use of Bates numbers; it just adapts the numbering to the appropriate unitization.
32. Parties use these Bates numbered files in the same manner as parties use any ESI in electronic discovery; that is, they employ a purpose-built e-discovery tool to view the contents of the file and the application displays the Bates number, rather than using the native Word, Outlook or PowerPoint program to view it. TIFF+ productions don’t obviate the use of review platforms, they just don’t enable the tools to be as efficient, economical or flexible.
33. The key to understanding why paged Bates numbering is simple and cheap for native productions is distinguishing how parties review ESI versus how parties present it as exhibits.
34. It’s unquestionably convenient to print ESI used as exhibits to paginated formats on those occasions when a clear record is facilitated by doing so. I’ve taken hundreds of depositions, argued countless of motions and tried many of cases. Depositions, trials and hearings haven’t changed much over my 38 years at the Bar; so, I’m no stranger to the value of embossed Bates numbers when data is printed for presentation to a witness or tribunal.
35. The question isn’t whether there’s a need and place for Bates numbered static forms (*i.e.*, paper and electronic printouts), but *when* should conversion occur, applied to *which parts of a production*, and importantly, *who gets to decide* and *at what cost* (measured in money, utility and completeness)?
36. Native production splits the process of Bates numbering. *The producing party retains the right to assign the Bates number to the file produced. The right to add page numbers belongs to the party who prints the electronic evidence for use in a proceeding.* The Bates number assigned by the producing party must be embossed on every page of the printout along with the page numbers and confidentiality labels. That way, the producing party can always relate a printed item to its source file. In turn, all parties can reference the printout by Bates number and page number in the conventional way lawyers cite to exhibits in proceedings.
37. The objection raised to this is, “*Won’t that mean that different printouts could have different pagination? Won’t that be confusing?*” It’s possible that slight variations in page breaks could occur if the same file is printed on different systems and printers. In theory, that could prompt confusion; but in practice, it’s not a

problem. The record is perfectly clear with respect to any version used by a witness or presented to the Court. You can concoct a situation where it's pesky, but the reality is that it works quite well.

38. The reason litigants never faced this presumptive confusion before e-discovery was because, if you used a document I'd produced to you in discovery, that document bore the Bates number I'd stamped on it. You were forced to use the pagination I'd assigned. You couldn't print a version with different pagination because I hadn't produced the electronic evidence to you; I'd produced a printout. That was convenient and acceptable back when the evidence and a printout were useful and complete in the same ways. However, ESI and printouts are not the same anymore. They aren't useful in the same ways. They aren't complete in the same ways. They don't cost the same to use. Notwithstanding these differences, the Plaintiff still claims the exclusive authority to assign pagination at the time of production. That is, they demand the power to impose the wrong form of unitization at the wrong point in the discovery process. The Defendants' proposed protocol makes more sense.

Native Production Will Be Markedly Less Costly, Month-After-Month

39. Just as a review platform is needed to search and review a TIFF+ production, a review platform is used to search and review a native production. Reliance on an e-discovery review platform is a necessity of 21st century trial practice. In the last decade, e-discovery review platforms have ceased to run on desktop and laptop computers but, like so much of business computing, have migrated to the Cloud and run in "hosted" online environments leased from "*hosted service providers*." In hosted environments, the subscriber pays a monthly fee tied to the gigabyte volume of information hosted, that is, stored and readily available to reviewers via a web browser and the Internet. Users may also pay by the gigabyte to add data ("ingest") into these repositories and export data out. Provider fee schedules vary making direct comparison difficult, but nearly all employ volumetric pricing, *viz., the larger the volume of data hosted, the greater the monthly subscription fee.*

40. *Larger files cost more. Much larger files cost much more. TIFF images are much larger files.*

41. Larger files also impair workflow. A larger file takes longer to transmit, prompts longer load times, longer times to process and, ultimately, more time just to move from one page to the next.

42. When I say, "TIFF images costs more," I do not mean *incrementally* more; I mean many *multiples* more. Where a native production costs \$1X to host, the *same* production as TIFF+ will cost \$3X, \$5X, \$10X *or more* to host, month-after-month, for less complete and utile forms. I cannot point to a fixed multiple because the difference hinges on the nature of the file, its compressibility, complement of rich media content, use of color and image resolution. Some Group 4 TIFF image productions sacrifice legibility for size and produce a smaller multiple.

43. I can attest, based on years of study, testing and experience, that a native format production set composed of file types often seen most in e-discovery will be substantially smaller in size versus a comparable TIFF production set. The difference is often startling.
44. To demonstrate the difference, I periodically process identical data sets in industry-standard e-discovery tools, generating a native production set and a TIFF production set, each adhering to customary specifications for, *inter alia*, image resolution, load file structure and Bates numbering.
45. For purposes of illustration in this declaration, I processed two simple sets of data as examples. Because I have no access to Plaintiff's responsive files, I processed a single e-mail from Plaintiff's counsel to defense counsel transmitting a native Word attachment. I also processed a set of publicly available PDF files composed of 24 Plaintiff publications and five sets of procedural rules from the U.S. Courts website. I chose these to be readily accessible to anyone wishing to do their own assessment, but the composition of the collection makes little difference. The upshot is that the conversion of native files to TIFF images hugely inflates the size of the files. *See Exhibit B.*

Example 1: A single email and attachment from Darrow Clarence, Esq. transmitting a draft protocol in Word format.

Native size: One file comprising 90.3 kilobytes

TIFF Images: 17 TIFF files comprising 3.77 megabytes

The TIFF images are **41.74 times larger** than the native source, yet they lack color and none of the tracked changes seen in the Word file are visible.

Example 2: 29 PDF files from Plaintiff and U.S. Courts

Native size: 29 files comprising 23.9 megabytes

TIFF Images: 869 TIFF files comprising 301 megabytes.

The TIFF images are **12.59 times larger** than the native source, yet they lack all the color used extensively in the Plaintiff documents, the hyperlinks were stripped, and the extensive internal navigation features are non-functional.

46. Whether the data are PDF files, Word documents or e-mail messages, converting the functional and complete native evidence to colorless TIFF images massively increases the size of the production even as it degrades utility and intelligibility. The difference directly translates to a much greater cost to Defendants to host the data, month-after-month. Not slightly higher but, as seen above, many multiples higher. The PDF examples

would cost 13 times more and the e-mail and attachment 34 times more. The TIFF image production Plaintiff seeks will cost Defendants much more even while the bloated files they want to substitute operate to slow review and conceal content.

47. It's easy to attack these examples because they don't use a larger swath of Plaintiff's own data or by asserting that Plaintiff's vendor has a better TIFF conversion tool or trims file sizes by lowering legibility. The multiples will move higher and lower as the data changes; but one fact won't change: *Swapping static TIFF images for native forms visits a punitive economic penalty on plaintiffs.*

Threading E-Mail for Review is Compatible with Producing E-Mail in Native Forms

48. Threading e-mail for review makes reviewers' lives easier. Instead of looking at each e-mail in a chain, threading presents the constituent messages as a conversation, using either the most inclusive message at the "top" of the chain (suppressing duplicate constituents) or by synthesizing a chain from constituent messages and suppressing intermediate attachments and message header data. This convenience comes at a cost when responsive, non-privileged suppressed evidence isn't produced to Defendants. Other witnesses and counsel have done an effective job outlining the hardships to Defendants attendant to Plaintiff's threading proposal, so I only wish to note that the review tools that suppress the constituent messages also track those constituent messages, making it feasible to gain the convenience of threading without neglecting the duty to make production.

49. Threading doesn't suppress constituent messages, attachments and headers as a matter of legal right. They aren't suppressed because they are privileged or irrelevant. They are suppressed because it's expedient. It saves money. Plaintiff claims nothing suppressed is material, and all is merely redundant. If that's so, then allowing the system tracking constituent messages to include the responsive constituent messages in the production is a trivial burden on the Plaintiff and a crucial safeguard for the Defendants. The cost savings are realized in the human review; the production of the constituent messages is a mechanical task that costs nearly nothing and poses no risk to the Plaintiff *if the Plaintiff is truly suppressing only redundant content as claimed.*

Color Documents

50. In the bygone days of paper production, parties fought over color production because color copies were ten times more expensive than grayscale copies and were reserved to, *e.g.*, reproduction of color photographs. Because color printing was exceptional and expensive, colorized business documents were scarce. The digital revolution put tools for color emphasis and imagery on every desktop. Spreadsheets used color to highlight cells and signal significance. Modern productivity files employ color photographs, color keys for maps and graphs, color-coding and color heat maps as just a few examples. Color is used across a wide range of electronic evidence to denote hyperlinks that would otherwise be indistinguishable from bold or underline

text. How are Defendants to determine whether a reference is merely plain bolded text, or if it was colored to reflect a hyperlink?

51. When used to convey or emphasize information, color is essential to comprehension of the evidence. Color is an integral feature of native file formats and requires no special handling or expense to produce. *The color is built into the file.* From the standpoint of clarity and completeness, black-and-white images are incapable of conveying all the information in a color document. Too, producing color-rich documents as static color images is costly because static color images are substantially larger in file size than static monochrome images, so they are many, many times more expensive to ingest and host. The better way—the ideal way—to supply essential color isn’t to add color to TIFF images, further bloating their size and increasing cost, but to make production in the native formats that convey the color information at no cost to any parties.
52. In practice, not all use of color translates to a discernable, shades-of-gray difference in appearance. Accordingly, the Plaintiff’s proposal to produce only black and white images doesn’t work. It’s difficult or impossible to perceive instances of color in grayscale documents to form that requisite “belief” that color is present; a belief required to request the item be reproduced in color. It’s a process certain to prompt delay and workflow disruption. The superior approach is native production, where color is cost-free and requires no time-consuming battles over whether color is substantive or decorative.

Cost of Hash Authentication

53. Plaintiff’s declarant, Jane Doe, argues that, “if the authenticity of a Native file is suspect, it would need to be validated by generating a hash value and comparing it to the hash value of the originally produced file to verify if a document has been changed.” Ms. Doe raises this as a burden because her employer, Service Provider, Inc, would impose additional fees to assist with the process.
54. My experience is that when the authenticity of evidence from a producing party is suspect on the theory that the requesting party has altered it, the cost of authentication is not a paramount concern. Reputations and law licenses hang in that balance. Ms. Doe fails to consider the cost to verify a suspect TIFF file would be considerably higher if hashing *weren’t* used. There, human beings billing princely sums would need to assess the integrity by eye. Ms. Doe overstates not only the likelihood of needing hash authentication, but also its cost, and this argument has no weight against Defendants’ proposal of a native production..

SIGNED this 25th day of August 2020 at New Orleans, Louisiana.

Craig D. Ball

APPENDIX A: Curriculum Vitae of Craig Ball



CRAIG BALL

**ESI Special Master and Texas Attorney
Certified Computer Forensic Examiner
Author and Educator**

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Craig Ball is a Texas trial attorney, certified computer forensic examiner and Adjunct Professor at the University of Texas teaching *Electronic Evidence and Digital Discovery* and at Tulane University Law School teaching Digital Evidence. Craig brings expertise in digital forensics, emerging technologies, visual persuasion, electronic discovery, and trial tactics, limiting his practice to service as a court-appointed Special Master and consultant in electronically stored information. A founder of the Georgetown University Law Center E-Discovery Training Academy, Craig serves on the Academy's faculty. He is an instructor in computer forensics and electronic evidence to multiple government agencies and an energetic speaker at CLE programs for the bench and the bar throughout the world. Craig's articles regularly appear in the national media. For nine years, he wrote the award-winning syndicated column, "Ball in your Court," for American Lawyer Media and still pens a popular blog of the same name at craigball.net. Craig is the 2019 recipient of the Cavin Award for Lifetime Achievement in Continuing Education.

EDUCATION

Rice University (B.A., 1979, triple major); University of Texas (J.D., with honors, 1982); Oregon State University (Computer Forensics certification, 2003); EnCase Intermediate Reporting and Analysis Course (Guidance Software 2004); WinHex Forensics Certification Course (X-Ways Software Technology 2005); Certified Data Recovery Specialist (Forensic Strategy Services 2009); Nux Certified E-Discovery Specialist (2014); numerous other classes on computer forensics and e-discovery.

SELECTED PROFESSIONAL ACTIVITIES

Law Offices of Craig D. Ball, P.C.; Licensed in Texas since 1982.

Board Certified in Personal Injury Trial Law by the Texas Board of Legal Specialization 1988-2019

Certified Computer Forensic Examiner, Oregon State University and NTI

Certified Computer Examiner (CCE), International Society of Forensic Computer Examiners

Certified Data Recovery Specialist, Certified E-Discovery Specialist (Nuix)

Faculty, University of Texas School of Law, Adjunct Professor teaching Electronic Discovery & Digital Evidence

Faculty, Tulane University School of Law, Adjunct Professor teaching Digital Evidence

Faculty and Founder, Georgetown University Law Center, E-Discovery Training Academy

Admitted to practice U.S. Court of Appeals, Fifth Circuit; U.S.D.C., Southern, Northern and Western Districts of Texas.

Board Member, Georgetown University Law Center Advanced E-Discovery Institute and E-Discovery Academy

Board Member, International Society of Forensic Computer Examiners (*agency certifying computer forensic examiners*)

Member, Sedona Conference WG1 on Electronic Document Retention and Production

Member, Maryland Committee on Federal E-Discovery Guidelines, 2014-17 (civil and criminal committees)

Special Master, Electronic Discovery, numerous federal and state tribunals

Instructor in Computer Forensics and Electronic Discovery, United States Department of Justice

Lecturer/Author on Electronic Discovery for Federal Judicial Center, FDIC (2019) and Texas Office of the Attorney General

Instructor, HTCIA Annual 2010, 2011 Cybercrime Summit, 2006, 2007; SANS Instructor 2009, PFIC 2010, CEIC 2011, 2012

Special Prosecutor, Texas Commission for Lawyer Discipline, 1995-96

Council Member, Computer and Technology Section of the State Bar of Texas, 2003-date; Chair 2015-2016

Chairman: Technology Advisory Committee, State Bar of Texas, 2000-02

President, Houston Trial Lawyers Association (2000-01); President, Houston Trial Lawyers Foundation (2001-02)

Director, Texas Trial Lawyers Association (1995-2003); Chairman, Technology Task Force (1995-97)

Member, Texas State Bar College

Member, Continuing Legal Education Comm., 2000-04, Civil Pattern Jury Charge Comm., 1983-94, State Bar of Texas

Life Fellow, Texas and Houston Bar Foundations

Adjunct Professor, South Texas College of Law, 1983-88

Selected publications available at www.craigball.com; achievement awards and honors on request.

**Matters in Which Craig Ball has Served as a Court Appointed Special Master or Neutral
or Testified as an Expert or in Connection with Computer Forensics/Electronic Evidence**

1. **Meyer v. Brown; Harris County, TX, Judge Baker; (Court's Neutral)**
2. In Re: Enron and Arthur Andersen Secs. Litigation; USDC SDTX (Lead Plaintiff's Counsel's ESI expert)
3. In Re: Tyco Securities Litigation; USDC NH (Lead Plaintiff's Counsel's ESI Expert)
4. **American Express v. Americap; USDC SDTX (Court's Special Master)**
5. **TXU v. Whittaker et al.; 151st Harris County, TX (Court's Special Master)**
6. Miller et al. v. Highland Medical Center; 295th JDC, Harris County, TX (Plaintiff's Counsel's Expert)
7. **Barnes v. Kissner; 190th JDC; Harris County, TX (Court's Neutral)**
8. BP Texas City Explosion Litigation, Galveston, TX (Joint Prosecution Group 's Expert)
9. Chart Industries v. Runyan and Applied Hydrocarbon Systems; USDC SDTX (Plaintiff's Expert)
10. Key Energy v. Crisp; USDC Midland, TX (Plaintiff's Counsel's Expert)
11. **Broussard v. Dunlap; 190th Harris County, TX (Court's Neutral)**
12. State Bar of Texas v. [Attorneys Under Investigation]; TX Office of the Disciplinary Counsel
13. In Re: Flowserve Securities Litigation; USDC NDTX (Lead Plaintiff's Counsel's Expert)
14. **Grooms v. Montelaro; 295th, Harris County, TX (Court's Special Master)**
15. Luk v. Eisner; 11th, Harris County, TX (Defense Counsel's Expert)
16. **MJCM, LLC. v. Floyd and Associates. Harris County, TX (Court's Neutral)**
17. PowerTrain v. American Honda; USDC NDMS (Hybrid Appointment)
18. **Shue v USAA et al; Kendall County, TX (Court's Special Master)**
19. In Re: Sirna Therapeutics Litigation; USDC NDCA (Defense Counsel's Expert)
20. **Yeh v. McDougal; 333rd Harris County, TX (Court's Neutral)**
21. Plus Technologia, SA de CV v ACI Worldwide; Pinellas Cty., FL (Plaintiff's Counsel's Expert)
22. **Anadarko Petroleum v. Geosouthern Energy; USDC SDTX (Hybrid/Court's Neutral)**
23. **ASC v. SCI; Ft. Bend County, TX (Court's Neutral by Stipulation)**
24. **Katrina Canal Breaches Consolidated Litigation; USDC EDLA (Court's Neutral)**
25. **Sellar v. Boecker; Harris County, TX (Court's Neutral)**
26. **In Re: Seroquel Products Liability Litigation; USDC MDFL (Court's Special Master-ESI)**
27. **Daimler Trucks N.A. LLC v. Younessi; USDC OR (Court's Special Master)**
28. **MDI v. NaphCare; USDC SDMS (Court's Neutral)**
29. Baker Hughes v. Pathfinder; USDC SDTX (Defense Counsel's Expert)
30. **Bd. of Comms. of the Port of N.O. v. Lexington Ins. Co. et al.; USDC EDLA (Special Master-ESI)**
31. **Stewart & Stevenson v. McGuirt; Harris County, TX (Neutral Expert by Stipulation)**
32. Fisher et al. V. Halliburton et al.; USDC SDTX (Plaintiff Counsel's Expert)
33. Aquamar S.A. v. E.I. Du Pont de Nemours & Co.; Broward County, FL (Plaintiff's Counsel's Expert)
34. **AmWINS Brokerage of Texas, Inc. v Hildebrand; Collin County, TX (Neutral by Agreement)**
35. **Arthur v. Stern; Harris County, TX (Court's Special Master in computer forensics)**
36. **Duke Energy Int'l, LLC et al. v. Napoli; Harris County., TX (Court's Special Master)**
37. **Austin Capital Mgmt. v. Balthrop; USDC WDTX (Court's Special Master in computer forensics)**
38. Grace et al. v. DRS Sensors & Targeting Systems, Inc.; USDC MDFL (Defense Counsel's Expert)
39. **Peironnet et al. v. Matador Resources Co. et al.; Caddo Parish, LA (Court's Neutral)**
40. Camp Mystic, Inc. et al. v. Eastland et al.; Kerr County, TX (Defense Counsel's Expert)
41. **Magette, Jacobs et al. v. BL Development et al.; USDC NDMS (Court's Special Master)**
42. Ridha et al. v. Texas A&M University et al.; USDC SDTX (Defense Counsels' Expert)
43. **In re: CityCenter Construction Litigation, Clark County, NV (Court's Special Master for ESI)**
44. In re: Bernard L. Madoff Investment Services Litigation; Bankruptcy Court SDNY (Trustee's Expert for ESI)
45. **Lexington v. Estate of John O'Quinn, Deceased; Probate Ct 2, Harris County, TX (Court's Neutral Examiner)**

46. Allison et al. v. Exxon Mobil Corp.; Circuit Court Baltimore County, MD (Court's Special Master-ESI)
47. PIC Group v LandCoast, Inc.; USDC SDMS (Court's Special Master)
48. SSC, et al v. Halberdier, et al; Harris County., TX (Neutral by Agreement)
49. Houlahan v. WWASPS; USDC DDC (Court's Neutral)
50. M-I L.L.C. v. Stelly et al; USDC SDTX (Court's Neutral)
51. Coyote Springs Inv. v Pardee Homes; Clark County, NV (Court's Special Master)
52. Segner v. Sinclair Oil & Gas; USDC NDTX (Court's Special Master)
53. Adams Golf v. Reed and Callaway Golf; 296th, Collin County, TX (Court's Special Master)
54. Elliott v. Tetlow and MCO-I; USDC SDTX (Court's Special Master)
55. 12001 Beamer, Ltd. V. Valtasaros; 295th, Harris County, TX (Court's Special Master)
56. William A. Sawyer v. Frank Gabrysch et al.; 269th. Harris County, TX (Court's Special Master)
57. Bridges et al. v. GES et al.; 164th, Harris County, TX (Court's Special Master)
58. Ramirez v. State Farm Lloyds; 206th, Hidalgo County, TX (Plaintiffs' Counsel's Expert)
59. In re: Forest Research Institute Cases, USDC DNJ (Plaintiffs' Counsel's Expert)
60. IDM v. May et al.; USDC EDVA (Plaintiffs' Counsel's Expert)
61. Radcliffe v. Tidal Petroleum; 218th , LaSalle County, TX (Court's Special Master)
62. Estate of Henry G. McMahon, Jr.; Travis County, TX (Court's Special Master)
63. Samame d/b/a Alamo Packing v. Arco Iris et al; USDC WDTX (Court's Special Master)
64. Huerta/Kodish v. BASF; Circuit Court, Cook County, IL (Court's E-Discovery Mediator)
65. EPAC v. Thomas Nelson, Inc.; USDC MDTN (Court's Special Master)
66. Gonzales and Select Caskets of Texas, Inc. v. Morris, et al.; 295th, Harris County, TX (Court's Special Master)
67. Ted W. Allen & Assoc. v. Norman et al.; 333rd Harris County, TX (Court's Special Master)
68. Preston Marshall et al. v. MarOpCo, Inc. et al.; 11th, Harris County, TX (Court's Special Master)
69. Marcus Huey et al. v. EQT Production Company, et al.; Wetzel County, WV (Defense Counsel's Expert)
70. Ravago Americas LLC v. Vinmar International LTD et al.; USDC SDTX (Court's Special Master)
71. In re: Plaintiff TBI Products Liability Litigation; USDC DNJ (Plaintiff's Counsel's Expert)

APPENDIX B: COMPARING NATIVE AND TIFF SIZES

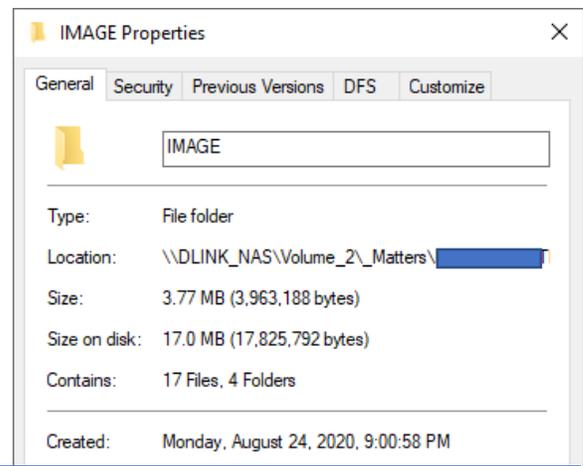
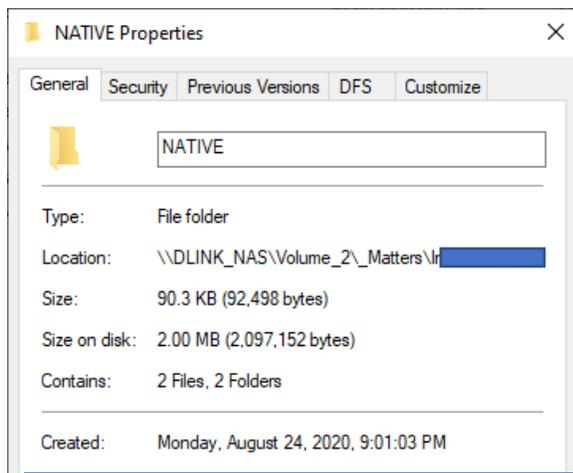
Appendix B: Processing Identical Collections to Produce Native and TIFF Production Sets

Measuring the size difference between native and TIFF formats for identical document collections.

Data Set 1: Single email with attachment from Darrow Clarence, Esq. transmitting a Word .DOCX file. Using Nuix Workstation ver. 8.2.14. TIFF configuration: 300dpi Monochrome Group 4 encoding. Added Bates numbers and a protective legend to each page. For native production, attachment was extracted and produced in native format with parent e-mail.

Native file size: .09 megabytes (90.3kB)

Size as TIFF Images: 3.77 megabytes

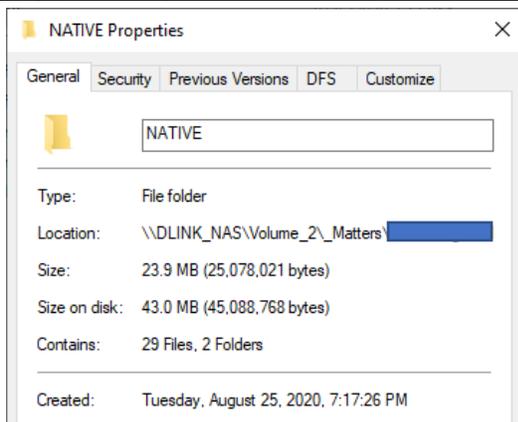


TIFF Production set is 41.74 times larger than the Native production set

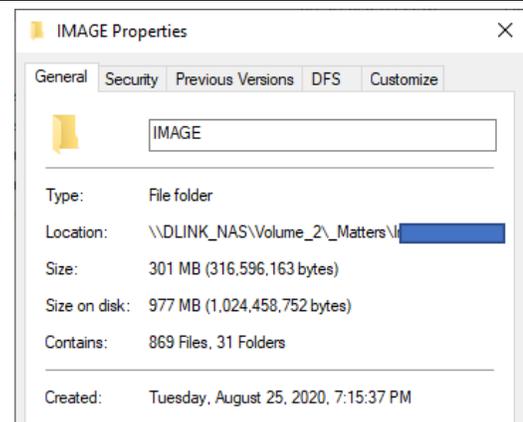
Data Set 2: Twenty-nine randomly selected, color-rich PDF files collected from PlaintiffSite.com (including financial reporting publications) and five PDF files of Federal Rules from <https://www.uscourts.gov/rules-policies/current-rules-practice-procedure>. The filenames, hash values and file sizes of files in the collection are set out in the table below.

Using Nuix Workstation ver. 8.2.14. TIFF configuration: 300dpi Monochrome Group 4 encoding. Added Bates numbers and a protective legend to each page.

Name	MD5 Digest	File Size
04659-20-087827.pdf	abb1e971116e95d96d1b1b82031c8412	95.59 kB
79110-20-007837.pdf	849f50829ce4f4857d02c9376f2cde35	70.11 kB
79110-20-008118.pdf	0066c5936f8dd1dfbde8948901c7d33d	71.82 kB
551152-20-000019.pdf	0d55e7adfb06f8b050d4c3d3dddf88fcde	230.91 kB
551152-20-000023.pdf	2cb18adb467e49baa88adbdee63ee8c7	424.18 kB
2Q20 Press Release.pdf	64f9ee0d6546dc100a3176660ccc92c9	1.66 MB
Governance-Guidelines.pdf	50ad12c8d61384661a5cf015f2b2bb74	86.14 kB
Impact.pdf	be4c84a4480ff002507639f33ac2dc8b	1.9 MB
Supplier-Code-of-Conduct-Brochure.pdf	5b679360e5eaf698bf733fdfd80e2a0e	148.45 kB
federal rules of appellate procedure - dec 1 2019 0.pdf	b59dd2cd4d4cf76eeb75000a68ea79e4	753.69 kB
federal rules of bankruptcy procedure - dec 1 2019 1.pdf	bf881bead131abd06e36758bffedf8f6	579.17 kB
federal rules of civil procedure dec 1 2019 0.pdf	cae0c10bdbaa7d28286e9495f53252ea	441.39 kB
federal rules of criminal procedure - dec 1 2019 0.pdf	9c16ab5ed26f906e03dcb66d99204116	306.17 kB
federal rules of evidence - dec 1 2019 0.pdf	a470a3b1ea2629554df53afc34ed17ef	193.38 kB
FINAL Collection Brochure.pdf	9dff43462a7481e512a3f8ce08a9f982	3.47 MB
L36.pdf	9eb227c743492b6b25a64d88e8bcb3c5	215.68 kB
web.pdf	82b090955e383e25bfd2deb003a11130	1.76 MB
ProductCatalog FINAL iPad 03.22.17.pdf	6277ab63df3c66801b9e7f6e022072c5	6.98 MB
-aug-m1209rev12.pdf	29a4516a552c20c121746930077f07c9	1.12 MB
Sales-Tool ST Sprds.pdf	0f919bd03660bae105ea9b4a08bd20ca	2.09 MB
Our-Commitment-to-Equality-Diversity-and-Inclusion.pdf	effe9446de01d004bec089b0c1a48233	177.62 kB
our-distracted-driving-standard.pdf	70ba9b468cfbacda763ce1adb4f25f34	248.64 kB
our-environmental-procurement-guidelines.pdf	b8293f772cb071d701619f645ec4f56a	276.47 kB
our-fleet-safety.pdf	f2cd67b00731a51f12314899aa9ea19d	314.95 kB
our-position-on-global-climate-change.pdf	3f273d7c9326be4da921a3a74c2f77ec	14.03 kB
ratings-and-recognition-072020.pdf	6c5a8871bd451cc2d01170b5cb876aee	87.05 kB
dfu-m712rev08.pdf	67ef0a9c99d824f2ade4ec34c6377109	365.63 kB
statement-of-opposition-to-capital-punishment.pdf	56cf2db8a575341e94caf4d29013d410	61.75 kB
warranty brochure.pdf	1ca3d991a9a0f91ad52f73a854bdd08b	947.54 kB



Native file size: 23.9 megabytes



Size as TIFF Images: 301 megabytes

TIFF Production set is 12.59 times larger than the Native production set