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INNOVATIVE DEVELOPMENTS IN
DEMONSTRATIVE EVIDENCE TECHNIQUES AND
ASSOCIATED PROBLEMS OF ADMISSIBILITY

MARK A. DOMBROFF*

INTRODUCTION

IT HAS OFTEN been said in articles dealing with the subject of demonstrative evidence that "a picture is worth a thousand words" or "seeing is believing." Both are true and yet neither adequately imparts or describes the effect that the proper use of demonstrative evidence can have in a courtroom. The phrase "proper use" bears not only upon how the evidence is actually used in court, but includes the pre-trial decision of what types or means of demonstration or demonstrative evidence will be utilized. In an aviation case, whether general aviation or air carrier, the opportunities for using demonstrative evidence of all types are legion and, in fact, limited only by the imagination of the attorney and the ability to meet the appropriate evidence standards. Of course, when speaking of demonstrative evidence, the traditional mainstays of models, charts, diagrams and photographs always come to mind. These techniques only scratch the surface of uses for demonstrative evidence and may be used in such a way as to increase their impact immensely. Conversely, the failure to properly prepare for and use demonstrative evidence of this type, and indeed, any type of demonstrative evidence, may have a negative effect far beyond the reasonable expectations of the trial lawyer.

The purpose of this article is to discuss, by category, some of the various types of demonstrative evidence that are either currently in use or that can be used in aviation cases. Within each

category, there is a discussion not only of the legal considerations regarding admissibility, but also of the substantive problems encountered in creating demonstrative evidence, problems that may later manifest themselves in the courtroom. The legal aspects of the discussion will address standards of a variety of state jurisdictions, in addition to federal standards of evidence and admissibility, dealing with questions of demonstrative evidence. The types of demonstrative evidence covered are videotapes, models, aircraft instruments and "black boxes," summaries of records, view of premises, charts, diagrams and graphic testimony, and computer processed evidence.

1. Videotapes

The use of videotapes in the courtroom actually presents more logistical than legal problems. The legal considerations present in using videotaped demonstrative evidence are essentially identical to those involved in using motion pictures. This is true despite the fact that videotape cannot actually be described as a series of still pictures because of the invisible nature of the electronic images on videotape versus the graphic nature of the individual still pictures on motion picture film. In a somewhat analogous situation, the Supreme Court of Nebraska, in Transport Indemnity Co. v. Seib, found that calculations stored on electronic tape rather than paper tape were properly admissible as business records. Since that time several courts have analogized videotape presented as demonstrative evidence to motion picture film and subjected it to the same admissibility requirements. These generally include a requirement that the motion pictures or videotape be authenticated by an individual who has seen the place or events depicted and a requirement that the place or events depicted be the same or similar to the places or events in issue. As with models and other types

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1 178 Neb. 253, 132 N.W.2d 871 (1965).
4 Miller, Videotaping the Oral Deposition, 18 Prac. Law. 45, 51 (1972).
of demonstrative evidence, however, the admission into evidence of videotapes for demonstrative purposes is largely within the discretion of the trial court.\(^5\)

Two specific uses of videotaped demonstrative evidence should be considered in connection with aviation cases.\(^6\) The first could be classified as the "travelogue" and the second as an "animation." The travelogue type of videotaped demonstrative evidence takes the trier of fact to a physical location without the necessity for an actual visit. It is useful when an actual visit is impractical due to time, scheduling or logistical problems. In the *In Re: Pago Pago Air Crash of January 30, 1974* litigation, the court and jury were shown two videotapes in this category. Since the crash occurred on the island of American Samoa, it was not possible to have the court or jury view the airport and its facilities, nor was it likely that any of them had ever been there for any length of time. For this reason, a videotaped tour of the airport facilities, navigational aids, weather facilities, air traffic facilities, airport layout, surrounding terrain and aerial views was prepared and shown at trial after it was viewed by counsel.\(^7\) The videotape was used in connection with a model of the airport.\(^8\) By freezing the videotape and pointing out the appropriate facility, location or other feature on the model, the jurors were, in effect, walked through the airport and the surrounding area.\(^9\)


\(^6\) This article will not address the use of videotaped depositions as demonstrative evidence or in lieu of live testimony. There are already numerous scholarly articles dealing with this subject as well as provisions for such in Rule 30(b)(4) of the Fed. R. Civ. P. See also Rubino v. G. D. Searle & Co., 73 Misc. 2d 447, 340 N.Y.S.2d 574 (Sup. Ct. 1973) for an extensive analysis of the use of videotape depositions in civil cases.

\(^7\) MDL No. 176 (C.D. Cal., judgment entered Oct. 6, 1978) (The Pago Pago accident involved the crash of a Boeing 707 aircraft operated by Pan American World Airways, Inc., which crashed on approach to landing at Pago Pago International Airport. Suit was commenced against Pan Am, the Boeing Company and the United States. After a seven month jury trial, advisory as to the United States, both Boeing and the United States were found free of negligence. Pan Am, on the other hand, was found guilty of wilful misconduct in causing the crash.).

\(^8\) See notes 11-79 infra and accompanying text.

\(^9\) See notes 20-36 infra and accompanying text.

\(^10\) The advantage of videotape over motion picture film becomes obvious in
While most aviation cases do not present locations as remote as American Samoa, it is not uncommon to have the trial in a jurisdiction other than that in which the crash occurred. In such situations, the use of a videotaped tour can be useful. Other subject areas for consideration as videotaped tours include air traffic control towers, air traffic control centers, radar rooms, aircraft cockpits, accident scenes, accident wreckage, airline training facilities, and aircraft simulators. Of course, as with models, careful steps should be taken to insure that either the facilities or locations depicted are identical or substantially similar to those involved in the litigation and that neither irrelevant or extraneous matters are portrayed. This requires careful preplanning and coordination with the individuals doing the actual taping and/or editing. Lack of care concerning such details or lack of foresight will result in the court exercising its discretion by not allowing the evidence into the record. Thus, one court would not permit motion picture evidence showing a claimant working projected at a speed other than that at which he worked when it was taken, or motion pictures depicting an injured party moving faster than she was actually moving at the time of an accident.

It is imperative that as much attention be paid to the quality of the videotape evidence as to its content. After having prepared the videotape, it is highly desirable, if not essential, that a scene-by-scene detailed written description or log be prepared for either reference or narrative purposes. Such a document will serve a dual function. In the trial, it permits easy reference to the videotaped scenes and to any given scene, if keyed to the video tape recorder's counter. In connection with an appellate record, it permits an appellate court to refer to a videotaped scene without the absolute necessity of actually viewing the videotape.

this type of situation wherein the videotape images may be frozen on the screen and where the lights in the courtroom may remain on.


13 For a description of how a videotape itself was used on appeal, see Stewart, supra note 2, at 263.
The second use of videotaped demonstrative evidence, the animation, is known to have been prepared for use or used in the form herein described in only two cases. In the typical aviation trial, either in the plaintiff's or defendant's case, a variety of pieces of evidence are received and, if appropriate, shown to the jury. Such evidence includes the tape of air-ground communications and a transcript thereof, the readout of the flight data recorder, the aviation charts applicable to the circumstances of the flight or flights and a reconstructed flight path based either on computer data or witness observations. While each of the foregoing items of evidence describes the same flight, each does it from a different perspective. The videotape animation combines all of these elements into a single graphic depiction of the relevant moments preceding an accident. As utilized in the Pago Pago litigation, the trier of fact was shown a videotape of approximately three minutes which, at any given second, depicted on the top third of the screen, a plan or overhead view of the aircraft track as it moved. The next third of the screen was a matching profile or side view synchronized in movement to the overhead view. The final third of the screen was a transcript of the synchronized soundtrack. This exhibit assimilated the various aspects of the flight heretofore shown by a number of separate exhibits, thereby permitting the viewer to compare various elements of the flight, i.e., a given statement with altitude and/or position over the ground or position over the ground with altitude.

From an evidentiary point of view, the problems to be encountered in using such an exhibit should theoretically be no greater than those encountered in introducing any of the individual components. Of course, claims of prejudice or cumulativeness may be expected. The unique nature of such an exhibit should outweigh the general prejudice and cumulative type arguments, so long as the individual aspects of the presentation are properly prepared and utilized, since it presents what otherwise is a rather disjointed portrayal of the various aspects of a single flight.

The overhead track of the aircraft is superimposed on a sectional or plan view portion of an approach chart of the same

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14 In Re: Charlotte Air Crash Disaster at Charlotte, N.C., on September 11, 1974, MDL No. 202 (J.P.M.D.L. 1975); In Re: Pago Pago Air Crash of January 30, 1974, MDL No. 176 (C.D. Cal., judgment entered Oct. 6, 1978).
type being utilized by the pilot at the time of the accident. The profile view is portrayed, in an approach type accident, over the profile view from the appropriate approach chart. The scale between the plan and profile views should, ideally, be the same as exists between the plan and profile view on an approach chart. If the fact pattern involves an aircraft striking a mountain or a mid-air collision, elevations may be obtained from topographic charts.

Plotted on top of each view is a synchronized solid or dotted line that moves as the aircraft flies. This information may be derived from a digital flight data recorder readout and plot thereof or from the traditional flight data recorder (FDR). The admissibility of flight data recorder readouts and the requirements in connection therewith are well-established. A reasonably reliable means of reconstructing the flight path is presented through the use of FDR's coupled with cockpit voice recorder statements, statements on the air traffic control tapes of position reports, radar fixes, or pilot observations. Far more tenuous are ground witness reports and the problems inherent therein. In any event, assuming the existence of some of these sources of flight path data, a reasonably certain flight path should be determinable. Certainly this is true in all carrier cases and in most cases involving radar control with ARTS III capability.

The bottom third of the videotape is a transcript of the soundtrack being utilized. In the typical air carrier case, the preferred tape is the cockpit voice recorder (CVR) because it contains both intra- as well as inter-cockpit communications. By coordinating the radio transmission indications from the flight data recorder with the appropriate radio transmissions, or by working backwards from a known time of impact, the flight track of the aircraft on the

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15 American Airlines, Inc. v. United States, 418 F.2d 180, 196 (5th Cir. 1969).
16 For an interesting discussion concerning witness observations and statements in aircraft accident investigations see International Civil Aviation Organization, Manual of Aircraft Accident Investigation, III-3-21 (4th ed. 1970).
17 Flight data recorders are required in air carrier aircraft pursuant to 14 C.F.R. § 121.343 (1978).
18 For an extensive evidentiary analysis concerning the use of both flight data recorders and cockpit voice recorders see Delory, Flight Recordings As Evidence In Civil Litigation, 9 VAL. U. L. REV. 321 (1975).
plan and profile views may be synchronized with the visual transcript and soundtrack.

There seems to be no reason why such evidence would not be admissible. The synergistic effect of putting these elements together, however, seems to create new objections. Of course, if presented by the plaintiff, it is less likely that a claim of cumulative evidence would be sustained. In any event, however, the key to admissibility for this type of videotape evidence is foundation. Thus, it may be necessary to depose the appropriate National Transportation Safety Board investigative personnel to authenticate the FDR and/or CVR readouts.\textsuperscript{19} Efforts required to properly prepare the foundation for this type of evidence are minimal when weighed against its visual and graphic impact in an area such as aviation, that is presupposed to be both a technical field and one beyond the ready understanding of the layperson.

2. Models

A model, properly used, can be one of the most effective types of evidence in a trial lawyer's arsenal. Before embarking on the costly process of having a model constructed, however, it is wise to consider several preliminary matters, including whether the particular case would benefit from the use of a model. Assuming that the use of a model will necessitate its construction,\textsuperscript{20} one should try to determine whether a model will aid the court and/or the jury in understanding the case. Implicit in this decision is the question of whether a model will be of more aid to your opponent than to you. For example, defendants may be more likely to use models than plaintiffs due to the high cost usually associated with their creation and the limited resources plaintiff's counsel may find available or the limitations that may be self-imposed. If the plaintiff has a technically complex theory, however, the defendant's model may prove to be the vehicle for laying out the defendant's liability. In such a situation, a defendant will have to balance the relative benefits derived from utilizing a model.

Having made the determination that the risks are outweighed

\textsuperscript{19}See 49 C.F.R. § 835 (1978) for the regulatory requirements regarding depositions of N.T.S.B. personnel.

\textsuperscript{20}In a number of cases, particularly in product liability cases, the manufacturer often will have a full or scale model of the product, obviating the requirement of constructing a model for trial.
by the benefits, another question to be addressed is the purpose of the model. Essentially, a model will be constructed differently depending on whether it is to recreate an event or occurrence thus requiring the model to be in-scale, or whether it is simply an illustrative example. This decision, as to which type to use is, dependent in large part upon the facts of the individual case but if an option is available, the latter choice is preferable because of the difficulties inherent in building scale models and the concurrent difficulties associated with introducing such a model into evidence. Thus, models of geography, flight paths, buildings, and aircraft, to list just a few should, if practicable, be built and presented to the court for illustrative purposes. In the Pago Pago\textsuperscript{1} air crash litigation, a rather extensive model of the airport and the terrain underlying the approach path was utilized at trial with an accompanying statement bearing upon its purposes. The statement was as follows:

Exhibit 1600 is a model of Pago Pago International Airport and certain portions of the terrain underlying the approach path. The portions of the terrain shown do not include obstructions, trees, lava bank or other objects that may extend above the surface. The model is not to scale nor does it represent the topography of the island in scale. Not all of the terrain surrounding the airport is shown, nor is all of the land between the coast and the airport.\textsuperscript{2}

On the basis of the foregoing statement, the model was accepted into evidence at the beginning of the United States' case\textsuperscript{3} and thereafter became the focal point of both the courtroom and of much testimony. While the model was, in fact, essentially constructed in-scale, the uses to which the model was put did not require that it be offered as in-scale, thereby obviating many foundational problems. Thus, an early decision should be made as to the purpose for which the model is being introduced.

No matter what determination is made relative to the purpose of the model, the work for laying the foundation for admissibility should begin early when the physical evidence is still in existence or before there are physical changes to geography or structure.

\textsuperscript{1}In Re: Pago Pago Air Crash of January 30, 1974, MDL No. 176 (C.D. Cal., judgment entered October 6, 1978).

\textsuperscript{2}Id., Reporters' Transcript of Proceedings, vol. 47B at 14,514-515. [hereinafter cited as Trial Transcript].

\textsuperscript{3}Id. at 14,514.
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which are integral to the model. This may involve obtaining charts, maps, and photographs or making measurements, surveys, or other types of studies aimed at memorializing the scene or object of the model as it existed at the time in question. Indeed, there may well have been changes or destruction of a magnitude sufficient to preclude construction of a model at all, thus making it imperative to get an early start.

The importance of making an early determination of the purpose of a model is underlined by the fact that the admission of demonstrative evidence is a matter largely within the discretion of the court. Since a model is presumably not direct or primary evidence in the case, but rather explanatory, illustrative, or demonstrative evidence, it is doubtful that the discretion of the trial judge in refusing to admit a model will be disturbed. Because a judge, sitting alone or with a jury, desires the maximum amount of simplification and explanation of the issues and interest at the trial, the tendency will be to allow models and photographs into evidence, to aid in this task. The admission into evidence of an exhibit, however, especially a model susceptible to claims that it is prejudicial and misleading, mandates the preparation of models to the highest standard and with the most airtight foundation that can be constructed. The Federal Rules of Evidence address this matter in a general sense in Rule 30, giving the trial judge maximum discretion. Thus, while federal, and indeed most courts, permit the introduction of demonstrative evidence such as models, maps, or diagrams, some models have been rejected because part of the model was not to scale or because of the great disparity in

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54 State Farm Mutual Auto Ins. Co. v. Jackson, 346 F.2d 484 (8th Cir. 1965); Sedlack v. General Motors Corp., 253 F.2d 116 (7th Cir. 1958).
56 Western Gas Const. Co. v. Danner, 97 F. 882 (9th Cir. 1899); Central Illinois Public Service Co. v. Deterding, 331 Ill. 277, 162 N.E. 865 (1928); Kelly v. City of Spokane, 83 Wash. 55, 145 P. 57 (1914).
57 Fed. R. Evid. 403 states: “Although relevant, evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence.”
59 Burriss v. Texaco, Inc., 361 F.2d 169 (4th Cir. 1966) (model rejected be-
size between the model and the original. Many of the considerations applicable to the admission of photographs, motion pictures, charts, and other types of demonstrative evidence are equally applicable to the use of models. First and foremost is the fact that a proper foundation must be laid for the use of the demonstrative evidence. There are seven criteria which, if adhered to, should effectively meet most foundation objections regardless of the purpose for which the model is used. They are:

1. Exhibit prepared according to scale;
2. Exhibit verified by witnesses as reliable and correct representations of areas or subject matter in issue;
3. Exhibit of such a nature as to be explanatory of verbal testimony;
4. Exhibit of such a nature as not to mislead jury or cause confusion or undue influence;
5. Exhibit prepared identical with original except as to size;
6. Witness qualified to testify as to accuracy of proposed exhibit; and
7. Nature of testimony such that reference to prepared model is necessary to understanding of testimony of jury.

Assuming the evidence is relevant and material to the litigation, a model prepared according to the foregoing formula should be

cautious tubing used to represent drainage pipe was not to scale, thereby rendering conditions of a proposed experiment substantially different).

30 County of San Mateo v. Christen, 22 Cal. App. 2d 375, 378 (1937). A model of a tract of land was rejected in an eminent domain case with the court stating: Conceding that a foundation was laid for the introduction of the model, the use of models must lie largely within the discretion of the trial court. While models may frequently be of great assistance to a court and jury, it is common knowledge that, even when constructed to scale, they may frequently, because of the great disparity in size between the model and the original, also be very misleading, and that courts must be allowed wide discretion in ruling upon whether to admit them into evidence or not. Upon the general subject of the admission of material objects into evidence section 1954, Code of Civil Procedure, provides: 'The admission of such evidence must be regulated by the sound discretion of the Court.'

See also Barney v. Rickard, 157 U.S. 352 (1895); Saldania v. Atchison, T. & S.F.R. Co., 241 F.2d 321 (7th Cir. 1957); Norfolk & W. Ry. Co. v. United States, 191 F. 302 (4th Cir. 1911); Republic Iron & Steel Co. v. Yanuszka, 166 F. 684 (6th Cir. 1909); Bloecher v. Duerbeck, 92 S.W.2d 681 (Mo. 1936); Tarr v. Keller Lumber & Const. Co., 106 W. Va. 1928, 144 S.E. 881 (1928).

31 See 7 AM. JUR. PROOF OF FACTS 604 (1960).
admissible with minimal problems for any use, be it for illustrative purposes or for purposes which necessitate accurate scale.\(^3\)

In aviation cases, a model depicting terrain could often be used as in the *Pago Pago* litigation.\(^3\) In such instances, an objection frequently encountered is that the vertical scale is not the same as the horizontal scale and therefore misleading. For instance, if the model depicts an area covering an airport to a point three miles from the approach end of the instrument runway, the entire model might cover an eight to ten foot area representing in excess of three miles of geographic area. If trees, hills, buildings, etc., are in that area as well, a reduction to the same scale as the horizontal scale would make many of these features meaningless and probably non-existent. One approach to meeting this objection is to utilize the same scales. If this is not practicable, point out the different vertical and horizontal scales present on instrument approach charts presumably relied on by pilots.\(^4\) It is not unlikely that in the absence of some gross exaggeration caused by the scales, the model will be admissible.

Another aspect of the question of scales is the presence of a knowledgeable witness to testify about the disparities in scale. In an eminent domain proceeding, despite different vertical and horizontal scales, a four feet by six feet model was admitted into evidence where the model-maker explained the scales and used aerial photographs to aid in this explanation.\(^5\) Similarly, a model of an industrial drill was allowed where its dissimilarities were pointed out, and the model was used only for illustrative purposes.\(^6\) If appropriate to the case, there is no question that a model should

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\(^3\) Indeed, there are decisions upholding the use of models though not admitted into evidence, where parts were not to scale, where there was no record made of vehicles as they were placed on a model and where one witness, despite an inability to remember, was allowed to position a vehicle. See, e.g., Kovrig v. Vasquez, 10 Ariz. App. 111, 456 P.2d 947 (1969).


\(^5\) The Jeppesen Instrument Approach charts for Pago Pago, for instance, as current on January 30, 1974, have a scale on the plan or overhead view of approximately one inch equaling five miles as opposed to one-half inch equaling twenty-five hundred feet on the profile or side view.


be utilized. Preparing it to the tightest possible standard and then being prepared to utilize it for its admitted purpose presents the best course of action in light of the wide discretion awarded the courts in this area.

3. Aircraft Instruments and Black Boxes

Perhaps one of the most difficult concepts to verbalize in the trial of an aviation case is how aircraft instruments perform and behave in flight. For instance, some of us have been at a loss to explain how a magnetic heading position deviation indicator (MHPDI) behaves as an aircraft undergoes various lateral or longitudinal changes. The term “flags” is rather common in aviation parlance as utilized with respect to malfunctioning instruments but doesn’t adequately describe what a pilot actually sees in the cockpit. The phrases “fly left” or “fly right” or “one dot displacement” have significant meanings relative to instrument approaches but might just as well be Latin prose to the typical layperson.

There are various ways to remedy this problem. First and foremost is a recognition that the trier of fact understands nothing about aviation. Such an assumption, although not always true, is the safest possible premise from which to proceed. Highly simplified verbal explanations, photographs, and motion pictures or videotapes can be helpful. For the purpose of depicting the movement and behavior of instruments, motion pictures or video tapes are preferable. Even those, however, have the disadvantage of being somewhat remote from the trier of fact in lieu of the alternatives available. While it is not possible to bring an entire airplane or radar room into the courtroom, it is feasible to bring aircraft instruments or components into the courtroom. If they are the same type and model instruments as those involved in the case, the trier of fact will be able to actually see the needles, “dots” or “flags” being spoken about and be in a far superior position to visualize what is being explained. From an evidentiary point of

37 For a general discussion of instrument landing systems (ILS) and ILS navigation see J. Elliott and G. Guerny, Pilot’s Handbook of Navigation (1977).
38 Id.
39 Id.; see also, Federal Aviation Administration Enroute, Terminal, Flight Service; Navaids; Reference Manual (1st ed. 1971).
40 The question of views will be considered infra in section 5.
view, most of the same considerations applicable to models are applicable here. The major difference is that, unlike many instances involving a model, the aircraft instrument or component is being offered into evidence either as the actual instrument the pilot was looking at or an exact duplicate of what the pilot actually utilized. Thus, foundation evidence is required to establish this fact either by the pilot (if he survived), by other flight or technical personnel or through the use of interrogatories or admissions.

Even this type of highly graphic evidence has inherent limitations in a courtroom. The typical aircraft instrument, when removed from its peripheral equipment and power source and taken out of the flight environment, does nothing to illustrate the movement of needles, gauges, flags, or other movable parts. Often it is the observation of instrument indications that is the core issue, i.e., the steadily decreasing altimeter, the instrument landing systems (ILS) warning flags, unstable glide slope flight indications. Such an issue was confronted by the United States in the Pago Pago litigation. The United States contended that the flight crew of the Pan American aircraft improperly flew the glide slope by permitting unsafe and unacceptable excursions of the glide slope needle. The United States also contended that had the radio altimeter, barometric altimeter or instant vertical speed indicator been observed and heeded, the approach may have been completed safely. The court and jury heard testimony about needles, needle widths, flags, one or more dots of deviation and other terms relating to glide slope instrument indications. While Pan American brought a glide slope instrument into court, identical to the one in the accident aircraft, it suffered from the fact that it was a "dead"

41 See section 2, supra.
42 For a discussion of the general principles applicable to using demonstrative evidence at a trial see Kennelly, Use of Demonstrative Evidence, Including Models, 72 TRIAL LAW. GUIDE 417 (1972).
44 Id. Memorandum of Contentions of Fact And Law Of The United States of America (filed July 20, 1977) (adopting the contention of the Plaintiffs' Discovery Committee Against Pan American And the Flight Crew, filed July 12, 1977).
45 Id.
46 See generally: Trial Transcript, vol. 47A at 14,337.
instrument. During the presentation of the evidence by the United States, what was characterized as a "black box" was received in evidence, after foundation testimony by the expert in instrument landing systems who assembled it. The black box was nothing more than a very simple glide slope localizer instrument enclosed in a black metal box with only the fact of the instrument showing. In the black box were batteries and, showing on either side of the instrument face, switches and dials which permitted anyone, by manipulating the switches, to simulate any magnitude of fly up, fly down, fly right or fly left signal on the instrument. There were also switches, though not utilized at trial, which allowed flag warnings to be put on the face of the instrument or allowed the illumination of a marker light. As utilized at trial, a witness was able to set the black box for the exact amount of fly up or fly down that the Pan American pilot would be receiving at any point prior to impact as extrapolated from the flight data recorder readout. There is little question that the admission of that type of demonstrative evidence is within the discretion of the trial court. Indeed, virtually the same general considerations applicable to models would be applicable to such matters. If such a device is not offered as an identical replica of the matter or item in issue, but rather as a demonstrative aid to assist the trier of fact in visualizing what instrument operation or movement looks like, there should be minimal difficulty in getting such evidence into the record. Indeed, it was on just such a basis that the described black box was received into evidence in the Pago Pago litigation.

One avenue of attack on admissibility may be that such evidence

47 The instrument was not functional and did not illustrate anything other than what the instrument looked like.
48 Trial Transcript, vol. 47B at 14,496.
49 Id.
50 Id.
51 Id. at 14,468 and 14,496.
52 Id. at 14,507.
54 Trial Transcript, vol. 47B at 14,491.
is in the nature of an experiment. There are numerous examples, however, of federal courts admitting the results of experiments as evidence.\textsuperscript{65} Furthermore, the conditions of tests need not be identical.\textsuperscript{66} Similarity is the standard of admission, and it has been held that the degree of similarity affects weight, not admissibility.\textsuperscript{57}

The phrase "black box" as used in the \textit{Pago Pago} litigation represents only a single, and rather narrow use of this concept. There is no reason, barring technical impossibility, why similar devices utilizing radar scopes with target simulators, navigational aid components or other aviation-related hardware, could not be set up in such a fashion so as to allow a courtroom demonstration of their operation. Certainly, the results warrant the efforts.

4. \textit{Summaries of Records}

If there were nothing else to distinguish aviation negligence litigation from other types of negligence litigation, it would be the mountain of records, documents, manuals, and other written material that is inevitably a result of the discovery process. In the typical air carrier case, there are cockpit crew, cabin crew and air traffic controller training and personnel records. There are airplane, air traffic, airline, and training manuals. The list is limited only by the imagination of the attorneys making the requests. In the \textit{Pago Pago} litigation, approximately twelve file cabinets remained in the courtroom throughout the trial devoted to exhibits and depositions. While much is made these days of computerizing files and exhibits for the benefit of trial counsel, there is a somewhat simpler tool available for the benefit of the trier of fact, namely, summaries of records.

\textsuperscript{55} Midwestern Wholesale Drug, Inc. v. Gas Service Co., 442 F.2d 663 (10th Cir. 1971); Ramseyer v. General Motors Corp., 417 F.2d 859 (8th Cir. 1969); Millers Nat'l Ins. Co. v. Wichita Flour Mills Co., 257 F.2d 93 (10th Cir. 1958).

\textsuperscript{56} Midwestern Wholesale Drug, Inc. v. Gas Service Co., 442 F.2d 663 (10th Cir. 1971); Ramseyer v. General Motors Corp., 417 F.2d 859 (8th Cir. 1969); Millers Nat'l Ins. Co. v. Wichita Flour Mills Co., 257 F.2d 93 (10th Cir. 1958).

\textsuperscript{57} Saldania v. Atchison, Topeka and Santa Fe Ry., 241 F.2d 321 (7th Cir. 1957), (test to see if two men could lift a railroad tie—admitted); Lobel v. American Airlines, 205 F.2d 927 (2d Cir. 1953) (experiments by pilots to determine results of paper in poppet valve—admitted); Lever Bros. Co. v. Atlas Assurance Co., 131 F.2d 770 (7th Cir. 1942). Contrary results, Glick v. White Motor Co., 458 F.2d 1287 (3d Cir. 1972) (tests not admitted because of lack of sufficient similarity); Northwest Airlines v. Glenn L. Martin Co., 224 F.2d 120 (6th Cir. 1955) (tests to show what could have or should have been done to avoid failure—not admitted as too complex and hindsight).
The Federal Aviation Regulations require, with respect to certificate holders, the maintenance of the following categories of records or manuals: flight operations manuals; maintenance manuals; maintenance records; manuals and records relating to crew member qualifications, training programs, and curricula; crew member and dispatcher training and personnel records; dispatch, flight release and load manifest forms; and aircraft maintenance logs and related maintenance reports. As can be seen, if nothing more than the records required of an airline were involved in the trial, there would still be a mountain of paper. This mountain becomes an avalanche when coupled with the government's documents and various manufacturers' documents. This is true in virtually every aviation case properly prepared for trial whether the issues involve air traffic, certification, pilot error or product liability. From an evidentiary standpoint, the admissibility of such records, presuming relevancy to the matters in issue, should not be a difficult task. The job confronted by trial counsel relates not so much to admissibility itself, but to the question of the utility of the records after they are admitted. It is likely that an opponent may object to the introduction of such records, contending that they may confuse the jury. The use of summaries of the records or manuals, offered at the same time as the original records, while necessitating considerable pre-trial effort, should cure such objections and problems.

In United States v. Silverthorne, the use of summaries of records was approved by the United States Court of Appeals for the Ninth Circuit. Silverthorne was a criminal case which involved misapplication of bank funds and fraudulent entries in bank rec-
ords. Faced with presenting complex bank records to the jury, the prosecution prepared and offered summaries of bank records prepared by an employee of the Federal Deposit Insurance Corporation. In approving the use of such a summary, the court found that the admission of the summaries was proper inasmuch as the summaries were based solely upon competent evidence already before the jury, i.e., the records themselves.

In the context of an aviation case, virtually any record is susceptible to summary. Thus, assuming relevance and materiality, a summary of the training records of a pilot prepared by another pilot qualified to prepare such a summary (for instance, a certified flight instructor or check pilot), can be offered along with the original records. The benefits of such summaries are obvious—they presumably shorten and simplify what is otherwise a complex and bulky set of records. Additionally, a sufficient number of summaries may be prepared so that each member of the jury may have one during the appropriate testimony without the dangers of distraction by extraneous entries or inability to follow a complex form.

In the Pago Pago litigation, summaries of the Pan American cockpit crew's training records were prepared, although not offered into evidence by the United States. In the case of the captain, the original file was several hundred pages in length, on numerous types of forms with handwritten entries and observations virtually undecipherable to the layperson. A summary of this file, less than thirty pages long, and briefly summarizing every entry in the records, was prepared by a Federal Aviation Administration air

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65 Id. at 678.
66 Id.
70 As actually used at trial, the court placed a time limit on how far back records could be considered relevant. As a result, during cross-examination of one of Pan American's pilots, the original records were utilized due to the limited number needed.

Typical entries on such a summary might have read as follows:


12/28/71  Proficiency Check—707—Repeated glide slope out ILS, failed to get to minimums. Repeated 3 engine ILS and go around, 20° off heading. Received additional training.

12/21/72  Proficiency Check—707—Repeated 3 engine ILS for
carrier operations inspector familiar with Pan American training files. When used in conjunction with the actual records themselves, or blowups of the actual records, the dramatic impact of having the summarized information is multiplied.

5. View of Premises

In aviation cases, the opportunities to view certain types of facts or evidence are numerous. The pitfall is in allowing the trier of fact to see too much. For instance, in allowing a view of an aircraft cockpit where the issues center around the altimeter, there exists a real danger of the trier of fact being either confused by the plethora of electronic devices or being overly impressed by them and thus improperly sympathizing with the pilot. When viewing air traffic facilities, the government is allowed, in effect, to stage the circumstances, time, and conditions of the view because of the nature of the air traffic control operation. The same danger of confusion exists, in this case as does the danger of the trier of fact being overly impressed with the complexity of the operation and the performance of the air traffic controllers then on duty. The bottom line of whether or not a view of the premises in this type of case will even be made, as with other types of demonstrative evidence, rests within the discretion of the court.\(^7\)

If a viewing is permitted, the facts which come to the attention of the trier of fact may be treated as evidence or simply as an aid to a better understanding of the evidence. The courts holding that it is not evidence in the case do so generally on the basis that an appellate court would have no adequate means of determining what evidence was considered in reaching a result.\(^8\) On the other

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\(^7\) Hecht Co. v. Harrison, 137 F.2d 687 (D.C. Cir. 1943); Hop v. Waters, 219 Cal. App. 2d 62, 32 Cal. Rptr. 786 (1963); Coons v. Pritchard, 69 Fla. 362, 68 So. 225 (1915); Manuta v. Lazarus, 104 Misc. 134, 171 N.Y.S. 1076 (City Ct. 1918).

\(^8\) Laflin v. Chicago, W. & N. R. Co., 33 F. 415 (7th Cir. 1887); McCollum v. State, 74 So.2d 74 (Fla. 1954); In re City of New York, 1 N.Y.2d 428, 136
hand, those courts favoring the position that observations made as a result of a view are evidence do so upon the general premise that any distinction between the knowledge of the trier of fact gained by a view and from evidence in the case is artificial and without meaning.\textsuperscript{73}

Of course, one of the primary considerations applicable to a viewing is the purpose for which it is being requested. In the traditional type of tort case, a slip and fall or auto accident situation, a view of the premises or scene where the accident occurred has far more direct impact upon the evidence and issues than would the typical view in an aviation case. In aviation cases, a view of the place where the impact occurred would be of virtually no relevance. Indeed, the negligence alleged in aviation cases traditionally is contended to have occurred in-flight in the cockpit, in an air traffic control tower, in a manufacturing facility or in a Federal Aviation Administration engineering office. Thus, in most aviation litigation these physical places do not themselves play the roles in terms of distances, locations, or physical conditions that intersections, street corners, or store floors play in other types of tort litigation. As a result, the viewing in an aviation case plays more of an informational role than evidentiary role even though the observations may be treated as evidence. Of course, in those cases where there are issues or conflicts as to what instruments were present, their physical relationship to one another or the physical layout of a radar room, a view will play a much more determinative role.

Having decided to request a view, an attorney must strictly establish the parameters of and purpose for the view.\textsuperscript{74} During the \textit{Pago Pago} litigation, Pan American requested a view of a Pan American 707 aircraft with a cockpit substantially similar to that of the aircraft which crashed. While it was opposed by the plaintiffs as causing an unreasonable delay\textsuperscript{75} and susceptible of descrip-

\textsuperscript{73} See, e.g., Snyder v. Massachusetts, 291 U.S. 97 (1934); Owsley v. Hammer, 36 Cal. 2d 710, 227 P.2d 263 (1951).

\textsuperscript{74} See Rodrigues v. Ripley Indus., Inc. 507 F.2d 782 (1st Cir. 1974), wherein it was held that counsel may not conduct tests or experiments at a view but could direct the jury's attention to particular relevant measurements.

\textsuperscript{75} See FED. R. EVID. 403.
tion by way of oral testimony used in conjunction with diagrams and photographs," the court felt that the jury would be aided by actually seeing a cockpit and its instruments available to the crew. At the same time, the aircraft manufacturer, Boeing, requested that there be a demonstration of the opening and closing of one of the cabin doors in connection with the crashworthiness claim against Boeing." While this also was objected to on the grounds of lack of similar circumstances," the court overruled these objections as well, inasmuch as the plaintiffs had raised the issues regarding door operation and seeing an actual operation of the door would aid the jury in understanding verbal descriptions and still photographs."

The view itself took approximately one-half day with approximately two to three jurors sitting in the cockpit at a given time and the trial judge having a Pan American employee point out agreed upon instruments. A court reporter was also present, making a record of the proceedings. The operation of the door was also demonstrated by the Pan American employee at the direction of the judge. Coupled with photographs, slides, and charts of the cockpit layout, the view in that case was an effective tool for putting everything together in the minds of the jury members.

6. Charts, Diagrams And Graphic Testimony

Perhaps the simplest and most basic forms of demonstrative evidence are charts, maps, and diagrams. Virtually every attorney who ever set foot in a courtroom has at one time or another found either himself or one of his witnesses in front of a chalk board, map, or large pad. Indeed, it is common practice to permit the introduction of such evidence where the facts cannot be as easily or clearly described by other means." Of course, there must, as with

76 See, e.g., State v. Coleman, 46 N.J. 16, 214 A.2d 393, cert. denied sub. nom. Coleman v. New Jersey, 383 U.S. 950 (1966) (view of premises denied in a murder prosecution where there were neither evidentiary complexities bearing on times and distances nor reason to believe that the jury had any difficulty in understanding the scene in view of the pictures and diagrams in evidence).

77 Trial Transcript, vol. 36B, at 11,952.


79 Trial Transcript, vol. 36B, at 12,018.

80 Western Gas Constr. Co. v. Danner, 97 F. 882 (9th Cir. 1899); Bergman
all types of evidence of this gender, be a proper foundation laid. It would be futile to attempt to catalogue the uses of this type of demonstrative evidence. Of all the various aids available to the trial lawyer in the presentation of a case, charts or diagrams are probably the most readily acceptable and easily used. Indeed, the extent to which the use of diagrams has been accepted is illustrated by the instance in which a witness in a robbery case was permitted to make a diagram on the courtroom floor of the layout of a building in which the robbery was committed. Drawings made by witnesses while testifying are admissible, even if done on a blackboard which itself is not susceptible of inclusion in the record. As a matter of trial practice, however, it may be wiser to utilize a large artist's pad in lieu of a blackboard or, if a blackboard must be used, to arrange to have photographs taken of diagrams or other material before they are replaced. In addition to witnesses' drawings, there is authority for the proposition that drawings made by attorneys while examining witnesses are also admissible as graphic representations of the witnesses' testimony. It is this last type of graphic evidence that presents the most fertile area for the astute trial lawyer.

In the typical trial setting, the trier of fact listens to the verbal testimony, reviews the documentary or demonstrative evidence and retires to reach a verdict, sometimes with and sometimes without parts of the documentary evidence. On occasion, in the case of a jury, they may ask that certain testimony be re-read to them. The

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[3] See Livergood v. S.J. Groves & Sons Co., 361 F.2d 269 (3d Cir. 1966); Petrich v. Hansen, 204 F.2d 261 (9th Cir. 1953).


trial judge may or may not accede to this request. In virtually no circumstance, however, will the jury be given the entire trial transcript, even assuming the preparation of daily copy. Considering the foregoing circumstance, the beneficial effects of preparing a witness' testimony in graphic form and then having it received into evidence are apparent. Not only is one then able to have a tangible record of the testimony before the jury, but it may then be used with other witnesses or during closing arguments.

During the Pago Pago trial, two government witnesses used extensive graphic testimony. The first was a pilot expert who testified regarding the negligence of the Pan American flight crew. As he testified, each negligent act or omission of the crew was numbered and written on a large pad, approximately twenty-four by thirty-six inches in size. At the conclusion of his testimony, there were twenty-eight individual items listed on three sheets of paper that had hung before the judge and jury throughout his two or three days of testimony. In addition to constantly being before the trier of fact, the sheets were also used by plaintiff's counsel when arguing Pan American's negligence during closing arguments and were available to the jury during deliberations.

The second example of the extensive use of graphic testimony in the Pago Pago trial came with the direct examination of the government's expert on the human visual system. Certain contentions were advanced during trial that the Federal Aviation Administration should have placed obstruction lights on the trees and terrain underlying the approach path, and, if such had been done, the crew would have known they were too low. The United States contended that the type of lighting urged by Pan American and the plaintiff-passengers would not have provided any such guidance

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88 The material taken into the jury room, as with the admission of demonstrative evidence, is a matter typically residing within the sound discretion of the court. Note 5, supra. See also Shane v. Warner Mfg. Corp., 229 F.2d 207 (3d Cir.), appeal dismissed, 351 U.S. 959 (1956); Murray v. United States, 130 F.2d 442 (D.C. Cir. 1942).

87 Without commenting upon the direct effect of this tactic, the jury found three of the four flight crew members negligent and Pan American guilty of wilful misconduct in the operation of the flight which culminated in the accident. See Trial Transcript, vol. 113A.

88 Trial Transcript, vols. 59B-61 (testimony of James L. Harris, Sr.).

89 Trial Transcript, vols. 31-33A (testimony of Jess R. Speckart), and vols. 45A-45B (testimony of C. O. Miller).
and, in fact, would have been misleading. The United States further contended that the exterior lighting available was more than adequate for the crew to know they were too low too early. The foregoing, albeit in a step-by-step form, was presented on a seventy-two by thirty-six inch chart. Along one side of the chart, written in heavy black ink, were the various types of lighting aids available (VASI, runway lights, etc.) or alleged as being needed (obstruction lights). Along the other side of the chart were listed all the various types of information that pilots can derive from ground lights (altitude, rate of descent, attitude, etc.). By drawing horizontal and vertical lines, the resulting boxes were filled in indicating to what extent each type of lighting told a pilot his altitude, rate of descent, etc. Thus, the word “yes” or “no” or “partial” appeared in the boxes indicating the degree to which each type of lighting contributed to the judgment of the involved parameter of flight. On the line for obstruction lights, however, the word “no” appeared all the way across the chart illustrating the expert’s testimony that the lighting of obstructions gave a pilot no information during a night approach. Again, the graphic impact of this visual testimony present throughout the testimony of this witness strengthened the impact of his conclusions. Furthermore, during closing arguments, just the mention of this large chart conjured up and, indeed, summarized the entire testimony of this witness. While the two charts described were prepared in court during the testimony, such charts or diagrams may also be done outside of court and may even be admissible despite the fact that they are prepared by a person not produced as a witness.

There is another use for this type of demonstrative evidence that

90 See note 88, supra.

91 Again, without commenting on the effectiveness of this tactic, both the court and the advisory jury found the United States free of any negligence. Trial Transcript, vol. 113A; see also Order and Judgment of October 6, 1978.


is not quite so common. This is their use in closing arguments without having been previously used in the trial. Arguably, this is nothing more than a derivative of using charts or diagrams as graphic testimony. Recognizing that the plaintiff typically has the right to the last word in closing argument, the use of a diagram or a chart to illustrate counsel's argument will, if allowed, go unrebutted. A skillful advocate will be able to simplify or illustrate the issues in a way most favorable to the client without fear of contradiction. Recognizing the wide discretion afforded the courts in the area of this type of evidence, some courts have permitted this type of use of demonstrative evidence in closing arguments, while others have not.

Some illustrative uses of diagrams and charts in aviation litigation include full-size line diagrams of cockpit layouts available from virtually every aircraft manufacturer or airline for the equipment they operate. Used in conjunction with either actual instruments or photographs, such relatively simple diagrams aid in explaining aircraft operation. Also of significant assistance in explaining the particular circumstances of an approach accident are the flight profiles of the type usually prepared by the National Transportation Safety Board. These charts are typically prepared by using flight data recorder information to derive the flight path and overlaying cockpit voice recorder and air/ground radio communications at the appropriate point on the flight path. The usual objection, assuming a proper foundation by way of National Transportation Safety Board depositions or requests for admission, relates to the use of different horizontal and vertical scales. On this point, the majority of the courts seem to favor the position that difference in scales does not affect admissibility.44


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46People v. Jones, 205 Cal. App. 2d 460, 23 Cal. Rptr. 418 (1962); Andrews v. Cardosa, 97 So.2d 43 (Fla. 1957) (counsel in this case also attempted to give pads and pencils to the jury during final arguments to permit them to make notes); Zube v. Weber, 61 Mich. 52, 34 N.W. 264 (1887).

47See, e.g., Grayson v. Williams, 256 F.2d 61 (10th Cir. 1958); Hart v. Grim, 179 F.2d 334 (8th Cir. 1950); State v. Smith, 357 S.W.2d 120 (Mo. 1962).
Another far more typical and certainly controversial question involving these types of exhibits grows out of the National Transportation Safety Board's use of a computer to plot the flight profile. Since the innovation of the digital flight data recorder and the ARTS III radar equipment, the aviation accident investigation community has been relying more and more on these impartial arbiters of flight path. Inextricably involved in such reliance is the computer which, in the case of the flight data recorder and the ARTS III recording, plots the flight path from ground based computer data and airborne recording equipment (DFDR) respectively.

7. Computer Evidence

Of all the types of evidence available to the trial lawyer today, the one that is probably the least used is computer-generated evidence. This is probably due to its relative newness as compared with other more conventional types of evidence. The present uses of the computer in litigation are most widespread in connection with the organization of files and depositions, maintenance of accounting records or, in the trial setting, with the presentation of computer printouts in lieu of ledger books and accounting records. Few lawyers are conversant with the full capabilities of the computer in the litigation setting and very little use of it has been made in connection with demonstrative evidence. In aviation litigation, the computer has a unique capability.

A large number of lawsuits arising out of airplane crashes result in controversies over whether the pilot, in the case of a mid-air collision, had the superior vantage point or, alternatively, whether the air traffic controller had a superior vantage point. In any event, the issue often comes down to an air traffic controller testifying as to what he could or could not see and various pilots or

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98 For an extensive discussion of flight data recorders, see National Transportation Safety Board Special Study—Flight Data Recorder Readout Experience In Aircraft Accident Investigation 1960-1973 (1975).
101 Id.
other experts testifying as to angles, locations or other elements resulting in an ultimate conclusion as to what could be seen by whom. While certainly not providing the ultimate solution, the introduction of the computer into this situation allows counsel to supplement a position with computer-generated photographs depicting what both pilots and controllers could see at a given time under given conditions.

In the typical type of mid-air collision factual situation, which involves a collision in the traffic pattern on a visual flight rules (VFR) day, the computer-generated photograph would depict, on a progressive basis, what the controller and each pilot could see from his individual vantage point. In a landing or approach type accident, the computer-generated photographs would depict the scene from the cockpit as the aircraft progressed on the approach. These photographs are created through the use of an IBM 360/44 computer in conjunction with a scanner focused on a model aircraft which converts optical signals into electrical signals. The software program utilized to process these signals in the computer is able to produce photographs of what the aircraft would look like at various distances and angles in varying atmospheric conditions or in relation to a second converging aircraft. The program is also able to recreate the exterior scene as perceived from an aircraft during an approach under various types of atmospheric and meteorological conditions.

While an attempt to describe the technical aspects of this process would be beyond the scope of this article, there are certain basics that are needed in order to create a relevant, material and competent computer photograph. These basics are very similar to those needed for the videotape animation. If such photographs are needed from the vantage point of the air traffic controller looking towards an aircraft on approach, it is necessary that the atmospheric conditions, distances, flight path and attitude, aircraft size, and configuration be specified. If given reliable information, the

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105 See section 1, supra.
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computer will be able to create a series of photographs depicting the changing view of the aircraft as perceived from the tower by processing images taken of an aircraft model. The next logical step would be to create a motion picture or videotape from these photographs which could, in effect, be an instant replay of an accident as perceived from the cockpit or the ground. Of course, considering the potential impact of this type of evidence, the foundation material needed to create it is of paramount importance. Of the necessary items, the flight path information has the most potential for variation, although the ground borne ARTS III recording equipment and the airborne digital flight data recorders do much to dispel some of the guesswork associated with this aspect. On the other hand, should the only evidence on flight path be the testimony of eyewitnesses, there must be a judgment made as to the ability to create a reliable series of computer photographs.

From a general evidentiary standpoint, computer printouts have been considered to be original documents, as are computer tapes. While most of the case law that has developed in connection with computer-generated evidence centers on computerized business or accounting records, there is no reason why the same argument advanced in those cases, coupled with competent foundation evidence and expert testimony, would be less than successful in the context of aviation litigation. Inasmuch as the computer photographs, which can be considered printouts, would presumably be coupled with expert testimony regarding flight visibility and the capabilities and limitations of the human visual system, there seems to be a substantial argument that such evidence is illustrative of expert opinions and admissible in the same way that printouts or charts and diagrams are admissible. Of course, the mysticism surrounding the computer in general and this use of it in particular is a hurdle that must be acknowledged and prepared for in advance of trial. The most effective means of doing so is to

couple this type of evidence with, and make it subsidiary to, expert testimony in the area of flight visibility as related to the facts of the case.

Conclusion

The use of demonstrative evidence is an effort that is limited in large part by the imagination of the trial lawyer. As can be seen from the foregoing discussion, the conventional legal principles regarding admissibility are applicable whether blackboard drawings or videotapes are involved. The keys to admissibility are: 1) a recognition of those elements of the case that require and are susceptible to the use of demonstrative evidence; and 2) an ability to properly prepare the evidence out of court and lay the proper foundation in court. While newer and better techniques may become available to illustrate the case through demonstrative evidence tools, the requirements of admissibility remain of paramount importance for no matter how innovative the technique, it is little more than an academic exercise if not properly prepared for admission.