

Chapter 5

Physical Evidence

Collecting Physical Evidence

TIP

To ensure consistent documentation, control, and security, it may be useful to designate a single team member or the administrative coordinator to be in charge of handling evidence.

The investigative team proceeds in gathering, cataloging, and storing physical evidence from all sources as soon as it becomes available. The procedures for access to, and the controlling of, evidence may be subject to National Legal requirements which vary from country to country. The most obvious physical evidence related to an accident or accident scene often includes solids such as:

- Equipment
- Tools
- Materials
- Hardware
- Pre- and post-accident positions of accident-related elements
- Scattered debris
- Patterns, parts, and properties of physical items associated with the accident.

Less obvious but potentially important physical evidence includes fluids (liquids and gases). Ships use a multitude of fluids, including chemicals, fuels, hydraulic control or actuating fluids, and lubricants. Analyzing such evidence can reveal much about the operability of equipment and other potentially relevant conditions or causal factors. Care should be taken if there is pathogenic contamination of physical evidence (e.g., blood); such material may require autoclaving or other sterilization. Specialized technicians experienced in fluid sampling should be employed to help the team collect and analyze fluid evidence. If required, expert analysts should be requested to perform tests on the fluids and report results to the team.

High speed vessel collisions or accidents involving explosions by result in an accident scene that is contaminated with human blood, body fluids or tissue remains. Upon entering such a scene, the investigative team must take proper precautions to protect itself from exposure to bloodborne pathogens. When handling potential bloodborne pathogens, universal precautions such as those listed in Appendix I, Chapter 5 should be observed to minimize potential exposure. All human blood and body fluids should be treated as if they are infectious. The precautions listed should be implemented for all potential exposures. Exposure is defined as reasonable anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials. Physical evidence should be systematically collected, protected, preserved, evaluated, and recorded to ultimately determine how and why failures occurred and whether use, abuse, misuse, or nonuse was a causal factor.

Documenting Physical Evidence

Evidence should be carefully documented at the time it is obtained or identified. The Accident Investigation Physical Evidence Log can help investigators document and track the collection of physical evidence. In a multi-investigator team investigation, the use of an evidence log will prevent several investigators asking for the same piece of evidence, thereby avoiding duplication of effort. Additional means of documenting physical evidence include sketches, maps, photographs, and videotape.

Sketching and Mapping

Sketching and mapping the position of debris, equipment, tools, and injured persons may be initiated by the team as soon as it arrives on scene. Position maps convey a visual representation of the scene immediately after an accident. Evidence may be inadvertently moved, removed, or destroyed, especially if the accident scene can only be partially secured. Therefore, sketching and mapping should be conducted immediately after recording initial witness statements.

Precise scale plottings of the position of elements can subsequently be examined to develop and test accident causal theories.

Photographing and Videotaping Physical Evidence

Photography is a valuable and versatile tool in accident investigation. Photos or videos can identify, record, or preserve physical accident evidence that cannot be effectively conveyed by words or collected by any other means.

Photographic coverage should be detailed and complete, including standard references to help establish distance and perspective. Videotapes should cover the overall accident scene, as well as specific locations or items of significance. A thorough videotape allows the team to minimize trips to the accident scene. This may be important if the scene is difficult to access or if it presents hazards.

Good photographic coverage of the accident is essential, even if photographs or video stills will not be used in the investigation report. However, if not taken properly, photographs and videos can easily misrepresent a scene and lead to false conclusions or findings about an accident. Therefore, whenever possible, accident photography and videotaping should be performed by professionals. Photographic techniques that avoid misrepresentation, such as the inclusion of rulers and particular lighting, may be unknown to amateurs but are common knowledge among professional photographers and videographers.

Even if photos are taken by a skilled photographer, the investigation team should be prepared to direct the photographer in capturing certain important perspectives or parts of the accident scene. Photographs of evidence and of the scene itself should be taken from many angles to illustrate the perspectives of witnesses and injured persons. In addition, team members may wish to take photos for their own reference. If available, digital photography will facilitate incorporation of the photographs into the investigation report. However, if this is not practical, high-quality 35mm photographs can be scanned for incorporation in the report.

As photos are taken, a log should be completed noting the scene/subject, date, time, direction, and orientation of photos taken, as well as the photographer's name and camera settings.

Inspecting Physical Evidence

Following initial mapping and photographic recording, a systematic inspection of physical evidence can begin. The inspection involves:

- Surveying the involved equipment, vehicles, structures, etc., to ascertain whether there is any indication that component parts were missing or out of place before the accident
- Noting the absence of any parts of guards, controls, or operating indicators (instruments, position indicators, etc.) among the damaged or remaining parts at the scene
- Identifying as soon as possible any equipment or parts that must be cleaned prior to examination or testing and transferring them to a laboratory or to the care of an expert experienced in appropriate testing methodologies
- Noting the routing or movements of records that can later be traced to find missing components
- Preparing a checklist of complex equipment components to help ensure a thorough survey.

These observations should be recorded in notes and photographs so that investigators avoid relying on their memories. Some investigators find a small cassette tape recorder

useful in recording general descriptions of appearance and damage; however, the potential failure of a recorder, inadvertent tape erasure, and limitations of verbal description suggest that verbal recorded descriptions should be used in combination with notes, sketches, and photographs.

Removing Physical Evidence

Following the initial inspection of the scene, investigators may need to remove items of physical evidence. To ensure the integrity of evidence for later examination, the extraction of parts must be controlled and methodical. The process may involve simply picking up components or pieces of damaged equipment, removing bolts and fittings, cutting through major structures, or even recovering evidence from beneath piles of debris. Before evidence is removed from the accident scene, it should be photographed and its position noted on an appropriate sketch of the scene. Remember, once it has been moved, it will never be able to be returned to exactly the same position that it occupied before it was moved. It should then be carefully packaged and clearly identified. The readiness team or a pre-assembled investigator's kit can provide general-purpose cardboard tags or adhesive labels for this purpose.

Equipment or parts thought to be defective, damaged, or improperly assembled should be removed from the accident scene for technical examination. If improper assembly is suspected, investigators should direct that the part or equipment be photographed and otherwise documented as each subassembly is removed.

Items that have been fractured or otherwise damaged should be packaged carefully to preserve surface detail. Delicate parts should be padded and boxed. Both the part and the outside of the package should be labeled. Greasy or dirty parts can be wrapped in foil and placed in polyethylene bags or other nonabsorbent materials for transport to a testing laboratory, command center, or evidence storage facility. If uncertainties arise, subject matter experts can advise the board regarding effective methods for preserving and packaging evidence and specimens that must be transported for testing.

When preparing to remove physical evidence, these guidelines should be followed:

- Normally, extraction should not start until witnesses have been interviewed, since visual reference to the accident site can stimulate one's memory
- Extraction and removal or movement of parts should not be started until position records (measurements for maps and photographs) have been made
- Be aware that the accident site maybe unsafe due to dangerous materials or weakened structures
- Locations of removed parts can be marked with orange spray paint or wire-staffed marking flags; the marking flags can be annotated to identify the part removed and to allow later measurement

- Care during extraction and preliminary examination is necessary to avoid defacing or distorting impact marks and fracture surfaces
- The lead investigator and team members should concur when the parts extraction work can begin, in order to assure that board members have completed all observations requiring an intact accident site.

Collecting Documentary Evidence

Documentary evidence can provide important data and should be preserved and secured as methodically as physical evidence. This information might be in the form of logbooks, equipment readouts, course recorder traces, licenses, documents, certificates, papers, photos, videotape, magnetic tape, or electronic media, either at the site or in files at other locations.

Some work/process/system records are retained only for the workday or the week. Electronic data is often stored in a memory buffer and is overwritten as new data is acquired. Once an accident has occurred, the investigator must work quickly to collect and preserve these records so they can be examined and considered in the analysis.

In some cases it may be necessary to obtain the services of a suitably competent translator.

Accident investigation preplanning should include procedures for identifying records to be collected, as well as the people responsible for their collection. Because records are not always located at the scene of the accident, and some documents may be overlooked in the preliminary collection of evidence.

Documents often provide important evidence for identifying causal factors of an accident. This evidence is useful for:

- Thoroughly examining the policies, standards, and specifications that molded the environment in which the accident occurred
- Indicating the attitudes and actions of people involved in the accident
- Revealing evidence that generally is not established in verbal testimony.

Documentary evidence generally can be grouped into four categories:

- Management control documents that communicate management expectations of how, when, where, and by whom work activities are to be performed
- Records that indicate past and present performance and status of the work activities, as well as the people, equipment, and materials involved

- Reports that identify the content and results of special studies, analyses, audits, appraisals, inspections, inquiries, and investigations related to work activities
- Follow-on documentation that describes actions taken in response to the other types of documentation.

Collectively, this evidence gives important clues to possible underlying causes of errors, malfunctions, and failures that led to the accident.

Analysis of documents may involve two major aspects, cross checking documents from different sources that contain the same information or scientific analysis.

Analysis could include cross checking the bridge movement or "bell" book with the engine room records. It cannot be emphasized enough that contemporaneous records, those made at the time, are of value, fair copies of log books, e.g. the scrap log copied out in a fair hand are of limited value. Of greater value is the cross checking of ship's records with external sources such as VTS tapes, harbor control tapes or log books, cargo terminal records, police records, customs records, or even TV or radio recordings.

Investigators must keep an open mind and think latterly asking "who else may have similar information".

Photocopies. Investigators should be sensitive to the possibility that photocopies of documents may not truly depict the original document. Erasures and/or the use of "white out" correction liquids, which may be apparent on the original document, may not show up on a photocopy of the document. Further, as in the case of logbooks, entire pages may be removed. If the investigator does not examine the original document, he will not know for sure that the photocopy provided him is, in fact, a true and accurate copy. Before photocopies of documents are accepted, the investigator should compare the copy with the original to assure that there have been no alterations to the original.

Marine Documents. A list of maritime documentation that may be collected or reviewed during a marine accident investigation can be found on Appendix II of Chapter 5. The list while lengthy, is far from complete. The specific documents needed by the investigator will vary depending on the type of accident.

International Safety Management System

Accident investigations must thoroughly examine organizational concerns, management systems, and line management oversight processes to determine whether deficiencies in these areas contributed to causes of the accident. The investigation team should consider the full range of management systems through all levels of management in accordance with the International Safety Management (ISM) Code. It is important to note that this focus should not be directed toward individuals.

The ISM Code documentation should be inspected as a matter of routine. It is important to ensure that the procedures in the code are adhered to.

The ship operator's "Documentation of Compliance" is valid for 5 years, subject to annual verification. The ship's "Safety Management Certificate" is valid for 5 years subject to periodical verification by the administration.

All aspects of the code are important to an investigator and include but are not confined to the following.

- ◇ Training (ISM Code 6.3)
- ◇ Passage planning and procedures with pilot embarked (ISM Code ?)
- ◇ Information and language of ISM Code.(ISM Code 6.6)
- ◇ Plans, instructions, check lists for the safety of the ship and pollution prevention.(ISM Code 7.0)
- ◇ Emergency preparedness (ISM Code 8.0)
- ◇ Reporting non-conforming incidents (ISM Code 9.1)
- ◇ Corrective Action (9.2)
- ◇ Maintenance (ISM Code 10.1)
- ◇ Critical equipment (ISM Code 10.3)
- ◇ Documentation (ISM Code 10.1)
- ◇ Record of internal audits (ISM Code 12.3)

If there was a departure from the code it is important to identify the non-conformity to establish whether the departure was consistent with reasonable decision making (see Course 1.3.4). Depending upon the incident it may also be necessary to check the ship's reporting of "non-conforming incidents"(ISM Code 9.1) and the management receipt of such records and subsequent action, which may include a record of corrective action (ISM Code 9.3).

Preserving and Controlling Evidence

Preserving and controlling evidence are essential to the integrity and credibility of the investigation. Security and custody of evidence are necessary to prevent its alteration or loss and to establish the accuracy and validity of all evidence collected. The point of contact is responsible for assuring that a chain of custody is established for all evidence removed from the accident scene before the board arrives. The board chairperson is responsible for establishing an evidentiary custody protocol to ensure that all evidence is well documented at the accident scene and carefully controlled when it is removed and stored after the board arrives. Evidence control procedures similar to the following guidelines will help assure that evidence is not adulterated, corrupted, or lost and that subsequent engineering tests, if conducted, and other analytical results are valid.

- Evidence should be photographed and/or videotaped in its original location immediately following the accident, provided it does not interfere with rescue or amelioration activities.
- A log should be maintained stating the location, date, and time that photos and videos are taken. The Accident investigation Photographic Log Sheet can be used for this purpose. Avoid using photographic attachments that digitally record the date and time on the negative because these images become a permanent part of the photo and may obscure evidence or important details in the photo or video. The computerized/printed date on the back of photos provided by film processors should be used in conjunction with, not in lieu of, a photo log, because the date on photos gives the day the film was processed, not the day the photos were taken.
- Board members should prepare and sign an inventory of all evidentiary items collected, including statements regarding:
 - Lists of items removed from the scene
 - Date and time items were removed from the scene
 - Person who removed items from the scene
 - Location where those items will be stored.
- Evidence should be controlled by signature transfer (signatures of the recipient and the person relinquishing custody) and made available only to those who need to examine and use the evidence during the accident investigation. The Accident Investigation Physical Evidence Log Form may be used for this purpose.
- Secure storage should be obtained immediately, and access to evidence controlled throughout the investigation.
- Access to the room or suite of offices used by the investigation board should be restricted. No one other than board members, advisors, and support staff should have access to the board's office space; this includes janitorial staff.
- The board chairperson should determine the disposition of evidence at the conclusion of the investigation.

Documentary evidence can easily be over-looked, misplaced, or taken. Documents can be altered, disfigured, misinterpreted, or electronically corrupted. Computer software and disks can be erased by exposure to magnetic fields. As with other evidence collected during the investigation, documentary evidence should be collected, inventoried (logged), controlled, and secured (in locked containers, if necessary.)

APPENDIX I - Chapter 5

Universal Precautions to Prevent Contact with Bloodborne Pathogens

On December 6, 1991, the U.S. Occupational Safety and Health Administration (OSHA) issued the regulation called "Occupational Exposure to Bloodborne Pathogens (BBP)," found in Title 29, Section 1910.1030 of the Code of Federal Regulations. The standard covers those occupations having a high potential for exposure to bloodborne pathogens, including law enforcement, emergency response, and accident investigation personnel. Individuals covered by this standard should observe Universal Precautions to prevent contact with human blood, body fluids, tissues and other potentially infectious materials. Universal Precautions require that employees treat all human blood, body fluids, or other potentially infectious materials to be infectious for hepatitis B virus (HBV), human immunodeficiency virus (HIV), and other bloodborne pathogens. Appropriate protective measures to be taken to avoid direct contact with these materials include:

- Use barrier protection at all times.
- Prohibit eating, drinking, smoking, or applying makeup at the accident scene/mass disaster.
- Use gloves when there may be hand contact with blood or other potentially infectious materials. Gloves should always be worn as if there are cuts, scratches, or other breaks in the skin. In some instances where there is heavily contaminated material, the use of double gloves is advisable for additional protection.
- Change gloves when contaminated or as soon as feasible if torn, punctured, or when their ability to function as a barrier is compromised.
- Always wash hands after removal of gloves or other personal protective equipment (PPE). The removal of gloves and other PPE should be performed in a manner which will not result in the contamination of unprotected skin or clothing.
- Wear safety goggles, protective facemasks or shields, or glasses with side shields to protect from splashes, sprays, spatters, or droplets of blood or other potentially infectious materials. These same precautions must be taken when collecting dried stains for laboratory analyses.
- Use disposable items, such as gloves, coveralls, shoe covers, etc., when potentially infectious materials are present.
- Place contaminated sharps (e.g. broken glass, needles, knives, etc.) in appropriate leak-proof, close-able, puncture-resistant containers when these sharps are to be discarded, transported, or shipped. If transported or shipped, containers should be appropriately labeled.
- DO not bend, recap, remove, or otherwise handle contaminated needles or other sharps.
- Use a protective device, such as a CPR mask, when performing mouth-to-mouth resuscitation.
- Decontaminate all equipment after use with a solution of household bleach (diluted 1:10), 70% isopropyl alcohol, or other appropriate disinfectants.
- After all evidence has been collected and the crime scene has been released, the owner or occupants of the affected property should be made aware of the potential risks from bloodborne pathogens.
- Evidence containing blood or other body fluids should be completely dried before it is packaged and shipped to the laboratory for analysis. Appropriate biohazard warning labels must be affixed to the evidence container indicating that a potentially infectious material may be present.

APPENDIX II - Chapter 5

A. Plans, Diagrams and Lists

1. General arrangement plans
2. General arrangement of engineroom machinery (elevation & plan views)
3. Shell expansion plans
4. Capacity plan
5. Main engine control system plans and description
6. Main engine fuel oil supply and return pumping/piping and tanks plans
7. Fuel oil service and transfer pumping/piping system plans and description
8. Fuel oil tank venting piping plan
9. Engineroom ventilation system plans
10. Passenger and crew ventilation system plans
11. General loading plans and procedures
12. Ullages and ullage tables
13. Bilge pumping and piping diagram and system description
14. Cargo pumping & piping plans and system description
15. Cargo tanks venting piping plans
16. IGS plans and system description
17. Ballast pumping & piping plans and description
18. Ballast tanks venting piping plans
19. Ballast tank coatings
20. Damage control plan (fire doors dampers, etc)
21. Fire detection plans and system description
22. Firemain piping & pumping system and description
23. CO piping system diagram and system description
24. Foam piping system diagram and description
25. Halon system diagram and description
26. One line electrical distribution diagram
27. List of bridge/radio room communication equipment
28. List of vessel navigation equipment

B. Statutory and Other Certificates

1. Gross tonnage/deadweight tonnage
2. Copy of the U.S. Certificate of Inspection (U.S. vessel only)
3. Copy of Cargo Ship Safety Construction Certificate
4. Copy of Cargo Ship Safety Radio Certificate
5. Copy of Cargo Ship Safety Equipment Certificate
6. Copy of MODU Certificate
7. Copy of Passenger Ship Safety Certificate
8. Copy of International Load Line Certificate
9. Copy of International Oil Pollution Prevention Certificate
10. Copy of Certificate of Class for Hull and Machinery
11. Copy of Vessel Radio Communication License

12. Minimum Safe Manning Certificate
13. Ship's Certificate of Registry
14. Copy of Control Verification Certificate
15. Copy of Certificate for fire extinguishing system inspection
16. International Safety Management System (ISM) Documentation
17. Copies of Officers' licenses and STCW Certificates ratings STCW certificates

C. Charts, Log Books and Other Records

1. Chart of area of casualty
2. Bunkering records
3. Crew list with addresses
4. Name and addresses of *previous* master, chief mate, and chief engineer
5. Passenger list with addresses
6. Passenger boarding passes
7. Cabin assignments for passengers and crew
8. Terminal generated checklist and cargo loading/discharge data sheets
9. Vessel generated checklist and cargo loading/discharge data sheets
10. Liquid cargo data sheets
11. Analysis of cargo samples
12. Deck log (smooth and rough)
13. Cargo control room log (smooth and rough)
14. Engine log (smooth and rough)
15. Radio log (smooth and rough)
16. Boiler/main engine maintenance log
17. Original of course recorder printout at time of casualty
18. List of certificated lifeboatman
19. On-board crew conducted repair and maintenance records for one year prior to accident
20. On-board repairs conducted by shore side company or personnel
21. Vessel repair/spare parts requisitions to company
22. Copy of last shipyard repair/survey specifications
23. Classification survey reports (annual and special and damage surveys)
24. Copy of the bridge record card
25. Port State and Flag State inspection reports (annual & drydocking)
26. Independent survey reports by insurance, towing, and/or fire/explosion specialist.
27. Copy of Control Verification Examination Booklet
28. Passenger and crew medical log (ship's doctor/purser)
29. Shore Fire Department response records
30. Dangerous Stores Manifest
31. Trim and Stability Booklet

D. Operating Procedures and Manuals

1. Oil transfer procedures for cargo and bunkers (fuel)
2. From the vessel's operation manuals:
main and emergency electrical power system description, engineroom control system, mooring gear on deck, cargo pumping and piping system description, ballast pumping and piping system description, steering and control system, boiler automation control system
3. List of safety manuals maintained on vessel
4. Company and vessel procedures for tank opening and entry
5. Oxygen Analyzing equipment specifications (model & type) and operating manual
6. Combustible gas analyzer (model & type) and operating manual
7. Description of the vessel's planned maintenance system
8. Lifeboat and liferaft launching plan
9. Vessel Evacuation Plan
10. Copy of posted firefighting procedures for engine room and other spaces
11. Specific company orders to masters/chief engineers
12. Standing orders of ship master/chief mate/chief engineer.
13. Company training records for officers and crew
14. Company training and safety manuals
15. Station Bill
16. Company/vessel firefighting procedures
17. SAR data, including communication tapes from RCCs involved
18. Operating manual including stability control (MODU)

E. Miscellaneous

1. 8x10 pre-accident color photo of vessel (profile view)
2. General vessel characteristics
3. Bunker analysis from terminal and samples on vessel and at terminal
4. Fuel oil heating in tanks and through engineroom heaters
5. Type of tank gauging system
6. Previous accidents to this vessel, sister vessels, type and class
7. Loading Plan for last cargo(s)
8. Cargo regulations
9. Type of blowers (fans) used to vent tanks
10. Description of all temporary and permanent post-casualty repairs
11. List of the quantity and location of steel plating and internals (including piping) removed post-casualty prior to drydocking and at drydocking
12. Copy of next shipyard repair/survey specifications
13. Company organization chart

