# S1000D/SCORM Redundancy Analysis and Conversion Guidelines Final Report

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The views, opinions, and findings contained in this report are those of the author(s) and should not be construed as an official Department of Defense (DoD) position, policy, or decision unless so designated by other official documentation.

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# Executive Summary

The AeroSpace and Defence Association of Europe/Aerospace Industries Association (ASD/AIA) S1000D and the Advanced Distributed Learning (ADL) Sharable Content Object Reference Model (SCORM) are specifications designed to accommodate specific content and data production needs for their respective Department of Defense (DoD) communities. The technical documentation community uses S1000D, and the training community uses SCORM. Frequently, both communities use the same authoritative source; however, the way they use this source differs considerably because of differences in their products and their focus. Harmonization of these communities and the S1000D and SCORM specifications to enable the development of dual-purpose content would achieve multiple data-production and life-cycle efficiencies. Hence, this project investigated methods to convert legacy content to accommodate both communities via integrated content development.

The hypothesis for this study was that S1000D can be used to name, identify, and structure technical training content without adversely affecting instructional design, learning content, or the science of learning.

The S1000D/SCORM Redundancy Analysis and Conversion Guidelines Final Report documents a case study that involved the identification and development of dual-purpose S1000D data modules (DMs) from legacy technical content that could be used not only in a technical publication but also in training. The source material for the case study included legacy technical documentation and training materials for three systems: the AEGIS Air Control Panel Assembly, the AN/AQS-20A towed body (hereafter referred to as the Q-20), and various systems on the F/A-18A/B/C/D. The DMs created for the project were used to create two 15-minute instructional modules and two IETMs, one each from the AEGIS materials and from the Q-20 materials. Although DMs were identified for the F/A-18 content, no instruction was developed.

Findings for the analysis were as follows:

- The way that the authoritative technical source content was written made it inappropriate for reuse as training content.
- Training requires greater granularity in source data than is needed by technical documentation.
- The S1000D data module code (DMC) provides only one character to identify content used in training.
- S1000D architecture does not support complex interactivity.
- Using DMs as assets in SCORM content packages presents no barrier to SCORM conformance.
- Use of S1000D DMs with a workflow that allowed instructional designers to plan how DMs can best be used in the presentation of training did not affect instructional efficacy.

Based on these findings, the following conclusions were reached:

- Development of dual-purpose S1000D DMs is most effective through close collaboration between technical and training representatives.
- Appropriate DM granularity is best determined through collaboration between the technical and training communities.
- The S1000D DMC does not allow for capture of all the descriptive metadata that needs to be associated with reusable learning objects.
- If complex interactions are used in the training content, they must be captured in DMs as self-contained Flash files.
- Using S1000D data modules to capture training information does not affect instructional efficacy as long as the workflow does not subvert instructional design processes.

This report provides the following recommendations for harmonizing S1000D and SCORM:

- Revise the S1000D specification to accommodate SCORM metadata.
- Explore other options for handling complex interactions.
- Develop an S1000D/SCORM-conformant data management and publishing environment.
- Ensure that the Manpower, Personnel, Education and Training (MPT&E) commands mandate conformance of content with both S1000D and SCORM.
- Ensure that acquisition documents specify collaboration between the technical and the training community during development of technical content.
- Ensure that technical and training representatives on a technical content development effort understand each other's positions and the basic requirements for both S1000D and SCORM.
- For maximum reusability, write S1000D technical content with dual use in mind and then subject it to the technical content verification and validation process.

It also provides the following content analysis and conversion guidelines for the development of dual-purpose DMs that can be used in both technical documentation and SCORM-conformant training:

- Conduct content analysis.
- Establish collaboration between technical and training communities.
- Determine granularity and chunking.
- Determine procedures and SCOs to create dual-purpose DMs.
- Identify appropriate workflow.

# 1. Introduction

## *1.1 Background*

The U.S. Navy spends millions of dollars every year for the development of technical publications and technical training, including the conversion of classroom training to online training. These two types of acquisitions—documentation and training—differ in their focus, production specifications, and resulting products. Systems acquisitions require the development of verified and certified technical documentation, either in print or digital formats. S1000D is a widely used specification for the production of technical documentation, resulting in hardcopy and interactive electronic technical manuals (IETMs).

On the other hand, training acquisitions—both new training and conversion efforts—focus on the development of products that provide not only technical information but also the cognitive support needed for learners to understand the content, remember it, and be able to transfer it to their jobs. For online training and performance-support products, the guiding specification is the Sharable Content Object Reference Model (SCORM).

Currently, these two types of acquisition are distinct from each other; a contract for one does not reference the other except possibly as source material. The S1000D/SCORM Redundancy Analysis and Tagging Guidelines project was an effort to recognize the interrelatedness of technical-publication and technical-training development, to determine whether content can be developed in such a way that it can be utilized for both purposes without undermining the underlying focus of each, and to develop guidelines for the analysis and development of dual-purpose technical content.

Harmonization of S1000D and SCORM to enable the development of dual-purpose content would achieve the following efficiencies:

- Increasing return on investment (ROI) by meeting the Navy's "develop once, use multiple times" directive
- Saving training dollars by eliminating the need for separate training and technical documentation acquisitions
- Ensuring that changes made to the original source are reflected in all products that use that source

## *1.2 S1000D and SCORM Overview*

### *1.2.1 S1000D*

S1000D is an open, neutral, international standards-based specification for the production of technical documentation. It is based on ISO 8879 (Information Processing—Text and Office Systems—Standard Generalized Markup Language [SGML]). While the specification is predicated on electronic concepts, it is not a software

specification. Its function is to specify how technical information is scoped, authored, managed, and processed for presentation on screen, on paper, or both. The specification contains SGML Document Type Definition (DTD) and eXtensible Markup Language (XML) schemas, in accordance with ISO 8879 and the W3C, which describe the structure and metadata of the information that comprises the technical publications.

The basic unit of content in S1000D is the data module (DM). A DM is a discrete piece of information that is stored and managed within a common source database (CSDB). DMs house a number of different types of technical information:

- Descriptive information
- Procedural information
- Maintenance planning information
- Fault diagnostic information
- Crew information
- Wiring data
- Parts data

There is also a type of DM that provides for context-sensitive navigation, called a process data module.

The S1000D data module code (DMC) provides a standardized naming convention for DMs. It comprises a number of major elements, each of which provides specific intelligence relating to the content:

1. *Model Identification code (MI)*. This element holds the project name. For AEGIS, the MI was set to "NAVSEAXXX" and for Q-20 it was set to "ANAQSXX20." It should be noted that for the Q-20, there was also information of a general safety nature. This information was treated as though it would be a suite of common "hazard data modules" and so was allocated a project name of "GENERALHAZARD." Following is an example with the MI highlighted:

   YYYYYYYYYYYYY-YYYY-YYY-YY-YYYY-YYYYY-YYYY-Y

2. *System Difference Code (SDC).* The SDC is a one- to four-character alphanumeric descriptor that indicates alternative versions of the system, subsystem, and sub-subsystem identified by the SNS. Following is an example with the SDC highlighted:

   YYYYYYYYYYYYY-YYYY-YYY-YY-YYYY-YYYYY-YYYY-Y

3. *Standard Numbering System (SNS)*. The SNS, which is composed of three groups of characters, essentially provides an alphanumeric code that reflects the physical, functional, or combined physical and functional breakdown of the subject equipment. Typically, the SNS is expressed as a system, subsystem, and sub-subsystem breakdown. The sub-subsystem is a child of the subsystem, which in turn is a child of the system. The more "descriptive" the SNS, the finer the granularity of the data modules. Following is an example with the SNS highlighted:

   YYYYYYYYYYYYYY-YYYY-YYY-YY-YYYY-YYYYY-YYYY-Y

4. *Disassembly Code (DC)*. The DC provides an opportunity for further breakdown should the content require a finer level of granularity. It is also used for sequential numbering of illustrated parts data modules. The final three characters in a 5-character DC identify the Disassembly Code Variant (DCV). Following is an example with the DC/DCV highlighted:

   YYYYYYYYYYYYYY-YYYY-YYY-YY-YYYY-YYYYY-YYYY-Y

5. *Information Code (IC)*. The IC is an alphanumeric code that describes a task associated with the subject equipment. For example, an SNS of 40-00-00 (describing a Control Panel) and an IC of 520 (defined as "remove") would mean that the data module describes how to remove the Control Panel. The final character in the IC is the Information Code Variant, which is a unique identifier for any variation in the activity defined by the IC. Following is an example with the IC/ICV highlighted:

   YYYYYYYYYYYYYY-YYYY-YYY-YY-YYYY-YYYYY-YYYY-Y

6. *Item Location Code (ILC)*. The ILC describes where an item should be physically located (on vehicle, off vehicle, etc.) before the task can be carried out or where the equipment information is applicable. Following is an example with the IC/ICV highlighted:

   YYYYYYYYYYYYYY-YYYY-YYY-YY-YYYY-YYYYY-YYYY-Y

### *1.2.2 SCORM*

SCORM is a set of technical specifications and guidelines that focus on the interface between training content and a conformant enterprise management system such as a content management system (CMS), learning management system (LMS), or an LMS/CMS hybrid learning content management system (LCMS). SCORM consists of four parts:

(1) An overview of the model, vision, and future of the SCORM

(2) The Content Aggregation Model (CAM), which defines how to put learning content together so it can be moved and reused

(3) The run time environment (RTE), which launches content, tracks the learner's progress, and reports progress back to the LMS

(4) The SCORM Sequencing and Navigation specification, which sets and governs the rules for the behaviors of aggregations of SCOs within a SCORM-conformant environment.

Together, these four parts provide a common standard for development and delivery of learning content for ingesting, cataloging, and rendering in a conformant learning management system (LMS).

Whereas the basic unit in S1000D is the data module, the basic building block of SCORM content is the Shareable Content Object (SCO). SCOs, in turn, are made up of assets, such as graphics, animations, audio, movies, and text. Each SCO is a stand-alone block of SCORM-conformant content that can be launched by an LMS. For this reason, all learner performance data is tracked at the SCO level. Although SCORM does not specify the granularity of a SCO, developers of online military training generally define a SCO as the content that supports a single learning objective. Groups of SCOs may be aggregated to form a learning event. In the Navy Integrated Learning Environment (ILE), a learning event is an individually tailored sequence of SCOs aggregated to help a learner attain a specified level of performance.

### *1.2.3 Basic Similarities and Differences*

Both S1000D and the SCORM are internationally used technical specifications that govern modular content. However, whereas S1000D is geared toward production, storage, and life-cycle maintenance of content, SCORM emphasizes the interface between content and the LMS that will host the content.

Generally, S1000D is a markup specification associated with technical documentation. The DM markup structures content within an XML file. SCORM is a reference model associated with training. Although it is used to aggregate and sequence learning objects (SCOs), it does not address how learning content is arranged within a SCO.

Both DMs and SCOs are identified by metadata. DM metadata includes content management and configuration information regarding the relationship of the DM to the product/equipment that it supports. Also, the structure of the metadata is identical in every type of DM. SCO metadata, which is governed by the Learning Object Metadata (LOM) specification, provides a means for identifying, retrieving, and reusing content. The LOM, which includes both mandatory and

optional metadata elements, provides a common way of describing learning objects. Because of the optional metadata elements, there is considerable variation in the amount and structure of the metadata among learning objects.

## 1.3 Comparison of Technical Focus and Training Focus in Data Production

The fact that the technical and training communities use two very different sets of specifications emphasizes the differences between the two communities. While both technical publications and training require development of discrete blocks of content that can be aggregated and published, each has a specific focus that governs product acquisition, development, and evaluation criteria.

### 1.3.1 Technical Focus

The purpose of the technical documentation process is to maintain, verify, and certify technical information over the course of a product's life cycle. All deliveries must include a record of their development and support. This accountability process promotes a holistic approach in how the content is packaged and used for periodic product verifications throughout a system's life cycle (U.S. Specification Implementation Group Training [USSIG-TRAIN] Subproject White paper, 2005).

The characteristics of effective technical content are governed by NAVSEAINST 4160.3A, which mandates that all new or revised NAVSEA manuals be procedurally validated by the preparing activity and have a training manual (TM) validation certificate, which certifies that the TM is accurate and has adequate content for the operation/maintenance functions of the system or equipment.

Before a technical manual can be validated, it must meet the following conditions (NAVSEA S0005-AA-GYD-070, 1991):

- The preparing activity's engineering technical review must be complete.
- The technical data must reflect the correct configuration of the system/equipment and must include all the latest engineering changes.
- The procedural instructions must be complete and easy to understand.
- The data must be adequate to support approved maintenance and support plans.
- Electronic manuals must function on the specified hardware.
- Theory, principles of operation, system/component descriptions, illustrated parts breakdown, schematic and wiring data must be validated against engineering source data.

S1 fully supports NAVSEA technical data policy; each data module carries its own verification and certification within its metadata. The originator of the data module is responsible for the mandatory first verification, which certifies that the data module is technically accurate and safe to use. The customer may also conduct an optional second verification to certify that a data module is fit for its intended purpose.

The technical community's primary directive, then, is to develop and present adequate, accurate, and accessible information in support of the end user's job performance. Although it is also important to support the user's cognitive processes in understanding and learning the information presented, providing that support is not the major focus in the development of technical publications (USSIG-TRAIN, 2005).

### *1.3.2 Training Focus*

When developing training/learning resources, instructional designers must likewise ensure that the content is complete and accurate. However, the technical content, instead of being the end product, is the raw material used to create training. Instructional designers manipulate that raw material and integrate appropriate research-based instructional strategies to craft an effective learning experience. Their primary directive is to provide cognitive support for the learning process. The level and amount of cognitive support depends on the audience for which the training is being designed.

Effective instructional design of a technical training course begins with an analysis of the tasks, sub tasks, knowledge, skills, abilities, tools, and performance standards related to a specific job performed by a specified audience. The instructional designer then considers the analysis results in conjunction with learning theories and instructional taxonomies to formulate an effective and efficient instructional design that will enable learners to meet the identified training/learning objectives.

Identifying the most appropriate taxonomy is critical for the development of effective instruction/training. For example, if the analysis has identified that the target audience's learning/training level varies from novice to expert, the instructional design must accommodate novice, intermediate, and advanced learners. The design for novices will employ lower-level learning taxonomies, provide more cognitive support (i.e., learner scaffolding), and limit accessible content to that which is appropriate for a novice level of proficiency. The design for more expert learners, who already have some knowledge of the system, will employ a higher learning taxonomy, include less scaffolding, and provide more content at greater depth and complexity. Because of this tailored approach to content design, content objects are not necessarily reusable or instructionally effective

in a different instructional context from the one for which they were designed.

### *1.4 Statement of Hypothesis*

The purpose of this study was is to determine whether technical content could be converted to dual-purpose S1000D data modules, which could then be used to produce both technical documentation and training content that would meet the needs of the respective communities. The hypothesis for this study was that S1000D can be used to name, identify, and structure technical training content without adversely affecting instructional design, learning content, or the science of learning. Testing this hypothesis would then result in analysis and conversion guidelines for preparing legacy technical and training content for an S1000D conversion project.

## 2. Case Study for Conversion of Technical Documentation

To test the hypothesis and develop the analysis and conversion guidelines, the analysis team conducted a case study that involved the identification and development of DMs from legacy technical content that could be used not only in a technical publication but also in training. The content source included legacy technical documentation and training materials for three systems: the AEGIS Air Control Panel Assembly, the AN/AQS-20A towed body (hereafter referred to as the Q-20), and various systems on the F/A-18A/B/C/D. As part of the case study, two 15-minute instructional modules were developed, one from the AEGIS materials and one from the Q-20 materials. Although DMs were identified for the F/A-18 content, no instruction was developed.

### *2.1 Conversion of AEGIS Content*

#### *2.1.1 Description of AEGIS Source Materials*

The AEGIS source materials consisted of the following:

- An illustrated equipment manual (pdf format) that addresses description, operation, and maintenance of the Air Control Panel Assembly
- AEGIS lesson plans for teaching maintenance of various AEGIS systems

The illustrations in the equipment manual are simple black-and-white block diagrams and line art.

#### *2.1.2 Collaborative Identification of Data Modules*

Initially, analysis of the AEGIS content involved only the equipment manual because it is the verified and validated content source. The technical representative began the process by "chunking" the equipment manual into blocks of related content according to a two-

part rule he devised based on the S1000D standard numbering system (SNS) and information code (IC) (see section 1.2.1):

- A change in the subject (e.g., discussion of a new physical item, such as a relay or a filter) would result in a change to the SNS and would therefore indicate the need to insert a break at that point in the content and begin a new data module.
- A change in the information type (e.g., remove, install, describe) would result in a change to the IC and would likewise indicate the need to insert a break and begin a new data module.

This approach resulted in logical divisions of the content, which generally paralleled the numbered sections in the equipment manual.

The training representative, who had also been analyzing the content, reviewed the initial S1000D-based content breakdown and provided comments, questions, and suggested changes. This dialog continued in a spiral manner, with each exchange closing the gap between the two positions, until they reached an agreement on a content breakdown that would accommodate as much as possible the requirements of training while remaining as faithful as possible to the requirements of the maintenance community (see Appendix A for a breakdown of the AEGIS DMs).

Later, the lesson plans (LPs) for the AEGIS air control panel were analyzed to determine whether their content or organization would have any impact on the decisions made during the initial analysis. Because their outline of instruction is at a very high level with no descriptive content, there was no impact.

#### *2.1.2.1 Granularity Issues*

Early in the project discussions, it became obvious that the granularity, or amount of content in a DM, would be one of the primary points of divergence between the technical and training communities. From the technical viewpoint, granularity should be based on the following:

- Divisions of content must reflect the maintenance philosophy, which is the conceptual framework that guides development of all maintenance content (e.g., the items to be repaired, the location of the repairs, and the skill level of the repair).
- The finer the granularity, the more DM files would be created; therefore, the granularity must not be so extreme as to create an unacceptable management overhead.

Training has a different orientation to chunking content:

- Divisions of content should be based on identification of related concepts.

- Content may be further subdivided if there is too much to present on a single screen without scrolling (given a predetermined screen size and resolution); however, each screen should present a complete idea.
- A large amount of content may be displayed on a single, interactive screen to reinforce the parts-to-whole relationship.

Through multiple exchanges of documents with comments and questions, eventually the technical and training representatives found an agreeable level of granularity. In general, however, it was determined that a relatively fine granularity provides greater reuse potential between the two communities, as long as the maintenance philosophy is not compromised. For example, the general functional description of the air control panel was so long that presenting it on a single screen would have necessitated either a solid screen of text or a scrolling screen of text with illustrative graphics. Breaking it down into four DMs, one for each stage in the functional description, provided the necessary granularity to allow association of each stage with a process diagram. This strategy not only promotes understanding but also enhances retention by encouraging learners to make cognitive connections between the text and the graphic.

#### *2.1.2.2 Issues with Technical Text in the Case Study*

During the analysis of the equipment manual, several issues were identified that would affect reuse of the technical content for training. Most of the proposed DMs had to be revised to make the content more acceptable for training purposes. Table 1 shows the original text with the problematic areas highlighted, the issues that the highlighted text present for dual use, and the revised text, which is written with dual use in mind.

| Original Text | Issue Affecting Dual Use | Rewritten for Dual Use |
|---|---|---|
| 1-1.1 This manual provides a technical description, operating instructions, and maintenance data for the Air Control Panel Assembly (air control panel) shown on Figure 1-1 (Without ORDALT 20086) or Figure 1-2 (With ORDALT 20086). The air control panel is part of the Auxiliary Equipment Group (auxiliary equipment group) of (CG 47-58) Radar System AN/SPY-1A (SPY-1A), (CG 59-64) Radar System AN/SPY-1B (SPY-1B), or (CG 65-73) Radar System AN/SPY-1B(V) (SPY-1B). | Within-text references to the delivery medium (e.g., "this manual," "the paragraph below," or "in Chapter 5") prevent use of text in another medium.<br><br>Note that the rewritten text would be divided into two DMs, one that contains all the references to the manual and one that introduces the system. The second one could be reused for training. | *Information that is specific to an IETM is broken out into a separate DM:*<br><br>This IETM provides a technical description, operating instructions, and maintenance data for the Air Control Panel Assembly (air control panel) shown on Figure 1-1 (Without ORDALT 20086) or Figure 1-2 (With ORDALT 20086). The level of coverage in this IETM is appropriate for task-oriented maintenance personnel.<br><br>*Information that can be used in* |

| Original Text | Issue Affecting Dual Use | Rewritten for Dual Use |
|---|---|---|
| The level of coverage in this manual is intended to support task-oriented maintenance personnel. | | *both an IETM and a SCO is put in a dual-purpose DM:*<br>The air control panel is part of the Auxiliary Equipment Group (auxiliary equipment group) of (CG 47-58) Radar System AN/SPY-1A (SPY-1A), (CG 59-64) Radar System AN/SPY-1B (SPY-1B), or (CG 65-73) Radar System AN/SPY-1B(V) (SPY-1B). |
| **5-3.4 FAULT CORRECTION.**<br>When a fault is isolated to a component, the technician uses a support work package to repair the fault. Support work packages contain standard procedures for removal and replacement of all components identified in FI work packages. After replacing the parts called out in the work package, the technician retests by initiating the encoded item identifier (EII) test that appeared in the FIAM. If the fault is corrected, the displayed FIAM states NONE, TEST RAN WITHOUT FAULTS. | Use of third person increases cognitive distance between the learner and the content.<br>Using second person increases the content's personal relevance to the learner and consequently increases the learner's motivation as well. | **FAULT CORRECTION**<br>After you have isolated the fault to a defective component, use a support work package to repair the fault. Support work packages contain standard procedures for removal and replacement of all components identified in FI work packages. After replacing the parts called out in the work package, retest the air control panel assembly by initiating the encoded item identifier (EII) test that appeared in the FIAM. If you have corrected the fault, the FIAM display will state NONE, TEST RAN WITHOUT FAULTS. |
| **AIR CIRCULATION CONTROLS**<br>Air circulation through the air control panel is controlled by two valves located on the panel. Inlet valve 1 and outlet valve 2 are opened to permit air flow through the panel. This air flow is acted upon by the pressure regulators and monitored by the flowmeter and pressure gauges. The air pressure supplied to the using assemblies is monitored by output pressure gauge 2. | Overuse of passive voice in instructional text causes it to seem flat, uninteresting, and even confusing.<br>Active voice is clearer and more direct. | **AIR CIRCULATION CONTROLS**<br>Inlet valve 1 and outlet valve 2 control air circulation through the air control panel. In the open position, they permit air flow through the panel. The pressure regulators control air pressure as air flows through the system, and the flowmeter and pressure gauges monitor the pressure of the air flow through the panel. Output pressure gauge 2 monitors the pressure of the air flow out of the air control panel to the using assemblies. |
| **MANIFOLD**<br>The manifold houses an air filter and the humistat-sensing element, which is electronically connected to the humistat. | Discrepancies in the content must be corrected before inclusion of the content in training. In this instance, the physical description indicates that there is only one manifold in | **INLET MANIFOLD**<br>The inlet manifold houses an air filter and the humistat's sensing element, which is electronically connected to the humistat. |

| Original Text | Issue Affecting Dual Use | Rewritten for Dual Use |
|---|---|---|
| | the system. The first mention of the outlet manifold is in the detailed functional description. To eliminate the resulting confusion, the physical description content was revised to name and differentiate between these two components. | |
| **INPUT REGULATION**<br>Air from the manifold passes through inlet valve 1 to inlet pressure regulator 1. The input air pressure is between 67 and 80 psig. Pressure regulator 1 reduces this pressure to 50 psig and maintains pressure at its output within 0.25 psig. Pressure gauge 1 monitors the pressure of the air leaving pressure regulator 1. | Inconsistencies in naming conventions can confuse the learner. Although the highlighted component names are consistent within this paragraph, they are not the same as the names used elsewhere in the manual. The manual has three names each for the two control valves, three names each for the two pressure gauges, and two names each for the two pressure regulators. For example:<br>• Inlet valve<br>• Inlet control valve<br>• Inlet valve 1 | **INPUT REGULATION**<br>Air from the inlet manifold passes through the inlet valve to the inlet pressure regulator. The input air pressure is between 67 and 80 psig. The input pressure regulator reduces this pressure to 50 psig and maintains pressure at its output within 0.25 psig. The input pressure gauge monitors the pressure of the air leaving the inlet pressure regulator. |

**Table 1. Text Issues.** *Legacy technical content had to be revised for training.*

### *2.1.3 Design of Training Content*

The analysis team selected portions of technical content during the collaborative DM identification process for reuse in two 15-minute instructional modules. The section dealing with component location was selected because the source had more graphics associated with this content. Graphics and animations are critical to training because they help learners to build a mental representation of the content.

All technical content development projects have a contact within the Fleet who can either provide photographs—or make arrangements for the developers to take photographs—for use in media production. However, since the purpose of the content development for the analysis was to prove or disprove the hypothesis rather than to develop deployable instruction, no contact was made available to provide supplemental photographs of task performance. Because this lack of graphics would have hurt the instructional efficacy of the demonstration module, it was necessary to use the system description and component location content, which had the most available graphics.

The content for each proposed DM in this section was revised as necessary (see Table 1) and copied into storyboards. Instructional strategies were then added to the storyboards, based on learning theory, instructional design, and best practices (see Table 2).

| Instructional Strategy | Purpose |
|---|---|
| Title of instruction overlaid on full-screen graphic | Gain attention |
| Opening scenario with question on component locations | Provide context and gain attention |
| Lesson objectives | Provide learning goals |
| Instructional text calling attention to a part of a figure | Provide learning guidance |
| Interactive list of components and functional diagram | Provide learning guidance by emphasizing interrelatedness |
| Detailed component graphics shown with a small reference diagram of the entire assembly that has the location of the component highlighted | Provide learning guidance by showing location and reinforcing parts-to-whole relationship |
| Functional diagram with an inset showing a photo or realistic graphic of the actual component | Provide learning guidance by helping learners make the connection between the component and its function within the assembly |
| Practice item with gaming element | Elicit learner performance, provide feedback, and provide a competitive element to motivate learners |
| "Think Back" questions | Stimulate recall of prior learning to help the learner associate new information with prior knowledge |
| "Think About It" questions | Provide learning guidance by encouraging learners to elaborate on what they already know |
| Pop-up definitions and explanations | Provide optional stimulus materials for learners who need additional information |
| Knowledge checks | Elicit learner performance and provide feedback |
| Lesson summary | Enhance retention and transfer |

**Table 2. Instructional Strategies.** *Using the technical content for training involved developing instructional strategies to aid learning.*

### *2.1.4 Development of AEGIS Graphics and Interactions*

After the training storyboards went through an internal review process to ensure their instructional efficacy, they were passed to the

production team for graphics and interactions development using Macromedia's Flash®. The completed graphics and interactions were then reviewed and revised as necessary.

## 2.2 Development of Q-20 Data Modules

### 2.2.1 Description of Q-20 Source Materials

The Q-20 source materials consisted of the following:

- Interactive Electronic Technical Manual (IETM) for Intermediate Level Maintenance of the Sonar Mine Detecting Set AN/AQS-2A
- MH-60S AN/AQS-20A O-Level Maintenance Course
    - Diagram sheets
    - Information sheets
    - Lesson plans
    - PowerPoint computer-aided instruction (CAI)
- MH-60S AN/AQS-20A Operator Course
    - Diagram sheets
    - Information sheets
    - Lesson plans
    - PowerPoint CAI
- MH-60S AN/AQS-20A Pilot Course
    - Diagram sheets
    - Information sheets
    - Lesson plans

The illustrations in the IETM consist of simple line art on a green background. The illustrations on the diagram sheets consist of color 2D graphics and photographs.

The PowerPoint CAI was not used in the analysis because (1) the PowerPoint for the O-Level Maintenance Course is an empty shell, and (2) the PowerPoint for the Operator Course was a corrupted file and there was no replacement file available.

### 2.2.2 Collaborative Identification of Data Modules

Initially, only the IETM was analyzed because it was the authoritative source for the technical content. A section of the Q-20 content was identified for development into a 15-minute instructional module. Again, this decision was predicated on the number of readily available source graphics because the project provided no access to Fleet personnel

who could provide photographs for creation of additional graphics. Because the section of the IETM dealing with component location and function had the most graphics, it was selected for DM development.

The spiral process used to collaboratively identify the AEGIS DMs (see section 2.1.2) was also used to identify the Q-20 DMs. Because the IETM was provided as HTML pages, the technical representative's initial approach involved allocating each HTML file to a DM.

This DM identification strategy did not satisfy training requirements because of excessive content within the file. The primary concerns were as follows:

- There was too much content to present on a single screen without scrolling.
- Text-heavy screens provide content but no learning support; explanatory or illustrative graphics, interactions, questions, and other instructional elements are needed to help learners construct mental models of the information being discussed for storage in and retrieval from long-term memory.

Through a collaborative dialogue—including comments, questions, answers, and discussions—the correct granularity was achieved to satisfy the requirements of both the training and technical communities.

### 2.2.3 Issues with Procedural Data Modules

Although procedural content was not used for the instructional module, there was a good deal of discussion about how it would be chunked for data modules. There were three major issues:

- *Amount of information.* From a training standpoint, the length of most maintenance procedures presents a challenge with regard to instructional design and presentation. Even a mere listing of the steps would require scrolling. However, good instruction would involve more than just a listing. At a minimum, it will involve the addition of graphics and animations that illustrate the steps, explanations as necessary for difficult steps, and expert advice.
- *Safety.* From a technical standpoint, it would be better to make each procedure a single DM to ensure safety. Dividing up a procedure introduces three potential threats to safety: (1) the possibility of "losing" critical steps because learners fail to access them, (2) the possibility of accessing steps in the wrong sequence, and (3) the possibility of losing the connection between critical safety information—warnings, cautions, and notes—and associated steps.

- *References to subordinate procedures.* Several of the Q-20 maintenance procedures reference subordinate procedures that are on a different Web page in the IETM (e.g., "Install towed body on maintenance stand IAW procedures in this manual"). Users have to click on the link to the subordinate procedure, perform those steps, and then return to the first procedure. This provides certain efficiencies within the IETM. The subordinate procedure, which is used more than once, is programmed only once and is then referenced as needed from multiple procedures. However, conformance to SCORM would prevent a training SCO on one procedure from referencing or linking to a reusable SCO containing the subordinate procedure.

### 2.2.4 Proposed Solutions for Procedural Data Modules

Collaborative discussions of the issues regarding procedural data resulted in the proposed solutions below.

#### 2.2.4.1 Chunking Maintenance Procedures

It is necessary to break out individual DMs from maintenance procedures in order to meet the needs of the training community (see section 2.2) and realize the efficiencies of dual-use DMs (see section 1.1).

#### 2.2.4.2 Keeping Safety Information with the Relevant Steps

When chunking maintenance procedures, subject matter experts and instructional designers should ensure that all warnings, cautions, and notes remain with the steps to which they apply.

#### 2.2.4.3 Combining Procedures in a Single SCO

In the IETM, if Procedure B (e.g., installing the towed body on the maintenance stand) is part of Procedure A (e.g., removing an assembly), then Procedure A merely references Procedure B as one of its steps. To create dual-purpose DMs, both procedures would be chunked into blocks of content, as reflected in the first and third columns below (Procedure A and Procedure B, respectively).

Whereas a procedure in an IETM can reference another procedure, one of the basic SCORM rules is that one SCO cannot access another. One solution, as shown in the middle column, is to create a single SCO that incorporates Procedure B in the instruction for procedure A.

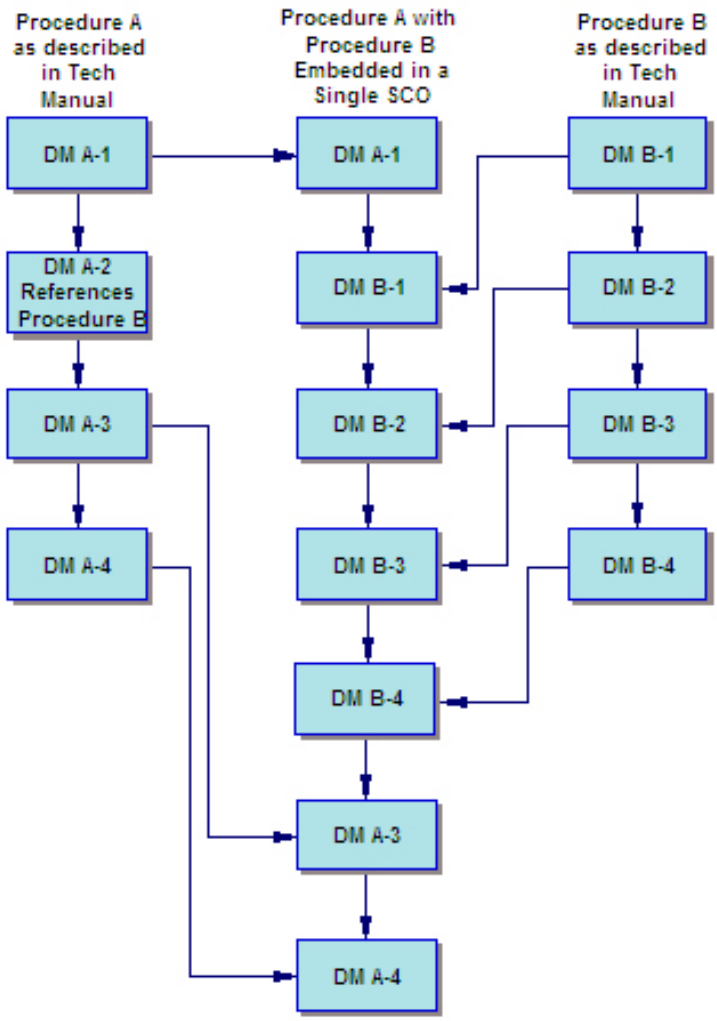


**Figure 1. Combining Procedures in a Single SCO.** *One solution to embedded procedures is to combine them in a single SCO.*

There are obvious advantages to this schema: (1) it is relatively simple, (2) it allows reuse of the DMs for procedure B with other procedures, and (3) it presents procedure A as a unified whole. The disadvantage is that it could produce some very large SCOs.

#### *2.2.4.4 Using Multiple SCOs for Embedded Procedures*

Another possible solution for working with embedded procedures is to use multiple SCOs that are sequenced using the SCORM 2004 Sequencing and Navigation Model. In Figure 2 below, the first two columns, depicting Procedure A and Procedure B, are identical to the first and third columns in the previous exhibit because the technical content would be broken out in the same way. However, as shown in the third column, Procedure A could be developed as a set of multiple DMs/SCOs, with a break occurring at the point where Procedure B is performed.

In this model, learners would study the procedural SCOs for Procedure A in sequence until they came to the step for Procedure B. If they have not previously completed the Procedure B SCO, they will take it next before continuing with the rest of Procedure A. However, if they already knew Procedure B (from having studied it as part of another procedure), they will have the option of either retaking the Procedure B SCO or skipping it and continuing with the rest of Procedure A. Procedure B would, of course, be included in Procedure A as a summary step (e.g. "Install towed body on maintenance stand.") to preserve the integrity of Procedure A.

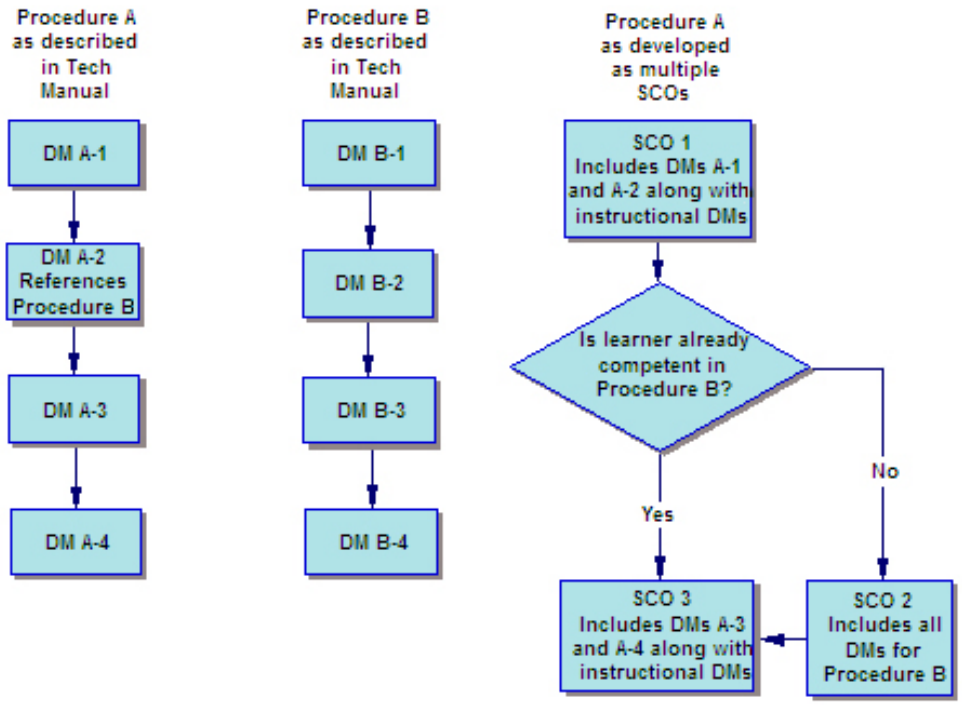


**Figure 2. Combining Procedures in Multiple SCOs.** *Another solution is to use sequenced SCOs to present the entire procedure.*

The advantage of using multiple sequenced SCOs to teach a procedure is that the embedded procedure is set off as optional material, which is accessed only if the user needs it, either for initial learning or remediation. Moreover, this presentation of Procedure B would enhance its reusability. Whereas in the previous solution (see Figure 2), only the Procedure B DMs are reusable, in this solution the Procedure B DMs *and* the Procedure B SCO would be reusable. The separation of the procedure into multiple DMs would not affect the presentation of the procedure in the IETM.

The primary disadvantage of this solution is that the procedure may seem fragmented because the full scope of the procedure is reflected only in the learning content management system (LCMS) structure.

However, there are design strategies that can be used to help learners to build a cohesive schema. For example, procedural SCOs could include scaffolding to provide cognitive support for learners to make a connection from what they know to new information.

### 2.2.5 Creation of Dual-Purpose Technical Content

During the next step of the analysis, the content of the technical DMs identified from the IETM was compared to the content of the other source materials. The proposed DMs were then revised based on a combination of all information sources to illustrate how legacy content can be converted to dual-purpose text for use in technical documentation and training (see Appendix B).

Additionally, several minor differences in the outlines of instruction for the three courses were noted that appeared to be unrelated to the differing needs of the target student populations (as indicated by the course names). Unnecessary differences of this sort undermine content standardization and impact ease of life-cycle maintenance. There were also differences between the lesson plan outlines and the information sheet outlines for trainees. These differences, highlighted in gray in the table in Appendix B, suggest that DMs might also be created for outputting to lesson plan outlines and student information sheets in order to realize the potential of standardization, reuse, and ease of content maintenance in an instructor-led course.

### 2.2.6 Design of Training Content

As with the AEGIS content, instructional DMs were created around the Q-20 technical DMs in order to design a 15-minute instructional module. Many of the same instructional strategies used for the AEGIS content (see Table 2, section 2.1.3) were reused for the Q-20 content. For graphic development, the source graphics from the IETM were supplemented by color source graphics from the diagram sheets for the Q-20 O-level training and operator training courses. These were then revised to ensure a consistent presentation of the towed body throughout the module and to more pointedly illustrate the content.

## 2.3 Analysis of F/A-18 Materials

### 2.3.1 Description of F/1-18 Source Materials

The F/A-18 source materials consisted of the following:

- A1-F18AC-742-100: Technical Manual/Organizational Maintenance/Principles of Operation/Radar System
- A1-F18AE-120-100: Technical Manual/Organizational Maintenance/Principles of Operation/Seat, Canopy, Survival Equipment, and Boarding Ladder

- A1-F18AE-460-100: Technical Manual/Organizational Maintenance/Principles of Operation/Fuel System
- A1-F18AE-580-100: Technical Manual/Organizational Maintenance/Principles of Operation/Flight Incident Recorder and Monitoring System
- A1-F18AE-740-100: Technical Manual/Organizational Maintenance/Principles of Operation/Weapon Control System
- A1-F18AE-760-100: Technical Manual/Organizational Maintenance/Principles of Operation/Tactical Electronic Warfare Systems
- C-646-9974A Change 3: Lesson Plan/F/A-18 Stores Management System (Career) Organizational Level Maintenance Course

### *2.3.2 Content Analysis and Identification of Data Modules*

The spiral process used to identify the AEGIS and Q-20 DMs (see sections 2.1.2 and 2.2.2) was minimized during the F/A-18 analysis. Because no IETM or courseware would be developed from this content, the purpose of this analysis was to determine how much redundancy existed across the technical manuals, the reason being that any redundant information could be developed as dual-use DMs, thereby achieving the efficiencies and cost savings discussed earlier (see section 1.1).

The analysis revealed no content overlap among the manuals other than the introductory information. Due to the nature of the content, it is anticipated that this information could be used not only in an IETM but also in a Help section for a technical training lesson. Moreover, creating S1000D DMs from the content would realize considerable savings in both the development and the maintenance of the IETMs.

The introductory content was chunked into proposed DMs, based on length and breaks in types of content. Proposed DMs are of the following types:

- Technical DMs that can be used to create any IETM but are not appropriate for training
- Dual-purpose DMs that can be used in both IETMs and training SCOs, provided recommended changes are made and approved
- Training-only DMs that had been repurposed from the original content because the original content referenced the IETM

Appendix C summarizes the analysis results. The first column contains a sequence number for the proposed DMs. The next three columns show the parallel content from each of the source documents. Differences are highlighted in gray. The fifth column shows the

proposed DMs. Again, any differences from the source text are highlighted in gray.

## 2.4 Data Module Development and Coding Strategy

After the project's technical and training representatives reached an agreement regarding the proposed DMs for the AEGIS and Q-20 content, the technical representative created two sets of DMs, one for the demonstration IETMs and one for the demonstration training SCOs. The reason for creating two sets was that almost none of the authoritative source could be used "as is" for training (see section 2.1.2.2), and DMs containing text that differed from the authoritative source could not be used for technical documentation.

### 2.4.1 Assignment of DMCs to Technical DMs

The first step in creating the DMs was to assign an appropriate data module code (DMC) to each one. The DMCs for the technical DMs (those with no changes to the authoritative source) follow S1000D guidelines (see section 1.2.1). The technical representative allocated a project name and then analyzed the DM content to determine the subject equipment and the level of breakdown. Based on the breakdown, an SNS was allocated to each chunk of content.

The document analysis of the AEGIS source materials had indicated that the content was fairly "flat" —that is, it did not indicate a physical hierarchy. The reason is that the Air Control Panel is quite far down the breakdown structure of a typical installation that would use such a panel. This meant that the panel was at least a child of a subsystem or, more probably, a grandchild. Moreover, almost all of the AEGIS content concerned the Air Control Panel's components, which were at the same hierarchical level. Therefore, the technical representative used his best engineering judgment to establish a breakdown of the components (such as the flowmeter, outlet pressure regulator, etc.) that were described in the source material.

On the other hand, the document analysis of the Q-20 revealed a much more hierarchical breakdown, since the Q-20 could be described as a system in its own right. This enabled a deeper level of granularity using the SNS.

After assigning an SNS, the technical representative used information from the document analysis to allocate an IC to indicate the activity described in the source material. Last of all, the ILC for all technical DMs was set to "D" to indicate that all tasks could be carried out anywhere.

### 2.4.2 Assignment of DMC to Training-Only DMs

In order for training DMs to fit within the S1000D architecture, it was necessary to find a means of identifying and categorizing them within

the DMC. The S1000D specification already includes a training designator. One of the options for the item location code is the letter "T," which indicates a training-only DM. However, this single-character training designator was too broad to provide any meaningful identification and search capability for training-only DMs. Recognizing the need to provide more training information as well as a discrete identifier within the DMC for training-only DMs, the team identified two major issues: (1) identifying a location in the DMC string for training content descriptors, and (2) identifying a syntax within the DMC that adequately describes the training content.

#### *2.4.2.1 Location of Training Information in DMC*

The difficulty in finding a location for an expanded training identifier is that S1000D specifies the length and format of the DMC, and each part of the code is already allocated to a particular subset of critical identifying information regarding the DM's content (see section 1.2.1). The only way to provide additional training information in the DMC, beyond the "T" for training, is to forego using one or more of the prescribed subsets of technical information. The technical representative at first suggested using the one-character information code variant to the right of the item location for an additional training identifier. However, one character was insufficient to provide further description of the training DM *and* act as a unique identifier to distinguish it from similar DMs. Often a SCO has multiple instances of an instructional event. For example, a SCO may contain five multiple-choice questions. If each of these questions was saved as a separate DM, the five DMs would require a unique identifier to distinguish among them.

The proposed solution was to use a three-character code in the place of the disassembly code variant. The first two characters would be training descriptors, and the third character would be the unique identifier. However, this solution was still limiting; two character codes were not sufficient to represent the various metadata associated with a single training object. The SCORM learning object metadata (LOM) standard, which is used to identify training objects, allows for multiple categories, subordinate elements, and tokens of metadata to identify and describe a single SCO or asset. For instance, the "Educational" category describes the key educational or pedagogic characteristics of the SCORM Content Model Component. This category allows for the description of the educational characteristics and is typically used by teachers, managers, authors and learners. The <educational> element is a parent element. Parent elements have no values associated with them. Parent elements act as “containers” for other elements, called child elements. The <educational> element contains the following 11 child elements:

- <interactivityType>
- <learningResourceType>
- <interactivityLevel>
- <semanticDensity>
- <intendedEndUserRole>
- <context>
- <typicalAgeRange>
- <difficulty>
- <typicalLearningTime>
- <description>
- <language> (CAM-4-54).

All of the child elements could be used to describe a single learning object. Within each element are various tokens. For instance <learning resource type> includes 16 tokens from which to choose. SCORM defines the <learningResourceType> element as a Best Practice Vocabulary element. This means that although SCORM does not require the use of this element, it does recommend the use of its vocabulary as best practice. The valid set of tokens defined by the SCORM Content Aggregation Model (CAM) includes:

- Exercise
- Simulation
- Questionnaire
- Diagram
- Figure
- Graph
- Index
- Slide
- Table
- Narrative text
- Exam
- Experiment
- Problem statement
- Self assessment
- Lecture (CAM-4-57)

#### *2.4.2.2 Descriptors within the DMC for Training-Only DMs*

The team considered several options for the training descriptors to be used in place of the disassembly code variant in the DMC. Trying to associate a training DM with the applicable learning theory would be confusing because of the overlap among theories. Trying to associate a DM with an instructional strategy would have been unmanageable because of the number of instructional strategies, the countless variations and combinations of these strategies, and the lack of standardized naming conventions for strategies.

There was a strong attempt to develop training descriptors for the DMC that would correspond to the SCORM LOM. Being able to do so would have produced further harmonization between the two standards. However, because of the numerous metadata categories and levels and sublevels within those categories, it was not possible to prescribe a distinctive two- to three-character alphanumeric training DM identification code that would capture all possible permutations of the LOM metadata. For example, a training SCO could have the following metadata:

```
<lom>
    <educational>
            <interactivityType>
                    <source>LOMv1.0</source>
                    <value>mixed</value>
            </interactivityType>
            <learningResourceType>
                    <source>LOMv1.0</source>
                    <value>figure</value>
            </learningResourceType>
            <learningResourceType>
                    <source>LOMv1.0</source>
                    <value>narrative text</value>
            </learningResourceType>
            <interactivityLevel>
                    <source>LOMv1.0</source>
                    <value>very low</value>
            </interactivityLevel>
            <semanticDensity>
                    <source>LOMv1.0</source>
                    <value>very low</value>
            </semanticDensity>
            <intendedEndUserRole>
                    <source>LOMv1.0</source>
                    <value>learner</value>
            </intendedEndUserRole>
            <context>
                    <source>LOMv1.0</source>
                    <value>training</value>
            </context>
            <typicalAgeRange>
                    <string language="en">18-</string>
            </typicalAgeRange>
            <difficulty>
                    <source>LOMv1.0</source>
                    <value>easy</value>
```

```
                </difficulty>
                <typicalLearningTime>
                        <duration>PT1H30M</duration>
                        <description>
                                <string language="en">Average length of
                                time to experience the
                                activity.</string>
                        </description>
                </typicalLearningTime>
                <language>en-US</language>
        </educational>
</lom>
```

The S1000D coding structure does not declare the learning-specific schema objects resident in the LOM. This is where S1000D falls short at fully describing learning content beyond its technical subject matter attributes. S1000D metadata content, like <dmc> can be passed to the LOM <entry> during production, which helps with configuration control. Other related datapoints exist. This is evidence that there is already a certain harmonization between S1000D and SCORM. However, for S1000D to fully embrace learning content, its descriptive capabilities must go beyond technical and configurable items.

The team proposed a simpler temporary solution for the project: using Gagne's nine events of instruction (Gagné, Briggs, & Wager, 1992) as the basis for categorizing and identifying training-only DMs. Gagné was a world-renowned experimental psychologist and proponent of cognitive learning theory, and his nine events of instruction were a major contribution to instructional systems design. Using the nine events as the basis for the training DM identifiers provided multiple benefits:

- The number of categories is limited. With other categorization schemata, the number would be subject to continual increases based on new variations in content elements and instructional strategies.
- The categories are broad enough to include every type of instructional element but narrow enough to provide the distinctiveness required for categorization.
- The events of instruction are one of the many data elements in the education category being proposed for inclusion in the AICC Learning Object Metadata (LOM) Standard. This would provide a cross-reference point between the S1000D and SCORM specifications.
- Every instructional designer learns the nine events of instruction in school and many use them to structure instructional content. Therefore, this schema provided a familiar framework for categorization of instructional elements that any instructional designer would understand and be able to use almost instinctively.

To further identify the training-only DMs, the team identified a list of instructional strategies characteristic of each event of instruction (as shown in Table 3 below). Therefore, the three characters in the proposed expanded T-codes consisted of the following:

- First character: A letter to identify the “parent” descriptor, which is the event of instruction associated with the DM, based on Gagne's nine events of instruction
- Second character: An alphanumeric character to identify the “child” descriptor (one of the characteristic strategies associated with the event of instruction)
- Third character: An alphanumeric character to provide a unique identifier for training DMs with the same 1st and 2nd characters.

For example, in addition to having the “T” identifier in the Item Location Code, which distinguishes all training-only DMs from technical DMs, the DMCs for three application-level questions (“application” is the third level in Bloom’s taxonomy of cognitive levels) would include the following three-character training descriptor, or T-code, in place of the disassembly code variant:

- ECA (elicit learner performance, application-level question, first instance)
- ECB (elicit learner performance, application-level question, second instance)
- ECC (elicit learner performance, application-level question, third instance)

Table 3 below shows the "parent" and "children" T-code training identifiers.

| Parent T-Codes | Associated Child T-Codes |
|---|---|
| **A**<br>Event: Gain attention<br><br>This parent code (A = attention) will identify any instructional element that is designed to grab learners' attention so that they will concentrate better on the content. | A. Visually stimulating graphic for the title screen<br>B. Opening scenario that provides job-related relevance<br>C. Opening scenario that provides job-related relevance and a thought-provoking question or problem<br>D. Introductory thought-provoking question that is not scenario based<br>E. Introductory problem that is not scenario based |

| Parent T-Codes | Associated Child T-Codes |
|---|---|
| | F. Explanation of the relevance of the instruction to the learner |
| **O**<br>Event: Inform learner of objectives<br><br>This parent code (O = objectives) identifies any listing of lesson objectives. Objectives provide learners an understanding of what they are to learn from the lesson and arouse a feeling of expectancy.<br><br>If all objectives are of the same type and level, they may be included in the same DM. | A. Knowledge-level terminal objective<br>B. Comprehension-level terminal objective<br>C. Application-level terminal objective<br>D. Analysis-level terminal objective<br>E. Synthesis-level terminal objective<br>F. Evaluation-level terminal objective<br>G. Knowledge-level enabling objective<br>H. Comprehension-level enabling objective<br>J. Application-level enabling objective<br>K. Analysis-level enabling objective<br>L. Synthesis-level enabling objective<br>M. Evaluation-level enabling objective |
| **R**<br>Event: Stimulate recall of prior learning<br><br>This parent code (R = recall) identifies instructional elements that help the learner to associate new information with prior knowledge. Although referencing content in another SCO is not allowed by SCORM guidelines, this type of element can be built around content presented within a SCO. | A. Question that triggers recall of prior relevant knowledge or experience<br>B. Thought-provoking question or activity that helps the learner to make a connection between new content and prior experience<br>C. Thought-provoking question or activity that helps the learner to make a connection between new content and previously learned content |
| **S**<br>Event: Present stimulus material<br><br>This parent code (S = stimulus) identifies training content that has been changed from the authoritative source or that provides additional, optional training content designed to help learners better understand | A. Textual information presentation<br>B. Video<br>C. Audio<br>D. Animation<br>E. Graphic (photo or figure)<br>F. Table |

| Parent T-Codes | Associated Child T-Codes |
|---|---|
| the content in dual-purpose technical DMs. | G. Graph<br>H. Schematic<br>J. Block diagram<br>K. Glossary<br>L. Index<br>M. Content segment in an Instructor Guide outline of instruction<br>N. CAI slide<br>P. Information sheet<br>Q. Diagram sheet |
| **G**<br>Event: Provide learner guidance<br><br>This parent code (G = guidance) identifies any instructional element that helps the learner to encode the content for storage in long-term memory. | A. Overview<br>B. Advanced organizer<br>C. Introductory statement<br>D. Example<br>E. Non-example<br>F. Analogy<br>G. Case study<br>H. Role play<br>J. Contextual information<br>K. Adaptive learning element<br>L. Discovery learning activity<br>M. Experiment<br>N. Elaboration question<br>P. Questionnaire or pretest for self-assessment only (scores are not kept by LMS)<br>Q. Collaborative learning activity<br>R. Discussion<br>S. Focusing statement that draws attention to important content<br>T. Transitional statement<br>U. Segment of the Related Instructor |

| Parent T-Codes | Associated Child T-Codes |
|---|---|
| | Activities in an Instructor Guide<br>V. Assignment sheet |
| **E**<br>Event: Elicit learner performance<br><br>This parent code (E = exercise) identifies instructional elements that require the learner to demonstrate knowledge acquisition, practice a new skill, or apply new knowledge to a problem or situation. | A. Knowledge-level question<br>B. Comprehension-level question<br>C. Application-level question<br>D. Analysis-level question<br>E. Synthesis-level question<br>F. Evaluation-level question<br>G. Activity<br>H. Problem<br>J. Game<br>K. Simulation<br>L. Lab exercise<br>M. Job sheet (trainee materials)<br>N. Problem sheet (trainee materials) |
| **F**<br>Event: Provide feedback<br><br>This parent code (F = feedback) identifies elements that either confirm correct understanding or correct misconceptions. In instructor-led training, feedback strategies developed for a performance test guide would be categorized as F. | A. Correct answer feedback<br>B. First incorrect answer feedback<br>C. Second incorrect answer feedback<br>D. Model answer<br>E. Test score<br>F. Performance summary for pretests<br>G. Performance summary for posttests<br>H. Performance exam feedback |
| **P**<br>Event: Assess performance<br><br>This parent code (P = performance) identifies instructional elements that require learners to demonstrate that they have internalized the content.<br>The primary difference between *E* elements | N. Knowledge-level question<br>O. Comprehension-level question<br>P. Application-level question<br>Q. Analysis-level question<br>R. Synthesis-level question<br>S. Evaluation-level question<br>T. Pretest (when stored as a single DM) |

| Parent T-Codes | Associated Child T-Codes |
|---|---|
| and *P* elements is that *P* elements are scored, and the assessment results are used by the LMS to determine the learner's proficiency in a pre-defined skill object. | U. Posttest (when stored as a single DM)<br>J. Performance test |
| **T**<br>Event: Enhance retention and transfer<br><br>This parent code (T= transfer) identifies instructional elements that help learners to remember content and to understand how content learned in one situation can be applied to other situations. | A. Mnemonic<br>B. Job aid<br>C. Lesson summary<br>D. Scenario-based activity that requires the learner to apply the knowledge in a different situation<br>E. Question that requires the learner to apply the knowledge in a different situation<br>F. Example that demonstrates application in another situation<br>G. Case study that demonstrates application in another situation |

**Table 3. T-Code Training Identifiers.** *The first two characters in the T-code indicate the event of instruction addressed by the DM as well as the specific instructional strategy.*

The proposed solution to use the three-character code in the place of the disassembly code variant was a temporary solution for this project to identify training objects and capture respective metadata. (See section 4.1.1 for recommendations regarding changes to the S1000D specification to accommodate training metadata consistent with the SCORM LOM.)

#### *2.4.2.3 Coding Training-Only DMs*

Coding the training-only DMs was also a collaborative process. The training representative assigned the T-code training identifiers to the proposed DMs, and the technical representative followed S1000D guidance as described in section 2.4.1 to develop the rest of the DMC.

## *2.5 Rendering of DMs*

After the DMs were assigned a DMC, they were rendered as either an IETM or a SCORM-conformant Shareable Courseware Object (SCO). This resulted in four demonstration pieces: an AEGIS IETM and SCO, and a Q-20 IETM and SCO.

Different rendering processes were used for the two output types. For the IETM development, DMs were rendered as XHTML pages using existing XML style

sheets. Macromedia® Flash® was used to render the training-only DMs as SCOs. There were two reasons for using Flash®: (1) the storyboards for the training demonstration module described far more sophisticated interactions than are used in IETMs, and (2) rendering complex interactions in XHTML would be difficult and costly because of its inherent difficulty.

As in all XHTML deployments, Web-enabled technical data IETMs customarily use a combination of HTML pages, JavaScript, and Cascading Style Sheets (CSS) to manage the layout and presentation of DM content and transform XML data into more comprehensible visual formats. Owing to its inherent difficulty and intricacy, XHTML development can be time consuming and costly. This is particularly true when the demands of the content presentation require sophisticated rendering techniques, as is often the case in training content designed for Web-enabled SCORM deployments. Macromedia Flash provides a relatively inexpensive, object-oriented, Rapid Application Development (RAD) alternative for rendering SCORM-conformant aggregations of S1000D DMs.

The basic principles and conceptual framework for rendering S1000D DMs in Flash® are the same as those used to render XHTML pages for Interactive Electronic Training Manuals (IETMs). In both cases, there is a main graphical user interface (GUI) that serves as a display container for the content pages. Because the main GUI also provides common screen navigation buttons, such as "Next," "Previous," and "Home," it is often called the navigational frame. Individual content pages are rendered in child frames housed within the main navigational frame.

When the navigational frame draws content data (text and graphics) from DMs, it gets the required screen sequencing and other presentational data from a Data Module Resource List (DMRL) document. For Flash® rendering, the DMRL also provides the URLs of Flash® files that serve as templates for rendering the individual DM's descriptive data (content). The Flash® templates display within the parent Flash® navigational frame and are dynamically populated with content objects (called "symbols" in Flash® development circles) through the use of Flash® ActionScript and the Flash® XML Document Object Model (DOM) parsing engine.

Using these techniques, a single dynamic Flash® template can serve many DMs. Dynamic Flash® files can load and render a wide range of external media file objects, including:

- JPEG
- GIF
- BMP
- TIFF
- PNG
- WMF
- Flash SWF (other Flash files)

- WAV
- WMV
- MPEG
- MP3
- DV
- AVI
- MOV
- DXF

In addition to the wide range of supported file types, Flash ActionScript can also manage the transfer of SCORM data to an instance of the SCORM API Adapter. This capability is essential to the deployment of SCORM Runtime (RTE)-conformant content.

Using Flash as a rendering engine for S1000D DMs is a new concept. As a result, the limits for its application have not yet been found, especially where legacy DMs are concerned. However, Flash has thus far proven to be a viable and promising alternative to XHTML.

## 2.6 Quality Assurance and SCORM Testing

After they were rendered, the four demonstration pieces underwent an internal quality assurance test to ensure that they were correct and functional. Then, to be verified as SCORM conformant, the SCOs were tested using the Advanced Distributed Learning (ADL) SCORM 2004 Conformance Test Suite Version 1.3.3. The Test Suite includes the following independent tests:

- *Content Package Test*. This test verifies that the deliverable courseware package conforms with the IMS/SCORM content packaging requirements.
- *Sharable Content Object (SCO) Runtime Environment Test (RTE).* The SCO RTE test verifies that the subject SCO(s) perform according to the specified requirements and formalities for SCO launch and termination. The RTE test also verifies that the methods of the SCORM implementation, deployment, and all associated scripting protocols meet the requirements of the RTE book of the SCORM specification.
- *Metadata Conformance Utility*. All Learning Object Metadata (LOM) is considered optional under the SCORM. The Metadata Conformance utility is provided by ADL to verify LOM in content packages where it is employed.
- *Manifest Utility*. Although this utility is encapsulated in the RTE and Content Package tests, it is used to validate the SCORM/IMS manifest file.

The project courseware samples passed all conformance tests (see test log in Appendix D).

# 3. Case Study Findings

## *3.1. Low Reusability for Legacy Content in the Case Study*

***The way that the authoritative technical source content was written made it inappropriate for reuse as training content.***

As discussed in section 2.4, two sets of DMs were created for both the AEGIS and Q-20 content, one set of technical DMs containing content taken directly from the authoritative source and one set of training-only DMs. The two sets of AEGIS DMs have four DMs in common, representing 17% reuse of the technical content in the training. The two sets of Q-20 DMs have no DMs in common, resulting in 0% reuse of the technical content in the training. However, some of the graphics from the Q-20 source materials were reused in both the IETM and SCO outputs.

There were multiple reasons why the legacy content in the AEGIS and Q-20 technical manuals had to be edited somewhat for use in training. For instance, the legacy content in the Q-20 technical manual needed to be edited for training because of the following:

- *Redundant information.* For instance, the fourth paragraph of the DM for "AN/AQS-20A Common Towed Body Configuration" is repeated almost word for word in the first paragraph of the DM for "Mid Section."
- *Improvement of textual clarity.* For example, the IETM contains the following text: "It also employs a tow termination point and electrical connections located in the wing center section for interface to the MH-60S helicopter." This was revised as follows: "A tow termination point and electrical connections in the wing's center section provide the interface between the towed body and the MH-60S helicopter."
- *References to figures*. Every technical DM had a linked textual reference to an associated figure (e.g., Figure 3-1). In training, illustrative figures and graphics appear on the same screen as the instructional text in compliance with the spatial contiguity principle of multimedia (Mayer, 2001).
- *References to other parts of the IETM.* For example, the DM for the wing assembly contains the following: "Functional descriptions for the compass assembly and CTD sensor are provided later in this chapter."
- *Lack of information that was provided in other content sources.* Analysis of other content sources, such as lesson plans and information sheets revealed information that was not included in the technical DMs taken from the existing IETM. For instance, the IETM does not state that the wing assembly has a fixed angle of attack.

- *Incorrect information.* The IETM section for "Wing Assembly," states that the compass assembly is located in the port wing section, whereas the section for "Compass Assembly" states that the assembly is located in the starboard wing section. The latter is correct according to the illustrated parts breakdown in the IETM.

The legacy content in the AEGIS technical manual presented the following challenges as well:

- *Dispersed information.* When related content is disbursed within the source instead of being tightly organized in the form of a system breakdown, with all activities and information associated with that breakdown in one place, then it cannot be reused as is but must be reorganized and brought together when creating DMs. For instance, location information on the Air Control Panel's relief valve was in two separate subsections. Of course, any reorganization of content affects certification of the content.
- *Inconsistent component naming conventions.* The AEGIS content used different names in different places for six of the Air Control Panel components. This inconsistency can be confusing, whether the content is used for an IETM or for training.

## 3.2. Differences in Granularity Requirements

***Training requires greater granularity in source data than is needed by technical documentation.***

There are no size restrictions on the size of a DM to be used for technical documentation. Instead, granularity is determined by the SNS and IC. However, a long DM cannot be used "as is" in training because of courseware design principles and best practices:

- Text should not scroll.
- Instructional screens should not be a solid block of text.
- A graphic or animation that provides cognitive support for textual information should display on the same screen as the text.
- Elements of content may be broken out for display in an interactive screen to reinforce the parts-to-whole relationship.
- Instructional content should combine information presentation with strategies that actively engage the learner with the content.

All of these principles and best practices, alone and in combination, limit the amount of text on a screen. Since DMs cannot be split between screens without repurposing them, training tends to require greater granularity.

## 3.3. Limited Identification of Training Content in the DMC

***The S1000D data module code (DMC) provides only one character to identify content used in training.***

The structure of the S1000D DMC includes a specific sequence of identifying and descriptive elements. Only the one-character Item Location Code (ILC) at the end can be used to identify training. The ILC can be set to "T" to indicate that the DM is specific to training.

## 3.4. Lack of Support in S1000D for Complex Interactivity

***S1000D architecture does not support complex interactivity.***

The S1000D architecture does not include the elements and attributes needed to handle the following interactions designed for the training modules produced during the case study:

- Graphical interactive content organizers with multiple, user-selected hot spots
- Assessment items with multiple instances of feedback, requiring logical looping structures and data arrays

For the demonstration training modules developed for this project, these special cases were handled by simply capturing the design requirements for these learning objects as hard-coded Flash® files. The Flash® files are included in the content markup as "figure" elements of the type "graphic." While this is a perfectly reasonable and allowable approach as far as S1000D is concerned, it runs counter to the philosophy of data management that S1000D promotes: the separation of content from the presentation layer, particularly where text is involved.

## 3.5. S1000D and SCORM RTE/IMS Packaging Compliance

***Using DMs as assets in SCORM content packages presents no barrier to SCORM conformance.***

The ADL SCORM does not specify formatting for conformant courseware asset file types. This independence allows developers the freedom to generate SCORM-conformant content according to the business practices and learning content development models they find most advantageous. It encourages content developers to choose the development tools and platforms most suited to their business needs and the needs of their learners.

Under these circumstances, S1000D markup of courseware assets is an acceptable practice within the SCORM specification. As long as the content package adheres to all applicable, targeted specifications—the SCORM Runtime Environment (RTE), Sequencing and Navigation (S&N), and Content Aggregation Model (CAM)—content developers are free to choose the tools, platforms, and media file types most suited to their needs and preferences. The use of S1000D DMs as SCORM assets does not violate any of the SCORM conventions or conditions for the IMS content packaging or SCORM RTE requirements.

To be verified as SCORM conformant, content must meet the requirements of the applicable modules of the ADL Test Suite, including the Content Package test, the SCO RTE test, and the Metadata Conformance Utility. The project courseware samples passed all of these tests (see test logs in Appendix D).

### *3.6. Affect of S1000D on Training Efficacy*

***Use of S1000D DMs, with a workflow that allowed instructional designers to plan how DMs can best be used in the presentation of training, did not affect instructional efficacy.***

The primary finding during the case study was that S1000D can be used to name, identify, and structure technical training content without adversely affecting instructional design, learning content, or the science of learning. However, this finding cannot be generalized to every conversion effort. For one thing, there are too many confounding factors that can affect instructional efficacy (e.g., instructional design skill). However, all other factors aside, it is essential that the development workflow allow for analysis of content to determine its suitability for training as well as appropriate strategies for engaging the learner.

## 4. Conclusions

### *4.1. Collaborative Process*

***Development of dual-purpose DMs is most effective through close collaboration between technical and training representatives.***

The technical and the training communities have very different focuses. For the technical community, the primary focus is the technical content, which must be maintained and certified as complete and accurate. For the training community, the technical content is only one of many elements considered when designing and developing a learning event. The primary focus of training is on the creation of effective learning based on established, theory-based guidelines and principles. Because of their different focuses, it is essential that both communities have input into the identification and development of technical DMs—whether the

DMs are to be used to create an IETM, a SCO, or both—in order to ensure maximum reusability.

## 4.2. Assigning Granularity to S1000D Content

***Appropriate granularity is best determined through collaboration between the technical and training communities.***

Neither SCORM nor S1000D provides an algorithm that can be applied to any project, let alone all projects, to indicate a level of granularity for chunks of content. The S1000D DMC does suggest levels of granularity based on the SNS and IC (see section 1.2.1). However, this is only one of many considerations. Because the two communities have such different perspectives regarding granularity, neither community can be expected to fully anticipate the needs and concerns of the other. Therefore, it is essential that they work collaboratively to identify DM content. Above all, they must keep in mind that the granularity for dual-purpose technical DMs should reflect both the maintenance philosophy and sound learning principles.

### 4.2.1 Technical Data Perspective on Granularity

From a technical perspective, the ideal granularity is based on the equipment and task description as reflected in the SNS and IC. Once that information is known, content can be broken out accordingly and captured as data modules. If the source data is part of a traditional chapter-based technical manual, then there is an argument for following that chapter breakdown when assigning the SNS and IC. However, this approach can lead to very large DMs. A large DM is not a problem for the technical community because their units of organization—manuals/IETMs, chapters, and paragraphs—have no limitations on length based on the visual presentation of content. Also, as regards maintenance procedures, a DM that contains the entire procedure maintains the integrity of the procedure and associated safety information.

### 4.2.2 Training Content Perspective on Granularity

On the other hand, a large DM is not appropriate for the training community. In determining the correct granularity, training must consider not only the relatedness of the content but also (1) the design of the content presentation to include other instructional elements and the strategies to support learning and (2) the available screen real estate to display the augmented content. These considerations require a much finer granularity. For example, the technical community might incorporate the following information into a single DM:

> Compressed air from the primary ship dry air system enters the air control panel, passing through the input filter to the humistat. Whenever the humidity rises

> above a preset value, the humistat sends an alarm signal to ORTS through the dry air distribution control assembly. The clean, dry air then passes through the input control and regulation stage. In this stage, the panel reduces and regulates the air pressure. In the monitor stage, the inlet pressure gauge and flowmeter provide a visual indication of the pressure and flow rate of the air. The outlet pressure gauge, which provides a visual indication of the output pressure, is also a part of the monitor stage. In the output control and regulation stage, the air control panel reduces the air pressure to the value required by the using system and regulates it at that value. A relief valve in the output line protects the system if excessive air pressure occurs.

Chunking this paragraph into smaller DMs (as shown below) provides the training community the latitude to display the content in a number of ways, depending on the instructional strategy—as a bulleted list, as links from a list of the four functional stages, or as pop-up text from an interactive diagram.

> Compressed air from the primary ship dry air system enters the air control panel, passing through the input filter to the humistat. Whenever the humidity rises above a preset value, the humistat sends an alarm signal to ORTS through the dry air distribution control assembly.
>
> The clean, dry air then passes through the input control and regulation stage. In this stage, the panel reduces and regulates the air pressure.
>
> In the monitor stage, the inlet pressure gauge and flowmeter provide a visual indication of the pressure and flow rate of the air. The outlet pressure gauge, which provides a visual indication of the output pressure, is also a part of the monitor stage.
>
> In the output control and regulation stage, the air control panel reduces the air pressure to the value required by the using system and regulates it at that value. A relief valve in the output line protects the system if excessive air pressure occurs.

### *4.2.3 Safety Perspective on Granularity*

Related to granularity is the question of safety. Both the technical and the training communities acknowledge that it is critical to keep safety information with associated content. However, in the case of the Q-20 content, it was found that all safety information applied to multiple segments of content. Therefore, it was sensible to create a set of common safety DMs that would apply to all source material information that was associated with that safety information. This allowed for reuse of the safety DMs wherever they were needed rather than duplicating the safety information every time.

## *4.3. Ability to Use DMC to Describe Training Content*

***The S1000D DMC does not allow for capture of all the descriptive metadata that needs to be associated with reusable learning objects.***

One of the requirements for this analysis was to determine if S1000D could be used to name and identify training content. Although a workaround was found for identifying training information using the current DMC guidelines, it is inadequate to describe training DMs for the following reasons:

- The "T" option for the ILC merely indicates that a DM is used specifically for training; people searching the database for DMs with potential reuse have no information about the nature of the training content in the DM.
- Appropriating the disassembly code variant for training identification would result in the possible loss of descriptive technical data.
- Any code developed to identify and describe a training-only DM must be able to accommodate the rich description of training objects made possible through the SCORM LOM.

## 4.4. Limits on the Use of S1000D for Capturing Training Content

***If complex interactions are used in the training content, they must be captured in DMs as self-contained Flash files.***

The S1000D markup does not readily support the development of highly interactive content. This issue specifically involves content items that may be typed as:

- Assessments
- Knowledge checks
- Practice
- Exercises

These learning objects usually require complex scripting to handle logical looping structures and data arrays to account for various user response cases. Some cases may require multiple instances of feedback text to be displayed according to business rules to govern allowed attempt numbers and specific responder choices. They may also require scoring and remediation.

In addition to requiring complex scripting, learning objects of this type also commonly present more complex rendering challenges. At their most elementary, they will require radio and submit buttons. They may also require matching, drag-and-drop, and a host of other possible complex interaction types.

The S1000D descriptive DM markup does not provide for assessment or practice items in any reliable, specific way. This is understandable in consideration of the fact that S1000D was not created or engineered with learning object markup needs of this sort in mind. In the simplest cases (such as single-answer questions), it could be possible to create project-specific business rules to cover the uses of certain document markup elements and their relative positioning and grouping. These rules might also make it possible for a project-specific rendering

engine to recognize and display the intended layout and provide for the required interactivity. However, these rules would not extend outside of the project because there is no global standard for S1000D rendering. Each use group or data project is free to create their own general business rules for addressing markup requirements.

Although it may be possible to adapt the Process Data Module to handle some of the logical requirements of the scripting, this has never been done. Such an adaptation could prove to be a difficult and time-consuming task to undertake. Further study is needed to determine whether this solution would be practical or feasible within the bounds of the specification as it now stands.

The practicality issue is particularly questionable in view of the fact that an extensive XML markup dedicated to assessments and the like already exists. The IMS Question and Test Interoperability Specification (IMS QTI) is a mature standard designed for capturing learning object data for assessments, practice items, knowledge checks, and other objects with similar interactions. Following is a basic sample of the markup (note the stem and responder markup, the specification of item width and height, and the hot spot display properties):

```
 <?xml version = "1.0" encoding = "UTF-8" standalone = "no"?>
<!DOCTYPE questestinterop SYSTEM "ims_qtiasiv1p2p1.dtd">
<!-- Version 1.2 Compliant Example: BasicExample018 -->
<questestinterop>
<qticomment>This is a standard connect-the-points example. The logical identifier response-type is used.
No response processing is incorporated.</qticomment>
<item title = "standard connect-the-points item" ident = "IMS_V01_I_ctpt_i_001">
        <presentation label = "BasicExample018">
                <flow>
                        <response_lid ident = "CTP01" rcardinality = "Multiple" rtiming = "No">
                                <material>
                                        <mattext>Connect the appropriate number of points to create a
                                        single right-angled triangle.
                                        </mattext>
                                 </material>
                            <render_hotspot showdraw = "Yes">
                                 <material>
                                        <matimage imagtype = "image/gif" uri = "ctpoint.gif" x0 = "0" width =
                                        "400" y0 = "0" height = "200"/>
                                </material>
                                <response_label ident = "A" rarea = "Ellipse">300,20,1,1</response_label>
                                <response_label ident = "B" rarea = "Ellipse">320,40,1,1</response_label>
                                <response_label ident = "C" rarea = "Ellipse">380,100,1,1</response_label>
                                <response_label ident = "D" rarea = "Ellipse">300,180,1,1</response_label>
                                <response_label ident = "E" rarea = "Ellipse">240,120,1,1</response_label>
                                <response_label ident = "F" rarea = "Ellipse">280,40,1,1</response_label>
                            </render_hotspot>
                        </response_lid>
                </flow>
        </presentation>
</item>
</questestinterop>
```

It would seem logical to apply this standard to assessments and the like rather than to force the S1000D markup to account for processes and structures it is not designed to support. SCORM does not care if content package assets are of mixed origin and type. Therefore, it would be entirely possible to assemble IMS QTI XML assets and rendering engines in a package alongside S1000D DMs.

## 4.5. Instructional Efficacy of Training Developed from S1000D DMs

***Using S1000D data modules to capture training information does not affect instructional efficacy as long as the workflow does not subvert instructional design processes.***

One of the requirements of this analysis effort was to determine if Navy training content tagged in the S1000D specification can negatively affect instructional design. The experiment demonstrated that S1000D data modules can be used to capture training content and that training can then be created using these data modules as assets. However, the workflow used to develop training using S1000D DMs will definitely impact the efficacy of the instruction. There are three possible workflows for training development utilizing S1000D, each with its own implications.

### 4.5.1 Workflow 1: Developing Training from Legacy Materials

Figure 3 shows the workflow used for this analysis, which involved conversion of legacy materials to S1000D DMs and subsequent rendering of them as SCORM-conformant training. This workflow strongly reflects standard courseware development processes.

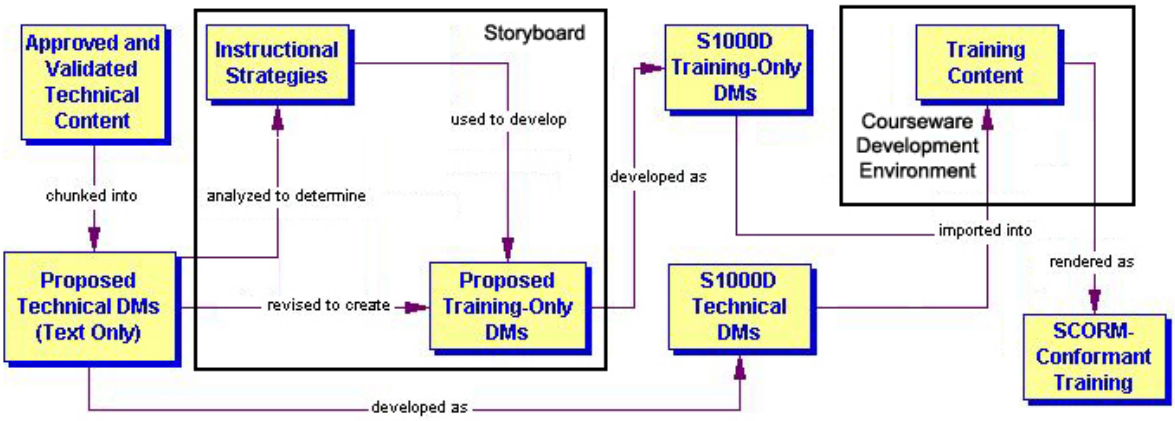


**Figure 3. Workflow 1.** *This workflow generally results in two sets of technical DMs, one containing approved and validated technical content and one designated for technical training only.*

The first step in the workflow is to identify the technical content to be used for courseware development and to chunk it appropriately. These chunks of content can be assigned a DMC and developed into

technical DMs. Because the content is the same as the approved and validated source, these DMs will still be valid.

During the storyboarding process the technical content is analyzed to determine (1) its suitability for training and (2) the instructional strategies that will provide the appropriate support for learning. Because of the issues noted previously (see section 2.1.2.2), it will be necessary to revise much if not all of the technical content before using it in training. The instructional strategies are implemented as chunks of instructional content consisting of text, interactions, graphics, animations, and/or sound. Each chunk is to be developed as a training-only DM.

The next step is to assign DMCs to the proposed DMs, comprising both the instructional content and the revised technical content, and develop each into a training-only S1000D DM. The courseware development environment imports these training-only DMs, as well as any usable technical DMs, and renders them as SCORM-conformant training.

Although this workflow realizes some of the possible life-cycle maintenance efficiencies afforded by S1000D, it does not result in any production efficiencies because of the need to develop two sets of technical DMs. When technical content is changed, even slightly, it cannot be used for technical publications unless it undergoes the standard approval and validation process, which would necessitate a considerable extension of the courseware development schedule.

### *4.5.2 Workflow 2: One-Time Dual Development*

Figure 4 shows an alternative courseware development, which can be used with both new and legacy technical content. The first step of this workflow is to collaboratively analyze and chunk technical source materials into potential technical DMs, revising them as necessary to create dual-purpose technical content. These chunks of content are then assigned a DMC, developed as dual-purpose DMs, and undergo verification and validation.

Analysis of the technical content will suggest appropriate instructional strategies, which are then developed and coded as training-only DMs. The courseware development environment ingests the verified and validated technical DMs as well as the training-only DMs and renders them as SCORM-conformant training.

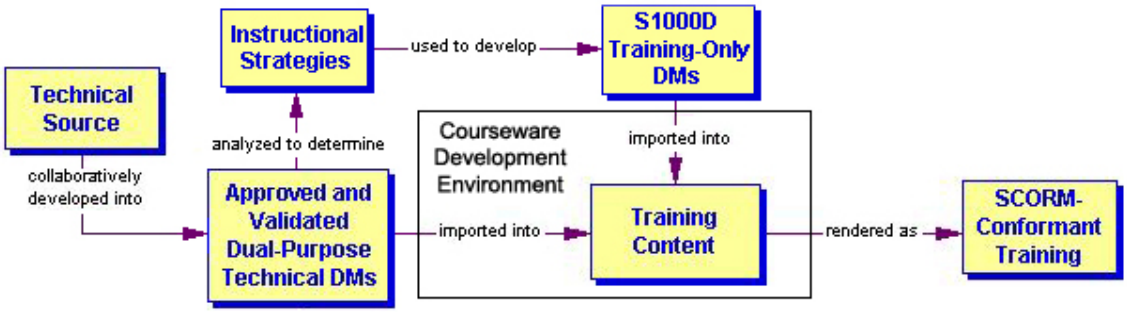


**Figure 4. Workflow 2.** *This workflow involves upfront development of dual-purpose technical and training-only DMs and automated ingestion to and rendering in the courseware development environment.*

Although this workflow provides multiple development efficiencies as well as better life-cycle maintenance, it is not likely to produce effective training:

- Instructional strategies are one-dimensional—that is, they are based only on content analysis and do not take into consideration learner characteristics, delivery platform, learning environment, integration with a broader learning system, etc.
- DMs are rendered as a sequential "page-turner."
- Automated aggregation and rendering of training content does not support spiral development processes, which promote instructional quality by providing incremental evaluation and feedback for continuous improvement.

### *4.5.3 Workflow 3: Blended Approach*

Workflow 3 (see Figure 5) blends features of the other two workflows. Like Workflow 2, it begins with the collaborative identification, development, approval, and verification of dual-purpose technical DMs. However, like Workflow 1, it provides for customized training development. Because the training-only DMs are not created until a training need is identified, instructional designers can consider all the variables that impact training development and delivery when designing the instructional elements.

This workflow also provides the flexibility to use instructional strategies that combine DMs into interactive presentations. For instance, hot spots on an interactive system graphic can display component information, thus reinforcing the parts-to-whole relationship for learners. Of course, a revision of this sort necessitates coding the interactive graphic as a training-only technical DM to indicate that it has not gone through the verification and validation process. The courseware development environment retrieves the technical and training DMs from the database and renders them as SCORM-conformant training.

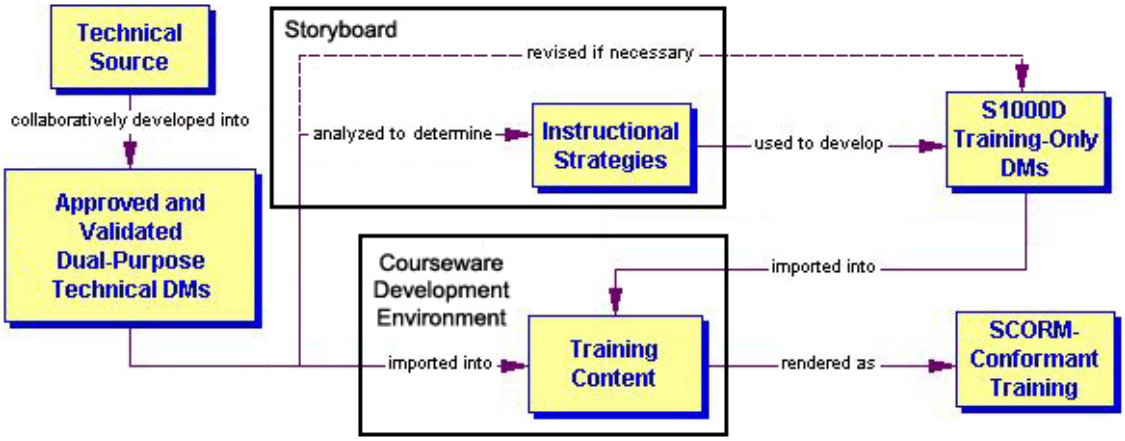


**Figure 5. Workflow 3.** *This workflow utilizes dual-purpose technical DMs and customized training-only DMs to produce effective SCORM-conformant training.*

### *4.5.4 Implications for Each Workflow Alternative*

The table below shows each workflow's implications for development and instructional efficacy.

| | **Workflow 1** | **Workflow 2** | **Workflow 3** |
|---|---|---|---|
| **Validity of Technical DMs** | ***Questionable***<br>Revised technical information, although reviewed by SMEs, does not go through the approval and verification process prior to creation of DMs. | ***Excellent***<br>DM content goes through the standard approval and verification process prior to courseware development. | ***Variable***<br>Technical content that is reused without change remains valid. Any change to a technical DM requires that it be saved as a training-only DM with a new DMC. |
| **Instructional Efficacy** | ***Variable***<br>The efficacy of the instruction is dependent on the expertise of the instructional designer and is not affected by the workflow. | ***Poor***<br>The automated process will likely result in page-turner instructional presentations with level 1 interactivity. | ***Variable***<br>The efficacy of the instruction is dependent on the expertise of the instructional designer and is not affected by the workflow. |

| | Workflow 1 | Workflow 2 | Workflow 3 |
|---|---|---|---|
| **Reuse of Technical Content** | ***Negligible***<br>There is little likelihood of reuse from the original technical content, and the new training-only technical DMs will need to go through the approval and verification process before they can be reused in an IETM. | ***Excellent***<br>Because there is no change to the content, there is 100% reuse of technical DMs. | ***Considerable***<br>Because the technical DMs are developed for dual-purpose use, the likelihood of direct reuse is greatly increased. However, instructional strategies may involve combining DMs in a single interaction rather than presenting them as sequential information. The resulting interaction would then be saved as a training-only DM. |
| **Reuse of Training Content in Other Training Packages** | ***Variable***<br>Technically, of course, all of the training content could be reused. However, the instructional efficacy would be highly questionable. The design of training content takes into account many factors. What is developed for one set of circumstances may not work for a different set. | | |

**Table 4. Implications for Each Workflow Alternative.** *Each of the three workflow alternatives has implications for technical validity, instructional efficacy, and reuse.*

# 5. Recommendations

## *5.1. Strategies for Harmonizing SCORM and S1000D*

### *5.1.1. Revision of S1000D*

***Revise the S1000D specification to accommodate SCORM metadata.***

One of the core concepts of harmonization is the ability to use the DMC to describe training-only DMs as well as technical DMs. S1000D currently accommodates multiple types of information regarding a

technical DM. To accommodate training data, the specification must be revised to accommodate multiple types of information regarding training data.

For this analysis, part of the DMC was appropriated for a limited set of training identifiers based on Gagne's nine instructional events. However, as mentioned in section 2.4.2.2, it would be far more effective to (1) maintain the level of technical identification currently provided by S1000D, (2) provide a more robust description of training objects, and (3) associate training identifiers to the SCORM LOM. The LOM provides categories and levels of training-specific descriptive information that will enable a much fuller description of training DMs. Moreover, such a bridge will underscore the harmonization of the two specifications.

It is suggested that the S1000D architecture accommodate for relational object identification via an optional element "wrapper" that provides common understanding between the S1000D and SCORM domains to allow object transfer and reprocessing. This element wrapper should have its own unique identifier and changeable metadata that can provide additional information regarding the application of the training object, its purpose, and other descriptive data as discussed in section 2.4.2.2. This wrapper would provide a data information exchange capability between S1000D and SCORM for the source information objects—both at the "document" and subcomponent levels—that will allow training objects not only to be identified but also to be optionally described with relational, changeable metadata that provides:

- Application
- Purpose
- Intention of use

The first capability, identification, is currently present within the S1000D element Data Type architectures, within the DMC structure, and within many of the element attributes. However, for the technical DMs to be reused in other use cases, such as training, additional relational object descriptors are necessary. This additional information should be an optional capability that a "non-owner" (external to the content development effort) could perform.

These subcomponent structures for capturing and sharing training object metadata should continue to provide relational information with a defined DMC (or extended DMC). This type of architecture would define an object for reuse and enable the sharing of selected subcomponent information (the training metadata). It should also be "durable"—that is, able to directly instantiate into another application that may have differing use-case requirements.

### *5.1.2. Markup Options for Highly Interactive Training Objects*

***Explore other options for handling complex interactions.***

The S1000D markup is not designed to structure training objects requiring complex scripting, for example, logical looping structures, data arrays, conditional feedback, scoring, and remediation. Although it may be possible to adapt the Process Data Module to handle some of the logical requirements of the scripting, it would valuable to explore the use of markup languages expressly designed to handle learning structures intended for interactive use. The IMS QTI provides a standard for this level of interactivity. Its use in partnership with S1000D would be complimentary to the harmonization objectives sought in this study. SCORM accepts assets of mixed origin and type, so training could be developed from a combination of IMS QTI XML assets and dual-purpose DMs.

- Such changes to S1000D, even if possible, would be expensive and costly.
- The IMS QTI already provides a standard for this level of interactivity.
- SCORM accepts assets of mixed origin and type, so training could be developed from a combination of IMS QTI XML assets and dual-purpose DMs.

### *5.1.3. A Dual-Purpose Publishing Environment*

***Develop an S1000D/SCORM-conformant data management and publishing environment.***

The other core concept of harmonization is the ability to produce and render S1000D DMs as technical documentation and as SCORM-conformant training in one production environment. Although there are no products on the market today capable of handling both tech data and training content processes, there is a government-lead prototype effort (as of this writing) underway that seeks to demonstrate how tech data and training content can be managed and developed from a common source database. A software solution that would manage DMs and publish them in the form of both IETMs and SCOs would be a major step toward harmonization of the two specifications.

## 5.2. Strategies for Harmonizing the Technical and Training Communities

### 5.2.1 Content Planning

***Ensure that the Manpower, Personnel, Education and Training (MPT&E) commands mandate conformance of content with S1000D and SCORM.***

In 2005, the Manpower, Personnel, Training, and Education (MPT&E) commands were aligned to more efficiently drive the Sea Warrior programs for which they are responsible. Sea Warrior is the human resource component of the CNO's Sea Power 21 transformation roadmap. Its focus is to deliver the right skills to the right people at the right time. MPT&E was charged with integrating manpower and personnel business processes with the training and education business processes in order to achieve greater efficiencies in developing and delivering optimally trained, motivated manpower to the fleet.

The MPT&E Information Management/Information Technology (IM/IT) shared services is organized around a centralized planning and decentralized execution construct that provides a standard level of service and IM/IT architecture. Applying this construct to content planning necessitates identification of efficiencies in the production of training and education, such as those afforded by development of dual-purpose content that is conformant with both S1000D and SCORM specifications.

### 5.2.2 Acquisition

***Ensure that acquisition documents specify collaboration between the technical and the training community during development of technical content.***

Every S1000D conversion or development contract should include both technical documentation and training requirements. In addition, acquisition should make collaboration between the technical and the training communities a requirement. For instance, acquisition documents should specify that every S1000D project team include a minimum of one instructional designer so that the content DMs meet the needs of both communities.

### 5.2.3 Technical and Training Collaboration

***Ensure that technical and training representatives on a technical content development effort understand each other's positions and the basic requirements for both S1000D and SCORM.***

The technical and training representatives on a technical content development team must be able to find a common ground for harmonizing content for use within both standards. Therefore, before commencing any work aimed at developing dual-purpose technical DMs, it is critical that they meet to discuss the project so that each fully understands the other's requirements. It is also extremely important that this collaboration is not a one-time activity but is instead the beginning of a collaborative relationship that continues throughout the life of the project.

The development process itself should be a collaborative effort that takes into consideration the needs of both communities. At a minimum, a subject matter expert should review all training DMs, and a qualified instructional designer should review all technical DMs as part of the development effort's quality control (QC) process.

#### 5.2.3.1 Mutual Understanding of Each Community's Focus

To enhance collaboration, members of the technical and training communities must understand the focus of each other's community. The focus of the technical community is the development, maintenance, verification, and certification of technical information over the course of a product's life-cycle. The focus of the training community is provision of the cognitive support needed for learning.

#### 5.2.3.2 Mutual Understanding of S1000D and SCORM

Subject matter experts should have a general understanding of the purpose and constraints of SCORM as well as a working understanding of an aggregation, a SCO, and an attribute. Instructional designers should have a general understanding of the purpose, capabilities, and constraints of the S1000D specification including a working knowledge of the DMC.

#### 5.2.3.3 Need for Operational Definitions

Both the technical and training communities have their own vocabularies as a result of common backgrounds, interests, and needs. These vocabularies ease communication among others in their respective communities. Understandably, when these specialized vocabularies are used in mixed communities, there is opportunity for misunderstanding. It poses a challenge to effective communication.

Even more confusing is the fact that the two communities sometimes attach different meanings to the same word. For instance, in one discussion between the technical and training community representatives, it was discovered that they had very different understandings of the word *lesson*. The technical representative stated that his concept of a technical lesson included an introduction, a description of the equipment, the theory of operation, operational and maintenance fault diagnostics, functional tests, and student assessment/evaluation. The training representative responded that this definition was far too limiting. In the training community, a lesson does not necessarily include all of those elements; also it does include elements that were not mentioned in the technical definition. Unfortunately, this type of language difference is harder to identify than unfamiliar terms because of the false assumption of shared meanings.

The solution to this problem is twofold. First, the two communities should work together to establish a taxonomy of commonly used technical and training terms that both can understand. Second, both communities must be cognizant of vocabulary differences and establish operational definitions for key terms used in negotiating a harmonized approach to DM creation. For instance, the training representative defines the term *lesson* as a purposefully designed learning experience that includes most or all of Gagne's nine instructional events. The key difference between the technical definition and the training definition of the term is that the first emphasizes types of content, whereas the second emphasizes how the content is taught.

### 5.2.4 Development of Dual-Purpose Data Modules

***For maximum reusability, write S1000D technical content with dual use in mind and then subject it to the technical content verification and validation process.***

This analysis has uncovered three primary challenges in developing dual-purpose S1000D content: (1) differences in writing style, (2) appropriate granularity, and (3) preservation of approved technical information.

#### 5.2.4.1 Avoidance of Product-Specific Text References

When developing content DMs, avoid including product-specific references. For instance, avoid direct references to *this manual* or *this chapter* or *this lesson*. Although there are occasions when these references are necessary—for instance, in a DM for a topic introduction or a training objective, recognize that the resulting DM will have limited reusability and work to minimize these occurrences.

#### *5.2.4.2 Passive vs. Active Voice*

Active voice uses a strong, descriptive action verb and specifies the person or thing that performs the action. Passive voice combines action verbs with *being* verbs. Research has shown that active voice is more direct and easier to understand than passive voice (Spyridakis, 2000).

| Problematic Passage | Dual-Purpose Passage |
|---|---|
| WARNINGs and CAUTIONs are used (passive voice) in this manual (product-specific text reference) to highlight operating or maintenance procedures, practices, conditions or statements which are considered essential to protection of personnel (WARNING) or equipment (CAUTION). | WARNINGs and CAUTIONs highlight operating or maintenance procedures, practices, conditions or statements which are considered essential to protection of personnel (WARNING) or equipment (CAUTION). |

**Table 5. Comparison of Problematic and Dual-Use Passages.** *Avoiding product-specific text references and using active voice where possible promotes dual-purpose text.*

#### *5.2.4.3 Appropriate Granularity*

Determining the appropriate granularity for DMs will necessarily require negotiation between the two communities in order to meet the needs of both (see section 3.2).

#### *5.2.4.4 Safety*

Safety is directly related to granularity. Both the technical and the training communities acknowledge that safety information in the source material must not be separated from the associated content. However, in the case of Q20, it was found that all associations to safety information were found to be common associations and so it was sensible to create a set of common safety data modules which would be applied to all source material information that was associated with that safety information. This meant that those safety data modules could be reused wherever they were needed rather than duplicating the safety information every time.

#### *5.2.4.5 Technical Validity*

It is anticipated that the low level of reuse demonstrated in this analysis will probably be the rule for legacy technical materials—unless legacy materials are developed as dual-purpose DMs that then undergo the verification and validation required for technical content.

If both these conditions are met (collaborative dual-purpose development and technical certification), there will likely be a dramatic increase in reuse. For instance, had the Q-20 content used for the demonstration pieces been developed as dual-purpose DMs and then undergone the standard approval process, 28 verified and validated

dual-purpose technical DMs would have been produced. Based on the usage of this content in the demonstration training module, it is estimated that 71% of these technical DMs would be directly reusable for training.

The reason that the estimate is not 100% is that two of the training-only DMS displayed multiple technical DMs in an interactive screen rather than in a sequential format, as they appeared in the IETM. The training community will always reserve the right to employ training strategies of this sort, which depict parts-to-whole relationships and help the learner develop a more elaborate mental model of the content.

## *5.3. Guidelines*

Based on the findings of this analysis, the following guidelines are suggested for converting legacy content to S1000D data module for use in development of technical documentation and training.

### *5.3.1. Conduct Content Analysis*

It is necessary to conduct a thorough content analysis prior to the design and development of the training courseware and technical IETMs. This can facilitate the reuse of the authoritative technical source content. Reuse does not just happen; it must be deliberate and planned prior to the writing phase.

It is important to consider both the instructional efficacy and the technical accuracy and safety. The analysis should include the following:

- Analyze the technical content to determine (1) its suitability for training, (2) all learning/performance objectives, and (3) the instructional strategies that will provide the appropriate support for learning
- Analyze the technical content to determine all technical procedures, steps, warnings, cautions, and notes
- Identify the types of content that should be covered in each training and technical DM to include both text and media elements
- Analyze authoritative technical source materials for completeness and accuracy, to include the following:
    - Redundant information
    - Textual clarity
    - References to figures and graphics
    - References to other parts of the IETM
    - Sufficient level of information and detail
    - Accurate information
    - Organization of related content

    - Consistent component naming conventions
- Develop detailed content outlines and storyboards that identify the length and learning objectives/performance outcomes for each training DM, to include references to respective media and/or other content
- Develop detailed content outlines that identify the length, procedures, steps, warnings, cautions, and notes for each technical DM, to include references to respective media and/or other content

### *5.3.2. Establish Collaboration between Technical and Training Communities*

Close collaboration between technical and training representatives is required for successful development of dual-purpose S1000D DMs.

- Development of dual-purpose DMs is possible only through close collaboration between technical and training representatives.
- Appropriate DM granularity is best determined through collaboration between the technical and training communities.
- Ensure that technical and training representatives on a technical content development effort understand each other's positions and the basic requirements for both S1000D and SCORM.
- Agreement on a content breakdown must accommodate as much as possible the requirements of training while remaining as faithful as possible to the requirements of the technical community.
- Review storyboards to ensure instructional efficacy and technical accuracy and safety prior to development.
- Review completed graphics and interactions to ensure that they support the instruction and are technically accurate; revise as necessary.

### *5.3.3. Determine Granularity and Chunking*

A relatively fine granularity of content provides greater reuse potential between the training and technical communities, as long as both the training and technical philosophies are not compromised. The following should be observed:

- There are no size restrictions on the size of a DM to be used for technical documentation. Instead, granularity is determined by the SNS and IC. However, a long DM cannot be used "as is" in training because of courseware design principles and best practices:
    - Text should not scroll.
    - Instructional screens should not be a solid block of text.
    - A graphic or animation that provides cognitive support for textual information should display on the same screen as the text.

    - Elements of content may be broken out for display in an interactive screen to reinforce the parts-to-whole relationship.
    - Instructional content should combine information presentation with strategies that actively engage the learner with the content.
- Include learning support; explanatory or illustrative graphics, interactions, questions, and other instructional elements that are needed to help learners construct mental models of the information being discussed to facilitate storage in and retrieval from long-term memory.
- Ensure that the amount of text does not lend itself to excessive scrolling.
- Chunk content so that it is appropriate for display on a single screen.
- In determining the correct granularity, training must consider not only the relatedness of the content but also the following:
    - Design of the content presentation to include other instructional elements and the strategies to support learning
    - Available screen real estate to display the augmented content
- With regard to safety, both the technical and the training communities acknowledge that it is critical to keep safety information with associated content.
- It is necessary to break out individual DMs from maintenance procedures in order to meet the needs of the training community (see section 2.2) and realize the efficiencies of dual-use DMs (see section 1.1).
- When chunking maintenance procedures, subject matter experts and instructional designers should ensure that all warnings, cautions, and notes remain with the steps to which they apply.

### *5.3.4. Determine Procedures and SCOs to Create Dual Purpose DMs*

Whereas a procedure in an IETM can reference another procedure, one of the basic SCORM rules is that one SCO cannot access another. Solutions include the following:

- Combine procedures in a single SCO
- Use multiple SCOs for embedded procedures
    - Multiple SCOs that are sequenced using the SCORM 2004 Sequencing and Navigation Model can be used to embed technical procedures.

### *5.3.5. Identify Appropriate Workflow*

Workflow has implications for technical validity, instructional efficacy, and reuse. Choose a workflow that

- begins with the collaborative identification, development, approval, and verification of dual-purpose technical DMs
- realizes the possible life-cycle maintenance efficiencies afforded by S1000D
- provides multiple development efficiencies as well as better life-cycle maintenance
- provides the flexibility to use instructional strategies that combine DMs into interactive presentations
- utilizes dual-purpose technical DMs and customized training-only DMs to produce effective SCORM-conformant training

### *5.4. Business Rules*

In a typical implementation of S1000D for a maintenance environment, business rules are extremely important for the production of data modules. They give the rules for populating every element and every attribute that is to be used in the markup. Typically—especially when there are multiple organizations producing data modules—they also contain the data module coding strategy that is to be used across the project. Establishing these rules before any production work ensures consistency of writing style, population, and presentation.

Developing dual-purpose technical DMs and training content DMs for use in both IETMs and SCOs is no different. All stakeholders must establish and agree to the business rules that will guide the project before beginning any conversion of legacy material or production of new material. The primary difference is that rules for harmonizing the technical and training perspectives must be established in the beginning in order to meet the requirements of both communities.

## 6. Summary

Currently, technical documentation and training are two distinct types of acquisitions; a contract for one does not reference the other except possibly as source material. The S1000D/SCORM Redundancy Analysis and Conversion Guidelines project was an effort to recognize the interrelatedness of technical-publication and technical-training development and to determine whether S1000D can be used to name, identify, and structure technical training content for use in training as well as technical documentation without adversely affecting instructional design, learning content, or the science of learning.

This analysis effort demonstrated that training data can be captured in an S1000D DM and that technical and training DMs can be rendered as a SCORM-conformant learning object without affecting learning efficacy—provided the workflow allows for content analysis and application of sound instructional design principles. It also showed ways to harmonize technical and training perspectives in the conversion or development of content and provided suggestions for changes to the S1000D specification to accommodate training.

The ideal approach to the development of dual-purpose content is to address both technical and training purposes during initial development. This approach requires planning for dual-purpose content from the beginning, selecting project teams that have representatives from both the technical and the training communities, and using development processes that support collaboration.

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# Appendix A

Proposed DMs Based on Analysis of Selected AEGIS Content

The table below shows proposed DMs for the AEGIS content based on the following:

- SW279-CL-AEG-040/AIR CONT PNL; Equipment Manual for the AEGIS Air Control Panel Assembly for Auxiliary Equipment Group for AN/SPY-1A, -1B, -1B(V), and FCS; Description, Operation, and Maintenance
- AEGIS Instructor Guides
- Instructional strategies for self-paced training based on this content.

The proposed DMs for technical content illustrate how legacy content can be converted to dual-purpose text for use in technical documentation and training. The DM column shows a sequence number and the T-codes for the proposed DMs.

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| 1-T-AA | | | *Screen 1: Training title screen* |
| 2-T-AC | | | *Screen 2: Scenario with question*<br>*(Flash file)* |
| 3-T-OG | | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>Describe the major and associated components of the AIR CONTROL PANEL ASSEMBLY. Include name, physical appearance, location, and function to support operation and maintenance. | *Screen 3*<br>**Objectives**<br>• Locate the twelve components of the air control panel.<br>• Match each of the twelve components of the air control panel with its description.<br>• Relate the function of each component to the function of the air control panel. |
| 4-T-SA | **INTRODUCTION, PURPOSE, 1-3.1**<br>The air control panel regulates the pressure of the dry air and monitors the humidity (dewpoint) of the dry air.<br>**DESCRIPTION, INTRODUCTION, 2-1.1**<br>**Introduction**<br>The air control panel regulates the pressure of the dry air and | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>3. Purpose<br>**Related Instructor Activity:**<br>Refer trainee to SW279-CL-AEG-040 figure 1-1.<br>Reference SW279-CL-AEG-040 paragraph 1-3.1.<br>**S-104-0191 Rev D Change 2_T0113-1-1.xml** | *Screen 4*<br>**Introduction**<br>The air control panel regulates the pressure of the dry air and monitors humidity of the dry air. The auxiliary equipment group has four air control panels that are designated T68, T69, T70, and T71. |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | monitors humidity of the dry air. The auxiliary equipment group has four air control panels that are designated T68, T69, T70, and T71. | 4. Operational Capabilities<br>a. Air Flow Rate<br>b. Air Pressure<br>**Related Instructor Activity:**<br>Refer trainee to SW279-CL-AEG-040 table 1-2. | |
| 5-T-GS | *Note: The information is based on INTRODUCTION,* 1-5.2, *Functional Description:*<br>The auxiliary equipment group provides clean, dry air for pressurization of waveguide and antenna components of SPY-1A/B and FCS. | **S-104-0191 Rev D Change 2_ T0113-1-2.xml**<br>1. Functional Interface<br>a. Dry Air Distribution Control<br>b. Self-Reactivating Dehydrator<br>c. Ship's Service<br>(1) Dry Air<br>**Related Instructor Activities:**<br>a. Refer trainee to SW279-CL-AEG-040 figure 1-3 and 1-4.<br>Reference SW279-CL-AEG-040 paragraph 1-5.2.1. | *Screen 4 Continued*<br>*This is a training DM that would appear on the same screen as the previous technical DM.*<br>Note in the figure below that the air control panel is critical to the pressurization function of the auxiliary equipment group, which provides clean, dry air for pressurization of the waveguide and antenna components of the SPY-1A/B and FCS radar systems. |
| 6-T-SA | **DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.1**<br>The air control panel is 17.9 inches in height, 9.6 inches in width, 5.5 inches in depth, and approximately 25 pounds in weight (see Figure 2-1). With ORDALT 20086, the air control panel is shown on Figure 2-2. The air control panel consists of the following components:<br>a. Humistat<br>b. Manifold<br>c. Relay enclosure<br>d. Inlet pressure regulator<br>e. Outlet pressure regulator<br>f. Relief valve<br>g. Control valves<br>h. Pressure gauges | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>5. Major and Associated Components and Functions<br>**Related Instructor Activities:**<br>Refer trainee to SW279-CL-AEG-040 figure 2-1.<br>Reference SW279-CL-AEG-040 paragraph 2-2.1. | *Screen 5*<br>**Physical Description**<br>The air control panel is 17.9 inches in height, 9.6 inches in width, 5.5 inches in depth, and approximately 25 pounds in weight.<br>The air control panel consists of the following components:<br>• **Humistat**<br>• **Inlet manifold**<br>• **Relay enclosure**<br>• **Inlet pressure regulator**<br>• **Outlet pressure regulator**<br>• **Outlet manifold and relief valve**<br>• **Control valves**<br>• **Pressure gauges**<br>• **Flowmeter**<br>• **Indicating desiccant and** |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | i. Flowmeter.<br><br>*Note: Component names were changed or added based on information in functional descriptions to provide internal consistency and reduce confusion.* | | **filter**<br><br>*Note: Each bullet above is linked to a DM as described below.* |
| 7-T-SA | **DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.2**<br><br>**Humistat**<br><br>The humistat consists of a printed circuit (PC) board and a sensing element housed in a protective enclosure. With ORDALT 20086, the enclosure is located in the humidity alarm box. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>5. Major and Associated Components and Functions<br><br>a. Humistat<br><br>**Related Instructor Activity:**<br><br>Refer trainee to SW279-CL-AEG-040 paragraph 2-2.2. | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "humistat" is clicked.*<br><br>**Humistat**<br><br>The humistat consists of a printed circuit (PC) board and a sensing element housed in a protective enclosure. With ORDALT 20086, the enclosure is located in the humidity alarm box. |
| 8-T-SA | **DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.3**<br><br>*Note: The description section does not differentiate between the inlet and outlet manifolds. Readers do not know there are two manifolds until they get to the Detailed Functional Description.*<br><br>**Manifold**<br><br>The manifold houses an air filter and the humistat-sensing element, which is electronically connected to the humistat. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>5. Major and Associated Components and Functions<br><br>a. Manifold<br><br>**Related Instructor Activity:**<br><br>Refer trainee to SW279-CL-AEG-040 paragraph 2-2.3. | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "inlet manifold" is clicked.*<br><br>**Inlet Manifold**<br><br>The inlet manifold houses an air filter and the humistat's sensing element, which is electronically connected to the humistat. |
| 9-T-SA | **DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.4**<br><br>**Relay Enclosure**<br><br>The relay enclosure houses a terminal board and a relay that is wired to the humistat and the high humidity alarm light. The high humidity alarm signal is sent to the Operational Readiness Test System (ORTS) by way of the dry air distribution control. With | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>5. Major and Associated Components and Functions<br><br>a. Relay Enclosure<br><br>**Related Instructor Activity:**<br><br>Refer trainee to SW279-CL-AEG-040 paragraph 2-2.4. | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "relay enclosure" is clicked.*<br><br>**Relay Enclosure**<br><br>The relay enclosure houses a terminal board and a relay that is wired to the humistat and the high-humidity alarm light. The relay sends a high-humidity |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | ORDALT 20086, the relay enclosure is in the humidity alarm box. | | alarm signal to the Operational Readiness Test System (ORTS) by way of the dry air distribution control. With ORDALT 20086, the relay enclosure is in the humidity alarm box. |
| 10-T-SA | **DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.5**<br><br>**Inlet Pressure Regulator**<br><br>The inlet pressure regulator houses a manually adjustable pressure control that is protected by a knurled brass cover cap. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>5. Major and Associated Components and Functions<br><br>a. Inlet Pressure Regulator<br><br>**Related Instructor Activity:**<br><br>Refer trainee to SW279-CL-AEG-040 paragraph 2-2.5. | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "inlet pressure regulator" is clicked.*<br><br>**Inlet Pressure Regulator**<br><br>The inlet pressure regulator houses a manually adjustable pressure control that is protected by a knurled brass cover cap. |
| 11-T-SA | **DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.6**<br><br>**Outlet Pressure Regulator**<br><br>The outlet pressure regulator houses a manually adjustable pressure control that is protected by a knurled brass cover cap. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>5. Major and Associated Components and Functions<br><br>a. Outlet Pressure Regulator<br><br>**Related Instructor Activity:**<br><br>Refer trainee to SW279-CL-AEG-040 paragraph 2-2.6. | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "outlet pressure regulator" is clicked.*<br><br>**Outlet Pressure Regulator**<br><br>The outlet pressure regulator houses a manually adjustable pressure control that is protected by a knurled brass cover cap. |
| 12-T-SA | **DESCRIPTION, DETAILED FUNCTIONAL DESCRIPTION, 2-4.2.5**<br><br>*Note: The first part of the proposed DM is based on the highlighted section of the paragraph below.*<br><br>**Output Regulation**<br><br>Air leaving the indicating desiccant and filter flows through outlet pressure regulator 2. This pressure regulator is adjustable for any output pressure between 0.5 and 30 psig. In this system, outlet pressure regulator 2 is adjusted for an outlet pressure of 3.0 psig. The regulator | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>5. Major and Associated Components and Functions<br><br>a. Relief Valve<br><br>**Related Instructor Activity:**<br><br>Refer trainee to SW279-CL-AEG-040 paragraph 2-2.7. | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "outlet manifold and relief valve" is clicked.*<br><br>**Outlet Manifold and Relief Valve**<br><br>The outlet manifold, which is not visible in the figure, is positioned between the outlet valve and the outlet port. The outlet manifold contains the relief valve, an adjustable valve that opens when pressure to the outlet port reaches 6 pounds per |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | maintains this pressure within 0.5 psig. The air then passes through outlet valve 2 to the outlet manifold for distribution to the using equipment. Output pressure gauge 2 monitors the pressure of the air in the outlet manifold. The outlet manifold has a pressure relief valve to relieve the air pressure if system pressure increases. This valve is adjustable and is normally set to 6 psig.<br><br>**DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.7**<br><br>**Relief Valve**<br><br>The relief valve is an adjustable valve that opens when pressure to the outlet port reaches 6 pounds per square inch gauge (psig). | | square inch gauge (psig). |
| 13-T-SA | **DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.8**<br><br>**Control Valves**<br><br>Inlet and outlet control valves (green) are included on the air control panel. The inlet control valve is located at the lower left corner of the air control panel, just to the left of the manifold sensing element. The outlet control valve is located in the air piping between the inlet and outlet pressure gauges. When shut, air flow to the inlet and outlet ports can be isolated. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>5. Major and Associated Components and Functions<br><br>a. Control Valves<br><br>**Related Instructor Activity:**<br><br>Refer trainee to SW279-CL-AEG-040 paragraph 2-2.8. | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "control valves" is clicked.*<br><br>**Control Valves**<br><br>The inlet and outlet valves control air flow through the panel. Turning the green cross handles to close the valves enables isolation of the air flow between the inlet and outlet ports. The inlet valve is at the lower left corner of the air control panel, just to the left of the humistat's sensing element in the manifold. The outlet valve is in the air piping between the inlet and outlet pressure gauges. |
| 14-T-SA | **DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.9**<br><br>**PRESSURE GAUGES.** Inlet and outlet pressure gauges indicate air pressure entering and leaving the air control panel. The inlet pressure gauge indicates 0 to 100 psig; the | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>5. Major and Associated Components and Functions<br><br>a. Pressure Gauges<br><br>**Related Instructor Activity:** | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "pressure gauges" is clicked.*<br><br>**Pressure Gauges**<br><br>Inlet and outlet pressure gauges |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
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| | outlet pressure gauge indicates 0 to 30 psig. | Refer trainee to SW279-CL-AEG-040 paragraph 2-2.9. | indicate air pressure entering and leaving the air control panel. The inlet pressure gauge indicates 0 to 100 psig; the outlet pressure gauge indicates 0 to 30 psig. |
| 15-T-SA | **DESCRIPTION, PHYSICAL DESCRIPTION, 2-2.10**<br><br>**Flowmeter**<br><br>The flowmeter is constructed of clear plastic with a floating cylinder that indicates a flow rate of 0 to 10 standard cubic feet per minute (scfm) of air. Refer to Paragraph 2-4.2.3. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>5. Major and Associated Components and Functions<br><br>a. Flowmeter<br><br>**Related Instructor Activity:**<br><br>Refer trainee to SW279-CL-AEG-040 paragraph 2-2.10. | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "flowmeter" is clicked.*<br><br>**Flowmeter**<br><br>The flowmeter is a clear plastic tube with a floating cylinder that indicates a flow rate of 0 to 10 standard cubic feet per minute (scfm) of air. |
| 16-T-SA | **DESCRIPTION, DETAILED FUNCTIONAL DESCRIPTION, 2-4.2.4**<br><br>*Note: The following functional description includes location information (highlighted), which was used for the associated DM.*<br><br>**Indicating Desiccant And Filter**<br><br>Air flowing out of the flowmeter passes through an indicating desiccant and filter. The indicating desiccant is located above the ball in the flowmeter. The desiccant consists of a quantity of silica gel crystals. The crystals are held in position by a filter pad of dacron felt below the crystals and another similar pad above the crystals, and are contained within the flowmeter housing. The crystals contain cobalt chloride which reacts to moisture by changing the color of the crystals. As long as the air passing through these crystals is very dry, the crystals remain a deep blue color. If the air becomes moist, the blue color gradually changes to | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br><br>6. Controls and Indicators<br><br>b. Indicators<br><br>(1) Desiccant | *Screen 5: Physical Description, Continued*<br><br>*The following DM is displayed when the bullet for "indicating desiccant and filter" is clicked.*<br><br>**Indicating Desiccant and Filter**<br><br>The indicating desiccant and filter are in the flowmeter housing, above the ball in the flowmeter. The indicating desiccant consists of silica gel crystals. Two filter pads of dacron felt, one above and one below the crystals, hold the crystals in position. |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
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| | white. A complete change to white indicates that the moisture content of the air has reached approximately 10 percent relative humidity. The color changes to black when the air is contaminated. | | |
| 17-T-EA | | | *Screen 6: Practice item*<br>*(Flash file)* |
| 18-T-RA | | | *Screen 7: "Think Back" question*<br>*(Flash file)* |
| 19-T-SA | **DESCRIPTION, 2-3 GENERAL FUNCTIONAL DESCRIPTION, 2-3.1**<br>*Note: Paragraph 2-3.1 is too long for a single DM. The stages have been broken out into the next 4 DMs.*<br>The functional block diagram for the air control panel is shown on Figure 2-3. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>7. Functional Operation<br>a. Air Circulation<br>**Related Instructor Activities:**<br>Refer trainee to SW279-CL-AEG-040 figure 2-4.<br>Reference SW279-CL-AEG-040 paragraph 2-3.1. | *Screen 8*<br>**General Functional Description**<br>The function of the air control panel consists of four stages, as shown in this functional block diagram. |
| 20-T-SA | **DESCRIPTION, 2-3 GENERAL FUNCTIONAL DESCRIPTION, 2-3.1**<br>The compressed air input from the primary ship dry air system is applied to an input filter and a humistat. Whenever the humidity rises above a preset value, the humistat sends an alarm signal to ORTS, through the dry air distribution control assembly. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>6. Controls and Indicators<br>b. Indicators<br>(2) High Humidity Alarm | *Screen 8: General Functional Description, Continued*<br>*The following DM is displayed when the Filter and Humistat block is clicked on the diagram for Screen 8.*<br>**Filter and Humistat**<br>Compressed air from the primary ship dry air system enters the air control panel, passing through the input filter to the humistat. Whenever the humidity rises above a preset value, the humistat sends an alarm signal to ORTS through the dry air distribution control assembly. |
| 21-T-SA | **DESCRIPTION, 2-3 GENERAL FUNCTIONAL DESCRIPTION, 2-3.1**<br>The air is then applied to the input control and regulation stage. The dry air passes through the input control and | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>6. Controls and Indicators<br>a. Pressure Regulators<br>(1) Inlet | *Screen 8: General Functional Description, Continued*<br>*The following DM is displayed when the Input Control and Regulation block is clicked on the diagram for Screen 8.* |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | regulation stage where the air pressure is reduced and regulated. | | **Input Control and Regulation**<br>The clean, dry air then passes through the input control and regulation stage. In this stage, the panel reduces and regulates the air pressure. |
| 22-T-SA | **DESCRIPTION, 2-3 GENERAL FUNCTIONAL DESCRIPTION, 2-3.1**<br>The monitor stage provides a visual indication of the pressure and flow rate of the air on an inlet pressure gauge and a flowmeter. The monitor also provides a visual indication of the output pressure on an outlet pressure gauge. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>6. Controls and Indicators<br>b. Indicators<br>(1) Desiccant<br>(3) Flowmeter<br>c. Pressure Gauges<br>(1) Inlet<br>(2) Outlet | *Screen 8: General Functional Description, Continued*<br>*The following DM is displayed when the Monitor block is clicked on the diagram for Screen 8.*<br>**Monitor**<br>In the monitor stage, the inlet pressure gauge and flowmeter provide a visual indication of the pressure and flow rate of the air. The outlet pressure gauge, which provides a visual indication of the output pressure, is also a part of the monitor stage. |
| 23-T-SA | **DESCRIPTION, 2-3 GENERAL FUNCTIONAL DESCRIPTION, 2-3.1**<br>From the monitor stage, the air passes through the output control and regulation stage. The air pressure, reduced to the value required by the using system, is regulated at that value. A relief valve in the output line protects the system if excessive air pressure occurs. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>6. Controls and Indicators<br>a. Pressure Regulators<br>(2) Outlet<br>d. Valves<br>(3) Bypass | *Screen 8: General Functional Description, Continued*<br>*The following DM is displayed when the Output Control and Regulation block is clicked on the diagram for Screen 8.*<br>**Output Control and Regulation**<br>In the output control and regulation stage, the air control panel reduces the air pressure to the value required by the using system and regulates it at that value. A relief valve in the output line protects the system if excessive air pressure occurs. |
| 24-T-GN | | | *Screen 9: "Think Back" question*<br>*(Flash file)* |
| 25-T-SA | **DESCRIPTION, DETAILED FUNCTIONAL DESCRIPTION, 2-4.2.1**<br>*Note: Paragraph 2-4.2.1 is broken into two DMs.* | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>7. Functional Operation<br>a. Air Circulation | *Screen 10*<br>**Air Circulation—Filter and Inlet Manifold**<br>Air from the primary ship dry air system enters the air control |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | **FILTER AND HUMISTAT**<br>The input air from the primary ship dry air system is applied to the inlet of the air control panel. Air entering this housing passes through a (randomly perforated) bronze disk (filter). This disk removes fine particles (varying in size from 12 to 25 microns) from the input air. After passing through the filter, the air enters the manifold where it passes the sensing element of the humistat. | (1) Filter and Humistat<br>**Related Instructor Activity:**<br>Reference SW279-CL-AEG-040 paragraph 2-4.2.1 through 2-4.2.5. | panel through the inlet port and passes through a filter at the entrance to the inlet manifold. The filter is a randomly perforated bronze disk that removes fine particles (varying in size from 12 to 25 microns) from the input air.<br>Inside the inlet manifold, the air passes the sensing element of the humistat. |
| 26-T-RA | | | *Screen 11: "Think Back" question*<br>*(Flash file)* |
| 27-T-SA | **DESCRIPTION, DETAILED FUNCTIONAL DESCRIPTION, 2-4.2.1**<br>**FILTER AND HUMISTAT**<br>The dry air distribution control assembly provides 115-Vac power for the humistat. The humistat is adjusted to provide alarms if the dewpoint of the dry air rises above -15 degrees Fahrenheit at 80 psig. When humidity is too high, the sensing element sends a signal to the printed circuit board. Without ORDALT 20086, a relay closure on the printed circuit board lights the alarm light on the air control panel and energizes the other relay housed in the relay enclosure; With ORDALT 20086, the relays are housed in the humidity alarm box. The appropriate relay sends an alarm signal to ORTS by way of the dry air distribution control. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>7. Functional Operation<br>a. Air Circulation<br>(1) Filter and Humistat<br>**Related Instructor Activity:**<br>Reference SW279-CL-AEG-040 paragraph 2-4.2.1 through 2-4.2.5. | *Screen 12*<br>**Air Circulation—Humistat**<br>The dry air distribution control assembly provides 115-Vac power for the humistat. The humistat is adjusted to provide alarms if the dewpoint of the dry air rises above -15° Fahrenheit at 80 psig.<br>When humidity is too high, the sensing element sends a signal to the printed circuit board. On a panel without ORDALT 20086, a relay closes on the printed circuit board, lighting the alarm light on the air control panel and energizing the other relay, which is housed in the relay enclosure. With ORDALT 20086, the relays are housed in the humidity alarm box. The appropriate relay sends an alarm signal to ORTS by way of the dry air distribution control. |
| 28-T-SA | **DESCRIPTION, DETAILED FUNCTIONAL DESCRIPTION, 2-4.2.2**<br>**INPUT REGULATION**<br>Air from the manifold passes | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>7. Functional Operation<br>a. Air Circulation | *Screen 13*<br>**Air Circulation—Input Regulation**<br>Air from the inlet manifold passes through the inlet valve |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | through inlet valve 1 to inlet pressure regulator 1. The input air pressure is between 67 and 80 psig. Pressure regulator 1 reduces this pressure to 50 psig and maintains pressure at its output within 0.25 psig. Pressure gauge 1 monitors the pressure of the air leaving pressure regulator 1. | (2) Input Regulation<br>**Related Instructor Activity:**<br>Reference SW279-CL-AEG-040 paragraph 2-4.2.1 through 2-4.2.5. | to the inlet pressure regulator. The input air pressure is between 67 and 80 psig. The input pressure regulator reduces this pressure to 50 psig and maintains pressure at its output within 0.25 psig. The input pressure gauge monitors the pressure of the air leaving the inlet pressure regulator. |
| 29-T-SA | **DESCRIPTION, DETAILED FUNCTIONAL DESCRIPTION, 2-4.2.3**<br>**FLOWMETER.** The air then passes through the flowmeter, which measures the volume of air flowing through the panel. The flowmeter consists of a cylinder that rides on top of a column of air within a tube. The greater the air flow, the higher the cylinder. Graduations on the tube permit reading the flow accurately between the flow rate of 0 and 10 scfm. Because the actual volume depends on pressure and temperature, the concept of air flowing at some volume per unit of time, such as cubic feet per minute (cfm), is meaningless unless pressure and temperature are both stated. However, there is a standard unit for volume flow that eliminates confusion. Instead of cfm, volume flow can be accurately stated in scfm where 1 standard cubic foot is equal to 1 actual cubic foot at 70 degrees Fahrenheit and 1 atmosphere of pressure (14.7 psig). | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>7. Functional Operation<br>a. Air Circulation<br>(3) Flowmeter<br>**Related Instructor Activity:**<br>Reference SW279-CL-AEG-040 paragraph 2-4.2.1 through 2-4.2.5. | *Screen 14*<br>**Air Circulation—Flowmeter**<br>The air then passes through the flowmeter, which measures the volume of air flowing through the panel. The flowmeter consists of a cylinder that rides on top of a column of air within a tube. The greater the air flow, the higher the cylinder. Graduations from 0 to 10 scfm on the tube permit reading the flow rate.<br>Because the **actual volume depends on pressure and temperature**, the concept of air flowing at some volume per unit of time, such as cubic feet per minute (cfm), is meaningless unless pressure and temperature are both stated. However, there is a standard unit for volume flow that eliminates confusion. Instead of cfm, volume flow can be accurately stated in scfm where 1 standard cubic foot is equal to 1 actual cubic foot at 70° Fahrenheit and 1 atmosphere of pressure (14.7 psig). |
| 30-T-SA | | | *Screen 14*<br>*Note: The following is additional pop-up information that was not included in the technical content.*<br>**Actual Volume Depends on Pressure and Temperature** |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | | | According to Boyle's Law, pressure and air volume are *inversely* proportional:<br>• When pressure increases, volume decreases.<br>• When pressure decreases, volume increases.<br>According to Charles's Law, temperature and air volume are *directly* proportional.<br>• When temperature increases, volume increases.<br>• When temperature decreases, volume decreases. |
| 31-T-SA | **DESCRIPTION, DETAILED FUNCTIONAL DESCRIPTION, 2-4.2.4**<br>**INDICATING DESICCANT AND FILTER**<br>Air flowing out of the flowmeter passes through an indicating desiccant and filter. The indicating desiccant is located above the ball in the flowmeter. The desiccant consists of a quantity of silica gel crystals. The crystals are held in position by a filter pad of dacron felt below the crystals and another similar pad above the crystals, and are contained within the flowmeter housing. The crystals contain cobalt chloride which reacts to moisture by changing the color of the crystals. As long as the air passing through these crystals is very dry, the crystals remain a deep blue color. If the air becomes moist, the blue color gradually changes to white. A complete change to white indicates that the moisture content of the air has reached approximately 10 percent relative humidity. The color changes to black when | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>7. Functional Operation<br>a. Air Circulation<br>(4) Indicating Desiccant and Filter<br>**Related Instructor Activity:**<br>Reference SW279-CL-AEG-040 paragraph 2-4.2.1 through 2-4.2.5. | *Screen 15*<br>**Air Circulation—Indicating Desiccant and Filter**<br>Air flowing out of the flowmeter passes through an indicating **desiccant** and filter. The desiccant consists of silica gel crystals that contain cobalt chloride.<br>Cobalt chloride reacts to moisture by changing the **color of the crystals**. As long as the air passing through these crystals is very dry, the crystals remain a deep blue color. If the air becomes moist, the blue color gradually changes to white. A complete change to white indicates that the moisture content of the air has reached approximately 10 percent relative humidity. The color changes to black when the air is contaminated. |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | the air is contaminated. | | |
| 32-T-SA | | | *Screen 15*<br>*Note: The following is additional pop-up information that was not included in the technical content.*<br>**Desiccant**<br>A desiccant is a drying agent. An everyday example of a desiccant is the small tubes or packages of crystals packaged inside bottles of medicines and health supplements and in boxed electronics, leather goods, and food products. Their purpose is to indicate and absorb moisture that may damage the product. |
| 33-T-SA | | | *Screen 15*<br>*Note: The following is additional pop-up information that was not included in the technical content.*<br>**Color of the Crystals**<br>The color of the crystals indicates the amount of moisture or contamination. Make a mental association between the colors and the conditions to help you remember them. For instance, associate black with dirt, blue with a cloudless blue sky, and white with a cloudy day that may threaten rain. |
| 34-T-SA | **DESCRIPTION, DETAILED FUNCTIONAL DESCRIPTION, 2-4.2.5**<br>**OUTPUT REGULATION**<br>Air leaving the indicating desiccant and filter flows through outlet pressure regulator 2. This pressure regulator is adjustable for any output pressure between 0.5 and 30 psig. In this system, outlet pressure regulator 2 is adjusted for an outlet pressure | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>7. Functional Operation<br>a. Air Circulation<br>(1) Output Regulation<br>**Related Instructor Activity:**<br>Reference SW279-CL-AEG-040 paragraph 2-4.2.1 through 2-4.2.5. | *Screen 16*<br>**Air Circulation—Output Regulation**<br>Air leaving the indicating desiccant and filter flows through the outlet pressure regulator. This pressure regulator is adjustable for any output pressure between 0.5 and 30 psig.<br>In this system, the outlet pressure regulator is adjusted |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| | of 3.0 psig. The regulator maintains this pressure within 0.5 psig. The air then passes through outlet valve 2 to the outlet manifold for distribution to the using equipment. Output pressure gauge 2 monitors the pressure of the air in the outlet manifold. The outlet manifold has a pressure relief valve to relieve the air pressure if system pressure increases. This valve is adjustable and is normally set to 6 psig. | | for an outlet pressure of 3.0 psig. The regulator maintains this pressure within 0.5 psig.<br>The air then passes through the outlet valve to the outlet manifold for distribution to the waveguide and associated components of the SPY-1A/B and FCS radar systems. The output pressure gauge monitors the pressure of the air in the outlet manifold.<br>The outlet manifold has a pressure relief valve to relieve the air pressure if system pressure increases. This valve is adjustable and is normally set to 6 psig. |
| 35-T-GN | | | *Screen 17: "Think Back" question*<br>*(Flash file)* |
| 36-T-SA | **DESCRIPTION, DETAILED FUNCTIONAL DESCRIPTION, 2-4.3**<br>**AIR CIRCULATION CONTROLS**<br>Air circulation through the air control panel is controlled by two valves located on the panel. Inlet valve 1 and outlet valve 2 are opened to permit air flow through the panel. This air flow is acted upon by the pressure regulators and monitored by the flowmeter and pressure gauges. The air pressure supplied to the using assemblies is monitored by output pressure gauge 2. | **S-104-0191 Rev D Change 2_T0113-1-1.xml**<br>6. Controls and Indicators<br>a. Pressure Regulators<br>(1) Inlet<br>(2) Outlet<br>c. Pressure Gauges<br>(1) Inlet<br>(2) Outlet<br>d. Valves<br>(1) Inlet<br>(2) Outlet<br>**Related Instructor Activity:**<br>Reference SW279-CL-AEG-040 paragraph 2-4.3. | *Screen 18*<br>**Air Circulation Controls**<br>The inlet and outlet valves control air circulation through the air control panel. In the open position, they permit air flow through the panel. The pressure regulators control air pressure as air flows through the system.<br>The flowmeter and pressure gauges monitor the pressure of the air flow through the panel. The outlet pressure gauge monitors the pressure of the air flow out of the air control panel to the dry air distribution units that supply the waveguide and associated components of the SPY-1A/B and FCS radar systems. |
| 37-T-EB | | | *Screen 19: Knowledge Check*<br>*(Flash file)* |
| 38-T-EA | | | *Screen 20: Knowledge Check*<br>*(Flash file)* |

| DM | Equipment Manual | Instructor Guides | Proposed DMs |
|---|---|---|---|
| 39-T-EA | | | *Screen 21: Knowledge Check*<br>*(Flash file)* |
| 40-T-EB | | | *Screen 22: Knowledge Check*<br>*(Flash file)* |
| 41-T-EA | | | *Screen 23: Knowledge Check*<br>*(Flash file)* |
| 42-T-TC | | | *Screen 24: Summary*<br>**Summary**<br>The twelve components of the air control panel work together to perform the panel's function: regulating the pressure and monitoring the humidity of the dry air required for operation of the waveguide and associated components of the SPY-1A/B and FCS radar systems.<br>If you are responsible for maintaining the air control panels in the auxiliary equipment group, knowing the components, their locations, and their roles in performance of the panel's function will help you to perform your job. Not only are you better prepared now to operate and monitor the panel, but you are also better prepared to troubleshoot any problems that arise. |

# Appendix B

Proposed DMs Based on Analysis and Cross Comparison of Selected Q-20 Content

The table below shows proposed DMs for the Q-20 content based on the following:

- A synthesis of the content for the AN/AQS-20A system, components, and interfaces from these sources:
  - Interactive Electronic Technical Manual (IETM) for Intermediate Level Maintenance of the Sonar Mine Detecting Set AN/AQS-2A
  - MH-60S AN/AQS-20A O-Level Maintenance Course
  - MH-60S AN/AQS-20A Operator Course
  - MH-60S AN/AQS-20A Pilot Course
- Instructional strategies for teaching this content.

The proposed DMs for technical content illustrate how legacy content can be converted to dual-purpose text for use in technical documentation and training. The DM column shows a sequence number and the T-codes for the proposed DMs.

It is interesting to note that there are minor differences in the outlines of instruction for the three courses that are unrelated to the needs of the target student populations. There are also differences between the lesson plan outlines and the information sheet outlines. These differences, highlighted in gray below, suggest that DMs might also be created for outputting to lesson plan outlines and student information sheets in order to realize the potential of standardization, reuse, and ease of content maintenance in an instructor-led course.

*NOTE: The PowerPoints were not included in the content analysis: (1) The PowerPoint for the O-Level Maintenance Course was an empty shell, (2) the PowerPoint files for the Operator Course were corrupt, and (3) there was no PowerPoint for the Pilot Course.*

| DM | IETM | O-Level Maint. Course | Operator Course | Pilot Course | Proposed DM |
|---|---|---|---|---|---|
| 1-T-AA | | | | | *Screen 1: Training title screen* |
| 2-T-AC | | **Diagram Sheet:**<br>DS 2-1-11.doc: Tow Body | *Because DS 2-1-11 shows the towed body on a maintenance stand, there is no comparable DS in the Operator Course.* | *There is also no comparable DS in the Pilot Course.* | *Screen 2: Scenario with questions* |
| 3-T-OG | | | | | *Screen 3:Objectives*<br>*Note: The training objectives had to be changed because of the demo's focus on the towed body to the exclusion of other components.* |
| 4-T- | | **LP 2.1, p. 2-1-3** | **LP 2.1., p. 2-1-3** | **LP 2.1., p. 2-1-3** | *Screen 4* |

| DM | IETM | O-Level Maint. Course | Operator Course | Pilot Course | Proposed DM |
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| SA | | 2. System Description<br>a. High-speed, helicopter-towed, mine hunting and identification system<br>(1) Mine hunting<br>(a) Detection, classification, and localization of mine-like objects (MLOs)<br>1) Bottom moored, close-tethered, and volume MLOs<br>2) Shallow and deep water<br>(b) Uses acoustic sensors<br>(2) Mine identification<br>(a) Bottom mines only<br>(b) Uses electro optic sensor<br>**IS 2-1 O-Lev 1_04.doc**<br>*The IS (p. 1) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-01.doc: Mine Descriptions | 2. System Description<br>a. High-speed, helicopter-towed, mine hunting and identification system<br>(1) Mine hunting<br>(a) Detection, classification, and localization of mine-like objects (MLOs)<br>1) Bottom moored, close-tethered, and volume MLOs<br>2) Shallow and deep water<br>(b) Uses acoustic sensors<br>(2) Mine identification<br>(a) Bottom mines only<br>(b) Uses electro optic sensor<br>**IS 2-1 (A) 8_26.doc**<br>*The IS (p. 1) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-01.doc: Corrupted file | 2. System Description<br>a. High-speed, helicopter-towed, mine hunting and identification system<br>(1) Mine hunting<br>(a) Detection, classification, and localization of mine-like objects (MLOs)<br>1) Bottom moored, close-tethered, volume, and near-surface MLOs<br>2) Shallow and deep water<br>(b) Uses acoustic sensors<br>(2) Mine identification<br>(a) Bottom mines only<br>(b) Uses electro optic sensor<br>**IS 2-1 (P) 8_26.doc**<br>*The IS (p. 1) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-01.doc: Mine Descriptions | **Introduction**<br>The Sonar Mine Detecting Set AN/AQS-20A is a high-speed, helicopter-towed system for mine hunting and identification.<br>During mine hunting operations, the AN/AQS-20A uses acoustic sensors to detect, classify, and localize the position of bottom-moored, close-tethered, volume, and near-surface mine-like objects (MLOs) in shallow or deep water.<br>When used for mine identification, it uses an electro-optic sensor to identify moored MLOs. Mine identification is limited to bottom mines. |
| 5 T-SA | **Chapter 3:**<br>**2. AN/AQS-20A COMMON TOWED BODY CONFIGURATION**<br>*Note: This page was broken up in order to* | **LP 2.1, p. 2-1-8**<br>d. Towed Body<br>(1) Manufactured by Raytheon Submarine Signal Division, | **LP 2.1, p. 2-1-8**<br>d. Towed Body<br>(1) Manufactured by Raytheon Submarine Signal Division, | **LP 2.1, p. 2-1-8**<br>d. Towed Body<br>(1) Manufactured by Raytheon Submarine Signal Division, | *Screen 5*<br>**Towed Body Description**<br>The towed body serves as a stable platform for mounting the system's acoustic sensors and |

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| | *prevent redundancy and provide a logical sequence of instruction. The first paragraph is used in the next DM.*<br><br>Assembled, the towed body serves as a stable platform for mounting the systems acoustic sensors and electronics. It also employs a tow termination point and electrical connections located in the wing center section for interface to the MH-60S helicopter. The acoustic sensors are mounted externally on the towed body and are designed to aid in the detection, classification, and localization of sea mines. The systems electronics are mounted inside the towed body cavity which is pressurized to prevent salt water intrusion.<br><br>*Note: The third paragraph is used in the next DM; the fourth paragraph is used in DM 17; and the fifth paragraph is used in DM 27.* | Portsmouth, RI<br><br>(2) Provides stable platform for sensors<br><br>(3) Maintains selected depths (below the surface) and altitudes (above the bottom)<br><br>**LP 2.1, p. 2-1-12**<br><br>5. Sensors<br><br>a. Each sonar sensor contains both transmit and receive arrays<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 4) mirrors the IG but has the following additional information regarding the towed body*:<br><br>(4) Zinc Anodes<br><br>(a) Numerous locations throughout towed body<br><br>1) One located in the nose section (VSS or EOID)<br><br>2) One located in center wing cavity<br><br>3) One located in tail cavity<br><br>4) Four located on Gap Filler Sonar (GFS) (one each corner)<br><br>(b) Installed in order to counteract galvanic | Portsmouth, RI<br><br>(2) Provides stable platform for sensors<br><br>(3) Maintains selected depths (below the surface) and altitudes (above the bottom)<br><br>**LP 2.1, p. 2-1-12**<br><br>5. Sensors<br><br>a. Each sonar sensor contains both transmit and receive arrays<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 4) mirrors the IG except for the highlighted information below*:<br><br>(1) Manufactured by Raytheon Integrated Defense Systems, Portsmouth, RI<br><br>**Movie:** anaqs20a.mpg<br><br>**Diagram Sheet:**<br><br>*There was no DS comparable to DS-2-11 in the O-Level Maintenance Course, which shows the towed body on a maintenance stand.* | Portsmouth, RI<br><br>(2) Provides stable platform for sensors<br><br>(3) Maintains selected depths (below the surface) and altitudes (above the bottom)<br><br>**LP 2.1, p. 2-1-12**<br><br>5. Sensors<br><br>a. Each sonar sensor contains both transmit and receive arrays<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 4) mirrors the IG except for the highlighted information below*:<br><br>(1) Manufactured by Raytheon Integrated Defense Systems, Portsmouth, RI<br><br>**Movie:** anaqs20a.mpg<br><br>**Diagram Sheet:**<br><br>*There was no DS comparable to DS-2-11 in the O-Level Maintenance Course.* | electronics. It is capable of maintaining selected depths (below the surface) and altitudes (above the bottom).<br><br>Externally mounted acoustic sensors aid in the detection, classification, and localization of sea mines. Each sonar sensor contains both transmit and receive arrays. Internally mounted electronics are protected from salt water intrusion by pressurization of the cavity inside the towed body.<br><br>A tow termination point and electrical connections in the wing's center section provide the interface between the towed body and the MH-60S helicopter. |

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| | | corrosion<br><br>**Movie:** anaqs20a.mpg<br><br>**Diagram Sheet:**<br><br>DS 2-1-11.doc: Tow Body | | | |
| 6 T-SA | **Chapter 3:**<br>**2. AN/AQS-20A COMMON TOWED BODY CONFIGURATION**<br><br>The AN/AQS-20A towed body standard configuration (Figure 3-1) is comprised of a FLS, VSS, port and starboard SLS, GFS, Doppler Velocity Log (DVL), subsystem interface electronics, and steering controls. As mission needs dictate, the towed body can be reconfigured to allow for mine identification (Figure 3-2) by removing the VSS and installing the EOID.<br><br>*Note: The missing paragraph is used for DM 9.*<br><br>The forward end or front of the towed body is comprised of either a FLS and VSS combination (Figure 3-3), or FLS and EOID combination (Figure 3-4). The VSS and EOID are interchangeable components and are selected as required to satisfy operational mission requirements. The FLS is common to both the VSS and EOID configurations.<br><br>*Note: The fourth and fifth paragraphs have been broken out for DMs on the mid section and tail section to prevent the redundancy in the IETM.* | **LP 2.1, p. 2-1-8**<br><br>4. Towed Body Sections<br><br>a. Forward section<br><br>(1) Two configurations<br><br>(a) Volume Search Sonar (VSS) with Forward-Looking Sonar (FLS)<br><br>(b) Electro-Optic Identification (EOID) module with Forward-Looking Sonar (FLS)<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 5) mirrors the IG except for the highlighted information below*:<br><br>(b) Electro-Optic Identification Device (EOID) module with FLS<br><br>**Diagram Sheets:**<br><br>DS 2-1-02.doc: Towed Body with VSS Installed<br><br>DS 2-1-03.doc: Towed Body with EOID Installed<br><br>DS 2-1-12.doc: Tow Body Sections | **LP 2.1, p. 2-1-8**<br><br>4. Towed Body Sections<br><br>a. Forward section<br><br>(1) Two configurations<br><br>(a) Volume Search Sonar (VSS) with Forward-Looking Sonar (FLS)<br><br>(b) Electro-Optic Identification (EOID) module with Forward-Looking Sonar (FLS)<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 4) mirrors the IG except for the highlighted information below*:<br><br>(b) Electro-Optic Identification Device (EOID) module with FLS<br><br>**Diagram Sheets:**<br><br>DS 2-1-02.doc: Towed Body with VSS Installed<br><br>DS 2-1-03.doc: Towed Body with EOID Installed<br><br>DS 2-1-10.doc: Tow Body Sections | **LP 2.1, p. 2-1-8**<br><br>4. Towed Body Sections<br><br>a. Forward section<br><br>(1) Two configurations<br><br>(a) Volume Search Sonar (VSS) with Forward-Looking Sonar (FLS)<br><br>(b) Electro-Optic Identification (EOID) module with Forward-Looking Sonar (FLS)<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 4) mirrors the IG except for the highlighted information below*:<br><br>(b) Electro-Optic Identification Device (EOID) module with FLS<br><br>**Diagram Sheets:**<br><br>DS 2-1-02.doc: Towed Body with VSS Installed<br><br>DS 2-1-03.doc: Towed Body with EOID Installed<br><br>DS 2-1-10.doc: Tow Body Sections | *Screen 6*<br><br>**Forward Section of the Towed Body**<br><br>The forward section of the towed body is composed of two acoustic sensors. One of the sensors is the Forward-Looking Sonar (FLS). The other is either the Volume Search Sonar (VSS) or the Electro-Optic Identification (EOID) assembly. These two interchangeable assemblies permit alternate configurations for meeting different operational mission requirements.<br><br>The **standard configuration** combines the FLS with the VSS for mine detection, classification, and location. Removing the VSS and installing the EOID sensor **reconfigures** the towed body for mine identification. |

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| 7 T-SA | **Chapter 3:**<br>**3. FORWARD LOOKING SONAR**<br>The FLS (Figure 3-8) assembly is installed on either the VSS or EOID (depending on mission requirements) and is positioned at the front end of the towed body.<br>*Note: The missing content in this section is used in the next DM.*<br>The FLS consists of a single planar receive array and three planar projector arrays. The receive array consists of 32 hydrophones spread sparsely in two dimensions. Preamplifier electronics are located immediately behind the receive elements.<br>*Note: The missing content at the end of the source paragraph is also in the next DM.* | **LP 2.1, p. 2-1-13**<br>d. Forward Looking Sonar (FLS)<br>(1) Installed on either VSS or EOID depending on mission<br>(2) Mounted on front of forward section<br>*Note: Section (3) is used for the following DM.*<br>**IS 2-1 O-Lev 1_04.doc**<br>*The IS (p. 7) mirrors the IG except for the highlighted information below:*<br>d. FLS<br>**Diagram Sheet:**<br>DS 2-1-17.doc: Forward Looking Sonar (FLS) | **LP 2.1, p. 2-1-13**<br>d. Forward Looking Sonar (FLS)<br>(1) Installed on either VSS or EOID depending on mission<br>(2) Mounted on front of forward section<br>*Note: Section (3) is used for the following DM.*<br>**IS 2-1 (A) 8_26.doc**<br>*The IS (p. 6) mirrors the IG except for the highlighted information below*:<br>d. FLS<br>**Diagram Sheet:**<br>DS 2-1-15.doc: FLS | **LP 2.1, p. 2-1-13**<br>d. Forward Looking Sonar (FLS)<br>(1) Installed on either VSS or EOID depending on mission<br>(2) Mounted on front of forward section<br>*Note: Section (3) is used for the following DM.*<br>**IS 2-1 (P) 8_26.doc**<br>*The IS (p. 7) mirrors the IG except for the highlighted information below*:<br>d. FLS<br>**Diagram Sheet:**<br>DS 2-1-15.doc: FLS | *Screen 7*<br>**Forward-Looking Sonar**<br>At the front of the towed body is the FLS assembly, which is installed on either the VSS or EOID depending on mission requirements. The FLS consists of a single planar receive array and three planar projector arrays.<br>The receive array consists of 32 hydrophones spread sparsely in two dimensions. Immediately behind the receive elements are the preamplifier electronics. |
| 8 T-SA | **Chapter 3:**<br>**3. FORWARD LOOKING SONAR**<br>The FLS provides coverage for mines located directly in front of the towed body and out to a cross track range where the VSS begins its coverage (Figure 3-9).<br>The FLS transmits from one of three transmit arrays that is selected based on the towed body yaw angle. | **LP 2.1, p. 2-1-13**<br>(3) Coverage for mines located in the water column near the towed body and out to a cross track range where the Volume Search Sonar (VSS) begins its coverage<br>**IS 2-1 O-Lev 1_04.doc**<br>*The IS (p. 7) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-18.doc: Forward Looking Sonar (FLS) Coverage | **LP 2.1, p. 2-1-13**<br>(3) Coverage for mines located in the water column near the towed body and out to a cross track range where the Volume Search Sonar (VSS) begins its coverage<br>**IS 2-1 (A) 8_26.doc**<br>*The IS (p. 7) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-16.doc: Corrupted file | **LP 2.1, p. 2-1-14**<br>(3) Coverage for mines located directly in front of the towed body and out to a cross track range where the Volume Search Sonar (VSS) begins its coverage<br>**IS 2-1 (P) 8_26.doc**<br>*The IS (p. 7) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-16.doc: Forward Looking Sonar (FLS) Coverage | *Screen 8*<br>**Forward-Looking Sonar Coverage**<br>The FLS provides coverage for mines located directly in front of the towed body and out to a cross-track range, where the VSS begins its coverage.<br>The FLS transmits from one of the three planar projector arrays. Selection depends on the towed body's yaw angle. |
| 9 T-SA | **Chapter 3:**<br>**4. VOLUME SEARCH SONAR**<br>The VSS (Figure 3-10) assembly is a cylindrical array installed on the forward end of the mid section. Combined with | **LP 2.1, p. 2-1-12**<br>b. Volume Search Sonar (VSS)<br>(1) Used to detect, classify, and localize close tethered, or | **LP 2.1, p. 2-1-12**<br>b. Volume Search Sonar (VSS)<br>(1) Used to detect, classify, and localize close tethered, or | **LP 2.1, p. 2-1-12**<br>b. Volume Search Sonar (VSS)<br>(1) Used to detect, classify, and localize bottom, close tethered, | *Screen 9*<br>**Volume Search Sonar**<br>The VSS assembly is a cylindrical array installed as a "belly band" around the nose assembly. It is one of |

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| | the FLS, the two assemblies are considered the forward section of the towed body. The VSS assembly consists of ten individual VSS modules oriented with their long axis parallel to the longitudinal axis of the hull. Each VSS module contains 36 receive and 10 transmit elements, totaling 360 receive and 100 transmit elements per VSS assembly.<br><br>*Note: The remaining text in the source paragraph is used for the next DM.* | volume mines in either shallow or deep water<br><br>(2) Consists of cylindrical array positioned as a "belly band" around nose assembly<br><br>(3) Interchangeable with EOID<br><br>(a) Either VSS or EOID installed, depending on the current operational mission requirement<br><br>*Note: Section (4) is used for the following DM.*<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 7) mirrors the IG except that VSS is not spelled out and sections (3) and (4) are reversed.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-13.doc: Volume Search Sonar (VSS) | volume mines in either shallow or deep water<br><br>(2) Consists of cylindrical array positioned as a "belly band" around nose assembly<br><br>(3) Interchangeable with EOID<br><br>(a) Either VSS or EOID installed, depending on the current operational mission requirement<br><br>*Note: Section (4) is used for the following DM*<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 6) mirrors the IG except that VSS is not spelled out and sections (3) and (4) are reversed.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-11.doc: Volume Search Sonar (VSS) | or volume mines in either shallow or deep water<br><br>(2) Consists of cylindrical array positioned as a "belly band" around nose assembly<br><br>(3) Interchangeable with EOID<br><br>(a) Either VSS or EOID installed, depending on the current operational mission requirement<br><br>*Note: Section (4) is used for the following DM.*<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 6) mirrors the IG except that VSS is not spelled out and sections (3) and (4) are reversed.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-11.doc: Volume Search Sonar (VSS) | the two interchangeable assemblies that comprise the forward section of the towed body. The VSS detects, classifies, and localizes bottom-moored, close-tethered, or volume mines in either shallow or deep water.<br><br>The VSS assembly consists of ten individual VSS modules oriented with their long axis parallel to the longitudinal axis of the hull. Each VSS module contains 36 receive and 10 transmit elements, totaling 360 receive and 100 transmit elements per VSS assembly. |
| 10 T-SA | **Chapter 3:**<br>**4. VOLUME SEARCH SONAR**<br><br>The signal received by the receive elements in each of the VSS modules is sent to a beamformer to make a set of fore and aft beam pairs. The beamformer is located between the preamplifier after each element and before the signal conditioner in the towed body processor. The final beams are generated by combining the module outputs (in the towed body processor) to form a pattern in the radial direction relative to the hull longitudinal axis (Figure 3-11). | **LP 2.1, p. 2-1-13**<br><br>(4) Covers area below the forward section<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 7) mirrors the IG except that VSS is not spelled out and sections (3) and (4) are reversed.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-14.doc: Volume Search Sonar (VSS) Coverage | **LP 2.1, p. 2-1-13**<br><br>(4) Covers area below the forward section<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 6) mirrors the IG except that VSS is not spelled out and sections (3) and (4) are reversed.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-12.doc: Corrupted file. *Because of this file's sequencing (after the DS with the VSS location), it seems that it should be the VSS coverage.* | **LP 2.1, p. 2-1-13**<br><br>(4) Covers area below the forward section<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 6) mirrors the IG except that VSS is not spelled out and sections (3) and (4) are reversed.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-12.doc: Corrupted file. *Because of this file's sequencing (after the DS with the VSS location), it seems that it should be the VSS coverage.* | *Screen 10*<br><br>**Volume Search Sonar Coverage**<br><br>The VSS coverage is the area below the forward section. Each of the VSS modules receives a signal via its receive elements and then transmits the signal to a beamformer to make a set of fore and aft beam pairs. The beamformer is between the preamplifier after each element and before the signal conditioner in the towed body processor.<br><br>The VSS module generates the final beams by combining the beamformer outputs in the towed body processor to form a pattern in the radial direction relative to the |

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| | | | | | hull longitudinal axis. |
| 11-T-EA | | | | | *Screen 11: Practice item* |
| 12 T-SA | **Chapter 3:**<br>**5. ELECTRO-OPTIC IDENTIFICATION**<br>The EOID (Figure 3-12) assembly is a fit and form replacement for the VSS assembly, however, it performs a different function. The EOID uses laser light to scan the seabed and create an image (Figure 3-13). It performs target cueing of objects found in the seabed. Range, contrast, and target cueing data are provided to the towed body.<br>*Note: Intervening text in the source paragraph is used for the next DM because of its correlation to IG content.*<br>The System Control Communications (SCC) interfaces with the Ethernet Switch for communications with the towed body as well as provides executive control over the EOID. The hardware controller also provides control for the EOID by enabling and disabling hardware at the appropriate times. | **LP 2.1, p. 2-1-13**<br>c. Electro-Optical Identification (EOID) Unit<br>(1) Used to scan previously detected and localized bottom MLOs for post mission analysis identification<br>(2) Interchangeable with VSS<br>*Note: Section (3) is used for the following DM.*<br>**IS 2-1 O-Lev 1_04.doc**<br>*The IS (p. 7) mirrors the IG except for highlighted information below*:<br>c. EOID Module<br>**Diagram Sheet:**<br>DS 2-1-15.doc: Electro-Optic Identification (EOID) Module | **LP 2.1, p. 2-1-13**<br>c. Electro-Optical Identification (EOID) Unit<br>(1) Used to scan previously detected and localized bottom MLOs for post mission analysis identification<br>(2) Interchangeable with VSS<br>*Note: Section (3) is used for the following DM.*<br>**IS 2-1 (A) 8_26.doc**<br>*The IS (p. 6) mirrors the IG except for highlighted information below*:<br>c. EOID Module<br>**Diagram Sheet:**<br>DS 2-1-15.doc: EOID. *This graphic shows the EOID cover partially off, and it includes labels that the others did not have.* | **LP 2.1, p. 2-1-13**<br>c. Electro-Optical Identification (EOID) Unit<br>(1) Used to scan previously detected and localized bottom MLOs for post mission analysis identification<br>(2) Interchangeable with VSS<br>*Note: Section (3) is used for the following DM.*<br>**IS 2-1 (P) 8_26.doc**<br>*The IS (p. 6) mirrors the IG except for highlighted information below*:<br>c. EOID Module<br>**Diagram Sheet:**<br>DS 2-1-13.doc: EOID. *This graphic shows the EOID cover partially off, and it includes labels that the others did not have.* | *Screen 12*<br>**Electro-Optic Identification Assembly**<br>The EOID assembly is a fit-and-form replacement for the VSS assembly; however, it performs a different function. The EOID scans the seabed for bottom MLOs that have previously been detected and localized. It then generates an image of any objects found. This image provides range and target cueing data to the towed body for post-mission analysis and identification.<br>The System Control Communications (SCC) interfaces with the Ethernet Switch to provide communications with the towed body and executive control over the EOID. The hardware controller also provides control for the EOID by enabling and disabling hardware at the appropriate times. |
| 13 T-SA | **Chapter 3:**<br>**5. ELECTRO-OPTIC IDENTIFICATION**<br>The EOID is comprised of a laser assembly that creates the light signal. The light is propagated to the water after a fan of light beams is created in the beam diverger. The Data Processor (DP) provides image processing. | **LP 2.1, p. 2-1-13**<br>(3) Uses laser fan beam to scan the seabed with the forward motion of the towed body and generate a high-resolution, contrast and range image<br>**IS 2-1 O-Lev 1_04.doc**<br>*The IS (p. 7) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-16.doc: Electro-Optic Identification (EOID) Coverage | **LP 2.1, p. 2-1-13**<br>(3) Uses laser fan beam to scan the seabed with the forward motion of the towed body and generate a high-resolution, contrast and range image<br>**IS 2-1 (A) 8_26.doc**<br>*The IS (p. 6) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-14.doc: Electro-Optic Identification (EOID) Coverage | **LP 2.1, p. 2-1-13**<br>(3) Uses laser fan beam to scan the seabed with the forward motion of the towed body and generate a high-resolution, contrast and range image<br>(4) Output used to perform Computer Aided Detection/Classi fica-tion (CAD/CAC) of objects<br>**IS 2-1 (P) 8_26.doc**<br>*The IS (p. 6) mirrors the* | *Screen 13*<br>**Electro-Optic Identification Assembly Coverage**<br>During operations, the EOID's laser assembly produces a light signal. A beam diverger creates a fan of light that spreads out from the bottom of the towed body to the sea bed. The Data Processor (DP) processes the information to create a high-resolution, high-contrast image of the MLO for Computer-Aided Detection/Classification (CAD/CAC). |

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| | | | | *IG.*<br>**Diagram Sheet:**<br>DS 2-1-14.doc: Electro-Optic Identification (EOID) Coverage | |
| 14-T-EA | | | | | *Screen 14: Practice item* |
| 15 T-SA | **Chapter 3:**<br>**2. AN/AQS-20A COMMON TOWED BODY CONFIGURATION**<br>*Note: These two sections of the IETM present redundant information, which has been synthesized to create the proposed DM.*<br>The mid section of the towed body (Figure 3-5) consists of a port and starboard SLS, GFS, and a DVL sensor (Figure 3-6). It also provides a smooth machined surface for wing assembly mounting at the top and most forward end of the mid section. Housed inside the mid section are the majority of electronic components required for various sonar operations.<br>**Chapter 3: 6. MID SECTION**<br>The mid section of the towed body consists of port and starboard SLS, GFS, and Doppler Velocity Log (DVL). It also provides a smooth surface for wing assembly mounting at the top and forward end of the mid section. Housed inside the mid section are the majority of electronic components required for various sonar operations.<br>The mid section (Figure 3-14) is a hollow cylinder....<br>*Note: The remainder of this paragraph appears in a DM for the interior components of the mid* | **LP 2.1, p. 2-1-8**<br>b. Mid section<br>(1) Hollow, pressurized cylinder<br>(2) Contains majority of the towed body electronics assemblies<br>*(Intervening information is used in other DMs.)*<br>(6) Configured with port and starboard Side Looking Sonar (SLS), Gap Filler Sonar (GFS), and Doppler Velocity Log (DVL)<br>**IS 2-1 O-Lev 1_04.doc**<br>*The IS (p. 5) mirrors the IG except for the highlighted information below*:<br>(1) Pressurized cylinder *The word (Hollow) is missing.*<br>**Diagram Sheet:**<br>DS 2-1-12.doc: Tow Body Sections | **LP 2.1, p. 2-1-9**<br>b. Mid section<br>(1) Hollow, pressurized cylinder<br>(2) Contains majority of the towed body electronics assemblies<br>*(Intervening information is used in other DMs.)*<br>(6) Configured with port and starboard Side Looking Sonar (SLS), Gap Filler Sonar (GFS), and Doppler Velocity Log (DVL)<br>**IS 2-1 (A) 8_26.doc**<br>*The IS (p. 4) mirrors the IG except for highlighted information below:*<br>(1) Pressurized cylinder *The word (Hollow) is missing.*<br>**Diagram Sheet:**<br>DS 2-1-10.doc: Tow Body Sections | **LP 2.1, p. 2-1-9**<br>b. Mid section<br>(1) Hollow, pressurized cylinder<br>(2) Contains majority of the towed body electronics assemblies<br>*(Intervening information is used in other DMs.)*<br>(6) Configured with port and starboard Side Looking Sonar (SLS), Gap Filler Sonar (GFS), and Doppler Velocity Log (DVL)<br>**IS 2-1 (P) 8_26.doc**<br>*The IS (p. 4) mirrors the IG except for highlighted information below:*<br>(1) Pressurized cylinder *The word (Hollow) is missing.*<br>**Diagram Sheet:**<br>DS 2-1-10.doc: Tow Body Sections | *Screen 15*<br>**Mid Section of the Towed Body**<br>The mid section of the towed body is a hollow, pressurized cylinder configured with four externally mounted acoustic sensor modules: a port and starboard Side-Looking Sonar (SLS), a Gap Filler Sonar (GFS), and a Doppler Velocity Log (DVL) sensor.<br>The top and most forward end of the mid section provides a smooth machined surface for mounting the wing assembly. The interior of the mid section houses the majority of the electronic components required for various sonar operations. |

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| | *section.*<br><br>Mounted to the exterior of the mid section are the port and starboard SLS, GFS and DVL. Functional descriptions for these components are provided later in this chapter. | | | | |
| 16 T-SA | **Chapter 3: 7. SIDE LOOKING SONAR.**<br><br>The SLS (Figure 3-15) arrays provide scanning capabilities for both the port and starboard sides of the towed body (Figure 3-16). Each SLS incorporates a sight gauge for viewing fluorinert fluid levels, a transmit array, receive array, and preamplifiers. A set of 13 beams are formed from the transmit array. The aperture used to form each beam varies with range. The system dynamically focuses each beam as a function of range. | **LP 2.1, p. 2-1-14**<br><br>e. Side Looking Sonar (SLS)<br><br>(1) Mounted on port and starboard sides of towed body mid section<br><br>*Note: Section (2) is used for the following DM.*<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 7) mirrors the IG except that SLS is not spelled out.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-19.doc: Side Looking Sonar (SLS) (only port side shown) | **LP 2.1, p. 2-1-14**<br><br>e. Side Looking Sonar (SLS)<br><br>(1) Mounted on port and starboard sides of towed body mid section<br><br>*Note: Section (2) is used for the following DM.*<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 7) mirrors the IG except that SLS is not spelled out.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-17.doc: Side Looking Sonar (SLS) (only port side shown) | **LP 2.1, p. 2-1-14**<br><br>e. Side Looking Sonar (SLS)<br><br>(1) Mounted on port and starboard sides of towed body mid section<br><br>*Note: Section (2) is used for the following DM.*<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 7) mirrors the IG except that SLS is not spelled out.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-17.doc: Side Looking Sonar (SLS) (only port side shown) | *Screen 16*<br><br>**Side-looking Sonar**<br><br>Two SLS arrays are mounted on the port and starboard sides of the towed body's mid section. Each SLS incorporates a sight gauge for viewing fluorinert fluid levels, a transmit array, a receive array, and preamplifiers.<br><br>The transmit array forms a set of 13 beams, using an aperture that varies with range. This allows the system to dynamically focus each beam as a function of range. |
| 17 T-SA | | **LP 2.1, p. 2-1-14**<br><br>(2) Scan downward, at an angle, from the sides of the towed body<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 7) mirrors the IG.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-20.doc: Side Looking Sonar (SLS) Coverage | **LP 2.1, p. 2-1-14**<br><br>(2) Scan downward, at an angle, from the sides of the towed body<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p.7) mirrors the IG.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-18.doc: Corrupted file | **LP 2.1, p. 2-1-14**<br><br>(2) Scan downward, at an angle, from the sides of the towed body<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 7) mirrors the IG.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-18.doc: Side Looking Sonar (SLS) Coverage | *Screen 17*<br><br>**Side-looking Sonar Coverage**<br><br>Each SLS scans downward at an angle from its respective side. |
| 18 T-SA | **Chapter 3: 8. GAP FILLER SONAR.**<br><br>The GFS (Figure 3-17) is comprised of a set of five receiving line arrays positioned on a flat horizontal surface on the underside of the mid section.<br><br>*(Note: Intervening material put in following DM.)*<br><br>Each array has 28 elements. The GFS preamplifiers, one for | **LP 2.1, p. 2-1-14**<br><br>f. Gap Filler Sonar (GFS)<br><br>(1) Located on flat horizontal surface on the underside of the towed body mid section<br><br>*Note: Section (2) is used for the following DM.*<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 8) mirrors the* | **LP 2.1, p. 2-1-14**<br><br>f. Gap Filler Sonar (GFS)<br><br>(1) Located on flat horizontal surface on the underside of the towed body mid section<br><br>*Note: Section (2) is used for the following DM.*<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 7) mirrors the* | **LP 2.1, p. 2-1-14**<br><br>f. Gap Filler Sonar (GFS)<br><br>(1) Located on flat horizontal surface on the underside of the towed body mid section<br><br>*Note: Section (2) is used for the following DM.*<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 7) mirrors the* | *Screen 18*<br><br>**Gap-Filler Sonar**<br><br>The GFS comprises a set of five receiving arrays positioned on a flat, horizontal surface on the underside of the mid section.<br><br>Each array has 28 elements, providing 28 outputs per array. The GFS preamplifiers, one for each receive element, are housed directly behind and as |

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| | each receive element, are housed directly behind and as close as possible to each of the receive elements. The GFS preamplifiers are followed by a receive array switching matrix. This switching matrix receives the preamplifier outputs of all five arrays and selects the 28 outputs of one array to send to the towed body processor. | *IG except that GFS is not spelled out.*<br>**Diagram Sheet:**<br>DS 2-1-21.doc: Gap Filler Sonar (GFS) | *IG except that GFS is not spelled out.*<br>**Diagram Sheet:**<br>DS 2-1-19.doc: Gap Filler Sonar (GFS) *Unlike the graphics used in the other two courses, this one has a side-by-side presentation of a locator graphic and a photo of the GFS.* | *IG except that GFS is not spelled out.*<br>**Diagram Sheet:**<br>DS 2-1-19.doc: Gap Filler Sonar (GFS) | close as possible to each of the receive elements. Behind the GFS preamplifiers is a receive array switching matrix. This switching matrix receives the preamplifier outputs of all five arrays and selects the 28 outputs of one array to send to the towed body processor. |
| 19 T-SA | The receiving arrays are electronically steered to different pointing directions. The angles are arranged to allow total coverage of the bottom swath beneath the towed body (Figure 3-18). | **LP 2.1, p. 2-1-14**<br>(2) Electronically aimed to different angles to allow total coverage of the bottom swath beneath the towed body<br>**IS 2-1 O-Lev 1_04.doc**<br>*The IS (p. 8) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-22.doc: Gap Filler Sonar (GFS) Coverage | **LP 2.1, p. 2-1-14**<br>(2) Electronically aimed to different angles to allow total coverage of the bottom swath beneath the towed body<br>**IS 2-1 (A) 8_26.doc**<br>*The IS (p. 7) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-20.doc: Gap Filler Sonar (GFS) Coverage | **LP 2.1, p. 2-1-14**<br>(2) Electronically aimed to different angles to allow total coverage of the bottom swath beneath the towed body<br>**IS 2-1 (P) 8_26.doc**<br>*The IS (p. 7) mirrors the IG.*<br>**Diagram Sheet:**<br>DS 2-1-20.doc: Gap Filler Sonar (GFS) Coverage | *Screen 19*<br>**Gap-Filler Sonar Coverage**<br>The receiving arrays of the GFS can be electronically aimed in different directions to provide total coverage of the bottom swath beneath the towed body. |
| 20 T-SA | **Chapter 3:**<br>**9. DOPPLER VELOCITY LOG AND ELECTRONICS.**<br>The DVL sensor is comprised of two components (DVL sensor and electronics) that are configured as a matched set. The DVL sensor (Figure 3-19) is mounted to the underside of the mid section, just forward of the tail section. The DVL electronics (Figure 3-20) are mounted to the processor cardrack assembly inside of the mid section. The DVL assembly main function is to report towed body velocity and altitude (distance from the bottom) as the towed body is pulled through the water.<br>*Note: The rest of the paragraph is used in the* | **LP 2.1, p. 2-1-14**<br>g. Doppler Velocity Log (DVL)<br>(1) Mounted on underside of mid section<br>(2) Measures altitude above bottom<br>*Note: Sections (2)(a) and (3) are used for the following DM.*<br>**IS 2-1 O-Lev 1_04.doc**<br>*The IS (p. 8) mirrors the IG except that DVL is not spelled out.* | **LP 2.1, p. 2-1-14**<br>g. Doppler Velocity Log (DVL)<br>(1) Mounted on underside of mid section<br>(2) Measures altitude above bottom<br>*Note: Sections (2)(a) and (3) are used for the following DM.*<br>**IS 2-1 (A) 8_26.doc**<br>*The IS (p. 7) mirrors the IG except that DVL is not spelled out.*<br>**Diagram Sheet:**<br>DS 2-1-21.doc: Doppler Velocity Log (DVL). *This is a locator graphic instead of the DVL photo used in O-Level Maintenance (see next DM.).* | **LP 2.1, p. 2-1-14**<br>g. Doppler Velocity Log (DVL)<br>(1) Mounted on underside of mid section<br>(2) Measures altitude above bottom<br>*Note: Sections (2)(a) and (3) are used for the following DM.*<br>**IS 2-1 (P) 8_26.doc**<br>*The IS (p. 7) mirrors the IG except that DVL is not spelled out.*<br>**Diagram Sheet:**<br>DS 2-1-21.doc: Doppler Velocity Log (DVL). *This is the same locator graphic as the one in the Operator course.* | *Screen 20*<br>**Doppler Velocity Log**<br>The two components of the DVL assembly, the sensor and the electronics, are configured as a matched set: The DVL sensor is mounted to the underside of the mid section, just forward of the tail section. The DVL electronics are mounted to the processor cardrack assembly inside of the mid section. The main function of the DVL assembly is to measure and report towed body velocity and altitude above the seabed as the aircraft pulls the towed body through the water. |

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| | *following DM.* | | | | |
| 21 T-SA | **Chapter 3:**<br>**9. DOPPLER VELOCITY LOG AND ELECTRONICS.**<br><br>To measure towed body velocity the DVL assembly emits four beams in a Janus configuration out of the DVL sensor to obtain velocity in three dimensions. The DVL assembly measures altitude, or distance from the bottom, through the use of frequency pulse transmissions. Bottom tracking has a typical single ping accuracy of a few millimeters per second and depth resolution is approximately 0.1 meter. Maximum altitude is a function of transmission frequency, transmitted power, and pulse repetition frequency. | **LP 2.1, p. 2-1-15**<br><br>(a) Maximum accurate altitude is approximately 600 feet<br><br>(3) Provides X and Y velocity estimates<br><br>(a) X: fore/aft Y: port/stbd<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 8) mirrors the IG.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-23.doc: Doppler Velocity Log (DVL) | **LP 2.1, p. 2-1-14**<br><br>(a) Maximum accurate altitude is approximately 600 feet<br><br>(3) Provides X and Y velocity estimates<br><br>(a) X: fore/aft Y: port/stbd<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 7) mirrors the IG.* | **LP 2.1, p. 2-1-15**<br><br>(a) Maximum accurate altitude is approximately 600 feet<br><br>(3) Provides X and Y velocity estimates<br><br>(a) X: fore/aft Y: port/stbd<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 7) mirrors the IG.* | *Screen 21*<br><br>**Velocity Measurements**<br><br>To measure towed body velocity, the DVL assembly emits four beams in a Janus configuration to obtain velocity measurements in three dimensions on an X-Y grid, where X ranges from forward to aft and Y ranges from port to starboard.<br><br>The DVL assembly measures altitude through the use of frequency pulse transmissions. Bottom tracking has a typical single-ping accuracy of a few millimeters per second and a depth resolution of approximately 0.1 meter. The altitude measurement is a function of transmission frequency, transmitted power, and pulse repetition frequency. The maximum accurate altitude is approximately 600 feet. |
| 22-T-EA | | | | | *Screen 22: Practice item* |
| 23 T-SA | **Chapter 3: 15. WING ASSEMBLY**<br><br>The wing assembly (Figure 3-26), mounted top side of the mid section, is used to provide hydrodynamic lift for the towed body. While moving through the water, the wing assembly steadies the towed body. The wing assembly is comprised of a port wing section, wing center and a starboard wing section.<br><br>*(Note: The rest of the paragraph is used in the next DM because there was too much for one screen.)* | **LP 2.1, p. 2-1-9**<br><br>(5) Wing assembly mounted slightly forward of center<br><br>(a) Provides hydrodynamic stability when towed body in motion<br><br>(b) Fixed angle of attack<br><br>*Note: Sections (c), (d), and (e) are in next DM.*<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 5) mirrors the IG.*<br><br>**Diagram Sheet:**<br><br>DS 3-1-15.doc: Wing Assembly *(This DS is included only because the graphic was used in* | **LP 2.1, p. 2-1-9**<br><br>(5) Wing assembly mounted slightly forward of center<br><br>(a) Provides hydrodynamic stability when towed body in motion<br><br>(b) Fixed angle of attack<br><br>*Note: Sections (c), (d), and (e) are in next DM*<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 5) mirrors the IG.* | **LP 2.1, p. 2-1-9**<br><br>(5) Wing assembly mounted slightly forward of center<br><br>(a) Provides hydrodynamic stability when towed body in motion<br><br>(b) Fixed angle of attack<br><br>*Note: Sections (c), (d), and (e) are in next DM*<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 5) mirrors the IG.* | ***Screen 23***<br><br>**Wing Assembly**<br><br>The wing assembly, which is mounted on the top side of the mid section, provides hydrodynamic lift for the towed body. With its fixed angle of attack, it steadies the towed body's movement through the water. The wing assembly comprises a port wing section, wing center, and a starboard wing section. |

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| | | *the demo. No comparison was made to the other courses.)* | | | |
| 24 T-SA | **Chapter 3: 15. WING ASSEMBLY**<br><br>Housed within the port wing section is the compass assembly. The wing center is the area where the tow termination and tow cable are attached. The starboard wing section houses the Conductivity, Temperature and Depth (CTD) sensor. Functional descriptions for the compass assembly and CTD sensor are provided later in this chapter.<br><br>**Chapter 3: 16. TOW CABLE TERMINATION ASSEMBLY**<br><br>The Tow Termination (Figure 3-27) is a removable assembly mounted and secured to the forward end of the wing center section using a termination screw. The tow termination assembly serves as the physical attachment point for connecting the tow cable to the towed body. During mission operations, the tow termination also serves as the towed body pivot point. As the towed body is maneuvered through the water, the tow termination allows for side to side, and forward and back movement.<br><br>**Chapter 3: 17. COMPASS ASSEMBLY**<br><br>The Compass Assembly (Figure 3-28) is installed in the starboard wing section. Its purpose is to provide magnetic heading of the towed body during mission operations.<br><br>**Figure used:** | **LP 2.1, p. 2-1-9**<br><br>(c) Mechanical termination for tow cable<br><br>(d) Contains Conductivity, Temperature, and Depth (CTD) sensor<br><br>1) Provides data to compute speed of sound in water<br><br>a) Salinity, temperature, and depth<br><br>2) Depth below surface<br><br>3) Water temperature<br><br>4) Water salinity<br><br>(e) Contains compass<br><br>1) Heading data compared with aircraft ground track to determine towed body yaw angle in relation to aircraft<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 5) mirrors the IG except for the addition of the highlighted information*:<br><br>(c) Mechanical and electro-optic termination for tow cable<br><br>1) Tow termination point for titanium tow staff connection<br><br>2) Electro-optic bulkhead connector for expanded beam | **LP 2.1, p. 2-1-9**<br><br>(c) Mechanical termination for tow cable<br><br>(d) Contains Conductivity, Temperature, and Depth (CTD) sensor<br><br>1) Provides data to compute speed of sound in water<br><br>a) Salinity, temperature, and depth<br><br>2) Depth below surface<br><br>3) Water temperature<br><br>4) Water salinity<br><br>(e) Contains compass<br><br>1) Heading data compared with aircraft ground track to determine towed body yaw angle in relation to aircraft<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 5) mirrors the IG except for highlighted information below*:<br><br>1) Provides data to compute speed of sound in water<br><br>a) Depth below surface<br><br>b) Water temperature<br><br>c) Water salinity<br><br>*Note: Whereas these are* | **LP 2.1, p. 2-1-9**<br><br>(c) Mechanical termination for tow cable<br><br>(d) Contains Conductivity, Temperature, and Depth (CTD) sensor<br><br>1) Provides data to compute speed of sound in water<br><br>a) Salinity, temperature, and depth<br><br>2) Depth below surface<br><br>3) Water temperature<br><br>4) Water salinity<br><br>(e) Contains compass<br><br>1) Heading data compared with aircraft ground track to determine towed body yaw angle in relation to aircraft<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 5) mirrors the IG except for highlighted information below*:<br><br>1) Provides data to compute speed of sound in water<br><br>a) Depth below surface<br><br>b) Water temperature<br><br>c) Water salinity<br><br>*Note: Whereas these are* | ***Screen 24***<br><br>**Wing Assembly Components**<br><br>The starboard wing section contains the **compass assembly**. This assembly provides magnetic heading data during tow operations. The system compares this data with the aircraft's heading to determine the towed body's yaw angle relative to the aircraft.<br><br>On the forward end of the wing center is the **tow termination assembly**, which is secured to the towed body by the termination screw. The termination assembly provides the attachment point for the **tow cable**. During mission operations, the tow termination also serves as the towed body pivot point. As the towed body moves through the water, the tow termination allows for side-to-side and forward-to-back movement.<br><br>The port wing section houses the **conductivity, temperature and depth (CTD) sensor**. This CTD sensor provides a digital indication of water salinity (conductivity), temperature (by centigrade), and depth (in feet).The system uses this data to compute the speed of sound in the water. |

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| | F3-28_fr.htm<br><br>**Chapter 3:**<br>**18. CONDUCTIVITY , TEMPERATURE AND DEPTH SENSOR**<br><br>The CTD sensor (Figure 3-29) is installed in the port wing assembly of the towed body. It provides a digital indication of conductivity, temperature (by centigrade), and depth (in feet) of the water.<br><br>**Figure used:**<br><br>F3-29_fr.htm<br><br>*Note: The locations for the compass assembly and the CTD sensor differ from those provided in section 15. The demo uses the information from section 15 because it fits with the orientation of the towed body in the graphic.* | connector<br><br>(d) Contains Conductivity, Temperature, and Depth (CTD) sensor (Port Wing)<br><br>1) Provides data to compute speed of sound in water<br><br>a) Depth below surface<br><br>b) Water temperature<br><br>c) Water salinity<br><br>*Note: Whereas these are subpoints under "1)" in the IS, they are on the same level as "1)" in the IG. The IS does not include the following redundant IG subpoint:*<br><br>a) Salinity, temperature, and depth<br><br>(e) Contains compass (STBD Wing)<br><br>**Diagram Sheet:**<br><br>DS 3-1-17.doc: Wing Assembly Zinc Anode *(This DS is included only because the graphic was used in the demo to show the tow termination assembly. No comparison was made to the other courses.)* | *subpoints under "1)" in the IS, they are on the same level as "1)" in the IG. The IS does not include the following redundant IG subpoint:*<br><br>a) Salinity, temperature, and depth | *subpoints under "1)" in the IS, they are on the same level as "1)" in the IG. The IS does not include the following redundant IG subpoint:*<br><br>a) Salinity, temperature, and depth | |
| 25 T-SA | *Note: All of the information in sections 6, 11, 13, and 14 below would be used in an actual lesson. The information has been abbreviated in the suggested DM in order to keep the size of the demonstration module down.*<br><br>**Chapter 3: 6. MID SECTION**<br><br>*Note: The paragraph* | **LP 2.1, p. 2-1-8**<br><br>(3) Contains liquid cooling system pump for towed body<br><br>(4) Leak detector circuitry<br><br>(a) Processes leak information from entire towed body | **LP 2.1, p. 2-1-9**<br><br>(3) Contains liquid cooling system pump for towed body<br><br>(4) Leak detector circuitry<br><br>(a) Processes leak information from entire towed body | **LP 2.1, p. 2-1-9**<br><br>(3) Contains liquid cooling system pump for towed body<br><br>(4) Leak detector circuitry<br><br>(a) Processes leak information from entire towed body | ***Screen 25***<br><br>**Mid Section Interior**<br><br>The hollow interior of the mid section contains four critical assemblies that support the rest of the components of the towed body:<br><br>• Hull leak detector circuitry, which processes leak information from the entire towed |

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| | *before this was used in a previous DM.*<br><br>The mid section (Figure 3-14) is a hollow cylinder that is comprised of three critical assemblies that support the rest of the components of the towed body. They are the hull leak detectors, power amplifier cardrack assembly and processor cardrack assembly. *(Additional information in this paragraph was left out. The final paragraph in this section of the IETM was used for a previous DM.)*<br><br>**Chapter 3: 11. PUMP ACCUMULATOR ASSEMBLY.**<br><br>The Pump Accumulator Assembly . . . ensures adequate cooling of internal electronic components inside the mid section. *(Additional information left out.)*<br><br>**Figure used:**<br><br>F3-22_fr.htm<br><br>**Chapter 3: 13. POWER CARDRACK ASSEMBLY.**<br><br>The Power Cardrack Assembly (Figure 3-24) is a box shaped assembly with 15 slots leading to an amplifier base plate. Installed in 10 of the slots are all the sonar power amplifier modules for the FLS, VSS, GFS, and SLS. A 15 VDC and two 26 VDC power supplies fill three slots, and the remaining two slots are used for spare modules. *(Additional information left out.).*<br><br>**Figure used:**<br><br>F3-24_fr.htm<br><br>**Chapter 3: 14. PROCESSOR CARDRACK ASSEMBLY.** | **IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 5) mirrors the IG except for the following highlighted information*:<br><br>(a) Processes leak information from V-band connection area<br><br>(b) When configured with EOID, the leak detector is extended to include the EOID to detect leaks around the optical windows. | **IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 4) mirrors the IG.* | **IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 4) mirrors the IG.* | body<br><br>• **Liquid cooling system pump**, which ensures adequate cooling of the internal components<br><br>• **Power amplifier cardrack assembly**, which contains the power amplifier modules and power supply modules for the FLS, VSS, GFS, and SLS<br><br>• **Processor cardrack assembly**, which provides all the sonar receive signal and data processing in the towed body |

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| | The Processor Cardrack Assembly (Figure 3-25) provides all the receive signal and data processing in the towed body. *(Additional information left out.)*<br><br>**Figure used:**<br><br>F3-25_fr.htm | | | | |
| 26-T-EA | | **Diagram Sheet:**<br><br>DS 3-1-15.doc: Wing Assembly *(This DS is included only because the graphic was used in the demo. No comparison was made to the other courses.)* | | | *Screen 26: Practice item* |
| 27 T-SA | **Chapter 3:**<br>**2. AN/AQS-20A COMMON TOWED BODY CONFIGURATION**<br><br>*Note: Previous paragraphs in this section have been used in other DMs.*<br><br>The tail section (Figure 3-7) primary purpose is to provide towed body flight control to the system operator. To facilitate this function, the tail section is equipped with an Inertial Navigation Unit (INU), electro-mechanical actuators, and movable tail fins. Through their use (via the common console and tow cable), the towed body can be maintained at preselected depths and angles while being pulled through the water. The transponder, is also installed in the open cavity at the back of the towed body. The transponders function is discussed later in this chapter.<br><br>**Chapter 3: 19 TAIL SECTION**<br><br>The tail section (Figure 3-30) provides the steering capability for the towed body. The towed body position and depth can be controlled | **LP 2.1, p. 2-1-11**<br><br>c. Tail Section<br><br>(3) Houses Inertial Navigation Unit (INU) and transponder<br><br>*Note: Subsections (1) and (2) are in the next DM.*<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 6) mirrors the IG.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-12.doc: Tow Body Sections | **LP 2.1, p. 2-1-11**<br><br>c. Tail Section<br><br>(3) Houses Inertial Navigation Unit (INU) and transponder<br><br>*Note: Subsections (1) and (2) are in the next DM.*<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 5) mirrors the IG.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-10.doc: Tow Body Sections | **LP 2.1, p. 2-1-11**<br><br>c. Tail Section<br><br>(3) Houses Inertial Navigation Unit (INU) and transponder<br><br>*Note: Subsections (1) and (2) are in the next DM.*<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 5) mirrors the IG.*<br><br>**Diagram Sheet:**<br><br>DS 2-1-10.doc: Tow Body Sections | *Screen 27*<br><br>**Tail Section of the Towed Body**<br><br>The tail section provides the steering capability that enables the system operator to maintain the towed body at preselected depths and angles as it moves through the water. Three tail section components facilitate this function:<br><br>• Inertial Navigation Unit (INU)<br>• Electro-mechanical actuators<br>• Movable tail fins<br><br>A transponder located in the open cavity at the back of the towed body provides a means of locating the towed body should it become disconnected. |

| DM | IETM | O-Level Maint. Course | Operator Course | Pilot Course | Proposed DM |
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| | by the system operator from the aircraft.<br><br>*Note: Intervening material is in the next DM.*<br><br>The tail section also houses two other sensors required for towed body operation. These are the Inertial Navigation Unit (INU) and transponder. Functional descriptions for these two components are provided later in this chapter. | | | | |
| 28 T-SA | **Chapter 3: 19 TAIL SECTION**<br><br>The tail section is located at the aft end of the towed body and is comprised of three tail fin assemblies. Each tail fin has an attitude control flap that is movable at angles of plus or minus 25 degrees.<br><br>The control flaps are driven by electrically powered actuators installed in the tail cone. To monitor control flap attitudes, position indicators are installed in the tail cone and provide positive feedback (control flap position) to the AN/AQS-20A system operator in the aircraft. | **LP 2.1, p. 2-1-11**<br><br>c. Tail Section<br><br>(1) Inverted “Y” tail configuration<br><br>(2) Each of the three tail fins has an attitude control flap (fin)<br><br>(a) Pitch, roll, and yaw control<br><br>(b) Commanded from Common Console<br><br>(c) Default to zero degrees upon initialization<br><br>(d) Control available when towed body is in the water and speed is greater than 2 knots<br><br>1) Positive control achieved at speeds greater than 6 knots<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 6)* mirrors the IG. | **LP 2.1, p. 2-1-11**<br><br>c. Tail Section<br><br>(1) Inverted “Y” tail configuration<br><br>(2) Each of the three tail fins has an attitude control flap (fin)<br><br>(a) Pitch, roll, and yaw control<br><br>(b) Commanded from Common Console<br><br>(c) Default to zero degrees upon initialization<br><br>(d) Control available when towed body is in the water and speed is greater than 2 knots<br><br>1) Positive control achieved at speeds greater than 6 knots<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 5) mirrors the IG.*<br><br>**Diagram Sheet:**<br><br>DS 3-1-07.doc: Tail Section *(This DS is included only because* | **LP 2.1, p. 2-1-11**<br><br>c. Tail Section<br><br>(1) Inverted “Y” tail configuration<br><br>(2) Each of the three tail fins has an attitude control flap (fin)<br><br>(a) Pitch, roll, and yaw control<br><br>(b) Commanded from Common Console<br><br>(c) Default to zero degrees upon initialization<br><br>(d) Control available when towed body is in the water and speed is greater than 2 knots<br><br>1) Positive control achieved at speeds greater than 6 knots<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 5) mirrors the IG.* | *Screen 28*<br><br>**Tail Fin Assemblies**<br><br>The tail section includes three tail fin assemblies configured in an inverted "Y." Each of the three tail fins has an attitude control flap capable of moving plus or minus 25 degrees. These flaps control pitch, roll, and yaw. Upon initialization, the default position of these fins is zero degrees.<br><br>Control of the flaps is available through the Common Console as soon as the towed body's speed in the water exceeds two knots. Command signals from the Common Console travel via the tow cable to electrically powered actuators in the tail cone, which in turn drive the control flaps. Once the towed body's speed is greater than six knots, position indicators in the tail cone provide positive feedback on control flap position to the AN/AQS-20A system operator. |

| DM | IETM | O-Level Maint. Course | Operator Course | Pilot Course | Proposed DM |
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| | | | *the graphic was used in the demo. No comparison was made to the other courses.)* | | |
| 29 T-SA | **Chapter 3:**<br>**21. INERTIAL NAVIGATION UNIT.**<br><br>The INU (Figure 3-32) is installed inside the forward end of the tail section. During towed body operation, the INU measures vehicle acceleration as well as roll, pitch and yaw rates. This information is used for vehicle flight control and, when required, for precise navigation functions needed to support reacquisition of targets for identification.<br><br>**Figure used:**<br><br>F3-32_fr.htm | **LP 2.1, p. 2-1-11**<br><br>(a) INU<br><br>1) Provides towed body processor with, pitch, roll, and yaw rates<br><br>a) Inputs for automated flight control<br><br>2) Produces latitude and longitude, position and attitude direction, altitude, velocity, wander angle, and status information<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 6) mirrors the IG except that INU is up one level in the outline:*<br><br>(4) INU | **LP 2.1, p. 2-1-11**<br><br>(a) INU<br><br>1) Provides towed body processor with, pitch, roll, and yaw rates<br><br>a) Inputs for automated flight control<br><br>2) Produces latitude and longitude, position and attitude direction, altitude, velocity, wander angle, and status information<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 5) mirrors the IG except that INU is up one level in the outline:*<br><br>(4) INU | **LP 2.1, p. 2-1-11**<br><br>(a) INU<br><br>1) Provides towed body processor with, pitch, roll, and yaw rates<br><br>a) Inputs for automated flight control<br><br>2) Produces latitude and longitude, position and attitude direction, altitude, velocity, wander angle, and status information<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 6) mirrors the IG except that INU is up one level in the outline and the second subpoint differs as shown:*<br><br>(4) INU<br><br>(b) Produces latitude and longitude position, attitude direction, altitude, velocity, wander angle, and status information | *Screen 29*<br><br>**Inertial Navigation Unit**<br><br>The INU is installed inside the forward end of the tail section. During towed body operation, the INU measures vehicle acceleration as well as roll, pitch and yaw rates. This information is used for automated flight control and, when required, for precise navigation functions needed to support reacquisition of targets for identification.<br><br>The INU also produces status information regarding the towed body's latitude and longitude, attitude, altitude, velocity, and wander angle. |
| 30 T-SA | **Chapter 3:**<br>**20. TRANSPONDER.**<br><br>The transponder (Figure 3-31) is cylindrical in shape and consists of signal sending electronics, powered by a replaceable, internal 6 volt Lithium battery. The transponder is installed in the open cavity at the back of the towed body tail section and is used for emergency recovery of the towed body. The transponder provides a beacon function for the towed body should the towed body become inadvertently detached | **LP 2.1, p. 2-1-12**<br><br>(b) Transponder<br><br>1) Used to locate the towed body in case of loss during mission<br><br>2) Transmits an acoustic signal when interrogated<br><br>**IS 2-1 O-Lev 1_04.doc**<br><br>*The IS (p. 6) mirrors the IG except that transponder is up one level in the outline:*<br><br>(5) Transponder<br><br>**Diagram Sheet:**<br><br>DS 3-1-38.doc: Tail | **LP 2.1, p. 2-1-12**<br><br>(b) Transponder<br><br>1) Used to locate the towed body in case of loss during mission<br><br>2) Transmits an acoustic signal when interrogated<br><br>**IS 2-1 (A) 8_26.doc**<br><br>*The IS (p. 6) mirrors the IG except that transponder is up one level in the outline:*<br><br>(5) Transponder | **LP 2.1, p. 2-1-12**<br><br>(b) Transponder<br><br>1) Used to locate the towed body in case of loss during mission<br><br>2) Transmits an acoustic signal when interrogated<br><br>**IS 2-1 (P) 8_26.doc**<br><br>*The IS (p. 6) mirrors the IG except that transponder is up one level in the outline:*<br><br>(5) Transponder | *Screen 30*<br><br>**Transponder**<br><br>The cylindrical transponder is installed in the open cavity at the back of the towed body tail section. Should the towed body become detached from the tow cable during a mission, the transponder emits an acoustic signal when interrogated by the aircraft. This signal acts as a beacon to aid in locating the assembly. A replaceable, internal 6-volt Lithium battery powers the electronics that send the signal.<br><br>Activation of the |

| DM | IETM | O-Level Maint. Course | Operator Course | Pilot Course | Proposed DM |
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| | from the tow cable. The transponder is activated automatically when completely immersed in water. It can also be activated by shorting the stainless steel button on the transducer to the housing. | Transponder *(This DS is included only because the graphic was used in the demo. No comparison was made to the other courses.)* | | | transponder is automatic as soon as the towed body is completely immersed in water. The transponder can also be activated by shorting the stainless steel button on the transducer to the housing. |
| 31-T-EA | | | | | *Screen 31: Knowledge check* |
| 32-T-EA | | | | | *Screen 32: Knowledge check* |
| 33-T-EA | | | | | *Screen 33: Knowledge check* |
| 34-T-EA | | | | | *Screen 34: Knowledge check* |
| 35-T-EA | | | | | *Screen 35: Knowledge check* |
| 36-T-TC | | **Diagram Sheet:**<br>DS 3-1-04.doc: FLS Shroud and Elements *(This DS is included only because the graphic was used in the demo. No comparison was made to the other courses.)* | | | *Screen 36: Summary* |

# Appendix C

Proposed DMs Based on Analysis and Cross-Comparison of F/A-18 Content

The following F/A-18 technical materials were analyzed to determine common content:

- A1-F18AC-742-100: Technical Manual/Organizational Maintenance/Principles of Operation/Radar System
- A1-F18AE-120-100: Technical Manual/Organizational Maintenance/Principles of Operation/Seat, Canopy, Survival Equipment, and Boarding Ladder
- A1-F18AE-460-100: Technical Manual/Organizational Maintenance/Principles of Operation/Fuel System
- A1-F18AE-580-100: Technical Manual/Organizational Maintenance/Principles of Operation/Flight Incident Recorder and Monitoring System
- A1-F18AE-740-100: Technical Manual/Organizational Maintenance/Principles of Operation/Weapon Control System
- A1-F18AE-760-100: Technical Manual/Organizational Maintenance/Principles of Operation/Tactical Electronic Warfare Systems
- C-646-9974A Change 3: Lesson Plan/F/A-18 Stores Management System (Career) Organizational Level Maintenance Course

The table below shows proposed DMs for common elements in the F/A-18 technical manuals. (There was not sufficient correspondence between the lesson plan and A1-F18AE-740-100, the only related technical manual, to enable synthesis of material in the proposed DMs.) The analysis revealed no content overlap among the manuals other than the introductory information. It is anticipated that this information could be used not only in an IETM but also in the Help section for a training lesson. Moreover, the use of S1000D DMs to create the IETMs would represent a considerable savings in both the development and the maintenance of the IETMs.

Proposed DMs are of the following types:

- Technical DMs that can be used to create any IETM but are not appropriate for training
- Dual-purpose DMs that can be used in both IETMs and training SCOs, provided recommended changes are made and approved
- Training-only DMs that had been repurposed from the original content because the original content referenced the IETM

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
|---|---|---|---|---|
| 1 | **A1-F18AC-742-100** | **A1-F18AE-460-100** | **A1-F18AE-740-100** | *Training-only DM:* |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
|---|---|---|---|---|
| | **TECHNICAL MANUAL**<br>**ORGANIZATIONAL MAINTENANCE**<br>**PRINCIPLES OF OPERATION** | *Note: The corresponding content is the same for all six manuals.* | *Note: The corresponding content is the same for all six manuals.* | *Title screen with appropriate graphic (not to be developed for this analysis).*<br>**ORGANIZATIONAL MAINTENANCE**<br>**PRINCIPLES OF OPERATION** |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same for all six manuals.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same for all six manuals.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same for all six manuals.* | |
| 2 | **A1-F18AC-742-100**<br>**<u>DISTRIBUTION STATEMENT C</u>. Distribution authorized to U.S. Government agencies and their contractors to protect publications required for official use or for administrative or operational purposes only, determined on 1 April 1999. Other requests for this document shall be referred to Commanding Officer, Naval Air Technical Data and Engineering Service Command, Naval Air Station North Island**<br>**P.O. Box 357031, Building 90 Distribution, San Diego, CA 92135-7031.**<br>**<u>DESTRUCTION NOTICE</u> - For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.**<br>***Published by Direction of the Commander, Naval Air Systems Command*** | **A1-F18AE-460-100**<br>*Note: The content is the same as that in A1-F18AC-742-100 except for the date, which is 15 May 2000.* | **A1-F18AE-740-100**<br>*Note: The content is the same as that in A1-F18AC-742-100 except for the date, which is 1 April 2000.* | *Note: This DM would not be used for training because it references documents.*<br>*The only difference in the content that affects reusability is the distribution date. We recommend that it be pulled out and put with other manual-specific information.*<br>*The additional differences in A1-F18AE-120-100 appear to be old information that will be changed when the manual is updated.* |
| | **A1-F18AE-120-100**<br>**DISTRIBUTION** | **A1-F18AE-580-100**<br>*Note: The content is the* | **A1-F18AE-760-100**<br>*Note: The content is the* | |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
|---|---|---|---|---|
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| 3 | **A1-F18AC-742-100**<br>**NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES/PAGES** | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same for all six manuals.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same for all six manuals.* | *This content would not be used for training because of references to work packages/pages.*<br>*The content is suitable for a reusable technical DM.* |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same for all six manuals.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same for all six manuals.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same for all six manuals.* | |
| 4 | **A1-F18AC-742-100**<br>Only those work packages/ pages assigned to the manual are listed in this index. Insert Change 2, dated 15 March 2005. Dispose of superseded work packages/pages. Superseded | **A1-F18AE-460-100**<br>*Note: The only difference between this section and the comparable section in the other manuals is the insertion message:*<br>Insert Change 7, dated | **A1-F18AE-740-100**<br>*Note: The only difference between this section and the comparable section in the other manuals is the insertion message:*<br>Insert Change 7, dated | *This content is not appropriate for training because of references to work packages/pages.*<br>*The content is suitable for a reusable technical DM except for the* |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | classified work packages/pages shall be destroyed in accordance with applicable security regulations. If changed pages are issued to a work package, insert the changed pages in the applicable work package. The portion of text affected in a change or revision is indicated by change bars or the change symbol "R" in the outer margin of each column of text. Changes to illustrations are indicated by pointing hands, change bars, or MAJOR CHANGE symbols. Changes to diagrams may be indicated by shaded borders. | 15 September 2002.<br>*If the insertion message were located separately from the paragraph, the paragraph could be a reusable DM.* | 1 August 2005. | *change insertion message (second sentence). Since the change is listed above the paragraph and is applicable only when the change is received (once the insertion is made, the directions to insert the change are no longer needed), is this redundant information necessary?* |
| | **A1-F18AE-120-100**<br>*Note: The only difference between this section and the comparable section in the other manuals is the insertion message:*<br>Insert Change 5, dated 15 June 1997. | **A1-F18AE-580-100**<br>*Note: The only difference between this section and the comparable section in the other manuals is the insertion message:*<br>Insert Change 9, dated 15 March 2005. | **A1-F18AE-760-100**<br>*Note: The only difference between this section and the comparable section in the other manuals is the insertion message:*<br>Insert Change 9, dated 1 September 2005. | |
| 5 | **A1-F18AC-742-100**<br>1. **PURPOSE.**<br>2. This manual provides the technician with a general understanding of how the various components function in the system. | **A1-F18AE-460-100**<br>*Note: The content for the Purpose section is the same in all six manuals.* | **A1-F18AE-740-100**<br>*Note: The content for the Purpose section is the same in all six manuals.* | *Training-only DM:*<br>This lesson provides the technician with a general understanding of how the various components function in the system. |
| | **A1-F18AE-120-100**<br>*Note: The content for the Purpose section is the same in all six manuals.* | **A1-F18AE-580-100**<br>*Note: The content for the Purpose section is the same in all six manuals.* | **A1-F18AE-760-100**<br>*Note: The content for the Purpose section is the same in all six manuals.* | |
| 6 | **A1-F18AC-742-100**<br>3. **REQUISITION AND AUTOMATIC** | **A1-F18AE-460-100**<br>*Note: The content is the same as that in A1-* | **A1-F18AE-740-100**<br>*Note: The content for sections 3 and 4 is the* | *This content is not appropriate for training because of* |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | with NAVSUP 485 to Routing Identifier Code "NFZ". MILSTRIP requisitions can be submitted through your supply office, Navy message, or SALTS to DAAS (Defense Automated Address System), or through the DAAS or NAVSUP web sites. For assistance with a MILSTRIP requisition, contact the Naval Inventory Control Point (NAVICP) Publications and Forms Customer Service at Defense Switched Network 442-2626 or (215) 697-2626, Monday through Friday, 0700 to 1600 Eastern Time. | | | |
| | **A1-F18AE-120-100**<br>3. **REQUISITIONING AND DISTRIBUTION OF NAVAIR TECHNICAL PUBLICATIONS.**<br>*Note: In addition to the highlighted text variations, this pub uses one paragraph instead of the separately numbered paragraphs used in A1-F18AC 742-100. This, of course, changes the paragraph numbering from this point forward.*<br>4. Procedures to be used by Naval Activities and other Department of Defense organizations requiring NAVAIR technical publications are defined in the NAVAL AIR SYSTEMS COMMAND TECHNICAL MANUAL PROGRAM manual, NAVAIR 00-25-100 and NAVAIRINST 5605.5, Distribution of aeronautic | **A1-F18AE-580-100**<br>*Note: The content for sections 3 and 4 is the same as that in A1-F18AC-742-100. Variations in sections 5 and 6 are highlighted below.*<br>5. To automatically receive future changes and revisions to NAVAIR technical manuals, an activity must be established on the Automatic Distribution Requirements List (ADRL) maintained by the Naval Air Technical Data and Engineering Service Command (NATEC). To become established on the ADRL, notify your activity central technical publications librarian. If your | **A1-F18AE-760-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | technical publications. To automatically receive future changes and revisions to NAVAIR technical manuals, an activity must be established on the Automatic Distribution Requirements List (ADRL) maintained by the Naval Air Technical Services Facility (NAVAIRTECHSERVFAC). To become established on the ADRL, notify your activity central technical publications librarian. If your activity does not have a library, you may establish your automatic distribution requirements by contacting the Commanding Officer, NAVAIRTECHSERVFAC, Attn: ADRL REQUEST, 700 Robbins Avenue, Philadelphia, PA 19111-5097. Annual reconfirmation of these requirements are necessary to remain on automatic distribution. Please use your NAVAIRTECHSERVFAC assigned account number whenever referring to automatic distribution requirements.<br><br>If additional replacement copies of this manual are required with no attendant changes in the ADRL, they may be ordered by submitting a DD 1348 requisition directly to the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Road, Philadelphia, PA 19120-5099. | activity does not have a library, you may establish your automatic distribution by contacting the Commanding Officer, NATEC, Attn: Distribution, NAS North Island, Bldg. 90, P.O. Box 357031, San Diego CA 92135-7031. Annual reconfirmation of these requirements is necessary to remain on automatic distribution. Please use your NATEC assigned account number whenever referring to automatic distribution requirements.<br><br>6. If additional or replacement copies of this manual are required with no attendant changes in the ADRL, they may be ordered by submitting a MILSTRIP requisition in accordance with NAVSUP 485 to Routing Identifier Code "NFZ". MILSTRIP requisitions can be submitted through your supply office, Navy message, or SALTS to DAAS (Defense Automated Address System), or through the DAAS or NAVSUP web sites. For assistance with a MILSTRIP requisition, contact the Naval Inventory Control Point (NAVICP) Publications and Forms Customer Service at DSN 442-2626 or (215) 697- | | |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | | 2626, Monday through Friday, 0700 to 1600 Eastern Time. | | |
| 7 | **A1-F18AC-742-100**<br>7. **CONTENT.**<br>8. Work packages contain description and operation of systems, subsystems, and components. The text is supported by component locators, block diagrams and simplified schematics. | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | *This DM is not appropriate for training because of the reference to work packages. However, the text could be improved. Recommended changes are highlighted below:*<br>Work packages describe the location, function, and operation of systems, subsystems, and components. They also include component locators, block diagrams, and simplified schematics to graphically depict information for increased understanding. |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | |
| 8 | **A1-F18AC-742-100**<br>9. **COMPONENT LOCATOR.** The component locator shows aircraft component location. The illustration shows the technicians view when possible. | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | *Dual-purpose DM with suggested changes highlighted:*<br>**COMPONENT LOCATOR.** The component locator shows aircraft component location. The illustration shows the technician's view when possible. |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, with the exception of the paragraph numbering in A1-F18AE-120-100.* | |
| 9 | **A1-F18AC-742-100**<br>10. **BLOCK DIAGRAMS.** Block diagrams are made up primarily of blocks connected by lines. These | **A1-F18AE-460-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | **A1-F18AE-740-100**<br>*Note: Variations in the content from that shown for A1-F18AC-742-100 are identical* | *Dual-purpose DM with suggested changes highlighted:*<br>**BLOCK DIAGRAMS.** Block |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | diagrams portray the function of a system or subsystem. | | *to those in A1-F18AE-120-100 except for the paragraph numbering.* | diagrams generally consist of squares, rectangles, and other arbitrary shapes connected by lines. These diagrams portray the function of a system or subsystem and show the relative position of the components. |
| | **A1-F18AE-120-100**<br>8. **BLOCK DIAGRAMS.** Block diagrams consist primarily of blocks connected by lines. These diagrams portray the function of a system or subsystem. | **A1-F18AE-580-100**<br>*Note: Variations in the content from that shown for A1-F18AC-742-100 are identical to those in A1-F18AE-120-100 except for the paragraph numbering.* | **A1-F18AE-760-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | |
| 10 | **A1-F18AC-742-100**<br>11. **SIMPLIFIED SCHEMATICS.** Simplified schematics are made up primarily of blocks connected by single lines with limited use of symbols and pictorial drawings of units. These schematics simplify system functions as much as possible. All schematics are shown with electrical power off, switches in off positions, and relays in deenergized position unless noted on schematic. | **A1-F18AE-460-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | **A1-F18AE-740-100**<br>*Note: Variations in the content from that shown for A1-F18AC-742-100 are identical to those in A1-F18AE-120-100 except for the paragraph numbering.* | *Dual-purpose DM with suggested changes highlighted:*<br>**SIMPLIFIED SCHEMATICS.** Simplified schematics consist of blocks connected by single lines with limited use of symbols and drawings of units. Schematics provide more detailed information than a block diagram. However, they still simplify system function as much as possible. All schematics are shown with electrical power off, switches in the off position, and relays in the deenergized position unless noted on the schematic. |
| | **A1-F18AE-120-100**<br>9. **SIMPLIFIED SCHEMATICS.** Simplified schematics consist primarily of blocks connected by single lines with limited use of symbols and pictorial drawings of units. These schematics simplify system functions as much as possible. All schematics are shown with electrical power off, switches in off positions, and relays in deenergized position unless noted on schematic. | **A1-F18AE-580-100**<br>*Note: Variations in the content from that shown for A1-F18AC-742-100 are identical to those in A1-F18AE-120-100 except for the paragraph numbering.* | **A1-F18AE-760-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | |
| 11 | **A1-F18AC-742-100**<br>12. **SCHEMATIC** | **A1-F18AE-460-100**<br>*Note: The content is the same as that in A1-* | **A1-F18AE-740-100**<br>*Note: The content is the same as that in A1-* | *This DM would not be used for training because of the* |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | **HIGHLIGHTS.**<br>13. For schematic highlights, see figure 1. | *F18AC-742-100.* | *F18AC-742-100.* | *reference to a numbered figure.*<br>*The content in A1-F18AC-742-100 is suitable for a reusable technical DM.* |
| | **A1-F18AE-120-100**<br>10. **SCHEMATIC HIGHLIGHTS.**<br>11. For schematic highlights see figure 1. | **A1-F18AE-580-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | **A1-F18AE-760-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | |
| 12 | **A1-F18AC-742-100**<br>14. **MANUAL ISSUE DATE.**<br>15. The date on the title page is the copy freeze date. No additions, deletions, or changes are made after the manual issue date except last minute safety of flight or required maintenance changes. Data collected after the manual issue date will be included in later changes or revisions of the manual. | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *This DM would not be used for training because of the reference to the manual.*<br>*The content is suitable for a reusable technical DM; however, some minor grammatical corrections are recommended, as highlighted below:*<br>The date on the title page is the copy freeze date. No additions, deletions, or changes are made after the manual issue date except last-minute safety-of-flight or required maintenance changes. Data collected after the manual issue date will be included in later changes or revisions of the manual. |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | |
| 13 | **A1-F18AC-742-100**<br>16. **EFFECTIVITIES.**<br>17. Effectivity notes on manual title pages, work package title pages, and within a work package indicate the aircraft or software program to which the data applies. If no effectivity note appears on the work package title page, the work package has the | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *This DM would not be used for training because of the reference to the manual.*<br>*The content is suitable for a reusable technical DM; however, some minor grammatical corrections are recommended, as highlighted below:* |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | same effectivity as shown on the manual title page. The effectivity notes may use:<br>a. Type, model, and series<br>**NOTE**<br>F/A-18D aircraft after bureau number 164967 was referred to as bureau number F/A-18D D-140. Now, F/A-18D aircraft after bureau number 164967 is 165409.<br>b. Bureau number (tail number)<br>c. Combination of type, model, series, and bureau numbers<br>d. Part number or serial number<br>e. Technical directive number<br>f. Configuration/ identification number | | | **NOTE**<br>F/A-18D aircraft after bureau number 164967 used to be referred to as bureau number F/A-18D D-140. Now, the bureau number for F/A-18D aircraft after bureau number 164967 is 165409. |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | |
| 14 | **A1-F18AC-742-100**<br>18. The table below shows examples of effectivity notes and their meanings:<br>(Table entitled **Effectivity Note Examples**) | **A1-F18AE-460-100**<br>*Note: The corresponding content—including the content of the table—is the same for all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content—including the content of the table—is the same for all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *This DM would not be used for training because of the reference to the information effectivity in the manual.*<br>*The content is suitable for a reusable technical DM.* |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content—including the* | **A1-F18AE-580-100**<br>*Note: The corresponding* | **A1-F18AE-760-100**<br>*Note: The corresponding* | |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | *content of the table—is the same for all 6 manuals, except for the paragraph numbering in A1-F18AE-12-100.* | *content—including the content of the table—is the same for all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *content—including the content of the table—is the same for all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | |
| 15 | **A1-F18AC-742-100**<br>19. **TECHNICAL DIRECTIVES.**<br>20. Technical directives are documents which provide instructions to add and record retrofit configuration modifications or inspection instructions to delivered aircraft, or aircraft components. | **A1-F18AE-460-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | **A1-F18AE-740-100**<br>*Note: Variations in the content from that shown for A1-F18AC-742-100 are identical those in A1-F18AE-120-100.* | *This DM would not be used for training because of the reference to documents.*<br>*The content is suitable for a reusable technical DM; however, some minor grammatical corrections are recommended, as highlighted below:*<br>Technical directives are documents that provide instructions to add and record retrofit configuration modifications or inspection instructions to delivered aircraft or aircraft components. |
| | **A1-F18AE-120-100**<br>17. **TECHNICAL DIRECTIVES.**<br>18. Technical directives are documents which provide instructions to incorporate and record retrofit configuration modifications or inspection instructions to delivered aircraft, or aircraft components. | **A1-F18AE-580-100**<br>*Note: Variations in the content from that shown for A1-F18AC-742-100 are identical those in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | |
| 16 | **A1-F18AC-742-100**<br>21. **AIRFRAME CHANGE (AFC) AND AIRBORNE SOFTWARE CHANGE (ASC).** Technical directives which change configuration of aircraft structure or equipment installation, i.e. AFC, will list aircraft bureau numbers in effectivity notes and show before and after the AFC. Technical directives which change configuration of operational flight programs (OFP), i.e. ASC, will list the OFP CONFIG/IDENT NUMBER in effectivity | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *This DM would not be used for training because of the references to effectivity notes and technical directives.*<br>*The content is suitable for a reusable technical DM; however, some minor grammatical corrections are recommended, as highlighted below:*<br>Technical directives that change configuration of aircraft structure or equipment installation, i.e. AFC, |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | notes and show the latest two authorized OFP programs. See AFC and ASC effectivity examples in Effectivity Note Example Table. | | | will include effectivity notes listing applicable aircraft bureau numbers for both before and after the AFC. Technical directives that change configuration of operational flight programs (OFP), i.e. ASC, will list the OFP CONFIG/IDENT NUMBER in effectivity notes and show the latest two authorized OFP programs. See AFC and ASC effectivity examples in Effectivity Note Example Table. |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | |
| 17 | **A1-F18AC-742-100**<br>22. **AIRCRAFT COMPONENT CHANGES.**<br>Technical directives which change configuration of aircraft components are listed below:<br>AAC Aviation Armament Change for armament equipment<br>ACC Aircrew System Change for aircrew survival equipment<br>AFC Airframe Change for aircraft structure and equipment<br>ASC Airborne Software Change for operational flight programs<br>AVC Avionics Change for airborne electronic equipment, including wiring | **A1-F18AE-460-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | **A1-F18AE-740-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | *This DM would not be used for training because of the reference to technical directives.*<br>*The content is suitable for a reusable technical DM; however, some minor grammatical corrections are recommended, as highlighted below:*<br>Technical directives that change configuration of aircraft components are listed below: |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | changes<br>AYC Accessory Change for mechanical system<br>PPC Power Plant Change for engines | | | |
| | **A1-F18AE-120-100**<br>*Note: The content in section 20 is the same as the content in A1-F18AC-742-100, section 22, except for the highlighted text in the following:*<br>ASC Airborne Tactical Software for operational flight programs | **A1-F18AE-580-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | **A1-F18AE-760-100**<br>*Note: The content is the same as that in A1-F18AC-742-100.* | |
| 18 | **A1-F18AC-742-100**<br>23. Component changes will list part numbers in the effectivities. See AVC effectivity examples in Effectivity Note Example table. | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *This DM would not be used for training because of the reference to effectivities.*<br>*The content is suitable for a reusable technical DM.* |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | |
| 19 | **A1-F18AC-742-100**<br>24. **RECORD OF APPLICABLE TECHNICAL DIRECTIVES.**<br>25. The technical directives affecting this manual are listed in the Record of Applicable Technical Directives of each affected work package. Because an ASC directs all aircraft be modified within 30 days, | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *This DM would not be used for training because of the references to the manual and the technical directives.*<br>*The content is suitable for a reusable technical DM; however, some minor grammatical corrections are recommended, as highlighted below:* |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| | ASC's are not listed. When all affected aircraft are modified, the before configuration is removed from the manual, and the technical directive entry is removed from the Record of Applicable Technical Directives. | | | The technical directives affecting this manual are listed in the Record of Applicable Technical Directives of each affected work package. Because an ASC directs all aircraft be modified within 30 days, ASCs are not listed. When all affected aircraft are modified, the before configuration is removed from the manual, and the technical directive entry is removed from the Record of Applicable Technical Directives. |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | |
| 20 | **A1-F18AC-742-100**<br>26. **TECHNICAL PUBLICATIONS DEFICIENCY REPORT (TPDR).**<br>27. The TPDR (OPNAV FORM 4790/66) is the form for reporting errors and suspected omissions in the technical manuals. The TPDR WP lists the TPDR's that are included in the current issue of the manual.<br>28. TPDR reporting procedures are in OPNAVINST 4790.2 SERIES. | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *This DM would not be used for training because of the references to the manuals.*<br>*The content is suitable for a reusable technical DM; however, some minor grammatical corrections are recommended, as highlighted below:*<br>The TPDR (OPNAV FORM 4790/66) is the form for reporting errors and suspected omissions in the technical manuals. The TPDR WP lists the TPDRs that are included in the current issue of the manual. |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
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| 21 | **A1-F18AC-742-100**<br>29. **DIAGRAMS.**<br>30. Simplified schematics and block diagrams are in this manual. System schematics are in A1-F18A( )-( )-500 series manuals. | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *This DM would not be used for training because of the references to the manual.*<br>*The content is suitable for a reusable technical DM; however, some minor grammatical corrections are recommended, as highlighted below:*<br>Simplified schematics and block diagrams are in this manual. System schematics are in A1-F18A( )-( )-500-series manuals. |
| | **A1-F18AE-120-100**<br>*Note: The content is the same as that in A1-F18AC-742-100, except that the paragraphs are numbered differently.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | |
| 22 | **A1-F18AC-742-100**<br>31. **NAVY (AN) STANDARD/COMMON NAME NOMENCLATURE.**<br>32. When an item has both Navy (AN) standard and common name nomenclature assigned, the common name nomenclature will be used in text and on illustrations. Full Navy (AN) standard nomenclature will be used in the Illustrated Parts Breakdown (IPB). | **A1-F18AE-460-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-740-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | *Dual-purpose DM with grammatical corrections as highlighted below:*<br>**NAVY (AN) STANDARD/COMMON NOMENCLATURE.**<br>When an item has both a Navy (AN) standard and a common name, the common name will be used in text and on illustrations. The Illustrated Parts Breakdown (IPB) will use Navy (AN) standard nomenclature.<br>*Note: The word "nomenclature" can refer to either a single name or a system of naming. To use it with the word "name" is redundant.* |
| | **A1-F18AE-120-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-580-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | **A1-F18AE-760-100**<br>*Note: The corresponding content is the same in all 6 manuals, except for the paragraph numbering in A1-F18AE-120-100.* | |
| 23 | **A1-F18AC-742-100**<br>33. **MANUAL REFERENCES TO** | **A1-F18AE-460-100**<br>*Note: The content—including the list of references—is the same* | **A1-F18AE-740-100**<br>*Note: The section entitled "MANUAL REFERENCES TO* | *This DM would not be used for training because of references to the manuals.* |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
|---|---|---|---|---|
| | **IETM.**<br>34. The manuals listed below have been converted into an Interactive Electronic Technical Manual (IETM) format. When an IETM is available, all references to the manuals below should be directed to the IETM.<br>*Note: The paragraph above is followed by a list of references.* | *as that in A1-F18AC-742-100.* | *IETM" is not included in this manual.* | *The content is suitable for a reusable technical DM even though it does not have across-the-board reusability.* |
| | **A1-F18AE-120-100**<br>*Note: The section entitled "MANUAL REFERENCES TO IETM" is not included in this manual.* | **A1-F18AE-580-100**<br>*Note: The section entitled "MANUAL REFERENCES TO IETM" is not included in this manual.* | **A1-F18AE-760-100**<br>*Note: The content—including the list of references—is the same as that in A1-F18AC-742-100.* | |
| 24 | **A1-F18AC-742-100**<br>**Figure 1. Schematic Highlights (Sheet 1)** | **A1-F18AE-460-100**<br>**Figure 1. Schematic Highlights (Sheet 1)**<br>*Note: The figure is the same as that in A1-F18AC-742-100.* | **A1-F18AE-740-100**<br>**Figure 1. Schematic Highlights (Sheet 1)**<br>*Note: The figure is the same as that in A1-F18AC-742-100.* | *This figure would be repurposed for training.*<br>*The current figure (except for the one shown in A1-F18AE-120-100) is suitable for inclusion as a reusable graphic in S1000D.* |
| | **A1-F18AE-120-100**<br>**Figure 1. Schematic Highlights (Sheet 1)**<br>*Note: The figure is the same as that in A1-F18AC-742-100 except that there is additional information in the right column of the block for Output Device (highlighted below):*<br>LEFT AND RIGHT DIGITAL DISPLAY INDICATOR LEFT AND RIGHT DIGITAL DISPLAY INDICATOR 1P-1317/A | **A1-F18AE-580-100**<br>**Figure 1. Schematic Highlights (Sheet 1)**<br>*Note: The figure is the same as that in A1-F18AC-742-100.* | **A1-F18AE-760-100**<br>**Figure 1. Schematic Highlights (Sheet 1)**<br>*Note: The figure is the same as that in A1-F18AC-742-100.* | |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
|---|---|---|---|---|
| 25 | **A1-F18AC-742-100**<br>**Figure 1. Schematic Highlights (Sheet 2)** | **A1-F18AE-460-100**<br>**Figure 1. Schematic Highlights (Sheet 2)**<br>*Note: The figure is the same as that in A1-F18AC-742-100.* | **A1-F18AE-740-100**<br>**Figure 1. Schematic Highlights (Sheet 2)**<br>*Note: The figure is the same as that in A1-F18AC-742-100.* | *This figure would be repurposed for training.*<br>*The current figure (except for the one shown in A1-F18AE-120-100) is suitable for inclusion as a reusable graphic in S1000D.* |
| | **A1-F18AE-120-100**<br>**Figure 1. Schematic Highlights (Sheet 2)**<br>*Note: The figure is the same as that in A1-F18AC-742-100 except for a symbol variation in the NO. 2 CIRCUIT BREAKER PANEL ASSEMBLY block:*<br> | **A1-F18AE-580-100**<br>**Figure 1. Schematic Highlights (Sheet 2)**<br>*Note: The figure is the same as that in A1-F18AC-742-100.* | **A1-F18AE-760-100**<br>**Figure 1. Schematic Highlights (Sheet 2)**<br>*Note: The figure is the same as that in A1-F18AC-742-100.* | |
| 26 | **A1-F18AC-742-100**<br>**Figure 1. Schematic Highlights (Sheet 3)** | **A1-F18AE-460-100**<br>**Figure 1. Schematic Highlights (Sheet 3)**<br>*Note: The figure is the same in all 6 manuals.* | **A1-F18AE-740-100**<br>**Figure 1. Schematic Highlights (Sheet 3)**<br>*Note: The figure is the same in all 6 manuals.* | *This figure would be repurposed for training.*<br>*The current figure (except for the one shown in A1-F18AE-120-100) is suitable for inclusion as a reusable graphic in S1000D.* |
| | **A1-F18AE-120-100**<br>**Figure 1. Schematic Highlights (Sheet 3)**<br>*Note: The figure is the same in all 6 manuals.* | **A1-F18AE-580-100**<br>**Figure 1. Schematic Highlights (Sheet 3)**<br>*Note: The figure is the same in all 6 manuals.* | **A1-F18AE-760-100**<br>**Figure 1. Schematic Highlights (Sheet 3)**<br>*Note: The figure is the same in all 6 manuals.* | |
| 27 | **A1-F18AC-742-100**<br>*Note: The items in the alphabetical index are not listed either alphabetically or in the sequence that they appear in the manual.*<br>**Reference Material**<br>None<br>**Alphabetical Index**<br>**Subject Page No.**<br>Nonstandard Abbreviations, | **A1-F18AE-460-100**<br>*Note: There is no corresponding content in this manual.* | **A1-F18AE-740-100**<br>*Note: The content shown below is similar to that of A1-F18AE-120-100, except it references schematics instead of illustrations.*<br>**Reference Material**<br>None<br>**Alphabetical Index**<br>**Subject Page No.** | *The table and figure in this DM would be repurposed for training.*<br>*The current content (except for what is shown for A1-F18AC-742-100) is suitable for reusable technical DMs, even though they do not have across-the-board applicability.*<br>*It seems that there should be two technical* |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
|---|---|---|---|---|
| | Table 1..... 1<br>Introduction ..... 1<br>Nonstandard Symbols, Figure 1..... 5<br>**Record of Applicable Technical Directives**<br>None<br>1. **INTRODUCTION.**<br>2. This work package supports all schematics contained in this manual.<br>3. Table 1 contains nonstandard abbreviations used on the schematics in this manual.<br>*Note: There is no paragraph 4 corresponding to paragraph 4 in A1-F18AE-580-100, which refers to Figure 1, in spite of the fact that Table 1 is followed by Figure 1, Nonstandard Symbols.* | | Introduction ..... 1<br>Nonstandard Abbreviations, Table 1..... 1<br>Nonstandard Symbols, Figure 1 ..... 9<br>**Record of Applicable Technical Directives**<br>None<br>1. **INTRODUCTION.**<br>2. This work package supports all schematics contained in this manual.<br>3. Table 1 contains nonstandard abbreviations used on the schematics in this manual.<br>4. Figure 1 contains the nonstandard symbols used in this manual.<br>*Note: The content in the table and the figure differs from that shown in the other manuals.* | *DMs—one having to do with schematics and the other with illustrations.* |
| | **A1-F18AE-120-100**<br>*Note: There is no corresponding content in this manual.* | **A1-F18AE-580-100**<br>**Reference Material**<br>None<br>**Alphabetical Index**<br>**Subject**<br>**Page No.**<br>Introduction ..... 1<br>Nonstandard Abbreviations, Table 1..... 2<br>Nonstandard Symbols, Figure 1 ..... 3 | **A1-F18AE-760-100**<br>*Note: The corresponding content in this manual is the same as that shown for A1-F18AE-580-100. However, the content in the associated table and figure are different.* | |

| DM | Technical Manuals<br>A1-F18AC-742-100<br>A1-F18AE-120-100 | Technical Manuals<br>A1-F18AE-460-100<br>A1-F18AE-580-100 | Technical Manuals<br>A1-F18AE-740-100<br>A1-F18AE-760-100 | Proposed DM |
|---|---|---|---|---|
| | | **Record of Applicable Technical Directives**<br>None<br>1. **INTRODUCTION.**<br>2. This work package supports illustrations contained in this manual.<br>3. Table 1 contains nonstandard abbreviations used on the illustrations in this manual.<br>4. Figure 1 contains nonstandard symbols used in this manual.<br>*Note: The content in the table and the figure differs from that shown in the other manuals.* | | |

# Appendix D

Advanced Distributed Learning (ADL) SCORM 20004 Conformance Test Log

**Advanced Distributed Learning (ADL)**

**Sharable Content Object Reference Model (SCORM®) 2004**

**Conformance Test Suite Version 1.3.3**

**Self Test Log**

Current Operating System "Windows XP - SP 2" Supported

WARNING: Current Java Run-Time Environment "1.5.0_06" NOT Supported

Current Browser "Microsoft Internet Explorer 6" Supported

Test Identification Information:
Date: Thursday, June 15, 2006 1:05:53 PM
Content Package Product: AEGIS Learning Content Sample
Content Package Version: 1.0
Content Package Vendor/Developer: IDSI

**********

The Content Package test has initiated.

It may take a few moments to begin logging messages, please be patient.

**********

**********

Content Package Test Conformance Summary

Testing Against the Content Aggregation Application Profile

The manifest is well-formed

File(s) Required For XML Parsing found

The manifest is valid against the controlling documents

The manifest is valid against the SCORM Application Profiles

The manifest does NOT contain extensions

Click here to view complete manifest test log (Link inactivated)

**********

========== Metadata Testing ==========

Testing for metadata found within package will be performed here

========== Metadata Testing ==========

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of ITEM-A67C14DE-D67E-1A86-6843-06AC97E81AFE

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-79A1655F-5863-BB18-AB1C-C157841130D6

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-7FAD641F-77BF-A33F-C362-669A3BD4B0D4

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-B91274A8-824B-1D52-4DA6-9899038617F9

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-DA4D8BE4-92C9-8F7F-58A7-9689945113B3

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-A27A1863-E493-49C0-DC8E-C3924DED1B25

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-643BE8D1-223B-

9A3D-E39D-35C48569E171

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-90B69843-5E66-F503-C0E5-145B0BBC679C

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-45E27BA6-0C32-DC26-BE6E-15A1324E57E3

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-55AA4A96-0C80-1448-4519-437F433D3E81

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-4324F57D-5E47-1267-0C99-6868BB2E7CD4

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-8E38BA93-8DA4-B4AE-3161-E81F9ED93F6D

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-62BC3E60-86A1-AD61-6AB2-97159D37C733

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-8B0A35F5-29EC-38A3-E0A3-00C55DB0B8ED

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-10441B2E-49DC-3AB6-6327-B95B2EE54A00

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-DCF99A5C-E9F4-1198-F829-603555195B24

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-290F81BB-8365-7DE8-F5D9-7E0B716DE65E

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-484DDDB0-95FA-

3331-601C-43AE18BB87F1

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-0A896F6A-C85E-56DA-BD77-D6FC29913EE5

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

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Testing Metadata with location of inline and parent identifier of RES-75FB019C-3C59-FCE8-7BBC-44FF7750DD8C

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-993F51A3-052C-7C90-1AA4-AA09438E2BFC

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-0D3F0BE3-2544-FE05-B838-D1AEB9CC574C

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-688E211B-B284-5043-7124-668779DE0DE4

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

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Testing Metadata with location of inline and parent identifier of RES-86BA1A0D-5B61-DDDF-1DF8-D79DBE7F7D5E

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

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Testing Metadata with location of inline and parent identifier of RES-688857F0-9A30-A983-4D52-5A9CBC77472C

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-D29ECF3E-0CA8-259E-92B4-C75F772238FD

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-B2E5B1AB-A40F-5DE3-781E-F4E1D8BB577A

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-E86E7917-87F5-A83B-C0B2-C8DA9DF68BD1

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-CB15297C-CFB3-1872-

1E34-1F8718B5A125

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-2267B0DD-99FC-949B-D267-D6D183E6C3CA

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-2F26CD81-B47B-A1C5-E24D-F4A253E02D42

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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**********

Metadata Test Conformance Summary

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Testing Metadata with location of inline and parent identifier of RES-CD465452-D09D-2185-02B3-E15F5FF0AADB

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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**********

Metadata Test Conformance Summary

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Testing Metadata with location of inline and parent identifier of RES-80F29761-3D88-AF18-3E1F-4C6310951550

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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**********

Metadata Test Conformance Summary

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Testing Metadata with location of inline and parent identifier of RES-CD2AC59D-BD1C-7560-41EA-D6C18794E0B3

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-5CAABA7A-9AFE-013E-28E2-641450555522

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-493932AB-73BE-53E9-F14E-9484275D8723

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-D75A79D6-005B-7546-3D43-0843C4C5F0C6

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-47CFD15B-677D-2ADC-8374-FACAE6F2489B

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

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Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-4CA19F8F-2905-8366-A6A8-20EF48B0F213

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-1D8AD344-88DD-

E1E8-A51A-0EE5803004C9

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-5206DD06-8DE4-EDE7-262F-FED21F32300F

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-F83B803B-CF64-77AC-0A0D-298286298498

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-D977D584-73A9-6E04-EE16-F45BDE1ECCA1

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-83D80D1E-052B-8D49-4DA4-E5AB22A9D0A0

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-616C2B3E-8CC3-533B-B827-828C4633C70E

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-DA3DE163-6FE8-40C2-D79A-0CE4A3E17D55

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-5D7165D3-45AC-A3C9-1B2C-341FD2F36090

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-B57EA7D5-5364-8100-ECFE-9878FAEC46E5

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-DB224F19-73ED-F441-5518-74E1E2A7041D

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-657618E9-8815-9C88-C695-86CA85B69552

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-AAFBB1D0-A475-

58E9-BAE6-04BEE52900A5

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-A694C5ED-CD8D-F7BF-C73B-6304C39D89F6

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-92B25210-A5A0-C044-7BD6-562E4DEE7E7C

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-A4847066-9E1A-4489-C8D2-5B5CFC090255

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-A0CD1320-7652-6C41-1DBF-CBA245C6BEEA

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-33D10708-0E0C-CB66-F6C5-8DC26654E98B

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-087EC890-353C-098F-031D-12B0E0D0620F

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-486BE19E-D246-2139-1EF1-2B993CE337F8

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-66BE5CF7-3F69-14D4-7538-83FFA268B414

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-E816FA10-FE93-49ED-F97C-63113CE5B08D

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-99C38FA9-E7D3-D3B8-501D-F3BF381C0438

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-54B1E9A8-BA35-

7EA4-00A9-7C45E329146B

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-BEB0A7F7-1151-BD23-BC8D-5EDA9D652EB0

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-7395D7C7-D200-2AA0-66AB-6AC01572419E

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-2A72DDB7-CCA6-BADD-A01D-70A697E86BBB

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-50BC647E-D435-9871-387C-A13367A4E2CC

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

**********

Metadata Test Conformance Summary

**********

Testing Metadata with location of inline and parent identifier of RES-A70DF499-2CDD-DC0B-61D1-220CA7698C75

The metadata is well-formed

The metadata is valid against the controlling documents

The metadata is valid against the SCORM Application Profiles

The metadata does NOT contain extensions

Click to view detailed metadata test log (Link inactivated)

**********

========== SCO Testing ==========

Testing for SCOs found within package will be performed here

========== SCO Testing ==========

Test Identification Information:
Date: Thursday, June 15, 2006 1:08:01 PM
SCO: C:\Documents and Settings\Administrator\My Documents\IDSI\NavSEA_CBT\A-Harold-ASC_Content\AEGIS\finals_frm_ah\index.htm

**********

Loading the Sharable Content Object

This may take a few minutes, please be patient.

**********

Click here to view complete SCO test log (Link inactivated)

Attempting to Launch SCO

C:\Documents and Settings\Administrator\My Documents\IDSI\NavSEA_CBT\A-Harold-ASC_Content\AEGIS\finals_frm_ah\index.htm

**********

SCO Summary

**********

Features Supported:

API Support

Find an LMS provided API Adapter

Session Methods:

Initialize()

Terminate()

Data Transfer:

None Supported

Support Methods:

None Supported

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SCORM Conformance Category:

The Content Package is CP CAM 1.3.1 Conformant

The Content Package is CP RTE 1.3.1 Conformant

Overall Conformance:

The Content Package is SCORM 2004 Conformant, according to Conformance Test Suite

Version 1.3.3

Successful outcome of this test does not constitute ADL Certification unless the test has been conducted by an ADL Certified Auditor.