Among several on-going developments by IATA and the Air Transport Association, Spec 2500 has been conceived to standardise the maintenance data exchanged between two airlines at an aircraft transaction. The need for this standard, the basis of its structure, and the implications for its use are examined.

ATA Spec 2500: Its purpose, development and the implications for its use

ATA Spec 2500 has been developed by the Air Transport Association (ATA) to provide a set of data and information format standards for the transfer of aircraft maintenance, component configuration and technical records in a standardised electronic format. Its aim is to make transitioning aircraft between operators and their maintenance and engineering (M&E) systems a smooth and timely process.

The traditional process of transferring aircraft from one operator to another involves several boxes of paper or a mix of electronic technical and paper records. With no uniform format or consistent standard for presentation of these documents, examining them takes several months. ATA Spec 2500 outlines the standards for data and information relating to aircraft's maintenance status.

Aircraft data & records

There are seven main groups of information for used aircraft that a prospective aircraft buyer and operator needs to assess.

The first is a covering letter describing the contents of information enclosed.

Next are the six groups of information relating to maintenance and technical records for the prospective operator to examine: i) the aircraft's asset status and its maintenance records, with respect to total flight hours (FH) and flight cycles (FC), the serial numbers (S/Ns) of the engines installed, and the aircraft's age; ii) a list of last done and next due maintenance tasks described in the aircraft's approved maintenance programme (AMP); iii) the aircraft's repair damage status; iv) the aircraft's technical records for its component configuration and the installed components; v) the aircraft's technical records for modifications performed in relation to service bulletins (SBs), engineering orders (EOs) and supplemental type certificates (STCs); and vi) the technical records relating to airworthiness directives (ADs) performed on the aircraft.

Within these seven groups of information, there are many elements, none of which have a standardised format or structure for describing them. Most airlines have devised their own systems for describing technical information such as maintenance task and component part numbers (P/Ns), and the physical location of a maintenance task performed on an aircraft, so there are many differences between airlines in how the same item is recorded in an M&E system.

"Not only does this lack of standardisation make examining the aircraft's technical data and information difficult, it also means that data for an aircraft cannot simply be lifted from one M&E system and transferred to another, followed by an immediate operation of the aircraft by a new airline," says Chris Reed, managing director at Trax.

There are two main issues relating to aircraft technical data. "The first is the structure and the second is the content," says Barend van de Vrande, vice president of product management, implementation and support at Aerosoft Systems. "The purpose of Spec 2500 is to standardise the structure of aircraft technical data, not the content. The structure refers to the standard and format of items such as numbering or description systems for P/Ns, S/Ns, and maintenance task numbers."

The content of data refers to several things. This is basically what is included in the crate. There is no defined order of information that is included, it is only required to be included. Although there is a list of what has to be included in the 'crate' of information, the collection of information is not provided and collated in any defined order. This is almost unique to very airline. Although Spec 2500 does not standardise the content, it recommends ways to standardise it.

Structural differences

There are several differences between airlines in the structure of data and information that make aircraft transitions complicated and time-consuming.

"One example is the arrangement of maintenance tasks in the airline's AMP," says Reed. "An airline may combine several maintenance planning document (MPD) tasks or sub-tasks into a single task; while another can split a single MPD task into several sub-tasks. This results in different numbering systems to list these. A second and related example of differences is that some airlines will require a single signature for a task with several steps or sub-tasks, while others require a signature for each step and sub-task."

A second example is the date format of maintenance tasks. Europe mainly uses the system of day-month-year in two, two and four digits, while the US uses the system of month-day-year in two, two and four digits. Some parts of the world use the systems of year-month-day or

The need for Spec 2500 data standard is to standardise the data exchange between two airlines' M&E systems during the process of an aircraft transaction. Once implemented and adopted, data can be taken form one M&E system and transferred into another M&E system. This saves several weeks of manually reviewing data. This does not, however, remove the need to audit the information.

year-day-month, both with four, two and two digits. An airline in Europe, for example, will have its maintenance planners and mechanics recording the date of maintenance tasks in the day-month-year format. If the airline is transferring an aircraft to a region of the world with a different date recording system, its maintenance records would have to be reformatted so that their dates fit with the culture of the new operator.

"There are also large differences in the numbering systems of maintenance tasks, P/Ns and S/Ns of aircraft and components," says Reed. "Some airlines will only list their unique maintenance task numbers in their M&E systems, while others will list both their unique and standard maintenance task numbers from the MPD."

In addition to the issues relating to maintenance and configuration, there are many that relate to maintenance performed being recorded in non-standardised formats. "The physical location of a maintenance task is one example, and the description of a finding is another," says Wayne Enis, vice president Middle East at Flatirons Solutions. "This could be something such as a crack or corrosion, or the units used for measurements."

In the case of the physical location of a maintenance task, the standard system to describe this has been to use the aircraft maintenance task oriented support system (AMTOSS) code. This is based on the ATA Chapter system, but only describes the zone of the aircraft to which the task relates. An AMTOSS code has a two-two-two-three digit format. The first pair of digits refers to the main chapter, which describes the system or section of the aircraft. Examples are 53 for the fuselage, 54 for the engine nacelles and pylons, 57 for the wings, and 73 for engine fuel controls mounted on the outside of the engine.

The second pair of digits refers to the section of the ATA chapter, while the third refers to the particular component or structure to which the maintenance task relates. Tasks in the aircraft maintenance manual (AMM) have an additional three digits to indicate the type of task being performed, such as a visual inspection or a lubrication.

While the AMTOSS code describes the type and zone of that task, it does not provide a system to accurately describe the exact physical location. It is up to each airline to devise its own system, so there are differences between airlines. These are compounded by the fact that airlines have different fields in their M&E systems to describe location.

Other differences between airlines include: the numbering or naming system used to describe non-aircraft parts, including consumables such as fluids and greases; the systems for describing a mechanic's skills and licensing details; the intervals for component removals, and the remaining intervals for fixed-life components, which can be in FH, FC and calendar time; and references to component repair certificates.

The development by each airline of its own descriptions for maintenance tasks and parts, and the large number of items associated with maintenance tasks, mean that each carrier has its own unique system for keeping an aircraft's technical records. There will be different fields and numbers of fields to describe maintenance-related items, as well as unique fields for unique items. This leads to large differences in the structure of maintenance information between airlines for the same aircraft type, even where an airline disposing of an aircraft has the same M&E system as the new operator.

There are also differences between M&E system databases, and therefore the ability to cope with different structures.

"Overall, this means that without standardisation, the transfer of data from airline A to airline B will result in data being lost, because there are insufficient fields to capture all the data that airline A has; and with data going from airline B to airline A, A will have empty fields in its M&E system because airline B will have fewer data fields and less detail than airline A, and consequently there will be incomplete information and data," explains Reed.

The third main issue that Spec 2500 is intended to address is M&E systems' lack of functionality to collate all the seven groups of information, and prepare them for transfer to the correct fields in another operator's M&E system.

Aircraft transition

Spec 2500 is intended to standardise the structure of data to simplify the process of data transition, and also to make all the data comprehensible and easy to analyse. In its simplest form, the transfer of data from airline A to B, or from B to A will be a process of taking data from one set of fields in an airline's M& system, and dropping it into the same set of fields in the other carrier's M&E system.

"Under the current system, it can take two to four months for an airline to collate all the data needed to complete the transfer 'crate'. The most difficult elements are long-term maintenance records, examining physical records, determining the aircraft's component configuration, determining the status of every SB and AD issued against the aircraft, and examining the certification records for every component repair," says Enis. "It can then take several more

An aircraft transaction requires engineers to manually audit a large volume of technical data and maintenance records. This is because there is no standard for a large portion of the data that has to be examined. Spec 2500 will standardise data and information standards. This will allow easy flow of data to new IT systems, and ease the audit process.

weeks for a new operator to analyse, examine and input the data into its M&E system. The large number of differences in data structure means that a lot of data must be manually keyed into the new M&E system. Spec 2500 will reduce the collection and collation of data to just a few hours, and will reduce the import of data into a new M&E system from several weeks to a few days. The potential cost savings are therefore substantial."

This is especially the case for lease rentals generated by the aircraft for a lessor, and revenues that can be generated while the aircraft is operational. Spec 2500 has largely been pushed by the aircraft lessors. The time-related savings that relate to collecting, collating, transferring and uploading the data are alone expected to generate savings of $250,000.

"Although Spec 2500 will make the collation, downloading, and uploading of data faster, engineers will still need to analyse and review it," says Mark Martin, director, commercial operator product line, aerospace & defence business unit, at IFS. "In reality, collating and transferring the data between M&E systems is only part of the problem. It is the M&E systems' utilisation of Spec 2500 that should simplify the aircraft transition process, save time, and eliminate the need for engineers to validate the data.

"In addition to whole aircraft transitions, Spec 2500 is also useful for the change in ownership of records when items, such as large rotables and components, are repaired, or when engines are sold," says Martin. "It may also gain traction when major assemblies and large components and engines are sub-contracted out by airlines for repair and overhaul. This is especially important since in these circumstances many components and parts are removed, and replaced or repaired."

Spec 2500 standards

Spec 2500 has been developed by the e-Business Program division of the ATA. Besides defining the purpose of Spec 2500 and outlining the main objectives, ATA has defined the standards for the specification of aircraft maintenance data and information.

The standards that have been developed require the data to be written and held in the M&E systems in extensible mark-up language (XML), to provide the content with intelligence. The use of XML will allow M&E systems to have conversion tables and algorithms to convert existing data into the standardised format.

In addition to information in text and numerals, pictures will also have to be kept in the case of some maintenance records. The XML language provides the ability to have links between a maintenance record and a related picture, so there can be links between the XML data and a pdf document or picture where relevant. Examples of the need to include pictures are fire-resistance certificates for certain materials in the aircraft interior. Items like this do not have maintenance tasks in the MPD.

The ATA Spec 2500 document is published in PDF format, and is available for airlines, M&E system vendors, and aircraft technical records specialists to use. Sections of the document detail the structure standards of the information in the crate of data transferred in an aircraft transaction.

As described, there are seven main elements of the crate of information. These are the description of the contents, plus six main groups of information.

The first of these is high-level header information that describes in detail the six main groups of information being transferred.

Aircraft asset status

The second group of information is a detailed document that lists the aircraft's asset status. This is in chapter 10 of the ATA Spec 2500 document.

This information includes the aircraft's S/N, registration and items such as the specification weights. It also lists the S/Ns for the main components that include the landing gear legs and the engines, and the total accumulated FH and FCs for the aircraft.

ATA Spec 2500 has tables that define the standard for certain types of information. The first sections of the document list the data type and number of characters that are used to describe the aircraft manufacturer's code, its name, the aircraft's S/N, the aircraft model identifier and several other elements. As an example, the aircraft manufacturer's code is fixed at five characters. The manufacturer's name has from one to 55 characters. Some elements are limited to digits or letters only, while others use an alphanumeric code.

The aircraft's detailed status includes more than 25 elements covering information relating to the aircraft's engine and installed components.

The next section of standards defined are elements that all relate to technical documents and manuals. These standards are used in all of the six sections of data.

The document and manual standards and specifications include document source and number; the various elements of the document numbering system that include the chapter, section, task, figure, sheet and items. They also define the standard for describing the type of document, the aircraft type it refers to, the document's revision number, and the document's revision date, and its URL for accessing it electronically. Many of these are a relatively small number of digits, such as the document chapter and section number. The URL has up to 1,000 characters.

There are also standards defined for the number of aircraft FH and FC, and calendar time.

Maintenance status & tasks

The third main group of information is a summary of the aircraft's maintenance status. This is provided in the form of a list of last done and next due maintenance tasks. This is described in chapter 8 of ATA Spec 2500.

The previous operator will have had the aircraft on an AMP, which includes a combination of MPD tasks issued by the aircraft manufacturer, and its own customised maintenance tasks. As each of these tasks are performed, using either a paper-based or an electronic task card system, a signed paper maintenance record or digitally-signed electronic maintenance record that appears on screen as a paper record, is generated. A complete set of all paper or electronic maintenance records can therefore be provided to the new operator. Paper records will be scanned, and later searched with optical character recognition (OCR) equipment for retrieval of completed maintenance tasks. From this, a set of records could be generated for the performance of the last of each task listed in the aircraft's AMP. These records will have to be reviewed manually to gather all the required information.

A prospective operator for the aircraft needs to determine when each of the MPD tasks and some of the previous operator's own tasks were last performed. This will then determine the aircraft's maintenance status, and produce a list of 'last done' and 'next due' maintenance tasks.

There are several pages in ATA Spec 2500 that describe the standards and specification of a large number of elements relating to maintenance tasks. The first of these include maintenance description, maintenance record number, the airline's internal tracking number, and the type of compliance the task relates to. The number and type of characters permitted in these elements is described.

There is also a lot of detailed information provided for the standards and specifications related to the description of the physical location of a maintenance task. This includes location description, which has a maximum of 100 characters to describe it. An example would be a lower fuselage skin inspection aft of the forward cargo door. Related information is a coordinate system to describe a physical location on the aircraft structure, and a group of elements used to identify a location by reference to a nearby structural member. This includes several sub-structural members that are the fuselage frame number, the wing rib number, the wing spar number, and the airframe stringer identifier.

Another element of maintenance task location description is a zone and panel description. An example will be the main landing gear well. Up to 30 characters are used to describe the particular zone and panel. Five letters are used to describe the side of the aircraft, and seven are used to describe if the location is inside or outside of the aircraft.

Other elements of maintenance tasks that have been standardised are units of measurement, and the number of decimal places. There is also a group of elements

that describes the type of measurements being taken, including length, width, depth, diameter and direction.

A set of standards or specifications is also required to define findings, defects, and non-routine rectifications as a result of routine tasks and inspections.

Another group of elements relates to standards for compliance status, maintenance record number, and compliance task type. There is also a group of elements that relates to parts information.

Repair & damage status

A third main element of the crate of technical information would be the aircraft's repair damage status or 'dent and buckle' record. This is described in chapter 7 of ATA Spec 2500.

This documents all physical damage incurred by the aircraft, including the position and nature of the damage, and a record of the repairs made over the aircraft's life history.

The 'dent and buckle' record for the aircraft includes a comprehensive chart of all physical repairs made to the aircraft, and links to a large number of pictures. It also has links and references to the structural repair manual (SRM).

This section of the 'crate' of information clearly includes a lot of pictures and images.

Component configuration

Chapter 9 of ATA Spec 2500 describes the fourth main element of the crate of maintenance and technical records. This comprises data relating to the aircraft's rotable and repairable components, such as their configuration, P/N and S/N, and installation position. Other related information include the component installation date, and the aircraft's total accumulated FH and FC since that date. From this, the FH and FC that each component has accumulated since installation can be determined at the time of the aircraft's transition.

ATA Spec 2500 have standardised methods for describing components in M&E systems, including P/N, part manufacturer's code, part description, part S/N, and airline S/N.

SB, EO & modification status

The fifth main element of aircraft technical records comprises all relevant information relating to the SBs, EOs, STCs, and modifications performed on the aircraft during its lifetime. This is described in chapter 6 of ATA Spec 2500.

SBs are modifications issued by the original equipment manufacturer (OEM). These are issued to all operators of a type, and start from its entry into service and continue as long as some remain in operation. Some SBs are incorporated on the production line as they are issued. All standalone SBs are voluntary. Later-built aircraft therefore have an improved configuration and build status compared to older aircraft that did not have the modification incorporated on the production line, and had it incorporated later by the operator.

EOs are internal airline modifications that have been designed and then incorporated on the aircraft. They include items such as the installation of premium-class seats with electronic controls, or the installation of an in-flight entertainment (IFE) system.

STCs are modifications that affect the operational safety of the aircraft, and have been approved by regulatory authorities.

These three categories of modifications are therefore all voluntary, so they may or may not have been incorporated on the aircraft. This element of technical records will thus inform the new operator about the aircraft's status.

Like the repair and damage status, this section of the crate of technical data will have a large number of references to pictures.

AD status

The sixth and final element of the technical records crate is all information

relating to ADs. This is described in chapter 5 of ATA Spec 2500.

ADs are issued by regulatory authorities, and so are mandatory. Some are simply inspections, while others include modifications detailed in SBs. The main complication of ADs is that they involve several steps, which can be performed over an extended calendar period or number of aircraft FH and FC.

The exact status of each AD issued with respect to the aircraft type has to be known. First, this relates to the aircraft's line number (L/N) or S/N, since an AD will only apply to some of the aircraft built, rather than the entire production line. The AD may also have been issued in relation to a particular engine type or variant used on the aircraft. The extent to which the AD has been complied with also has to be known and determined.

ATA Spec 2500 has a group of elements related to ADs. This will be an AD status report.

This includes a standard to describe the regulatory authority issuing the AD; and the AD number, which has a maximum of 50 characters. There is also a standard to produce a unique identifier for the related AD datapoint or document, and a standard to describe the source document. This is assigned to the unique identifier. Other related information that requires standard specifications includes the work done, the work still due, the maintenance intervals, and the work order reference used for the inspection.

M&E systems

M&E systems will have to be adapted so that they have all the relevant fields and use the correct standards and specifications for every element in ATA Spec 2500. In addition, M&E systems will need to have the functionality to collate and download all the data into the aircraft transition crate, as well as upload it. The main onus is on the vendors of M&E systems to develop their systems to cope with the standard.

Although Spec 2500 is not mandatory, and is only recommended by the ATA, it is being pushed by the aircraft lessors which have a lot of persuasive power. "We believe the use of Spec 2500 will begin to gain traction as aircraft lessors start to require airlines to return aircraft off lease and their accompanying data in Spec 2500 format," says Martin. "This should be a translation activity for most M&E system vendors. Developing the functionality for M&E systems to ingest Spec 2500 data will require more effort, and demand for this is likely to lag a bit."

In addition to these developments, the aircraft, engine and component OEMs are all now starting to deliver aircraft with at least some of the data and information elements in the ATA Spec 2500 standards and specifications. Component data in Spec 2500 standard in particular is being provided with new aircraft deliveries.

In parallel to Spec 2500, the ATA is developing other data standards. One standard under development, and about 18 months behind Spec 2500, is ATA Spec 2000, Chapter 18. The objective of this is to provide a standard and specification for data in the maintenance workpackage, which can be transferred from an aircraft operator's M&E system to a maintenance provider's M&E system in preparation of task cards for an aircraft maintenance check. This will either be with traditional paper task cards, or electronic task cards using tablet devices. This standard will enable the smoother transfer of data from the operator to the maintenance provider, and back to the operator after maintenance completion. This system will save engineering staff a lot of time in changing the data using exchange algorithms *(see The complexities of data transfer between M&E & CMS systems, Aircraft Commerce, December 2014/January 2015, page 40).* AC