AMC

A Publication for the Avionics Maintenance Conference

PLANE TALK®

January 2006

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IN THIS ISSUE

Notice

The material in *Plane Talk*® is meant only as general information. In all cases no maintenance action published in *Plane Talk*® should be taken that is not in consonance with your particular company's operating and maintenance procedures, your approved maintenance manuals, or your certification agency's directives.

ARINC

AERONAUTICAL RADIO, INC.

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AMC News

Avionics Maintenance Conference
April 3 - 6, 2006
Hotel New York
Paris, France

Hosted By

AIR FRANCE THALES EADS TEST & SERVICES

AMC Questions – Due January 12, 2006

For those airline and vendor representatives who have not completed the task of gathering questions form the various groups within your organization, please take notice, you now have less than one month. The AMC Discussion Item Form may be downloaded at http://www.arinc.com/amc/upcoming. To ensure that your questions are included in the upcoming meeting, they must be submitted to the AMC Staff on or before January 12, 2006.

PLANE TALK – Subscription Renewal

Your subscription to PLANE TALK is scheduled to expire with the March 2006 issue. In order to continue receiving PLANE TALK please renew your subscription by February 16, 2006, using the Renewal Form on page 1. The Renewal Form may also be accessed at www.arinc.com/amc.

Plane Talk® Subscription Request/Renewal

This subscription expires with the March issue. Please mark the appropriate box (or boxes) and fax this form to +1 410-266-2047 by **February 16, 2006**. You may also subscribe online at the AMC home page at **www.arinc.com/amc/plane_talk/subscription_form.html**. Failure to return this form will result in removal from our mailing list.

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AMC News

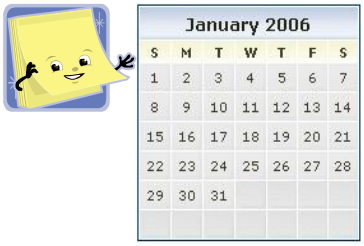
AMC Follow-Up Items

The responses to most AMC discussion items result in a solution being accepted and the discussion item being closed. When discussion items need further action by one ore more suppliers, the resolution is published in PLANE TALK®. The following list identifies those discussion items still unresolved at the time of publication of this AMC Report.

For a description of items removed from the follow-up list, refer to appropriate issues of PLANE TALK®.

ITEM	SECTION	SUBMITTER	SUPPLIER	ACTION
04-158	Navigation Systems	Asiana	Rockwell Collins	Asiana to ensure their controller and local regulatory authority understand the nuisance TCAS RA warnings based on Rockwell Collins SIL 05-01
05-136	Navigation Systems	Hawaiian Airlines	Boeing	Boeing to investigate the possibility of a dual heater element for the pitot probe
05-196	Autoflight Systems	TAM	MPC Stork Fokker	Stork Fokker to assist TAM in obtaining a response from MPC
05-210	Flight Controls	Air France	BAE Systems	BAE Systems to provide proposal to standardize Actuator Control Electronics
05-244	Landing Gear	Northwest Airlines	Messier	Messier to provide the requested documentation for the Brake Steering Control Unit
05-264	Electrical Power	Finnair	Acme Boeing	Boeing to resolve the battery charger failures

Airline & Supplier—Final Call for Questions



The 2006 AMC will be held April 3-6, 2006, at the Hotel New York in Paris, France. Before proceeding any further, please mark your calendar:

January 12, 2006—AMC Questions Due

For those airline and vendor representatives who have not begun the task of gathering questions from the various groups within your organization, please make note, you now have less than two months before the deadline.

In order to justify to yourself or your management the importance of AMC; consider the results of over 60 airlines participating in the 2005 AMC:

- Of the 286 questions submitted in 2005, 281 resulted in positive actions taken—that's over 98%.
- Airline representatives walked away with cost reduction ideas valued at over $108 Million.

If you've never attended AMC and are still not convinced, try answering the following:

1. Does your airline have chronic avionics maintenance problems?
2. Would your airline benefit from access to over 60 airlines?
3. Would your airline benefit from access to the key airframe manufacturers?
4. Would your airline benefit from access to over 150 avionics suppliers?

And remember, if your manager is still not convinced that AMC is a must for your organization, bring him or her along!

To submit questions on behalf of your organization, please use the AMC Discussion Form at http://www.arinc.com/amc/upcoming. As a guide for submitting questions, they should fall into one or more of the following categories:

☐ Line Maintenance	☐ Flight Controls
☐ Avionics Management and Philosophy	☐ Engine Systems
☐ Product Support	☐ Fire Detection Systems
☐ Test Systems	☐ Fuel Systems
☐ Air Conditioning Systems	☐ Electrical Power
☐ Communications Systems	☐ Lighting
☐ IFE Systems	☐ Landing Gear
☐ Indicating Systems	☐ Others
☐ Navigation Systems	
☐ Autoflight Systems	

2006 AMC Highlights

- Official Opening – Monday, April 3, 2006 @ 0900

To add to the AMC discussions, the AMC Steering Group is planning a series of one hour symposiums focusing on:

- Monday, April 3, 2006 @ 1520 – Requirements for Instructions for Continued Airworthiness
  Moderated by Mark Sorensen, Northwest Airlines

- Tuesday, April 4, 2006 @ 1520 – New Technology and the Impact on Maintenance
  Moderated by Curtis Martin, American Airlines

- Wednesday, April 5, 2006 @ 1520 – Digital Publications for Future Aircraft
  Moderated by David Nesseler, Air Wisconsin

For the latest details, visit us at http://www.arinc.com/amc/upcoming

- Submit AMC Discussion Items
- Registration and Travel Information
- Supplier Hospitality Information
- AAI Registration

AMC - Registration Information

Important Dates to Remember

Discussion Item Due	January 12, 2006
Begin Program Mailing	February 17, 2006
Volare Nominations Due	February 20, 2006
Hotel Reservation Cut-Off	March 10, 2006
Final AMC Program Mailing	March 17, 2006

How do I register - To register for the AMC, please visit us at http://www.arinc.com/amc/upcoming.

By pre-registering for the meeting, you will automatically be mailed a copy of the AMC Program once it becomes available.

How do I obtain a hotel room - To obtain a hotel room, please visit us at http://www.arinc.com/amc/upcoming.

AMC Hospitality Suites - All AMC hospitality activities will be held at the Hotel New York. Many suppliers wish to meet with customers during AMC. In addition to casual contact during the meeting, many suppliers will use hospitality suites. To maximize the opportunities for contact, attendees are encouraged not to attend functions outside the hotel over the dates of the meetings.

All attendees are invited to visit the hospitality suites!

AAI Exhibit/Reception - The Airline Avionics Institute (AAI) Exhibit/Reception will be held on Tuesday, April 4, 2006, at 1800. Attendance is limited to airline representatives, AAI members, and their guests.

AMC - Supplier Hospitality Information

Hospitality and Events - Many suppliers wish to meet with customers during AMC and are planning hospitality suites to demonstrate their products. To maximize the opportunity for your customers to visit all of the hospitality suites, suppliers are kindly asked to refrain from holding any events, dinners, etc. outside the hotel.

AMC and AAI - The Airline Avionics Institute (AAI) - www.airlineavionics.org is an independent organization of avionics suppliers. AAI is a membership organization with dues and other membership requirements. Although AMC encourages suppliers to join AAI, AAI membership is not required to attend and fully participate in all AMC activities.

AAI Exhibit/Reception - The AAI Exhibit/Reception will be held on Tuesday, April 4, 2006, at 1800. Attendance is limited to airline representatives, AAI members, and their guests only. Phil Wright, AAI's Business Manager, coordinates details of the reception with the hotel. Manufacturers who wish to be included as a sponsor of the Exhibit/Reception should contact:

Phil Wright, AAI
aaiassoc@comcast.net or tel +1 941-313-0471

AMC Hospitality Suites - All AMC hospitality activities will be held at the Hotel New York. AMC blocks several suites for this purpose with the hotel. The suites are assigned on a first come, first serve basis to any supplier. AAI membership is not required to have a suite. Persons desiring a hospitality suite should contact:

Pauline Delzeux, Disney Business Solutions
pauline.delzeux@disney.com or tel +33 1 60 45 76 20

All attendees are invited to visit the hospitality suites!

AMC Shipping - AMC has selected Transit Air Cargo as the official freight carrier for the handling of ground and air shipments, as well as storage, delivery, pickup and reshipment of materials. Please note the Hotel New York is unable to accept direct shipments due to a lack of storage.

For further information, please contact:

Howard Umeda, Transit Air Cargo
howardu@transitair.com, tel +1 800 247-1600, Ext. 106, or fax +1 714-571-0406

Transit Air Cargo will handle air and ocean shipments, including the inbound and outbound customs documentation.

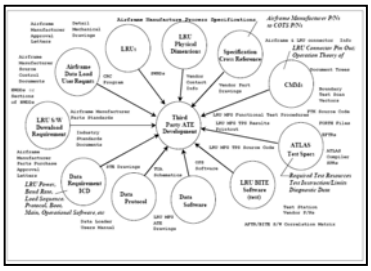
Future Concepts for Maintenance

AEEC FCM Subcommittee/FCM Task Group 111 **A joint activity of AEEC and AMC**

TPS Quality Working Group to Meet

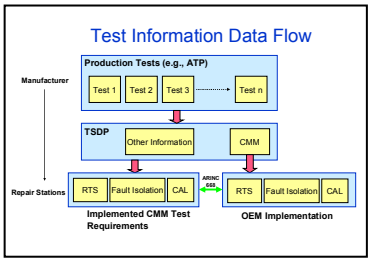
By Roger Goldberg
ARINC Industry Activities

The TPS Quality Working Group, chaired by Axel Mueller, Lufthansa, will meet January 18-20, 2006, in Atlanta, Georgia, to continue the development of **ARINC Report 625-2:** *Industry Guide for Component Test Development and Management.*



ARINC Report 625-1: *Quality Management Process for Test Procedure Generation* attempted to define the data necessary for an avionics supplier to provide to a third party TPS developer to enable the production of shop-verified ATLAS for general purpose Automatic Test Equipment (ATE). ARINC 625-1 recognized the need for the industry to migrate from ATLAS to COTS tools (e.g., LabWindows).

Until the launch of A380 and B787, in absence of any new aircraft programs, there have been very few applications of ARINC 625. As a result, the avionics suppliers have only limited experience in the production of Technical Support and Data Packages (TSDPs).



With the proliferation of electronics into traditionally mechanical applications (e.g., pneumatics, hydraulics), the group has proposed revising ARINC 625 to expand its scope beyond traditional avionics.

Comments, questions, or working papers are invited. If you wish the material to be reviewed at this meeting, please send it to Roger Goldberg by **January 4, 2006**.

Please direct any requests to my attention, +1 410-266-2915, rsg@arinc.com, or www.arinc.com/aeec/projects/maintenance

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The Saga of Papa Whiskey

By Matt Thurber, Editor

By all accounts, the Lufthansa Airbus A320 known as Papa Whiskey remains flying today due to the incredible skill and teamwork of the two pilots at the controls on March 21, 2001. Papa Whiskey carried 121 passengers and crew on that fateful day and was scheduled to fly from Frankfurt to Paris.

All was normal prior to takeoff; there was no indication that there was a profound problem with the Airbus's fly-by-wire flight controls. As Papa Whiskey accelerated on the runway and lifted off, the left wing dropped slightly. The captain, who was flying this leg of the trip, reacted normally, instinctively nudging the sidestick gripped in his left hand just a tiny amount to the right, sending an electrical command to the elevator-aileron computer (ELAC), which in turn signaled the hydraulic actuators at the ailerons to move—down in the case of the left wing and up for the right wing aileron—to lift the left wing back to level. An utterly routine matter, under normal circumstances, but unfortunately Papa Whiskey did not react in the normal fashion. The left wing dropped more, coming to within a few feet of the ground. The captain blurted, "I can't do anything more!"(according to the German accident report).

Lufthansa has been at the forefront of training its flight crews to work as a team and not in a hierarchical manner. The first officer immediately pushed the Takeover Push Button to take control and raised the left wing with a twist of his right wrist, in the correct direction. The two pilots put Papa Whiskey on autopilot and climbed to 12,000 feet and tested both sets of flight controls. The first officer's sidestick worked normally. The captain's sidestick, incredibly, caused the Airbus to bank left when the stick was pushed right and vice versa; it was working backwards.

The pilots elected to return to Frankfurt and they reported the incident. Lufthansa immediately consulted with the German regulatory authorities and Airbus. A lengthy investigation ensued. How could Papa Whiskey's aileron controls be reversed?

The official investigation by the German BFU, similar to the U.S. National Transportation Safety Board, was not released until two years later, in April, 2003. But it didn't take people at Lufthansa and at its maintenance company Lufthansa Technik, which maintains Papa Whiskey, long to find out what had happened and figure out a way to prevent such mistakes from occurring again.

The story of how Papa Whiskey's flight controls were reversed has been told and by now it's not exactly news, but this is the rest of the story; not just how the problem occurred but how a proud, diligent, careful maintenance company like Lufthansa Technik dealt with this near-tragedy and took it firmly to heart, making sure that what happened to Papa Whiskey wasn't brushed off as an anomaly but served as a catalyst for improvement and growth for everyone in the company, from mechanics on the hangar floor to top management.

By skill, teamwork, and perhaps a helping of luck, Papa Whiskey didn't crash that day. Nor did Lufthansa Technik and the mechanics and managers involved get punished. A mistake was made, but the results reveal a fascinating tale of a company that focuses on learning, not punishing, growing, not stagnating, and by sharing this publicly, helping advance aviation safety.

Aviation Maintenance editor Matt Thurber asked Lufthansa Technik officials if the company would be interested in sharing details of the Papa Whiskey incident so that the industry at-large can benefit. The result was a fascinating interview with Dr. Burkhard Andrich, senior vice president aircraft maintenance and Robert Nyenhuis, head of Airbus A320 maintenance. The story that follows is derived from that interview and the report by the German BFU (Federal Bureau of Aircraft Accidents Investigation).

The day started normally, with an on-time departure at 11 a.m. by a Lufthansa Airbus A320-200, D-AIPW, loaded with 115 passengers and six crew. The weather was benign, with scattered clouds at 3,200 feet, good visibility, and a slight crosswind from the east for the takeoff on Frankfurt's Runway 18. The 41-year-old pilot-in-command had logged 3,300 hours in the A320 and the second-in-command, age 27, 1,500 hours. Both were on duty about six and a half hours before taking off in Papa Whiskey.

During preparations for the flight, the pilots performed the normal required flight control check and noted no discrepancies in the flight control system. This was Papa Whiskey's first flight after maintenance.

On March 17, one of Papa Whiskey's two elevator aileron computers (ELACs) failed and was replaced. On March 18, ELAC 2 announced another failure but the pilots were able to reset the system and proceeded on a flight to Moscow. In Moscow that evening, ELAC 2 signaled a failure again. This time, the two ELACs were swapped, and the failure remained on ELAC 2, so the crew pulled the applicable circuit breakers to isolate the failed ELAC and flew back to Frankfurt in accordance with Lufthansa's minimum equipment list procedure.

On the night of March 18 and the early morning of March 19, Lufthansa Technik technicians troubleshooting the ELAC problem found a defect in the X-TALK-BUS (cross-talk bus, which allows the ELACs to communicate) between ELAC 1 and 2. The ELACs are connected to the Airbus flight control system with four large plug segments labeled AA, AB, AD, AE, each of which has 105 wires attached with connection pins. One of the connection pins (Pin 6K) in segment AE was bent, thus the error.

The technicians were unable to repair the connection pin because they could not reinsert the pin's safety spring, which had come out. The decision was made to replace plug segment AE, but there wasn't one in stock. There was an entire plug segment assembly in stock, but the AE segment of the new assembly would not match the remaining three segments, so they decided to replace all four segments, which meant reconnecting 420 connection pins, while working in the avionics bay. The German BFU report calls the bay "a most confined space," and a photo in the report shows the ELACs surrounded by numerous tightly bundled wires.

"There was no time pressure for the people involved," said Dr. Burkhard Andrich, Lufthansa Technik senior vice president aircraft maintenance, during the interview with Aviation Maintenance. A spare A320 was available, and Papa Whiskey was removed from the flight schedule.

On March 19, technicians with the required qualifications began the job and finished rewiring segments AA, AD, and AE. The AB segment was done by the following shift. The work was accomplished by the one-to-one method, where each wire was disconnected from the old plug then immediately installed into the new plug, in an attempt to avoid potential miswiring of such a critical component. The A320 has fly-by-wire flight controls and their correct operation is completely dependent on miles and miles of carefully routed and attached wiring.

Papa Whiskey had an unusual design feature in its ELAC wiring. Two pairs of wires—they are all red and blue on the ELAC—are attached in what could appear to be an illogical and odd manner. While the rest of the wire pairs are attached in a red/blue configuration, these two pairs, assigned to pins 3C/3D and 15J/15K, are sequenced blue/red. Airbus engineers were aware of this anomaly and had designed it out of the A330 and A340 models and some later A320s. "An interchange of colours was accepted for a certain transition period," the BFU report stated. Unknown to the Lufthansa Technik technicians, Papa Whiskey was one of those transitional A320s.

Further confusion developed when the technicians tried to interpret the service bulletin status of Papa Whiskey. They ended up referring to an incorrect wiring diagram due to difficulty interpreting the airplane's service bulletin compliance. Because they didn't realize that one service bulletin hadn't been accomplished, the wiring diagram showing a logical sequence of wiring colors (all red/blue) should not have been applicable to Papa Whiskey, yet this was the diagram that the technicians ended up using.

The stage was now set for an error to occur. The technicians completed the final pin connections on segment AB. Instead of installing pins 3C/3D and 15J/15K in the blue/red sequence, the technicians made the connection in the red/blue sequence specified in the incorrect wiring diagram to which they referred, which also appeared perfectly logical as all the other wires were connected in this sequence.

After working on flight controls, a functional check is required and this was done. An error message on ELAC 1 was noted and the technicians found a faulty bridge on plug segment AA and fixed it. This error, the BFU noted, "did not relate to the original complaint." One can't help wondering, however, if repairing this error might have led the technicians to feel that they had worked all of the bugs out of the ELAC system, predisposing them not to expect further problems and thus not seeking to find any more discrepancies.

The technicians performed another functional check, but only using the right-hand side-stick and in accordance with the aircraft maintenance manual. The manual instructed the technicians to "Push the FLT CTL ELAC 1 (2) pushbutton switch. – Move the side-stick around in its two axis [spelling is correct] from stop to stop." The manual did not suggest that anyone observe the movement of the ailerons and elevators to ensure that they moved in the correct direction. Did the mechanics perhaps assume that if the controls moved in an incorrect direction, a fault message would illuminate? And is this a potential expectation trap that might be prevalent on modern electronically operated aircraft?

Lufthansa Technik says the Papa Whiskey near-disaster generated permanent beneficial changes in its maintenance and safety procedures.

"All the functional checks are in the cockpit," said Robert Nyenhuis, Lufthansa Technik's head of Airbus A320 maintenance. The maintenance manual did not specify double-checking the movement of the control surfaces.

The BFU report on the incident flight is unclear on the sequence of events just prior to takeoff, regarding the flight crew's normal flight control check. While the report does note that the crew performed the flight control check, it also said that the crew checked only for full aileron deflection, but not for the correct direction of deflection. The report doesn't say who performed the flight control check with which sidestick, the pilot-in-command in the left seat or the first officer in the right seat. It seems that a flight control check with the right sidestick would have resulted in correct aileron deflection, hence there was a 50-50 chance that this last check would not have resulted in discovery of the problem. In any case, the pilots would also have to have noted the direction of movement of the ailerons, and it's not clear that they were looking at this or simply relying on cockpit indications.

The BFU did issue a safety recommendation to Lufthansa and the German regulatory authority (LBA) suggesting that "operators of fly-by-wire aeroplanes...amend their checklists accordingly."

During the takeoff, it quickly became apparent that something was wrong. As the Airbus rotated, the pilot-in-command, flying from the left seat, saw that the airplane was banking to the left. "He tried to correct the bank angle through an opposite input on the left sidestick," the BFU report said, "but it grew increasingly larger."

The Loral flight data recorder later showed that the left wing dropped nearly 22 degrees. By this time, the Airbus had accelerated to 170 knots. Noticing that the left wing continued to drop, the first officer "instinctively made an input to the right on his sidestick, which prevented the bank angle from increasing even further, but did not lead to an improvement of the situation." Finally, after the pilot stated that he couldn't do anything to control the banking left wing, the first officer pushed his sidestick's TAKE OVER PUSH BUTTON and then he was able to control the Airbus normally.

The pilots climbed to 12,000 feet on autopilot then cautiously tested the flight controls. Operation with the right sidestick was normal, but when they switched control to the left sidestick, lateral control was reversed, with the wing moving opposite of the way the sidestick was moved instead of the same way. The flight returned to Frankfurt, under control of the right-hand sidestick. Lufthansa notified the German LBA immediately and Papa Whiskey reentered Lufthansa Technik's hangars for some serious scrutiny.

It should be noted that Lufthansa and Lufthansa Technik are separate organizations. As aircraft operator, Lufthansa bears responsibility for overseeing maintenance on its aircraft. The BFU reported that this function was weak.

The technicians and managers at Lufthansa Technik quickly began testing Papa Whiskey to learn what had happened. There was no question that the investigation was not seeking to point the blame at a specific person who could then be punished. It is more important, Nyenhuis said, to figure out "what to improve in the process and not to punish people."

The technicians and managers discovered that two wire pairs had been installed incorrectly in the ELAC plug segment AB. The Airbus A320 maintenance manual flight control check, which had been accomplished, did not require verification of the movement of the control surfaces, as is the case on older airplanes, according to Nyenhuis.

They also found that the technicians did not perform a continuity check on all the wires that were re-installed, as specified in the maintenance manual standard practices. It turns out that Lufthansa

Technik had its own standard practice, Nyenhuis explained, which permits a deviation from a maintenance manual standard practice. The technicians on Papa Whiskey consulted with Lufthansa Technik's maintenance support department, which agreed that the continuity check was not necessary because they would have to perform a functional check anyway, and this check should uncover any remaining faults. The BFU report also noted this discrepancy between the maintenance manual requirements and the Lufthansa Technik technicians' deviation from those requirements and said it was a factor in the incident.

Immediately after the initial internal investigation, Nyenhuis and Andrich called meetings with all the Lufthansa Technik technicians, beginning at Frankfurt and eventually spreading to the entire organization worldwide. "We discussed what happened," he recalled, "the root cause."

During these meetings, managers focused on a fundamental issue: the first objective during maintenance is to make sure the airplane is safe. Secondary to safety—always—is being on time. The case of Papa Whiskey was dissected, and everyone at the meetings had to sign a document acknowledging that they were familiar with the details.

From feedback received during the initial meetings, Nyenhuis and Andrich launched a change project to re-engineer the entire maintenance organization, from documentation to training to leadership.

Beginning with leadership, the big change was to make sure planning personnel budgeted enough time for team leaders to lead at least 50 percent of the time. This ensures that during critical maintenance operations, leaders are not tied up with functions that are better delegated to someone else and that they can be physically present to observe the critical tasks. "They must be there," Andrich said. "If you go into the flight controls or a chip detector, you must be really aware of what you are doing. You should focus on safety, not efficiency." Team leaders, he added, must make sure their team members understand this and are fully aware of when they are performing critical operations.

To bring this point home, all 350 team leaders and supervisors went through two to three days of off-site training, focusing on the hierarchy of safety and efficiency. The priority actually goes: first, safety and quality procedures; second, work ethics, values, and leadership; third, efficiency.

From feedback generated during this round of training, it was decided that the double-check inspector on duty has the authority to request a test flight if he or she deems it necessary. And the test flight will be a real test, not a revenue flight with passengers.

Another ongoing focus is improving the workplace culture and values. "Communication between hierarchies is very important," said Andrich. A younger workforce helps with that because, he added, younger people are used to a more bottom-up environment, where the traditional lines between internal silos are blurred.

This kind of training is now ongoing, with one day a year for technicians, two days for supervisors and double-check inspectors. "To have these communications costs a lot of money," Nyenhuis admitted. But the training is worthwhile. "Even with the economic crisis last year, we didn't cancel training," he said.

"We tried to change in a systems approach," Nyenhuis added. "Not action-reaction, but change procedures, minds, and the safety culture."

Now, he explained, the double-check inspectors get involved early in any maintenance operation, especially those that are considered critical. And these inspectors are not operating under the efficiency mandate but are considered 100 percent efficient by definition. Whatever they need to do

must be done. “The double-checker is there as a mentor,” Nyenhuis continued. “We don’t need an inspector who is loud and punishes. They are the most experienced people we have. The look over, they ask questions, and they escalate if necessary. They took an active role in improving our procedures.”

Another new effort was adapting some of Lufthansa’s obviously successful human factors pilot training to the maintenance operation. One immediate change was improving the problem-reporting system and using some ideas from the pilots’ anonymous reporting system. More important, however, was convincing the personnel that taking advantage of any of the various methods of reporting problems would not result in punishment. “It’s important to say that we trust each other,” Nyenhuis said.

Something that once belonged solely to the quality inspectors is now part of everyone’s daily work. The company calls this “daily spot checks,” and now not only are these done by quality inspectors but they also must be done by the maintenance teams themselves. Management compares the spot checks by the maintenance teams to those from the quality department to calibrate what is actually happening. “They should match,” Nyenhuis explained. “It tells us if we’re right or wrong.”

In order to improve some regular important processes, Lufthansa Technik implemented an integrated quality management system that includes most processes on an employee-accessible intranet, which is available at any of the company’s maintenance bases. The mechanics helped developed the processes, which helped them buy into the program because it wasn’t just a case of the quality department forcing its desires on the workforce.

To improve communications between the people who do the work and management, the company created quality circles composed of a variety of personnel. The quality circles meet every two weeks, and inspectors from the German regulatory authority—the LBA—are invited as well.

As far as keeping the LBA inspectors up to speed, Lufthansa Technik delivered an action plan to the LBA in July, just four months after the Papa Whiskey incident. Much of the action plan included the improvements mentioned above.

A key to making the improvements really happen is that management must be strongly supportive. “It’s really a question of doing it, not just talking about it,” said Andrich. “How do you implement it? It means sitting down with front-line people, not just writing checks.”

For Andrich, the Papa Whiskey near-disaster and the learning that resulted from the incident has generated permanent beneficial results. Referring to the classic Swiss cheese model (Schweizer Käsemodell in German), which shows how an accident or incident results from the lining up of holes in multiple slices of “cheese,” Andrich said, “we’re making sure that no seven slices of cheese line up. We really learned a lesson here. If we would face the same thing now, the safety net is much better.”

SYNCHROS

SIMPLE AND ACCURATE

Reprinted by kind permission from ***Avionics News***, October 2004

By Kim Wiolland, Tech-Aid Products

What are they?
Synchros and Synchro Resolvers form a group of transducing elements using an electromechanical scheme. In its basic form, synchros are specially wound rotary transformers with the stator windings typically fixed. These transducer devices played a large role in the Air Force and Navy during WWII and proved their value enormously. Their two most common uses are for shaft angle measurement or to position a system or dial in a servo loop system.

The mechanical input or shaft rotation is converted to a unique set of output voltages, or when driving a receiver a set of input voltages is used to turn the rotor to the desired position. Internally most all synchros are similar in construction, having a rotor with one or three windings (depending on type) capable of revolving inside a fixed stator assembly. These synchro stator voltages are expressed in the following form as shown in MIL-S-20708:

$Es3\text{-}s1 = N\ Er1\text{-}r2 \sin v\ t \sin \theta$
$Es2\text{-}s3 = N\ Er1\text{-}r2 \sin v\ t \sin (\theta+120)$
$Es1\text{-}s2 = N\ Er1\text{-}r2 \sin v\ t \sin (\theta+240)$

Where N is the transformation ratio of the synchro and θis positive for a CCW rotation from electrical zero as viewed from the shaft's end.

This results in an absolute analog angle that accurately reflects the rotor position and at no point through the shaft's complete rotation is the same. As shown in the relationships above, the induced phase voltage will depend on the shaft angle. The primary winding is usually the rotor and the stator is the secondary or output winding. The rotor shaft angle is expressed in degrees and with more resolution as minutes (1/60 of a degree) and seconds (1/3600 of a degree). The typical synchro accuracy is 6' (6 arc minutes) however some synchro accuracies can be as high as 30" (30 arc seconds). This resolution is used when measuring in a rotational plane as evidenced here. The synchro construction is such that the three-stator windings (S1, S2, S3) are separated each by 120 degrees in a wye fashion. In physical form these synchros resemble small AC/DC motors.

Conventions
The control synchros include the transmitter (CG), control transformers (CT), differentials (CD) resolvers (CS), transolvers (CSD), and differential resolvers. In respect to the transmitter it consists of a single-phase, salient-pole rotor and a three phase, wye connected stator (the word "phase" here indicates a space phase relationship). The primary or input winding is usually the rotor (R1, R2) and the stator (S1, S2, S3) is usually the secondary or output element. The synchro resolver (CS) consists of a cylindrical rotor with two phases wound in space quadrature and a stator also with two quadrature phases. In this standard resolver, the rotor phases are internally connected and brought out to a common lead. In the case where all four leads are brought out separately, the designation is CZ. In similar fashion the resolver rotor leads are designated R1 and R2 with the four stator leads designated

S1, S2, S3 and S4. The avionics industry has also assigned other designators to these windings and most commonly they are: A, B and C for the rotor, with C being the common rotor connection. The four stator leads are commonly assigned D, E, F and G. The original equipment manufacturers may vary the designations depending on how they are used in their equipment.

Voltage Categories
Synchros predominately fall into three voltage/frequency categories as listed here:

- 115 volt r.m.s. 60 hz reference excitation with a 90 volt r.m.s. line to line signal voltage.
- 115 volt r.m.s. 400 hz reference excitation with a 90 volt r.m.s. line to line signal voltage.
- 26-volt r.m.s. 400 hz reference excitation with an 11.8-volt r.m.s. line to line signal voltage.

The most prevalent excitation voltage used in the aviation synchro community is 26 vrms/400 hz with a smaller percentage using 115 vrms/400 hz. The excitation frequency plays importance in the physical size of the synchro and a size 11 (1.1 in diameter) is again the common size in the aviation community. The Navy and their shipboard systems typically use a reference excitation of 115 vrms/60 hz or 115 vrms/400 hz, this results in a larger frame size of either 18 (1.8 in diameter) or 23 (2.3 in diameter).

Synchro Nulling
The synchro null is composed of both a fundamental component in time quadrature with the reference excitation and odd harmonics. The fundamental results from magnetic distortions and the odd harmonics imperfect distribution of the air gap flux. The method of nulling is described in MIL-S-20708C for synchros and MIL-S-20708E for synchro resolvers using a phase sensitive voltmeter. Each winding of the device has two null points and a typical synchro resolver operated at 26 vrms/400 hz can be specified as having a maximum null of 20-30 mv or .1 percent of the reference excitation. These low synchro null voltages are critical for maintaining proper system performance.

Accuracy Defined
The error in angle is defined as the difference between the true physical positions of the synchro shaft and the angle as defined by the stator voltages at its output (CX or transmitter). In a synchro receiver (CT) the angular error is defined as the angular amount required that the rotor has to be moved from the angular positions as defined by the stator voltages in order to produce a minimum output. The leading manufacturers will specify a maximum allowable error in the form of arc-minutes (1/60º) or even more accurately in arc-seconds (1/3600º) for a particular device. In the family of transducer types the rotary inductosyn is typically most accurate.

Pointing Fundamentals
The following discussion relates to a torque transmitter (CG) and a torque receiver (CR) with their stators wired in parallel and the same excitation applied to both units' rotors. The field produced by the input voltage induces a voltage into each of the transmitter's stator phases. These stator voltages are either approximately in time-phase or approximately 180 degrees out-of-time-phase with the applied voltage. The synchro inherently has some phase shift so the output voltages will differ some from the exact 0 or 180 degree relationship with the input voltage. In a synchro operated at 400 hz (no load) the output voltage will lead the input by several degrees. At the instant the excitation is applied to this loop the rotors of each unit are not at the same phase angle therefore voltage differences exist across each pair of stator windings, causing current to flow in both stators. This then results in a torque on each rotor.

Since the synchro transmitter (CG) rotor is fixed and can't rotate, the resulting torque then acts on the synchro receiver (CR) rotor in the proper direction to align itself with the transmitter. When alignment occurs, the voltage at each stator is equal and opposite and current flow ceases. A subsequent further rotation of the transmitter rotor will re-exert a force on the receiver's rotor with the torque proportional

to the angle developed between the two rotors. The response time of the receiver's rotor to realign itself is referred to as the synchronizing time. Multiple receivers can be wired in parallel to the transmitter but the downside of this scheme is reduced accuracy.

Resolver Fundamentals
The Synchro Resolver (CS) is a form of synchro in which the windings on the stator and rotor are displaced mechanically at 90 degrees to each other instead of the 120 degrees as in the case of synchros.

The resolver thus employs the use of the sinusoidal relationship between the rotor shaft angle and the output voltage. The resolvers utilize the same standard frame sizes as the synchro. Internally the resolvers come in many forms of winding configurations and transformation ratios. The simplest resolver employs a single rotor winding and two stator windings at 90 degrees to each other. The frame or outward appearance of the resolver is similar to that of the synchro. In developing the resolver voltage relationships we can look at the following;

Let's assume the rotor is excited by an AC reference voltage:

A Sin ш t

This yields voltages appearing on the stator terminals that are:

S1 to S3 = VSin ш t Sin θ
S4 to S2 = VSin ш t Cos θ
Where the resolver shaft angle is shown as θ and the carrier (reference) frequency is shown as ш.

The resolver is another form of angular transducer which can be used in applications which require performance of trigonometric computations, conversion between rectangular and polar coordinates and transmission and reception of angular position data by one or more rotor shafts. The resolver is described in MIL-S-20708E and MIL-S-23417. The expressions above show that the output voltages will vary as a function of the Sine and Cosine of the shaft angle. Some current applications are: target acquisition, gun trunnions, FLIR systems, Radar and missile seekers. In general, resolvers can have leading phase shifts between 0 and 20 degrees. Resolvers also can be used in time phase shifting applications with great accuracy. In these applications the output voltage remains constant with rotor position, but the time phase shift in electrical degrees between the input and output is equal to the rotor position angle in mechanical degrees. In using a balanced R-C network across the stator windings you can obtain accuracies of +/- 1/4 of a degree. This technique is used in the aviation community in the VHF navigation systems omni bearing selector (OBS) to establish the desired radial the pilot wants to fly. This application of the resolver represents its classic function, as the name implies, and that is to resolve a vector into its individual components.

It is interesting to note here that the resolver as it applies to aircraft instruments is zeroed at 300 degrees on the azimuth card of either the standard OBS indicator or the horizontal situation indicator (HSI). This alignment procedure is documented in RTCA/DO-62. In practice several compensation circuits can be configured around a 400 hz resolver to allow operation at 30 hz with minimal phase shift error. In a higher degree of complexity three resolvers can be wired together to transform the inertial platform coordinates (N, E, G) to their airborne coordinates (X, Y, Z).

Still Today
Synchros and Synchro Resolvers still to this day play a very important part in today's motion and position sensing applications. On board ships, for example, a multitude of information is acquired—engine data, heading, roll angle, pitch angle, speed, radar, longitude and latitude can all be interfaced

into a common node or control point for the required processing and or digitizing. Robotics also employs many uses for synchros and synchro resolvers for positioning of their extremities. Still today, the electromechanical aviation instruments almost without exception employ some form of synchro for providing attitude, azimuth position or some form of displacement or position feedback. The resolver still provides a simple yet necessary interface between the pilot and his navigation equipment. The evolution of the “Glass” cockpit and the solid-state transducers has reduced the requirement for these synchros, to be sure. Even as we see this trend however, there is still the need to synthesize these signal formats to provide that much needed bridge between the old and the new technologies. Synchros and synchro resolvers, regardless of application, must be properly aligned. The alignment of these synchros is performed easily with an Angle Position Indicator which measures the phase relationship of the stator voltages and displays the shaft angle in digital form.

The Lighter Side

Regulatory Activities

Note: All entries contained in the Regulatory Activities Section may be found in the Federal Register, 14 CFR Part 39, Section Federal Aviation Administration, DOT.

AIRBUS

Vol. 70, No. 225 – Wednesday, November 23, 2005

Airworthiness Directives; Airbus Model A318-100, A319-100, A320-200, A321-100, and A321-200 Series Airplanes, and Model A320-111 Airplanes

Action: Final rule, request for comments.

Summary: The FAA is adopting a new airworthiness directive (AD) for all Airbus Model A318-100, A319-100, A320-200, A321-100, and A321-200 series airplanes, and Model A320-111 airplanes. This AD requires an inspection to determine whether certain braking and steering control units (BSCUs) are installed or have ever been installed. For airplanes on which certain BSCUs are installed or have ever been installed, this AD requires an inspection of the nose landing gear (NLG) upper support and corrective action if necessary, and a check of the NLG strut inflation pressure and an adjustment if necessary. For some of these airplanes, this AD also requires a revision to the aircraft flight manual to incorporate an operating procedure to recover normal steering in the event of a steering failure. This AD results from a report of an incident where an airplane landed with the NLG turned 90 degrees from centerline. We are issuing this AD to prevent landings with the NLG turned 90 degrees from centerline, which could result in reduced controllability of the airplane.

Dates: This AD becomes effective November 30, 2005.

For Further Information Contact: Tim Dulin, FAA, telephone (425) 227-2141; fax (425) 227-1149.

BOEING

Vol. 70, No. 220 – Wednesday, November 16, 2005

Airworthiness Directives; Boeing Model 737 Airplanes

Action: Final rule.

Summary: The FAA is adopting a new airworthiness directive (AD) for certain Boeing Model 737 airplanes. This AD requires, for certain airplanes, a one-time detailed inspection for interference between a clamp assembly and the wires behind the P15 refuel panel, and corrective actions if necessary. For certain other airplanes, this AD requires a one-time detailed inspection for discrepancies of the wires behind the P15 refuel panel; and corrective and related investigative actions if necessary. This AD is prompted by evidence of chafed wiring behind the P15 refuel panel and arcing to the back of the P15 refuel panel and adjacent wing structure. We are issuing this AD to detect and correct chafing of the wiring behind the P15 refuel panel, which could lead to arcing and fire with consequent airplane damage and injury to refueling personnel.

Dates: This AD becomes effective December 21, 2005. The incorporation by reference of certain publications listed in the AD is approved by the Director of the Federal Register as of December 21, 2005.

For Further Information Contact: Sherry Vevea, FAA, telephone (425) 917-6514; fax (425) 917-6590.

Vol. 70, No. 230 – Thursday, December 1, 2005

Airworthiness Directives; Boeing Model 737-100, -200, -200C, -300, -400, and -500 Series Airplanes

Action: Supplemental notice of proposed rulemaking (NPRM); reopening of comment period.

Summary: The FAA is revising an earlier proposed airworthiness directive (AD) for all Boeing Model 737-100, -200, -200C, -300, -400, and -500 series airplanes. The original NPRM would have required an inspection for

chafing of certain wire bundles located above the center fuel tank, corrective actions if necessary, and replacement of wire bundle clamps with new clamps. The original NPRM resulted from fuel system reviews conducted by the manufacturer. This action revises the original NPRM by adding an inspection for damage to the fuel vapor barrier area located below the wire bundles and corrective action, if necessary. We are proposing this supplemental NPRM to prevent chafed wire bundles near the center fuel tank, which could cause electrical arcing through the tank wall and ignition of fuel vapor in the fuel tank, and result in a fuel tank explosion.

Dates: We must receive comments on this supplemental NPRM by December 27, 2005.

For Further Information Contact: Binh Tran, FAA, telephone (425) 917-6485; fax (425) 917-6590.

Vol. 70, No. 220 – Wednesday, November 16, 2005

Airworthiness Directives; Boeing Model 737-600, -700, -700C, -800, and -900 Series Airplanes

Action: Final rule.

Summary: The FAA is adopting a new airworthiness directive (AD) for certain Boeing Model 737-600, -700, -700C, -800, and -900 series airplanes. This AD requires modification of certain wire bundles located above the center fuel tank. This AD results from fuel system reviews conducted by the manufacturer. We are issuing this AD to prevent chafed wire bundles near the center fuel tank, which could cause electrical arcing through the tank wall and ignition of fuel vapor in the fuel tank, and result in a fuel tank explosion.

Dates: This AD becomes effective December 21, 2005. The Director of the Federal Register approved the incorporation by reference of a certain publication listed in the AD as of December 21, 2005.

For Further Information Contact: Binh Tran, FAA, telephone (425) 917-6485; fax (425) 917-6590.

Vol. 70, No. 225 – Wednesday, November 23, 2005

Airworthiness Directives; Boeing Model 767-300 Series Airplanes

Action: Final rule.

Summary: The FAA is adopting a new airworthiness directive (AD) for certain Boeing Model 767-300 series airplanes. This AD requires replacing the frequency converters used to supply power for medical and galley utility outlets with modified frequency converters, and related actions. This AD results from a report indicating that a hard short circuit condition between the output of certain frequency converters and their downstream circuit breakers will produce a continuous output current that could cause the undersized output wiring to overheat when the frequency converters fail to shut off. We are issuing this AD to prevent overheating of the output wiring of the frequency converters, which could result in the failure of a wire bundle and consequent adverse effects on other systems sharing the affected wire bundle.

Dates: Effective December 28, 2005. The Director of the Federal Register approved the incorporation by reference of a certain publication listed in the AD as of December 28, 2005.

For Further Information Contact: Binh Tran, FAA, telephone (425) 917-6485; fax (425) 917-6590.

EMBRAER

Vol. 70, No. 232 – Monday, December 5, 2005

Airworthiness Directives; Empresa Brasileira de Aeronautica S.A. (EMBRAER) Model EMB-120, -120ER, -120FC, -120QC, and -120RT Airplanes

Action: Final rule.

Summary: The FAA is adopting a new airworthiness directive (AD) for all EMBRAER Model EMB-120, -120ER, -120FC, -120QC, and -120RT airplanes. This AD requires modifying electrical harnesses located at the left- and right-hand wing roots; and re-routing and modifying the harness of the right-hand outboard flap actuator. This AD results from fuel system reviews conducted by the manufacturer. We are issuing this AD to prevent chafed electrical harnesses, which could result in a potential source of ignition for fuel vapors near a fuel tank and consequent fire or fuel tank explosion.

Dates: This AD becomes effective January 9, 2006. The Director of the Federal Register approved the incorporation by reference of a certain publication listed in the AD as of January 9, 2006.

For Further Information Contact: Dan Rodina, FAA, telephone (425) 227-2474; fax (425) 227-1149.

■ AIRBUS S.A.S.

Airbus S.A.S., is an EADS joint company with BAE SYSTEMS.
Airbus has three major training centers – in Toulouse (France), Miami (USA) and Beijing (China). All three centers are equipped with the latest technology training equipment and learning systems and offer a wide range of courses. A fourth training center in Hamburg, Germany, provides A320 maintenance training.

■ AIRBUS Kid-Systeme - Cabin Electronic Systems

Kid-Systeme-sponsored courses are located in Buxtehude, Germany

February 20-24	A318 - A321 Enh. CIDS Maintenance
March 16-17	KID-Systeme GmbH Skypower Training
March 20-24	A330EC / A340-600 CIDS Maintenance
May 8-12	A380 CIDS Maintenance
June 12-16	A330EC / A340-600 CIDS Maintenance
June 26-30	A330 / A340 CIDS Classic Maintenance
July 3-7	A318 – A321 Enh. CIDS Maintenance
September 4-8	A330EC / A340-600 CIDS Maintenance
September 25-29	A319/A320/A321 CIDS Classic Maintenance
October 12-13	KID-Systeme GmbH Skypower Training
October 16-20	A318 – A321 Enh.CIDS Maintenance
October 23-27	A380 CIDS Maintenance

■ AVIATION COMMUNICATIONS & SURVEILLANCE SYSTEMS

Aviation Communication and Surveillance Systems-sponsored courses are located in Phoenix, Arizona.

■ BOEING

Boeing-sponsored courses are located as noted.

Long Beach, California

Mar 20-24	Maintenance Reliability and Cost Analysis
Jun 12-16	Production Planning Requirements for Maintaining Continued Airworthiness
Sep 18-22	Maintenance Reliability and Cost Analysis

Seattle, Washington

May 8-12	Airline Maintenance Program Development
Oct 23-27	Aging Airplane Scheduled Maintenance Requirements

■ DEMO SYSTEMS

Demo Systems-sponsored courses are located in Moorpark, California. Courses are scheduled on customer request.

On Request	LoadStar Operators Course: File Installation, Reports, and Operation
On Request	PMAT 2000 Operators Course: Data Loading, LoadStar Fundamentals, PDL/MSD mass storage Interface
On Request	Data Loading Fundamentals: Pdl Operation, Loading Mass Storage from LoadStar, 615A data Loading From PMAT 2000

■ DELTA AIR LINES, INC

Tech Ops Technical Training

Delta Air Lines, Inc-sponsored courses are located in Atlanta, Georgia. Additional courses may be scheduled at customer's request and location. Please send training requests to TOTraining.delta@delta.com for Solder Training.

Solder Training

On Request	Gull-Wing Components Lab (based on IPC-7711 Module 6) for Application Specialists
On Request	IPC-620 Basic: Wiring, Termination & Soldering for Application Specialists
On Request	IPC-7711 Rework of Electronic Assemblies (Module 6 only) for Certified IPC Specialist (CIS)
On Request	IPC-7711 Rework of Electronic Assemblies for Certified IPC Specialist (CIS)
On Request	IPC-7711 Rework of Electronic Assemblies **Recertification** for CIS

On Request IPC-7711/7721 Rework, Repair & Modification of Electronic Assemblies for Certified IPC Trainers (CIT)
On Request IPC-7711/7721 Rework, Repair & Modification of Electronic Assemblies **Recertification** for CIT
On Request IPC-7721 Repair and Modification of Printed Boards and Electronic Assemblies for CIS
On Request IPC-A-610D Acceptability of Electronic Assemblies for CIS
On Request J-Lead Components Lab (based on IPC-7711 Module 6) for Application Specialists

■ DIEHL AVIONIK SYSTEME GmbH

(formerly BGT and VDO)
Diehl Avionics-sponsored courses are located in Frankfurt, Germany and Toulouse, France. Courses are scheduled on customer request.

A300 B2/B4 equipment
On Request ATA 22: Autothrottle Computer
On Request ATA 22: Pitch Trim Computer
On Request ATA 22: Autothrottle Actuator
On Request ATA 22: Autothrottle Output Gear
On Request ATA 22: Coupling Unit Engine 1
On Request ATA 22: Coupling Unit Engine 2

A310/A300-600 equipment
On Request ATA 22: Thrust Control Computer
On Request ATA 22: Autothrottle Actuator
On Request ATA 22: Autothrottle Output Gear
On Request ATA 22: Coupling Unit Engine 1
On Request ATA 22: Coupling Unit Engine 2
On Request ATA 31: ECAM-SGU
On Request ATA 34: EFIS-SGU
On Request ATA 34: EFIS-Ctl-Pnl

A319/A320/A321 equipment
On Request ATA 22: Flight Control Unit (FCU)
On Request ATA 49: APU Electronic Control Box (V)ECB
On Request ATA 31: Display Management Computer (DMC)

A330/A340 equipment
On Request ATA 22: Flight Control Unit (FCU)
On Request ATA 27: Slat Flap Control Computer (SFCC)
On Request ATA 31: Display Management Computer (DMC)
On Request ATA 49: APU Electronic Control Box (V)ECB

■ GABLES ENGINEERING, INC

Gables offers no charge on-demand customized training of our equipment to airline customers since each airline has a unique mix of Gables equipment. Please send training requests to Stephanie Tallon at stallon@gableseng.com.

■ GOODRICH CORPORATION

Fuel and Utility Systems

Goodrich Corporation-sponsored courses are located in Vergennes, Vermont.

February 6-7, 2006 –**Scheduled training for 757/767 FQIS**

Boeing
On Request AD 99-03-04 - 737 TSD
On Request AD 99-03-04 - 737 IFQT
On Request AD 98-20-40 - 747 Classics FQIS
On Request 757/767 FQIS
On Request 777 Potable Water Retrofit
On Request DC-9 LGIWS Prox Retrofit

Airbus
On Request A300 FQ Retrofit
On Request A320 Level Sensing
On Request A321 FQMS
On Request A330/A340 FQMS

■ HONEYWELL

Honeywell-sponsored courses are located as noted.

Aerospatiale
On Request SPZ-6000 & HT-1000/ATR-42/72
Bell
On Request SPZ-7600/Bell 412
Dehavilland
On Request SPZ-8000/deHavilland Dash 8
Fairchild/Dornier
On Request Primus 2000/DO-328 TP & Jet
Sikorsky
On Request SPZ-7600/Sikorsky S-76
Airline Site
B747-400
On Request Weight and Balance OJT
B777
On Request Custom Design AMI Authorship
On Request AFS
On Request CFDIU On Request DADC
On Request EIS
On Request ESC
On Request FMC (H/W)
On Request FMS (FAM/LM)
On Request FSC/AFSC
On Request HSC
MD-11
On Request MCDU/HMCDU (H/W)
On Request MSC
On Request STS 1000 MD 11 TPS
MD-80
On Request FMS (FAM/LM)
MD-80/90
On Request DFGS/ACS (FAM/LM)
On Request DFGS/ACS (H/W)
On Request EFIS
On Request FMC (H/W)
On Request Indicators and Flight Instruments
On Request Windshear
MD-90
On Request CADC
On Request FMS (FAM/LM)
On Request MCDU (H/W)
On Request VIA (ACD)
Test Equipment
On Request FMSTP O & M
On Request SATCOM Manual Tester
On Request SATCOM MCS 7000 (MTS)
On Request STS 1000 O & M
On Request STS 2000 O & M

Avionics Training Calendar

Airline Selected Equipment
On Request HART Training
On Request HT9000 Familiarization for Flight Instructors
On Request HT9100 Familiarization for Flight Instructors

■ KITCO FIBER OPTICS

KITCO Fiber Optics-courses are taught in Virginia Beach, Virginia. Courses can be scheduled at customer request and taught at customers on-site location.

Jan 23-27
Mar 20-24
May 15-19
Jul 24-28
Oct 23-27

Aerospace Fiber Optic Fabricator and Installer Course has been scheduled on the dates listed above and is based on the new ETA Aerospace Fiber Optic Certification. The course covers Aerospace Fiber Optic Theory - Aerospace Fiber Optic Connector Termination Procedures – Testing – Troubleshooting – Repair and Restoration.

On Request Aviation Fiber Optic Familiarization Course: Introduction to common aviation Fiber Optic Connectors, Cables, and Test Equipment

■ L-3 COMMUNICATIONS CORP, AVIATION RECORDERS DIVISION

March 21-23 ACSS will offer T2CAS and TCAS 2000 Systems
November 14-16 ACSS will offer T2CAS and TCAS 2000 Systems

L-3 Communications-sponsored courses are located in Sarasota, Florida.

■ NORD MICRO AVIATION RECORDERS DIVISION

Nord-Micro-sponsored courses are located in Frankfurt**,** Germany.

■ NORTHROP GRUMMAN ELECTRONIC SYSTEMS

(Navigation Systems Division)

January 10-12 LTN-92 INS
February 7-10 LTN-101 GNADIRS
March 7-8 LTN-XXX
April 4-6 LTN-92 INS
May 2-5 LTN-101 GNADIRS
June 7-7 LTN-72 INS
July 11-13 LTN-92 INS
August 1-4 LTN-101 GNADIRS
September 12-13 LTN-XXX
October 3-5 LTN-92 INS
November 7-10 LTN-101 GNADIRS
December 5-6 LTN-72 INS

NSD-sponsored courses are located in Woodland Hills, California. More in-depth classes (Shop Maintenance and Component Maintenance) and/or older system training may be arranged by mutual agreement between NSD and the customer.

■ PROFESSIONAL AVIATION MAINTENANCE ASSOCIATION (PAMA)

March 28-30 **35th Annual Aviation Maintenance Symposium, Las Vegas Convention Center**

PAMA-sponsored courses are located as noted.

■ SEKAS GmbH

Sekas-sponsored courses are located in Munich**,** Germany.
The following courses are available on request
6004 Test Program Development and Debugging

6005-A ATLAS IEEE Std 716-1989 Language
6005-D ARINC 626-3 ATLAS Language

■ SMi

January 30-31 **6th Annual Aircraft Maintenance Conference on Future MRO in Civil Aviation, London**
SMi-sponsored courses are located as noted.

■ SMITHS AEROSPACE

Smiths Industries Aerospace-sponsored courses are located as noted.
Courses are scheduled on customer request.

■ TELEDYNE CONTROLS

Teledyne-sponsored courses are located in Los Angeles, California.

■ THALES

Thales-sponsored courses are located as noted.

Chatellerault, France
A318/A319/A320/A321
On Request Fuel Quantity Indication Computer
Global Express
On Request Flight Control System
Frankfurt, Germany
A318/A319/A320/A321
On Request Display Management Computer
A330/A340
On Request Display Management Computer

■ THE UNIVERSITY OF ARIZONA

The University of Arizona-sponsored courses are located in Tucson, Arizona.

May 8-11 **The 32nd Annual Reliability Testing Institute**

■ UCLA EXTENSION

UCLA Extension-sponsored courses are located as noted.

■ UNIVERSITY OF KANSAS

University of Kansas-sponsored courses are located as noted.

Anytime	Reliability & 1309 Design Analysis for Aircraft Systems-Computer-based Course
Mar. 20-22	FAA Functions & Requirements Leading to Airworthiness Approval • Williamsburg, VA
Mar. 20-24	Fundamental Avionics • Williamsburg, VA
Apr. 4-7	Reliability & 1309 Design Analysis for Aircraft Systems • Lawrence, KS
Apr. 24-28	Flight Control & Hydraulic Systems • Seattle, WA
Apr. 24-28	Flight Test Principles & Practices • Seattle, WA
Apr. 24-28	Fundamental Avionics • Seattle, WA
Apr. 25-27	FAA Functions & Requirements Leading to Airworthiness Approval • Seattle, WA
June 5-9	Fundamental Avionics • San Diego, CA
June 6-8	FAA Functions & Requirements Leading to Airworthiness Approval • San Diego, CA
June 6-8	FAA Production Quality & Airworthiness Approval Requirements • San Diego, CA
June 6-9	Software Safety, Certification, & DO-178B • San Diego, CA
Aug. 7-11	Basic MATLAB/Simulink • Lawrence, KS
Sept. 11-14	Flight Control & Hydraulic Systems • San Diego, CA
Sept. 11-15	Digital Flight Control Systems: Analysis & Design • San Diego, CA
Sept. 11-15	Fundamental Avionics • San Diego, CA
Sept. 11-15	Operational Aircraft Performance & Flight Test Practices • San Diego, CA
Sept. 12-14	FAA Production Quality & Airworthiness Approval Requirements • San Diego, CA
Sept. 18-21	Reliability & 1309 Design Analysis for Aircraft Systems • San Diego, CA
Sept. 18-21	Software Safety, Certification, & DO-178B • San Diego, CA

Avionics Training Calendar

Sept. 18-22 Advanced Flight Tests • San Diego, CA
Sept. 19-21 FAA Functions & Requirements Leading to Airworthiness Approval • San Diego, CA
Oct. 30-Nov. 2 Software Safety, Certification, & DO-178B • Orlando, FL
Oct. 30-Nov. 3 Flight Test Principles & Practices • Orlando, FL
Oct. 30-Nov. 3 Fundamental Avionics • Orlando, FL
Oct. 31 Nov. 2 FAA Functions & Requirements Leading to Airworthiness Approval • Orlando, FL

■ VIBRO-METER

Vibro-Meter-sponsored courses can be performed at Vibro-Meter Switzerland or at customer site. Courses are scheduled on customer request.

FOR FURTHER INFORMATION CONTACT:

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2006 Meetings	Date	Venue
Navigation Data Base	Jan 10-12	NASA Langley Hampton, Virginia
DLK Security	Jan 17-19	Columbia, Maryland
Digital Video	Jan 17-19	Honeywell, Inc. Phoenix, Arizona
Fiber Optics	Jan 18-19	Tempo Research Camarillo, California
TPS Quality	Jan 18-20	Atlanta, Georgia
Cockpit Display Sys	Jan 24-26	Phoenix, Arizona
DLK Users Forum	Jan 31-Feb 2	San Francisco, California
Aircraft Network File Server	Feb 7-9	Phoenix, Arizona
AMC	Apr 3-6	Hotel New York Paris, France