FAA HUMAN FACTORS PROGRAM EMPHASIS

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I would like to welcome you this morning to the FAA Meeting on Human Factors Issues in Aircraft Maintenance and Inspection. This meeting is the eighth in this series on human factors in maintenance. It serves to illustrate the FAA's continuing belief in the importance of the human element in the operation of the national air transport industry. My welcome is extended on behalf of our office in Aviation Standards and, in part, on behalf of the Office of Aviation Medicine, which has served as sponsor for all these meetings. The meetings provide a forum for the exchange of ideas and information among those working on the human factors technology base, those in industry who understand the day-to-day problems and are in a position to apply new technologies aimed at improving safety and efficiency, and those of us concerned with regulatory oversight of the U.S. aviation industry. We all benefit from this information exchange.

The theme for today's meeting is *Trends and Advances in Aviation Maintenance Operations.* Usually, with a theme such as this, we might be talking about new diagnostic equipment for examining aircraft structures, the incorporation of new composite materials in aircraft design, new techniques for corrosion proofing, and the like. While these topics might arise today, the focus of this meeting is on the human, and rightly so.

Recognizing the importance of the human in aviation operations is not a new insight. The Wright brothers clearly understood that a pilot was necessary in the first airplane. Likewise, a competent mechanic has always been considered necessary for continuing flight operations. These components represent the human essentials for aviation -- a good flight crew and a good maintenance team. As aviation has developed, we have learned that simply selecting and training a good pilot or a good mechanic may not be enough. Aviation safety requires continuing attention to the human. In flight operations, year after year statistics show that between 50 and 85 percent of all accidents list human error as either the primary or as a contributing cause. This is true of even highly motivated and well-trained flight crews. We must understand that the human is a fallible element in an aviation system and deal with this fact in system design and operation.

A good example of human-oriented problems in flight operations is found in incident reports submitted to NASA's Aviation Safety Reporting System. These reports describe in-flight and on-the-ground incidents that jeopardized safety. In a study of over 12,000 incident reports, more than 73 percent showed evidence of some problem in the transfer of information within the aviation system. The pilot misunderstood ATC instructions; ATC misunderstood the pilot's response; the pilot misread some information display in the cockpit; and so on. Fortunately, there are enough redundancies in aviation systems that most of these errors are detected and corrected before a catastrophe occurs. However, this is not always the case.

If communications represents a problem in flight operations, so can it be a problem in maintenance. Maintenance job cards can be misread; information can be lost during the transfer of responsibilities from one maintenance crew to another as shifts change; diagnostic signals can be misinterpreted; and so on. The human, however well motivated and well trained, requires on-going support in terms of his compatibility with the system in which he is working and in terms of the activities he is called on to accomplish.

The call to arms, in terms of the importance of human factors in aviation maintenance, came, as we all know, with the Aloha incident. Here we had an airplane, judged safe for flight as a routine matter, in which some 18 feet of the cabin structure suddenly was ripped away due to structural failure. Until that time, we operated on the philosophy and assumption that given proper inspection, preventive maintenance, replacement of parts as required, aircraft could be flown to their economic design goal and well beyond. The degree of damage to the Aloha airplane was shocking to everyone and was totally unexpected. Immediately, a number of questions were raised. One was "Should a fixed service life be set for aircraft in the commercial fleet?" Obviously, this is a difficult question to answer and raises any number of engineering and economic issues. One conclusion, however, was made immediately. If we are to combat the safety issues raised in the Aloha incident, the aviation maintenance technician represents our first line of defense. The success of any program to preclude future in-flight incidents comparable to that of Aloha rests with the performance of the aviation maintenance technician.

In order to bring full attention to problems of aging aircraft, an International Conference on Aging Aircraft was held in Washington, DC in June 1988. This conference highlighted the importance of human factors support for aviation maintenance. Dr. Bill Shepherd, who is our host today, noted that "The more we looked at problems in maintenance operations, and particularly those of aging aircraft, the more we saw human factors as some part of the problem."

When we speak of *human factors* in aviation, and particularly in aviation maintenance, we are dealing with a very broad topic. Dr. John Jordan, the Federal Air Surgeon, noted these when he addressed your group last year. The first human factors element affecting the performance of a maintenance technician is his *health*. Here, we refer to much more than whether or not he is sick. Health, again in the broad sense, can be affected by external as well as internal factors. For example, environmental influences such as noise and temperature can affect the momentary health of a worker and in turn his ability to perform his job well.

The second human factors element refers to the performance capability of a technician. Here we were interested primarily in the basic capacities of a worker to perform. Does he have the necessary strength, vision, etc. Of greater importance, however, are the effects of training. What are his performance capabilities after appropriate training for the task?

The next human factors element is one not usually considered in a discussion of human performance in complex systems, yet it is of great importance. Here I refer to any transitory condition which impacts performance. This might be recent or on-going drug use, emotional stress, financial problems, or any other factor that serves to degrade ability to perform. In the Office of Aviation Medicine, we support a number of research activities in which we identify the effects of substance abuse, whether abuse of alcohol or other drugs, on performance. Within the FAA, we also have an industry-wide anti-drug program in effect for all segments of aviation, including aviation maintenance.

The final human factors element to note is, for today's purposes, the most important one. Here I refer to *task demands*. This topic encompasses most of the typical human factors issues one would find in a text on this subject. Man-machine relationships, communication systems, job aids, and all components of the human/system interface are of concern. How does the human function as one part of this man-machine system? How must the system be structured to draw on the best human capabilities and reduce the potential for human error?

Just as we learn more of the complexities of human performance, we also note that aviation itself, and certainly aviation maintenance, is becoming more complex and, in turn, presenting new demands to the maintenance workforce. Procedures and systems for the delivery of maintenance information are changing. Hard copy is rapidly being replaced by electronic delivery systems. Do these changes improve maintenance quality? We do not know as yet. New composite materials are being tested for use in aircraft. These composites appear to have greater strength and lower weight than conventional aluminum plate. They also appear to offer a service life three to five times greater than that of corresponding aluminum structures, with greater resistance to fatigue crack growth after repeated stress loadings. What does this mean for inspection procedures and for repair requirements? Fiber optic harnesses now are being tested in aircraft for the transmission of flight deck maintenance data. While this system should increase transmission capacity, does it impose new maintenance requirements as well? Is the potential for maintenance error changed in either direction?

We might also note that All Nippon Airways recently opened a new hangar at Tokyo's Haneda Airport. This hangar is believed to be the world's largest truss-roofed aircraft hangar and has room for five wide-body transports. The hangar has an automated parts storehouse that can accommodate some 130,000 items. Will this facility, and its automated systems, have a significant affect on the quality of maintenance? Certainly, this facility is further indication of an increasing role for automation in maintenance programs. I suspect we will hear more about the pros and cons of automated maintenance systems in our presentations and discussions today and tomorrow.

Now, in closing, I would like to return again to our theme *Trends and Advances in Aviation Maintenance Operations*. The FAA program **"Human Factors in Aviation Maintenance"** has been in operation now for approximately five years. During this time research has been conducted; meetings have been held; reports have been prepared and distributed to industry. If nothing else, this effort can be justified in terms of the extent to which it has sensitized the aviation maintenance community to the importance of human factors and to the extent to which human factors technology can contribute both to operational efficiency and to the control of error. However, the contributions of this program go far beyond simple increased sensitivity. New human factors maintenance technologies have been developed and new ways of dealing with man-machine interface issues prepared. Some of this work has been done by the FAA and its contractor team. Other work has been done within industry facilities. Together considerable progress has been made. I am most interested in hearing the presentations today to learn of current industry programs and the successes for which we all may take some measure of credit.

This meeting should be a pleasant one as we review recent accomplishments. It should also be stimulating as we consider the challenges that lie ahead in a growing and increasingly complex maintenance industry. I wish you a very productive and successful meeting. Thank you.