



# Human Factors in Non-Destructive Testing

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## **THE RELIABILITY OF NON-DESTRUCTIVE TESTING**

(NDT) can be significantly influenced by the environment in which components are processed and inspected. Consideration of human factors is an area that is all too frequently overlooked. Human factors are typically dependent on a large number of influences, and the following may be areas in which you and your company may want to pay special attention when considering the NDT process within your company.

At a recent NDT Task Group meeting, the topic of human factors came up, and it took me back to my previous position as an FAA Repairman. Part of my responsibility was to help develop a Training Manual as a companion to our Repair Station and Quality Control Manual. Handbook Bulletin for Airworthiness Order 8300.10 then required human factors to be included in the training program. Numerous FAA documents had suggested elements on human factors but none that would apply to our small compressor blade repair facility.

Luck struck when our local Flight Standards District Office (FSDO) was having a two-day Aviation Safety Program Workshop and one of the topics was human factors. The facilitator defined human factors as "The discipline of optimizing the relationship between people and their activities by the systematic application of the human sciences, integrated within the framework of system engineering." He also defined human error as "Where there is general agreement that a person should have done something other than what they did."

Most important to our facility were the twelve human factors (the Dirty Dozen<sup>1</sup>) that can cause human error:

- Lack of Communication
- Lack of Resources
- Complacency
- Pressure
- Lack of Knowledge
- Lack of Assertiveness
- Distraction
- Stress
- Lack of Teamwork
- Lack of Awareness
- Fatigue
- Norms

The following is a synopsis of each of the human factors described in the presentation.

**Lack of Communication** is possibly the most important human factor issue that has played a role in aviation accidents. Either someone was assuming that someone else had done his/her job, or was not given proper instructions. Employees need to communicate before, during and at the end of each task and detailed information must be passed along at shift change.

**Complacency** is lack of sufficient stress. We all know that too much stress can cause confusion and fixation. However, too little stress can cause a person to be bored and complacent. When a person becomes complacent, not only does their stress level for the task decrease, but their performance decreases also. Error or complacency can be lessened by always following written instructions, procedures or specifications. Do not attempt to do work from memory, and never sign off on work if you are not totally sure that you have completed the task.

**Lack of Knowledge.** Aircraft systems are so complex and integrated today that it is next to impossible to perform the necessary tasks without substantial technical training and reference sources.

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*It has been suggested that if we make the effort to study one hour a day for a year on the subject of our profession, we will be among the top 15% of knowledgeable persons within our profession.*

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Make a daily commitment to spend a small part of everyday reading on subjects that affect you in your daily job to avoid falling victim to the lack of knowledge human factor.

**Distraction.** Psychologists have identified distraction as the number one cause of forgetting. We humans are always thinking ahead, both consciously and subconsciously. If we are distracted to the point of interruption during a task or procedure, when we return to the job, we often think we are further along than we actually are. Errors from distraction can be lessened by always finishing a task or marking the incomplete work, double inspect by another or self, and when

you return to the job always go three steps back and use a detailed check sheet.

**Lack of Teamwork.** Teamwork does not just happen by mistake; a lot of constructive communication needs to take place by all departments involved in order to produce teamwork. When there is trust and good communication among employees, teamwork develops. A good team member wants everyone to succeed; we can start out by praising the people we work with.

**Fatigue** is the body's normal reaction to physical or mental stresses of prolonged duration. Acute and operational fatigue is caused by hard work and long hours. Chronic fatigue, however, may be something that requires medical attention. Symptoms of fatigue can be reduced attention, diminished memory, withdrawn mood, and low situational awareness.

The three most important ways of dealing with fatigue are regular sleep, a well-balanced diet and a regular exercise program.

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*Editor's Note: According to Dr. Mark Rosekind, National Transportation Safety Board Member, 70 to 80 percent of all accidents are "because of human error." In a MRO facility, maintenance errors are foremost a safety issue, but it can be a financial issue, too. Consider for example, that engine problems yield at least half the flight cancellations, which cost an average \$66,000 each in the U.S., according to Boeing.*

—David Jensen

*"An Awakening to MX Personal Fatigue"  
Aviation Maintenance magazine, June/July 2012*

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**Lack of Resources.** A list of important resources would be money, people, time, tools and data/knowledge to name a few. Making sure that we have correct tools for the job is just as important as having the proper parts. Technical data is another critical resource which can lead to problems. If we cannot find the data, we need to ask a supervisor or technical representative. When we have the proper resources for the task at hand there is a greater chance that we will do a better and more efficient job.

**Pressure** can affect our judgment during critical moments at work. Pressure to complete the job is part of the stress that motivates us to do the job. Positive stress is the extra stimulation that helps us to perform at our best. Negative stress occurs when pressures layer one on top of the other and become uncomfortable. A few ways to reduce pressure is to put everything into perspective, be sure the pressure is not self-induced, communicate your concerns to someone in a position to make a difference or ask for extra help.

**Lack of Assertiveness.** Assertiveness can be defined as standing up for rights and expressing feelings in an honest, open, appropriate and direct way which will not violate

another person's rights. Assertiveness takes the view that all individuals can pursue their own goals, protect their own rights and achieve results without violating the rights of others. Assertiveness can be said to be the middle ground between aggressiveness and passiveness. One way to practice assertiveness is to refuse to compromise your standards and do what is right, even when no one supports you.

**Stress.** It's a blessing and a curse: a blessing in that it motivates us to perform and a curse in that it can adversely affect your health, both mental and physical. Stress can be created from many different sources, some can be family changes, work, or personal or financial issues. Knowing the early warning signs can give us a chance to use stress reduction or coping techniques. Some early signs are disruptions in eating patterns and sleep habits, errors in judgment occurring more frequently, poor concentration and memory loss become noticeable, personality changes and stomach distress. Techniques for reducing stress work differently in different people. Some examples are to go with change rather than against it. If job factors are creating stress, talk with your supervisor or someone in your organization in a position to make a difference, establish a balance between work, family and recreation, smile more, and laugh. Laughter is a proven stress-coping mechanism.

**Lack of Awareness,** or reduced situational awareness, can be an indication that one or more of the other human factors are in action, such as fatigue or distraction or lack of communication. To maintain our awareness level throughout our careers and in our day-to-day job we can rely on our experience and training. Experience creates a mental file of how one interprets and responds to conditions and events. Use your experience to maintain a constant state of awareness.

**Norms.** A norm in the context of the Dirty Dozen<sup>1</sup> means that our group has a better way to do the job than the written instruction, procedure or specification. It could be considered "Tribal Memory," which are unwritten rules enforced by the group, peer pressure or habit. Always work as per the instructions or have the instructions changed. At least if things go badly, we can say we were following the published procedure. "It's not my fault" is a nice position to hold.

Human factors should be considered in the design and operation of any NDT facility. The consideration of human factors will often lead to an efficient and effective NDT process. ●

<sup>1</sup> Due to a spate of maintenance-related aviation incidents and accidents in the late 1980s and early 1990s, Transport Canada, together with the aviation industry, identified 12 human factors and christened them the "dirty dozen." These human factors could degrade people's ability to perform effectively and lead to maintenance errors. (<http://aviationknowledge.wikidot.com/aviation:dirty-dozen>)