



U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: Maintenance Human Factors
Training

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AC No: 120-72A

Initiated by: AFS-300

Change:

1 PURPOSE OF THIS ADVISORY CIRCULAR (AC). This advisory circular:

1. Provides descriptions of references and training materials to ensure that the reader can assemble a Maintenance Human Factors (MxHF) training program matched to the applicable needs of their specific organization.
2. Provides many sources of current information to develop, implement, reinforce, and assess MxHF training materials.
3. Streamlines MxHF training development at the local level.
4. Is not mandatory, like any AC, and does not constitute a regulation. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way, and the document is intended only to provide information to the public regarding existing requirements under the law or agency policies.

2 AUDIENCE. This AC applies to the following regulated Title 14 of the Code of Federal Regulations (14 CFR) entities:

- Air carriers or air operators conducting operations in accordance with part 121 or 135.
- Operators conducting operations in accordance with part 91, 91 subpart K (part 91K), 125, 133, or 137.
- Airmen certification course operators who provide instruction and evaluation of Aviation Maintenance Technicians (AMT) in accordance with part 65.
- Persons performing airmen certification of AMTs in accordance with part 65.
- Individuals performing maintenance or preventive maintenance in accordance with part 43.
- Repair stations operating in accordance with part 145.
- Aviation Maintenance Technician School (AMTS) programs that provide instruction and evaluation in accordance with part 147.
- Organization Designation Authorization (ODA) holders under part 183 subpart D.

3 WHERE YOU CAN FIND THIS AC. You can find this AC on the Federal Aviation Administration's (FAA) website at https://www.faa.gov/regulations_policies/advisory_circulars and the Dynamic Regulatory System (DRS) at <https://drs.faa.gov>.

- 4 WHAT THIS AC CANCELS.** This AC cancels AC 120-72, Maintenance Resource Management Training, dated September 28, 2000.
- 5 DEFINITIONS.** For the purposes of this AC, the terms listed below have the following meanings:
1. Active Failure. A type of human error whose effects are felt immediately in a system.
 2. Certificate Holder (CH). Air carriers, operators, and air agencies.
 3. Compliance Program. Federal Aviation Administration (FAA) recognition, established in 2015, that most operators comply with regulations and also use Safety Management Systems (SMS) to identify hazards and mitigate risk. The philosophy avoids immediate strict enforcement action for inadvertent violations/errors, instead focusing on best timely means to achieve compliance.
 4. Crew Resource Management (CRM). Team-based human factors (HF) training focusing on effective use of all available resources: human resources, hardware, and information.
 5. Dirty Dozen. The twelve most common maintenance-related causes of errors. These twelve causes are:
 - Lack of Communication.
 - Complacency.
 - Lack of Knowledge.
 - Distraction.
 - Lack of Teamwork.
 - Fatigue.
 - Lack of Resources.
 - Pressure.
 - Lack of Assertiveness.
 - Stress.
 - Lack of Awareness.
 - Norms.
 6. Ergonomics. The applied science having the objective of adapting work, working conditions, and equipment to enhance performance of the worker.
 7. Human Factors (HF). HF is a multidisciplinary field that generates and compiles information about human capabilities and limitations, and applies it to design, development, and evaluation of equipment, systems, facilities, procedures, jobs, environments, staffing, organizations, and personnel management for safe, efficient, and effective human performance.

8. Instructional Systems Design (ISD). A generic term for the methodology of creating and implementing a training program.
9. Leadership. The ability to direct and coordinate the activities of group members and stimulate them to work together as a team.
10. Maintenance Resource Management (MRM). A general process for maintaining an effective level of communication and safety in maintenance operations. This term was more widely used in the 1990s than currently. In comparison, the term Maintenance Human Factors (MxHF) is more descriptive, all-encompassing, and widely used.
11. People, Environment, Actions, Resources (PEAR). A summary of the concept suggesting that the following words help describe any HF situation to include: People, Environment, Actions, and Resources.
12. Safety Culture. A pervasive, organization-wide attitude placing safety as the primary priority driving the way employees perform their work.
13. Safety Management System (SMS). A formal, top-down business approach to managing safety risk, which includes a systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies, and procedures.

6 ACRONYMS AND ABBREVIATIONS.

1. AC Advisory Circular.
2. AMT Aviation Maintenance Technician.
3. AMTS Aviation Maintenance Technician School.
4. CAA Civil Aviation Authority (UK).
5. CASA Civil Aviation Safety Authority (Australia).
6. CFR Code of Federal Regulations.
7. CH Certificate Holder.
8. CRM Crew Resource Management.
9. DOT Department of Transportation.
10. EASA European Aviation Safety Agency.
11. FAA Federal Aviation Administration.
12. FSIMS Flight Standards Information Management System.
13. HF Human Factors.
14. ICAO International Civil Aviation Organization.
15. ISD Instructional Systems Design.
16. MxHF Maintenance Human Factors.
17. MRM Maintenance Resource Management.

- 18. MRO Maintenance Repair Organization.
- 19. NAA National Aviation Authority.
- 20. ODA Organization Designation Authorization.
- 21. PEAR People, Environment, Actions, Resources.
- 22. SMS Safety Management System.
- 23. TC Transport Canada.

7 BACKGROUND.

7.1 CRM Transition. CRM on the flight deck started the attention to MxHF in the late 1980s. It remains important for continuing safety. Matters of organizational culture remain very important today and are contained in many of the references cited herein. The aviation community has expanded its approach to continuing safety by identifying, analyzing, and managing risk. While this AC replaces the original AC 120-72 (September 2000), it continues to endorse the importance of the organization and safety culture.

7.2 MxHF Implementation. Since 2000, there has been an extensive acceptance of the importance of HF training and programs for maintenance environments. Many MROs, U.S. carriers, U.S. Air Agencies, and U.S. Air Agencies with EASA Part-145 approval certificates have implemented required HF programs since 2005. FAA Airworthiness inspectors have been taking the 3-day HF course since 2006. Required or not, U.S. maintenance organizations and airlines have implemented MxHF programs for commercial reasons, like worker safety and reduced maintenance rework.

7.3 Evolving Part 147 School Interest in HF. The AMT General Exam tests on the HF topics as described in the FAA Aviation Maintenance Technician Handbook—General, Chapter 14, Human Factors. Since many new part 147 school graduates find employment in U.S.-based EASA Part-145 MROs, that further stimulates school interest in quality MxHF training.

8 TRAINING SUMMARY. Delivering new and modern HF training does not have to be complicated. Appendix [A](#), Related Material, provides the links to all necessary materials. The two most significant available training programs are available from the FAA and from the CASA of Australia (see Appendix A for websites). Whatever material you decide to use, it should match your organizational needs dictated by your SMS or other risk assessment programs.

8.1 Sample Topics Summary. There are no FAA regulations that mandate specific content requirement for MxHF content. The most common topics covered in an MxHF training program are reflected in EASA, TC, and other NAA regulations. Those sample topics are:

- General HF Introduction.
- Safety Statistics.

- Safety Culture and Organizational Factors.
- Human Performance and Limitations.
- The Physical Work Environment.
- Human Error.
- Physiological Factors.
- Communication at Work.
- Hazards in the Workplace.

9 AC FEEDBACK FORM. For your convenience, the AC Feedback Form is the last page of this AC. Note any deficiencies found, clarifications needed, or suggested improvements regarding the contents of this AC on the Feedback Form.



John Barbagallo
Deputy Director, Flight Standards Service

APPENDIX A. RELATED MATERIAL

A.1 References. The references in this appendix contain links and information to a variety of hardcopy and multimedia training for human factors (HF) to empower those who develop and deliver Maintenance Human Factors (MxHF) training. The most important links are to the FAA and Civil Aviation Safety Authority (CASA) HF training websites. The following bibliographic information is critical to the value of this AC. It is the most important part of the AC because it takes you to the best information sources. It brings together a detailed listing of information sources that help the reader to prepare for and deliver up-to-date MxHF training. This document does not attempt to include the content of these resources due to the abundance of material. Many of the references contain annotations to help guide the reader.

A.1.1 Human Factors (HF). The documents below focus on a variety of general, as well as maintenance-specific, HF materials. Many are available at no cost from the FAA and other National Aviation Authorities (NAA).

1. Aircraft Technical Books Company. (2016). *Module 9 Human Factors Training*. Tabernash, CO. Available at www.actechbooks.com.
2. Civil Aviation Authority (CAA) UK. (2009). *Aviation Maintenance Human Factors, EASA Part-145 (CAP 716)*. West Sussex, UK. Available at <https://www.caa.co.uk/>.
3. Civil Aviation Safety Authority (CASA) of Australia. (2013). *Safety Behaviours: Human Factors for Engineers. A Multimedia Training System*. Available at <https://www.casa.gov.au/safety-management/standard-page/safety-behaviours-human-factors-engineers-resource-kit>.

Note: The training materials, including videos, available at this site are an absolute must for HF trainers.

4. Code of Federal Regulations (CFR). (2014). Title 14 CFR part [145](#), § [145.163](#), Training Requirements.
5. Dekker, S. (2006). *The Field Guide to Understanding Human Error*. Burlington, VT: Ashgate.
6. FAA. (2006, 2nd edition). *The Human Factors Guide for Aviation Maintenance and Inspection*.
7. FAA. FAA Order 8900.1, Volume 6, Chapter 9, Section 14, Safety Assurance System: Inspect, Review, and Approve a Part 145 Repair Stations' Training Program. Available via the applicable Flight Standards (FS) repository at <https://drs.faa.gov/browse>. Washington, DC.

Note: This section of the order shows FAA inspectors an outline for the training manual.

8. FAA. *Fatigue Education and Awareness Training Program*. AC [117-2](#). Washington, DC.

9. FAA. *Fitness for Duty*. AC [117-3](#). Washington, DC.

Note: The FAA prepared this material for flight operations, but it is relevant to maintenance.

10. FAA. *Crew Resource Management Training*. AC [120-51](#). Washington, DC.

11. FAA. *Basics of Aviation Fatigue*. AC [120-100](#). Washington, DC.

Note: The FAA prepared this material for flight operations, but it is relevant to maintenance.

12. FAA. *Fatigue Risk Management Systems for Aviation Safety*. AC [120-103](#). Washington, DC.

Note: The FAA prepared this material for flight operations, but it is relevant to maintenance.

13. FAA. *Repair Station Training Program*. AC [145-10](#). Washington, DC.

Note: This AC addresses all aspects of maintenance training-specific design, development, delivery, and evaluation. It makes recommendations for HF training content so that it also meets EASA Foreign Part-145 requirements.

14. Hobbs, A., Avers, K. B., Hiles, J. J. (2011). *Fatigue Risk Management in Aviation Maintenance: Current Best Practices and Potential Future Countermeasures*. (Technical Report DOT/FAA/AM-11/10.) Washington, DC: FAA Office of Aerospace Medicine.

Note: This document discusses many aspects of maintenance-related fatigue and offers suggested interventions.

15. International Civil Aviation Organization (ICAO). (1998). *Human Factors Training Manual*. (Doc 9683-AN/950). <https://www.globalairtraining.com>.

16. ICAO. (2003). *Human Factors Guidelines for Aircraft Maintenance*. (Doc 9824-AN/450). https://www.faa.gov/about/initiatives/maintenance_hf/library/documents.

17. infoWerk-Media. (2016). *Training for Human Factors and for Fatigue Risk Management*. Zirl, Austria. Available at www.infowerk.at.

18. Johnson, W. B. (2007). *The Maintenance Human Factors Presentation System*. https://www.faa.gov/about/initiatives/maintenance_hf.

Note: Multimedia presentation with 135 PowerPoint slides with notes and 11 video programs written and co-produced by William B. Johnson. It is an absolute “must have” for those developing or modifying MxHF training.

19. Johnson, W. B. (2010). *Grounded*. Available at https://www.faa.gov/about/initiatives/maintenance_hf.

Note: A maintenance fatigue story written for video. Produced on September 14, 2010, this award-winning video can be used for initial HF training, continuation training, or merely for fatigue awareness training. Also available on YouTube.

20. Johnson, W. B. (2013). “Need HF Training? Look Down Under.” *Aircraft Maintenance Technology*. September 2013, pages 36–40.
21. Johnson, W. B. (2013). “Maintenance Human Factors Training: Time for Curricula Renewal.” *Aviation MX Human Factors Newsletter*. Volume 1, Issue 4, December 2013. (Refer to https://www.faa.gov/about/initiatives/maintenance_hf.)
22. Johnson, W. B. (2015). “Human Factors Training: How FAA Trains Airworthiness Inspectors.” *Aircraft Maintenance Technology*. August 2015, pages 30–31.
23. Johnson, W. B. (2015). “Two Countries Apply Trusted Human Factors Model to Manage Safety.” *Aviation MX Human Factors Newsletter*. Volume 3, Issue 1, March 2015. (Refer to https://www.faa.gov/about/initiatives/maintenance_hf.)
24. Johnson, W. B. and Avers, K. A. (Eds.) (2014). *The Operator’s Manual for Human Factors in Aviation Maintenance*. Washington, DC: FAA Office of Aerospace Medicine. (Refer to https://www.faa.gov/about/initiatives/maintenance_hf.)

Note: Chapter 3 is dedicated to HF training.

25. Johnson, W. B. and Bryant, M. (2015). “A Human Factors Program Health Checklist.” *Aviation MX Human Factors Newsletter*. Volume 3, Issue 3, September 2015, pages 1-5. (Refer to https://www.faa.gov/about/initiatives/maintenance_hf.)

Note: While this is an HF program checklist, it can also be a training aid.

26. Lufthansa Technical Training. (2016). *Computer-Based Training for Human Factors*. Frankfurt, Germany. (Refer to <https://www.ltt.aero>.)
27. Reason, J. T. and Hobbs, A. (2003). *Managing Maintenance Error: A Practical Guide*. Hampshire, UK: Ashgate.
28. Reason, J. T. (1997). *Managing the Risks of Organizational Accidents*. New York, NY: Ashgate.
29. Salvendy, G. (Ed.) (1997). *Handbook of Human Factors and Ergonomics*. New York, NY: John Wiley & Sons.

A.1.2 HF and Industrial Safety Websites.

1. Aviation MX Human Factors Newsletters. https://www.faa.gov/about/initiatives/maintenance_hf/fatigue/publications/.

Note: This quarterly newsletter provides interesting and valuable new information to refresh your HF classes.

2. Blue Tuna. Aviation Human Factors Training. <https://www.bluetunadocs.com/aviation-human-factors-training/>.

Note: Commercial provider of web-based HF training.

3. CAA UK, List of Human Factors Publications. <https://www.caa.co.uk/Our-Work/Publications/Publications/>.

4. Dupont, Gordon, Father of the Dirty Dozen. System Safety Services. <https://www.system-safety.com>.

5. FAA Lessons Learned From Transport Airplane Accidents—Accident Common Themes—Human Error. <https://lessonslearned.faa.gov/>.

Note: An award-winning website that helps one learn about HF from event experiences.

6. Health and Safety Executive (UK): Human Factors and Ergonomics Website. <https://www.hse.gov.uk/humanfactors/>.

7. Human Factors and Ergonomics Society—Publications. <https://www.hfes.org/publications/>.

Note: This site provides general HF information, not necessarily related to maintenance.

8. Human Factors in Aviation Maintenance. https://www.faa.gov/about/initiatives/maintenance_hf/.

Note: This is the largest MxHF resource in the world. We strongly suggest bookmarking it.

9. Ford, J.K. (2014). *Improving Training Effectiveness in Work Organizations*. New York, NY: Psychology Press.

10. Sofema Aviation Services. EASAOnline.

Note: Commercial provider of HF eLearning.

11. Skybrary Human Factors Training. <https://skybrary.aero/>.

A.1.3 Training Design Resources. These documents are extremely important information sources for training system design. If you have to build training, you should look at these sources. Remember that there are a lot of HF training materials available where the design work is already completed. The FAA and CASA materials are but two examples.

1. American Society for Training and Development. (2008). *ASTD Handbook for Workplace Learning Professionals*.
2. American Society for Training and Development Editors. (2007). *Instructional Systems Development: An Infoline Collection*.
3. Air Transport Association of America (ATA) Spec 104. (2017). Available for purchase by non-Airlines for America (A4A) members at <https://publications.airlines.org/CommerceProductDetail.aspx?Product=11>.
4. Barbazette, J. (2007). *Managing the Training Function for Bottom Line Results: Tools, Models and Best Practices*. John Wiley & Sons. (Essential Tools Resource.)
5. Biech, E. (2009). *10 Steps to Successful Training*. ASTD Press.
6. FAA HF Research and Engineering group web portal—HF Training. <https://www.hf.faa.gov>.
7. Hodell, C. (2004). *Basics of Instructional Systems Development*. ASTD Press.
8. Johnson, W. B. (2008). “Designing Training Programs for Human Factors”—a chapter in *The Maintenance Human Factors Guide, 2nd Edition*. (Refer to https://www.faa.gov/about/initiatives/maintenance_hf.)
9. Kirkpatrick, D. L. and Kirkpatrick, J. D. (2007). *Implementing the Four Levels: A Practical Guide for Effective Evaluation of Training Programs*. Berrett-Koehler.
10. Morrison, G. R., Ross, S. M., and Kemp, J. E. (2006). *Designing Effective Instruction*. John Wiley & Sons.
11. Phillips, J.J. and Pulliam-Phillips, P. (2005). *ROI at Work*. ASTD Press.
12. Rothwell, W. J. and Kazanas, H. C. (2008). *Mastering the Instructional Design Process: A Systematic Approach*. John Wiley & Sons.
13. Walter, D. (2002). *Training on the Job*. ASTD Press.

A.1.4 ICAO Documents. The following ICAO documents are available from:

ICAO
Document Sales Unit
999 Robert-Bourassa Boulevard
Montreal, Canada H3C 5H7
Phone: +1 514-954-8219
Fax: +1 514-954-6077
Email: icaohq@icao.int

1. ICAO, International Air Transport Association (IATA), International Federation of Air Line Pilots' Associations. (2011). *Fatigue Risk Management Systems: Implementation Guide for Operators*.
2. ICAO. (1989). Human Factors Digest Number 2. *Flight Crew Training: Cockpit Resource Management (CRM) and Line-Oriented Flight Training (LOFT)*. (Circular 217-AN/132.) Montreal, Canada.
3. ICAO. (1993). Human Factors Digest Number 10. *Human Factors, Management and Organization*. (Circular 247-AN/148.) Montreal, Canada.
4. ICAO. (1995). Human Factors Digest Number 12. *Human Factors in Aircraft Maintenance and Inspection*. Montreal, Canada.

Note: This document provides a very good overview of the problems in aviation maintenance. It uses a few high profile accidents to illustrate its points and discusses the importance of looking past the obvious micro issues to organizational culture factors, which contribute to latent failures and overall systems problems.

5. ICAO. (1995). *Annex 6: To the Convention on International Civil Aviation, Part I: International Commercial Air Transport-Aeroplanes*. Montreal, Canada.
6. ICAO. (2009). *Safety Management Manual (SMM), 2nd edition*. (Doc 9859-AN/474.) Montreal, Canada.
7. ICAO. (2013). *Safety Management Manual (SMM), 3rd edition*. (Doc 9859-AN/474.) Montreal, Canada.
8. ICAO. (2012). *Fatigue Risk Management Systems—Manual for Regulators*. (Doc 9966.) Montreal, Canada.

Advisory Circular Feedback Form

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by contacting the Flight Standards Directives Management Officer at 9-AWA-AFB-120-Directives@faa.gov.

Subject: AC 120-72A, Maintenance Human Factors Training

Date: _____

Please check all appropriate line items:

An error (procedural or typographical) has been noted in paragraph _____
on page _____.

Recommend paragraph _____ on page _____ be changed as follows:

In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

Other comments:

I would like to discuss the above. Please contact me.

Submitted by: _____

Date: _____