Aeronautical MRO

EGA Master's Value Proposition

The aeronautical sector faces constant pressure: to reduce downtime, comply with strict technical regulations, and ensure safety in every intervention. In this environment, MRO (Maintenance, Repair and Overhaul) is not merely an operational necessity, but a strategic pillar of competitiveness.

INTRODUCTION

The aeronautical sector is under constant pressure: to **reduce downtime, comply with stringent technical regulations, and ensure safety in every intervention**. In this context, MRO (Maintenance, Repair and Overhaul) is not merely an operational requirement but a strategic pillar of competitiveness.

EGA Master, with decades of industrial experience and a solution-driven engineering approach, has developed offerings tailored to the real needs of both civil and military aerospace maintenance environments. This document provides a technical overview of MRO and how to optimise it through customised tool kits, control systems, and design focused on airworthiness.

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1

MRO: MUCH MORE THAN MAINTENANCE

The term MRO (Maintenance, Repair and Overhaul) in aviation goes far beyond performing isolated maintenance tasks or repairs. MRO is a complex, multidimensional ecosystem that encompasses all activities required to ensure that an aircraft remains airworthy, safe, and operational within demanding regulatory and commercial standards.

It's not just about changing a tire or inspecting an electrical system; it involves the coordination of technical, human, and logistical resources to maintain the aircraft's availability and reliability in optimal condition. The entire process must align with strict international regulations—such as those set by EASA (European Union Aviation Safety Agency) or the FAA (Federal Aviation Administration)—as well as the internal protocols of each operator or manufacturer.

1.1 KEY DIMENSIONS OF MRO

Line Maintenance

Line Maintenance refers to quick, typically routine and scheduled interventions carried out between flights or while the aircraft is on the apron. These activities are essential to ensure that the aircraft is ready for its next mission with maximum safety and efficiency.

- Typical examples include:
- Visual and functional inspections of basic systems
- Tyre or light replacement
- Fluid replenishment (oil, hydraulic)
- Minor repairs that do not require disassembly

This type of maintenance is characterized by its speed and frequency, as it must be performed with minimal disruption to avoid impacting normal operations.

Base Maintenance

Base Maintenance involves deeper and more complex interventions, generally scheduled at longer intervals (such as the well-known C-Checks and D-Checks). These are carried out in specialized workshops or hangars equipped with advanced technical infrastructure.

Key characteristics include:

- Comprehensive inspections that may involve disassembly of systems or components
- Detailed structural inspections to detect fatigue or corrosion
- Major repairs and replacement of critical parts
- Extensive functional testing

This type of maintenance is essential to ensure the aircraft's structural and functional integrity over the long term, but it requires the aircraft to be out of service for days or even weeks.

MRO is a complex, multidimensional ecosystem that encompasses all activities required to ensure an aircraft is airworthy, safe, and operational

AOG (Aircraft on Ground)

AOG (Aircraft on Ground) is the most critical situation in MRO: when an aircraft is grounded due to an unexpected failure or incident and cannot operate until the issue is resolved.

Every minute counts, as the downtime directly impacts commercial operations and can result in significant costs from lost flights and customers.

The AOG team must respond swiftly and accurately, mobilizing resources, spare parts, and experts to resolve the issue as quickly as possible.

Spare parts management in AOG situations is vital: having adequate stock and rapid access to critical components can mean the difference between a quick repair and a prolonged delay.

Aviation MRO is a comprehensive discipline that combines technical expertise, logistical management, regulatory compliance, and operational capability to keep the aircraft in optimal condition, ensuring its availability and safety at all times.

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2

TYPES OF INSPECTIONS AND THEIR IMPACT ON PLANNING

Periodic inspections are the backbone of aeronautical maintenance. They enable timely detection of potential faults, ensure the structural and functional integrity of the aircraft, and guarantee compliance with regulatory standards. Each type of inspection is designed based on technical complexity, operational usage, and elapsed time, creating a maintenance schedule that directly impacts fleet operations and planning.

Below are the main types of inspections and their operational impact:

TYPE	FREQUENCY	OPERATIONAL EXAMPLE
Transit/Daily	Every day	Visual checks, inspection of lights, brakes, and fluid levels. Typically performed before the first flight of the day or between flights
A-Check	Every 400–800 flight hours	Light maintenance that can be performed on the ramp or in hangars without requiring extended downtime. Includes functional tests, system inspections, and minor repairs.
C-Check	Every 18–24 monthss	Thorough inspection involving extensive structural and functional checks. The aircraft is grounded for days or weeks and the process includes partial disassembly and specialized work.
D-Check	Every 6–10 years	Complete overhaul—the most exhaustive and costly inspection. It requires disassembling nearly the entire aircraft to inspect and renew systems, structures, and critical components. Downtime can last several weeks or even months.

2.1 IMPACT ON MRO PLANNING

Each type of inspection requires not only different technical capabilities but also specific logistics and detailed planning.

Tools and Equipment

From simple hand tools for daily checks to sophisticated equipment for non-destructive testing, electronic diagnostics, and structural disassembly.

Infrastructure

Minor inspections can be performed on the ramp or in basic hangars, whereas C and D-Checks require large hangars equipped with scaffolding, lifts, environmental control systems, and component storage areas.

Specialized Personnel

Certified technicians for each type of inspection, ranging from line mechanics to engineers and specialists in complex structures and systems.

Documentation and Control

Each inspection generates comprehensive documentation that must comply with national and international regulations. This includes records of work performed, regulatory compliance, and strict control of potential FOD (Foreign Object Debris) to prevent damage.

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Parts and Spare Management

Planning ahead for the availability of critical spare parts is key, especially for C and D-Checks, which involve major replacements and complete overhauls.

Operational Impact

Planning must balance maintenance needs with aircraft availability to avoid impacting fleet operations and profitability.

Efficient management of the different types of inspections is vital to ensure aircraft safety and operational continuity, while optimizing costs and downtime. MRO planning must be proactive, integrated, and tailored to each operator's specific circumstances.

MRO planning must be proactive, integrated, and tailored to the specific realities of each operator

3

THE REGULATORY FRAMEWORK: THE COMMON LANGUAGE OF THE INDUSTRY

Maintenance, repair, and overhaul (MRO) of aircraft is regulated by international organizations and national or regional aviation authorities that set the technical, organizational, and safety requirements operators, technicians, and maintenance centers must meet. Understanding this regulatory ecosystem is essential to operate in compliance, ensure operational safety, and offer solutions aligned with industry needs.

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3.1 REGULATIONS BY REGION AND SCOPE

ICAO (International Civil Aviation Organization):

Scope: Worldwide (UN agency)

Role: Establishes general principles and standards for international civil aviation, set out in the Annexes to the Chicago Convention.

Impact on MRO: Does not directly regulate technical operations but serves as a global reference framework for harmonizing national regulations such as EASA and FAA.

EASA (European Union Aviation Safety Agency):

Scope: Europe (European Union + associated countries)

Role: European agency regulating airworthiness and aviation safety, including certifications, licenses, and maintenance.

Key MRO Regulations:

- Part-145: Certification of maintenance organizations
- Part-66: Qualification of technical personnel (B1, B2, C licenses)
- Part-M / ML: Continuous airworthiness management (CAMO)

Implications: Requires traceability, documentation, tool calibration, standardized processes, and rigorous technical compliance.

FAA (Federal Aviation Administration):

Scope: United States (and international reference)

Role: U.S. aviation authority, counterpart to EASA in Europe.

Key MRO Regulations:

- FAR Part 43: Maintenance standards
- FAR Part 145: Certification of maintenance centers
- FAR Part 65: Certification of technical personnel

Implications: Although standards differ, many global operators and manufacturers comply with both FAA and EASA regulations for commercial or contractual reasons.

3.2 TECHNICAL STANDARDS AND REGULATIONS

Beyond regulatory agencies, technical standards facilitate interoperability and organization within maintenance workshops.

ATA iSpec 2200: A standardized structure based on technical chapters (ATA Codes) to organize documentation, aircraft systems, and tools.

To manage the enormous technical complexity of aircraft, the industry uses the ATA (Air Transport Association) structure, which codes systems and operations into standard chapters. This facilitates communication and the organization of tasks, documentation, and tools.

Some relevant ATA chapters include:

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ATA	System
28	Fuel
32	Landing Gear
35	Oxygen
34	Navigation/Avionics
25	Cockpit
52-57	Structure/Composites

TABLE WITH DIFFERENT REGULATIONS

Characteristics / Role	EASA (Europe)	FAA (USA)	ICAO (Global)	ATA (Industry)
Full Name	European Union Aviation Safety Agency (EASA)	Federal Aviation Administration (FAA)	International Civil Aviation Organization (ICAO)	Air Transport Association (Now A4A)
Type of Entity	Government Agency (EU)	Government Agency (USA)	UN Specialized Agency	Industry Association /Standards Body
Geographical Scope	EU + Associated States (e.g. Norway)	United States	Worldwide (193 ICAO member states)	Global (used industry-wide)
Primary Role	Regulate and enforce aviation safety	Regulate and enforce aviation safety	Establish international standards and policies	Provide technical documentation standards
Key Publications	Regulations: Part-145, Part-66, Part-M	Regulations FAR 145, 43, 91,etc.	Annexes (6, 8, 19), Documents (9760, etc.)	ATA iSpec 2200 (manual structuring)
Enforcement Authority?	Yes (within the EU)	Yes (within the USA)	No (Only provides guidance)	No (used voluntarily by OEMs and MROs)
Area of Focus	EASA Parte - 145	FAA FAR 145	ICAO Annex 6 or Document 9760	ATA 100 / iSpec 2200
Relationship with others	Adapts ICAO, coordinates with FAA	Adapts ICAO, coordinates with EASA	Sets foundational standards used by FAA, EASA, others	Supports tools/ organization structures for EASA/ FAA

While ICAO establishes the global framework, EASA and FAA define how it is applied in Europe and the U.S., respectively. Understanding these differences is essential to provide technical solutions (such as tool kits or traceability systems) that are valid, safe, and certifiable across different regions.

EGA Master designs its solutions in line with these regulatory frameworks, enabling technicians, MRO centers, and operators to comply with required standards without compromising efficiency or safety.

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4

TOOLS AS SAFETY FACTOR

In the aerospace MRO environment, the diversity and complexity of tasks demand precise organization of tools. Each type of intervention requires a specific kit tailored to its particularities, timing, environment, and technical requirements. This segmentation not only enhances efficiency but is fundamental to complying with safety standards and current regulations.

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4.1 LINE MAINTENANCE KITS

Main Features: These kits are compact, lightweight, and highly portable, designed to facilitate quick and recurrent interventions performed between flights or on the airport apron. Their primary objective is to ensure the aircraft can continue operating safely without significant delays.

Contents and Functionality: They include basic and frequently used tools such as wrenches, screwdrivers, quick-measurement instruments, and components for visual checks or minor adjustments on brakes, lights, electrical systems, or tires.

- They also incorporate devices for rapid, simple inspections to identify obvious issues or perform immediate adjustments.
- The design enables quick location and return of each tool, minimizing the risk of loss or Foreign Object Debris (FOD).

Operational Importance: Given that the intervention window can range from minutes to a few hours, these kits are optimized for maximum speed and functionality with minimal volume and weight.

4.2 BASE MAINTENANCE KITS

Main Features: These kits are much more comprehensive and complex, designed for tasks carried out in main hangars or workshops where the aircraft remains grounded for an extended period for deep maintenance.

ATA Organization: They follow the ATA structure to organize tools by technical systems (engines, landing gear, avionics, structures, etc.), making it easier for technicians to have everything they need for a specific system in a single kit or tray.

Specialized Contents: They include advanced and specific tools such as:

- Borescopes for internal inspections of engines or visually inaccessible systems.
- Crimping tools and wire strippers for precision electrical and avionics work.
- Calibrated measuring equipment for structural inspections.
- Kits for disassembly and reassembly of complex components.

Operational Importance:

These kits enable technicians to perform high-level interventions with the full range of required tools, improving quality and reducing downtime due to missing equipment.

4.3 AOG KITS (AIRCRAFT ON GROUND KITS)

Main Features: These kits are designed for emergency situations or unexpected breakdowns when an aircraft is grounded (AOG). They are highly portable, durable, and traceable to ensure a fast and safe response anywhere.

Usage Conditions: They must withstand harsh conditions such as extreme weather or challenging environments (remote airstrips, improvised hangars). For this reason, their cases and packaging are robust and allow for secure transport**.**

Critical Contents: They include the essential tools for quick diagnostics, temporary repairs, and operational recovery:

- Special wrenches and universal adapters.
- Quick diagnostic devices and temporary repair kits.
- Documentation and labeling for strict usage control and traceability.

Each type of kit addresses specific needs, with features tailored to the environment and the complexity of the tasks.

Operational Importance:

In AOG situations, every minute counts to minimize economic and logistical losses. These kits allow for rapid response while ensuring traceability and safety.

4.4 SPECIALIZED WORKSHOP KITS

Main Features:These kits are designed for highly specific technical areas within MRO that require specialized tools and extremely careful handling.

Included Sectors:

- **Sheet metal and structural repairs:** tools for cutting, shaping, and repairing metal panels.
- **Composites:** kits for handling and repairing composite materials, including resins, adhesives, and precision equipment.
- **Non-Destructive Testing (NDT):**instruments for ultrasonic, radiographic, magnetic, and dye penetrant inspections.
- **Aircraft carpentry:** tools specifically for interior work, paneling, and structural components made of wood or similar materials.

Precision and Care: These kits require strict management to ensure that every tool is calibrated and well-maintained, as errors in these areas can compromise structural integrity or maintenance quality.

Operational Importance: Given their specialized and critical use, proper organization and traceability are essential to avoid delays and ensure the final quality of the work.

Proper classification and management of tool kits according to their intended use not only optimizes MRO processes but is also a fundamental pillar of aviation safety. Each type of kit addresses specific needs, with features adapted to the environment and complexity of the tasks, facilitating efficiency, traceability, and regulatory compliance.

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5
SOLUTIONS BY THE EGA GROUP

EGA Master does not offer a generic catalogue. It provides tailored solutions aligned with the real challenges faced by maintenance technicians.

5.1 Tool Control System

As outlined throughout this document, tool control is essential in many industries—particularly where lost or forgotten tools increase risk and compromise safety, such as in aircraft repair, wind turbine maintenance, or high-altitude construction.

To address this, EGA Master offers an exclusive and customized tool control system designed to prevent loss and ensure accountability.

5.1.1 EGAWARE Software

In the aviation MRO sector—where traceability, operational safety, and tool accountability are essential to preventing incidents like FOD (Foreign Object Debris)—smart tool management is key.

That's why the EGA Group has developed EGAWARE, a digital management system for tools, equipment, and consumables, specifically designed for demanding aerospace maintenance environments.

Key features include:

- ***Access and movement control:*** Digital log of tool check-ins and check-outs during shifts, providing full traceability of each item's origin and destination.
- ***Certification and recalibration management:*** Automated alerts for recertification, inspection, periodic maintenance, and calibration of critical equipment.
- ***Location tracking and return guidance:*** Clear indication of the designated location for each tool after use, minimizing losses and placement errors.
- ***Automated provisioning requests:*** Real-time detection of supply needs and automatic digital requests, eliminating paperwork.

The EGAWARE software allows to track which user takes or returns each tool

- ***Advanced connectivity:*** Generates usage and consumption reports, sends alerts (e.g. tool not returned, use outside authorized hours), and supports remote access via WiFi or SIM.
- ***Flexible and centralized control:*** Compatible with fixed storage systems, mobile tool carts, shelving, and RFID systems, enabling centralized oversight across multiple storage points.
- ***Smart electronic locking:*** Access restricted by technician profile, both at general and individual tray level, eliminating the need for traditional key management.

EGAWARE is the One-Stop solution to ensure traceability, efficiency, and safety in tool management within aviation MRO operations.

Maintenance personnel must be familiar with safety procedures and protocols, as well as the specific technologies and equipment used

5.1.2 Smart Drawer Opening System

This system prevents errors in the selection of tools and equipment, thereby increasing efficiency and, consequently, productivity.

Each drawer is linked to an RFID card that must be scanned on the tool cart's reader, allowing the drawers to be opened or locked as required.

Laser technology that detects errors such as drawers not being fully closed.

LED indicators on each drawer that provide visual feedback on the status (open/locked).

The smart drawer opening system prevents errors in the selection of tools and equipment.

5.2 CONTROLLED TIGHTENING

In the installation, maintenance, and repair processes of aircraft engines — including turbines and Auxiliary Power Units (APUs) — it is essential to carry out tightening, inspection, and replacement of bolted joints.

These tasks require the precise application of the torque specified by the Original Equipment Manufacturer (OEM), ensuring the structural integrity of critical components and the safety of both the aircraft and the technical personnel.

At EGA Group, we have built solid expertise in controlled torque applications, which has allowed us to develop a comprehensive range of solutions for the aerospace sector, including tools designed to comply with regulations such as EASA Part-145 and FAA.

Our offerings include:

Torque wrenches:

- Reversible analog
- Digital with torque control
- Wireless communication
- Simultaneous angle and torque measurement
- Interchangeable heads
- Battery-powered for mobility in hangars
- Hydraulic for high torque applications

Adapters and angle gauges

Torque multipliers

Torque screwdrivers and torque drivers

These tools are designed for demanding environments such as line maintenance, overhaul workshops (MRO shops), and hangar operations, where traceability, repeatability, and safety are paramount.

At EGA Group, we have built solid expertise in the field of controlled tightening, which has enabled us to develop a comprehensive range of solutions

5.3 EGATORK CONTROL SYSTEM

Operating conditions in aerospace environments—especially during line maintenance and overhaul in hangars or workshops—can be demanding, with factors such as vibrations, extreme temperatures, and limited access directly affecting the reliability of bolted joints.

Therefore, it is essential to apply the correct torque in each intervention, ensuring the structural integrity of critical components and the safety of both the aircraft and technical personnel.

Aware of this need, at EGA Group we have developed the EGATORK CONTROL SYSTEM, a remote torque management system based on software and automated tools with wireless connectivity, specifically designed for MRO environments.

This system allows:

- Ensuring quality and repeatability of assemblies
- Obtaining complete traceability and post-certification for audits (EASA, FAA, etc.)
- Optimizing intervention times and improving operational safety

5.4 WIRELESS TORQUE TRANSDUCERS

As previously mentioned, in aircraft maintenance, precision in tightening bolted joints is critical to ensure the structural safety of the aircraft and full traceability of each intervention.

This is especially relevant in line maintenance operations, overhaul tasks in certified workshops (Part-145), and work in hard-to-reach areas where reliability and documentation are essential.

Therefore, at EGA Group we have developed wireless torque transducers with RF communication, a solution that allows the digitalization of conventional tools such as ratchet wrenches, pneumatic tools, or impact wrenches, transforming them into controlled torque instruments with full traceability.

Key advantages include:

- Real-time measurement of torque and angle, with wireless transmission up to 100 meters.
- Compatibility with a wide range of tools, including impact and click wrenches.
- Rechargeable lithium battery via USB-C and quick mounting.
- Integration with the EGATORK system, enabling centralized management, generation of graphs, and automatic alerts upon reaching the target torque.
- Automatic verification of battery status, signal, torque, and angle before each use.

An ideal solution for environments where traceability, efficiency, and safety are not optional but mandatory.

5.5 SPECIFIC SETS FOR MRO

EGA Master provides targeted solutions aligned with the real challenges faced by maintenance technicians:

Kit Name	Line	Base	AOG	ATA Chapter	System/ Subsystem
Structure and Fuselage Kit	✓✓	✓✓✓	✓	51-57	Fuselagem outer panels, doors
AOG Kit (General)	✗	✗	✓✓✓	Mixed	Rapid intersystems repair
Avionics Diagnostic Kit	✓✓✓	✓✓	✓✓	23/31/34	Instruments, navigation, GPS
Cabin Maintenance Kit	✓✓✓	✓✓	✗	23/33/77	Seats, lighting, entertainment systems
Composite Material Repair Kit	✓✓	✓✓✓.	✓	51 (SRM)	Bonded composite structures
Electrical Diagnostic Kit	✓✓✓	✓✓	✓✓	24	Batteries, relays, electrictal distribution
Engine Maintenance Kit	✗	✓✓✓	✓✓	70-80	Turbines, APU, piston engines
Rapid Deployment AOG Kit	✓✓	✗	✓✓✓	Mixed	Essential for rapid deployment
Fuel System Kit	✓✓✓	✓✓✓	✓✓✓	28	Tanks, pumps, valves
Ground Support Kit	✗	✓✓✓	✗	N/A	Jacks, ladders, tow bars, carts
Hangar Tool Kit	✗	✓✓✓	✗	Mixed	Special tools for hangar work
Hydraulic and Pneumatic Kit	✓✓	✓✓✓	✗	29/36	Brakes, landing gear, auxiliary systems
Oxygen System Repair Kit	✓✓✓	✓	✓✓✓	35	Oxygen for crew and passengers
Sheet Metal Repair Kit	✓✓	✓✓✓	✓	51-57	Aluminium panels, frames
Aeronautical Carpentery Kit	✗	✓✓✓	✗	Linked to25	Interior panels, furnishings
Private Jet Kit	✓✓	✓	✓	21-80	Cockpit, avionics, APU, oxygen
European Light Aircraft Kit	✓✓	✓✓	✗	24, 28, 72, 25	General aviation tools (piston engines)
UAV Maintenance Kit	✓✓	✓✓	✓✓	Adapted 24, 72, 34	Engines, sensors, batteries

5.4 CUSTOMIZED SETS

At EGA Group, we offer customized dual-color foam trays and laser-engraved tools, designed to optimize inventory control, prevent losses, and enhance traceability in maintenance workshops and hangars.

Key advantages include:

1. ***Custom dual-color trays:*** Tailor-made for trolleys, tool cases, or boxes, they allow immediate visual identification of missing tools, reducing errors and search times.
2. ***Permanent laser engraving:*** Each tool can be marked with the maintenance center's logo, code, or name, facilitating traceability, technician assignment, and loss prevention.
3. ***Color coding and visual management:*** Reinforces a culture of order and safety through intuitive workspace organization — particularly useful in line maintenance operations or shared hangar environments.

9

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By EGA Master