

INGERSOLL RAND WHITE PAPER | NOVEMBER 2023

Using Compressed Air to Increase Production & Minimize Resource Costs in Aerospace MRO



Table of Contents

Introduction 3

The MRO Industry is Resilient 4

Maintaining Air Purity 5

High-Quality Airfrom Start to Finish - Uses of Compressed Air 6

Air Separation 6

Instrument Air 6

Service Air 6

Paint Booth 6

Removing the Pain Points 7

Service and Maintenance Programs 9

PackageCARE™: We Protect You 9

PlannedCARE™: We Help You 9

Performance Services 9

System Automation 9

24/7 Remote Monitoring With The Helix™ Connected Platform 10

Reliability for Life 10



Introduction

Due to a challenging few years, the aviation industry has lost more than \$118 billion, bringing an end to the five-year growth spurt that the industry had previously enjoyed. It is now predicted that the industry could experience a decade of uncertainty and, for at least the next two or three years, considerable financial pressure.

When United Airlines CEO Scott Kirby has predicted that business and personal travel would return to normal, he predicted it wouldn't be before 2024. At the same time, consulting firm Bain & Co. announced plans to cut business travel emissions by 35% per employee over the next five years. This plan was said to offset global warming and operate in a more environmentally friendly way rather than cut costs.

Regardless of the reasoning or cause, these market pressures put stress on aviation and aerospace maintenance, repair and overhaul (MRO) facilities to run their operations even more efficiently. Moreover, facilities will be driven to manage costs even more carefully, forcing activities such as preventative maintenance, repair and overhaul to occur within very tight time frames.

In This White Paper, You Will Learn:

- How to maintain air purity across all applications
- The highly reliable, high-performance solutions that are available today
- How compressed air solutions can help increase MRO throughput rates and minimize resource costs
- How to find service and maintenance programs that optimize the total cost of ownership



Facilities will seek ways to minimize overhead costs, move aircraft through service bays more efficiently and extend equipment life.

The MRO Industry is Resilient

It's no surprise that the last few years have wreaked havoc on the aerospace industry. Global carriers are still burning cash, except for airlines in China, where business and personal travel have returned to normal. Other regions, however, are facing restructuring and consolidation, and some carriers are counting losses into the tens of billions of dollars.

The mantra "cash is king" remains a top priority for airlines as they preserve cash, put their aircraft into storage, retire twice as many planes as normal, convert some planes for carrying cargo and cancel or defer delivery of new planes.

All these factors translate into less work for MRO facilities. According to Oliver Wyman's "Global Fleet and MRO Market Forecast Commentary 2021-2031", demand is expected to be 33%, or \$60 billion. Moving forward, facilities will seek ways to minimize overhead costs, move planes and aircraft through the service and maintenance bays more efficiently, and extend the life of their tool and equipment investments.

MRO managers and engineers tend to take an optimistic, glass-half-full approach, a fact that is demonstrated by their remarkable response to the pressures caused by industry uncertainty. In addition to expanding their current capabilities, they have been using nearly every lever at their disposal, including:

- Implementing operational efficiency measures
- Focusing on digitization
- Diversifying into additional revenue streams, such as military MRO or adjacent markets, or establishing new divisions
- Reducing, postponing, or cancelling some planned expansions
- Reducing their headcount
- Decreasing inventory
- Optimizing supply chain management
- Increasing investment in maintenance operations



So far, these investments and changes have paid off. Airlines and aerospace manufacturers have created new frameworks to better guide them in identifying risks and opportunities, developing a distribution strategy and facilitating cross-functional decision-making. These new frameworks have also increased the demand for MRO service providers who have evolved with Industry 4.0 and the Internet of Things (IIoT) by interconnecting various technological platforms and providing the opportunity to interface with manufacturing equipment located anywhere in the world.

Maintaining Air Purity

Industry 4.0 and IIoT aren't the only things operators should consider as they look to recover from the uncertainties caused by the last few years. Maintaining air purity, particularly in the aerospace industry, is critical for ensuring optimal performance and safety. However, doing so can be difficult. Due to operating in the field, often surrounded by dirty and dusty outdoor conditions, maintaining high-quality air is a challenge for many maintenance technicians. Doing so while increasing production rates and minimizing resource costs can pose further difficulties.

In many other industries, people's lives aren't at stake if the equipment isn't functioning properly, but equipment must meet rigorous quality and performance standards in aerospace. When looking at all the different options, it is important to consider the significant effect compressed air systems can have on workflow and product quality.

Air compressors in the aerospace industry are used for a range of applications, including:

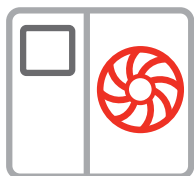
- Air separation
- Aircraft engine manufacturing
- Aircraft wing structural testing
- Electronics and galley cooling
- General military use
- Ground support equipment
- Oxygen and nitrogen generation
- Potable water supply on commercial aircraft
- Structural testing of wings
- Test bench supply
- Vacuum waste systems
- Work holding devices

Many of these applications require strict contamination control, ruling out certain technologies that can potentially compromise compressed air quality by allowing fluid to mix with exhausted air.

For this reason, oil-free compressor technologies are often deemed the only choice, but oil-flooded and contact-cooled rotary compressors can also produce the same standard of clean, contaminant-free air! All they need is an effective downstream system in place to maximize air quality and reliability.

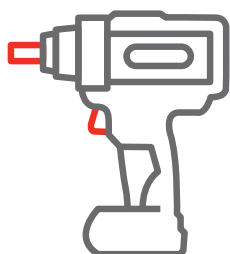
High-Quality Air from Start to Finish - Uses of Compressed Air

From the maintenance and repair phase to re-painting and coating overhauled components like metal sheeting and wings, compressed air plays a role in aerospace and aviation. MRO hangars operate on strict schedules. Each aircraft moves through the maintenance or repair process within a specific time frame. As a result, clean, high-quality compressed air must always be ready and available.



Air Separation

To maintain the safety of the workspace for maintenance technicians and uphold quality MRO output, rotary screw compressors are used as the supply air source for gas generators. Whether using membrane technology or pressure swing adsorption methods, compressors separate nitrogen from oxygen and supply clean, dry nitrogen at the required purity and pressure. Once separated, technicians use the nitrogen in the process of coating metal sheets. Using nitrogen coating minimizes the risk that moisture will come into direct contact with the metal, which could cause corrosion over the long term.

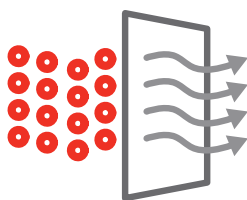


Instrument Air

An MRO operation is heavily reliant on pneumatic equipment and tools. Moisture and dust are the enemies of all pneumatic assembly tools, which technicians rely on heavily for riveting, re-attaching sheets of metal and other alloys, and precisely fastening components together.

Compressed air operates solenoid valves as well as pneumatic equipment. The air triggering the valves must be clean and contaminant-free to not introduce dirt or moisture to the pneumatic systems and instruments. High-quality air keeps your tooling operating at its best, reduces tool maintenance, and helps extend the lifecycle of the tools.

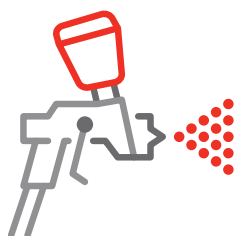
But how can you achieve this air quality? The secret to removing contaminants such as dirt or moisture is an effective downstream system, including a dryer, filtration system and condensate management unit.



Service Air

Technicians in aerospace work in large hangars and warehouses that are often open to the outdoors as planes roll in and out. There are also a variety of MRO stations running simultaneously, each increasing the potential for dust and dirt to enter the ambient environment, meaning an air filtration system is essential!

Yet, technicians working to repair mission-critical components must keep both the components they are working with and their workspaces free of debris to meet strict quality standards. Air drops at each workstation allow technicians to quickly and conveniently blow off debris from the surrounding environment and clean and cool metal sheeting and other components they are working with.



Paint Booth

Painting is one of the final stages in the process. Oil-free, low-moisture air ensures a smooth, long-lasting paint finish or coating free of bubbling or particles. At this stage, the pressure dew point of the compressed air needs to fit the application precisely. Desiccant dryers are often used here to ensure ultra-dry, clean, compressed air with a low-pressure dew point!



Removing the Pain Points

Using Compressed Air to Increase Production & Minimize Resource Costs

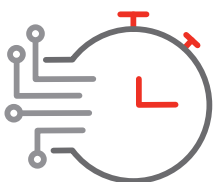
Compressed air plays a vital role in MRO facilities; however, maximizing the value of compressed air systems can be complex and overwhelming. As your compressed air solutions partner, Ingersoll Rand can take the burden off you, collaborating to design, deliver and install compressed air systems that are a perfect match for your operations. This can allow you to operate more efficiently, using your compressed air to increase production and minimize resource costs. But how do we do this?

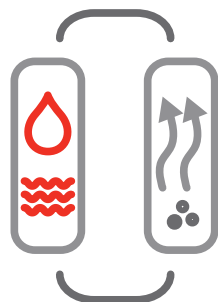
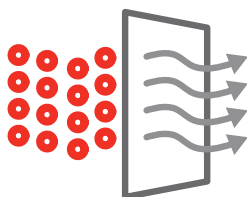
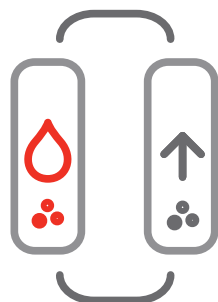
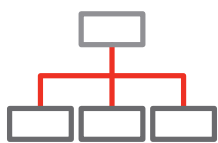
1. AIR AUDIT

The best place to start when transforming your compressed air system is to begin with a thorough air audit. This will help us to analyze your existing system, checking for inefficiencies, leaks and potential areas of improvement. It will also help us to work with you to identify the compressed air needs for your applications. Then, we can either enhance your existing system or design a compressed air system that delivers the right level of quality, quantity and power for your required process. We can also oversee the installation and recommend service and maintenance programs that optimize the total ownership cost.

2. EFFICIENT TECHNOLOGIES

To enable you to increase production and minimize resource costs, it's important that you have the right equipment within your system. With various configuration options available, including fixed or variable speed drives, single or two-stage airends, as well as Total Air System packages, our team collaborates with you to design a complete, integrated solution that maximizes efficiency and airflow.





3. DOWNSTREAM EQUIPMENT

Due to the uncompromisable high-quality of compressed air demanded by the aerospace MRO industry, a reliable and effective downstream system is essential to ensure health and safety standards, in particular, are met! This consists of 3 key components:

Dryers:

Dryers are essential within your system to remove moisture from your compressed air, which, as mentioned, is particularly important for aerospace MRO due to the stringent quality of air required. It is also essential for powering pneumatic tools, as the presence of moisture can lead to degradation of the equipment's performance and longevity. There is a range of dryers available on the market, but for this particular industry, we'd recommend a desiccant dryer which uses absorbent material to remove moisture and produce ultra-dry, clean, compressed air with a low-pressure dew point. There are other options available, including refrigerant systems, which are better suited to more general applications, and heat of compression dryers, which help to regenerate the heat created as a natural by-product of compressing air. This could help to minimize your resource costs, as they regenerate the desiccant throughout the drying process.

Filtration System:

Alongside an efficient compressed air dryer, a reliable filtration system is also an essential part of air treatment. This system is used to remove other contaminants from your air, including dust, oil and particulates, in order to produce high-quality, ISO Class 0 standard compressed air. Again, this is essential to meet the air quality standards of the aerospace MRO industry and is particularly important for applications such as powering pneumatic tools and painting, where air quality can affect the finish of your paint.

Condensate Management & Treatment:

Another important part of air treatment is condensate management, as condensate is a natural by-product of compressing air. Left unmanaged, the water condensate created can cause costly equipment damage and degradation, meaning tools and resources will need to be replaced. Typically, the best way to deal with condensate is to implement a condensate management unit which utilizes an oil water separator. This set-up is vital to ensure condensate is being disposed of properly and in a way that adheres to strict industry regulations. Again, this is essential for powering pneumatic tools and painting, two applications where clean, condensate-free air is essential to ensure efficiency and high-quality results!

4. MANAGEMENT & MONITORING SYSTEMS

Managing and monitoring your system is another way to ensure you are getting the most out of it! For system management, compressor controllers are ideal for keeping an eye on your system, as they allow you to adjust flow rates and pressure to prevent inefficiency and wasted energy, thus helping you to reduce your resource costs. We also offer a 24/7 IIoT remote monitoring platform, which is ideal for ensuring your compressor is operating at its most energy and cost-efficient.

5. HEAT RECOVERY SYSTEMS

Another way to reduce resource costs in your aerospace MRO facility is to reuse and repurpose the heat that is created by the compression process. By implementing an efficient heat recovery system, you can use the heat to heat your facility, as well as for heating or preheating process water. These systems are able to recover 90% of the

wasted heat generated by your compressed air setup, meaning that you can potentially save 1000s of dollars a year whilst also reducing your carbon footprint and environmental impact. This will also help you to reduce resource costs by helping you to save money on your energy bills!



6. WARRANTIES, OEM PARTS & MAINTENANCE

We can also provide a range of service options and preventative maintenance programs that optimize your total cost of ownership and extend the life of your compressed air equipment. For example, at Ingersoll Rand, we offer a suite of CARE maintenance plans, which you can discover more about later on in this Whitepaper. When communicating with our customers, we analyze their exact application needs and compare them to our available maintenance packages to ensure they are receiving the service they need! Whether this may be a warranty, scheduled maintenance, total asset management, OEM parts and accessories or remote monitoring, correctly managing your compressed air system is vital to increase your production whilst also minimizing your resource costs!



Service and Maintenance Programs

There are many applications you will require high-quality compressed air for in your plant. You also now understand how to use compressed air to increase production and minimize resource costs in Aerospace MRO (Maintenance, Repair and Overhaul). Now it's time to look at how to service and maintain your equipment to avoid unplanned, unbudgeted downtime and production interruptions.

Lower cost of ownership, quality results, increased uptime, and efficient energy use all add up to peace of mind.

PackageCARE™: We Protect You

- The greatest value for asset management
- Transfer operational risk for up to 10 years
- Includes all scheduled maintenance
- Predictive and analytical tools prevent production interruptions

PlannedCARE™: We Help You

- Predictable, on-time planned maintenance
- Preventative diagnostics to catch potential problems
- Up to five-year coverage on major airend components in new rotary compressors

Performance Services

Our performance services include electronic, air leak and system assessments. Whether you need to manage costs, increase reliability, or plan for future growth, our portfolio of assessment tools provides you with detailed diagnostics that give you the proper insights to help lower the total cost of ownership.

System Automation

System assessments often identify waste caused by a lack of adequate controls.

Our suite of system automation solutions lowers energy costs and stability pressure.



24/7 Remote Monitoring With The Helix™ Connected Platform

Developed to maximize uptime and peace of mind, the Helix™ Connected Platform from Ingersoll Rand gives you real-time monitoring that provides visibility into machine functionality and equips you to operate at maximum efficiency. Your team will have direct access anytime to Helix™ insights and diagnostic reporting that can help prevent lost productivity from unforeseen breakdowns. Maintenance scheduling is simplified thanks to proactive service reminders and automated communications that help to preserve machine health.

Reliability for Life

- Generate air in any environment. We offer solutions that operate indoors and outdoors in compact spaces and extreme temperatures.
- Enjoy increased oversight with controls you can access remotely. Regulate your air use with compressor controls that monitor critical operating parameters and adapt the system to prevent downtime.
- Designed for easy serviceability and maintenance, our compressors minimize the total cost of ownership.
- An extensive catalogue of genuine OEM consumable and replacement parts are available to you to make service and maintenance easy and cost-effective. Genuine OEM parts guarantee a perfect fit and function to the highest quality standards.

There's a lot riding
on the quality
of your air.
Let Ingersoll Rand
help you get
it right!



Notes

This image shows a full page of blank, lined paper. It features approximately 28 horizontal blue or grey lines spaced evenly apart, typical of notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings on the page.



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Ingersoll Rand Inc. (NYSE:IR), driven by an entrepreneurial spirit and ownership mindset, is dedicated to helping make life better for our employees, customers and communities. Customers lean on us for our technology-driven excellence in mission-critical flow creation and industrial solutions across 40+ respected brands where our products and services excel in the most complex and harsh conditions. Our employees develop customers for life through their daily commitment to expertise, productivity and efficiency. For more information, visit irco.com

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