



# ENHANCING MILITARY HYDRAULICS: MAINTENANCE-FREE BELLOWS ACCUMULATORS & RESERVOIRS

## THE CHALLENGE

Today's military aircraft place greater demands on system hydraulics than previous generation aircraft. The operating environments are more severe, performance requirements more demanding, and reliability and maintainability requirements have increased. To meet these challenges on the F-35 Joint Strike Fighter, Eaton Aerospace and Lockheed Martin were looking for hydraulic components that could perform flawlessly while withstanding severe operating conditions, including aircraft vibrations and a wide temperature range, while maintaining integrity and delivering the required performance.

## OUR SOLUTION

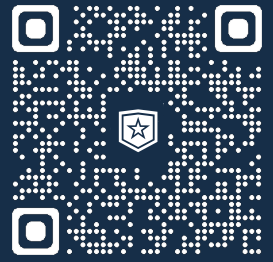
Senior Metal Bellow's maintenance-free accumulators and reservoirs utilize an edge-welded metal bellows that forms a leak-tight chamber, separating the hydraulic fluid from the gas precharge. This chamber adjusts to flow demands during operating mode and hydraulic shutdown mode, and its leak-free performance ensures there are no maintenance or re-charge requirements over the life of the aircraft. The accumulators and reservoirs utilize pressure vessels with an optimal strength-to-weight ratio ideal for the application, and the edge-welded bellows assemblies are designed to ensure smooth motion and durability.

These innovative design features made the maintenance-free accumulator and reservoir the ideal choice to meet the performance and reliability requirements of the F-35's utility system hydraulics and the electrohydrostatic actuators that are used on all the flight control surfaces.

Offering maintenance-free service, high performance, reliability, zero leakage, and long life, these bellows accumulators and reservoirs are perfectly suited for a wide range of military and commercial platforms including manned and unmanned aerospace, marine, ground vehicle, and industrial applications.

# RESULTING PRODUCT FEATURES

## Key features of our mission-critical accumulators & reservoirs:



- **Maintenance-Free with No Need for Recharging**

The all-metal, welded hermetic construction eliminates charge gas migration into the hydraulic fluid. This hermetic construction also removes the need for charging lines, valves, and access panels on the aircraft. SMB's bellows accumulators and reservoirs do not contain elastomeric seals or wear surfaces. This, along with their hermetic construction, allows them to last the lifetime of the aircraft with no need for refurbishment, recharging, or replacement.

- **Weight-Optimized Design**

Our accumulators and reservoirs can be manufactured from a variety of high strength alloys that allows for a lightweight design, minimizing fuel costs

- **Lifetime Helium or Nitrogen Precharge**

The all-metal construction of SMB's bellows accumulators and reservoirs permanently seals the precharge gas inside. Since there is no leakage of precharge gas, this allows SMB to use helium as a charge gas. The difference in compressibility and the thermodynamic properties of helium lead it to be advantageous to nitrogen as a precharge gas in most scenarios. Under conditions where the properties of helium do not provide benefit over nitrogen, SMB will use a nitrogen precharge to ensure optimal envelope is achieved

- **Temperature Resistant**

The bellows accumulators and reservoirs remain unaffected by temperature extremes and are compatible with all hydraulic system fluids.

OUR ENGINEERING TEAM SPECIALIZES IN PROVIDING  
CUSTOM-ENGINEERED SOLUTIONS FOR CHALLENGING APPLICATIONS



- **LET'S TALK!**

For any questions or to engage with our technical solution team, please contact

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