

# Friction Reduction System

Significant Advantages in High-Performance Centrifugation

## Friction Reduction System: Designed to Perform

Beckman Coulter has been using a Friction Reduction System (FRS) in its high-speed centrifuges for nearly 50 years. The Beckman Coulter FRS was implemented to improve on traditional high-speed centrifuge designs in terms of efficiency and capacity. This system allows Beckman Coulter to use rotors with greater capacities and centrifugal forces, improved temperature control, faster acceleration, extended centrifuge drive life, and reduced operating costs. This bulletin explains the advantages of the FRS and the enhanced performance it provides to users of Beckman Coulter high-performance centrifuges, especially in the new Avanti JXN.

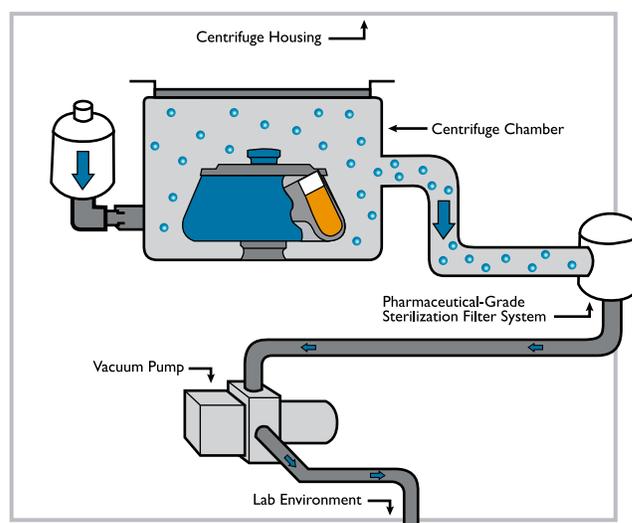
So, what is FRS? The heart of the FRS is the powerful vacuum pump that pulls air from the centrifuge chamber, reducing the chamber to one-fourth of atmospheric pressure while the rotor is spinning. The FRS increases total centrifuge reliability by reducing the workload of the centrifuge's two major mechanical components—the drive and refrigeration systems. Furthermore, removal of partial atmosphere from the chamber significantly reduces the friction or drag inherent in a rotating system, decreasing heat generation and leading to a more energy-efficient drive system.

## Higher Centrifugal Acceleration

Maximum acceleration in a centrifuge is mandated by a number of factors, including the geometry and weight of the rotor, power of the motor, and frictional drag resulting from wind resistance and rotor mechanics.



Avanti JXN-26 Centrifuge



The FRS of the Avanti JXN uses an external vacuum pump to reduce chamber pressure, filtering air from the centrifuge to the lab, all while the rotor is spinning.

The FRS increases centrifugal acceleration by reducing the friction resulting from atmospheric resistance—making it easier for the centrifuge to accelerate and maintain maximum speed.

### **Enhanced Temperature Control**

The reduced frictional system provides improved temperature control for rotors with large surface areas, such as those in the high-performance line. To illustrate the advantages of the FRS, let's look at a typical rotor—the JA-14.50. At its top speed of 14,000 rpm, the surface speed is ~845 kilometers per hour (~525 mph) at the point in the tube cavity furthest from the axis of rotation ( $r_{\text{max}}$ ). These high speeds create large amounts of friction under atmospheric pressure, generating copious amounts of heat. A reduced atmosphere decreases friction due to wind resistance. Large temperature fluctuations are very difficult for a centrifuge to offset, so maintenance of a fixed temperature is difficult to achieve in a centrifuge not equipped with an FRS—also requiring larger compressors that consume additional energy.

### **Extended Centrifuge Life**

Beckman Coulter centrifuges are built to last. The FRS enhances durability by providing a reduced chamber atmosphere, requiring less strain on the drive train, refrigeration compressor, and rotor itself.

### **Improved Energy Efficiency**

The Avanti JXN centrifuge operates at approximately one-quarter atmosphere, further reducing frictional heat and wind resistance. The Avanti JXN is able to reach the one-quarter atmosphere operation pressure while the rotor is accelerating to set speed. When the appropriate pressure is reached in the chamber, the vacuum pump shuts off. The FRS operates as a “smart system” thereafter, with the vacuum pump operating only when losses in

the system require further vacuum, saving users valuable energy costs while also enhancing temperature control.

### **Lower Operating Costs**

Going hand in hand with extending the life of the centrifuge and improving energy efficiency, Beckman Coulter centrifuge/rotor systems equipped with the FRS reduce lab expenses. Reduced frictional air drag on the spinning rotor makes it easier for the centrifuge to accelerate to speed—and to maintain maximum speed. Furthermore, the refrigeration compressor requires less energy to reach and maintain the set temperature within the rotor chamber, resulting in a more efficient and cooler instrument. Most laboratories contain many refrigerators, freezers, and other instrumentation that generate excess heat. This reduction in heat output makes it easier and cheaper to maintain an ambient lab environment. This—coupled with machines that withstand the test of time—minimizes your lab's environmental footprint and reduces overall cost.

### **Increased Safety**

Yet another important advantage of the FRS in Beckman Coulter centrifuges is increased lab safety. Many researchers work with biologically hazardous or radioactive samples. Since the FRS works by creating a partial vacuum in the centrifuge chamber, a pharmaceutical-grade sterilizing filter system can be installed between the vacuum pump and rotor chamber of the Avanti JXN. This filter acts to remove aerosols, pathogens, and other particles that are released in the event of a tube or bottle failure, protecting lab occupants by helping to prevent sample vapors from entering the lab atmosphere. Furthermore, the FRS increases mechanical safety by allowing wind resistance to be used as a parameter for checks on rotor safety and compatibility. In an undefined rotor chamber pressure, this check would be difficult to accomplish, resulting in rotor failure and possibly significant injuries and damage.

## Summary

The FRS of the Beckman Coulter Avanti JXN centrifuge provides many design advantages including increased rotor volumes, tube capacities, rotor speed and accurate temperature control. Additionally, the FRS increases the overall system reliability by decreasing the load on the drive and refrigeration. The evacuation of air from the rotor chamber allows the inclusion of the optional pharmaceutical-grade sterilizing filter system for improved safety. In summary, the FRS enhances centrifuge performance and safety while lowering energy consumption, making the Avanti JXN an extremely sophisticated high-performance centrifuge.

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