

# ROTOR CONSTRUCTION



**Compare for  
Yourself**

## Copper

For over a century, Westinghouse motors have been synonymous with quality and reliability. Over time, product enhancements have been continually refined, resulting in dependable, long-term performance year after year.

Today, as always, all large Westinghouse Motor Company Induction motors greater than 250 HP feature copper or copper alloy rotor bars and end rings.

Some of our competitors will try to persuade you to save a few dollars and settle for aluminum rotors on their large machines. We believe you cannot afford to operate without copper rotor construction. Please read on and decide for yourself.

The real test for rotor material is during starting because this is when the motor is subjected to extreme operating conditions. During this period, large AC motors can be rotor limited. This means that the rotor cage will reach its thermal limit before the stator winding.

In this demanding period of operation, copper offers a significantly higher range of resistivity and a much higher thermal margin.

Copper also provides a lower coefficient of expansion, higher tensile strength, and ideal conductivity.

Without a doubt, Westinghouse Motor Company's copper rotor construction gives you greater reliability, efficiency, and versatility with which aluminum cannot compare.

## Aluminum

Cast aluminum rotors appeared years ago on small motors and are now accepted as the industry standard for those machines.

Today, many motor manufacturers have switched to fabricated aluminum rotors in their large motors, presumably because of the lower cost of aluminum.

In fact, most of our competitors have standardized on aluminum rotors.

Aluminum rotors have many limitations compared with copper. For example, an aluminum die cast rotor cannot be repaired. And aluminum fabricated rotors only can be repaired with great difficulty.

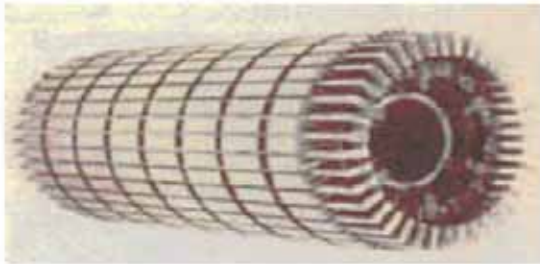
The Westinghouse Motor Company uses only copper on large AC machines because our experience leads us to believe that aluminum rotors are more likely to fail.

These damaged aluminum rotor bars were removed from competitors' failed motors. Note the severe deformity and degradation.

## Copper

### **Lower Coefficient of Expansion**

Aluminum will creep and move approximately 33% more than copper. This large movement will eventually lead to fatigue failure in rotor material due to thermal expansion and contraction.



WMC's copper rotor design ensures higher reliability compared to aluminum bars.

### **Tensile Strength**

Copper is 300% stronger than aluminum and thus able to withstand high centrifugal force and repeated hammering of the current-induced forces during each start.

### **Higher Melting Point**

Copper can better withstand thermal cycling over the life of the motor.

### **Conservative Temperature Rise**

Copper features conservative temperature rise limitations which prevent excessive deterioration in mechanical properties.

### **Improved Joint Design**

Westinghouse Motor Company's improved bar to end ring joint design minimizes stresses and stress concentrations.

## Aluminum

### **Limited Range of Resistivity**

A far greater range of resistivity is available on copper alloys than with aluminum and aluminum alloys. As a result, performance may have to be compromised if aluminum is used.

### **Fatigue Sensitivity**

Many tests indicate that aluminum is more susceptible to fatigue than copper or copper alloy.

### **High Temperature Rise**

Aluminum has a 35% higher temperature rise than copper for the same KW loss.

### **Adverse Effect of Temperature on Mechanical Properties**

The physical properties of heat-tested aluminum will decrease even at temperatures as low as 150° C. Temperature rises on bars much higher than this are not unusual during starting and acceleration.

### **Poor Joint Design**

Welded Aluminum joints, with attendant stress concentration, residual thermal stresses, and reduction in physical properties, can result in failure.

### **Laminations Become Loose**

Through repetitive thermal cycling, aluminum laminations can become loose, resulting in early failure.

## Rotor Design

A key to the reliability of Westinghouse Motor Company motors is our emphasis on superior rotor design.

Rotor cores are held together by sturdy end plates and rugged thru-bolt construction or other clamping methods.

In addition to our proven copper construction, our large AC rotors are precision-crafted with the following time-tested design features:

### ■ *Swaging*

Swaged rotor bars ensure long life by minimizing the movement and vibration that can cause bar fatigue and failure.

### ■ *High Frequency Induction Brazing*

End rings are joined to the bars by high frequency induction brazing on most rotors. This reduces stresses and hot spots in the joint.

### ■ *Keeper Blocks*

These ensure increased rotor integrity by preventing cage migration from end to end.

## Repair Considerations

Our experience leads us to believe that aluminum rotor designs are more likely to fail and are more difficult to repair compared with copper.

The primary causes for most rotor failures are loose rotor bars and poor bar to end ring welds.

By now you already understand how copper's inherent advantages -lower coefficients of expansion, higher tensile strength, and improved joint design -make it a superior material.

The Westinghouse Motor Company's practice of swaging, high frequency induction brazing, and thru-bolt construction further ensure long-term reliability.

In the unlikely event that a copper rotor does fail, it is significantly easier to repair than aluminum. Copper's usual rectangular design makes it easy for repair shops to rework bars and laminations.

Aluminum bars, on the other hand, are built in a wider variety of shapes with correspondingly designed slots in the rotor laminations.

We believe that the resulting lamination slot design often makes aluminum rotors either difficult or impossible to repair.

Don't be misled by aluminum's lower initial selling price. Because of the risk of failure, aluminum may cost you a lot more in the long run.

## Customer Focus

The Westinghouse Motor Company designs, manufactures, and sells Induction, Synchronous, and DC motors and generators to customers throughout the world.

As our customer, you have access to exceptional service. Engineering support, computer studies, product information, quotation assistance, and professional order management are top priorities.

Also, you can rely on our worldwide field service and engineering network to service and protect your investment.

For more information about the Westinghouse Motor Company's dependable copper rotor construction or any of our outstanding world-class products, contact your local Westinghouse salesperson or call us at our Round Rock, Texas, headquarters at 1- 800- 451-8798