

# LOW NO<sub>x</sub> REPLACEMENT AIR REGISTERS AND BURNERS



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RESTORE AIR FLOW CONTROL OF YOUR OLD WALL-FIRED LOW NO<sub>x</sub>  
COAL BURNERS WITH A COMPACT SWIRL GENERATING REGISTER

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## A SOLUTION FOR FAILING BURNERS

With many low NO<sub>x</sub> wall-fired coal burners nearing their end of life, long term overheating of components, corrosion, and mechanical binding has led to loss of air flow control. Emissions may have increased and furnace outlet gas constituents and/or temperature profiles have degraded. To restore performance and control, R-V Industries offers a replacement modular low NO<sub>x</sub> (LN<sub>x</sub>) air register that will fit over your existing low NO<sub>x</sub> coal nozzles. The low NO<sub>x</sub> register is also available as a complete plug-in low NO<sub>x</sub> coal burner assembly.

We recognize that replacing all burners can be an expensive investment. To minimize your costs, we engineered our register to be compact and available as modules to fit into tight boiler houses and windboxes. This significantly reduces both retrofit time and equipment cost. The register design is also ideal as a long term solution for severely damaged burners.

For long term maintenance and reliability, this register design uses only three (3) moving parts while providing a nearly infinite range of air flow and flame shaping to restore emission control. Also included are many other innovative features that further improve combustion system control and monitoring.

In addition to restoring wall-fired burner mechanical reliability, improved combustion air control will reduce NO<sub>x</sub> and CO emissions. Coal-fired **NO<sub>x</sub> reductions of 50%** with burner-only replacements and **up to 65%** with overfire air additions (from uncontrolled levels) can be expected. Oil and gas firing capability is also available.

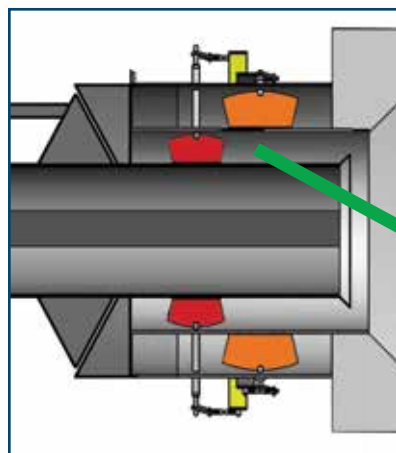




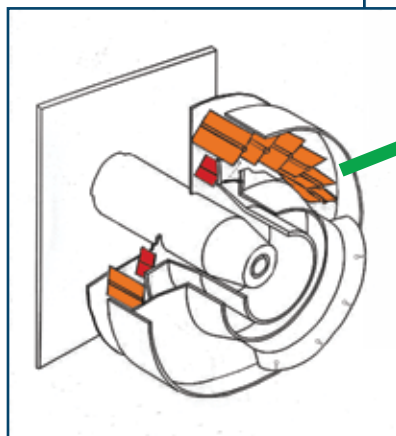
## AXIAL SWIRLER ASSEMBLY REPLACES MULTIPLE VANES TO MINIMIZE FAIL POINTS

Instead of the multiple interconnected and inefficient radial or axial “flat” plate swirl vanes that are used on 90% of the worlds low NOx burners, the LNx air register design uses a single fixed aerodynamically formed swirler assembly to generate swirl. By positioning the tapered assembly into a conical section of the register, a wide range of swirl is available for flame shape and emission control.

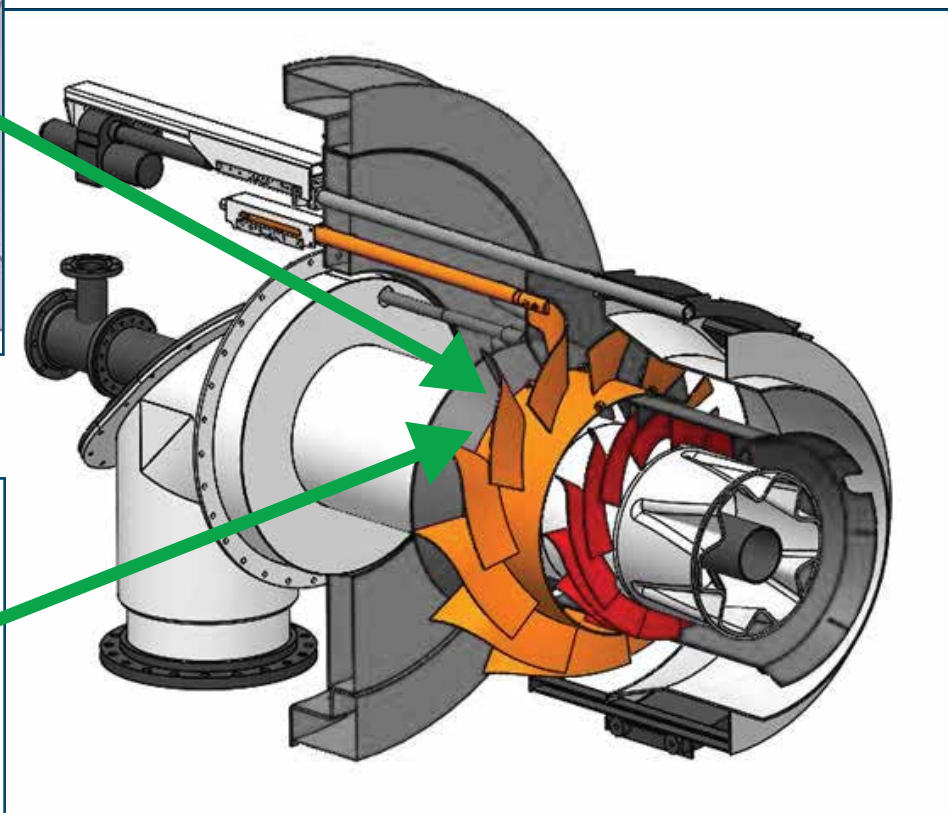
The wide range of swirl generating capability from this register makes it compatible with most existing low NOx coal nozzles. The one piece axial swirler assembly also eliminates the linkage hysteresis that plagues other wall-fired swirl generating arrangements.



COMMON MULTIPLE AXIAL VANE AND LINKAGE REGISTER



COMMON RADIAL VANE AND LINKAGE REGISTER



THE SOLUTION TO THE COMMON PROBLEM

R-V's low NOx axial swirl assembly replaces dozens of radial vanes and associated bushings, shafts, and linkages. This simplicity assures long-term reliability.



## EFFICIENT COMPONENT UTILIZATION

The R-V LNx register uses only two axial swirler assemblies and two dampers to independently control air flow and swirl generation. The aerodynamic axial swirler vanes are engineered for each application to generate a wider range of swirl numbers, an industry standard for evaluating swirl and recirculation generation.

High grade materials are used throughout to prevent thermal distortion. In addition, the R-V register's key components are recessed further back from the furnace, providing additional protection from furnace radiation damage.

The register design is based on a 40 year experience curve of wall fired burner process design, R&D, and application experience spanning 150 units made by various OEMs. Based on this experience, we have developed an optimized register design that surpasses any other low NOx register both in mechanical reliability and combustion control.

### 1.) Outer Zone Damper

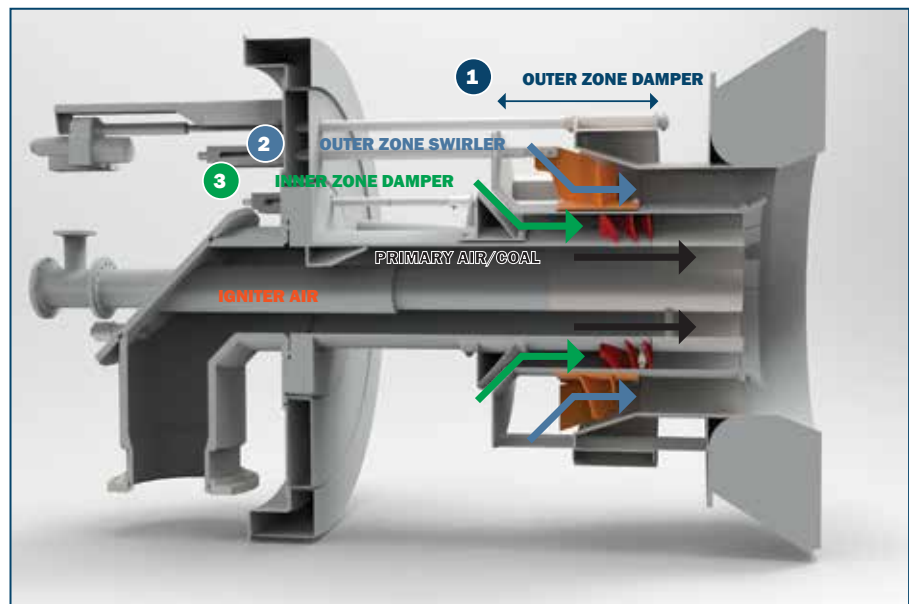
Outer zone sleeve damper provides individual burner air flow control to the outer zone axial swirler and for burner to burner biasing control.

### 2.) Outer Zone Swirler

Outer zone aerodynamic axial swirler produces a wide range of effective swirl generation.

### 3.) Inner Zone Conical Damper

Inner zone conical air damper controls air flow and swirl generation to the inner zone around the coal nozzle.





## REGISTERS AVAILABLE AS MODULES OR COMPLETE LOW NO<sub>x</sub> BURNERS

REUSE YOUR EXISTING COAL NOZZLES  
OR SUBSTITUTE NEW R-V'S LOW NO<sub>x</sub>  
COAL NOZZLE ASSEMBLIES

EXISTING MOUNTING PANEL CAN BE MODIFIED  
FOR MODULAR REGISTER CONTROL DEVICES  
OR A NEW REPLACEMENT AND INSULATED  
PANEL CAN BE SUPPLIED

**STEP 3**

**STEP 2**

**STEP 1**

MODULAR, COMPACT REPLACEMENT  
DUAL ZONE AIR REGISTER FOR  
EXISTING LOW NO<sub>x</sub> BURNER  
UPGRADES OR AS A NEW  
LOW NO<sub>x</sub> BURNER

EXISTING BURNER THROAT



## DUAL ZONE LOW NOX AIR REGISTER BURNER DESIGN

A properly-sized and designed dual air zone burner register is the key to achieving low NOx. The objective is to have efficient combustion yet minimize evolving fuel nitrogen from combining with excess oxygen to form NOx. To accomplish this, the R-V register produces very strong swirl intensity for mixing along with tighter air flow control to reduce NOx.

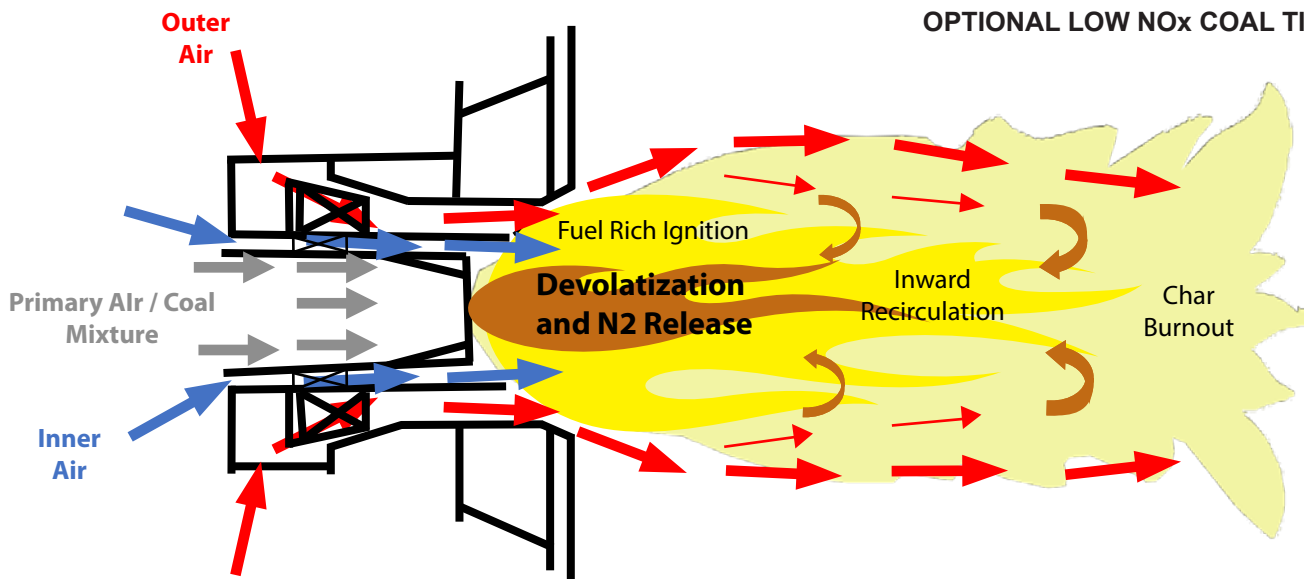
Windbox air pressure applied to the contoured outer zone axial swirler generates a very strong vortex. The vortex produces an internal low-pressure zone that recirculates hot furnace gases back into the throat for flame stability and the creation of a low oxygen zone inhibiting NOx formation. The outer perimeter is a high velocity tornadic-type swirl that confines the coal stream inside its oxygen deficient center. The internally expanding coal jet is then gradually sheared along the vortex length as it intersects with the vortex air, improving char burnout.

A linear motion sleeve damper controls air flow to the outer zone axial swirler. It is controlled as a function of coal flow but is also used for biasing combustion air between burners for controlling furnace outlet gas temperature and emission constituent profiles.

Controlling inner zone air flow reduces NOx by minimizing excess oxygen from combining with the fuel nitrogen. The inner damper is also used for optimizing the flame front position and minimizing overall CO and UBC levels.



OPTIONAL LOW NOx COAL TIP

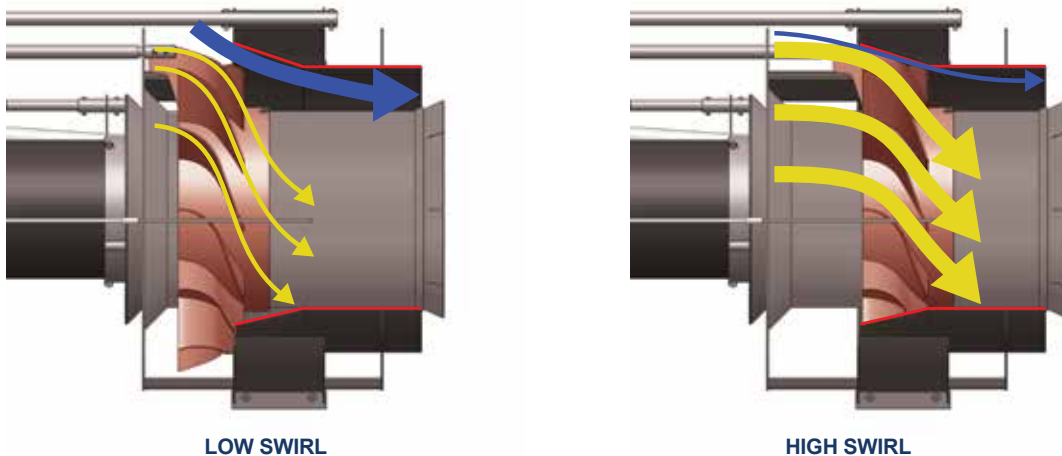




## MANUALLY SET AERODYNAMIC SWIRLER ASSEMBLY GENERATES A WIDE RANGE OF SWIRL THROUGH SIMPLE AXIAL MOVEMENT

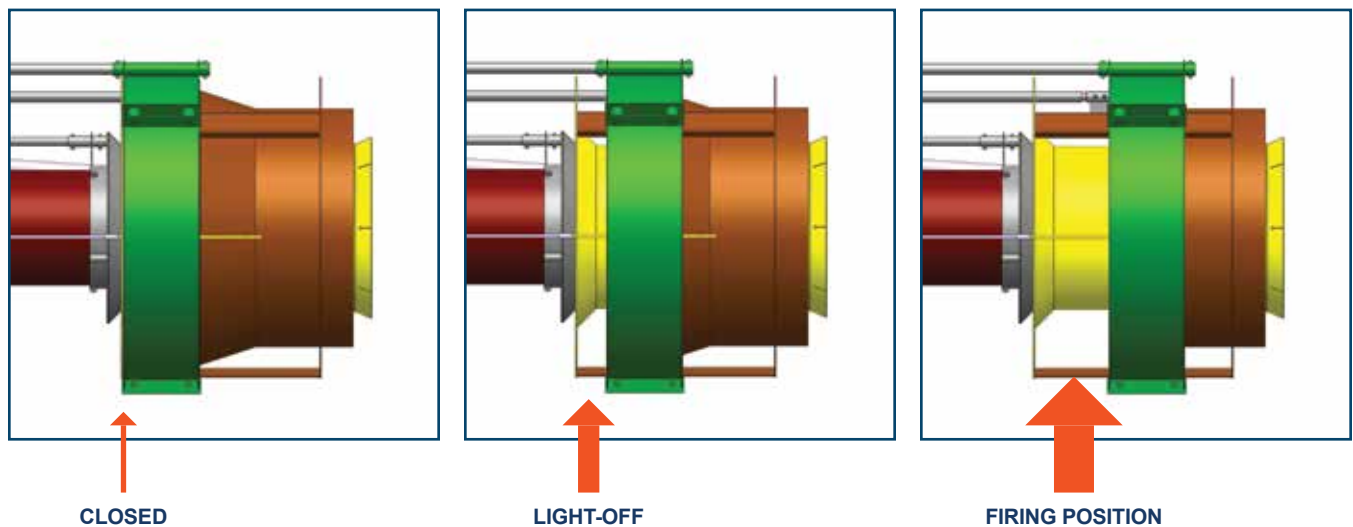
By manually positioning the tapered axial swirler assembly relative to the conical section of the register, a wide range of swirl generating capability is possible.

Depending on unit size, LNX register pressure drop typically ranges between 4.0 and 6.0 in.wg. However, unlike most wall-fired low NOx burner systems that commonly generate DP across their air flow control dampers, these registers use the combustion air supply pressure to primarily generate effective swirl rather than air flow control.



## SLEEVE DAMPER

Remote controlled register sleeve damper controls the air flow quantity to each burner as well as air biasing between burners.





With 40 years of wall-fired design and application experience, R-V can help you find a solution for all your wall-fired burner system shortcomings.

- Mechanical reliability issues
- Component overheating
- Erosion mitigation
- System resizing to improve air fuel control
- Control system issues
- Emission performance
- Fuel changes
- Oil and gas firing
- Technical field support
- Boiler house design and performance engineering



UNCHECKED PROBLEMS LEAD TO SYSTEM FAILURE



## TOP FEATURES

- Independent air flow and swirl control
- Clear indication labels and easy access to swirl adjusting drivers
- Local relative air flow measurement between air zones
- Register components are protected from radiation
- Thermocouple guide tubes with spring loaded thermocouples
- Register and nozzle inspection ports
- Oil and gas firing capabilities
- Adaptable to all industry common igniters and flame scanners
- Adaptable to most common industry coal nozzle assemblies
- Insulated mounting panels reduce boiler house heating and hot zones

