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# Monitoring Vibration on Tunnel Fans

## Safety First

The world's developing infrastructure creates many technical challenges for engineering and construction. Quite often names like "Chunnel" (English Channel), "Big Dig" (Boston), and "Nam Wan" (Hong Kong) are feats to marvel at as they provide passages underground, underwater, or straight through a mountain for today's highways and rapid transit systems.



*Commuter Train Exiting Underground Tunnel*

Although the tunnels provide a very unique form of infrastructure, they also come with their own set of environmental problems. It is only natural in today's world that the tunnels will become polluted with CO<sub>x</sub> from gasoline based engines, and NO<sub>x</sub> and smoke from diesel based engines. These toxic gas emissions need to be cleared from the tunnel and replaced with fresh air. This ventilation process keeps those of us that use the tunnels healthy, and in the case of an emergency, safe.

## Ventilation

Purging of toxic gases with a supply of clean air requires Tunnel Jet Fans. These fans provide longitudinal ventilation of the tunnel and are the primary sources of clean air. Jet fans provide a very high impulse or thrust of clean air into the tunnel and through the tunnel. They are often found in multiple sets mounted on the roof or side wall of the tunnel at selected intervals. The number of fans required is based on tunnel length and design.



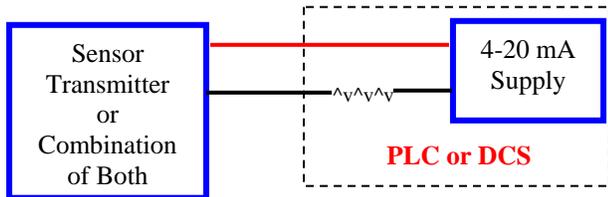
*A Pair of Tunnel Jet Fans*

Axial flow fans are also used to vertically clear smoke from the tunnel in case of a fire. These very large axial flow fans are mounted in vertical shafts, and act as forced air chimneys during emergencies. Often a series of dampers is also placed in the roof of the tunnel to allow the

longitudinal jet fans to assist air flow to the axial flow ventilation fans. This combination quickly clears the tunnel of smoke and allows emergency crews to take the necessary actions.

### Process Monitoring

The critical nature of these fans to provide environmentally safe air requires 100% performance 24 hours/day. Monitoring the vibration of these fans is one of the requirements to make sure that they are running smoothly, and will not unexpectedly fail. Trending and alarming the vibration in the tunnel control center utilizes 4-20 mA current loops from sensors and transmitters.



**Typical 4-20 mA Loop Power Circuit**

Utilizing such a common industrial circuit design means that the fans can be monitored by the tunnels “in house” PLC or DCS control system. This makes it easy for the operators to trend and track fan vibration during normal day – day activities.

The vibration monitoring of the fan can be accomplished in two different manners.

1. General purpose accelerometers, like the AC102 Series, can be placed on the fan, and connected to a transmitter, like the VX Series, that filters and converts the vibration signals to 4-20 mA. This combination will provide process control and allow for dynamic vibration analysis.



**AC102 Series Sensors with Transmitters**

2. Dual output loop power sensors, like the AC400 Series, could be installed on the fans. This dual output sensor filters and converts the vibration signals to 4-20 mA to provide process control and also allows for dynamic vibration analysis.



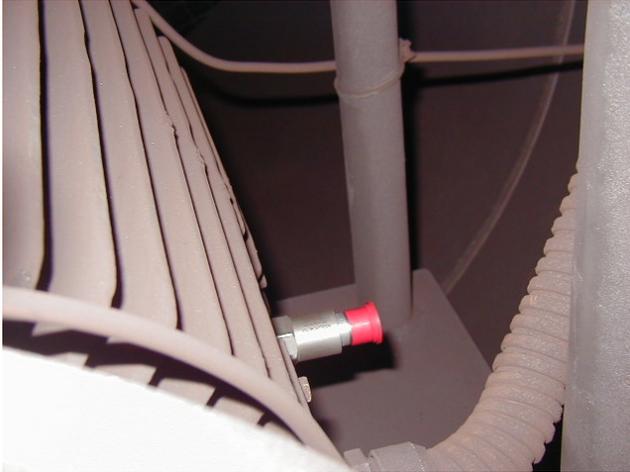
**LP400 Series Dual Output Sensors**

- Pin A = 4-20 mA supply*
- Pin B = Common*
- Pin C = Dynamic Vibration*

### Sensor Mounting

The number of sensors to mount on each fan will be determined by the design of the fan and the extent of monitoring required. A secure mounting method is required, and the time should be taken to properly locate and mount the sensors. Several options are available for permanent mounting.

1. Stud mounting with spot face
2. Mounting pad with adhesive
3. Zerk fitting adaptor
4. Fin mount



***Horizontal Vibration Sensor Mounted on Tunnel Fan Motor***

**Cables**

Cable management is also a concern with tunnel fans. Quite often there is a significant amount of air flow and long distances involved from the sensors to the transmitters, or directly to the control room in the case of dual output sensors. Care must be taken and plans put in place to assure that the cables are run in a manner that protects them. Access holes and conduit pipes may be required to protect the cables.



***Drilling Access Hole for Conduit***

Good organization of the wiring will provide robust and understandable wire runs. Each wire should be labeled, and matched to the corresponding sensor.



***Completed Conduit Connection***

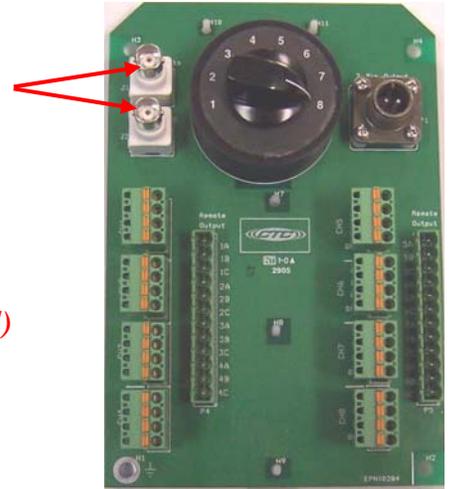
**Junction Boxes**

Sensor outputs will be collected by junction boxes, and then processed by the PLC or DCS. If you are using the LP400 series sensor, the SB142 or SB242 series junction boxes will manage the dual outputs.

***Dual Output Junction Box***

***SB142 (Fiberglass)***

***SB242 (Stainless Steel)***



If an alarm occurs, the vibration analyst can measure the dynamic vibration and analyze the frequencies to determine root cause.

**Summary**

Monitoring the vibration on tunnel fans is critical to maintain fresh air for health and safety providing reliable sources of infrastructure.

