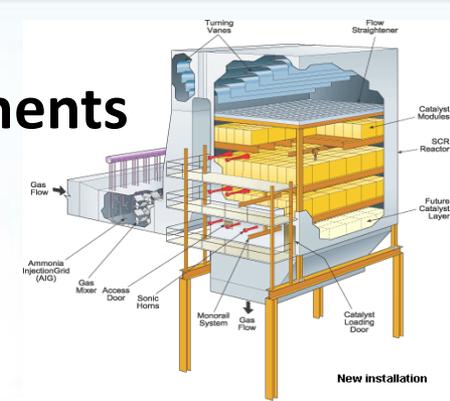


What to do with the ID Fan's additional requirements has no single answer and depends on the ...

- ✓ anticipated pressure increase from SCR
- ✓ existing equipment capability and reserve available
- ✓ floor plan or space available
- ✓ willingness to increase the rotational speed
- ✓ most economical approach considering initial investment, merchantable lost production downtime and current operating efficiency of existing ID Fan
- ✓ consideration for future maintenance costs



Proper maintenance is everything!

In a world of increasing price pressure, power plants are being asked to run for longer and longer periods. However, our recommendation would be that an outage should be taken annually at the least. PB recommends a minimum preventive maintenance inspection be made on each fan in these outages that would include bearing inspection and re-lubrication, coupling check, support structure check, rotor check for cracking and wear, etc. Any loss of material from erosion or corrosion should be mapped and documented for trending purposes to predict safe life.



Standard Blade Designs Used Today



Radial – 72%



Forward Curved – 76%



Radial Tip – 79%



Backward Flat – 81%



Backward Curved – 83%



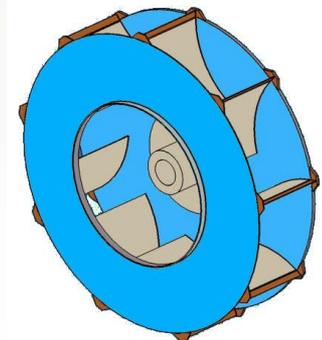
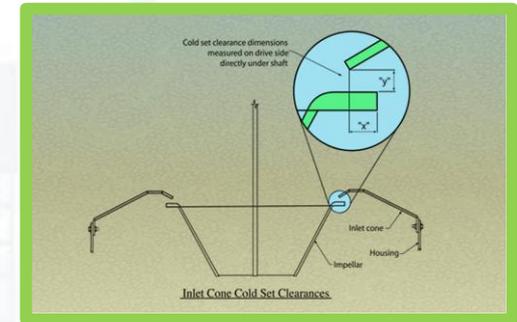
Airfoil – 88%

WEAR SOLUTIONS FOR FANS

- Same material as parent material
- Quenched and tempered low alloy steels - generic AR and proprietary specialty alloys
- Chrome carbide overlay on carbon steel
- Furnace brazed tungsten carbide on CS
- Thermal sprays - chrome carbide / tungsten
- Ceramic tiles
- Tungsten carbide tiles
- Bolt-on high hardness white iron castings

Improve fan capacity / efficiency by

- ✓ properly mating inlet cone to impeller eye
- ✓ tipping or de-tipping the impeller
- ✓ improving inlet / outlet ductwork
- ✓ adding turning vanes
- ✓ changing to variable speed operation
- ✓ redesigning to meet actual system requirements
- ✓ using the appropriate damper
- ✓ replacing an antiquated design



You might have a candidate for optimization ...

- ✓ if you have a fan that is dampered or closed more than 1/3 of it's travel.
- ✓ if you have a process or boiler is limited because of the fan.
- ✓ if you have a fan that has a calculated efficiency of 50% or less.
- ✓ if you have a clean application that currently operating with a RB or RT blade.
- ✓ if you have a FD fan that has not been modified on a boiler that was converted from positive pressure to balanced draft.
- ✓ if you have a fan that there are complaints on the ability to control.

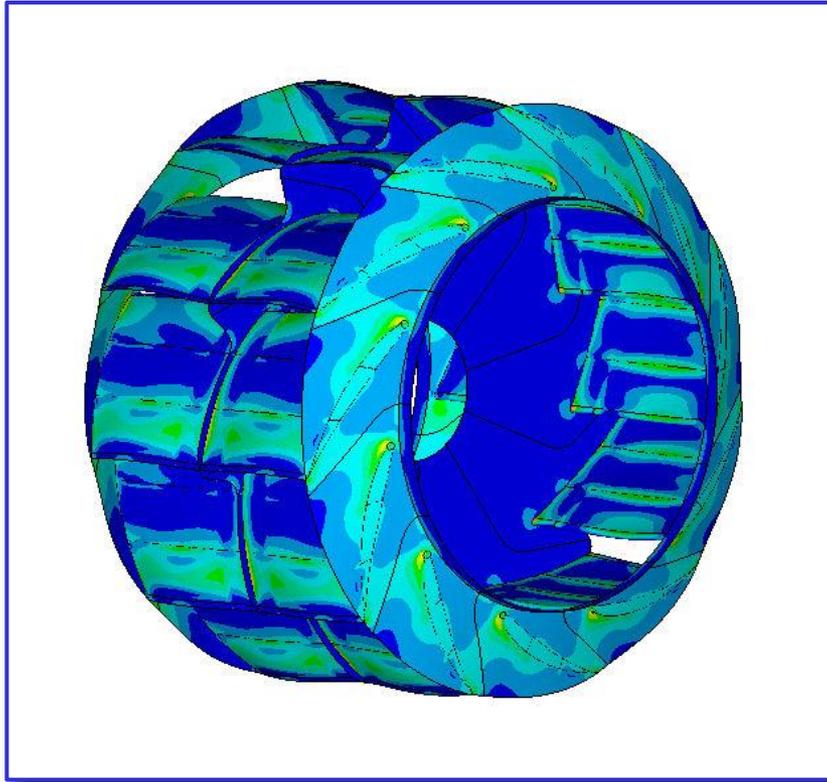
General Rules for Good Duct Design

- **Minimize the number of cross-sectional area changes.**
- **The total angle of convergence should be less than 30°.**
- **The total angle of divergence should be less than 15°.**
- **Reduce the number of turns.**
- **Use turning vanes.**
- **Maintain reasonable turning radius in elbows**
- **The aspect ratio should be between 1:1 and 4:1.**

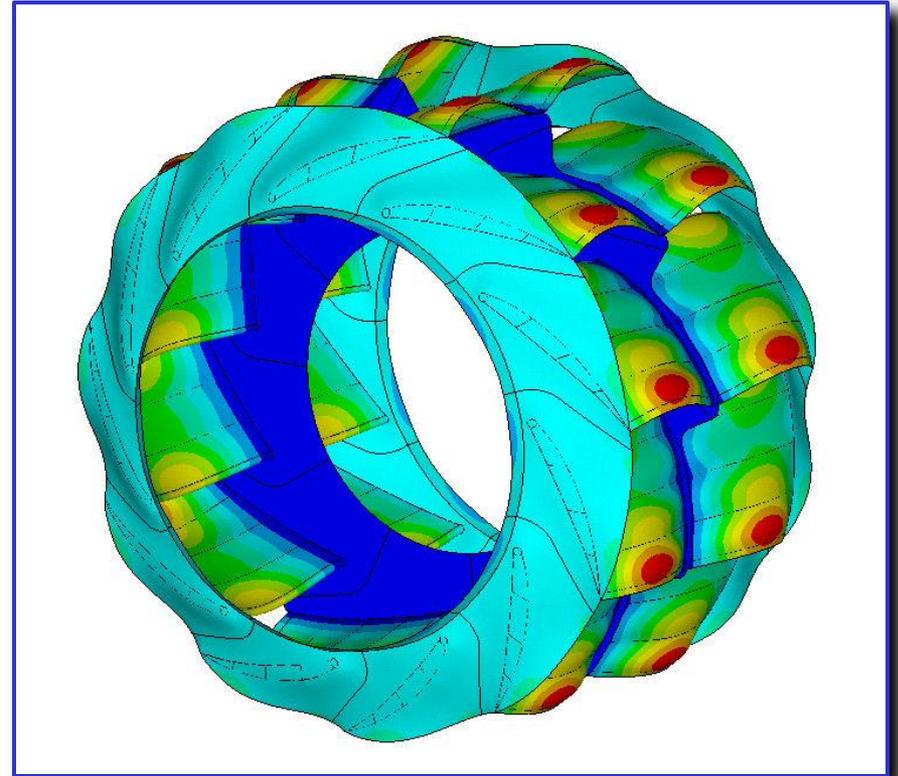


Rotational speed selection is dependent on the application. Generally, maximum speeds are 1800 rpm for FD fans, 1200 rpm for clean ID service and 900 rpm for dirty ID service. Clean FD fans can operate successfully at 1800 rpm and with the faster speed, the overall fan will be smaller, requiring a smaller footprint and be more economical to build. On ID Fans that are downstream of an ESP or baghouse, the flue gas is relatively clean and 1200 rpm operation is considered normal and experience shows that fans such as this have successful operation. On dirty applications, the slower rotation speed the better. Larger, self-cleaning rotors going selected at 900 rpm or lower normally have a longer wear life and react better to build-up problems.

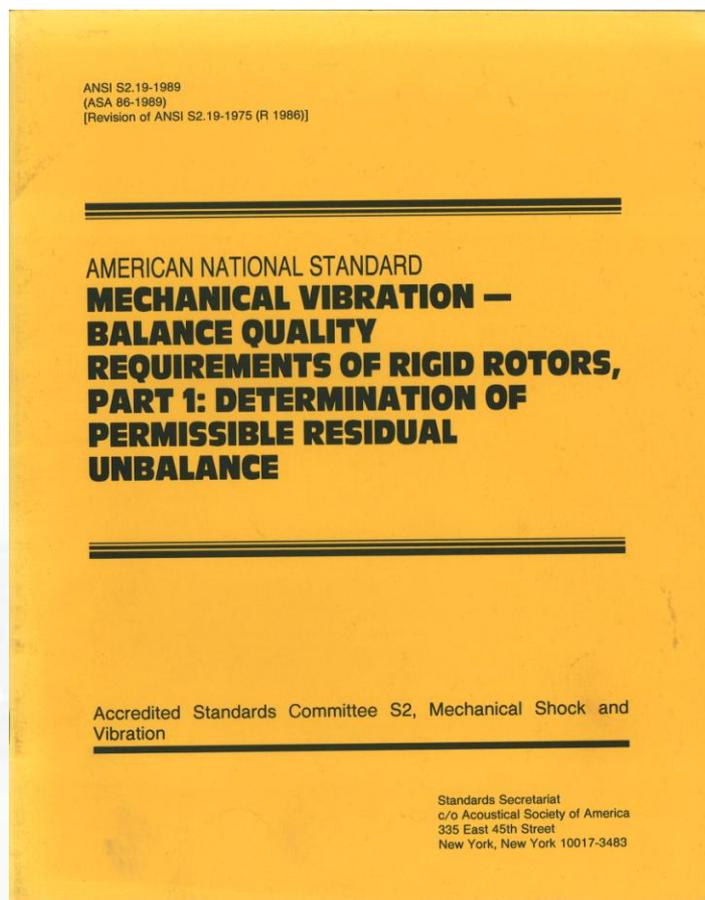
Finite Element Analysis - FEA



Stress
Contours



Displacements

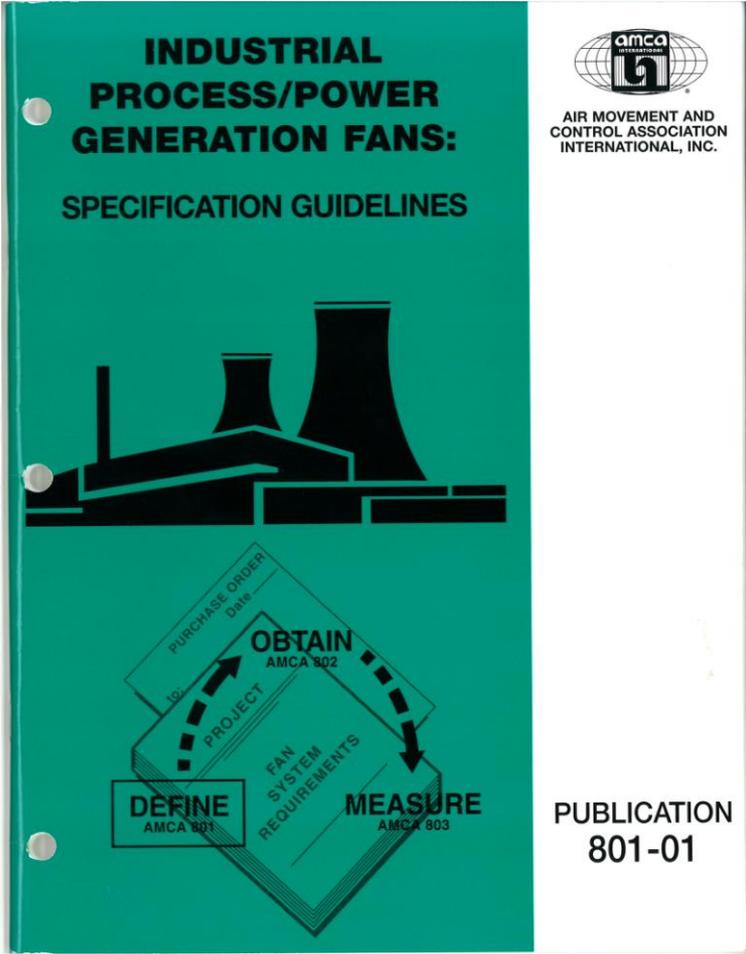
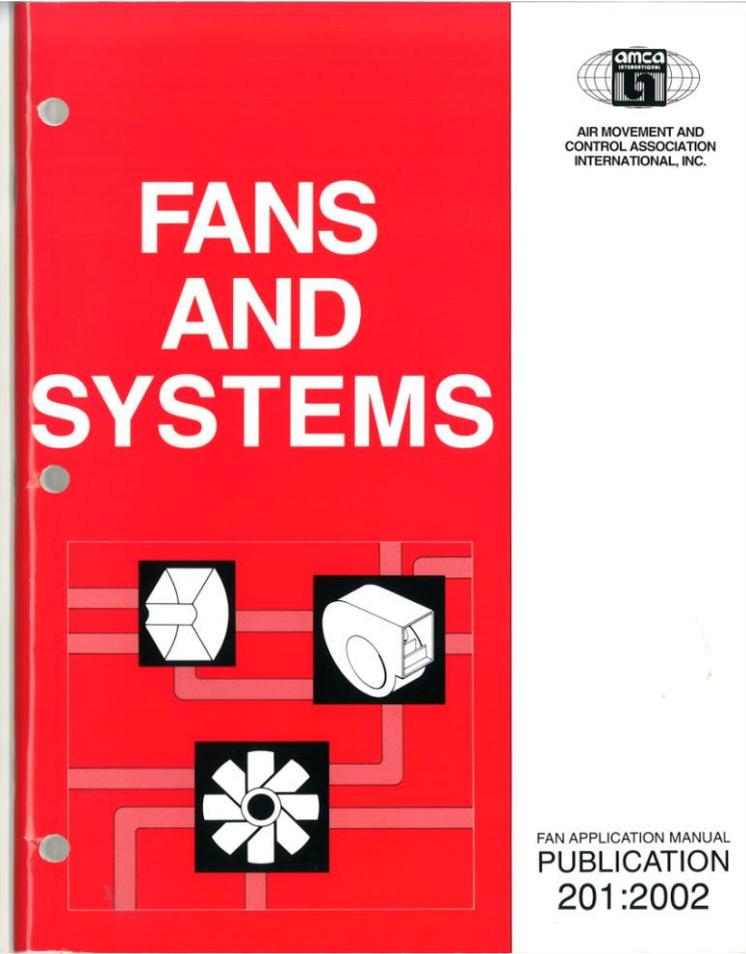


Latest Revision 2004

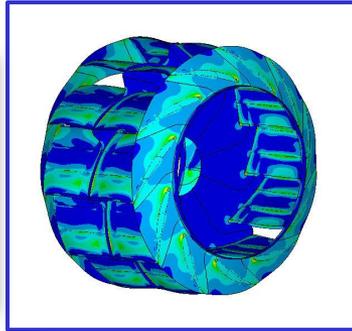


Balance rotating assembly to
ANSI Standard S2.19 – Grade
6.3 or Grade 2.5 or the
AMCA equivalent Standard
204-05: Balance and
Vibration Levels for Fans

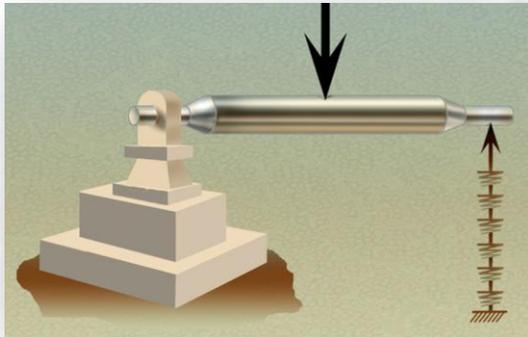
Recommended References



Factory Analyses and Testing Recommendations



Evaluate the stresses in rotors using current FEA methods



Verify the first rigid shaft critical speed so that the appropriate separation can be designed for

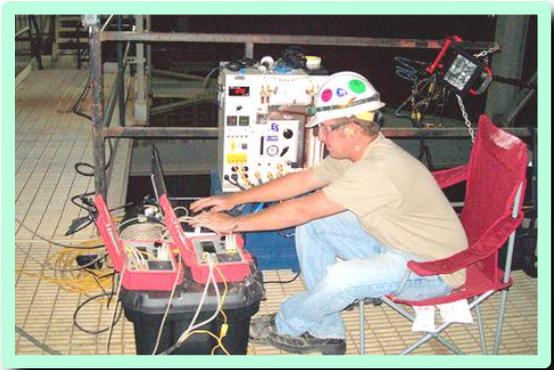
Calculate the design installed resonant speed (foundation boundary conditions will need to be identified to the OEM)



Factory Analyses and Testing Recommendations



Perform a torsional analysis on the drive system and fan for VFD applications.



Do NDE – minimum 10% random radiography on butt and splice welds and dye penetrant or magnetic particle testing of all welds.



Do ultrasonic testing on all shafts and hubs.

Factory Analyses and Testing Recommendations



Perform a natural frequency evaluation to prevent a resonance in the rotor with known forcing function (operating speed, blade pass, harmonics, etc.)



Balance to ANSI Standard S2.19 Grade 6.3 or Grade 2.5.

Question 1

