CBS Canadian Boiler Society

Canadian Boiler Society 2019 Education Days

Adding Variable Speed Fan Control to your Boiler Opportunities and Pitfalls

Speaker(s):

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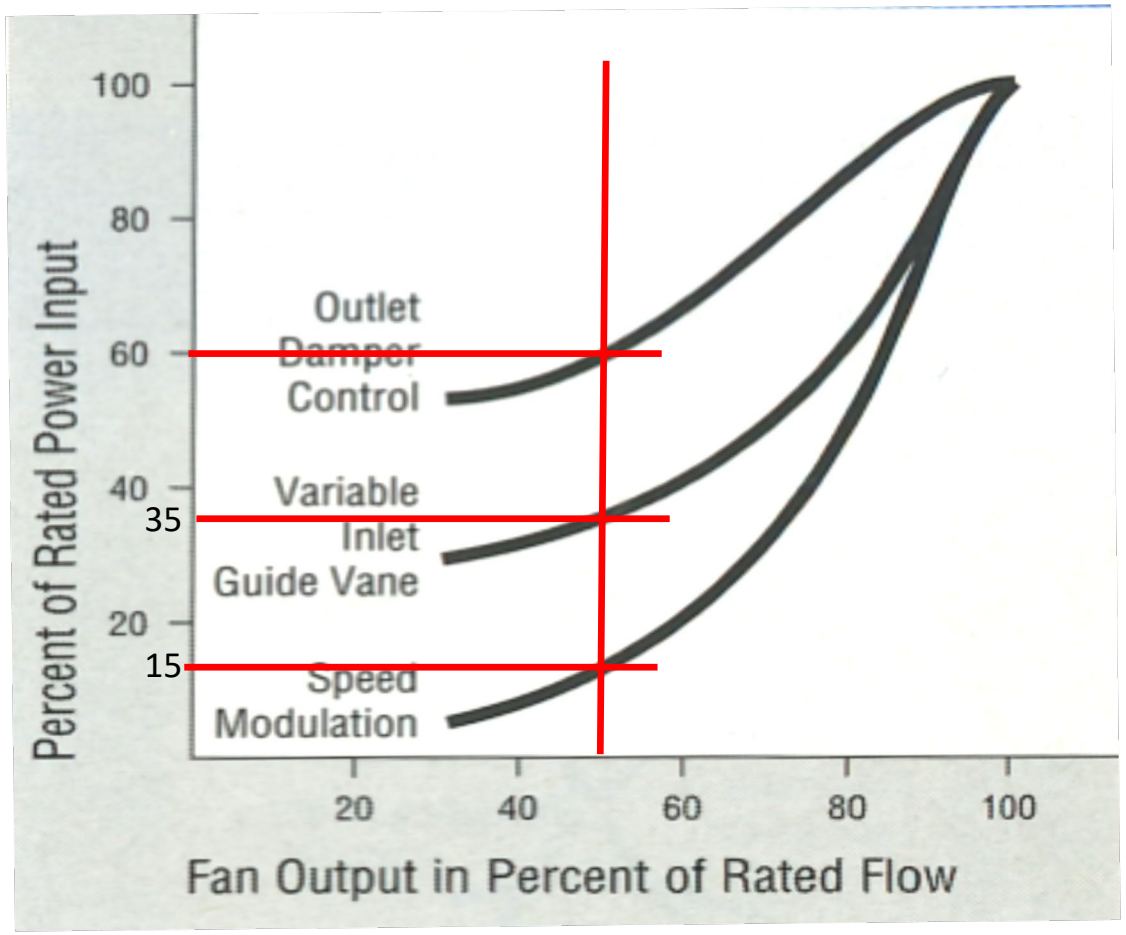
Engineering, Daltec Process Fans

DALTEC PROCESS FANS

Why Control the Fan?

Methods of Fan Control

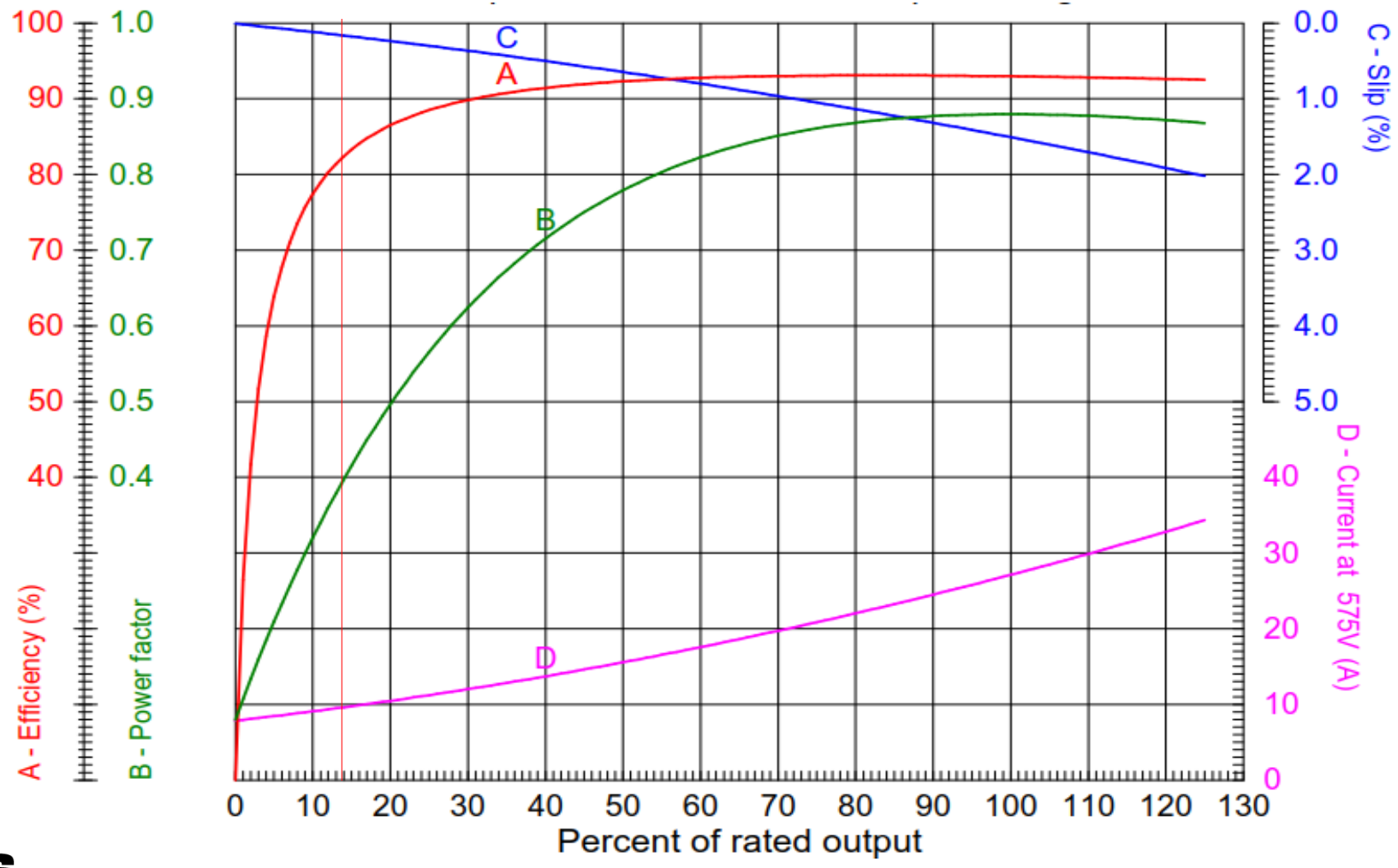
- Duct Damper
- Inlet Louver Damper
- Variable Inlet Vane
- Variable Speed

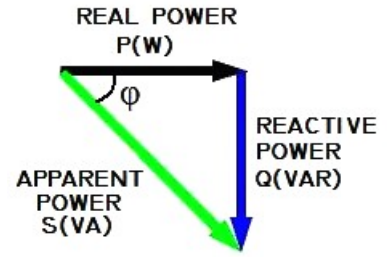


Variable Speed Options

- Induction Motor w/ VFD
- ECM Motor w/ VFD
- Steam Turbine
- Fluid Drive

Induction Motor Efficiency





Induction Motor Efficiency

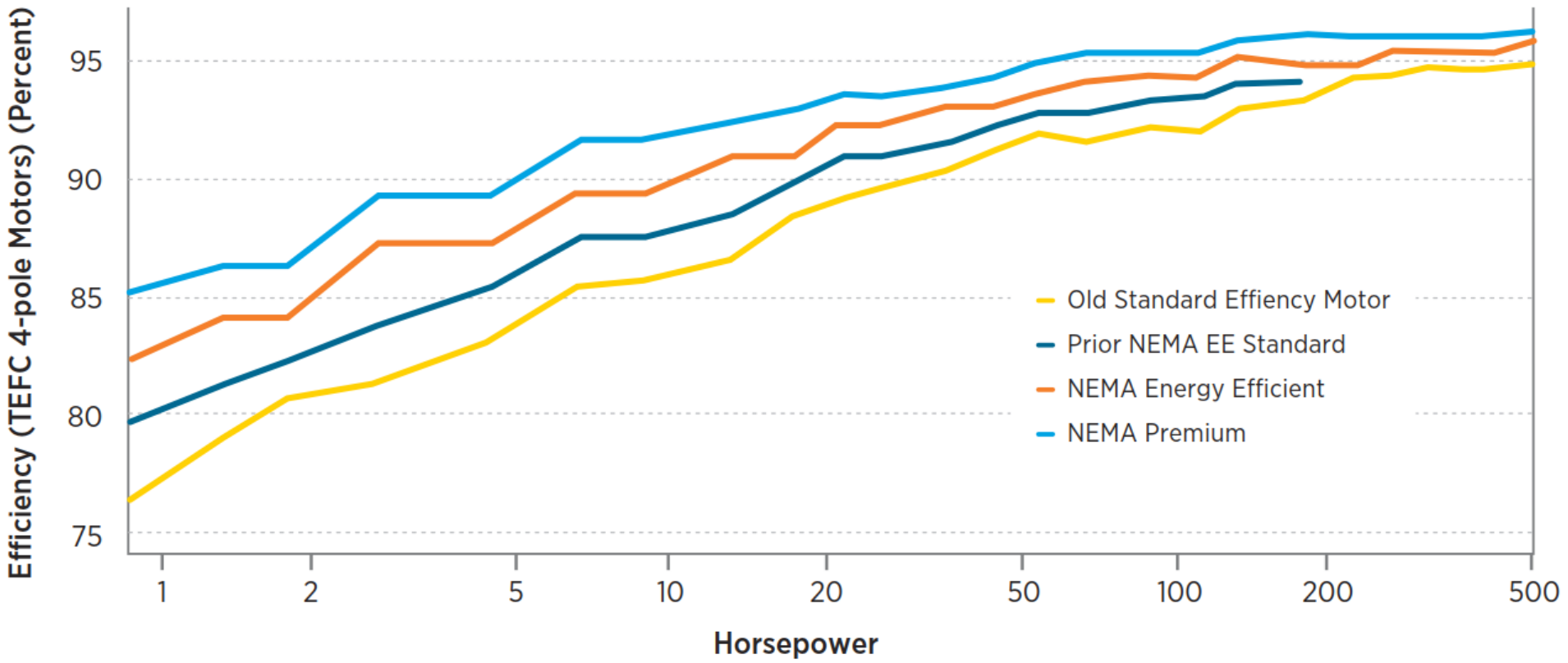


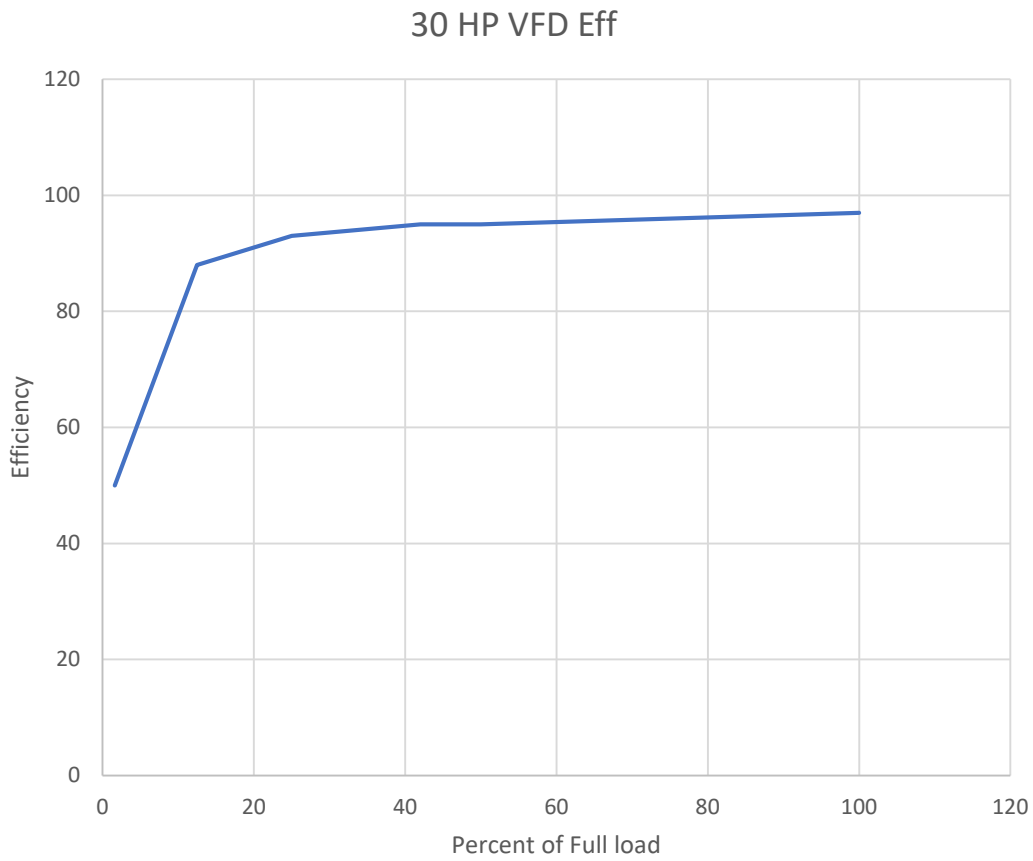
Figure 2-1. Standard, energy-efficient and premium efficiency motor performance

VFD Efficiency

Table 1. Adjustable Speed Drive Part-Load Efficiency*

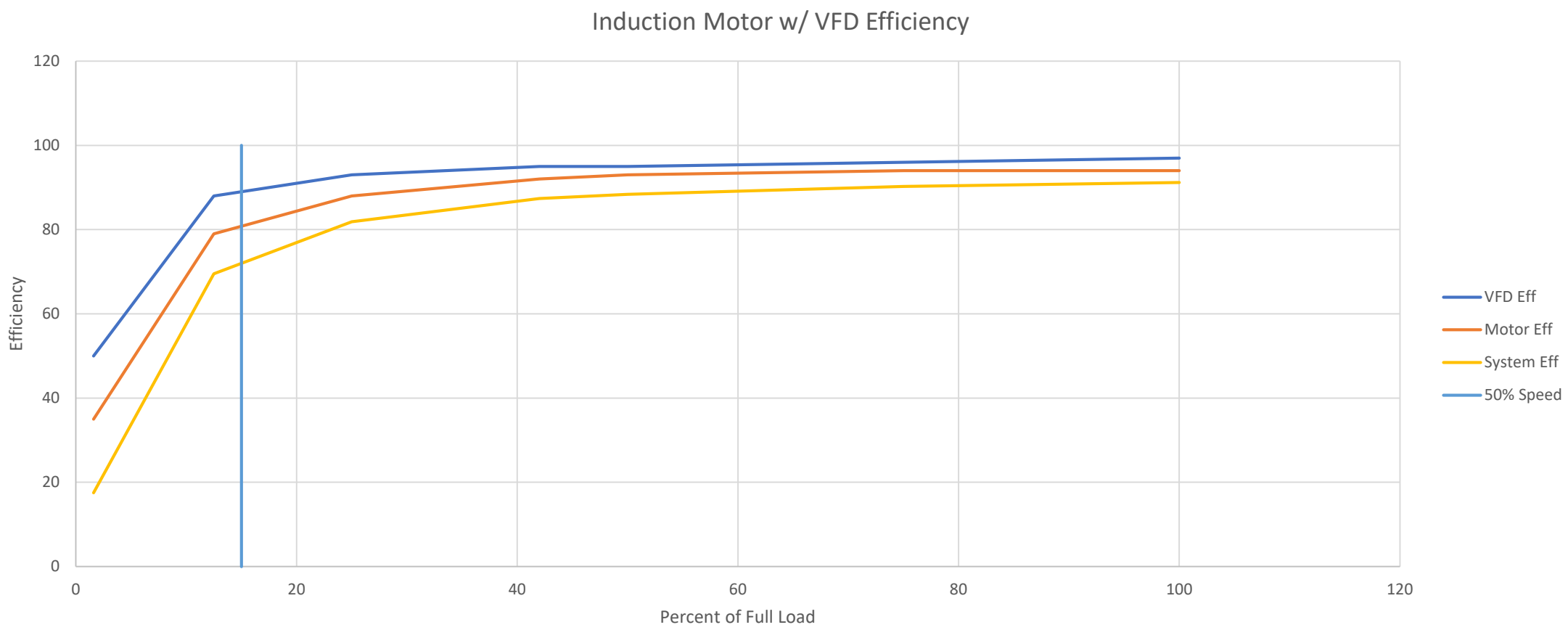
Variable Drive hp Rating	Efficiency (%)						
	Load, Percent of Drive Rated Power Output						
	1.6	12.5	25	42	50	75	100
5	35	80	88	91	92	94	95
10	41	83	90	93	94	95	96
20	47	86	93	94	95	96	97
30	50	88	93	95	95	96	97
50	46	86	92	95	95	96	97
60	51	87	92	95	95	96	97
75	47	86	93	95	96	97	97
100	55	89	94	95	96	97	97
200	61	81	95	96	96	97	97

*These efficiency values may be considered representative of "typical" PWM VFD performance. There is no widely accepted test protocol that allows for efficiency comparisons between different drive models or brands. In addition, there are many ways to set up a VFD that can affect the operating efficiency. *Source: Saftronics, Inc.*

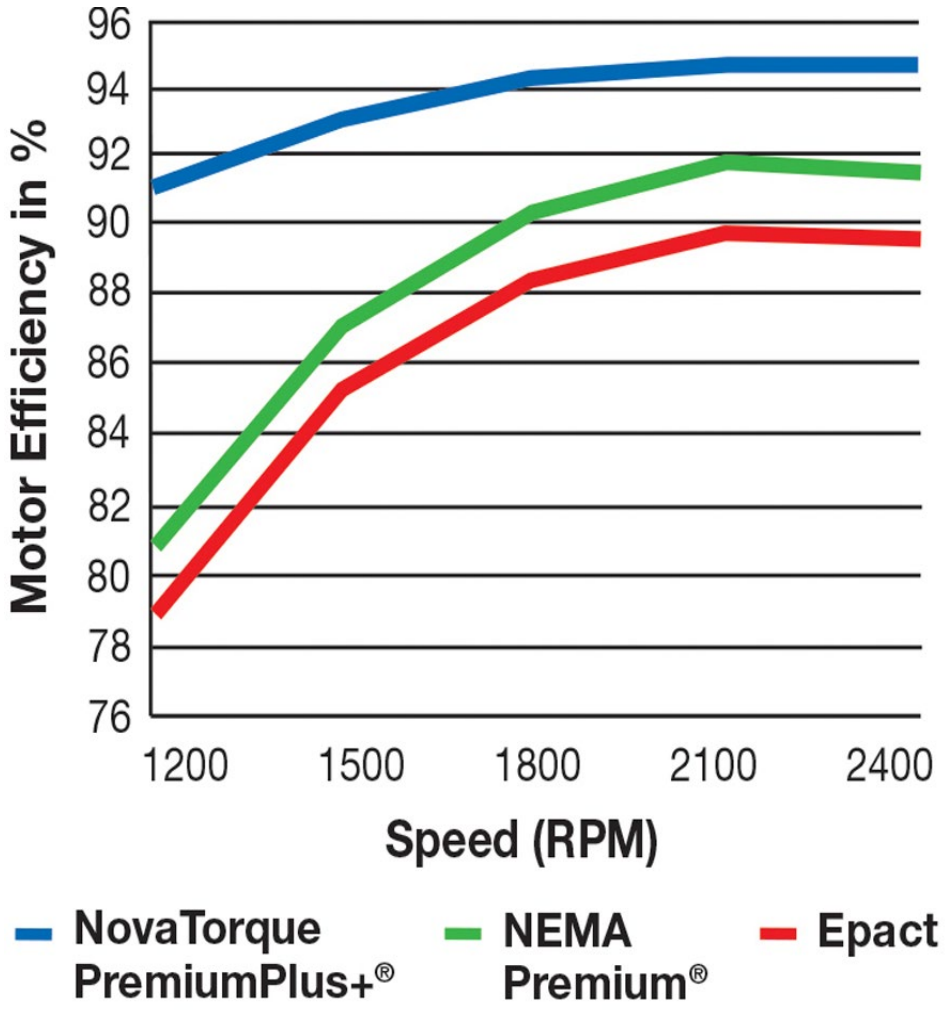


https://www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/motor_tip_sheet11.pdf

Induction Motor w/ VFD Efficiency



Brushless PM Motor Efficiency



- Better efficiency
- Limited availability
  - Up to 200 HP
  - Limited vendors
  - Higher first cost than induction motor

Fluid Drive

- Mechanical speed control
- Established, mature technology
- Efficiency profile similar to VFD but less efficient.
- Dampens torsional vibrations and torque shocks
- Load-free motor run-up

Turbine

- Mechanical speed control
- Established, mature technology
- Dampens torsional vibrations and torque shocks
- Needs steam(
- May need to be isolated from fan during start-up
- High first cost

VSD – Design Considerations

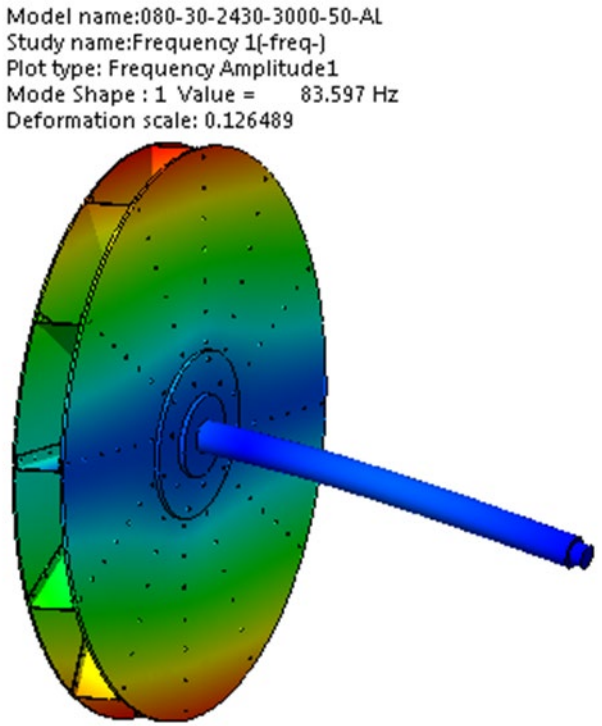
- Natural Frequencies
  - Impeller
  - Fan Support
  - Torsional Frequencies
- Electrical System Harmonics

VSD – Design Considerations

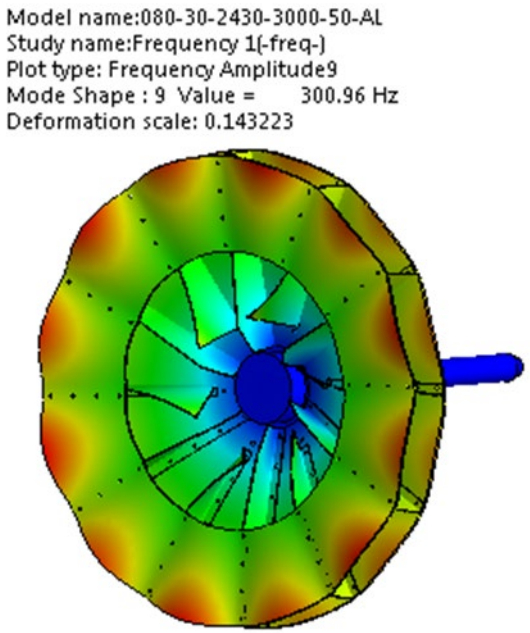
- Low Cycle Fatigue
- Surge

Impeller Frequencies

Impeller



Blade Pass



Torsional Critical Speed

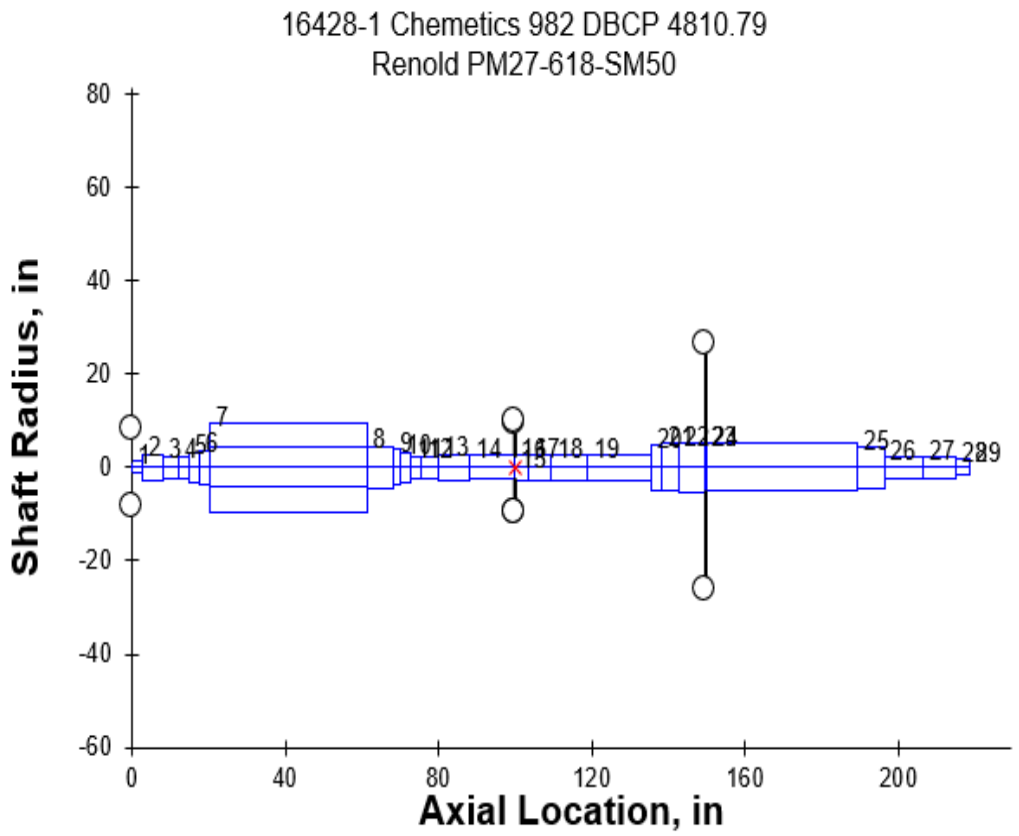


Figure 9 - Torsional Model

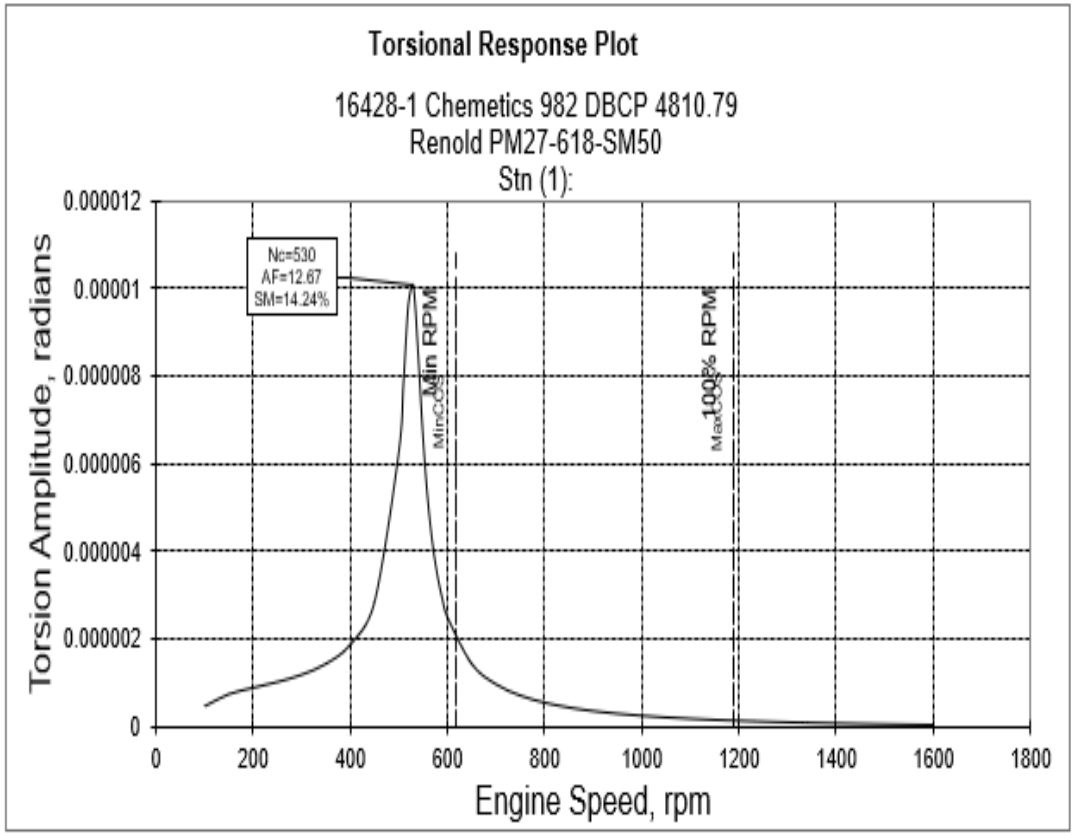
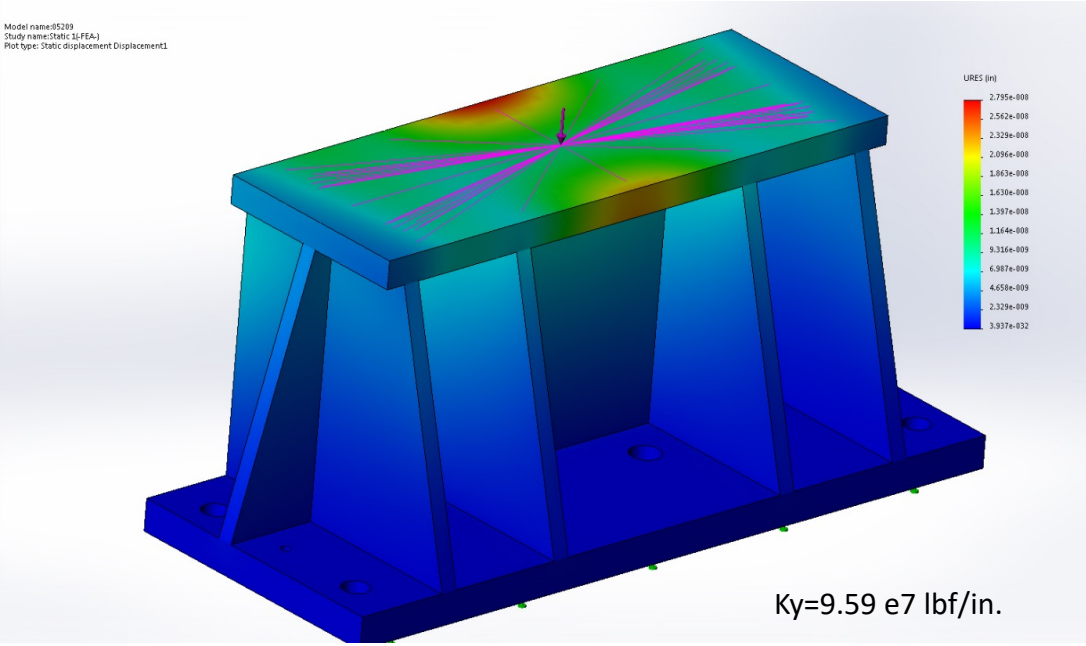
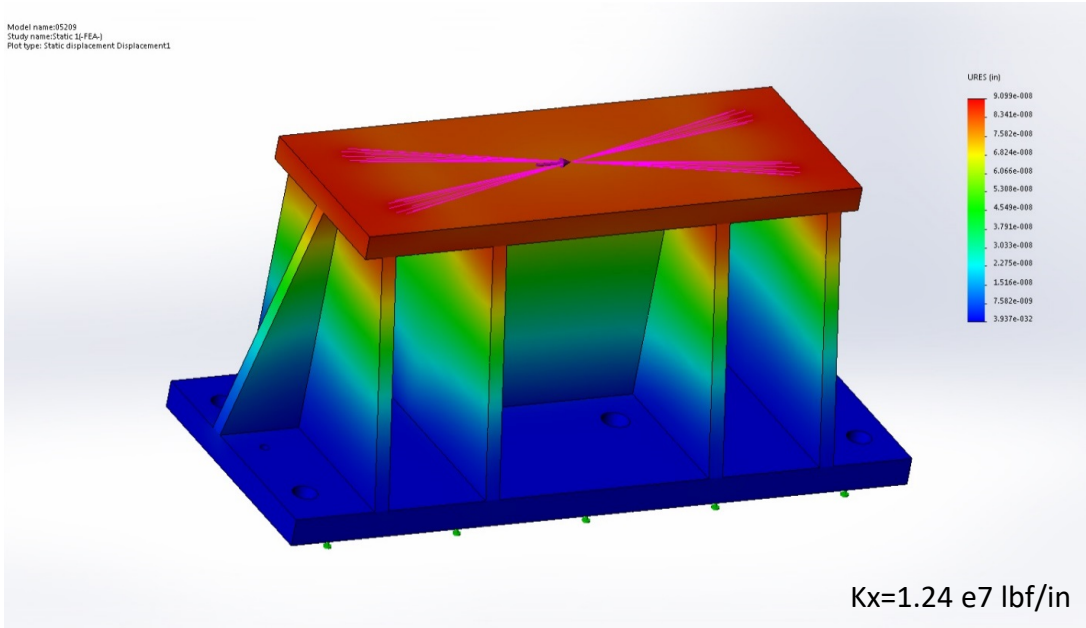


Figure 11- Torsional response at low operating speed

Fan Support Structure



Ky=9.59 e7 lbf/in.

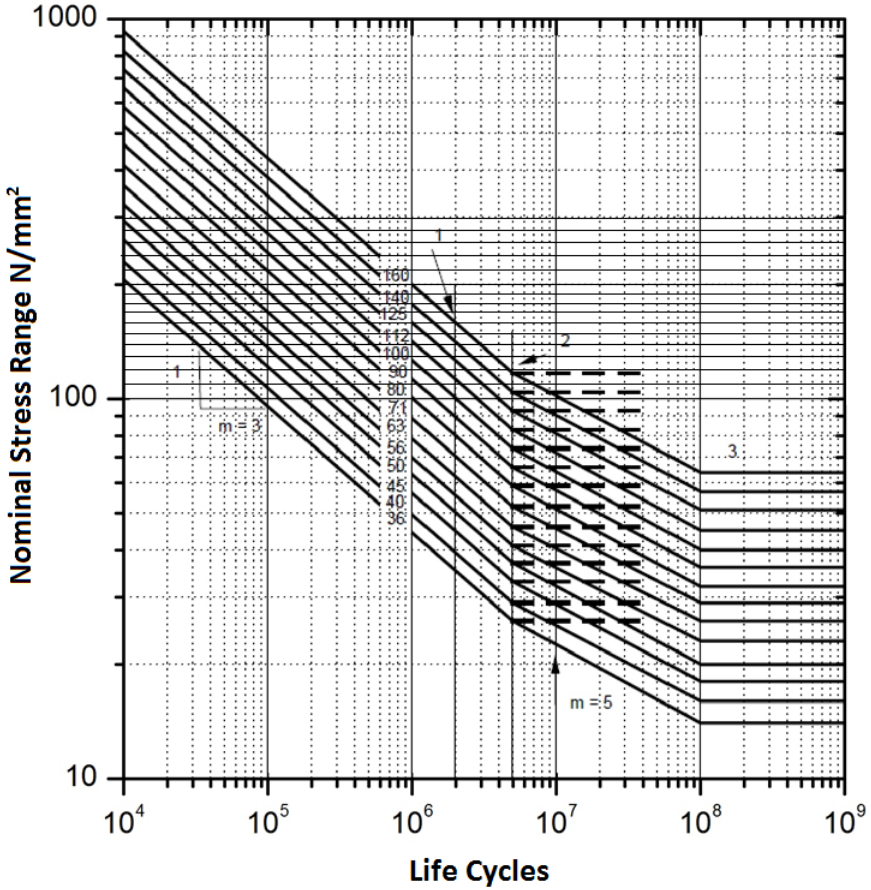


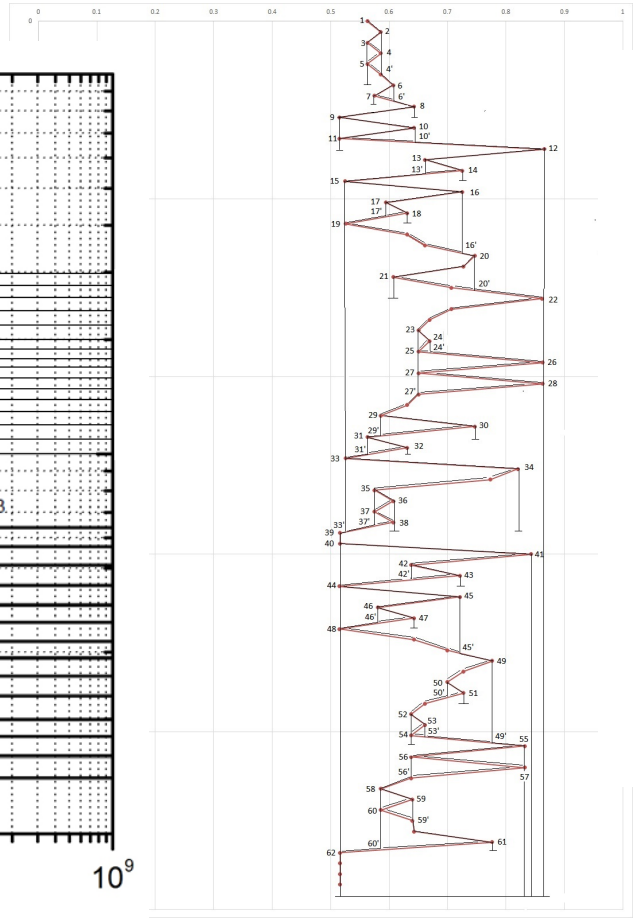
Kx=1.24 e7 lbf/in

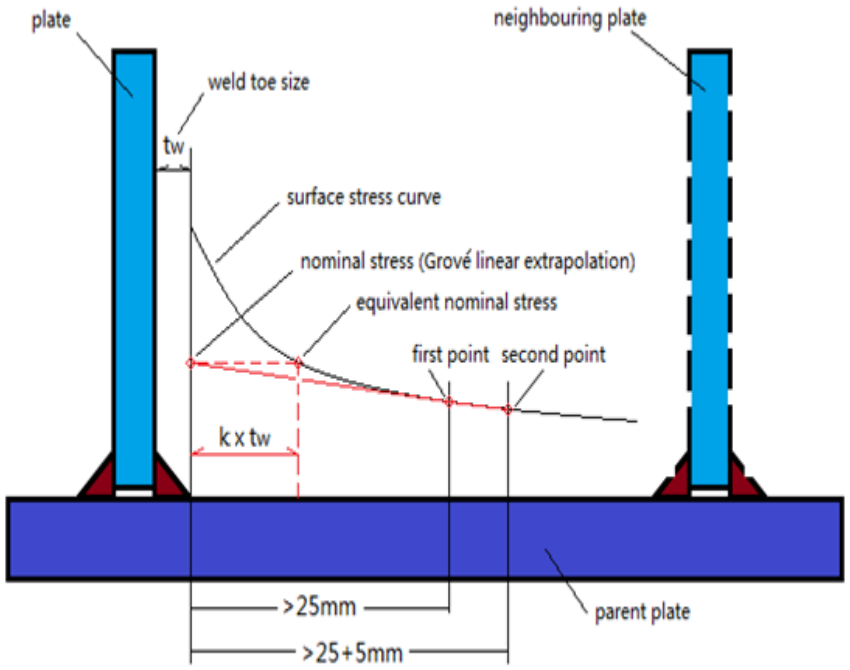
VFD Harmonics

- Air Gap torques
- 6X and 12X line frequencies

Low Cycle Fatigue







Strategies

- Define load cycle
- Specify fan requirements
  - Cheaper to design ahead than risk catastrophic failure

Thank you

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