

W8 Test Plans with StreamVaner

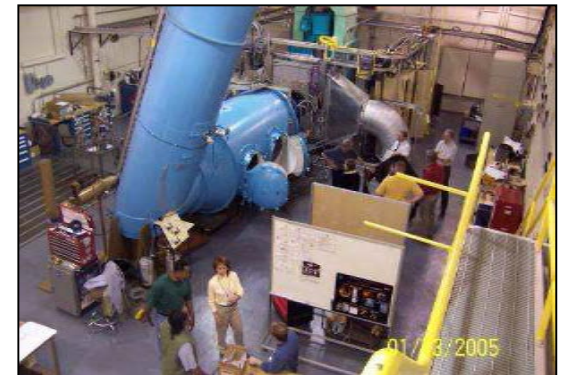
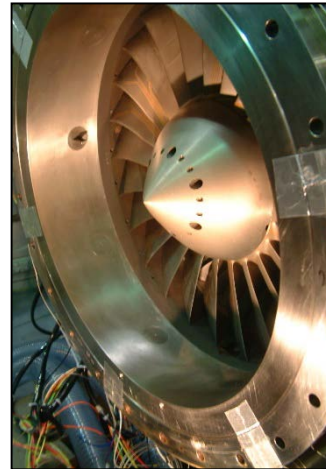
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May 31, 2018





<https://www1.grc.nasa.gov/aeronautics/bli/>
NASA GRC, Dave Arend

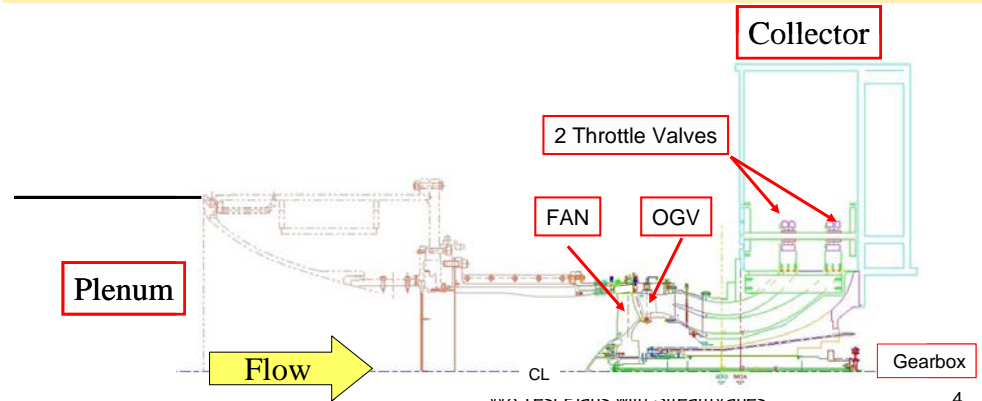
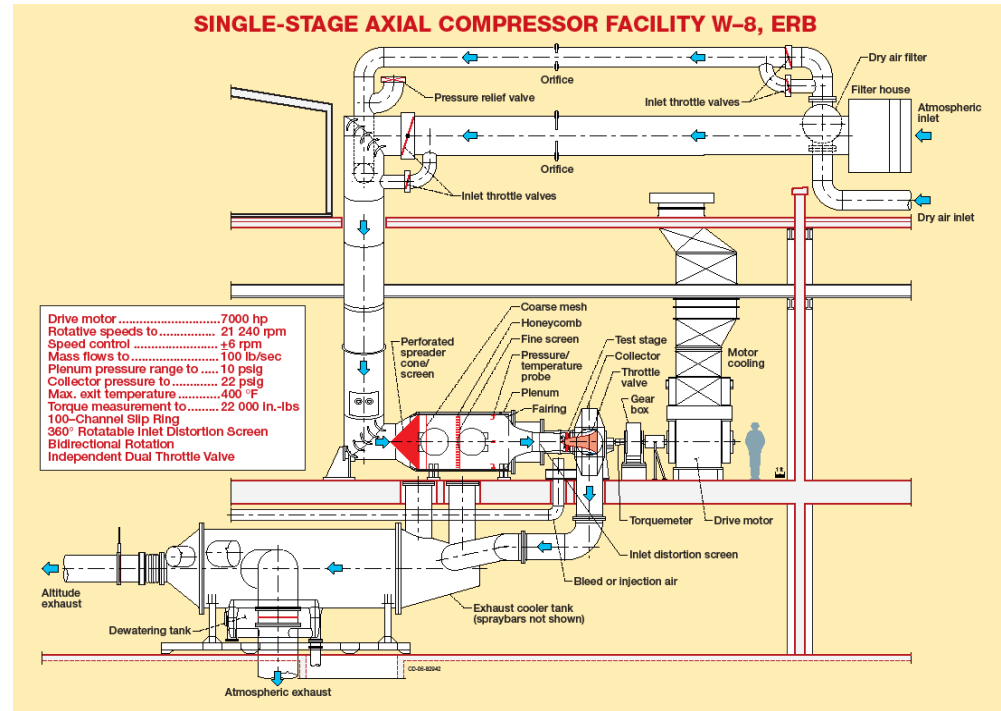
W8 Facility

- A single axial stage facility designed to:
 - Acquire detailed data for model development as well as to validate CFD codes
 - Investigate innovative flow control strategies for improving and/or controlling compressor performance and operability
 - Study the effects of inlet distortion on fans
 - Investigate the aerodynamic performance and operability of fans and compressors

W8 Overview

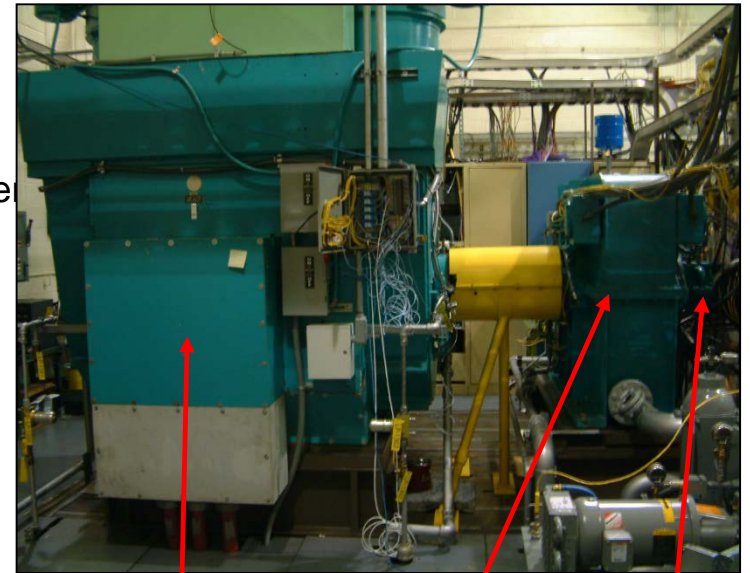
Unique Capabilities

- Compatibility with both 20.2" and 22.0" dia. fans/compressors which provides compatibility with AFRL, NASA, and industry
- Bi-directional bearings which provides compatibility with 9x15 LSWT drive system as well as compatibility with industry rotation conventions.
- Common shaft attachment scheme with W-7 Multistage Facility & the 9X15 LSWT
- Inlet Bleed system - modifies inlet boundary layer thickness to simulate various inlet installations.



▪ Drive System

- Electric Drive Motor
 - 7000hp, 3600 rpm
 - Powered by the ERB Variable Frequency System
- Gear Box
 - 7000hp
 - 5.9:1 gear ratio
- Compressor Bearing Housing
 - Speed: 1,860 rpm to 20,300 rpm
 - Tilting pad journal bearings and thrust bearing
- In-line torquemeter rated for 22,000 in-lbs
- Separate lube modules for motor, gearbox, torquemeter, and compressor bearing housing.
- Slip ring installed on the high speed shaft of the gearbox.



Drive Motor

Gearbox

Torquemeter

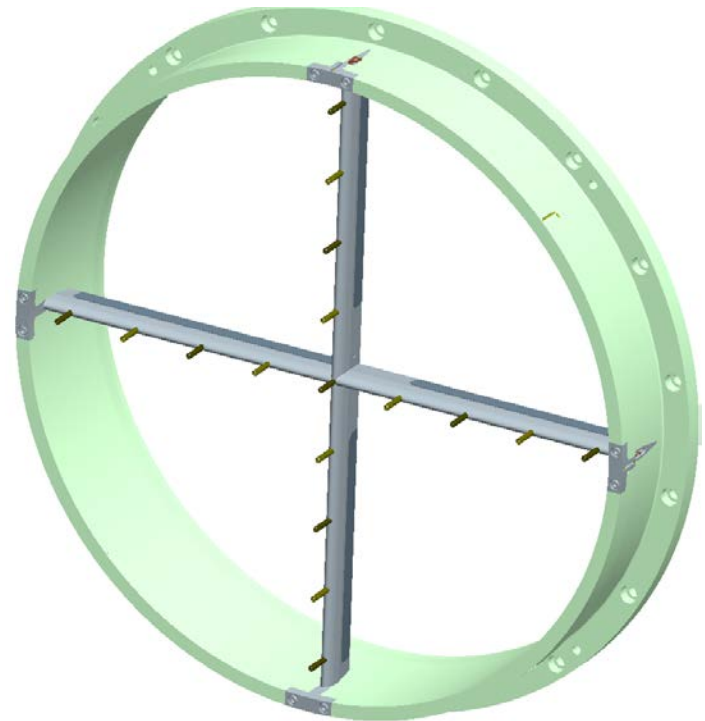
Capabilities

- **W-8 Facility Capabilities**

<u>Parameter</u>	<u>Operating value</u>
Inlet air pressure	5-20 psia
Inlet air temperature	Ambient
Inlet airflow	100 lb/s max
Atmospheric exhaust	0.8 psid blowers
Altitude exhaust	26 in. Hg vacuum max
Rotor speed	20,600 rpm max
Rotor size	22 in. max
Drive motor	7,000 hp max

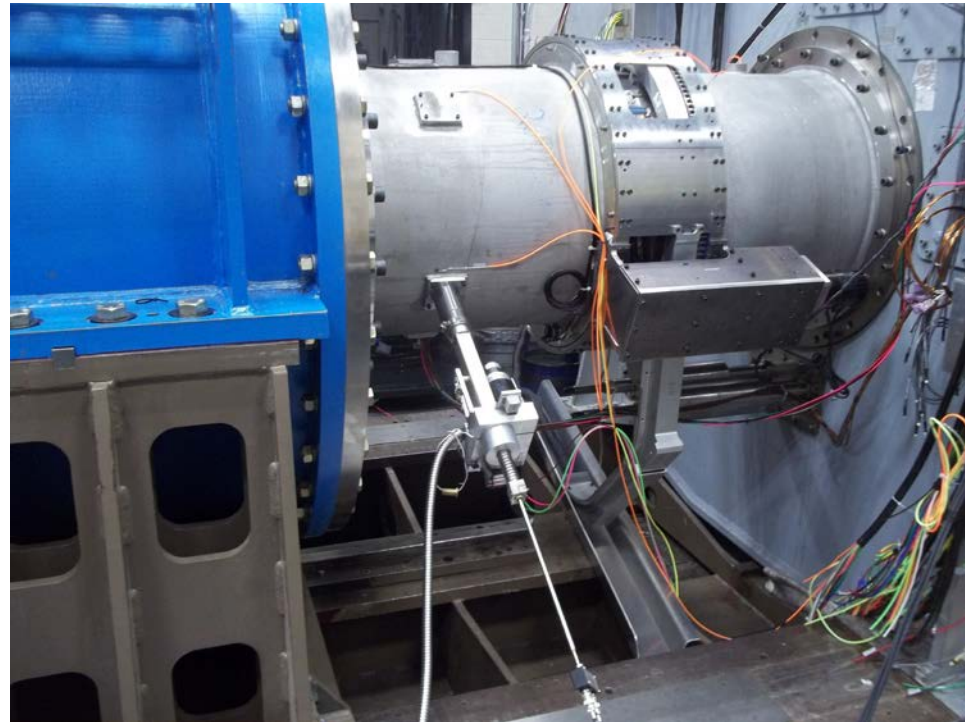
Inlet Characteristics

- 8 total Pressure
 - Calibrated for total pressure recover
- 9 total temperature
 - Calibrated for total temperature recovery, density sensitivity, and angle sensitivity
- 8 static Pressures

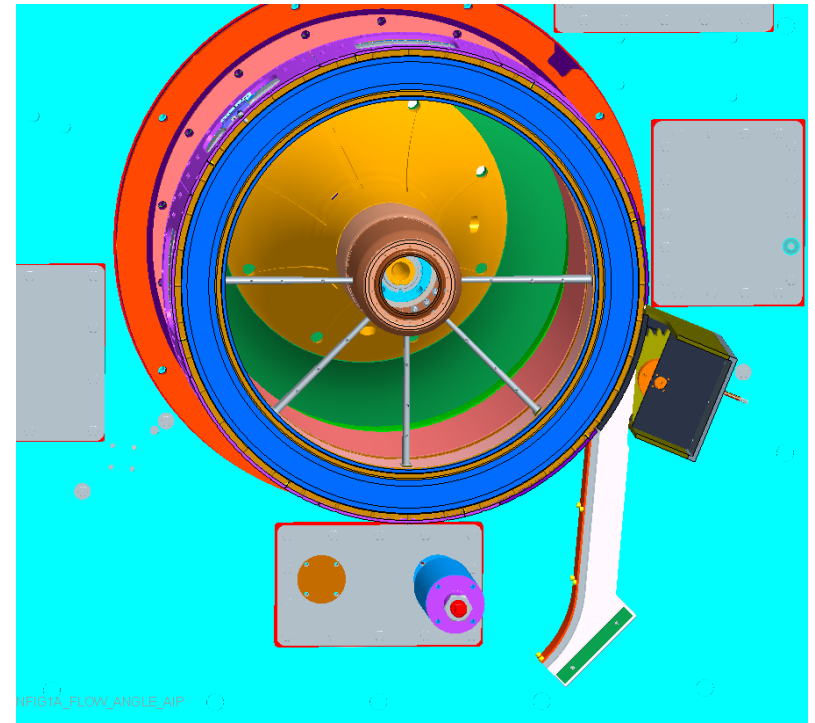
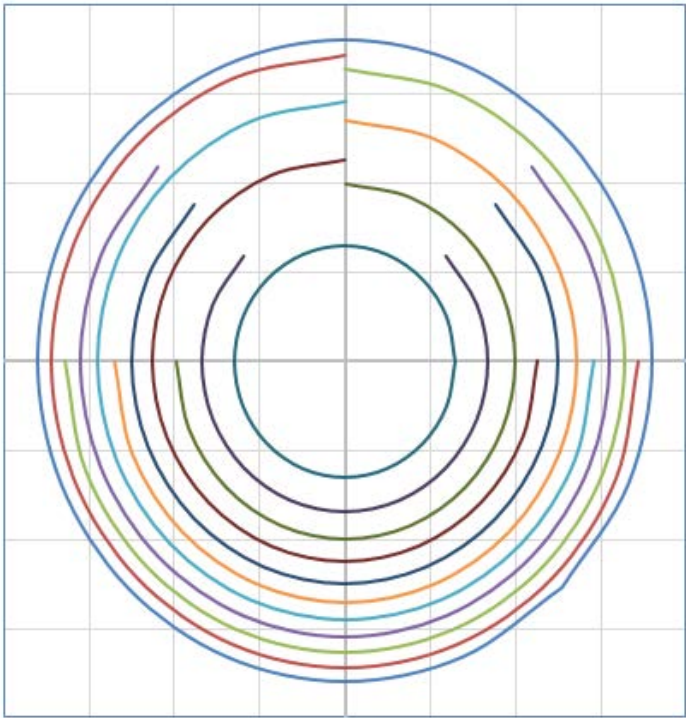


Characterize Baseline Facility

- Turbulence intensity has been shown to be $< 1\%$ at the fan entrance (Van Zante 2007, Bozak 2017)
- Desire to show circumferential uniformity
- Need to know at StreamVane Location upstream of fan

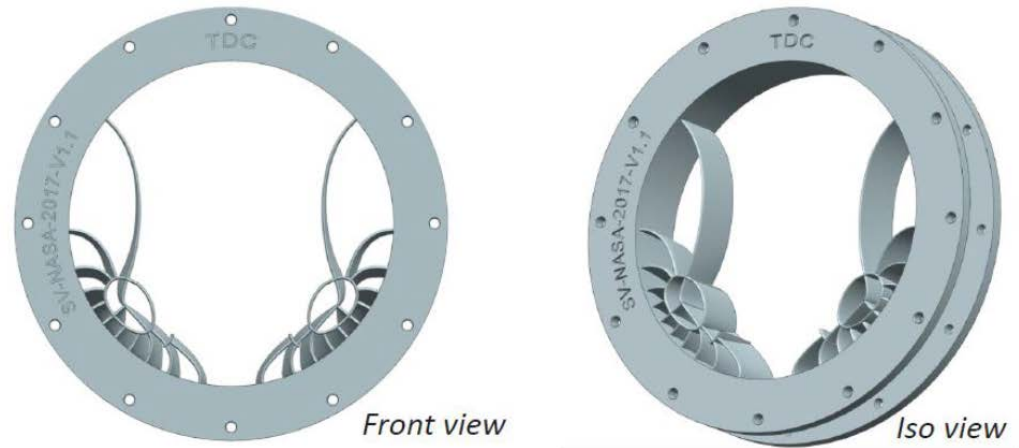


Empty Section Swirl



StreamVane™ Method (AIAA 2016-0534)

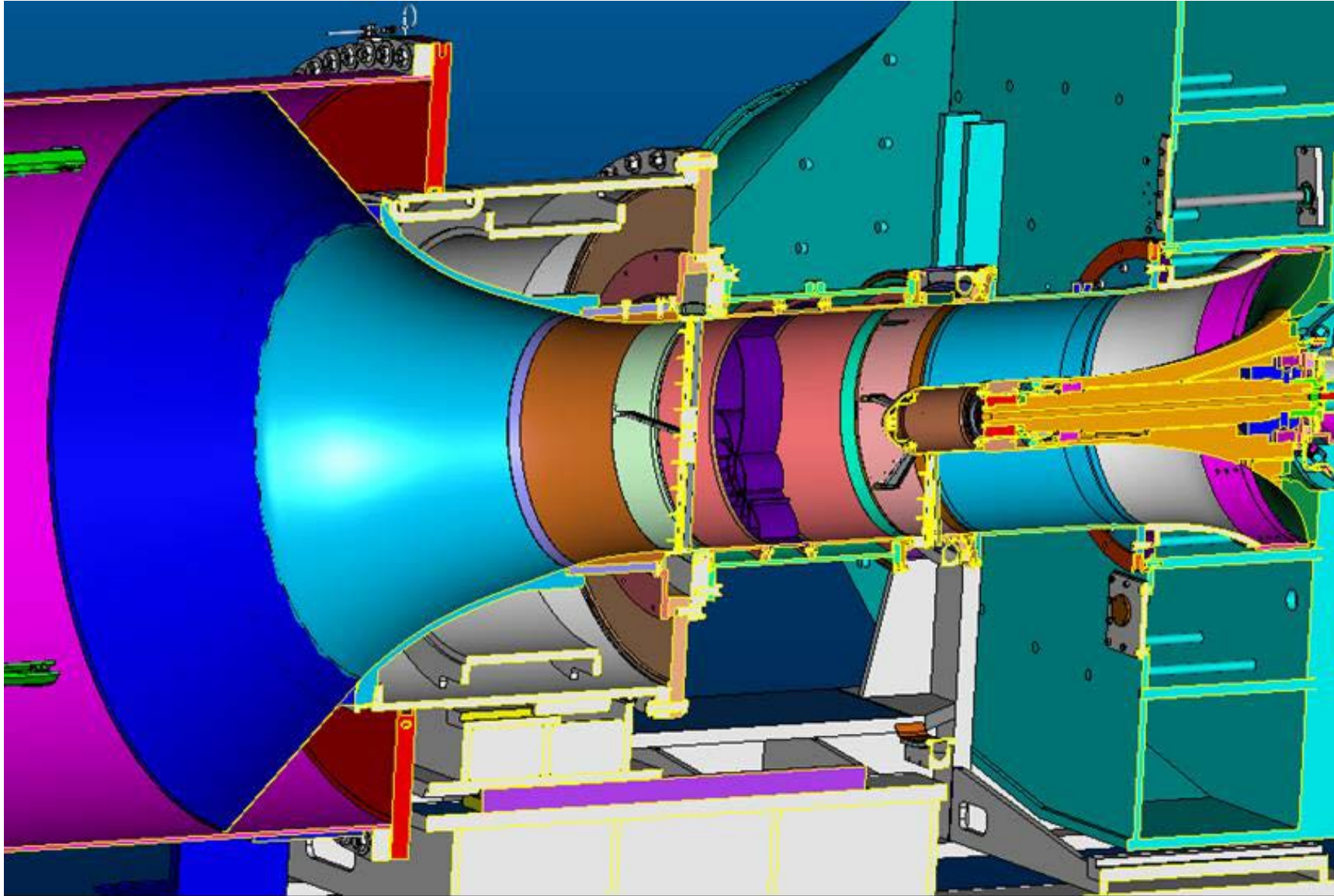
- Patented Virginia Tech Technology process



- Generates user

defined swirl patterns from a 2-D vector field

- NASA is working with Virginia Tech University to develop StreamVaness for testing with 22" diameter fans
- Can be upgraded with screens to include total pressure distortion



Piping Upgrades

- Increase test section length to allow for entire fan system with upstream and downstream measurements
- Turbulence under 1%
- No swirl

Driveline Upgrades

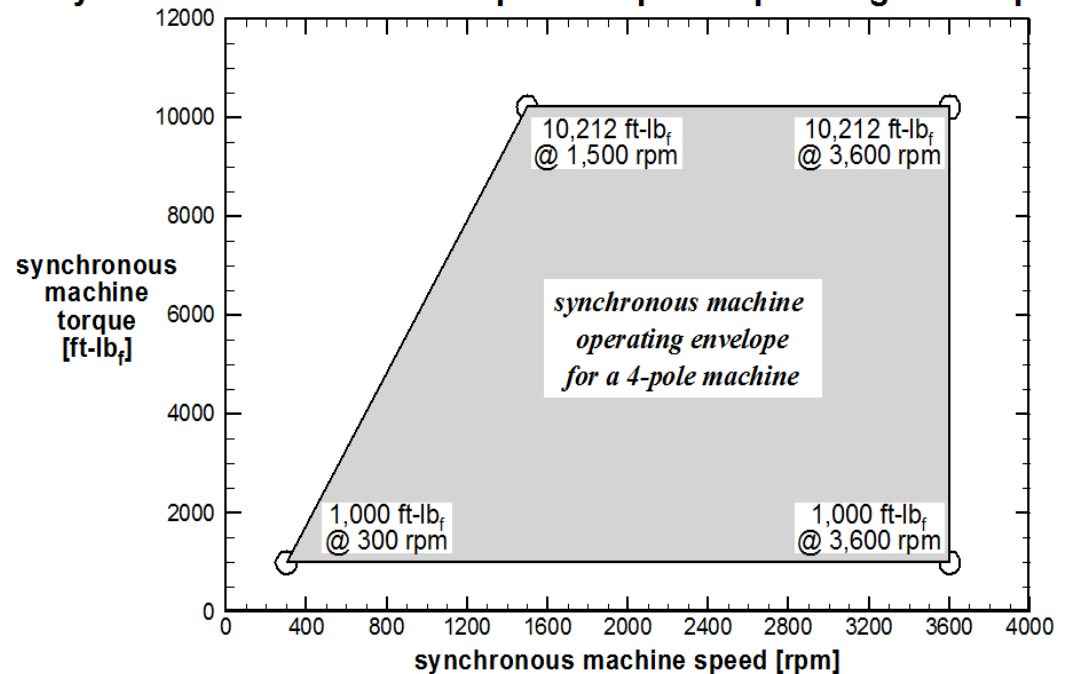
Fall 2018

- New Motor

FY 2019

- New Shaft with Balance capability
- New Bearings

NASA Glenn Research Center - Test Cell W-8
Synchronous Machine Torque vs. Speed Operating Envelope



Data Upgrades

- Netscanner Pressure Measurement
- Cobra Data Acquisition
- New Shaft with balance capability
- Upgrade the on board data system and slip ring

Testing With the BLI Fan

