

WEI HAO WANG

INVACARE

MECHANICAL INTERNSHIP

WORK EXAMPLES

Skills

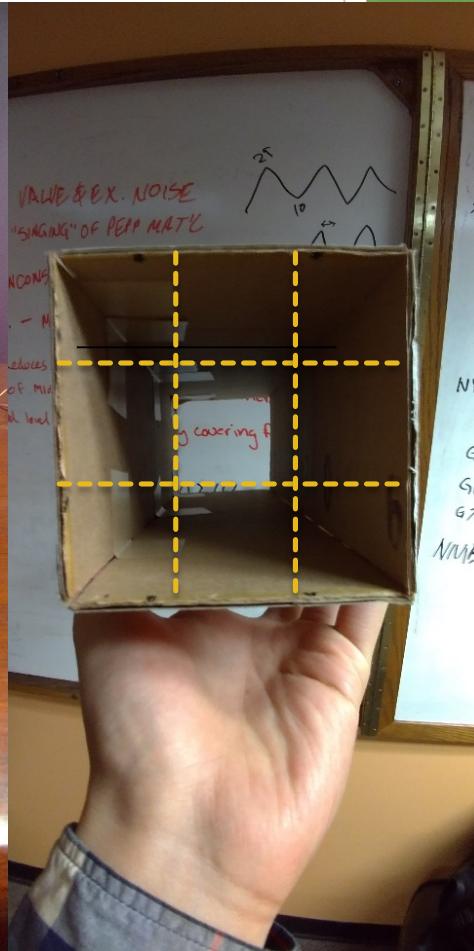
- ▶ Skills identified
 - ▶ Laboratory measurement skills
 - ▶ Vibration and noise analysis
 - ▶ Root cause analysis
 - ▶ Data analysis and data acquisition
 - ▶ 3D CAD modeling and flow analysis with ANSYS FLUENT
 - ▶ Prints create and review with SOLIDWORKS
 - ▶ Failure Mode Effect Analysis
 - ▶ Communication across divisions

Fan Evaluation Project

- ▶ Objective of the project
 - ▶ Issue #1: Try to achieve 40 dB for EU unit and the existing NMB fan has resonance in the unit
 - ▶ Objective #1: Find a fan that is quieter than NMB fan without the resonance
 - ▶ Issue #2: The compressor temperature can't be higher than 68 degree C
 - ▶ Objective #2: Find a fan that produce higher CFM and static pressure to cool down compressor
- ▶ Procedure
 - ▶ Tested fan sound level, CFM, static pressure
 - ▶ Compared the testing results between NMB fan and all other fans available
 - ▶ Selected the fans that satisfy Objective #1 and #2
 - ▶ Performed the regular sound testing with NMB and selective fans
 - ▶ Performed thermal testing with NMB and selective fans
- ▶ Outcome
 - ▶ Y.S.TECH. fan (QYW922512BH model) provide higher airflow and lower noise level than NMB
 - ▶ Eliminated 1000 Hz noise of singing (resonance) by replacing NMB fan
 - ▶ This Y.S.TECH. fan enable us to install more sound mitigations foam as well

Fan Evaluation Project

- ▶ Testing for fan sound level, CFM, static pressure



Fan Evaluation Project

- Testing for fan sound level, CFM, static pressure

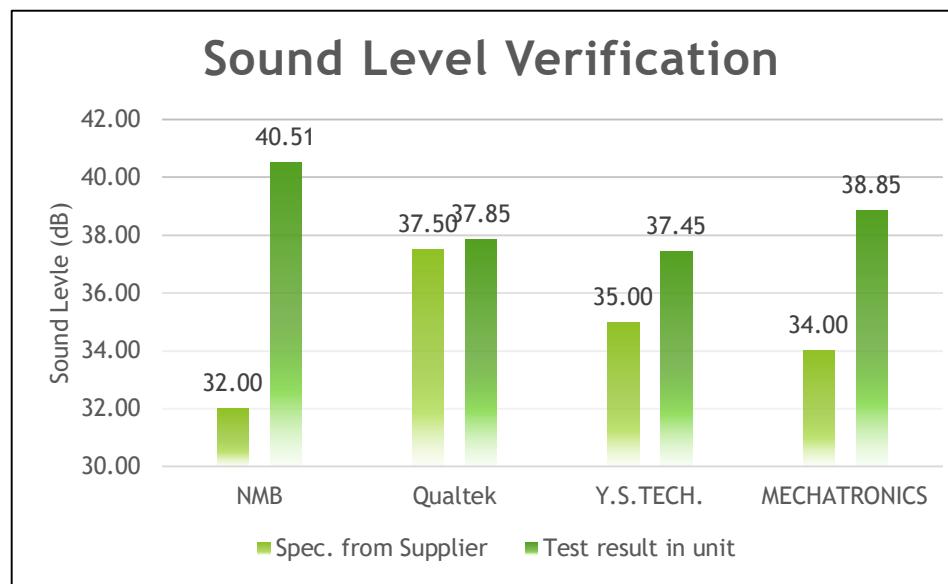
Make	Model	CFM	Static (mmH ₂ O)	dB(A)	Test CFM	Test Static	Test dB(A)
ELINCO JPC	E0925C12B3EZ-K	N/A	N/A	N/A	49.02	2.13	36.17
Qualtek	FAD1-09225CBHW11	56.10	3.70	37.50	53.80	2.98	39.41
SUNON	MF92251V1-1000U-A99	51.50	3.80	34.00	48.22	2.55	36.91
NIDEC SERVO	D0925C12B6AZ-00	59.00	4.90	37.50	59.78	3.55	N/A
NMB	09225SS-12N-ET-D1	51.20	4.59	32.00	52.81	3.33	39.69
Y.S.TECH.	QYW09225012BM	39.60	4.60	28.20	41.25	2.10	35.74
Y.S.TECH.	QYW09225012BH	50.30	6.90	35.00	51.21	3.33	37.46
Y.S.TECH.	YW09225012LM	48.70	2.20	32.00	42.64	2.25	33.63
Y.S.TECH.	NYW09225012LL	45.80	3.10	32.50	40.65	2.00	32.37
Y.S.TECH.	NYW09225012LM	53.50	4.30	38.00	51.01	2.68	36.90
Y.S.TECH.	YW09225012SM	48.70	2.20	32.00	43.64	2.03	33.69
Y.S.TECH.	NYW09225012SL	45.80	3.10	32.50	42.44	2.18	33.86
MECHATRONICS	G9225M12B	40.00	1.80	23.00	41.45	1.93	35.60
MECHATRONICS	G9225H12B	48.00	2.50	26.00	48.22	2.43	35.92
MECHATRONICS	G9225E12B	57.00	3.40	30.00	51.41	2.80	36.89
MECHATRONICS	G9225X12B				3.85		40.33
MECHATRONICS	E9225H12B				3.63		40.93
MECHATRONICS	E9225E12B				4.25		42.45
ebmpapst	8412NH				3.95		38.29



Fan Evaluation Project

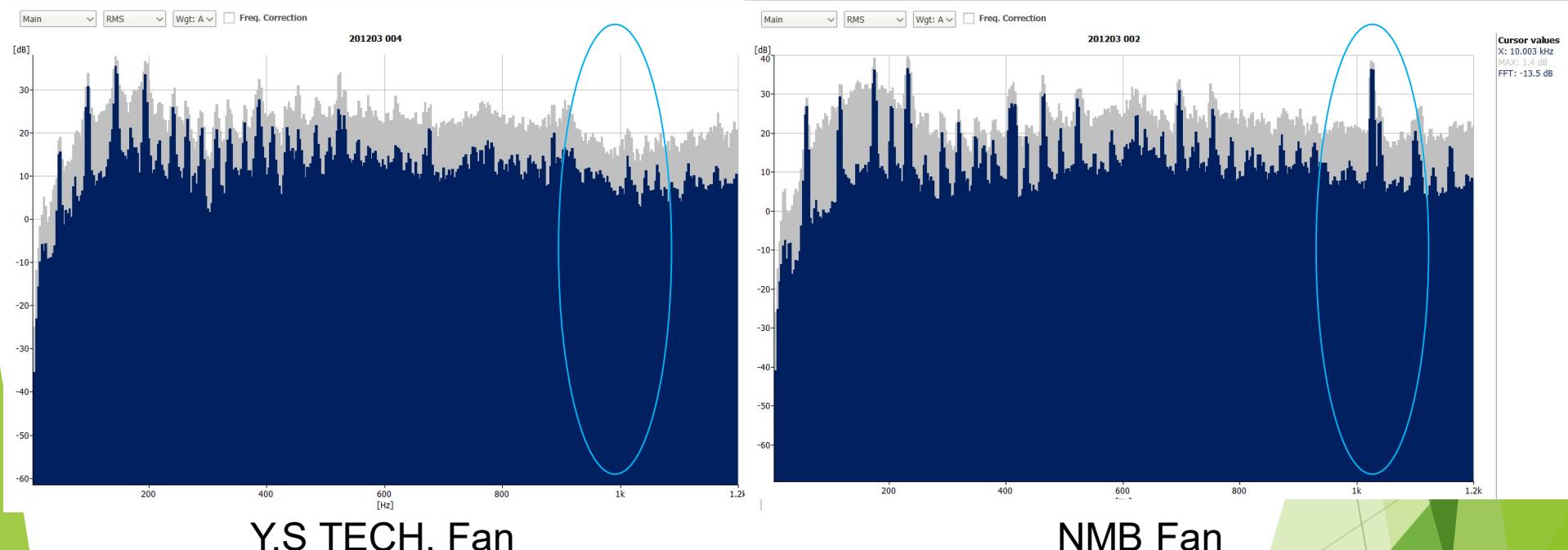
- Testing for fan sound level, CFM, static pressure

Make	Model	CFM	Static (mmH2O)	dB(A)	Test CFM	Test Static	Test dB(A)
NMB	09225SS-12N-ET-D1	51.20	4.59	32.00	52.81	3.33	39.69
Qualtek	FAD1-09225CBHW11	56.10	3.70	37.50	52.81	3.33	39.69
Y.S.TECH.	QYW09225012BH	50.30	6.90	35.00	51.21	3.33	37.46
MECHATRONICS	G9225X12B	66.00	4.38	34.00	59.18	3.85	40.33



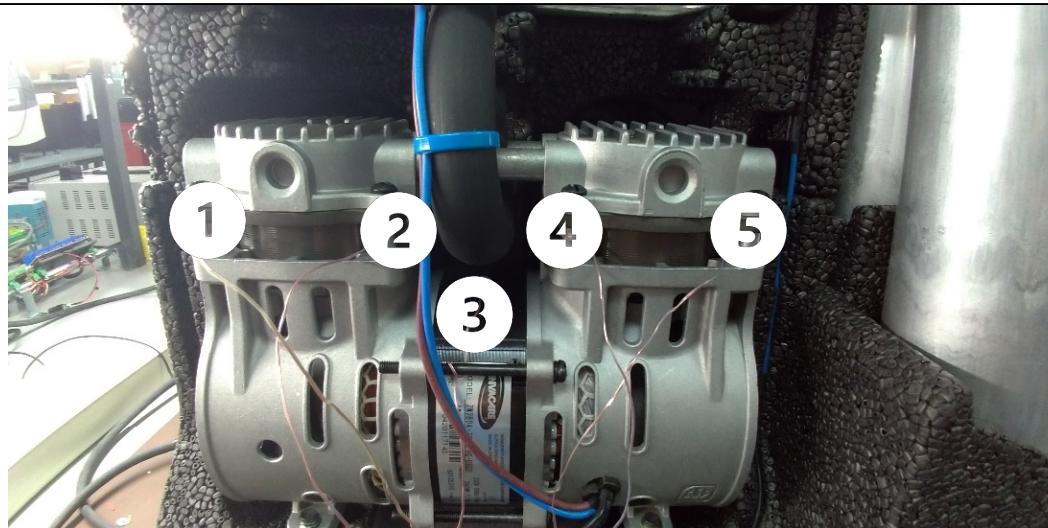
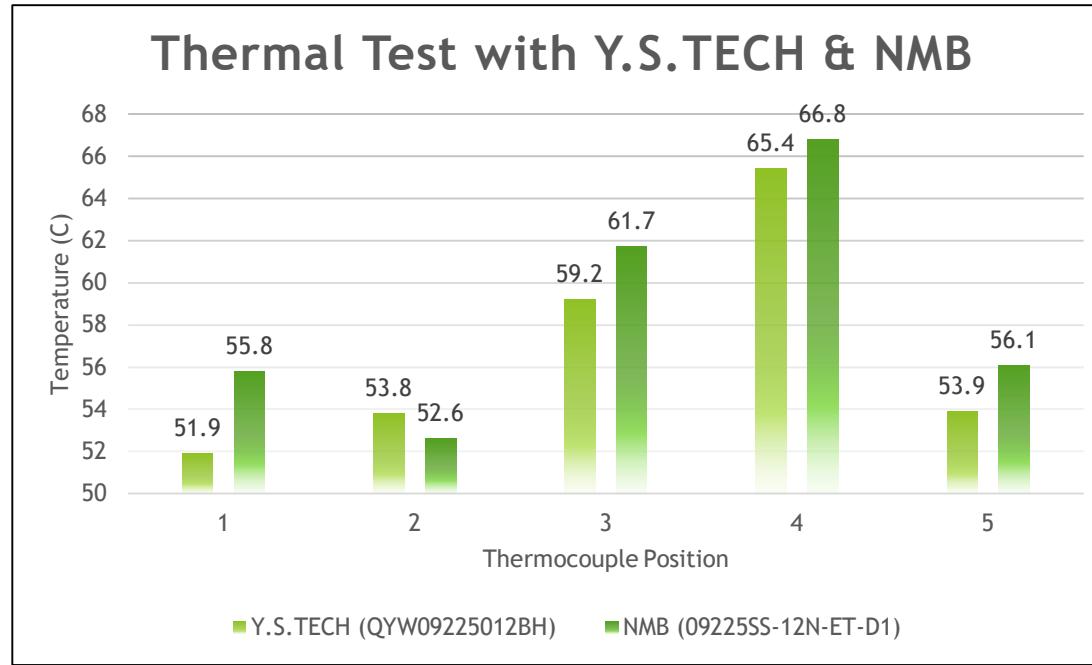
Fan Evaluation Project

■ Vibration Analysis



Fan Evaluation Project

- Thermal Analysis for NMB and Y.S.TECH. fan

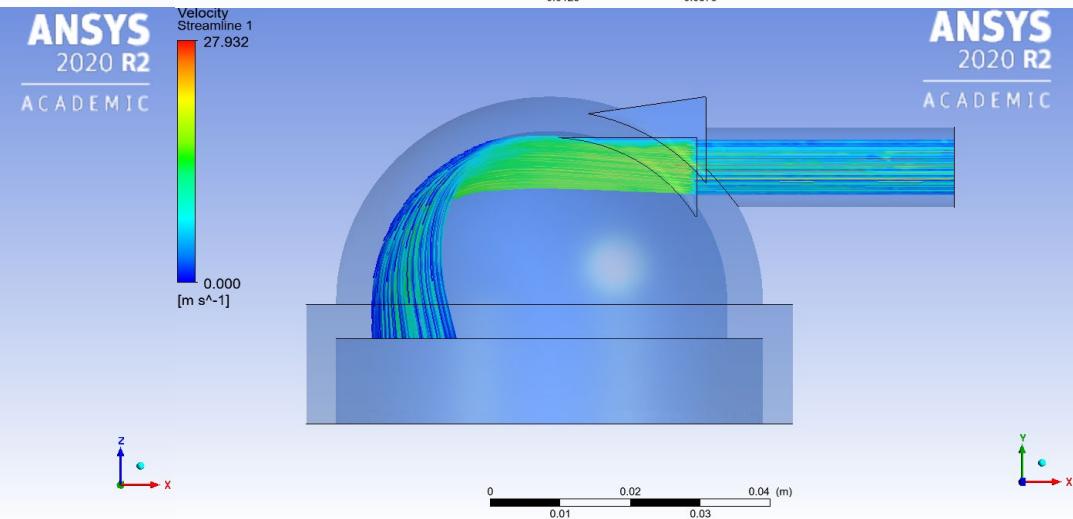
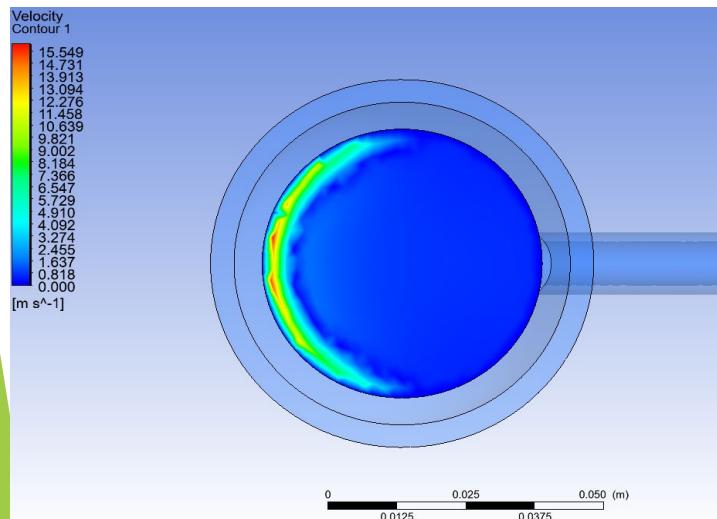
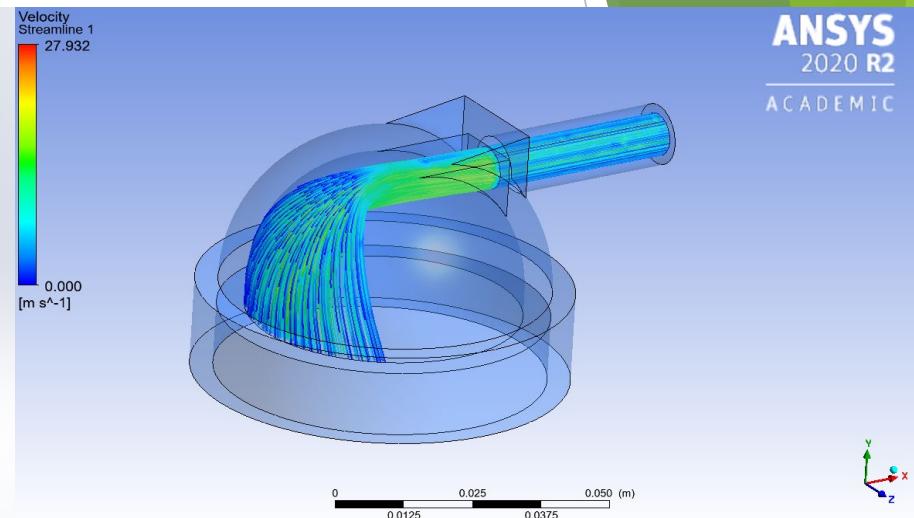
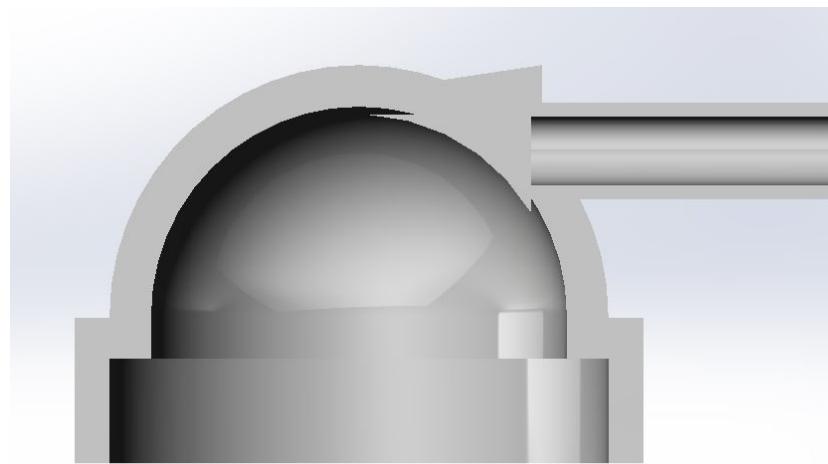


Air Flow Simulation of Sieve Cap Project

- ▶ Objective of the project
 - ▶ Issue: The airflow was not uniformly distributed before it going through the honeycomb structure in the sieve bed. This could shorten the lifetime of sieve bed.
 - ▶ Objective: Perform computational fluid dynamics (CFD) per new design sieve cap or deflectors
- ▶ Procedure
 - ▶ Simplified the real geometry of sieve cap design to get a quick but reasonable simulation result
 - ▶ Set the correct boundary conditions for incoming and exhaust situations
 - ▶ Performed CFD through ANSYS FLUENT
 - ▶ Produced post-processing images of airflow streamlines and velocity distribution contour
 - ▶ Checked if there is an improvement of the airflow distribution
- ▶ Outcome
 - ▶ The airflow of incoming becomes more uniform distributed with 3 ribs added on sieve cap
 - ▶ Significantly reduced the maximum incoming airflow velocity from 15.5 m/s to 5.6 m/s
 - ▶ Slightly increased maximum exhaust airflow velocity from 13.3 m/s to 18.3 m/s

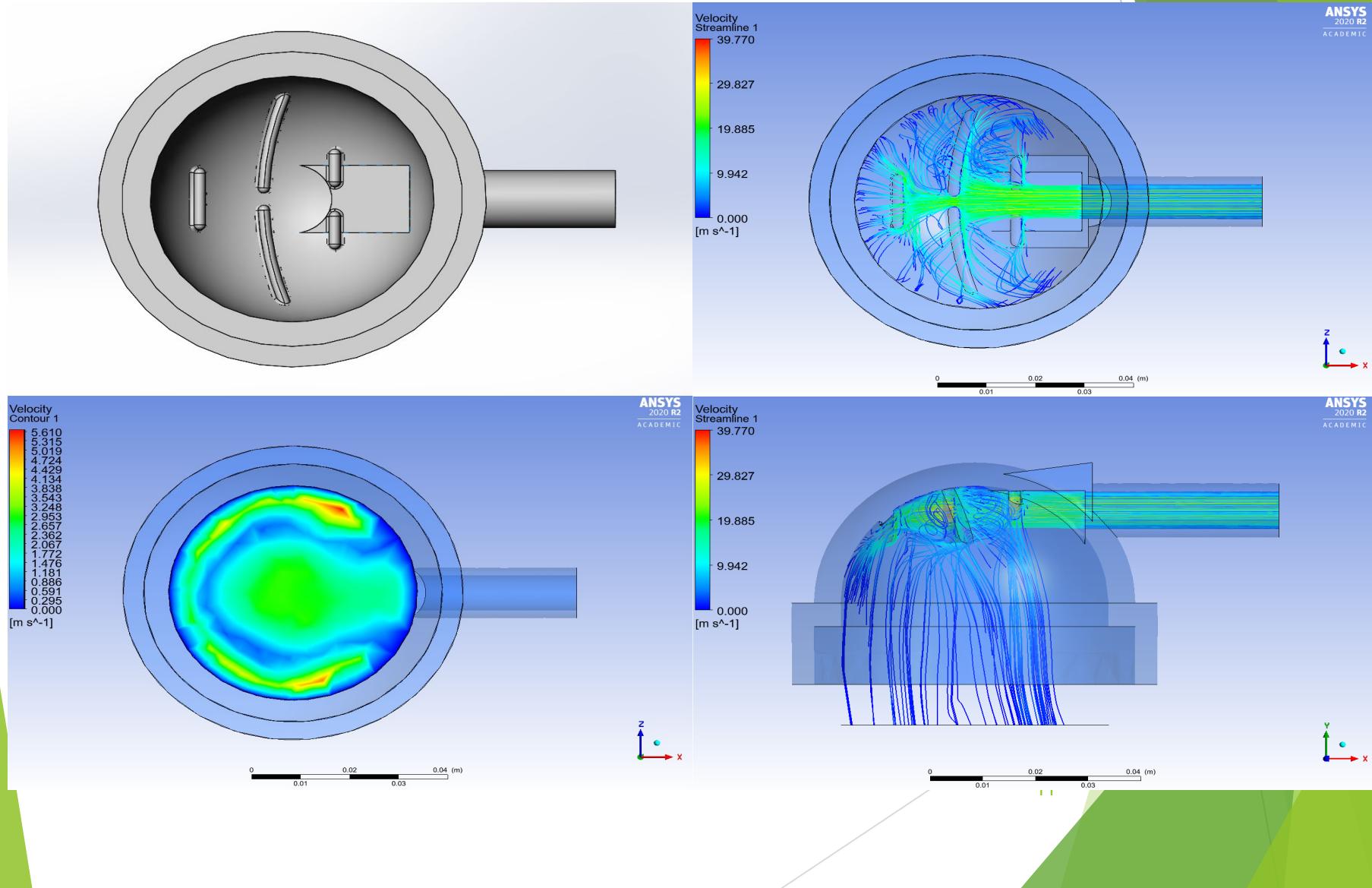
Air Flow Simulation of Sieve Cap Project

- Original Design of Sieve Cap - Incoming



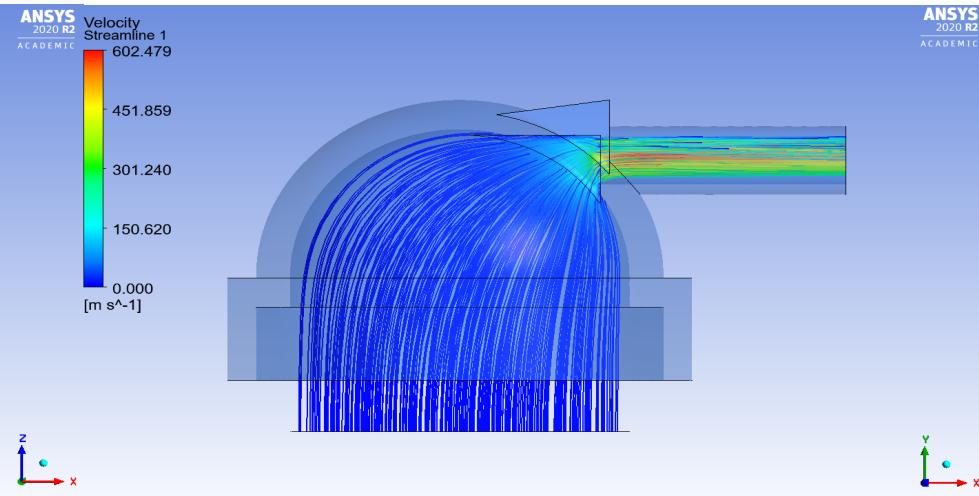
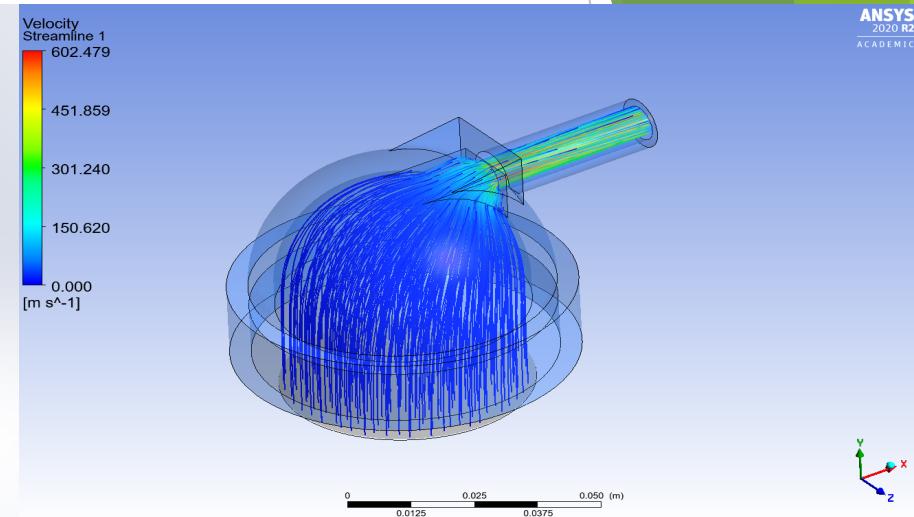
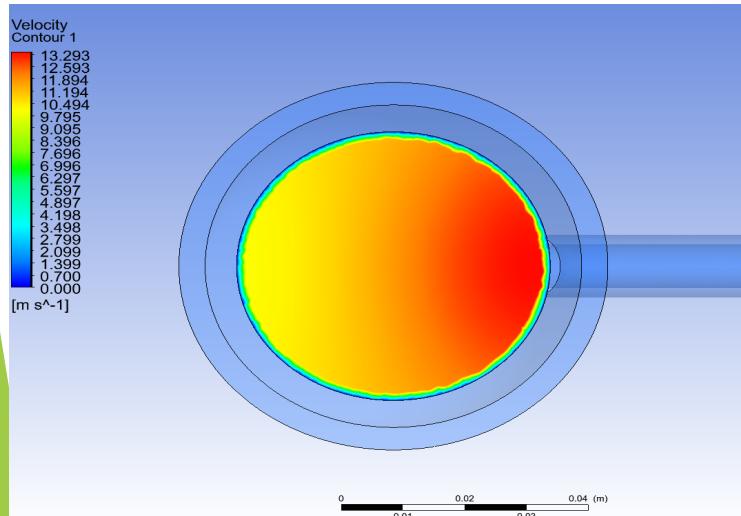
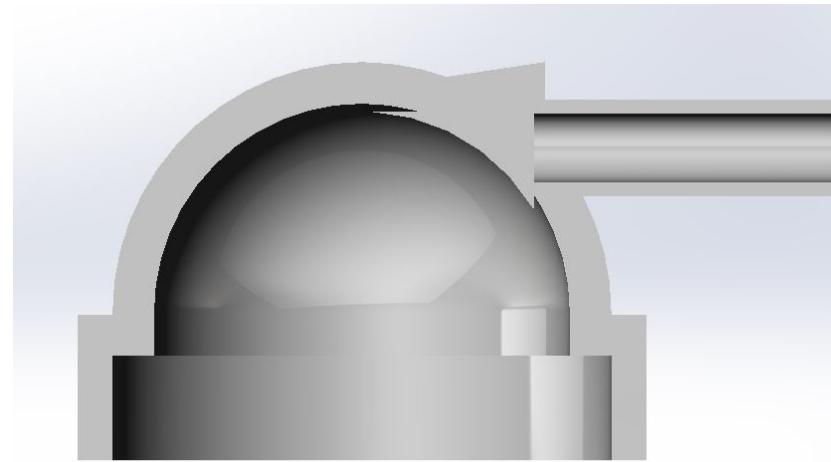
Air Flow Simulation of Sieve Cap Project

► New Design of Sieve Cap - Incoming



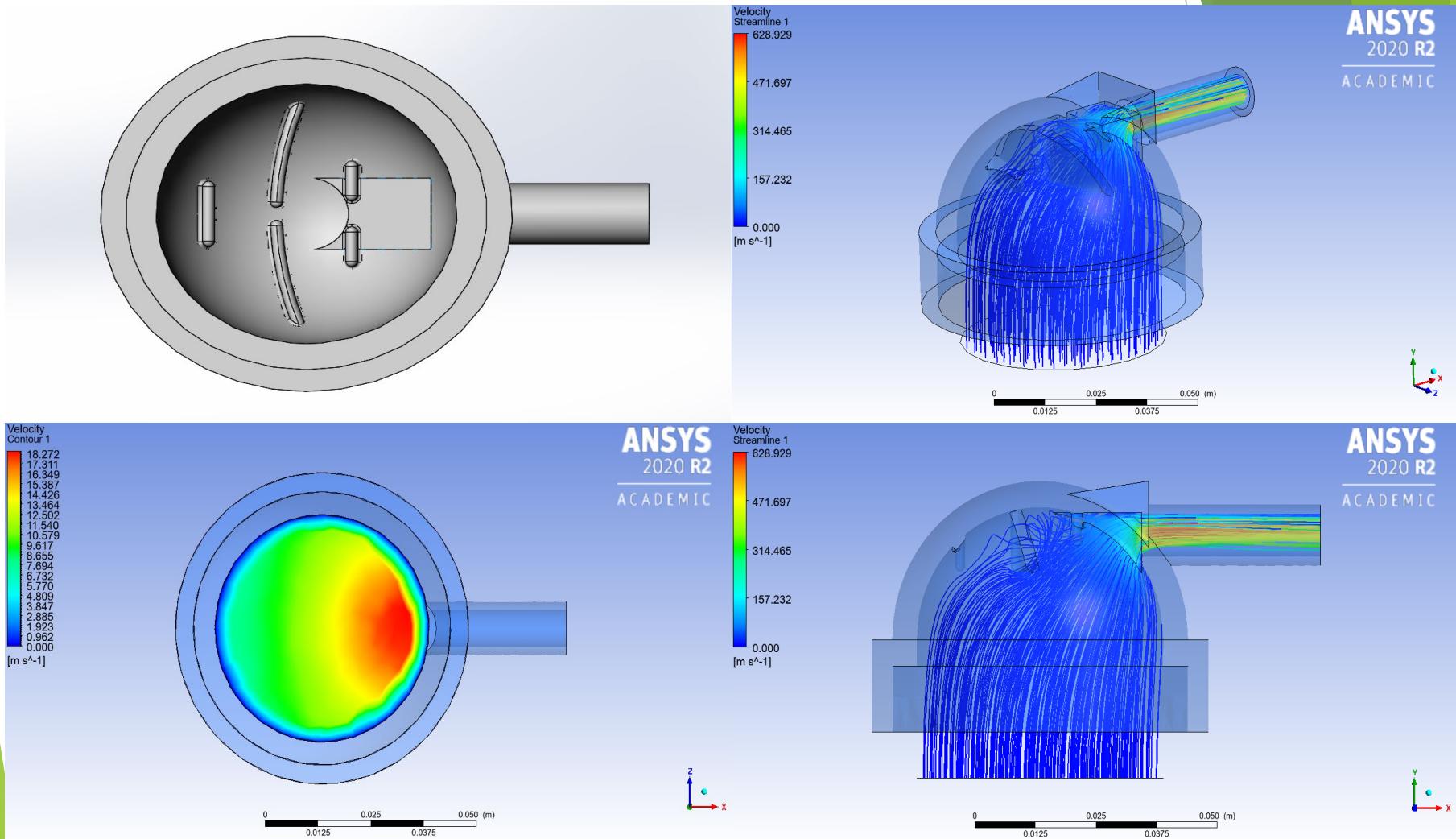
Air Flow Simulation of Sieve Cap Project

- Original Design of Sieve Cap - Exhaust

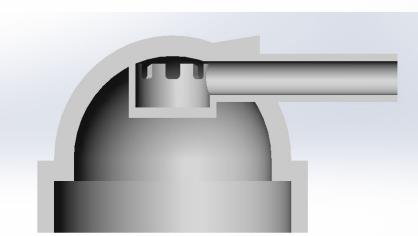
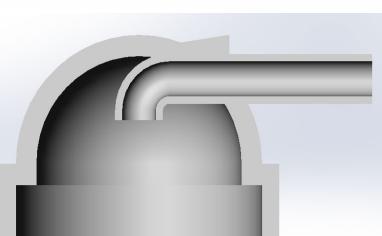
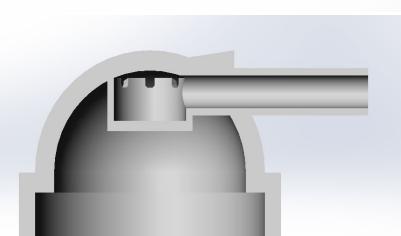
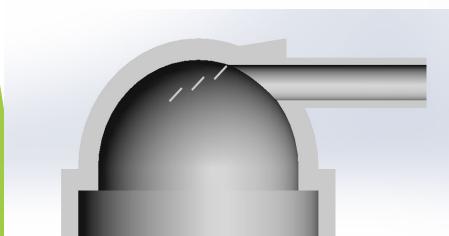
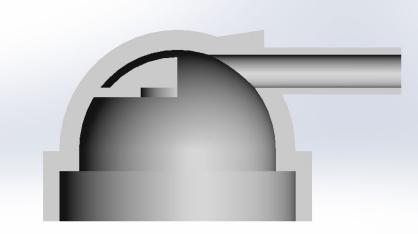
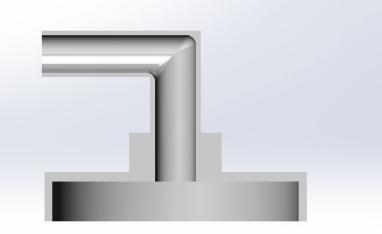
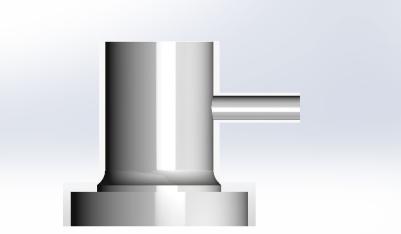
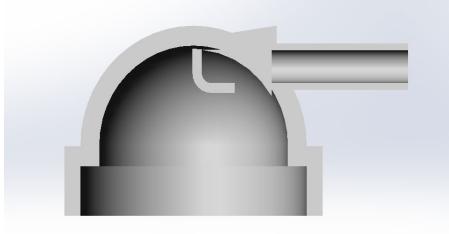
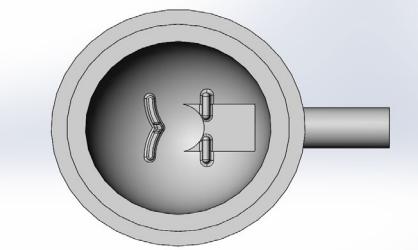
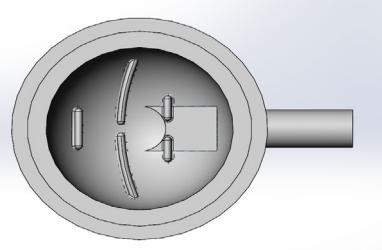
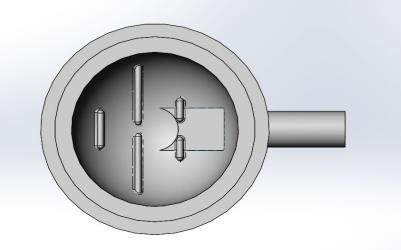
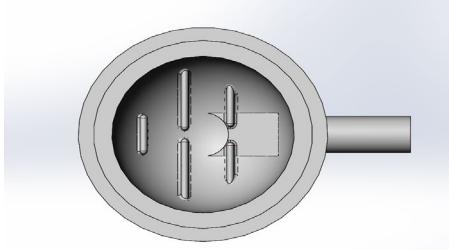
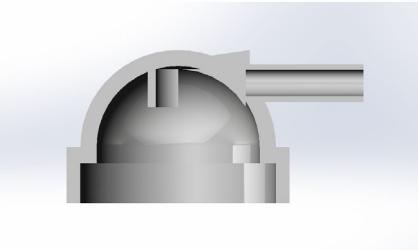
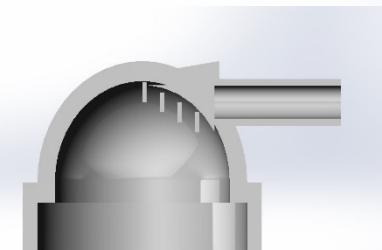
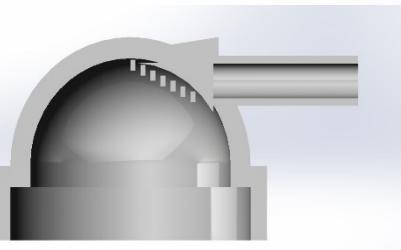
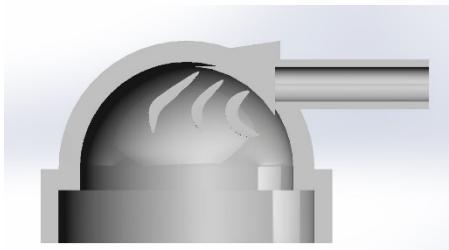
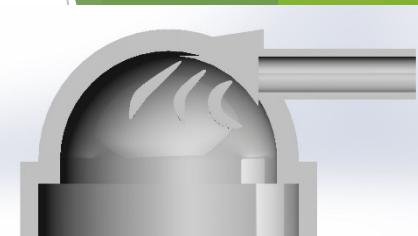
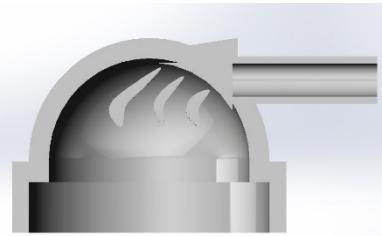
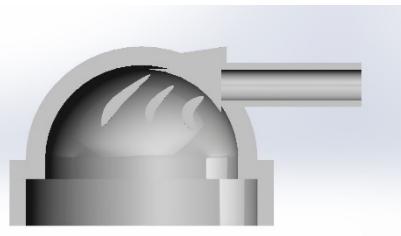
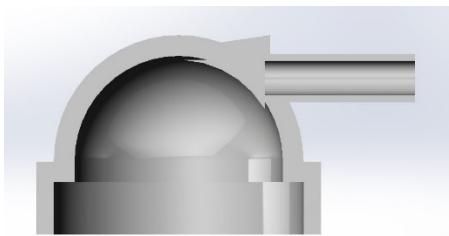


Air Flow Simulation of Sieve Cap Project

- ▶ New Design of Sieve Cap - Exhaust



Air Flow Simulation of Sieve Cap Project



Main Projects & Small Projects

► Main Projects

- ▶ Fan Evaluation Project (plus Interesting Findings)
- ▶ Air Flow Simulation of Sieve Cap Project

► Small Projects

- ▶ Created the template for sound correction factor
- ▶ Official sound test for US unit at CSU
- ▶ Evaluation of permanent deformation of shroud after loading 480 lbs. for an hour
- ▶ Performed CFD on compressor chamber and exhaust path to locate low airflow velocity region
- ▶ Adhesive strength test for AG and Mueller foam
- ▶ Prepared sound mitigations for 5 US units; 2 EU units to APAC; 1 EU unit to Germany
- ▶ Tested new foam material (dB Engineering) for sound mitigations
- ▶ Sound test with 80 mm fans wrapped with $\frac{1}{4}$ " polyurethane foam

Small Projects

- ▶ Created the template for sound correction
- ▶ Official sound test for US unit at CSU

Input Variable	
Measured Sound Level (dB)	45.2800
Ambient Sound Level (dB)	17.7700
Height of Sound Chamber (m)	4.7244
Width of Sound Chamber (m)	3.6881
Length of Sound Chamber (m)	4.6025
Mean Absorption Rate	0.5000
Distance btw Meter and Unit (m)	1.0000

Calculated Variable	
A (Room Absorption Area, m ²)	56.1422
S (Measuring Area, m ²)	6.2832
Noise Correction K1	0.0077
Noise Correction K2	1.6067

Result	
Sound Level w/ Correction (dB)	43.6656

Small Projects

- ▶ Evaluation of permanent deformation of shroud after loading 480 lbs. for an hour

Top Left



Top Right



Bottom Left



Bottom Right



Left



Right



Top

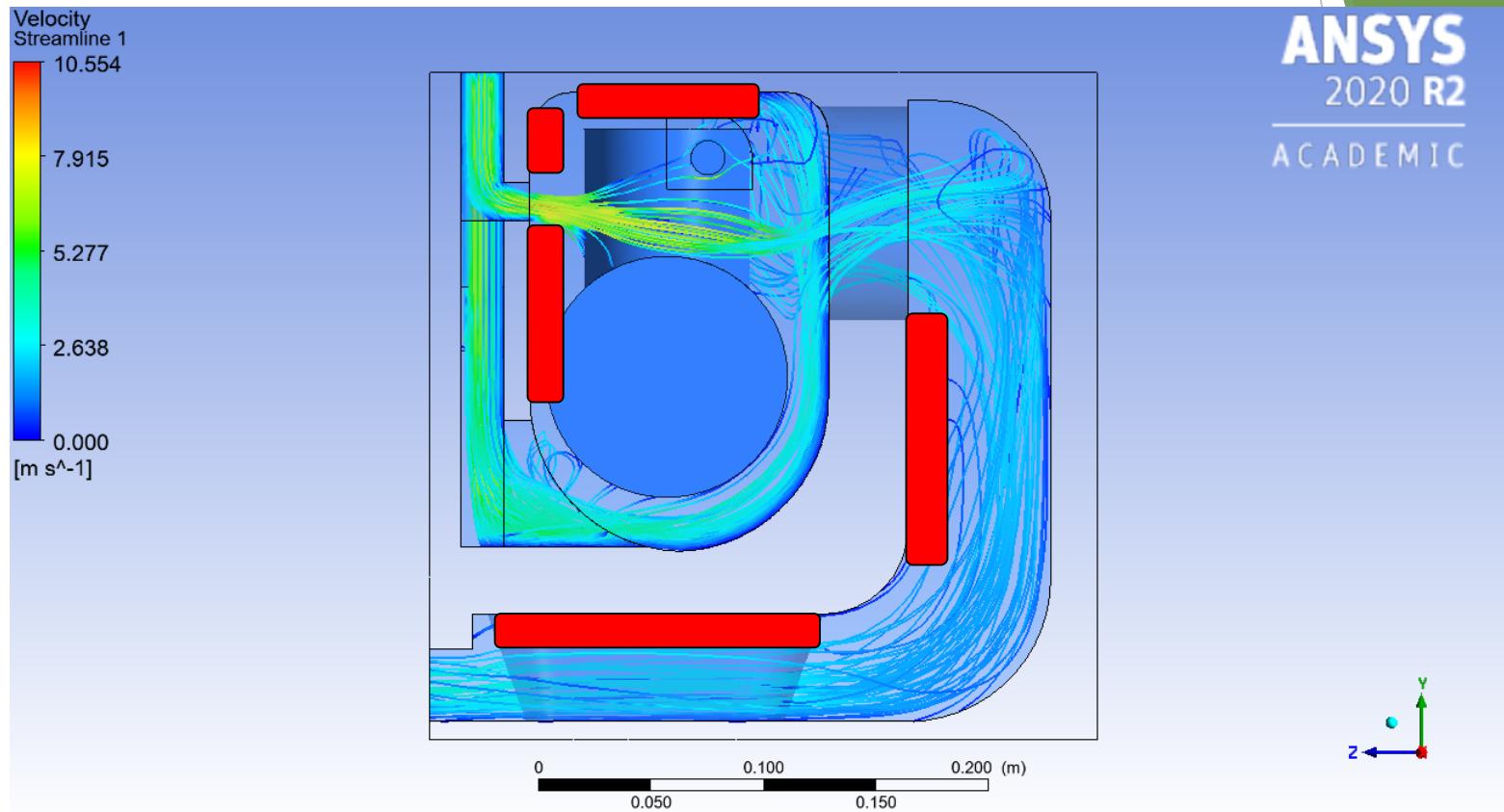


Bottom



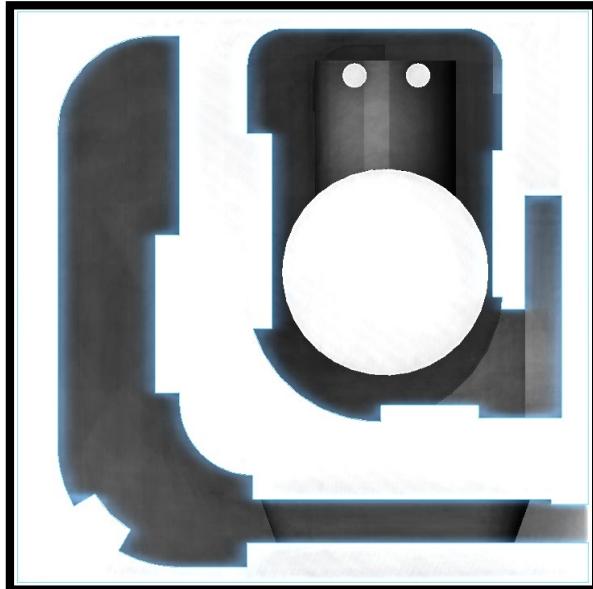
Small Projects

- Performed CFD on compressor chamber and exhaust path to locate low airflow velocity region

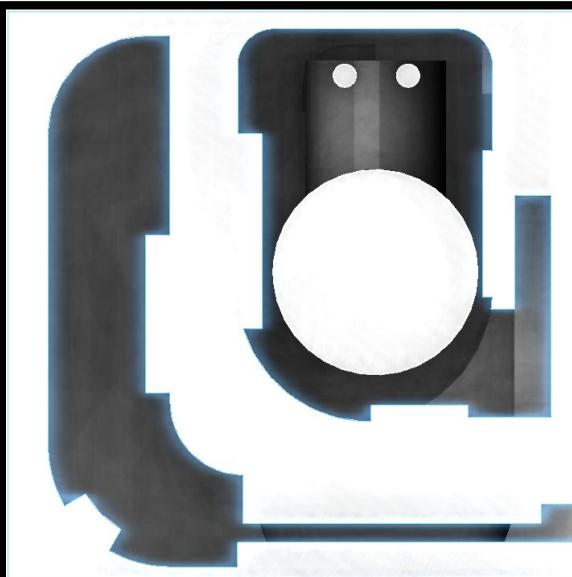


Small Projects

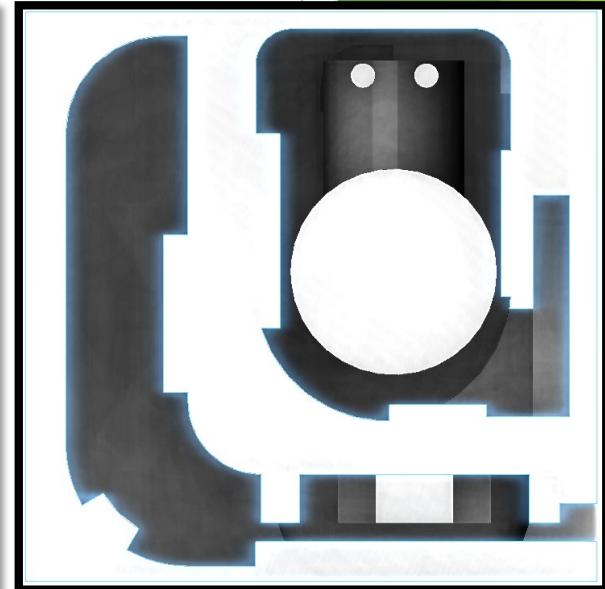
- ▶ Performed CFD on compressor chamber and exhaust path to locate low airflow velocity region



Current configuration



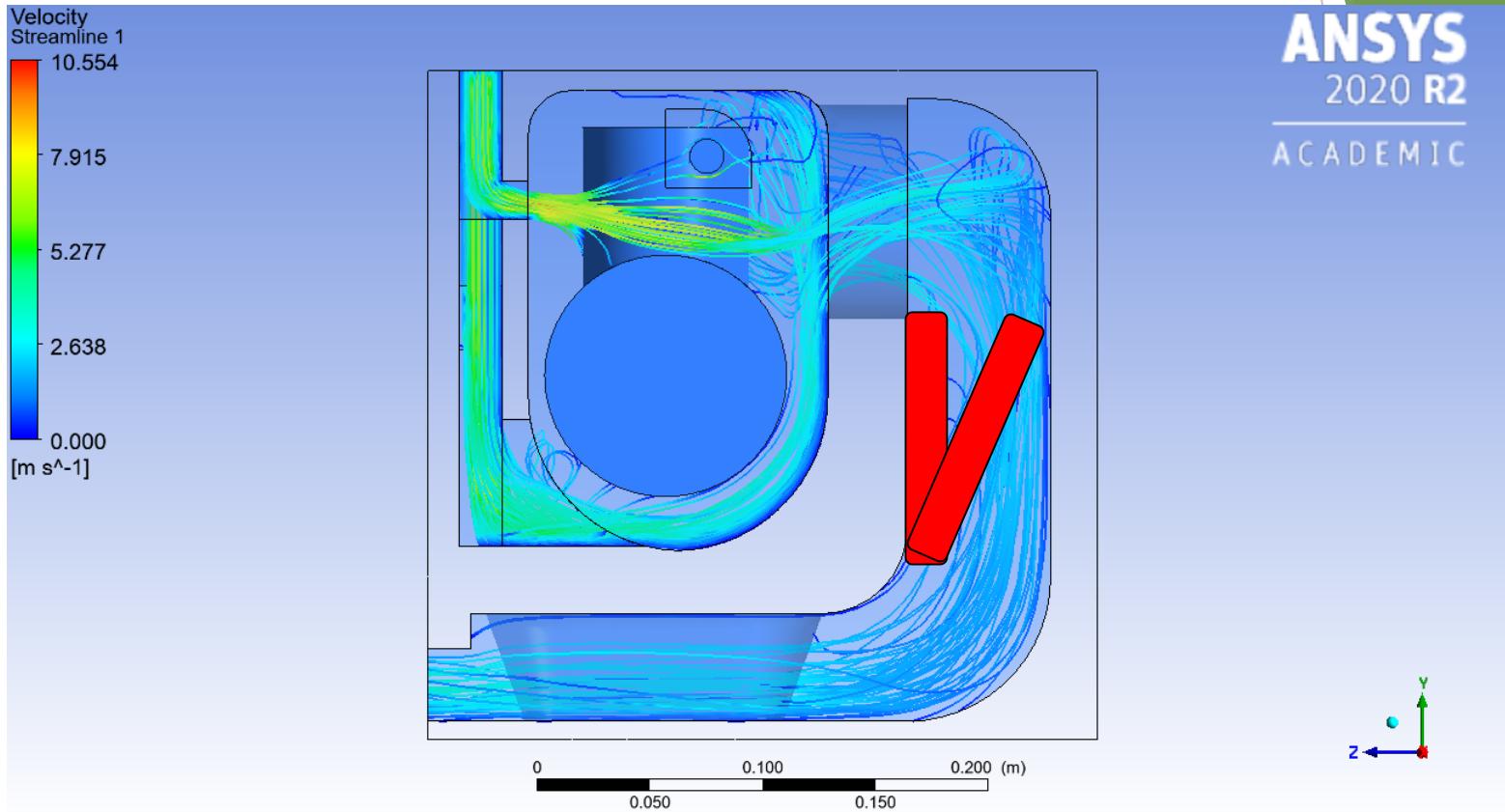
1" polyurethane at
the bottom



Zigzag 1" polyurethane
at the bottom

Small Projects

- Adhesive strength test for AG and Mueller foam



Small Projects

- Adhesive strength test for AG and Mueller foam

