

# Colorado Springs School District 11 Facilities

## *COVID-19 HVAC Strategy*

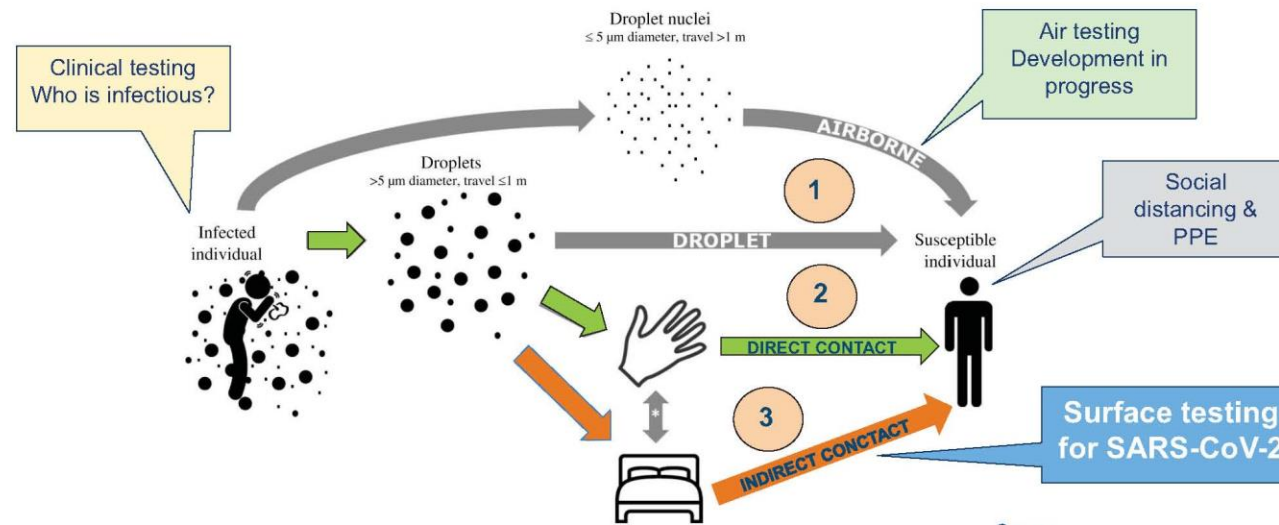
Josh Chism, PE, CEM  
Capital Program Manager





# Virus Transmission

## SARS-CoV-2 Transmission



\* Transmission routes involving a combination of hand & surface = indirect contact.

Source:  
Otter et al., 2016, J. Hospital Infect.

Brought to you by TRC

10

- Current data suggests main transmission vector is airborne



# Topics

---

- Repair HVAC Systems
  - Ventilation Focused
- Increase Outside Air (OSA)
- Morning/Evening Purge
- Increase Filtration?
- Other Considerations
  - Disinfection
  - Humidity Control





# Repair HVAC Systems

---

- District-Wide HVAC Assessment
  - Six teams of two (One BAS Operator and One Tech)
  - 8 business days
  - 4M square feet
- Assessment Focus
  - Outside Air Damper Operation/Condition
  - Return Air Damper Operation/Condition
  - Supply/Return/Exhaust Fan Operation
  - Controls Issues
  - Electrical Issues
  - Other Issues?





# Repair HVAC Systems

A	B	C	D	E	F	G
	Coronado High School					
	Room Num	Labels from Floor Plan	Equipment ID	OSA Damper Working? 1 = Yes 0 = No	Equipment Issue?	Notes
	410	Classroom	MAU-S2	?	1. Exhaust pipe rotted off, need replaced. 2. No power to controller, COM issue. 3. Could not check operation. 4. Scheduled to run 24/7. Change to 6 AM to 6 PM.	Building B (I/A) Located on roof (from rm 403) in penthouse.
	413		MZU-S1	1	1. Outside Air says "Down". 2. Scheduled to run 24/7. Change to 6 AM to 6 PM.	Building B (I/A) Needs new Filters. Located on roof (from rm 403) in penthouse.
	413A		RTU-B1	1	1. Outside Air says "0.00F". 2. SF Motor and belt need replaced. Motor smells like its burning. Found power off to unit. 3. Scheduled to run 24/7. Change to 6 AM to 6 PM.	Building B (I/A) Located on roof (from rm 403) in penthouse.
	500J		DE-3	1		Building D Located in Mezzanine on 2nd Floor. South Side.
	500K		DS-7	N/A	No Dampers	Building D Located in Mezzanine on 2nd Floor. South Side.
	501	Gymnasium	HV-2E	0	1. OSA Sensor is "Down". Unit is operational. 2. One of two SF belts are worn out. Replace both belts. 3. Dampers do not function.	Building D Located in Mezzanine on 2nd Floor. North Side.
	501A		HV-2W	1	OSA Sensor is "Down". Unit is operational.	Building D Located in Mezzanine on 2nd Floor. North Side.
	502	Gymnasium	DS-2	0	Dampers do not operate. Pneumatics issue? Dampers do not operate. Pneumatics issue?	Building D Located in Mezzanine on 2nd Floor. North Side.
	502A		DS-1	0	OSA temp reads "Down".	Building D Located in Mezzanine on 2nd Floor. North Side.
	508		DS-6	0	Dampers do not operate. Pneumatics issue?	Building D Located in Mezzanine on 2nd Floor. South Side.
	509		DS-8	0	Dampers do not operate. Pneumatics issue?	Building D Located in Mezzanine on 2nd Floor. South Side.
	511	Classroom	DS-7	0	Dampers are not operational. Pneumatic issues?	Building D Located in Mezzanine on 2nd Floor. North Side.
	512		DS-9	1		Building D Located in Mezzanine on 2nd Floor. North Side.



# Repair HVAC Systems

---

- Start Repairing!
- Funding Constrained
  - \$\$\$\$
- Resource Constrained
  - Mechanical Contractors
  - Controls Contractors
  - In-House Technicians
- Prioritization Method
  - Elementary Schools First
    - Back Full Time
    - Full Student Load
    - Mask Compliance is Lower
    - Less Maturity (nose wipers)
  - Highest Occupancy per Square Foot





# Repair HVAC Systems



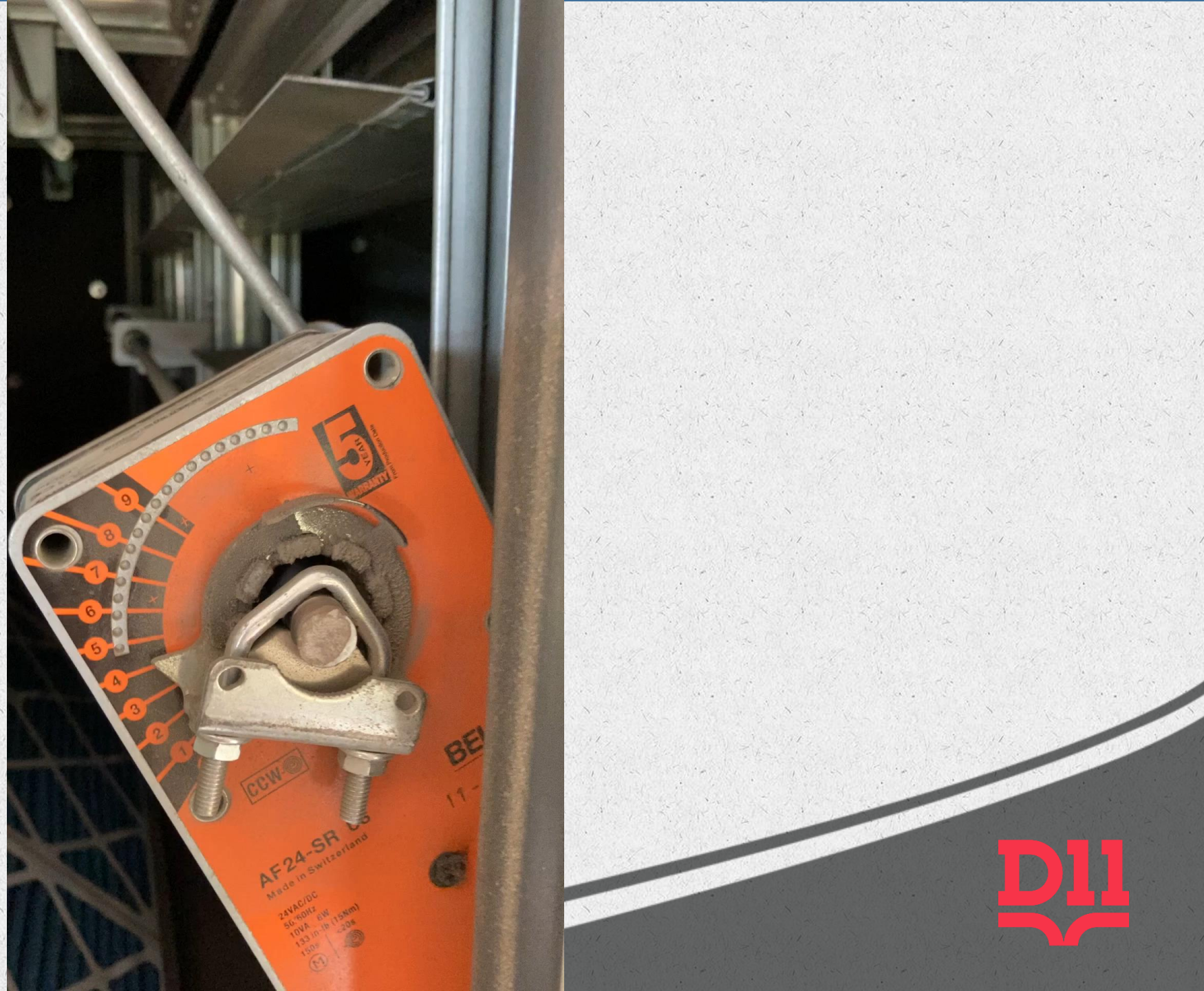


# Repair HVAC Systems





Don't be deceived





# Increase Outside Air

---

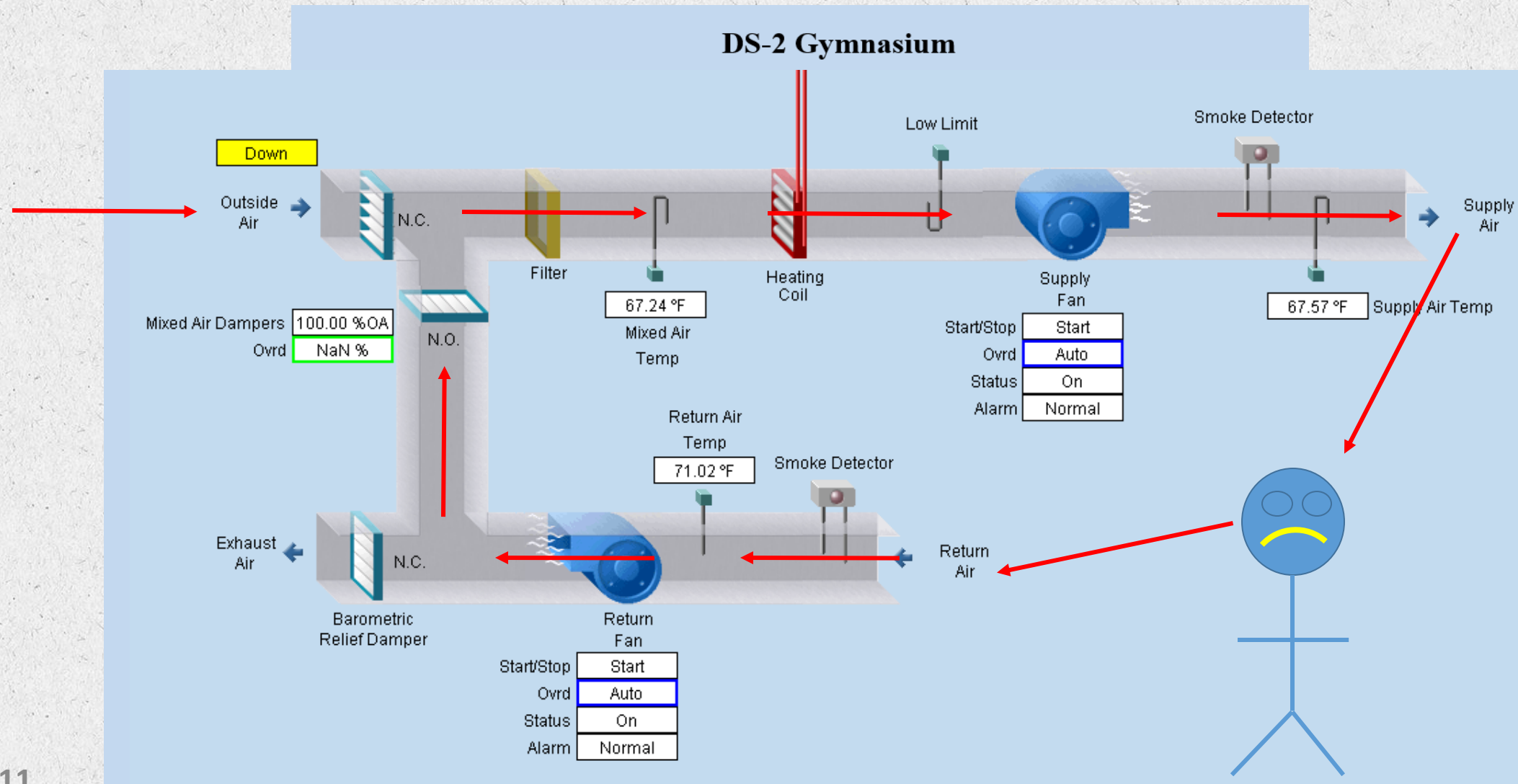
## Existing Functionality

- This is a VERY generalized statement:
  - Our HVAC Systems provide a minimum 20% OSA while occupied.
  - Therefore, 80% of the air in a classroom is being recirculated.





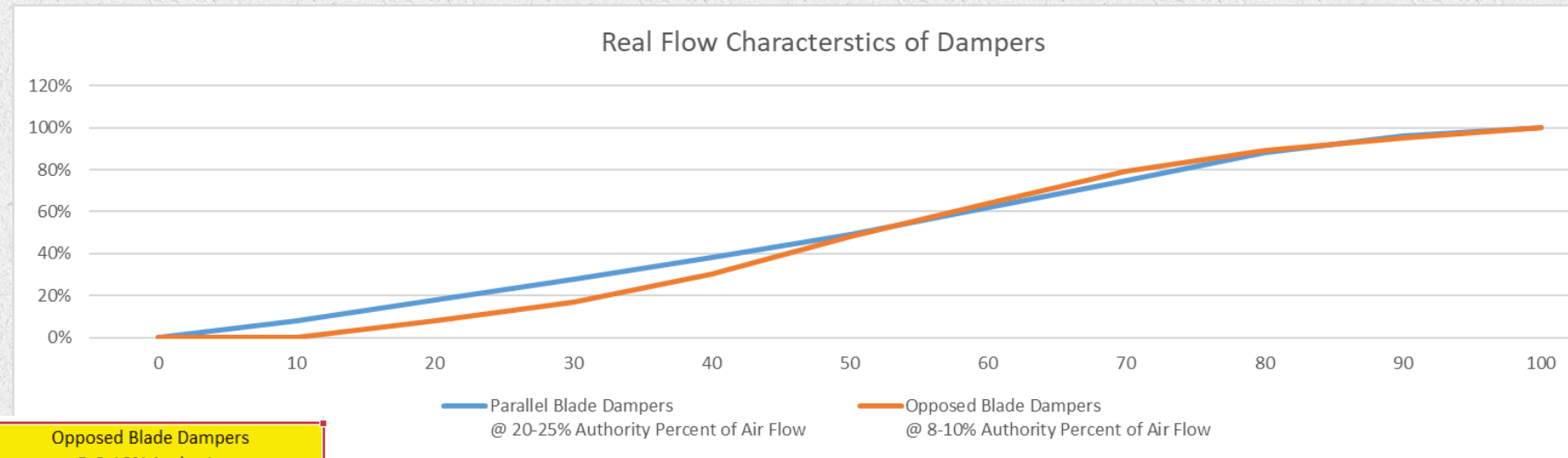
# Increase Outside Air





# Increase Outside Air

- Question: How much more OSA will we get by increasing damper position?
- Damper Position vs Air Flow is not a linear equation (10% to 20%  $\neq$  x2)



	Parallel Blade Dampers @ 20-25% Authority	Opposed Blade Dampers @ 8-10% Authority
Percent of Damper Shaft Rotation	Percent of Air Flow	Percent of Air Flow
0	0%	0%
10	8%	0%
20	18%	8%
30	28%	17%
40	38%	30%
50	49%	48%
60	62%	64%
70	75%	79%
80	88%	89%
90	96%	95%
100	100%	100%



# Increase Outside Air

Average Classroom	
900	Square Feet
10	Feet Tall Ceiling
9000	Volume (Ft^3)
31	Students + Teacher
10	CFM/Person
310	Minimum OA (CFM)
0.034	Air Changes / Min
<b>2.067</b>	<b>Air Changes / Hour (ACH)</b>

Assuming 20% open.

Existing Conditions

Where we landed  
30% OSA  
150% Increase  
2 ACH -> 3 ACH

Increasing OA by x% Changes ACH to ->		
Percent of Damper Shaft Rotation	Parallel Blade Dampers @ 20-25% Authority	Opposed Blade Dampers @ 8-10% Authority
0	N/A	N/A
10	N/A	N/A
20	N/A	N/A
30	3.2	4.4
40	4.4	7.8
50	5.6	12.4
60	7.1	16.5
70	8.6	20.4
80	10.1	23.0
90	11.0	24.5
100	11.5	25.8

1.5x the design OSA

2.1x the design OSA

## 30% vs 40% Justification

Increase in OSA is still 1.5x

More likely to maintain space temp setpoint.

Schools without AC will be cooler.

Equipment strain is lower: (1) extends the life of our equipment (2) lower outages (3) lower maintenance resource requirements.





# Increase Outside Air

---

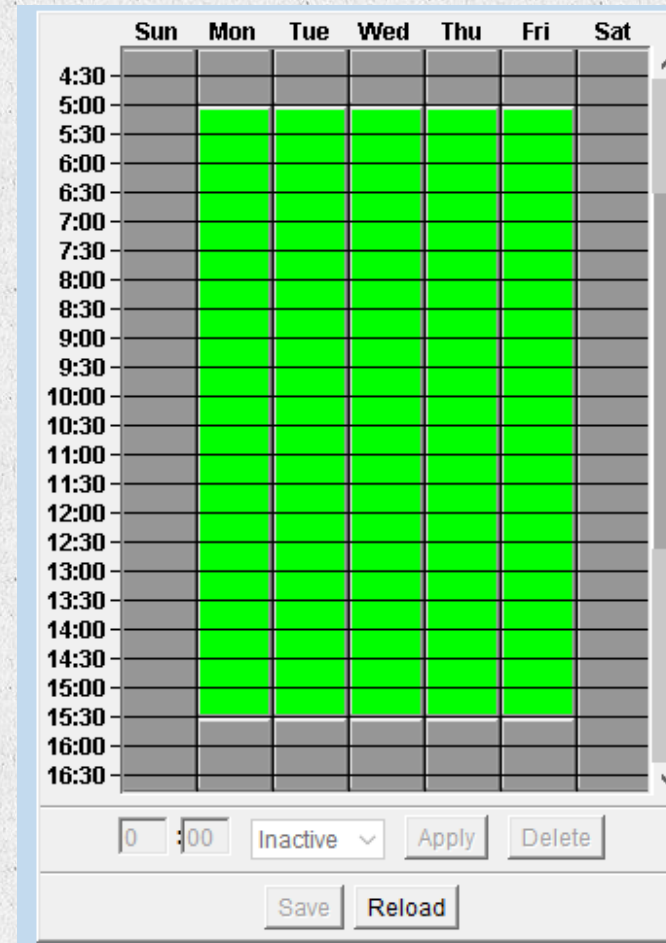
- How much is too much?
- Sacrifices of bringing in too much OSA:
  - Comfort level in the spaces
    - Design Day
  - Longevity of Equipment
    - Running it Harder
  - Reliability of Equipment
    - Outages = Zero Ventilation
  - Utility Bills
    - More electricity and natural gas
  - Building Damage Potential
    - Freeze Protection is Key
- Advantages
  - Decrease likelihood of viral transmission through respiratory droplets
  - Save lives?





# Morning/Evening Purge

- Running Equipment in “Occupied Mode”
  - 2 Hours Longer at End of Day
  - 2 Hours Earlier at Beginning of Day

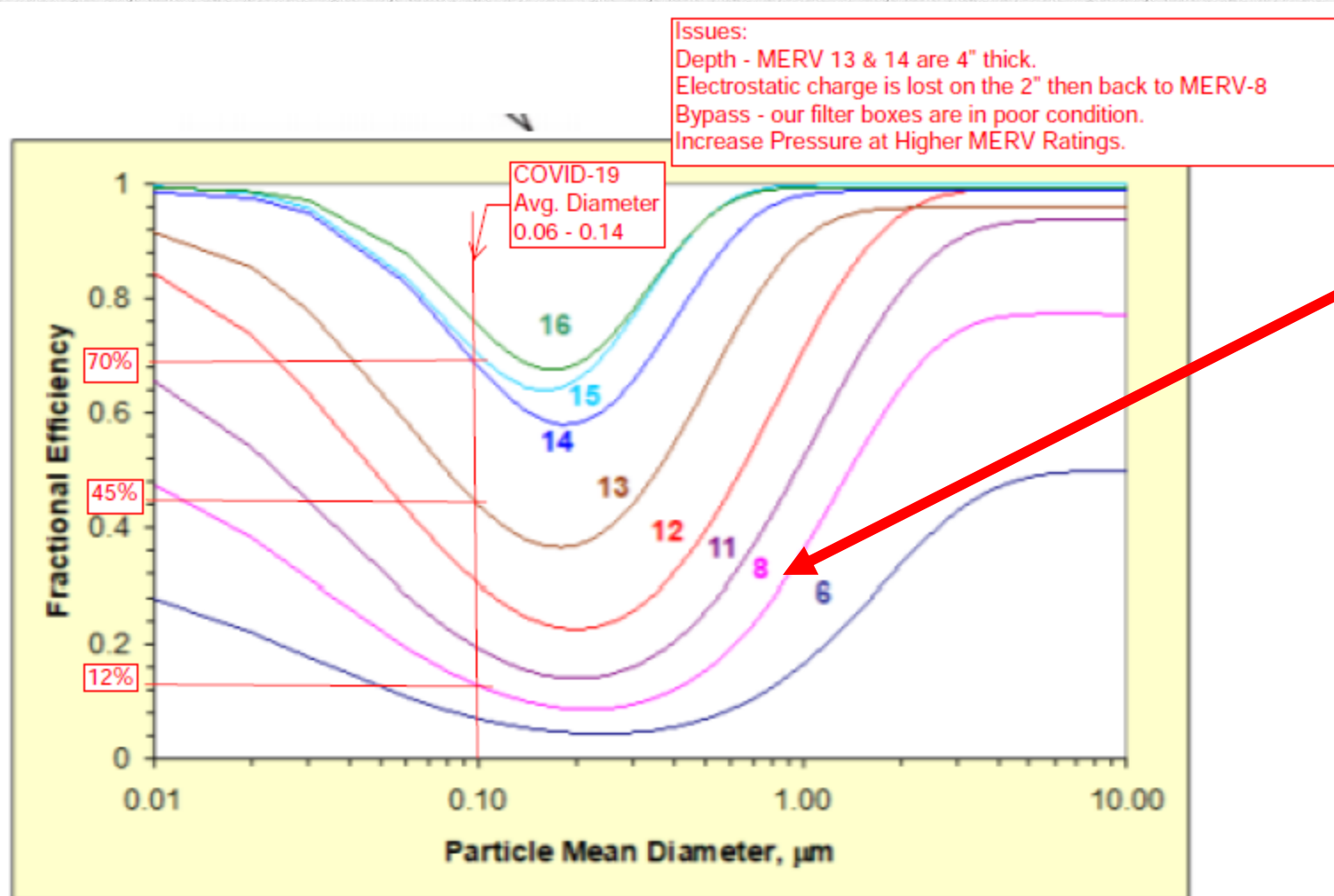




# Increase Filtration?

MERV = Minimum Efficiency Reporting Value

- Existing filtration = MERV-8





# Increase Filtration?

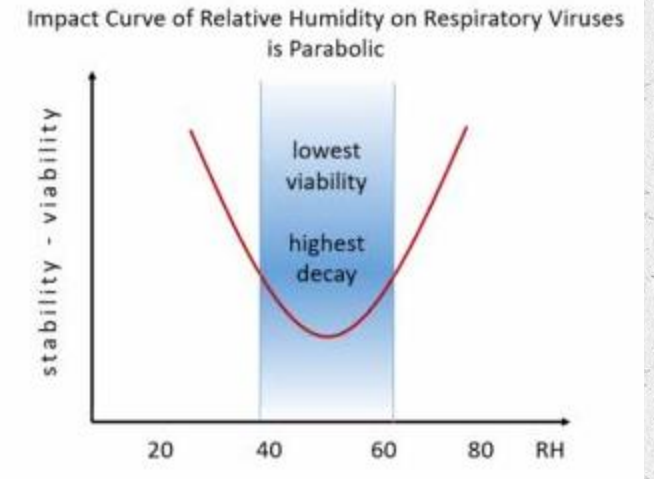
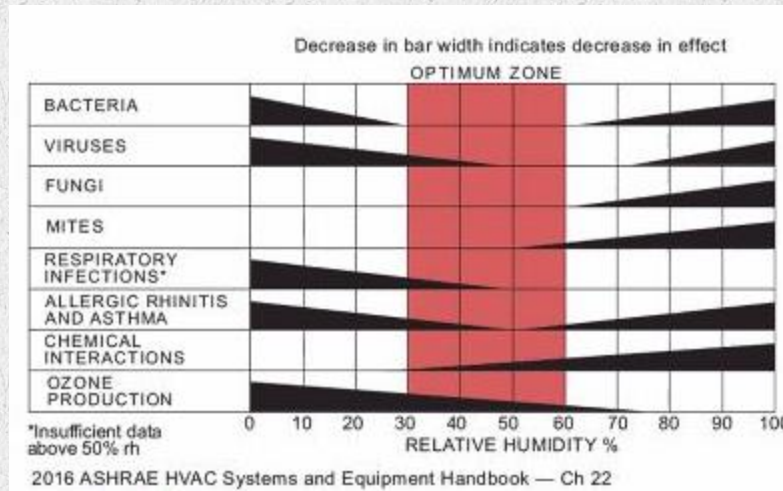
---

- Decision:
  - Keep MERV-8 Filters
  - Replace filters 3 times this year (versus normal = 2).
- Challenges
  - Size/Fit
    - Filter boxes are not large enough for non-electrostatically charge MERV-13 filters
  - Higher Static Pressures on Fans/Motors
    - Increase failure, outages, financial constraints (maintenance + utilities)
    - Brake horse power on motors not (or barely) designed for 25% increase SP.
  - Bypass (around the filters) is high on our antiquated equipment
    - Increases with static pressure
  - Efficiency of Electrostatically Charged Filters is lost quickly
  - Funding
  - Resources



# Other Consideration

- Considered the following, but financial constrained:
  - UV Light
    - In-line
    - Portable units
  - Bipolar Ionization
    - In-line
    - Portable Units
  - Humidification Control
    - Colorado Springs is in an arid climate.
    - In-line





# Recap

---

- **Fix Existing HVAC System Issues**
  - Some ventilation is better than no ventilation...
- **Increase OSA from 20% to 30%**
  - Ensure Freeze Protection has priority to protect equipment and buildings
  - Monitor temperature control
  - Toggle Switch – Pandemic vs Normal Conditions – Pay Once
  - Shut of Demand Control Ventilation
- **Morning/Evening Purge**
  - 2 Hours Each
- **No increase in filtration rating**
  - Stick with MERV-8
- **Yes increase in filtration change frequency**
  - 3x per year versus 2x





# For More Information

---

Josh Chism, PE  
Capital Program Manager  
Colorado Springs School District 11  
5240 Geiger Blvd  
Colorado Springs, CO 80915  
Cell: (719) 499-1144  
[Josh.Chism@d11.org](mailto:Josh.Chism@d11.org)





# Sources

---

- **Damper Shaft Position versus CFM**

- Johnson Controls, Damper and Actuator Manual 268.1, Damper Design Section, Engineering Report, Issue Date 0991

- **ASHRAE**

- EPIDEMIC TASK FORCE: SCHOOLS & UNIVERSITIES BUILDING READINESS GUIDE | Updated 5-5-2020
- 62.1 VENTILATION STANDARD
- INDOOR AIR QUALITY GUIDE
- FUNDAMENTALS HANDBOOKS