Individual Project
ENGD3000, 2008

Leycroft RSV Simulation

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Structure of Presentation

1. What are RSV's, and who uses them?
2. Background - Leycroft System, RSV Design
3. Aim of investigation
4. How to model the system
5. Testing
6. RSV Functionality
7. Re-testing
8. Discrepancies
9. Conclusions
10. Further Testing

RSV's – ROTARY SPIN VANE SEPARATORS

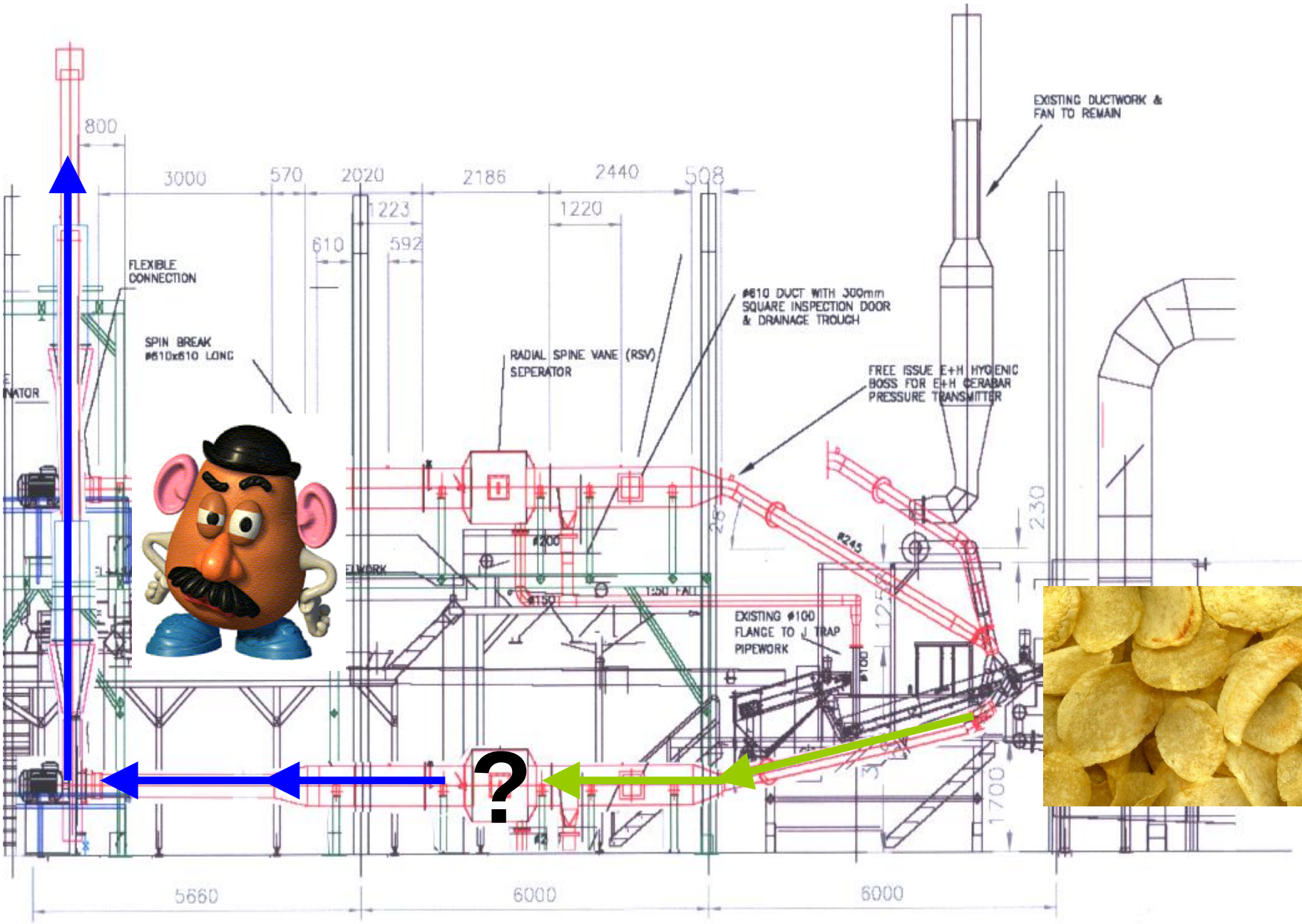
Function:

"To separate unwanted contaminants from a fluid flow"

Why?: Suitable applications include: -

- **OIL INDUSTRY**
- **SPACE INDUSTRY**
- **FOOD INDUSTRY** *applicable to project*

HOW ARE THESE LOVELY SNACKS MADE???...


800
3000
570
2020
2186
2440
508
1223
1220
610
592
FLEXIBLE CONNECTION
SPIN BREAK ø610x610 LONG
RADIAL SPINE VANE (RSV) SEPERATOR
ø610 DUCT WITH 300mm SQUARE INSPECTION DOOR & DRAINAGE TROUGH
EXISTING DUCTWORK & FAN TO REMAIN
FREE ISSUE E+H HYGIENIC BOSS FOR E+H CERABAR PRESSURE TRANSMITTER
ø200
ø150
ø245
ø100
EXISTING ø100 FLANGE TO J TRAP PIPEWORK
230
1250
1700
?
5660
6000
6000

INVESTIGATION

AIM:

To investigate what happens inside an RSV, and what effects changing the pipe length have on the RSV

OBJECTIVES:

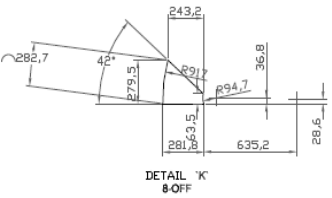
Research RSV's and fluids in motion

Produce a model and test to simulate the system

Introduce new pipe lengths before and after the RSV

MODEL

MODEL



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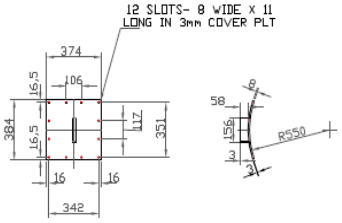

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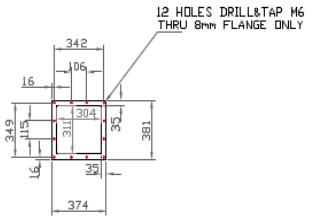

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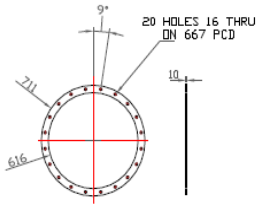
DETAIL 'C'
2-OFF

DETAIL 'D'
1-OFF



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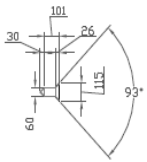

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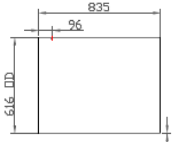

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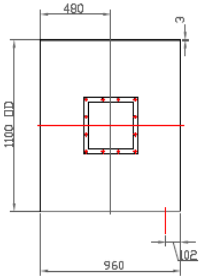

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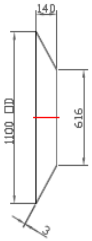

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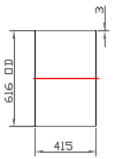

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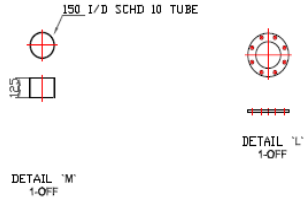

DETAIL 'M'
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DETAIL 'L'
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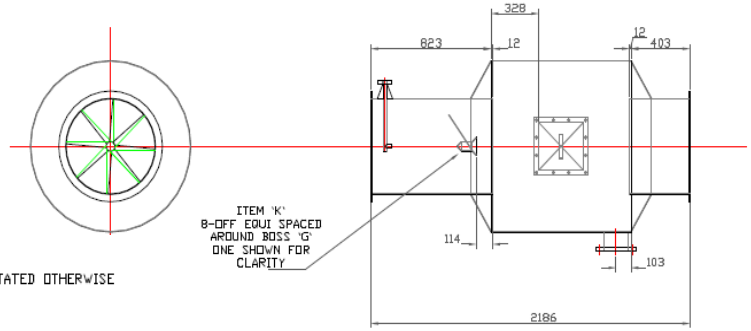


NOTE

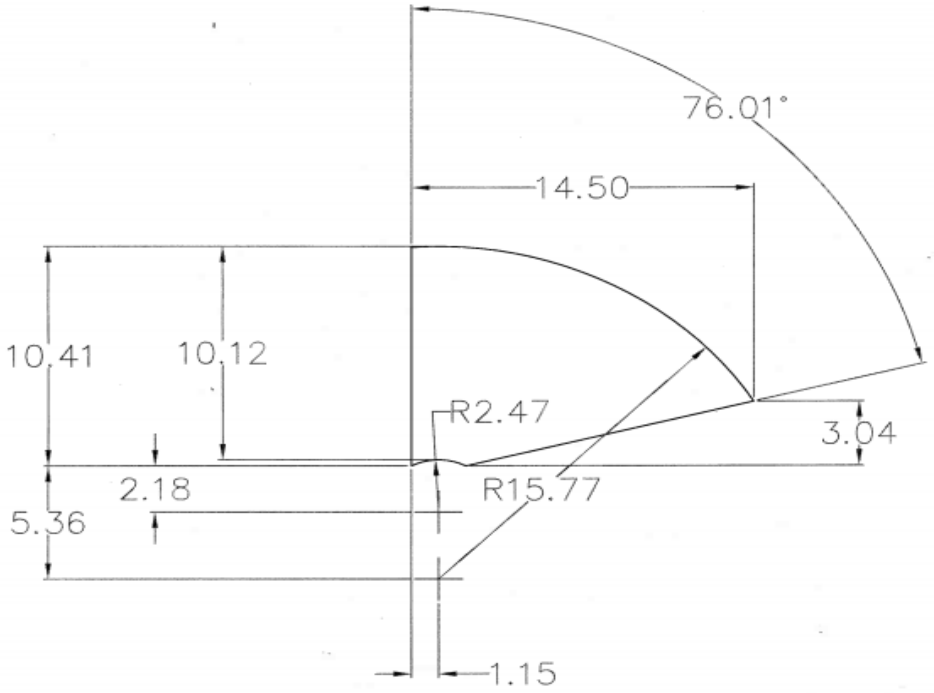
MATERIAL:- 304 3mm STAINLESS STEEL -UNLESS STATED OTHERWISE

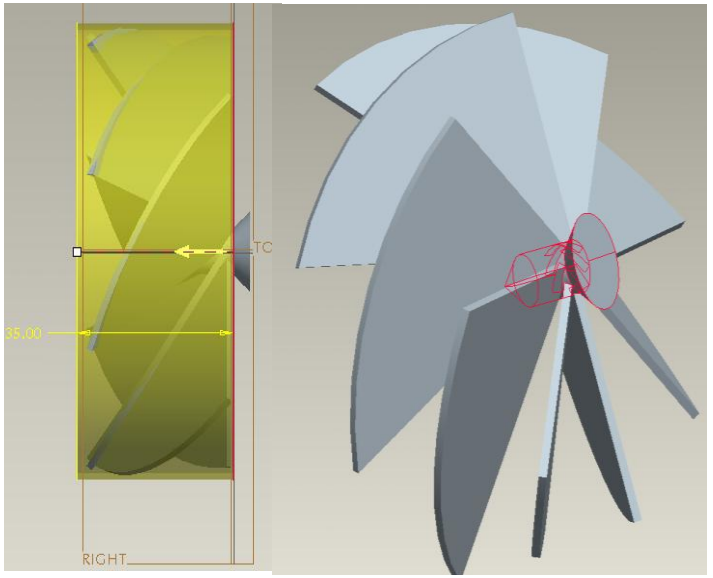
MANUFACTURE DUCTING WITH SEAMS ON TOP

QTY	DETAIL	DESCRIPTION
2	A	FLANGE (INLET/OUTLET)
1	B	20mm NB 150LB PIPE FLANGE
2	C	GUSSET
1	D	20mm PIPE C/W NOZZLE-BETE MODLE P/No MP-218M-316 WASH SPRAY RATE 7.4 U.S.G.P.M DELIVERY PRESSURE @ NOZZLE 30 P.S.I.G
1	E	INLET TUBE
2	F	END CONE
1	G	DIVERTER
1	H	CHAMBER
1	I	ACCESS DOOR
1	J	OUTLET TUBE
8	K	BLADE
1	L	150 I.P.S. 150LB R.F.S.O. FLANGE
1	M	150 ID SCHEDULE 10 TUBE
1	N	ACCESS DOOR FLANGE
3	O	3THK WHITE FOOD QUALITY RUBBER GASKETS

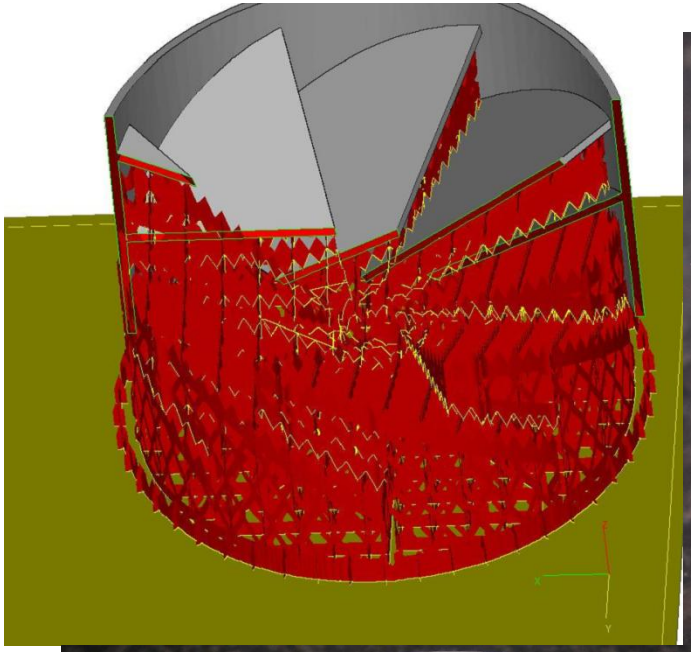
MODEL

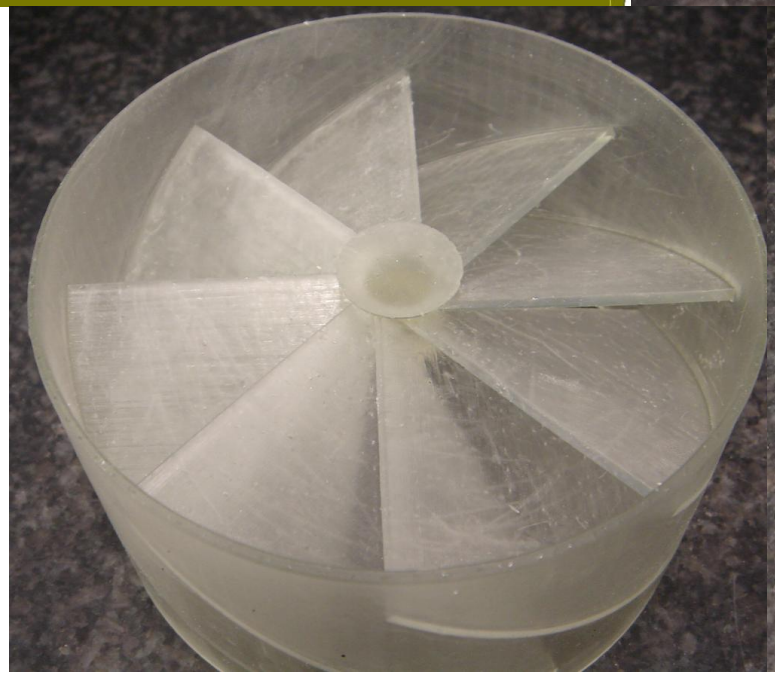
Scale of model $\frac{94}{610}$ mm





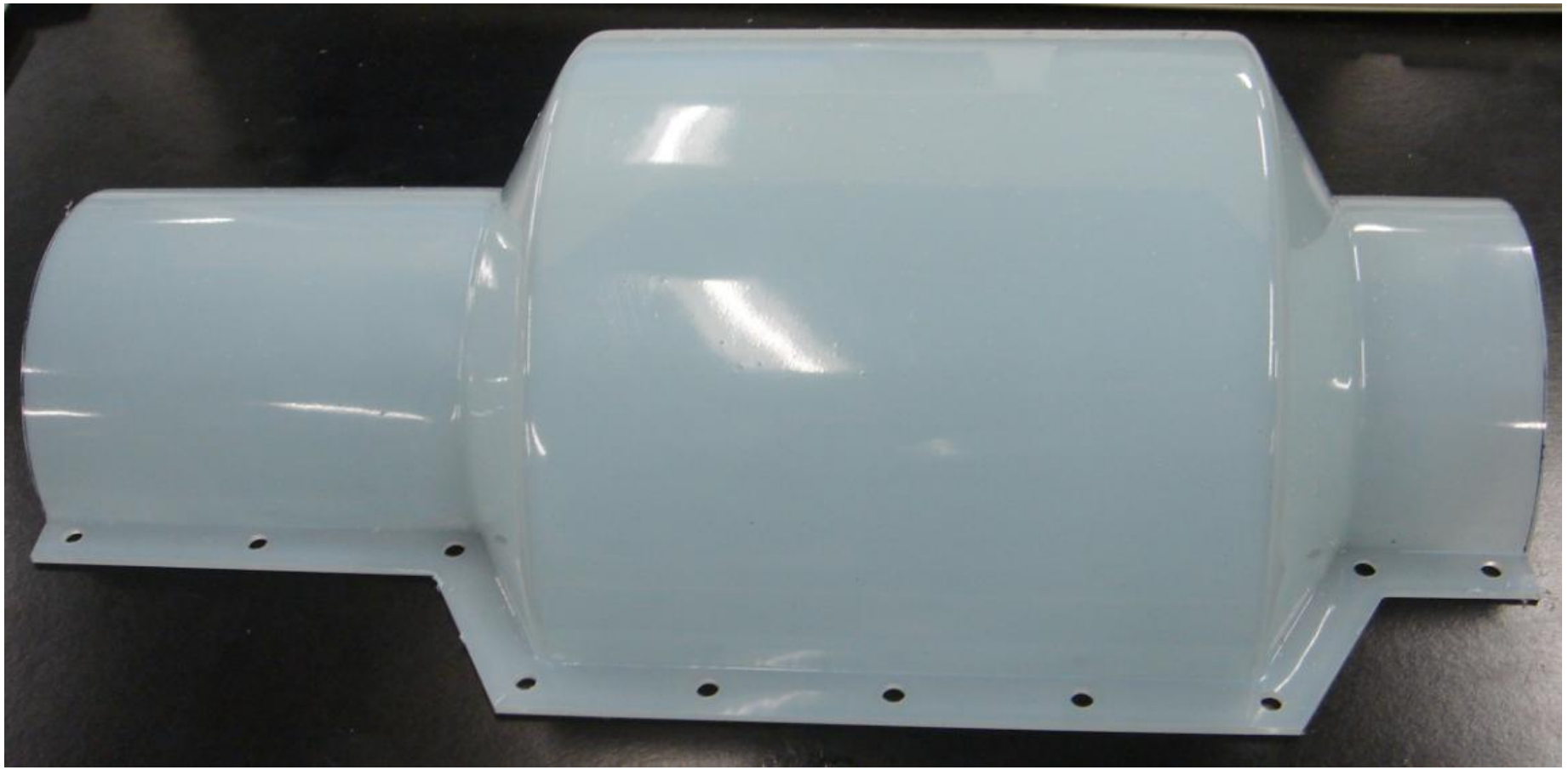
VANE-600 MM I.D. SEPORATOR

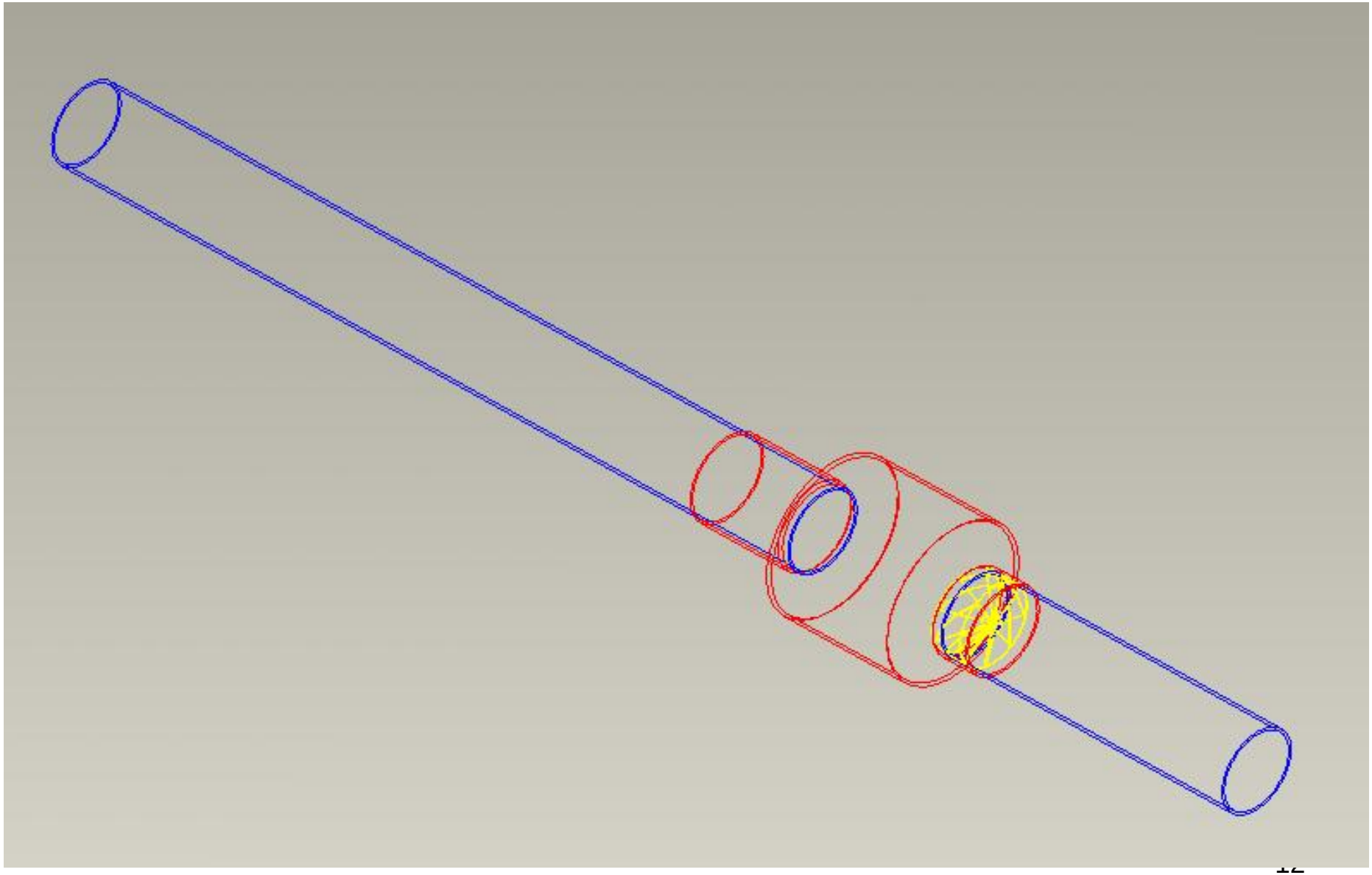


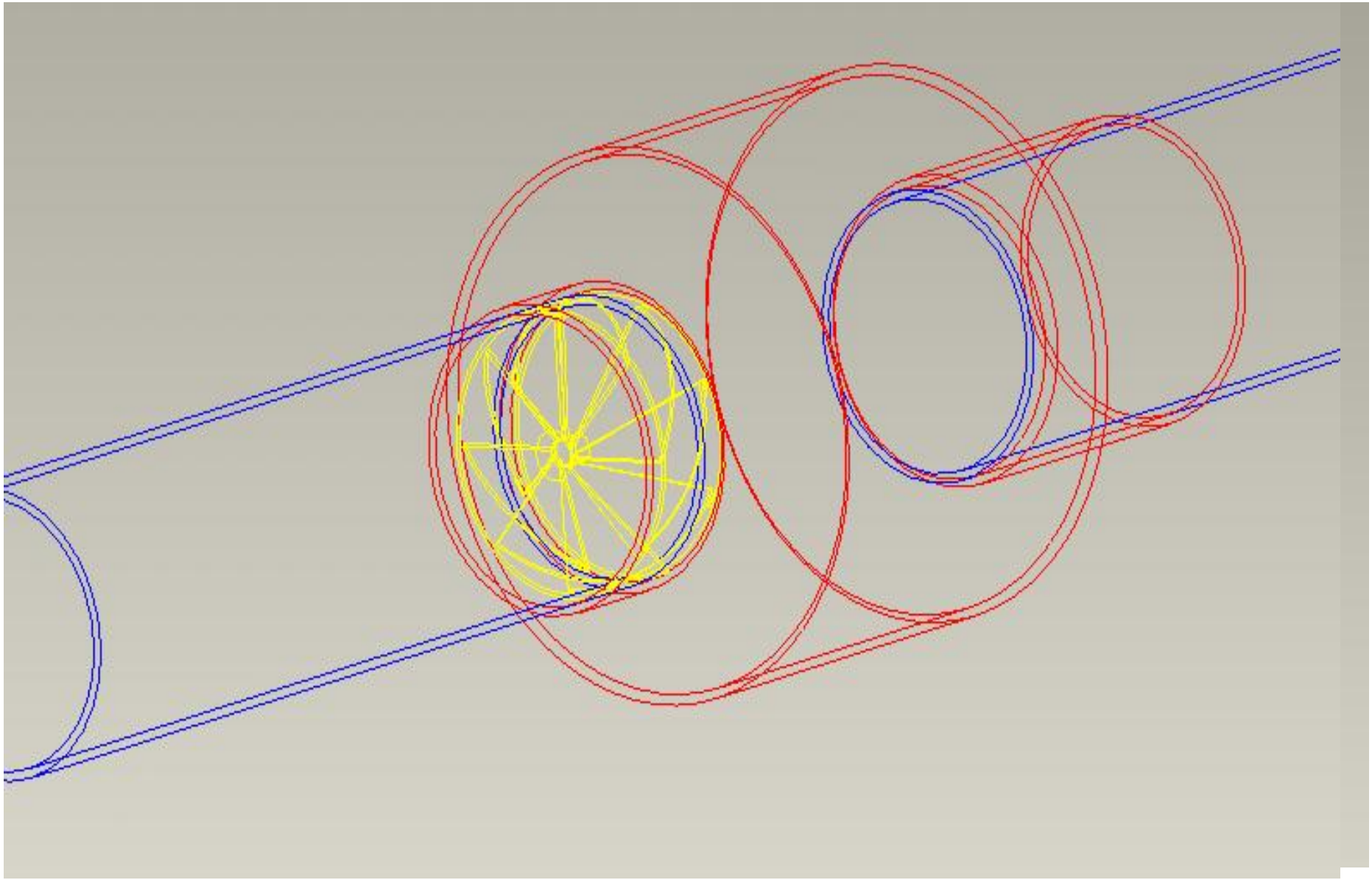


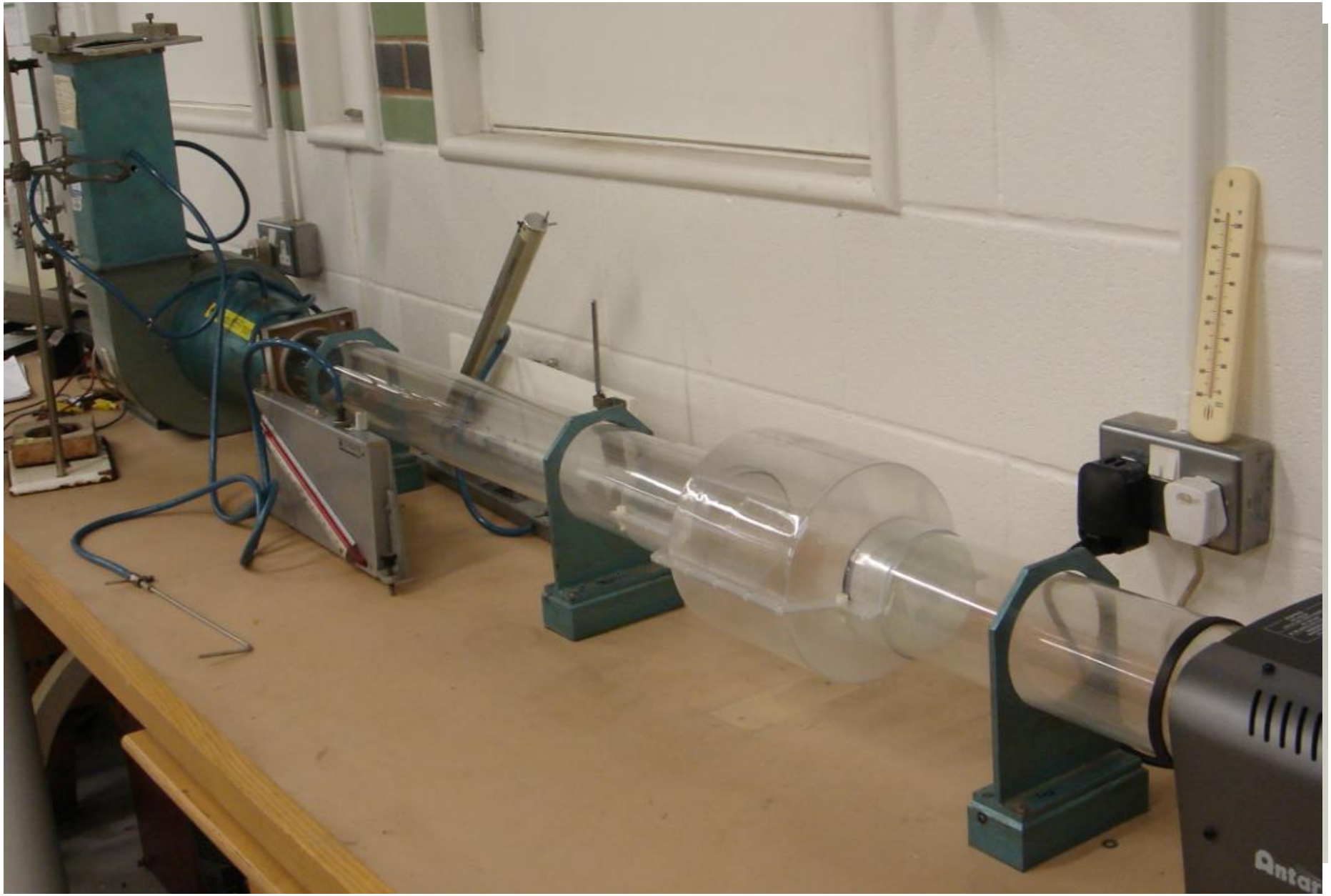
MODEL

The RSV shell:

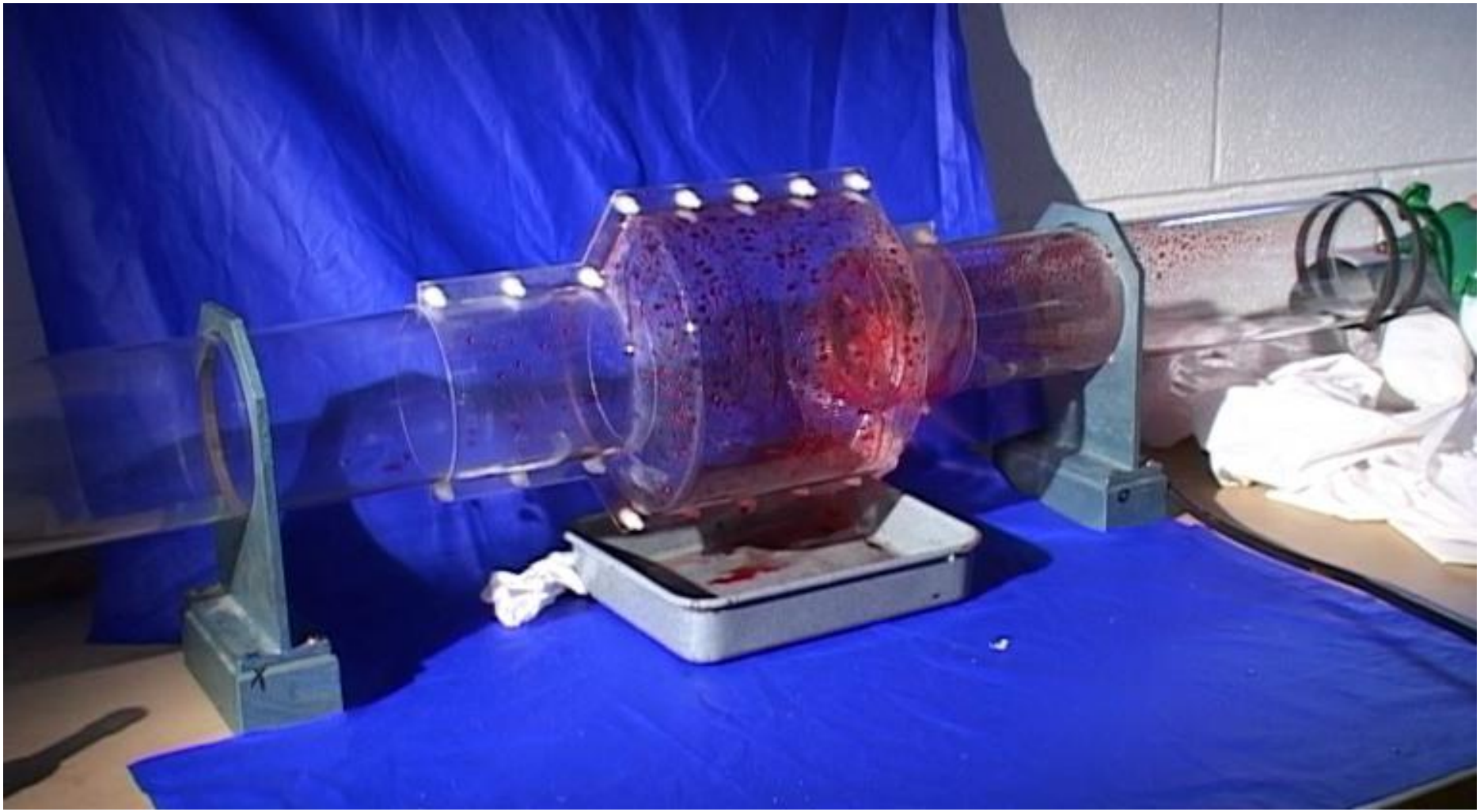








TESTING



TEST OUTCOME

Observed that some water did pass the RSV and into the pipe when the length was

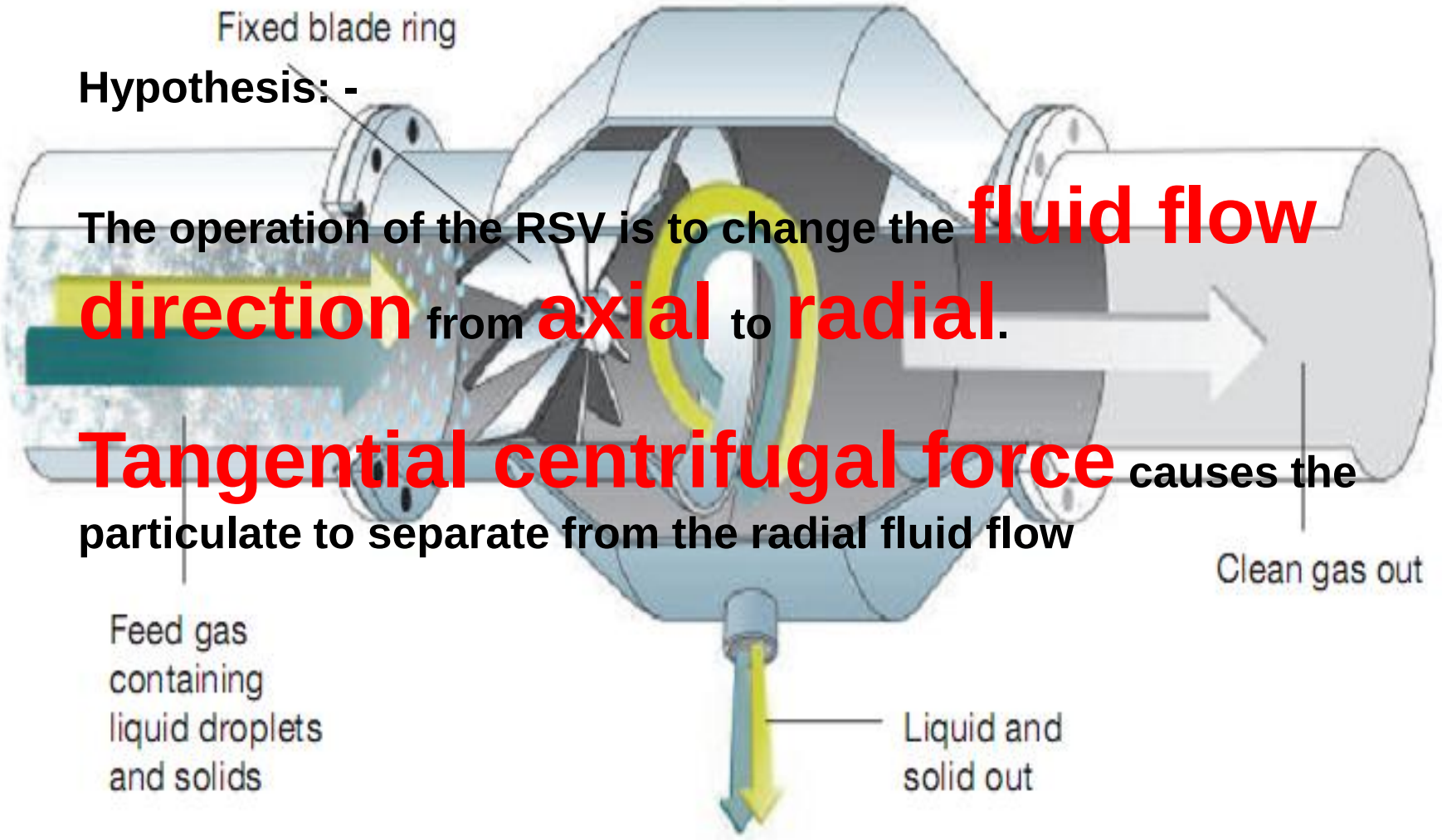
0.36m after the RSV.

RSV FUNCTIONALITY

Hypothesis: -

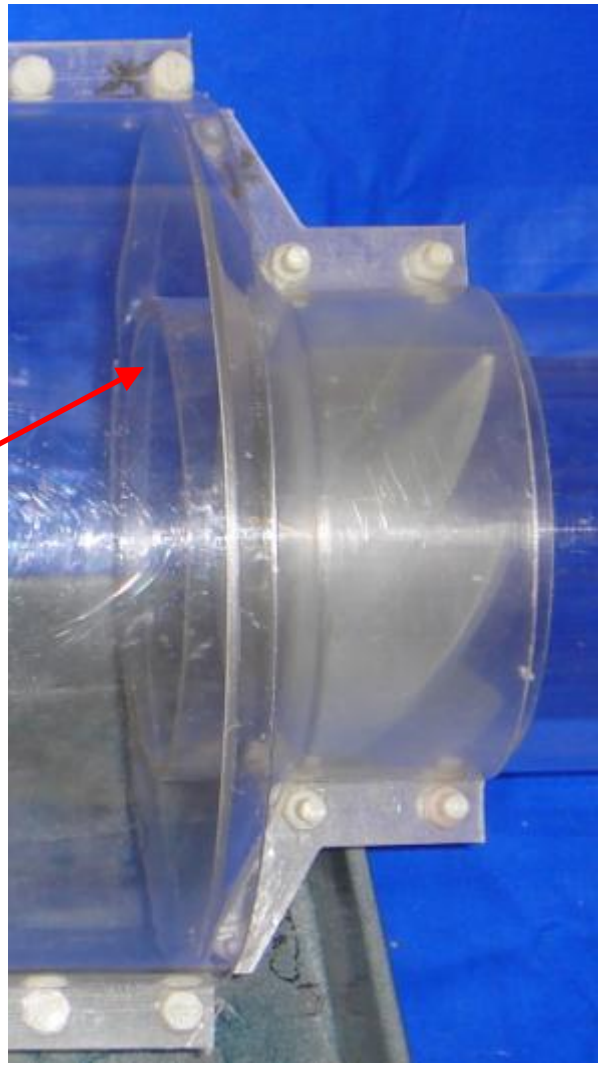
The operation of the RSV is to change the fluid flow direction from axial to radial.

Tangential centrifugal force causes the particulate to separate from the radial fluid flow



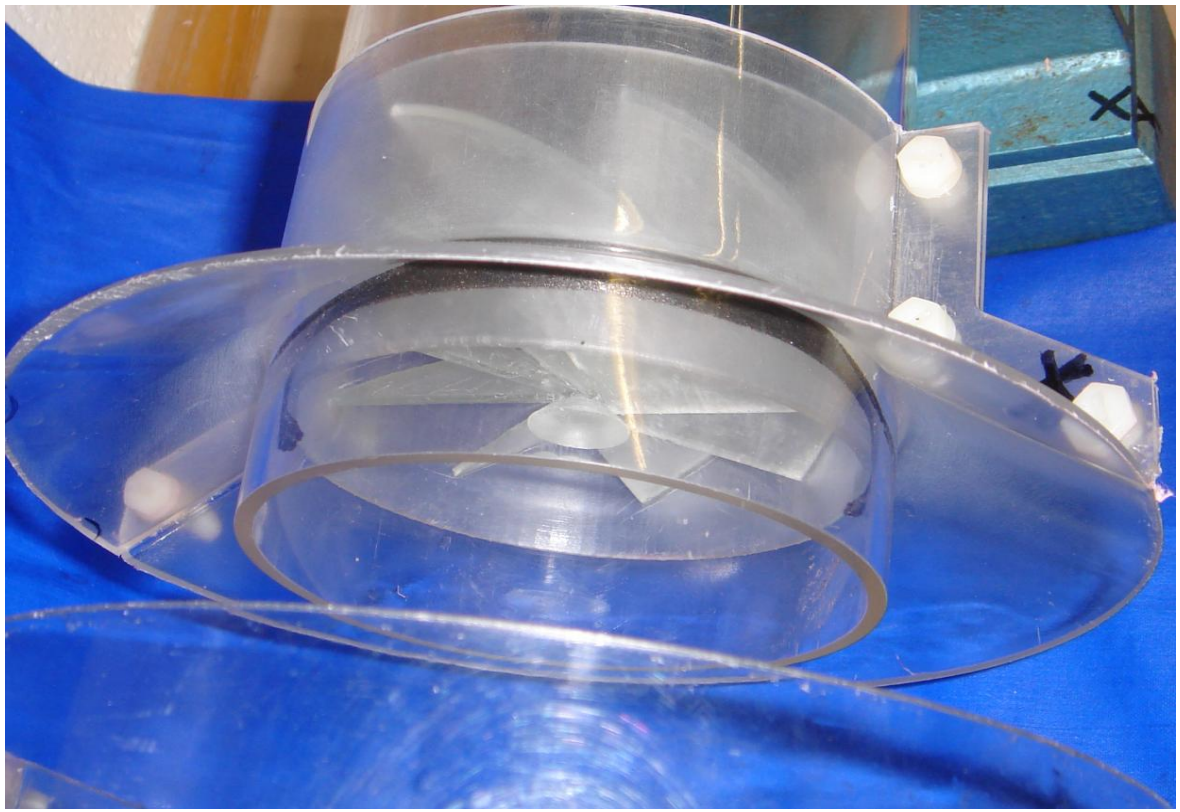
RSV FUNCTIONALITY

1. **Geometry of the blades – angle and surface area**
2. **Geometry – diameter and length, and surface of the RSV shell**
3. **Speed of the fluid flow – external influences**
4. **Insert of pipe into the RSV**

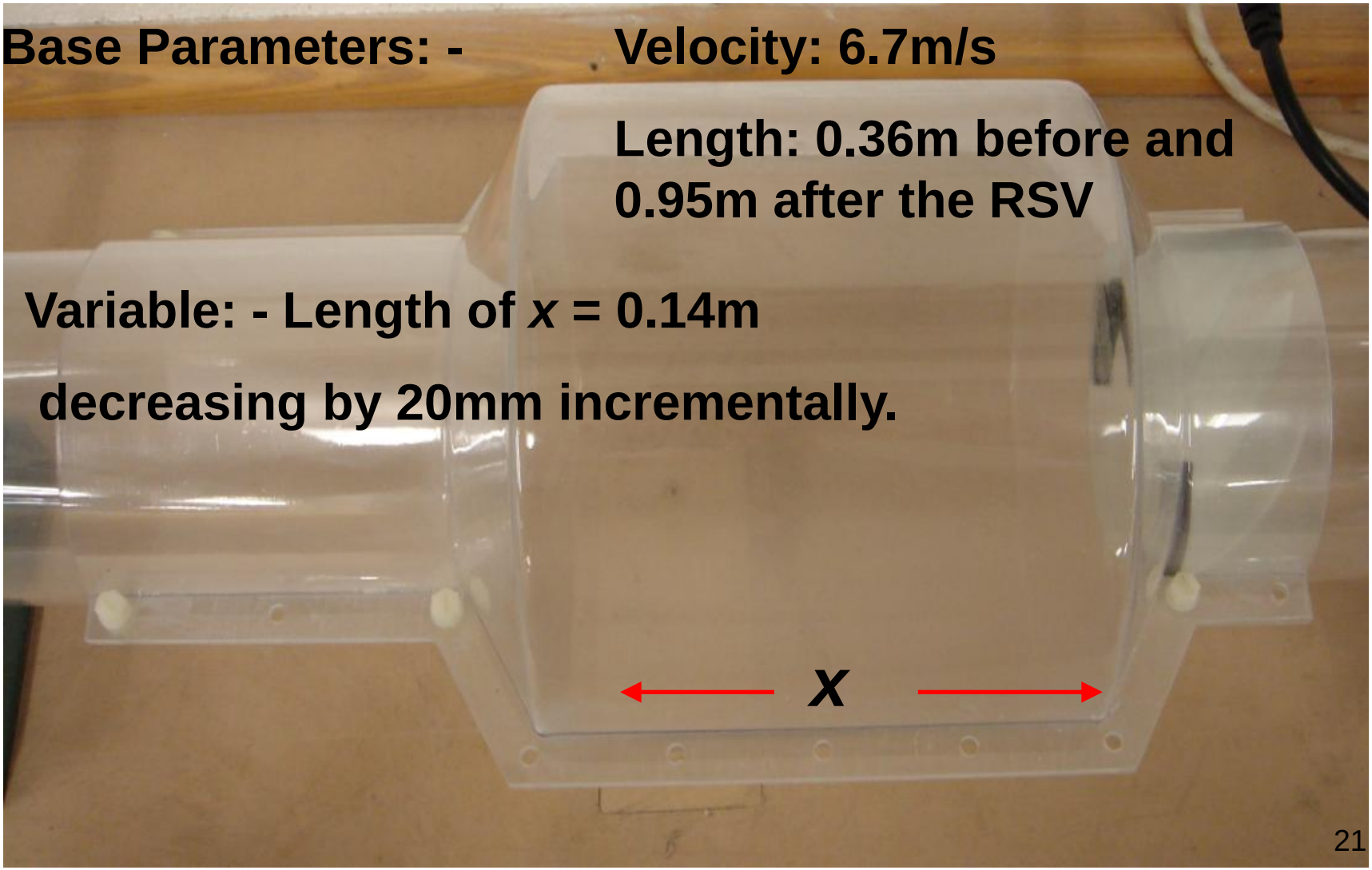


TESTING (2)

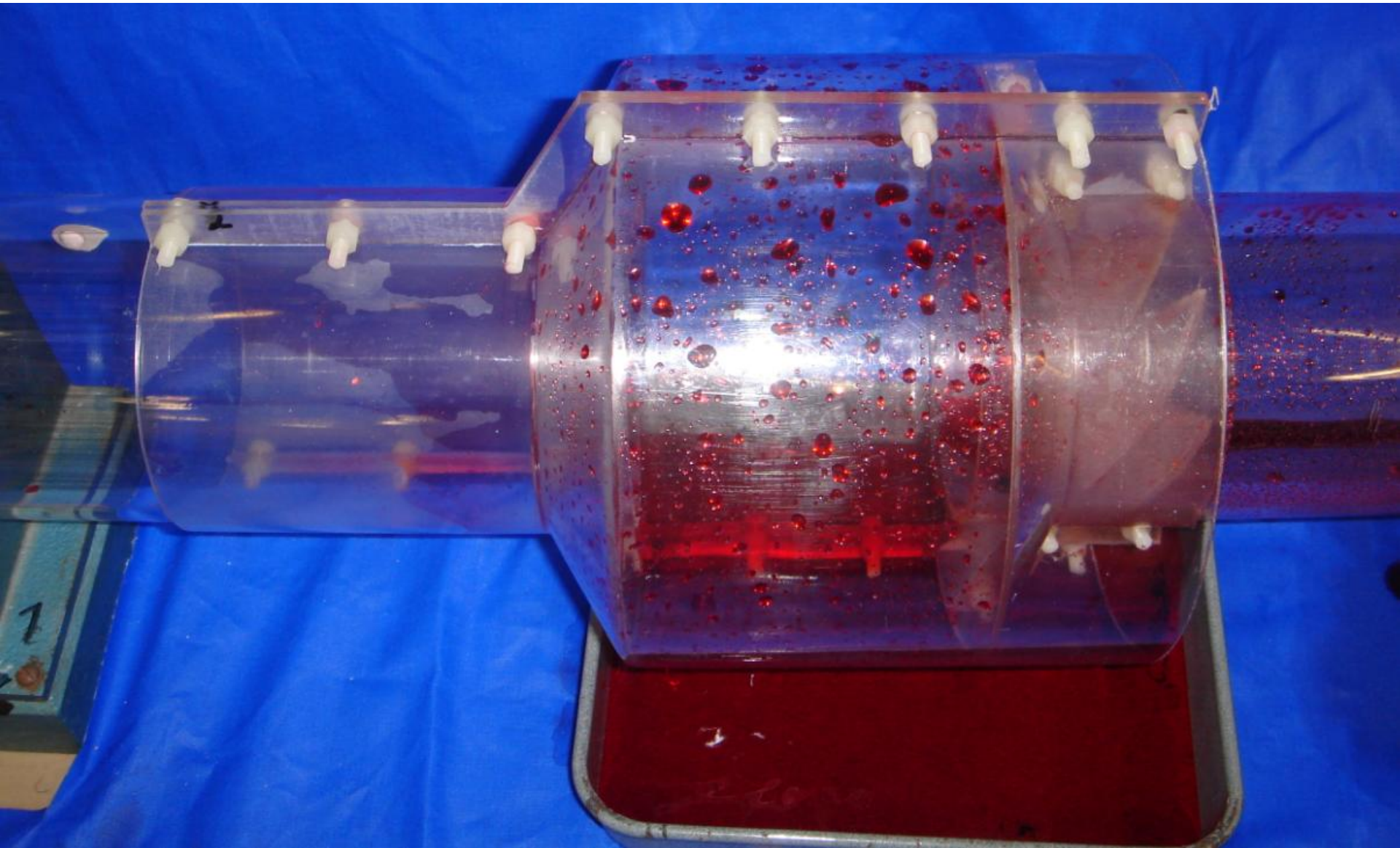
Investigate the length of the RSV shell: -



TESTING (2)


Base Parameters: -
Velocity: 6.7m/s
Length: 0.36m before and 0.95m after the RSV
Variable: - Length of x = 0.14m
decreasing by 20mm incrementally.
x

TESTING (2)



TEST (2) OUTCOMES

Limitation of the length of RSV is 0.8m

However ,the lack of a pump

may be the cause.

LIMITATIONS OF THE TESTS

$$\text{Leycroft System, } A_1 = \frac{\pi d^2}{4} = \frac{\pi 0.61^2}{4} \approx 0.3\ \text{m}^2$$

$$\text{Model, } A_2 = \frac{\pi 0.094^2}{4} \approx 6.94\times10^{-3}\ \text{m}^2$$

$$\text{Flow Rate of Model} = \frac{A_1}{A_2}\cdot 0.66 = \frac{0.3}{6.94\times10^{-3}}\times 0.66 \approx \mathbf{28.5}\ \text{l/min}$$

Sprayer dispersed 0.66 l/min

Leycroft system separation rate of 80 to 100 l/min

CONCLUSIONS

(Applicable to the Leycroft System)

- Length of pipe work after RSV **> 4m**
- Pipes with bends, radius of curvature **> 0.19m**
- Increase fluid velocity and separation rate will increase
- RSV shell length (*x*) **> 0.5m**,

  and hence D/L ratio **= 2.2**
- Blade surface insensitive to operation, due to high shear stress

CONCLUSIONS

The values are conservative estimates of the Leycroft System limitations. The system may be compacted more, subject to the lack of a pump in the system.

The limitations of pipe length are possibly due to the relative pressure inside the pipe after the RSV. The pressure difference post separator would be greater if the pipe length was longer, and hence it will increase the likelihood of sucking particulate from the surface of the RSV. But the lack of a pump could be accountable for the observed liquid in the pipe.

FURTHER ANALYSIS

If taken further: -

- Liquid flow rate increased to 2.3 l/min
- Add a pump
- Flip fan
- Multiple curved pipes pre-RSV
- Two static fans introduced