

**Lighter Than Air Systems**  
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**Lecture - 40**  
**Tutorial Problem 06 on Effect of Superpressure**

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**Tutorial Problem No 6**

Consider an airship of envelope volume  $6000 \text{ m}^3$  operating under ISA Sea level conditions.

Calculate  $\Delta L_N$  &  $V_{BA}$  if  $P_{Sp}$  is increased by 49 Pa

Ans:  $\Delta L_N = -35 \text{ N}$  and  $V_{BA} = + 2.9 \text{ m}^3$

Calculate  $\Delta L_N$  &  $V_{BA}$  if the airship is depressurized from  $P_{Sp} = 490 \text{ Pa}$

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So, let us look at this particular expression. So, the same airship 600 meter cube operating on same conditions ISA. If the  $P_{Sp}$  is increased by 49 Pascal calculate the  $\Delta L_N$  and volume of ballonnet. Give me give me the same expression. You will be able to get these two numbers.

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### Change in $P_{SP}$

- Recall that  $L_g = \frac{(P_s - (1 - RD_{WT})e)}{T_A} KV = \frac{P_s}{T_A} KV$ , ignoring RH (i.e., e)
- Hence,  $\Delta P_s$  directly impacts  $L_g$   $L_g = \frac{(P_{s2} - P_{s1})}{T_A} KV$
- Recall that  $W_{ba} = \frac{(P_s + \Delta P_{sp} - (1 - RD_{WT})e)}{T_A + \Delta T_{sh}} (1 - I) KV$
- Ignoring Humidity (e), we get  $W_{ba} = \frac{(P_s + \Delta P_{sp})}{T_A + \Delta T_{sh}} (1 - I) KV$
- Hence, the expression for  $W_{ba,2} - W_{ba,1}$  is :
- $W_{ba,2} - W_{ba,1} = \left\{ \frac{(P_{s2} + \Delta P_{sp})(1 - I_2)}{T_A + \Delta T_{sh}} - \frac{(P_{s1} + \Delta P_{sp})(1 - I_1)}{T_A + \Delta T_{sh}} \right\} KV$

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For your use, I show you the expressions so that you can use them. You can use these expressions. In fact, you may also be able to use these expressions. They are the same actually are the same expressions. So now at sea level we have pressure of 101325 and increased by 49 because of superpressure.

What is the answer you get? -35 Newtons and do you get cubic meter as units by finding the volume of weight and then using the density. Now let us go to a situation when you are depressurizing the airship. So now you assume that the  $P_{SP}$  is 490 and suddenly it become zero. That mean you have an airship with  $P_{SP}$  of 490. Then suddenly it will go down to atmospheric pressure there is a reduction of 490. So, now you take  $\Delta P_{SP}$  as -490. Actually, you can do it orally, see if it is +49 it was -35 and 2.9.

If it is -490 it will simply be 350 and 29. So if you reduced superpressure very quickly ballonet has to be filled up with more gas ballonet air has to be pushed out.