The apparent power advantage

Therefore, the ratio of the apparent power in the primary and secondary of the autotransformer to the apparent power **actually** traveling through its windings is

$$\frac{S_{IO}}{S_W} = \frac{N_{SE} + N_C}{N_{SE}} \qquad (4.71.1)$$

The last equation described the apparent power rating advantage of an autotransformer over a conventional transformer.

S_W is the apparent power actually passing through the windings. The rest passes from primary to secondary parts without being coupled through the windings.

Note that the smaller the series winding, the greater the advantage!

The apparent power advantage

For example, a 5 MVA autotransformer that connects a 110 kV system to a 138 kV system would have a turns ratio (common to series) 110:28. Such an autotransformer would actually have windings rated at:

$$S_W = S_{IO}\frac{N_{SE}}{N_{SE}+N_C} = 5\cdot\frac{28}{28+110} = 1.015\ \ MVA$$

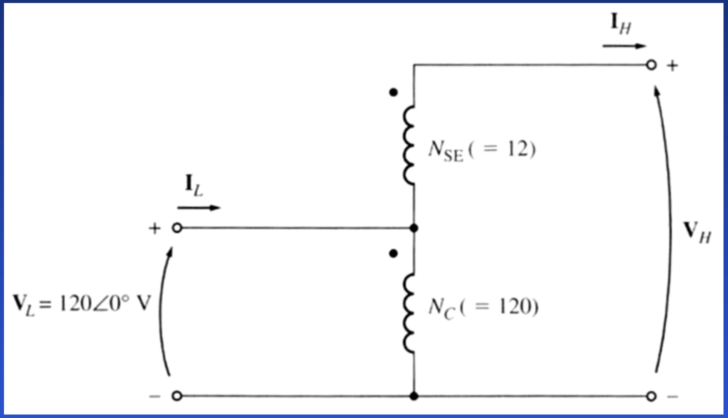
Therefore, the autotransformer would have windings rated at slightly over 1 MVA instead of 5 MVA, which makes is 5 times smaller and, therefore, considerably less expensive.

However, the construction of autotransformers is usually slightly different. In particular, the insulation on the smaller coil (the series winding) of the autotransformer is made as strong as the insulation on the larger coil to withstand the full output voltage.

The primary disadvantage of an autotransformer is that there is a direct physical connection between its primary and secondary circuits. Therefore, the electrical isolation of two sides is lost.

The apparent power advantage: Ex

Example 4.7: A 100 VA, 120/12 V transformer will be connected to form a step-up autotransformer with the primary voltage of 120 V.



a. What will be the secondary voltage?
b. What will be the maximum power rating?
c. What will be the power rating advantage?

a. The secondary voltage:

$$V_H = \frac{N_C + N_{SE}}{N_C} V_L = \frac{120+12}{120} 120 = 132\,V$$

b. The max series winding current: $$I_{SE,\max} = \frac{S_{\max}}{V_{SE}} = \frac{100}{12} = 8.33\,A$$

The secondary apparent power: $$S_{out} = V_S I_S = V_H I_H = 132 \cdot 8.33 = 1100\ VA$$

c. The power rating advantage:

$$\frac{S_{IO}}{S_W} = \frac{1100}{100} = 11$$

or

$$\frac{S_{IO}}{S_W} = \frac{N_{SE}+N_C}{N_{SE}} = \frac{120+12}{12} = \frac{132}{12} = 11$$