

RAILWAY CAR

1. TECHNICAL DESCRIPTION, BACKGROUND

When connecting the different railway cars at the train station, the cars are pushed against each other, and then locked together. The cars which are being connected are carrying a liquid solvent. This liquid is filled to the brim of the car, where a ventilation hole can be found. This hole is placed here, in order to allow the liquid to expand with the change of temperature. When the different cars collide, the liquid bursts out of the small ventilation holes at the top of the tank.

2. PHENOMENON

- The liquid bursts out of the ventilation hole.

3. FIND THE REASON

- Why does the liquid burst out of the hole?

- Where can the smallest pressure in the tank of the railway car be found?

4. ENGINEERING CALCULATIONS

A/ Calculate the critical acceleration, by which the railway car can be accelerated at collision, without spilling the liquid.

B/ What is the largest pressure difference appearing on the tank wall, and where is it?

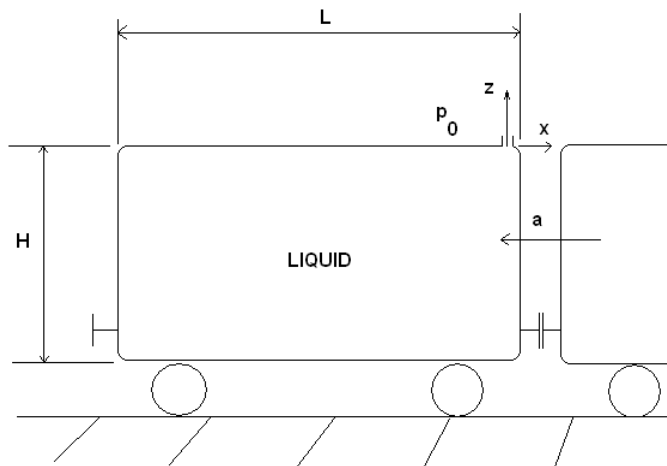


Figure 1.

Data:

Height of the tank $H = 4$ [m]

Length of the tank $L = 15$ [m]

Gravity $g = 9.81$ [N/kg]

Density of the solvent $\rho = 800$ [kg/m³]

Atmospheric pressure $p_0 = 10^5$ [Pa]

Saturated steam pressure $p_s = 10^4$ [Pa]