FIRE RISK CONSULTANCY

Expansion of solid, liquids and gases

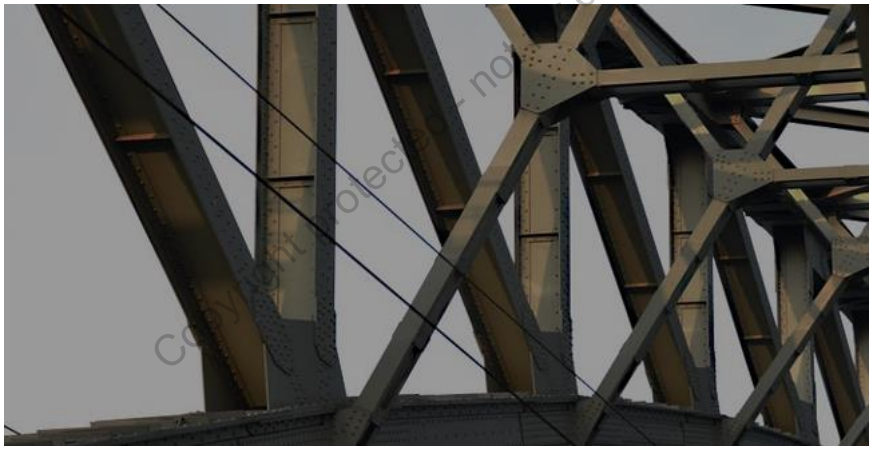
These modules are part of the IFE Level 2 and IFE Level 3 Fire Safety Certificate course. They look at the issues of determining the expansion of solids, liquids and gases

Exercise 16

Determine how much a metal bridge will expand on a freezing cold day when the sun comes out and heats it to 30C?

Temperature of = -10C Co-efficient of linear expansion = 0.000032 C

Original length of bridge = 50m



Exercise 17

At 25C a sphere has a diameter of 1m. It is involved in a fire and heated to 100C. What is the final volume of the sphere?

Ambient temperature of steel = 15C Co-efficient of linear expansion = $0.000015^{0}C$

Exercise 18

Determine the final length of a beam that is heated in a fire to 1000C?

Ambient temperature of beam = 15C Co-efficient of linear expansion = 0.00002 C

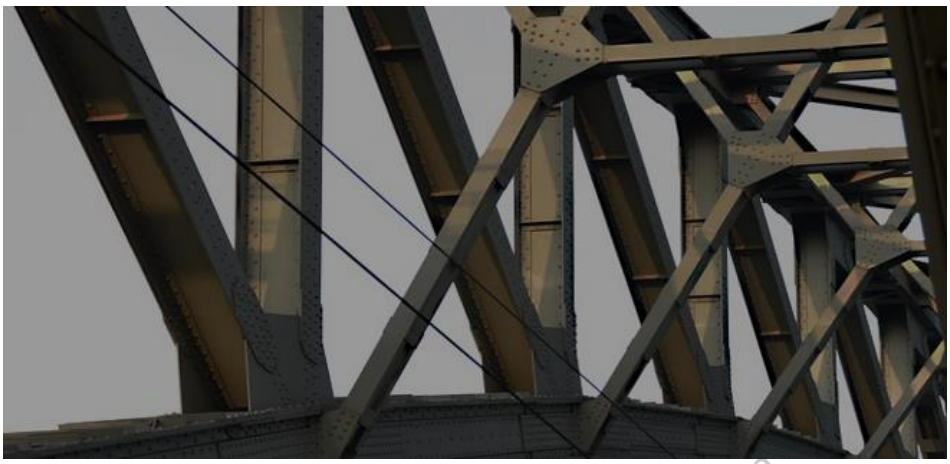
Original length of beam = 20m

Exercise 19

Determine how much a metal bridge will shrink when subject to freezing cold conditions of -30C?

Temperature = 25C Co-efficient of linear expansion = 0.0001 C

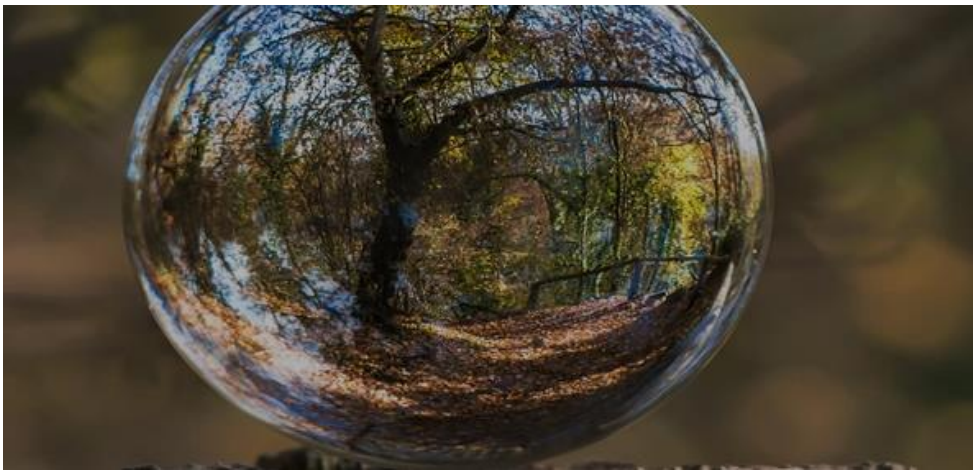
Original length of bridge = 30m



Exercise 20

At 30C a sphere has a diameter of 2m. It is involved in a fire and heated to 1000C. What is the final volume of the sphere?

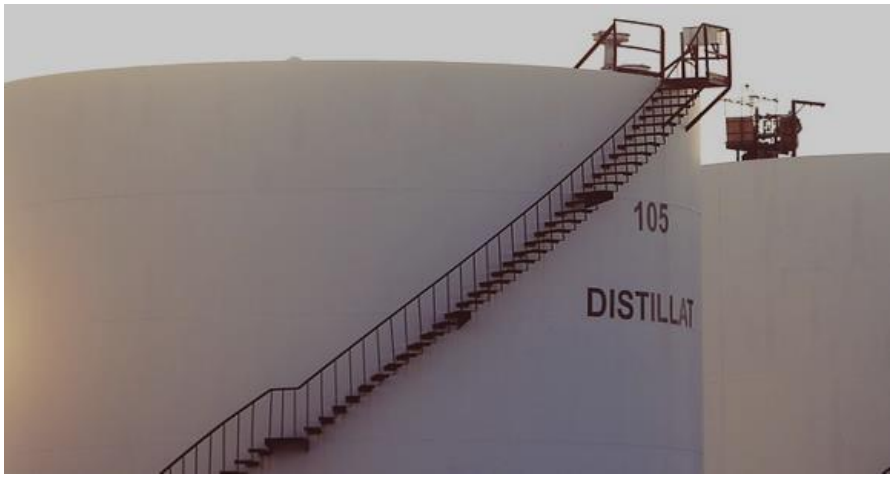
Ambient temperature of steel = 15C Co-efficient of linear expansion = 0.00001^{0}C



Exercise 21

A tank containing 1450 litres of a liquid is heated in a fire from ambient 20C to 1000C what will be its new volume?

Cubical expansion rate of liquid = 0.000009



Exercise 22

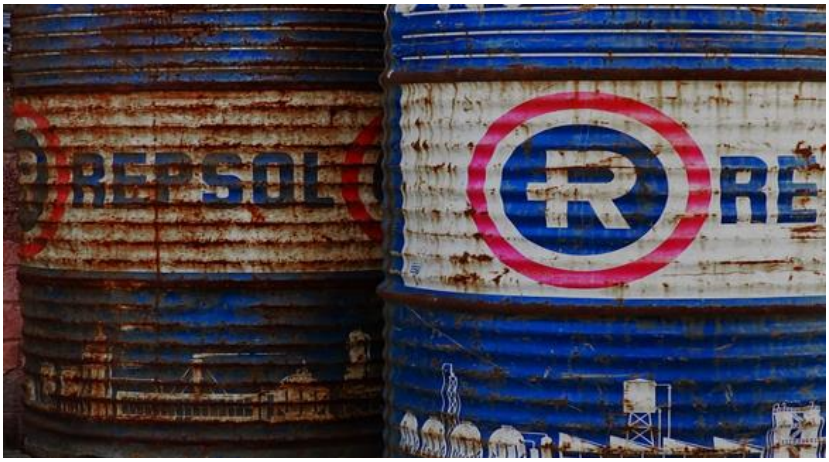
A tanker containing 20,000 litres of a liquid is heated in a fire from ambient 20C to 60C what will be its new volume?

Cubical expansion rate of liquid = 0.00001

Exercise 23

An oil drum containing 90 litres of a liquid is heated in a fire from ambient 20C to 800C what will be its new volume?

Cubical expansion rate of liquid = 0.0000125



Exercise 24

A glass of a liquid containing 0.45 litres of a liquid is heated from ambient 20C to 80C what will be its new volume?

Cubical expansion rate of liquid = 0.00004

Exercise 25

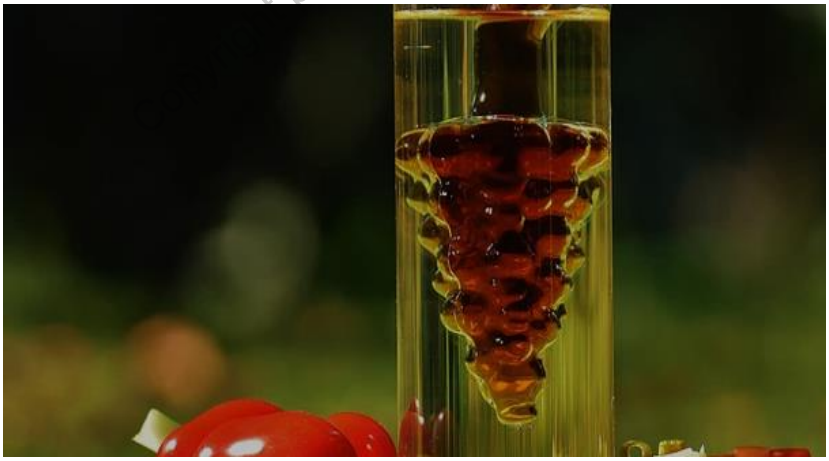
A tanker with a liquid containing 2300 litres of a liquid is heated from 0C to 30C what will be its new volume?

Cubical expansion rate of liquid = 0.000023

Exercise 26

The density of a liquid is 1000kg.m^3 at 0C and it is 900kg.m^3 at 100C.

Determine the coefficient of cubical expansion of the liquid?

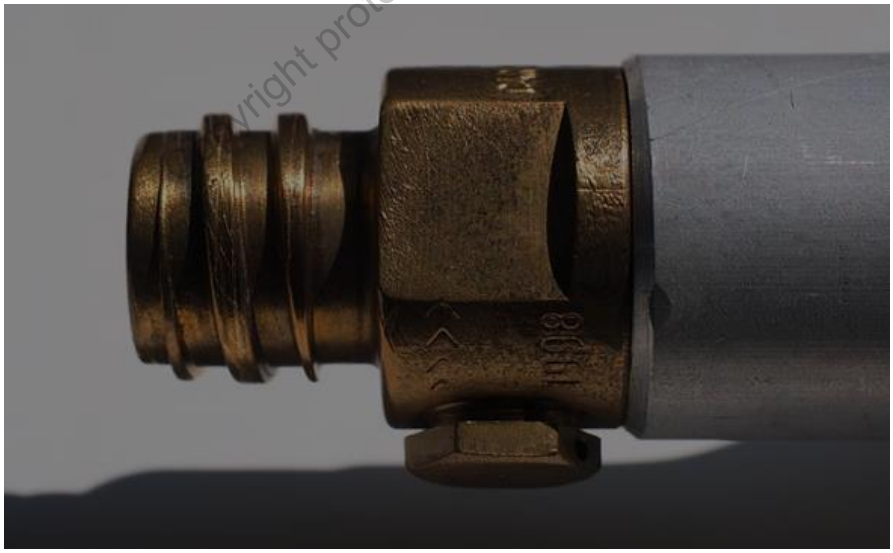


Exercise 27

A bulk fuel storage cylinder 5m in diameter and 8.5m high made of steel is 90% filled with aircraft fuel at a temperature of 18C. If the storage cylinder is involved in a fire and heated to 415C, how much fuel will be forced out?

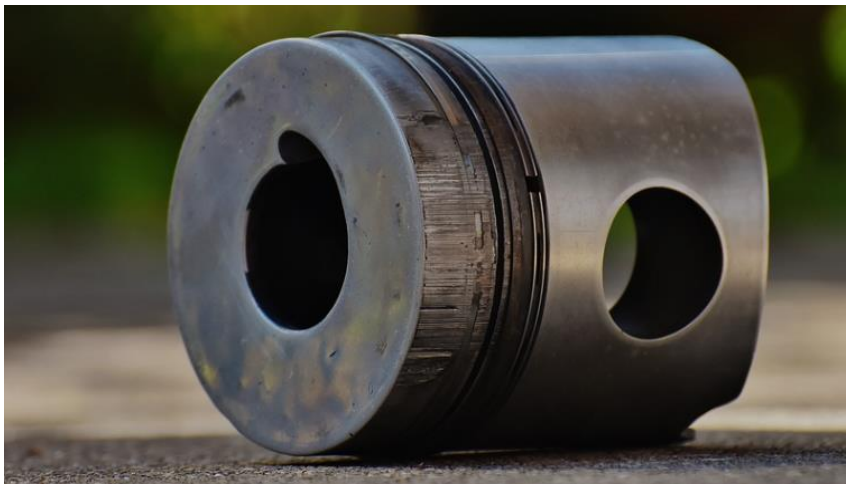
Exercise 28

A cylinder occupies 4 litres when its temperature is 20C. What will be its volume when heated to 600c if the pressure remains constant?



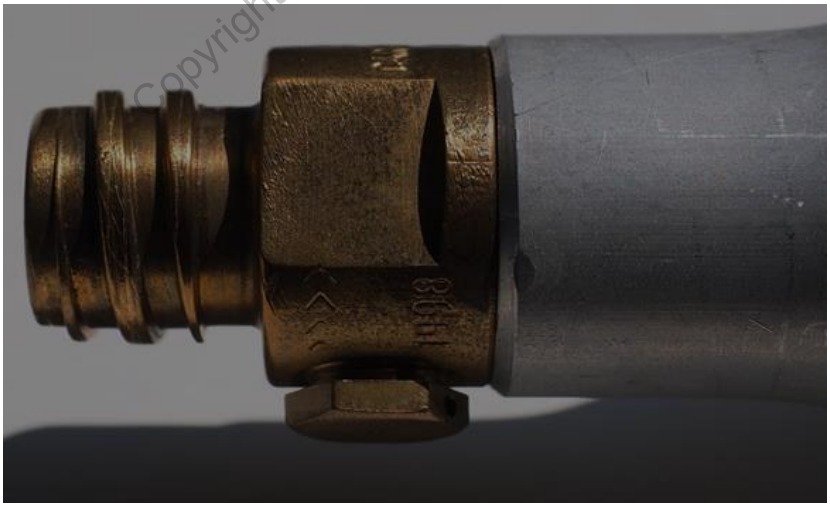
Exercise 29

A piston occupies 8 litres of a gas when its temperature is 20c, what will be its temperature if the volume is increased to 16 litres if the pressure remains constant?



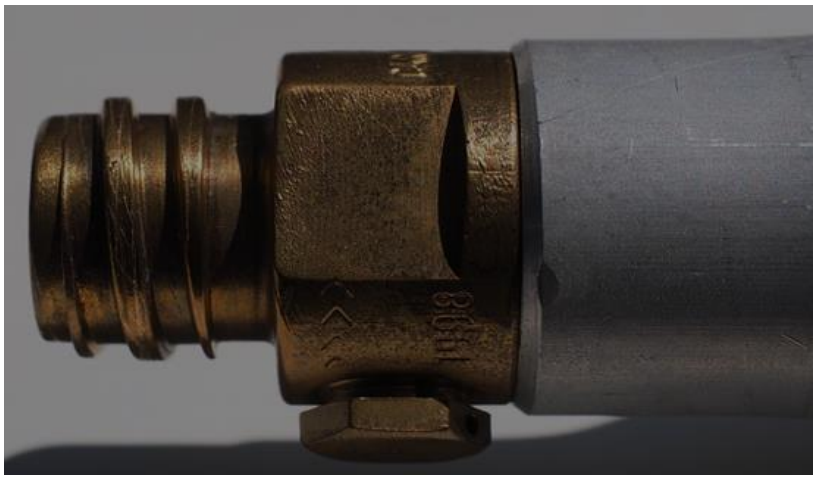
Exercise 30

A cylinder occupies 44 litres when its temperature is 0C, what will be its volume when heated to 560c if the pressure remains constant?



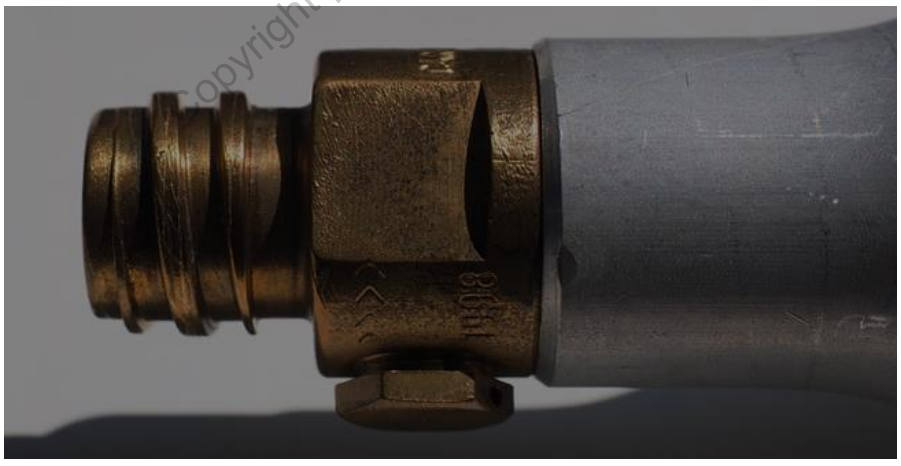
Exercise 31

A cylinder occupies 23 litres when its pressurised to 7 Bar, what will be the pressure if the volume is increased to 33 litres?



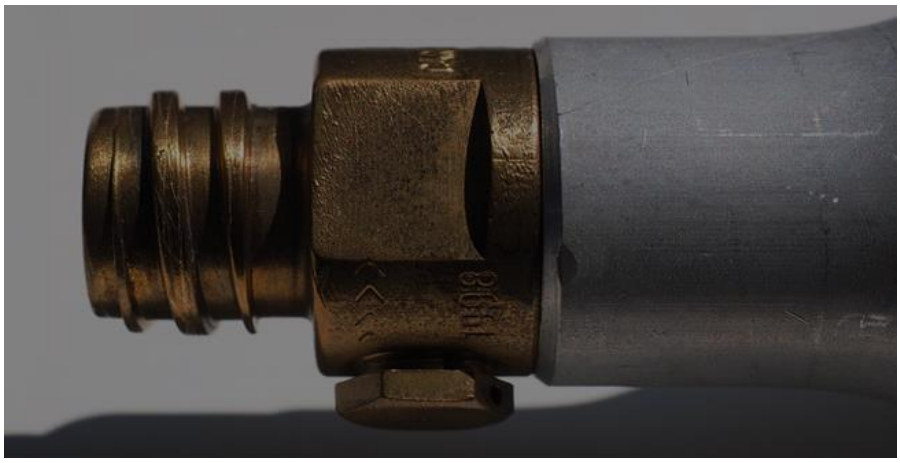
Exercise 32

A cylinder occupies 222 litres when its pressurised to 22 Bar, what will be the pressure if the volume is increased to 333 litres?



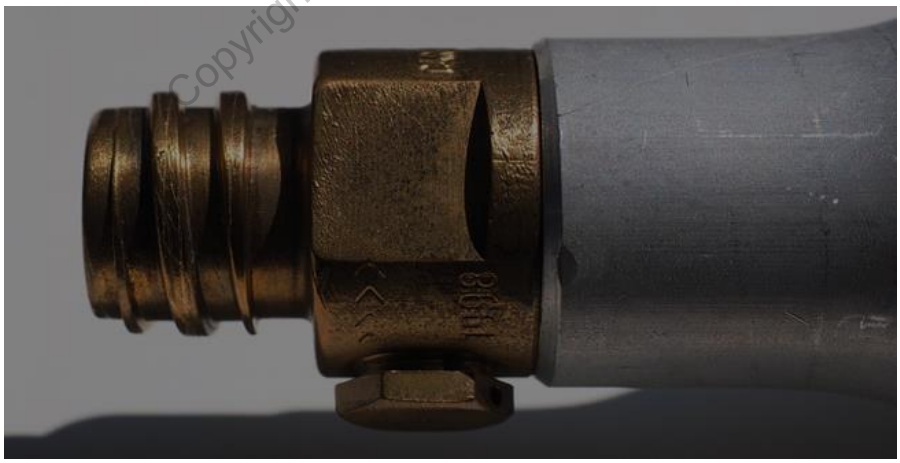
Exercise 33

A cylinder occupies 9 litres when its pressurised to 200 Bar, what will be the pressure if the volume is increased to 11 litres?



Exercise 34

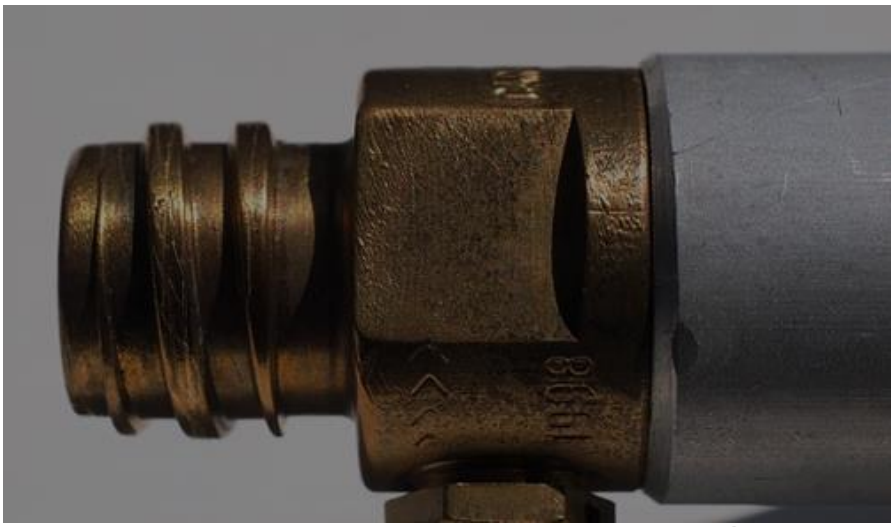
A cylinder charged to 56 Bar has a volume of $1m^3$ at 25C. It is involved in a fire and reaches a temperature of 550C, its volume increases to $1.001m^3$. What would be the pressure inside the cylinder?



Exercise 35

A vessel at -55C contains gas at a pressure of 15 Bar. We can assume that the volume of the vessel will remain constant.

If the bursting pressure = 60 Bar, at what temperature will the vessel fail?



Exercise 36

An acetylene cylinder at a pressure of 10 bar is stored in a container which is involved in a fire and is heated to 500C. The vessel is protected by a fusible plug which operates at 30 bar. Would the fusible plug have operated in the fire? You can assume that the volume of the cylinder remains constant. Original temperature of the cylinder is 20C

Exercise 37

A nitrogen cylinder has a volume of 0.1m^3. It contains 7m^3 of nitrogen when released at normal temperature and pressure 1 bar 15C.

1. What is the pressure of the Nitrogen in the cylinder at 15C?
2. If the cylinder is heated in a fire to a temperature of 300C. What will be the pressure of the gas?
3. If the gas is suddenly released, what volume will it occupy?