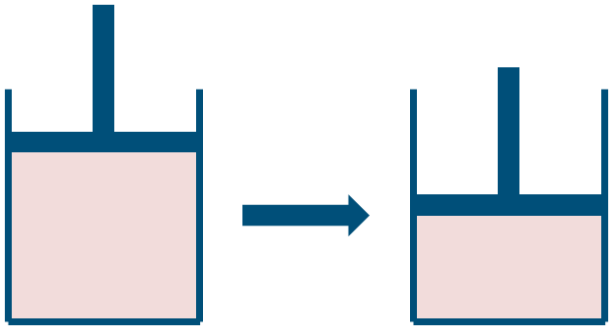
Isothermal Compression of Methane

Introduction

Methane is

- initially at 400 K and 2 MPa,
- and then isothermally compressed to 5 MPa.



The work done on the gas is $\int_{V_2}^{V_1} P\,dV$ where V is the specific volume.

This application calculates the work done (via numeric integration), and the heat transferred from the methane.

```
> restart :
  with( ThermophysicalData ) :
  with( Units[ Simple ] ) :
```

Parameters

```
> T_1 := 400K :
> p_1 := 2 ·10^6 Pa :
> p_2 := 5·10^6 Pa :
> fluid := "Methane" :
```

State 1

```
> s_1 := Property( entropy, fluid, temperature = T_1, pressure = p_1 )
```

$$5.80\ \frac{kJ}{kg\,K} \qquad \textbf{(3.1)}$$

> $u_1 := \text{Property}(\text{massspecificinternalenergy}, \text{fluid}, \text{temperature} = T_1, P = p_1)$

$$935.42 \ \frac{\text{kJ}}{\text{kg}} \tag{3.2}$$

> $v_1 := \dfrac{1}{\text{Property}(\text{density}, \text{fluid}, \text{temperature} = T_1, \text{pressure} = p_1)}$

$$1.03 \times 10^{-1} \ \frac{\text{m}^3}{\text{kg}} \tag{3.3}$$

State 2

> $T_2 := T_1$:

> $s_2 := \text{Property}(\text{entropy}, \text{fluid}, \text{temperature} = T_2, \text{pressure} = p_2)$

$$5.29 \ \frac{\text{kJ}}{\text{kg K}} \tag{4.1}$$

> $u_2 := \text{Property}(\text{U}, \text{fluid}, \text{temperature} = T_2, \text{pressure} = p_2)$

$$921.21 \ \frac{\text{kJ}}{\text{kg}} \tag{4.2}$$

> $v_2 := \dfrac{1}{\text{Property}(\text{density}, \text{fluid}, \text{temperature} = T_2, \text{pressure} = p_2)}$

$$4.07 \times 10^{-2} \ \frac{\text{m}^3}{\text{kg}} \tag{4.3}$$

Calculation

Pressure at specific volume V

> $p := \text{Property}\left(\text{"pressure"}, \text{fluid}, \text{"temperature"} = T_1, \text{"D"} = \dfrac{1}{V}\right)$:

Work done

> $w := \displaystyle\int_{v_1}^{v_2} p \, dV$

$$-189.61 \ \frac{\text{kJ}}{\text{kg}} \tag{5.1}$$

Heat transferred per unit mass of methane

> $q := u_2 - u_1 + w$

$$-203.82 \ \frac{\text{kJ}}{\text{kg}} \tag{5.2}$$