

## A.03.01 – Trabalho de Fronteira (Sistemas Fechados)

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## 1 Trabalho de Fronteira

- Qualitativo
- Quantitativo

## 2 Tópicos de Leitura

A.03.01 – Trabalho de Fronteira

# Trabalho de Fronteira – Aplicações

Aplicações incluem:

- Motores de combustão interna
- Motores **Stirling**
- Compressores alternativos
- Motores **lineares**
- Elevadores de carga e atuadores
- Expansores **criogênicos**



Image by Schlaich Bergermann und Partner from wikipedia.org

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Image by DarkWorkX from pixabay.com

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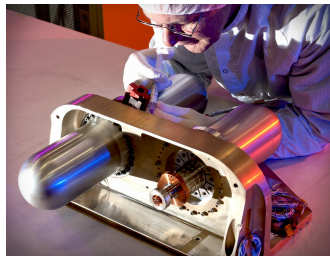
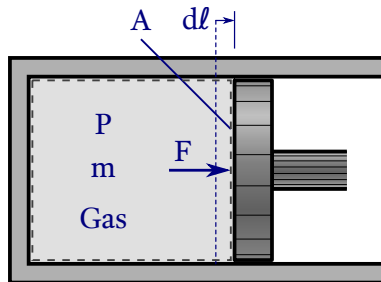


Image by NASA Goddard Space Flight Center from flickr.com

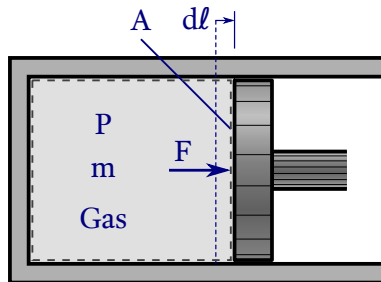
# Trabalho de Fronteira – Diferencial

$$\delta W_f \equiv \vec{F} \cdot d\vec{\ell}$$



# Trabalho de Fronteira – Diferencial

$$\delta W_f \equiv (|\vec{F}| \cdot |d\vec{\ell}|) \times \frac{A}{A} \rightarrow$$

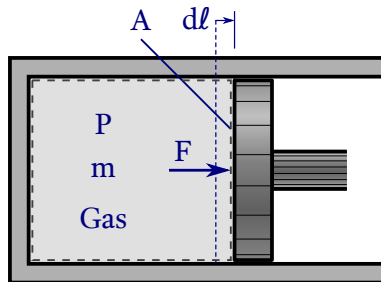




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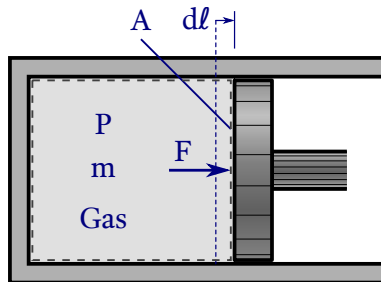


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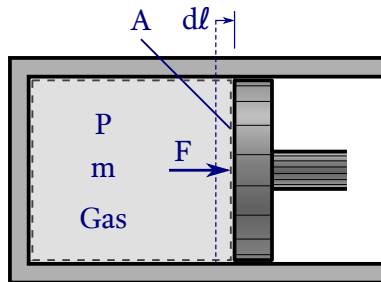
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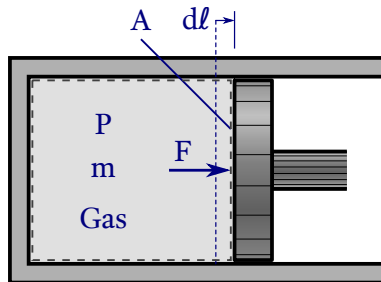
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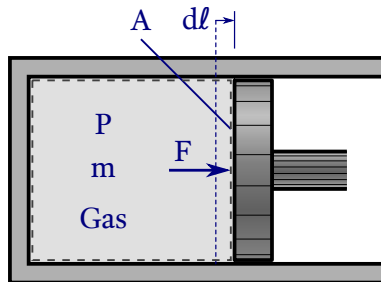
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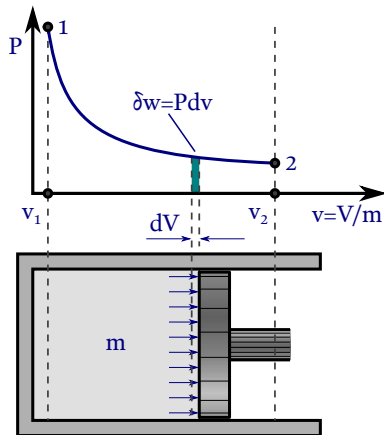
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# Trabalho de Fronteira – Processo

Processo de **quase-equilíbrio** 1-2:

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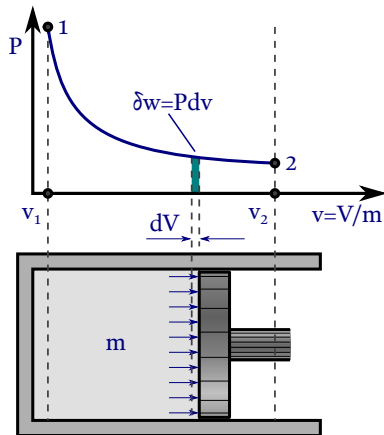


# Trabalho de Fronteira – Processo

Processo de **quase-equilíbrio** 1-2:

$$\delta w_f = P dv$$

$$w_{12} = \int_1^2 \delta w_f = \int_1^2 P dv$$

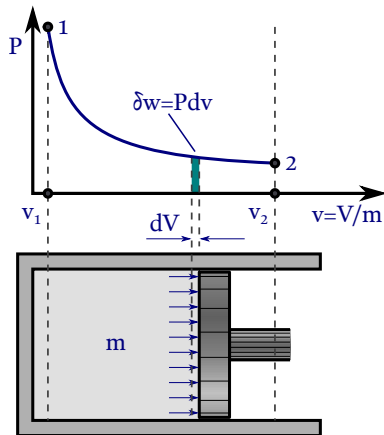


# Trabalho de Fronteira – Processo

Processo de **quase-equilíbrio** 1-2:

$$\delta w_f = P dv$$

$$\left( w_{12} = \int_1^2 \delta w_f = \int_1^2 P dv \right) \times m \rightarrow$$





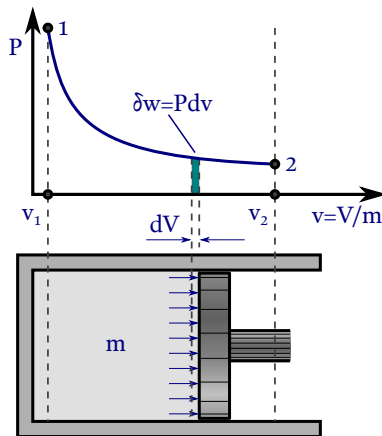
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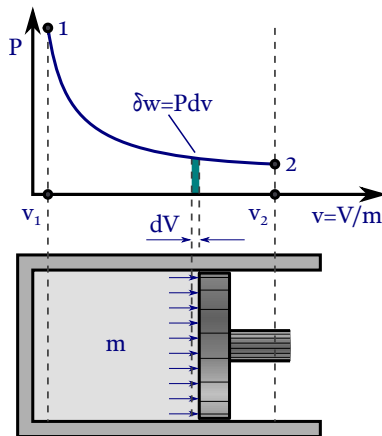
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# Trabalho de Fronteira – Processo

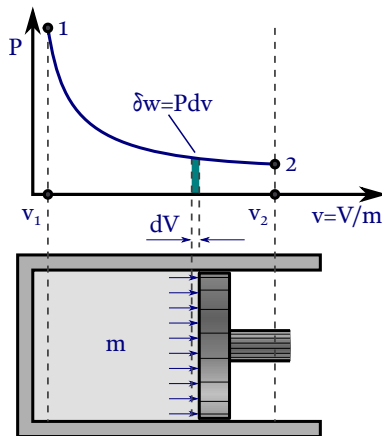
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$W_f$  é a **área** sob o processo em coordenadas  $P - v$ .



# Trabalho de Fronteira

# Trabalho de Fronteira – Teorema

Here's a subtitle

Theorem

*Colors do mix.*

Demonstração.

It's all over this presentation!



# Tópicos de Leitura I



Çengel, Y. A. e Boles, M. A.

*Termodinâmica 7ª Edição.* Seção 4-1.

AMGH. Porto Alegre. ISBN 978-85-8055-200-3.



Image by David Mark from pixabay.com