ME 201
Thermodynamics

Boundary Work Guide

The boundary work out of a system (work done by system on the surrounds) is defined as

$$W_{bnd} = \int PdV$$

or on a per mass basis

$$w_{bnd} = \int Pdv$$

If following a calculation it is determined that the boundary work is negative this implies that the work is into the system (work done by surrounds on the system) rather than out of the system.

Clearly, the boundary work depends on the process and that will determine the relationship between P and v. The evaluation of the boundary work for a number of different processes and substance types is given below. Though these are represented on a per mass basis, the use of the total volume in these expressions will yield the total work.

PROCESS	BOUNDARY WORK		
	Ideal Gas	**Compressible Substance**	**Incompressible Substance**
Isotropic	0	0	0
Isobaric	$P(v_2 - v_1)$	$P(v_2 - v_1)$	$P(v_2 - v_1)$
Isothermal	$RT \cdot \ln\left(\frac{v_2}{v_1}\right)$	Numerical Integration (Unless phase change is occurring, then it may also be an isobaric process)	0
Isentropic	$\frac{P_1 v_1^k}{(1-k)}\left[v_2^{1-k} - v_1^{1-k}\right]$ or $\frac{P_2 v_2 - P_1 v_1}{(1-k)}$ with $k = \frac{c_P}{c_V}$	Numerical Integration	0
Polytropic	$\frac{P_1 v_1^n}{(1-n)}\left[v_2^{1-n} - v_1^{1-n}\right]$ or $\frac{P_2 v_2 - P_1 v_1}{(1-n)}$	$\frac{P_1 v_1^n}{(1-n)}\left[v_2^{1-n} - v_1^{1-n}\right]$ or $\frac{P_2 v_2 - P_1 v_1}{(1-n)}$	Not Defined