Amplitude Reference

Ultrasonic

An ultrasonic weld is governed by the following formula: E = P x T, where E = energy, P = power, and T = time. Power is a function of force times velocity: P ~ F x V. ~ Force is derived from pressure and down speed, and velocity is derived from frequency and amplitude. (See Figure 1.)

Amplitude is defined as the peak-topeak longitudinal displacement at the face of the horn. (See Figure 2.) It

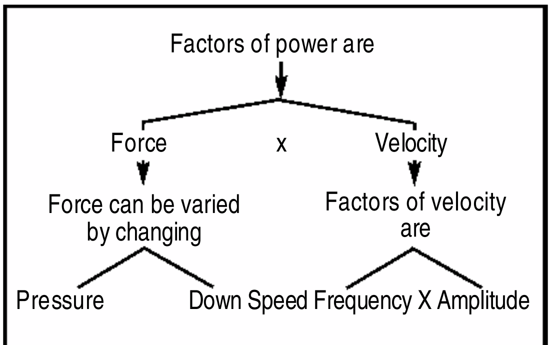

Figure 1

has the most impact on the ultrasonic process, in that the heat generated at the joint interface is based on the *square* of the amplitude. Therefore, small increases or decreases in amplitude have a greater affect than changes to other parameters, because the results are magnified by the square rather than incrementally.

One can calculate amplitude by using static gain factors of the

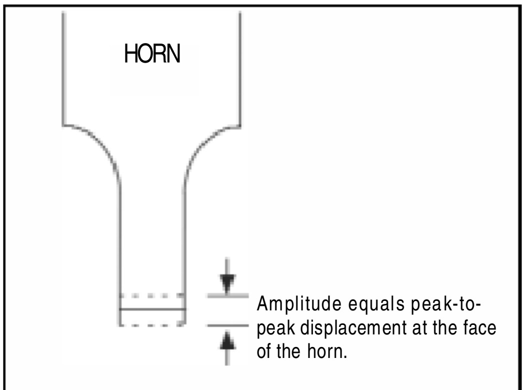

Figure 2

components that make up an acoustic stack: the converter, booster, and horn. (Gain is the ratio of output amplitude to input amplitude of a horn or booster.) To arrive at approximate stack amplitude, multiply the amplitude of the converter by the gain factors of the booster and horn. (See Figure 3.) For example:

Depending on the material and ultrasonic process utiized, different amplitudes will be necessary. Amplitude can be measured in either thousandths of an inch or microns

$$Amplitude_{output} = Amplitude_{converter} \text{ X } Gain_{booster} \text{ X } Gain_{horn}$$

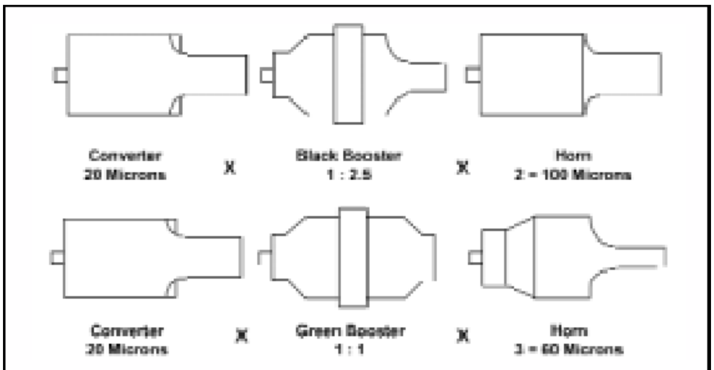

Figure 3

(0.001" = 25 microns).

Amplitude guidelines based on material and process have been arrived at through research and practical experience. The matrix on the reverse side of this page should be used as a ***guideline*** to determine amplitude for the setup of your particular application, based on the frequency of the equipment.

AMPLITUDE REFERENCE GUIDE for ULTRASONIC WELDING (in M icrons (µm))

Resin	*Frequency*			
Amorphous	**15 kHz**	**20 kHz**	**30 kHz**	**40 kHz**
Acrylonitrile Butadiene Styrene (ABS)	36-84	30-70	24-56	18-42
Acrylonitrile Styrene Acrylate (ASA)	36-84	30-70	24-56	18-42
Polycarbonate (PC)	72-120	60-100	48-80	36-60
PC/ABS	72-120	60-100	48-80	36-60
PolycarbonateÆolyester	60-1 20	50-100	40-80	30-60
Polyetherimide (PEI)	84-120	70-100	56-80	42-60
Polyethersulfone (PES)	84-1 20	70-100	56-80	42-60
Polymethyl Methacrylate (Acrylic, PMMA)	48-84	40-70	32-56	24-42
Polyphenylene Oxide (PPO)	60-1 08	50-90	40-72	30-54
Polystyrene (PS)	36-84	30-70	24-56	18-42
Polysulfone (PSU)	84-120	70-100	56-80	42-60
Polyvinyl Chloride (rigid PVC)	48-96	40-80	32-64	24-48
Styrene-Acrylonitrile (SAN)	36-84	30-70	24-56	18-42
Semi- Crystalline				
Cellulosics (CA, CAB, CAP)	72-1 20	60-100	48-80	36-60
Liquid Crystal Polymer (LCP)	84-1 44	70-120	56-96	42-72
Polyoxymethylene, Polyacetal (POM)	84-1 44	70-120	56-96	42-72
Polyamid (Nylon, PA)	84-144	70-120	56-96	42-72
Polybutylene Terephthalate (Polyester,	84-144	70-120	56-96	42-72
Polyethylene Terephthalate (Polyester,	96-144	80-120	64-96	48-72
Polyetheretherketone (PEEK)	84-1 44	70-120	56-96	42-72
Polyethylene (PE)	108-144	90-120	72-96	54-72
Polyphenylene Sulfide (PPS)	96-1 44	80-120	64-96	48-72
Polypropylene (PP)	108-144	90-120	72-96	54-72