DUKANE

Intelligent Assembly Solutions

Ultrasonic Staking Configurations

Ultrasonic staking, or riveting, is an assembly procedure used to join dissimilar materials, usually plastic to metal or dissimilar plastics. A hole in the metal part receives the plastic rivet, or stud, and a specially contoured horn contacts the stud. The stud melts and reforms to create a locking head over the metal.

As in any process involving localized heating by the dissipation of ultrasonic vibrations, an efficient system is necessary. The designer must control where and how fast a temperature rise will occur. Geometry plays an important role in determining the location of high strain which results in desirable localized heating, so an energy director is used in designs employing the ultrasonic staking technique. That is, the cross sectional area / height ratio of the material at the location where the initial dissipation is to occur is drastically reduced as compared to the adjacent segments which in this case are the body of the horn and the piece part containing the stud.

Two common designs are used to produce the needed geometry. The first (Flat Stud, see figures 1, 9) makes use of a point or line type contact by incorporating the joint design in the tip (or base) of the horn itself. The second technique (Pointed Stud, see figures 2, 10) calls for the energy director to be designed into the stud. The following lists examples and advantages of each variation to establish guidelines for the wide variety of possible applications.

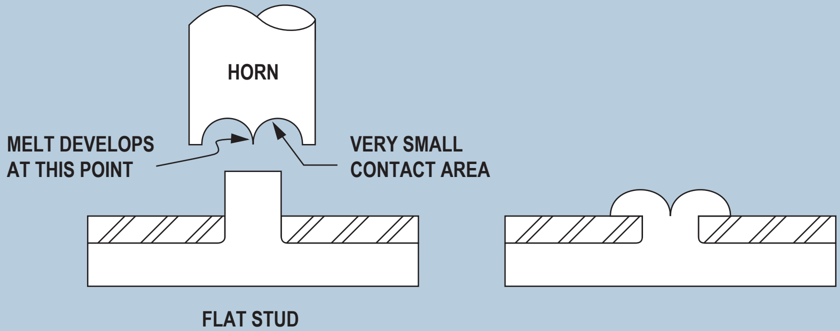


figure 1

Examples: Rosette Style (see figures 4,5); Hollow Stud (see figure 8).
Advantages: The rosette style is used primarily in press operations. This style gives better results with sharp transitional materials (e.g. nylon). However, hollow studs can also be used with hand-held units, depending on material and size. The hollow stud can easily be removed for repair, which leaves a pilot hole for a screw.

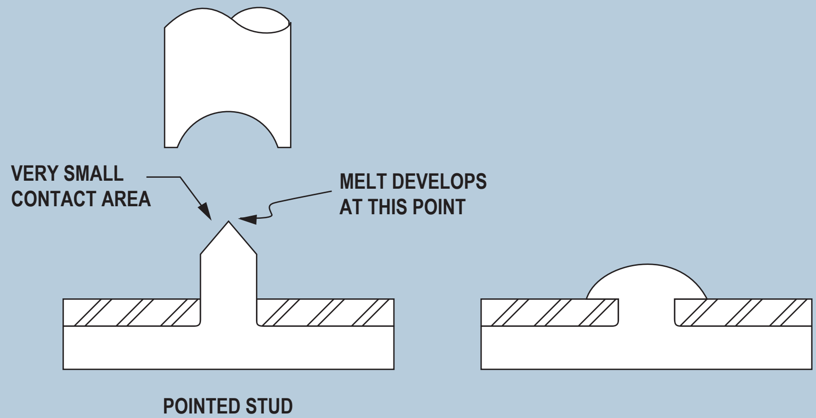
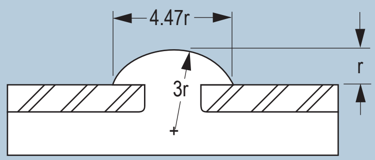


figure 2

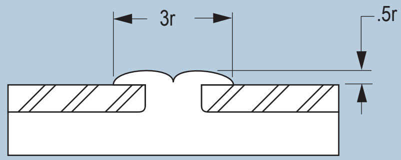
Examples: Simple Profile (see figure 3); Flat Head Profile (see figure 6); Pan Head Profile (see figure 7).
Advantages: This is an excellent design for handgun operations involving staking. The pointed stud design yields excellent results with broad transitional materials (e.g. ABS). It provides for easier alignment of parts (looser alignment tolerances) and can be used with a wide variety of head configurations to meet special design requirements. The pointed stud design also reduces horn wear and problems with glass-filled plastics.

(continued on reverse)

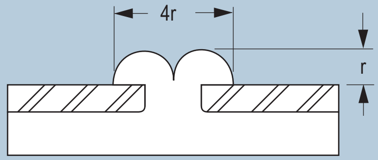
Staking Configurations



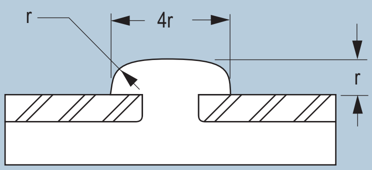
SIMPLE PROFILE
figure 3



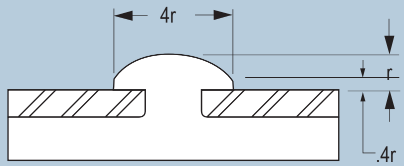
ROSETTE (LOW) PROFILE
figure 4



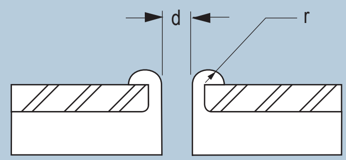
ROSETTE (STANDARD) PROFILE
figure 5



FLAT HEAD PROFILE
figure 6

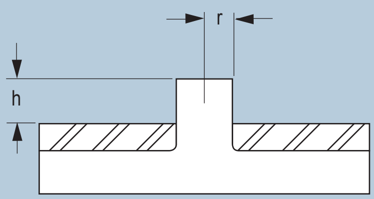


PAN HEAD PROFILE
figure 7

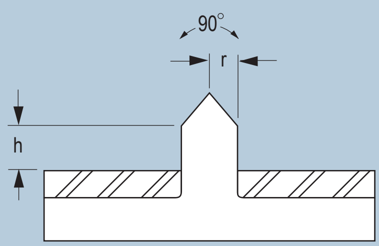


HOLLOW PROFILE
figure 8

Stud Types*



FLAT STUD
figure 9



POINTED STUD
figure 10

Formulas for Deriving Stud Height**

Stud Type	Head Form	Stud Diameter	Head Diameter	Head Height	Stud Height
Flat Stud	Rosette Low Profile, figure 4	2r	3r	.5r	1.20r
Flat Stud	Rosette Standard Profile, figure 5	2r	4r	r	3.14r
Flat Stud	Hollow Profile, figure 8	2r + d	4r + d	r	$3.14r \frac{(2r + d)}{2 (r + d)}$
Pointed Stud	Simple Profile, figure 3	2r	4.47r	r	2.33r
Pointed Stud	Flat Head Profile, figure 6	2r	4r	r	2.90r
Pointed Stud	Pan Head Profile, figure 7	2r	4r	r	2.50r

** In the previous table the value of h was calculated assuming 0 degrees draft angle. This is reasonable with rigid thermoplastics such as polycarbonate. When circumstances make it necessary to include a draft angle, adjust the value of h to maintain the material volume balance necessary to insure a complete fill yet avoid excessive flash. If the application requires a draft angle, the best course to take is to contact Dukane Ultrasonics' horn design department since they have had extensive experience designing under these boundary conditions.

DUKANE

Intelligent Assembly Solutions

Dukane Ultrasonics 2900 Dukane Drive St. Charles, Illinois 60174 630-584-2300 ussales@dukane.com 630-584-3162 (fax) www.dukane.com/us Form No. 9839-A-01