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Semiconductor Probe Current Carrying Capacity

The current carrying capacity (or ampacity) of a cantilevered probe is limited by the maximum permissible temperature rise of the conductor and the bond pad under normal operating conditions. Unfortunately, determination of the ampacity of the probe depends on many factors that vary according to application.
These factors can include, but are not limited to -

- **Probe tip diameter**
- **Temperature at which the die is probed**
- **Mechanical considerations**
- **Duration of current pulse**
- **Time between current pulses**
- **Temperature rise of probe tip**
- **Contact resistance at the probe tip–bond pad interface**

Pitney (1972) reports an empirically determined "rule of thumb" ampacity formula for a round wire under steady state current conditions.

$$I = 0.11 D^{1.17} \left(T_2 - \frac{T_a}{\rho} \right)^{1/2}$$

where,
I = current through the conductor, amp
D = wire diameter (mils)
T_2 = temperature within the conductor (°C)
T_a = ambient temperature (°C)
ρ = wire resistivity (Ω cir mil/ft)

NOTE - this formula DOES NOT account for the duration of the current pulse or the time between current pulses. It has been shown that for short current pulses the conductor can withstand higher currents. Pitney states that the current capacity can be multiplied by 5 for 0.5 sec pulses and 10 for 50 millisecond pulses. Using multiple contact points in electrical parallel increases the high current capability further.

By using the probe tip diameter as the critical dimension, an approximation of the STEADY STATE, current carrying capacity of a probe can be made. As expected, the larger probe tips can carry greater amounts of current.

*Research focused on this issue for vertical probe applications was presented by D. Gonzales and J. Kister in 1999 at the SouthWest Test Workshop.

*(http://www.swtest.org/1999proc/PDF/S03_DG.pdf)