Written by

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**ATLANTA** – After 50 years in electronics, Jim Raby believes the industry's greatest invention was not the transistor, but the plated through-hole.

The guru of electronics, Raby led what an audience member called a "fireside chat" at yesterday's Atlanta SMTA Expo. He warmly shared stories from the dawn of the modern electronics industry. Raby, founder of **STI Electronics**, and a few others brought an Electrovert wave soldering machine from Canada with fake "Made in the USA" stickers on it.

They ultimately used peanut oil in the machine to bring the flashpoint down, causing a massive fire, since the machine was sitting next to drums of alcohol.

"Wave soldering machines were dangerous things," he chuckled.

After a long career in the military, Raby started a new career with NASA in January 1970. His job there was electronics prototyping. He recalls with humor, "I was one hot-shot technician." When Raby started, he asked about the hours, to which his boss replied, "See that light under your door? When the light is on, you are to be here."

It turns out that light came from his boss's office, and his boss was always there. He said, "And sometimes the light was on even when he wasn't there, so I worked a lot."

"It was an interesting time because electronics weren't going anywhere." Pointing to his laptop, Raby noted, "This has more power than the whole Saturn Apollo program. Everything was done with slide rules. It took a long time."

His boss at NASA wanted everything to be tested thoroughly. Raby and his colleagues made thousands of solder joints at NASA, assessing them with the early version of pull tests. "That's how we came up with temperatures and dwell times."

He marveled at the progress through the years. "PCBs are the key item in our whole industry. We went from single-sided, to double-sided, to double-sided with through-holes, to multilayers."

And ultimately, "the problem we have encountered is cracks in solder joints on one side of the board." He then stressed, "All solder joints will fail with time and stress."

He also emphasized, "The best invention in my time was plated through-hole," as opposed to the transistor, which he mentioned is what many people say is the best invention.

Then came surface mount. "It scared me to death. What kind of stresses would there be on just the surface of the board?" As usual, daunting problems were overcome through engineering and a little ingenuity, as when they learned that preheating could control wave-soldering operations.

Still, there were hurdles. One unexpected problem was no-clean fluxes. "The industry fell in love with them," Raby recalls. Even so, he said, "Most of the failures we see are caused by no-clean fluxes," noting that given enough time, temperature and a little humidity, dendrites will grow. As such, STI steers clear of such chemistries. "I still have my military hat on; I don't want my name on it if it's going to fail."

The future of electronics, Raby noted, is "closer to the board, smaller components, less space." That means devising methods to clean flux residues from underneath those low-profile parts. This will require better cleaning methods, Raby believes.

Raby finished his discussion with information about current technology: imbedded component/die. With imbedded component/die technology, we can "achieve *near* hermetic environmental protection," he said. And, "We are able to dissipate an awful lot of heat." (Raby holds a patent in this technology.)

He reports similar success with aluminum wedge bonding. "We have not had one failure. We

## Raby: â€~Greatest Invention Not Transistor'

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have used the same board and tested it a lot of times. We have gone up to 20,000Gs of shock with no failures."

Raby received a round of applause when he said, the technology "won't go offshore in my lifetime."

Raby made a name for himself as a master of soldering, thus his final prediction might surprise some. "We won't be soldering 10 years from now on new designs," he asserted.