

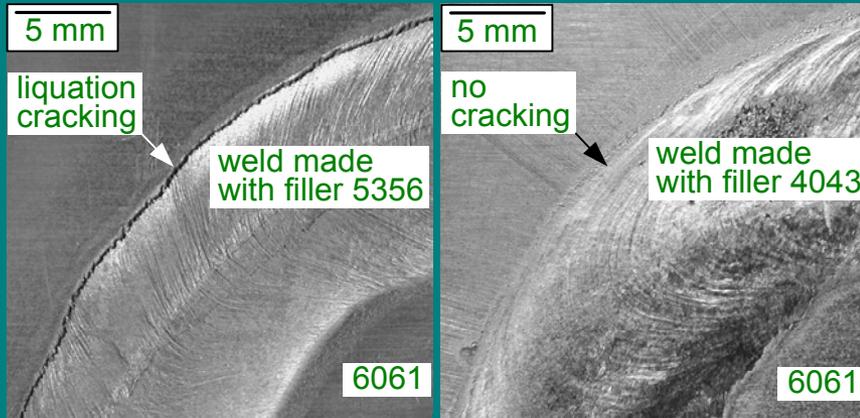
Partially Melted Zone (PMZ) Cracking in Aluminum Welds

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PMZ cracking:

- (1) Many aluminum alloys susceptible (e.g., 6061, 2024, 7075), also called liquation cracking,
- (2) Cracking in PMZ, i.e., region outside weld metal where grain-boundary liquation occurs due to overheating ($>$ eutectic temperature) during welding,
- (3) Caused by solidifying weld metal that contracts and hence pulls solidifying PMZ.

Effect of Filler Metal on Liquation Cracking
(Huang and Kou, Welding Journal, accepted)



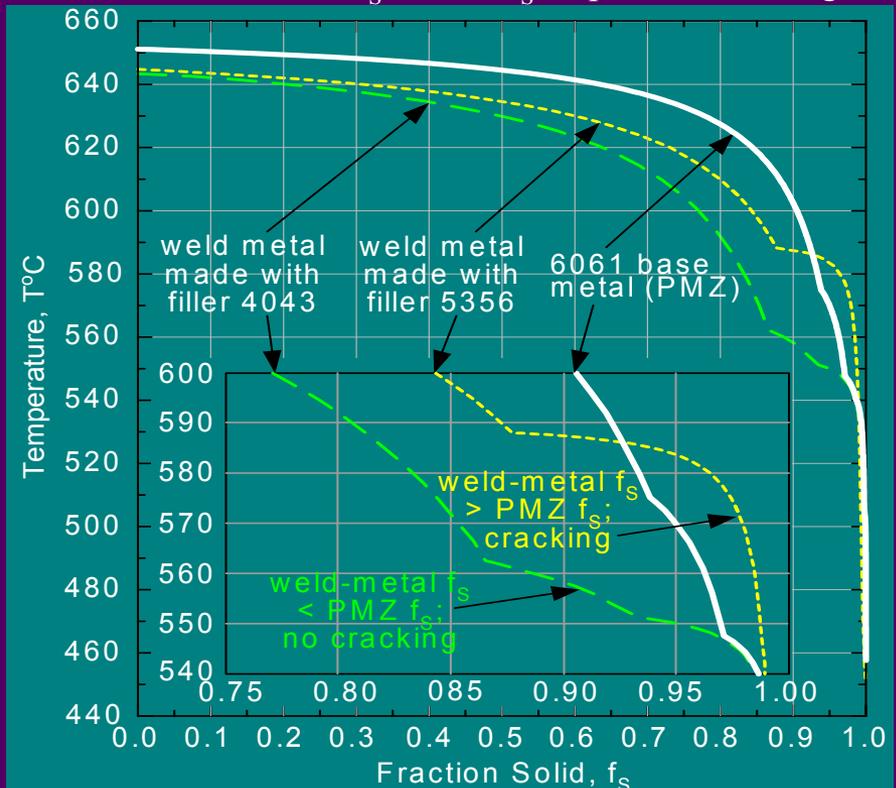
Alloy 6061: Al-1Mg-0.6Si
Filler 5356: Al-5Mg
Filler 4043: Al-5Si

Proposed cracking criteria:

- (1) Solidifying weld metal exceeding solidifying PMZ in fraction solid (f_s) and hence strength during PMZ terminal solidification,
- (2) PMZ weakened significantly by liquation,
- (3) Workpiece restrained tightly,
- (4) No solidification cracking nearby to relax tensile strains in PMZ.

Filler-metal selection guide:

Filler metals that change weld-metal composition such that weld-metal $f_s <$ PMZ f_s help avoid cracking.



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Broad Impact:

- A review article “Solidification and Liquation Cracking Issues in Welding,” was published in the general-public journal *JOM* (June 2003, pp. 37-42).
- Results on cracking in welds of 6061 aluminum were presented in the 2003 Campbell Lecture of ASM-International by Professor Y. A. Chang.