CARPENTER TECHNOLOGY CORPORATION
SPECIAL PRODUCTS DIVISION
SAN DIEGO, CALIFORNIA 92160
CarTech®

BICYCLE FRAME FABRICATION DATA

AerMet® 100 Alloy

Mitring

Bicycle tubing produced from AerMet 100® alloy is twice as strong as tubing produced using any other steel. For comparison, AerMet 100 alloy possesses a hardness of ~HRC 55 and strength of 280 ksi minimum while the hardness of 4130 is 20 to 35 HRC and strength is 150 ksi.

High-speed steel hole saws have a hardness similar to AerMet 100 alloy (~HRC 55); therefore, AerMet 100 alloy cannot be cut satisfactorily with standard high-speed steel hole saws.

Grinding is the standard method used to mitre AerMet 100 alloy. This can be done with a 60 grit bench grinding wheel, abrasive belts or abrasive grinding discs. We have tested a profiled grinding wheel on a pedestal grinder at 3500 RPM to grind a mitre on a 1" tube. The process works quickly and produces an accurate cut.

Clean-up using a file provided excellent fit up. The profiled grinding wheel costs between $20-$30 and is available through Tooling Solutions in San Diego, CA, at 619-693-9444, Part Number RA60-J-V8, 8" wheel, or from your own supplier who can grind the necessary radius on the wheel. Soon to be available from Tooling Solutions is a bench grinder with a wheel dresser attachment that will produce a full radius profile on a standard bench grinding wheel.

Water bottle holes can be drilled with carbide drills. AerMet 100 alloy resists denting so the center punching operation must be adjusted accordingly.

Use hand filing to complete the mitre. Since AerMet 100 alloy tubes are .020" (.51 mm) thick, hand filing will not be difficult.

Brazing

AerMet 100 alloy can be brazed with Cu-Zn, nickel silver or silver but may be subject to liquid metal embrittlement. Liquid metal embrittlement occurs only when there is stress in the joint.

Mitring fit and finish must be proper. Cracks in a lugless joint are related to a poor- or fair-quality fit as mitred.

The brazing temperature for Cu-Zn or nickel silver must be kept to 1850°F (1010°C) maximum. Since the tubes' walls are .020" (0.51 mm), this may take some practice. A trial is suggested with a metallurgical examination by CarTech.

Attaching stays to the seat tube involves brazing metals with a major difference in thickness. If the construction is lugless, avoid overheating. Avoiding liquid metal embrittlement will require a high level of operator skill.

Metallographic examination should reveal a grain size of ASTM 8 or finer. Coarse grain size is an indication of excessive heat. A grain size of ASTM 5 would indicate that the brazing temperature reached 2000°F (1093°C).

Following brazing, allow the tubes to air cool completely to room temperature. AerMet 100 alloy is air hardenable and must never be water quenched. The M_s of AerMet 100 alloy is 400°F (204°C), and the M_f is room temperature. If the tubes are quenched, even from 200°F (93°C), distortion and residual stress will occur. Water quenching also results in brittleness, destroying the very high combination of strength and toughness normally experienced.

The frame must then be aged at 200°F (93°C) for 1 hour. This will restore full strength and toughness to the area that has been brazed, and to the adjacent heat-affected zone. Failure to do this mild postweld anneal could result in frame cracking.

AerMet 100 alloy will be very difficult to cold set, given the high strength of the tubes. Following the anneal after joining, the frame can be cold set. Following cold setting, the main triangle must be given a 200°F (93°C) 1 hour stress relief.

Practice joints are strongly recommended. Exercise care in seat cluster fabrication due to stress-related warping of seat tube. A 200°F (93°C) 1 hour stress relief between main-triangle braze and attachment of seat stays is required.