



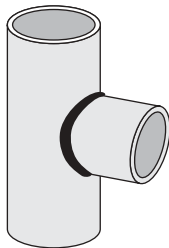
**MLI Branch Connection Comparison
Full-Bore / Full Penetration vs. Extruded Tee**

This application note provides a comparison of Orion’s full-bore/full penetration (conventional) branch connections and extruded tee branch connections as used on Magnetic Level Indicators (MLIs).

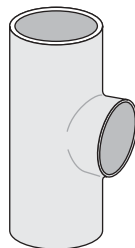
The fundamentals of branch connections

Full-bore/full penetration connection – is a machined opening in the chamber with a fitting welded to it.

Extruded tee connection – is an opening in a chamber that is formed by either internally or externally forcing the chamber wall material to form a collar.



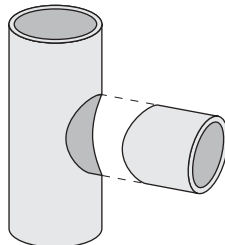
Full Bore



Extruded Tee

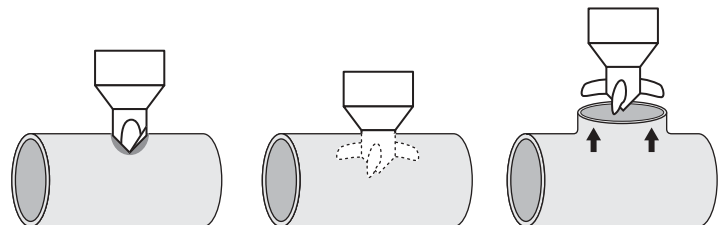
Achieving the styles

Full-bore/full penetration connections are made by cutting a circular opening into the chamber, machining a fitting (coupling/nipple) to the precise curvature of the chamber and welding that fitting to the chamber. Fittings can be forged (Bonney couplings or a saddled pipe nipple), machined from round stock or pipe.



Full Bore

Extruded tee connections are made by cutting a pilot hole into the chamber material. A forming head with retractable pins is inserted into the chamber through the pilot hole. The retractable pins are then extended and the head begins to revolve. While the pins are revolving the forming head is pulled through the pilot hole forcing the reshaping of the chamber material into the extruded tee connection.



Drilling of Pilot Hole

Forming Pins Extended

Forming of Collar

Extruded Tee

Important points to consider

1. Extruded tee connections do not produce a superior MLI. The primary purpose behind this method is to reduce welding and other fabrication costs for the manufacturer.
2. Extruded tee process connections cannot be achieved with schedule 80 and 160 stainless steel pipe. Full-bore/full penetration branch connections must be employed in these cases.
3. Extruded tees will always fail prior to a similar full-bore/full penetration branch connection when taken to maximum pressures. This is due to reduced material thickness at the extrusion.

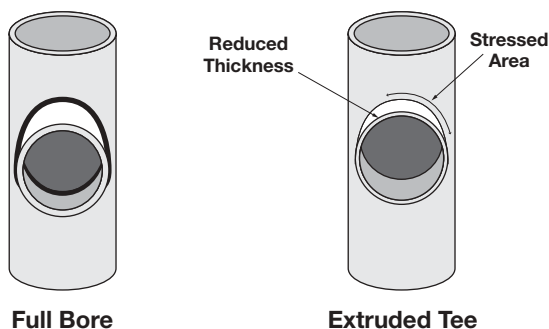
Orion Tech Note ORI-T003

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Important points to consider

4. Unlike full-bore/full penetration connections, extruded tees result in visible thinning of the process connection metal—typically a reduction in thickness of 25 to 30 percent. To achieve ASME (American Society of Mechanical Engineers) code compliance, maximum allowable pressures must be reduced. In addition, the thinner material results in a mismatch in material thickness between the extruded tee and the branch connection. It is typically noted that internal diameters of the extruded tee and the process connection will match. Additional weld metal must be applied to compensate for the mismatched outside diameter.



5. Perhaps the most important issues with extruded tees involve corrosion and stress-cracking. The end user should be aware:

- A. There will be less corrosion allowance due to the reduced material thickness.
- B. Due to “Work Hardening” during the cold forming process, increased hardness of the formed outlet produces internal stress in the area of the process connection. This will result in a reduction of corrosion resistance at the formed process connection.

An explanation from the ASM (American Society for Metals) International Handbook Volume 13 Corrosion applies:

“Processes such as cold working, in which the material is plastically deformed into some desired shape lead to the formation of elongated and highly deformed grains and a decrease in corrosion resistance. Cold working can also introduce residual stresses that make the material susceptible to stress-corrosion cracking.”

It is therefore logical that cold-formed branch connections will add yet another potential area of failure into an already complex equation of corrosion.

6. The purported advantage of extruded tee branch connections is the ability to x-ray 100% of the branch connection weld. A more preferred option would be to utilize butt-weld tee fittings that produce 100% x-ray quality welds. This method does not require de-rating of the MLI chamber.

7. Through the use of proper tooling, welding techniques, and sufficient material thickness Orion’s full-bore/full penetration connections eliminate the possibility of chamber bowing.

Note: MLI process connections provide a structural function in that the entire mass of the instrument is supported at these points. Application of extruded tee technology should be approached with caution due to the increased pipe strain and reduced structural strength.

Summation

Orion’s full-bore/full penetration method is time-proven and the widely accepted industry standard that provides the strongest most durable branch connections.



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BULLETIN: ORI-T003.0
EFFECTIVE: August 2004