What is Inertia Welded Drill Pipe?

Some say friction welded, some refer to it as inertia welded but the process is simply attaching tool joints to green tubes (plain end pipe). To simplify, during drill pipe manufacturing the tool joint spins against the tube under applied compression to create tremendous heat. This heat causes the face of the tool joint and tube end to melt together.

More specifically and in more detail, the tool joint is mounted in a chuck attached to a flywheel and the tool joint is pushed into contact with a stationary tube and the tool joint spins against the tube under a specific compression load. When the flywheel reaches a pre-determined rotating speed the two components reach forging temperature (over 1,800°F) and the flywheel is released. These two pieces are pushed together under a tremendous compression load. When the fly wheel stops the two pieces have been joined together. After completion of the inertia welding process the excess melted material (rams head) left at the transition point is removed by machining to form a smooth, invisible union between the tool joint and tube. This process is performed on both ends of the green tube to provide a box and pin end on the drill pipe.

Inertia Welding VS Integrally Forged Tubes

Integrally forging tubes is an expensive procedure. As well, if the forging process does not gather enough material in the thread area to provide a sufficient cross section to resist the bending loads exerted by the tube section. Improper forming during forging can result in premature pin breakage and box flaring or splitting.

The proper raw material for forging is limited to materials with 30 carbon points, usually AISI 4130. This material requirement is due to the post forging heat treat process. Using lower carbon materials means the tool joint material and resulting threads will have a lower hardness, reduced strength, shorter fatigue life and lower wear resistance when compared to a tool joint made with higher carbon material.

Hammer forging processes are highly temperature dependent and if not closely monitored will lead to cold laps. A cold lap is a flaw that results when a work piece fails to fill the die cavity during forging. These flaws in the forging are not visible on the surface and require special quality control techniques such as radiographic examination and ultrasonic testing to detect.

Inertia welding procedures are not as process or operator dependent as the forging processes and inertia welded drill pipes can be provided using the optimum material when and where it is needed. AISI 4140 or equivalent materials are generally used to form into quenched and tempered tool joints and green tubes. These components are used to make drill pipe utilizing the inertia welding process.

Inertia Welding VS Arc Welding

Inertia welding is a reliable process which yields 100% weld penetration. In addition, the weld faces are never exposed to the atmosphere during the inertia welding procedure. Arc welding can and will allow atmospheric impurities and impurities from other sources to enter the weld metal and cause porosity which induce small inclusions in the weld. To combat these imperfections special filler material and techniques, flux coated rods or inert gas shielded welding wire, are used help reduce introduction of impurities which can cause porosity in the weld area.

Inertia welding also eliminates inconsistencies introduced with improper or inaccurate welder settings such as the speed of the wire feed, weld speed, amperage, voltage, shielding gas flow, etc. As well, arc welding requires many passes to fill in between the weld bevels. Multiple passes can create improper penetration and weld cold laps (components not properly fused together) resulting in a weak weld. Also in the arc welding procedure parts are slowly rotated. Slip between the two parts being joined can occur and can cause poor weld penetration in the parent material and cold laps which result in a nonhomogeneous weld.

Shielding gases are used in MIG welding process to protect the arc from impurities in the atmosphere. If these shielding gases don't burn off before the weld solidifies porosity can result throughout the weld joint.

Preheat and post heat with controlled cooling is required on raw materials, such as AISI 4140, that have a carbon content over 30 points. If not preheated and properly cooled quench cracks can occur through the weld joint and may not be visible on the weld surface. These cracks will result in a weak weld joint. Finding these imperfections takes special and costly NDE, non-destructive examination, procedures such as radiography (X-ray), liquid die penetrant examination, ultrasonic testing and magnetic particle examination.

Manufacturing Technology, Inc, "How Does Inertia Welding Work?" http://www.youtube.com/user/dougw246 (2011).

Cutting Edge Underground, "Horizontal Drilling Tools & Accessories, Vibrator Plowing Blades & Parts", http://www.shopceu.com/ceu11a-drill-pipe.html (2009-2011).