Incremental sheet forming process

Volume 53, Issue 1, 2004, Pages 203-206View full text Increamental skin formation (or ISF, also known as Single Point Formation) is a sheet metal formation technique where a sheet is formed in the final workpiece by a series of small inkremental disorders. However, studies have shown that it can also be applied to polymer and compound skins. In general, the skin is formed by a round tipped tool, typically 5 to 20mm in diameter. The tool, which can be attached to a CNC machine, a robotic arm or similar, indtents in the sheet with about 1 mm and follows a contour for the desired part. It then indents further and pulls the next contour for sharing into the skin and continues to do so until the full part is formed. ISF can be divided into variants depending on the number of contact points between instrument, skin and dying (if there are any). The term Single Point Increamental Formation (SPIF) is used when the opposite side of the skin is supported by a face plate and Two Point Increational Formation (TPIF) when a full or partial die supports the skin. Advantages over conventional sheet metal formation Because the process can be entirely controlled by CNC processes, no dying is required as in traditional sheet metal formation. Eliminating the die in the manufacturing process reduces the cost per piece and increases turnaround time for low production runs because the need to manufacture a die is eliminated. However, for high production, the time and cost of producing a die are absorbed by the higher per piece of speed and lower per piece of cost. Several authors acknowledge that the formation of metal material under the localized deformation imposed by increated formation is better than in conventional deep drawing. [1] In contrast, there is a loss of accuracy with the ISF process. [2] Implementation The ISF process is generally implemented by clamping a sheet into the XY aircraft, which is free to move along the Z ah ash. The tool moves into the XY aircraft and is coordinated with movements in the Z ale to create the desired part. It is often convenient to retrofit a CNC grinding machine to accommodate the process. Spherical, flat-bottomed, and parabolic tool profiles can be used to achieve different surface finishes and formation limits. [3] The machine uses a combination of elastic formation by incrementally drawing off the skin over a die, with the CNC tool approach described above. It is said to produce a more even distribution of thickness of the material. The process is well suited for one-time manufacturing, though problems with simulation of the process mean that toolspaths are complex and time-consuming to determine. Ford Motor Company recently released Ford Freeform Manufacturing Technology, a two-point increative plate-forming technique implemented in the rapid prototyping auto parts. Complex shapes such as the human face[4] and cranial implants[5] were successfully manufactured using this manufacturing process. Advances in the technology are increase adoption in the near future by other sheet metal-reliable manufacturers. List of process parameters The mechanics of the process are influenced by many parameters, including: the transverse X-Y feed rate,[6] the vertical Z feed rate or pitch,[7] the (optional) instrument rotation,[8] the coefficient of friction,[9] the instrument form (radius),[10] the sheet temperature,[11] Current research research is underway at several universities. [12] The most common implementation is to fit out a traditional grinding machine with the spherical instrument used in the ISF process. Key research areas include developing rolling instruments to reduce friction. Reduced thinning of skins to the formation of Increase accuracy by eliminating springback[14][15] Develop novel uses, especially expanding the process to new materials (e.g. composite) and applying heating [16] Improve surface roughness[17] References^ Strano, Matteo (December 31, 2004). Technological representation of the formation of limits for negative incremental formation of thin aluminum blades. Journal of Manufacturing Processes. 7 (2): 122–129. Doi:10.1016/S1526-6125(05)70089-X. ^ Dieless NC formation. Retrieved 2008-11-05. ^ Investigate tool forms in single-point incremental formation (Cawley et al, 2013) ^ Behera, Amar Kumar; Lauwers, Bert; Duflou, Joost R. (2014-05-01). Tool path generation framework for accurate manufacture of complex 3D sheet metal parts using single point increated formation. Computers in industry. 65 (4): 563–584. Doi:10.1016/j.compind.2014.01.002. ^Duflou, Joost R.; Behera, Amar Kumar; Vanhove, Hans; Bertol, Liciane S. (2013-01-01). Manufacturing accurate Titanium Cranio-Facial Implants with a high formation angle using single point incremental formation. Key engineering materials. 549: 223–230. Doi:10.4028/www.scientific.net/kem.549.223. Issn 1662-9795. ^Hamilton, K.; Jeswiet, J. (2010). ScienceDirect. Cirp Annals. 59: 311–314. Doi:10.1016/j.cirp.2010.03.016. ^Golabi, Sa'id; Khazaali, Hossain (August 2014). Determination of frustum depth of 304 stainless steel plates with various diameters and thicknesses by increated formation. Journal of Mechanical Science and Technology. 28 (8): 3273–3278. Doi:10.1007/s12206-014-0738-6. Issn 1738-494X. ^Davarpanah, Mohammad Ali; Mirkouei, Amin; Yu, Xiaoyan; Malhotra, Rajiv; Pilla, Srikanth (August 2015). Effects of increative depth and tool rotation on failure modes and microstructural properties in Single Point Increative Formation of Polymers. Journal of Material Processing Technology. 222: 287–300. Doi:10.1016/j.jmatprotec.2015.03.014. ^Lu, B.; Fang, Y.; Xu, D.C.; Chen, J.; Old, H.; Moser, N.H.; Cao, J. (October 2014). Mechanism examination of friction-related effects in single point incremental formation using a developed slant roller-ball tool. International Journal of Machine Tools and 85: 14–29. Doi:10.1016/j.ijmachtools.2014.04.007. ^Carrino, L.; Giuliano, G.; Strano, M. (2006), The Effect of the Punch Radius in Dieless Dieless Formation, Intelligent Production Machines and Systems, Elsevier, pp. 204–209, doi: 10.1016/b978-008045157-2/50040-7, ISBN 9780080451572^ Fan, Guoqiang; Gao, L.; Hussain, G.; Wu, Zhaoli (December 2008). Electric hot incremental formation: A new technique. International Journal of Machine Tools and Manufacturing. 48 (15): 1688–1692. Doi:10.1016/j.ijmachtools.2008.07.010. ^[1] Retrieved 2008-11-05. ^ J Jeswiet: Asymmetric Single Point Collection of Sheet Metal, CIRP Annals - Manufacturing Technology, 2005^ Behera, Amar Kumar; Lu, Bin; Old, Hengan (2016-03-01). Characterization of shape and dimensional accuracy of incredulously formed titanium sheet parts with intermediate curvatures between two attribute types. The International Journal of Advanced Manufacturing Technology. 83 (5–8): 1099–1111. Doi:10.1007/s00170-015-7649-2. Issn 0268-3768. ^Behera, Amar Kumar; Verbert, Johan; Lauwers, Bert; Duflou, Joost R. (2013-03-01). Tool path compensation strategies for single point increatic skin formation using multivariate adaptive regression splines. Computer-assisted design. 45 (3): 575–590. Doi:10.1016/j.cad.2012.10.045. ^ Walczyk, Daniel F.; Hosford, Jean F.; Papazian, John M. (2003). Using reconfigurable tools and surface heating for increated formation of composite aircraft parts. Journal of Manufacturing Science and Engineering. 125 (2): 333. Doi:10.1115/1.1561456. ^Behera, Amar Kumar; Old, Hengan (2016-12-01). Effect of stress relief heat treatment on surface topography and dimensional accuracy of increatically shaped grade 1 titanium skin parts (PDF). The International Journal of Advanced Manufacturing Technology. 87 (9–12): 3233–3248. Doi:10.1007/s00170-016-8610-8. Issn 0268-3768. External Links Production Processes - Single point increamental formation Robot-based Single Point Collection Detected from Increated Plate Formation (ISF) is an umbrella term for some variations of a sheet metal formation technique. By ISF, a sheet is formed in the finished workpiece by a progression of small, increamental and localized deformations. The skin is generally formed by a spherically-ended indenter, which can be attached to a CNC machine and moved across a custom, numerically controlled tool path. Flat-bottomed and parabolic indenter profiles can also be used to achieve different surface finishes and formation limits. Single-point incremental formation (SPIF) is the most researched method of incremental formation. This technique involves a skin clamped around the edges but not supported underneath and formed by a single indenter. With Two-Point Incremental Formation (TPIF), on the other hand, a skin is formed at full or partial die using one or more indexer tools. Benefits The main advantage of ISF (especially SPIF) remaining plate formation processes are that no specialized die is required. It reduces reduced cost per piece and improve turnaround time for low production runs. Some experts argue that the formability of the metal material is better with the localized deformation of ISF than with conventional deep drawing. However, there is some loss of accuracy with the ISF technique. ISF also provides sustainability, as smaller machines can be used to form the skin and the material expenses of specialized dying are eliminated. In addition, this production can be easily implemented locally, with long-distance transportation. Finally, ISF can be used to re-operate or reshape old products, a less energy-intensive process than re-melting the material. Applications Inkremental Sheet Formation is an ideal process for small batch or custom productions with lower tolerance requirements. ISF in particular called for applications for the automotive industry and has potential use for medical implants, architectural features, laboratory equipment and specialized parts across many industries. Current Research stream and ongoing research focuses primarily on the potential of the SPIF technique. Although TPIF provides the benefit of improved control and accuracy, using specialized parts in many ways denies the benefits of the increated technique. Research at many universities is focused on improving the capabilities of SPIF to further benefit from this method without specialized tools. Such research areas that are currently addressing attention include: developing rolling tools to reduce friction; reducing thinning of skins to the formation; improve the smoothness of the surface; increasing accuracy by eliminating springback; developing new, innovative uses for the ISF process. Process.