REDUCTION OF DENTS DUE TO FLOATING SCRAP THROUGH INSTALLATION OF COUNTERBORE TYPE LOWER DIE CUTTING INSERT

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ABSTRACT

Metal stamping is a widely used manufacturing process in various industries, offering cost-effective solutions for producing intricate components. However, the occurrence of dents during the stamping process poses a significant challenge, impacting both product quality and production efficiency. The presence of floating scrap during the punching process led to an unintended dent on the metal surface as the loose fragments were pressed against the material to ensure optimal manufacturing quality.

This technical report aims to contribute valuable insights into the reduction of dents in metal parts through the innovative approach by installing counterbore type lower die cutting insert and focuses on the reduction of dents particularly on item Plug Z331-0G5. Occurrence of dents decreases drastically by 99% during monitoring of effectiveness upon implementation of the die improvement.

1. INTRODUCTION

In metal stamping, a dent refers to an undesirable deformation or depression in a metal workpiece during the stamping process. Metal stamping is a manufacturing technique where sheets or coils of metal undergo various operations such as cutting, punching, bending, and forming to produce final components. Dents can occur due to several factors, including imperfections in the stamping die, variations in material thickness, misalignment of the tooling, or issues with the feed system. These dents not only affect the visual appearance of the stamped metal parts but can also compromise their structural integrity and functionality. The precision and quality of metal stamping processes are crucial in minimizing the occurrence of dents, as any deviation from the desired specifications can result in defective parts. Manufacturers employ meticulous tool design, quality control measures, and process optimization to mitigate dent-related issues. Additionally, post-stamping inspections and corrective measures may be implemented to ensure that the final products meet the required standards. Effectively addressing dent problems in metal stamping is essential for producing high-quality components that meet both aesthetic and functional requirements in various industries.

One of the common causes of dent problem is floating scrap accidentally pressed on parts surface during die related process. Floating scrap typically refers to excess or waste material generated during the stamping process that remains detached or separated from the desired metal components.

1.1 Understanding Progressive Die

A progressive die is a sophisticated tool used in metal stamping processes, designed to efficiently transform sheet metal into complex and intricate components. This type of die is particularly valuable in high-volume manufacturing environments, where precision, speed, and consistency are paramount. At its core, a progressive die consists of a series of individual stations or operations arranged in a sequential pattern. As the sheet metal advances through the die, each station performs a specific cutting, forming, or shaping operation. This progressive movement allows for multiple steps to be completed in a single pass, streamlining the production process and enhancing overall efficiency.
the key advantage of progressive dies lies in their ability to produce intricate parts with tight tolerances in a continuous, automated fashion. This makes them well-suited for applications where large quantities of complex components are needed, such as in the automotive, electronics, and appliance industries. The design of a progressive die is a meticulous process that requires careful consideration of the part's geometry, material properties, and production requirements. Engineers must strategically plan each station to ensure that the material is manipulated accurately at each step, ultimately yielding the desired final product. Additionally, the die's construction involves high-quality materials and precise machining to withstand the rigors of repeated use. One notable feature of progressive dies is their versatility. They can be adapted to accommodate various sheet metal thicknesses and materials, making them suitable for a wide range of applications. Moreover, the modular nature of progressive dies allows for easy reconfiguration and adjustments to meet evolving production needs.

Despite their advantages, the use of progressive dies requires skilled operators and regular maintenance to ensure optimal performance. Issues such as wear and tear, misalignment, or material inconsistencies can impact the die's effectiveness. Consequently, proactive maintenance schedules and thorough quality control measures are crucial for sustaining the longevity and accuracy of progressive dies. In summary, progressive dies represent a cutting-edge solution in the realm of metal stamping, combining efficiency, precision, and adaptability to meet the demands of modern manufacturing. Their intricate design and automated processes make them indispensable tools for industries that rely on high-volume production of intricate components with consistent quality. Dies consist of several components, each playing a crucial role in the overall functionality of the tool. The primary parts of a die include Die Block, Punch, Die Cavity, Die Insert, Die Plate, Guide Pins/Bushings, Die Springs etc.

Tapered type lower die cutting insert is commonly use component in die assembly where-in the design is prone to floating scrap. Some of P.IMES dies uses tapered type cutting insert and some of the items which are critical in appearance criteria and may affect functionality due to dent must need to investigate and provide countermeasures to lessen the defect problem and improve the quality of the product as well as the productivity.

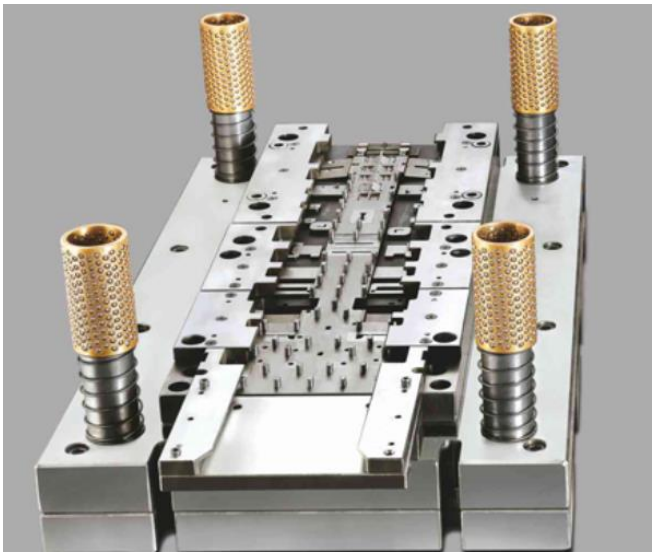

Figure 1: Sample Die Illustration

1.2 Plug Z331-0G5 High Defect Rate Due to Dent

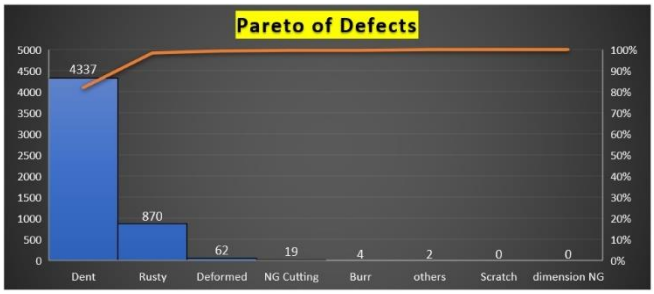

Figure 2: Pareto of defects

Figure 2 shows the Pareto of Defects (July 2023- September 2023) for item Plug Z331-0G5.

After conducting a Pareto analysis on the defects in production process, it has been identified that dents emerge as the primary contributor, representing a significant portion of the issues. Addressing and mitigating dent-related issues should be a priority to enhance overall product quality and efficiency in production system.

1.3 Problem Statement

5 Why Analysis:

Why 1: Encountered dent on Plug Z331-0G5 surface during progressive process.
Why 2: Dent was due to floating scrap being pressed on the parts surface.
Why 3: Scrap was not totally slide down on cutting insert.

Why 4: Floating scrap was stuck on the lower die.
Why 5: Type of cutting insert was tapered type.

1.4 Understanding Tapered Type Lower Die Cutting Insert.

Tapered type cutting inserts is more prone to produce floating scrap due to their narrow design.

See below description of tapered type cutting insert:

- Tapered Type exhibits moderate effectiveness in minimizing scrap retention due to its design.
- Tapered Type necessitate more frequent die cleaning and maintenance.
- Tapered Type adapts well to varying material thickness but may face challenges with scrap ejection.

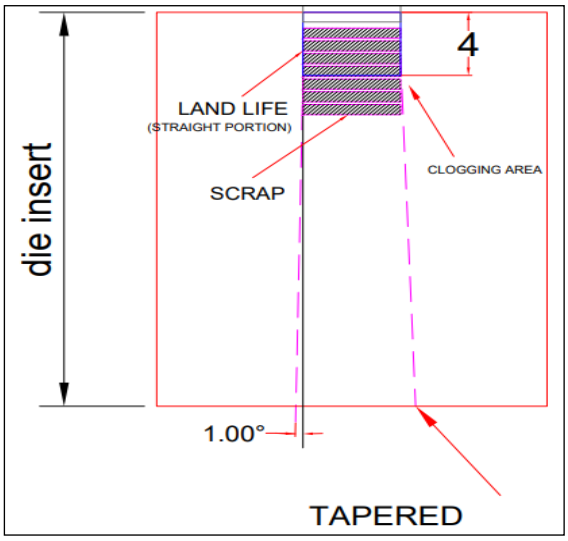

Figure 3: Tapered Type Cutting Insert Illustration

1.5 Understanding Counterbore Type Lower Die Cutting Insert.

Counterbore type cutting insert is where a portion of a hole on lower part of the insert is enlarged to a greater diameter.

See below description of counterbore type cutting insert:

- Counterbore type excels in efficient scrap removal, reducing the risk of floating scrap due to its design.
- Counterbore type often requires less frequent maintenance due to effective scrap ejection.
- Counterbore type maintains efficient scrap removal even in applications with uniform or irregular material thickness.

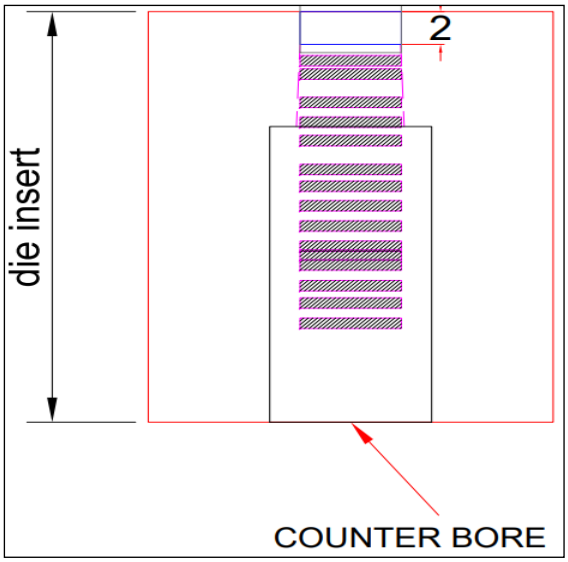

Figure 4: Counterbore Type Cutting Insert Illustration

2.0 EXPERIMENTAL SECTION

2.1 Materials

To start the progressive process, the die setter needs to load the improved die (with counterbore type lower die cutting insert) and set-up the Press Machine based on Standard Parameters/Work Process. Once passed the IPQA inspection, the operator will start the mass pro with product Work Process, Monitoring Sheet, and Workpiece/item.

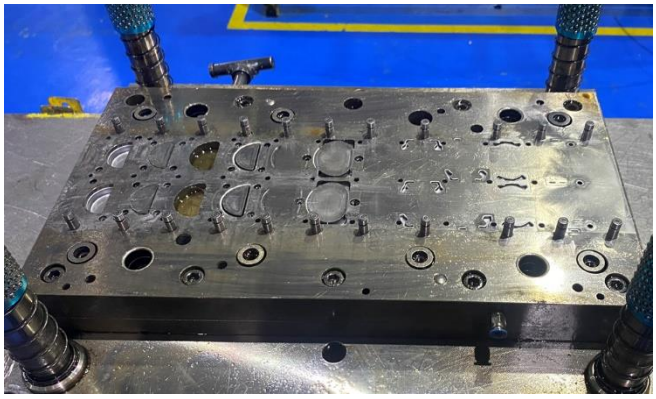

Figure 5: Improved Die (With Installed Counterbore Type)

3.2 Procedure

Installation of counterbore type lower die cutting insert on Plug Z331-0G5 progressive die was performed to improve the process.
For the month of October 2023, usage of improved die (with installed counterbore type lower die cutting insert on Plug Z331-0G5 progressive die was implemented. Monitoring of effectiveness in terms of dent defect was performed to distinguish the effectivity of die improvement.

Figure 6: Actual Progressive Process

3.0 RESULTS AND DISCUSSION

4.1 Result of Monitoring

Data gathering have been completed; effectiveness has been monitored for the past 3 months started October 2023-December 2023.

Table 1 shows data comparison before and after progressive die improvement. Defect rate prior to improvement, 3 months monitoring dated July 2023 – September 2023 shows high rate of dents rejection and is drastically decreases on the succeeding months upon implementation of Counterbore type cutting insert.

Lower Die Cutting Insert Type	Input Qty.	NG Qty.	NG Rate
Tapered Type	364,400	4337	**1.19%**
Counterbore Type	478,000	8	**0.002%**

Table 1: Data Comparison Before and After Progressive Die Improvement

4.1 Graphical Representation

Figure 7 and 8 shows the graphical representation before and after implementation of progressive die improvement.

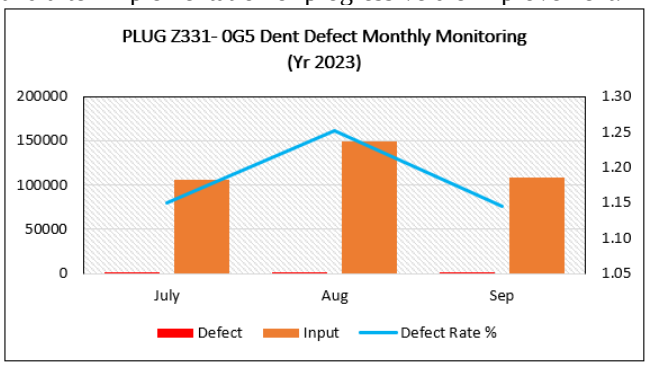

Figure 7: Dent Defect Monthly Monitoring (Jul 23-Sept 23)

The defect rate for dent problem decreases from the month of October 2023 where-in the improved progressive die started to used. (See figure 8).

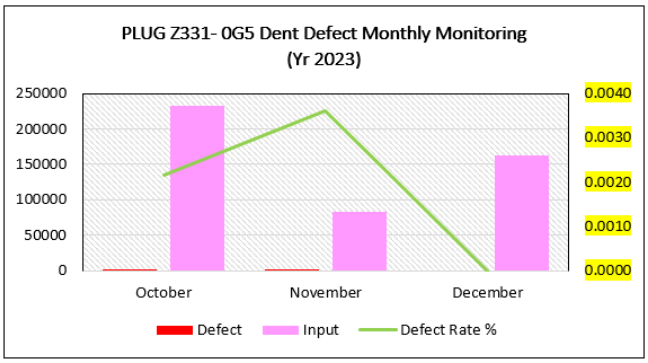

Figure 8: Dent Defect Monthly Monitoring (Oct23 - Dec 23)

4.0 CONCLUSION

Based on the result of Evaluation, occurrence of dents drastically decreases by 99% during monitoring of effectiveness upon implementation of the improvement. Resulting to increase in production efficiency and decrease on loss cost from scrapping of rejected parts since defect is not reworkable.

5.0 RECOMMENDATIONS

It is highly recommended to implement installation of counterbore type cutting insert on die for progressive items and for dies that needs counterbore type cutting insert to reduce high defect rate related to dents as well as it improves the tool life expectancy of the die since it lessens die damage/broken die due to clogging and floating scrap.

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7.0 REFERENCES

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8.0 ABOUT THE AUTHORS

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