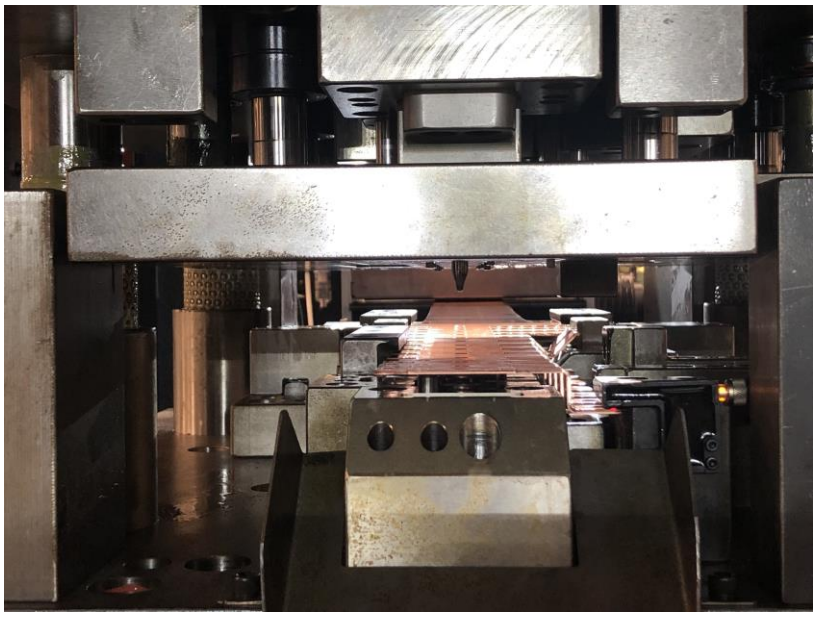
SANGIACOMO Americas presses



Why Use the Shortest Possible Stroke in Metal Stamping?

One commonly overlooked factor in metal stamping is the use of the shortest possible stroke length. In this paper we break down the importance of the using the shortest stroke, and highlight the benefits associated with doing so.

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Introduction

The influence of the stoke length is not well understood. Press operators, however, have an inclination, because most often they will comment: “This job can only run in this press” or “We can’t run this job as fast as it should”, without being able to articulate why. There may be a variety of reasons, but most often it is related to the integrity of the press and the stroke length.

Many stamping operations happen under less than ideal conditions. One detail often over looked or misunderstood is the impact of the stroke length. There are four reasons why using the shortest stroke for the stamping process is best:

1) Reduce Wasted Time

Unnecessary ram movement is wasting time and energy. A shorter stroke reduces thermal losses and guide wear.

2) Smaller Dynamic Forces in Press Structure

Moving the ram and the upper tool section up and down a shorter distance in a given amount of time reduces the harmful forces within the press frame and drive system.

3) Better Forming

Time allocated to shaping metal is most critical. More time for forming yields better results and a more stable process. The forming time is inversely related to the stroke length. This is illustrated in the following example.

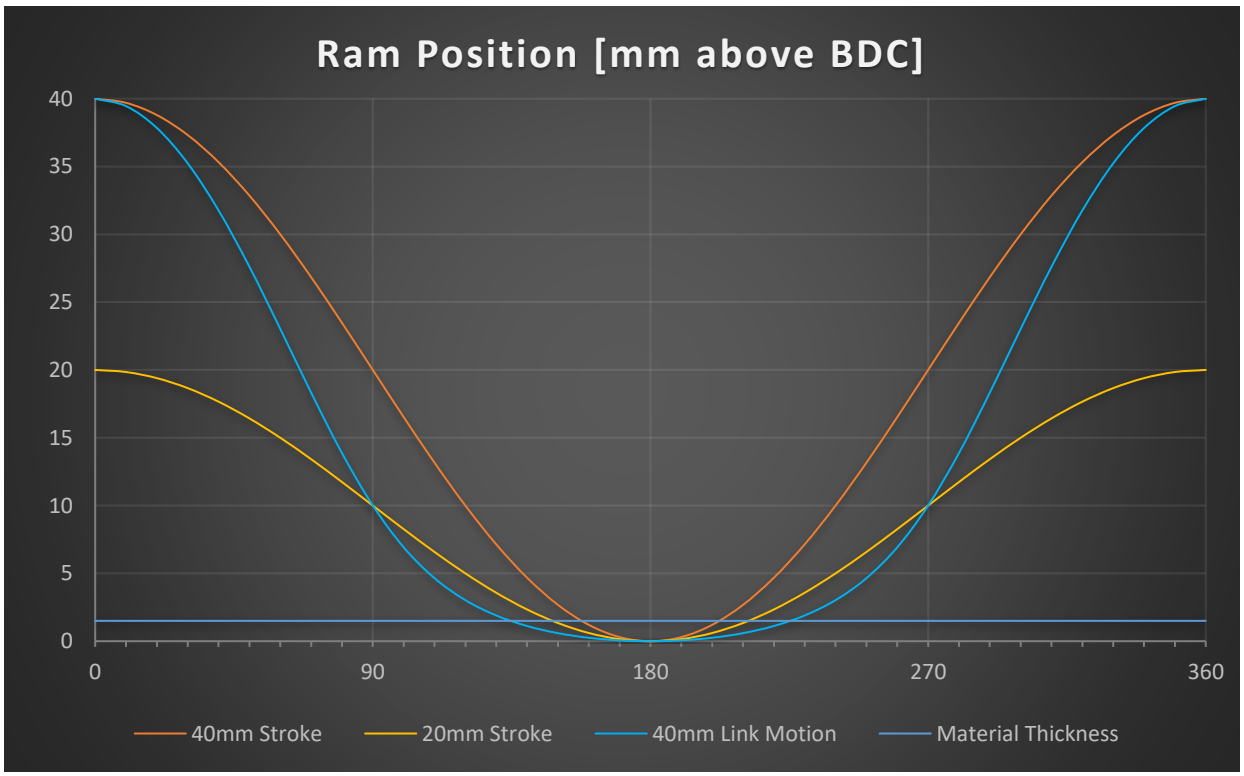

Fig. 1, Ram Position Diagram of 40mm, 20mm, and 40mm Link motion stroke

As can be seen in figure 1, the ram position curve for the 40mm stroke (Orange) intersects the material thickness line at 158 degrees, while the 20mm stroke (Yellow) intersects this line at 148 degrees. That means that the shorter stroke allocates 10 additional degrees of crank rotation to the forming or cutting process, which translates to 17 milliseconds at 100 Strokes per Minute (SPM). That is a 45% increase in forming time!

4) Longer Tool life

Shorter strokes reduce the velocity at the point where the die punches make contact with the material. As a result, cutting punches are less likely to chip or get dull.

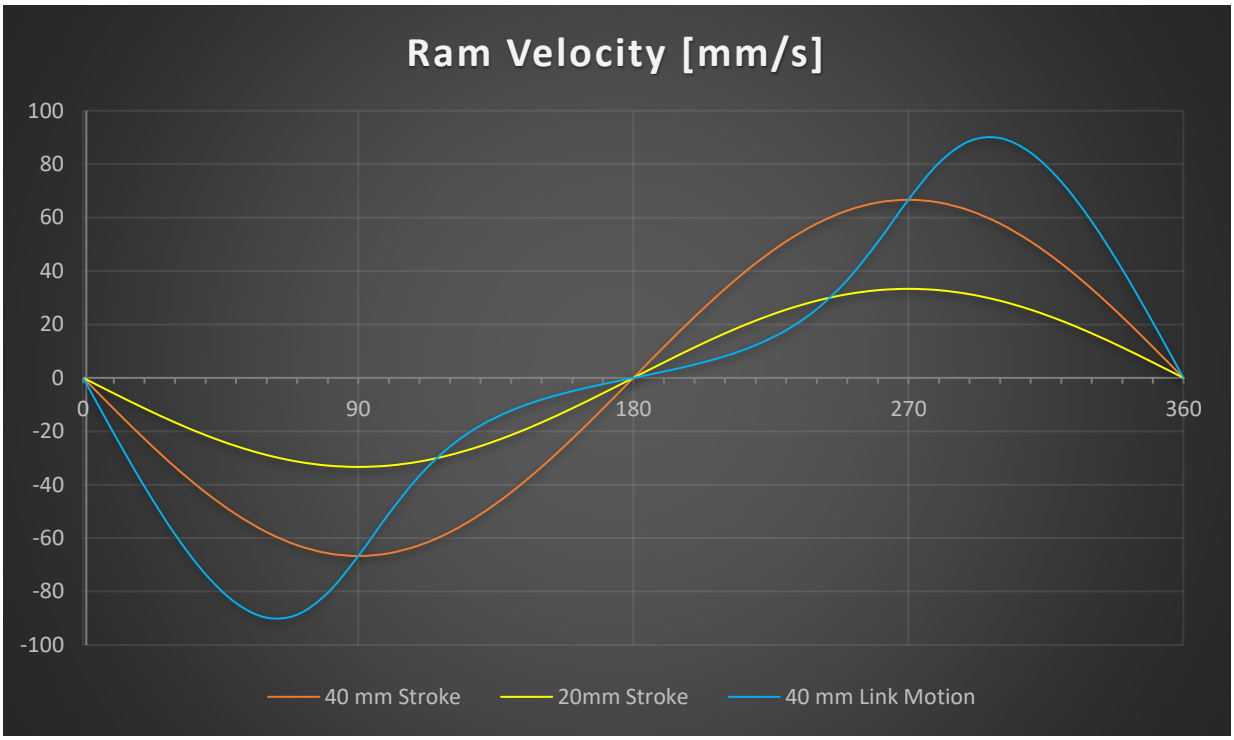

Fig. 2, Velocity Diagram of 40mm, 20mm, and 40mm Link motion stroke

In keeping with the previous example, reducing the stroke length by half decreases the impact velocity by 28% (The ram velocity of the 40mm stroke at 158 degrees is 25mm/sec, compared to 18mm/sec with the 20mm stroke at 148 degrees.)

* The 40mm link motion was included to illustrate that it's forming time is longer and the impact lower. This comes however at a cost of significantly higher forces within the press structure. If a mechanical feed is coupled to a link motion press the working portion of the stroke is half of the stroke of an eccentric press. In the example above, the working portion between 90 and 180 degrees is only 10mm. Hence the comparison should made with a 20mm stroke of an eccentric press.

The optimal stroke is always the shortest stroke possible

A careful analysis of the part to be shaped and the feed system will provide insight into what the shortest stroke length possible for a given process can be. At any point during the crank rotation, one of the following occurs:

- Cutting, Forming, Etc.
- Feeding
- Piloting
- Gap opening/closing to provide clearance for feeding

Other operations, such as inspection or welding, can be incorporated in the cycle. This should only be considered when the value-add is greater than the reduction of efficiency at the press. In the trade off consideration, all factors discussed above need to be considered.

A shorter stroke yields:

- Fewer punch breakages in tool
- Longer interval between tool sharpening
- Better forming results
- Longer press life
- Less vibration
- Less noise
- Fewer nuisance faults

Other reasons for less than optimal conditions

Biases and assumptions in the tool design or equipment selection are causes that are difficult to detect and to change. More obvious reasons for less than optimal stamping processes are:

1) Equipment is not used for its intended purpose:
    - Make a job work on equipment available
    - Purchased equipment that “would do the job”
    - Purchased new equipment at discounted price
    - Repurposed existing equipment
2) Operating conditions/Trade off values have changed dramatically:
    - Production Volumes/Lot sizes have changed significantly
    - Product Specifications/Part tolerances have been tightened
    - Production requirements for quality, certifications, packaging and delivery have changed
3) Equipment is outdated:
    - Newer technology not utilized
    - Automation
    - Lack of spare parts
    - Decreased serviceability
4) Equipment lost its precision from when it was new
    - Damages due to operating error
    - Material fatigue, improper repairs
    - Normal wear
    - Past modifications

How can stamping processes be improved?

Efforts to optimize start with an open mindset and a willingness to allow discoveries to effect change. It requires an environment where assumptions are replaced with reason, and prior decisions are re-evaluated based on changes in the operating conditions. Hiring an outside expert that provides an unbiased analysis and technological insights can be helpful. Sometimes simple remedies can make a significant difference.

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