

Starm Industries

STARM Industries produces several components for tractors. This case concerns one product family- Steering Arms- which are produced in many configurations. STARM's customers for this product family are both original-equipment tractor builders and the aftermarket repair business.

Because of the wide variety of product configurations and the fact that customer configuration requirements vary from order to order, steering arms are a "make-to-order" business. It currently takes a customer order 27 days to get through STARM's production processes. This long lead time and a significant order backlog have prompted STARM to quote a 60-day lead time to customers. However, STARM's customers cannot accurately predict their size requirements more than 2 weeks out, and thus they make adjustments to their orders 2 weeks before shipment. These order adjustments lead to order expediting on the shop floor at STARM.

Although STARM Production Control releases customer orders to production roughly in the order that they are received, orders are batched by product configuration on the shop floor to reduce the number of time-consuming changeovers. This also creates a need for order expediting.

The Product

- A steering arm is a metal rod with a forged fitting welded to each end.
- STARM's steering arms are available in 20 different lengths, 2 diameters, and with 3 different types of end fittings. (Each end of the steering arm can have a different fitting.) This means there are 240 different steering arm part numbers that STARM supplies.

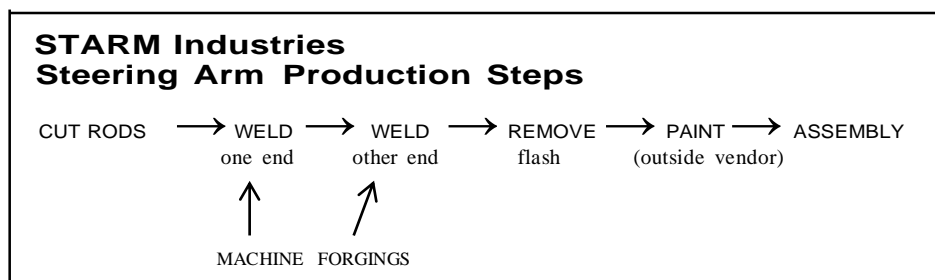


Customer Requirements

- 24,000 pieces per month.
- A customer order ranges from 25 to 200 pieces, with an average of 50 pieces.
- Customer requires 1 configuration per order.
- Corrugated-box packaging with up to 5 steering arms in a box.
- Several daily shipments per day by truck to various customers.
- Each customer's configuration requirements vary greatly from order to order.
- STARM requires orders to arrive 60 days before shipping date.
- Customers often adjust their size mix 2 weeks before the shipping date.

Production Processes (see diagram)

- STARM's processes for the steering arm product family involve cutting a metal rod followed by welding end fittings to the rod, deflash (machine removal of excess weldment), painting at an outside vendor, and subsequent assembly of the end fittings. The forged end-fitting sockets are also machined at STARM. Finished steering arms are staged and shipped to customers on a daily basis.
- Switching between rod lengths requires a 15 minute changeover at the cutting, welding, and deflash operations.
- Switching between rod diameters takes a 1 hour changeover at the cutting, welding, and deflash operations. The longer change-over for diameters is due mostly to an increased quality-control inspection requirement.
- Switching between the three types of forged end fittings takes a 2 hour changeover at the machining operation.
- Steel rods are supplied by Michigan Steel Co. The lead time for obtaining rods is 16 weeks. There are two shipments per month.
- Raw forgings for the end fittings are supplied by Indiana Castings. The lead time for obtaining forgings is 12 weeks. There are two shipments per month.
- STARM reaches high quality levels and hasn't any scraps in the production processes.



Work Time

- 20 days in a month.
- Two shift operation in all production departments.
- Eight (8) hours every shift, with overtime if necessary.
- Two 15-minute breaks during each shift.
- Unpaid lunch.

STARM Production Control Department

Receives customer orders 60 days out and enters them to MRP.

- Generates one "shop order" per customer, which follows the order through the entire production process.
- Releases shop orders to production 6 weeks before shipment to accelerate MRP's procurement of rods and forgings.
- Issues daily "priority" list to production supervisors. Supervisors sequence shop orders through their departments according to this list.
- Receives customer size-changes 2 weeks before shipment and advises supervisors to expedite these orders.
- Issues daily shipping schedule to Shipping Department.

Process Information

1. **Cutting** (The saw cuts rods for many products, it dedicates 50% of time to this product family)
 - Manual process with 1 operator.
 - Cycle Time: 15 seconds.
 - Changeover time: 15 minutes (for length) and 1 hour (for diameter).
 - Reliability: 100%.
 - Observed Inventory: 24000 uncut rods before the saw, 6000 cut rod.
2. **Machining of Forgings** (dedicated to this product family)
 - Automatic machining process with one machine attendant
 - Cycle Time: 20 seconds.
 - Changeover time: 2 hours.
 - Reliability: 100%.
 - Observed Inventory: 48000 raw forgings from the supplier, 4800 machined forgings
3. **Welding Workstation I** (dedicated to this product family)
 - This operation welds the first machined forging to the rod.
 - Automatic process, with operator load external to machine cycle, automatic unloading too.
 - Cycle Time: Operator = 10 seconds, Machine = 30 seconds.
 - Changeover time: 15 minutes (for length) and 1 hour (for diameter).
 - Reliability: 90%.
 - Observed Inventory: 3600 welded arms.
4. **Welding Workstation II** (dedicated to this product family)
 - This operation welds the second machined forging to the rod.
 - Automatic process, with operator load external to machine cycle, automatic unloading too.
 - Cycle Time: Operator = 10 seconds, Machine = 30 seconds.

- Changeover time: 15 minutes (for length) and 1 hour (for diameter).
- Reliability: 80%.
- Observed Inventory: 3600 welded arms.

5. Deflash Workstation (dedicated to this product family)

- Automatic process, with operator load external to machine cycle, automatic unloading too.
- Cycle Time: Operator = 10 seconds, machine = 30 seconds.
- Changeover time: 15 minutes (for length) and 1 hour (for diameter).
- Reliability: 100%.
- Observed Inventory: 6000 deflashed arms.

6. Painting (steering arms are shipped to an outside vendor for painting)

- Painting lead time = 2 days.
- One daily truck pickup of unpainted arms and drop-off painted arms.
- Observed Inventory: 2400 arms at the painter 7200 painted arms at STARM.

7. End-fitting Assembly (dedicated to this product family)

- Manual process with six operators.
- Total Work Time Per Piece: 215 seconds.
- Changeover time: 10-minute fixture swap.
- Reliability: 100%.
- Observed Finished-Goods Inventory in Warehouse: 4800 finished steering arms.

8. Shipping Department

- Removes parts from finished goods warehouse and stages them for truck shipment to customer.