TECHNICAL BULLETIN

PROGRESSING CAVITY PUMPS | LS-TB-009

LIFTING SOLUTIONS

BULLETIN	TOPIC	ISSUE DATE	ISSUED BY
LS-TB-009	PCP MANUFACTURING STATOR INSPECTIONS	FEBRUARY 20, 2020	ENGINEERING

IN PROCESS INSPECTIONS

Manufacturing of stators incudes many critical steps. In Process inspections are made in each area as per procedure and with the results recorded in the Travel Document.

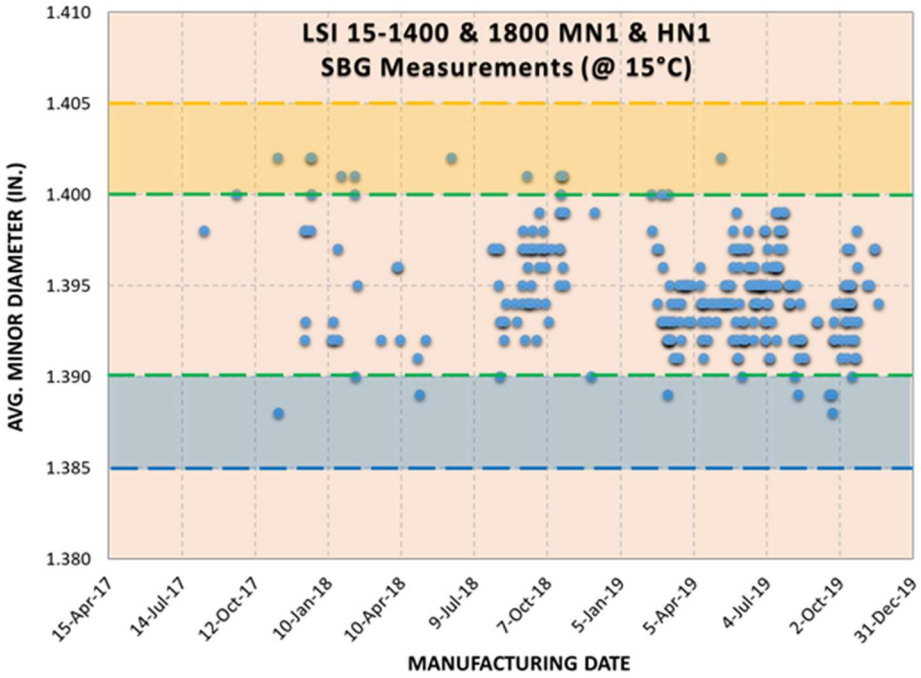
1) Drilling – closure screws are installed in the same step that forms part of the inspection for the tapped holes.
2) Thermal Degreasing – Semi-automated process with continuous tube temperature monitoring. The maximum and minimum temperatures of the tube during the process are recorded.
3) Grit Blasting – Automated process with preset recipes based on the tube size and length to ensure consistency. Tube internal surface roughness is measured at both ends and recorded on the Travel Document.
4) Adhesive Coating – Automated process with preset recipes based on the coating being applied and tube size and length to ensure consistency. Tube coating thickness is measured at both ends and recorded on the Travel Document.
5) Preheating – temperature controlled oven ensure tubes are not overheated. Maximum temperature and heating time are recorded on the travel document.
6) Extrusion– automated process with predefined recipes and process cycle for each model and elastomer combination with full cycle data logging for many parameters. Injection time and maximum pressure are recorded on the Travel Document.
7) Vulcanization – salt bath to cure the elastomer after extrusion. Salt bath is maintained at a specific temperature. Cure time is monitored by PLC system that logs in the load time and beeps an alarm for the operator to remove the stator. This ensures the stator is never under cured or over cured. This helps maintain consistent sizing, elastomer and bonding properties.

QUALITY CONTROL INSPECTIONS

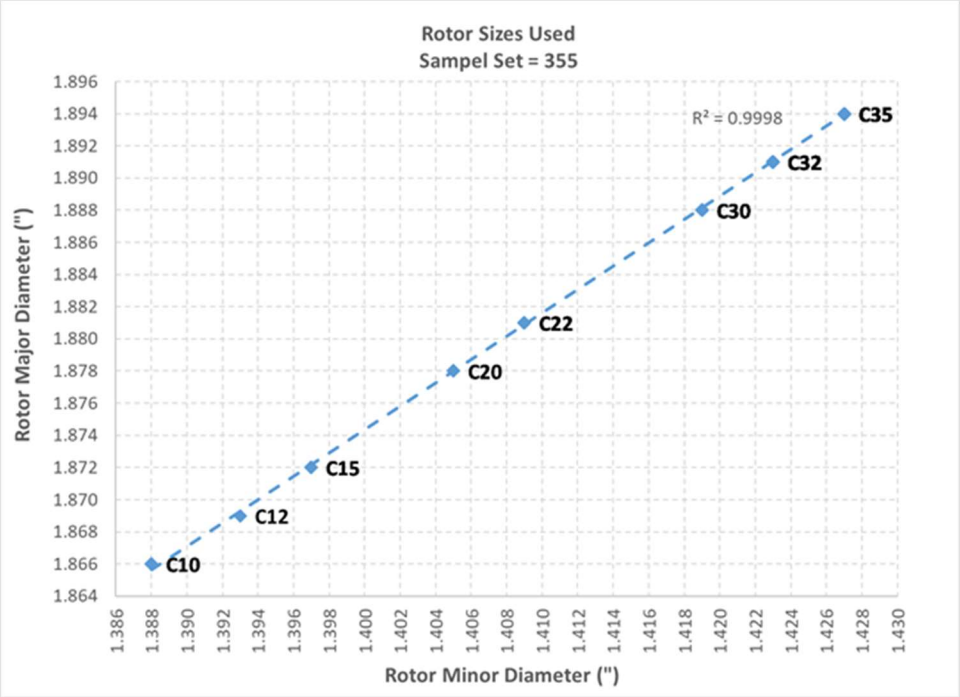
Quality control inspections of the raw stator component and include the following:

8) Bond Testing
    a. Bond samples are obtained from both ends and pushed out on a press using a specific base and die for the model. The press measures/records the maximum load required to push the elastomer out.
    b. The pushout load measured is recorded to ensure it exceeds the specifications for the minimum pushout load.
    c. The sample is examined to ensure there is 100% rubber-to-rubber failure, i.e. no bond failure.
9) Stator measurements
    a. For every manufactured stator, the minor diameter is measured using a device that is inserted inside the stator and pulled out. While moving through the stator it automatically captures the minor diameter measurements.
    b. Typical acceptable range for the average minor diameter is 0.010”.

c. This process can be thought of as a measure of consistency for the manufacturing process. Here is an example of the trending chart for one model vs time. The acceptance bands for the stators measuring out of the typical 0.010" range are identified by orange (loose) and blue (tight) color codes on the stator tube.



d. The stator size control along with rotor size control is critical in successful pump test results in the final pump assembly/rotor matching process. Consistent stator sizing makes it possible for maintaining a scientific rotor sizing methodology based on balanced fit between the major and minor. As a result, the rotor sizing is kept to a few compression sizes, defined by size codes. The following chart shows the rotor sizes used for over 350 rotors for the same model above with all elastomers showing the rotor sizes are interchangeable between different elastomers of the same model if similar performance test result is desired.



10) Final Inspection

a. This is a quick visual inspection of the stator OD, Length, tube external surface and elastomer at the ends
b. The stator completion/assembly process includes the following:
c. Stator End Threading/Weld Prep – deepening on the order the stator ends are threaded or weld prepped on a CNC machine. Visual inspection on the elastomer bond is performed on this step as well. The threads are inspected with API go-no-go gauges.
d. Stator Phase welding – sometimes the required pump lifts are longer than what can be manufactured in single sections so multiple stator section are joined together via phase welding to create higher lift pumps. The process includes a backing sleeve for added strength, a butt weld the joint and four plug welds on both sides of the joint reinforced with the sleeve. This type of weld is much stronger than just a butt weld.
e. Stator end connections – sometimes the stators required welded connections which are welded similar to a phase weld with backing sleeve and plug welds for added strength.
f. Pump Testing – completed according to the predefined procedure and used to establish a baseline pump torque and efficiency.