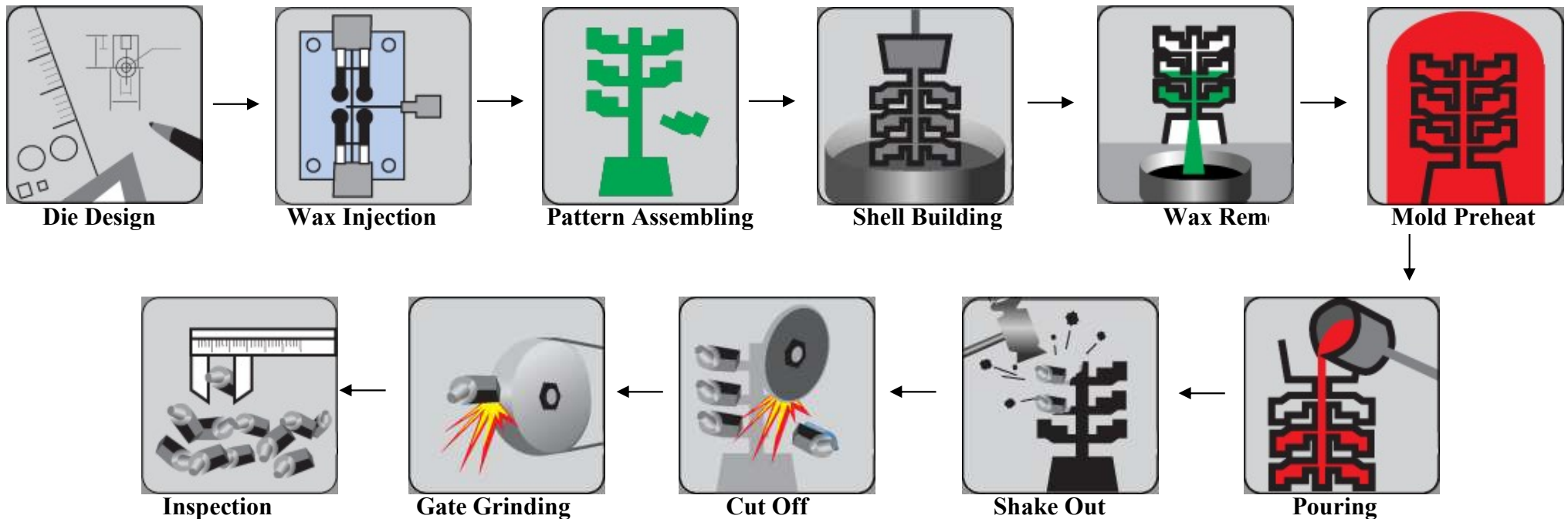


## Quality Control Plan

The investment casting process begins by production a wax pattern employing a precision mold. The wax patterns are fastened by the gate to a runner to form a cluster. The cluster is dipped in refractory slurry and coated with fine sand then dried. The process of dipping and drying is repeated until a robust thickness is achieved. After this, the ceramic shell is heated, and the wax is melted away. This leads the mold into a cavity that can be filled with the molten metal. The hollow mold is fired, and the liquid alloy is poured into the pre-heated mold. After the metal has solidified, the slurry shell is broken off and the individual part is cut away from the connecting gates. The parts are cleaned and subjected to further secondary operations.



Following is the quality control plan for our investment casting process. At the table below, it describes each step of investment casting process, how the quality control does, and its reaction plan.

Process No.	Process Name/ Operation Description	Machine Device/Tool for Manufacturing	Characteristics	Methods	Reaction Plan
1.	Tooling	Die Design & Die Making	Precision	1. Make the die from customer's drawings. 2. Make sure the dimensions have to meet the specifications. 3. For year run products, will prepare a spare die to replace the repairing one in order to keep the production on time.	Provide samples to customers for approval. Start production after the samples are approved.
2.	Material		Standard Specification	1. Lab test each lot's composition when material arrives. 2. Incoming material test reports are required.	If the material does not meet the specification, return it to supplier.
3.	Investment Casting	Dies	Accuracy	1. Engineering inspection before each use. a. Check mold slottings are tight or not. b. Check the two pieces of mold are close tightly or not. c. Air spray the mold to clean the impurities. 2. Replacement with a new die before the die failure.	Make necessary adjustment if needed. If the mold need to be repaired, replace with the spare mold.
4.	Investment Casting	Wax Injection	Wax Temperature	1. Wax injection machine set up at 56 ~ 58 ° C	Temperature will be adjusted if it is out of the range.
			Pressure of Injection	1. Pressure set up at : 25 ~ 30 kgw/cm 2. Injection Time: 10 ~ 15 seconds	Pressure and time are set. Will be adjusted if its out of the range.
			Shrinkage	1. Shrinkage rate: 32/1000	If wax pattern shrinkage is off the rate, the die will need to be corrected.

5.	Investment Casting	Pattern Assembling	Appropriate	1. Numbers of wax pattern which are assembled in one cluster have to be appropriate. It will affect the metal pouring.	If failure, keeps testing until get the appropriate numbers.
6.	Investment Casting	Shell Building	Self Supporting	1. Each layer of refractory slurry and sand have to be coated evenly.	If failure, the whole shell will be Disposed.
			Environment Controlling	1. Room Temperature: Keeps at 23 ~25 ° C 2. Room Humidity: Keeps at 65%	Temperature and Humidity will be adjust if out of the range.
7.	Investment Casting	Wax Removal	Autoclave Dewaxing	1. Heat up promptly. Temperature and pressure are controlled automatically. 2. Heated Time: 10 minutes; Temperature: 110 ° C Pressure: 8 kgw/cm	Time, Temperature, and Pressure are set, and will adjust if necessary.
8.	Investment Casting	Mold Preheat	Mold Temperature	Heated Time: 1 hours; Temperature: 1050 ° C	Temperature has to heat up to 1050 ° C. If not, it will be adjusted.
9.	Investment Casting	Pouring	Metal Alloy Pouring	1. Molten metal alloy temperature: 1580 ° C 2. Molten metal alloy composition has to meet the specification.  3. Computer controls and records the temperature and composition automatically.	1. If the material composition does not meet the specification, the parts will be disposed. 2. Material test report will be sent to the customers.
10.	Investment Casting	Casting Parts	Solidification & Cut Off	1. Keep the parts in room temperature to cool down. 2. Remove the individual casting part from the cluster by high speed friction saw.	Monitor to keep the parts completed. If failure, dispose the parts.
11.	Investment Casting	Gate Grinding	Properly	Grinding off the attached gate has to be properly. The part itself can not be hurt.	If failure, the parts will be disposed.
12.	Investment Casting	General Inspection	Visual	Check if blend smoothly and have no voids; 100% inspection.	If failure, the parts will be disposed.
			Size Measurement	Test on random selection. If specified, will be 100% tested.	
			Material	Spectrum meter inspection of material on each batch.	
13.	Secondary Operation	Machining	Precision	The parts have to meet all of the specification after secondary operation.	Sawawada will respond for the final inspection.
		Heat treating	Accurate		
		Finish	Outstanding		