M3 Product Teardown – Asko Dishwasher

Summary

Why do the product teardowns?

Part of the product development process is to apply knowledge gained from prior experience during the concept development and design phases. Some experience comes from having directly designed something in the past and other experience is more indirect. It is this indirect product development experience that is gained from product teardowns.

Teardowns are different from Reverse Engineering

Reverse engineering a product is nothing more than figuring out the design and manufacturing methods, typically for copying. M3 Design views product teardowns as ways to gain insight into the design to become better product developers. We focus on "Why" questions.

- Why did the designer make the choices they did?
- Why were certain construction techniques chosen?
- Why were some features included and others left out?
- Why was the design approach chosen?

This serves to gain more in depth understanding into the product's design rather than a superficial once-over.

How Does M3 Design Approach Product Teardowns?

The product teardown process is a rigorous approach to carefully catalog the deconstruction in both pictures and written descriptions. This serves two purposes.

It forces the deconstruction team to carefully investigate the product pieces and learn as much as possible about the design details.
It provides a detailed record of the process for future reference by other product designers. The end result is adding to one's knowledge of product designs that can be used during brainstorming, design, prototype development, and troubleshooting. This method of obtaining indirect product development experience is another important tool that sets M3 Design apart from other product development firms.

Overview

The M3 Teardown Squad took the opportunity to "analyze" the dishwasher that has served us faithfully for the past seven years. Over the past few months, a decrease in cleaning capability was noticed and we replaced it with a new unit. In addition to gaining insight into consumer durable goods construction were interested in determining why its cleaning performance had deteriorated. Once the teardown was complete, the "carcass" was recycled.

The dishwasher is a stainless steel model designed for home consumer use.

Systems

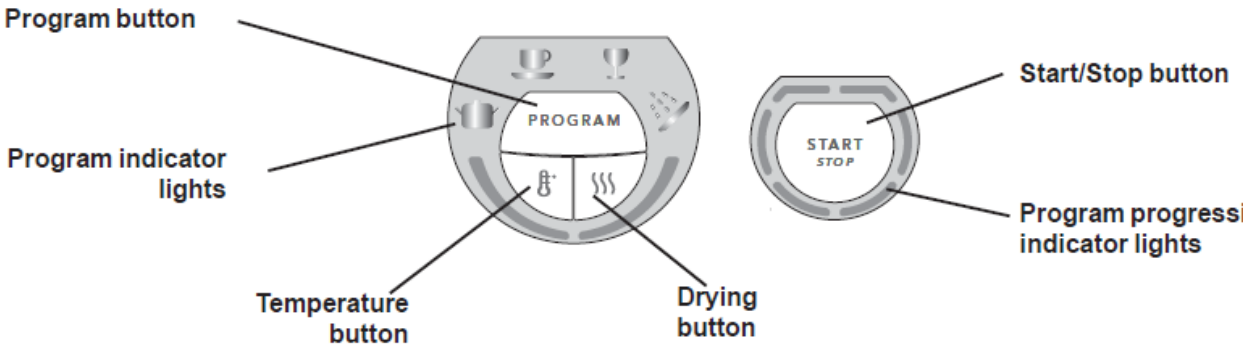
The areas of investigation for the dishwasher were the User Interface, Electronics and Pumping / Water Management systems.

User Interface

The control interface is mechanical with LED lights to indicate wash status and cleaning option selection. Simple and robust. The dishwasher interface consists of backlit pushbuttons without any digital displays. Feedback to the user is in the form of backlit icons. The buttons were pretty interesting – the spring return features were molded cantilever fingers that would return the button to its hard stop. After seven years it did not appear that the fingers had stress-relieved at all. Backlighting is provided by a series of surface-mounted LEDs, which shone through cutouts in the button bezel – no light pipes were needed, simplifying the development of the button.

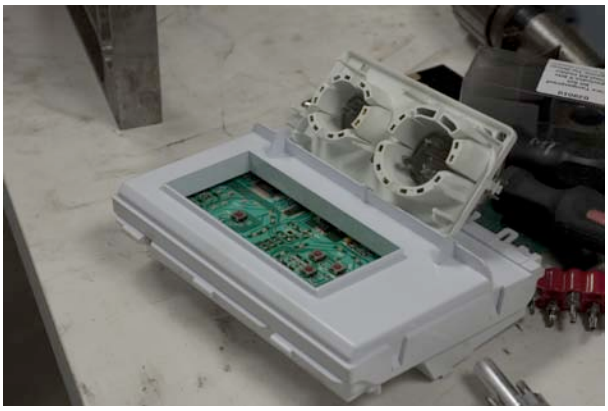
Dishwasher front panel

Simple pushbutton interface

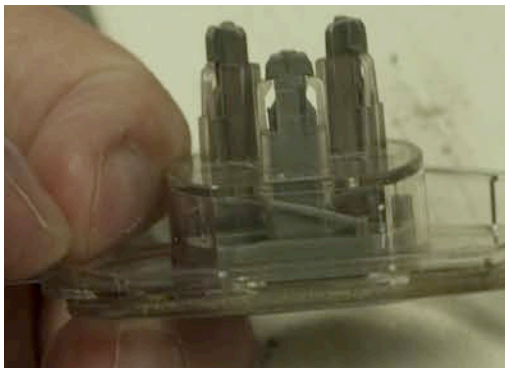


Pushbutton Icons and user interface

Electronics

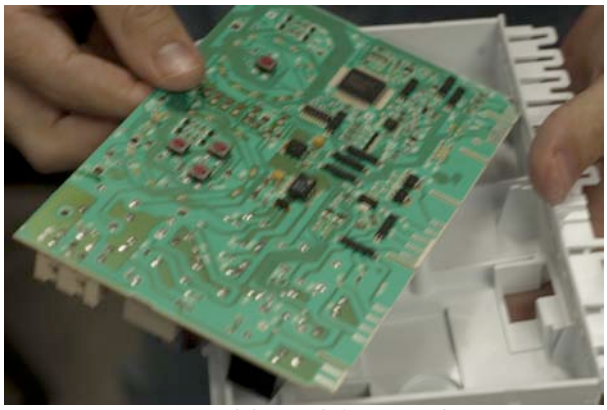


Cutouts in pushbutton bezel for backlighting



Cantilever spring fingers

The controller board is a very simple single-sided PCB design with control electronics on one side and power electronics on the other.



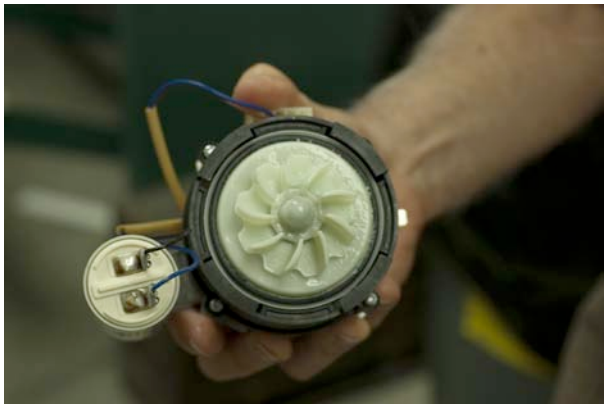
Control board front side

Control board back side

Pumping and Water Management

The pumping system consists of a high-pressure inlet pump and a low-pressure drain pump, as one would expect. The inlet pump was an AC motor with a large starter capacitor. Part of the inlet water system was a propeller type flow meter. While we do not know for sure, it is probably used by the system to determine if the dishwasher is hooked to a water source to prevent pump burn out.
The drain pump consists of a two-piece inductive-coupled rotor and stator. The stator is a series of steel laminates that the rotor housing fits inside of. This allows a completely sealed impeller/rotor assembly and eliminates any risk of leaks. A very creative and low-cost solution.

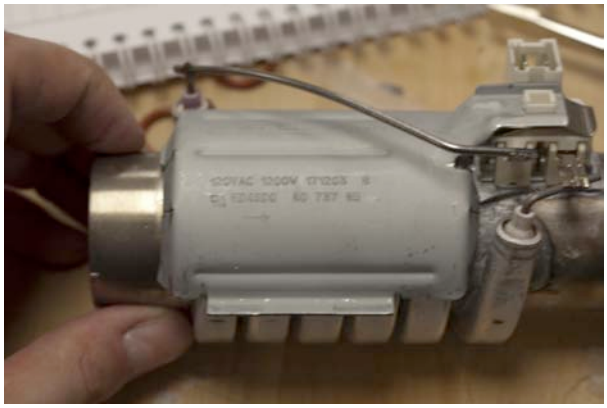
Inlet pump and motor



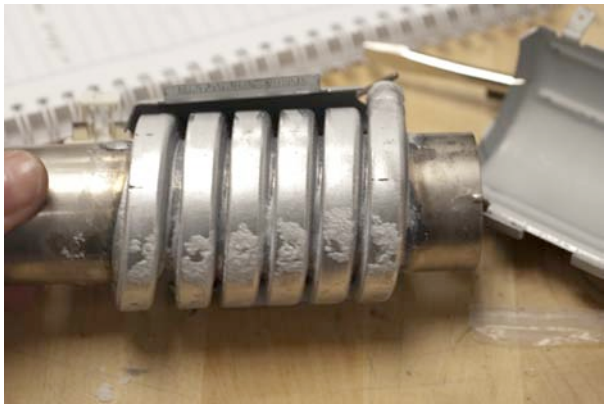
Inlet pump impeller

Separate drain pump rotor and stator

Next is the inline heater, which is designed to raise the water temperature to 160°F. The heater is a 1200W serpentine coil placed around the inlet pipe to the dishwasher, downstream of the inlet pump. A protective metal shell then surrounded the coil. Very compact and simple.



Inline water heater



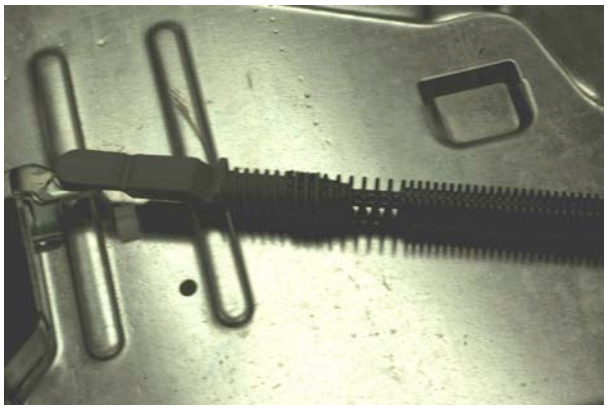
Heater with elements shown

Observations

The construction of the dishwasher is well thought out from the design for manufacturing (DFM) perspective. For example, major systems are assembled using the same size T20 Torx screws to reduce part-type count and assembly error.

A feature that caught our eye is the front-accessed rear leveler foot. A lower kick panel can be removed which allows access to an adjuster screw which turned a leveler foot via 1 meter long flexible drive coupling. This makes it much easier for the installer to adjust for uneven surfaces without having to remove the dishwasher every time an adjustment is required. A real time saver.

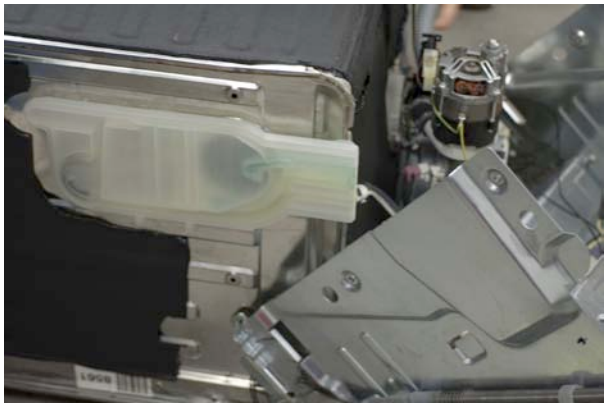
The door closing spring and damper is an elegant and simple design. Because the dishwasher tub takes up most of the product width there isn't much room on the sides for much else besides insulation. A low profile solution that is inexpensive is required. To accomplish this, the door closing spring and damper are nested within the same tubular assembly. The plastic tube consists of outer threads that the extension spring threads into for tension adjustment. One end of the tube is connected to the door linkage and the other end was the damper piston. The damper is a simple porous material mounted on the end of a plastic shaft. The damper cylinder connects to a hole in the dishwasher housing with a simple hook. Very clever, low cost and compact.



Door linkage with threaded spring adjuster

Damper piston and cylinder

To us, the most interesting item in the teardown was a strange oval shaped plastic molding that attached to the side of the inner tub, called the "airbreak softener" in the parts list. It is a two-piece plastic assembly that is bonded together with a labyrinth / serpentine water path. We could not initially understand why something so intricate was required when all that was going on was providing clean water to the dishwasher tub. After studying it a bit, we determined that its primary purpose is to prevent backflow of "gray" water to the "clean" water mains by providing an air break in between the clean and dirty water. Its secondary use appears to be providing a "damping" function to prevent high-pressure pulses of water in the inlet system. Wow.



Airbreak softener mounted to tub

Close-up of airbreak softener

Final Carcass

Summary & Conclusions

The dishwasher parts were mostly what we expected to find. The manufacturer's challenge is to build a reliable, low-cost unit that is also appealing to their consumer customers. None of the sub-systems or components appeared to be over-engineered for their task, which is critical for cost management. The unit itself was clearly reliable in that it worked well for seven years in an environment where it was operated at least on a daily basis.
The most complicated system we uncovered was the water intake and outlet. This subsystem includes a flow sensor, inline heater, drain pump/motor configuration, and the "airbreak softener". It is clearly a challenge to manage water inlet and outlet for a device like this. This resulted in a lot going on under the main cabinet.
Some dishwashers may have more sensors to monitor the water conditions (temperature and turbidity) to manage the wash cycles, but were not needed in this model, probably due to the simplicity of the available wash cycles.
We found the airbreak system to be fascinating, and will look for other implementations when we perform appliance teardowns in the future.

We did figure out the source of the reduced cleaning ability. There were significant mineral deposits on the "wetted" components, especially the rotating water jets. We suspect that water flow was significantly reduced through the rotating arms. That likely led to the degradation of the cleaning ability. Adding a water softening system would certainly reduce this problem. Maybe that will be our next teardown……

Mineral deposits in the tub basin