Case Study: Wheelbarrow Wet/Dry Vacuum System

Client: Construction contractor

Client Problem: Develop a rugged and high output vacuum system that incorporates a wheelbarrow for collection of large volumes of heavy construction debris including wood cuttings, gravel, mud, and water. The vacuum system should mount directly and seal tightly onto the top rim of standard metal wheelbarrow, be strong and robust for rough use in construction, and provide high vacuum capability for minimum 8 foot water lift.

GEOMETRIXDESIGN Solution: To provide a strong, robust, lightweight, and cost efficient design, an injection molded solution was developed for the structural foam molding process where a blowing agent is injected into the molten resin to fill the mold cavity with a foamed resin at a low pressure. A solid skin forms on the surface of the part and the core remains structurally foamed. This process results in parts with 20% less weight, larger size and thicker wall, low stress and low warpage, much higher strength, and uses lower cost mold tooling than standard injection molding.

A High Density Polyethylene (HDPE) was used for all molded components. The benefits of HDPE are:

- Cost
- Weight
- Strength
- Moldability
- Chemical resistance

which prove ideal for this application.

Design Details: The design of the wheelbarrow vacuum used a "domed" one-piece housing to allow for the accumulation of large volumes of debris typical of a wheelbarrow. The domed structure also provided a natural concave shape for strength in withstanding high vacuum loads. To provide a flat surface for vacuum sealing around the perimeter of the top wheelbarrow rim, structural ribs under the inside lower edge of the housing strengthened the dome and created a grid for mounting a flat annular plate to mate against the wheelbarrow rim. A compliant seal pad was adhered to this plate to provide the vacuum seal with the rim of the wheelbarrow.

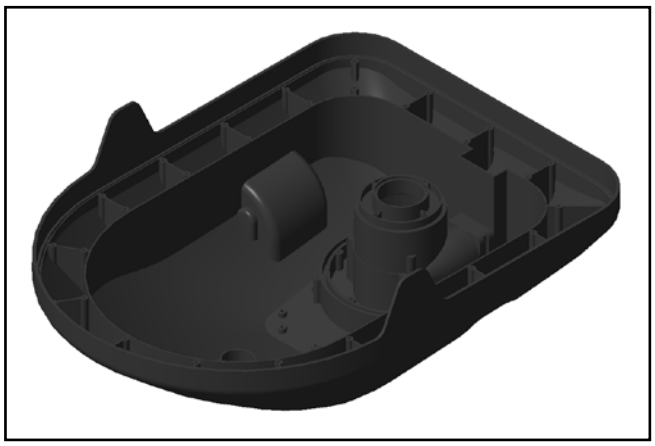
Wheelbarrow vacuum system

Features were integrated into the housing for direct mounting all of the vacuum system components, including the blower motor, ball stop, filter, and screen. A recess at the top of the domed housing allows for quick insertion and securing of these components during assembly.

A two-piece structural foam molded top cover provides for water resistant air intake for the blower motor cooling. A foam filter prevents dust and particles from entering the motor. The two-piece design provides for drainage of water entering the air intake during spray cleaning.

Since the vacuum system will be frequently mounted and removed from a wheelbarrow, it was designed to stand independently. Two side flanges and a filter shroud provide a triad of legs when placed on the ground or other flat surface. The side flanges were integrated directly into the housing and share the same structural foam strength properties.

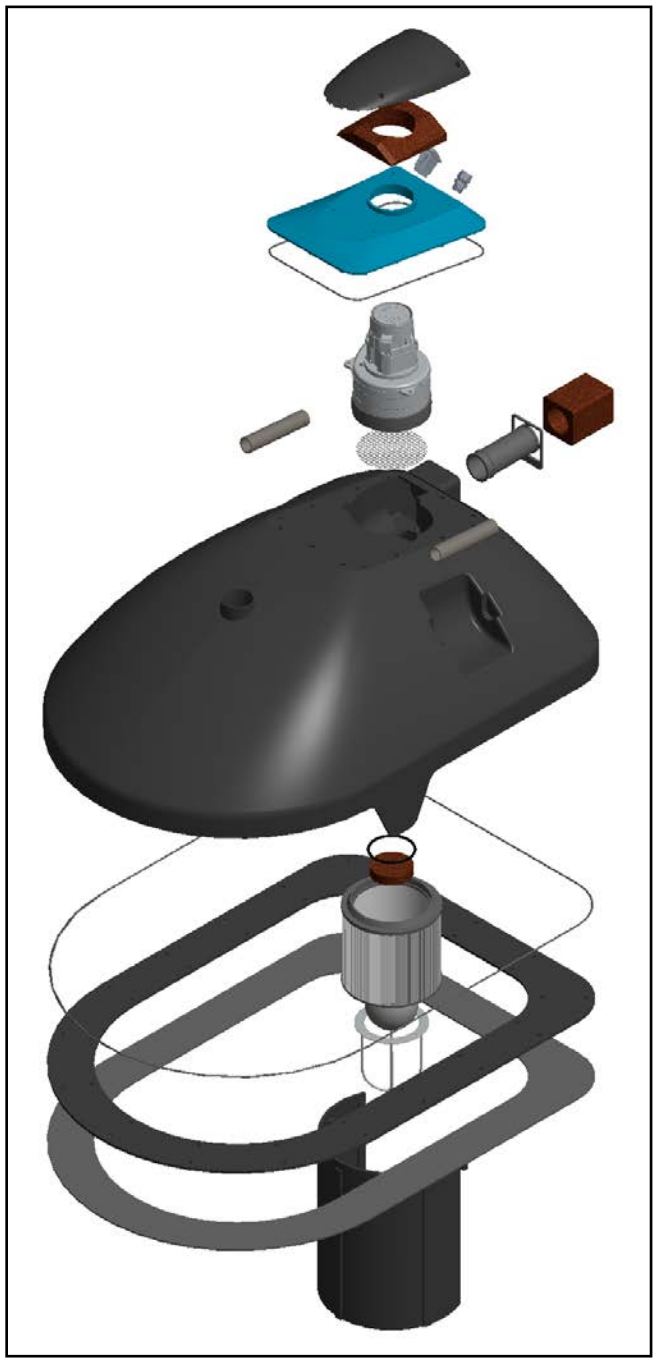
Two handles for lifting the vacuum system were integrated into the top of the housing. These handles provide easy lifting from the normal position of the wheelbarrow. The power switch and electric cord are located at the back of the top cover for easy access from this same wheelbarrow position.



One-piece structural foam molded wheelbarrow vacuum housing (bottom view) showing features and ribs

The vacuum hose inlet was positioned directly above the deepest section of the wheelbarrow for optimum accumulation of the largest amount of debris. Also, the domed shape of the housing allowed for easy use of the vacuum hose from any position around the sides and front of the wheelbarrow, preventing hose snagging and repositioning of the wheelbarrow.

Assembly of the wheelbarrow vacuum system components was efficient. A small quantity of screws were used to secure the blower motor, fastening the top cover, mounting the flat annular plate, and securing the filter shroud to the housing.



Exploded assembly view of wheelbarrow vacuum system components