based on the biomedical process variables. Because of these specifications, instead of the originally planned flexible tube pump with a triple head for all activators and the same pump for all stopping liquids, six separate pumps had to be selected to achieve the objective.

Another main functional element was the frame (rack) for the modules. Extruded aluminium sections and accessories, available as a modular system and frequently used for automation engineering, were used in the design. The choice of section size depended on the calculated loads. Figure 5.12 shows the initial design of the working module.

5.4.3 Detailed Design of the Main and Secondary Functional Elements

The design of the main and secondary functional elements is a process that takes place in parallel in everyday design, as both groups may have a strong influence on each other. The pump–valve module (Fig. 5.13) is one of the main functional elements. Its decisive design requirements are those resulting from the biomedical process variables (size of the metered volume) and the boundary conditions resulting from the technical requirements (low mass, small space requirement, etc.)

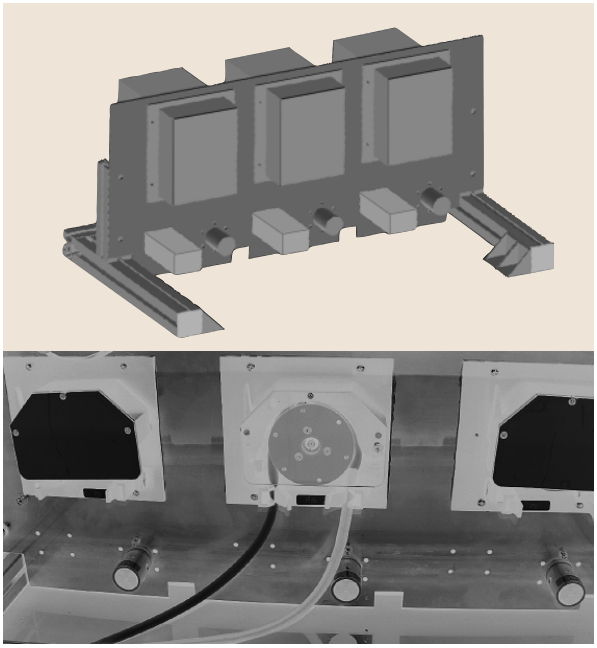

Fig. 5.13 Pump–valve module (during development and assembly)

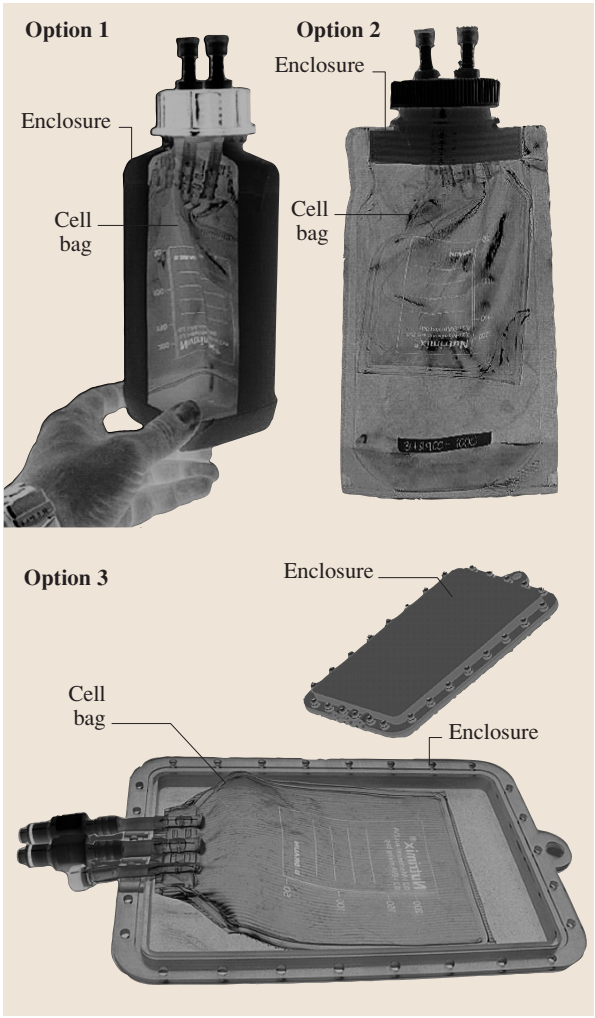

Fig. 5.14 Possible options for the secondary functional element: cell vessel (cell compartment)

A secondary functional element is the cell vessel which contains 15 ml of cell liquid at the beginning and into which the activator is injected before weightlessness starts, followed by the stopping solution after approximately 22–25 seconds. The filling must be able to take place under the exclusion of air and in sterile conditions. Further, due to the safety requirements, this vessel must be designed with a double wall and enable fast removal of the contained liquids after the experiment. For biological and economic reasons the inner part of the vessel should be a one-off (disposable) product and the outer one should be reusable. Due to these requirements, further solutions were conceived and tested (Fig. 5.14).