Table 19-1 Advantages and Disadvantages of Sterile Product Filling Methods

Filling mechanism	Advantages	Disadvantages
Time–pressure	• Clean—few parts in the product path • Easy to maintain and change over • Product path easy to CIP/SIP • No leakage in product path • Can handle sensitive products • Can run dry • Accurate for small or large fill volumes • Possible self-adjustment of fill volumes between fill cycles at line speed	• Pressure change sensitivity • Pressure control and monitoring required • Temperature sensitivity • Viscosity sensitivity • Expensive parts for change over of fill volume
Fill-by-weight	• Clean • Easy to maintain and change over • Easy to clean and to CIP/SIP • No leakage in product path • Can handle sensitive products • Can run dry • Real-time fill volume control • 100% documentation of fill volumes • Accurate for small and large fill volumes	• High cost of scales and control system • Maintenance (potential of spillage on scales) • Complex container handling • Longer fill times • Accuracy for small fills decreases with fill volume reduction • Dripping or spills can damage scales—protection of scales complicates the system
Piston pumps with lapped rotary valves	• Simplicity-3 parts—no consumable parts such as a rubber seal or diaphragm • Simplicity of motion • No sophisticated controls required • Accurate for small or large fill volumes • Reasonably easy to CIP/SIP	• May damage shear-sensitive products • Greater source of metallic particles • Push–pull actuation—actuating mechanism must be backlash free • Thorough cleaning required between filling campaigns • Must be located in clean environment • Costs • Handling issues during cleaning—nicking, cannot interchange piston and cylinder • Cannot run dry • Potential for seizing • Leakage varies with input pressure
Piston pumps with rolling diaphragm	• Clean—few parts in product path • No leakage in product path • Gentle to sensitive products since no shear is involved • Can run sugar-based products without seizing • Can handle slurries • Can run dry • Accurate for small or large fill volumes • Pump loads the actuating mechanism, eliminating backlash	• Special assembly requirements, need highly trained people to assemble • Vacuum source required • Diaphragm must be discarded and replaced • Number of components • Pump must be horizontally oriented for CIP/SIP that can affect drainage
Peristaltic	• Clean—very few parts in product path • Easy to maintain and change over • Product path easy to CIP/SIP • No leakage in the product path • Can handle sensitive products • Can handle suspensions and slurries • Can run dry • Easy cleanup for potent products—best of all filling systems	• Pulsating flow • Accuracy issues due to tubing tolerances, angular position of rotor at start and stop, change of tubing size and shape over time, and check weigh and adjustment must compensate for volume drift

Abbreviations: CIP, clean-in-place; SIP, sterilize-in-place. *Source*: From Ref. 1.