

12 Best Practices Supporting Flawless Delivery of Medical Device Packaging

Best Practice #1: Packaging Design Requirements

Defining the requirements of a packaging system as early as possible during the development process sets the stage for downstream success. Collaboration between the packaging engineer and the project team members helps create a packaging design requirements document that sets clear parameters for the following design issues:

- Function
- Limitations
- Special features
- Aesthetics
- Product/company branding
- Cost limitations
- Size limitations
- Sterilization method
- Labeling requirements
- Hospital/clinic storage requirements
- Case count
- Possible adverse use conditions
- Possible adverse distribution conditions
- Possible adverse storage conditions

Best Practice #2: Hazard Analysis

Identifying possible packaging system hazards and proactively addressing them during the design phase helps to ensure patient safety. High severity hazards such as breach of the sterile barrier and damage to the medical device must be eliminated. Sometimes such hazards are not easily detected but nonetheless effort must be made to eliminate them. Medium and low severity hazards are to be reduced or eliminated and are often balanced against the packaging design requirements defined above.

Best Practice #3: Labeling Requirements

Medical device labeling is regulated by 21 CFR Part 801 which contains active subparts A, C, D, E and H. Review of Subpart A - General Labeling Provisions as well as determining the applicability of special compliance details in active subparts A, C, D, E and H will shape your labeling initiative. Label content development early in the design phase will help define placement as well as address labeling copy requirements for the FDA submission package.

Best Practice #4: Evaluation of Similar or Competing Devices

Evaluating similar or competing devices is a practice that should be employed when possible. Identifying comparable devices and actively evaluating them prompts you consider real use in the clinical setting. Understanding what your target customers value (and do not value) about these packages will help shape your design decisions. Addressing as few as three of the top customer requirements can lead to valuable design insights.

Best Practice #5: Understanding the Clinical Application

This best practice goes hand in hand with but is distinct from Best Practice #4 above. Observing access and utilization of similar devices in a clinical setting will provide insight as to how clinicians could utilize your device and as such influence important design choices.

Best Practice #6: Clinical Trial Packaging

Clinical trial packaging may need to address several unique requirements. Frequent shipping, prolonged temperature extremes, and unusual transport conditions must be taken into account. Discussion with your project team members and enlisting the assistance of your shipping and logistics team or provider will ensure that this package design meets the requirements needed for rigors of clinical trial transport.

With Best Practices 1-6 attended to, you're ready to prototype your package.

Best Practice #7: Prototyping the Packaging System

Creation of a packaging system prototype is a key tool in advancing the design and validation portion of a medical device development project. Building time into the project to develop prototypes and perform package system testing can save headaches and costly delays further downstream especially when package design and validation are necessary elements for the development project.

A prototype makes the concept real and naturally elicits input. Thoughtful review of this input allows you to modify the design. A good packaging system prototype can be sterilized and does not compromise the device or the device's safety.

Best Practice #8: Stability Testing, Accelerated and Real Time Aging of the Sterile Barrier System

For medical devices, the industry recognized compliance standards are ISO 11607-1 and ISO 11607- 2. ISO 11607-1 requires stability testing of the sterile barrier system where manufacturers execute shelf life studies to support product and package (sterility) expiration dating. The evaluation of age related phenomena for whole package and seal integrity is carried out at specified time intervals as called for in accelerated aging and real time aging protocols. Test samples are pulled from these aging populations and then are evaluated to assess the effects of aging on physical package integrity.

Best Practice #9: Testing Sterilization Effects on Biocompatibility & Sterilization Validation, Device & Package

Work with your in-house chemistry department or contract life sciences laboratory for evaluation of cytotoxicity and heavy metals evaluation of your selected packaging materials. There are U.S. Pharmacopeia tests that can be performed to ensure absence of cytotoxic packaging materials and/or heavy metals content. Additionally, work with your in-house sterilization department, microbiology department or a contract sterilizer to confirm the sterilization method and dosing and then execute a sterilization validation of the device within the prototype package to ensure an acceptable microbial kill or log reduction value (LRV).

Best Practice #10: Testing Sterile Barrier System Integrity and Packaging System Performance

ISO 11607-1 requires a demonstration of physical package integrity in order to validate a system's sterile barrier integrity. Annex B within ISO 11607-1 provides a listing of test methods that may be used to demonstrate compliance including accelerated aging, performance testing, seal strength testing and various test methods for materials. It is important to ensure that functional or simulated devices are contained within the package during performance testing. Assemble the device/package system and sterilize the test units per the intended production sterilization process. The inclusion of functional medical devices will facilitate the project team's assessment of device performance and functionality in the clinical setting, post shipping and handling.

Suggested Test Methods:

- Conditioning of packaging materials and packages: ASTM D4332-01 (2006) Standard Practice for Conditioning Containers, Packages, or Packaging Components for Testing
- Performance testing: ASTM D4169-09 Standard Practice for Performance Testing of Shipping Containers and Systems; ISTA 1, 2, 3 Series - International Safe Transit Association Pre-shipment Test Procedures
- Package integrity for porous packages: ASTM F 1929-12 Standard Test Method for Detecting Seal Leaks in Porous Medical Packaging by Dye Penetration
- Package integrity via internal pressurization: ASTM F2096-11 - Standard Test Method for Detecting Gross Leaks in Packaging by Internal Pressurization (Bubble Test)
- Seal strength: ASTM F88-09 - Standard Test Method for Seal Strength of Flexible Barrier Materials

Best Practice #11: Installation and Operational Qualifications

For ISO 11607-2 compliance, it is required to qualify the packaging equipment used to form, seal and assemble a sterile barrier system. The installation qualification (IQ) is a process of obtaining and documenting evidence that equipment has been supplied to the end user and installed in accordance with the manufacturer's specifications. The equipment user's manual is an excellent starting point to develop the IQ component to verify the equipment's features and attributes against the Manufacturing Bill of Materials. The second key component of the IQ is a utilities (electricity, compressed air, etc.) review and verification for proper and appropriate set-up. This should be executed in collaboration with a facilities or maintenance department.

The operational qualification (OQ) demonstrates that the installed equipment operates within predetermined limits when used in accordance with its operational procedures. The OQ demonstrates that the packaging equipment performs within the full range of its manufacturing limits with acceptable repeatability and precision as measured through the activities of a protocol.

Best Practice #12: Performance Qualification

The quality of the forming and sealing processes directly affects a sterile barrier system's integrity. Performance qualification (PQ) is the process of obtaining and documenting evidence that the equipment used to manufacture the sterile barrier system consistently performs in accordance with predetermined criteria and yields product meeting its specification. Process limits are developed for each piece of equipment in order to produce substrates and seals with a high degree of statistical confidence and reliability. The PQ must demonstrate that the previously validated forming and sealing specifications are being met for all product produced on the packaging equipment.