Before a medical device can undergo sterilization or high-level disinfection (HLD), it first must be cleaned. Cleaning, according to ANSI/AAMI ST79:2017, is the “removal of contamination from an item to the extent necessary for further processing or for the intended use.”

Thus, thorough cleaning is the first and most important step in processing reusable medical devices. Cleaning removes microorganisms and other organic and inorganic materials. Cleaning may be a manual process, an automated process, or, as often is the case, involve both manual and automated processes.

According to ANSI/AAMI/ISO 17664:2017, medical device manufacturers (MDMs) are responsible for supplying healthcare facilities with validated cleaning instructions for medical devices. The instructions, which may include manual processes, automated processes, or a combination of both, need to be included in the instructions for use (IFU) provided by the MDM.

Of important note, because cleaning only removes, but does not kill, microorganisms, subsequent disinfection or sterilization processes may be necessary to render an item safe for patient use.

Manual Cleaning and Brushes
According to the Centers for Disease Control and Prevention, manual cleaning has two essential components: friction and fluidics. Friction (e.g., rubbing/scrubbing the soiled area with a brush) is a time-tested and dependable method. Fluidics (i.e., fluids under pressure) refers to the use of a fluid to remove soil and debris from internal channels after brushing and when the device design does not allow passage of a brush through a channel.

For cleaning a medical device manually by friction, the most common tool is a brush. The cleaning procedure varies greatly depending on the design of the medical device to be cleaned. In fact, complex medical devices frequently require more than one type of brush for thorough cleaning. Therefore, referring to the MDM’s IFU is essential to determining the method, type, design, composition, and size of the brush(es) required to clean a device.

Determining which brush to use to clean a medical device can be a confusing process. The following general principles can help in selecting the proper brush:

- Identify the medical device to be cleaned.
- Examine the medical device to understand what areas must be cleaned, such as the external and internal surfaces.
- Review and understand the IFU, looking specifically at cleaning steps and brush recommendations from the MDM.
- Identify the equivalent brush(es) that will be used in the process.
- Ensure the brush(es) is available.
- Inspect the brush before use.

Brush Terminology
Common terms associated with brushes are as follows:

- **Lumen brush.** Designed to clean the internal channels of a medical device. Often called “tube brushes.”
- **Surface brush.** Designed to clean the exposed surfaces of a medical device. Often called “block style brushes.”
- **Brush part.** The area where the bristles are located. For a lumen brush, this is expressed in terms of length. For a surface brush, this is expressed in terms of the length and width.
- **Filament.** The type of material (e.g., nylon, thermoplastic, brass, stainless steel) used for the bristles of the brush.
- **Internal diameter.** The distance between the inside walls of a lumen.
- **Outside diameter.** The distance between the outside walls of a lumen.
- **Trim length.** With a lumen brush, this most often will be referred to as the diameter of the brush part. For a surface brush, this usually will be referred to as the length of the bristle from the end of the bristle to the block in which it is held.
• **Overall length.** For a lumen brush, this is the entire length of the brush part (i.e., from the proximal end to the distal end). For a surface brush, this is the entire length of the block and handle of the brush.

• **Single-use brush.** According to ST79, a “use” should be determined by the facility. The exception to this is when the MDM or manufacturer of the brush specifies what a “use” means (e.g., one brush for one device).

### Tools to Have Available

The following tools can prove useful when measuring and selecting the correct brush for medical device cleaning:

- The IFU for the medical device to be cleaned.
- The IFU for the brush(es) that is being considered.
- A brush size gauge, ruler, or similar tool. Such a tool may be needed to measure the medical device (i.e., the internal diameter of a lumen) and/or to measure the dimensions of the brush(es) being considered.

### Decision Point 1: Specifications Supplied by the MDM

Although the MDM is supposed to provide the specifications for the appropriate brush(es) to be used, often this is not the case. Therefore, decision point 1 is to determine the completeness of the specifications provided. If they are complete, then one can move to the brush-purchasing stage (as described below). If some or all of the specifications are missing, then one must first assess these gaps (as described below).

The following is a list of key specifications that should be provided by the MDM:

- **Brush for lumens.** Diameter of the brush part, overall length of the brush, length of the brush part (if specified), composition of the filament (recommended materials and materials that should not be used), and other design considerations/specifications.

- **Brush for external surfaces.** Length of the brush bristles, dimensions of the brush part (length and width), composition of the filament (recommended materials and materials that should not be used), and other design considerations/specifications.

### Decision Point 2: Gaps in Supplied Specifications

If the MDM has failed to provide all specifications needed to identify appropriate brush(es) to clean a device, then the user will need to determine these specifications. Depending on what information is missing, one or more of the following may need to be determined:

- **Brush for lumens**
  - Dimensions: internal diameter(s) of the lumen(s), which is also known as the “actual ID.” Channel dimension terminology is shown in Figure 1.
  - Select a brush with a diameter somewhat larger than the diameter of the lumen.
  - With the correct-sized brush, some resistance within the lumen will occur. Lack of resistance indicates that the brush is too small.
  - The brush should not be forced. This indicates the brush part is too wide and could damage the device. If too large, the bristles will “fold” and not effectively contact the surface.

- Dimensions: overall length of the lumen(s). Select a brush with an overall length greater than the length of the lumen.

- Material composition of the lumen: Considering whether the composition involves soft metal or other soft material can help in determining the filament(s) not to use (e.g., stainless steel, brass, stiff nylon), as damage to the device can result.

- Other design considerations
  - A brush that can be pulled all the way through the lumen may be necessary. Brush designs with a loop at the end typically cannot be pulled through and will have to be removed at the same end in which they entered. Brushes without a loop on the end can be pulled all the way through.
  - A disposable brush may be needed. This is common in the case of flexible endoscopes, as the risk of cross contamination is high. Single-use brushes might be preferable for other reasons. For instance, using a new brush every day (or every shift) means the quality of brush used from day to day will remain the same.
• **Brush for external surfaces**
  - Dimensions: depth of the area(s) to be cleaned. Select a brush with bristles long enough to reach these surfaces and cavities.
  - Dimensions: width of the area(s) to be cleaned. May need to select a brush wide enough to reach all areas in a tight spot.
  - Handle design and construction: the ability to adequately hold the brush during cleaning action.
  - Material composition(s) of the device surface(s): Considering whether the composition involves soft metal or other soft material can help in determining the filament(s) not to use (e.g., stainless steel, brass, stiff nylon), as damage to the device can result.
  - Other device design considerations: unique cavities.

**Purchasing the Proper Brush**

After specifications for the proper brush are available, the search for appropriate candidates can begin. At a minimum, the brush manufacturer should supply the dimensions for and composition of the brush. The following should be considered:

- **Dimensions of the brush**
  - Lumen brush: brush part diameter, brush part length, overall length of the brush
  - Surface brush: brush part length, brush part width, trim length of the brush, overall length/width of the brush

- **Design considerations**
  - Single versus reusable
  - Special design features

- **Pricing**

Ideally, the brush manufacturer will supply additional information. For instance, test methods for comparing brush parts are available from ASTM International. One may find that some manufacturers have used these test methods to characterize the performance of their brush(es) and even have compared their brush part design with a design supplied by the original equipment manufacturer or other supplier. Applicable ASTM methods include:

- **Lumen brushes**: ASTM F3275-19
  - Comparison of force to move a brush within a lumen
  - Comparison of soil removal of a brush from a lumen
- **Surface brushes**: ASTM F3276-19
  - Comparison of force exerted on a surface by moving a brush
  - Comparison of soil removal from a surface by moving a brush

**Selecting and Using the Right Brush**

The tools identified earlier (i.e., IFUs for the medical device and brush, sizing gauge, other tools) also can be useful when selecting and using the right brush. In addition, the brush manufacturer may provide additional tools, such as color coding a brush based on its diameter.

To select the correct brush:
1. Identify the medical device to be cleaned.
2. Examine the physical characteristics of the medical device.
   a. External surface: smooth, serrated, rough
   b. Internal surface: diameter, length
3. Read/review the IFU for any specific brush recommendations.
4. Select the brush(es) from available inventory.

**Figure 1.** Channel dimension terminology. Abbreviations used: ID, internal diameter; OD, outside diameter.
These tips can be used to clean a device with a brush successfully:
• Brushing is done on the decontamination area, not the clean side (assembly).
• Upon inspection, if an instrument is dirty, send it back to decontamination to be recleaned.
• Brush, flush/rinse (repeat as needed), dry, and inspect the device.
• Be sure to keep the instrument completely under the waterline when brushing.
• To ensure worker safety and for more effective cleaning, do not brush outside the water (unless directed otherwise by the IFU).
• When new instrumentation is acquired, a review of the reprocessing IFUs should be included in the evaluation to ensure that the reprocessing department has the tools to effectively reprocess the device.
• Always inspect the brush before use and after use.
• Clean off bristles before reinserting in lumens.

• If no direction is given in the IFU regarding the type of brush or method to use, use critical-thinking skills to determine the best method(s).

An orthopedic shaver (Figure 2) is a good example of a device that presents common challenges and illustrates the value of the tips listed previously. The following steps can be implemented to determine the brushes needed to properly clean a shaver:
1. When examining the physical characteristics of a shaver, note that it has both an external and internal surface.
2. Read/review the IFU for the type of brushes needed.
3. For the external surface, a soft bristle brush (Figure 3) is required.
4. For the internal surface cleaning, three types of brushes are required (Figure 4) and are to be used in a specific order.
5. Brushes are selected from inventory and used according to the IFU.

When new instrumentation is acquired, a review of the reprocessing IFUs should be included in the evaluation to ensure that the reprocessing department has the tools to effectively reprocess the device.

Figure 2. Example of a shaver

Figure 3. Examples of external soft bristle brushes for shavers
Therefore, based on the process described earlier, at least four separate brushes are needed to properly clean a shaver per the IFU.

**Cleaning (and Disinfecting) a Brush During and Between Uses**

*Open-ended lumen.* In cases where a brush is passed through the end of the lumen and is going to be pulled back from the end in which it entered, it should first be inspected for any debris/residue and that debris/residue should be removed before withdrawing the brush. Regardless of whether the brush is pulled through or pulled back, it should first be inspected for any debris/residue, which should be removed prior to reintroducing it into the same or another channel within the same device. A brush should always be cleaned prior to using it on another device.

*Close-ended lumen.* In cases where the lumen is closed on one end, upon withdrawal from the lumen, the brush should be inspected for any debris/residue and that debris/residue should be removed before reintroducing it into the same or another channel within the same device. A brush should always be cleaned prior to using it on another device.

**Processing a reusable brush.** Brushes that are intended to be reused on a daily basis should be reprocessed. At a minimum, these brushes should be thoroughly cleaned and disinfected daily or more frequently in accordance with the IFU. Reusable brushes intended to clean flexible endoscopes should undergo HLD or sterilization between uses on individual scopes.

If the brush can be run through a washer disinfector with a thermal disinfection stage, this would be the first choice. If the brush cannot withstand such a cycle (or a washer disinfector is not available), then thorough manual cleaning should be used. Typically, sterilization is not required for brushes that are used to clean medical devices that will undergo further processing after they are cleaned. However, exceptions always exist, and some brushes may be compatible with specified sterilization cycles.

**When to Dispose of a Brush**

In the case of single-use brushes, the IFUs for the brush and medical device should be consulted. According to ST79, if it is not specified in the IFUs of the brush or device, a “use” should be defined by the facility.¹ A “use” could be considered per device, per instrument set, per shift, per day, if it fails inspection before use, or other criteria.

All brushes need to be inspected before each use. Because brushes are considered consumable items that are subject to wear and tear, if damage is identified, the brush should not be reused. Common issues identified with reusable cleaning brushes include missing, loose, damaged, or fallen bristles; damage to the shaft; or other issues (as specified in the IFU).

Figure 5 provides examples of damage commonly associated with cleaning brushes and can help in determining whether a brush should be discarded, while Table 1 provides a worksheet that can be used to select the correct brush. In addition, a flow chart to aid in selecting an appropriate brush for a given instrument is provided in the online data supplement (available at https://aami-bit.org/loi/bmit).

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¹ A “use” could be considered per device, per instrument set, per shift, per day, if it fails inspection before use, or other criteria.

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Figure 4. Examples of internal brushes for shavers
Conclusion
Brushing is a mechanical action used to remove soiled particles, such as blood, tissue, and other contaminants, from internal and external surfaces prior to HLD or sterilization. Both friction and fluidics are required to clean effectively with a brush. Identifying, acquiring, selecting, properly using, cleaning (and disinfecting or sterilizing reusable brushes, as directed), and replacement are critical aspects associated with the use of brushes. The MDM may provide specifications in varying detail for the brush(es) to be used. If that information is not supplied or is incomplete, then critical-thinking skills are required to make an effective decision.

Acknowledgment
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References

Figure 5. Examples of damage commonly associated with cleaning brushes

<table>
<thead>
<tr>
<th>Device Area</th>
<th>Characteristic</th>
<th>Brush Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumen</td>
<td>Internal diameter</td>
<td>Diameter of the brush part should match the internal diameter.</td>
</tr>
<tr>
<td>Lumen</td>
<td>Length of the channel</td>
<td>Overall length of the brush needs to be longer than the length of the lumen.</td>
</tr>
<tr>
<td>Lumen</td>
<td>Material incompatibilities</td>
<td>Trim material</td>
</tr>
<tr>
<td>Surface</td>
<td>Width, length, and depth of any crevices, uneven surfaces, etc.</td>
<td>Trim length, width of brush part, length of brush part, special design/configurations, soft, moderate, hard</td>
</tr>
<tr>
<td>Surface</td>
<td>Material incompatibility</td>
<td>Trim material, avoid damaging the surface while brushing</td>
</tr>
</tbody>
</table>

Table 1. Worksheet to aid in selecting an appropriate brush