

# American National Standard

*for Power Tools –*

*Power-Driven Brushing Tools–  
Safety Requirements for  
Design, Care, and Use*

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**ANSI<sup>®</sup>**  
**B165.1-2005**  
Revision and redesignation  
ANSI/ABMA B165.1-1991  
(R2000)

American National Standard  
for Power Tools –

**Power-Driven Brushing Tools –  
Safety Requirements for  
Design, Care, and Use**

Sponsor

**American Brush Manufacturers Association**

Approved August 5, 2005

**American National Standards Institute, Inc.**

# American National Standard

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**Foreword** (This foreword is not part of American National Standard ANSI B165.1-2005.)

In an endeavor to react with sensitivity to the safety of those associated with power-driven brushes, this standard has as its primary objective the prevention of injuries to those who use them. It would do so by establishing the requirements for the design, care, and use of power-driven brushing tools, excluding those brushing tools constructed with wood, plastic, or composition hubs or cores.

Information contained in this standard is designed to assist machine operators and their supervisors in maintaining and operating all types of brushing equipment, including portable power tools.

The Safety and Standards Committee of the American Brush Manufacturers Association (ABMA) recognizes that it has an obligation to reflect, within this standard, the balanced best interests of the manufacturers and users. To assist in the interpretation of the requirements of this standard, responsibilities have been assigned to brush manufacturers, brushing machine manufacturers, and brush users. This assignment of responsibilities shows that safety must be a cooperative effort shared equally by each of these segments.

This standard is a revision of *American National Standard Safety Requirements for Design, Care and Use of Power-Driven Brushing Tools*, ANSI/ABMA B165.1-1991 (R2000)). The original 1991 standard was developed after it was recognized that there was a need for a safety standard for power-driven brushes. To develop the standard, the Industrial Division of ABMA established a Safety and Standards Committee, which worked cooperatively with the Society of Manufacturing Engineers (SME).

Prior to publication of the 1991 standard, SME canvassed a large number of interested, concerned, and representative industry associations, government agencies, societies, institutions, foundations, and commissions to ensure the development of a consensus. After approval, the standard was published by SME in 1991 with the co-sponsorship of the ABMA and the cooperative help of the American National Standards Institute (ANSI).

During the past five years, the 2000 reaffirmation of the 1991 standard served the best interests of those most affected or influenced by its use. In accordance with the revisions of the American National Standards Institute's five-year periodic review procedure, their standard has been reviewed, revised, and updated through the Canvass Method. The standard was reaffirmed in 2000 and revised in 2005.

Suggestions for improvement of the standard are welcomed. They should be sent to the American Brush Manufacturers Association, 2111 Plum Street, Aurora, IL 60506-3268.

The following organizations recognized as having an interest in the standardization of power-driven brushing tools were contacted prior to the approval of this standard. Inclusion in this list does not necessarily imply that the organization concurred with the submittal of the proposed standard to ANSI.

Alliance of American Insurers  
American Association of Industrial Management  
American Dental Association  
American Electroplaters and Surface Finishers Society  
American Federation of Labor and Congress of Industrial Organizations (AFL-CIO)  
American Foundry Society  
American Insurance Association  
American Iron and Steel Institute  
American Occupational Medical Association  
American Petroleum Institute  
American Society for Testing and Materials  
American Society of Safety Engineers  
American Supply and Machinery Manufacturers Association  
American Textile Machinery Association  
American Welding Society  
Association for Manufacturing Technology  
Canadian Brush Manufacturers Association  
Consumer Product Safety Commission  
Consumer Testing Laboratories, Inc.  
European Brush Manufacturers Association (FEIBP)  
Factory Mutual Research Corporation  
Industrial Health Foundation  
Industrial Risk Insurers  
International Safety Equipment Association  
Motor Vehicle Manufacturers Association  
National Association of Dental Laboratories  
National Hardwood Lumber Association  
National Restaurant Association  
National Safety Council  
National Welding Supply Association  
Power Tool Institute  
Society of Automotive Engineers  
Society of Manufacturing Engineers  
Society of the Plastics Industry  
Triodyne Incorporated  
Underwriters Laboratories  
Union of Needletrades, Industrial and Textile Employees  
United Abrasives Manufacturers Association  
United Brotherhood of Carpenters and Joiners of America  
United Steelworkers of America  
U.S. Department of Labor - OSHA  
U.S. General Services Administration

## **Explanation of Standard Format**

This standard uses a two-column format to provide both specific requirements and supporting information.

The left column, designated "Standard Requirements" is confined solely to these requirements and is printed in bold type. Where supporting photographs or sketches are required, they are designated as "figures."

The right column, designated "Explanatory Information" contains only information that is intended to clarify the standard. This is *not* a part of the standard. Where supplementary photographs or sketches are required, they are designated as "illustrations."

Operating rules (safe practices) are not included in either column unless they are of such nature as to be vital safety requirements, equal in weight to other requirements or guides to assist in compliance with the standard.

## American National Standard for Power Tools –

## Power-Driven Brushing Tools – Safety Requirements for Design, Care, and Use

### Standard Requirements

### *Explanatory Information*

*(Not part of American National Standard ANSI B165.1-2005)*

#### 1 Scope

The purpose of this standard is to establish the rules and specifications for safety that apply in the design, use, and care of power-driven brushing tools. It includes specifications for shanks, adapters, flanges, collets, chucks, and safety guards and rules for the proper storage, handling, mounting, and use of brushes. It embraces all configurations of brushing tools whose functional performance is accomplished by power-driven operation. Covered are brushing tools whose brushing elements are made up of ferrous wire, nonferrous wire, plastic, abrasive filaments, vegetable fibers, animal hair, or other materials, and brushes fabricated with any combination of such elements.

Brushing tools whose primary function is vehicle or train washing, carpet sweeping, dental hygiene, floor maintenance, sewer cleaning, street sweeping, and brushing tools manufactured in accordance with other applicable American National Standards are not covered.

#### *E1 Scope*

It is the intent of this standard to cover all power-driven brushes, of any size, any materials, any construction or any configuration except those specifically excluded under the scope. Brushes with wood or synthetic hubs and cores, which have overall appearances very similar to power brushes of this standard, have been excluded because the parameter of construction and use differ fundamentally from brushes covered in this standard. Other brushes excluded in this standard have been omitted because of significant differences in construction, dimension, service conditions or application.



## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

**ANSI B7.1-2000, *Safety requirements for the use, care, and protection of abrasive wheels***

**ANSI Z87.1-2003, *Practice for occupational and educational eye and face protection***

**ANSI/UL 60745 (Series), *Safety standard for portable electric tools***

**ANSI/UL 987-2005, *Safety standard for stationary and fixed electric tools***

**Z88.2, *Practices for respiratory protection***

## 3 Definitions

### 3.1 General definitions

**3.1.1 brush:** For brevity in this standard, used interchangeably with “brushing tool,” “power-driven brushing tool,” or “power-driven brush.”

**3.1.2 shall and should:** The word “shall”, where used, is to be understood as mandatory, and “should” as advisory.

**3.1.3 revolutions per minute (rpm):** The number of complete turns that a brush makes in one minute.

## E2 Bibliography (informative)

ANSI/NFPA 91-2004, *Exhaust systems for air conveying of materials*

ANSI/UL 154 CAN/ULC-5503-2005, *Safety standard for carbon-dioxide fire extinguishers*

OSHA Safety Code 1910.94

OSHA Title 29, Chap. 17, Part 1910.94(b)

### E3.1.3 Revolutions per minute

Although machine spindle speeds are usually indicated in revolutions per minute (rpm), and motor name plate speeds invariably are described in terms of the number of revolutions the motor will produce in one minute, brush speeds often classified in surface feet per minute (sfpm) or surface meters per minute (smpm). It is, therefore, essential to know the difference between how they are measured and what those measurements mean..

**3.1.4 surface feet per minute (sfpm):** The distance in feet traveled by any spot on the peripheral surface of a brush in one minute.

$$\text{sfpm} = \frac{3.1416 \times \text{diameter in inches} \times \text{rpm}}{12}$$

or: **0.262 × diameter in inches × rpm for a very close approximation**

**3.1.4a surface meters per minute (smpm):** The distance in meters traveled by any spot on the peripheral surface of a brush in one minute.

$$\text{smpm} = \frac{3.1416 \times \text{diameter (mm)} \times \text{rpm}}{1000}$$

or: **0.003 × diameter in millimeters × rpm for a very close approximation**

**3.1.5 the brush manufacturer:** Any individual, partnership, corporation, or other form of enterprise that manufactures or assembles any kind of power-driven brushing tools.

**3.1.6 the brush machine or power tool builder:**

- Any individual, partnership, corporation, or other form of enterprise that is engaged in the development, or manufacture, or both, of any type of machine or power tool that uses power-driven brushing tools.
- One who converts, changes, or otherwise alters the original design of such machines or power tools.

**3.1.7 the user:** Any individual, partnership, corporation, or other form of enterprise that uses any kind of power-driven brushing tools or brush machines.

#### *E3.1.4 Surface feet per minute*

When the diameter of a brush is indicated in inches, it is necessary to divide by 12 the result of multiplying the diameter by rpm by pi (3.1416). An example of this equation follows for a brush 12 inches in diameter turning at 1000 rpm:

$$\frac{3.1416 \times 12 \times 1000}{12} = 3141.6 \text{ sfpm}$$

This measurement is also referred to as "circumferential speed."

#### *E3.1.4a Surface meters per minute*

When the diameter of a brush is indicated in millimeters, it is necessary to divide by 1000 the result of multiplying the diameter by rpm by pi (3.1416). An example of this equation follows for a brush 305 millimeters in diameter turning at 1000 rpm:

$$\frac{3.1416 \times 305 \times 1000}{1000} = 957.6 \text{ smpm}$$

This measurement is also referred to as "circumferential speed."

**3.1.8 maximum safe free speed (MSFS or max. SFS):** Synonymous with maximum safe rpm (free rotation). The maximum speed at which the brush shall be rotated with no work applied (spinning free) to ensure safe operation. All brush manufacturers have the responsibility of determining the MSFS for their products. A recognized criterion for establishing this value for each brush is described in 8.3.

**3.1.9 operating face width:** The width of the face of the brush, measured at operating speed.

*E3.1.9 Operating face width*

The width of a wheel brush rotating at operational speeds frequently is different from the width or face of the same brush in a stationary condition. The face width of brush filaments in a static brush is usually wider than the same assembly of filaments at point of attachment. When rotating at operational speeds, centrifugal force orientates all filaments into a radial, more compact configuration that substantially reduces any lateral displacement. As a result, the mass of filaments are nearly the same width at the periphery as they are at the point of attachment.

**3.1.10 fill or fill material:** The filaments that do the brushing in a brush. Fill material can be ferrous or nonferrous wire, abrasive loaded plastic, plastic, composites, vegetable fiber, animal hair, or other materials. Sometimes the fill is a combination of two or more different fill materials, such as wire, tampico, horsehair, plastic, vegetable fiber, and pig bristle.

**3.1.10.1 crimped plastic fill material:** Synthetic fill material whose linear configuration is not straight or level, but is corrugated in appearance from having been passed through gears or other devices.

*E3.1.10.1 Crimped plastic fill material*

The configuration of crimped plastic fill materials is similar to that of crimped wire (see 3.1.13).

**3.1.10.2 abrasive loaded plastic fill materials:** Synthetic fill material made of plastic monofilaments that have abrasive grit homogeneously dispersed throughout.

**3.1.10.3 straight or level plastic fill material:** Synthetic fill material that is straight before being used in a brush or before being formed into a tuft or other configuration as part of a brush.



**3.1.10.4 vegetable fiber fill material:** An end product resulting from the processing of the fibrous part of the leaf or root of various types of plants and trees. Typical fibers are tampico, palmyra, bassine, and palmetto.

**3.1.10.5 hair fill material:** The hair of any animal except a pig, hog, or boar. Whalebone and feathers are not construed to be hair.

**3.1.10.6 bristle fill material:** The hair of a pig, hog, or boar.

**3.1.11 brush flexibility:** The brush's capability to conform to irregular or contoured surfaces are measured by filament deflection.

#### *E3.1.10.6 Bristle fill material*

The term "bristle," when used in relationship to brushes, is restricted and limited to the hair of the swine exclusively and should not be used to describe any other filaments.

#### *E3.1.11 Brush flexibility*

The quality of a brush that determines resiliency or stiffness is measured in terms of resistance to the bending of filaments. This physical characteristic of flexibility, sometimes referred to as "modulus of elasticity (stiffness)," can be varied in a number of ways. Primary ways are as follows:

- Change modulus of elasticity of the fill materials, which varies for different materials. For example: steel, brass, hair, nylon.
- Increase or decrease the diameter of fill material. For example: 0.020 inch (0.508 mm) steel wire is stiffer than 0.005 inch (0.127 mm) steel wire of same analysis.
- Increase or decrease the trim length of the fill material. For example: A steel wire filament that is 0.010 inch (0.254 mm) in diameter and 1 inch (25.4 mm) long is stiffer than a similar steel wire filament that is 0.010 inch (0.254 mm) in diameter and 4 inches (101.6 mm) long.
- Increase or decrease the speed of rotation. For example: The faster a brush is rotated, the stiffer it becomes because of the influence of centrifugal force.
- Change the construction of the brush. For example: Filaments of wire twisted together as in a knotted or twisted tuft brush are stiffer than those in a crimped wire brush. In the knot or twisted tuft construction, the filaments being twisted

together act as a family of filaments, while in a crimped wire brush, they act more independently of other filaments.

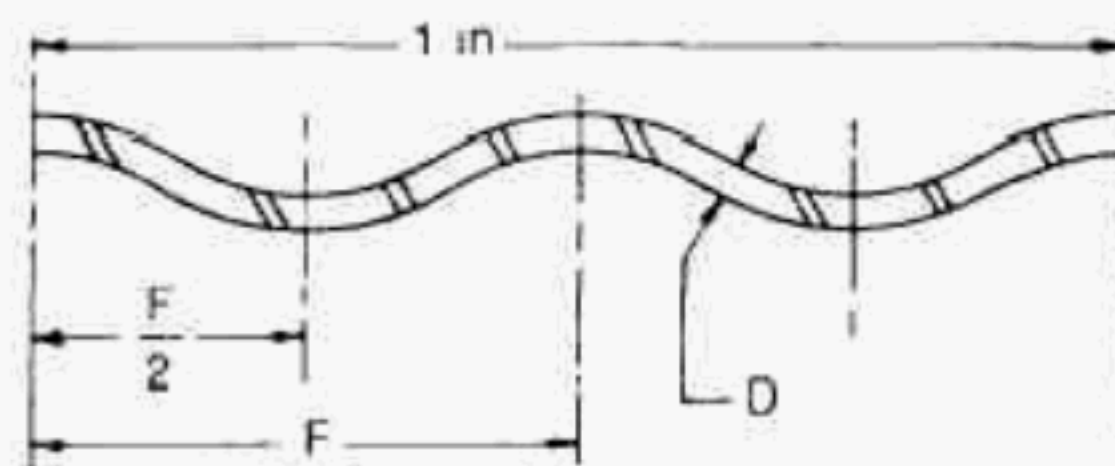
- Increase or decrease the number of brushing points per square unit of brush face. This changes the brush flexibility through wire packing, load division, or both; accordingly, flexibility increases as density decreases and, conversely, less capability to conform to the surface being brushed will result as density increases.

Encapsulating, coating, or treating the brushes makes them less flexible than the brushes without encapsulation, coating, or treatment.

**3.1.12 bonded brushes (also, elastomerically encapsulated brushes):** Brushes that have elastomer material molded into them unitizing the fill material.

**3.1.13 crimped wire:** Wire that has been passed through gears or other devices to impart a configuration similar to a sine waveform to the wire.

*E3.1.13 Crimped wire*



**NOTES**

1 The illustration shows a single-plane crimped filament; however, dual-plane crimped filaments are more commonly used.

2  $F$  = Full wave length;  $F/2$  = Half wave length;  $D$  = Filament diameter;  $A$  = Crimp amplitude

**Illustration 1 – Single-plane crimped filament**

**3.1.14 straight wire:** Wire that was straight before being used in a brush or before being formed into a tuft or other configuration as part of a brush.

**3.1.15 twisted tuft or knot:** A group of straight wires of equal length that are passed through or around a retaining member, bent into a U-shape, then twisted together to form a single tuft. The helix angle, or angle of twist of a tuft is the angle through which a radial section of a group of wires deflects from its normal position when the wires are subjected to a predetermined twisting torque. The helix

angle is a variable, contingent upon the type of wire, the diameter, and the size of the tuft.

**3.1.16 shank:** Male extension and driving means (usually of an end, wheel, or cup brush) capable of being gripped in a chucking device or collet of proper size.

**3.1.17 arbor adapter:** Device used to reduce the size of an arbor hole in a brush. Frequently, an adapter is a concentric ring with or without a shoulder.

#### *E3.1.17 Arbor adapter*

Adapter should be designed so that, when tightened, the adapter shoulder is bearing against the brush. Brushes using adapters without a shoulder are tightened to bear against the brush. When used in pairs, adapters should be of the same or proper shape to avoid cross-bending pressures and distortion of the brush; and should be of sufficient rigidity to resist distortion from mounting pressure.

Adapters can be distorted by excessive tightening, or burred by dropping; therefore, they should be checked periodically.

In some brush operations in which wheel slippage may be a problem, it may be necessary to key or otherwise securely fasten the adapters to the spindle.

**3.1.18 density:** The number of filament ends per given area of brush face.

**3.1.19 face width:** The axial dimension at the outside diameter of a brush when it is measured in its static condition.

**3.1.20 brush face:** The surface of the brush that does the brushing as viewed from the ends of the filaments.

**3.1.21 trim length:** Dimension of fill material extending from beyond the retaining member, face plate, or bridle (visible length of filament).

**3.1.22 safety guard:** Enclosure designed to contain any filaments, or any particles removed by brushing, that might be thrown from the brush or by the brush while it is rotating. Guards shall be placed where necessary, except in the open area of operation to allow access to the work.

**3.1.23 safety shield:** Fixed or adjustable transparent visor or eye shield that is connected to the brushing machine, which

provides additional safety for the operators while permitting them to visually observe the brushing being accomplished. In addition to fixed or adjustable transparent visors or eye shields that are attached to a machine, brush operators and others in the area of the brushing operation shall wear safety goggles, full face shields over safety glasses with side shields, or other forms of personal eye protection as described in ANSI Z87.1.

**3.1.24 barrier:** any partition, wall, or separate brushing booth that provides protection to the operator and/or other personnel in the area.

*E3.1.24 Barrier*

Such protection takes the form of an enclosure that isolates the operation from the remaining work area. Barriers can be either fixed or adjustable enclosures and are usually not connected with the brushing machine.

**3.1.25 arbor hole bushing:** Centering device placed in an arbor hole to reduce its size. Tubular bushings are frequently used for this purpose and are used in the same way as adapters without a shoulder.

**3.1.26 bridle:** Brush component used to control or restrain flare on cup or end brushes.

**3.2 Definitions of brush configurations**

Elastomerically encapsulated brushes of the following types and classes shall be subject to the same regulations as the base brush.

**3.2.1 Type I, straight cup brushes:** As shown in figure 1, type I brushes are brushes with a cup configuration and straight sides that are parallel to the axis of the brush. Dimensions shall include the outside diameter, inside diameter, trim length, overall height, face width, and arbor hole diameter.

- **Class 1:** Crimped wire, abrasive loaded plastic, plastic, fiber, or hair fill material: As shown in figure 1(a), class 1 brushes with crimped wire, abrasive loaded plastic, or plastic fill material have additional dimensions such as wire or plastic diameter, crimp amplitude, and crimp wave length. Specifications include the appropriate chemical and physical attributes of the fill material. When



brushes are furnished with fiber or hair fill material, the type of quality of the material shall be specified.

- Class 2: Twisted tuft or knot fill material: As shown in figure 1(b), class 2 brushes with a twisted tuft or knot have additional dimensions such as wire diameter and number of rows or tufts. Specifications include the appropriate chemical and physical attributes of the fill material. Helix angle or twist configuration of tufts and length of twist may be described.

**3.2.2 Type II, flared cup brushes:** As shown in figure 2, type II brushes are brushes with a cup configuration that have flared cups with the included angle of the cup being a variable depending upon the application. Dimensions shall include outside diameter, inside diameter, trim length, overall heights, face width, and arbor hole diameter.

- Class 1: Crimped wire, abrasive loaded plastic, plastic fiber, or hair fill material: As shown in figure 2(a), class 1 brushes with crimped wire, abrasive loaded plastic or plastic fill material have additional dimensions such as wire or plastic diameter, crimp amplitude, and crimp wave length. Specifications include the appropriate chemical and physical attributes of the fill material. When brushes are furnished with fiber or hair fill material, the type and quality of the material shall be specified.
- Class 2: Twisted tuft or knot fill material: As shown in figure 2(b), class 2 brushes with a twisted tuft or knot have additional dimensions such as wire diameter and number of rows or tufts. Specifications include the appropriate chemical and physical attributes of the fill material. Helix angle or twist configuration of tufts and lengths of twist may be described.

**3.2.3 cup brush with shank:** Type I straight cup brushes, both class 1 and class 2, can be furnished with a shank as shown in figures 3(a) and 3(b). Dimensions and specifications shall be the same as in 3.2.1, except arbor hole dimensions are not

**applicable. Additional dimensions shall include diameter and length of shank.**

**Type II flared cup brushes, both class 1 and class 2, can be furnished with a shank as shown in figures 4(a) and 4(b). Dimensions and specifications shall be the same as in 3.2.2, except arbor hole dimensions are not applicable. Additional dimensions shall include diameter and length of shank.**

**3.2.4 Type III, wheel or radial brush: As shown in figure 5, type III brushes are circular brushes with a wheel configuration. Dimensions shall include diameter, trim length, face width, and arbor hole dimensions. Radial brushes whose length exceeds their diameter are called cylinder or wide-face brushes (see 3.2.11).**

- **Class 1: Crimped wire, abrasive loaded plastic, plastic, fiber, or hair fill material: As shown in figure 5(a) class 1 brushes with crimped wire, abrasive loaded plastic, or plastic fill material have additional dimensions such as wire or plastic diameters, crimp amplitude, and crimp wave length. Specifications include appropriate chemical and physical attributes of the fill material. When brushes are furnished with fiber or hair fill material, the type and quality of the material shall be specified.**
- **Class 2: Twisted tuft or knot: As shown in figure 5(b), class 2 brushes with a twisted tuft or knot have additional dimensions such as wire diameter and number of rows or tufts. Specifications include the appropriate chemical and physical attributes of the fill material. Helix angle or twist configuration of tufts and length of twist may be described.**

**3.2.5 wheel or radial brush with shank: Type III wheel brushes, both class 1 and class 2, can be furnished with a shank as shown in figures 6(a) and 6(b). Dimensions and specifications shall be the same as 3.2.4, except that arbor hole dimensions are not applicable. Additional dimensions shall include diameter and length of shank.**

**3.2.6 Type IV, end brush:** As shown in figure 7, type IV brushes have an end brush configuration with the fill material protruding from one end of the driving component. They generally have a permanently attached shank. The fill material is oriented so that its length is parallel to the axis of the brush. Dimensions shall include face outside diameter, trim length, shank diameter, shank length, overall length, and cup diameter.

- **Class 1: End brush with crimped wire, abrasive loaded plastic, plastic, fiber, or hair fill material.** There are three styles of class 2 end brushes (see figure 7(a)). They all have additional dimensions that include wire, abrasive loaded plastic, or plastic diameter, crimp amplitude, and crimp wave length. Specifications include appropriate chemical and physical attributes of the fill material. When brushes are furnished with fiber or hair fill material, the type and quality of the material shall be specified.

Elastomerically encapsulated brushes of this class shall be subject to the same regulations as the base brush.

- **Style A, Solid filled end brush:** Style A brushes have the cup end filled so that the brush presents a continuous face.
- **Style B, Hollow center end brush:** Style B brushes are identical to style A brushes in every respect, except that the face has a circular void centrally located on the face of the brush. These brushes have the additional dimensions of face inside diameter.
- **Style C, Pilot end brush:** Style C brushes are identical to style A brushes in every respect, except that a pilot protrudes from the central part of the face. It has the additional dimensions of the diameter, center length, and radius of the pilot. The chemical and physical properties of pilot material shall be identified.

- **Class 2: End brush with twisted tuft or knot, hollow center:** Class 2 end brushes (see figure 7(b)) with a twisted tuft or knot have additional dimensions that include wire diameter, number of tufts, inside diameter, and face outside diameter. Specifications should include appropriate chemical and physical attributes. Helix angle or twist configuration of tufts and length of twist may be described.

**3.2.7 Type V, flared end brush:** As shown in figure 8, type V flared end brushes have a self-contained shank. The fill material that protrudes from the retaining cup is flared into a circular pattern, with the filaments being oriented into a radial configuration. Dimensions shall include flared diameter, face width, cup diameter, shank diameter, shank length, overall length, filament diameter, crimp amplitude, and crimp wave length. Specifications include appropriate chemical and physical attributes of wire or other fill materials.

**3.2.8 Type VI, tubular end brush:** As shown in figure 9, type VI tubular end brushes are constructed both with and without shank extension. The fill wire, abrasive-loaded plastic, plastic, or other fill material is oriented so that its length is parallel to the axis of the brush. Dimensions shall include outside diameter, trim length, and overall length. The brushes can be filled with either straight or crimped fill material. The diameter of the wire, abrasive-loaded plastic, or plastic fill material shall be specified. If crimped wire, abrasive loaded plastic, or plastic is used, the dimensions of crimp wave length and crimp amplitude shall be specified. Specifications include appropriate chemical and physical attributes of the fill material. When brushes are furnished with fiber or hair fill material, the type and quality of the material shall be specified.

Elastomerically encapsulated brushes of this class shall be subject to the same regulations as the base brush.



If the tubular end brush contains a shank, the diameter and the length of the shank shall be specified.

**3.2.9 Type VII, twisted-in wire brush (or tube cleaning brush):** As shown in figure 10, type VII twisted-in wire brushes are made by twisting the fill material between two or more retaining stem wires. This construction places each filament in a radial position in which the total mass of fill material is helical or spiral in configuration. Specifications include type of fill, outside diameter and length of brush part, number of stem wires, stem length, and stem diameter.

Either straight or crimped fill material can be used. The size of the fill material shall be specified. If crimped material is used, the dimensions of crimp wave length and the crimp amplitude shall be specified. Specifications include appropriate chemical and physical attributes of both the fill materials and the stem wire.

If the twisted-in wire brush has a shank or extension affixed to the stem, the diameter of the shank or extensions shall be specified. If the shank is threaded, the size and length of the thread is specified.

Elastomerically encapsulated brushes of this class shall be subject to the same regulations as the base brush.

**3.2.10 Type VIII, strip brush:** As shown in figure 11, type VIII strip brushes are manufactured in a continuous strip form and subsequently cut to the required finish length. In addition to their straight configuration (shown in figure 11), strip brushes may also be helically wound around the outside of an arbor for use as wide-face rotary brushes (see the coil-wound strip in figures 12 and 13).

Strip brushes are commonly manufactured by roll forming a metal channel and pressing the fill material into the channel in a hairpin configuration. A retaining member runs the entire length of the strip to ensure retention of the fill material.

**3.2.11 Type IX, cylinder or wide-face brushes:** As shown in figure 12, type IX cylinder brushes are either directly mounted on reusable arbors by the brush manufacturer or assembled as replacement elements by the user. The mandrel on which the brushes are mounted can be manufactured by either the brush manufacturer, the brush machine builder, or the user. The specifications of the arbor shall be determined by the brush machine builder. The specifications may be modified by the brush manufacturer if the modifications do not preclude the arbor being used in the machine for which it was designed.

The dimensions for the brushes shall include outside diameter, inside diameter, face width, and trim length.

- **Class 1: Cylinder or wide-face brushes that are mounted by brush manufacturer:** Class 1 brushes are either sectional built-up face brushes or strip brushes. Many modifications of each of them are produced and many are customized for particular applications of users. Figure 12 shows several types of sectional built-up face and strip cylinder brushes.

The specifications frequently include provisions for brushes in which coolant or other liquids are pumped through the face of the brush.

- **Style A, Sectional built-up face:**
  - **Crimped fill material:** Specifications include fill diameter, crimp amplitude, and crimp wave length and appropriate chemical and physical attributes of the fill material.
  - **Twisted tuft or knot fill material:** Specifications include wire diameter and the number of rows of tufts, helix angle (twist configuration, length of

*E3.2.11 (1) Class 1: Cylinder or wide-face brushes that are mounted by brush manufacturer*

Aside from the two primary styles mentioned in this clause, there are many other types of class 1 cylinder or wide-face brushes. Since they are too numerous to describe in this standard, only the two most common styles have been included.

- twist, and tuft concentration). Specifications include appropriate chemical and physical attributes of the fill material.
- Nonmetallic fill material: Specifications shall include type of fill and size of filaments.
- Style B, strip: Strip brushes can be inserted in mounting clips or otherwise anchored on the permanent (reusable) arbors so that the density of the fill can range from very light to very heavy.

Dimensions shall include height and width of metal retaining device, overall height of strip, number of strips, description of the fill material, and helix (spiral) angle of the strip.

- Straight strip brushes with wire or nonmetallic fill material: Straight strip brushes are fastened parallel to the axis of the hub. Specifications include wire diameter, crimp amplitude, crimp wave length, and appropriate chemical and physical properties of the wire fill material, type of material if nonmetallic, and diameter of filaments, where appropriate.
- Helix strip brushes: Helix strip brushes can be assembled in a helically disposed arrangement with the individual strip brushes positioned in a longitudinal direction.
- Coil-wound strip brushes: Strip brushes can be wound circumferentially around the arbor with either a long lead (pitch) or a closely wound

lead (pitch) to provide open or dense construction.

- **Class 2: Expendable brushes, unitized brushes, or both:** Like class 1 brushes, class 2 brushes are either sectional built-up face brushes or strip brushes. These brushes can be manufactured either by factory assembly directly onto the user's shaft or as a cartridge-type unit that is made for later assembly on the user's arbor at the time of need. Examples of these brushes are provided in figure 13.

*E3.2.11 (2) Class 2: Expendable brushes, unitized brushes, or both*

Aside from the two primary styles mentioned in this clause, there are many other types of class 2 cylinder or wide-face brushes. Since they are too numerous to describe in this standard, only the two most common styles have been included.

- **Style A, Sectional built-up face:**
  - **Crimped fill material:** Specifications include type of fill material, fill diameter, crimp amplitude, crimp wave length, and appropriate chemical and physical attributes of fill material.
  - **Twisted tuft or knot fill material:** Specifications include wire diameter and number of rows of tufts, helix angle (twist configuration), length of twist, tuft concentration, and appropriate chemical and physical attributes of wire fill material.
  - **Nonmetallic fill material:** Specifications shall include type of fill and size of filaments.
- **Style B, strip:** Strip brushes can be inserted in mounting clips on the permanent (reusable) arbors or anchored to cartridges that can be mounted on the user's arbors. The mounting method allows a variation in the density of the brush from very light to very heavy. Dimensions shall include height and width of metal retaining device, overall height of strip, number of strips, description of the fill material,

and helix angle of the strip,  
where applicable.

- **Straight strip brushes with wire fill material:** Straight strip brushes are fastened parallel to the axis off the hub. Specifications include wire diameter, crimp amplitude, crimp wave length, and appropriate chemical and physical properties of the wire fill material.
- **Straight strip brushes with nonmetallic fill material:** In addition to the specifications for straight strip brushes with wire fill material, specifications for strip brushes with nonmetallic fill material also include the type of material and the diameter of filaments, where appropriate.
- **Helix strip brushes:** Helix strip brushes can be assembled in a helically disposed arrangement with the individual strip brushes positioned in a longitudinal direction.
- **Coil-wound strip brushes:** Strip brushes can be wound circumferentially around the arbor with either a long lead (pitch) or a closely wound lead (pitch) to provide open or dense construction.

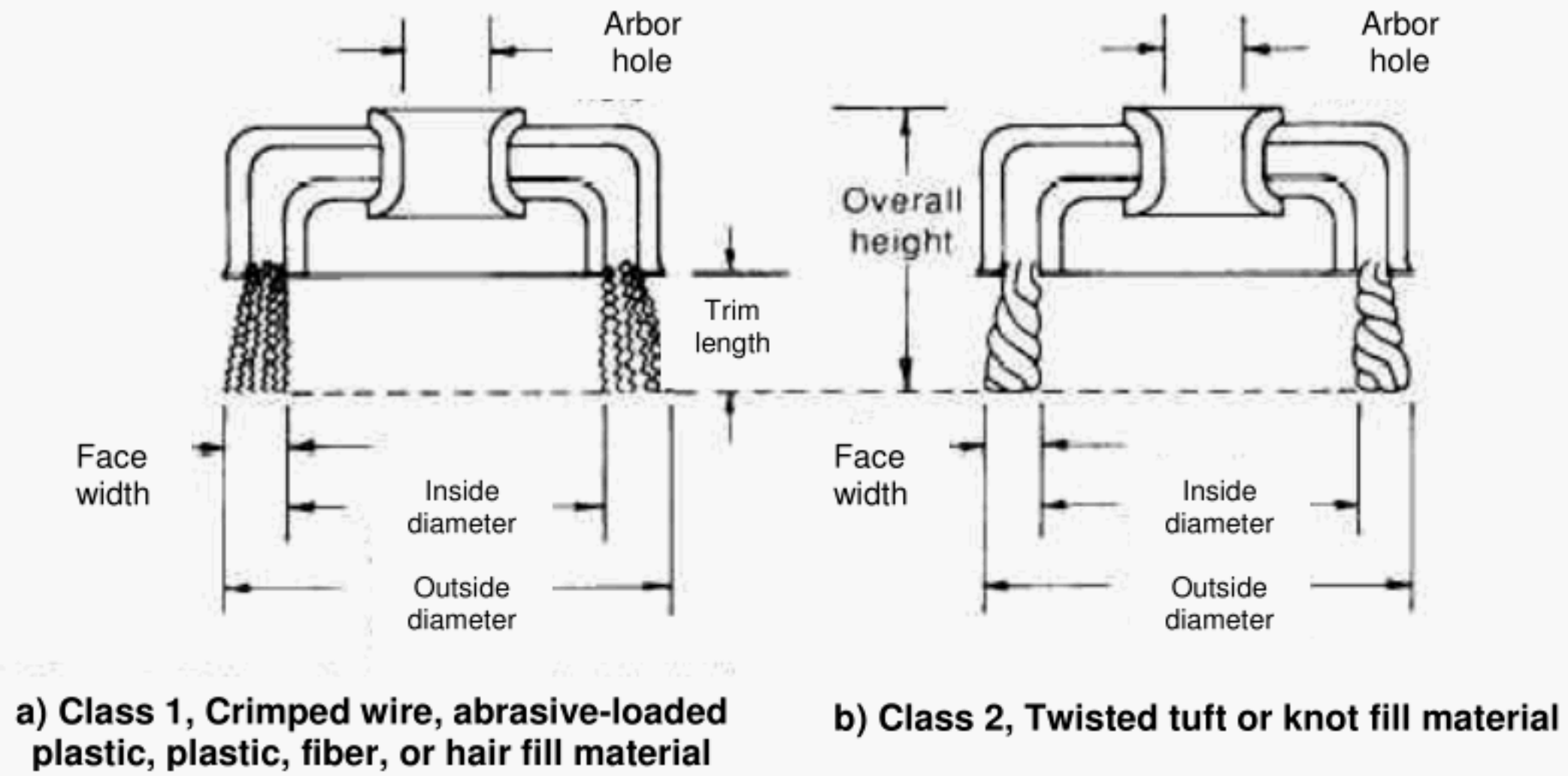


Figure 1 – Type I, Straight cup brush

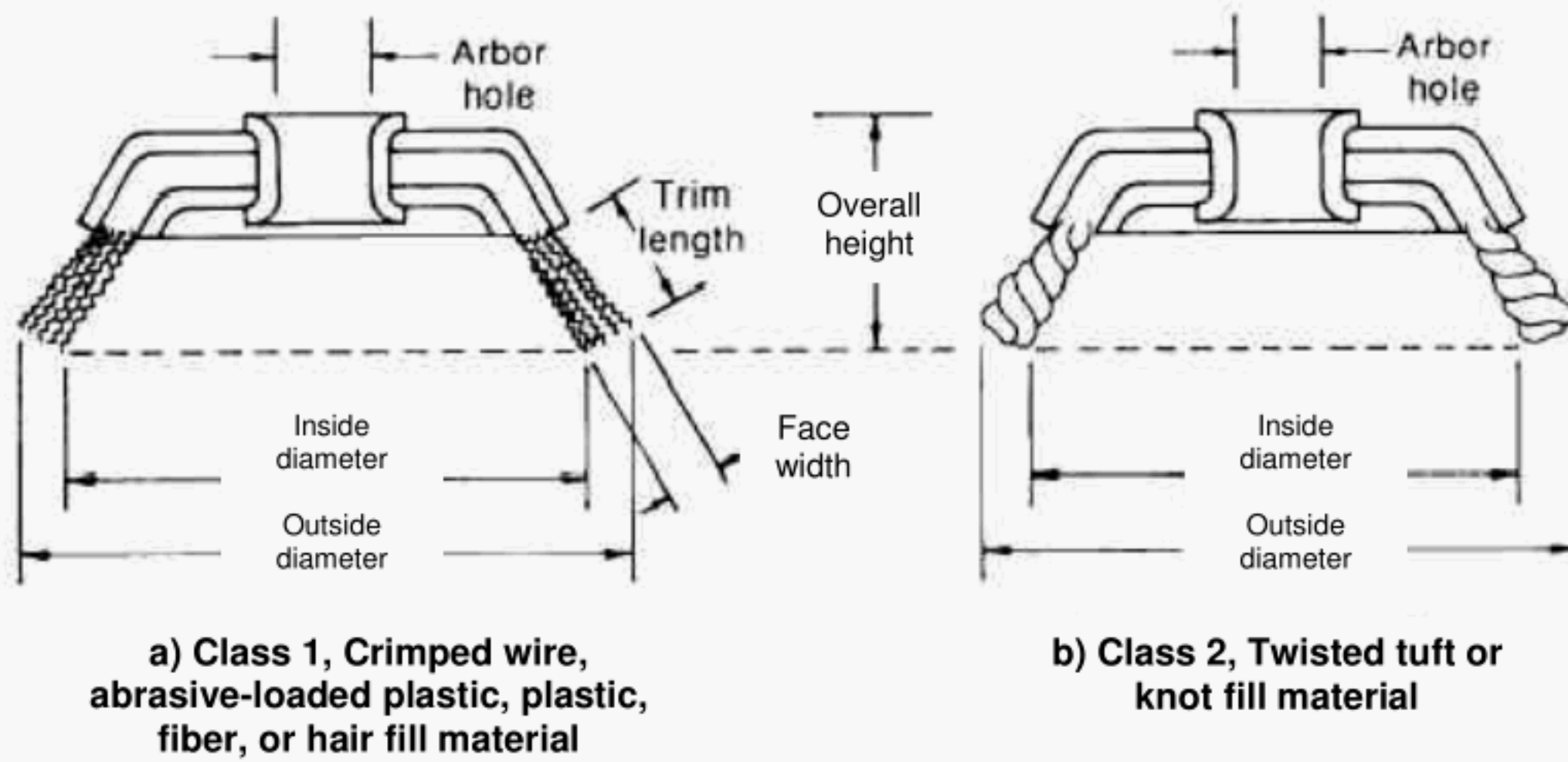


Figure 2 – Type II, Flared cup brush



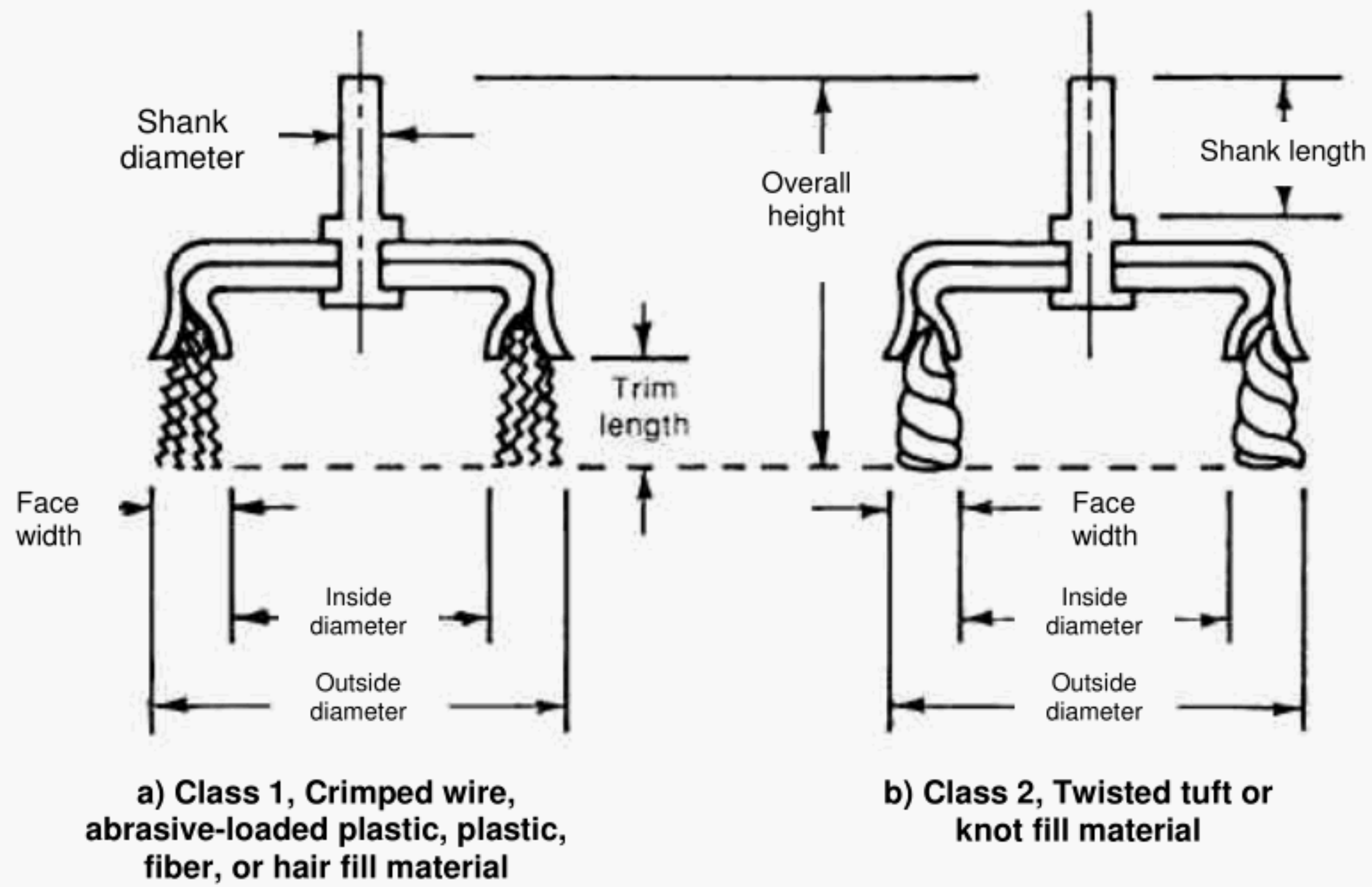


Figure 3 – Type I, Straight cup brush with shank

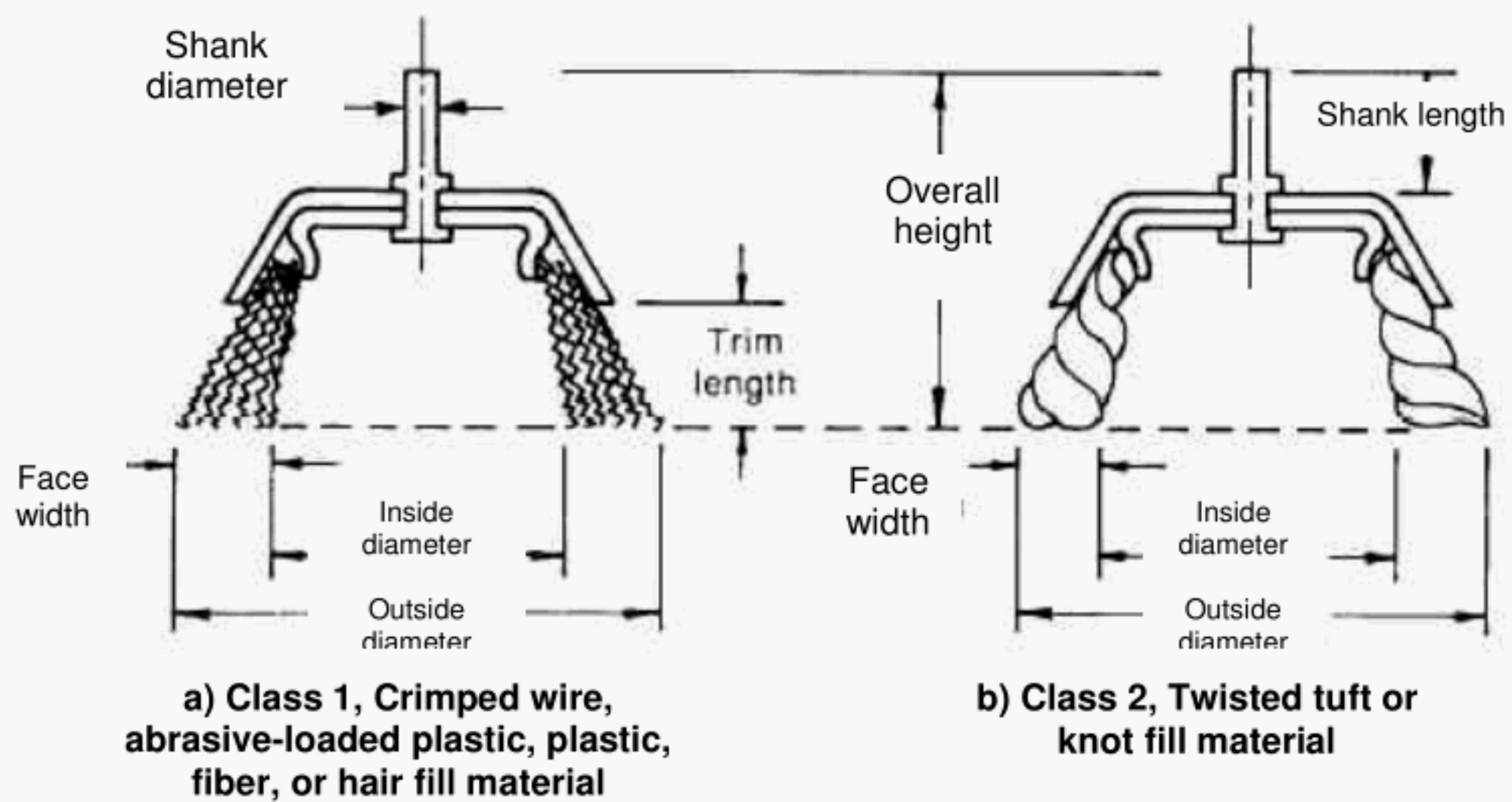


Figure 4 – Type II, Flared cup brush with shank

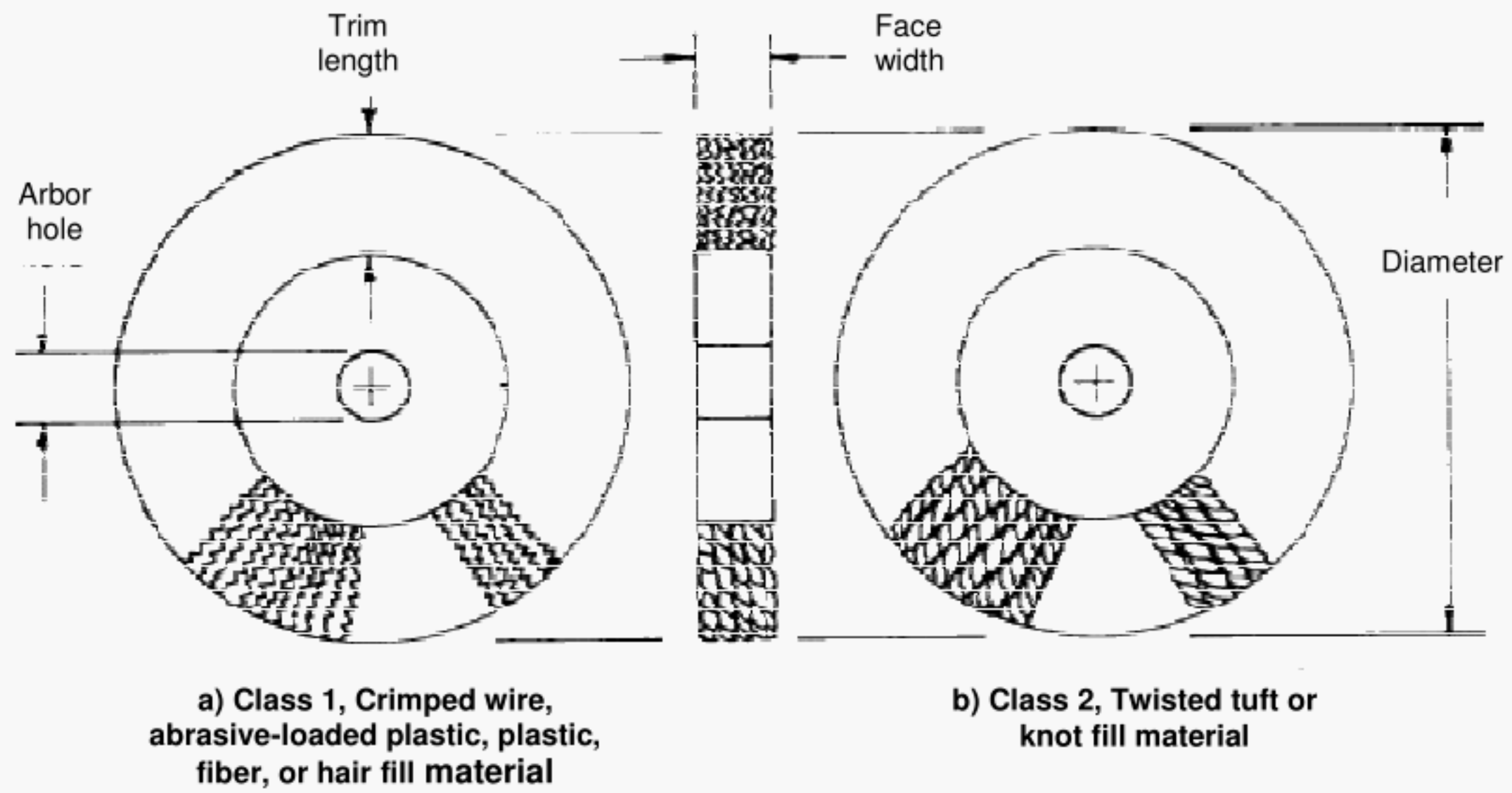


Figure 5 – Type III, Wheel or radial brush

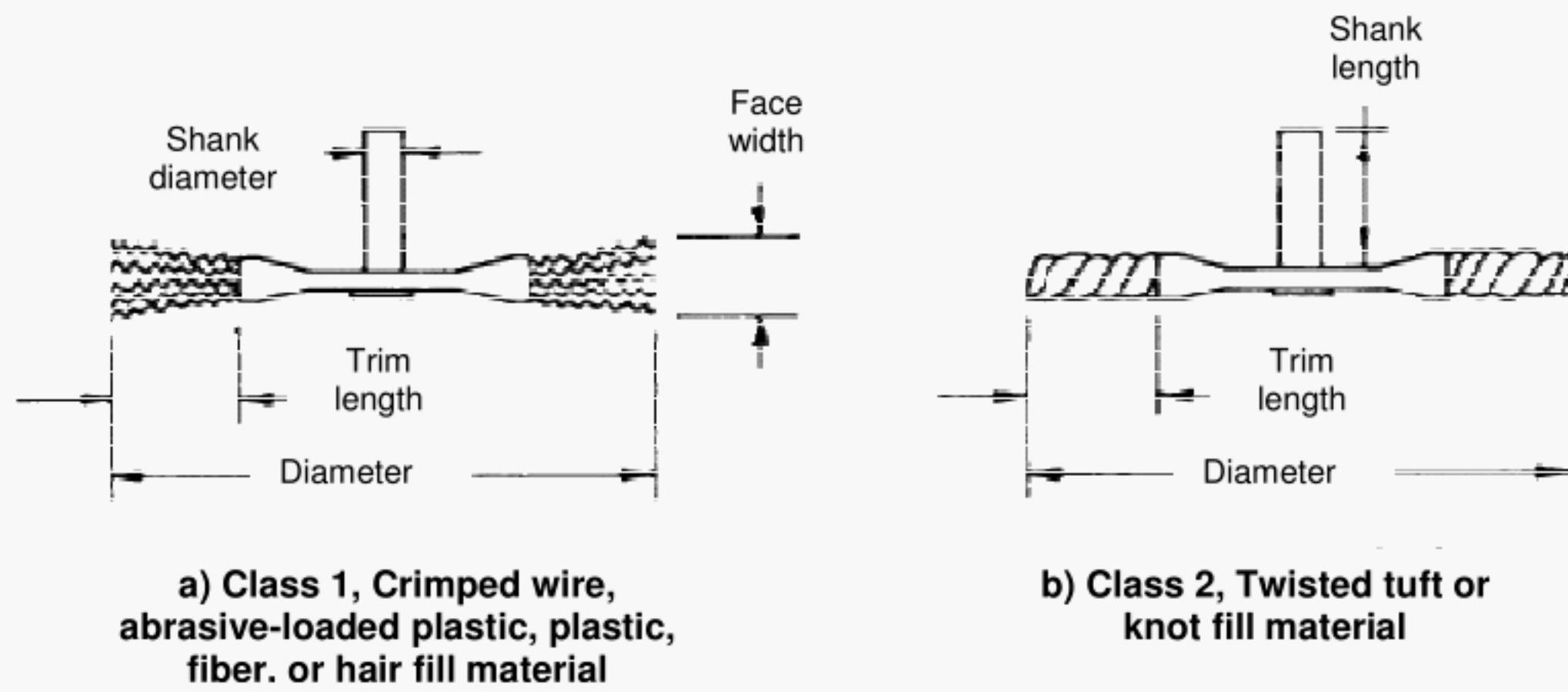
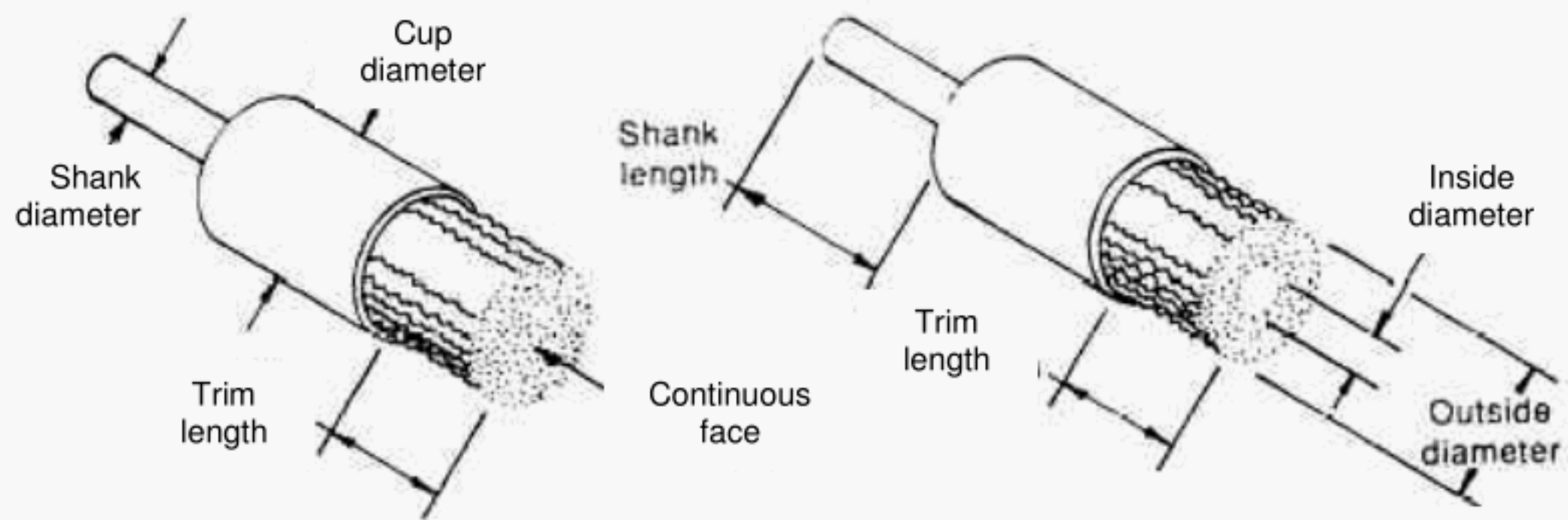


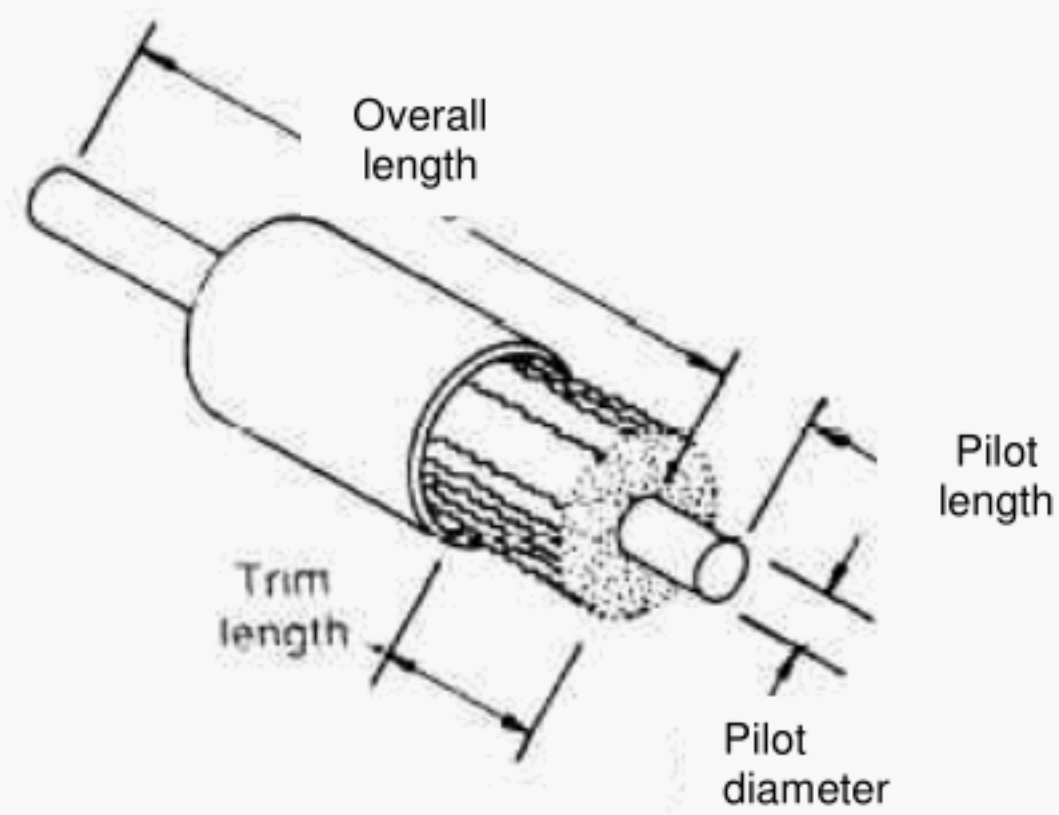
Figure 6 – Type III, Wheel or radial brush with shank





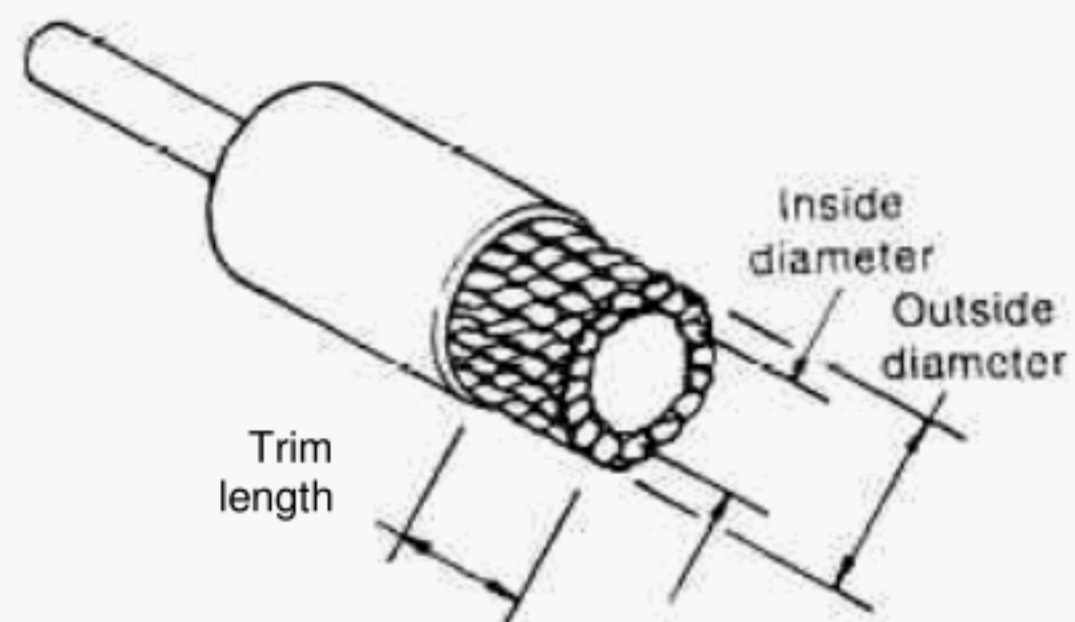
**Style A, Solid filled end brush**

**Style B, Hollow center end brush**



**Style C, Pilot end brush**

**a) Class 1, Crimped wire, abrasive-loaded plastic, plastic, fiber, hollow center or hair fill material**



**b) Class 2, Twisted tuft or knot fill material, hollow center**

**Figure 7 – Type IV, End brush**

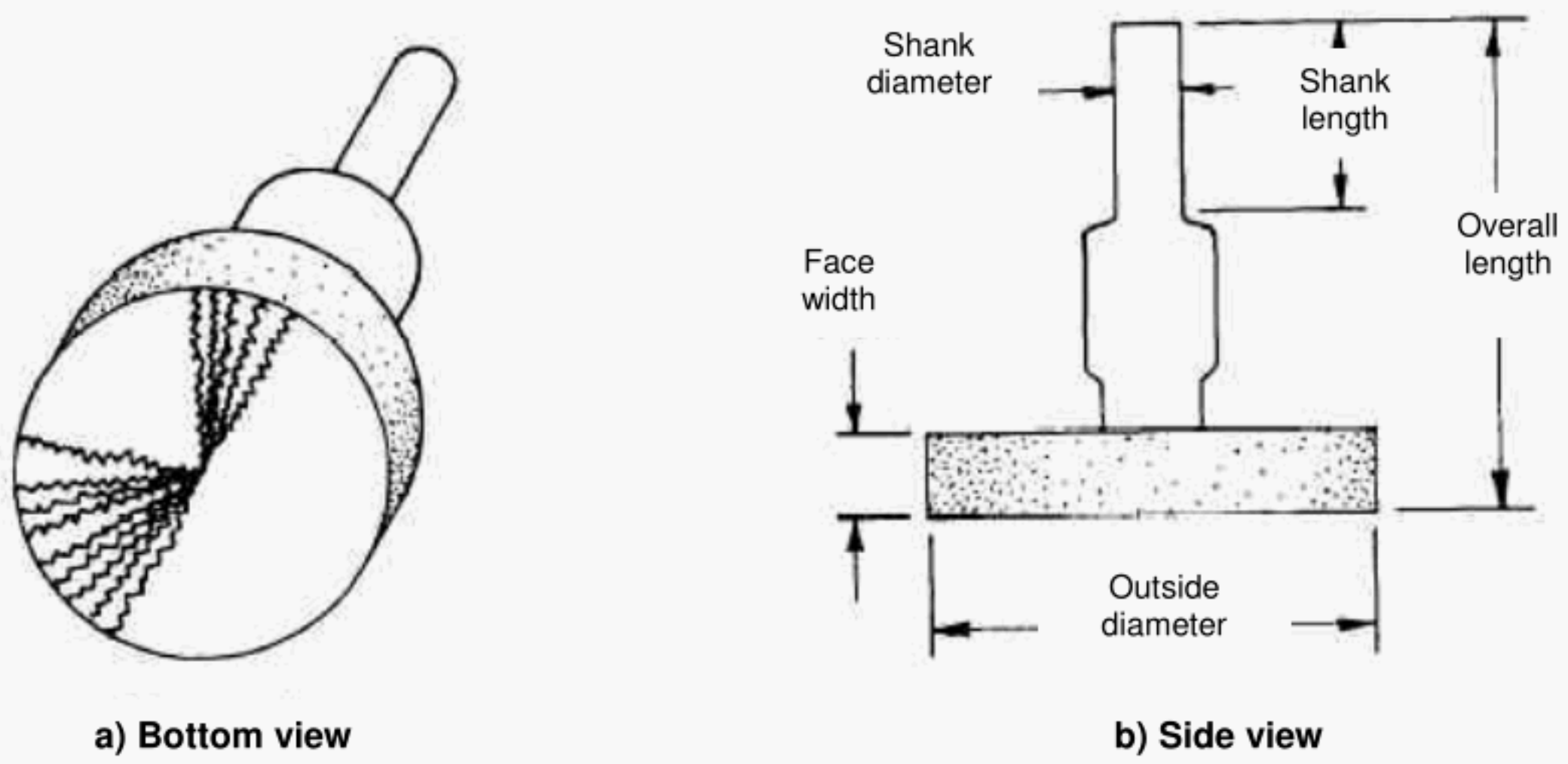


Figure 8 – Type V, Flared end brush

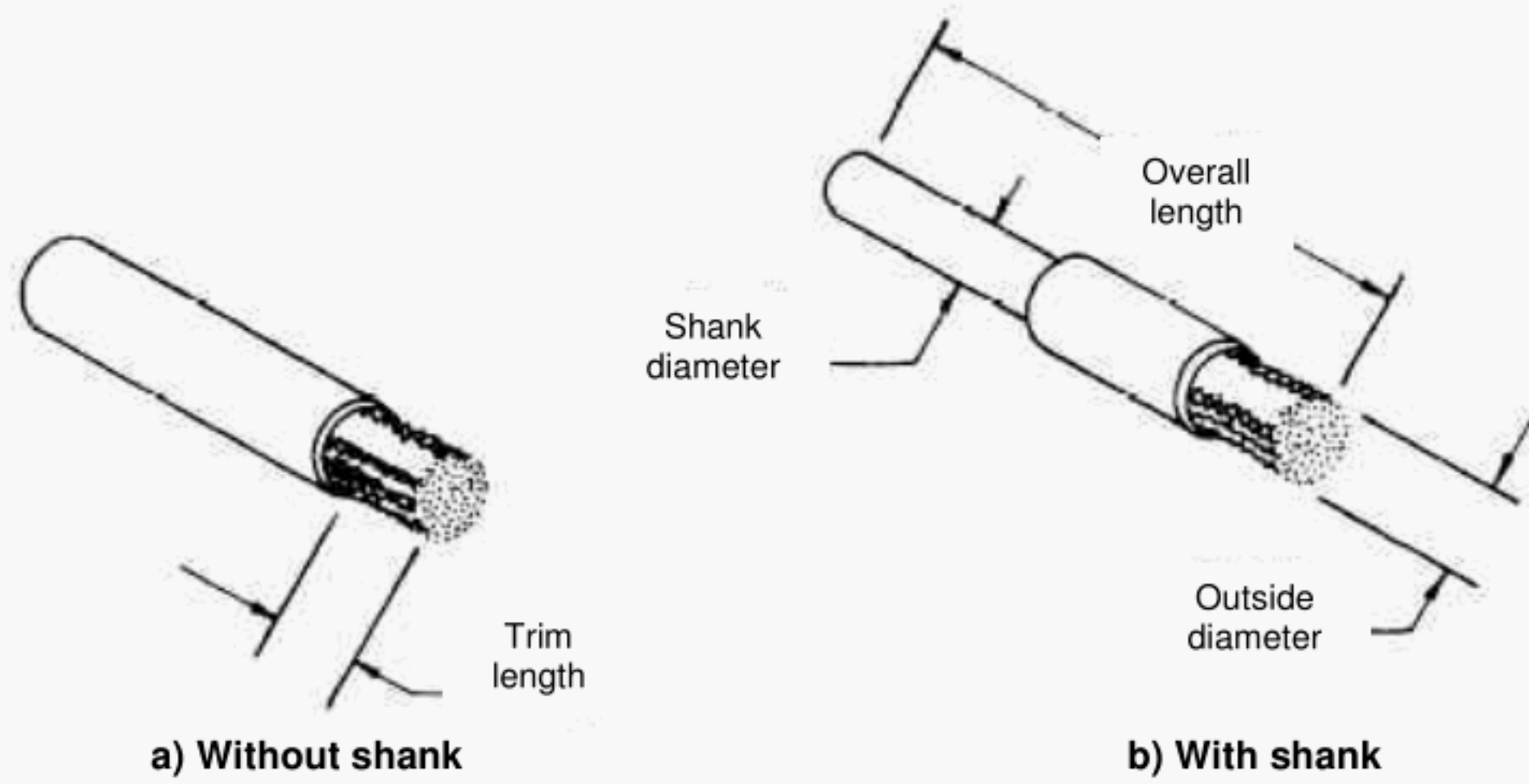


Figure 9 – Type VI, Tubular end brush

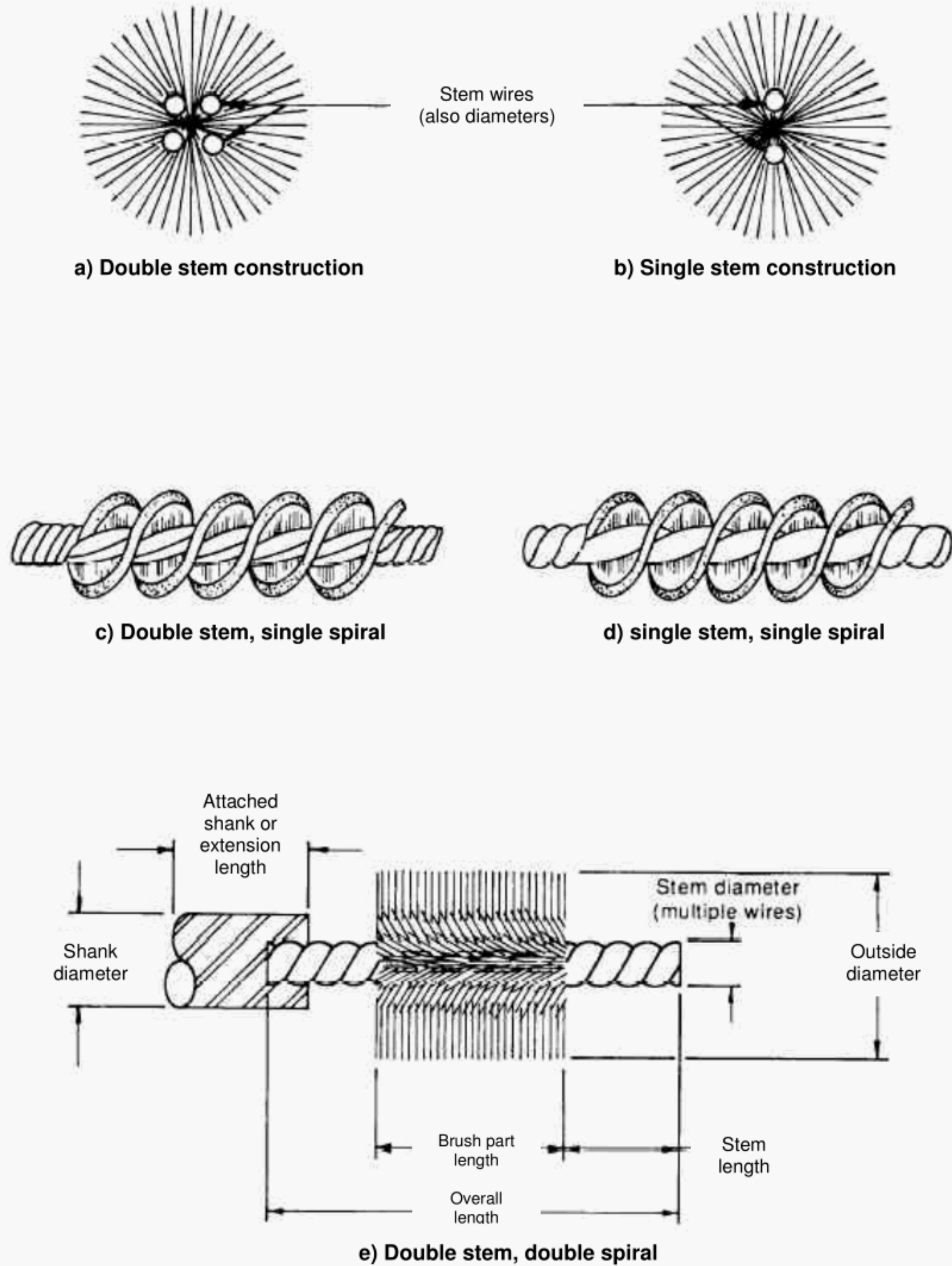
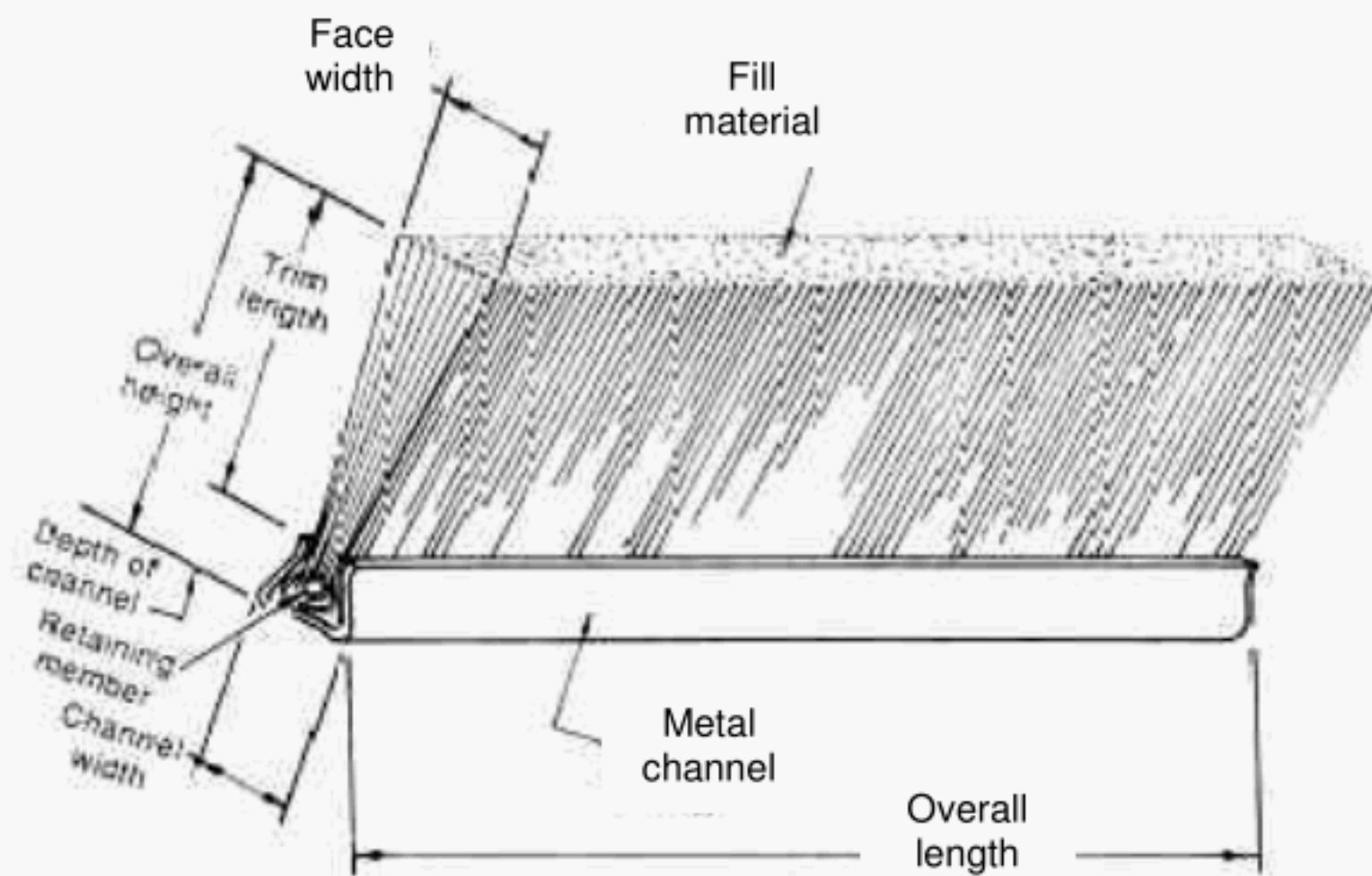
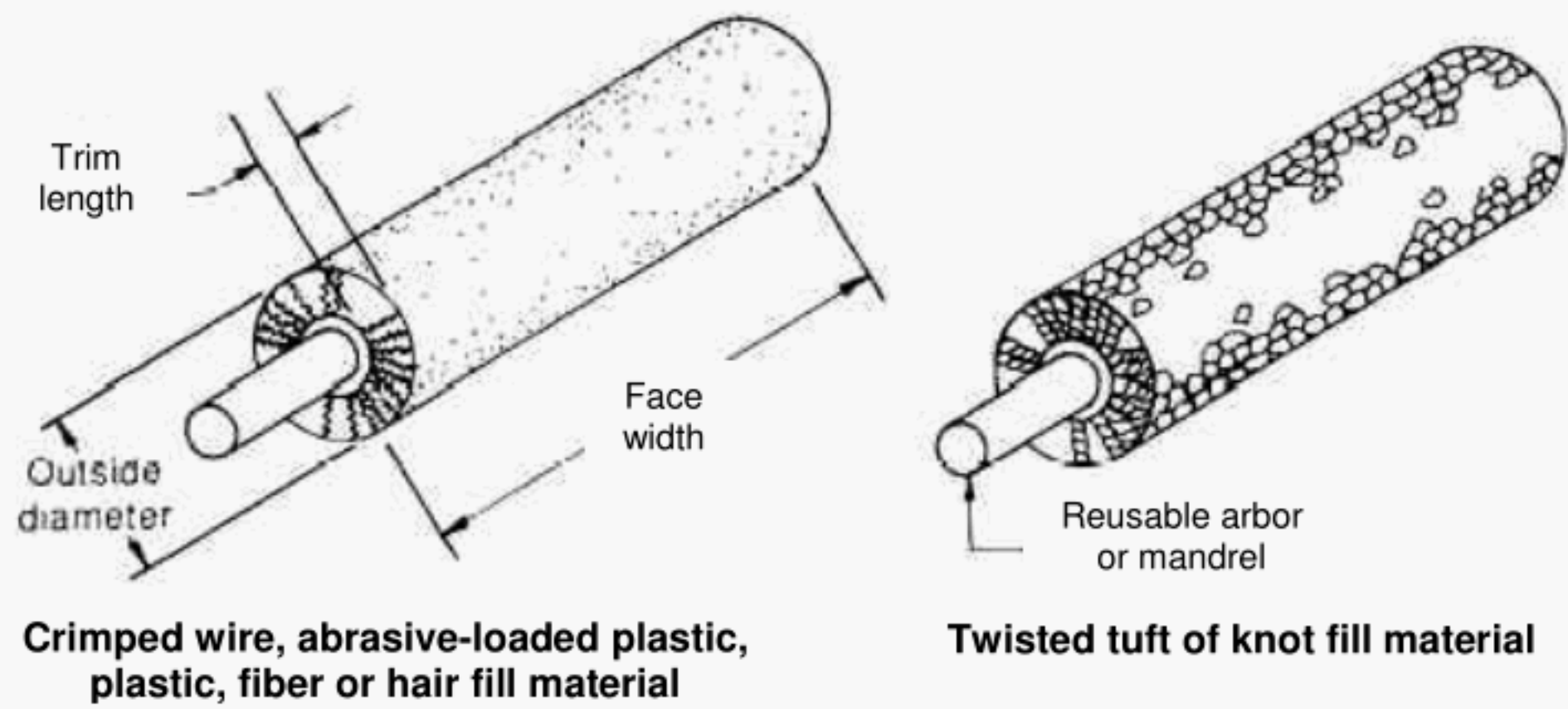


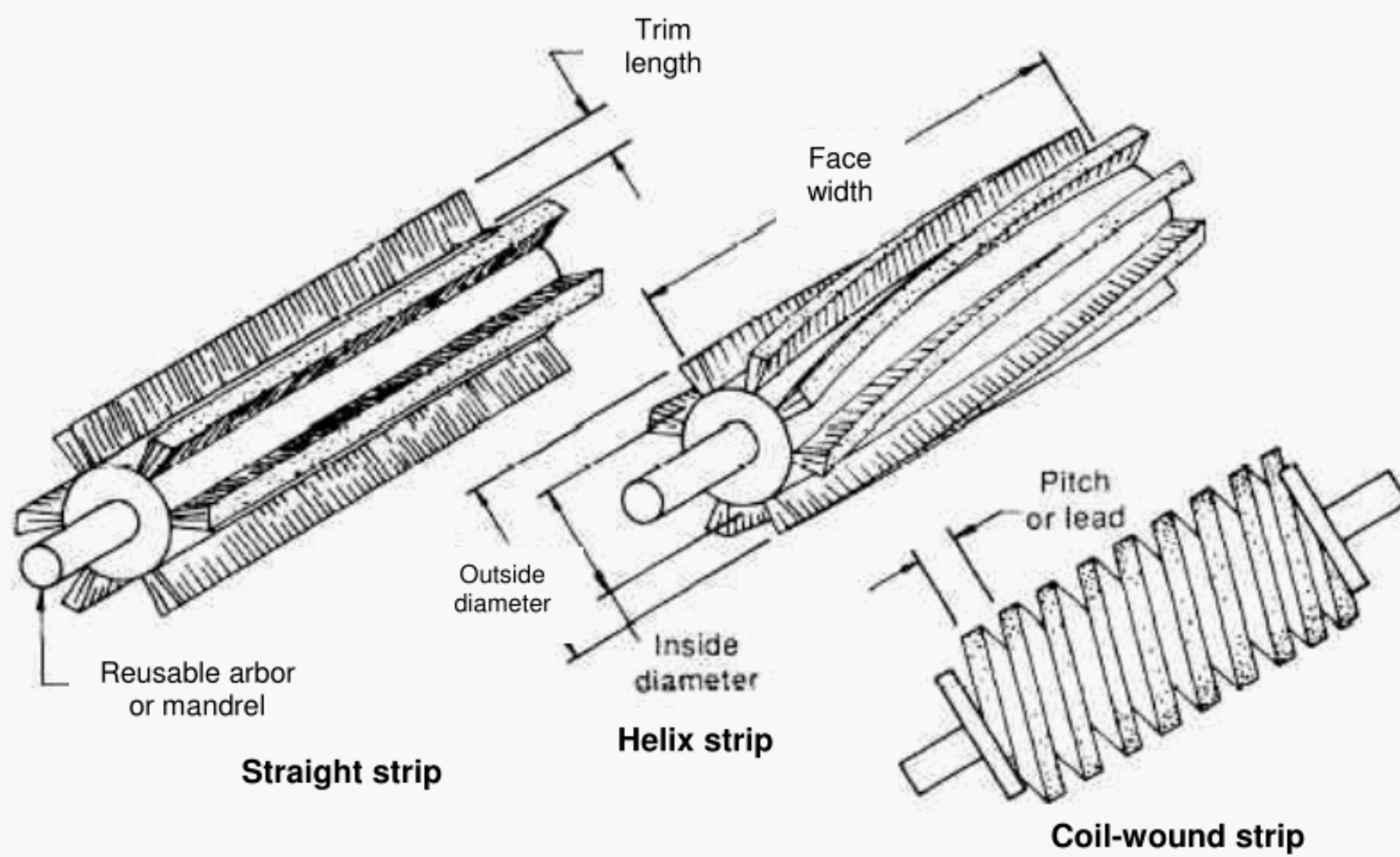
Figure 10 – Type VII, Twisted-in wire brush (or tube cleaning brush)



**Figure 11 – Type VIII, Strip brush**



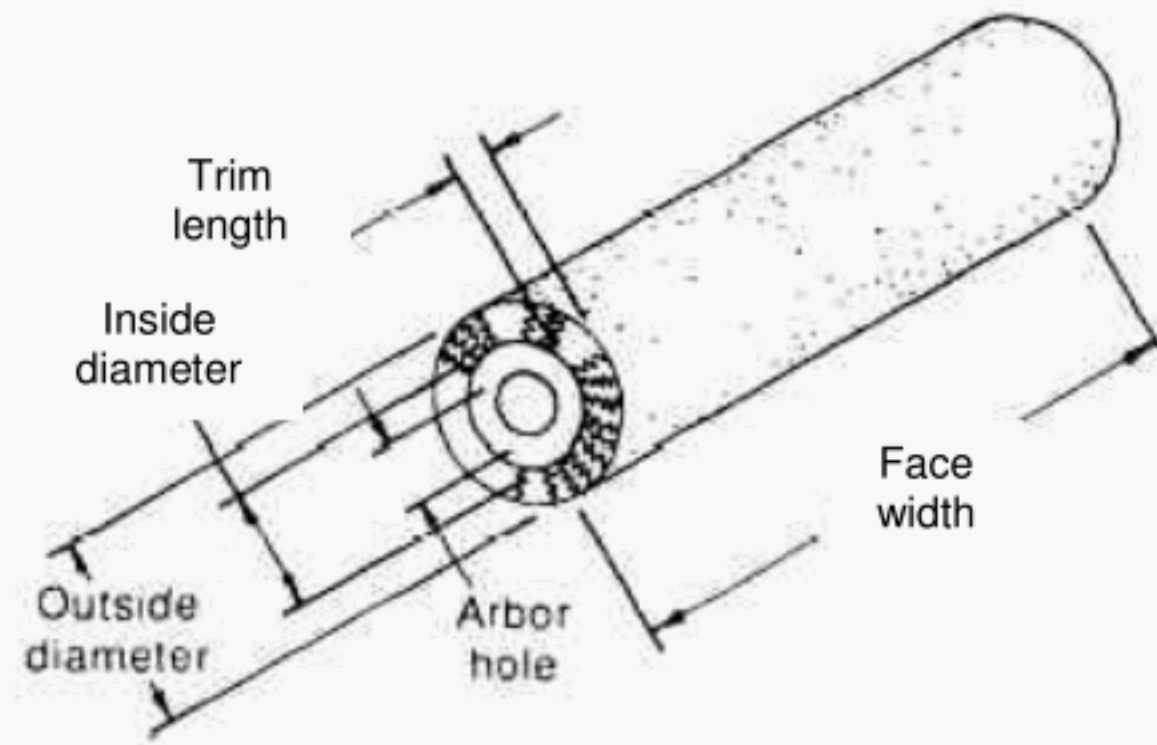
a) Style A, Sectional built-up face



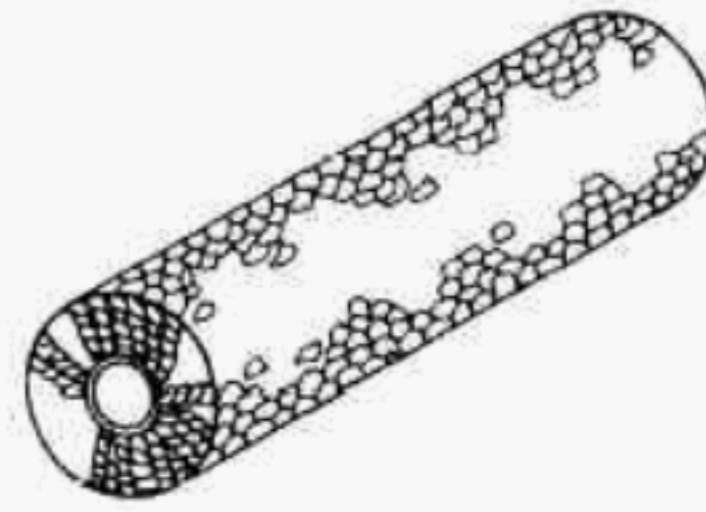
b) Style B, Strip face

Figure 12 – Type IX, Class 1, Cylinder or wide-face brushes mounted by manufacturer



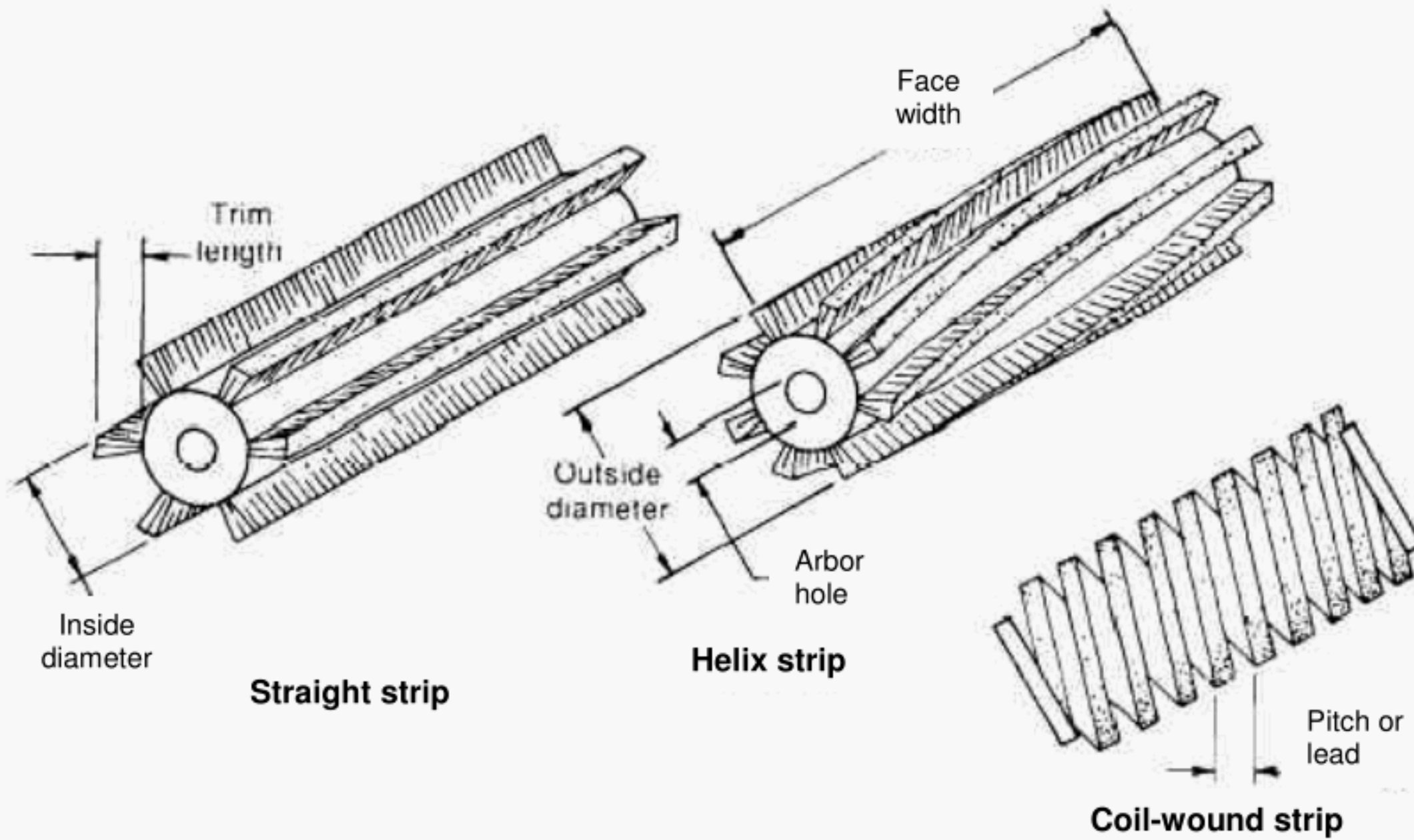


**Crimped wire, abrasive-loaded plastic, plastic, fiber or hair fill material**



**Twisted tuft or knot fill material**

**a) Style A, Sectional built-up face**



**Straight strip**

**Helix strip**

**Coil-wound strip**

**b) Style B, Strip face**

**Figure 13 – Type IX, Class 2, Expendable or unitized cylinder or wide-face brushes**

## 4 Design

### 4.1 Manufacture of brushes

**The brush manufacturer shall be responsible for the design of brushes produced and shall apply the principles of strength of materials to ensure that satisfactory materials are utilized and adequate proportions obtained to resist functional forces produced by centrifugal forces or impact.**

### 4.2 Material

**All components of the brush shall be of such design as to transmit the driving torque from the spindle to the brush periphery. They shall be constructed in such a manner as to ensure an even distribution of fill material throughout the brush so that good balance can be attained.**

**Adequate provision for filament retention shall be made. The fill material shall not be burned, broken, or otherwise affected by any assembly operations so as to make it unsafe.**

### 4.3 Marking

**When sufficient surface space is available, each brush shall be marked in a permanent manner to show the maximum safe free speed in revolutions per minute; the brush shall also carry the words, "Wear eye protection," when sufficient space is available.**

**The manufacturer's name or trademark shall also be included. If only the trademark is used, it shall be of such known character that the source of manufacture can be readily determined.**

### *E4.1 Manufacture of brushes*

Brush manufacturers know the basic construction of their own brushes best, are knowledgeable about the nature and characteristics of their products, and are aware of the use and functions for which they were designed.

The design parameters for a brush used to defuzz a peach is obviously different from those for brushes used to descale steel. Brush manufacturers recognize the need for different strength requirements for various applications and consequently design their brushes so that the working stresses encountered in a given application will not exceed the strength of the material of the brushes.

### *E4.2 Material*

The design of the brush and the material from which it is made should be established with operator safety in mind.

### *E4.3 Marking*

The required type of marking will leave permanent, as well as legible, admonishments and identification on the brush.

The markings can be etched, molded in, or die stamped.

Marking or labeling the packages of smaller items (under 1 inch or 2.54 cm) is desirable and would meet the requirements of this standard.

The American Brush Manufacturers Association (ABMA) shall maintain a list of

**Brush manufacturers may omit their names or trademarks on a brush sold to a distributor or another brush manufacturer whose own name or trademark will appear on the brush. In such cases (known as “private branding”), the brush manufacturer and the private brander shall mutually determine which of them is to do the marking. It shall, however, be the responsibility of the private brander to see that the brush is not transferred to the user without being permanently marked with identifying markings.**

manufacturers and their marks. Each manufacturer will submit a current sample of their mark or their marks to ABMA and advise them of any future changes.

All packages containing brushes should have a summary of the safety precautions given in this standard printed either on each package or on a card or slip placed inside the package. See Illustration 2 for the recommended text for this summary.



## READ THIS SAFETY SLIP - BOTH SIDES

### SAFETY INFORMATION AND USAGE RECOMMENDATIONS

**Pressure:** Avoid excessive pressure when using a power brush. Excessive pressure causes over-bending of the filaments and heat build-up resulting in filament breakage, rapid dulling, and reduced brush life. Instead of greater pressure on a brush, it is suggested that you try: (1) a brush with a more aggressive cutting action (increased wire size, decreased filament length, change to a different brush type, i.e., knot type instead of crimped wire type), or (2) higher speed (increased R.P.M., increased brush diameter.) **IMPORTANT NOTE:** Never exceed the recommended MAXIMUM SAFE FREE SPEED R.P.M. (MSFS) rating of the brush.

**Inspection and storage:** Upon receipt, inspect brushes for damage, rust, and deterioration. Store in original containers in a clean, dry location. Do not allow distortion of brush filaments/components or foreign matter to become lodged in brush face.

**Dust and Fumes:** Wear respiratory protection against this hazard (see ANSI Z88.2).

**Instruction manual:** Read the Instruction Manual of your tool (grinder) carefully before operation and follow it.

**Speed:** Make sure the maximum operating speed (Max. RPM) marked on the wire brush is at least as high as the "NO LOAD" speed shown on the name plate of the power tool.

**Starting the brush:** Before rotating the brush, during rotation, and until rotation stops, operators and others in the area must wear safety goggles, or full face shields worn over safety glasses with side shields. Brushes should be run at operating speed for at least one minute before applying work. Inspect for flutter or vibration that might be caused by poor installation or a damaged brush. During this time, no one is to stand in front of or in line with the brush.

**Mounting brushes:** Inspect brushes before mounting for damage, rust or other types of deterioration. Brush arbor hole and spindle diameter should be the same. Install the brush securely on the tool.

**Brushing problems:** Do Not Allow Unsafe Conditions to Continue - Occasionally, due to worn bearings, a bent spindle, an unusual application, operator abuse, or inappropriate use, a brush may fail. Do not use or continue to use a failed brush or one which is functioning improperly (i.e., throwing filaments, out-of-balance, etc.) as this increases the possibility for further brush failure and hazard of injury. The cause of the failure should be evaluated and corrected.



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This information is based on the collective experience of the ABMA Industrial Division members and provided solely as a public service for the guidance of the users of the members' products. These recommendations are not necessarily complete with respect to any particular application and common sense safety considerations should be adhered to generally. Any applicable federal, state, local law or regulation, must be strictly adhered to, and is controlling over any recommendation contained herein.

#### AVAILABILITY OF ANSI STANDARDS

On this slip reference is made to these ANSI Standards: ANSI B165.1, ANSI Z87.1, ANSI Z88.2. Copies of these standards are available at Public Libraries and from American National Standards Institute, Inc. (ANSI), 1430 Broadway, New York, NY 10018, or, American Brush Manufacturers' Association.

READ THIS SAFETY SLIP — BOTH SIDES!

## LISEZ CETTE NOTICE DE SÉCURITÉ - RECTO ET VERSO!

### MESURES DE SÉCURITÉ ET MODE D'EMPLOI

**Pression:** évitez toute pression excessive durant l'utilisation de la brosse électrique. La pression excessive provoque une courbure excessive des filaments et une accumulation de chaleur qui cassent les filaments, émoussent et usent rapidement la brosse. Au lieu de forcer la pression sur la brosse, il est recommandé d'essayer (1) une brosse plus tranchante (fil plus gros, filament moins long, type de brosse différent, par ex. brosse à noeuds ou en fil ondulé), ou (2) d'augmenter la vitesse (augmentation des tr/min, augmentation du diamètre de la brosse). **NOTE IMPORTANTE:** Ne dépassez jamais l'indice de le nombre de TR/MIN DE VITESSE LIBRE MAXIMUM DE SÉCURITÉ (MSFS) recommandé pour la brosse.

**Inspection et entreposage:** à la réception, inspecter les brosses pour tout dommage, rouille ou détérioration. Entreposer dans l'emballage original, dans un endroit propre et sec. S'assurer que les filaments des brosses ou des accessoires ne pourront pas se déformer et qu'aucun corps étranger ne pourra se loger dans la brosse.

**Poussière et émanations:** porter l'équipement respiratoire approprié pour ce genre de danger (voir ANSI Z88.2).

**Manuel d'instruction:** bien lire le manuel d'instruction pour l'outil (meuleuse) avant de l'utiliser et bien suivre les instructions.

**Vitesse:** s'assurer que la vitesse maximale d'opération (tr/mn max.) inscrite sur la brosse métallique est au moins aussi élevée que la vitesse "NO LOAD" "vitesse à vide" indiquée sur la plaque signalétique de l'outil électrique.

**Démarrage de la brosse:** lors du fonctionnement d'une brosse, et jusqu'à son arrêt complet, l'utilisateur ainsi que toutes les personnes se trouvant à proximité doivent porter des lunettes de protection ou des lunettes de sécurité surmontées d'un masque facial avec écrans de protection latéraux. Les brosses doivent tourner à la vitesse de fonctionnement pendant au moins une minute avant d'être utilisées. Vérifier tout flottement ou vibration qui pourrait être causé par une mauvaise installation ou une brosse endommagée. Lors de cette vérification, personne ne doit se tenir devant ou dans l'alignement de la brosse.

**Montage de la brosse:** inspecter les brosses avant le montage pour s'assurer qu'elles ne sont pas endommagées, rouillées ou détériorées de quelque manière que ce soit. Le diamètre du mandrin et de l'orifice d'arbre de la brosse doivent être les mêmes. Bien installer la brosse sur l'outil.

**Problèmes de brossage:** ne maintenez pas de conditions d'utilisation dangereuses. Une brosse peut parfois ne pas fonctionner correctement du fait de l'usure des roulements, d'un axe tordu, d'une application inhabituelle ou enfin d'une utilisation abusive ou incorrecte. N'utilisez pas ou ne continuez pas d'utiliser une brosse défectueuse ou qui fonctionne mal (par ex. perdant des filaments, déséquilibrée etc.), car ceci augmente les possibilités de panne ultérieure et les risques de blessure. La cause de cette défaillance doit être déterminée et corrigée.



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Ces informations est basée sur l'expérience de l'ensemble des membres de la Division le Industrielle de l'ABMA. Il s'agit d'un service public destiné à aider les utilisateurs des produits de ses membres. Ces recommandations ne couvrent pas nécessairement toutes les applications particulières, et les considérations de sécurité de sens commun restent généralement valables. Toute loi ou réglementation fédérale, provinciale ou locale applicable doit être strictement observée et prévaut sur les recommandations du présent document.

#### OÙ TROUVER LES NORMES ANSI

Les normes ANSI auxquelles cette notice se réfère sont: ANSI B165.1, ANSI Z87.1, ANSI Z88.2. Des copies de ces normes peuvent être obtenues auprès des bibliothèques municipales et de l'Institut national américain de normalisation, (ANSI), 1430 Broadway, New York, NY 10018; ou auprès de l'Association américaine des fabricants de brosses.

LISEZ CETTE NOTICE DE SÉCURITÉ — RECTO ET VERSO!

## LEA ESTA HOJA DE SEGURIDAD - EN AMBOS LADOS

### INFORMACION DE SEGURIDAD Y RECOMENDACIONES PARA EL USO

**Presión:** Evite presión excesiva cuando use el cepillo. La presión excesiva dobla los filamentos y causa fricción resultando en rompimiento excesivo de los filamentos, rápida pérdida de afilado, y reducción de la vida del cepillo. Se recomienda que en vés de presión excesiva se trate lo siguiente: (1) un cepillo con acción de corte superior (incremente el diámetro del alambre, use un filamento más corto, use un tipo diferente de cepillo, (ejemplo: tipo trenza en vés de rizado), (2) velocidades más altas (Incremento R.P.M., incremente el diámetro del cepillo). **NOTA IMPORTANTE:** Nunca exceda la velocidad máxima recomendada R.P.M. (MSFS) del cepillo.

**Inspección y almacenamiento:** Cuando reciba el cepillo, determine si esta dañado, oxidado o deteriorado. Almacene el cepillo en el empaque original en un lugar limpio y seco. No permita la distorsión de los filamentos/componentes o que contaminantes se incrusten en el cepillo.

**Polvo y vapores:** Use protectores de respiración contra este peligro (Vea ANSI Z88.2).

**Manual de instrucción:** Lea el manual de instrucción de su herramienta (pulidora) cuidadosamente. Cumpla con sus instrucciones.

**Velocidad:** Esté seguro que la velocidad máxima (Max. RPM) - velocidad de la herramienta sin accesorio - marcada en la herramienta no exceda la velocidad máxima recomienda en el cepillo.

**Empezando el cepillo:** Antes de empezar el cepillo, cuando este rotando, y hasta que el cepillo se detenga, operadores y otros en la zona deben usar gafas de seguridad, o caretas de protección con pantallas laterales sobre gafas de seguridad. El cepillo debe girar libremente al menos un minuto antes de empezar el trabajo. Inspeccione por movimiento irregular (ondeo) o vibración que puede ser causada por mal montaje o un cepillo dañado. Durante esta inspección, nadie debe estar en frente o en línea con el cepillo.

**Montando el cepillo:** Determine si existe daño, óxido u otros problemas con el cepillo antes de montarlo. El eje del cepillo debe ser del mismo tamaño que el tamaño de la flecha de la herramienta. Instale el cepillo de la manera apropiada en la herramienta.

**Problemas de Cepillado:** No permita que prácticas peligrosas continúen - De vez en cuando, bolilleros (cojinetes) gastados, ejes torcidos, aplicaciones poco usuales, abuso o uso incorrecto por parte del operador, pueden conducir a la falla del cepillo. No use o continúe el uso de un cepillo dañado o un cepillo que no funciona apropiadamente (ejemplo: tirando filamentos, o fuera de balance, etc.), esto incrementa la posibilidad de la falla del cepillo y peligro de lesiones. La causa de la falla debe ser evaluada y corregida inmediatamente.



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Esta información está basada en la experiencia colectiva de los miembros de la división industrial de ABMA y proveída solamente como un servicio público para los usuarios de los productos de los miembros. Estas recomendaciones no son necesariamente completas para todo tipo de aplicaciones, observe todas las normas de seguridad y use sentido común. Cualquier ley o norma Federal, Estatal, y Local que apliquen deben ser estrictamente obedecidas. Estas leyes controlan las recomendaciones en esta hoja.

#### DISPOSICION DE LAS NORMAS DE ANSI

Esta hoja hace referencia a las siguientes normas ANSI: ANSI B165.1, ANSI Z87.1, ANSI Z88.2. Copias de estas normas se encuentran en librerías publicas y en el Instituto Nacional Americano de Estandartes, Inc. (ANSI), 1430 Broadway, New York, N.Y. 10018, o, en la Asociación Americana de Fabricantes de Cepillos.

LEA ESTA HOJA DE SEGURIDAD; LEA AMBOS LADOS!



# READ THIS SAFETY SLIP - BOTH SIDES



**Avoid Injury**  
**Observe Brush Safety Rules**

**IMPORTANT:**  
All operators *must* read this information thoroughly and completely before using the brush!

Deliver this Safety Slip with the brush to the operator. Keep this Safety Slip with the brush for the reference of future operators.

**WARNING** failure to observe safety **INJURY** precautions may result in **INJURY**

## Summary- Power Brush Safety Requirements

- 1. Safety Goggles:** Safety goggles or full face shields worn over safety glasses with side shields *MUST BE WORN* by all OPERATORS and OTHERS IN THE AREA of power brush operations. Comply with the requirements of ANSI Z87.1 "Occupational Eye and Face Protection."
- 2. Guards:** Keep all machine guards in place.
- 3. Speeds:** Observe all speed restrictions indicated on the brushes, containers, labels, or printed in pertinent literature. "MSFS" means Maximum Safe Free Speed (R.P.M.) - spinning free with no work applied. For reasons of safety the "MSFS" should not be exceeded under any circumstance.
- 4. Safety Standard:** Comply with the Safety Standards of the Industrial Division of the American Brush Manufacturers' Association and the American National Standards Institute Standard ANSI B165.1 "Safety Requirements - Power Brushes".
- 5. Protective Equipment:** Appropriate protective clothing and equipment (such as gloves, respirator, etc.) must be used where a possibility of injury exists that can be prevented by such clothing or equipment.

**Warning:** In normal power brushing operations, the material being removed, such as burrs, scale, dirt, weld slag, or other residue, will fly off the brush with considerable force along with the brush filaments which break off due to fatigue.

The potential of serious injury exists for both the brush operator and others in the work area (possibly 50 or more feet from the brush). To protect against this hazard, before rotating the brush, operators and others in the area must wear SAFETY GOGGLES or FULL FACE SHIELDS WORN OVER SAFETY GLASSES WITH SIDE SHIELDS, along with PROTECTIVE CLOTHING.

You must follow all operator and safety instructions, as well as common safety practices which will reduce the likelihood or severity of physical injury.

Many brush manufacturers mark some safety warnings, recommendations, and usage restrictions directly on the product. It is not always practical to include even the most limited safety information on the brush itself. Therefore, the operator **MUST READ** and **FOLLOW** all instructions supplied in or on the product container as well as those marked on the product itself. The operator should also refer to the safety and operating information printed in the brush manufacturer's catalog and other literature.

**READ THIS SAFETY SLIP— BOTH SIDES!**

# LISEZ CETTE NOTICE DE SÉCURITÉ - RECTO ET VERSO!



**Évitez les blessures.**  
**Respectez les règles de sécurité de ces brosses**

**ATTENTION: Tout utilisateur DOIT LIRE ces informations attentivement et en entier avant d'utiliser la brosse!**

Donnez cette notice de sécurité à l'utilisateur avec la brosse. Conservez cette notice avec la brosse pour les futurs utilisateurs.

**ATTENTION** le non-respect des précautions de sécurité peut provoquer des **BLESSURES**

## Résumé - Conditions de sécurité pour brosses électriques

- 1. Lunettes protectrices:** des lunettes protectrices ou des lunettes de sécurité surmontées d'un masque avec écrans protecteurs latéraux DOIVENT ÊTRE PORTÉES PAR TOUS LES UTILISATEURS ET PERSONNES DANS LA ZONE DE TRAVAIL autour des brosses à électriques. Conformez-vous aux spécifications de la norme ANSI Z87.1 "Protection des yeux et du visage dans le cadre du travail".
- 2. Dispositifs de protection:** laissez tous les dispositifs de sécurité de la machine en place.
- 3. Vitesses:** respectez les limitations de vitesse indiquées sur les brosses, les emballages et les étiquettes ou dans les ouvrages spécialisés. "VLMS" (MSFS) signifie Vitesse Libre Maximum de Sécurité (R.P.M.) - c-à-d. rotation libre sans effort. Pour des raisons de sécurité, la "VLMS" (MSFS) ne doit être dépassée en aucune circonstance.
- 4. Normes de sécurité:** observez les normes de sécurité de la Division industrielle de l'Association américaine des fabricants de brosses et les normes ANSI B165.1 "Exigences de Sécurité - Brosses à Moteur".
- 5. Équipement de protection:** des vêtements et des équipements de protection appropriés (tels que gants, respirateur, etc.) doivent être portés s'ils peuvent réduire les risques de blessure.

**Avertissement:** pendant le fonctionnement normal des brosses électriques, des filaments usés ainsi que des matériaux enlevés tels que les ébarbures, les écailles, la saleté, les scories de soudage ou autres résidus se détachent de la brosse et sont expulsés avec une force considérable.

Un risque de blessure sérieuse existe à la fois pour l'utilisateur et pour les personnes dans un rayon de 15 mètres ou plus autour de la brosse. Pour limiter ce risque, les utilisateurs et autres personnes dans la zone de travail doivent, avant de mettre la brosse en marche, porter des LUNETTES PROTECTRICES ou un ÉCRAN FACIAL COMPLET PAR DESSUS LES LUNETTES DE SÉCURITÉ AVEC PROTECTEURS LATÉRAUX, ainsi que des VÊTEMENTS DE PROTECTION.

Vous devez suivre toutes les instructions d'utilisation et de sécurité, ainsi que les règles de sécurité de utilisation qui réduisent l'éventualité ou la gravité des blessures.

Plusieurs fabricants de brosses inscrivent quelques avertissements de sécurité, recommandations et limites d'utilisation sur le produit même. Il n'est pas toujours pratique d'inscrire des recommandations de sécurité, même très brèves, sur la brosse. L'utilisateur DOIT donc LIRE et SUIVRE toutes les instructions inscrites sur et dans l'emballage du produit, ainsi que celles sur le produit. L'utilisateur doit également se référer aux informations de sécurité et d'utilisation figurant dans le catalogue du fabricant de brosses et dans d'autres ouvrages.

**LISEZ CETTE NOTICE DE SÉCURITÉ - RECTO ET VERSO!**

# LEA ESTA HOJA DE SEGURIDAD - EN AMBOS LADOS



**Evite lesiones**  
**observe normas de seguridad del cepillo**

**IMPORTANTE:**  
¡Todos los operadores deben leer y entender la información de seguridad completamente antes de usar el cepillo!

Facilite estas instrucciones de seguridad con el cepillo. Mantenga estas instrucciones de seguridad cerca del cepillo para la referencia de todos los operadores del cepillo.

**ADVERTENCIA** El no observar las normas de seguridad puede causar **LESIONES**

## Resumen - Requisitos de seguridad para cepillos industriales

- 1. Gafas de seguridad:** Todos los operadores y otras personas presentes en la zona de operación de los cepillos deben usar gafas de seguridad o máscaras faciales completas sobre gafas protectoras con pantallas laterales. Observe los requisitos de ANSI Z87.1 ("Occupational eye and face protection")
- 2. Resguardos:** Use todos los resguardos de la maquina.
- 3. Velocidad:** Observe las restricciones de velocidad en el cepillo, cajas, instrucciones, o instrucciones en otra literatura o manuales pertinentes. "MSFS o MAX. SFS" significa máxima velocidad segura (R.P.M.) - rotando libremente sin aplicar la pieza de trabajo: Por razones de seguridad, **nunca exceda** la "MSFS/MAX. SFS."
- 4. Normas de seguridad:** Obedezca las normas de seguridad del Instituto Nacional Americano de normas (American National Standards Institute), ANSI B165.1 "requisitos de seguridad - cepillos industriales".
- 5. Equipo Protector:** Ropa protectora apropiada y equipo protector (como gafas de seguridad con pantallas laterales, guantes, aparato respirador, etc.) deben usarse cuando la posibilidad de lesiones que se pueden prevenir con este equipo existe.

**Advertencia:** En operaciones normales del cepillo, el material que se remueve, como rebabas, escoria, mugre, escoria de soldadura, y otro residuos, se desprenderán del cepillo con fuerza considerable junto con alambres que se rompen por fatiga.

El riesgo de lesiones serias existe para el operador y otros en la zona (posiblemente 50 pies - 15 m. - del cepillo). Para protección contra este peligro, antes de rotar el cepillo, durante rotación, y hasta que el cepillo se detenga, operadores y otros en la zona deben usar GAFAS DE SEGURIDAD o GAFAS DE SEGURIDAD CON PANTALLAS PROTECTORAS LATERALES, junto con ROPA PROTECTORA.

Obedezca instrucciones para el uso, instrucciones de seguridad, y también otras precauciones comunes de seguridad que puedan reducir el riesgo o la severidad de lesiones.

Muchos fabricantes de cepillos marcan algunas advertencias de seguridad, recomendaciones, y restricciones de uso directamente en el producto. No es siempre posible incluir toda la información de seguridad en el cepillo. Por esta razón, antes de usar el cepillo, el operador DEBE LEER y SEGUIR todas las instrucciones en la caja o adentro de la caja, y también las instrucciones marcadas en el producto. El operador también debe referirse a la información de operación y seguridad impresas en el cepillo o en el catálogo de la herramienta, manuales, y otra literatura.

**LEA ESTA HOJA DE SEGURIDAD; LEA AMBOS LADOS!**

## Illustration 2 - Summary of Safety Requirements



#### 4.4 Balance

Brushes that are out of balance set up vibrations that can result in marred work surfaces or machine damage, and can also cause stress that could result in brush failure. A brush that vibrates in service shall not be used (see 4.1).

#### 4.5 Adapters

If arbor adapters are used in a brush to reduce it to the correct arbor hole size, they shall seat properly in the brush to maintain alignment and balance.

### 5 General machine conditions

#### 5.1 Machine design and maintenance

It shall be the brush machine builder's responsibility to indicate the maximum rpm of the machine and the size of the brush to be used on the machine based on the requirements for guarding the machine as described in ANSI/UL 60745 and ANSI/UL 987.

It shall be the user's responsibility to maintain the machines in safe operating condition.

#### 5.2 Safety Guards

When accommodating brushes, machines and power tools shall be equipped with safety guards as required by 7.7.

#### 5.3 Power

Brushing machines and other power tools on which brushes are used shall be supplied with sufficient power to maintain the rated spindle speed under operating load.

#### E4.4 Balance

Unlike many other rotating tools, it would be difficult for the user to bring back into true balance.

#### E5.1 Machine design and maintenance

It is important that the maintenance of the machine be such that the equipment remains in the same condition as originally furnished. If the brush machine builder has provided special operating instructions or placed warning signs on the machine, these, as well as the general operating rules, should be followed to ensure a safe brushing operation.

#### E5.3 Power

Deterioration of operating conditions caused by insufficient power causes many problems. For example, reduction in brush speed, even while holding normal brush pressures, will cause a substantial decrease in cutting rate and efficiency. If pressure is increased to compensate for low brush speed, excessive heat and wear will be encountered, resulting in decreased cutting rate and efficiency. Reduced speed means reduced centrifugal force and a consequent reduction in the stiffness of the brush fill material. This loss of stiffness permits normal brush pressures to overflex the filament and induce premature fatigue. Over-stressed filaments that undergo

fatigue will break off, creating a hazard.  
Adequate power will avoid this hazard.

#### **5.4 Exhaust provision**

**It shall be the user's responsibility to provide adequate ventilation and swarf removal in dry brushing operations. If the user determines that stationary brushing machines used for dry brushing are creating an unsafe amount of dust or other contaminants, then the user shall make provision for connection to an exhaust system.**

**The exhaust system shall conform to the requirements in Z88.2 (see 7.9).**

#### **5.5 Diameter of spindle**

**Tables 1 and 1a show the minimum diameters of spindles that shall be used for brushes of various sizes. They apply to power tools and machines in which power brushes are not mounted between bearings. Spindles shall be sufficiently heavy and of adequate diameter to perform safely as designed. In some situations, the use of heavier spindles than those listed in Tables 1 and 1a as the minimal diameters is desirable.**

#### *E5.4 Exhaust provision*

The adequacy of the ventilation should be determined by following the minimum exhaust provisions shown in E7.9 and E7.9a. If connection of an exhaust system is not possible, then personal respirators for operators and others in the area should be provided.

#### *E5.5 Diameter of spindle*

Spindles are also referred to as "shafts" or "arbors" depending upon the nomenclature used by the various brush machine builders. Their usual machine design generally conforms to the minimum shaft diameters shown in Tables 1 and 1a. It is not uncommon for the user to unwittingly circumvent Tables 1 and 1a by requests for brushes larger in diameter than were originally intended for the machine. Since such a change in the outside diameter would also likely require a larger shaft hole and arbor, this is a dangerous practice that is to be avoided.

**Table 1 – Minimum spindle (shaft) diameter for brushes of various sizes (in)**

Maximum outside diameter of wheel brush (in)	Maximum face width (in)	Minimum outside diameter of spindle (shaft) (in)
2	1/4	1/4
3	3/4	1/4
3 (Heavy duty)	1	3/8
4	1	3/8
6	1-1/4	1/2
8	1-1/4	5/8
10	2	3/4
12	3	1
14	3	1-1/4
15	3	2
16	3	2
NOTE – These diameters are based upon the wheel brush being mounted next to the supported end of the bearing, rather than the unsupported end, in order to minimize overhang.		

**Table 1a – Minimum spindle (shaft) diameter for brushes of various sizes (mm)**

Maximum outside diameter of wheel brush (mm)	Maximum face width (mm)	Minimum outside diameter of spindle (shaft) (mm)
50	20	6
75	20	6
75 (Heavy duty)	25	10
100	25	10
150	32	13
200	32	16
250	50	19
300	75	25
350	75	32
380	75	32
400	75	50
NOTE – These diameters are based upon the wheel brush being mounted next to the supported end of the bearing, rather than the unsupported end, in order to minimize overhang.		

## 5.6 Work rests

**On single- or double-end pedestal machines used for brushing, work rests shall be used,**

### E5.6 Work rests

Measurement of the 1/8-inch (3.175-mm) clearance can be accomplished from the nominal face condition while the brush is



where applicable, to support the work. They shall be of rigid construction and designed to be adjustable to compensate for brush wear.

Work rests shall be kept adjusted close to the brush with a maximum opening of 1/8 inch (3.175 mm) to prevent the work from being jammed between the brush and the work rest, as such jamming may cause failure of the brush or injury to the operator. The work rest shall be securely clamped after each adjustment. The adjustment shall be made with the power source off, with the machine in zero mechanical state, and with no possibility of the brush rotating.

#### 5.7 Limiting brush diameter

Nonportable brushing machines shall be provided with a means of limiting the diameter of the brush to be mounted.

On variable-speed machines, the speed-shifting device shall be connected with an adjustable guard or other diameter-limiting device to prevent the mounting of a brush that might run at higher than the recommended surface speed or rated rpm.

#### 5.8 Direction of machine spindle thread

If brushes are secured by means of a spindle nut, the direction of the thread in relation to the direction of the rotation shall cause the nut to tighten as the spindle revolves.

stationary. Jogging of the brush will establish whether further adjustment is necessary to help compensate for a normal expansion.

#### *E5.7 Limiting brush diameter*

The safety guard can be used to limit the diameter of the brush on single-spindle or multiple-spindle machines. On variable-speed machines, a positive mechanical or manual regulation check should be maintained to avoid overspeeding another or full-sized brush after a worn brush has been removed.

In general, brush driving equipment that is stationary (fixed position) should use brushes with an outside diameter of 6 inches (152.4 mm) or larger. Portable tools (6000 rpm maximum) should use brushes 6 inches (152.4 mm) or smaller, whereas hand-held power tools and tools that rotate the brushes at speeds higher than 6000 rpm should use brushes 3 inches (76.2 mm) or smaller.

#### *E5.8 Direction of machine spindle thread*

In many types of equipment, such as double-end pedestal or bench grinders on which brushes are used, a right-hand thread is found on one end and a left-hand thread on the opposite end. If such machines are disassembled for maintenance or repair, it is essential that they be reassembled correctly in relation to the direction of threads.

The following rule will assist in determining the proper relationship: "To remove the nut, it must be turned in the direction in which the spindle revolves when the brush is in operation."

**5.9 Length of machine spindle thread**

If brushes are mounted by means of a spindle nut and flanges, two conditions shall be maintained:

- Spindles shall be of sufficient length to allow a full nut mounting;
- The threaded portion shall be sufficient so that the threading will extend well inside the flange but not more than halfway within the arbor hole of the brush.

**5.10 Spindle, drive arbor, and arbor hole size**

The size of the arbor hole of the brush shall be such that the brush will slip-fit on the drive spindle or drive arbor and shall remain within this fit class under all operating temperatures.

The brush spindle or drive arbor shall not be made larger than the nominal dimension size. The arbor hole of the brush shall be made oversize from the nominal dimension by the brush manufacturer by an amount necessary to ensure a free fit but not a loose fit. When the arbor hole is changed by the manufacturer or user, the recommended tolerances for the arbor hole shall be as follows:

Arbor Hole Size (in)	Minimum Tolerance (in)	Maximum Tolerance (in)
Under 5/8	+0.001	+0.005
5/8 – 2	+0.001	+0.006
2 – 6	+0.002	+0.007
6 – 12	+0.003	+0.012

Arbor Hole Size (mm)	Minimum Tolerance (mm)	Maximum Tolerance (mm)
Under 15.9	+0.025	+0.127
15.9 – 50.8	+0.025	+0.152
50.8 – 152.4	+0.051	+0.178
152.4 – 304.8	+0.076	+0.305

The minimum arbor hole to be used for each class of brush shall be the smallest size offered for sale by the individual brush manufacturer. The minimum size offered shall be compatible with the service

*E5.9 Length of machine spindle thread*

These two conditions are necessary to avoid the geometry of the threads from inadvertently preventing proper axial compressions and anchoring of brush rolls, especially when made up of sections.

*E5.10 Spindle, drive arbor, and arbor hole size*

It is important that the diameter of the spindle not be larger than the nominal size (usually +0.000 inch, -0.002 inch or +0.000 mm, -0.051 mm) and that the hole in the brush be kept suitable oversized to ensure a free fit under all operating conditions. This clearance is needed for expansion of the spindle caused by the heat of the operation.

conditions for which the brush is intended. Where the user reduces the arbor hole by use of a bushing, or otherwise, the minimum arbor size, the maximum brush face length, and the maximum overhang length shall be in accordance with the recommendations of the brush manufacturer.

The user shall ensure that the size and shape of the arbor hole of the brush will not cause the hole to catch the threads during mounting, which would cause the brush to be eccentric or would prevent proper axial compression and tightening.

#### **5.11 Threaded hole brushes**

Machines on which threaded hole brushes are mounted shall be designed with spindles that are threaded so as to allow the brush to be screwed firmly and flat against the back flange, with a minimum engaged thread length of 1X diameter for steel and 2X diameter for aluminum components.

The back of the flange shall be flat, securely fastened, and square to the spindle axis. The fixed back flange shall be of sufficient diameter to ensure proper support to the brush. The direction of the thread shall be such that, in order to be removed, the brush must be turned in the direction of rotation.

If threaded hole brushes have blind holes, the length of the spindle shall be in relationship to the depth of the hole such that the end of the spindle will not touch the bottom of the brush hole.

#### **5.12 Solid shanks for brushes to be used with collets and chucks**

These requirements do not apply to shanks on twisted-in wire brushes.

Shank diameters shall be of nominal size, expressed in decimal form with a tolerance not exceeding +0.000 inch –0.005 inch or +0.000 mm –0.127 mm.

The geometric configuration of shank-type brushes or shank-type arbors shall include generous fillets where the diameters of the parts increase and where stress concentration is likely to occur.

#### *E5.11 Threaded hole brushes*

If the flange that is in contact with the threaded portion of the brush is not flat or is recessed, it would be possible, by tightening the brush on the arbor, to distort the brush or even pull the threaded bushing out of the brush.

If the spindle stops quickly when power is shut off, the energy stored in the spinning brush may cause it to unscrew from the arbor and “spin off” the machine.

To help prevent “spinning off,” the thread on the machine arbor should be maintained in good condition and the brush should be held in contact with the work piece until the brush has stopped rotating.

When applicable, a spindle end nut should be used to preclude “spinning off.”

#### *E5.12 Solid shanks for brushes to be used with collets and chucks*

The method of manufacture of twisted-in wire brushes precludes holding shank diameters to the same tolerances as those for shanks made by turning, forming, cold-heading, or machining techniques.

Where extension of a brush shank or arbor shank is needed to obtain additional reach, a special tool extension shall be used. This tool or brush holder shall be of such dimension and geometrical shape as to withstand the brushing pressure used, and avoid deflection that causes vibrations that can become dangerous. The brushes shall be test-run under guarded or shielded conditions for 30 seconds after each mounting or remounting to ensure that they are properly gripped in the chuck or collet.

Shank brushes used with an extension shall only be rotated when contained within the cavity or interior to be abraded. The power shall be turned off and the rotation of the brush stopped before the brush is extracted from the part.

Construction details of user-made or user-selected extension holders shall meet the foregoing requirements.

Brushes used with shanks (types I through VI) are hazardous when chucked with the axis of the brush not parallel to, and concentric with, the axis of the chuck; or not tightened in the chuck tightly enough to drive it under load; or when used at speeds higher than those recommended by the brush manufacturer; or when the shank has not been inserted to the maximum depth with the minimum overhang.

## **6 Mounting of brushes**

### **6.1 Inspection**

Immediately before mounting, all brushes shall be closely inspected to make sure they have not been damaged in transit, storage, or otherwise (see 9.2 and 9.3). The spindle speed of the machines shall be checked before mounting the brush to be certain that it does not exceed the maximum safe free speed marked on the brush or the manufacturer's recommended maximum safe free speed if the brush is of such a size or configuration that marking is not feasible.



## 6.2 Arbor size

**Brushes shall fit freely on the spindle and remain free under all brushing conditions. If, however, the spindle is worn or undersized, the brush shall not be mounted, since off-center mounting will cause the brush to be out of balance. If the spindle is oversized, the brush shall not be forced on, since damage to the brush and the machine is almost unavoidable. A sufficient clearance between the arbor hole of the brush and the machine spindle (or adapters) shall be maintained to avoid problems in mounting or removal caused by spindle expansion from temperature change.**

**To accomplish this, the machine spindle and the brush arbor hole shall be made in accordance with the requirements of 5.10.**

## 6.3 Surface condition

**All contact surfaces of brushes, flanges, and adapters shall be flat and free of foreign matter that could result in uneven pressure. Flanges, adapters, and brushes shall be checked periodically to see that they are not distorted or burred so as to cause improper functioning.**

## 6.4 Bushing

**When a bushing is used in the arbor hole of the brush, it shall center the brush and ensure that the brush, rather than the bushing, will be gripped by the machine spindle shoulder or machine flange. The driving of the brush shall be accomplished positively through the back or center of the brush rather than through the bushing to ensure proper anchoring and driving of the brush.**

## 6.5 Multiple-section brushes mounted on a common arbor

**When more than one brush is mounted on a common arbor, they shall have equal arbor hole diameters. They shall be of a type manufactured for multiple mounting and so designated by the brush manufacturer.**

## *E6.2 Arbor size*

Arbors that become undersize from wear, and brush adapters that become oversize from wear, can cause the machine to become unbalanced. The user should maintain both the arbor and the brush adapter diameters to preclude this problem.

## *E6.3 Surface condition*

Excessive tightening can cause serious distortion of the flanges. They should be inspected prior to each mounting to ascertain that they are still flat and suitable for proper seating in the brush.

## *E6.4 Bushing*

If the bushing is wider than the brush in which it is used, it will interfere with proper tightening of the flanges against the brush. The power required to drive a brush is transferred through the flanges. If this power is partially or completely transferred through the bushing, failure of the brush could occur.

## *E6.5 Multiple-section brushes mounted on a common arbor*

In some applications of wide-face brushes that consist of sections in a stacked array mounted on a common arbor, slippage of the whole unit of brushes or of sections within the group of brushes may be a problem. In these cases, it may be necessary to key or otherwise securely fasten each of the individual brushes to the arbor.



**6.6 End nut**

The spindle end nut shall be tightened only enough to drive the brush and prevent slippage, and shall be used only if the direction of the threads (right hand or left hand) is such that the nut tends to tighten when rotated and under load.

Spindle end nuts with locking devices such as set screws shall be used under heavy duty conditions or where brush rotation reversal or stopping by brake action is practiced.

**6.7 Mounting of shank-type brushes**

All shank-type brushes of types I through V, and type VI brushes with and without shank, shall be firmly tightened in a chuck or collet so that no slippage can occur. The shank shall be inserted into the chuck or collet as far as possible on the uniform diameter of the shank with minimum possible overhang of the brush.

**6.8 Twisted-in wire brush**

Twisted-in wire brushes, type VII, used under power, shall be securely held in a collet, chuck, or similar holding device. The operator shall secure the unit to be brushed and position all guards before starting the brush. The equipment in and the arrangement of the workplace shall ensure rotation of the brush on the true centerline to avoid deflection that may instantly multiply to destructive bending.

**6.9 Strip and cylinder brushes**

Types VIII and IX brushes shall be affixed firmly to the arbor so that no axial or rotational movement is possible between the brush and the arbor. Keys and keyways that fit shall be used so that no radial movement is possible.

**6.10 Flanges**

Flanges shall be used when integral face plates are not provided or to ensure safe mounting on the driving shaft or arbor.

*E6.6 End nut*

If multiple screw flanges are used, they must be tightened uniformly to prevent springing of the flanges and to ensure even distribution of mounting pressure over the entire surface of the flanges.

*E6.7 Mounting of shank-type brushes*

Since the overhang of a shank-type brush is a factor in determining the maximum allowable operating speed, care should be taken to ensure that the overhang conforms to the limitations that have been established for the brush.

*E6.8 Twisted-in wire brushes*

The shank of a twisted-in wire brush, because of its basic construction, is not inherently as strong as the shank on most other brushes. Therefore, it is even more important that the overhang not be excessive, and that other conditions of use avoid the load application and speed of rotation that will cause the shank to deflect, and therefore bend, instantly resulting in total destruction of the brush and creating an unsafe condition for the operator.

*E6.9 Strip and cylinder brushes*

Arbors that accommodate cylinder brushes usually are fitted with two keyways at 180° from each other. If one key is omitted, an imbalanced condition is created because of loss of weight. If only one key is used, the cylinder brush should be rebalanced before use to compensate for the asymmetrical weight distribution.

*E6.10 Flanges*

The major stresses produced in an operating brush tend to combine and become greatest at the true retaining member of the brush

**Flanges shall be used with brushes where bushings are installed to prevent the axial separation of the brush and the bushing while the brush is in service. The outside diameter of the flanges shall be larger than the bushing and shall actually grip the brush retaining member.**

**Each pair of flanges shall be of the same size and geometry so that tightening or compressing of the brushes on the arbor will not cause distortion of the retaining members.**

**Flanges shall be of such size and shape so as not to destructively contact the fill material and cause stress concentration that swiftly leads to long filament breakage.**

**In multiple-section wide-face brushes, flanges shall contact only the solid brush retaining member that is capable of withstanding the required anchoring compression without distortion. The flanges shall not be of a size or geometry that will contact central web areas or equivalent areas that will bend or distort.**

**Flanges with either two keys or two keyways, 180° apart, shall be used under heavy duty conditions or with type IX wide-face brushes.**

**Threaded flanges shall have the correct thread so as to tighten when rotated and under load.**

## **7 Use of brushes**

### **7.1 General**

**The general rules of this clause shall be equally applicable to all types of classes of brush.**

### **7.2 Inspection**

**Before mounting, all brushes shall be closely inspected to make sure that they have not been damaged from handling, shipping, storage, or other causes.**

**If the brushes are wire filled, the wire in the brushes shall be inspected to ensure that no rust or degradation has occurred.**

structure. It is therefore important that stresses due to mounting and driving do not unnecessarily concentrate on the same part of the brush.

Flanges should be identical in diameter and radial bearing surface to avoid cross-bending pressures and stresses in the brush.

Flanges should be large enough in diameter to approximately equal the size of the face plate of a brush, or the size that a face plate would be, if used, so that the brush retaining members (the wire anchoring means) are safely enclosed between the face plates. Such ample flanges ensure positive driving of the brush.

### *E7.2 Inspection*

The first inspection should be made on the original shipping container. If there is visible evidence of damage to the container, special attention should be given to an immediate inspection of the brushes.

It is important that all brushes be inspected carefully before mounting.

Any rust, discoloration, or other evidence of chemical or physical change in the surface finish of the wire can cause premature failure of the brush by fatigue (see 9.2 and 9.3).

### 7.3 User's responsibilities

Persons qualified by experience shall be assigned to the mounting, care and inspection of brushes and brush machinery.

The user shall be responsible for the proper handling, storage, and inspection of brushes after receipt and shall maintain them and the equipment on which they are mounted in a safe operating condition at all times.

It shall be the responsibility of the user to fully inform all operating personnel about all of the hazards relating to use of the brush and to instruct them in all aspects of safety in operation of the brush, including but not limited to, correct speeds, proper guarding, protective clothing, and especially, eye protection. All operation and safety instructions shall be followed, as well as common safety practices that will reduce the likelihood or severity of physical injury.

### 7.4 Brush speed

Before mounting a brush, it shall be determined that the machine speed does not exceed the maximum safe free speed for the brush, as established by the brush manufacturer.

Under no circumstances shall a brush be mounted on a machine whose rpm exceeds the maximum safe free speed recommended for the brush.

### 7.5 Protective clothing and equipment

Appropriate protective clothing and equipment required for any brushing operation will vary with the size, nature, and location of the work. The user shall specify the special protective clothing and equipment required for all personnel in the area of each brushing operation.

Use of protective eye equipment shall be required for all brush operators and others in the area of the brushing operation, and face equipment shall also be required where there

### E7.3 User's responsibility

On new and future products developed by the brush manufacturer and the brush machine builder, the standard recommended practices may apply. However, the user should review and understand provided information, operating manuals, safety data sheets, and recommended practices to ensure safe operation.

### E7.4 Brush speed

Based on the structural strength of the brush, a maximum safe free speed is established. This speed should not be exceeded. Faster speeds may be expected to exceed the ability of the brush to withstand the stresses that are developed by the rotational forces and tangential forces combined.

### E7.5 Protective clothing and equipment

In normal power brushing operations, the material being removed (such as burrs, scale, dirt, weld slag, or other residue) will fly off the brush with considerable force along with the brush filaments, which break off due to fatigue.

The potential of serious injury exists for both the brush operator and others in the work area (possibly 50 feet (15.2 meters) or more from the brush). Before rotating the brush, the operator and others in the area are



**is a reasonable possibility of injury that can be prevented by such equipment. In such cases, users shall make conveniently available a type of protector recommended for the work to be performed, and personnel shall use such protection. No unprotected personnel shall be purposely subjected to a hazardous environmental condition, and the user shall supply adequate eye protection equipment to all personnel working or coming into the hazardous area.**

**Design, construction, testing, and use of devices for eye and face protection shall be in accordance with ANSI Z87.1.**

#### **7.6 Additional enclosure (or barrier)**

**Because the nature of many brushing operations requires personnel, other than the operator, to be in proximity to the brushing area, these personnel shall be protected by an enclosure that isolates the operation from the remaining work area, or equivalent (see 3.1.24). (See also 7.5 for the required protective clothing and equipment for such personnel.)**

**All personnel who have occasion to come into the enclosed brushing area (even if not in close proximity to the brushing operation) shall wear suitable eye protection as well as protective clothing and equipment described in 7.5.**

#### **7.7 Guarding of brushes**

**Because rotating brushes are inherently hazardous, the operator, as well as other workers in proximity to the brushing station, shall be protected by safety guards.**

**Rotating brushes shall be used only on machines provided with safety guards, however, safety guards are not required for brushes used for recessed work, brushes used for internal work and brushes used on hand-held power tools, i.e., drills and grinders, unless recommended by the power tool manufacturer in the instruction manual provided with the tool.**

required to wear protective eye equipment and face equipment, such as safety goggles or full face shields, worn over safety glasses with side shields, along with protective clothing capable of resisting a force of 23 Newtons with a penetration of 0.5 inch (1.3 centimeters).

#### *E7.6 Additional enclosure (or barrier)*

Any wall, partitions, or booths serving as an enclosure or barrier for a brushing operation should be identified as such.

It is the user's responsibility to identify the additional enclosure or barrier.

#### *E7.7 Guarding of brushes*

Exceptions to the use of safety guards are based on the impossibility of using smaller brushes with conventional guards in place. In these cases, the work often forms a guard. Eye and face protection is particularly important when using smaller brushes.

#### **7.7.1 Safety guards on pedestal grinders, bench and floor stands**

**Machines known as bench or pedestal grinders shall comply with ANSI B7.1.**

#### *E7.7.1 Safety guards on pedestal grinders, bench and floor stands*

Maximum guard openings are based on the fact that the line of flight of particles from the part being brushed, swarf, and the residue from the brush will be tangential in the direction of rotation of the brush. The maximum exposure angle should not be exceeded.

#### **7.7.2 Safety guards on automated equipment**

**The safety guards on automated brushing equipment shall be designed to admit the work to be brushed, but not the hands or other parts of the operator's body. It may be constructed so as to be adjustable for brushes of different sizes, but, once adjusted, it shall be affixed in that position.**

#### *E7.7.2 Safety guards on automated equipment*

Frequently, in automated brushing equipment fitted with large cylinder brushes, the machine is made in such a manner as to totally enclose the brush. This type of guarding restrains bursting brushes, swarf produced by brushing, and brush filaments that have broken off, and also prevents access to the brush while it is rotating.

#### **7.7.3 Interlocking safety guards**

**Interlocking safety guards shall be considered if fixed safety guards are not practical.**

#### *E7.7.3 Interlocking safety guards*

An interlocking safety guard is not fixed, and may be operated or removed as the operation requires. However, due to an electrical or mechanical interlocking connection with the operating mechanism, the operation of the machine is prevented until the guard is returned to an operating position and the operator can no longer reach the point of danger.

After mounting a brush, care should be taken to see that the electrical or mechanical mechanisms actuated by an open safety guard are operational. This should be ascertained before starting the brush.

#### **7.7.4 Safety guards for exposed brush protrusions**

**Brushes with exposed collars, couplings, cams, clutches, flywheels, shaft ends, or other protrusions shall have such protrusions guarded with a brush safety guard or the equivalent.**

#### **7.7.5 User's responsibility**

**It shall be the user's responsibility to maintain the safety guards, safety shields, and barriers in good condition. The user shall also make provision for the safety and**



protection of the personnel in the operating area (see 7.3, 7.5, and 7.6).

#### 7.8 Starting the brush

Before starting the machine on which a brush is mounted, all required personal eye protection and personal protective equipment, safety guards, barriers, or enclosures shall be in place. The machine shall be jogged to ensure that it is in readiness for use and that the brush is fastened securely and is concentric with the axis of rotation.

After the machine has been turned on, the brush shall be run at operating speed for at least one minute before applying work to dislodge loose particles. During this time, no one shall stand in front of or in line with the brush.

#### 7.9 Exhaust provision

On dry brushing operations, where brushes are mounted on floor stands, pedestals, benches, or special purpose machines, the user shall determine the need for connection to an exhaust system.

If it is determined that there is such a need, then provision shall be made for connection to an exhaust system that conforms to the minimum exhaust provisions recommended by OSHA Safety Code 1910.94 (see E7.9 and E7.9a). The exhaust system shall be in operation before the brushing is started (see 5.4).

#### E7.8 Starting the brush

This provides for the safety of the operator and others, should there have been damage to the brush, foreign matter accumulated in the brush, or malfunction of the machine from any cause.

#### E7.9 Exhaust provision

According to OSHA Safety Code 1910.94 under section 2, Table G5, the recommended minimum exhaust volume that should be used is as follows:

Wheel Diameter (in)	Minimum Width (in)	Exhaust Volume (ft <sup>3</sup> /min)
To 9	2	300
9 to 16	3	500
16 to 19	4	610

To determine the need for an exhaust system, see OSHA Title 29, Chap. 17, Part 1910.94 (b) Table G, or ANSI/NFPA 91.

#### E7.9a Exhaust provision

According to OSHA Safety Code 1910.94 under section 2, Table G5, the recommended minimum exhaust volume that should be used is as follows:

Wheel Diameter (mm)	Minimum Width (mm)	Exhaust Volume (mm <sup>3</sup> /min)
To 229	50.8	8.5
229 to 406	76.2	14.2
406 to 483	101.6	17.3

To determine the need for an exhaust system, see OSHA Title 29, Chap. 17, Part 1910.94 (b) Table G, or ANSI/NFPA 91.

## 8 Speeds

### 8.1 Safe free speeds

Safe free speed is any speed below the maximum safe free speed. The maximum safe free speed for each brush shall be established by the brush manufacturer (see 3.1.8).

### 8.2 Maximum speeds

It shall be the user's responsibility not to exceed the maximum safe free speed established by the manufacturer.

It shall be recognized that the maximum safe free speed is not necessarily the most efficient brushing speed. Better results are frequently obtained at speeds lower than maximum safe free speeds.

### 8.3 Speed test (brush manufacturer's responsibility)

The speed test described in this subclause is based on the fact that centrifugal forces caused by excessive speeds can permit the working stresses to which the brush is subjected to exceed the strength of its materials. The purpose of the test is to ensure the existence of a factor of safety to minimize this risk. Representative brushes shall be speed-tested in accordance with Table 2. These brushes shall be speed-tested for a period of 30 seconds at the test speed, determined by multiplying the maximum safe free speed of the brushes by the minimum test factor as shown in the table. However, the ultimate destruction speed shall be greater than the minimum test speed. If any representative brushes burst during the test at speeds shown in Table 2, the entire lot shall be rejected.

This speed test is not designed to determine the mechanical properties of the brush, which should already have been determined by the brush manufacturer (see 4.1 and E4.1).

### *E8.2 Maximum speeds*

The maximum safe free speed as determined by the manufacturer is dependent upon the brush shape and strength. The strength of a brush may be defined as the ability of the brush to withstand rotational stress under no-load conditions.

### *E8.3 Speed test (brush manufacturer's responsibility)*

The test speed subjects a brush to significantly greater forces than does the maximum safe free speed. This test establishes an adequate factor of safety, provided the brushes are used in accordance with safe practices outlined in this standard, and have not been altered, damaged, or abused.

The speed test does not justify operation of the brush at higher than the maximum safe free speed established by the brush manufacturer. The maximum safe free speed should never be exceeded, because the additional test strength covers other normal brushing stresses encountered in use.

No simple formula can possibly accommodate all of the various types and proportions of brushes, and, at the same time, provide a uniform factor of safety for each. Because of the considerations of safety, such a formula would penalize the better constructions to accommodate the weaker designs.

**In some cases, the shape, size, construction, or conditions of use of the brush make the speed test inapplicable or misleading.**

**Examples of brushes that need not be speed-tested include twisted-in wire brushes and strip brushes.**

**The brush manufacturer shall, upon demand, furnish certification showing that representative brushes have been speed-tested and have passed the test satisfactorily.**

**Table 2 – Test factors for speed test of brushes**

Class of brush	Minimum test factor <sup>1)</sup>
Type I. Straight cup brush	
Class 1. Crimped	1.2
Class 2. Twisted tuft or knot	1.2
Type II. Flared cup brush	
Class 1. Crimped	1.2
Class 2. Twisted tuft or knot	1.2
Type I. Straight cup brush with shank	
Class 1. Crimped	1.2
Class 2. Twisted tuft or knot	1.2
Type II. Flared cup brush with shank	
Class 1. Crimped	1.2
Class 2. Twisted tuft or knot	1.2
Type III. Wheel or radial brush	
Diameter	
Class 1. Crimped	
2 to 6 inches	1.2
6 to 9 inches	1.3
9 inches and over	1.5
Class 2. Twisted tuft or knot	
2 to 6 inches	1.2
6 to 9 inches	1.3
9 inches and over	1.5
Type III. Wheel or radial brush with shank	
Class 1. Crimped	1.2
Class 2. Twisted tuft or knot	1.2
Type IV. End brush	
Class 1. Crimped	
Style A. Solid fill	1.2
Style B. Hollow center	1.2
Style C. Pilot end	1.2
Class 2. Twisted tuft or knot	
Hollow center	1.2
Type V. Flared end brush	1.2
Type VI. Tubular end brush	
With shank	1.2
Without shank	1.2
Type VII. Twisted-in wire brush	No Speed Test
Type VIII. Strip brush	No Speed Test
Type IX. Cylinder brush	
Class 1. Mounted by manufacturer	
Style A. Crimped, or twisted tuft or knot	No Speed Test
Style B. Straight, helix, or coil-wound strip	No Speed Test
Class 2. Expendable or unitized	
Style A. Crimped, or twisted tuft or knot	No Speed Test
Style B. Straight, helix, or coil-wound strip	No Speed Test
<sup>1)</sup> Maximum safe free speed shall be multiplied by this test factor to establish the minimum speed at which brushes are to be tested by the brush manufacturer	



**8.4 Brush machine and power tool builder's responsibility**

**All brushes classified for use under table 2 of this standard shall be used on machines and power tools designed and equipped in accordance with all of the requirements for guards and other general machine conditions described in clauses 5 and 9.**

**8.5 User's responsibility**

**All brushes shall be used in conformance with instructions given in clauses 4 to 9.**

**8.5.1 Speed check of machines and power tools**

**The speed of the spindle on brush machines or power tools shall be checked frequently with suitable instruments, by competent personnel employed by the user, to make sure that the speed is correct for the type and size of brushes used.**

**8.5.2 Speed adjustment control**

**If the speed of the machine spindle is adjustable, the speed adjustment shall be under the supervision and control of competent and authorized personnel only.**

**Such personnel shall use care in determining that the speed at any present moment conforms to and does not exceed the peripheral speeds (in surface feet/meters per minute), the rated MSFS as established for a new brush, or both (see tables 3 and 3a).**

*E8.4 Brush machine and power tool builder's responsibility*

The reference to other applicable clauses and regulations are important. All designers of brush machinery should be familiar with them. Their proper application has a direct relationship to the safe use of brushes.

*E8.5 User's responsibility*

The references to other applicable clauses and regulations are important. All users of brushes should be familiar with them. Their proper application has a direct relationship to the safe use of brushes.

*E8.5.1 Speed check of machines and power tools*

It is of special importance that the portable air grinders be checked to be sure that proper air pressure is maintained and that the machine governor mechanism is clean, in good operating condition, and functioning properly. This reference to air tools is not intended to downplay the necessity for a regular check of the speed on all types of brushing machines. Various types of speed-testing equipment are available, including tachometers, revolution counters, speed indicators, and stroboscopic mechanisms. A record of such speed checks should be maintained by the user.

*E8.5.2 Speed adjustment control*

Certain machines are designed with adjustable speeds to permit maintenance of efficient surface speeds by increasing the speed of the brush spindle to compensate for the reduction of the brush diameter.



Table 3 – Conversion table for brush speeds

Surface speed in feet per minute									
Brush diameter (inches)									
r/min*	2	3	4	6	8	10	12	15	16
200	105	157	209	314	419	524	629	785	838
400	209	314	419	628	838	1 047	1 257	1 571	1 676
600	314	471	628	942	1 257	1 571	1 885	2 356	2 513
800	419	628	838	1 257	1 676	2 094	2 513	3 142	3 351
1 000	524	785	1 047	1 571	2 094	2 618	3 142	3 927	4 189
1 200	628	942	1 257	1 885	2 513	3 142	3 770	4 712	5 027
1 400	633	1 100	1 466	2 199	2 932	3 665	4 398	5 498	5 864
1 600	838	1 257	1 676	2 513	3 351	4 189	5 027	6 283	6 702
1 800	942	1 414	1 885	2 827	3 770	4 712	5 655	7 069	7 540
2 000	1 047	1 571	2 094	3 142	4 189	5 236	6 283	7 858	8 378
2 200	1 152	1 728	2 304	3 456	4 608	5 760	6 912	8 639	9 215
2 400	1 257	1 885	2 513	3 770	5 027	6 283	7 540	9 425	10 053
2 600	1 361	2 042	2 723	4 084	5 445	6 807	8 168	10 210	10 891
2 800	1 466	2 199	2 932	4 398	5 864	7 330	8 796	10 996	11 729
3 000	1 571	2 356	3 142	4 712	6 283	7 854	9 425	11 781	12 566
3 200	1 676	2 513	3 351	5 027	6 702	8 378	10 053	12 566	13 404
3 400	1 780	2 670	3 560	5 341	7 121	8 901	10 681	13 352	14 242
3 600	1 885	2 827	3 770	5 657	7 540	9 425	11 310	14 137	15 080
3 800	1 990	2 985	3 979	5 969	7 959	9 948	11 938	14 923	15 917
4 000	2 094	3 142	4 189	6 283	8 378	10 472	12 566	15 708	16 755
4 400	2 304	3 456	4 608	6 912	9 215	11 519	13 823	17 279	18 431
4 800	2 513	3 770	5 027	7 540	10 053	12 566	15 080	18 850	20 106
5 200	2 723	4 084	5 445	8 168	10 891	13 614	16 336	20 420	21 782
5 600	2 932	4 398	5 864	8 796	11 729	14 661	17 593	21 991	23 457
6 000	3 142	4 712	6 283	9 425	12 566	15 708	18 850	23 562	25 133
6 500	3 403	5 105	6 807	10 210	13 614	17 017	20 420	25 525	27 227
7 000	3 665	5 498	7 330	10 996	14 661	18 326	21 991	27 499	29 322
7 500	3 927	5 890	7 854	11 781	15 708	19 635	23 562	29 452	31 416
8 000	4 189	6 283	8 378	12 566	16 755	20 944	25 133	31 416	—
8 500	4 451	6 676	8 901	13 352	17 802	22 253	26 704	—	—
9 000	4 712	7 069	9 425	14 137	18 850	23 562	28 274	—	—
9 500	4 974	7 461	9 948	14 923	19 897	24 971	29 845	—	—
10 000	5 236	7 854	10 472	15 708	20 944	26 180	31 416	—	—
11 000	5 756	8 639	11 519	17 279	23 038	28 798	—	—	—
12 000	6 283	9 425	12 566	18 850	25 133	31 416	—	—	—
13 000	6 807	10 210	13 614	20 420	27 727	—	—	—	—
14 000	7 330	10 996	14 661	21 991	29 322	—	—	—	—
15 000	7 854	11 781	15 708	23 562	31 416	—	—	—	—
16 000	8 377	12 566	16 755	25 133	—	—	—	—	—
17 000	8 901	13 352	17 802	26 704	—	—	—	—	—
18 000	9 425	14 137	18 850	28 274	—	—	—	—	—
19 000	9 948	14 923	19 897	29 845	—	—	—	—	—
20 000	10 472	15 708	20 945	31 416	—	—	—	—	—
22 000	11 519	17 279	23 038	—	—	—	—	—	—
24 000	12 566	18 850	25 133	—	—	—	—	—	—
26 000	13 614	20 420	27 227	—	—	—	—	—	—
28 000	14 661	21 991	29 322	—	—	—	—	—	—
30 000	15 708	23 562	31 416	—	—	—	—	—	—

\*Revolutions per minute for various diameters of brushes to give surface speed in feet per minute as indicated.

NOTE – "Centrifugal force," the force that tends to rupture a given brush when overspeeding, increases as the square of the velocity of that wheel brush. For example, the centrifugal force in a brush running at 5 500 surface feet per minute is 49% greater than in the same brush running at 4 500 surface feet per minute, although the speed is actually only 22% greater.

**Table 3a – Conversion table for brush speeds**

Surface speed in M per minute									
Brush diameter (millimeters)									
r/min*	51	76	102	152	203	254	305	381	406
200	32	78	64	96	128	160	192	239	255
400	64	96	128	192	255	319	383	479	511
600	96	144	192	287	383	479	585	718	766
800	128	192	255	383	511	638	766	958	1 021
1 000	160	239	319	479	638	798	958	1 197	1 277
1 200	192	287	383	575	766	958	1 149	1 436	1 532
1 400	223	335	447	670	894	1 117	1 341	1 676	1 787
1 600	255	383	511	766	1 021	1 277	1 532	1 915	2 043
1 800	287	431	575	862	1 149	1 436	1 724	2 155	2 298
2 000	319	479	638	958	1 277	1 596	1 915	2 394	2 553
2 200	351	527	702	1 053	1 404	1 756	2 107	2 633	2 809
2 400	383	575	766	1 149	1 532	1 915	2 298	2 873	3 064
2 600	415	622	830	1 245	1 660	2 075	2 490	3 112	3 320
2 800	447	670	894	1 341	1 787	2 234	2 681	3 351	3 585
3 000	479	718	958	1 436	1 915	2 394	2 873	3 591	3 830
3 200	511	766	1 021	1 532	2 043	2 553	3 064	3 830	4 086
3 400	543	814	1 085	1 628	2 170	2 713	3 256	4 070	4 341
3 600	575	862	1 149	1 724	2 298	2 873	3 447	4 309	4 596
3 800	606	910	1 213	1 819	2 426	3 032	3 639	4 548	4 852
4 000	638	958	1 277	1 915	2 553	3 192	3 830	4 788	5 107
4 400	702	1 053	1 404	2 107	2 809	3 511	4 213	5 267	5 618
4 800	766	1 149	1 532	2 298	3 064	3 830	4 596	5 745	6 128
5 200	830	1 245	1 660	2 490	3 320	4 149	4 979	6 224	6 639
5 600	894	1 341	1 787	2 681	3 575	4 469	5 362	6 703	7 150
6 000	958	1 436	1 915	2 873	3 830	4 788	5 745	7 182	7 660
6 500	1 037	1 556	2 075	3 112	4 149	5 187	6 224	7 780	8 299
7 000	1 117	1 676	2 234	3 351	4 469	5 586	6 703	8 379	8 937
7 500	1 197	1 795	2 394	3 591	4 788	5 985	7 182	8 977	9 576
8 000	1 277	1 915	2 553	3 830	5 107	6 384	7 660	9 576	-
8 500	1 357	2 035	2 713	4 070	5 426	6 783	8 139	-	-
9 000	1 436	2 155	2 873	4 309	5 475	7 182	8 618	-	-
9 500	1 516	2 274	3 032	4 548	6 065	7 581	9 097	-	-
10 000	1 596	2 394	3 192	4 788	6 384	7 980	9 576	-	-
11 000	1 756	2 633	3 511	5 267	7 022	8 778	-	-	-
12 000	1 915	2 873	3 830	5 745	7 660	9 576	-	-	-
13 000	2 075	3 112	4 149	6 224	8 299	-	-	-	-
14 000	2 234	3 351	4 469	6 703	8 937	-	-	-	-
15 000	2 394	3 591	4 788	7 182	9 576	-	-	-	-
16 000	2 553	3 830	5 107	7 660	-	-	-	-	-
17 000	2 713	4 070	5 426	8 439	-	-	-	-	-
18 000	2 873	4 309	5 745	8 618	-	-	-	-	-
19 000	3 032	4 548	6 065	9 097	-	-	-	-	-
20 000	3 192	4 788	6 384	9 576	-	-	-	-	-
22 000	3 511	5 267	7 022	-	-	-	-	-	-
24 000	3 830	5 745	7 660	-	-	-	-	-	-
26 000	4 149	6 224	8 299	-	-	-	-	-	-
28 000	4 469	6 703	8 937	-	-	-	-	-	-
30 000	4 788	7 182	9 576	-	-	-	-	-	-

\*Revolutions per minute for various diameters of brushes to give surface speed in meters per minute as indicated.

NOTE – “Centrifugal force,” the force that tends to rupture a given brush when overspeeding, increases as the square of the velocity of that wheel brush. For example, the centrifugal force in a brush running at 5 500 surface meters per minute is 49% greater than in the same brush running at 4 500 surface meters per minute, although the speed is actually only 22% greater.

**8.6 Requirements for special speeds**

**On effectively guarded, fully protected machines, brushes used on special applications at speeds higher than those recommended by the brush manufacturer shall be used only in accordance with 8.6.1 through 8.6.3, as applicable.**

**If the brush manufacturer allows a special speed, the special speed shall replace the safe free speed for that brush. In this case, the brush manufacturer shall determine the special maximum safe free speed.**

**8.6.1 The brush manufacturer's responsibility**

**It shall be the manufacturer's responsibility to speed-test brushes required for special speeds and to identify them as being able to operate safely at special speeds.**

**If it is impractical to mark the brush, then the box or package in which it is wrapped shall contain the required markings, either on the outside of the package or printed on an insert placed inside the package.**

**The brush manufacturer shall make certain that the brushes are of adequate strength, have been speed-tested in accordance with table 2, and bear the brush manufacturer's approval of the higher speed.**

**8.6.2 The brush machine builder's responsibility**

**The brush machine builder shall make certain at the time of manufacture that the machine has been designed and guarded in such a manner as to protect the operator from injury.**

**It shall be the brush machine builder's responsibility to design and construct those machine components that are concerned with the safe operation of the brushing machine at the speed and for the type of operation for which the machine is intended.**

**Particular attention shall be given to the design of the safety guards and the mounting spindle of the brush.**

*E8.6 Requirements for special speeds*

When brushes are used at speeds in excess of standard speeds, extra precautions should be observed to ensure safe operation of the brush.

*E8.6.1 The brush manufacturer's responsibility*

The brush manufacturer should do the testing necessary to establish an adequate factor of speed. The brush should be marked to indicate that it has been approved for high speed under specific conditions of use.

*E8.6.2 The brush machine builder's responsibility*

The machine builder should be sure that the components of the machine, such as the spindle, bearings, guards, flanges, and horsepower, are adequate for the brushing operation.

The brush machine builder and brush manufacturer should cooperate to make sure that a brush of adequate strength can be manufactured for the operation; design and composition limitations might preclude making a brush for operation at special speeds.

The brush machine builder should decide upon the fitness of the machine for the proposed operation. If it becomes necessary or desirable to convert, change, or alter the machine from the design or purpose for which it was originally



**If an existing machine is to be adapted for use at a special speed, the brush machine builder shall check all component parts of the brushing machine and, if necessary, modify or adjust all component parts prior to operation at the special speed.**

**When the operation is beyond the conditions for which the guards were designed, the brush machine builder shall ensure by test or calculation that the guards are capable of withstanding the special speeds, and, if necessary, replace, modify, or adjust the guards prior to operating at the special speed.**

**When the operating conditions are determined as exceeding the capacity of the machine and guards, the brush machine builder shall ensure by test or calculation the specifications for adequate replacement of the mechanical mechanisms and apparatus.**

#### **8.6.3 The user's responsibility**

**Before operating the machine at a special speed, the machine user shall make certain that the machine is operated with approved safety guards as defined in 7.7, and that the machine is maintained in a satisfactory condition, as defined in clause 5.**

**After receipt of the brushes, it shall be the user's responsibility to provide safe handling, storage, and inspection for the brushes designed for special needs in accordance with clause 4 and to maintain his/her brushing equipment in a safe operating condition at all times. Rules of safe operation of this equipment submitted by the brush machine builder shall be observed as well as those rules specified in other clauses of this standard. A user shall not operate a brush designed for special needs faster than the special maximum safe free speed established by the brush manufacturer.**

**When an existing machine is altered by the user to operate at special speeds, the user shall assume all of the responsibility of a machine builder as outlined in this standard.**

made by the builder, the components involved with the use of the brush should be designed in accordance with the appropriate classes of this standard.

#### *E8.6.3 The user's responsibility*

The user should establish that all guards on the machine are adequate for the higher speed and should also maintain the machine in good condition for continuing safety.

The special speed as determined by the manufacturer is dependent on the size, geometry, and material of the brush. In this instance, strength is defined as the ability of the brush to withstand rotational stress.

The user shall fully inform all operating personnel that only brushes identified for operation at special speeds shall be used, and that, at no time, shall the special maximum safe free speed be exceeded.

## 9 Handling, storage, and inspection

### 9.1 Handling

All power-driven brushing tools can be damaged by improper handling. The following rules shall always be observed:

- 1) Handle brushes carefully so that the fill material is not disoriented or bent, potentially causing an imbalanced condition to exist.
- 2) Do not rest any brush on its face, or place any object on the face of the brush that might tend to distort the face or become imbedded in the face.
- 3) Do not roll cylinder brushes (barrel fashion) or wheel brushes (hoop fashion).
- 4) When handling cylinder brushes with a sling, do not use a sling that is narrow enough to become impressed into the face of the brush.
- 5) Do not open packaged brushes until they are to be used or unless they need to be inspected. After inspection, repackage them in a manner that will ensure the same amount of protection as the original package.
- 6) During handling, keep all brushes boxed or covered so that foreign matter cannot accumulate and become lodged in the face of the brush.
- 7) Place brushes carefully on shelves or in boxes, bins, or other compartments so that brushes do not rest in any way that could cause a distorted condition.

### *E9.1 Handling*

Poor handling of brushes can contribute to unsafe conditions in a number of ways. Brushes damaged as in 9.1(1), (2), (4), and (7) that have filaments permanently deformed prior to use must be expected to adversely affect brush life, fill stiffness, surface finish, and safety itself, since stress concentrations at bends will occur and higher stresses will result when non-radially disposed wires lengthen upon contact with the work surface. This condition can also create imbalance in a brush that could result in extensive damage to the machine and the operator. Brushes that are out of balance and that cannot be balanced by adding or removing weight should be removed from the machine (see 4.2).

Poor handling creates safety hazards in another way, as shown in 9.1(2), (3), (5), and (6). In each instance, there is a possibility of foreign objects being lodged in the face of the brush. These imbedded objects can be thrown from the brush at great velocities when the brush attains operating speed.



## 9.2 Storage

**Suitable racks, bins, drawers, or boxes shall be provided by the user to store the various types of brushes used. Storage recommendations of the brush manufacturer shall be followed. Brushes shall not be stored where they will be subjected to:**

- **Exposure to high humidity, heat, water, UV or other liquids that might induce deterioration or dimensional changes to the filaments or other brush components. (This deterioration includes rusting of ferrous metals and rotting, checking, or warping of wood and degrading of plastics.)**
- **Exposure to acids or fumes from acids that might induce deterioration to the filaments or other brush components.**
- **Any temperature low enough to cause condensation on the brushes when they are moved from storage to an area of higher temperature or humidity or both, or low enough to cause embrittlement or other deterioration of the filaments or other brush components.**
- **Storage that causes bent or distorted brush components.**
- **Damaged brush filaments from sliding the brushes across abrasive or rough surface.**
- **Exposure to the accumulation of foreign matter that may become attached to or lodged in any of the brush components.**

## E9.2 Storage

Any type of storage that permits the formation of rust on the filament wires or any corrosion to the filament surfaces, or that permits such mechanisms as hydrogen embrittlement to occur, can cause premature failure of the material. The failure is caused by corrosion fatigue. When corrosion occurs, there is a general roughening and etching effect that influences the fatigue strength of the material. Pitting caused by corrosion can result in a reduced cross section, thus increasing the magnitude of the stress unit. Even when only a few spots on the material are involved, the results are harmful, since the first crack will almost always occur prematurely in the corroded area, and, once started, will propagate through the unaffected area.

When corrosion is occurring during in-service use due to the repeated stressing that occurs naturally in a brush during use, the deleterious effect of corrosion fatigue is even greater. Special care should be exercised to avoid this condition because filaments that have been fatigued by corrosion present a hazard since they break off in use in long lengths and fly from the brush at dangerous velocities.

If rust is visible, corrosion has already become extensive enough to reduce the fatigue life of the brush.

If it is unavoidable that wire brushes will be stored in an environment that may contribute to corrosion, some protective steps can be taken. The brushes can be wrapped in protective paper before being placed in the storage area. This practice, or some equivalent, can preclude much difficulty assignable to corrosion resulting from storage conditions that are less than desirable.

Some users who have less than adequate storage facilities compensate for the lack by better planning of deliveries. They schedule deliveries so that brushes do not remain long in poor storage conditions.

Brushes can also be damaged by sliding them over an abrasive surface. This abrades the fill material and consequently creates a new fatigue hazard. Such fatigue failures frequently start from even superficial-appearing surface scratches, markings, and discontinuities that

develop into fatigue cracks. As the material flexes in use, these cracks, even though initially microscopic in size, propagate and material breaks off. This flying material poses a safety hazard for the brush operator and those in the area.

### 9.3 Inspection

**Immediately after being unpacked or uncrated, all brushes shall be closely inspected to make sure that they have not been damaged from handling, shipping, or other causes. If examination discloses damage, the brushes shall not be used.**

**A typical defect that might be encountered on wire brushes is oxidation caused by exposure to environmental conditions.**

### *E9.3 Inspection*

The first inspection should be made on the box, crate, or container in which the brushes were shipped. If there is any evidence of damage to the container, special care should be used in the inspection of brushes.

Other examples of damage caused by poor handling or packaging are bent or dented shafts or arbors and disarranged working faces that preclude safe balance and concentric operation. Other typical defects may include any or all defects as a result of incorrect handling (see 9.1) and storage (see 9.2).