



# SURFACE VEHICLE RECOMMENDED PRACTICE

J694™

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(R) Disc Wheel and Hub or Drum Interface Dimensions - Truck and Bus

## RATIONALE

The primary change was adding 5.3 on two-piece sleeve flange nuts due to the increase in usage of this type of fastener in the North American market.

### 1. SCOPE

This SAE Recommended Practice contains dimensions and their tolerances concerning disc wheel to hub or drum interface areas for truck and bus applications. Disc wheels designed only for single wheel applications (not dual wheels) for light trucks and special or less common applications are not covered in this document.

#### 1.1 Purpose

This document defines wheel mounting systems and documents the dimensions and tolerances necessary to maintain serviceability, and interchangeability in the interface areas. To be consistent with ISO, it is divided into two sections (I and II). Section I is in concert with ISO 4107, describing mounting systems currently used internationally and nominated for, or included in, the international standard for bolt circle interfaces. Section II records information on current mounting systems also used in North America. **Components of different mounting systems with common bolt patterns could be mis-assembled together and cause service problems. Therefore, it is important to note that each mounting system should be treated individually, and their components not be intermixed.**

### 2. REFERENCES

#### 2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

##### 2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

SAE J393 Nomenclature - Wheels, Hubs, and Rims for Commercial Vehicles

SAE J1671 Outboard Mounted Brake Drum/Disc Wheel Hub Interface Dimensions - Truck and Bus

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### 2.1.2 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 4107 Commercial vehicles - Wheel hub attachment dimensions

ISO 7575 Commercial Road Vehicles - Flat Attachment Wheel Fixing Nuts

### 2.1.3 DIN Publications

Copies of these documents are available online at <https://www.beuth.de/en>.

DIN 74361-3 Disc wheels for motor vehicles and trailers -Part 3: Dimensions and fastening devices for hub-centering

## 2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

### 2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

SAE J1842 Disc Wheel Hub/Spoke Wheel and Axle Interface Dimensions - Commercial Vehicles

SAE J2696 Inboard Mounted Disc Brake Rotor/Disc Wheel Hub Interface Dimensions - Commercial Vehicles

## 3. DEFINITIONS

A detailed listing of basic nomenclature is contained in SAE J393 which introduces, illustrates, and specifies additional nomenclature and definitions.

### 3.1 MOUNTING SYSTEM

The combination of wheel/hub or drum interface characteristics that identify uniqueness are: number of bolt holes, bolt circle diameter, and fastener type. Unique mounting systems are identified by the Roman numerals in applicable tables throughout the document. Within a given mounting system, the wheels are interchangeable only by use of the appropriate fasteners and/or hubs with appropriate dimensions for the wheel material shown.

### 3.2 SCALLOPED HUBS

In an attempt to reduce wheel end package weight, some hub manufacturers have adopted the practice of creating scallops in the wheel mounting flange on the hub. The term scallop refers to the removal of material from the wheel backup diameter that results in an interrupted support face. In some applications, the use of scalloped hubs has led to the development of cyclical fatigue cracks in disc wheels. It is recommended that scalloped hubs not be used when the disc wheel is mounted directly to the mounting face on the hub. Use of scalloped hubs with outboard mounted brake drums is generally deemed acceptable. Wheel manufacturers should be consulted for each particular application.

## 4. ABBREVIATIONS

Abbreviations used are as follows:

BSN = Ball seat nut

BSN-AL = Ball seat nut for aluminum wheels

BSN-HD = Ball seat nut, heavy duty

FN = Flange nut

SFN = Sleeved flange nut for aluminum wheels

N/A = Not applicable

## 5. SECTION I - DISC WHEEL/HUB OR DRUM INTERFACE COMPATIBLE WITH ISO 4107 AND ISO 7575 NUTS

### 5.1 Wheel Dimensions

#### 5.1.1 Definitions of Wheel Dimensions

See Figures 1 and 2.

- A = Number of bolt holes
- B = Bolt circle diameter
- C = Center hole diameter
- D = Bolt hole diameter
- E = Disc flat clearance diameter
- F = Disc thickness

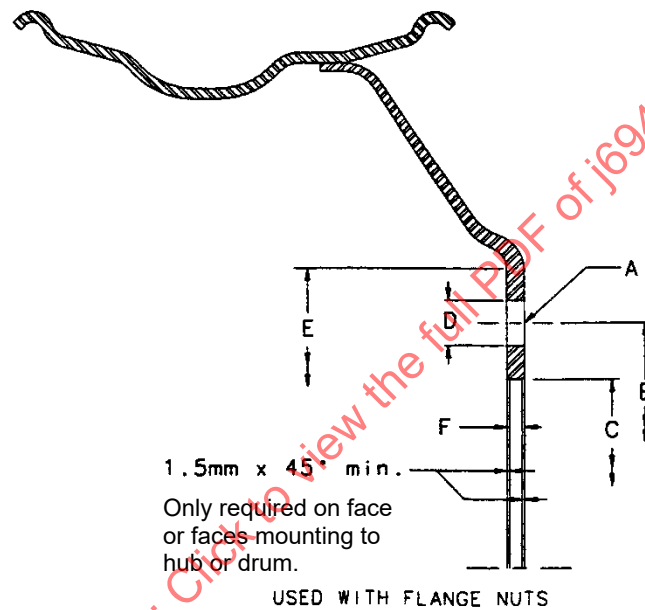


**Figure 1 - Ferrous disc wheel**

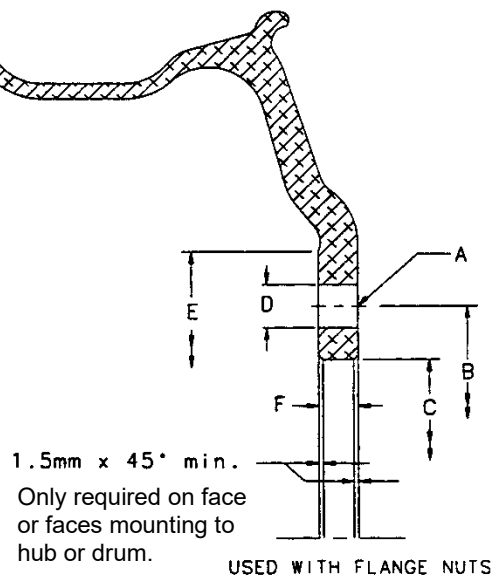


**Figure 2 - Aluminum disc wheel**

## 5.1.2 Dimensions and Tolerances of Wheels

### 5.1.2.1 Metric System Mountings - Wheel Dimensions

All dimensions are in millimeters. See Table 1.

**Table 1 - Metric system mountings - wheel dimensions**

| Mounting System | Mounting Systems No. of Bolt Holes A | Mounting Systems Bolt Circle Diameter B<br>$\pm 0.40 \varnothing$ | Mounting Systems Fastener Type <sup>(1)</sup> | Mounting Systems Wheel Material <sup>(1)</sup> | Dimensions Center Hole Diameter C<br>+0.2, -0 | Dimensions Bolt Hole Diameter for Flange Nut D<br>+1, -0 | Dimensions Disc Flat Clearance Diameter E<br>Minimum | Dimensions Disc Thickness <sup>(1)(2)</sup><br>F<br>Maximum |                          |                    |
|-----------------|--------------------------------------|-------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|-----------------------------------------------|----------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------|--------------------------|--------------------|
|                 |                                      |                                                                   |                                               |                                                |                                               |                                                          |                                                      | $\leq 8.25$<br>Rim Width                                    | 8.50 & 9.00<br>Rim Width | >9.00<br>Rim Width |
|                 |                                      |                                                                   |                                               |                                                |                                               |                                                          |                                                      |                                                             |                          |                    |
| II              | 8                                    | 275                                                               | FN                                            | Ferrous                                        | 221.0                                         | 24                                                       | 325                                                  | 13                                                          | N/A                      | N/A                |
|                 |                                      |                                                                   | FN                                            | Aluminum                                       | 221.1 <sup>(3)</sup>                          | 24                                                       | 325                                                  | 25.4                                                        | N/A                      | N/A                |
|                 |                                      |                                                                   | SFN                                           | Aluminum                                       | 221.1 <sup>(3)</sup>                          | 30                                                       | 325                                                  | 25.4                                                        | N/A                      | N/A                |
| III             | 10                                   | 285.75                                                            | FN                                            | Ferrous                                        | 220.0                                         | 26                                                       | 345                                                  | 14                                                          | 16                       | 16                 |
|                 |                                      |                                                                   | FN                                            | Aluminum                                       | 220.1                                         | 26                                                       | 345                                                  | 25.4                                                        | 25.4                     | 30                 |
|                 |                                      |                                                                   | SFN                                           | Aluminum                                       | 220.1                                         | 32                                                       | 345                                                  | 25.4                                                        | 25.4                     | 30                 |
| IV              | 10                                   | 335                                                               | FN                                            | Ferrous                                        | 281.0                                         | 26                                                       | 390                                                  | 14                                                          | 16                       | 16                 |
|                 |                                      |                                                                   | FN                                            | Aluminum                                       | 281.1                                         | 26                                                       | 390                                                  | 25.4                                                        | 25.4                     | 30                 |
|                 |                                      |                                                                   | SFN                                           | Aluminum                                       | 281.1                                         | 32                                                       | 390                                                  | 25.4                                                        | 25.4                     | 30                 |
| XIII            | 6                                    | 205                                                               | FN                                            | Ferrous                                        | 161.0                                         | 21                                                       | 255                                                  | 13                                                          | N/A                      | N/A                |
|                 |                                      |                                                                   | FN                                            | Aluminum                                       | 161.1                                         | 21                                                       | 255                                                  | 20                                                          | N/A                      | N/A                |
|                 |                                      |                                                                   | SFN                                           | Aluminum                                       | 161.1                                         | 26                                                       | 255                                                  | 20                                                          | N/A                      | N/A                |
| XV              | 6                                    | 245                                                               | FN                                            | Ferrous                                        | 202.0                                         | 21                                                       | 295                                                  | 13                                                          | N/A                      | N/A                |
|                 |                                      |                                                                   | FN                                            | Aluminum                                       | 202.1                                         | 21                                                       | 295                                                  | 20                                                          | N/A                      | N/A                |
|                 |                                      |                                                                   | SFN                                           | Aluminum                                       | 202.1                                         | 26                                                       | 295                                                  | 20                                                          | N/A                      | N/A                |
| XVI             | 8                                    | 222.25                                                            | FN                                            | Ferrous                                        | 164.0                                         | 24                                                       | 280                                                  | 13                                                          | N/A                      | N/A                |
|                 |                                      |                                                                   |                                               | Aluminum                                       | 164.1                                         | 24                                                       | 280                                                  | 20                                                          | N/A                      | N/A                |

<sup>(1)</sup> Disc thickness and fastener type are not included in ISO 4107.

<sup>(2)</sup> N/A signifies a number not applicable to the given configuration.

<sup>(3)</sup> This value is 221.2 in ISO 4107.

## 5.2 Hub or Drum Interface Dimensions

### 5.2.1 Definitions of Hub or Drum Interface Dimensions

See Figure 3.

A = Number of studs or bolts

B = Bolt circle diameter

C1 = Wheel pilot diameter

D2 = Stud or bolt size

E1 = Diameter of wheel backup - hub or outboard drum (usually not coincident with hub flange outside diameter)

F1 = Wheel pilot length (does not include lead in radius or chamfer)

G = Stud or bolt standoff beyond wheel mounting face of hub or outboard drum. This is calculated with the maximum wheel thickness plus the maximum nut thickness to permit full thread engagement.

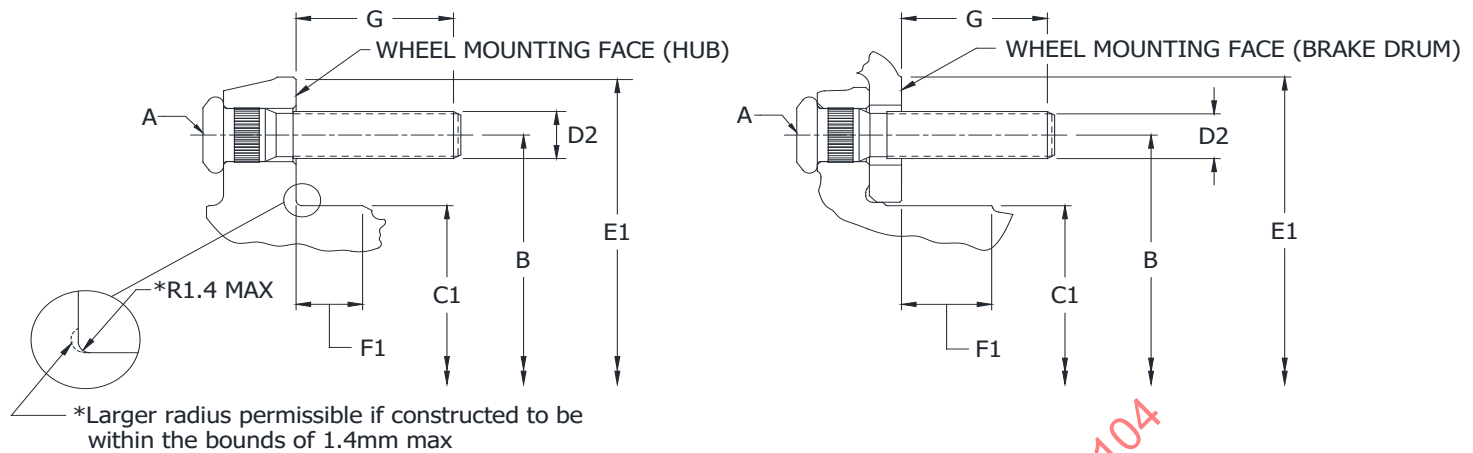


**Figure 3 - Hub or drum interface dimensions**

## 5.2.2 Interface Dimensions and Tolerances of Hubs or Drums

### 5.2.2.1 Metric System Mountings - Hub Dimensions

All dimensions are in millimeters. See Table 2.

**Table 2 - Metric system mountings - hub dimensions**

| Mounting System | Mounting Systems No. of Studs or Bolts A | Mounting Systems Bolt Circle Diameter B $\pm 0.40$ $\varnothing$ | Mounting Systems Fastener Type <sup>(1)</sup> | Mounting Systems Wheel Material <sup>(1)</sup> | Stud or Bolt Diameter D2 | Wheel Pilot Diameter C1 $+0, -0.2$ | Wheel Backup Diameter E1 | Wheel Pilot Length Single <sup>(1)</sup> F1 Minimum | Wheel Pilot Length Dual <sup>(1)</sup> F1 Minimum | Standout Single G <sup>(1,2)</sup> Minimum $\leq 8.25$ Rim Width | Standout Dual G <sup>(1,2)</sup> Minimum $\leq 8.25$ Rim Width | Standout Single G <sup>(1,2,3)</sup> Minimum 8.5&9.0 Rim Width | Standout Dual G <sup>(1,2,3)</sup> Minimum 8.5&9.0 Rim Width | Standout Single G <sup>(1,2,3)</sup> Minimum $>9.0$ Rim Width |
|-----------------|------------------------------------------|------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|--------------------------|------------------------------------|--------------------------|-----------------------------------------------------|---------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------|
| II              | 8                                        | 275                                                              | FN                                            | Ferrous                                        | 20                       | 220.8                              | 315/320                  | 13                                                  | 20                                                | 42                                                               | 55                                                             | N/A                                                            | N/A                                                          | N/A                                                           |
|                 |                                          |                                                                  | FN                                            | Aluminum                                       | 20                       | 220.8                              | 315/320                  | 13                                                  | 35                                                | 55                                                               | 80                                                             | N/A                                                            | N/A                                                          | N/A                                                           |
|                 |                                          |                                                                  | SFN                                           | Aluminum                                       | 20                       | 220.8                              | 315/320                  | 13                                                  | 35                                                | See 5.3.2.2                                                      |                                                                | N/A                                                            | N/A                                                          | N/A                                                           |
| III             | 10                                       | 285.75                                                           | FN                                            | Ferrous                                        | 22                       | 219.8                              | 335/340                  | 13                                                  | 20                                                | 48                                                               | 62                                                             | 50                                                             | 66                                                           | 50                                                            |
|                 |                                          |                                                                  | FN                                            | Aluminum                                       | 22                       | 219.8                              | 335/340                  | 13                                                  | 35                                                | 60                                                               | 85                                                             | 60                                                             | 85                                                           | 64.6                                                          |
|                 |                                          |                                                                  | SFN                                           | Aluminum                                       | 22                       | 219.8                              | 335/340                  | 13                                                  | 35                                                | See 5.3.2.2                                                      |                                                                |                                                                |                                                              |                                                               |
| IV              | 10                                       | 335                                                              | FN                                            | Ferrous                                        | 22                       | 280.8                              | 380/385                  | 13                                                  | 20                                                | 48                                                               | 62                                                             | 50                                                             | 66                                                           | 50                                                            |
|                 |                                          |                                                                  | FN                                            | Aluminum                                       | 22                       | 280.8                              | 380/385                  | 13                                                  | 35                                                | 60                                                               | 85                                                             | 60                                                             | 85                                                           | 64.6                                                          |
|                 |                                          |                                                                  | SFN                                           | Aluminum                                       | 22                       | 280.8                              | 380/385                  | 13                                                  | 35                                                | See 5.3.2.2                                                      |                                                                |                                                                |                                                              |                                                               |
| XIII            | 6                                        | 205                                                              | FN                                            | Ferrous                                        | 18                       | 160.8                              | 245/250                  | 10                                                  | 20                                                | 40                                                               | 53                                                             | N/A                                                            | N/A                                                          | N/A                                                           |
|                 |                                          |                                                                  | FN                                            | Aluminum                                       | 18                       | 160.8                              | 245/250                  | 10                                                  | 30                                                | 47                                                               | 67                                                             | N/A                                                            | N/A                                                          | N/A                                                           |
|                 |                                          |                                                                  | SFN                                           | Aluminum                                       | 18                       | 160.8                              | 245/250                  | 10                                                  | 30                                                | See 5.3.2.2                                                      |                                                                | N/A                                                            | N/A                                                          | N/A                                                           |
| XV              | 6                                        | 245                                                              | FN                                            | Ferrous                                        | 18                       | 201.8                              | 285/290                  | 10                                                  | 20                                                | 40                                                               | 53                                                             | N/A                                                            | N/A                                                          | N/A                                                           |
|                 |                                          |                                                                  | FN                                            | Aluminum                                       | 18                       | 201.8                              | 285/290                  | 10                                                  | 30                                                | 47                                                               | 67                                                             | N/A                                                            | N/A                                                          | N/A                                                           |
|                 |                                          |                                                                  | SFN                                           | Aluminum                                       | 18                       | 201.8                              | 285/290                  | 10                                                  | 30                                                | See 5.3.2.2                                                      |                                                                | N/A                                                            | N/A                                                          | N/A                                                           |
| XVI             | 8                                        | 222.25                                                           | FN                                            | Ferrous                                        | 20                       | 163.8                              | 272/277                  | 10                                                  | 20                                                | 42                                                               | 55                                                             | N/A                                                            | N/A                                                          | N/A                                                           |
|                 |                                          |                                                                  | FN                                            | Aluminum                                       | 20                       | 163.8                              | 272/277                  | 10                                                  | 30                                                | 49                                                               | 69                                                             | N/A                                                            | N/A                                                          | N/A                                                           |

<sup>(1)</sup> Wheel pilot length, stud or bolt standout, and fastener type are not included in ISO 4107.

<sup>(2)</sup> For wheels with disc thicknesses that are outside the scope of this document, longer standouts than those shown may be required.

<sup>(3)</sup> N/A signifies a number not applicable to the given configuration.

### 5.2.2.2 Interface Area of Wheel and Hub

There are applications that can reduce the contact area between the wheel and the hub. A typical application is the case of a disc brake rotor attachment. SAE J2696 defines rotor attachment methods for wheel hubs.

Figure 4 illustrates the least material condition of the most common areas of contact for mounting systems II, III, and IV. Only one option in Figure 4 can be used for each hub and wheel. Testing has demonstrated that for the most common mounting (system III), that there is no measurable degradation in wheel performance when tested per SAE J267. One assembly configuration was tested for each option. As part rigidity may vary, consult wheel manufacturers for specific configurations. The diameters specified represent holes where no contact is offered to mating wheels.

### 5.2.2.3 Definitions of Hub or Drum Interface Dimensions

See Figure 4.

- A = Basic angle of symmetry for rotor mounting pitch circle
- R1 = Maximum radius of rotor mounting holes for rotor mounted on wheel mounting pitch diameter
- R2 = Maximum radius of rotor mounting holes for rotor mounted below wheel mounting pitch diameter
- D1 = Rotor mounting pitch circle diameter (option 1)
- D2 = Rotor mounting pitch circle diameter (option 2)

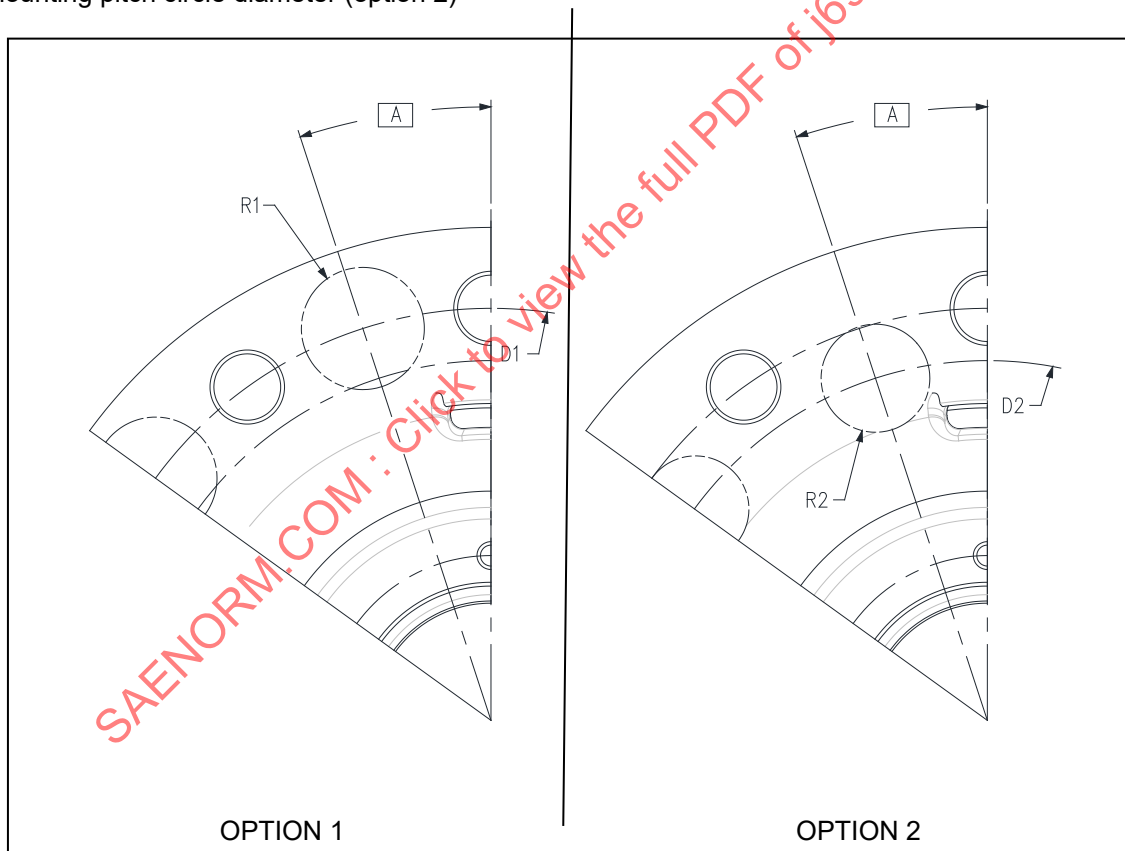


**Figure 4 - Interface area of hub and wheel**

**Table 3 - Hub interface dimensions**

| Mounting System | D1     | D2    | Basic Angle A | R1 Maximum | R2 Maximum |
|-----------------|--------|-------|---------------|------------|------------|
| II              | 275    | 266.7 | 22.5          | TBD        | TBD        |
| III             | 285.75 | 249.5 | 18            | 21.3       | 21.3       |
| IV              | 335    | 249.5 | 18            | TBD        | TBD        |

### 5.3 Fastener Dimensions and Tolerances

#### 5.3.1 Definitions of Fastener Dimensions for Two-Piece Flange Nuts (FN)

See Figure 5.

$h_1$  = Distance to first thread from flange face

$d$  = Thread size

$d_2$  = Flange inner diameter

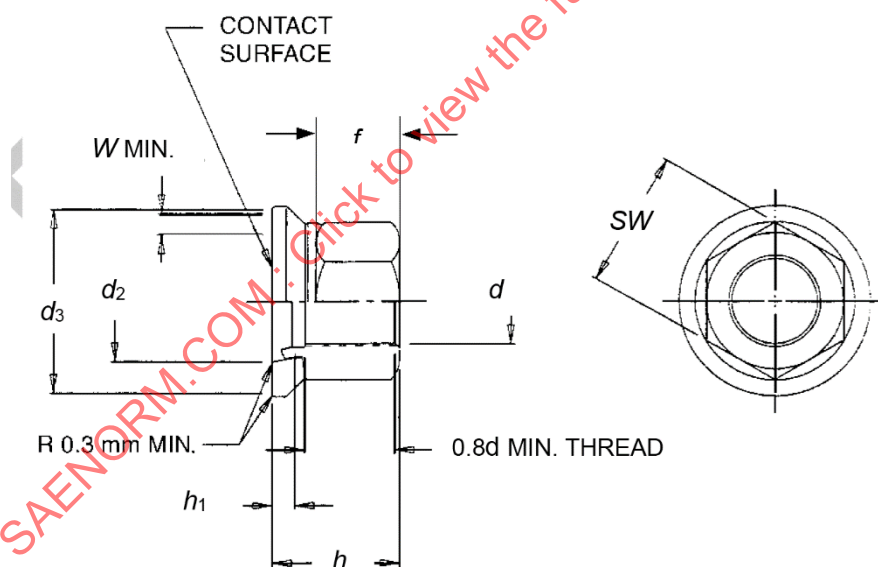
$d_3$  = Flange outer diameter

$h$  = Overall nut height

$f$  = Wrench height engagement

$SW$  = Hex size

$W$  = Width of flange contact

**Figure 5 - Two-piece flange nut**

##### 5.3.1.1 Dimensions and Tolerances of Two-Piece Flange Nuts (FN)

All dimensions are in millimeters. See Table 4.

**Table 4 - Metric system mountings - two-piece flange nut (FN) dimensions**

| Thread Size<br>$d$ | Hex Size<br>$SW$ | Flange Inner Diameter<br>$d_2$<br>Minimum | Flange Outer Diameter<br>$d_3$<br>Maximum | Thread Start<br>$h_1$<br>Minimum | Width of Flange Contact<br>$W$<br>Minimum | Height of Nut and Flange<br>$h$<br>Maximum | Wrench height engagement<br>$f$<br>Minimum |
|--------------------|------------------|-------------------------------------------|-------------------------------------------|----------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|
| M18 x 1.5          | 27               | 23                                        | 40                                        | 4.5                              | 5.0                                       | 27                                         | 10.5                                       |
| M20 x 1.5          | 30               | 26                                        | 45                                        | 4.5                              | 5.5                                       | 29                                         | 11.0                                       |
| M22 x 1.5          | 33               | 28                                        | 49                                        | 4.5                              | 6.0                                       | 34                                         | 12.5                                       |

### 5.3.2 Definitions of Fastener Dimensions for Two-Piece Sleeved Flange Nuts (SFN) for Aluminum Wheels

See Figure 6.

$d$  = Thread size

$d_1$  = Sleeve inner diameter

$d_2$  = Sleeve outer diameter

$d_3$  = Flange outer diameter

$h$  = Overall nut height

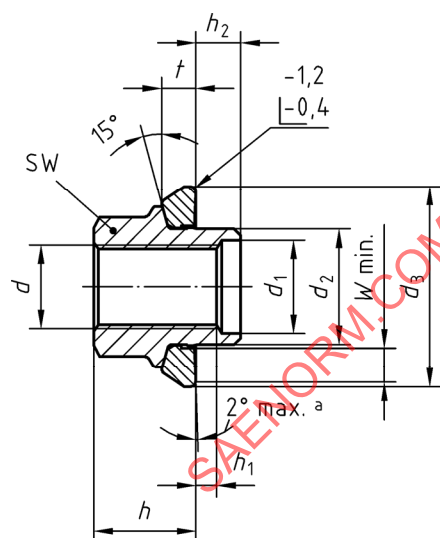
$h_1$  = Distance to first thread from seat end

$h_2$  = Distance to sleeve tip from seat end

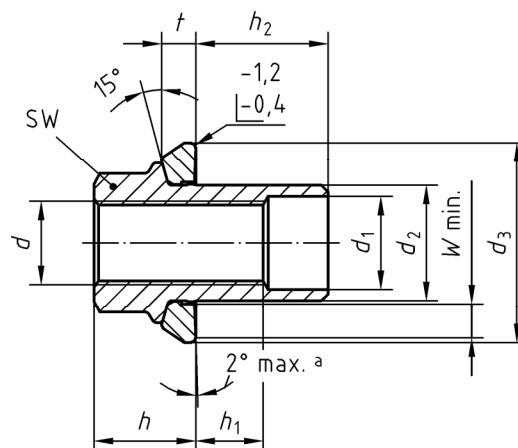
$t$  = Flange height

$SW$  = Hex size

$W$  = Width of flange contact



**Short Sleeve (K)**



**Long Sleeve (L)**

a – not convex

**Figure 6 - Two-piece sleeved flange nut (SFN) with short sleeve (K) and long sleeve (L)**  
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### 5.3.2.1 Two-Piece Sleeve Flange Nuts (SFN) with Short Sleeve K

Nuts with short sleeve K for use with single or dual aluminum wheels must meet the requirements of Figure 7 and Tables 5 and 6.

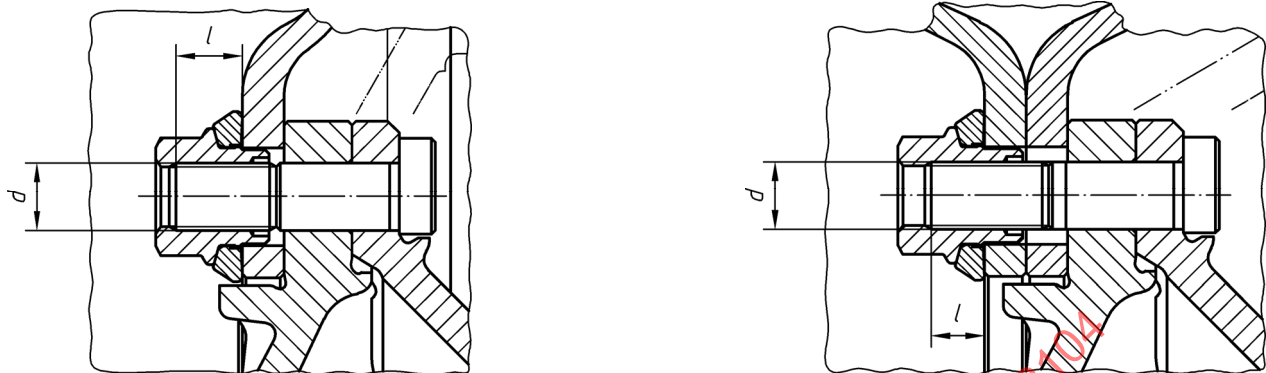


**Figure 7 - Single and dual wheel mounting with short sleeve nut K**

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### 5.3.2.2 Two-Piece Sleeved Flange Nuts (SFN) with Long Sleeve L

Nuts with long sleeve L for use with dual aluminum wheels only, must meet the requirements of Figure 8 and Table 5 and 6.

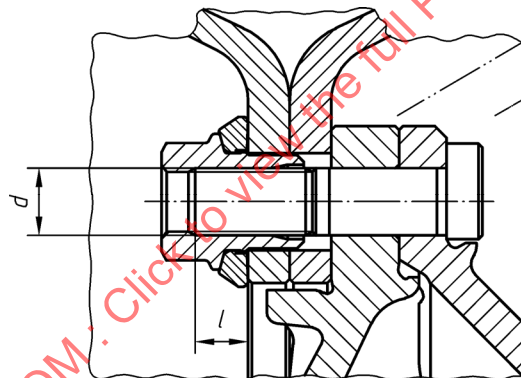


**Figure 8 - Dual wheel mounting with long sleeve nut L**

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### 5.3.2.3 Thread Engagement and Stud Standout Requirements for Two-Piece Sleeved Flange Nuts (SFN)

5.3.2.3.1 The thread engagement requirement between the stud and nut when using Two-Piece Sleeved Flange Nuts (SFN) has the following two components.

1. The length of thread engagement above the flange/wheel interface (shown as “ $l$ ” in Figures 7 and 8).
2. The length of the thread engagement below the flange/wheel interface (shown as “ $h_1$ ” in Figure 6).

The dimensional requirements of “ $l$ ” and “ $h_1$ ” are shown in Table 5.

## 5.3.2.3.2 Calculation of Minimum Stud Standout for Two-Piece Sleeved Flange Nut (SFN) Applications

$$\text{Single wheel: } G = F + l \quad (\text{Eq. 1})$$

$$\text{Dual wheel: } G = 2F + l \quad (\text{Eq. 2})$$

where:

G = stud or bolt standout beyond wheel mounting face of hub or outboard drum (shown in Figure 3)

F = disc thickness (shown in Figure 2 and Table 1)

l = minimum thread engagement length above flange/wheel interface from Table 5

## 5.3.2.4 Dimensions and Tolerances of Two-Piece Sleeved Flange Nuts (SFN)

All dimensions are in millimeters. See Tables 5 and 6.

**Table 5 - Mounting dimensions for two-piece sleeved flange nuts (SFN)**

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| Thread Size<br>$d$ | $l$<br>min <sup>a</sup> | $h_1$<br>min <sup>b</sup> |
|--------------------|-------------------------|---------------------------|
| M18 x 1.5          | 8.9                     | 6.5                       |
| M20 x 1.5          | 9.3                     | 7.5                       |
| M22 x 1.5          | 9.7                     | 8.5                       |

<sup>a</sup> Bevel of bolt thread must not be counted.

<sup>b</sup> Chamfer of the nut thread must not be counted.

$h_1$  See Figure 6.

$l$  See Figures 7 and 8.

**Table 6 - Metric system mountings two-piece sleeved flange nuts (SFN) dimensions**

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| Thread Size<br>$d$ | Hex Size<br>$S$ | Overall Nut Height<br>$h$<br>Min | Flange Height<br>$t$<br>Max | Short Sleeve Nut<br>$K$<br>$h_2^a$<br>Max | Long Sleeve Nut<br>$L^b$<br>$h_2^a$<br>Min | Sleeve Inner Diameter<br>$d_1$<br>$\pm 0.3$ mm | Sleeve outer Diameter<br>$d_2$<br>$\pm 0.25$ mm | Flange Outer Diameter<br>$d_3$<br>Max | Width of Flange Contact<br>$W$<br>Min |
|--------------------|-----------------|----------------------------------|-----------------------------|-------------------------------------------|--------------------------------------------|------------------------------------------------|-------------------------------------------------|---------------------------------------|---------------------------------------|
| M18 x 1.5          | 27              | 24                               | 7.5                         | 9                                         | 27                                         | 20                                             | 25                                              | 44                                    | 5.0                                   |
| M20 x 1.5          | 30              | 25                               | 9.5                         | 11                                        | 27                                         | 22.5                                           | 28.5                                            | 52                                    | 5.5                                   |
| M22 x 1.5          | 32              | 26                               | 11.0                        | 19                                        | 35                                         | 24.5                                           | 30.5                                            | 54                                    | 6.0                                   |
| M22 x 1.5          | 33              | 26                               | 11.0                        | 19                                        | 35                                         | 24.5                                           | 30.5                                            | 54                                    | 6.0                                   |

<sup>a</sup> Sleeve length must be less than the thickness of the wheel disc(s) with care taken to insure the sleeve does not contact the wheel stud shoulder such that it would prevent properly tightening the SFN.

<sup>b</sup> Long sleeve nuts (L) can only be used in dual wheel applications.

## 6. SECTION II - LEGACY DISC WHEEL/HUB OR DRUM INTERFACE AND NUTS USED IN NORTH AMERICA

## 6.1 Wheel Dimensions

## 6.1.1 Definitions of Wheel Dimensions

See Figures 9 and 10.

- A = Number of bolt holes
- B = Bolt circle diameter
- C = Center hole diameter
- D = Bolt hole diameter
- E = Disc flat clearance diameter
- F = Disc thickness
- K = Ball Seat Radius
- L = Ball Seat Intersection

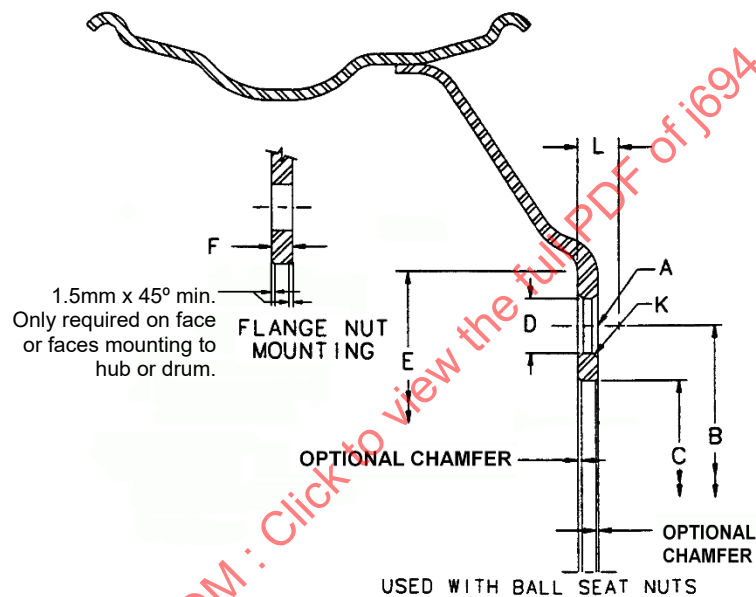


**Figure 9 - Ferrous disc wheel**

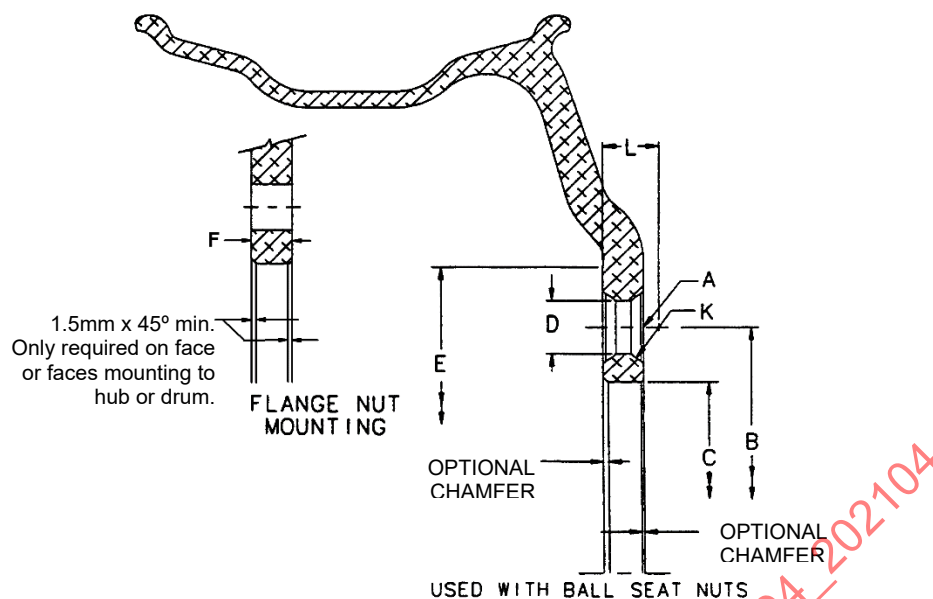


**Figure 10 - Aluminum disc wheel**

## 6.1.2 Dimensions and Tolerances of Wheels

### 6.1.2.1 Metric System Mounting used with Flange Nuts - Wheel Dimensions

All dimensions are in millimeters. See Table 7.

**Table 7 - Metric system mounting used with flange nuts - wheel dimensions**

| Mounting System | Mounting System No. of Bolt Holes A | Mounting System Bolt Circle Diameter B $\pm 0.40 \text{ } \varnothing$ | Mounting System Fastener Type | Mounting System Wheel Material | Dimensions Center Hole Diameter C $+0.2, -0$ | Dimensions Bolt Hole Diameter D $+1, -0$ | Dimensions Disc Flat Clearance Diameter E Minimum | Dimensions Disc Thickness F Maximum |
|-----------------|-------------------------------------|------------------------------------------------------------------------|-------------------------------|--------------------------------|----------------------------------------------|------------------------------------------|---------------------------------------------------|-------------------------------------|
| XIV             | 8                                   | 275                                                                    | FN                            | Ferrous                        | 221.0                                        | 26                                       | 345                                               | 14                                  |
|                 |                                     |                                                                        | FN                            | Aluminum                       | 221.1                                        | 26                                       | 345                                               | 25.4                                |
| XVII            | 10                                  | 225                                                                    | FN                            | Ferrous                        | 170.15                                       | 15.5                                     | 279.4                                             | 10.2                                |
|                 |                                     |                                                                        |                               | Aluminum                       | 170.20                                       | 20.0                                     | 279.4                                             | 15.2                                |
| XVIII           | 8                                   | 225                                                                    | FN                            | Ferrous                        | 170.15                                       | 15.2                                     | 279.4                                             | 10.2                                |

## 6.1.2.2 Inch System Mountings used with Flange Nuts - Wheel Dimensions

All dimensions are in inches. See Table 8.

**Table 8 - Inch system mountings used with flange nuts - wheel dimensions<sup>(1)</sup>**

| Mounting System | Mounting System No. of Bolt Holes A | Mounting System Bolt Circle Diameter B<br>$\oplus 0.016 \ominus$ | Mounting System Fastener Type | Mounting System Wheel Material | Dimensions Center Hole Diameter C | Dimensions Bolt Hole Diameter D<br>+0.09, -0 | Dimensions Disc Flat Clearance Diameter E<br>Minimum | Dimensions Disc Thickness F<br>Maximum |
|-----------------|-------------------------------------|------------------------------------------------------------------|-------------------------------|--------------------------------|-----------------------------------|----------------------------------------------|------------------------------------------------------|----------------------------------------|
| I               | 8                                   | 6.500                                                            | FN                            | Ferrous                        | 4.878/4.888 <sup>(2)</sup>        | 0.60                                         | 8.60                                                 | 0.35                                   |
|                 |                                     |                                                                  | FN                            | Aluminum                       | 4.880/4.888                       | 0.60                                         | 8.60                                                 | 0.57                                   |
| VI              | 8                                   | 6.500                                                            | FN                            | Ferrous                        | 4.563/4.573 <sup>(3)</sup>        | 0.60 <sup>(4)</sup>                          | 8.30                                                 | 0.35                                   |
|                 |                                     |                                                                  | FN                            | Aluminum                       | 4.565/4.573                       | 0.60 <sup>(4)</sup>                          | 8.30                                                 | 0.57                                   |
| VII             | 10                                  | 7.250                                                            | FN                            | Ferrous                        | 5.251/5.261                       | 0.64                                         | 9.23                                                 | 0.38                                   |
|                 |                                     |                                                                  | FN                            | Aluminum                       | 5.251/5.254                       | 0.64                                         | 9.23                                                 | 0.57                                   |
| IX              | 10                                  | 8.750                                                            | FN                            | Ferrous                        | 6.251/6.259                       | 0.72                                         | 11.32                                                | 0.50                                   |
| XI              | 10                                  | 11.250                                                           | FN                            | Ferrous                        | 8.665/8.673                       | 1.18                                         | 13.56                                                | 0.50                                   |
|                 |                                     |                                                                  | FN                            | Aluminum                       | 8.669/8.677                       | 1.18                                         | 13.56                                                | 0.90                                   |

<sup>(1)</sup> CAUTION: Components of different mounting systems with common bolt patterns must not be intermixed.

<sup>(2)</sup> Center hole chamfer 0.030 x 45 degrees minimum, non-curb side.

<sup>(3)</sup> Center hole chamfer 0.055 x 45 degrees minimum, non-curb side.

<sup>(4)</sup> 0.75 - for 0.625 diameter stud.

## 6.1.2.3 Inch System Mounting used with Ball Seat Nuts - Wheel Dimensions

All dimensions are in inches. See Table 9.

**Table 9 - Inch system mounting used with ball seat nuts - wheel dimensions**

| Mounting System | Mounting System No. of Bolt Holes A | Mounting System Bolt Circle Diameter B<br>$\oplus 0.016 \ominus$ | Mounting System Fastener Type | Mounting System Wheel Material | Dimensions Center Hole Diameter C<br>Minimum | Dimensions Bolt Hole Diameter D<br>+0.09, -0 | Dimensions Disc Flat Clearance Diameter E<br>Minimum | Dimensions Ball Seat Radius Reference K | Dimensions Ball Seat Intersection L<br>Maximum |
|-----------------|-------------------------------------|------------------------------------------------------------------|-------------------------------|--------------------------------|----------------------------------------------|----------------------------------------------|------------------------------------------------------|-----------------------------------------|------------------------------------------------|
| V               | 6                                   | 8.750                                                            | BSN                           | Ferrous                        | 6.469                                        | 1.21                                         | 11.32                                                | 0.875                                   | 0.98                                           |
|                 |                                     |                                                                  | BSN-AL                        | Aluminum                       | 6.495                                        | 1.18                                         | 11.32                                                | 0.875                                   | 1.50                                           |
| VIII            | 10                                  | 8.750                                                            | BSN                           | Ferrous                        | 6.469                                        | 1.21                                         | 11.32                                                | 0.875                                   | 0.98                                           |
| X               | 10                                  | 11.250                                                           | BSN                           | Ferrous                        | 8.725                                        | 1.21                                         | 13.56                                                | 0.875                                   | 1.02                                           |
|                 |                                     |                                                                  | BSN-AL                        | Aluminum                       | 8.722                                        | 1.18                                         | 13.56                                                | 0.875                                   | 1.50                                           |
| XII             | 10                                  | 13.188                                                           | BSN-HD                        | Ferrous                        | 10.650                                       | 1.35                                         | 15.48                                                | 1.188                                   | 1.50                                           |
|                 |                                     |                                                                  | BSN-HD                        | Aluminum                       | 10.650                                       | 1.35                                         | 15.48                                                | 1.188                                   | 2.03                                           |

## 6.1.3 Interface Dimensions and Tolerances of Hubs or Drums

## 6.1.3.1 Metric System Mountings used with Flange Nuts - Hub Dimensions

All dimensions are in millimeters. See Table 10.

**Table 10 - Metric system mounting used with flange nuts - hub dimensions**

| Mounting System | Mounting System No. of Studs or Bolts A | Mounting System Bolt Circle Diameter B $\oplus 0.40 \varnothing$ | Mounting System Fastener Type | Mounting System Wheel Material | Dimensions Stud or Bolt Diameter D2 | Dimensions Wheel Pilot Diameter C1 $+0, -0.2$ | Dimensions Wheel Backup Diameter E1 | Dimensions Wheel Pilot Length Single F1 Minimum | Dimensions Wheel Pilot Length Dual F1 Minimum | Dimensions Standout Single <sup>(1)</sup> G Minimum | Dimensions Standout Dual <sup>(1)</sup> G Minimum |
|-----------------|-----------------------------------------|------------------------------------------------------------------|-------------------------------|--------------------------------|-------------------------------------|-----------------------------------------------|-------------------------------------|-------------------------------------------------|-----------------------------------------------|-----------------------------------------------------|---------------------------------------------------|
| XIV             | 8                                       | 275                                                              | FN                            | Ferrous                        | 22                                  | 220.8                                         | 334/343                             | 13                                              | 20                                            | 49                                                  | 63                                                |
|                 |                                         |                                                                  |                               | Aluminum                       | 22                                  | 220.8                                         | 334/343                             | 13                                              | 35                                            | 61                                                  | 86                                                |
| XVII            | 10                                      | 225                                                              | FN                            | Ferrous                        | 14                                  | 170.05                                        | 273/279                             | 10                                              | 20                                            | 38                                                  | 50                                                |
|                 |                                         |                                                                  |                               | Aluminum                       | 14                                  | 170.05                                        | 273/279                             | 10                                              | 30                                            | 44                                                  | 64                                                |
| XVIII           | 8                                       | 225                                                              | FN                            | Ferrous                        | 14                                  | 170.05                                        | 273/279                             | 10                                              | 20                                            | 38                                                  | 50                                                |

<sup>(1)</sup> For wheels with disc thickness that are outside the scope of this document, longer standouts may be required.

## 6.1.3.2 Inch System Mountings Used with Flange Nuts - Hub Dimensions

All dimensions are in inches. See Table 11.

**Table 11 - Inch system mounting used with flange nuts - hub dimensions<sup>(1)</sup>**

| Mounting System | Mounting System No. of Studs or Bolts A | Mounting System Bolt Circle Diameter B $\oplus 0.016 \varnothing$ | Mounting System Fastener Type | Mounting System Wheel Material | Dimensions Stud or Bolt Diameter D2 | Dimensions Wheel Pilot Diameter C1 | Dimensions Wheel Backup Diameter E1 | Dimensions Wheel Pilot Length Single F1 Minimum | Dimensions Wheel Pilot Length Dual F1 Minimum | Dimensions Standout Single <sup>(2)</sup> G Minimum | Dimensions Standout Dual <sup>(2)</sup> G Minimum |
|-----------------|-----------------------------------------|-------------------------------------------------------------------|-------------------------------|--------------------------------|-------------------------------------|------------------------------------|-------------------------------------|-------------------------------------------------|-----------------------------------------------|-----------------------------------------------------|---------------------------------------------------|
| I               | 8                                       | 6.500                                                             | FN                            | Ferrous                        | 0.563                               | 4.872/4.877                        | 8.38/ 8.50                          | 0.28                                            | 0.52                                          | 1.39                                                | 1.74                                              |
|                 |                                         |                                                                   |                               | Aluminum                       | 0.563                               | 4.872/4.877                        | 8.38/ 8.50                          | 0.28                                            | 0.86                                          | 1.61                                                | 2.18                                              |
| VI              | 8                                       | 6.500                                                             | FN                            | Ferrous                        | 0.563                               | 4.554/4.562                        | 8.00/ 8.25                          | 0.28                                            | 0.52                                          | 1.44                                                | 1.79                                              |
|                 |                                         |                                                                   |                               | Aluminum                       | 0.563                               | 4.554/4.562                        | 8.00/ 8.25                          | 0.28                                            | 0.86                                          | 1.66                                                | 2.23                                              |
| VII             | 10                                      | 7.250                                                             | FN                            | Ferrous                        | 0.625                               | 5.245/5.250                        | 9.00/ 9.13                          | 0.28                                            | 0.52                                          | 1.47                                                | 1.85                                              |
|                 |                                         |                                                                   |                               | Aluminum                       | 0.625                               | 5.245/5.250                        | 9.00/ 9.13                          | 0.28                                            | 0.86                                          | 1.66                                                | 2.23                                              |
| IX              | 10                                      | 8.750                                                             | FN                            | Ferrous                        | 0.688                               | 6.242/6.250                        | 11.00/11.25                         | 0.28                                            | 0.75                                          | 1.59                                                | 2.09                                              |
| XI              | 10                                      | 11.250                                                            | FN                            | Ferrous                        | 0.875                               | 8.656/8.660                        | 13.18/13.50                         | 0.45                                            | 0.75                                          | 1.88                                                | 2.38                                              |
|                 |                                         |                                                                   |                               | Aluminum                       | 0.875                               | 8.656/8.660                        | 13.18/13.50                         | 0.45                                            | 1.35                                          | 2.28                                                | 3.18                                              |

<sup>(1)</sup> CAUTION: Components of different mounting systems with common bolt hole patterns must not be intermixed.

<sup>(2)</sup> For wheels with disc thicknesses that are outside the scope of this document, longer standouts than those shown may be required.

## 6.1.3.3 Inch System Mounting used with Ball Seat Nuts - Hub Dimensions

All dimensions are in inches. See Table 12.

**Table 12 - Inch system mounting used with ball seat nuts - hub dimensions<sup>(1)</sup>**

| Mounting System | Mounting System No. of Studs or Bolts A | Mounting System Bolt Circle Diameter B<br>$\oplus 0.016 \text{ } \varnothing$ | Mounting System Fastener Type | Mounting System Wheel Material | Dimensions Stud or Bolt Diameter D2 | Dimensions Wheel Pilot Diameter C1 Maximum | Dimensions Wheel Backup Diameter E1 | Dimensions Standout Single <sup>(3)</sup> G Minimum | Dimensions Standout Dual <sup>(3)</sup> G |
|-----------------|-----------------------------------------|-------------------------------------------------------------------------------|-------------------------------|--------------------------------|-------------------------------------|--------------------------------------------|-------------------------------------|-----------------------------------------------------|-------------------------------------------|
| V               | 6                                       | 8.750                                                                         | BSN                           | Ferrous                        | 0.750                               | 6.45                                       | 11.00/11.25                         | 1.28                                                | 1.31/1.44 <sup>(2)</sup>                  |
|                 |                                         |                                                                               | BSN                           | Ferrous                        | 1.125                               | 6.45                                       | 11.00/11.25                         | 1.28                                                | N/A                                       |
|                 |                                         |                                                                               | BSN-AL                        | Aluminum                       | 0.750                               | 6.45                                       | 11.00/11.25                         | 1.80                                                | 1.31/1.44 <sup>(2)</sup>                  |
|                 |                                         |                                                                               | BSN-AL                        | Aluminum                       | 1.125                               | 6.45                                       | 11.00/11.25                         | 1.80                                                | N/A                                       |
| VIII            | 10                                      | 8.750                                                                         | BSN                           | Ferrous                        | 0.750                               | 6.45                                       | 11.00/11.25                         | 1.28                                                | 1.31/1.44 <sup>(2)</sup>                  |
|                 |                                         |                                                                               | BSN                           | Ferrous                        | 1.125                               | 6.45                                       | 11.00/11.25                         | 1.28                                                | N/A                                       |
| X               | 10                                      | 11.250                                                                        | BSN                           | Ferrous                        | 0.750                               | 8.720                                      | 13.18/13.50                         | 1.32                                                | 1.31/1.44 <sup>(2)</sup>                  |
|                 |                                         |                                                                               | BSN                           | Ferrous                        | 1.125                               | 8.720                                      | 13.18/13.50                         | 1.32                                                | N/A                                       |
|                 |                                         |                                                                               | BSN-AL                        | Aluminum                       | 0.750                               | 8.720                                      | 13.18/13.50                         | 1.80                                                | 1.31/1.44 <sup>(2)</sup>                  |
|                 |                                         |                                                                               | BSN-AL                        | Aluminum                       | 1.125                               | 8.720                                      | 13.18/13.50                         | 1.80                                                | N/A                                       |
| XII             | 10                                      | 13.187                                                                        | BSN-HD                        | Ferrous                        | 0.938                               | 10.645                                     | 15.25/15.38                         | 1.98                                                | 1.68/1.81 <sup>(2)</sup>                  |
|                 |                                         |                                                                               | BSN-HD                        | Ferrous                        | 1.312                               | 10.645                                     | 15.25/15.38                         | 1.98                                                | N/A                                       |
|                 |                                         |                                                                               | BSN-HD                        | Aluminum                       | 0.938                               | 10.645                                     | 15.25/15.38                         | 2.51                                                | N/A                                       |
|                 |                                         |                                                                               | BSN-HD                        | Aluminum                       | 1.312                               | 10.645                                     | 15.25/15.38                         | 2.51                                                | N/A                                       |

<sup>(1)</sup> CAUTION: Components of different mounting systems with common bolt hole patterns must not be intermixed.

<sup>(2)</sup> Standout for dual BSN wheels is to the end of the stud and includes a maximum chamfer of three threads.

<sup>(3)</sup> For wheels with disc thicknesses that are outside the scope of this document, longer standouts than those shown may be required.

## 6.2 Fastener Types, Dimensions and Tolerances

## 6.2.1 Definitions of Fastener Dimensions

See Figures 11 to 16.

- a = Distance to first thread from seat end
- b = Depth of inner thread from seat end
- c = Distance of outer thread from seat end
- d1 = Thread size
- d2 = Outer thread size
- d3 = Flange inner diameter
- d4 = Flange outer diameter
- e = Seat diameter
- f = Shoulder length
- g = Nominal width across flats
- h = Bottom of nut to top of threads
- r = Ball seat radius (must be appropriate to nut seat of wheel)
- w = Width of flange contact
- x = Ball seat intersection reference diameter

6.2.2 Dimensions and Tolerances of Ball Seat Nuts (BSN) for Inch System Mountings

All dimensions are in inches. See Figure 11.

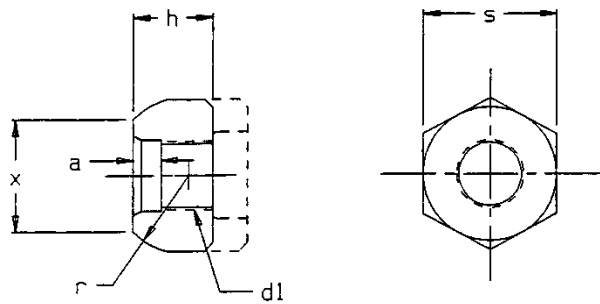


Figure 11 - Single or outer dual ball seat nut for ferrous wheels

6.2.2.1 Single or Outer Dual Ball Seat Nut for Ferrous Wheels (BSN)

See Table 13.

Table 13 - Single or outer dual ball seat nut for ferrous wheels (BSN)

| Fastener Type | Thread Size<br>d1 | Hex Size<br>s | Ball Seat Radius<br>r<br>±0.010 | Thread Start<br>a<br>Minimum | Height to end of Thread<br>h | Reference Intersection Diameter<br>x |
|---------------|-------------------|---------------|---------------------------------|------------------------------|------------------------------|--------------------------------------|
| BSN           | 3/4-16            | 1.50          | 0.875                           | 0.25                         | 0.91                         | 1.25                                 |
| BSN           | 1-1/8-16          | 1.50          | 0.875                           | 0.06                         | 0.91                         | 1.25                                 |
| BSN-HD        | 15/16-12          | 1.75          | 1.188                           | 0.12                         | 1.41                         | 1.47                                 |
| BSN-HD        | 1-5/16-12         | 1.75          | 1.188                           | 0.12                         | 1.41                         | 1.47                                 |

6.2.2.2 Inner Dual Ball Seat Nut for Ferrous Wheels (BSN)

See Figure 12 and Table 14.

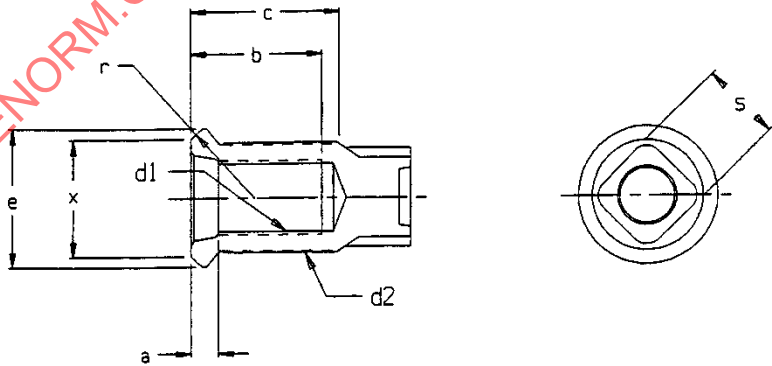


Figure 12 - Inner dual ball seat nut for ferrous wheels