SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

J694

REV. JUN2007

Issued 1955-05
Revised 2007-06

Superseding J694 FEB2001

Disc Wheel/Hub or Drum Interface Dimensions—Truck and Bus

RATIONALE

This revision was made to add comments on design practices that are gaining in popularity.

1. SCOPE

This SAE Recommended Practice contains dimensions and their tolerances concerning disc wheel to hub or drum interface areas for commercial vehicles and multipurpose passenger vehicles. Stamped disc wheels for single applications 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 Publications

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, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

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

SAE J1671 Outboard Mounted Brake Drum/Disc Wheel Hub Interface Dimensions—Commercial Vehicles

2.1.2 ISO Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 4107 Commercial vehicles—Wheel hub attachment dimensions

ISO 7575 Road vehicles—Wheels for commercial vehicles—Flat attachment—Fixing nuts

2.2 Related Publication

The following publication is provided for information purposes only and is not a required part of this document.

2.2.1 SAE Publication

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

SAE J1842 Axle End Standardization

3. DEFINITIONS

A detailed listing of basic nomenclature is contained in SAE J393. Figures 1 to 13 introduce, illustrate, and specify additional nomenclature and definitions.

3.1 Mounting System

The combination of wheel/hub or drum interface characteristics that identify uniqueness. These characteristics 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
N/A = Not applicable

5. SECTION 1 - DISC WHEELS/HUB OR DRUM INTERFACE FOR ISO COMPATIBLE WHEELS

5.1 Wheel Dimensions

5.1.1 Definitions of Wheel Dimensions

Reference 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

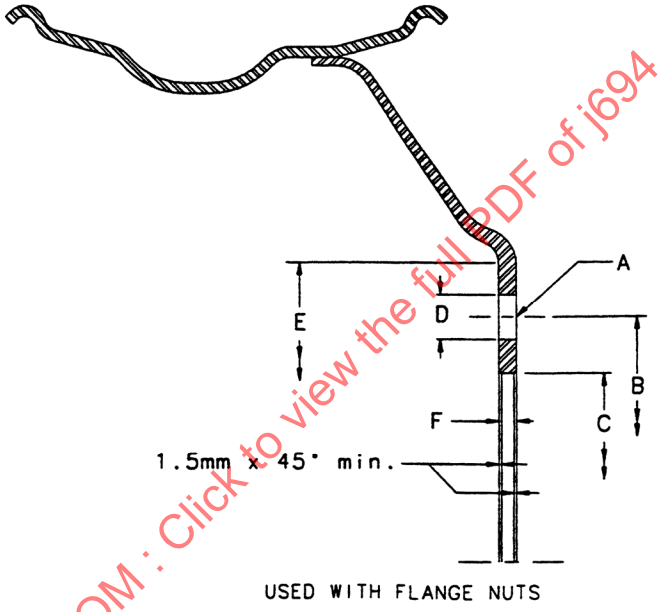

FIGURE 1 - FERROUS DISC WHEEL

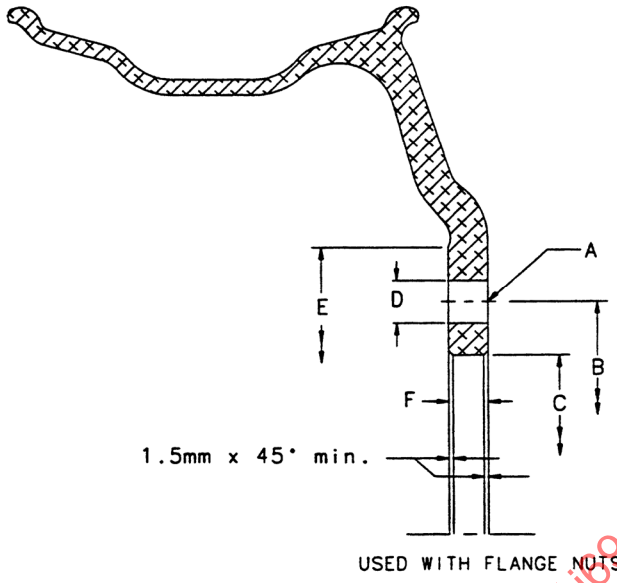

FIGURE 2 - ALUMINUM DISC WHEEL

5.1.2 Dimensions and Tolerances of Wheels

5.1.2.1 Metric System Mountings - Wheel Dimensions

All dimensions in millimeters. Reference Table 1.

TABLE 1 - METRIC SYSTEM MOUNTINGS - WHEEL DIMENSIONS

Mounting System	Mounting Systems # of Bolt Holes A	Mounting Systems Bolt Circle Diameter B ⊕ 0.40 Ⓜ	Mounting Systems Fastener Type(1)	Mounting Systems Wheel Material(1)	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(1) F Maximum
II	8	275	FN	Ferrous	221.0	24	325	13
				Aluminum	221.1	24	325	25.4
III	10	285.75	FN	Ferrous	220.0	26	345	14
				Aluminum	220.1	26	345	25.4
IV	10	335	FN	Ferrous	281.0	26	390	14
				Aluminum	281.1	26	390	25.4
XIII	6	205	FN	Ferrous	161.0	21	255	13
				Aluminum	161.1	21	255	20
XV	6	245	FN	Ferrous	202.0	21	295	13
				Aluminum	202.1	21	295	20
XVI	8	222.25	FN	Ferrous	164.0	24	280	13
				Aluminum	164.1	24	280	20

1. Disc thickness, fastener type and aluminum disc wheels are not included in ISO 4107.

5.2 Hub or Drum Interface Dimensions

5.2.1 Definitions of Hub or Drum Interface Dimensions

Reference 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 standout 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.

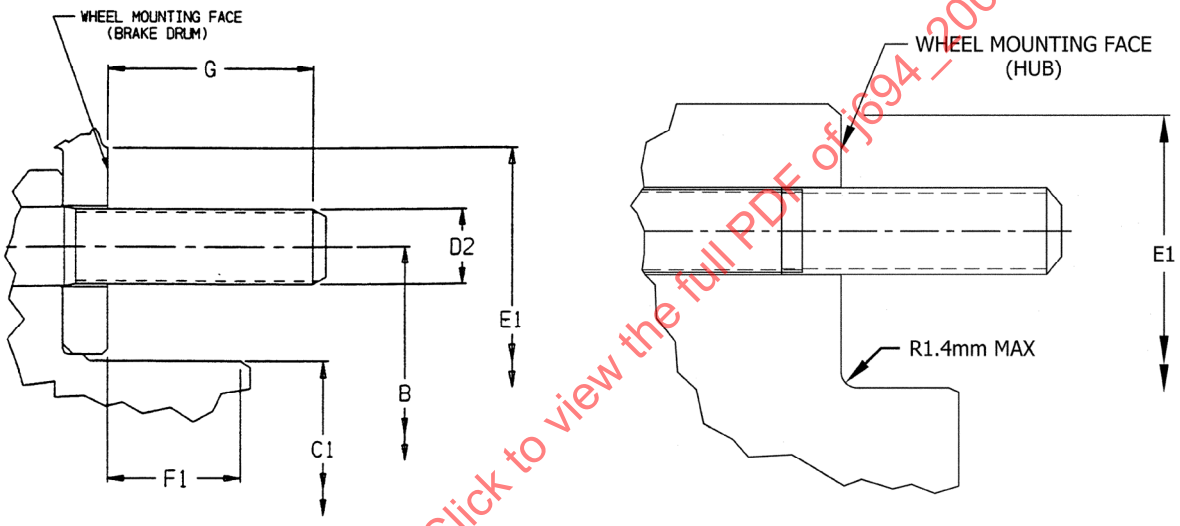

FIGURE 3 - HUB OR DRUM INTERFACE DIMENSIONS

5.2.2 Interface Dimensions and Tolerances of Hubs or Drums

5.2.2.1 Metric System Mountings - Hub Dimensions

All dimensions in millimeters. Reference Table 2.

TABLE 2 - METRIC SYSTEM MOUNTINGS - HUB DIMENSIONS

Mounting System	Mounting Systems # of Studs or Bolts A	Mounting Systems Bolt Circle Diameter B ⊕ 0.40 ∅	Mounting Systems Fastener Type(1)	Mounting Systems Wheel Material(1)	Dimensions Stud or Bolt Diameter D2	Dimensions Wheel Pilot Diameter C1 +0, –0.2	Dimensions Wheel Backup Diameter E1	Dimensions Wheel Pilot Length Single(1) F1 Minimum	Dimensions Wheel Pilot Length Dual(1) F1 Minimum	Dimensions Standout Single(1,2) G Minimum	Dimensions Standout Dual(1,2) G Minimum
II	8	275	FN	Ferrous	20	220.8	315/320	13	20	42	55
				Aluminum	20	220.8	315/320	13	35	55	80
III	10	285.75	FN	Ferrous	22	219.8	335/340	13	20	48	62
				Aluminum	22	219.8	335/340	13	35	60	85
IV	10	335	FN	Ferrous	22	280.8	380/385	13	20	48	62
				Aluminum	22	280.8	380/385	13	35	60	85
XIII	6	205	FN	Ferrous	18	160.8	245/250	10	20	40	53
				Aluminum	18	160.8	245/250	10	30	47	67
XV	6	245	FN	Ferrous	18	201.8	285/290	10	20	40	53
				Aluminum	18	201.8	285/290	10	30	47	67
XVI	8	222.25	FN	Ferrous	20	163.8	272/277	10	20	42	55
				Aluminum	20	163.8	272/277	10	30	49	69

1. Wheel pilot length, stud or bolt standout, fastener type and aluminum disc wheels are not included in ISO 4107.
2. For wheels with disc thicknesses that are outside the scope of this document, longer standouts than those shown may be required.

5.3 Fastener Dimensions and Tolerances

5.3.1 Definitions of Fastener Dimensions

Reference Figure 4.

a = Distance to first thread from seat end
d1 = Thread size
d3 = Flange inner diameter
d4 = Flange outer diameter
h = Overall nut height
j = Hex flat
s = Nominal width across flats
w = Width of flange contact

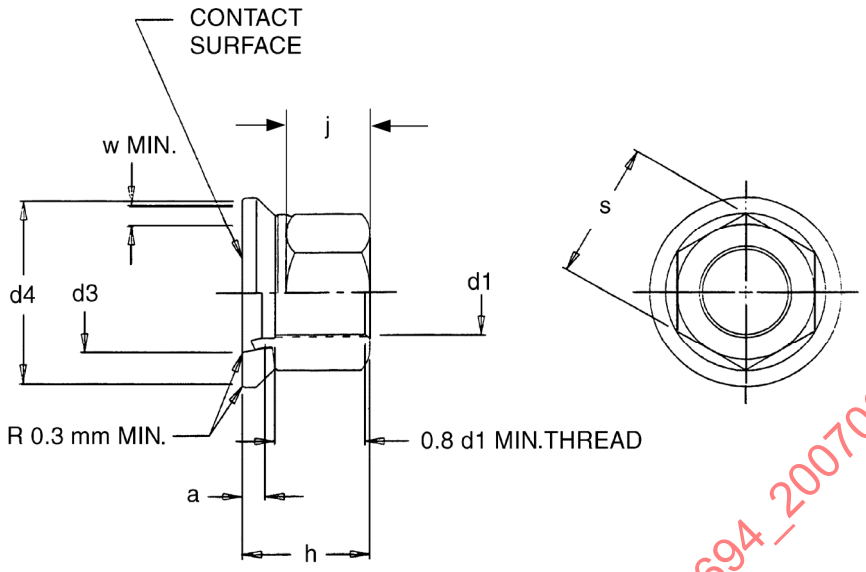

FIGURE 4 - TWO-PIECE FLANGE NUT

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

5.3.2.1 Metric System Mountings

All dimensions in millimeters. Reference Table 3.

TABLE 3 - METRIC SYSTEM MOUNTINGS

Thread Size d1	Hex Size s	Flange Inner Diameter d3 Minimum	Flange Outer Diameter d4 Minimum	Thread Start a Minimum	Width of Flange Contact w Minimum	Height of Nut and Flange h Maximum	Hex Flat j 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

6. SECTION II - INFORMATION ON MOUNTING SYSTEMS ALSO USED IN NORTH AMERICA

6.1 Wheel Dimensions

6.1.1 Definitions of Wheel Dimensions

Reference Figures 5 and 6.

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

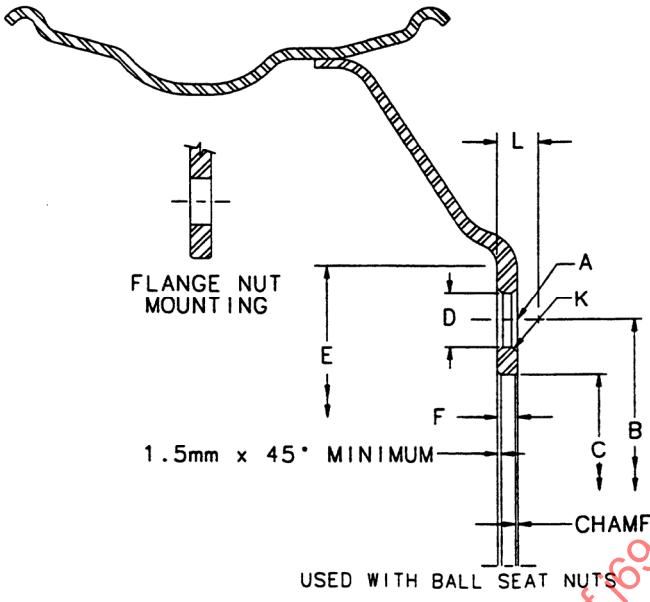

FIGURE 5 - FERROUS DISC WHEEL

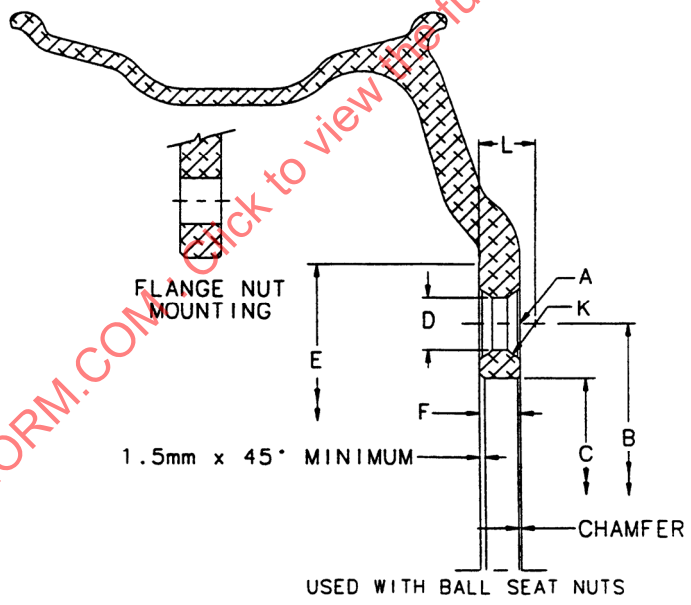

FIGURE 6 - ALUMINUM DISC WHEEL

6.1.2 Dimensions and Tolerances of Wheels

6.1.2.1 Metric System Mounting used with Flange Nuts - Wheel Dimensions

All dimensions in millimeters. Reference Table 4.

TABLE 4 - METRIC SYSTEM MOUNTING USED WITH FLANGE NUTS - WHEEL DIMENSIONS

Mounting System	Mounting System # of Bolt Holes A	Mounting System Bolt Circle Diameter B ⊕ 0.40 ∅	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
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 in inches. Reference Table 5

TABLE 5 - INCH SYSTEM MOUNTINGS USED WITH FLANGE NUTS - WHEEL DIMENSIONS[1]

Mounting System	Mounting System # of Bolt Holes A	Mounting System Bolt Circle Diameter B ⊕ 0.016 ∅	Mounting System Fastener Type	Mounting System Wheel Material	Dimensions Center Hole Diameter C	Dimensions Bolt Hole Diameter D +0.09, –0	Disc Flat Clearance Diameter E Minimum	Disc Thickness F Maximum
I	8	6.500	FN	Ferrous	4.878/4.888[2]	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[3]	0.60[4]	8.30	0.35
			FN	Aluminum	4.565/4.573	0.60[4]	8.30	0.57
VII	10	7.250	FN	Ferrous	5.251/5.261	0.64	9.23	0.36
			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

1. **CAUTION**: Components of different mounting systems with common bolt patterns must not be intermixed.
2. Center hole chamfer 0.030 x 45 degrees minimum, non-curb side.
3. Center hole chamfer 0.055 x 45 degrees minimum, non-curb side.
4. 0.75 - for 0.625 diameter stud

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

All dimensions in inches. Reference Table 6.

TABLE 6 - INCH SYSTEM MOUNTING USED WITH BALL SEAT NUTS - WHEEL DIMENSIONS

Mounting System	Mounting System # of Bolt Holes A	Mounting System Bolt Circle Diameter B ⊕ 0.016 ∅	Mounting System Fastener Type	Mounting System Wheel Material	Dimensions Center Hole Diameter C Minimum	Dimensions Bolt Hole Diameter D +0.09, –0	Dimensions Disc Flat Clearance Diameter E Minimum	Dimensions Ball Seat Radius Reference K	Dimensions Ball Seat Intersection L 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

6.2 Hub or Drum Interface Dimensions

6.2.1 Definitions of Hub or Drum Interface Dimensions

Reference Figure 7.

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 standout 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.

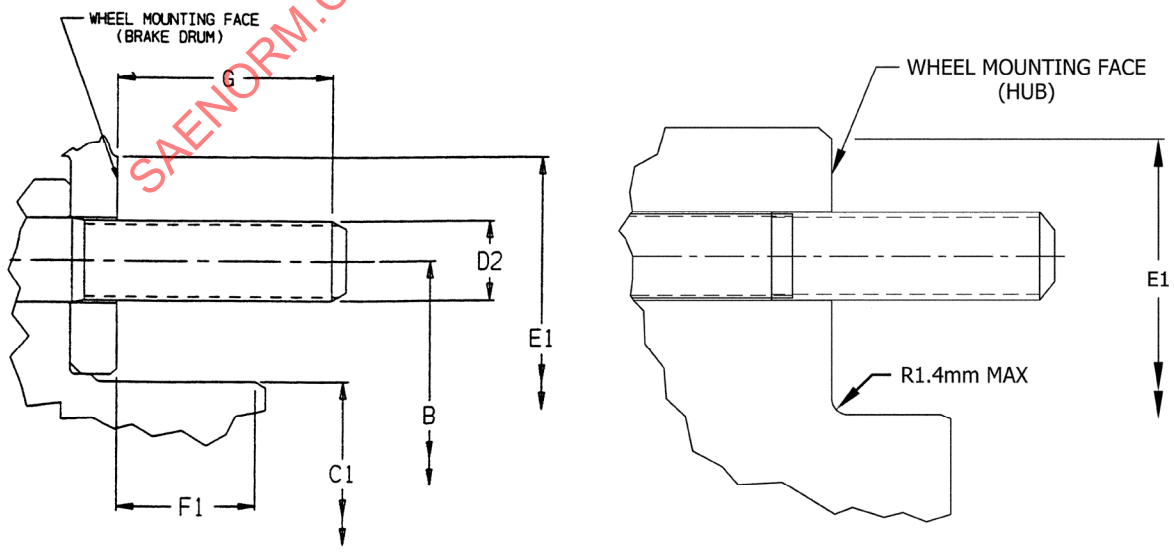

FIGURE 7 - HUB OR DRUM INTERFACE DIMENSIONS

6.2.2 Interface Dimensions and Tolerances of Hubs or Drums

6.2.2.1 Metric System Mountings used with Flange Nuts - Hub Dimensions

All dimensions in millimeters. Reference Table 7.

TABLE 7 - METRIC SYSTEM MOUNTING USED WITH FLANGE NUTS - HUB DIMENSIONS

Mounting System	Mounting System # of Studs or Bolts A	Mounting System Bolt Circle Diameter B ⊕ 0.40 ∅	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[1] G Minimum	Dimensions Standout Dual[1] 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
XVIII	8	225	FN	Ferrous	14	170.05	273/279	10	20	38	50

1. For wheels with disc thickness that are outside the scope of this document, longer standouts may be required.

6.2.2.2 Inch System Mountings Used with Flange Nuts - Hub Dimensions

All dimensions in inches. Reference Table 8.

TABLE 8 - INCH SYSTEM MOUNTING USED WITH FLANGE NUTS - HUB DIMENSIONS[1]

Mounting System	Mounting System # of Studs or Bolts A	Mounting System Bolt Circle Diameter B ⊕ 0.016 ∅	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[2] G Minimum	Dimensions Standout Dual[2] 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
			FN	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
			FN	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	1.45	1.81
			FN	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
			FN	Aluminum	0.875	8.656/8.660	13.18/13.50	0.45	1.35	2.28	3.18

1. **CAUTION**: Components of different mounting systems with common bolt hole patterns must not be intermixed.
2. For wheels with disc thicknesses that are outside the scope of this document, longer standouts than those shown may be required.

6.2.2.3 Inch System Mounting used with Ball Seat Nuts—Hub Dimensions

All dimensions in inches. Reference Table 9.

TABLE 9 - INCH SYSTEM MOUNTING USED WITH BALL SEAT NUTS - HUB DIMENSIONS[1]

Mounting System	Mounting System # of Studs or Bolts A	Mounting System Bolt Circle Diameter B ⊕ 0.016 ∅	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[3] G Minimum	Dimensions Standout Dual[3] G
V	6	8.750	BSN	Ferrous	0.750	6.45	11.00/11.25	1.28	1.31/1.44[2]
			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[2]
			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[2]
			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[2]
			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[2]
			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[2]
			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

1. **CAUTION**: Components of different mounting systems with common bolt hole patterns must not be intermixed.
2. Standout for dual BSN wheels is to the end of the stud and includes a maximum chamfer of three threads.
3. For wheels with disc thicknesses that are outside the scope of this document, longer standouts than those shown may be required.

6.3 Fastener Types, Dimensions and Tolerances

6.3.1 Definitions of Fastener Dimensions

Reference Figures 8 to 13:

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

6.3.2 Dimensions and tolerances of Ball Seat Nuts (BSN) for Inch System Mountings

All dimensions in inches. Reference Figure 8.

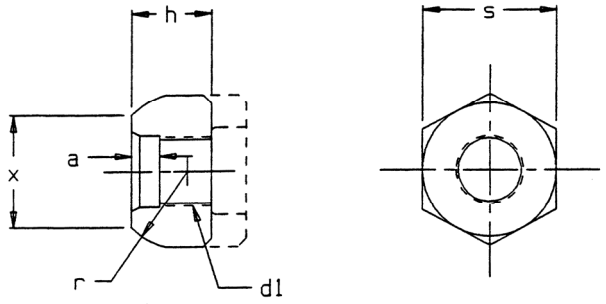

FIGURE 8 - SINGLE OR OUTER DUAL BALL SEAT NUT FOR FERROUS WHEELS

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

Reference Table 10.

TABLE 10 - SINGLE OR OUTER DUAL BALL SEAT NUT FOR FERROUS WHEELS (BSN)

Fastener Type	Thread Size d1	Hex Size s	Ball Seat Radius r ±0.010	Thread Start a Minimum	Height to end of Thread h	Reference Intersection Diameter 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

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

Reference Figure 9 and Table 11.

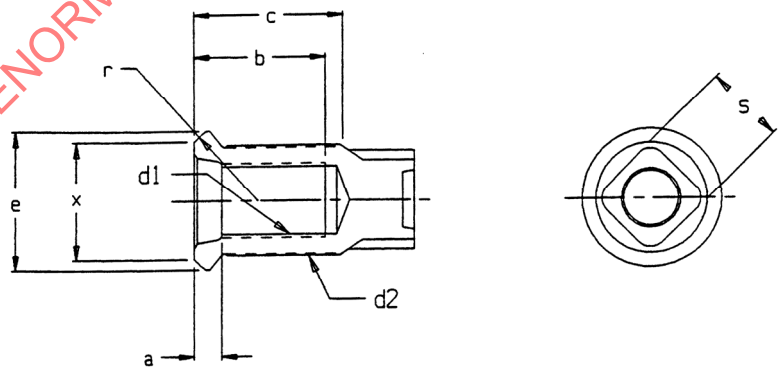

FIGURE 9 - INNER DUAL BALL SEAT NUT FOR FERROUS WHEELS