Measure and record the stud tensile load required to separate the stud from the socket assembly. A typical load application rate is 5 mm/min. Repeat the test with another sample using a compressive load.

The acceptance criteria for stud pull or push-out should be established from the calculated or measured loads based on the application.

5.2.6 BALL STUD AND SOCKET ANGULARITY

5.2.6.1 *Objective*—To determine if the socket throat is capable of providing the required stud angularity.

5.2.6.2 *Procedure*—This test is applicable to either suspension or steering system components. Assemble the ball stud and socket assembly into a rigid fixture simulating the assembly into a suspension arm or steering linkage.

Measure and record stud travel angularity both along the socket throat major axis and across the minor axis.

The acceptance criteria is based on the angularity requirements in the specific application adjusted to take into account the effect of dimensional variations and suspension/linkage compliance.

BALL JOINTS—SAE J490 OCT81

SAE Standard

Report of the Miscellaneous Division, approved March 1920, last revised by the Ball Joint and Spherical Rod End Committee October 1981.

1. General Specifications

1.1 Scope—This SAE Standard covers the general and dimensional ϕ data for various types of ball joints with inch threads commonly used on control linkages in automotive, marine, and construction and industrial equipment applications.

1.1.1 Inasmuch as the load carrying and wear capabilities of ball joints vary considerably with their design and fabrication, it is suggested that the manufacturers be consulted in regard to these features and for recommendations relating to application of the different types and styles available.

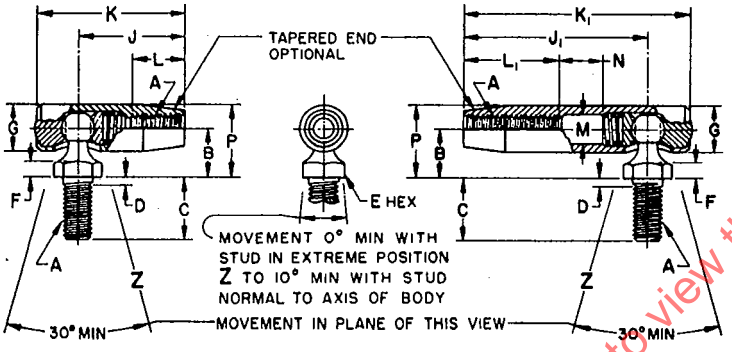

FIG. 1—TYPE A

CRIMPED END PLUG WITH SPRING CONSTRUCTION

FIG. 2—TYPE AL

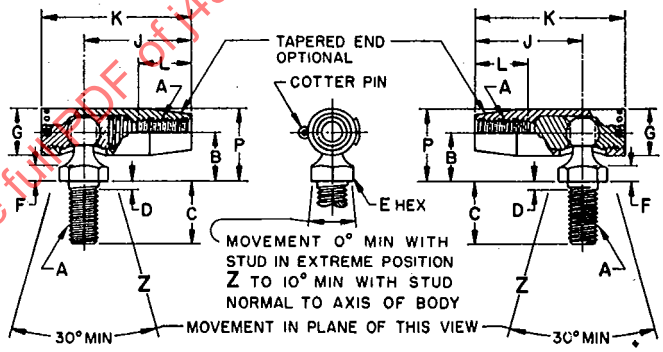

FIG. 3—TYPE B

THREADED END PLUG WITH SPRING CONSTRUCTION

FIG. 4—TYPE C

THREADED END PLUG WITHOUT SPRING CONSTRUCTION

ϕ **TABLE 1—DIMENSIONS OF TYPES A, B, C AND AL BALL JOINTS (FIGS. 1–4)**

Nominal Ball Joint Size and Thread Diameter, A, in		Threads per in	B in ±0.02	B mm ±0.5	C in ±0.02	C mm ±0.5	D Max in	D Max mm	E Hex in	E Hex mm	F Min in	F Min mm	G Dia in	G Dia mm	J in ±0.03	J mm ±0.8	J_1 in ±0.03	J_1 mm ±0.8
No. 10	0.190	32	0.44	11.2	0.44	11.2	0.06	1.5	0.312	7.92	0.12	3.0	0.38	9.7	0.88	22.3	1.50	38.1
No. 12	0.216	32	0.44	11.2	0.44	11.2	0.06	1.5	0.312	7.92	0.12	3.0	0.38	9.7	0.88	22.3	1.50	38.1
1/4	0.250	28	0.47	11.9	0.56	14.2	0.09	2.3	0.375	9.52	0.12	3.0	0.44	11.2	0.97	24.6	1.81	46.0
5/16	0.3125	24	0.53	13.5	0.69	17.5	0.09	2.3	0.438	11.12	0.16	4.1	0.50	12.7	1.12	28.4	1.94	49.3
3/8	0.375	24	0.69	17.5	0.88	22.3	0.09	2.3	0.500	12.70	0.19	4.8	0.62	15.8	1.38	35.0	—	—
7/16	0.4375	20	0.88	22.3	1.12	28.4	0.12	3.0	0.625	15.88	0.25	6.4	0.75	19.0	1.94	49.3	—	—
1/2	0.500	20	0.88	22.3	1.12	28.4	0.12	3.0	0.625	15.88	0.25	6.4	0.75	19.0	1.94	49.3	—	—

Nominal Ball Joint Size and Thread Diameter, A, in		K in ±0.03	K mm ±0.8	K_1 in ±0.03	K_1 mm ±0.8	L Min Full Thread in	L Min Full Thread mm	L_1 Min Full Thread in	L_1 Min Full Thread mm	M Dia in +0.01 −0.00	M Dia mm +0.3 −0.0	N[a] (Ref) in	N[a] (Ref) mm	P[a] Max (Ref) in	P[a] Max (Ref) mm	Stud Ball Diameter (Ref)[a] Max in	Stud Ball Diameter (Ref)[a] Max mm	Stud Ball Diameter (Ref)[a] Min in	Stud Ball Diameter (Ref)[a] Min mm
No. 10	0.190	1.25	31.8	1.81	46.0	0.44	11.2	0.56	14.2	0.20	5.1	0.50	12.7	0.65	16.5	0.255	6.48	0.250	6.35
No. 12	0.216	1.25	31.8	1.81	46.0	0.44	11.2	0.56	14.2	0.23	5.8	0.50	12.7	0.65	16.5	0.255	6.48	0.250	6.35
1/4	0.250	1.38	35.0	2.25	57.2	0.50	12.7	0.88	22.3	0.27	6.9	0.50	12.7	0.72	18.3	0.305	7.75	0.300	7.62
5/16	0.3125	1.56	39.6	2.38	60.5	0.56	14.2	1.00	25.4	0.33	8.4	0.50	12.7	0.81	20.6	0.350	8.89	0.345	8.76
3/8	0.375	1.94	49.3	—	—	0.75	19.0	—	—	—	—	—	—	1.03	26.2	0.424	10.77	0.419	10.64
7/16	0.4375	2.62	66.5	—	—	1.00	25.4	—	—	—	—	—	—	1.28	32.5	0.555	14.10	0.550	13.97
1/2	0.500	2.62	66.5	—	—	1.00	25.4	—	—	—	—	—	—	1.28	32.5	0.555	14.10	0.550	13.97

[a] These dimensions are given for design purposes only and are not intended for inspection.

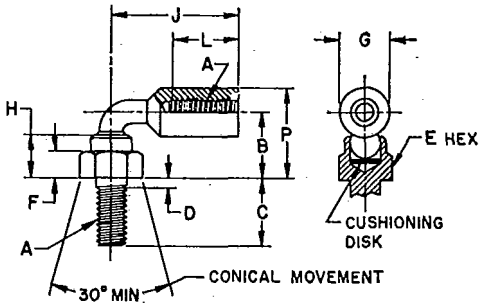

FIG. 5—TYPE D*

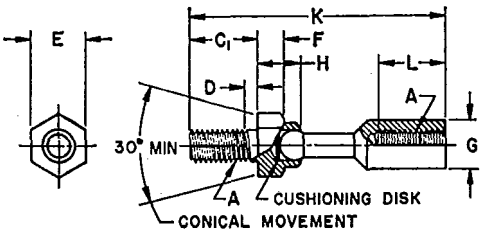

FIG. 6—TYPE DS*

*TYPES D AND DS ARE NOT RECOMMENDED FOR APPLICATIONS INVOLVING TENSION OR SEVERE VIBRATION.

CUSHIONED TWO PIECE CONSTRUCTION

ϕ **TABLE 2—DIMENSIONS OF TYPES D AND DS BALL JOINTS (FIGS. 5 AND 6)**

Nominal Ball Joint Size and Thread Diameter, A, in		Thds per in	B in ±0.03	B mm ±0.8	C in ±0.02	C mm ±0.5	C_1 in ±0.02	C_1 mm ±0.5	D Max in	D Max mm	E Hex in	E Hex mm	F Min in	F Min mm	G Dia in	G Dia mm	H in ±0.03	H mm ±0.8	J in ±0.03	J mm ±0.8	K in ±0.03	K mm ±0.8	L Min Full Thread in	L Min Full Thread mm	P[a] Max (Ref) in	P[a] Max (Ref) mm
No. 10	0.190	32	0.53	13.5	0.44	11.2	0.56	14.2	0.06	1.5	0.375	9.52	0.19	4.8	0.28	7.1	0.33	8.4	1.03	26.2	2.03	51.6	0.50	12.7	0.70	17.8
No. 10	0.190	32	0.53	13.5	0.44	11.2	—	—	0.06	1.5	0.375	9.52	0.19	4.8	0.28	7.1	0.33	8.4	0.78	19.8	—	—	0.38	9.7	0.70	17.8
No. 12	0.216	24	0.53	13.5	0.56	14.2	0.56	14.2	0.06	1.5	0.375	9.52	0.19	4.8	0.28	7.1	0.33	8.4	1.03	26.2	2.03	51.6	0.50	12.7	0.70	17.8
No. 12	0.216	32	0.53	13.5	0.56	14.2	0.56	14.2	0.06	1.5	0.375	9.52	0.19	4.8	0.28	7.1	0.33	8.4	1.03	26.2	2.03	51.6	0.50	12.7	0.70	17.8
1/4	0.250	28	0.56	14.2	0.56	14.2	0.56	14.2	0.06	1.5	0.438	11.12	0.19	4.8	0.31	7.9	0.35	8.9	1.06	26.9	2.09	53.1	0.56	14.2	0.75	19.0
5/16	0.3125	24	0.69	17.5	0.69	17.5	0.69	17.5	0.09	2.3	0.562	14.28	0.28	7.1	0.44	11.2	0.45	11.4	1.31	33.3	2.63	66.8	0.69	17.5	0.94	23.9

[a] These dimensions are given for design purposes only and are not intended for inspection.

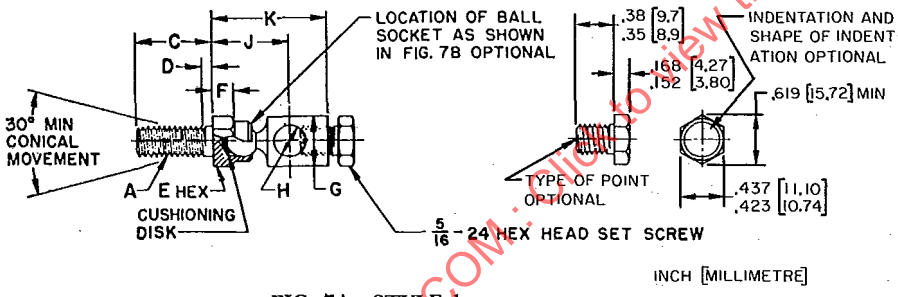

FIG. 7A—STYLE 1

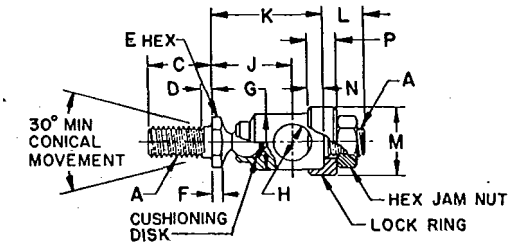

FIG. 7B—STYLE 2

FIG. 7—TYPE DC

ϕ **TABLE 3—DIMENSIONS OF TYPE DC BALL JOINTS (FIGS. 7A AND 7B)**

Nominal Ball Joint Size and Thread Diameter, A, in		Thds per in	C in ±0.02	C mm ±0,5	D Max in	D Max mm	E Hex in	E Hex mm	F Min in	F Min mm	G Dia in	G Dia mm	H Dia in ±0.005	H Dia mm ±0.13	J in ±0.03	J mm ±0.8	K in ±0.03	K mm ±0.8	L in ±0.02	L mm ±0.5	M Dia in	M Dia mm	N in ±0.01	N mm ±0.3	P in ±0.005	P mm ±0.13
STYLE 1																										
No. 10	0.190	32	0.31	7.9	0.06	1.5	0.438	11.12	0.19	4.8	0.50	12.7	0.323	8.20	0.75	19.0	1.12	28.4	—	—	—	—	—	—	—	—
1/4	0.250	20	0.44	11.2	0.09	2.3	0.438	11.12	0.19	4.8	0.50	12.7	0.323	8.20	0.75	19.0	1.12	28.4	—	—	—	—	—	—	—	—
1/4	0.250	20	0.56	14.2	0.09	2.3	0.438	11.12	0.19	4.8	0.50	12.7	0.323	8.20	0.75	19.0	1.12	28.4	—	—	—	—	—	—	—	—
1/4	0.250	28	0.44	11.2	0.09	2.3	0.438	11.12	0.19	4.8	0.50	12.7	0.323	8.20	0.75	19.0	1.12	28.4	—	—	—	—	—	—	—	—
1/4	0.250	28	0.56	14.2	0.09	2.3	0.438	11.12	0.19	4.8	0.50	12.7	0.323	8.20	0.75	19.0	1.12	28.4	—	—	—	—	—	—	—	—
5/16	0.3125	24	0.62	15.8	0.09	2.3	0.438	11.12	0.19	4.8	0.50	12.7	0.323	8.20	0.75	19.0	1.12	28.4	—	—	—	—	—	—	—	—
5/16	0.3125	24	0.75	19.0	0.09	2.3	0.438	11.12	0.19	4.8	0.50	12.7	0.323	8.20	0.75	19.0	1.12	28.4	—	—	—	—	—	—	—	—
3/8	0.375	24	0.62	15.8	0.09	2.3	0.438	11.12	0.19	4.8	0.50	12.7	0.323	8.20	0.75	19.0	1.12	28.4	—	—	—	—	—	—	—	—
STYLE 2																										
No. 10	0.190	32	0.50	12.7	0.06	1.5	0.375	9.52	0.09	2.3	0.44	11.2	0.197	5.00	0.62	15.8	0.78	19.8	0.40	10.2	0.56	14.2	0.12	3.0	0.250	6.35
1/4	0.250	20	0.44	11.2	0.09	2.3	0.438	11.12	0.09	2.3	0.50	12.7	0.328	8.33	0.78	19.8	1.02	25.9	0.34	8.6	0.62	15.8	0.12	3.0	0.250	6.35
1/4	0.250	28	0.44	11.2	0.06	1.5	0.438	11.12	0.09	2.3	0.50	12.7	0.328	8.33	0.78	19.8	1.02	25.9	0.34	8.6	0.62	15.8	0.12	3.0	0.250	6.35
5/16	0.3125	24	0.62	15.8	0.09	2.3	0.438	11.12	0.11	2.8	0.56	14.2	0.380	9.65	0.75	19.0	1.03	26.2	0.53	13.5	0.75	19.0	0.19	4.8	0.344	8.74

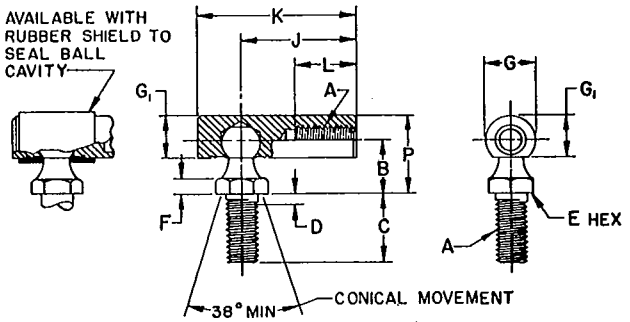

FIG. 8A—STYLE 1

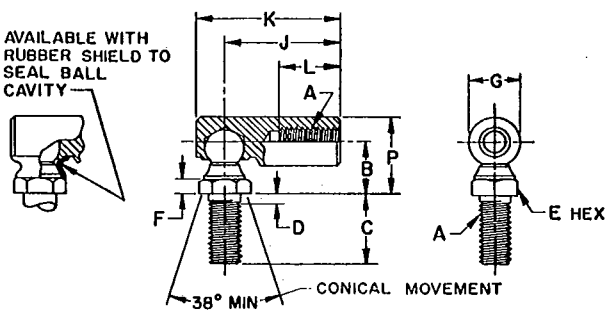

FIG. 8B—STYLE 2

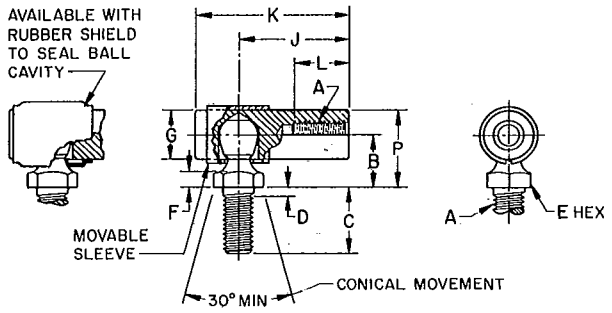

FIG. 8C—STYLE 3[b]

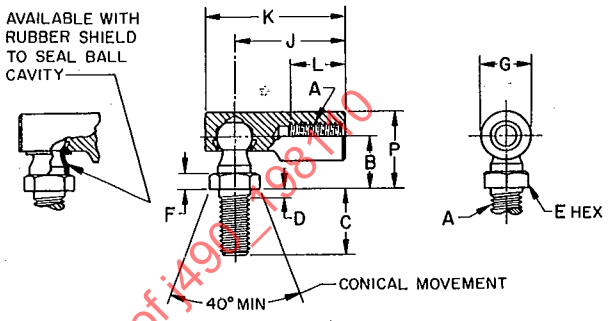

FIG. 8D—STYLE 4[c]

FIG. 8—TYPE G NONDETACHABLE CONSTRUCTION WITHOUT SPRING

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TABLE 4—DIMENSIONS OF TYPE G BALL JOINTS (FIGS. 8A-8D)

Nominal Ball Joint Size and Thread Diameter, A, in		Thds per in	B in ±0.02	B mm ±0.5	C in ±0.02	C mm ±0.5	D Max in	D Max mm	E Hex in	E Hex mm	F Min in	F Min mm	G in	G mm	G_1 Min in	G_1 Min mm	J in ±0.02	J mm ±0.5	K in ±0.02	K mm ±0.5	L Min Full Thread in	L Min Full Thread mm	P[a] Max (Ref) in	P[a] Max (Ref) mm
STYLE 1																								
No. 10	0.190	32	0.44	11.2	0.44	11.2	0.06	1.5	0.312	7.92	0.12	3.0	0.38	9.7	0.31	7.9	0.88	22.3	1.16	29.5	0.47	11.9	0.65	16.5
1/4	0.250	28	0.47	11.9	0.56	14.2	0.06	1.5	0.375	9.52	0.12	3.0	0.44	11.2	0.38	9.7	0.97	24.6	1.31	33.3	0.53	13.5	0.72	18.3
5/16	0.3125	24	0.53	13.5	0.69	17.5	0.09	2.3	0.438	11.12	0.16	4.1	0.50	12.7	0.44	11.2	1.12	28.4	1.56	39.6	0.59	15.0	0.81	20.6
3/8	0.375	24	0.69	17.5	0.88	22.3	0.09	2.3	0.500	12.70	0.19	4.8	0.62	15.8	0.56	14.2	1.38	35.0	1.81	46.0	0.81	20.6	1.03	26.2
7/16	0.4375	20	0.88	22.3	1.12	28.4	0.12	3.0	0.625	15.88	0.25	6.4	0.75	19.0	0.69	17.5	1.94	49.3	2.50	63.5	1.12	28.4	1.28	32.5
1/2	0.500	20	0.88	22.3	1.12	28.4	0.12	3.0	0.625	15.88	0.25	6.4	0.75	19.0	0.69	17.5	1.94	49.3	2.50	63.5	1.12	28.4	1.28	32.5
STYLE 2																								
No. 10	0.190	32	0.44	11.2	0.44	11.2	0.06	1.5	0.312	7.92	0.12	3.0	0.38	9.7	—	—	0.88	22.3	1.06	26.9	0.47	11.9	0.65	16.5
1/4	0.250	28	0.47	11.9	0.56	14.2	0.09	2.3	0.375	9.52	0.12	3.0	0.44	11.2	—	—	0.97	24.6	1.22	31.0	0.50	12.7	0.72	18.3
5/16	0.3125	24	0.53	13.5	0.69	17.5	0.09	2.3	0.438	11.12	0.16	4.1	0.50	12.7	—	—	1.12	28.4	1.41	35.8	0.56	14.2	0.81	20.6
3/8	0.375	24	0.69	17.5	0.88	22.3	0.09	2.3	0.500	12.70	0.19	4.8	0.62	15.8	—	—	1.38	35.0	1.69	42.9	0.75	19.0	1.03	26.2
7/16	0.4375	20	0.88	22.3	1.12	28.4	0.12	3.0	0.625	15.88	0.25	6.4	0.75	19.0	—	—	1.94	49.3	2.38	60.5	1.00	25.4	1.28	32.5
1/2	0.500	20	0.88	22.3	1.12	28.4	0.12	3.0	0.625	15.88	0.25	6.4	0.75	19.0	—	—	1.94	49.3	2.38	60.5	1.00	25.4	1.28	32.5
5/8	0.625	18	1.00	25.4	1.12	28.4	0.12	3.0	0.750	19.05	0.31	7.9	0.88	22.3	—	—	2.06	52.3	2.58	65.5	1.00	25.4	1.47	37.3
3/4	0.750	16	1.06	26.9	1.12	28.4	0.12	3.0	0.875	22.22	0.31	7.9	1.00	25.4	—	—	2.12	53.8	3.00	76.2	1.12	28.4	1.59	40.4
STYLE 3[b]																								
No. 10	0.190	32	0.44	11.2	0.44	11.2	0.06	1.5	0.312	7.92	0.12	3.0	0.38	9.7	—	—	0.88	22.3	1.16	29.5	0.47	11.9	0.65	16.5
1/4	0.250	28	0.47	11.9	0.56	14.2	0.06	1.5	0.375	9.52	0.12	3.0	0.44	11.2	—	—	0.97	24.6	1.31	33.3	0.53	13.5	0.72	18.3
5/16	0.3125	24	0.53	13.5	0.69	17.5	0.09	2.3	0.438	11.12	0.16	4.1	0.50	12.7	—	—	1.12	28.4	1.56	39.6	0.59	15.0	0.81	20.6
3/8	0.375	24	0.69	17.5	0.88	22.3	0.09	2.3	0.500	12.70	0.19	4.8	0.62	15.8	—	—	1.38	35.0	1.81	46.0	0.81	20.6	1.03	26.2
1/2	0.500	20	0.88	22.3	1.12	28.4	0.12	3.0	0.625	15.88	0.28	7.1	0.75	19.0	—	—	1.94	49.3	2.62	66.5	1.12	28.4	1.28	32.5
5/8	0.625	18	1.06	26.9	1.12	28.4	0.12	3.0	0.875	22.22	0.31	7.9	1.00	25.4	—	—	2.12	53.8	3.00	76.2	1.12	28.4	1.59	40.4
3/4	0.750	16	1.06	26.9	1.12	28.4	0.12	3.0	0.875	22.22	0.31	7.9	1.00	25.4	—	—	2.12	53.8	3.00	76.2	1.12	28.4	1.59	40.4
STYLE 4[c]																								
No. 10	0.190	32	0.47	11.9	0.44	11.2	0.06	1.5	0.375	9.52	0.12	3.0	0.44	11.2	—	—	0.97	24.6	1.22	31.0	0.44	11.2	0.72	18.3
1/4	0.250	28	0.47	11.9	0.56	14.2	0.09	2.3	0.375	9.52	0.12	3.0	0.44	11.2	—	—	0.97	24.6	1.22	31.0	0.50	12.7	0.72	18.3
5/16	0.3125	24	0.53	13.5	0.69	17.5	0.09	2.3	0.438	11.12	0.16	4.1	0.50	12.7	—	—	1.12	28.4	1.41	35.8	0.56	14.2	0.81	20.6
3/8	0.375	24	0.69	17.5	0.88	22.3	0.09	2.3	0.500	12.70	0.19	4.8	0.62	15.8	—	—	1.38	35.0	1.69	42.9	0.75	19.0	1.03	26.2
7/16	0.4375	20	0.88	22.3	1.12	28.4	0.12	3.0	0.625	15.88	0.25	6.4	0.75	19.0	—	—	1.94	49.3	2.38	60.5	1.00	25.4	1.28	32.5
1/2	0.500	20	0.88	22.3	1.12	28.4	0.12	3.0	0.625	15.88	0.25	6.4	0.75	19.0	—	—	1.94	49.3	2.38	60.5	1.00	25.4	1.28	32.5
5/8	0.625	18	1.00	25.4	1.12	28.4	0.12	3.0	0.750	19.05	0.31	7.9	0.88	22.3	—	—	2.06	52.3	2.58	65.5	1.00	25.4	1.47	37.3

[a] These dimensions are given for design purposes only and are not intended for inspection.

[b] Type G Style 3 ball joints are furnished with ball studs and ball cavities (ball stud only on 5/8 and 3/4 in sizes) hardened to assure longer wear.

[c] Type G, Style 4 ball joints in all sizes are furnished with both ball studs and ball sockets hardened to assure longer wear.