The
JOHNSON GAGE COMPANY

April 29, 1994

Mr. Charles E. Rossi
Nuclear Regulatory Commission
NRR/DRIL
11555 Rockville Pike
Rockville, MD 20852

Dear Mr. Rossi,

Reference my April 25, 1994, letter to you and separate April 12, 1994, letter to Mr. Selin. This is to alert you to a typographical error in the top paragraph on page 2 of the referenced letter to you and to share some interesting information on a current threaded product standard used within the industry. The typo is in line 7 that reads, "System 21 thread gaging ..." which should read:

> **"System 22 thread gaging CAN assure that the threaded product is within tolerance, thus greatly reducing or eliminating these problems."**

I apologize for any confusion this may have caused.

I have also discovered that the nuclear power industry currently has a **REQUIREMENT** to use a System 22 thread measurement in its procurement of Socket, Shoulder, and Set Screws (Inch Series) per ASME/ANSI B1.18.3 - 1986 (copy of pertinent pages enclosed). This standard is used extensively within the nuclear industry and, if properly followed, should assure the user that the threads are dimensionally conforming to the Unified thread Standard cited, (ASME B1.1). I am reviewing other threaded product standards to determine which others presently have a System 22 thread measurement requirement.

As I have previously shared in letters and meetings with the NRC, non-conforming threads jeopardize threaded joint integrity and invalidates engineering safety factors calculated because initial calculations **ASSUMED** the threads to be dimensionally conforming. The NRC acknowledged this fact in our April 15 meeting. Threaded joint performance depends on a number of factors to include thread dimensional conformance. Without thread dimensional control, the design engineer and the user are not assured of joint performance because the torque-preload relationship can not be predicted and/or there is error in the amount of material or thread form that leads to relaxation, vibration loosening, fatigue failure, static shear strength failure (stripping) or other possible failure modes.

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I remain available to assist the NRC and the nuclear industry in resolving the issue of thread dimensional non-conformance.

Respectfully,

THE JOHNSON GAGE COMPANY

Stanley P. Johnson
CEO

Enclosures

cc: *Mr. Brian Sheron* *Nuclear Regulatory Commission - NRR/DE*
11555 Rockville Pike
Rockville, MD 20852

Mr. Ivan Selin *Nuclear Regulatory Commission*
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AN AMERICAN NATIONAL STANDARD

Socket Cap, Shoulder, and Set Screws (Inch Series)

ASME/ANSI B18.3-1986

(REVISION OF ANSI ASME B18.3-1982)

Including Dimensions of
Hexagon and Spline
Sockets and Keys to Match

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United Engineering Center 345 East 47th Street New York, N.Y. 10017

TABLE 1A (CONT'D)

(10) Standard Lengths. Standard length increments for socket head cap screws shall be as tabulated below.

Nominal Screw Size, in.	Nominal Screw Length	Standard Length Increment
0 to 1.00, incl.	0.13 through 0.25	0.06
	0.25 through 1.00	0.13
	1.00 through 3.50	0.25
	3.50 through 7.00	0.50
	7.00 through 10.00	1.00
Over 1.00	1.00 through 7.00	0.50
	7.00 through 10.00	1.00
	Over 10.00	2.00

(11) Length Tolerances. The allowable tolerance on length shall be as tabulated below.

Nominal Screw Size	0 Through 3/8, Incl.	7/16 Through 3/4, Incl.	7/8 Through 1 1/2, Incl.	Over 1 1/2
Nominal Screw Length, in.	Tolerance on Length			
Up to 1.00, incl.	−0.03	−0.03	−0.05	
Over 1.00 to 2.50, incl.	−0.04	−0.06	−0.10	−0.18
Over 2.50 to 6.00, incl.	−0.06	−0.08	−0.14	−0.20
Over 6.00	−0.12	−0.12	−0.20	−0.24

(12) Threads. Threads shall be Unified external threads with radius root: Class 3A UNRC and UNRF Series for screw sizes 0 (0.060 in.) through 1 in.; Class 2A UNRC and UNRF Series for sizes over 1 in. to 1½ in., inclusive; and Class 2A UNRC Series for sizes larger than 1½ in.

For plated or unplated screws, acceptability shall be based upon System 22, ANSI/ASME B1.3M.

Class 3A does not provide a plating allowance. When plated products are required, it is recommended that they be procured from the manufacturer (see para. 1.8).

(13) Thread Length L_T. The length of thread shall be measured, parallel to the axis of the screw, from the extreme point to the last complete (full-form) thread. The thread length on socket head cap screws shall be as defined by Table 1C and notes thereto.

(14) Grip Gaging Length L_G. Grip gaging length is the distance, measured parallel to the axis of the screw, from the bearing surface of the head to the first complete (full-form) thread under the head (see Table 1C).

(15) Body Length L_B. Body length is the length, measured parallel to the axis of the screw, of the unthreaded portion of the shank (see Table 1C).

(16) Screw Point Chamfer. The point shall be flat or slightly concave and chamfered. The plane of the point shall be approximately normal to the axis of the screw. The chamfer shall extend slightly below the root of the thread, and the edge between the flat and chamfer may be slightly rounded. The included angle of the point should be approximately 90 deg. Chamfering of screw sizes up to and including size 8 (0.164 in.) and lengths below $0.75d$ shall be optional.

TABLE 2A (CONT'D)

(10) Grip Gaging Length L_{GH}. Grip gaging length is the distance, measured parallel to the axis of the screw, from the top of the head to the first complete (full-form) thread under the head (see Table 2C).

(11) Body Length L_{BH}. Body length is the length, measured parallel to the axis of the screw, of the unthreaded portion of the shank and the head height (see Table 2C).

(12) Screw Point Chamfer. The point shall be flat or slightly concave and chamfered. The plane of the point shall be approximately normal to the axis of the screw. The chamfer shall extend slightly below the root of the thread, and the edge between the flat and chamfer may be slightly rounded. The included angle of the point should be approximately 90 deg. Chamfering of screw sizes up to and including size 8 (0.164 in.) and lengths below $1.5d$ shall be optional.

(13) Fillet. A fillet between the conical bearing surface of the head and the shank (body) of the screw is allowable above the maximum tabulated value for D within the value listed for F.

(14) Bearing Surface. The axis of the conical bearing surface shall be parallel to the axis of the body within ½ deg.

(15) Concentricity. Concentricity of the thread with the body shall be within 0.005 in./in. of body length (unthreaded portion) full (total) indicator reading, taken directly under the head when the screw is held by the full threads closest to the head of the screw and shall not exceed 0.025 in.

(16) Threads. Threads shall be Unified external threads with radius root: Class 3A UNRC and UNRF Series for sizes 0 (0.060 in.) through 1 in.; Class 2A UNRC and UNRF Series for sizes over 1 in. to 1½ in., inclusive.

Acceptability shall be based on System 22, ANSI/ASME B1.3M.

Class 3A does not provide a plating allowance. When plated products are required it is recommended that they be procured from the manufacturer (see para. 1.8).

(17) Material

(a) Steel, alloy. Flat countersunk head cap screws shall be fabricated from an alloy steel and shall conform in all respects to ASTM F 835, Alloy Steel Button and Flat Countersunk Head Cap Screws (Inch).

(b) Steel, corrosion-resistant. Flat countersunk head cap screws shall be fabricated from austenitic corrosion-resistant steel and shall conform in all respects to ASTM F 879, Stainless Steel Socket Button and Flat Countersunk Head Cap Screws (Inch).

(18) See Table 7 for spline socket dimensions, and Appendix I for gaging of spline sockets.

(19) See Table 6 for hexagon socket dimensions, and Appendix I for gaging of hexagon sockets.

(20) Designation. Hexagon and Spline Socket Flat Countersunk Head Cap Screws shall be designated by the following data in the sequence shown: nominal size (number, fractional or decimal equivalent); threads per inch; length (fractional or decimal equivalent); product name; material; and protective finish, if required. See examples below:

.25 – 28 × 1.75 Hexagon Socket Flat Countersunk Head Cap Screw, Alloy Steel

.250 – 28 × 1.75 Hexagon Socket Flat Countersunk Head Cap Screw, Corrosion-Resistant Steel

6 – 32 × 0.50 Spline Socket Flat Countersunk Head Cap Screw, Alloy Steel, Cadmium Plated

TABLE 3 (CONT'D)

is a smooth and continuous curve having a bearing surface juncture radius no less than that tabulated below.

Nominal Screw Size	Juncture Radius Min.	Nominal Screw Size	Juncture Radius Min.
0	0.002	10	0.006
1	0.003	1/4	0.007
2	0.003	5/16	0.009
3	0.004	3/8	0.012
4	0.004	1/2	0.016
5	0.005	5/8	0.021
6	0.005		
8	0.006		

(9) Bearing Surface. The plane of the bearing surface shall be perpendicular to the axis of the shank within 2 deg.

(10) Concentricity. The head shall be concentric to the axis of the shank of the screw within 3% of the maximum head diameter *A* or 0.004 in. (0.008 in. total runout), whichever is greater.

Concentricity is defined as one-half the total indicated value obtained by holding the screws by the threads next to the head and indicating the outer surface of the head on the rounded portion, adjacent to but not on the extreme periphery of the head.

(11) Threads. Threads shall be Unified external threads with radius root: Class 3A UNRC and UNRF Series.

Acceptability shall be based on System 22, ANSI/ASME B1.3M.

Class 3A does not provide a plating allowance. When plated products are required, it is recommended that they be procured from the manufacturer (see para. 1.8).

(12) Material

(a) Steel, alloy. Button head cap screws shall be fabricated from an alloy steel and shall conform in all respects to ASTM F 835, Alloy Steel Socket Button and Flat Countersunk Head Cap Screws (Inch).

(b) Steel, corrosion-resistant. Button head cap screws shall be fabricated from austenitic corrosion-resistant steel and shall conform in all respects to ASTM F 879, Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.

(13) See Table 7 for spline socket dimensions, and Appendix I for gaging of spline sockets.

(14) See Table 6 for hexagon socket dimensions, and Appendix I for gaging of hexagon sockets.

(15) Designation. Hexagon and Spline Socket Button Head Cap Screws shall be designated by the following data in the sequence shown: nominal size (number, fractional or decimal equivalent); threads per inch; length (fractional or decimal equivalent); product name; material; and protective coating, if required. See examples below:

10 – 32 × 0.75 Hexagon Socket Button Head Cap Screw, Alloy Steel

.190 – 32 × 0.75 Spline Socket Button Head Cap Screw, Alloy Steel, Cadmium Plated

TABLE 4 (CONT'D)

(13) Threads. Threads shall be Unified external thread, Class 3A, UNC Series.

Acceptability is to be based on System 22, ANSI/ASME B1.3M.

Class 3A does not provide a plating allowance. When plated products are required, it is recommended that they be procured from the manufacturer (see para. 1.8).

(14) Material. Shoulder screws shall be fabricated from an alloy steel having one or more of the following alloying elements: chromium, nickel, molybdenum, or vanadium in sufficient quantity to assure that the specified hardness range of 32 to 43 HRC at the surface is met when hardened by quenching from the austenitizing temperature and tempered at not lower than 343°C (650°F). Decarburization and carburization limits shall be the same as those specified for socket head cap screws in ASTM A 574, Alloy Steel Socket Head Cap Screws.

Shoulder screws shall meet the following mechanical property requirements:

(a) ultimate tensile strength of 140,000 psi, based on the minimum thread neck area;

(b) shear strength of 84,000 psi in thread neck area, based on the minimum thread neck area;

(c) shear strength of 84,000 psi in the shoulder area, based on the minimum shoulder area.

(15) See Table 6 for hexagon socket dimensions, and Appendix I for gaging of hexagon sockets.

(16) Designation. Hexagon Socket Head Shoulder Screws shall be designated by the following data in the sequence shown: nominal size or basic shoulder diameter (fractional or decimal equivalent); shoulder length (fractional or decimal equivalent); product name; material; and protective coating, if required. See examples below:

.250 × 1.250 Hexagon Socket Head Shoulder Screw, Alloy Steel

.250 × 1.250 Hexagon Socket Head Shoulder Screw, Alloy Steel, Phosphate Coated

TABLE 5A (CONT'D)

NOTES:

(1) Nominal Size. Where specifying nominal size in decimals, zeros preceding decimal and in the fourth decimal place shall be omitted.

(2) Length. The length of the screw shall be measured overall, parallel to the axis of the screw. The basic length dimension on the product shall be the nominal length expressed as a two-place decimal.

(3) Standard Lengths. Standard length increments for set screws shall be as tabulated below.

Nominal Screw Length	Standard Length Increment
0.13 through 0.19*	0.06
0.13 through 0.50	0.13
0.50 through 1.00	0.13
1.00 through 2.00	0.25
2.00 through 6.00	0.50
Over 6.00	1.00

*Applicable only to sizes 0 (0.060 in.) through 3 (0.099 in.), inclusive.

(4) Tolerance on Length. Tolerance on length of set screws shall be as tabulated below.

Nominal Screw Length, in.	Tolerance on Length
Up to 0.63, incl.	±0.01
Over 0.63 to 2.00, incl.	±0.02
Over 2.00 to 6.00, incl.	±0.03
Over 6.00	±0.06

(5) Threads. Threads shall be Unified external thread: Class 3A, UNC and UNF Series.

As standard gages provide only for engagement lengths up to 1½ diameters, changes in pitch diameter of either or both external and internal thread may be required for longer lengths of engagement.

Acceptability shall be based on System 22, ANSI/ASME B1.3M.

Class 3A does not provide a plating allowance. When plated products are required, it is recommended that they be procured from the manufacturer (see para. 1.8).

(6) Material

(a) Steel, alloy. Socket set screws shall be fabricated from alloy steel and shall conform in all respects to ASTM F 912, Alloy Steel Socket Set Screws (Inch).

(b) Steel, corrosion-resistant. Socket set screws shall be fabricated from austenitic corrosion-resistant steel and shall conform in all respects to ASTM F 880, Stainless Steel Socket Set Screws.

(7) Socket Depths. The key engagement dimensions given in columns T_H and T_S of this Table shall apply only to nominal screw lengths equal to or longer than the lengths listed in columns B and B_1, respectively. For hexagon socket key engagement dimensions in screws of shorter nominal lengths than those listed in column B of this Table, see Table 5B. Spline sockets in screws shorter than those listed in column B_1 of this Table shall be as deep as practicable.