AMERICAN NATIONAL STANDARD

ENGINEERING DRAWING AND RELATED
DOCUMENTATION PRACTICES

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Mechanical Spring Representation

ANSI Y14.13M-1981

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SECRETARIAT

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
SOCIETY OF AUTOMOTIVE ENGINEERS

PUBLISHED BY

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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

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FOREWORD

(This Foreword is not a part of American National Standard, Engineering Drawing and Related Documentation Practices, Mechanical Spring Representation, ANSI Y14.13M-1981.)

Subcommittee 13 of the American National Standards Committee Y14, Standards for Engineering Drawing and Related Documentation Practices, was organized prior to 1963 for the purpose of determining the need for a national drawing standard on mechanical springs. At that time, in addition to various proprietary industry design and drafting documents, two national standards existed: MIL-STD-29A and Section C3 of the SAE Aerospace-Automotive Drawing Standards. Both of these standards were replete with design information.

At the May 1972 meeting of the Y14 Committee, it was agreed that Subcommittee 13 should be reorganized and a new effort made to develop a national drawing standard for mechanical springs. This effort was made to first determine whether a standard was actually needed. The investigation showed that MIL-STD-29A was being used in military programs requiring acquisition of springs from industry and showed that the Spring Manufacturers Institute and spring industry supported the need for establishing a standard for expressing functional requirements on engineering drawings (corresponding to the existant manufacturing standard). Consequently, a first draft was produced using MIL-STD-29A as the basis and attempting to eliminate design information. Circulation of the first draft to various individuals in the manufacturing as well as the drawing preparation category occurred late in February 1978. The comments that were received were considered in preparing subsequent drafts.

This Standard does not presume to restrict drawing content to only that which appears herein. Drawings must convey design intent and be complete enough that a designated part can be produced from them.

This Standard does not intend to suggest that the types of springs presented herein are more important than those omitted. The choice of which types of springs to present was made on the basis of those types found in MIL-STD-29A.

This document has been prepared in a manner that is independent of the system of measurement to be used. Traditional terms (such as "load") have been changed to technically correct terms (such as "force").

Suggestions for improvement of this Standard will be welcomed. They should be sent to the American National Standards Institute, 1430 Broadway, New York, New York 10018.

This Standard was approved by the American National Standards Institute on October 30, 1981.

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AMERICAN NATIONAL STANDARD
ENGINEERING DRAWING AND RELATED DOCUMENTATION PRACTICES

MECHANICAL SPRING REPRESENTATION

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1 GENERAL

This Standard establishes uniform methods for specifying end product data on drawings for mechanical springs. A mechanical spring is defined as an elastic body whose mechanical function is to store energy when deflected by a force and to return the equivalent amount of energy upon being released.

2 SCOPE

This Standard illustrates a method of drawing, dimensioning, and specifying data on detail drawings of each of the types of mechanical springs described herein.

2.1 Types of Springs

The types of springs described in this Standard are as follows.

(*a*) compression – helical, cylindrical, volute, coned disk (Belleville)
(*b*) extension – helical
(*c*) torsion – helical, torsion bar, spiral
(*d*) flat – cantilever
(*e*) constant force – flat
(*f*) garter – helical

3 APPLICABLE DOCUMENTS

American National Standards

When the following American National Standards referred to in this Standard are superseded by a revision approved by the American National Standards Institute, the revision shall apply.

(*a*) ANSI Y1.1-1972, Abbreviations – for Use on Drawings and in Text
(*b*) ANSI Y14.1-1980, Engineering Drawing and Related Documentation Practices - Size and Format
(*c*) ANSI Y14.2M-1979, Engineering Drawing and Related Documentation Practices - Line Conventions and Lettering
(*d*) ANSI Y14.3-1975 (R1980), Engineering Drawing and Related Documentation Practices - Multi and Sectional View Drawings

Military Standard

MIL-STD-12 (latest revision), Abbreviations

4 GENERAL DRAWING PRACTICES

General drawing practices are covered in ANSI Y14.1 through ANSI Y14.3 of the American National Standards for Engineering Drawing and Related Documentation Practices (see Section 3). For the particular practices, refer to the applicable standard.

4.1 Notes

Notes in capital letters are intended to appear on finished drawings. Notes in lower case letters are explanatory only and are not intended to appear on drawings.

4.2 Abbreviations

Abbreviations in notes and text shall conform to ANSI Y1.1-1972. For U.S. Department of Defense drawings and technical publications, MIL-STD-12 shall be used.

4.3 Angular Dimensions

All angular dimensions are expressed in degrees and decimal portions thereof. Specification of angles in degrees, minutes, and seconds is optional.

5 DEFINITION OF TERMS

The following terms are used on drawings of mechanical springs to describe end product data.

5.1 Coils, Active

The number of coils used in computing the total deflection of a spring.

5.2 Coils, Total

The number of active coils plus the coils forming the ends (compression springs).

5.3 Deflection, Total

The movement of a spring from free position to maximum operating position. In a compression spring, it is the deflection from the free length to the solid length.

5.4 Force

The force exerted upon or by a spring in order to reproduce or modify motion, or to maintain a force system in equilibrium.

5.5 Helix, Direction of

When a spring is viewed from one end, the direction of helix is right hand when the coil recedes in a clockwise direction and left hand when it recedes in a counterclockwise direction. A right-hand helix follows the same direction as the threads on a standard screw. A left-hand helix is most popular for compression and extension springs.

5.6 Length, Free

The overall length of a spring to which no external force has been applied.

5.7 Length, Solid

The overall length of a compression spring when all coils are fully compressed.

5.8 Pitch

The distance between adjacent active coils of a spring in the free position and measured at the material center.

5.9 Reference Information

Information that is not restricted by design requirements. It is considered auxiliary information and is derived from other drawing specifications. Reference information appears on a drawing enclosed in parentheses or followed by the abbreviation REF.

5.10 Set

The permanent distortion from the manufactured dimensions which occurs when a spring is stressed beyond the elastic limit of the material.

5.11 Spring Rate

The force required to deflect a compression or extension spring one unit of length, or the force required to deflect a torsion spring one degree or one revolution.

5.12 Stress Relieve

To remove residual stresses caused by the forming operation by applying a low-temperature heat treatment after coiling or bending. Also called "strain relieve," "stress equalizing," "tempering," "blueing," and "baking."

5.13 Tension, Initial

A force wound into certain helical extension springs during the coiling operation. It keeps the coils tightly closed and must be exceeded by an applied force before the coils begin to open.

5.14 Tolerance

The total amount by which a specific dimension is permitted to vary.

5.15 Torque

A turning force about an axis multiplied by the perpendicular distance from the force to the axis; always used in conjunction with the number of degrees of rotation, number of revolutions, or deflected position.

6 DETAIL REQUIREMENTS

6.1 Introduction

Drawing examples shown in this Standard illustrate a method of drawing and dimensioning the various types of springs listed in 2.1. They include compilations of spring data to be used as applicable when

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specifying the requirements for a mechanical spring. These examples should not be interpreted as a requirement that spring characteristics must be specified on engineering drawings only in the manner shown.

6.1.1 Delineation. The simplified drafting methods shown on the drawing examples for helical springs are generally satisfactory.

6.2 Requirements Applicable to All Spring Drawings

Requirements applicable to all spring drawings are material specifications and inspection notes.

6.2.1 Material Specifications. Material specifications are designated in the space provided on the drawing. Where such space is inadequate, enter "SEE NOTE" and describe the material requirements in a general note.

6.2.1.1 Material Size. Wire cross section or width and thickness of material shall be designated as applicable, and unless otherwise specified, all dimensions apply before plating or applying finishes. Tolerances on diameter and thickness shall not be specified where they are covered in the appropriate material specification or by general tolerance notes. Specify a tolerance on the width where applicable.

6.2.2 Inspection Notes. Detail drawings of all springs, including those subjected to critical conditions of temperature, stress, or corrosive environments, shall include appropriate inspection requirements. Specify those characteristics requiring inspection and the tests required.

6.3 Format for Special Data Notes

The following are examples of special data notes that are required on detail drawings of springs.

(*a*) STRESS RELIEVE TO REMOVE COILING (FORMING) STRAINS

(*b*) HARDNESS RANGE Rc____ to _____

(*c*) SQUARENESS OF ENDS IN FREE POSITION WITHIN_____ deg.

(*d*) SHOT PEEN FOR MAXIMUM LIFE

(*e*) PROTECTIVE COATING_____(Give specification.)

(*f*) NONDESTRUCTIVE INSPECTION _______ (Give specification.)

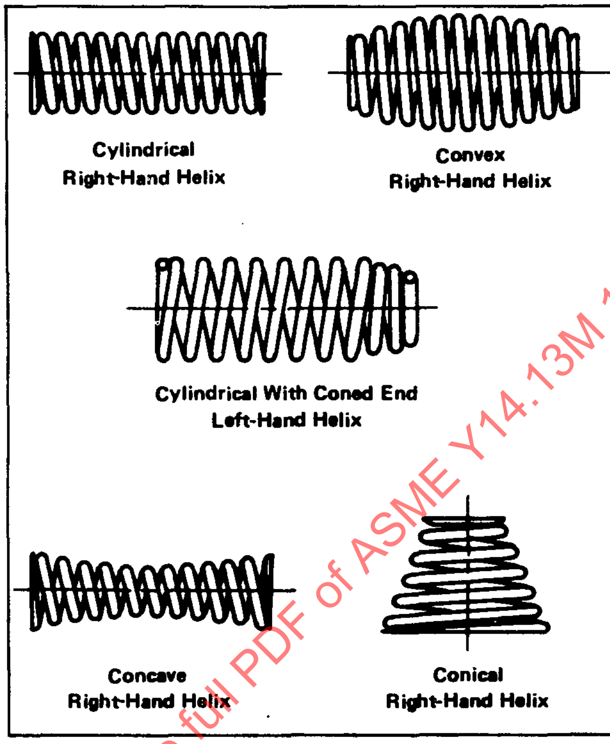

FIG. 1 HELICAL COMPRESSION SPRING FORMS

(*g*) THE BODY SHALL NOT CAMBER MORE THAN_____IN ITS ENTIRE LENGTH

(*h*) TEST OVER ARBOR DIAMETER ________

(*i*) TO WITHSTAND TEMPERATURES OF _____deg. FOR __________HR AT A LENGTH OF _____WITH FORCE LOSS NOT TO EXCEED____%

(*j*) TO WITHSTAND_________ DEFLECTIONS FROM INITIAL TO FINAL POSITION WITH FORCE LOSS NOT TO EXCEED______ %

6.4 Helical Compression Springs

A compression spring is an open coil helical spring that offers resistance to a compressive force applied axially. Compression springs are generally cylindrical in form, although other forms are available (such as conical, tapered, concave, or convex). Wire of circular cross section is normally used. However, where there is a design advantage, wire of square or rectangular cross section should be specified. Figure 1 illustrates several forms of helical compression springs.

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6.4.1 Drawing Requirements for Helical Compression Springs. Guidelines which provide for helical compression spring design requirements on an engineering drawing (dimensionally and physically) and which allow maximum latitude in manufacturing are categorized as follows.

(*a*) *No Force Specified.* The design activity accepts the responsibility for the capability of the spring. The manufacturer must furnish a spring that meets the dimensional data specified. The free length, the coil diameter, and the total number of coils are specified, each with a tolerance. The tolerance on the wire diameter conforms to the governing material specification. See Fig. 2.

(*b*) *One Force Specified.* This category has application where the spring is required to resist a force, within a specified tolerance, preferably at the initial assembled length. The spring is not normally subjected to further deflection in operation. The manufacturer is required to meet physical requirements, but the free length and the total number of coils are not restricted. The tolerance on the wire diameter conforms to the governing material specification and the specific coil diameter is dependent upon spring function. See Fig. 3.

(*c*) *Two Forces Specified.* This category has application where the spring is required to resist a force, within a specified tolerance, at each end of two definite compressed lengths, normally at the initial and the final operating positions in the assembly. The manufacturer is required to meet the physical requirements, other spring characteristics being designated as described in (b) above. See Fig. 4.

(*d*) *Spring Rate Specified.* This category has application in assemblies in which the spring rate is the most significant characteristic, for example, in calibrated scales. Because spring rate is not perfectly linear, the two lengths between which the rate is to be checked should be specified. The manufacturer is required to meet a prescribed spring rate, but the free length and the total number of coils are permitted to vary. The tolerance on the wire diameter conforms to the governing material specification and the specific coil diameter is dependent upon the spring function. Additionally, where closer control of the force to be resisted at the initial assembled length is desired, one force, with a tolerance to be developed at the assembled length, should be specified. See Fig. 5.

6.4.1.1 Coil Diameter. Depending upon the application of the spring, specify the following as required:

(*a*) TO WORK OVER _____MAX. DIAMETER ROD

(*b*) TO WORK IN_____MIN. DIAMETER BORE

(*c*) I.D. (with tolerance) _______

(*d*) O.D. (with tolerance) _______

6.4.1.2 Direction of Helix. Where governed by design requirements, specify the direction of helix as "LEFT HAND" (LH), or "RIGHT HAND" (RH), as applicable; otherwise, specify the direction of helix as "OPTIONAL." In most cases, the hand is not important except where a plug is screwed into the end or where one spring fits inside another. In the case of the latter, one spring should be designated left hand and the other spring right hand.

6.4.1.3 Type of Ends. The type of ends having application to helical compression springs are illustrated in Fig. 6. Specify the type of ends on the drawing. Where necessary, the ends should be dimensioned.

6.4.1.4 Solid Length. The maximum solid length shall be specified for any spring category where this parameter is essential to design requirements. However, solid length should be omitted wherever practicable. Except where necessary to satisfy function, springs should not be designed to go solid in operation. It may be desirable to include the following note:

SPRING TO MEET FORCE REQUIREMENTS
EVEN AFTER BEING COMPRESSED
TO SOLID LENGTH.

6.5 Helical Extension Springs

A helical extension spring is a close-wound spring with or without initial tension, or an open-wound spring that offers resistance to an axial force tending to extend its length. Extension springs are formed or fitted with ends which are used for attaching the spring to an assembly. Figure 7 illustrates various forms of helical extension springs.

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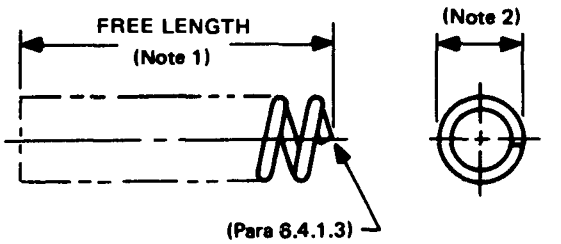
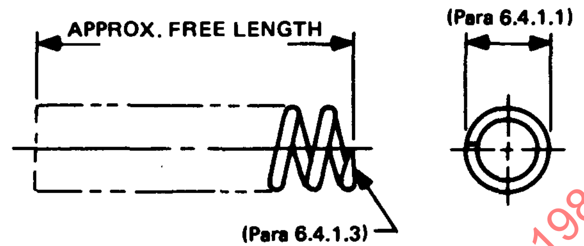


SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
WIRE DIAMETER	6.2.1.1
DIRECTION OF HELIX	6.4.1.2
TOTAL COILS	Note 3
(Special data)	6.3

NOTES:
(1) Specify free length, with tolerance (or by limits).
(2) When spring operates over guide, specify inside diameter of coil, with tolerance (or by limits). For other applications, specify outside diameter, with tolerance (or by limits).
(3) Specify total number of coils, with tolerance.

FIG. 2 DRAWING REQUIREMENTS FOR HELICAL COMPRESSION SPRINGS WHERE NO FORCE IS SPECIFIED

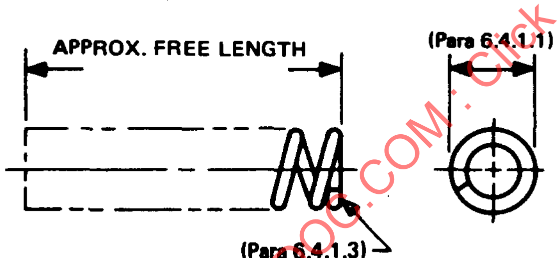


SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
WIRE DIAMETER	6.2.1.1
DIRECTION OF HELIX	6.4.1.2
TOTAL COILS	Note 1
FORCE REQUIRED AT ____	Note 2
(Special data)	6.3

NOTES:
(1) Specify total number of coils; designate reference.
(2) Specify the force, with tolerance, that is required at one definite length.

FIG. 3 DRAWING REQUIREMENTS FOR HELICAL COMPRESSION SPRINGS WHERE ONE FORCE IS SPECIFIED

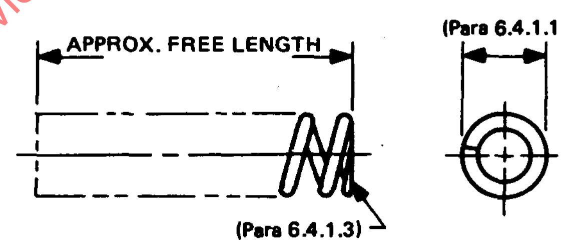


SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
WIRE DIAMETER	6.2.1.1
DIRECTION OF HELIX	6.4.1.2
TOTAL COILS	Note 1
FORCE REQUIRED AT ____	Note 2
FORCE REQUIRED AT ____	Note 2
(Special data)	6.3

NOTES:
(1) Specify total number of coils; designate reference.
(2) Specify the force required at each of the two defined compressed lengths.

FIG. 4 DRAWING REQUIREMENTS FOR HELICAL COMPRESSION SPRINGS WHERE TWO FORCES ARE SPECIFIED



SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
WIRE DIAMETER	6.2.1.1
DIRECTION OF HELIX	6.4.1.2
TOTAL COILS	Note 1
FORCE REQUIRED AT ____	6.4.1(d)
SPRING RATE	Note 2
VERIFY SPRING RATE AT ____ AND ____ LENGTH	Note 3
SOLID LENGTH WITHOUT PERMANENT SET	6.4.1.4
(Special data)	6.3

NOTES:
(1) Specify total number of coils; designate reference.
(2) Specify spring rate.
(3) Specify the two lengths between which the rate should be checked.

FIG. 5 DRAWING REQUIREMENTS FOR HELICAL COMPRESSION SPRINGS WHERE SPRING RATE IS SPECIFIED

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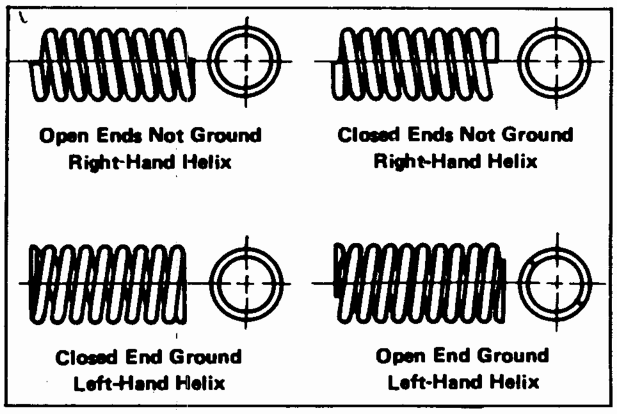

FIG. 6 TYPES OF HELICAL COMPRESSION SPRING ENDS

6.5.1 Drawing Requirements. Guidelines for specifying dimensional and force data on engineering drawings showing helical extension springs are similar to those established for helical compression springs. Figures 8 through 11 show suggested guidelines for use in selectively delineating helical extension springs in the categories described in 6.4.1.

6.5.1.1 Total Coils. All coils in an extension spring usually are active. Exceptions are those with plug ends and those with end coils coned over swivel hooks. Specify the total number of coils as required.

6.5.1.2 Maximum Extended Length. Where essential to design requirements, specify the maximum allowable extended length without permanent set as a protection against over extending the spring during assembly.

6.5.1.3 Types of Ends. Typical types of ends applicable to helical extension springs are illustrated in Fig. 12. The type of end required shall be completely delineated and dimensioned on the drawing.

6.5.1.4 Relative Position of Ends. Where required, the relative position of the ends shall be specified with tolerance. Where relative position of ends is not important, add the following note:

ANGULAR RELATION OF ENDS
NOT IMPORTANT

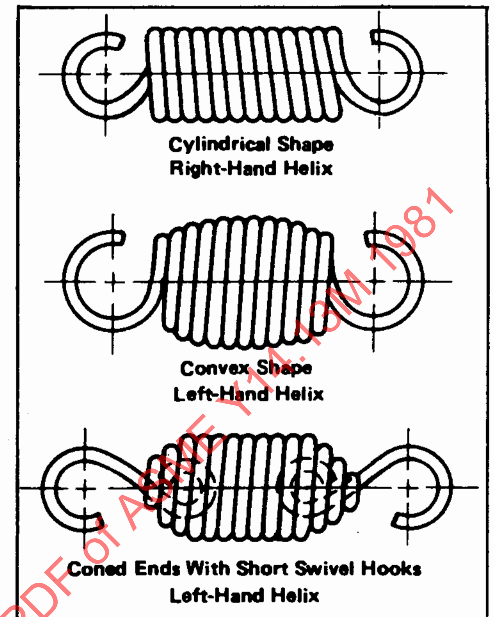

FIG. 7 HELICAL EXTENSION SPRING FORMS

6.6 Helical Torsion Springs

Helical torsion springs are springs that offer resistance to or exert a turning force in a plane at right angles to the axis of the coil. Figures 14 and 15 illustrate various forms of torsion springs and some of the ends used on such springs.

6.6.1 Drawing Requirements. Explanation of the spring data shown in Fig. 13 is indicated in 6.6.1.1 through 6.6.1.6.

6.6.1.1 Total Coils and Length Over Coils. All coils in a torsion spring usually are active. Specify the total number of coils and the length over coils in the free position as required.

6.6.1.2 Direction of Helix. The helix of a torsion spring is important. Specify as "LEFT HAND" or "RIGHT HAND" as applicable.

6.6.1.3 Torque. Specify the torque at the initial and final position between the deflected ends and not at deflection from free position. However, if more than one revolution is required, specify the number of revolutions from free position. Tolerance shall be applied to the torque but not to the angle between the ends. Also state, under "special data," the diameter of the shaft over which it is operated, if applicable.

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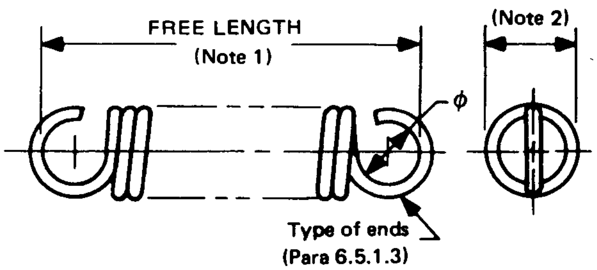
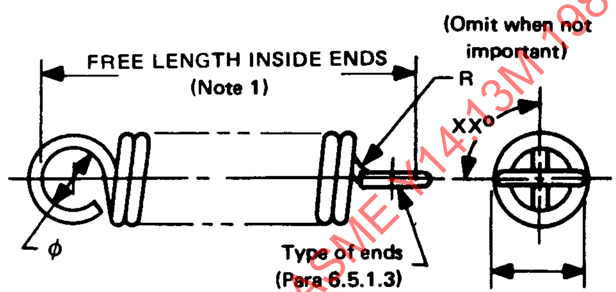


SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
WIRE DIAMETER	6.2.1.1
DIRECTION OF HELIX	6.4.1.2
TOTAL COILS	Note 3
RELATIVE POSITION OF ENDS	6.5.1.4
EXTENDED LENGTH WITHOUT PERMANENT SET	6.5.1.2
INITIAL TENSION	Note 4
(Special data)	6.3

NOTES:
(1) Specify free length with tolerance or as reference, whichever is applicable.
(2) Specify outside diameter of coil, with tolerance (or by limits).
(3) Specify total number of coils.
(4) When essential to design requirements, specify tension; otherwise specify "INITIAL TENSION OPTIONAL."

FIG. 8 DRAWING REQUIREMENTS FOR HELICAL EXTENSION SPRINGS WHERE NO FORCE IS SPECIFIED



SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
WIRE DIAMETER	6.2.1.1
DIRECTION OF HELIX	6.4.1.2
TOTAL COILS	Note 2
EXTENDED LENGTH WITHOUT PERMANENT SET	6.5.1.2
RELATIVE POSITION OF ENDS	6.5.1.4
INITIAL TENSION	Note 3
FORCE AT OPERATING LENGTH OF ____	Note 4
(Special data)	6.3

NOTES:
(1) Specify free length without tolerance or as reference, whichever is applicable.
(2) Specify total number of coils;designate reference.
(3) When essential to design requirements, specify initial tension;otherwise specify "INITIAL TENSION OPTIONAL."
(4) Specify the force, with tolerance, that is required at one extended length.

FIG. 9 DRAWING REQUIREMENTS FOR HELICAL EXTENSION SPRINGS WHERE ONE FORCE IS SPECIFIED

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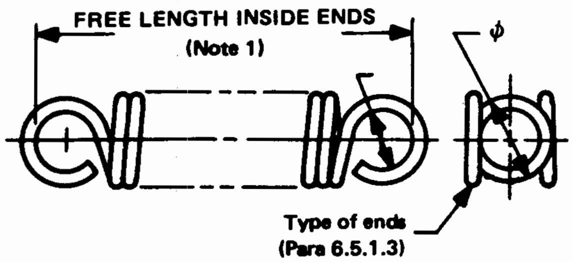
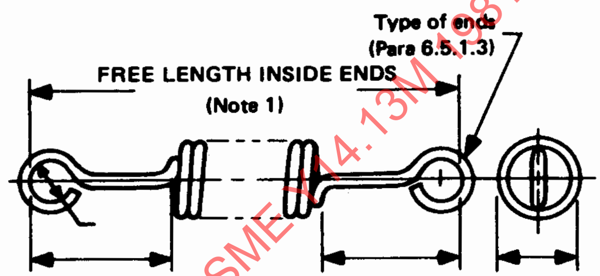


SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
WIRE DIAMETER	6.2.1.1
DIRECTION OF HELIX	6.4.1.2
TOTAL COILS	Note 2
RELATIVE POSITION OF ENDS	6.5.1.4
EXTENDED LENGTH WITHOUT PERMANENT SET	6.5.1.2
INITIAL TENSION	Note 3
FORCE AT EXTENDED LENGTH ____	Note 4
FORCE AT OPERATING LENGTH OF ____	Note 4
(Special data)	6.3

NOTES:
(1) Specify free length without tolerance or as reference, whichever is applicable.
(2) Specify total number of coils; designate reference.
(3) When essential to design requirements, specify initial tensio; otherwise specify "INITIAL TENSION OPTIONAL."
(4) Specify the force required at each of the two defined extended lengths.

FIG. 10 DRAWING REQUIREMENTS FOR HELICAL EXTENSION SPRINGS WHERE TWO FORCES ARE SPECIFIED



SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
WIRE DIAMETER	6.2.1.1
DIRECTION OF HELIX	6.4.1.2
TOTAL COILS	Note 2
RELATIVE POSITION OF ENDS	6.5.1.4
EXTENDED LENGTH INSIDE ENDS WITHOUT PERMANENT SET	6.5.1.2
INITIAL TENSION	Note 3
SPRING RATE	Note 4
FORCE AT OPERATING LENGTH OF ____	6.4.1(d)
(Special data)	6.3

NOTES:
(1) Specify free length without tolerance or as reference, whichever is applicable.
(2) Specify total number of coils; designate reference.
(3) When essential to design requirements, specify initial tension; otherwise specify "INITIAL TENSION OPTIONAL."
(4) Specify spring rate.

FIG. 11 DRAWING REQUIREMENTS FOR HELICAL EXTENSION SPRINGS WHERE SPRING RATE IS SPECIFIED

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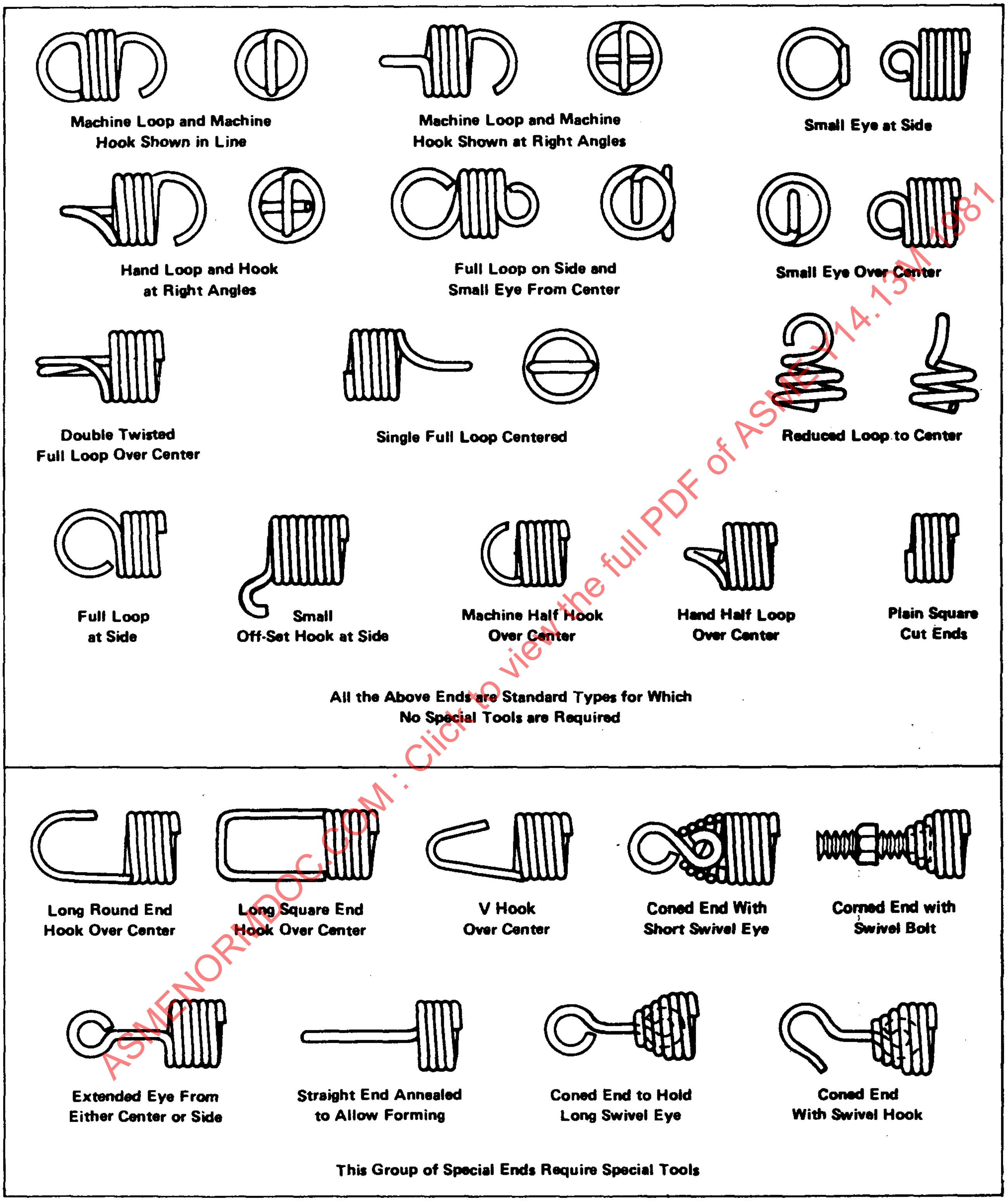

FIG. 12 TYPES OF HELICAL EXTENSION SPRING ENDS

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6.6.1.4 Maximum Deflection Without Permanent Set. If essential to design requirements, specify the maximum allowable deflection without permanent set in degrees of rotation beyond the final position as a precaution against overstressing the spring during assembly.

6.6.1.5 Spring Rate. Specify the spring rate as torque per degree of deflection as reference except where particular design requirements necessitate a tolerance. Where the spring rate is specified with a tolerance, designate the force at deflected positions as reference.

6.6.1.6 Types of Ends. Some of the types of ends applicable to helical torsion springs are illustrated in Figs. 14 and 15. The types of ends required and the relative position of the ends shall be completely dimensioned and clearly delineated on the drawing.

6.7 Spiral Torsion Springs

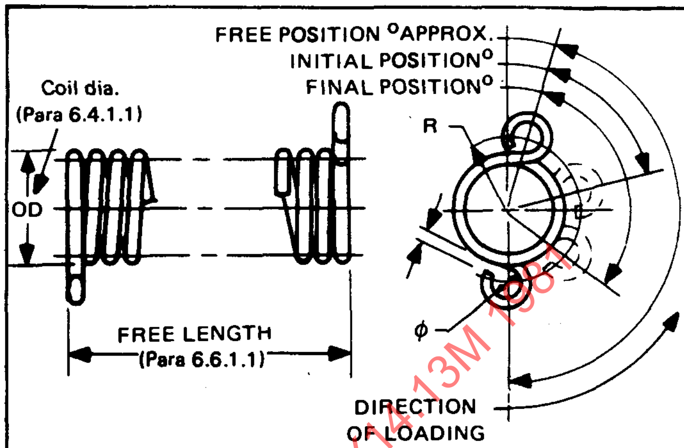
A spiral torsion spring is usually made by winding flat spring material on itself in the form of a spiral. It is designed to wind up and exert a force in a rotating direction around the spring axis. This force may be delivered as torque, or it may be converted into push or pull force.

6.7.1 Drawing Requirements. Explanation of the spring data listed in Fig. 16 is given in 6.7.1.1 through 6.7.1.5.

6.7.1.1 Outside and Inside Diameters of Coil. Specify and delineate the number of coils in the free position as reference.

6.7.1.2 Developed Length of Material and Active Length of Material. Specify the developed and the active length of material as reference. To the active length is added the inactive material forming the ends and the portion of a coil or coils that hugs the shaft, the sum of which is the developed length.

6.7.1.3 Number of Coils in Free Position. Specify and delineate the number of coils in the free position as reference.



SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
WIRE DIAMETER	6.2.1.1
DIRECTION OF HELIX	6.6.1.2
TOTAL COILS	6.6.1.1
TORQUE AT INITIAL POSITION	6.6.1.3
TORQUE AT FINAL POSITION	6.6.1.3
MAXIMUM DEFLECTION WITHOUT SET BEYOND FINAL POSITION	6.6.1.4
SPRING RATE	6.6.1.5
TYPE OF ENDS	6.6.1.6
(Special data)	6.3

FIG. 13 DRAWING REQUIREMENTS FOR HELICAL TORSION SPRINGS

6.7.1.4 Torque. Specify the torque at the final position of the outside end as it relates to the delineated inside end.

6.7.1.5 Types of Ends and Angular Relation of Ends. There are a variety of end formations possible for spiral torsion springs, a few of which are illustrated in Fig. 17. The ends shall be completely delineated and dimensioned on detail drawings.

6.8 Torsion Bar Springs

Torsion bar springs are straight bars or rods of definite cross section used to offer resistance to a twisting moment about the longitudinal axis. The cross section may be round, square, rectangular, or hexagonal as directed by design and availability. Circular cross sections are generally used. Both ends are generally upset to diameters larger than the body

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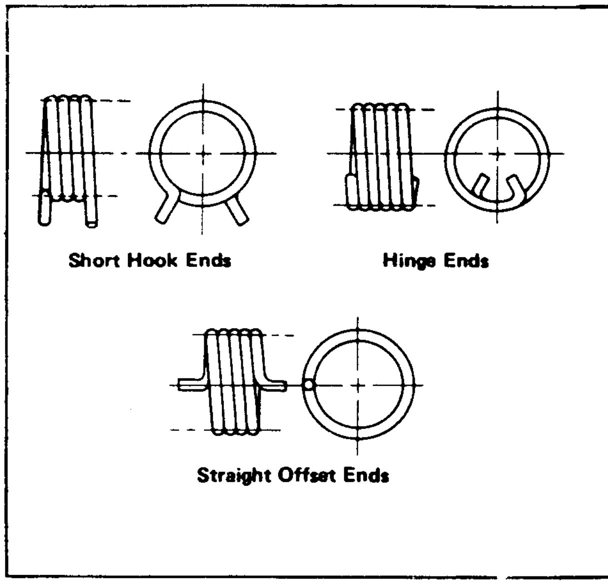


FIG. 14 TYPES OF HELICAL TORSION SPRING ENDS

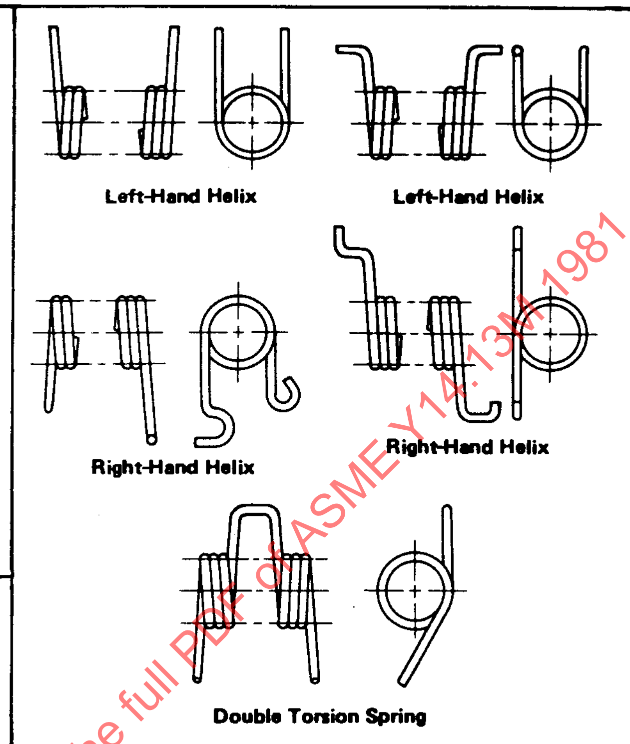


FIG. 15 HELICAL TORSION SPRING FORMS

diameter with a tapered transition section between body and ends to keep stress concentrations to a minimum. Splines, serrations, or other types of couplings are cut on the upset ends to form the means of anchorage.

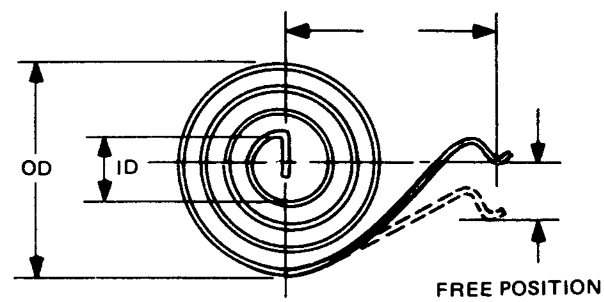
6.8.1 Drawing Requirements. Explanation of the spring data listed in Fig. 18 is given in 6.8.1.1 through 6.8.1.8.

6.8.1.1 Diameters of Body and Ends. Specify in the delineation both the end diameter and the body diameter.

6.8.1.2 Overall Length and Length of Ends. Specify in the front view the overall length and length of the ends.

6.8.1.3 Angle of Taper. Specify the angle of taper.

6.8.1.4 Torque. The torque with tolerance should be specified, as appropriate, at definite amounts of deflection in degrees of rotation from the free position. Torque should preferably be specified at the initial and the final operating positions in the assembly.



SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
MATERIAL SIZE	6.2.1.1
OUTSIDE DIAMETER	6.7.1.1
INSIDE DIAMETER	6.7.1.1
DEVELOPED LENGTH OF MATERIAL	6.7.1.2
ACTIVE LENGTH OF MATERIAL	6.7.1.2
NUMBER OF COILS IN FREE POSITION	6.7.1.3
TORQUE AT FINAL POSITION	6.7.1.4
MAXIMUM DEFLECTION BEYOND FINAL POSITION WITHOUT SET	6.6.1.5
TYPE OF ENDS	6.7.1.5
(Special data)	6.3

FIG. 16 DRAWING REQUIREMENTS FOR SPIRAL TORSION SPRINGS

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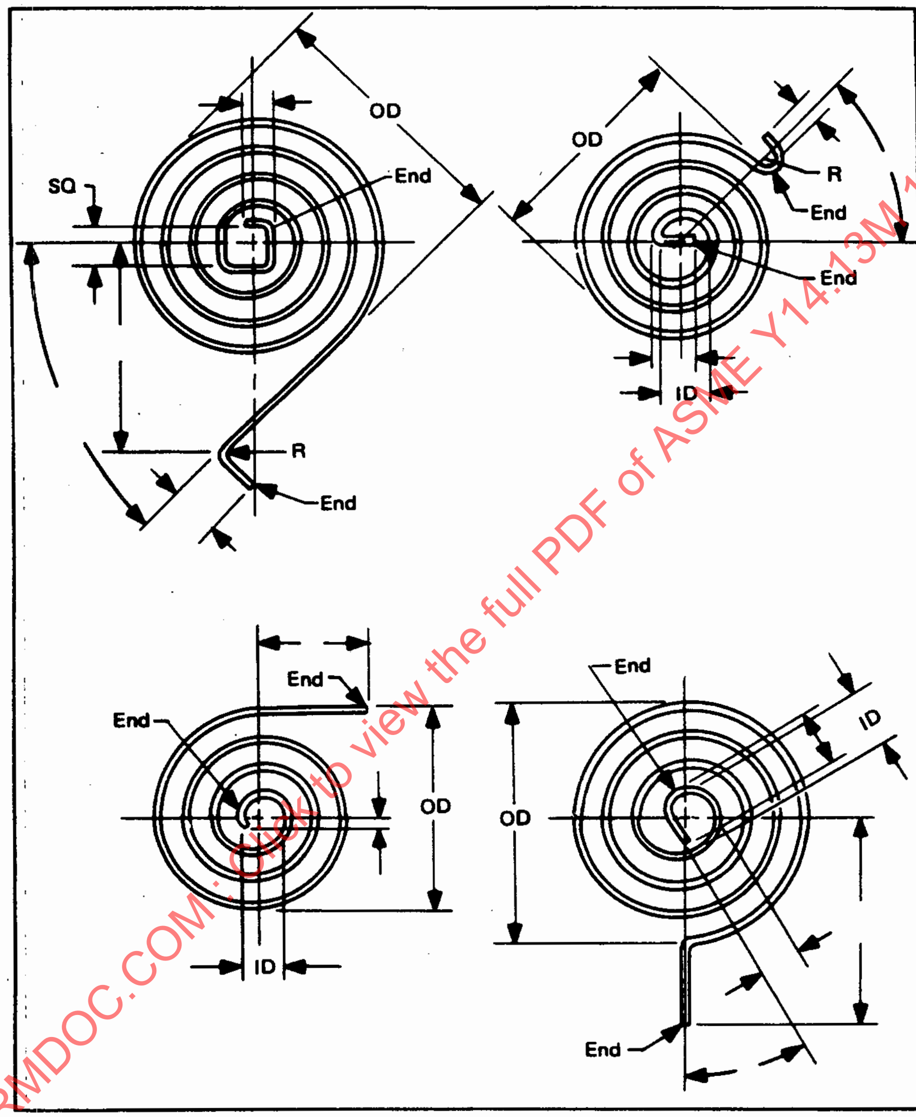

FIG. 17 TYPES OF SPIRAL TORSION SPRING ENDS

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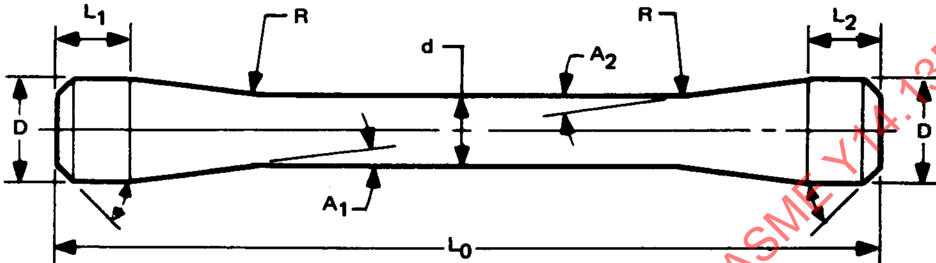

SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
DIAMETER OF BODY (d)	6.8.1.1
DIAMETER OF ENDS (D)	6.8.1.1
LENGTH OVERALL (l_o)	6.8.1.2
LENGTH OF ENDS (L_1 and L_2)	6.8.1.2
ANGLE OF TAPER (A_1 and A_2)	6.8.1.3
TORQUE AT _____ DEGREES DEFLECTION	6.8.1.4
SPRING RATE	6.8.1.5
TYPE OF ENDS	6.8.1.6
DIRECTION OF WINDUP MARKING	6.8.1.7
ANGULAR RELATION BETWEEN ENDS	6.8.1.8
(Special data)	as req'd

FIG. 18 DRAWING REQUIREMENTS FOR TORSION BAR SPRINGS

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6.8.1.5 Spring Rate. Specify the spring rate as torque per degree of deflection as reference.

6.8.1.6 Type of Ends. The type of end (involute spline, serrations, etc.) shall be completely delineated and dimensioned.

6.8.1.7 Direction of Windup Marking. For preset torsion bar springs, the direction of windup (load application in service) shall be indicated with an arrow on the end of the spring. For torsion bar springs which are not preset, direction of windup marking is not required.

6.8.1.8 Angular Relation Between Ends. For torsion bar springs that will be preset, a groove (approximately 1.5 mm x 60°V) shall be stamped on each end of the spring. An end view shall show the angular relation of the end groove before and after presetting. For torsion bar springs that will not be preset, angular relation must be maintained between end shapes.

6.9 Volute Springs

Volute springs are conical shaped compression springs made of rectangular cross-sectional material so constructed that the coils are capable of telescoping into each other.

6.9.1 Drawing Requirements. Explanation of the spring data listed in Fig. 19 is given in 6.9.1.1 through 6.9.1.7.

6.9.1.1 Outside and Inside Diameters. Specify both the outside and inside diameters.

6.9.1.2 Free Length. Specify the free length as a reference dimension.

6.9.1.3 Total Coils. Specify the number of total coils as reference or with a tolerance if essential to the design.

6.9.1.4 Radial Pitch. Specify.

6.9.1.5 Axial Pitch and Helix Angle. The axial pitch and the helix angle of a volute spring determine its force, length, and bottoming characteristics. Specify either the helix angle or preferably the axial pitch as constant. If the helix angle is constant, the pitch will vary; if the pitch is constant, the helix angle will vary.

6.9.1.6 Forces. Specify the force with tolerance to be developed at definite compressed lengths.

6.9.1.7 Solid Length. Specify the solid length as a maximum dimension, including appropriate tolerances on the width of the coil and protective coating. The spring should not ordinarily be permitted to go solid in operation, except when used as a bumper or dictated by other design requirements.

6.10 Coned Disk (Belleville) Springs

A coned disk (Belleville) spring is a spring washer in the form of a frustrum of a cone, having constant material thickness and used as a compression spring.

6.10.1 Drawing Requirements. Explanation of the spring data listed in Fig. 20 is given in 6.10.1.1 through 6.10.1.6.

6.10.1.1 Inside and Outside Diameters. Specify both the inside and outside diameters.

6.10.1.2 Free Height and Method of Stacking. It is usually best to specify the free height of the individual disk as a reference dimension, but if essential to the design it may be a toleranced dimension. Where springs are used in sets, as in Fig. 21, specify the method of stacking and specify the free height of the stack.

6.10.1.3 Forces. Where disks are to be installed singularly, only one force with a tolerance applied shall be specified. Where disks are to be installed in sets, specify the forces with a tolerance at definite compression length, preferably at the initial and final operating positions.

6.10.1.4 Bearing Surfaces. Bearing surfaces may be provided where necessary to meet the design requirements.

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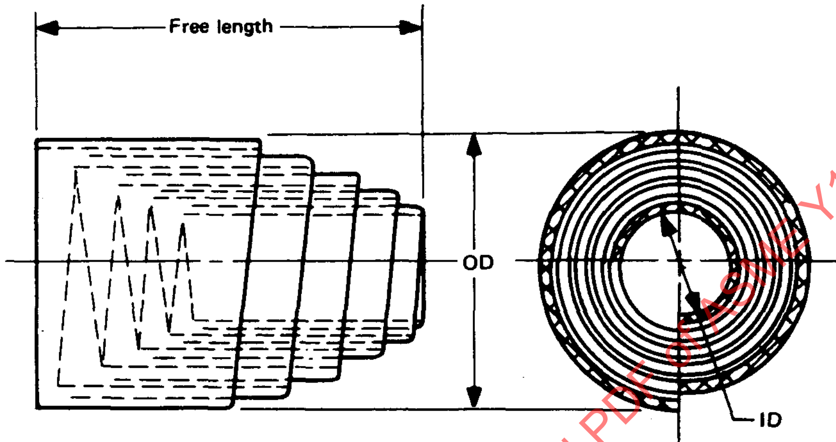

SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
MATERIAL SIZE	6.2.1.1
TOTAL COILS	6.9.1.3
DIRECTION OF HELIX	6.4.1.2
RADIAL PITCH	6.9.1.4
AXIAL PITCH	6.9.1.5
HELIX ANGLE	6.9.1.5
FORCE AT COMPRESSED LENGTH OF ______	6.9.1.6
FORCE AT COMPRESSED LENGTH OF ______	6.9.1.6
SOLID LENGTH	6.9.1.7
(Special data)	6.3

FIG. 19 DRAWING REQUIREMENTS FOR VOLUTE SPRINGS

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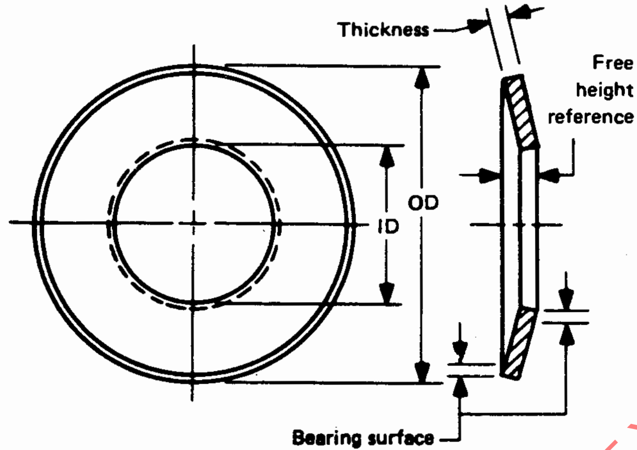

SPRING DATA

	Para
MATERIAL SPECIFICATION	6.2.1
THICKNESS OF MATERIAL	6.2.1.1
FREE HEIGHT	6.10.1.2
FORCE AT COMPRESSED HEIGHT OF ____	6.10.1.3
(Special data)	6.3

FIG. 20 DRAWING REQUIREMENTS FOR CONED DISK (BELLEVILLE) SPRINGS

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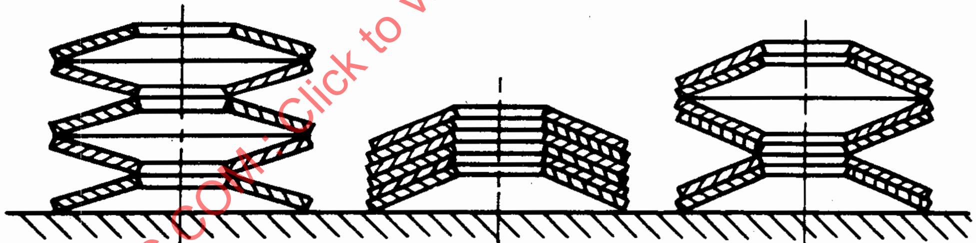

FIG. 21 METHODS OF STACKING CONED DISK (BELLEVILLE) SPRINGS

6.10.1.5 Bearing Surfaces Parallel. Indicate where required.

6.10.1.6 Concentricity Between Outside and Inside Diameters. Specify the concentricity between the outside and inside diameters, where important.

6.11 Flat Springs

A flat spring is, in the broad sense, any spring made of flat strip or bar stock which deflects as a cantilever or as a simple beam. Any metal stamping which stores energy when deflected and returns an equal amount of energy is a flat spring. Excluded from this definition are coned disk (Belleville) springs, spiral torsion springs, spring washers, and rings.

6.11.1 Drawing Requirements. Explanation of the spring data listed in Fig. 22 is given in 6.11.1.1 through 6.11.1.3. Because of the wide variation of shapes for flat springs, a complete specification is beyond the scope of this Standard.

6.11.1.1 Developed Lengths. Specify the developed overall length if essential to keep within space limitations.