Designation: D 6092 – 97$^{\epsilon 1}$

Standard Practice for Specifying Standard Sizes of Stone for Erosion Control[1]

This standard is issued under the fixed designation D 6092; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ϵ^1 NOTE—Paragraph 1.4 was added editorially in October 1998.

1. Scope

1.1 This practice covers size designations and maximum ranges in mass or gradation for standard sizes for riprap, spalls, or bedding, or both, used for slope protection of dam embankments, streambank erosion control, bridge piers and abutments. Sizes used for outer harbor structures such as breakwalls, revetments, confined diked disposal structures (heretofore described as armor stone, cover stone, or dimension stone) for which stone sizes range between 5 and 25 tons, or that require cut dimensions for layed-up structures are beyond the scope of this practice.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This practice offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 4992 Practice for Evaluation of Rock to be Used for Erosion Control[2]

D 5519 Test Method for Particle Size Analysis of Natural and Manmade Riprap Materials[2]

3. Terminology

3.1 *Definitions:* Definitions of other terms in this guide are listed in Terminology D 653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *filter/bedding stone*—stone, filter stone consisting of crushed stone ranging in size from ¾ in. (19 mm) to number 40 sieve size, and bedding stone (often referred to as "spalls") consisting of crushed stone ranging in size from 6 in. (152 mm) (maximum) to ½ in. (12.7 mm) minimum. Filter and bedding may be placed in two layers beneath the riprap, that is, a filter layer 8 to 10 in. (203 to 254 mm) thick and a bedding thickness of 6 to 8 in. (152 to 203 mm).

3.2.2 *geotextiles*—suitable geotextile fabrics that meet the design requirements may be used instead of the above bedding and spalls. Suitable cover thickness maybe required.

3.2.3 *gradation*—the proportions by mass of stones distributed within specified ranges between maximum and minimum limits.

3.2.4 *riprap*—stone materials generally less than two tons in weight, specially selected and graded, and when properly placed prevents erosion through minor wave action, or strong currents and thereby preserves the shape of a surface, slope, or the underlying structure.

3.2.5 *standard size designation*—one of a group of stones with specified gradation limits.

4. Summary of Practice

4.1 The design team shall establish the size of the mass of graded quarry stone using acceptable design criteria. If design criteria and economic factors permit, standard gradations shown in the designated tables should be selected. Using standard sizes, the design team shall select the appropriate gradation; this might require the next larger size thereby creating an over-designed structure, but economically, a cheaper structure. Added cost may result due to the increased volume of stone required, and in transporting and placing the additional stone at the project site. The cost effectiveness of

[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.17 on Rock for Erosion Control.

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[2] *Annual Book of ASTM Standards*, Vol 04.08.

TABLE 1 Standard Sizes for Riprap[A]

Size Designation		R-1500	R-700	R-300	R-150	R-60	R-20
Particle Mass		Percent Lighter Than the Mass Specified[B]					
Pounds	(Kilogram)[C]						
3000	(1400)	100	. . .	. . .	. . .	. . .	. . .
1500	(680)	50 to 100	100	. . .	. . .	. . .	. . .
1000	(450)	. . .	. . .	. . .	. . .	. . .	. . .
700	(320)	15 to 50	50 to 100	100	. . .	. . .	. . .
500	(230)	. . .	. . .	. . .	. . .	. . .	. . .
300	(140)	. . .	15 to 50	50 to 100	100	. . .	. . .
250	(110)	0 to 15	. . .	. . .	. . .	. . .	. . .
150	(68)	. . .	. . .	15 to 50	50 to 100	100	. . .
60	(27)	. . .	0 to 15	. . .	15 to 50	50 to 100	. . .
45	(20)	. . .	. . .	0 to 15	. . .	. . .	100
30	(14)	. . .	. . .	. . .	. . .	15 to 50	. . .
20	(9.1)	. . .	. . .	. . .	0 to 15	. . .	50 to 100
10	(4.5)	. . .	. . .	. . .	. . .	0 to 15	15 to 50
2	(0.9)	. . .	. . .	. . .	. . .	. . .	0 to 15

[A] Revised Nov 14, 1995, and modified to conform to the gradations proposed by the producers and the National Crushed Stone Association.
[B] Established by determining the mass of the individual stone particles.
[C] Rounded to two figures from conversion of inch-pound (U.S. Customary) units.

TABLE 2 Effect of Specific Gravity on the Weight of Stone of Various Shapes (Pounds)

Maximum Dimension, in.	Cube				Sphere			
	Specific Gravity				Specific Gravity			
. . .	2.60	2.65	2.70	2.75	2.60	2.65	2.70	2.75
42	6950	7090	7225	7350	3640	3712	3780	3850
30	2535	2584	2635	2680	1325	1353	1380	1405
20	750	766	780	390	390	401	410	415
12	160	165	168	172	85	87	88	90
6	20	20.5	21	21.5	10	11	11	11

	Prolate Sphere				Average of Cube and Sphere			
	Specific Gravity				Specific Gravity			
. . .	2.60	2.65	2.70	2.75	2.60	2.65	2.70	2.75
42	3238	3300	3362	3424	5300	5401	5500	5600
30	1180	1202.5	1225	1248	1930	1968	2005	2845
20	350	356	363	370	570	583	595	405
12	75	77	78	80	123	126	128	131
6	9.4	9.6	9.8	10	15	16	16	16

using “standard grading” versus “non-standard gradings” always should be evaluated, and standard gradations used whenever possible.

5. Significance and Use

5.1 The standard size designations listed in this practice are provided so that the design team, consumer, and the producer have a common reference in sizing stone materials used in erosion control. The design team should perform a materials survey, and subsequent testing to determine which quarry sources may have suitable in-place rock and perform suitable blasting and processing procedures to produce the required gradations. The design team must recognize the fact that not all sources are capable or willing to produce the required gradations. Only those sources listed by the design team should be considered for construction of the project.

5.2 The standard size designations provided in this guide are suitable for protective surfacing and structures designed for erosion control. These sizes are for typical structures such as jetties, revetments, groin baffles, bulkheads, lining for drainage/irrigation ditches and for intake or outlet facilities, bridges and stream channel banks, gabions, and slope protection for earth embankment and rock-fill dams.

5.3 The design selection of stone sizes, durability, placement, filter/bedding materials, or geotextiles, steepness of slopes for placement, and layer thickness are beyond the scope of this guide.

6. Manufacture

6.1 The standard size designations of quarried stone for erosion control in this guide may be produced by any suitable commercial quarrying method, and by the use of any type of sizing device, shape or size of plant grizzly or screen openings, or combinations thereof, necessary to produce the required sizes within the gradation limits specified in Section 6.

6.2 Stones shall be hard, angular to subangular, and of such quality that they will not disintergrate on exposure to water or weathering during the designed life of the structure. The stone shall be free from fractures, shale partings, deleterious materials, and overburden soil (including clays from sink structures, that is, chimneys and stopes). The design team shall specify acceptance criteria based on the requirements for the individual

project. Additional guidance may be found in Practice D 4992 and Test Method D 5519.

7. Standard Sizes

7.1 Standard size designations of stone for erosion control are defined on the basis of mass or equivalent sieve size. The sizes are separated into riprap [R-1500 through R-20] and filter/bedding stone [FS-1 and FS-2] and spalls [FS-3].

7.1.1 Graded stone sizes are shown on Table 1, and are based on mass.

7.1.2 Equivalent dimensions are not shown. Any calculated dimensions would have to assume shapes such as a cube, a sphere, an prolate sphere, or a combination of shapes. Table 2 provides additional information on converting to approximate dimensions for graded stone.

7.1.3 Gradation curves for each stone size are presented in Figs. 1-9.

7.1.4 Filter/bedding stone sizes are shown in Figs. 7-9.

7.2 The stone shall be reasonably well-graded and fall within the limits of the gradation curve for each size designation. Gradation test results that begin on the coarse side of the curve and end up on the fine side of the curve are considered as “skip-graded” and will not be accepted.

8. Keywords

8.1 erosion control; filter/bedding stone; gradation; quarried stone; riprap; standard size designation

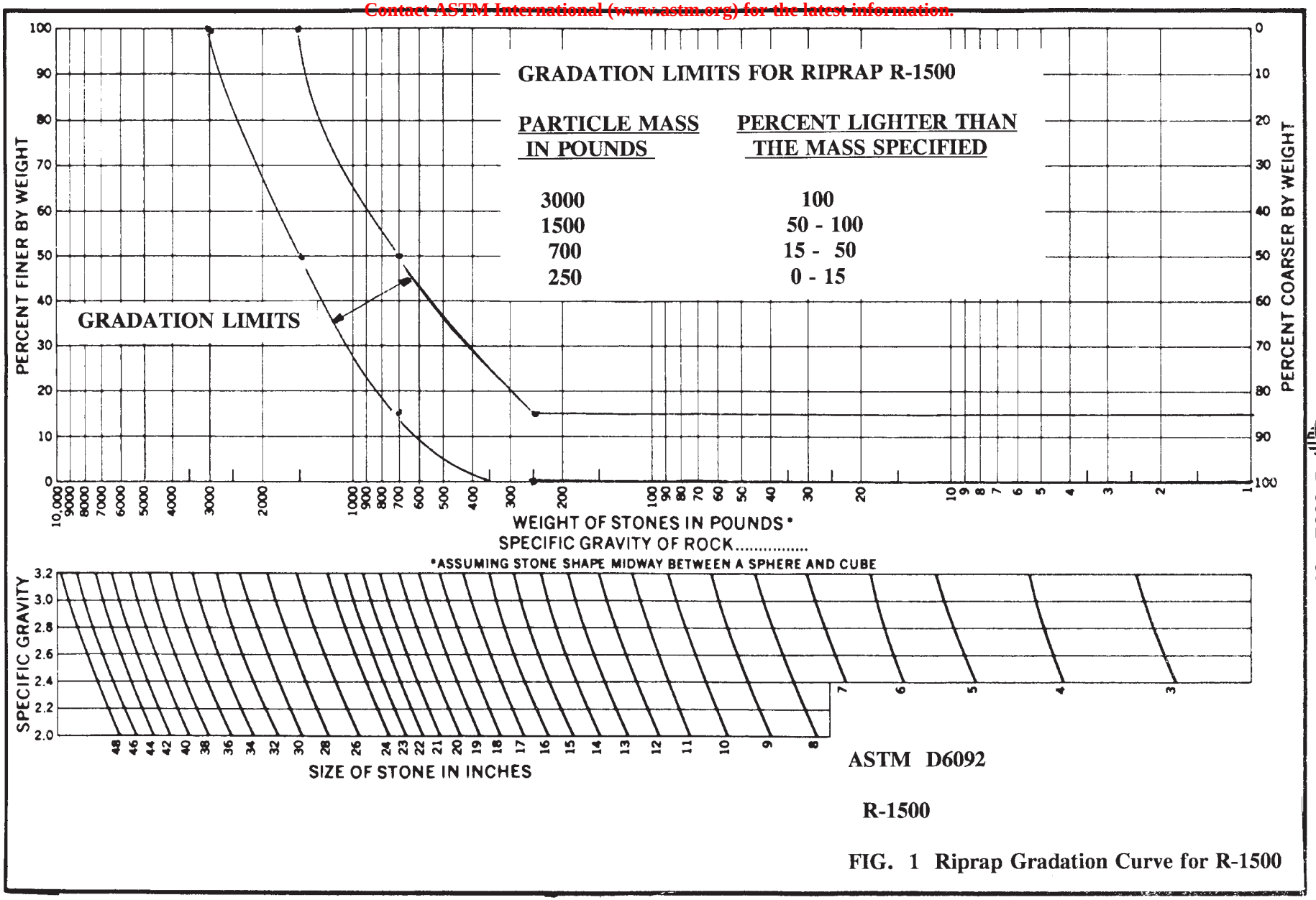

FIG. 1 Riprap Gradation Curve for R-1500

NOTE 1—Gradations curves for each of the riprap types are plotted on the following pages. Test results for each gradation performed in the field should be plotted on the appropriate curve. Acceptable products will plot somewhat parallel to the gradation limits. Test results of the products that start on the coarse side of the curve and end on the finer side of the curve shall be deemed as skip graded and are unacceptable.

FIG. 1 Gradation Limits for Riprap R-1500

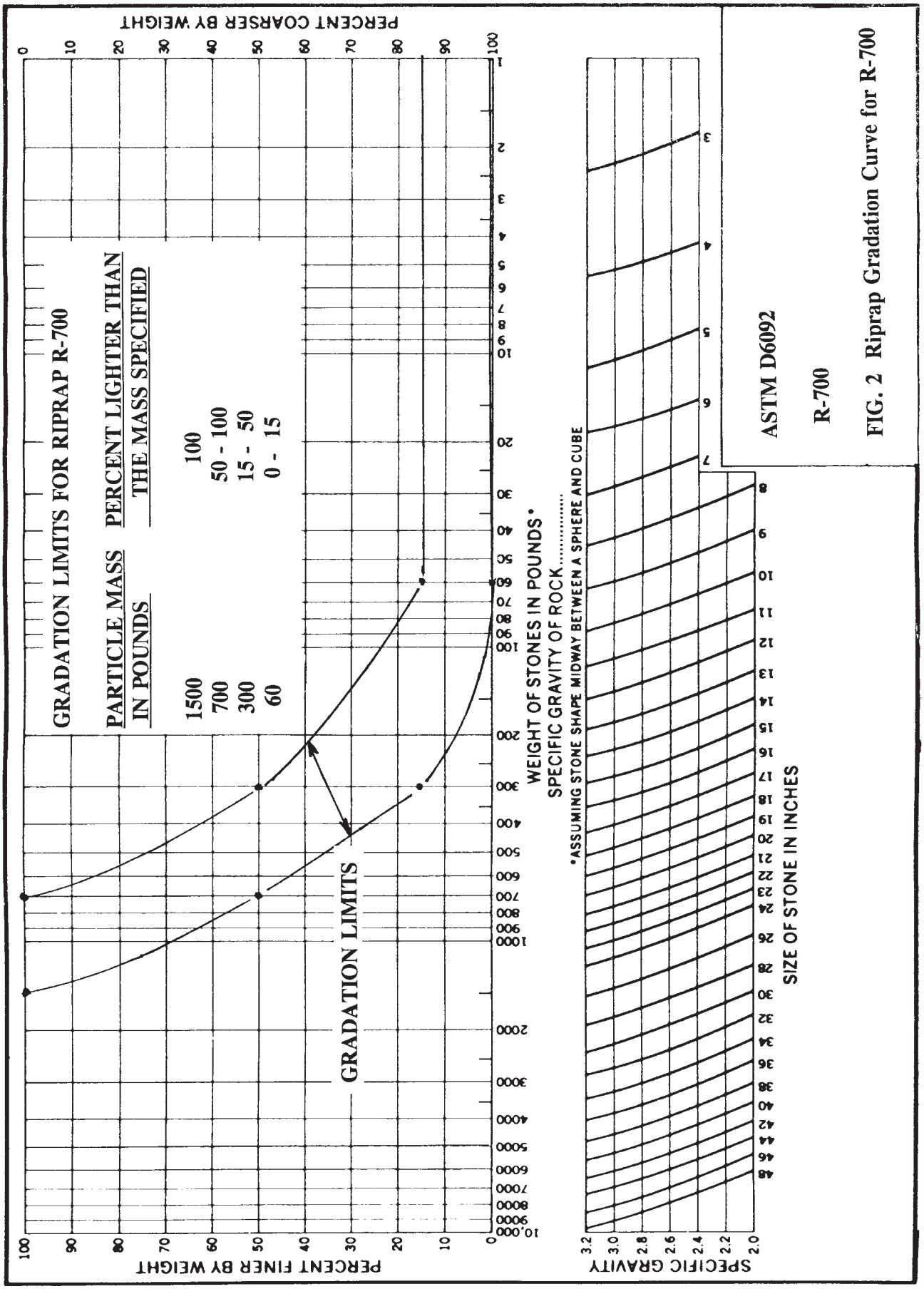

FIG. 2 Gradation Limits for Riprap R-700

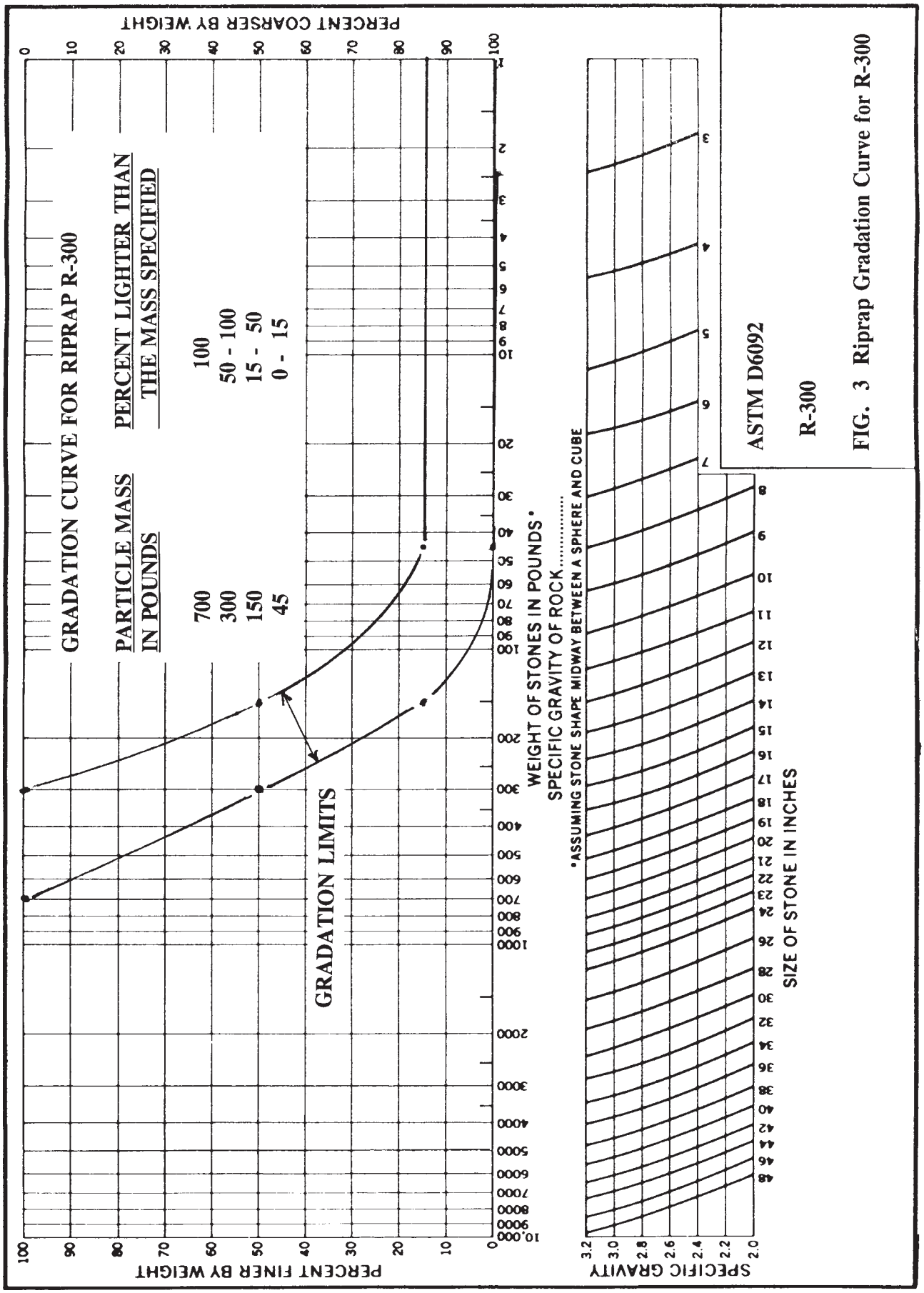

FIG. 3 Gradation Curve for Riprap R-300

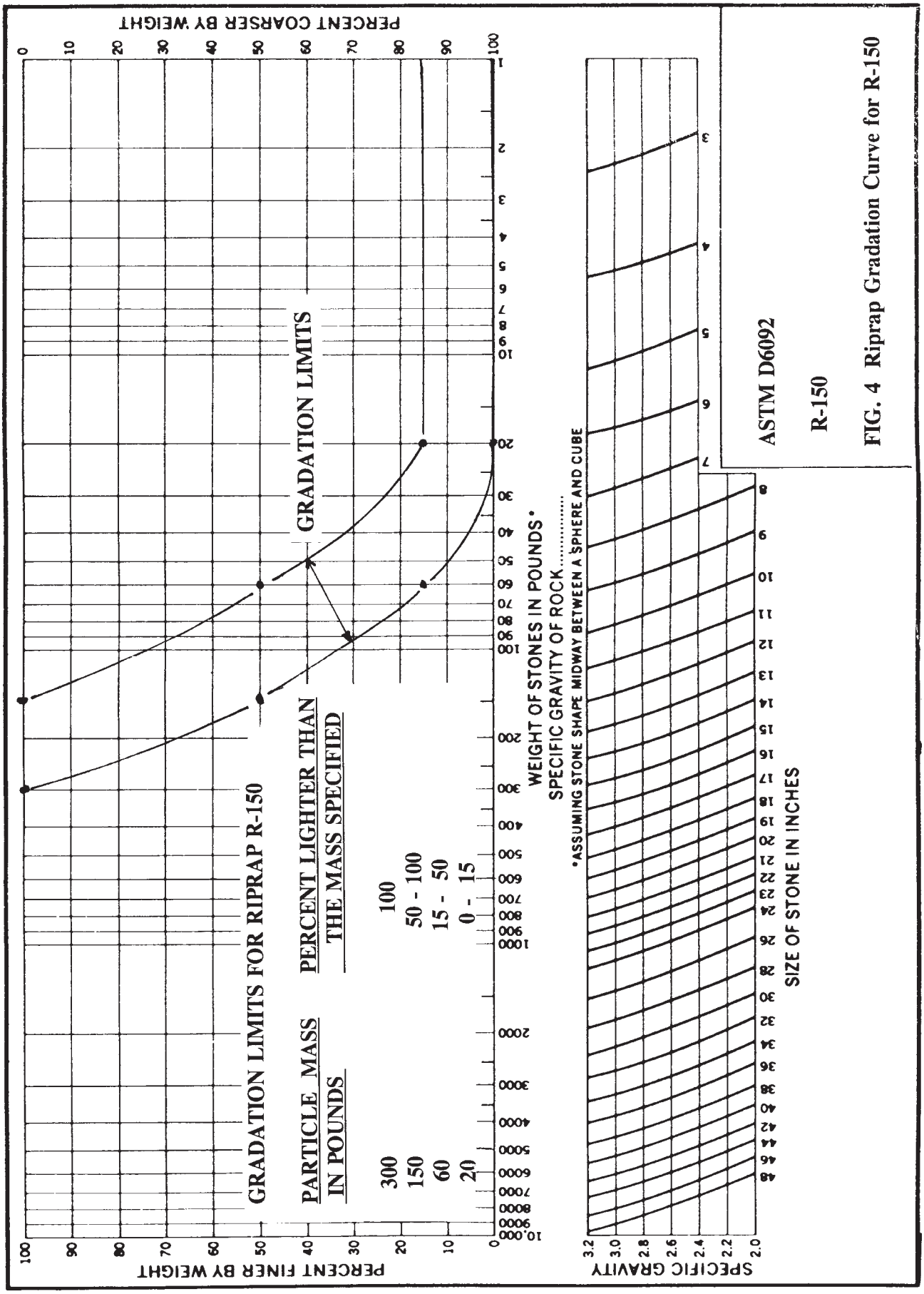

FIG. 4 Gradation Limits for Riprap R-150

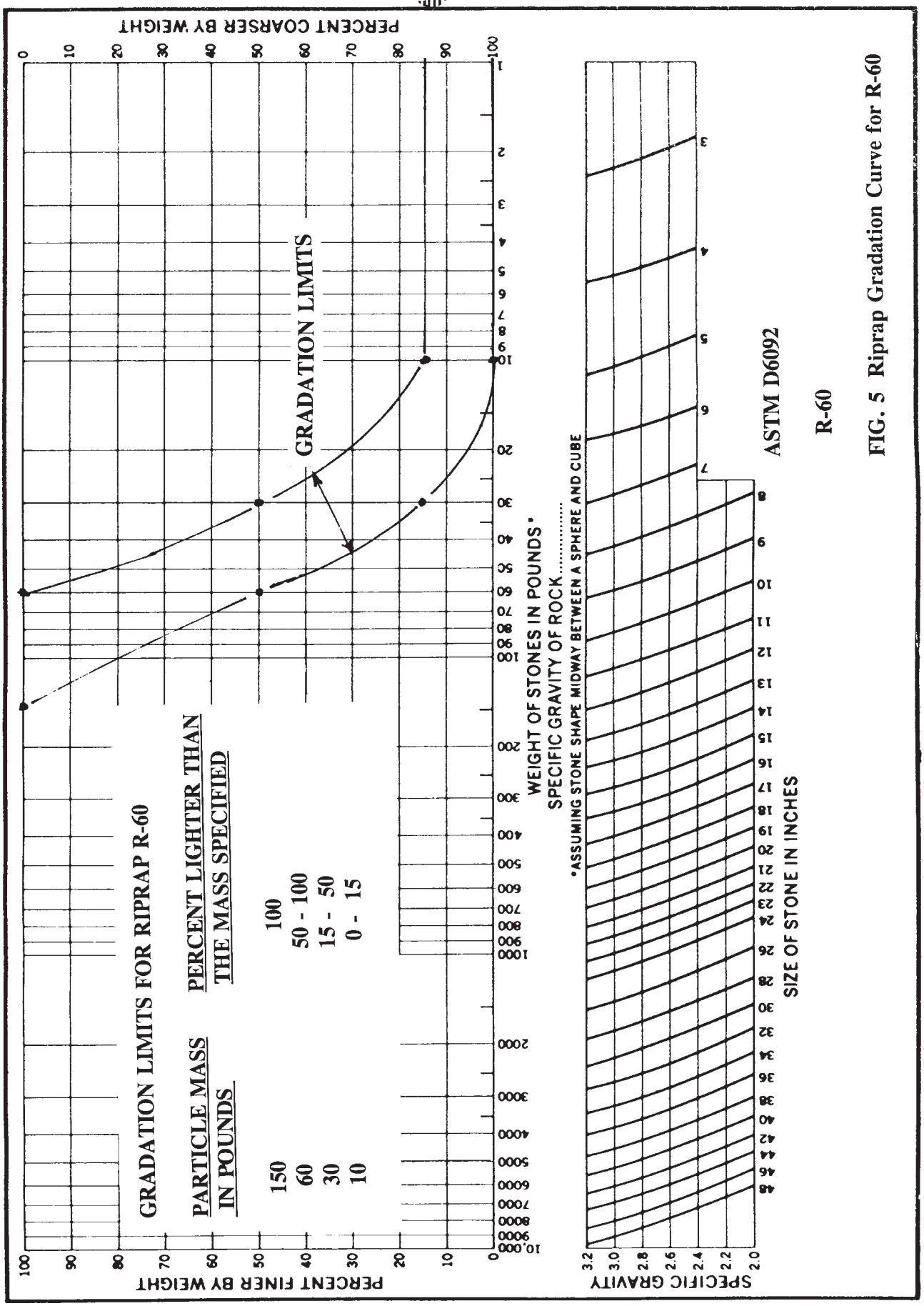

FIG. 5 Riprap Gradation Curve for R-60

FIG. 5 Gradation Limits for Riprap R-60

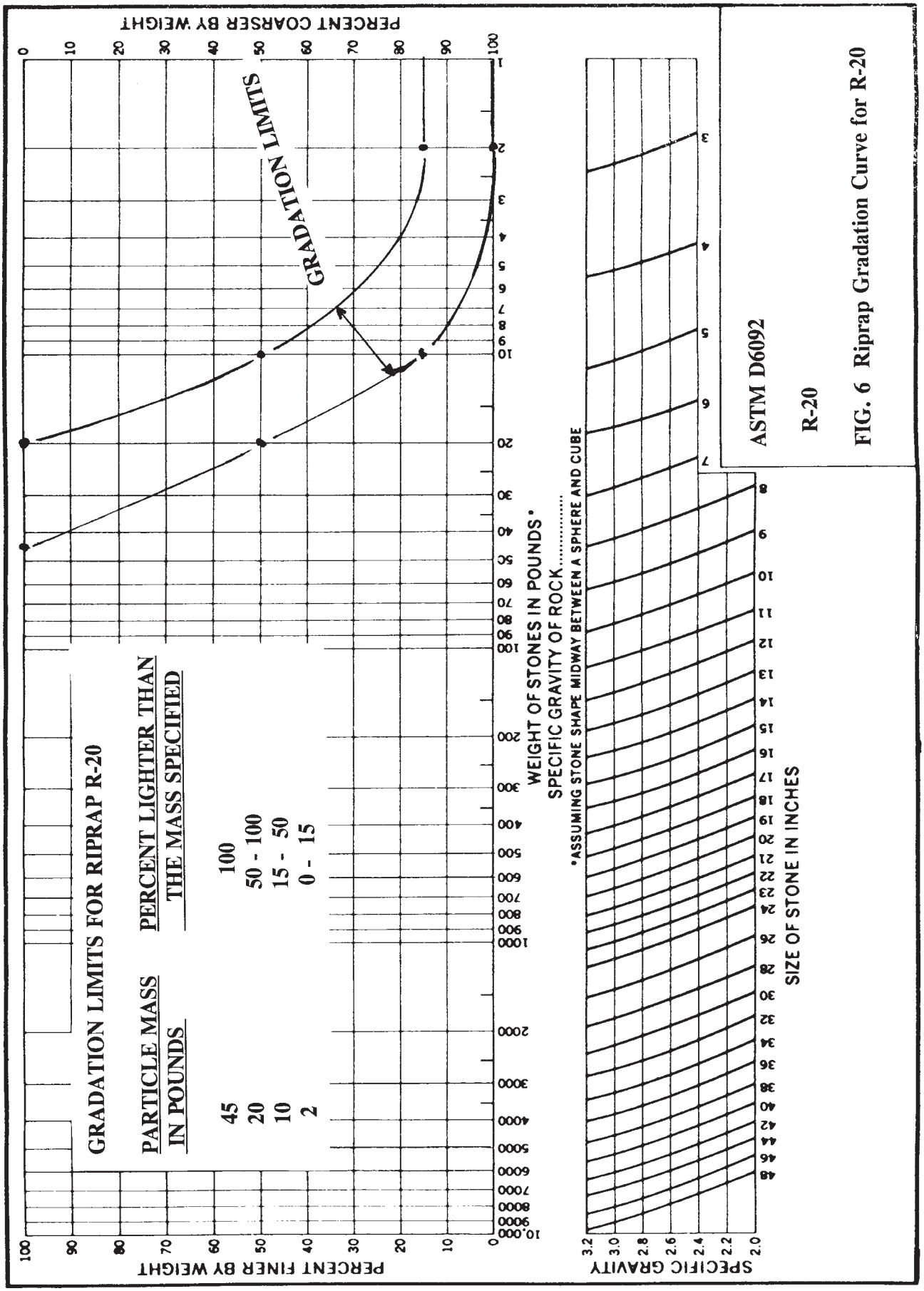

FIG. 6 Gradation Limits for Riprap R-20

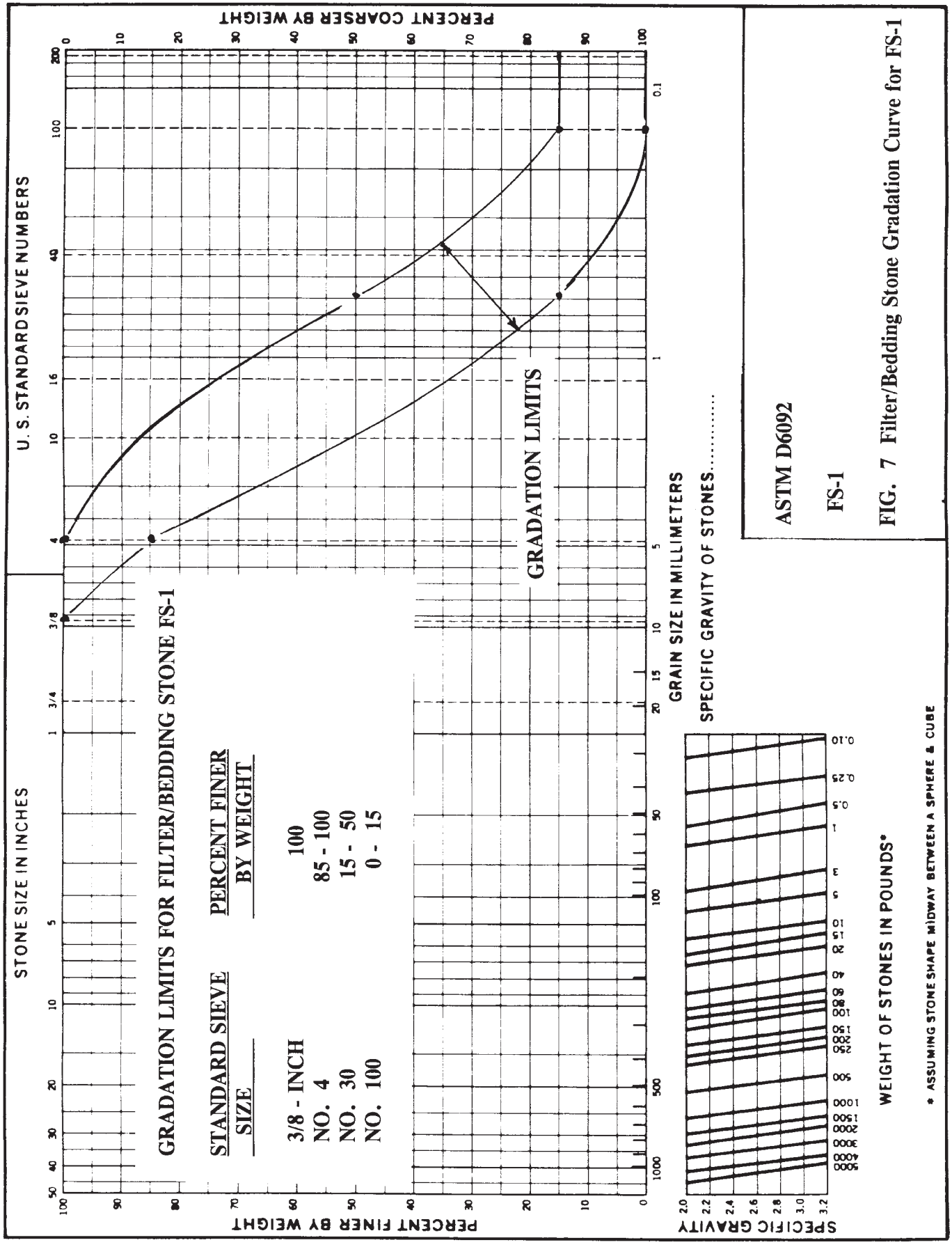

FIG. 7 Gradation Limits for Bedding FS-1

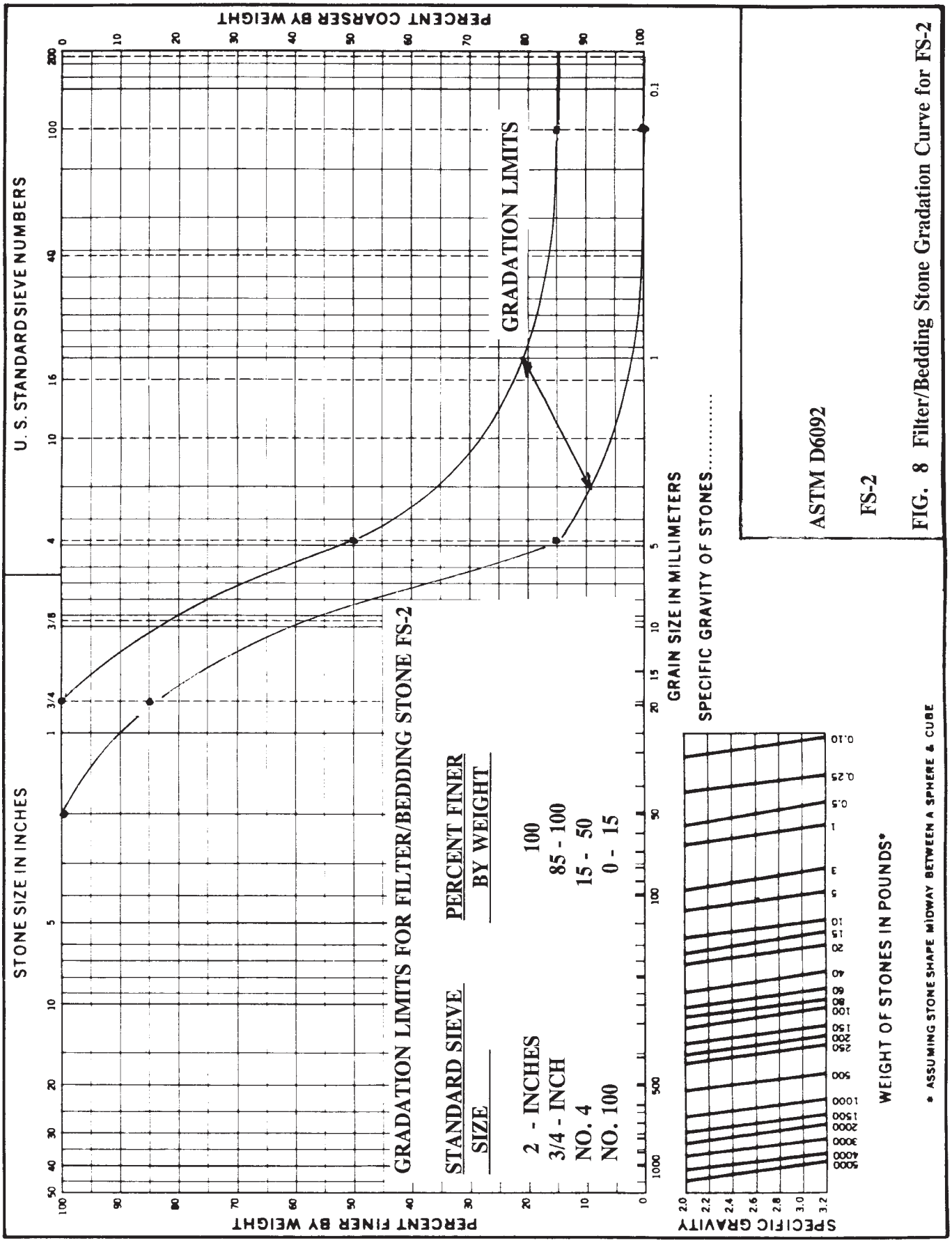

FIG. 8 Gradation Limits for Bedding FS-2

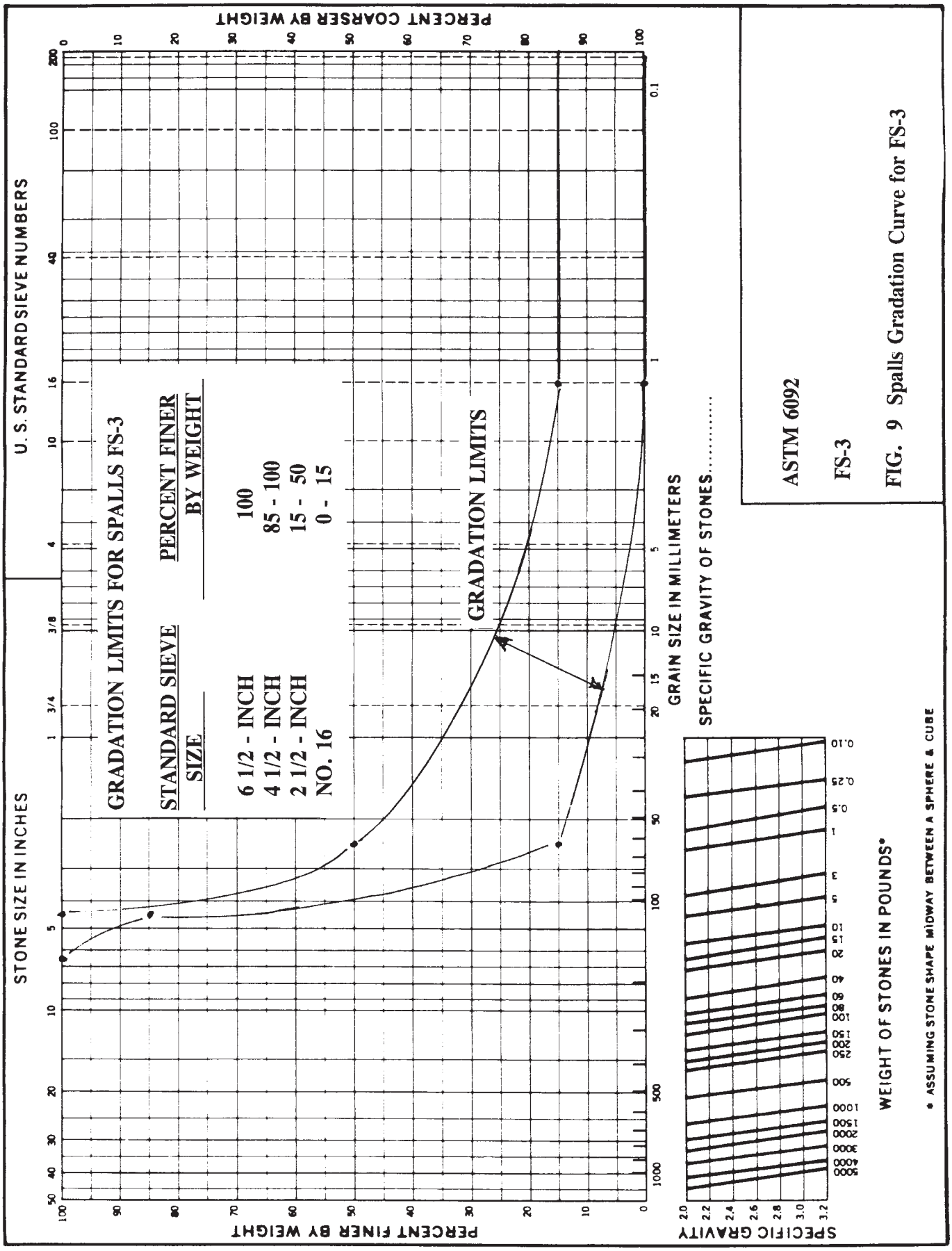

FIG. 9 Gradation Limits for Spalls FS-3