

INCH-POUND

MIL-C-43701B
30 July 1990
SUPERSEDING
MIL-C-43701A
21 January 1987

MILITARY SPECIFICATION

CORD, ELASTIC, NYLON OR POLYESTER

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers elastic cord encased within a braided nylon or polyester cover.

1.2 Classification. The cord shall be of the following types as specified (see 6.2).

Type I - General purpose cord

Type II - Lacing cord

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be used in improving this document should be addressed to U.S. Army Natick Research, Development and Engineering Center, Natick, MA 01760-5014, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 8305

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SPECIFICATIONS

FEDERAL

- A-A-203 - Paper, Kraft, Untreated
- UU-T-81 - Tag, Shipping and Stock
- PPP-B-636 - Boxes, Shipping, Fiberboard
- PPP-T-45 - Tapes, Gummed, Paper, Reinforced and Plain, for Sealing and Securing

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- MIL-C-3131 - Cordage; Packaging Of
- MIL-L-35078 - Loads, Unit: Preparation of Semiperishable Subsistence Items; Clothing, Personal Equipment and and Equipage; General Specifications for

STANDARDS

FEDERAL

- FED-STD-191 - Test Textile Methods
- FED-STD-595 - Colors Used in Government Procurement

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- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 3951 - Standard Practice for Commercial Packaging

(Application for copies should be addressed to the American Society for Testing and Material, 1916 Race Street, Philadelphia, PA 19103-1187).

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(Non-Government standards and other publications are normally available from organizations that prepare or distribute the documents. These documents may also be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3) in accordance with 4.3.

3.2 Standard sample. The cord shall match the standard sample for shade and shall be equal to or better than the standard sample with respect to all characteristics for which the standard sample is referenced (see 6.4).

3.3 Materials. It is encouraged that recycled material be used when practical as long as it meets the requirements of this document.

3.3.1 Yarn. The yarn used in the fabrication of the cover sleeving of type I and type II cord shall be nylon or textured polyester yarn. The yarn used to overwrap the core (elastic strands) of the type II lacing cord shall be spun nylon or textured polyester.

3.3.2 Elastic strands. The elastic strands shall be made of a heat-resistant, compounded natural rubber, synthetic rubber, or a mixture thereof. The strands shall be of the gage specified in table I, when tested as specified in 4.5.3.

3.4 Color. Unless otherwise specified (see 6.2), the color of the cord shall be Camouflage Green 483 or shall approximate color chip number 34094 of FED-STD-595. When dyed cord is specified, the nylon or polyester yarn shall be dyed before braiding (see 3.4.1).

3.4.1 Color matching. The shade of the dyed cord shall match the standard sample when viewed under filtered tungsten lamps that approximate artificial daylight and that have a correlated color temperature of $7500 \pm 200\text{K}$, with illumination of 100 ± 20 foot candles, and shall be a good match to the standard sample under incandescent lamplight at $2300 \pm 200\text{K}$.

3.4.2 Colorfastness. The dyed nylon or polyester yarns shall show fastness to weathering, laundering, and crocking equal to or better than the standard sample, or equal to or better than a rating of "good" when tested as specified in 4.4.4.

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3.5 Construction and physical requirements. The nylon or polyester yarns shall be tightly braided around multiple elastic strands to form a cord conforming to the physical requirements specified in table I, when tested as specified in 4.4.4.

TABLE I. Physical requirements and construction

| Type | Diameter, (inches) $\pm 1/32$ | Weight (oz per linear yard) min. | Elastic strands min. | Number of carriers | Picks per inch, min | Rubber gage | Elongation (percent) |
|------|-------------------------------------|--|----------------------------|--|------------------------------|--------------------------|-------------------------|
| I | 7/32 | 0.70 | 35 | 16 carriers, 1 end per carrier | 44 | 24-38 | 90-110 |
| II | 3/16 | 0.20 | 7 | 16 carriers, 1 end per carrier or 8 carriers, 2 ends per carrier | 24 | 36 (max. fineness) | 115-140 |

3.5.1 Cover braid.

3.5.1.1 Type I. The outer braid of the type I cord shall be braided so as to give a two over and two under conventional stitch (i.e., each carrier alternates with the next carrier in direction and each strand passes alternately over and under two of the opposite strands).

3.5.1.2 Type II. The outer braid of the type II cord shall be braided over the core in a basket weave construction with the carriers braiding in pairs.

3.5.2 Core.

3.5.2.1 Type I. The core of the type I cord shall be composed of a minimum of 35 unwrapped elastic strands grouped together and encased within the outer braid cover.

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3.5.2.2 Type II. The core of type II cord shall be composed of seven ends (elastic strands) of rubber, each end individually wrapped first, with four ends of singles nylon or polyester, S-twist and overwrapped with one end of singles spun or filament nylon or polyester, Z-twist.

3.5.3 Length and tipping (type II, lacing cord only). The lacing cord shall be 24 inches (± 1 inch) in length. The ends of the lacing cord shall be tipped with nylon sheets or film, or either tipped or impregnated with cellulose acetate or cellulose acetate butyrate to prevent raveling. The tipped or impregnated end shall be at least 1/2 inch in length.

3.6 Put-up.

3.6.1 Type I. Unless otherwise specified (see 6.2), the type I cord shall be put-up on flat head type spools, containing 144 ± 2 yards, with not more than three pieces per spool, and no one piece less than 10 yards in length. The cord shall be wound on the spools so that each turn and layer is free from entanglement.

3.6.2 Type II. Unless otherwise specified (see 6.2), one gross of type II lacing cords shall be grouped full length and securely tied together with cotton tape or twine.

3.7 Identification. Each spool of cord or gross of lacing cords shall have a ticket (identification tag) or label attached to it for identification purposes. The ticket shall conform to the requirements for type B, class 1, size 4 or 5 of UU-T-81. The ticket shall be made of not less than 15-point paper stock and shall have a minimum tearing resistance in both directions (total) of 850 grams when tested as specified in UU-T-81. When spool labels are used, the label shall be attached in such a manner as to remain in place and be clearly legible until all cord has been removed. All entries on the ticket or label shall be legibly printed, stamped, or typed with water insoluble ink. The ticket or label shall contain the following information:

Stock number
Nomenclature
Document number
Length
Contract number and date
Date of manufacture
Contractor's name

3.8 Workmanship. The end item shall conform to the quality of product established by this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein.

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Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Responsibility for dimensional requirements. Unless otherwise specified in the contract or purchase order, the contractor is responsible for ensuring that all specified dimensions have been met. When dimensions cannot be examined on the end item, inspection shall be made at any point, or at all points in the manufacturing process necessary to ensure compliance with all dimensional requirements.

4.1.3 Certificates of compliance. When certificates of compliance are submitted, the Government reserves the right to inspect such items to determine the validity of the certification.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.3).
- b. Quality conformance inspection (see 4.4).

4.3 First article inspection. When a first article is required (see 3.1 and 6.2), it shall be examined for the defects specified in 4.4.2 through 4.4.3.2 and tested as specified in 4.4.4 and table IV.

4.4 Quality conformance inspection. Unless otherwise specified, sampling for inspection shall be performed in accordance with MIL-STD-105.

4.4.1 Component and material inspection. In accordance with 4.1, components and materials shall be inspected in accordance with all the requirements of referenced documents unless otherwise excluded, amended, modified, or qualified in this specification or applicable purchase document.

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4.4.1.1 Component and material certification. A certificate of compliance may be acceptable as evidence that the characteristics listed in table II conform to the specified requirements.

TABLE II. Component tests

| Characteristic | Requirement paragraph | Test method |
|---------------------------|-----------------------|----------------|
| Nylon or polyester yarns: | | |
| Material | 3.3.1 | 1530 <u>1/</u> |
| Cover construction | 3.5.1 | -- |
| Core (singles type II) | 3.5.2.2 | -- |
| No. of yarns | 3.5.2.2 | Visual |
| Direction of twist | 3.5.2.2 | 4050 <u>1/</u> |
| Elastic strands: | | |
| Material | 3.3.2 | -- |
| Gage | Table I | 4.5.3 |

1/ Refers to test method of FED-STD-191.

4.4.2 End item examination of type I cord.

4.4.2.1 Yard-by-yard examination (type I). The end items shall be examined for the defects listed below. All defects found shall be counted regardless of their proximity to each other. A continuous defect shall be counted as one defect for each linear yard or fraction thereof in which it occurs. The lot size shall be expressed in yards. The sample unit shall be one linear yard. The inspection level shall be I and the acceptable quality level (AQL), expressed in terms of defects per hundred units, shall be 2.5. The number of spools from which the sample yardage is to be selected shall be in accordance with table III. The sample yardage shall be apportioned equally among the selected rolls.

Defects

Core not completely covered

Any cut or tear

Broken or missing end

Spot or stain clearly visible at normal inspection distance (approximately 3 feet)

Abrasion mark, resulting in a weak place

Unevenly braided resulting in open place, break in continuity of braid or soft spot

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TABLE III. Sample sizes

| Lot size (yards) | Sample size (spools) | Acceptance number |
|------------------------------------|-------------------------|-------------------|
| Up to 1,200 | 3 | 0 |
| 1,201 up to and including 3,200 | 5 | 0 |
| 3,201 up to and including 10,000 | 8 | 0 |
| 10,001 up to and including 35,000 | 13 | 0 |
| 35,001 up to and including 150,000 | 20 | 1 |
| 150,001 and over | 32 | 2 |

4.4.2.2 Overall examination (type I). The end items shall be examined for the defects listed below. Each defect listed shall be counted not more than once in each spool examined. The sample size shall be the applicable number of spools indicated in table III. Each spool in the sample shall be examined over its entire length. The lot shall be rejected if the total number of defects in the sample exceeds the applicable acceptance number specified in table III.

Defects

Mottled, or uneven color, when dyed

Not clean throughout

Improperly wound resulting in kinking, knotting, entangling or slippage during unwinding or otherwise affecting free unhampered unwinding of cord

4.4.2.3 Length examination (type I). During the overall examination, each spool in the sample shall be examined for the defects listed below. The cord shall be measured while in a completely relaxed state. If the total number of defects in the sample exceeds the applicable acceptance number specified in table III or if the total of the actual lengths of cord on the spools in the sample is less than the total of the lengths marked on the spool labels or tickets, the lot shall be rejected.

Defects

The total length of cord on any spool is less than or more than the length specified (including permitted tolerances)

Length of cord on spool more than 2 yards less than length marked on ticket

More than three pieces of cord per spool

Any piece of cord on spool less than 10 yards in length

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4.4.3 End item examination of type II cord.

4.4.3.1 End item visual examination (type II). The end items shall be examined for the defects listed below. The lot size shall be expressed in units of lacing cords. The sample unit shall be one lacing cord. The inspection level shall be II and the AQL, expressed in terms of defects per hundred units, shall be 4.0.

Defects

Mottled, or uneven color, when dyed.
 Core not completely covered.
 Any cut or tear.
 Broken or missing end.
 Spot or stain. 1/
 Abrasion mark, resulting in a weak place.
 Unevenly braided resulting in open place, break in continuity of braid or soft spot.

1/ Clearly visible at normal inspection distance (approximately 3 feet).

4.4.3.2 End item dimensional examination (type II). The lacing cords shall be examined for conformance to the dimensions for length and tipping as specified in 3.5.3. The evaluation of the length requirements shall be made on a completely relaxed cord. Any dimension not within the specified tolerance shall be classified as a defect. The lot size shall be expressed in units of lacing cords. The sample unit shall be one lacing cord. The inspection level shall be S-3 and the AQL, expressed in terms of defects per hundred units, shall be 4.0.

4.4.4 End item testing. The end items shall be tested for the characteristics listed in table IV. The methods of testing specified in FED-STD-191 wherever applicable and as listed in table IV shall be followed. All test reports shall contain the individual values utilized in expressing the final results. The lot size for type I shall be expressed in units of yards. The lot size for type II shall be expressed in units of lacing cords. The sample unit for type I shall be 7 yards. The sample unit for type II shall be 10 lacing cords. The lot shall be rejected if one or more sample units fail to meet any requirement specified. The sample size shall be in accordance with the following:

| <u>Lot size</u> | <u>Sample size (sample units)</u> |
|--------------------------------|-----------------------------------|
| 800 or less | 2 |
| 801 up to and including 22,000 | 3 |
| 22,001 and up | 5 |

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TABLE IV. End item tests

| Characteristic | Requirement paragraph | Test method | No. of determinations per individual sample unit | Results reported as |
|---------------------------------------|-----------------------|--------------------------|--|-------------------------|
| Color matching | 3.4.1 | Visual | 1 | Pass or fail |
| Colorfastness to: | | | | |
| Laundering | 3.4.2 | 5614 | - | Pass or fail |
| Crocking | 3.4.2 | 5651 | - | Pass or fail |
| Weathering | 3.4.2 | 5671 <u>1</u> / | - | Pass or fail |
| Diameter | Table I | Micrometer <u>2</u> / | 5 | To nearest 1/32 inch |
| Weight per linear yard | Table I | 5041 <u>3</u> / | - | - |
| Total number of elastic strands | Table I | Visual | 1 | Pass or fail |
| Number of carriers | Table I | Visual | 1 | Pass or fail |
| Ends per carrier | Table I | Visual | 1 | Pass or fail |
| Picks per inch | Table I | 4.5.1 | 5 | Nearest whole number |
| Elongation | Table I | 4.5.2 | 3 | Nearest 0.1 percent |
| Weave | 3.5.1 | Visual | 1 | Pass or fail |

1/ Time of exposure shall be 40 standard fading hours.

2/ The evaluation of the diameter requirements is based on a completely relaxed cord.

3/ Except that the test specimens for type II cord shall be completely fabricated lacing cords.

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4.4.5 Packaging inspection. The inspection shall be in accordance with the quality assurance provisions of MIL-C-3131 except that the inspection level shall be S-2 and the AQL, expressed in terms of defects per hundred units, shall be 2.5.

4.5 Methods of inspection.

4.5.1 Picks per inch. Picks per inch shall be counted visually with the cords so positioned that the repeat of the stitch pattern creates a straight line parallel to the axis of the cord.

4.5.2 Elongation. Cut a 14-inch specimen from a representative sample cord and make two marks on the cord so that a distance of 10 inches is between the gage marks. Suspend the cord from a clamp in such a manner as to allow a 4-pound weight to be hung on the lower end of a type I cord and a 2-pound weight to be hung on the lower end of a type II cord. Gradually lower the weight until the entire load is carried by the cord. After 2 minutes, take a measurement between the two marks and calculate the increase in length as follows:

$$\frac{B - A}{A} \times 100 = \text{percent elongation}$$

where

A = Initial measurements, and

B = Measurement of elongation at 4 pounds or 2 pounds, as applicable.

4.5.3 Gage of rubber. The gage of rubber (elastic strands) shall be determined by counting the actual number of strands, laid side by side, contained in 1 inch. The gage is equivalent to the actual number of rubber yarns contained in 1 inch. A measuring device that measures the gage of rubber yarns may be utilized providing results are comparable.

5. PACKAGING

5.1 Preservation. Preservation shall be level A or Commercial as specified (see 6.2).

5.1.1 Level A preservation.

5.1.1.1 Type I. The type I cord shall be packaged in accordance with the level A requirements of MIL-C-3131.

5.1.1.2 Type II. Five gross of the type II lacing cords shall be put-up in a compact bundle. Prior to bundling, the lacing cords shall be grouped full-length in one-gross lots and securely tied together. Each bundle of lacing cords shall be completely wrapped in 60-pound minimum basis weight kraft paper conforming to A-A-203. The wrap shall be securely sealed with 2-inch minimum width gummed paper tape conforming to type III, grade B of PPP-T-45. Alternative to the kraft paper wrap, each bundle shall be inserted in a snug-

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fitting clear polyethylene film bag of 0.0015-inch thickness (\pm 20 percent tolerance). The polyethylene bag shall be formed with heat-sealed seams that are straight, continuous, and parallel to each other and the formed edges of the bag. Closure of the bag shall be accomplished by means of a mechanical tie (e.g., paper or plastic covered soft steel wire, aluminum band). Prior to or during the closure operation, excess air within the bag shall be expelled.

5.1.2 Commercial. The type I or type II cord shall be preserved in accordance with ASTM D 3951.

5.2 Packing. Packing shall be level A, B, or Commercial as specified (see 6.2).

5.2.1 Level A packing. Cord, preserved as specified in 5.1, shall be packed in accordance with the applicable requirements of MIL-C-3131, except that the fiberboard shall be grade V2s material conforming to PPP-B-636. Shipping containers shall be arranged in unit loads in accordance with MIL-L-35078 for the type and class of load specified (see 6.2). Strapping shall be limited to nonmetallic strapping, except for type II, class F loads.

5.2.2 Level B packing. Cord, preserved as specified in 5.1, shall be packed in accordance with the applicable requirements of MIL-C-3131.

5.2.3 Commercial packing. Cord, preserved as specified in 5.1, shall be packed in accordance with ASTM D 3951.

5.3 Marking. In addition to any special marking required by the contract or purchase order, unit packs and shipping containers shall be marked in accordance with MIL-C-3131 or ASTM D 3951, as applicable. Polyethylene bagged unit packs may have the required information legibly printed or stamped in black on a white paper label inserted within the bag so as to permit ready identification.

6. NOTES

6.1 Intended use. The elastic cord is intended for use in miscellaneous equipment and armor applications.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Type required (see 1.2).
- c. Color when other than specified (see 3.4).
- d. When first article is required (see 3.1, 4.3, and 6.3).
- e. When put-up other than specified is required (see 3.6.1 and 3.6.2).
- f. Levels of preservation and packing (see 5.1 and 5.2).
- g. Type and class of unit load required (see 5.2.1).

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6.3 First article. When a first article is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209. The first article should be a preproduction sample. The contracting officer should specify the appropriate type of first article and the number of units to be furnished. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for selection, inspection, and approval of the first article.

6.4 Sample. For access to samples, address the contracting activity issuing the invitation for bids.

6.5 Government and supplier purchases. The requirements specified in 3.6 and 3.7 apply only to cord purchased directly by the Government. All other requirements apply to cord purchased by a supplier as a component for an end item and to cord purchased directly by the Government.

6.6 Subject term (key word listing).

Braid
General purpose
Lacing

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - GL
Air Force - 99
Navy - NU

Preparing activity:

Army - GL
(Project 8305-0336)

Review activities:

Army - MD
Air Force - 82
DLA - CT

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

| | | | |
|---|--|--|---|
| I RECOMMEND A CHANGE | | 1. DOCUMENT NUMBER MIL-C-43701B | 2. DOCUMENT DATE (YYMMDD) 1990 July 30 |
| 3. DOCUMENT TITLE CORD, ELASTIC, NYLON OR POLYESTER | | | |
| 4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.) | | | |
| 5. REASON FOR RECOMMENDATION | | | |
| <div style="background-color: black; height: 100px; width: 100%;"></div> | | | |
| <div style="background-color: black; height: 100px; width: 100%;"></div> | | <div style="background-color: black; height: 100px; width: 100%;"></div> | |
| 8. PREPARING ACTIVITY | | b TELEPHONE (Include Area Code) | |
| NAME U.S. Army Natick RD&E Center | | (1) Commercial 508-651-5221 | (2) AUTOVON 256-5221 |
| c ADDRESS (Include Zip Code) Commander, U.S. Army Natick RD&E Center ATTN: STRNC-ES Natick, MA 01760-5014 | | IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340 | |