

METRIC

DOD-S-63543
19 February 1982

MILITARY SPECIFICATION

STUD AND ROD, THREADED, METRIC,
GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers plain type studs (length up to 400 mm), and rods (length greater than 400 mm), which are headless externally threaded fasteners the entire length of which has the same nominal threaded diameter.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

- | | |
|------------|---|
| QQ-B-637 | - Brass, Naval, Rod, Wire, Shapes, Forgings, and Flat Products with Finished Edges (Bar, Flat Wire and Strip) |
| QQ-N-281 | - Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections |
| QQ-Z-325 | - Zinc Coating, Electrodeposited |
| QQ-P-416 | - Plating, Cadmium (Electrodeposited) |
| PPP-H-1581 | - Hardware (Fasteners and Related Items), Packaging and Packing for Shipment and Storage of |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Armament Research and Development Command, ATTN: DRDAR-TST-S, Dover, NJ 07801, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 5307

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- DOD-S-63543/1 - Stud, Plain, Metric (1.25 Dia. and 2 Dia. Engagement)
- DOD-S-63543/2 - Rod, Continuous Thread, Metric
- DOD-S-63543/3 - Stud, Continuous Thread, Metric
- MIL-F-495 - Finish, Chemical, Black, for Copper Alloys
- MIL-I-6866 - Inspection, Penetrant Method of
- MIL-I-6868 - Inspection Process, Magnetic Particle
- MIL-H-6875 - Heat Treatment of Steels (Aircraft Practice), Process for

STANDARDS

FEDERAL

- FED-STD-66 - Steel, Chemical Composition and Hardenability
- FED-STD-151 - Metals, Test Methods
- FED-STD-H28/21 - Screw-Thread Standards for Federal Services. Section 21 Metric Screw Threads

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- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-1312 - Fasteners, Test Methods

(Copies of specifications, standards, handbooks, drawings and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DOD adopted shall be the issue listed in the current DODISS and the supplement thereto, if applicable.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI B 46.1 - Surface Texture

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

AEROSPACE MATERIAL SPECIFICATIONS (AMS)

- AMS 6322 - Steel, Bars, Forgings and Rings
- AMS 7456 - Studs, Steel, Low-Alloy, Heat Treat, Rolled Threaded

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(Application for copies should be addressed to the Society of Automotive Engineers, Inc. Two Pennsylvania Plaza, New York, NY 10001.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM E 10 - Metallic Materials, Method of Test for Brinell Hardness of
- ASTM A 380 - Cleaning and Descaling Stainless Steel Parts, Equipment and Systems

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

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between requirements of the specification and the specification sheet, the latter shall govern.

3.2 Material. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all material, and articles incorporated in the work covered by this specification shall be new and fabricated using materials produced from recovered materials, consistent with mechanical properties specified in 3.7, to the maximum extent possible without jeopardizing the intended end use of the item. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specified.

3.2.1 Studs. Unless otherwise stated, studs shall be made from materials specified herein (see 3.2.1.1) and shall meet the mechanical properties specified in 3.7.

3.2.1.1 Composition. The composition of the studs, as specified, shall conform to the requirements of table 1.

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3.2.1.2 Treatment and finish.

3.2.1.2.1 Heat treatment. Studs requiring heat treatment shall be processed in accordance with MIL-H-6875 to develop the mechanical properties specified.

3.2.1.2.2 Protective plating and surface treatment. Studs shall be furnished with a protective plating or surface treatment as specified in table 1.

3.2.1.2.3 Black chemical finish. Unless otherwise specified, brass studs shall be completely coated with a black chemical finish conforming to table 1.

3.2.1.2.4 Cleaning and descaling. Unless otherwise specified, corrosion-resistant steel studs shall be cleaned and descaled in accordance with table 1.

TABLE 1. Material composition, treatment and finish requirements.

Material	Applicable document	Protective finish	Applicable document
Alloy steel	FED-STD-66, Composition 8740	Cadmium plate or Zinc plate (see 3.1)	QQ-P-416, Type II, Class 2 (7.6 μm thick) or QQ-Z-325, Type II, Class 2 (13 μm thick)
Carbon steel	FED-STD-66, Composition; 1109,1110, 1116,1117,1118,1119,1132, 1137,1139,1140,1141,1144, 1145,1146,1151,1211,1212, 1213, and 1215.		
Corrosion-resistant steel	FED-STD-66, Stainless and heat-resisting steels, composition 302 or 316	Cleaning and Descaling	ASTM A 380
Brass	QQ-B-637, Copper alloy No. 464	Black chemical finish	MIL-F-495
Nickel-copper alloy	QQ-N-281, Class B, cold drawn	None	None

3.3 Design, dimensions and tolerances. Design, dimensions and tolerances shall conform to the requirements of the applicable specification sheet, and shall apply after application of the protective finish or surface treatment.

3.4 Threads. Threads shall be in accordance with FED-STD-H28/21 "M" or "MJ" profile and toleranced in the applicable specification sheet. Unless otherwise specified, all threads shall be right-hand (see 6.2).

3.4.1 Thread forming. Threads shall be fully formed after heat treatment and prior to application of protective finish by either machining, grinding or rolling (preferred). Thread rolling per AMS 7456 shall be used on studs requiring material conforming to alloy steel, composition 8740 per FED-STD-66.

3.4.2 Incomplete threads. The runout threads shall be faired into the shank within a minimum of one, and a maximum of two pitches without an abrupt change in cross sectional area. Lead threads may deviate from true form, but shall be smooth and free of tool marks.

3.4.3 Grain flow. The grain flow in rolled threads shall be continuous and shall follow the general thread contour with maximum density at the bottom of the root radius as shown in figure 1.

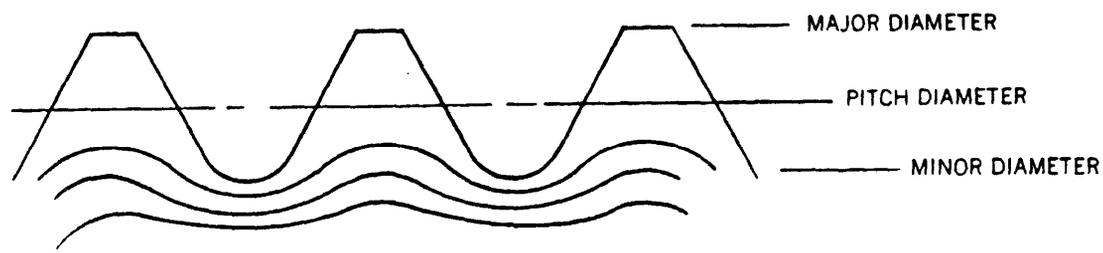


FIGURE 1. Thread grain flow.

3.5 Surface roughness. The surface roughness, prior to plating, shall not exceed the values stated in the applicable specification sheet and shall be in accordance with ANSI B 46.1.

3.6 Straightness. The straightness of the stud shall be with the value obtained by $BT/5D$, when tested in accordance with 4.5.1.2 (where B is the nominal length, D is the nominal diameter and T is the pitch diameter tolerance of the thread).

3.7 Mechanical properties. Studs conforming to the design and dimensions specified, in the applicable specification sheet, shall be capable of developing for a load rating the appropriate minimum ultimate tensile strength.

3.7.1 Tensile strength. Studs made of material conforming to 3.2 shall develop not less than the minimum tensile load requirements specified in tables II and III when tested as specified in 4.5.2.

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TABLE II. Mechanical properties (Metric coarse threads). *

Thread diameter nominal mm	Thread pitch mm	Stress area nominal mm ²	Material				
			Copper alloy No.464 MPa=358	Nickel-copper alloy MPa=482	Carbon steel MPa=355	Corrosion resistant steel MPa=579	Alloy steel MPa=896
Minimum ultimate tensile strength (kilonewtons) kN = Area X MPa							
2	0.4	2.07	.7	1.0	.7	1.2	1.9
2.5	0.45	3.39	1.2	1.6	1.2	2.0	3.0
3	0.5	5.03	1.8	2.4	1.8	2.9	4.5
4	0.7	8.78	3.1	4.2	3.1	5	8
5	0.8	14.2	5	7	5	8	13
6	1	20.1	7	10	7	12	18
8	1.25	36.6	13	18	13	21	33
10	1.5	58.0	21	28	21	34	52
12	1.75	84.3	30	41	30	49	76
16	2	157	56	76	56	91	141
20	2.5	245	88	118	87	142	220
24	3	353	126	170	125	204	316
30	3.5	561	201	270	199	325	503
36	4	817	292	394	290	473	732
42	4.5	1121	401	540	398	649	1004
48	5	1473	527	710	523	853	1320
56	5.5	2030	727	978	721	1175	1819
64	6	2676	958	1290	950	1549	2398

TABLE III. Mechanical properties (Metric fine threads). *

Thread diameter nominal mm	Thread pitch mm	Stress area nominal mm ²	Material				
			Copper alloy No.464 MPa=358	Nickel-copper alloy MPa=482	Carbon steel MPa=355	Corrosion resistant steel MPa=579	Alloy steel MPa=896
			Minimum ultimate tensile strength (kilonewtons) kN = Area X MPa				
8	1	39.2	14	19	14	23	35
10	1.25	61.2	22	29	22	35	55
12	1.25	92.1	33	44	33	53	83
16	1.5	167	60	80	59	97	150
20	1.5	272	97	131	97	157	244
24	2	384	137	185	136	222	344
30	2	621	222	299	220	360	556
36	2	914	327	441	324	529	819
42	2	1264	453	609	449	732	1133
48	2	1671	598	805	593	968	1497
56	2	2301	824	1109	817	1332	2062
64	2	3031	1085	1461	1076	1755	2716

*The words "coarse" and "fine" are given in order to conform to usage. No concept of quality shall be associated with these words. Coarse pitches only indicate the largest metric pitches used in current practice.

3.7.2 Hardness. Studs shall have a hardness range as specified in the applicable specification sheet when tested as required in 4.5.3.

3.8 Metallurgical properties.

3.8.1 Discontinuities. Studs, when inspected as specified in 4.5.5, shall not contain discontinuities which exceed the following limitations:

3.8.1.1 Cracks. Studs shall be free of cracks in any direction or location.

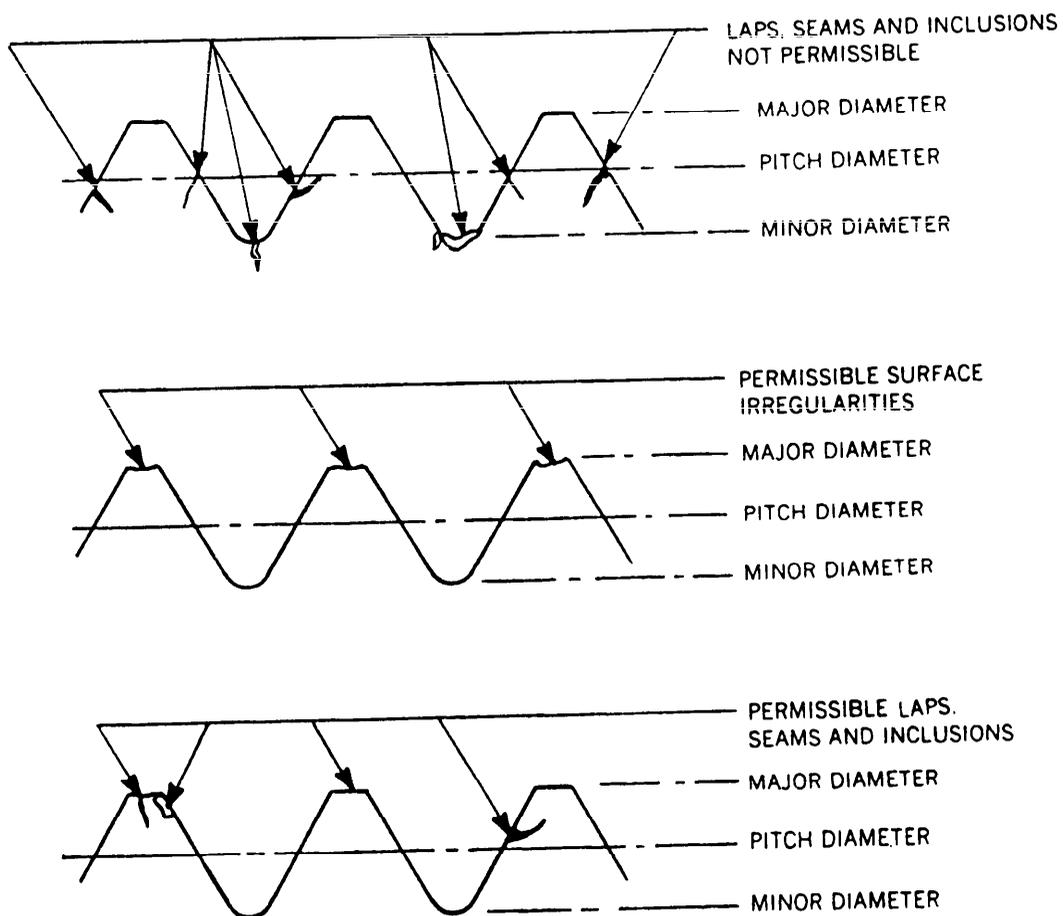
3.8.1.2 Laps and seams. Studs may possess laps and seams, except in locations as shown in figure 2. Permissible laps and seams as shown in figure 2 shall not exceed the depths specified in table IV.

TABLE IV. Maximum discontinuity depth. 1/

Thread size	Below M4	M4 to M8	Above M8
Maximum depth in mm	.06	.13	.20

1/ Depth of discontinuity shall be measured normal to the surface at a point of greatest penetration.

3.8.1.3 Inclusions. Studs shall show no evidence of surface or subsurface inclusions at the thread root as shown in figure 2 when examined as specified in 4.5.5.

FIGURE 2. Laps, seams and surface thread.

3.8.2 Grinding burns. The studs shall show no evidence of grinding burns.

3.9 Workmanship. Workmanship shall be consistent with the type of product; finish and class of thread fit specified. Studs shall be of uniform quality and free from defects which would be detrimental to the performance of the stud.

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 as specified herein. 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 the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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

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

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that materials used in fabricating studs are in accordance with 3.2, 3.2.1.2.2, and 3.7.

4.3.1 Protective finish. Sample studs shall be inspected for minimum thickness and continuity of the finish in accordance with the applicable specification (see table I).

4.4 Quality conformance inspection. Quality conformance inspection shall be as specified in table V.

TABLE V. Quality conformance inspection.

Inspection	Requirement paragraph	Test method paragraph
Heat treatment	3.2.1.2.1	4.5.2
Dimensions	3.3	4.5.1.3
Thread requirements	3.4	4.5.1.1, 4.5.6
Surface roughness	3.5	4.5.1.3
Straightness	3.6	4.5.1.2
Mechanical properties	3.7	4.5.2, 4.5.3
Metallurgical properties	3.8	4.5.4, 4.5.5

4.4.1 Inspection lot. An inspection lot shall consist of all studs covered by a single specification sheet produced under essentially the same conditions and offered for inspection at one time.

4.4.2 Sampling for visual and dimensional examination. Sampling for visual and dimensional examination shall be in accordance with MIL-STD-105, inspection level II with an acceptable quality level (AQL) of 1.5 percent defective for major defects. For total defects (major plus minor defects), inspection level I with an AQL of 4.0 percent defective shall apply.

4.4.2.1 Classification of defects. Defects shall be classified as specified in table VI.

4.4.3 Sampling for tests. Samples for tests shall be selected from lots which have been visually and dimensionally examined and accepted. Sampling shall be in accordance with MIL-STD-105, inspection level S-2 with an AQL of 1.5 percent defective.

4.4.3.1 Disposition of sample units. Studs which have been subjected to tests which may compromise its intended use shall not be delivered on the contract.

4.4.4 Packaging inspection. The sampling and inspection of the preservation-packaging, packing, and container marking shall be in accordance with PPP-H-1581.

4.5 Methods of inspection.

4.5.1 Visual and dimensional examination. Samples taken as specified in 4.4.2 shall be thoroughly examined to determine conformance with this specification and applicable specification sheet. Examination shall be conducted in accordance with table VI.

TABLE VI. Classification of defects.

Category	Defect	Inspection method
<u>Major</u>		
101	Surface finish plating, not as specified (3.2.1.2.2), (3.2.1.2.3), (3.2.1.2.4)	Visual
102	Unthreaded diameter, not as specified (3.3).	SIE <u>1/</u>
103	Thread size and form, not as specified (3.4).	SIE
104	Thread length, not as specified (3.4).	SIE
105	Incomplete threads (3.4.2).	SIE
106	Thread formed by rolling process (3.4.1 and 3.4.3).	Macroexamination
107	Surface roughness, not as specified (3.5).	SIE
108	Straightness of stud, not as specified (3.6).	SIE
<u>Minor</u>		
201	Overall length, not as specified (3.3).	SIE
202	Chamfer on thread ends, not as specified (3.4).	SIE
203	Burrs, tool marks, and grinding burns (3.8.2, 3.9).	Visual

1/ Standard inspection equipment.

4.5.1.1 Threads. Threads shall be inspected for thread form per M or MJ profile, and Handbook H-28, section 21, metric screw threads.

4.5.1.2 Straightness. Straightness of the stud shall be checked when rolled on a surface and the maximum clearance measured with a feeler gage and shall not exceed the values obtained using the formula specified in 3.6.

4.5.1.3 Finish, dimensions and surface roughness. Finish, dimensions and surface roughness shall be checked visually and by standard inspection equipment.

4.5.2 Mechanical properties. Studs, selected as specified in 4.4.3, shall be tested in accordance with the applicable requirements of 3.7 and tables II and III by test no. 8 of MIL-STD-1312 in tension. Samples shall be of sufficient length to develop the full strength of the stud without stripping the thread. Studs of insufficient length for tensile tests shall be accepted on the basis of hardness tests (see 4.5.3).

4.5.3 Hardness test. Samples of studs, taken in accordance with 4.4.3, shall be tested for hardness requirements of 3.7.2. The test procedure shall be test no. 6 of MIL-STD-1312 for alloy steel and ASTM E 10 for corrosion resistant steel.

4.5.4 Chemical analysis. The sample stud, taken in accordance with 4.4.3, shall be tested for the composition requirement of 3.2.1.1. The test procedure shall be by method 111.2 or 112.2 of FED-STD-151.

4.5.5 Discontinuities. To determine the presence of cracks and discontinuities, such as laps, seams, and inclusions, the sample stud, taken in accordance with 4.4.3, shall be inspected in accordance with MIL-I-6866, for alloy and carbon steels. Penetrant particle inspection, as specified in MIL-I-6866, shall be used for corrosion-resisting steel and brass.

4.5.6 Grain flow. Thread grain flow as shown in figure 1 shall be determined by macroexamination of studs whose ends are designated "stud-end" and "nut-end". Specimens, taken in accordance with 4.4.3, shall be sectioned as shown in figure 3. The specimen shall be etched in an aqueous solution containing 50 percent (by volume) of commercial hydrochloric acid at 71° to 82°C for sufficient time to reveal the macrostructure properly.

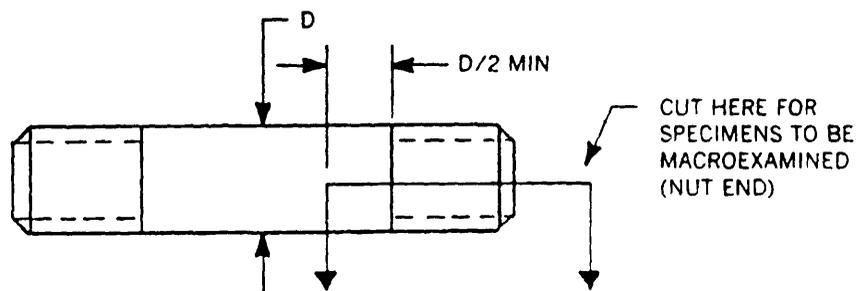


FIGURE 3. Metallurgical specimen.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging, packing and container marking shall be in accordance with PPP-H-1581.

6. NOTES

6.1 Intended use. Studs and rods covered by this specification are intended for use as a general purpose fastener, with application requirements determining stud and rod material type.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number and date of this specification and the applicable specification sheet.
- b. Applicable specification sheet part number (see 3.1).
- c. Tensile test, if required (see 4.5.2).

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- d. Hardness test, if required (see 4.5.3).
- e. Chemical analysis, if required (see 4.5.4).
- f. Discontinuity test, if required (see 4.5.5).
- g. Grain flow test, if required (see 4.5.6).
- h. Level (degree) of protection, in accordance with PPP-H-1581, ordering data (see 5.1).
- i. Left-hand threads, if required (see 3.4).

6.3 Definitions.

6.3.1 Terms. In this specification, when reference is made to "studs", it shall be understood to mean "studs and rods", if applicable.

Custodians:

Army - AR
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(Project 5307-0262)

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DOD-S-63543 STUD AND ROD, THREADED, METRIC GENERAL SPECIFICATION FOR

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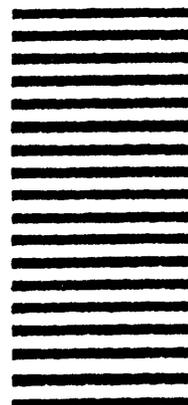
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