

**Connections for Fluid Power and High Pressure Use – Ports, Stud Ends, and Plugs with  
ISO 261 Threads and O-Ring Sealing—Part 2: Stud End Requirements, Dimensions,  
Design, and Test Methods**

**Foreword**—This part defines requirements, dimensions, design and test methods for eight metric stud ends for the **port connection system for hydraulic applications**.

In fluid power systems, power is transmitted and controlled through a fluid (liquid or gas) under pressure within an enclosed circuit. In general applications, a fluid may be conveyed under pressure. Components are connected through their threaded ports by stud ends on fluid connectors to tubes or to hose fittings and hoses. Test procedures for metric **ports, stud ends (connectors) and plugs** are in accordance with SAE J1644 and may be used at working pressures shown in Table 1.

## 1. Scope

- 1.1 Purpose**—This part of SAE J2337 specifies dimensions, design, and performance requirements for eight connectors using a conical seal to insure leak proof performance with a design factor of 4 to 1.
- 1.2 Field of Application**—These connectors are intended for general and hydraulic systems on industrial equipment and commercial products, where elastomeric seals are acceptable to overcome leakage and variations in assembly procedures. These connectors are capable of providing leak proof full flow connections in hydraulic systems operating from 95 kPa vacuum to the working pressures shown in Table 1. Since many factors influence the pressure at which hydraulic systems will or will not perform satisfactorily, these values should not be construed as guaranteed minimums. For any application, it is recommended that sufficient testing be conducted and reviewed by both the user and manufacturer to ensure that the required performance levels are met.

**CAUTION**—For use of these connectors in conditions outside the pressure and temperature limits specified, contact the manufacturer.

## 2. References

- 2.1 Applicable Publications**—The following standards contain information, which through reference in this text, constitute provisions of this document. All standards are subject to revision, and parties to agreements based on this document shall apply the most recent of the standards. Members of IEC and ISO maintain registers of currently valid International Standards. Unless otherwise indicated, the latest version of SAE publications shall apply.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright ©2002 Society of Automotive Engineers, Inc.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER:

Tel: 877-606-7323 (inside USA and Canada)  
Tel: 724-776-4970 (outside USA)  
Fax: 724-776-0790  
Email: [custsvc@sae.org](mailto:custsvc@sae.org)  
<http://www.sae.org>

SAE WEB ADDRESS:

SAE J2337-2 Issued OCT2002

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J515—Hydraulic O-Rings  
SAE J1644—Metallic Tube Connections for Fluid Power and General Use—Test Plan Methods for Threaded Fluid Power Connections  
SAE AS568A—Aerospace Size Standard for O-Rings

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor, West Conshohocken, PA 19428-2959.

ASTM B 117—Method of Salt Spray (Fog) Test

2.1.3 ISO PUBLICATIONS—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ISO 261—ISO general-purpose metric screw threads—General plan  
ISO 3601—Fluid Systems—O-rings—Part 1  
ISO 4759-1—Tolerances for fasteners – Part 1: Bolts, Screws, Nuts with threaded diameters between 1.6 (inclusive) and 150 mm (inclusive) and product grades A, B, and C  
ISO 5598—Fluid Power Systems and Components—Vocabulary  
ISO 9927—Corrosion tests in artificial atmospheres—Salt spray

**2.2 Related Publications**—The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J343—Test and Test Procedures for SAE 100R Series Hydraulic Hose and Hose Assemblies  
SAE J517—Hydraulic Hose (Types 100R1 through 100R17)  
SAE J1065—Pressure Ratings for Hydraulic Tubing and Fittings  
SAE J1176—External Leakage Classifications for Hydraulic Systems  
SAE J2337-1—Connections for Fluid Power and High Pressure Use—Ports, Stud Ends, and Plugs with ISO 261 Threads and O-Ring Sealing—Part 1: Ports—Requirements, Dimensions, Design, and Test Methods  
SAE J2337-3—Connections for Fluid Power and High Pressure Use—Ports, Stud Ends, and Plugs with ISO 261 Threads and O-Ring Sealing—Part 3: Port Plug – Requirements, Dimensions, Design, and Test Methods  
SAE J2435—Welded Flash Controlled, SAE 1021 Carbon Steel for Bending and Flaring  
SAE J2467—Welded and Cold-Drawn, SAE 1021 Carbon Steel for Bending and Flaring

2.2.2 ISO PUBLICATIONS—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ISO 1302—Technical drawings—Method of indicating surface texture on drawings  
ISO 2944—Fluid power systems and components—Nominal pressures  
ISO 3304—Plain end seamless precision steel tubes—Technical conditions for delivery  
ISO 3305—Plain end welded precision steel tubes—Technical conditions for delivery  
ISO 3448—Industrial liquid lubricants—ISO viscosity classifications  
ISO 10763—Hydraulic fluid power—Plain-end, seamless, and welded steel tubes—Dimensions and nominal working pressures

2.2.3 ASME PUBLICATIONS—Available from The American Society of Mechanical Engineers, 345 East 47th, New York, NY 10017.

ASME B46.1—Surface Texture (Surface Roughness, Waviness, and Lay)

2.2.4 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor, West Conshohocken, PA 19428-2959.

ASTM B 633—Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

3. **Definitions**—For the purpose of this document, the definitions given in ISO 5598 and the following shall apply:

3.1 **Fluid Power**—(From ISO 5598) Means by which energy is transmitted, controlled, and distributed using a pressurized fluid as the medium.

3.2 **Connector**—(From ISO 5598) Leak proof device to connect pipelines (conductors) to one another, or to equipment.

4. **Requirements**

4.1 **Material**

4.1.1 **STUD ENDS**—Stud ends shall be manufactured from carbon steel that will exceed the minimum pressure/temperature requirements specified in Table 1 and 4.1.2.

**CAUTION**—For materials other than steel, contact the manufacturer.

4.1.2 **TEMPERATURE**—Carbon steel connectors shall meet the working pressures when used at temperatures between -40 °C and +125 °C. For temperatures outside these ranges, the manufacturer shall be consulted.

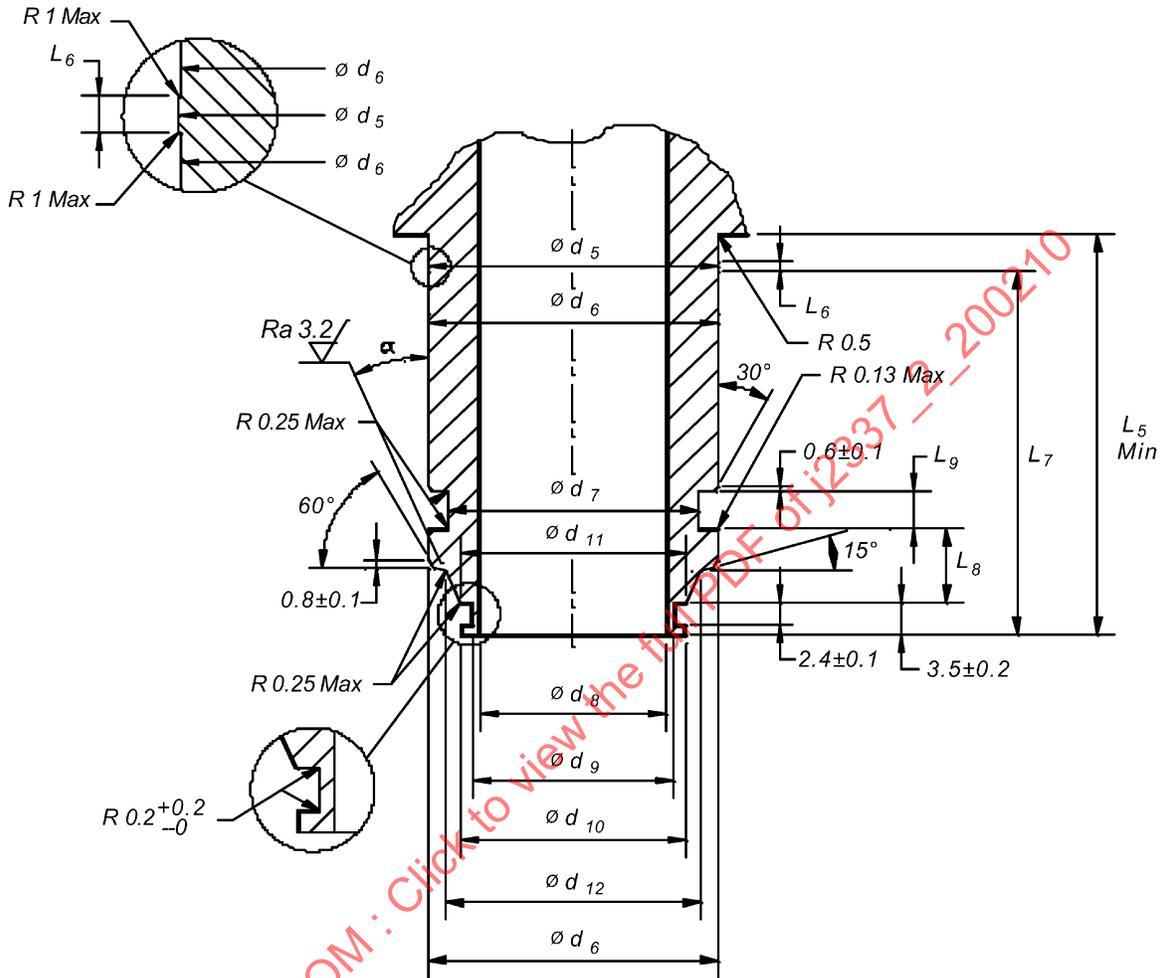
TABLE 1—PERFORMANCE REQUIREMENT

Nom Tube OD mm	Inch Nom Tube Dash Size	d Thread Size	Working Pressure MPa	Proof Pressure MPa	Burst Pressure MPa	Impulse Pressure MPa	Qualification Test	
							Torque N·m +10%	Torque N·m -0%
6	-4	M14 X 1.5	80	160	320	106	24	35
10	-6	M18 X 1.5	80	160	320	106	34	51
12	-8	M22 X 1.5	80	160	320	106	70	105
16	-10	M27 X 2	80	160	320	106	120	180
20	-12	M30 X 2	63	126	252	84	182	273
25	-16	M39 X 2	63	126	252	84	275	413
30	-20	M45 X 2	50	100	200	67	320	480
38	-24	M50 X 2	40	80	160	53	400	600

4.2 **Design**—See Figures 1 and 2 and Table 2 for Dimensions.



**Enlarged View A**



**Enlarged View B**

FIGURE 2—DESIGN FOR LARGE BODY M39 THROUGH M50 INCLUSIVE

**TABLE 2—BODY DIMENSIONS**  
All dimensions in mm

Nom Tube OD mm	Inch Nom Tube Dash Size	d Thread Class 6g (1)	d <sub>5</sub>	d <sub>6</sub>	d <sub>7</sub> (2)	d <sub>8</sub>	d <sub>8</sub>	d <sub>9</sub>	d <sub>10</sub>	d <sub>11</sub>	d <sub>12</sub>	L <sub>5</sub>	L <sub>6</sub>	L <sub>7</sub>	L <sub>8</sub>	L <sub>9</sub> (2)	Angle
			+0 -0.1	+0 -0.1	+0 -0.1	Drill Nom	Drill TOL	±0.05	±0.15	±0.05	±0.1	MIN	±0.3	±0.2	±0.15	+0.1 -0	∞° +0 -0.5
6	-4	M14 X 1.5	9.8	9.65	7.85	4.3	±0.1	5.9	8	8.5	—	30.5	3.5	25.7	4.5	2.1	21
10	-6	M18 X 1.5	13.1	12.95	10.75	6.7	±0.2	8.9	11	11.5	—	31.5	3.5	26.5	4.5	2.1	21
12	-8	M22 X 1.5	16.9	16.75	14.1	9.6	±0.2	12.9	15	15.5	—	34	3.5	30.1	4.5	2.9	21
16	-10	M27 X 2	21.1	20.95	18.2	12.3	±0.2	15.4	17.5	18	—	41	3.5	37	7.5	2.9	21
20	-12	M30 X 2	24.05	23.9	20.35	15.5	±0.2	17.9	20	20.5	—	44	4	38.5	8	4.1	25
25	-16	M39 X 2	31.85	31.7	27.5	20.6	+0.2	22.4	24.5	25	28.1	44	4	38.5	8.2	4.1	25
30	-20	M45 X 2	38.65	38.45	34.55	26.8	+0.3	28.4	30.5	31	34.95	48	5	41.3	10.2	4.1	25
38	-24	M50 X 2	44.05	43.85	39.9	32.0	+0.3	35.4	37.5	38	41.55	48	5	42	10.2	4.1	25

1. In accordance with ISO 261.
2. May be different with another method of nut attachment.

SAENORM.COM : Click to view the full PDF of J2337-2-2002

### 4.3 Manufacturing

- 4.3.1 **GENERAL WORKMANSHIP**—Workmanship shall conform to the best commercial practice to produce high quality stud ends. Stud ends shall be free from visual contaminants, all hanging burrs, loose scale, and slivers which might be dislodged in use and any other defects that might affect the function of the stud ends.
- 4.3.2 **SURFACE FINISH**—Unless otherwise specified, surface finish on all machined surfaces shall be  $R_a < 6.3 \mu\text{m}$  or  $R_a < 3.2 \mu\text{m}$  in all seal grooves.
- 4.3.3 **PLATING**—The external surfaces and threads of all carbon steel connectors shall be plated or coated with a suitable material that passes 72 h salt spray test in accordance with ASTM B 117 (ISO 9927). Any appearance of red rust during the 72 h salt spray test shall be considered failure.

**NOTE**— Cadmium plating is not allowed due to environmental reasons.

- 4.3.4 **EXCEPTIONS**—The following exceptions to the plating requirements apply:

Corrosion protection requirements do not apply to the corners or edges such as hex points, serrations, and the crest of threads.

### 5. Test Methods and Quality Procedures

- 5.1 **Test Procedures**—Test procedures shall be in accordance with SAE J1644.
- 5.2 **Test Frequency**—Qualification testing shall be required when there is a change in design, material, or processing.
- 5.3 **Required Tests and Sample Size**—The required sample size is 2 vacuum, 3 proof, 3 burst, 6 impulse, and 3 over torque in accordance with Table 1 and reported on form from SAE J1644.

### 6. Dimensions

- 6.1 **Stud Ends**—Stud ends shall conform to the dimensions shown in Figures 1 and 2 and Table 2, except as noted.
- 6.2 **Screw Threads**—The screw threads on the nuts shall be metric threads to ISO-261.
- 6.3 **Hex Tolerances Across Flats**—Hex Tolerances across flats shall be according to ISO 4759-1 product grade C. Minimum across corner dimensions are 1.092 times the nominal width across flats. The minimum side flat is 0.43 times the nominal width across flats. See Figure 3.
- 6.4 **Hex Chamfers**—Unless otherwise specified or shown, hex corners are chamfered 15 to 30 degrees to a diameter equal to the width across flats, with a tolerance  $+0.0 \text{ mm} -0.4 \text{ mm}$ .
- 6.5 **Hex Tolerances**—Tolerances for across flats shall be  $+0 -0.3$  up to 19 mm,  $+0 -0.4$  24 mm to 32 mm, and  $+0 -0.6$  41 mm to 52 mm.
- 6.6 **Nut**—The nut shall conform to the dimensions shown in Figure 4 and Table 3, except as noted. One of the ring options is shown in Figure 5 and Table 4. Manufactures may use their own ring and groove design, but must meet the performance requirements of Table 1.
- 6.7 **Marking of Nuts**—Nuts shall be permanently marked with manufacturers name or trademark. A Code identifier, as agreed upon between purchaser and manufacturer, may be used instead of the manufacturers name or trademark.

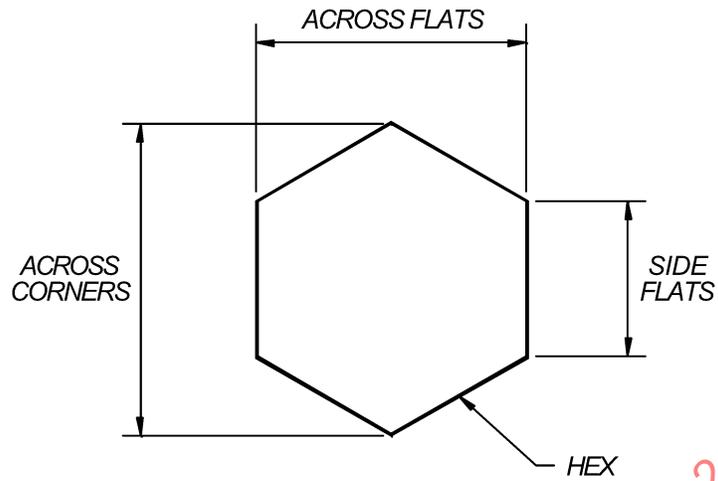


FIGURE 3—HEX DETAILS

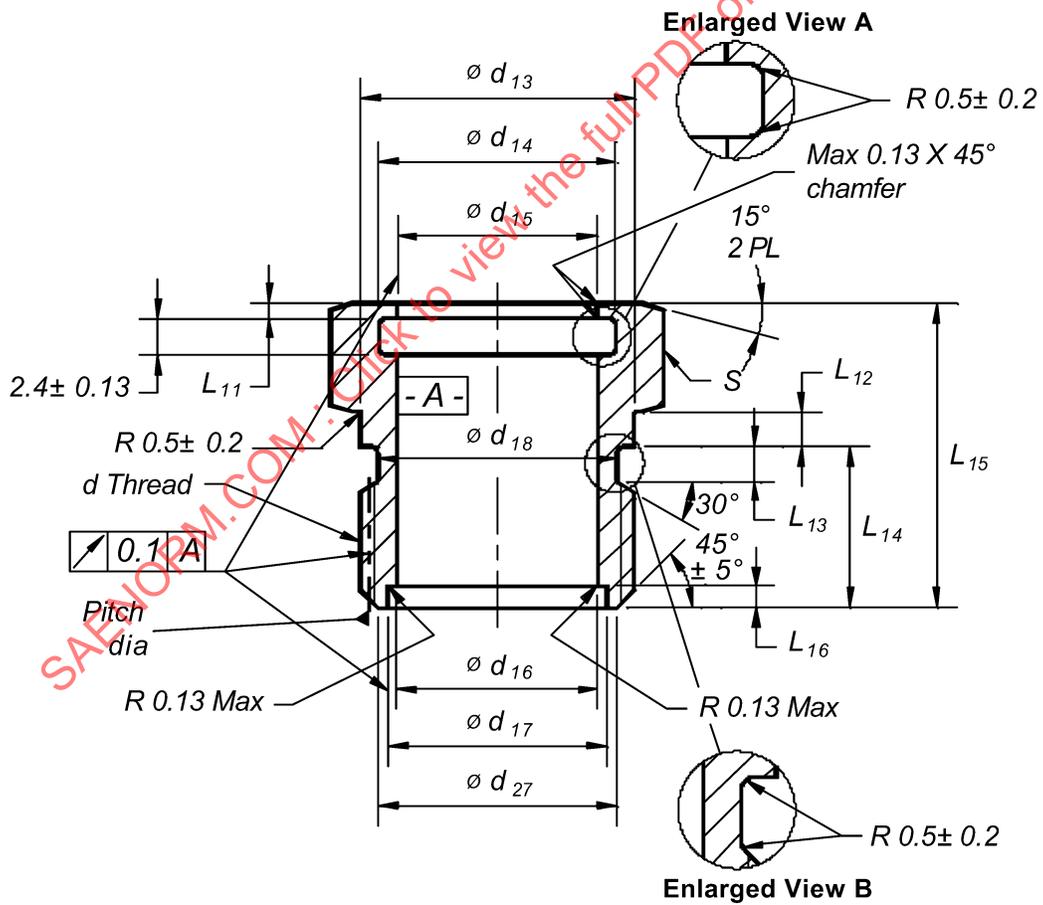


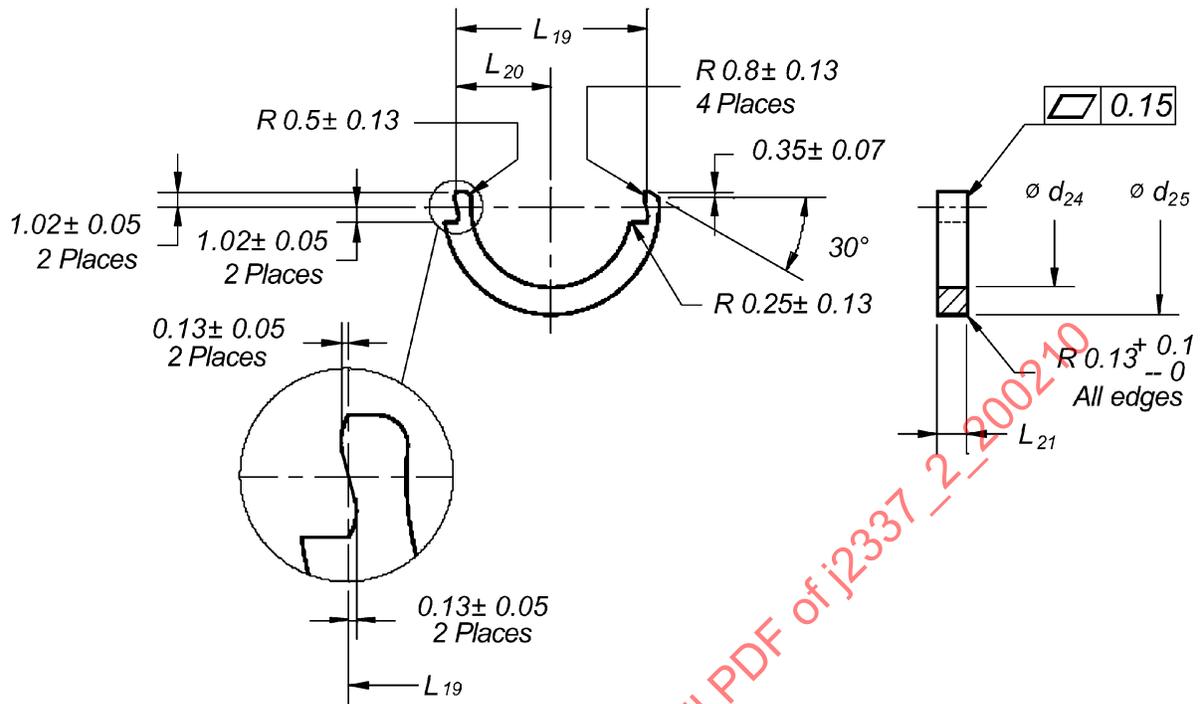
FIGURE 4—NUT

**TABLE 3—NUT DIMENSIONS**  
All dimensions in mm

Nom Tube OD mm	Inch Nom Tube Dash Size	d Thread Class 6g ( <sup>1</sup> )	S Hex	d <sub>13</sub> ±0.1	d <sub>14</sub> ±0.05	d <sub>15</sub> +0.05 -0	d <sub>16</sub> ±0.05	d <sub>17</sub> ( <sup>2</sup> ) +0.1 -0	d <sub>18</sub> +0 -0.1	d <sub>27</sub> ±0.15	L <sub>11</sub> ±0.2	L <sub>12</sub> ±0.2	L <sub>13</sub> ±0.1	L <sub>14</sub> ±0.1	L <sub>15</sub> ±0.2	L <sub>16</sub> ( <sup>2</sup> ) ±0.1
10	-6	M18 X 1.5	19	18	15.6	13.12	13.2	14.4	15.7	15.6	1	2.3	3.7	9.2	20	1.4
12	-8	M22 X 1.5	24	22	19.35	16.92	17	19.4	19.7	19.8	1	2.3	3.7	11.1	22	0.8
16	-10	M27 X 2	28	27.5	23.57	21.12	21.25	23.55	24	24	1	3	4	13.2	26	0.8
20	-12	M30 X 2	32	30.5	26.54	24.07	24.2	26.4	27	27	1.5	3	4	12	26.7	1.3
25	-16	M39 X 2	41	39.5	34.3	31.87	32	34.55	36	36	1.5	3	4	12.1	26.8	1.3
30	-20	M45 X 2	46	45.5	41.05	38.67	38.85	41.25	42	42	2.5	3	4	13.8	28.5	1.3
38	-24	M50 X 2	52	50.5	46.43	44.07	44.25	46.75	47	47	2.5	3	4	14.3	29.3	1.6

1. In accordance with ISO 261.
2. May be different with another method of nut attachment.

SAENORM.COM : Click to view the full PDF of J2337-2 (2002)



Enlarged View

**SPLIT RETAINING RING <sup>1)</sup>**

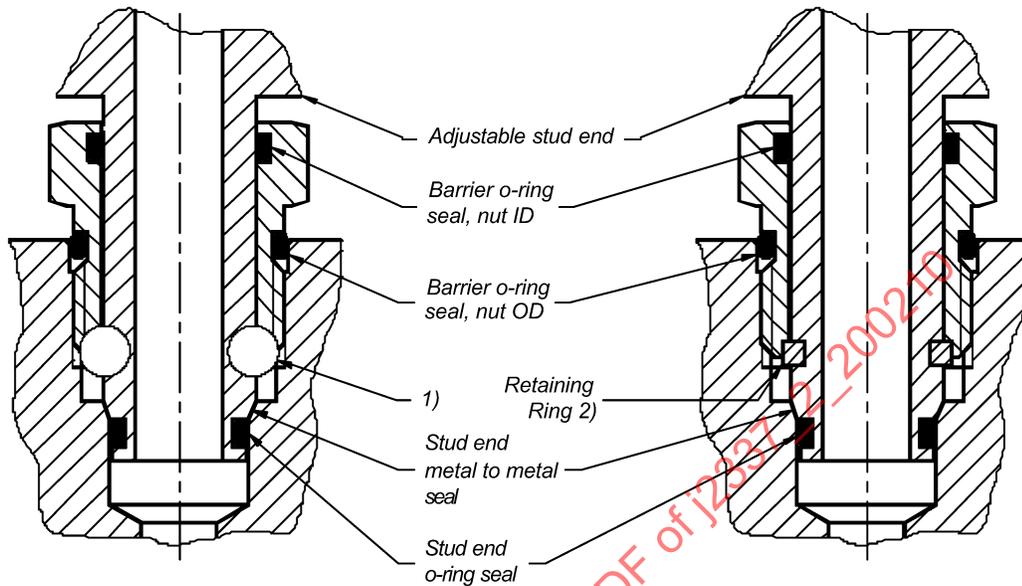
- 1) Retaining ring design depends on the method of attachment by the manufacturer. The design shown here is one of the options.

FIGURE 5—RETAINING RINGS

**TABLE 4—RETAINING RING DIMENSIONS**  
All dimensions in mm

Nom Tube OD mm	Nom Tube Dash Size	d Thread Ref	d <sub>24</sub> +0.1 -0	d <sub>25</sub> +0 -0.13	L <sub>19</sub> ±0.07	L <sub>20</sub> ±0.03	L <sub>21</sub> ±0.05
6	-4	M14 X 1.5	8	11.45	9.7	4.85	2
10	-6	M18 X 1.5	10.9	14.35	12.6	6.3	2
12	-8	M22 X 1.5	14.25	19.35	16.8	8.4	2.8
16	-10	M27 X 2	18.35	23.5	20.9	10.45	2.8
20	-12	M30 X 2	20.5	26.35	23.4	11.7	4
25	-16	M39 X 2	27.65	34.5	31.1	15.55	4
30	-20	M45 X 2	34.7	41.2	37.9	18.95	4
38	-24	M50 X 2	40.05	46.7	43.4	21.7	4

6.8 See Figure 6 for typical assembly drawing. (See note 1).



- 1) Method of nut attachment to be determined by Manufacturer, but must meet the design performance requirements.
- 2) Method of nut attachment shown here is one of the options.

FIGURE 6—ASSEMBLY DRAWING

7. **Ring**—If retaining rings are utilized for nut attachment, the manufacturer may use the ring designs defined in Figure 5 and Table 4, or a ring and groove in accordance with manufacturers own design. When assembled with body and nut, the ring (or rings) must be capable of meeting the performance requirements of Table 1.
8. **O-Rings**—O-Rings used with stud ends and nut barrier seals shall conform to the dimensions given in ISO3601-1, AS 568A, or SAE J515 as shown in Table 5.
- 8.1 Material specifications for Stud End O-Rings are in accordance with SAE J515. Stud End O-Rings shall be Nitrile Elastomer, 90 durometer hardness and are good for temperature range of  $-35$  to  $+125$  °C for petroleum based fluids. Material specifications for Barrier Seals may include general purpose 70 durometer Nitrile compounds.