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Aluminium alloy gas cylinders — Operational requirements for avoidance of neck and shoulder cracks

Bouteilles à gaz en alliage d'aluminium — Exigences opérationnelles pour éviter les fissures du goulot et de l'ogive

Reference number
ISO 13770:1997(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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Introduction

Over the years it has become recognized that in general, aluminium alloy cylinders should be treated differently in some respects than cylinders constructed of other materials, e.g., steel. One concern for certain alloy/manufacture processes is neck and/or shoulder cracking. Conditions occurring in aluminium cylinders which may lead to neck and/or shoulder cracking depends on material sensitivity, cylinder design, manufacturing defects or uncontrolled operational stresses. The intent of this document is only to provide recommended procedures for operational controls to reduce the risk of neck/shoulder cracking in aluminium cylinders. The material sensitivity, cylinder design and manufacturing defects are covered in ISO 7866.

Aluminium alloy gas cylinders — Operational requirements for avoidance of neck and shoulder cracks

1 Scope

This International Standard specifies operational procedures for avoidance of neck and shoulder cracks in aluminium alloy cylinders having water capacities from 0,5 l to 150 l.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7866:—[1], *Refillable transportable seamless aluminium alloy gas cylinders for worldwide usage — Design, construction and testing.*

ISO 10461:1993, *Seamless aluminium alloy gas cylinders — Periodic inspections and testing.*

ISO 10463:1993, *Cylinders for permanent gases — Inspection at time of filling.*

ISO 10920:1997, *Transportable gas cylinders — 25E taper thread for connection of valves — Specification.*

ISO 11113:1995, *Cylinders for liquefied gases (excluding acetylene and LPG) — Inspection at time of filling.*

ISO 11116:—[1], *Gas Cylinders — 17E taper thread for connection of valves to gas cylinders — Specification.*

ISO 11191:1997, *Gas Cylinders — 25E taper threads for connection of valves to gas cylinders — Inspection gauges.*

ISO 11219:—[1], *Gas Cylinders — 17E taper thread for connection of valves to gas cylinders — Inspection Gauges.*

ISO 11372:1995, *Cylinders for dissolved acetylene-Inspection at time of filling.*

ISO 11755:1996, *Cylinders in bundles for permanent and liquefiable gases (excluding acetylene) — Inspection at time of filling.*

ISO 13341:—[1], *Transportable gas Cylinders — Fitting of valves to gas cylinders.*

3 Definitions

For the purposes of this International Standard the following definitions apply.

3.1 neck crack: Defect which manifests itself as a line which runs vertically down the thread (it should not be confused with tap marks) and/or across the top face of the neck. [See figures 1 a) and 1 b).]

1) To be published.

3.2 fold: Manufacturing defect caused by uneven wave-like distribution of metal resulting in a peak and root situated in the internal shoulder area that may extend into the threaded area. [See figures 2 a) and 2 b).]

3.3 shoulder crack: Defect which normally starts from a fold in the internal shoulder area and may propagate into the cylindrical machined or threaded area. [See figures 2 a) and 2 b).]

4 Procedures

The following information and operational procedures are provided to assist in avoidance of neck/shoulder cracks in aluminium alloy gas cylinders.

4.1 Inspection of neck threads and internal shoulder

Whenever valves are removed (i.e. at re-test, change of service or replacement of valve), the opportunity shall be taken to visually inspect the cylinder's top face, neck threads and internal shoulder for freedom from defects. Inspection procedures are given in 4.3, 4.4 and 4.6.

4.2 Verification of material composition

It is known that high levels of lead are detrimental to the structural integrity of aluminium alloy cylinders. It is important that lead levels be kept to an acceptable limit.

Caution — At the beginning of the 1980s some cylinders were manufactured with remelt aluminium containing greater than 0,01 % lead. The serial numbers of these cylinders are known and the manufacturer should be contacted. Ensure that these cylinders are not placed into service. They shall be removed from service and scrapped.

The composition of the cast of all new cylinders is checked under the responsibility of the manufacturer and is reported in manufacturing certificates. For new cylinders, levels of lead shall be in accordance with ISO 7866.

If cracking occurs during use, the manufacturing certificates may be consulted to determine if the cause is high lead. If so, consideration can be given to removing cylinders of that cast from service.

4.3 Inspection prior to valving

Prior to placing cylinders into service make sure that the internal inspection of the neck and shoulder area has been performed in accordance with ISO 7866 and/or ISO 10461. See figures 1 a), 1 b), 2 a) and 2 b) for examples of conditions necessitating inspection.

4.4 Inspection of cylinder and valve threads

4.4.1 General

All valves, new or used, should be inspected prior to the valving operation. Valves shall be free of burrs and sharp edges on the leading thread to avoid cylinder neck thread damage/stripping. Also inspect for possible taper mismatch. (See figure 3.)

Ovality of the cylinder neck threads and the need for re-tapping to correct damage are features which need to be considered during this inspection.

4.4.2 Checking for possible taper mismatch

For new cylinders, prior to installing a valve make sure that the cylinder and valve threads are within acceptable tolerances. For acceptable tolerances see ISO 10920 or ISO 11116 for dimensions and ISO 11191 and ISO 11219 for gauging.

For cylinders previously in service, consider that the valve taper may be less than that of the cylinder (see figure 3, Case B) or the taper may be greater than that of the cylinder (see figure 3, Case C). The ideal condition is the "No-mismatch" situation where the tapers of the valve and the cylinder are equal (see figure 3, Case A).

4.4.3 Explanation of possible taper mismatch

See figure 3.

Machining operations may produce a different taper on the cylinder compared to the valve. The valve/cylinder threads should be suitably toleranced to provide an acceptable fit as indicated in figure 3. Thread mismatch should be checked during the valve fitting operation.

— Figure 3, Case A is the ideal thread fit. Select valve/cylinder with such a fit, if possible.

— Figure 3, Case B taper is acceptable. Such a valve/cylinder fit may be valved.

— Figure 3, Case C taper condition is unacceptable. Valve/cylinder with such a fit should not be valved.

NOTE — In Case C, if the thread tolerances are greater than those given in ISO 10920, local yielding of the cylinder neck can occur at relatively low torque levels and a seal not obtained. In Case B the stresses are placed at the bottom of the cylinder threads where a much greater stress is required for plastic deformation of the cylinder material. The conditions of Case C are unacceptable and should be avoided if the thread tolerances are greater than ISO 10920, especially for alloys susceptible to sustained-load-cracking. (For SLC test see annex D of ISO 7866:—). Figure 4 is a schematic representation of stress conditions of various valve/cylinder thread matches. The conditions of Case B are acceptable, and those of Case A are ideal. Methods for gauging cylinder and valve threads can be found in ISO 11191 and ISO 11219.

4.5 Control of valving torque

The lowest possible torque shall be used for valving taper threads consistent with gas tightness and operational parameters. For valving cylinders follow the complete procedures as given in ISO 13341.

Caution — Never use any torque values without using exact measurement procedures described in ISO 13341.

NOTE — A method to reduce tensile stress in the cylinder neck is by a shrunk-on neck-ring reinforcement (this puts the neck into compression). Material for the neck ring should be chosen with care to ensure compatibility with the cylinder material, e.g., to avoid galvanic corrosion, etc. This method of reducing local tensile stresses should be carried out by the manufacturer or with the manufacturer's guidance.

4.6 Inspection at time of filling

In addition to the applicable requirements specified in ISO 10463, ISO 11113, ISO 11372 and ISO 11755, the following inspections shall be made.

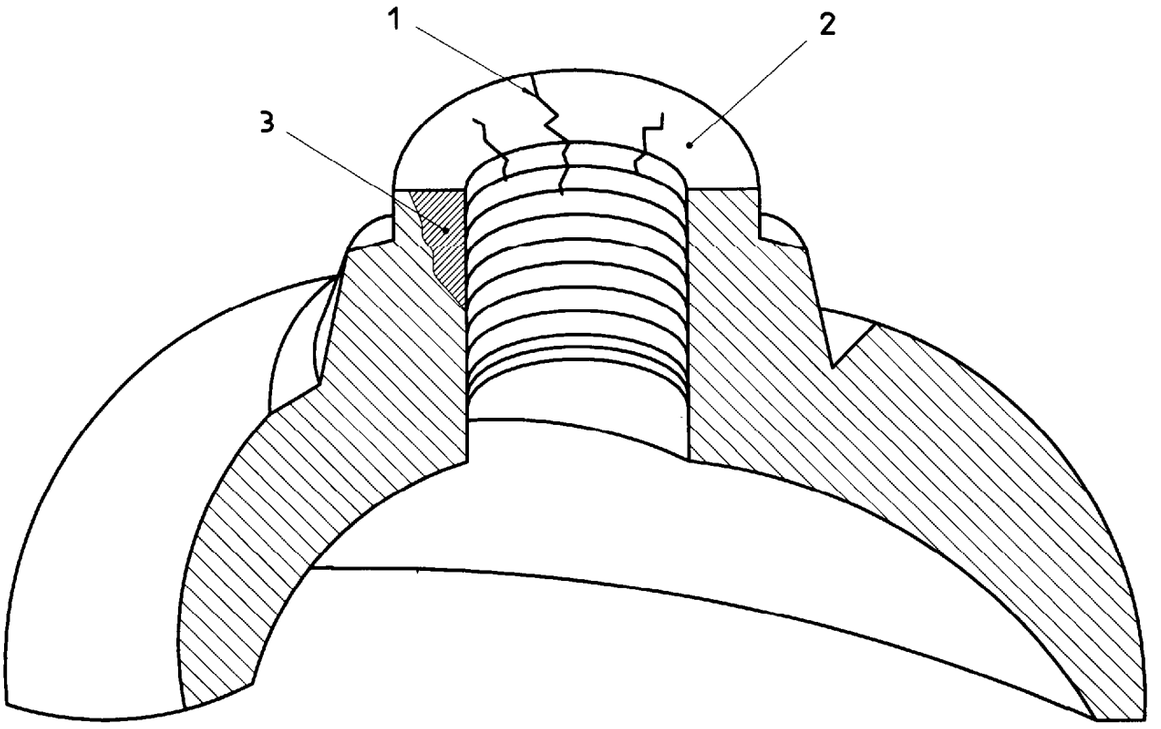
4.6.1 Prior to filling, visually inspect the top face of the cylinder neck for evidence of a crack. [See figures 1 a) and 1 b).]

Cracks may appear as a radial mark across the face of the neck starting at the thread and extending across the top face of the neck. If such a radial mark is seen, the surface may be lightly cleaned by abrasive paper to determine whether the radial mark is a crack or just a surface mark.

Cylinders with neck cracks shall be removed from service and scrapped.

4.6.2 After filling, each cylinder should be checked for leakage as a result of a neck crack. This test can be performed in conjunction with the normal leak test of the valve/cylinder joint. When using a liquid-type leak-detector solution (compatible with aluminium and the gas contained) spray the solution to cover both the thread joint and top face of the neck. Care should be taken to avoid visual interference from the test date ring, if present. Alternative equivalent methods such as a "sniffer"-type leak detector may be used.

Cylinders with leaks from a neck crack shall be removed from service and scrapped.



Key

1 Neck cracks
2 Top face of neck
3 Propagated neck crack

Figure 1 a) — Sketch of neck cracks

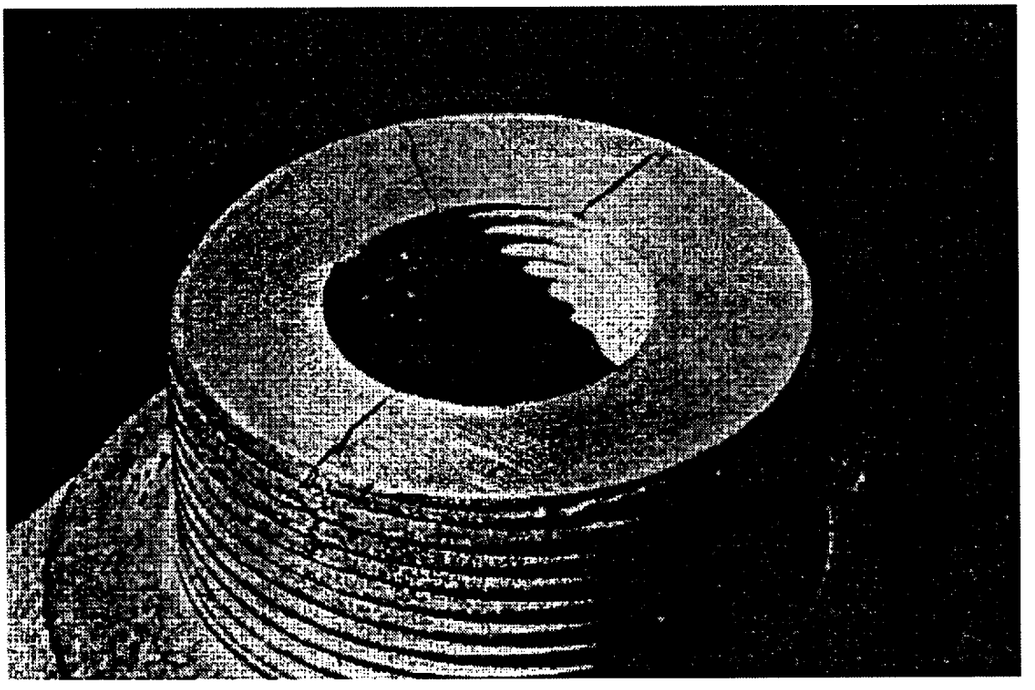
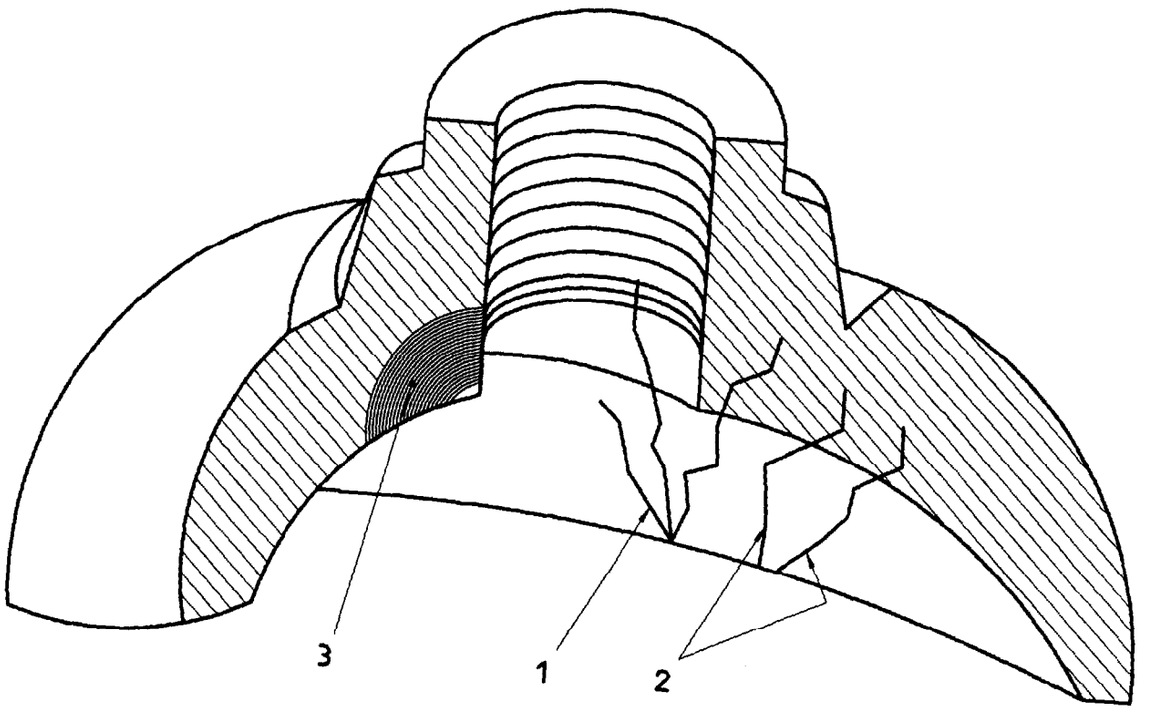


Figure 1 b) — Photograph of neck cracks



Key

1 Shoulder cracks
2 Folds
3 Propagated shoulder crack

Figure 2 a) — Sketch of shoulder folds and cracks

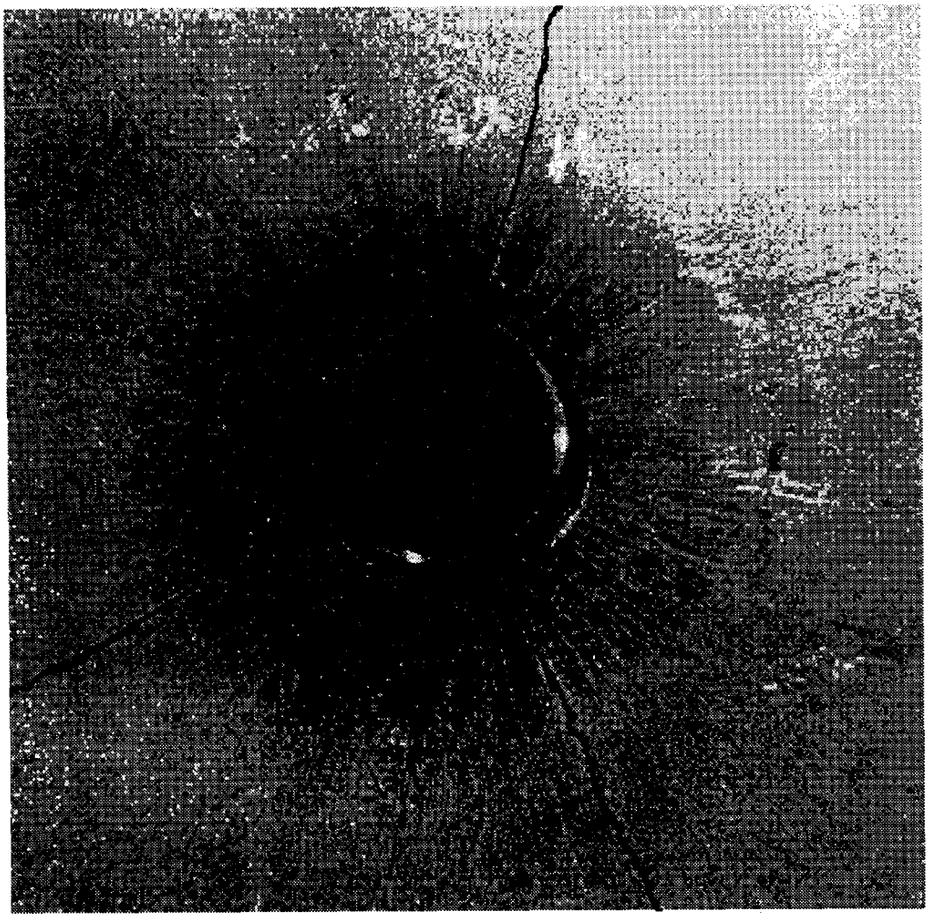
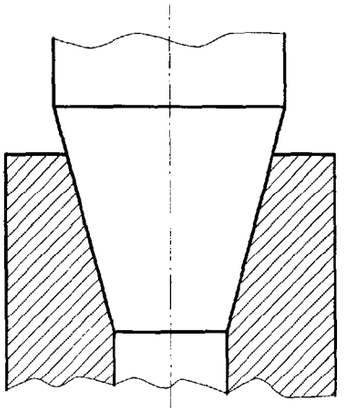
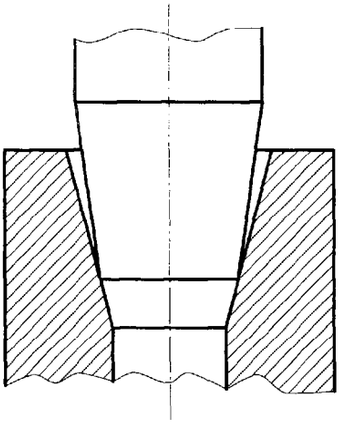


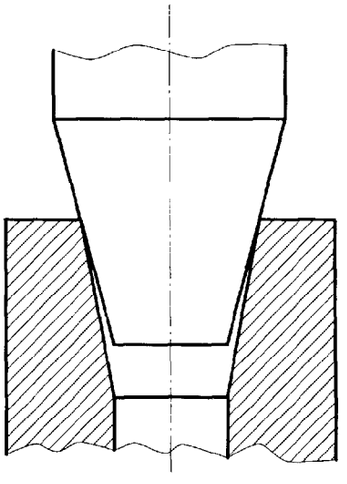
Figure 2 b) — Photograph of shoulder folds and cracks



Case A — Ideal fit — Taper of cylinder and valve are equal



Case B — Valve taper less than cylinder — Acceptable, can be used



Case C — Valve taper greater than cylinder — Unacceptable, cannot be used

Figure 3 — Explanation of possible taper mismatch (see 4.4.3)

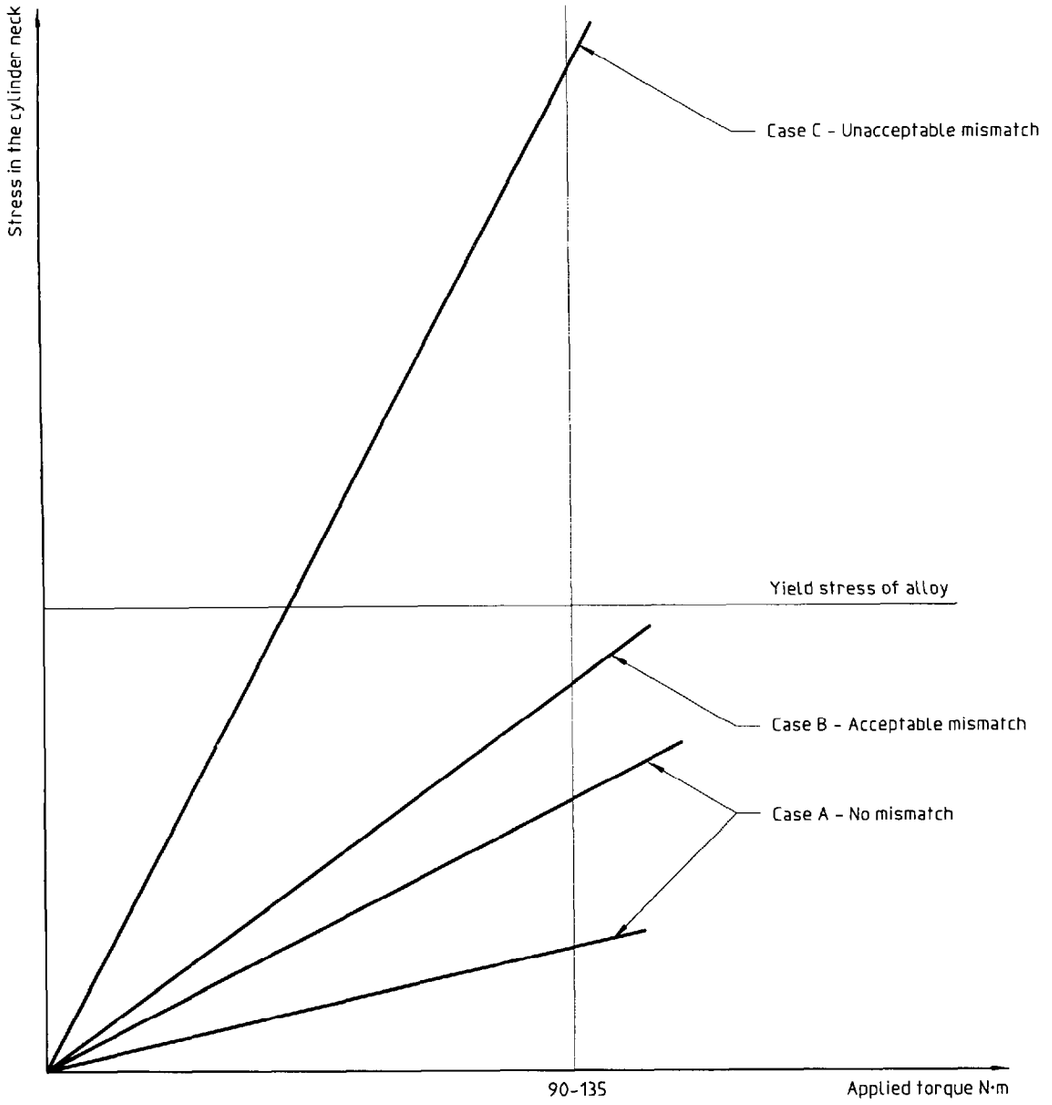


Figure 4 — Schematic representation of valve/cylinder neck mismatch on stress in the neck

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