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Adhesives — Test methods for fatigue properties of structural adhesives in tensile shear

*Adhésifs — Méthodes d'essai de tenue à la fatigue d'adhésifs structuraux
en traction-cisaillement*



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Foreword

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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.

International Standard ISO 9664 was prepared by Technical Committee ISO/TC 61, *Plastics*, Sub-Committee SC 11, *Products*.

Annexes A and B form an integral part of this International Standard.

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International Organization for Standardization

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Adhesives — Test methods for fatigue properties of structural adhesives in tensile shear

1 Scope

This International Standard specifies a method for estimating the fatigue strength of adhesives in shear by tension loading, using standardized specimens under specified conditions, with the aim of characterizing structural adhesives on a given metallic substrate.

The fatigue properties are a function of the specimen geometry. The results do not correspond to intrinsic properties of the adhesive and cannot be used for design purposes.

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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing*.

ISO 4587:1979, *Adhesives — Determination of tensile lap-shear strength of high strength adhesive bonds*.

ISO 4588:1989, *Adhesives — Preparation of metal surfaces for adhesive bonding*.

3 Definitions and symbols

For the purposes of this International Standard, the following definitions and symbols apply.

3.1 shear stress (τ): Stress determined by dividing the force by the bonded surface area.

It is expressed in megapascals (MPa).

3.2 static shear strength (τ_R): Average static shear stress at rupture as determined by ISO 4587.

It is expressed in megapascals (MPa).

3.3 stress cycle: Smallest part of the stress/time function which is repeated at regular intervals.

It is of sinusoidal form (see figure 1) with undulating shear.

Cyclic stress may be considered to be the superposition of an alternating stress on a static stress which is the mean stress.

3.3.1 maximum stress ($\tau_{\max}$): Greatest algebraic value reached at regular intervals by the stress.

It is expressed in megapascals (MPa).

3.3.2 minimum stress ($\tau_{\min}$): Smallest algebraic value reached at regular intervals by the stress.

This stress shall always be positive and is expressed in megapascals (MPa).

3.3.3 mean stress (τ_m): Algebraic mean of the maximum and minimum stresses.

$$\tau_m = \frac{\tau_{\max} + \tau_{\min}}{2}$$

It is expressed in megapascals (MPa).

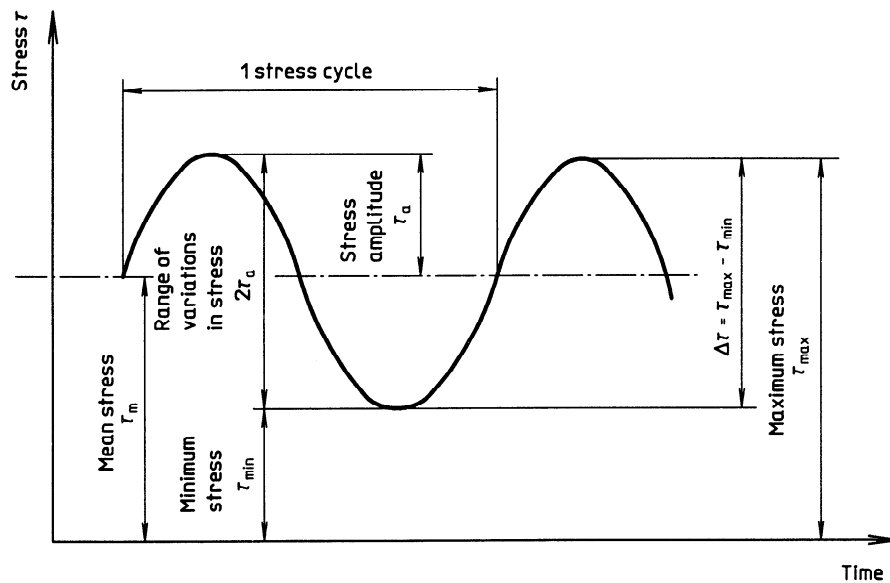


Figure 1 — Fatigue stress cycle

3.3.4 stress amplitude (τ_a): Alternating stress equal to half the algebraic difference between the maximum and minimum stresses.

$$\tau_a = \frac{\tau_{\max} - \tau_{\min}}{2}$$

It is expressed in megapascals (MPa).

3.3.5 stress ratio (R_τ): Algebraic ratio of the minimum stress to the maximum stress in one cycle.

$$R_\tau = \frac{\tau_{\min}}{\tau_{\max}}$$

3.4 fatigue limit (τ_D): Limiting value which the stress amplitude τ_a approaches when the number of cycles becomes very large, for a given mean stress τ_m or stress ratio R_τ .

For some materials, stress amplitude versus the number of cycles does not reach a limiting value but decreases constantly on increasing the number of cycles. In this case it is useful to determine a limit of endurance.

3.5 limit of endurance [$\tau_D(N_F)$]: Shear stress determined at a specific number of fault test cycles N_F .

It is expressed in megapascals (MPa).

Depending on whether the tests are carried out at constant τ_m or at constant R_τ , the results should be presented in the form:

$$\tau_D(N_F, \tau_m) \text{ in megapascals (MPa)}$$

or

$$\tau_D(N_F, R_\tau) \text{ in megapascals (MPa)}$$

3.6 service life (N): Number of stress cycles applied to a specimen until it has reached the chosen end of the test. Where it has not failed, the service life is not defined but is termed greater than the test duration.

3.7 cycle ratio (n/N): Ratio of the number of applied cycles (n) to the service life (N). This ratio is used in tests with load bearings, together with an SN curve (Woehler's curve).

3.8 SN curve: Curve, allowing the resistance of the material to be seen, which indicates the relationship observed experimentally between service life N , shown conventionally in abscissae (logarithmic scale) and stress τ_a or $\tau_{\max}$ shown in ordinates in linear scale [typical curve in figure 2 a)] or in logarithmic scale [typical curve in figure 2 b)]. This curve is established by keeping either τ_m or R_τ constant. The SN curve is defined by the relationship between amplitude of stress and service life. On this curve [figure 2 a)] we can distinguish:

- the endurance zone where, for a given stress, failures as well as non-failures for a number of fault test cycles N_F can be identified;
- the fatigue zone where, for a given stress, all the specimens fail at the end of a number of cycles less than the number of conventional fault test cycles N_F mentioned above.

4 Principle

The specimen is cyclically stressed in a way that may be regarded as the superposition of an alternating stress on a static stress which is the mean stress.