BRITISH STANDARD

BS EN 4662:2010

Aerospace series — Test specification for vibration control components

ICS 17.160; 49.035

BSI
British Standards

National foreword

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The UK participation in its preparation was entrusted to Technical Committee ACE/12, Aerospace fasteners and fastening systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Aerospace series - Test specification for vibration control components

Série aérospatiale - Spécification d'essais pour des composants de contrôle en vibration

Luft- und Raumfahrt - Prüfspezifikation für Bauteile zur Schwingungsminderung

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Foreword

This document (EN 4662:2010) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

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1 Scope

This standard specifies the procedure and the parameter for testing static and dynamic stiffness of vibration control components (e.g. shock mounts with bushes).

This standard applies to vibration control components all installed for aircraft applications. It may be applied when referred to in the product standard or in a design specification.

2 Definition and symbols

For the purposes of this document, the following definition and symbols apply.

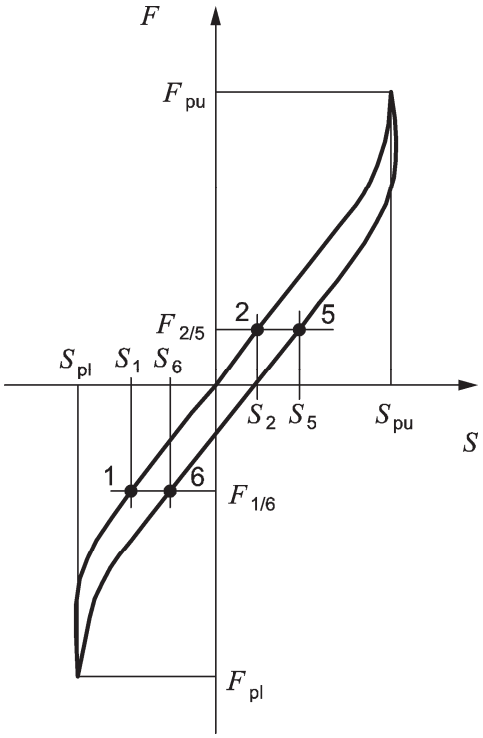
2.1 Coordinate system

The functional requirements shall be defined in a Cartesian coordinate system. The directions for translation and rotation shall be defined in the specifications of the relevant product standards.

2.2 Symbols

2.2.1 Static stiffness

Due to the material damping vibration control components can have a hysteresis load versus displacement curve as shown exemplary in Figure 1.



Key

F_{pu} Upper load
F_{pl} Lower load
S_{pu} Upper displacement
S_{pl} Lower displacement
F_1 Load value 1
F_2 Load value 2
F_5 Load value 5
F_6 Load value 6
S_1 Displacement value 1
S_2 Displacement value 2
S_5 Displacement value 5
S_6 Displacement value 6

Figure 1 — Load and displacement symbols for translation direction

The symbols and parameters for the translation directions can be analogy adapted to the rotational data (see Table 1).

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Table 1 — Torque and angle symbols for rotation direction

Symbols for		
Translation direction	**Rotation direction**	
F_{pu}	M_{pu}	Upper torque
F_{pl}	M_{pl}	Lower torque
S_{pu}	α_{pu}	Upper angle
S_{pl}	α_{pl}	Lower angle
F_1	M_1	Torque value 1
F_2	M_2	Torque value 2
F_5	M_5	Torque value 5
F_6	M_6	Torque value 6
S_1	α_1	Angle value 1
S_2	α_2	Angle value 2
S_5	α_5	Angle value 5
S_6	α_6	Angle value 6

Further symbols are defined in Table 2.

Table 2 — General symbols for static test

Symbols	Static test
F_{pre}	Static constant load
M_{pre}	Static constant torque
S_{pre}	Static constant displacement
α_{pre}	Static constant angle
N	Number of load cycles
V	Test speed
$C_{1/2}$	Secant stiffness (see Figure 1)
$C_{5/6}$	Secant stiffness (see Figure 1)
$C_{1\text{-}6}$	Resulting stiffness
C_k	Correction stiffness
C_{stat}	Resulting static stiffness
T	Environmental test temperature

2.2.2 Dynamic stiffness

An exemplary curve for dynamic stiffness and loss angle is shown in Figure 2.

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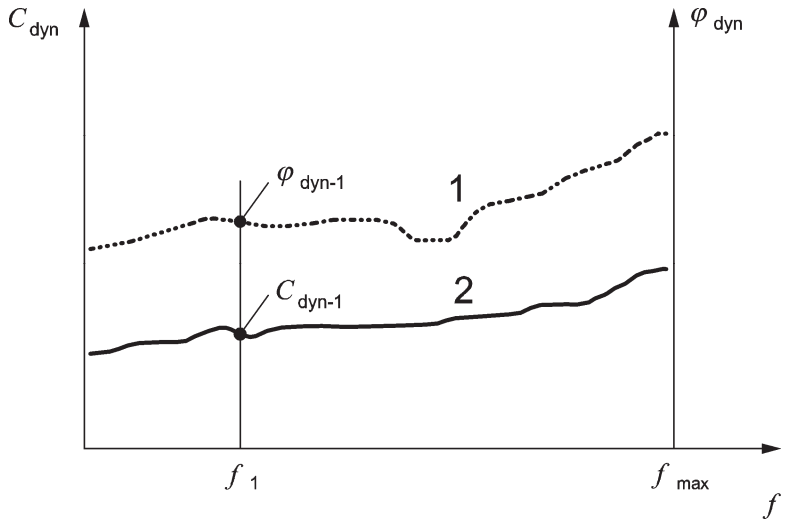

Key

1 Loss angle
2 Dynamic stiffness
f Frequency

$f_{max.}$ Limit test frequency
C_{dyn} Dynamic stiffness
φ_{dyn} Loss angle
f_1 Frequency value 1
C_{dyn-1} Stiffness value 1
φ_{dyn-1} Loss angle value 1

Figure 2 — General symbols for dynamic test

Further symbols are defined in Table 3.

Table 3 — General symbols for dynamic test

Symbols	Dynamic test
F_{pre}	Static constant load
A	Amplitude
T	Environmental test temperature

3 Test set up

The test set up shall be designed and manufactured ready to install and measure the specimens due to the specified stiffness directions. The test device shall reproduce the real aircraft installation as exact as possible and needed. If necessary surrounding original aircraft parts has to be integrated in the test set up.

The test set up shall be as rigid as possible and support the maximum test loads without significant deformation (specimen and original aircraft parts excluded) or failure.

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For the measure of the dynamic values the test set up shall be resonance free at minimum factor 2 over the maximum test frequency.

The test set up including type of testing machine shall be in accordance with the specifications of the relevant product standards and documented by pictures and drawings.

4 Static stiffness

4.1 Test parameters

See Table 4

Table 4 — Parameter setting

Control type	Default parameters	Requirements pre-load cycle	Requirements test cycle	Measurement data
Force	F_{pre}	In accordance with the specifications of the relevant product standards	In accordance with the specifications of the relevant product standards	Load versus displacement Sample rate > 100
	F_{pl}			
	F_{uu}			
	N			
	V			
Torque	M_{pre}			Torque versus angle Sample rate > 100
	M_{pl}			
	M_{uu}			
	N			
	V			
Displacement	S_{pre}			Load versus displacement Sample rate > 100
	S_{pl}			
	S_{uu}			
	N			
	V			
Angle	α_{pre}			Torque versus angle Sample rate > 100
	α_{pl}			
	α_{uu}			
	N			
	V			
NOTE Temperature T in accordance with the specifications of the relevant product standards.				

4.2 Stiffness evaluation

See Table 5.

Table 5 — Measurement values

Control type	Default parameters	Evaluation data	Requirements	
Force	F_1	S_1	Parameters and evaluation data in accordance with the specifications of the relevant product standards	Nominal values and tolerances for stiffness C_{stat} in accordance with the specifications of the relevant product standards
	F_2	S_2		
	F_5	S_5		
	F_6	S_6		
Torque	M_1	α_1		
	M_2	α_2		
	M_5	α_5		
	M_6	α_6		
Displacement	S_1	F_1		
	S_2	F_2		
	S_5	F_5		
	S_6	F_6		
Angle	α_1	M_1		
	α_2	M_2		
	α_5	M_5		
	α_6	M_6		

The formulae to calculate the stiffness are:

$$C_{1/2} = \frac{F_2 - F_1}{S_2 - S_1}$$

$$C_{5/6} = \frac{F_5 - F_6}{S_5 - S_6}$$

$$C_{1-6} = \frac{C_{1/2} + C_{5/6}}{2}$$

$$C_{stat} = C_{1-6} - C_k$$

where

C_k is the parasitic or correction stiffness as defined in 4.3.

4.3 Parasitic stiffness

Before testing the specimen the correction factor for the test set up shall be determined. This parasitic stiffness depends on the test machine itself and on the test set up.

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The correction factor shall be measured by substitution of the specimen including the original aircraft parts with a rigid dummy.

The same test parameters shall be applied as for the test cycle (see Table 4) and the stiffness C_k shall be calculated analogue to $C_{1\text{-}6}$.

5 Dynamic stiffness

5.1 Parameters

See Table 6.

Table 6 — Parameter setting

Default parameters	Measurement data	Requirements test cycle
F_{pre} $f_{max.}$ A	Dynamic stiffness versus frequency Sample rate > 100	In accordance with the specifications of the relevant product standards
	Loss angle versus frequency Sample rate > 100	
NOTE Temperature T in accordance with the specifications of the relevant product standards		

5.2 Stiffness evaluation

See Table 7.

Table 7 — Parameter setting

Default parameters	Measurement data	Requirements test cycle
f_{dyn}	C_{dyn}	In accordance with the specifications of the relevant product standards
	φ_{loss}	

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