Guideline No.: M-21(201510)

M-21

ELASTIC COUPLING

Issued date: October 20,2015

Foreword:

CCS Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at http://www.ccs.org.cn. Your comments or suggestions are welcomed and may be sent to our email addressed mp@ccs.org.cn.

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ELASTIC COUPLING

1 Application

1.1 This chapter applies to the propelling shafting driven by diesel engines、steam turbines or electrical motors and the power transmission shafting of other auxiliary machineries.

1.2Elastic couplings are used in coaxial transmission shafting to provide certain compensation to relative offset and reduce torsional vibration.

2 Normative references

CCS Rules for Classification of Sea-going Steel Ships

CCS Rules for Materials and Welding

3 Terms and definitions

3.1 Elastic coupling consists of input and output flanges together with the elastic elements between these flanges.

3.2 Elastic elements are usually rubber or rubber and metallic elastic leaves or plates, such as rubber elastic coupling and springs (pack) such as elastic damping leaf coupling.

4 Drawings and documentation to be submitted

4.1 The drawings and documentation to be submitted listed below are to be submitted to CCS for approval:

(1) Main technical parameters of elastic coupling: type, model, rated torque, instantaneous maximum torque, allowable vibratory (variable) torque, allowable revolution speed, static torsional angle (rated, maximum), static torsional stiffness, dynamic stiffness (if applicable), damping factor (if applicable);

(2) Strength calculations (keys, connecting bolts, etc.);

(3) Technical specifications (design basis, enterprise standard, etc.);

(4) Routine test program;

(5) Assembly drawing;

(6) Drawings of main part (input/output flanges/discs, elastic parts/components, etc.);

4.2 The drawings and documentation to be submitted listed below are to be submitted to CCS for review:

(1) Operation instruction

4.3 Other plans and technical documents deemed necessary by CCS.

5 Materials and components

5.1 Materials and components are to comply with relevant requirements of CCS Rules.

5.2 Materials and components include input and output flanges, connecting disc, spline shaft, internal and external limiting discs, elastic leaf/spring (only applicable to elastic damping leaf coupling), retaining ring elastic damping leaf (only applicable to elastic damping leaf coupling), plate and rubber components, etc.

6 Technical requirements

6.1General requirements

6.1.1 Elastic couplings are to comply with the “general requirements” of Section 2, Chapter 1, PART THREE of CCS Rules for Classification of Sea-going Steel Ships;

6.1.2 Steel materials of elastic couplings are to comply with the relevant requirements of CCS Rules for Materials and Welding.

6.2 Technical requirements

6.2.1 The working temperature of elastic couplings is to comply with the requirements of 21.6.1(1);

6.2.2 Elastic couplings are generally to be fitted with torque limiters;

6.2.3 The permissible tolerance of (radial, axial and angular) alignment between two shafts connected by an elastic coupling is to be expressly specified in the manufacturer's technical documents and instructions for use;

6.2.4 The rubber materials of torque-bearing elastic elements are to comply with the following requirements:

Test technical requirements of rubber materials of torque-bearing elastic elements **Table 6.2.4**

Test item	Technical requirements	Test method	Remark
Tensile (breaking) strength	≧17MPa	GB/T 528	Other equivalent standards are also acceptable.
Rate of elongation at break	≧350%	GB/T 528	
Permanent deformation at break	≦25%	GB/T 528	
Coefficient of hot air ageing	≧0.7(70 ℃,96h)	GB/T 3512	
Rubber-metal bonding strength	≧4.0MPa	GB/T 11211	

Note: Where the rubbers not in compliance with the above requirements are intended to be used, the designation and main technical parameters of these rubbers are to be submitted to CCS for review.

6.2.5 The bolts used in elastic coupling are to have a grade not lower than 8.8.

6.2.6 The surface of rubber materials is to be smooth, even and free from defects such as crack and bareness; the rubber and the metal are to be tightly connected and free from any detachment, stamp dents more than 1.0mm in depth, minor unevenness, burrs or air voids more than 1.5mm in depth;

6.2.7 The rubber surface is to be coated with an anti-ageing layer;

6.2.8 The rubber is not to generate any crack or detachment from the metal at the maximum torque;

6.2.9 The tightening torque of all bolts of elastic coupling (elastic element being rubber) is to be in accordance with the applicable requirements of GB/T2496; otherwise, the specific technical parameters are to be submitted to CCS for review;

6.2.10 The materials of the main parts of elastic damping leaf coupling are to be the materials specified below or other materials having a grade no lower than that of such grade materials: clamping ring (42CrMo), inner star (40Cr) and spring (50CrVA);

6.2.11 The inner star and spring of elastic damping leaf coupling are to be examined through NDT;

6.2.12 The elastic damping leaf coupling is to be capable of withstanding the working pressure of lubricating oil without leaks;

6.2.13 The deviation of the static torsional stiffness within the range of 110% rated torque is to be no greater than ±8% between the measured value and the specified value.;

6.2.14 The elastic damping leaf coupling is not to be broken down at a static torque equal to 3.25 times of rated torque;

6.2.15 When the revolution speed of the elastic damping leaf coupling is greater than 1500r/min, the grade of dynamic balance of the external coupling components is to be no less than G6.3 specified in GB/T9239.1;

6.2.16 Where the elastic damping leaf coupling is of non-reverse rotation type, permanent signs of the rotating direction are to be marked on the surface of associated parts.

7 Type test

7.1 Selection of prototype

One piece of elastic coupling with the maximum specifications (maximum torque) is to be selected at random respectively from each different type of structure..

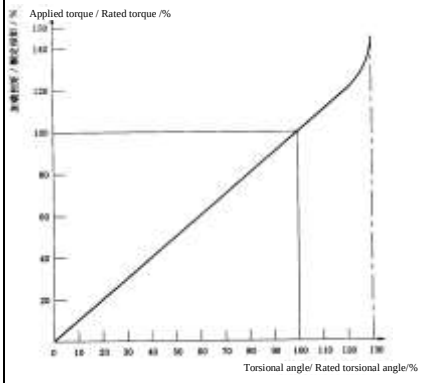
7.2 Type test items

Refer to Table 7.2 below for details.

Elastic Coupling Type test Items **Table 7.2**

No.	Test item	Description	Remark
1	Visual inspection	The surface of rubber materials is to be smooth, even and free from the defects such as crack and bareness; the rubber and the metal are to be tightly connected and free from any detachment, stamp dents more than 1.0mm in depth, minor unevenness, burrs or air voids more than 1.5mm in depth; the surface of couplings is to be free from bruise, scratch, rust, etc.	
2	Review of mechanical and chemical tests and NDT reports for materials of main parts	Mechanical and chemical properties of the elastic elements (rubber, spring) and torque-bearing metallic structural components; NDT of the inner star and spring of elastic damping leaf couplings	
3	Rated torque test	Torque is applied at a rate of 20% of rated torque per minute to the elastic rubber ring on the static torsion test bench. The static torsional angle φn at nominal torsional moment Tn is measured for two times, then the initial state is reinstated and maintained for 5min and the average value taken. The results are to meet the design requirements.	Applicable to rubber elastic couplings only.

Continued Table 7.2

No.	Test item	Description	Remark
4	Static torsional stiffness test	When the static torsional stiffness test is carried out, the torque is applied at a rate of 20% of the rated torque per minute till 100%~150% of the rated torque (as large as possible), following the test method for "rated torque test". Each applied torque and its corresponding relative torsional angle are recorded. Then the procedure is repeated for two times and the average value taken. Static torsional stiffness is calculated by the formula below: Cs=(T2-T1)/(φ2-φ1), Cs--- static torsional stiffness, expressed in kN.m/rad; T1---75% of nominal torque Tn, expressed in kN.m; T2---125% of nominal torque Tn, expressed in kN.m; φ1、φ2---static torsional angles corresponding to T1 and T2, expressed in rad; The result is to meet the design requirements.	For elastic damping leaf couplings, the internal and external components of the couplings are fixed respectively onto the torsion test bench. The torque is applied at a rate of 20% of the rated torque per minute till 100%~150% of the rated torque (as large as possible). Each applied torque and its corresponding relative torsional angles of the internal and external components under the action of corresponding torque values are recorded. Then the chart below showing the torque-torsional angle relationship curve is plotted according to the following formula: C3i=Ti /φi C3i ——measured value of static torsional stiffness, expressed in meganewton meter per radian (MN•m/rad); Ti ——applied torque, expressed in kilonewton meter(kN•m); φi ——torsional angle, expressed in milliradian (mrad); i=1、2、3、4、5.....  Torque-torsional angle relationship curve

Continued Table 7.2

No.	Test item	Description	Remark
5	Dynamic torsional stiffness test	When the dynamic torsional stiffness test is carried out (the revolution speed of couplings is to be in line with the design values), following the test method for "rated torque test", the torque is applied at a rate of 20% of the rated torque per minute till 100%~150% of the rated torque (as large as possible). Each applied torque and its corresponding relative torsional angles are recorded. Then the procedure is repeated for two times and the average value taken. Damping factor is calculated. The result is to meet the design requirements.	Applicable for rubber elastic couplings only.
6	Maximum torque test	When the maximum torque test is carried out (at rated torque equal to 3 times or 4 times of the test torque, or the maximum test torque the coupling can withstand), the torque is applied at a rate of 20% of the rated torque per minute to the elastic rubber ring on the static torsion test bench till the maximum torque Tmax. The coupling's maximum torsional angle Ψmax is measured and recorded. Then this maximum torsional angle is kept for 3min. At the same time, the surface quality of the elastic rubber ring is visually inspected. The result is to meet the design requirements.	
7	Tightness test	The coupling is immersed in a vessel containing antirust water at room temperature. Compressed air is introduced to build a pressure of 0.5MPa and this pressure is held for 5min. All seals of the coupling are observed for any sign of leakage.	Applicable to elastic damping leaf couplings only.
8	Dynamic balance test (only for couplings of revolution speed greater than 1500r/min)	After the external components of the coupling are assembled, the dynamic balance test is carried out by the method specified in GB/T9239.1.	Applicable to elastic damping leaf couplings only.
9	Overload test	The internal and external components of the coupling are fixed respectively to the static torsion test bench. The torque is applied at a rate of 20% of the rated torque per minute till 3.25 times of the rated torque. At this point, the coupling is not to be broken down. This test may be carried out only for couplings of medium and small specifications depending on the ability of the test bench.	Applicable to elastic damping leaf couplings only.

8 Unit/batch inspection

8.1 The sampling proportion for unit/batch inspection of elastic couplings is to be no less than 5%, however, at least one test specimen is to be selected from each type.

8.2 Unit/batch inspection items

Unit/batch inspection items for rubber elastic couplings are to be determined in accordance with 1, 2, 3 and 6 of Table 1 in 7.2.

Unit/batch inspection items for elastic damping leaf couplings are to be determined in accordance with 1, 2, 7 and 8 of Table 1 in 7.2.