# Guidance for Approval of Manufacturing Process and Type Approval, Etc.

(Development Review : For external opinion inquiry)

2024. 01.


Machinery Rule Development Team

# - Main Amendments -

## (1) Effective date : 1 Jul. 2024 (Date of contract for construction or an application for certification of an engine)

◉ Reflecting IACS UR M82 (New Mar 2023), the requirements for type approval for explosion relief device (ERD) for internal combustion engines using gas as fuel have been established.

## (2) Effective date : 1 Jul. 2024 (Date of contract for construction or an application for approval)

◉ The requirement for real ship tests for propeller shafts with corrosion resisting has been deleted.

| Present | Amendment | Reason |
|---|---|---|
| # CHAPTER 3 TYPE APPROVAL<br>## Section 9 Crankcase Explosion Relief valves<br><br>(hereafter, omitted) | # CHAPTER 3 TYPE APPROVAL<br>## Section 9-1 Crankcase Explosion Relief valves<br><br>(hereafter, same as the present Rules)<br><br>## Section 9-2 Explosion Relief Devices for Reciprocating Internal Combustion Engines Using Gas as Fuel *(2024)*<br><br>**911. General**<br><br>**1. Application**<br><br>The requirements in this Section specify testing procedure for explosion relief devices for combustion air inlet manifold and exhaust gas manifold of reciprocating internal combustion engines using gas as fuel.<br><br>**2. Definitions**<br><br>(1) Definitions addressing gas as fuel as given in **Pt 5, Annex 5-7, 1** (2) of the Guidance, Safety of Internal Combustion Engines Supplied with Low Pressure Gas, apply.<br>(2) **Explosion relief device (ERD)** means a device to protect a component against a determined overpressure in the event of a gas explosion. The device is fitted with a flame arrester and may be a valve, a rupture disc or other, as applicable.<br><br>**912. Data to be submitted**<br><br>The following reference data are to be submitted to the Society in addition to those specified in **102.**<br>(1) Specification data sheet including operating conditions and design limits such as:<br>(A) Maximum permissible operating pressure, resulting from maximum charging air or exhaust gas back pressure<br>(B) Maximum permissible operating temperature, resulting from maximum charging air or exhaust gas temperature<br>(C) Static opening pressure, resulting from maximum charging air or exhaust gas back pressure<br>(D) Maximum explosion pressure, i.e. maximum pressure that the device can withstand<br>(E) Geometric relief area | 〈Guidance for Approval of Manufacturing Process and Type Approval, Etc.〉<br><br>- As Section 9-2 was newly added, Section 9 was renamed to Section 9-1.<br><br>(Amendment) Established type approval requirements for explosion relief device (ERD) for internal combustion engines using gas as fuel. Reflecting IACS UR M82 (New Mar 2023) 〈application date: the date of contract for construction or an application for certification of an engine, on or after 1 Jul. 2024〉<br>- UR M82 1, 2, 3 |

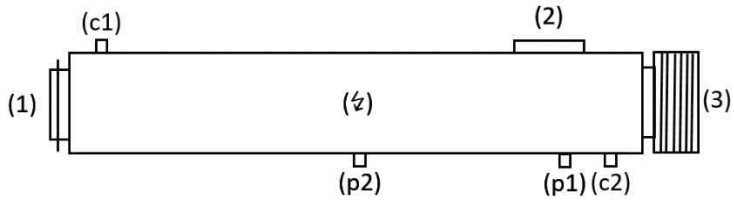
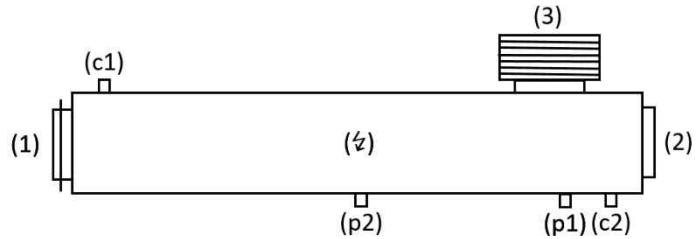
| Present | Amendment | Reason |
|---|---|---|
| | (2) Test program<br>(3) Specification of test vessel | |
| | **913. Type tests** | - UR M82 4.1 |
| | **1. Test specimens** | |
| | (1) The ERD used for the explosion test is to be selected from the manufacturer's production line by a representative of the Society:<br>(2) If necessary, an additional ERD may need to be selected for the demonstration of the opening pressure. The selected ERD has to be clearly marked.<br>(3) If applicable, the selected ERD is to be representative for the type range and operating conditions, for example:<br>(A) Kind of ERD (valve, rupture disc, etc.),<br>(B) Mounting orientation (vertical, horizontal)<br>(C) Design of ERD (e.g., spring design, sealing)<br>(D) Design of flame arrester<br>(E) ERD intended to be fitted to the air inlet or exhaust gas manifold of an engine having a turbocharger with characteristics as per the testing conditions for test vessel in **Table 3.9.2**.<br>The selection of the representative ERD is subject to approval by the Society. | |
| | **2. Demonstration of opening pressure** | - UR M82 4.2 |
| | The ERD which has been selected is to be subjected to a pressure test at the manufacturer's works to demonstrate that the static opening pressure is kept within the manufacturer's specification and that the ERD is air tight at the maximum permissible operating pressure for at least 30 seconds. | |
| | **3.** Type tests are to comply with the requirements given in **Table 3.9.2**. | |

| Present | Amendment | Reason |
|---|---|---|
| | **Table 3.9.2 Type test for ERD** | |

| Kinds | Requirements |
|---|---|
| Test facility | (1) The test facilities are to be accredited to a national or international standard, e.g. (KS Q) ISO/IEC 17025:2017, and are to be acceptable to the Society.<br>(2) The test facilities are to be equipped so that they can perform and record explosion testing in accordance with this procedure.<br>(3) The test facilities are to have equipment for controlling and measuring a methane gas concentration within a test vessel to an accuracy of ± 0.1%.<br>(4) The test facilities are to be capable of effective point-located ignition of a methane/air mixture.<br>(5) The test facility arrangements are to be capable of measuring and recording the pressure changes throughout an explosion test at a frequency recognizing the speed of the events during an explosion (10 kHz or above).<br>(6) ERD test (stage 2) is to be documented by high speed (250 frames/s or above) video recording. The video recording shall be provided with a time stamp. |
| Test vessel | (1) The test vessel is a simplified model of the air inlet or exhaust gas manifold. The free area of the connected turbo charger (compressor or turbine wheel) is to be considered.<br>(2) The test vessel is to comply with the following requirements:<br>(A) The shape of the test vessel is to correspond to a pipe with L/D ≥ 10.<br>(B) The test vessel is to be equipped with a rupture disc at one front end to simulate the turbo charger. The relief area of the rupture disc is to be in relationship to the test vessel diameter based on turbocharger manufacturer data for an equivalent free area of compressor or turbine wheel. The opening pressure is to be ± 10% of the static opening pressure of the ERD.<br>(C) The volume of the test vessel is to comply with the specific relief area of the ERD of 700 $cm^2/m^3$ ± 15%.<br>(D) The test vessel is to be provided with all necessary flanges and connection to mount the ERD in the intended position, to mount a rupture disc as turbo charger simulation, to connect the Methane-air mixture supply and the measurement equipment.<br>(E) The ignition is to be made at the middle of the test vessel.<br>(F) The test vessel is to be designed to verify a homogeneous air/methane mixture inside the vessel.<br>(G) The test vessel is to have connections for measuring the pressure in the test vessel in at least two positions, one at the ERD and the other at the test vessel center.<br>(H) The test vessel is to have a design pressure of not less than the maximum explosion pressure of a stoichiometric air/methane mixture at test conditions in explosion test method.<br>(I) The test vessel configuration is subject to approval by the Society. |

Reason:
- UR M82 4.3.1
- UR M82 4.3.2
- reference standard: EN14994

| Present | Amendment | Reason |
|---|---|---|
| | **Table 3.9.2 Type test for ERD (continued)** | |

| Kinds | Requirements |
|---|---|
| Test vessel | (3) Typical test vessel configurations<br>All test vessel configurations to be equipped with a rupture disc (1) (turbo charger simulation) at one front end. The ignition is in the centre of the test vessel (↯). The pressure sensors are mounted at the valve flanges (p1) and at the test vessel centre (p2). The measuring of the methane concentration to verify a homogeneous air/methane mixture can be performed at both ends of the test vessel, e.g. (c1) and (c2).<br>  <br><br>**Fig 3.9.2 Configuration without ERD (flanges for ERDs closed (2))**<br>  <br><br>**Fig 3.9.3 Configuration with ERD (3) mounted at the front end of the test vessel**<br>  <br><br>**Fig 3.9.4 Configuration with ERD (3) mounted on top of the test vessel** |

| Present | Amendment | Reason |
|---|---|---|
| | **Table 3.9.2 Type test for ERD (continued)** | |

| Kinds | | Requirements |
|---|---|---|
| Explosion test process | General | (1) The explosion testing is to be performed in two stages below for each ERD that is required to be approved as type tested.<br>(2) The explosion testing is to be witnessed by a Society surveyor.<br>(3) Calibration records for the instrumentation used to collect data are to be presented to, and reviewed by, the attending surveyor. |
| | Reference test (stage 1) | (1) Explosion test without ERD<br>(2) Two explosion tests are to be carried out in the test vessel without ERD. The test vessel configuration is shown in **Fig 3.9.2**.<br>(3) The aim of this test is to establish a reference pressure level in the test vessel which can be used for determination of the capability of a relief valve in terms of pressure relief. |
| | ERD test (stage 2) | (1) Explosion test with ERD<br>(2) Two explosion tests are to be carried out in the test vessel with the same ERD at the required position. If the ERD is a rupture disc with flame arrester, the rupture disc shall be replaced.<br>(3) If shielding arrangements to deflect the emission of explosion combustion products at the ERD are intended, the ERD are to be tested with the shielding arrangements fitted. The test vessel configuration is shown in **Fig 3.9.3** or **Fig 3.9.4**. |
| Explosion test method | | (1) The test conditions shall comply with the intended use of the ERD, such as:<br>(A) Pipe diameter<br>(B) Operating pressure<br>(C) Operating temperature<br>(D) Installation orientation<br>(2) All explosion tests are to be carried out using an air and methane mixture with a volumetric methane concentration of 9.5% ± 0.5%. A homogeneous air/methane mixture inside the test vessel is to be verified. The concentration of methane shall not differ by more than 0.5%.<br>(3) The initial pressure in the test vessel is to be the specified maximum operating pressure of the ERD.<br>(4) The initial temperature in the test vessel is to be the specified maximum operating temperature of the ERD.<br>(5) If the initial pressure and/or initial temperature deviate from the design limits, the ERD manufacturer shall prove the acceptability of this deviation either using standards or generally applicable calculation methods.<br>(6) The ignition is to be made using an explosive charge of 50 – 100 Joule. |

| Reason |
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| - UR M82 4.3.3 |
| - UR M82 4.3.4 |
| - UR M82 4.3.5 |
| - UR M82 4.3.6 |

| Present | Amendment | Reason |
|---|---|---|
| | **Table 3.9.2 Type test for ERD (continued)** | |

| Kinds | Requirements |
|---|---|
| Explosion test method | (7) Successive explosion testing to establish an ERD functionality is to be carried out as quickly as possible during stable weather conditions.<br>(8) The pressure rise and decay during all explosion testing is to be recorded.<br>(9) The effect of an ERD in terms of pressure relief following an explosion is ascertained from maximum pressure recorded at the centre of the test vessel during the two stages. The pressure relief within the test vessel due to the installation of an ERD is the difference between average pressure of the two explosions of the reference test (stage 1) and the average of the two explosions of the ERD test (stage 2).<br>(10) For acceptance of correct functioning of the flame arrester, there is to be no indication of flame or combustion outside of the ERD during ERD test (stage 2). This is to be monitored by a high-speed video camera, for which ambient light conditions are to be considered to maximise the potential for flame/combustion detection. The use of a dark, ideally matt finish, background and an avoidance of direct light onto the video camera monitored area are recommended.<br>(11) After each ERD test (stage 2), the external condition of the flame arrester to be examined for signs of damage and/or deformation that may affect the operation of the ERD. |
| Check of ERD components | After completing the explosion tests, the ERDs are to be dismantled and the condition of all components are to be ascertained and documented. |

- UR M82 4.4

**4. Test report**

- UR M82 5

(1) A complete test report for the demonstration of opening pressure in **2** and the explosion test in **3** has to be submitted to the Society .

(2) The reports shall include respective information according to the requirements in **903.**, as applicable:

(A) Test specimens

(B) Test facility, including measuring equipment and test vessel

(C) Measuring results (pressures, temperatures, flame velocities, volumetric methane concentration, ambient conditions etc.)

(D) Video documentation of explosion tests

(E) Photo documentation of ERD components

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# CHAPTER 3 TYPE APPROVAL

## Section 15 Machinery and Equipment for Ships

(hereafter, omitted)

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# CHAPTER 3 TYPE APPROVAL

## Section 15 Machinery and Equipment for Ships

(same as the present Rules)

**Table 3.15.1 Type test item of machinery and equipment of ship *(2018)***

<table>
<tr><th>Kinds</th><th>Type test item</th></tr>
<tr><td rowspan="2">Kind 1 propeller shafts with corrosion resisting</td><td>(A) 〈same as the present〉</td></tr>
<tr><td>(B) In the type tests of kind 1 propeller shafts with synthetic resin sleeve, following items are to be included.<br>(a) Watertightness verification test with the test shaft worked up in accordance with the "Work Procedure Manual"<br>This test is to be carried out as the endurance test of the watertightness at the portion between synthetic resin sleeve and copper alloy sleeve under repeated twisting and bending loads. In this case, the construction drawing of the test shaft and the drawing of the test rig are to be indicated in the type test program.<br>(b) Adhesion test correspondingly in accordance with KS M 6518 (adhesion between the bonded areas of synthetic resin, shaft and sleeve)<br>(c) Water absorption rate test at the portion of synthetic resins is to be as deemed appropriate by the Society.<br>(d) Falling ball impact test at the portion of synthetic resins correspondingly in accordance with (KS M) ISO 6603-1 (2019)<br>~~(e) Real ship tests~~<br>~~The shafts which have passed the type tests, are to be subjected to real ship tests. In ships having a post-installing period of two years, the condition of coatings is to be confirmed in the presence of the Surveyor.~~<br>(e) 〈same as the present〉</td></tr>
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(hereafter, same as the present Rules)

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〈Guidance for Approval of Manufacturing Process and Type Approval, Etc.〉

(Amendment) Deletion of the real ship tests requirement for propeller shafts with synthetic resin coating. (New Mar 2023) 〈application date: date of contract for construction or an application for approval, on or after 1 Jul. 2024〉

- Deleted according to the results of internal deliberation.

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