CONSEIL INTERNATIONAL DES MACHINES A COMBUSTION

INTERNATIONAL COUNCIL ON COMBUSTION ENGINES

CO-ORDINATING WORKING GROUP

"CLASSIFICATION SOCIETIES – DIESEL"

ST-12-049

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Use of Aluminium and –alloys in Engine Rooms of Category „A“

Statement of CIMAC WG2 towards IACS MP

Background

Since many years discussions are ongoing between CIMAC WG2 and the IACS MP with regard to the use of Alu and/or Alu-alloys in engine rooms of category "A".

Today, mainly for 4-stroke medium- and high speed engines quite a number of components are made of Alu and/or such alloys.

It is of utmost importance for all engine designers and engine builders to rely on clear definitions and test requirements/procedures for future developments and applications.

Use of Alu and/or Alu-alloys on 4-stroke medium- and high speed engines

- Fuel filter components, fuel leakage housings
- Oil heat exchanger components, oil extractors, oil centrifuges
- Housings, covers, pans, flanges, elbows, plates, consoles, rail holders
- Actuating cylinders, pumps, control valves, pistons
- Connection parts, plug-in pipes
- TC components
- In general where such materials are being regarded as suitable with respect to stresses, loads wear and other parameters

Use of Alu and/or Alu-alloys on 2-stroke engines

- Hydraulic cylinders
- Shieldings

Other equipment

- Gas admission valves
- Housings for metering plates
- Control and solenoid valves etc.

Arguments for applying subject materials

- Light, easy machining/handling/maintenance

- Cost effective
- Non magnetic (especially for DF engines)
- Approx.three times higher heat conductivity than iron/steel
- Two time higher heat capacity

Possible risks in case of fire when applying subject materials

- Cabling and wiring will be destroyed before any Alu or Alu alloys will be affected by high temperatures
- Engine will be stopped automatically beforehand as installation equipment will not supply any inflammable liquids any more
- Eventually available and burnable liquids in small amounts will not feed a fire

Countermeasures already available in today's engine rooms

- Today's engine rooms are equipped with water sprinkling systems or other fire fighting systems
- Possible risky piping and components are suitably shielded
- Appropriate shut-off valves are applied (especially on DF/GF engines)

Arguments for leaving the today's regulations as they are

- In case of an engine room fire other materials will burn before Alu will be melted
- Oil/lube oil and fuel feeding will be interrupted long before melted Alu would release any burnable liquids
- Engines will be stopped anyway under such circumstances
- Automatic fire fighting systems will be activated
- To ban Alu and/or Alu alloys from engine rooms would have a tremendeous impact on the design (new solutions), weight, price, vibration behaviour, handling and acquisition time
- This would also have an impact on the test beds
- We have no information about fire accidents in engine rooms where possible application of Alu and/or Alu alloys has negatively influenced an existing engine room fire
- CIMAC WG2 is of the opinion that already today enough contributions for protection are available

Conclusion/Proposal

- No regulations regarding the prohibition of Alu and/orAlu alloys in engine rooms of category "A" shall be entered to the existing rules
- Any already stipulated regulations in above respect shall be removed from existing rules
- Clear definitions shall be made available for exactly which components an embargo has to be envisaged, if any
- The implementation of an embargo shall be related to new engines only (with a transition period of at least two years), if ever
- Furthermore, we recommend to take Appendix I into consideration

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ST-12-059 15.11.2012

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APPENDIX I

to ST-12-049 dated 14.11.2012

Actual situation

In a lot of cases, Aluminium is used on diesel engines and in equipment installed in machinery spaces of category A. Aluminium is used instead of iron and steel due to its specific material properties as e.g.

	Steel / Iron	Aluminium
Specific weight	7,8	2,7
Heat / thermal conductivity	50	170
Heat capacity	490	880
Melting point °C	1150	660
E-modul	210	70
	magnetic	unmagnetic

According to the existing SOLAS requirements, Aluminium as metal is a non combustible material, because it neither burns nor produces flammable vapours in sufficient quantity for self-ignition when heated to approximately 750°C. This has to be determined in accordance with the Fire Test Procedure Code. According to the Fire Test Procedure Code 2010, 6 “Products which may be installed without testing and/or Approval” and in connection with Annex 2 “Products which may be installed without testing and/or approval”, 1 “Non combustible materials”, are in general, products made only of glass, concrete, ceramic products, natural stone, masonry units, common metals and metal alloys considered as being non-combustible and they may be installed without testing and approval. Therefore, aluminium is a non-combustible material.
Only due to structural reasons, to keep the stability and integrity of the ship body and hull, aluminium has to be protected against excessive heat and tested according to SOLAS and FTP-Code. But this technical requirement is not applicable to the components fitted on the diesel engines and equipment installed in the machinery spaces of category A. Therefore it is assumed, that parts made of aluminium, installed on the diesel engines, as e.g. crankcase doors, cylinder covers etc. could be made of aluminium.

The requirement of "Steel or other equivalent material" means any non-combustible material which, by itself or due to insulation provided, has structural and integrity properties equivalent to steel at the end of the applicable exposure to the fire standard test (e.g., aluminium alloy with appropriate insulation) according to SOLAS. This is required by SOLAS, consolidated edition 2009, Chapter II-2, Part B: "Prevention of fire and explosion", Regulation 4 "Probability of ignition", 2.2.5 "Oil fuel piping". For filters, regulation valves, separator for oil mist, strainer etc. installed in machinery spaces of category A, the structural integrity of the pressure loaded housing, body and piping is not the main fire protection criteria due to the very special and comprehensive fire detection and fighting system requirements to keep the function of the machinery installed in this machinery spaces. The machinery will fail at temperature below 150°C due to the installed sensors, cables, sealing, electronic etc. To maintain the propulsion energy and electrical energy, any high temperature or any fire is to be detected by the fire detection system. Additional, it has to be considered, that steel bolts and nuts used for the connection of conventional steel flanges lose their mechanical strength by heating up from 20°C to 200°C for bolts strength class 5.6 from 300N/mm² to 195 N/mm² and bolts of strength class 8.8 from 640 N/mm² to 480 N/mm². Based on this strength loss, any flange connection sealing system will be untight because of the loss of the pretension of the sealing. The leaking flammable liquids of the steel piping system will make light and spread any fire in the machinery space. A lot of sealings, especially O-ring sealing, are not heat-resistant for more than 200°C.

Conclusion

In regard to the above mentioned reasons, aluminium should be allowed to be used in and on machinery and the related equipment and piping installed in machinery spaces of category A.

References:

SOLAS consolidated edition 2009, Chapter II-2. "Construction – fire protection, detection, extinction" Part A "General", Regulation 3 "Definitions", 33; 43
2010 FTP Code, International Code for Application of fire test Procedures, 2010, 2012 edition:
Annex 1: Part 1, Appendix "Fire test procedures for non-combustibility test", "Introduction"
6 "Products which may be installed without testing and/or Approval",
Annex 2 "Products which may be installed without testing and/or approval", 1 "Non combustible materials"