SiO Guidelines to SOLAS Ch. II-2/15.2.9-12 (Consolidated Edition 2001)

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Introduction

Through the SOLAS 1994 Amendments (MSC 31(63)) the International Maritime Organisation (IMO) introduced new regulations in SOLAS Chapter II-2 Part A Regulation 15.2.9 to 15.2.12 on oil fuel arrangements.

The regulations have been valid for new ships build on or after 1 July 1998. From 1 July 2003, Reg. 15.2.9 to 11 are made retroactive for all ships regardless of date of build.

This has led to an increased focus on the subject of SOLAS Regulations and fire protection among the Flag Authorities (through IMO), Port State Control (PSC), ship owners and diesel engine manufacturers.

In response to this increased focus, it is found necessary to present DNV's interpretations of the above mentioned regulations. These are mainly based on the discussions, still ongoing, in both IACS and IMO concerning these matters. Due to the ongoing discussions, DNV may be forced to review these interpretations later.

This paper is meant to be a guideline for SiO surveyors to the SOLAS regulations 15.2.9 to 15.2.12, and its content is based on frequent questions (FAQ) from our surveyors and owners/managers. Attached to these guidelines is a drawing showing a typical fuel oil system.

Remember:

- These are not DNV class requirements. This is part of the Safety Construction Certificate (CCC) and is to be dealt with by DNV only if DNV is authorised by the Flag Authorities to do so.
- In cases where DNV is not issuing the Safety Construction Certificate, above regulations are the responsibility of the Flag state and the class survey, as always, is only to confirm continuous compliance with the applicable class rules.
- Do not confuse the SOLAS requirements with DNV rules for vessels with E0 class notation. There is no connection, even if the requirements are similar.
- DNV enforces the SOLAS requirements on behalf of the Flag states, and possible exemptions from the regulations can only be granted by the Flag state.
- The regulations 15.2.9 to 11 are only made retroactive for fuel oil and not for lubricating oil (15.3) or other flammable oils (15.4).
- A standard "Statement of Compliance" covering these regulations is available at MTPNO376 and may be used when asked to issue such statement.

Practical handling of the requirements

Verification of compliance with the requirements is normally carried out as part of the annual survey. DNV has no obligation to survey all ships or ships affected by the retroactive requirements before 1 July 2003 to verify compliance, but will of course do so on request from owners.

A "Statement of Compliance" has been prepared for issuance upon completion of a survey of the items covered by the requirements in 15.2.9 - 12. It is not mandatory for any vessel to have such a document on board, but it may prove useful.

Until 1 July 2003, it is necessary to take the vessel's construction date into consideration if the surveyor finds that the vessel is not in compliance with the requirements:

- If the vessel was built before 1 July 1998 no action should be taken. If requested to issue a "Statement of Compliance", items found not to be in compliance with the requirements should be listed.
- If the vessel was built on or after 1 July 1998 the requirements already apply, and a CA (or CC as described below) may be issued based on the findings.
- For vessels built after 01 January 2001, a CC should be issued instead of a CA. The background for this distinction is that the SOLAS requirements were implemented in the DNV rules from that date.

After 1 July 2003 the requirements are the same for all ships, and a CA (or CC as described above) may be issued based on non-compliance regardless of construction date.

Upon completion of a safety construction survey, form no CEC 303.1a also is to be completed.

Some notes on the intention of the SOLAS regulations

The SOLAS Regulations are clearly aimed at minimising the risk of fire. With the Regulations fire is prevented with two equally applicable measures, insulation of hot surfaces and screening/shielding of pipe connections in pipelines containing fuel oil, lubrication oil and hydraulic oil (*remember: only fuel oil is made retroactive*!).

It is important to note that both these measures are required. Hence, even if the hot surfaces of the engine are sufficiently insulated, screening of pipe connections is still required. There are two reasons for this duplication of safety measures. Firstly, no common industrial standard exists for this insulation. Secondly, the insulation has a tendency to deteriorate to the extent that surfaces with temperatures above 220°C may become exposed.

History and supporting documents

DNV has taken proactive action by issuing a letter to owners and operators of vessels affected by the retroactive requirements. This letter may be found on our intranet pages. Here you will also find the circulars issued by IMO with regard to this matter.

Document	Issued
IMO MSC/Circ.647	6 June 1994
IMO MSC/Circ.851	1 June 1998
DNV Letter to owners	11 December 2001
Reminder to owners in Classification News 4.2001	
DNV Reminder to surveyors (Newsletter)	19 April 2002
Memo to surveyors (MTPNO373/KRESSE/262-J-29202)	04 March 2003

You will also find a collection of service letters from engine makers regarding compliance with the requirements.

SOLAS Reg. II-2/15.2.9:

> *"All external high-pressure fuel lines between the high-pressure fuel pumps and fuel injectors shall be protected with a jacketed piping system capable of containing fuel from a high-pressure line failure. A jacketed pipe incorporates an outer pipe into which the high-pressure fuel pipe is placed, forming a permanent assembly. The jacketed piping system shall include a means for collection of leakages and arrangements shall be provided for an alarm to be given of a fuel line failure."*

Intention/purpose
The sole purpose of the jacketed pipe is to contain the fuel from a possible high pressure line failure.

Explanation/clarification of the requirement
A "jacketed piping system" consists of: high pressure jacketed pipes, drainage to a leak collecting tank with alarm connected to the ships main alarm & monitoring system and an overflow pipe from the leak collecting tank to a fuel oil overflow tank.

The high pressure fuel pipes that are to be protected with a jacketed piping system are, as stated in the SOLAS text, the external high pressure fuel pipes between the high pressure fuel pumps and the fuel injectors. The fuel pumps in this case are the high-pressure pumps attached to the engine, and the only pipes that are to be jacketed are the ones between these pumps and the injectors (see enclosed drawing).

The requirement only applies to *external* high-pressure fuel lines. On engines where the piping is totally enclosed in such a manner that any leakage is contained and collected, single-walled piping may be accepted. The condition for acceptance of such arrangements is that contamination of lubricating oil in case of a leakage is prevented, and any leakage must be detectable.

To use a fuel drain tank as a leak collecting tank is not acceptable. The leak collecting tank should contain less than approximately 1-30 litres, depending on the size of the engine. This is to make sure any possible leaks are detected at an early stage.

Practical survey guidance
The surveyor, when asked or doing Safety Construction Survey after 1 July 2003, is to check that a jacketed piping system is installed. It can in many cases be difficult to decide whether a pipe is double or single walled just by looking at it. However, a jacketed piping system should be equipped with a leak collector tank with alarm. Ask an engineer to demonstrate the system. Another way of finding out is to take a closer look at a spare pipe or in the engines manual on board.

In case the jacketed piping system has to be retrofitted, the main principles are:

- If jacketed piping system is available from the original engine manufacturer, DNV does not accept any other solutions.
- If jacketed piping system is **not** available from the original engine manufacturer DNV does accept case by case approval on request from the Manager/Owner (if applicable, further guidelines are available at MTPNO376).

The surveyor does not have to find out if original equipment is available. For acceptance of retrofitted jacketed piping, proof of origin or documentation of MTPNO approval is to be available.

SOLAS Reg. II-2/15.2.10:

> *"All surfaces with temperatures above 220° C which may be impinged as a result of a fuel system failure shall be properly insulated."*

Intention/purpose
The purpose of insulating hot surfaces is to prevent any flammable liquid from getting in contact with such surfaces, thereby minimising the risk of ignition in case of a leakage.

Explanation/clarification of the requirement
Equivalent requirements have already been a part of DNV rules since the mid 1970s and as it now is a part of SOLAS as well, we can expect more focus on hot surfaces from PSC. As mentioned in the introduction, DNV enforces the retroactive SOLAS requirements on behalf of the Flag states, and should thereby follow their interpretation.

All hot surfaces are to be insulated to ensure that no exposed surface has temperature above 220°C. The insulation material must be fit for purpose, i.e. made of non-combustible material with a non oil-absorbing surface. It is important to ensure proper insulation of flanges, indicator cocks, bolts and studs and other protruding parts. Even water cooled exhaust manifolds may have flange connections with temperatures exceeding 220°C.

Known trouble areas are;
- indicator valves
- exhaust pipes from each cylinder
- exhaust manifold, in particular overlaps between steel sheets and laggings
- turbochargers, in particular flanges to such
- cut outs for pressure / temperature sensors, etc

Practical survey guidance
This requirement that involves detection of hot surfaces has traditionally been difficult and time-consuming for the surveyors to enforce. Today, thermo graphic analysis, which is a quick and reliable way to reveal hot spots, is readily available more or less all over the world.

We recommend any of the three following methods for identifying hot spots:
- Surface/Contact thermometer
- Laser based infrared heat tracers
- Infrared thermo scanning video equipment

As there is no requirement to carry out such measurements, it is entirely up to the surveyor whether to rely on measurements carried out by others.

Unfortunately, detection of hot surfaces using the methods above requires running the machinery at or near full load. If this is not possible, or if adequate equipment is not available, common sense has to be applied. On board a ship there will be other good indicators of hot spots, such as faded or burned paint and destroyed/burned insulation. Unpainted steel will, when repeatedly heated, over a period of time attain a surface colour distinguishable from unheated steel.

When issuing a "statement of compliance", the surveyor should state which method(s) that have been used to verify proper insulation of surfaces.

SOLAS Reg. II-2/15.2.11:

> "*Oil fuel lines shall be screened or otherwise suitably protected to avoid as far as practically possible, oil spray or oil leakages onto hot surfaces, into machinery intakes, or other sources of ignition. The number of joints in such piping systems shall be kept to a minimum.*"

Intention/purpose
The intention with screening of pipe connections is to prevent spray or dribbling caused by loose or broken pipe connections, from reaching any potentially hot surface, machinery intakes, or any other source of ignition. By potentially hot surface is meant any surface on or around the engine where the surface temperature may exceed 220°C in case of defective or insufficient insulation.

Explanation/clarification of the requirement
Shielding is only required for piping systems under pressure exceeding 0.18 N/mm2 (1,8 bar) which are located above or near units of high temperature, including boilers, steam pipes, exhaust manifolds, silencers or other equipment required to be insulated by SOLAS reg. II-2/15.2.10. It is further required if oil spray or oil leakages may reach machinery intakes or other sources of ignition. IMO, and so DNV, is focusing only on pipe connections and not entire pipelines. This is because all our experience indicates that leakages occur in way of pipe connections and not in way of the piping itself.

Remember: Requirements for shielding are retroactive for existing ships for fuel oil pipes only. The requirements regarding lubricating oil (15.3) and other flammable oils (15.4) are only applicable to ships built on or after 1 February 1992 (15.3) and 1 July 1998 (15.4).

The screening need not enclose the pipe connections, i.e. need not contain a leakage. It is acceptable to have leakage dribbling out of the screening, of course provided that there is no potentially hot surface beneath. It is in fact preferable to allow for visualisation (by e.g. dribbling) of the leakage in order to have the situation detected and rectified. It is, however, not required to have any detection system for leakage in such cases.

Flexible hoses have to be screened when installed in positions where they as mentioned above may suffer external damage.

There is no requirement for type approval of screening arrangements or materials used; any solution that fulfils the intentions of the requirement is acceptable. This may include large area sheeting solutions covering many complex joints, individual joint wrappings, re-routing of piping to "safe" areas or complete enclosure of piping and connector by conduit.

Practical survey guidance
Verify by visual inspection that flanged joints, bonnets and any other flanged or threaded connections (i.e. all pipe connections regardless of the nature of the connection) have been adequately screened. In judging adequacy, it is important to have the intentions of the regulations (as explained above) fresh in mind. The critical items in piping systems are the pipe connections and fittings working loose and flexible hoses located in such a way that they could suffer external damage.

Examples of screening are a spray shield around flanged connections or shields protecting valve blocks or other components with pipe/hose connections that if working loose could cause spray.

Some guidance is given by the following examples:

Screening formed by parts of engine construction itself:
The screening may be formed by parts of the engine construction itself. Take as an example, a vee engine where the exhaust manifold and any other *potentially (ref. above)* hot surface is located within the vee and where fuel pipelines (and connections) are located well down on the side of the engine. For these fuel pipes connections it will (depending on engine construction and possibility for a spray to reach potentially hot surfaces *on* the engine itself) be sufficient to apply a half-moon shaped spray sheet around the outer part of the pipe connection. This spray sheet will protect against spray onto any potentially hot surface *next to* the engine.

Pipe connections subject to circumferential screening:
Take as an example pipelines running in longitudinal direction on top of cylinder heads, but on the outer side (again a vee engine) of rocker gear cover. Where pipe connections may be located in the "gap" between two adjacent rocker gear covers, spray from a leakage may reach parts of exhaust manifold in the vee. For such connections, a practicable approach would be to apply circumferentially formed spray sheets around the connection that would protect from spray both onto the *potentially* hot exhaust manifold as well as any other *potentially* hot surface around the engine.

Pipe and pipe connections located above potentially hot surfaces:
Pipelines that are running over potentially hot surfaces must be treated with care. The pipe connections are to be properly screened (see above for examples). However, due attention must also be paid to possible dribbling down onto any *potentially* hot surface beneath. In this context one should also consider possible dribbling from liquids that are leaking along the outside of the pipe. For such arrangements drip trays (in form of e.g. drip moulding) should be considered.

Please keep in mind that there are many alternative acceptable solutions which will satisfy the intention of the SOLAS regulations

SOLAS Reg. II-2/15.2.12:

> "*Ships constructed before 1 July 1998 shall comply with the requirements of paragraphs 2.9 to 2.11 not later than 1 July 2003, except that a suitable enclosure on engines having an output of 375 KW or less having fuel injection pumps serving more than one injector may be used as an alternative to the jacketed piping system in paragraph 2.9.*"

Intention/purpose
The purpose of this paragraph is to impose the requirements in paragraphs 2.9 to 2.11 on ships constructed before 1 July 1998. The paragraph also describes the only exemption from the requirements.

Explanation/clarification of the requirement
A suitable enclosure for the fuel injection piping system can be accepted in lieu of a jacketed piping system provided:

1) Engine maximum continuous output is less than 375 kW
2) Engine is equipped with one fuel injection pump serving more than one injector (engines with only one cylinder is considered to be included in this category).

As the enclosure is to be an alternative to a jacketed piping system, it should to the extent possible meet the same requirements. The enclosure should:

- Together with existing "cold" surfaces (such as engine block or inlet manifold) enclose the h.p. piping in such a manner that a jet or spray from a leakage will not be able to escape the enclosure onto a potentially hot surface.
- Have sufficient strength to withstand penetration by a jet of fuel.
- Prevent leaking fuel from dripping onto potentially hot surfaces.

Screening such as the use of for instant FN tape is not applicable as a suitable enclosure.

No approval of the suitable enclosure is required.

According to 15.2.9 the alarm constitutes part of the jacketed piping system. Substituting a jacketed piping system with a "suitable enclosure" will thus cancel the leak alarm requirement. The same applies for leak collection.

Practical survey guidance
Certified engine output should be verified to ensure that engine power actually is less than or equal to 375 kW.

The surveyor will have to rely on his own judgement with regard to the design and workmanship of the enclosure. Keep in mind that the enclosure should withstand penetration by a high-pressure jet of fuel; normally you would expect the enclosure to be made of sheet metal. The enclosure must be properly attached to the engine in such a manner that the entire length of the h.p. piping is properly enclosed. The enclosure shall enclose the piping in such a manner that no jet or spray of fuel from a leakage may escape the enclosure onto a potentially hot surface, but it does not have to collect the fuel.

Typical fuel system