



SUB-COMMITTEE ON FIRE PROTECTION
48th session
Agenda item 3

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**UNIFIED INTERPRETATIONS TO SOLAS CHAPTER II-2, THE FSS CODE
AND RELATED FIRE TEST PROCEDURES**

Guidelines on insulation of high temperature surfaces

Submitted by the Republic of Korea

SUMMARY

Executive summary: This document proposed guidelines on insulation method of high temperature surfaces in compliance with SOLAS regulation II-2/4.2.2.6

Action to be taken: Paragraph 7

Related documents: MSC/Circ.647

Introduction

1 SOLAS regulation II-2/4.2.2.6.1 concerning the protection of high temperature surfaces stipulates as follows:

“Surfaces with temperatures above 220°C which may be impinged as a result of fuel system failure shall be properly insulated.”

2 The Maritime Safety Committee, at its sixty-third session, approved MSC/Circ.647 on Guidelines to minimize leakages from flammable liquid system. Among others, appendix 7 of the aforementioned circular recommends installation, inspection and maintenance details of the insulation of hot surfaces to reduce the risk of fire by reducing temperatures of surfaces below the auto-ignition temperature of flammable oils.

Purpose of research

3 SOLAS regulation II-2/4.2.2.6.1 and MSC/Circ.647, however, do not provide where the hot surfaces actually or possibly exist on board ships. Moreover, since implementation of the regulation and dissemination of the circular, there have been a number of machinery fire incidences caused by hot surfaces.

4 In this regard, the Republic of Korea carried out a study to find out where the hot surfaces still exist in machinery space on board ships which hold all valid SOLAS certificates. The study was carried out using the thermal imager and portable digital temperature gauge on board ships in service with the help of ship owners. The measurement of temperature was carried out in the maximum continuous revolution condition for main propulsion engine and the normal navigational load condition for electric generating engine. The study was conducted for new ships in order to focus on design conception and for older ships aged 10 years or over to evaluate the adequacy of current inspection and maintenance schemes.

5 Annex 1 shows the details of study results which have been circulated to shipbuilders and engine manufacturers in the Republic of Korea for the future modification of insulation methods at the new ship building stage.

Proposals

6 Based on the study results, the Republic of Korea would like to propose guidelines on insulation method of high temperature surfaces, as set out in annex 2, to provide information to engine manufacturers, shipyards, shipowners, classification societies and other parties concerned. The Republic of Korea is of the opinion that the guidelines could be developed into an MSC circular, as appropriate, to supplement the guidance contained in MSC/Circ.647 by providing the accurate description of the hot surfaces and by suggesting adequate installation method and maintenance practice for various parties concerned.

Action requested of the Sub-Committee

7 The Sub-Committee is invited to consider the above comments and take action as appropriate.

ANNEX 1

ONBOARD INVESTIGATION RESULT

1 High temperature surface

In general, hot surfaces with temperatures above 220 °C on board ships are:

- .1 Exhaust gas piping: It is known that the typical surface temperature range of exhaust gas pipe is between 350 – 500 °C when it is not insulated, although it varies according to engine's type, out-put and specific characteristics.
- .2 Superheated steam piping: Normal saturated steam is below 200 °C and super heated steam, however, is over 500 °C.

In this regard, most passenger ships and typical normal cargo ships are generally installed with auxiliary boiler with less than 10 bar of pressure which means that the maximum temperature is less than 200 °C. Therefore, the only hot surface in engine room is expected around the exhaust gas piping except for ships fitted with steam turbine engine such as LNG carrier. As for the steam line, regardless of saturated steam or super heated steam, it is known to be insulated for protection of personnel on board ships from hot surfaces and pressured steam. Hence, this research focused on exhaust gas piping excluding super heated steam pipe.

2 Results of measurement

2.1 In new ships

The measurement result of newly built ships showed that the insulation were normally in good condition. However, some inappropriate workmanship were observed revealing higher temperature than expected.

.1 Exhaust gas manifold

Generally, exhaust gas manifold are insulated with glass fabric encased in steel sheathing or equivalent material to prevent the oil penetration. If insulated properly, the temperature of surfaces is in the 100 °C (plus/minus 5) range in engine full load condition as shown Figure 1. Around exhaust gas manifold supporting stay, however, the points over 220 °C were observed due to misplaced insulation in those parts as shown in Figure 2.

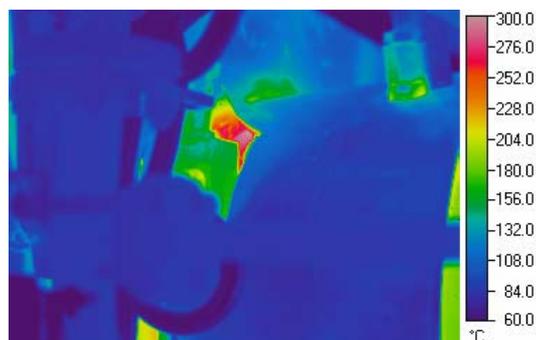
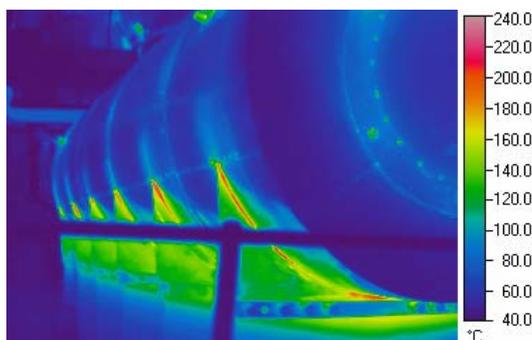


Figure 1. Exh. gas manifold of M/E

Figure 2. Exh. gas manifold of M/E (close-up)

.2 Exhaust gas piping

The areas around exhaust gas piping between turbo charger and exhaust gas manifold, and exhaust gas piping before and after turbo charger was mostly found to be hot surfaces. In these cases, the problem stemmed from the poor workmanship on that area caused by complicated shape. This in turn has caused discontinuity of insulation making the exhaust gas pipe exposed to high temperature surfaces. Figures 3 and 4 show the typical temperature of these areas.

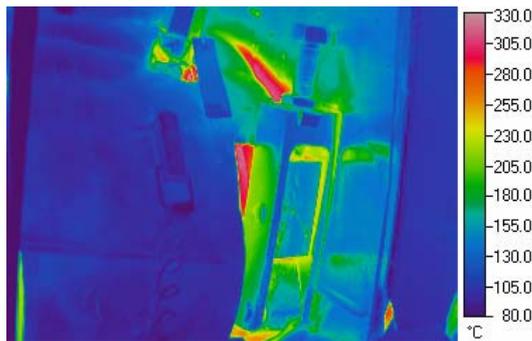


Figure 3. Exhaust gas outlet compensator to manifold(M/E)

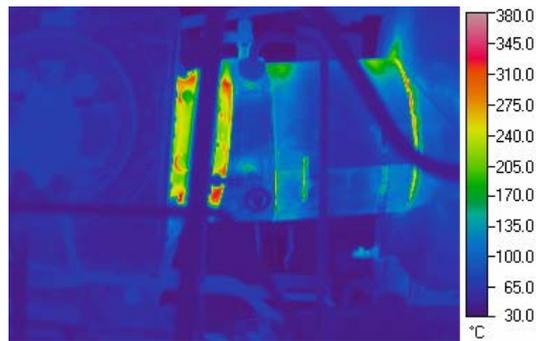


Figure 4. Exhaust gas pipe to T/C (M/E)

.3 Turbo charger

Turbo-chargers of main engine are normally water-cooled type. By this reason, their surface temperature is in the 80 °C range. Therefore, the non-insulation of the turbo charger is a normal practice. The temperature range of turbine side is shown in Fig 5. However, turbo chargers used in small diesel engines with less than 1000 kW output such as diesel generating engine, etc. have hot surfaces due to some parts not being insulated. As shown in Figure 6, the temperature at inlet and outlet of turbine side were measured to be around 400 °C.

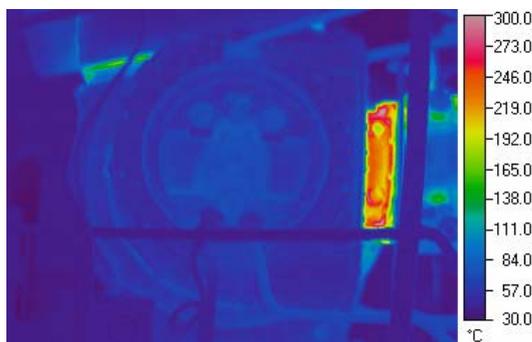


Figure 5. Turbo charge turbine side of M/E

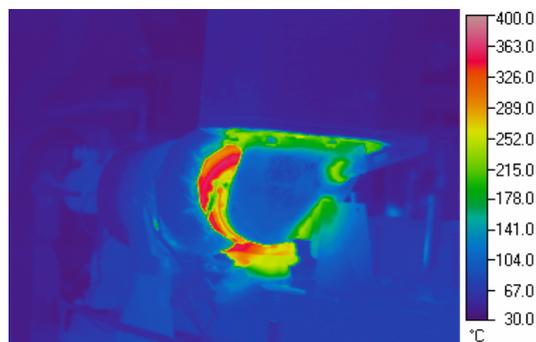


Figure 6. Turbo charger of G/E

.4 Boiler furnace

Boilers were found to be well insulated as shown in figures 7 and 8 and the only hot surfaces over 220 °C found were area around peep hole as shown in figure 8.

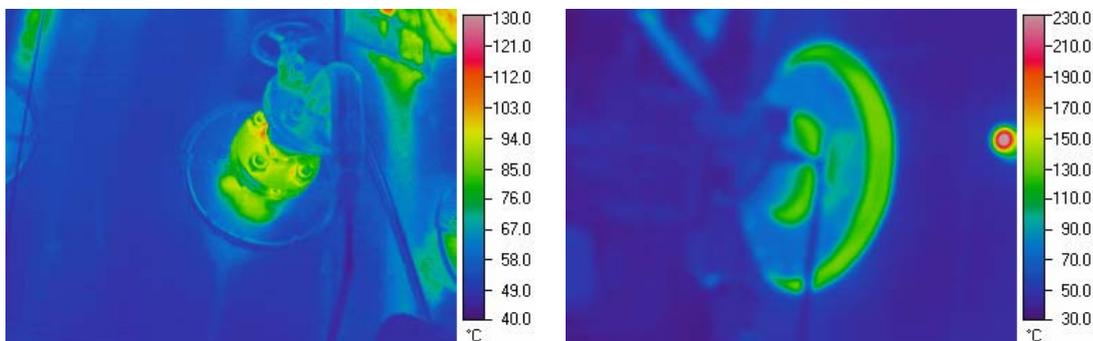


Figure 7. Boiler feed water valve close-up **Figure 8. Boiler burning point**

2.2 In existing ships

For ships aged over 10 years, in addition to facts mentioned paragraph 2-1 above, problems which can be attributed to inappropriate maintenance were found as follows:

.1 Exhaust gas manifold (silencer)

For main engine as shown in figure 9, joint areas of manifolds were measured as having relatively high temperature due to aging of insulation material. Figure 10 shows the hot surfaces at manifold support of main engine. Figure 11 indicates that the hot surfaces found were around inspection man hole located at both ends of exhaust gas manifold. In this case, the insulation for inspection man hole was properly fitted, but the part of the insulation material was taken off and the gap has become widened due to frequent inspection and maintenance. Figure 12 shows that some parts of exhaust gas piping to manifold were found to have high temperature.

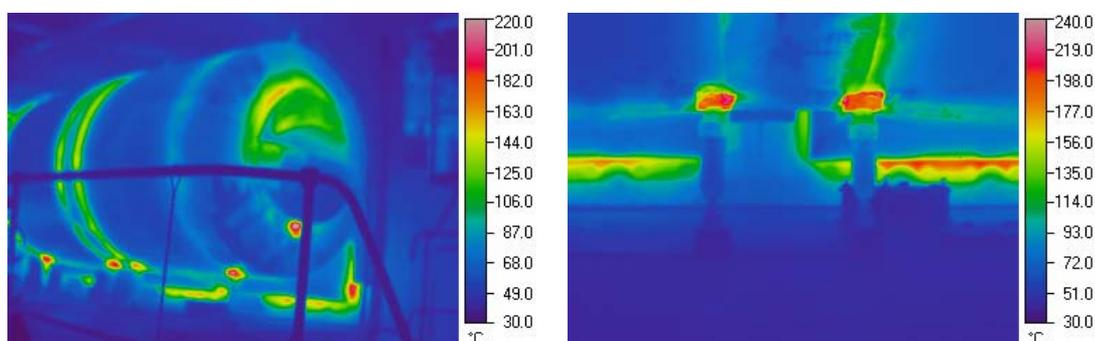


Figure 9 Exhaust gas manifold of M/E **Figure 10 Exh. gas manifold support of M/E**

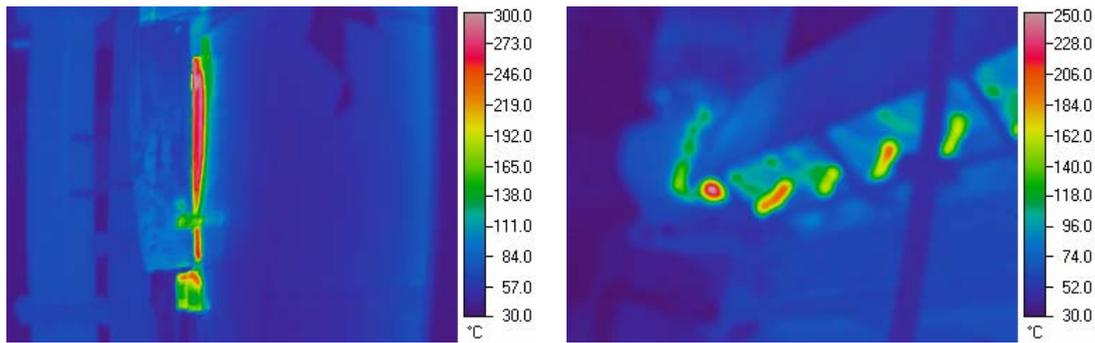


Figure 11 M/E exh. gas manifold end Figure 12 G/E exh. gas manifold row

.2 Exhaust gas piping

The measured temperatures around exhaust gas piping on older ships were of similar in pattern to that of new ships. Like new ships, areas around exhaust gas piping before and after turbo charger and exhaust gas piping between cylinder and exhaust gas manifold were found as hot surfaces. Figure 13 shows that an inappropriate replacement of insulation has resulted in hot surface after maintenance work of exhaust gas compensator (expansion joint). In general, when the insulation is arranged in horizontal direction there is no problem, but when installed in vertical direction, the insulation materials tend to compress down resulting in hot surfaces.

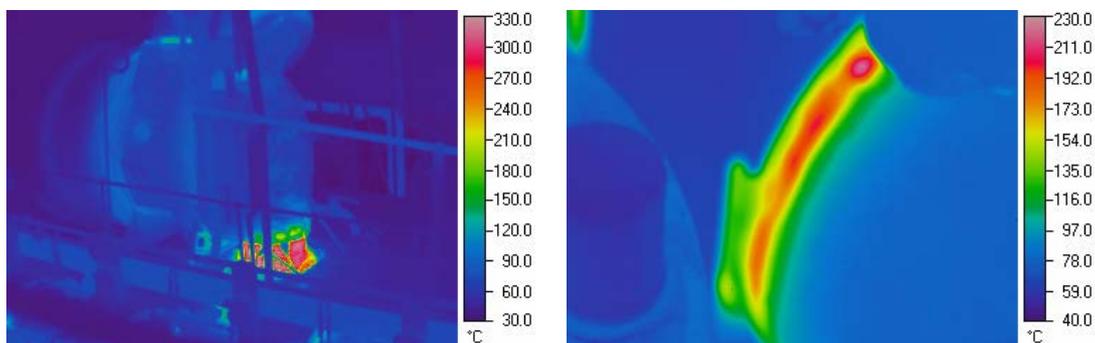


Figure 13 T/C inlet compensator (missing part) Figure 14 M/E outlet compensator to manifold

.3 Turbo charger

In case of M/E turbo charger, normally being of wet type, the surface temperature was in 90 °C range. Figure 15, however, shows the high temperature area around compensator when the insulation was removed after maintenance. In case of G/E turbo charger, normally being of dry type, many parts of surfaces were revealed as areas having high temperature as shown in figure 16.



Figure15 M/E turbo charger

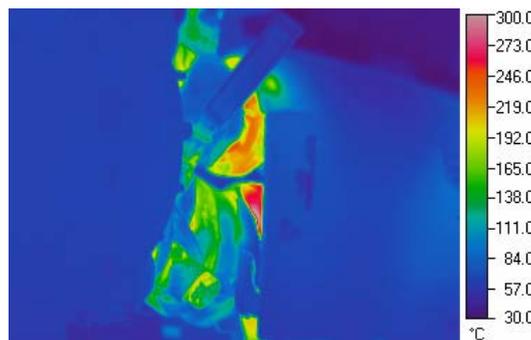


Figure16 G/E turbo charger

2.3 Super-heated steam line

As shown in Figure17, superheated steam pipe and globe stop valve were found not to exceed 220 °C and over. However, superheated steam pipe and angle valve were found to have relatively high temperature - around 360 °C. In this case, the problem was found to stemming from the discontinuity of insulation because the direction of insulation changed at the valve.

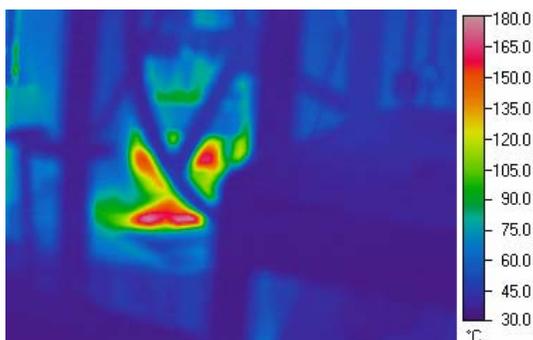


Figure 17 Superheated steam pipe and globe V/V

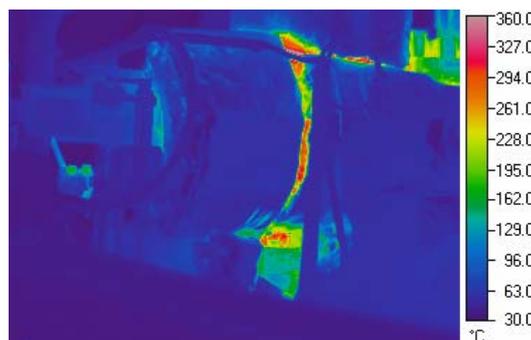


Figure 18 Superheated steam pipe & angle V/V

2.4 Other high temperature areas

As shown in figures 19, 20, 21 and 22, there was no significant sign of hot surfaces around main engine, indicator cock and cylinder head. Whereas the temperature of fuel injection nozzle was found to be around 140 °C like the temperature of fuel oil, the temperature around cylinder was found to be similar to engine cooling temperature. Even the area of M/E indicator cock was found to indicate lower temperature than expected. The step area of the indicator was found to have relatively high temperature - around 160 °C.

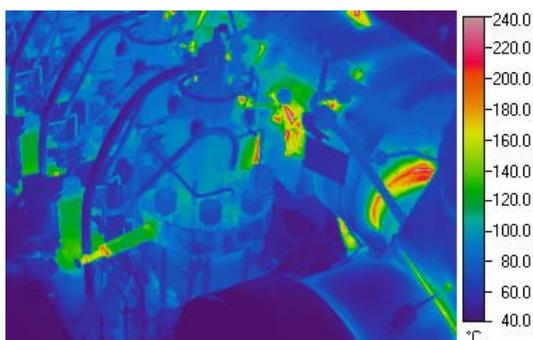


Figure19 Main engine (front view)

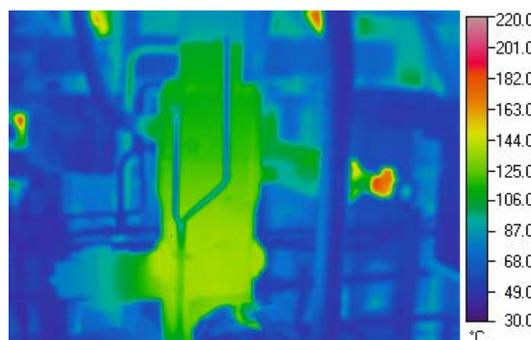


Figure20 Main engine(front view, close-up)

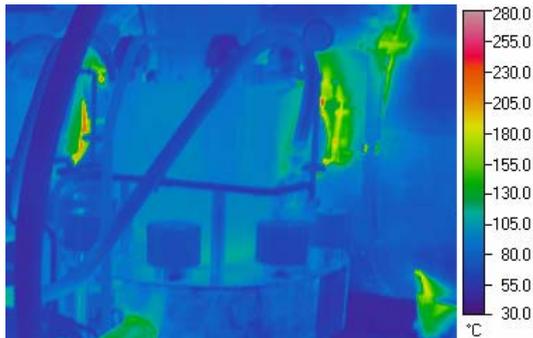


Figure 21 M/E cylinder(close-up)



Figure 22 Indicator cock of M/E

3 Shipyard/manufacturer practice

In general, the installation of insulation on outlet area of turbo charger is conducted by ship builder according to shipyard practice and the area between cylinder and exhaust gas pipe and inlet area of turbo charger are conducted by engine manufacturer according to manufacturer practice. Therefore, when fitting insulation on exhaust gas pipe, the engine manufacturer and shipyard should pay special attention.

ANNEX 2

DRAFT GUIDELINES ON INSULATION OF HIGH TEMPERATURE SURFACES

1 Scope

1.1 SOLAS regulation II-2/4.2.2.6 requires the protection of high temperature surfaces. Appendix 7 of MSC/Circ.647 recommends installation, inspection and maintenance details of the insulation of hot surfaces to reduce the risk of fire by reducing temperatures of surfaces below the auto-ignition temperature of flammable oils.

1.2 SOLAS regulation II-2/4.2.2.6.1 and MSC/Circ.647, however, do not provide where the hot surfaces actually or possibly exist on board ships. Moreover, since implementation of the regulation and dissemination of the circular, there have been many machinery fire incidences caused by hot surfaces.

2 Purpose

2.1 This document is to provide guidelines to comply with SOLAS regulation II-2/4.2.2.6 and to supplement the guidance contained in MSC/circ.647 by suggesting adequate installation method of insulation and maintenance practice for various parties concerned.

3 Insulation practice for new ship

3.1 General

Different kinds of insulation method for high temperature surface are possible and their design should be confirmed by relevant Administrations or recognized organizations. Examples of insulation practice are given in figures A2-1 and A2-2 below.

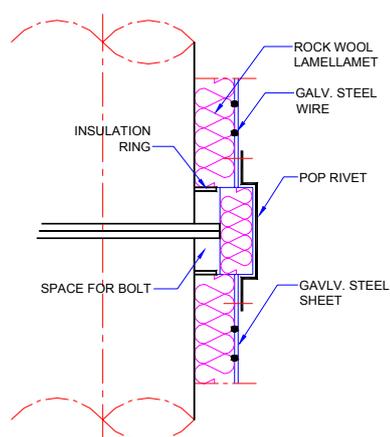


Figure A2-1 Insulation method on flanged part

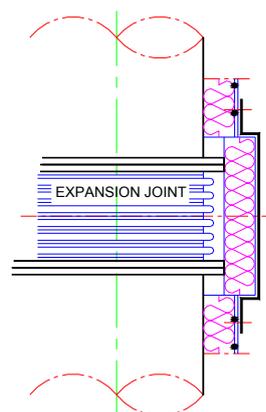


Figure A2-2 Insulation method on compensator part

3.2 Exhaust gas piping

In order to avoid the discontinuity of insulation of the exhaust gas piping (i.e. the exhaust gas piping before and after turbo charger and the exhaust gas piping between cylinder and exhaust gas manifold), special finishing material (e.g. pot rivet or finish insulation mat) should be used as shown in figure A2-3.

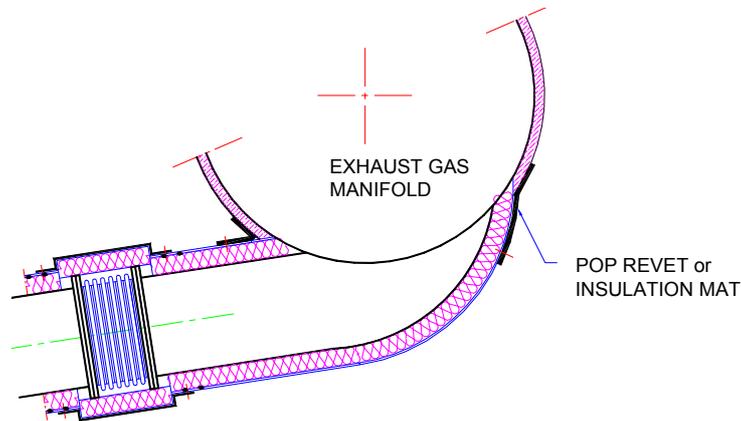


Figure A2-3 Insulation practice of discontinuous part

3.3 Exhaust gas manifold

Even though the insulation of exhaust gas manifold is considered sturdy and satisfactory, special attention should be given to insulating supporters of manifold which are susceptible to become hot surfaces due to heat transfer.

3.4 Exhaust gas turbo charger

Dry type turbo charger, if installed, should be completely insulated, as practicable, to prevent the existence of high temperature surface.

3.5 Indicator cock

If there is drastic change in size on indicator cock, insulation mat should be taped smoothly in order not to reveal naked part of the pipe

3.6 Superheated steam pipe

In order to avoid the discontinuity of insulation of superheated steam piping, special finishing material, e.g. pot rivet or finish insulation mat, should be used.

4 Inspection and maintenance

4.1 A regular check of equipment or material should be made to confirm that the insulation is in place as installed. When maintenance or repair to equipment has been carried out, checks should be made to ensure that the insulation covering the heated surfaces has been properly replaced. Especially, special attention should be paid on the following:

- .1 insulation part where vibration may be happened normally;
 - .2 discontinuous part of exhaust gas piping;
 - .3 exhaust gas piping and turbo charge of generating engine; and
 - .4 other suspected part.
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Note : One copy of this document containing color image of figures 1 to 22 of annex 1 will be distributed during the session.