TECHNICAL PAPER

HOT SURFACES IN ENGINE ROOMS

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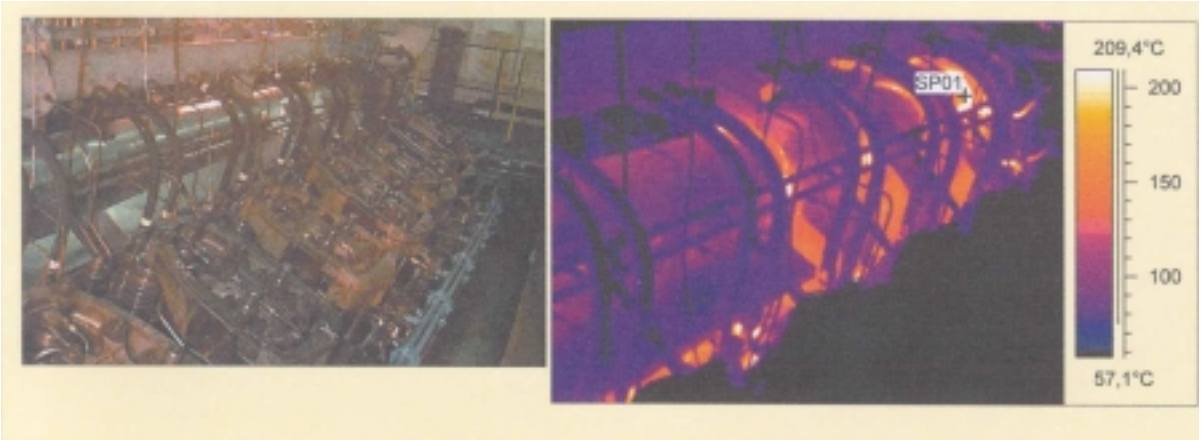

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1 INTRODUCTION

Oil leakage hitting hot spots on engines is the most common cause of engine room fires on board ships. According to DNV casualty statistics, more than 60% of all engine room fires have been initiated by a hot spot. It is also our impression that fires caused by oil leakage / hot spots are in general more serious than fires caused by other factors.

Most lubrication, hydraulic and fuel oils have a autoignition point above 250°C. If a liquid hits a surface hotter than its autoignition temperature, the liquid may ignite spontaneously. Any such hot spot represents an immediate hazard in the case of oil leakage.

This paper will address how to detect hot surfaces on engines.

1.1 Rules

According to IACS / DNV rules and after 1998 also SOLAS, all surfaces above 220°C are to be insulated or equivalent protected in order to avoid ignition of flammable fluids.

The relevant rule references can be found in the DNV Rules for Classification of Ships Pt.4 Ch.1 Sec.3, A507 and SOLAS Ch.II-2, Reg.15.2.10 (implemented July 1998 – not included in SOLAS Consolidated Edition, 1997). DNV surveyors should also apply IS I-B4.3 (2.7, 3.7, checklist) and IS I-C2.3 (2.3).

2 HOT SURFACES

2.1 Areas to be Examined

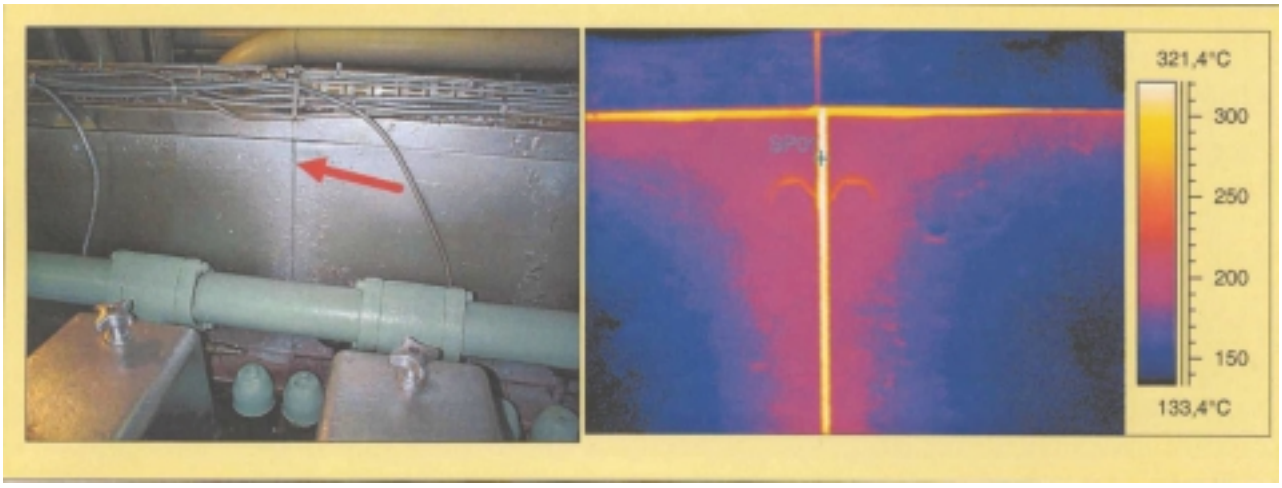
A full review of diesel engines should include the items listed below – common trouble areas are marked with (!)

- engine “body”
- indicator valves (!)
- cylinder hoods
- exhaust pipe from each cylinder (!)
- tie in to exhaust manifold
- exhaust manifold, in particular overlaps between steel sheets and laggings (!)
- foundation and lifting lugs on exhaust ducts
- turbochargers, in particular flanges to such (!)
- cut outs for pressure / temperature sensors, etc. (!)
- surfaces of floodlights.

2.2 Known Trouble Areas

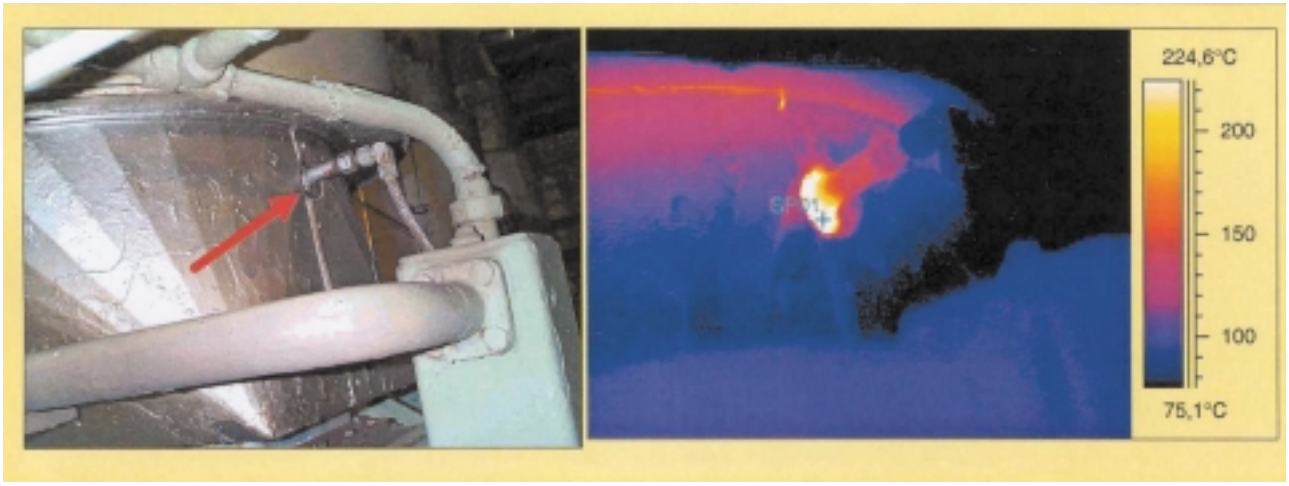
From the above scope of work list we have picked out five areas where most hot spots are found.

Detail 1. Hot indicator valve. Area is only a few cm² and difficult to detect. It is advised to examine area around one chosen cylinder thoroughly, as many items will be identical on all other cylinders on that engine. Hot spot as indicated by arrow is 260°C.

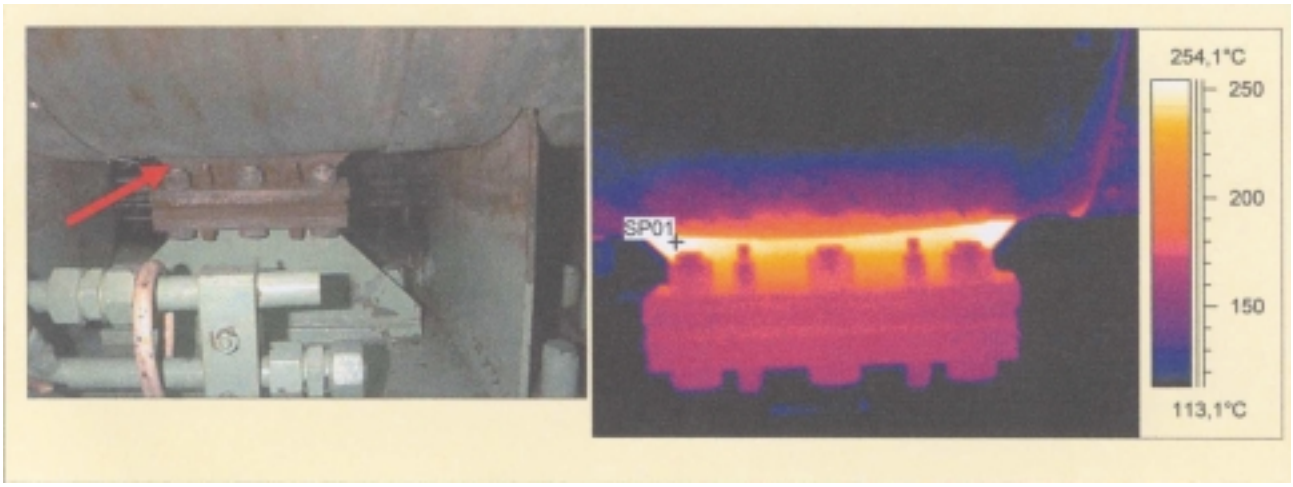


Detail 2: No overlap between steel sheeting covering exhaust manifold. Same problem often found on "insulation pad" type insulation. Larger gaps in insulation than shown on above picture can often be found. New steel sheeting with proper overlap to be provided or additional protection to be applied in way of joints. Hot spot = 320°C.

Detail 3: No insulation of flanges between exhaust manifold and exhaust duct. Hot spot = 230°C.



Detail 4: Cut out for sensor. Insulation and steel cover to be applied tight to sensor pipe or in some cases along sensor pipe. Hot spot = 230°C.



Detail 5 – Foundation penetrates exhaust duct insulation. Flanges to be provided with insulation. Hot spot = 260°C.

3 INSTRUMENTS / TOOLS

We recommend any of the three following methods for identifying hot spots:

- Surface/contact thermometer
- Laserbased Infrared Heat Tracers
- Infrared Thermoscanning Video Equipment

3.1 Surface/contact thermometer

Surface contact thermometers are in general inexpensive (approximately 100 USD) and reliable equipment. Most thermometers will give a temperature reading within a few degrees C of the true temperature. Most contact thermometers are also less dependent on calibration. As these thermometers will measure directly onto the surface one need not estimate the emissivity factor, which will be described in more detail below. A surface thermometer may therefore be suitable for calibration of laser-based heat tracers and thermoscanning video equipment.

Contact thermometers have some disadvantages as access to every object is required and that each reading takes some time. Further, curved surfaces may be a challenge to the surveyor as the thermometer often takes several seconds to give a correct reading. Basically, the thermometer is suitable for large surfaces (engine bodies and exhaust ducts) and for calibration purposes.

3.2 Laserbased Infrared Heat Tracers

“Lasertracers” are an effective tool when used correctly. We will address two important issues, measured area and emmissivity factors.

All lasertracers will measure the average temperature in an area, which is dependent upon the distance from lasertracer to object. In most cases this will be a different temperature than for the spot indicated by the laser! For conventional lasertracers with a field of view on 1:8, this average area will be 200 mm in diameter at 1.5 m. Considering the notable temperature variation shown in picture 1, chapter 2, we can conclude that it is difficult to detect these details without knowing the effect of average areas. Some advanced models have a much more narrow field of view and will, in addition, indicate the field of view by a circle of lasers-points outside the centre laser (see picture).

Lasertracer with field of vision 1:60. Average temperature within shown circle is returned.

As lasertracers measure the temperature based on the radiation from the object, the surveyor has to estimate emissivity (rate of reflection). For painted engine bodies, carbon steel pipes and similar an emissivity rate of 0.85 to 0.98 may be used. If in doubt, calibrate with a surface thermometer.

Normal prices for standard lasertracers is approximately 200 USD, whereas the advance models cost 500 USD or more.

3.3 Infrared Thermoscanning Video Equipment

Thermoscanning equipment is expensive (50,000 USD) and difficult to use. We include it in our presentation, as it may in some cases be worthwhile hiring personnel to do surveys (1,000 USD/day). A continuous infrared picture will be available. A conventional picture of the same object is recommended for tracing purposes. Such services can be co-ordinated by DNV.

If used as part of a formal DNV survey, a surveyor should be present to verify calibration.

For further information, please contact:
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Det Norske Veritas is an autonomous, independent Foundation with the objective of safeguarding life, property and the environment. The DNV organisation comprises 300 offices in 100 countries, with a total of 5,500 employees.

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