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Instructions and guidelines to surveyors engaged in pre-risk and risk assessment activities, or when appointed to attend a marine related casualty, carry out a risk based survey for hull and machinery insurers, or a condition based survey for a P&I club.

Contents

1.0 Introduction

These guidelines have been prepared to assist surveyors who have been appointed by insurers, to attend on their behalf. These guidelines are particularly applicable to surveyors appointed by Inserve Marine Technical Services Ltd, in order that the quality and content of the survey report meets with minimum requirements and reports share a common format.

2.0 Casualty surveys - general

An Inserve surveyor will generally be appointed by insurers, to represent their interests. It is, however, important for the surveyor to know who his principals are and for what purpose he is being asked to carry out the survey.

There are various types of casualty which produce claims on marine policies, and the surveyor should be aware of which type of claim he is dealing with. These include:

- Particular Average – probably the most common type of claim, where a vessel's hull or machinery has suffered a partial or total loss from an accident such as a grounding, fire, collision, mechanical or electrical breakdown.

- General Average – damage to a vessel and/or cargo caused voluntarily in order to prevent further damage, such as the effect of water used to extinguish a fire, jettison of cargo to prevent a capsize, or damage caused to hull or machinery in efforts to re-float following a grounding.

- Loss of Hire – where a vessel has insurance to compensate for periods which are spent off-hire or otherwise out of operation, undergoing repairs.

- Builders' Risk – damage to a vessel and/or shipyard sustained during a construction project.

- Ship Repairer's Liability – damage to a vessel during repairs at a repair yard or damage caused following repairs which are felt to be the fault of the repairer.

- Cargo – where cargo damage has occurred and the cargo is insured, other than where it is felt to be the fault of the vessel, i.e. unseaworthiness, where it falls on the vessel's P&I policy, see below.

- P&I – damage to third parties covered by the vessel's Protection and Indemnity insurance, which might include pollution, damage to cargo, personal injuries, collision damage to other vessels or objects.

- Marine Property – where a port suffers physical damage or is responsible for damage to third parties (liabilities) such as cargo, employees, vessels.

In each case the surveyor should be sure of the purpose of the survey. He should familiarise himself with the policy conditions and the cover offered by the relevant policy, before starting the survey. By surveying the casualty with the policy conditions in mind, the surveyor is able to ask the right questions and obtain a greater amount of relevant information.

2.1 The Survey Report

Reporting to principals on a regular basis is encouraged so that they are kept up to date on the status of the damages and repairs. Reporting in the very early stages might be in the form of a telephone conversation or email, but this should not substitute for more formal reporting as soon as possible. The formal reporting process might consist of a sequence of reports titled Preliminary, First Interim, Second Interim…….Final.

The content of the survey report is vital if the surveyor is going to communicate what he has seen and heard during the survey to his principal in a way that they will fully understand.

The surveyor must remember that most people reading his report are not technically minded and may not be familiar with ship construction and maritime terms. He must therefore describe in clear simple English, what has happened, why it happened, what was or will be done about it.

The surveyor must make his opinions clear. He is employed to give clear pictures and opinions, and not to issue a diplomatic communiqué. The best reports are as concise as possible while not leaving out any pertinent information.

There are some basic rules for effective report writing. These are applicable to all the reports that we provide.

1. Prefer familiar and simple words.
2. Keep sentences short - 15 to 20 words per sentence is fine.
3. Prefer the active to the passive tense.

For example:

Don't use	When you can use
In the opinion of the undersigned…	In my opinion…
There is reason to believe that…	I think…
In view of the fact that…	Because….
Initiate….	Start….
Proximity….	Near……
Utilise….	Use…..

Other rules:

1. Sentences should be separated by a two character (i.e. space bar) gap.
2. Single numerals (e.g. two) in words, double in numbers (e.g. 12).
3. Right justified (i.e. as the layout of this document).
4. Photographs central in the text, all one size, description (if necessary) centrally beneath.
5. All text, other than main headings, font 11.
6. Page breaks after each main section. Don't use multiple returns.
7. Don't refer to rules and regulations unless absolutely necessary. Rules and regs are for statutory and class surveyors.
8. It is not necessary to list equipment or certificates unless there is a problem related to it.
9. Don't make general recommendations. Every recommendation must be related to a deficiency found.
10. Don't cut and paste – each report should be unique – the only exception could be under the Loss Prevention section.

2.1.1 Preliminary Advice

If asked to provide a preliminary advice as soon as possible (often for the purpose of estimating the likely repair cost and advising underwriters accordingly) this can be done in the form of a short, punchy report in the shape of an inverted pyramid. The report should start with the most important information at the beginning, followed by increasingly less important information.

For example:

Name of vessel, details of casualty, date, time, place etc.

Brief circumstances surrounding the casualty

Estimated cost of repairs or loss

Nature of damage

Other.

2.1.2 Preliminary, Interim and Final Reports

Each report should have a structured logical order. For example, a casualty survey report might be broken down and consist of the following headings:

- **Introduction** – who the survey is being conducted for, on what vessel and for what purpose. Include the names of those persons present at the survey. Include the details of the present voyage such as from where the vessel has sailed and its destination after the survey. Details of the previous voyage and the proposed next voyage should also be included where obtainable.

- **Background information** – always include full particulars of the ship and machinery such as:

  Name, and any recent previous names
  IMO number
  Flag
  Tonnages
  Date and place of build
  Type of ship
  Machinery, age, make, type, serial numbers

- **Summary of facts** – list the events leading up to the casualty, extracts from log books, maintenance history of machinery (where relevant), list the items which have sustained damage and what in your view is the most reasonable repair procedure.

- **Extent of damage** – a bulleted list of damaged parts, describing exactly how and by how much the item was damaged.

- **Recommended repairs** – a bulleted list of the damaged parts with your opinion on the best course of action regarding repairs or renewals.

Where you attend on more than one occasion, include the dates of the various attendances.

- **Photographs** – and illustrations should be included in the text to show the extent of damage, or attached as an appendix and appropriately captioned.

- **Cause of damage** – traditionally in the London market, it is for the owners to put forward an allegation of cause, and for the surveyor to comment whether he agrees with it or not. However, the more modern loss adjusting approach requires the surveyor to be more proactive, to survey the damage, oversee and assist on repairs and get the ship back to sea earning freight as soon as possible. Therefore, in the best interests of co-operation, and to help any claim proceed quickly and efficiently, the surveyor should discuss cause with and work closely with the owners in this regard. If despite much discussion, the surveyor does not agree with the cause being suggested by the owners, you advise your principals in a separate email advice on what you consider to be the most likely cause, and how this differs with the cause being put forward. It is important to keep an open mind, communicate well with all parties, and try to establish cause at an early stage.

- **Cost of repairs** - very often the repair accounts will not be available for comment until after the repairs have been completed, in which case you may be required to provide an estimated cost of repairs.

When the final accounts are available you will normally be required to comment on the following:

- what proportion of the repair work within the accounts relate to damage repairs
- what proportion of the repair work is not damage related and is for the owner's account
- are the damage repair costs fair and reasonable
- the extra cost of overtime and the time saved by working overtime (see 2.11)

If the cause of damage has not been agreed, the apportionment of the accounts between damage and non-damage cannot be made. Instead, the surveyor can comment on the reasonableness of the costs, and leave the final apportionment until after the cause has been agreed. If this is the case, then the surveyor should make it clear that he is commenting on the costs only and not their applicability to the repairs.

- **Chronology of Events** - to include the relevant important times and dates of the events, such as the casualty, commencement of tow, arrival in port, completion of tow, commencement of repairs, completion of repairs, departure from port, etc.

- **Survey status** – it is helpful if the surveyor can sight the various statutory certificates held on board the vessel and comment briefly on their validity. Also, a brief review of the classification society survey status can provide useful information. If damage repairs involve the removal of the tailshaft, then the date when the tailshaft is next due for classification withdrawal survey is very useful.

- **Drydocking** - always note the date of the last drydocking and when the next drydocking is due.

- **Conclusions** - if any are to be made.

- **Loss Prevention** - include here your recommendations on how similar accidents can be prevented in the future.

Signatures:

Attending Surveyor

2.2 The Survey

After receiving instructions to attend a casualty, usually from the insurers via the broker, it is essential that the surveyor acknowledges the instructions, understands who his principals are and makes arrangements to attend the casualty as soon as reasonably possible. Liaison with the shipowner and/or his representative so as to arrive on board promptly and not delay the ship, is important. Liaison with brokers and insurers as to the proposed timing of the survey is encouraged, so that all parties know that the survey is proceeding.

If for any reason there is insufficient time to carry out a thorough survey, then this should be made clear in the reports, along with advice on the further information required or whether another survey is needed.

As with any survey, the surveyor must consider the wellbeing and fatigue of the master, officers and crew. The survey should be planned around the work and rest of the crew as much as possible, remembering that the ship is the crew's home.

Points to remember during the loss adjusting survey:

- Prompt attendance is required and it is important to remember that the shipowner is the "client" in the whole insurance process, and we are representing his insurers, offering a survey and claims handling service. The client therefore be treated respectfully and given every assistance in the aftermath of the casualty.

- During the survey ask plenty of questions, make plenty of written notes, and take plenty of photographs.

- Inspect deck and engine log books, maintenance records, and survey history.

- Don't rush the survey, spend plenty of time talking to the ship's staff and owners representative in order to find out as much as possible about the casualty.

- Don't give the impression that you are the insurers representative who is protecting the insurer's interest against those of the shipowner. Establish a good mood of co-operation with the owner, and work with him to agree the most reasonable course of action necessary to restore the vessel to it's pre casualty condition. If you don't agree with a particular course of action the owner is planning to take, then you should make this clear. Put your disagreement in writing at the time if you think it necessary. If you consider an item of equipment can be repaired rather than renewed, then advise the owner accordingly, and make a note of it in the survey report. The owner is entitled to recover from his insurers the reasonable cost of repairs. There is nothing stopping him from renewing a damaged item when it could be repaired, but the additional cost of doing so, and the circumstances behind the

decision to renew, should be noted. Situations such as this, show how important it is to gather all the necessary information, as conflicts can arise over the "reasonable cost of repairs" when most marine policies include a "new for old" provision. Sometimes the opinion of an insurance expert will be required.

- Traditionally it falls upon the owner or his representative to put forward an allegation of cause of damage. If the owner's representative makes an allegation of cause which you are not able to agree with easily, then you should say so, and state that you require further information/time to consider it. You are under no obligation to give an instant reply; do not be rushed into making a decision that you might regret later. Don't forget that many people representing all sorts of different interests may read your report with the sole purpose of showing that your conclusions are erroneous.

- The owner should be guided on suitable repair methods. A local surveyor should have a good local knowledge of the capabilities of local ship repairers and can advise the owner accordingly.

- Where practicable the owner should be persuaded to draw up a repair schedule and obtain quotations from local repairers before putting any damage repair work in hand. Assist the owner in this regard, if necessary, but do not show favour to any particular yard. It is a matter for the owner to decide on the repairer, based on a combination of cost and time on repairs, and a matter for the surveyor to note all of the quotations, and make his feelings felt in the survey report.

At the time the owner makes his decision the surveyor should make it clear whether or not he agrees with this course of action. If a repair quotation includes aspects of work which would not strictly form part of damage repairs then make a note of this in the report. For example, if an engine crankshaft is being renewed as part of damage repairs, the owners will usually take the opportunity to overhaul all of the cylinder heads while they are removed from the engine. This would form part of the owner's maintenance and should not form part of the claim on insurers.

It is much easier to identify this kind of work at the time of the damage repairs. Explain to the owner what in your opinion will be to his account at the time of the survey and not after the event. This way he will have a better idea of what is recoverable from insurers and what is for his account, and will not be faced with any surprises.

- Where it is necessary to attend at various times throughout the repair period, do not wait to be invited to re-attend by the owners representative. Remain in close contact with those involved with the repair process and attend as often as you feel necessary to fully cover all aspects of the repairs. If, having completed the damage survey, the repairs are to be deferred to a later date, ensure that the owners' representative understands the importance of arranging second and subsequent surveys, and that it is the owners' responsibility to do so via their broker, in the usual way.

2.3 A survey requested in the event of a Particular Average (PA).

This is one of the most common reasons for a surveyor to be appointed. A particular average is where damage has been sustained by the ship's hull and/or machinery in circumstances which did not cause danger to both the ship and its contents and therefore is not a general average loss. Most hull and machinery claims fall into this category. A ship has sustained damage, the nature and extent of the damage is not yet known and a surveyor is appointed to assess the damage and review the repair methods and costs.

The insurance conditions which should be borne in mind when carrying out PA surveys will usually be based upon one of the following: Institute Time Clauses (ITC(Hulls)), American Institute Hull Clauses (AIHC), The Norwegian Plan, or variations based on one of the above. Details of the relevant wordings of each of these insurance conditions are included in the appendix.

It is important for the surveyor to have a basic understanding of what is and what is not covered under the terms of the insurance - the "insured perils". However, this subject contains many contentious areas which are outside the expertise of a surveyor. Whilst the surveyor should view a particular casualty with the insurance conditions in mind, he must not give definite advice to owners (or other parties) as to whether a particular damage is or is not covered by the policies. The surveyor is expected to be an expert of ships and machinery and not insurance.

2.3.1 General

2.3.1.1 Proximate or Root Cause

When investigating the cause of damage it is important to arrive at the root cause, and not stop the investigation at a cause somewhere along the chain of causation which is not the root cause.

An example of this is where there has been an engine damage caused by a seized piston. The piston has seized due to lack of lubrication. Further investigations show that the lack of lubrication was brought about by cooling water entering the cylinder. The reason for this was a cracked cylinder liner. Further investigations showed that the liner had cracked due to overheating. The overheating was caused by a build up of scale on the cooling water side of the liner. The reason for the build-up of scale was a lack of adequate cooling water treatment. Investigations showed that adequate supplies of cooling water treatment were available on board, but the crew had not been testing or treating the cooling water in line with engine manufacturer's recommendations.

Therefore, while there were many points in the chain of causation that eventually led to the piston seizure, the root cause was the failure of the crew to treat the engine cooling water with corrosion inhibiter. With a named perils policy, such a cause might come under the cover offered for crew negligence, "Negligence of Masters, Officers and Crew" being the insured peril.

2.3.1.2 Intervening Cause

Having identified the chain of causation which led to the casualty, any intervening causes which acted to increase the extent of the damage and the cost of repairs should be identified and included in the survey report. In the example of the piston seizure above, the

crew stopped the engine and realised that the piston had seized. Rather than repair it straight away, they continued to operate the engine with a partially seized piston and this caused the bottom end bearing to overheat and fail, and damage the crankshaft. The crankshaft damage is not a direct consequence of the lack of cooling water treatment and is the result of an intervening cause, i.e. an error of judgement by the crew. Such an intervening cause in the chain of events is often treated as a separate accident and if so, would attract a second deductible.

2.3.1.3 Multiple Causes

Where an accident has been caused by a combination of causes the surveyor should try to identify which, if any, is the most dominant cause. For example it might have been found that the piston seizure above was caused by a combination of lack of cooling water treatment plus a design defect in the cooling water passages which made the cylinder susceptible to overheating. There may also have been a recent incident of overheating when a sea water strainer became blocked during operation. The surveyor might comment to the effect that the primary cause is the scale build-up due to a lack of cooling water treatment. In conjunction with this are the design defect and recent incident of overheating which might be considered contributory causes. Providing that they all act at the same time and there is not an intervening cause which increases the extent of damage (see above) then it is considered to be a single accident. It is worth mentioning here that no matter how many contributory causes may combine to create an accident, it is a case of "one accident – one deductible".

2.3.1.4 Insured/Uninsured Perils

Having identified the chain of causation, the various contributory causes and any intervening causes, the claims handler will be in a better position to process the claim. If the casualty has been caused by a combination of causes, some of which are covered by the policy (insured perils) and some are not (uninsured perils) this does not necessarily jeopardise any claim. However, it is important for the surveyor to identify the various causes from a technical viewpoint and leave the commenting on and processing of any claim to the insurance experts.

2.3.1.5 Items Specifically Excluded by the Policy

When commenting on the various causes of the casualty the surveyor should be aware of various causes which are specifically excluded by the insurance policy. Typically these are matters relate to normal wear and tear, and any negligence of the shore based management.

If the surveyor feels that the ships management were negligent in any way that contributed to the casualty, such as failing to supply adequate spare parts or failing to supervise the vessel correctly, then he should mention this in his reports.

2.3.1.6 Temporary Repairs

Where the owner elects to carry out temporary repairs and defer the permanent repairs to a future time, the surveyor should take note of which repairs are temporary and which are part permanent. It will be necessary for the surveyor to differentiate between temporary, part permanent, deferred, and full permanent repairs when the repair process is finally completed. The surveyor should also note:

a. The cost of applying any temporary repairs;

b. The time required to apply them;

c. The cost and time of removing them during permanent repairs;

d. Any scrap value to the removed temporary repairs;

e. Any enhancement in permanent repair costs due to the application of temporary repairs;

f. Any further deterioration in the vessel due to continued operation in the temporarily repaired state;

g. The reason for the temporary repairs, e.g.

    i. impossible to carry out permanent repairs due to insufficient resources available in that location.
    ii. unreasonable delays and lead time on required parts or labour.
    iii. the owner wishes to defer permanent repairs due to a tight schedule.
    iv. the owner wishes to delay repairs until a more convenient time or until scheduled routine repairs or drydocking.

h. Any cost savings by carrying out temporary repairs followed by deferred permanent repairs.

2.3.1.7 Improvements or Betterment

Generally speaking, the reasonable cost of repairs as dealt with by most policies of insurance will not include the costs of any modification, improvement or betterment. This might occur if an accident or failure showed up a particular weakness in part of the ship and during repairs this weakness was dealt with by improving the design. Therefore the surveyor has to identify the reasonable cost of restoring the damaged item to its pre-casualty condition. However, there are exceptions to this such as:

a. Hull damages where the new hull plates are thicker than the old – perhaps for reasons of metric/imperial equivalents and where it would be unreasonable to specially order plates of exactly the same size.

b. Machinery damages where it is more economical to renew the entire assembly than to repair the damaged one on a piecemeal basis.

c. In cases where a particular spare part or item of equipment is no longer available, and the current replacement is a 'better' version and where the owners have no alternative but to use it.

Therefore where improvements or betterment applies, the surveyor should comment accordingly.

2.3.1.8 Superimposed Damage

In cases where multiple damages have occurred in one area, one damage can become superimposed on another. This is particularly the case when dealing with hull damages where a vessel might have touched bottom on a number of occasions or come into contact with a dock or quayside. It is helpful if the surveyor can determine which damage incident was the most severe as it is this incident which becomes the casualty for the purpose of the claim. The other damages on to which that incident damage has been superimposed is sometimes said to have been obliterated. This obviates the need to process each of the multiple damages separately, thereby avoiding multiple deductibles being applied.

2.3.1.9 Wear and Tear

When assessing the extent of the damages and the repairs which would form part of any claim the surveyor should take note of any items which would have required renewal in any event by reason of their condition at the time of the repairs. This applies to machinery parts, perhaps bearings which are worn and require renewal, or to hull plating which has wasted to a level that the vessels classification society would require immediate renewal. (A 30% loss of thickness through wastage is the usual maximum permitted by class).

2.3.1.10 Delayed Repairs

If any part of the repair process suffers delays or is extended due to unforeseen difficulties then the surveyor should make note of the reasons behind the delay and what measures were taken to try to overcome them. This might include additional labour or overtime being incurred, or changes to agreed repair procedures. Any insurance claim would be limited to the cost of repairs carried out within a reasonable time-frame and would not include any additional cost due to delays. However, in some circumstances, average adjusters and underwriters will look favourably at the costs incurred due to delays provided it can be shown that all reasonable steps had been taken and the delays were largely unforeseeable or, with hindsight, inevitable. This is another reason why it is important for the surveyor to keep a very close eye on the repair process. Very often, during the processing of the claim, disagreements arise over how much time should be apportioned to damage repairs and how much additional overtime or additional shift work was incurred by delays.

2.3.1.11 Extended Repairs

Where the repair process goes smoothly but the time on repairs is extended because of interaction with other categories of repair then the surveyor should comment accordingly. Damage repairs can be extended due to classification society work, owners maintenance work, manufacturer's requirements or just to suit the shipyard schedule. Any extension in the repair time for any reason should be commented upon when apportioning repair times to the various categories of work. (See 2.3.2.3)

2.3.1.12 Abortive Repairs

Where a repair method or process has been agreed as being a reasonable way of repairing the damage but subsequently proves to be unsuccessful, the surveyor should include all details of these abortive repairs as they can under certain circumstances be included in any claim. The surveyor should include in his report;

a. details of the attempted repair process which subsequently proved to be abortive.

b. whether he was in agreement with the proposal when it was made.

c. the opinions of other parties to the proposal e.g. the owners, the classification society, manufacturers and repairers.

d. the costs of time taken by the abortive repairs.

e. whether or not the final repair process was increased in terms of cost and time due to the abortive repairs and if it was, by how much.

f. whether there were any savings by attempting repairs which subsequently proved abortive, or what the potential savings might have been had they been successful.

2.3.1.13 Un-repaired Damage

Where damage or parts of a damage are to be left unrepaired, or the repairs are being deferred to a later date, the surveyor should note the extent of the damages which remains unrepaired at the end of his attendance and the approximate repair costs involved.

2.3.1.14 Labour Rates

The surveyor should note the labour rates prevailing for the various disciplines employed on the repairs, and with reference to the normal rates for the repair location, comment on their reasonableness.

2.3.1.15 Extra Costs of Overtime and Time Saved

The surveyor should make note of the type of shift system being worked by the repair yard, and whether or not any extra costs are being incurred by the use of overtime working which has been requested by owners. Sometimes, ship repairers work a standard two shift system which does not attract any extra costs of overtime, but this changes when the third (optional) shift is introduced to provide all-night working.

When approving the accounts at a later stage, the surveyor should advise on the extra cost of overtime over and above the cost that would have applied if the work was done in normal hours. He should advise the amount of time saved as a result of working such overtime (expressed as both working days and calendar running days).

For example: Mon to Fri, 40 man hours @ $30 = $1200, Sat, 8 man hours @ $45 = $360. The extra costs of overtime is 8 x (45 – 30) = $120. The time saved in this case is one working day, but two calendar running days on repair. The ship was able to sail on Saturday evening rather than wait for normal working to return on Monday.

2.3.1.16 Avoidable/Unavoidable Overtime

Overtime should be dealt with in terms of avoidable and unavoidable. Where a repair process requires work to progress continuously, which means running into an overtime situation then this is classed as "unavoidable" overtime, and is sometimes treated differently. An example of this is where a welding process is being carried out which requires preheating, welding and a post weld heat treatment. If the post weld heat treatment runs into overtime then it was unavoidable, otherwise the heat treatment would

have to be terminated and the repair would be unsatisfactory. Conversely, where the overtime could be terminated without any adverse effects on the repair process, then it is considered "avoidable".

2.3.1.17 Residual Secondhand/Scrap Values

When overseeing the repairs, identify any tools which are purchased and not returned after the repairs as they might possess a residual or secondhand value. If the purchase price of the tool is known, give your opinion of the reasonableness of this cost and what in your opinion is a reasonable value of the tool after the repairs.

Identify any items which might be recoverable if reconditioned such as turbocharger rotors, and comment on secondhand or residual values. Often, a damaged turbocharger rotor will be replaced with a new one in order to save time, and then the damaged one sent for reconditioning. The residual value of the damaged turbocharger would be the difference between its value in the reconditioned state less the cost of reconditioning.

Scrap values are also important when renewing larger items such as crankshafts, bedplates etc. The cost of transportation of the scrap parts to a suitable scrapyard should be taken into account to give the net scrap value. It is the net scrap value which is required and overheads such as transportation tend to eliminate the scrap value of smaller items.

2.3.1.18 Loss Prevention

Once the cause of damage has been agreed, the surveyor should consider ways in which the casualty could have been avoided. If, with the benefit of hindsight, the casualty in question and future casualties could be avoided by the introduction of certain loss prevention measures, modifications to equipment, changes in procedures etc. then the surveyor should advise the owner accordingly. This is particularly relevant where the owner has a sister ship or ships fitted with similar equipment that might encounter a similar casualty. Such loss prevention measures should be included in the survey report.

2.3.1.19 Repair Specifications and Warranties

Where the surveyor is involved in compiling a repair specification in conjunction with or on behalf of the owners, he should try to separate the repairs according to damage and non damage related items at the time of compiling the specification. This makes the division of repair costs much easier when reviewing the final accounts. As already said the owner has the final decision on the selection of the repairer, however, the surveyor should offer guidance where required, and in so doing, the surveyor should take account of repairers which offer warranties or guarantees on their workmanship.

In this way, any mistakes made during the repairs which might result in further damage and a subsequent claim on the insurers can be;

i. Shown to have been part of the schedule of work which the repairer carried out and,
ii. Give insurers a path to recover the repair costs of this additional damage through the cover offered by the terms of the warranty or the repairer's liability cover.

2.3.1.20 New/Second-hand Parts

Where the surveyor is advising the owners on repair options, he should try to persuade the owners to accept a second-hand or reconditioned part. He should emphasise that while the policy might include a new for old provision, insurers look favourably upon clients who accept a reconditioned or second-hand part rather than insist on a new part being fitted. Owners should also be made aware that the costs of delays and waiting time incurred for a new part might not be recoverable if a satisfactory reconditioned part is readily available.

2.3.2 Hull Damage

With hull repairs, such as those required in the event of a grounding or collision, it is important to identify the position and the extent of the damage to the hull. This is usually done by referred to frame numbers, strake letters/longitudinals and the shell expansion plan.

Generally, the transverse frames with which the ship is constructed are numbered from aft to forward.

Strakes are conventionally lettered starting from the keel and working outboard and up the sides of the ship, whereby A strake is next to the Keel, then B strake then C and so on. The bilge strake is at the turn of the bilge and the sheer strake at the sides of the maindeck.

Sometimes, longitudinals are numbered from the keel outwards and upwards to the main deck.

The shell expansion plan can also be used to identify the position of hull plating in question. We prefer surveyors to identify the position of a hull plate according to frame number and strake/longitudinal. For example, "Area of B strake between frame 58 and 62 of 6.0m x 1.5m x 22mm to be cropped and renewed".

Whichever method is used, it is essential that persons reading the survey report can picture in their minds the position of the hull plate in question. Always include sketches if you think these will illustrate the position of damages in the hull of a ship. For example, some areas of plating which might have been damaged beyond repair and should be cropped and renewed could be cross hatched, and areas which can be made good by heating and fairing could be shaded. Make sure your sketches are done in such a way that they can be fully understood in photocopy or fax.

When dealing with areas of ship's hull plating which have to be renewed as part of a casualty, the exact area of plating which has been damaged may be enlarged when the most suitable crop lines are defined. It is not always possible to crop out solely the damaged area. Any increase in the extent of the repairs is usually accepted by insurers as being "reasonable" under the circumstances, although it should be noted in the survey report. The exact position of the crop lines will usually be drawn up by the repair yard, in accordance with normal repair procedures, although the classification society surveyor, owner's representative, and insurer's surveyor should all be able to agree the extent of the renewals required to repair the damage.

2.3.2.1 Items Already Condemnable by Reason of their Pre-casualty Condition.

When dealing with hull plating renewals, that might be required as a result of a casualty, remember to comment on the state of the plating being removed. If some areas of the plating had wasted or been previously damaged to the point where it would have required renewal in any event, then point this out to the owner, and mention it in the survey report. Be careful to differentiate between steel members which are:

i. Suffering from corrosion but with material thickness within class requirements,

and

ii. Corroded so badly as to be below class requirements and therefore would have needed renewal regardless of any damage.

Once the area of plating and internals that is being renewed has been decided upon, the areas and their position in the hull should be documented as above, and the weight of steel calculated. It is important for the insurer to have a god idea of the weight of steel being renewed as this reflects directly on the cost of repairs. Underwriters will want to check that the repairers have not charged for renewing 20,000 kg of steel when the surveyor calculated that 10,000 kg was enough. As a rough guide, steel weights can be calculated according to the volume of steel multiplied by the density, for example;

B strake between frame 58 and 62 of 6.0m x 1.5m x 22mm = 1,600 kg

Calculated according to 6.0m x 1.5m x 0.022m = 0.2m^3 x 8000 kg/m^3 = 1,600 kg.

2.3.2.2 Bottom Painting Exclusions

It is also important for the attending surveyor to identify the area of hull plating which has been either renewed or otherwise repaired and which falls below the lightship waterline. This area of hull plating may be subject to the "bottom treatment exclusion clause" and as such is of importance to insurers, adjusters and the like. For example, "in my opinion, 35 square metres of ship side plating is below the lightship waterline".

Also identify separately any areas of paintwork below the lightship waterline which are repaired/renewed as a result of the casualty but which no steel repairs are necessary, i.e. scratched paintwork.

2.3.2.3 Categories of Repair

With hull damages sustained from grounding incidents, the surveyor should be aware that grounding damages, and damage caused by efforts to refloat may be treated differently by insurers. For this reason he should identify these two categories of damage. Also, there is nearly always an element of owners maintenance work to take into account. For example, during a grounding, the propeller blades, rudder and 50 square metres of shell plating may have been damaged, whereas, during efforts to refloat, an anchor may have been lost, the stern tube seals damaged, and the main seawater system contaminated with sand and the main engine overheated. Owners might also take the opportunity of a drydocking to inspect all ship's side valves. The surveyor should give an opinion of which category he considers the repairs to fall into.

Having categorised the repairs according to either:

i. grounding damage,

ii. damage sustained during efforts to refloat,

iii. owners work,

The surveyor should indicate how long each category of repair would have required if carried out alone in terms of the number of days in drydock and afloat in each case. The surveyor must make it clear whether he means working days or calendar days.

In cases where the total number of days in drydock and/or under repair exceeds the longest time of any of the above categories, the surveyor must explain why i.e. either interference between two or more categories of repair, or due to delays caused by owners or repairers.

2.3.2.4 Owner's Hull Maintenance Work

The surveyor should not just limit himself to the damage repairs, but be aware of any owner's work which is being carried out concurrently with damage repairs. Where possible the surveyor should state whether owners work is only routine maintenance/surveyor work or whether it includes work which was "immediately necessary for seaworthiness" such as:

- Shell plating renewed due to another casualty or because it has wasted below class minimum.

- Classification society Conditions of Class recommendations or surveys which are due or overdue.

- Any other works which the surveyor considers immediately necessary, such as any defects discovered during the repairs, which had the classification society been of them would have requested immediate repairs.

This is particularly relevant where the vessel has been taken out of service specifically for damage repairs. Owners can normally take incidental advantage of the vessel being out of service to effects repairs of a routine nature for their own account, but if the owners' repairs are immediately necessary for seaworthiness, then the owners have to contribute to any drydock/general service charges.

Where owners work is substantial and includes some work which is and some which is not immediately necessary for seaworthiness, then the time needed to effect repairs necessary for seaworthiness is to be identified separately. It is recommended that surveyors deal with owners work along the lines of:

"Owners work comprised routine docking maintenance and required 6 days in dock and 4 days afloat. Of this, the work which was immediately necessary for seaworthiness required just 3 days in dock".

2.3.3 Machinery

With machinery failures it is important to identify the various categories of damage:

- Which parts have been damaged in the casualty, (consequential damage).
- Parts which were found damaged, but due to reasons unconnected with the casualty.
- Which parts, if any, were previously condemnable as a result of their condition prior to the casualty (worn out).
- If the casualty was caused by the failure of a particular part, identify this part (if possible) and ascertain as far as possible the cause of its failure. However, do NOT use the term "latent defect". This phrase is for Adjusters and the Legal Profession, not surveyors.
- Which parts are being serviced, repaired, renewed etc on this occasion which are not damaged or casualty related and therefore form part of owners maintenance.

Machinery damage, particularly diesel engine damages can be catastrophic in nature, and it is important to agree with the owners at an early stage the extent of the damage – which items were and which items were not damaged in the casualty. This is often difficult to agree in entirety, and therefore there may be some outstanding items which cannot be agreed upon. If so give your opinion of these items in the survey report.

It is important to form an opinion over which parts you consider were condemned in the casualty, which parts can be repaired, and which parts can be re-used. Give reasons and communicate these reasons to the owners or their representatives. In cases where you cannot be sure which parts are condemnable, request owners to arrange for the parts to be further inspected, for example, by:

- The engine manufacturer
- A metallurgist, or
- The Classification Society Surveyor.

In cases where you can see controversy arising with regard to the condition of a particular piece of machinery (or for that matter any other component involved in a casualty, e.g. shell plating or framing) request the owner's representative to retain this part. It can be arranged for this part to be examined and tested by the appropriate parties at a more convenient time.
Problems often arise when owners renew major items such as crankshafts, bedplates etc in the belief that the insurer's surveyor is in agreement. The owners then purchase a new crankshaft for a considerable sum, only to find that the surveyor is taking the view that the damaged shaft could have been repaired at minimal cost. This results in an unsatisfactory, and often unnecessary, outcome for any insurance claim.

Although the owner often listens to the insurer's surveyor for advice and assistance, ultimately it is a matter for the owner to decide how the repairs should be carried out.

If you do not agree that the repair methods and costs which have been chosen are reasonable then say so at the time and make a note of it in one of your reports. If you think this is an important matter which could affect the quantum of any claim, reply to your principals immediately on this matter alone, so that they are aware of the owner's decision and can offer you support if necessary.

Very often more information will be required concerning the maintenance history of the machinery which failed in order for the surveyor to be in a position to comment on the owner's allegation of the cause of damage. If some of this information is outstanding at the end of the survey and when writing to principles then give details of the information which has been supplied and the details of that which remains outstanding.

In cases which involve rotating machinery, it is usual to request information along the following lines:

- Results of lubricating oil analysis before and after the casualty
- The maintenance history of the machinery
- The last time the item of machinery was surveyed by class
- The last time it was overhauled by ships crew or shore repairers etc.

Mention in the report, the items which have been sighted and those which are outstanding.

2.4 A Survey requested in the event of a General Average (GA)

When acting in the general interests, the surveyor is required to deal with the effects of a voluntary act which was taken to protect the ship and its contents (usually cargo but sometimes only time charterer's bunkers), such as:

- Water damage to the ship and/or cargo following efforts to extinguish a fire on board.
- Damages sustained to the hull, main engine, propeller, etc. during efforts to refloat the vessel following a grounding.
- Jettison of cargo in order to save the vessel from the effects of a cargo shift in heavy weather.
- Putting in to a port of refuge, sometimes under tow, following a main machinery failure

2.4.1 The Role of a GA surveyor

The general average surveyor is appointed on behalf of the shipowner, sometimes by the average adjuster, to attend the vessel at a port of refuge and/or destination. His role is an advisory one, and he has no authority to order any particular course of action. He should remain impartial at all times.

The general average surveyor is guided by the York-Antwerp rules for general average which deal with the treatment of items which can be included in a general average claim. He is not normally expected to investigate the cause of the incident, such as the cause of fire, as a particular average surveyor will normally be appointed to deal with that if required. Instead the GA surveyor is expected to:

1. advise all parties on the steps necessary to ensure the common safety of the ship and cargo, such as the use of tugs to tow the ship to a port of refuge (the nearest safe port where repairs can be carried out), or the use of appropriate fire fighting arrangements to cause least damage to the cargo.

2. monitor the steps actually taken by the parties during the period the ship and cargo are in peril, and during the associated repair period. The shipowner has a duty to protect the cargo.

3. quantify the extent of damage which was voluntarily incurred to protect the ship and cargo, such as differentiating between damage due to fire, and damage due to effort to extinguish the fire. Only the damage due to efforts to extinguish the fire falls within the remit of the GA surveyor.

4. review the repair costs of the items damaged by the general average act, and to advise whether the costs are fair and reasonable.

5. to ensure that the general average damage is minimised wherever possible. For example, the surveyor may be asked to advise how the cargo can best be disposed of.

The surveyor will need to carry out a full survey of all the damages and prepare a report for his principals. The report can take the usual format, although usually it will not be necessary to agree a cause of damage. Instead the surveyor may be asked to comment on whether he considers the ship and cargo were in a position of peril at the time the general average act was made.

a. The GA survey

During the survey, the GA surveyor should bear in mind the following:

- If a PA surveyor is appointed to survey the damaged areas of the ship which do not form part of the general average act, such as bottom damage sustained during a grounding, then the GA surveyor has to come to an agreement with the PA surveyor over which items were damaged as a result of the accident, and which items were damaged through efforts to mitigate the loss to the ship and cargo. For example, in the event of a fire damage, the PA surveyor will normally be representing hull and machinery insurers, and will be concerned with those items damaged by the fire. Damage caused by fire, smoke and heat are included in any PA claim and should be noted by the GA surveyor but not included in his list of damages. The GA surveyor is only interested in those items damaged by efforts to extinguish the fire such as water damage, or damage through contact with CO2 gas. With items that have been damaged by fire and water it is important to agree with the PA surveyor the division of damages between PA and GA.

- There may be other losses to take into account such as those caused by acts taken to protect the ship and cargo, such as jettisoning cargo overboard which may have damaged parts of the main deck, and loss of the cargo itself.

- If appropriate the GA surveyor should recommend ways of protecting the ship and cargo from further damage until the cargo can be discharged.

- Come to an agreement with the PA surveyor if possible, and apportion the time on repairs in drydock and afloat for each of the categories. The categories are:
    - PA repairs
    - GA repairs
    - Owners works
    - Owners work immediately necessary for seaworthiness

- It is important to know when the ship and cargo were first in a position of peril, and when the common peril ceased. The ship AND cargo have to be in a position of peril for there to be a general average. As soon as either the ship or the cargo is no longer in peril, general average no longer applies.
  For example, following a main engine breakdown in heavy weather, the ship and cargo would be in a position of peril until the ship could be towed to a sheltered safe anchorage. Or, following a grounding where water enters the holds, there will be a common peril until either the leak can be stopped, or the cargo discharged from the ship.

- When overseeing GA repairs, the surveyor should identify all material over 15 years old which is being renewed and include the costs of renewal in the report, for which a deduction is made by the adjuster.

- If dealing with a grounding, the grounding damage is PA while the efforts to refloat are GA. Damage due to efforts to refloat might include damage to the propeller blades, stern seals and hull. An agreement should be reached with the PA surveyor to apportion the damage repairs between those caused by the initial grounding and

those caused by efforts to refloat depending on the exact circumstances of the casualty.

- If assistance has been given by other vessels then the full details of such assistance will be needed by the GA adjuster. If the vessel has been towed to a position of safety during the GA period, the surveyor should include all known details of the tow, such as towage charges, the types of vessel engaged for the tow, and the time when the tow commenced and finished.

- If the cargo has become damaged or slightly damaged, the GA surveyor should comment on the extent of the damage and give his opinion as to options available for disposal of the damaged cargo. It may be worthless, or have a value in the partially damaged state, or if it can be reconditioned/repaired at a modest sum, it may be possible for it to achieve its full value.

- If the cargo is removed from the vessel for transhipment, lightering or similar, then cargo discharge costs and procedures should be reported on.

- If temporary repairs were carried out to enable the ship to complete the voyage in safety, the nature and cost of the temporary repairs should be noted. It is also helpful to know if full permanent repairs were possible at that location.

- Where the repair of GA damage requires the vessel to be drydocked the surveyor should investigate and advise the date of the last previous painting on the ships bottom.

The permanent repair process should be approached in the same manner as for PA damages. A repair specification should be made and quotations sought from suitable repairers. If possible, the GA surveyor should recommend that the repair specification is split into PA and GA categories while it is being compiled, as this makes the apportionment of the final repair costs a lot easier.

b. Unseaworthiness

When commenting on the cause of the casualty which put the ship and cargo in a position of peril the GA surveyor should look for defect(s) in the vessel which may have contributed to the casualty, and which, had they been present at the commencement of the voyage would have rendered the vessel unseaworthy.

For example, at the start of a voyage one of the main engine bearings had been in use for a long period of time, in excess of the maximum number of running hours recommended by the manufacturers. If this bearing fails, immobilises the engine, and puts the ship and cargo in a position of peril, then the vessel could be considered unseaworthy at the commencement of the voyage. If it is another bearing that fails, which is within its normal working life then provided the overdue bearing is not involved in the casualty in any way, there would not be an unseaworthiness issue.

2.4 A survey in response to a loss under an energy policy

The role of the surveyor acting on behalf of an Energy Loss Adjuster is a complex one. He is required to do much more than report upon the nature and extent of the damage. However, the general comments on report writing mentioned earlier still apply.

As with any appointment to survey a casualty on behalf of another organisation it is firstly important to be sure who you are acting for, and what they require from the survey. This information should be provided as part of the instruction from principles.

The following four sections describe the survey and the information which is required from the survey in the same logical order as the survey report may be written, i.e:

- Introduction,
- Circumstances of loss,
- Description of the damage,
- Repair methods and costs.

2.4.1 Background Information

Normally, the first requirement of any energy related survey is to determine the background of the installation and the field in which the loss occurred. The type of information to be gathered concerning the background of the installation is:

- The size, location, nature and name of the field, installation and project in which the loss has occurred.

- The history of the field, installation or project.

- What role the damaged equipment played in the installation.

- The identity of the Assured, and all other parties engaged in the project e.g. Principals, Operators/Partners and Contractor and if appropriate other parties which may have been involved in the incident such as sub-contractors, vendors etc.

- Determine the contractual relationship of the Assured, Principles, Contractors etc.

- Determine the type of contract in force e.g. EPIC, Turnkey, Lumpsum, Reimbursable etc.

- Determine liabilities and indemnities under contract.

- Obtain, or arrange to obtain copies of the contract "Terms and Conditions", "Schedule of Reimbursement" and the "Scope of Work".

2.4.2 Circumstances of the Loss

Describe in detail the circumstances giving rise to the damage:

- Day, date, time of the incident

- What happened

- Where it happened
- How it happened
- Why it happened
- The personnel, equipment, plant etc involved
- What were the various parties doing before, during and after the incident. Include full details of events following the loss such as endeavours to identify the extent of the full damage, to salvage and/or secure damaged property, and any temporary repairs and reasons why they were effected, and any attempts to minimise the loss or damage e.g. fire fighting.
- Identify who or what in your opinion was responsible for the incident, the Assured, or third party. If it was a third party, identify the third party involved. If there is a contrary opinion held by one of the parties involved then report it objectively.
- Remember not to comment to the assured on legal or insurance liability related matters. The surveyor should issue his report only to his principals.

All of this information should be made available to the surveyor during the survey. If it should not be, then the surveyor should request in writing that any outstanding information be provided as soon as possible. The surveyor should also obtain copies of any reports relating to the incident which were prepared by the assured or any other party, both when the loss occurred and subsequently.

Basically the surveyor should obtain as much information as possible while he is on site at the time of the survey, this is particularly relevant where the loss has occurred offshore or where the time and expense incurred in sending a surveyor to the site might prevent a second survey being easily carried out.

2.4.3 Description of the damage

Some items of equipment in the energy industry can be very complex and therefore it is important to describe the damage in a way that will be understood by non-technical personnel. Points to remember when compiling the report:

- Start with a general description of the equipment/module etc. Include if appropriate he details of the manufacturer and supplier.
- Describe concisely and accurately each damaged component, it purpose, what it is called and the nature/extent of the damage. Words like 'it is bent' or 'it is cracked' are not sufficient, and should at least be accompanied by the dimensions of the crack, bend etc.
- Describe the position, orientation and relationship of all the various damaged components.
- Include ample diagrams, field sketches and photographs. Sketches and photographs should be made in such a way, as to show location, orientation, scale, date and time.

2.4.4 Repair methods and costs

In conjunction with the Assured, a suitable repair procedure should be discussed, and details of the Repair Scope of Work included in the report. It is advisable to discuss a broad scope of work with the Assured's engineers, along with other matters relating to the repairs such as manning levels, the disciplines to be specifically involved in the repairs, plant and equipment requirements, etc. Collect or arrange to have provided any other information such as copies of daily lg sheets, wok reports, daily progress reports, daily diving reports etc. on a regular basis as the repair proceeds.

Normally, the site engineers will already have prepared much of the information required for their own management. Listen to their views, and offer whatever constructive comments you can. Obtain the names of the site personnel with whom such matters have been discussed.

It will not always be possible to arrive at an exact repair scenario at the time of the initial survey, and this is often a matter which is arrived at after a second or subsequent survey or after further consultation with the Assured. It can therefore be expanded upon in subsequent reports as necessary, but some information is essential in the first report, or the reason given for not including it.

Points to remember when dealing with repair methods and costs:

- How will the damage be repaired/renewed, and what resources and equipment will be required, including
    - Who will provide the work force, the Assured, or a Contractor
    - Is the work to be done under a Variation Order procedure
    - If contractors are used , on what terms are they engaged
    - What labour disciplines will be required
    - The rates, e.g. hourly/daily for those disciplines
    - What plant and equipment will be required
    - The rates for that plant and equipment
    - Where the rates have been obtained from
    - Are the required facilities already available to the Assured
    - If facilities have to be brought in, what will be required and from where
    - What contractual work will be done whilst the repair is undertaken
    - Determine how the man hours are recorded, controlled and allocated to the repairs.

If the personnel on site at the time of the survey cannot provide all the answers, then obtain the names and contact details of those who can. If possible, these people should be visited in conjunction with the survey.

- Your opinion on the cost of repairs is particularly valuable in view of your local knowledge of repair costs in that area. The anticipated repair costs are important to underwriters when reserving or allocating funds to meet the expected claim. For this reason repair costs should be estimated as accurately as possible, showing a breakdown between services, parts and labour. Preferably, any estimate should be an overestimate rather than an underestimate.

- Discuss with the Assured how the claim is to be presented. Explain that full substantiation for all time expended, materials employed, plant and equipment utilised.

- The expected time scale for the repairs should be included, along with a chronology of events, such as:
    - Date of loss
    - Determination of repair procedure
    - Preparation of scope of work
    - Obtaining repair quotes/tenders (if applicable)
    - Mobilisation of equipment
    - Commencement of repairs
    - Completion of repairs
    - Any delays that may be incurred

If delays are experienced determine what caused the delays, and what effects on the cost of repairs those delays had.

Arrange for daily progress reports for the repair period to be sent to you on a frequent and regular basis by email, fax or similar.

If the surveyor is attending repairs that are being conducted in a fabrication yard the following points should also be dealt with:

- What other work is underway in the yard

- For whom is this work being carried out

- Pay particular attention to the availability of plant and equipment, and how the availability will affect the progress of the repair work

- Determine how the man hours are recorded, controlled and allocated to the repairs

- If the fabrication yard is run by the Assured, what is the effect of the repair work on existing labour levels.

- Do the repairs give rise to an increase in the amount of labour engaged and the yards ability to meet its prior commitments or do the repairs simply increase the productivity of the existing workforce with no net increase in employment costs to the yard? This point should be also e addressed if the work is being undertaken offshore.

Whatever method is agreed for the repair process, and wherever it may be undertaken maintain good contact with the Assured throughout the damage repair process, become completely familiar with all aspects of the repair work so that future questions can be answered, and ensure that the repairs are carried out accordingly to the agreed procedures.

If the work deviates from the agreed procedure the surveyors opinion will be required to establish the reason for the alternative procedures, their reasonableness and their cost impact.

2.5 Guidelines to surveyors attending cargo damage surveys, and reminders as to what to include in their reports.

Introduction

- Report identification number.
- Name of insurer.
- Name of insured.
- On whose behalf the survey is being carried out.
- Who is making the claim.
- The purpose of the survey.
- Date loss/damage first noticed.
- Location of cargo/goods at the time of the loss/damage.
- Date loss/damage reported.
- Date survey requested.
- Date and place of survey.
- Those attending the survey.
- Location of cargo/goods at time of survey.
- Details of all surveyors/interested parties.

Background information

- Full description of the consignment of cargo or goods being surveyed.
- Origin/manufacturer.
- Details of:
    - Consignee
    - Shipper
    - Charterer
    - Ship or conveyance
    - Forwarding agents

Route identification

- Identification of consignment of goods/cargo as per air way bill, freight number, container number, tracking ID number, bill of lading etc.
- Route form origin, including carriers, method of carriage, transhipment etc.
- Remaining route to destination.
- Relevant dates, such as date of manufacture, date sold, packed, commencement of carriage, loading, transhipment, discharge, arrival at destination.
- Details of any delays on route.

Condition

- Details of the previous condition of the cargo/goods where known, such as:
    - As manufactured
    - On loading (pre-shipment survey?)
    - Any previous surveys
    - Description of previous condition from the bill of lading
    - Description of previous condition from packers, stevedores, ships crew etc.
- Current condition of the cargo/goods
- Original packing intact?
- Packaging sufficient?

- Seals intact?

Damage

- Extent of damage.
- Where, when and under what circumstances the damage occurred.
- Opinion on cause of damage.
- If water damage, salt or fresh?
- Any other consignments damaged? If so, more details.
- Ship or other conveyance damaged? If so, more details.
- What steps have been/should be taken to minimise the loss.

Disposal

- By how much has the utilisation of the cargo/goods been affected by the loss/damage.
- What options exist for the use of the damaged cargo/goods.
- In unusable, what are the methods and costs of disposal.
- What scrap value is attached to the damaged cargo/goods.

Loss

- What is the net loss to the consignee by reason of the damage?
- Will there be a refund of duty applicable to the damaged goods/cargo?

Subrogation

- Who/what in your opinion is responsible for the damage?
- What actions can be taken against third parties to recover the loss?

3.0 Pre-risk and Risk Assessment Surveys

3.1 General

Inserve carries out risk based surveys for insurers of ships, ports and shipyards. The requirement for a survey is often a warranty on the insurance policy. A breach of warranty will make the policy void. It is important that the warranty wording is fully understood prior to carrying out the survey. We have an obligation to comply with and provide the survey services that the warranty states.

Such surveys will include the following.

3.1.1 Risk Assessment Survey - is usually where we are required to survey a single ship. It is a standard format report and covers all areas of structural physical condition as well as operation and maintenance. There is a section on the management company, but we do not go out of the way to meet the management unless they happen to be in the area or if a superintendent is on board. We like to sail on the ship whenever possible, although this is really only feasible with ferries on fixed routes.

3.1.2 Technical Appraisal - is for smaller fleets and involves us meeting the management, and giving underwriters an understanding of the way in which the company operates, manages and maintains its vessels. We then survey a representative sample of vessels, perhaps two or three. Again, we try to sail on one of the vessels if possible.

3.1.3 Loss Prevention Study - is a higher level risk assessment exercise for larger fleets. We start by giving an opening presentation, which explains the purpose of the exercise. We spend quite a lot of time with the technical management, looking at maintenance, loss records, accident reporting, drydock reports, safety management system, etc. We survey a sample of the fleet, perhaps four or five vessels, and will use two or three different surveyors, each specializing in different areas. We will make a point of sailing on at least one vessel so that operational, crewing, navigating practices can all be covered. We then give a final presentation of our findings to the company so that they fully understand the issues raised, before compiling a written report with recommendations.

3.1.4 Shipyard Builders Risk – in response to an initiative by the Joint Hull Committee following a number of high profile losses on ships under construction, shipyard surveys are now carried out according to the JH143 format. A copy of the JH143 requirements are provided, along with an Inserve survey report which was carried out with those requirements in mind. Surveyors should remember that the risks presented by a newbuild project are constantly changing as the vessel goes from keel laying to final fitting out. It is difficult to appreciate the risks at the survey stage of a project when construction may not have started. However, it is important to ensure that the yard address the risks on an ongoing basis, for example, when a vessel goes afloat for the first time, bilge pumping and watertight integrity should be in place. By the time flammable materials and liquids are placed on board, fire detection and extinguishing systems should be fully operational.

3.1.5 Ship Repairers Liability (SRL) – surveys against the liabilities of a ship repairer vary according to the insurer involved. Each insurer has their own guidelines, and these guidelines should be followed in each case. Essentially, fires are the greatest area of risk - too many vessels catch fire when under repair. Hot work procedures and gas freeing etc, are key areas to inspect.

3.1.6 Port surveys – similar to shipyards these can be for physical damage insurers and for liability insurers, only in some cases, the insurer will offer combined cover for both elements. Again, it is necessary to determine the insurance conditions and the survey warranty wording to know exactly what it required.

3.1.7 P&I surveys – the P&I Clubs are the liability insurers for ships, covering things like pollution, crew injuries, cruise passenger injuries, damage to third parties such as dock damage. Where a cargo insurer avoids a cargo damage claim on the basis that the vessel was unseaworthy, then the claim for damages falls onto the owners P&I Club. This typically involves cargo claims where the hatch covers have leaked and is the reason why P&I Clubs place great emphasis on the integrity of the hatch covers and the cargo containment area in general

There are 13 P&I Clubs in the International Group. Large claims such as the Exxon Valdez, break through the ceiling of any one club and become a "pool claim" whereby all clubs in the international group, contribute.

Each club has its own survey report form. They are generally more of a checklist, and are either an "entry" survey or "routine" survey. All ships are surveyed on entry, and those over a certain age surveyed routinely every year.

The clubs look upon their ship owners as "members". The clubs work on a mutual basis whereby they charge an insurance premium at the beginning of the year, February 20th, and invest it. Claims are paid and if there is anything left at the end of the year then a return is made to the members. Conversely, if claims exceed premium income plus investment income, then the members are asked to pay an additional amount "supplementary call". The disadvantage of this, for some shipowners, is that it can take two or three years before an accounting year is settled and supplementary calls can take ship owners by surprise at a later date, sometimes even after they have left the club or sold their ships.

Surveyors acting for the clubs should adopt a "clubby" approach and remember they the link between the club and its member. They should be welcoming and hospitable, and not act in an unnecessarily authoritative manner, such as Port State Control or Flag State surveyors might.

The alternative to the mutual clubs are the fixed premium P&I providers such as Terra Nova (Markell), Southern Seas, and Navigators. Again, each have their survey report formats, some of which are more general than the specific checklists which the clubs use. It is necessary to know exactly who the insurer is and what their specific requirements are. For example, some P&I providers require extensive hatch and tank testing.

Most report forms are available from the P&I insurers via the internet, and often, the completed reports can be returned electronically, although some insurers still require hard paper copies – again, find out first, before you start the survey.

3.1.8 Loss of Hire - loss of hire insurance is purchased by a shipowner to cover his mortgage commitments and provide him an income should his vessel be out of service and unable to earn freight. Loss of hire insurance will have a deductible in terms of number of days, usually 14 days has to pass before the shipowner can start to claim. There will also be an upper limit, also in terms of a number of days, usually 120, whereby it is considered to be a "total loss". For the loss of hire insurance to be triggered, the vessel must be out of service under repair for a damage which is covered under the hull and machinery policy. If the hull and machinery policy does not respond for any reason, then nor does the loss of hire.

Typical loss of hire claims are caused by major casualties such as fires and groundings. From a machinery perspective, gearbox damages are the worst, because it can take up to two months to manufacture replacement parts.

Surveys for loss of hire insurers take a slightly different approach. The surveyor should cover all items contained within the Risk Assessment Survey and in addition should concentrate on:

1. Critical items of equipment, the failure of which would prevent the vessel from operating.
2. Single point failures – single screw vessels, shafting, stern tube bearings, propeller, rudder, steering gear, thrust block, gearbox, main engine, maintenance, oil analysis, records of reliability, crankshaft bearings, undersize bearings, crankshaft deflections, engine alignment.
3. Availability of spare parts, obsolete machinery, whereabouts of spare parts, contingency plans if parts are not readily available – i.e. other operators who might have spare parts, the whereabouts of spare parts sitting on shelves in other locations, manufacturer's who could be contacted should a part be required in future, etc.
4. Boilers and economisers, cleaning, water washing, safety and protection devices.
5. Turbochargers particularly where the engine might be fitted with a single turbocharger and there is susceptibility to scavenge fires or explosions.
6. Fire risks generally, throughout the vessel.
7. Hot work, deck work, gas freeing, risk of fire / explosion on deck, even when in a shipyard.
8. Collisions, groundings, hull damages, navigation, operation, manning, passage planning etc.
9. Hull cracking, water ingress, contamination of ballast and fuel tanks, pumproom flooding, and flooding of any other spaces.

3.2 The Risk Assessment Survey

The Inserve Risk Assessment Survey is carried out when a single ship is surveyed on behalf of hull and machinery insurers.

In the past, the Joint Hull Committee and the Salvage Association tried to standardise various survey formats and the terminology is still being used. The Risk Assessment Survey is Inserve's equivalent of the JH115 or JH115A, which is sometimes still specified by insurers. It can also be used to complete a "Condition Survey" should this be the requirement of insurers.

The Risk Assessment Survey is a risk based approach to surveying a ship and includes everything that a condition survey or a JH115 includes, and more besides.

The report format has been developed in order to standardise the report and not to provide a checklist. It should be treated as an aide memoir to ensure all areas are covered.

The report format has been broken down into 10 sections. Within each section are sub headings which focus on the areas which typically give rise to casualties and insurance claims.

It can be seen that nowhere in the report is it required to list the ship certificates, look at life saving appliances etc. While ship certificates are fine for providing background information about a ship, when was a casualty or breakdown ever the result of a certificate being out of date or missing?

Hull and machinery insurers are not liability insurers and are only concerned with physical damage to the ship, so there is no point looking at crew safety issues, lifeboats, pollution aspects etc. These are matters for the P&I Clubs.

The risk assessment exercise is designed to be fluid. If an area is found to be satisfactorily low risk, then less time is spent and more time devoted to high risk areas. Not all parts of the ship need to be examined just for the sake of it, as long as the high risk areas have been identified.

3.3 Marinsure Risk Assessment Survey.

When carrying our surveys for the Marinsure facility at Lloyds, they require a particular format to be used. This includes some additional areas such as a comment on the value of the vessel, just a comment, not a valuation. Ask the owner what he paid for it etc. Also, thee is an enlarged section regarding the management, and what further action is recommended such as a follow-up survey, an office visit etc.

3.4 Risk Assessment - High Speed Craft.

This is an adaption of the usual Risk Assessment Survey format, designed to suit the peculiarities of high speed craft such as aluminium hulls, void spaces, waterjets etc.

3.5 The Technical Appraisal

A sample Technical Appraisal survey format is provided. It follows the same format as the Risk Assessment Survey in terms of the section headings, but without the details in the

boxes. Under each section heading, all of the items that appear within the Risk Assessment Survey should be looked at, but it is not necessary to comment if they are found satisfactory. Generally then, there is less writing needed, although it is important to include some positive aspects or the report takes on a negative, critical feel.

Risk reduction recommendations are made at the back of the report, within the conclusions section. Timescales are applied but not risk ratings.

Follow-up surveys to check that all recommendations have been complied with, are usually carried out.

3.6 The Loss Prevention Study

These will be co-ordinated from the London office although various surveyors will be asked to contribute in order to cover the widespread nature of such a study and to create a balanced view by using a multi discipline team.

Reports tend to be tailor-made and not follow any strict format. There will be an Executive Summary at the front, and the recommendations will either be at the back, or appear within the body of the report.

Surveyors should be careful when they accept survey instructions directly to the overseas offices. There have been instances when an overseas office has been asked to survey a single ship and the surveyor has quite rightly worked to the Risk Assessment format, only to then be asked to survey another ship in the same fleet, and another. He ends up producing three Risk Assessment surveys when a Technical Appraisal or a Loss Prevention Study would have been more appropriate. Hence it is important to ask the instructing party, usually the broker, the full extent of our involvement at the very beginning.

Technical Bulletins

Technical Bulletin #1

The following notes are intended for guidance, and to ensure that we have a standard approach to certain issues. It prevents surveyors straying too far from what is company policy on certain key issues.

Watertight Doors

Generally, watertight doors are to be kept closed whilst the ship is on passage:-

- In conditions of restricted visibility;
- Within port limits or compulsory pilotage limits;
- Where depth of water is les than three times the ships draught;
- In other conditions which the master considers potentially hazardous owing to –
    i. The proximity of underwater hazards having regards to the degree of reliance that can be placed on the chart of the area;
    ii. The density of traffic; or
    iii. Any other high risk situation;

And if a door is opened in such circumstances then it shall be closed immediately after passage through has been effected.

On passenger ships, where there are watertight doors in passenger and crew areas, operators may categorise the watertight doors to assist operations.

Categories of watertight door:

- Type "A" – a door which may be kept open.

- Type "B" – a door which should be closed, but may be open for the length of time personnel are working in the adjacent compartment.

- Type "C" – a door which should be closed, but may be opened to permit passage through it.

Smoke Detectors

All vessels should have a fire detection system in the machinery spaces. Where accommodation areas are without a fixed fire detection or extinguishing systems and there is a reasonable amount of combustible material and there is no vertical sub-division at the stairwells, it is recommended that as a minimum, battery operated smoke detectors are to be installed. The recommendation is to advise the crew to modify the monthly safety routine to account for the monthly testing of the batteries. The batteries are to be renewed on an annual basis. Fire detection systems should be tested regularly, there should be no faults or loops disconnected.

Lub oil analysis

Lub oil analysis is recommended to be carried out on main and auxiliary machinery on a three monthly basis. Emphasis should be made in the reports that both shore side technical management and ship's crew review the analysis results as soon as received. Historical data should be maintained such that trend analysis to identify increases in wear metals or contaminants.

With regards to smaller auxiliary engines where the sump lub oil is changed in its entirety, it is recommended that analysis continues to be carried out on a three monthly basis or perhaps every oil change, or alternate oil changes.

For ships over say 3,000 DWT, onboard testing for basic parameters such as water content and viscosity should be undertaken on a weekly basis using onboard test kits provided by the lub oil suppliers.

Stern tube lub oil analysis should also be undertaken on a three monthly basis. Visual drawing off of a sample and examination for water contamination should be carried out on a weekly basis.

Gearboxes and CPPs should be included in three monthly sampling and analysis where they are large enough to trigger a claim should there be oil contamination.

Other systems can be included at the discretion of the surveyor.

Boiler and Cooling Water testing

It is generally recommended that water analysis is carried out on a weekly basis with chemical dosing carried out in accordance with the chemical suppliers requirements. Copies of test results should be sent to the chemical supplier every month and to the superintendent.

Passage Planning and position fixing

Passage planning is to be carried out on a berth to berth basis. Position fixing should not rely entirely on electronic means. There should be evidence of radar bearings, parallel indexing and distances off being used to check the accuracy of the GPS. Charts should be in use with courses plotted and prohibited areas shaded, and with recognised anchorages and abort point clearly shown. An example is provided.

Drills & safety equipment maintenance

Emergency drills are to undertaken in accordance with the requirements of SOLAS Chapter III/B, Regulation 19.

Subsection 3.2

- Every crew member shall participate in at least one abandon ship drill and one fire drill every month.
- The drill of the crew shall take place within 24 h of the ship leaving port if more than 25% of the crew have not participated in abandon ship and fire drills on board that particular ship in the previous month.

Subsection 3.3

- Each life boat shall launched with its assigned operating crew aboard and manoeuvred in the water at least every 3 months during an abandon ship drill.

Subsection 5

- The date when musters are held, details of abandon ship drills and fire drills, drills of other life-saving appliances and onboard training shall be recorded in such log-book as may be prescribed by the administration. If a full muster, drill or training session is not held at the appointed time, an entry shall be made in the log-book stating the circumstances and the extent of the muster, drill or training session held.

There should be realistic drills carried out, not just discussions, and these should include fire drills in the machinery spaces and the galley at least every three months.

Maintenance and test of the operational requirements of the equipment is to be undertaken in accordance with Regulation 20. The most applicable aspects are as follows:-

- Weekly inspections – the following inspections shall be carried out
    i. All survival craft, rescue boats and launching appliances shall be visually inspected to ensure that the are ready for use.
    ii. All engines in lifeboats and rescue boats shall be run for a total of period of not less than 3 min. During this period if time, it should be demonstrated that the gear box and gear box train are engaged satisfactorily.
    iii. The general emergency alarm system shall be tested.

- Monthly inspections – Inspections of the life saving appliances, including lifeboat equipment shall be carried out monthly using the checklist required by regulation 36.1 to ensure that they are complete and in goods order. . A report of the inspection shall be entered in the logbook.

Regulation 36 gives instructions for on-board maintenance of life saving appliances. The requirements are as follows:-

- A checklist for use when carrying out the inspections required by regulation 20.7
- Maintenance and repair instructions
- Schedule for periodic maintenance.
- Diagram of lubrication points with the recommended lubricants
- List of replaceable parts
- List of sources for spare parts; and
- Log for records of inspections and maintenance

While we are not necessarily interested in the records of maintenance of safety equipment, it is important that key safety item are maintained and the crew are familiar with their operation. Typical equipment that should be considered should include fire dampers (internal and external), fan, pump and vent stops, quick closing valves and fixed fire extinguishing systems.

Connecting rods

During overhauls of four stroke engines, emphasis is to be made to the inspection of bottom end bearing, the crankpin and connecting rod bore. The calibration reports should make provision for the measurement of crankpins and connecting rod bore ovality. When separated the serrated mating surfaces of the connecting rod bottom end are to be visually inspected for signs of cracking, and subject to further tests if in doubt. Where possible NDE should be undertaken in way of the root area.

Connecting rod bottom end bolts should be measured for signs of elongation and replaced when the manufacturer's allowable limits are being reached.

With four stroke diesel engines, the connecting rod bolts are subject to cyclical stresses. This can trigger fatigue failures after a prolonged period of service. Many manufacturers apply a fatigue life to the bolts, usually around 20,000 hours or five years, and this should be adhered to.

Single point failures

Always look for areas of the vessel, particularly machinery, where a single failure would jeopardise the safety of the vessel. Single screw ships are a typical example. Always check to see where the propeller thrust is being imparted to the hull, as this is a critical point in the already critical drive train.

Single hold, single sided (no wing tanks) cargo vessels need particular attention.

If there is time, apply FMEA techniques to see if critical areas identified will fail into a safe mode or not, i.e. controllable pitch propellers.

Loss Prevention advice

When adding machinery loss prevention advice, refer to the machinery database provided.

Electrical ~ meggar testing

Insulation resistance measurements should be undertaken on a six monthly basis:

The minimum resistance values depend on the related voltage at the operating temperature. The table below is taken from the IACS Unified Requirement E13:4.2 and can be used as a suitable guide for typical measurements values.

Related voltage (V)	Minimum test voltage (V)	Minimum insulation resistance (MΩ)
Un $\leq$ 250	2 x Un	1
250 < Un $\leq$ 1000	500	1
1000 < Un $\leq$ 7200	1000	(Un/1000) + 1
7200 < Un $\leq$ 15000	5000	(Un/1000) + 1

Double wall piping

In order to provide a common understanding and standard approach in our application of the requirements of SOLAS with regard to the use of flammable liquids (fuel oil, lubricating

oil, hydraulic oil) within machinery spaces the following information has been collated to highlight the applicable requirements which are dependant on the ships age or where subsequent modifications have been carried out.

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

Precautions shall be taken to prevent any oil that may escape under pressure from any pump, filter or heater from coming into contact with heated surfaces.

Oil fuel lines shall not be located immediately above or near units of high temperature, including boilers, steam pipelines, exhaust manifolds, silencers or other equipment required to be insulated.

As far as practicable, oil fuel lines shall be arranged far apart from hot surfaces, electrical installations or other sources of ignition and shall be screened or otherwise suitably protected to avoid oil spray or oil leakage onto the sources of ignition. The number of such joints in pipes shall be kept to a minimum.

Fuel tanks which are sited on decks above the main engines and generators should be given particular attention as to their integrity.

New Construction:

The requirements of SOLAS Amendments 2000, Chapter II-2, Part B (Prevention of fire and explosion), Regulation 4 (probability of ignition), Section 2.2.5.2 to 2.2.6.2, apply to all ships constructed on or after 1 July 2002. Note that a minimum engine power output is not specified.

Existing Vessels:

For existing vessels the requirements of SOLAS Consolidated Edition 2001, Chapter II-2, Part A, Regulation 15 (Arrangements for oil fuel, lubricating oil and other flammable oils), Section 2.9 to 2.11, applies to all ships constructed on or after 1 July 1998. The expression all ships means ships constructed before, on or after 1 July 1998.

However, section 2.12 states that ships constructed before 1 July 1998 shall comply with the requirements of 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 injections pumps serving more than one injector may be used as an alternative to the jacketed piping systems in paragraph 2.9.

The above requirements are also applicable to the arrangements for lubricating oil and other flammable oils employed under pressure.

While the implication of the SLAS requirements is that only high pressure fuel piping on engines of 375kW or more is applicable, the surveyor should look at the risks from low pressure piping and hydraulics.

May 2005

Technical Bulletin # 2

P&I surveys

As we have completed a number of P&I Club surveys, a few points have come out. Many of these are from American Club surveys.

1. When quoting, if the ship is large (eg more than 5 hatches/ holds), an additional half a day should be allowed for. All quotes for P&I work should allow for colour printing and courier of at least two copies of the final report.

2. Inserve's Terms and Conditions should be appended to any report sent out.

3. The ship should be left a handwritten list of recommendations/ deficiencies (no timescales stated). This should be signed, dated and stamped by the master and a copy of this will then be incorporated into the Preliminary and Final Reports. It must include all deficiencies found – the final report should not include any others.

   "It is not usually a good policy to change your defect list after you leave the vessel. We encourage our surveyors to ensure they are certain they have noted and written down everything and presented it to the Master prior to leaving. In the event something does show up on a photo that was missed, and it is not just an artifact of the photo, it should be added in at the preliminary report and explained that it was picked up during your initial review process. We have all walked past things we did not notice until they jumped out at us as we were reviewing our pictures; but these kinds of things can be problematic with respect to our credibility with the Member if we do not explain how we found them." – American Club.

4. "As far as some items that are usually difficult to see in service, here are a few examples: We require all cargo holds to be internally inspected for mechanical damage, corrosion, cracks, degraded or damaged ballast vents and sounding tubes and their guards, corrosion and damage to ladders and platforms, and corrosion and damage to coamings, corrosion and damage to ballast tank manhole plates, rings and studs and nuts, and bilge wells should be checked for filters, alarms, and tested. For tankers, all cargo tanks are to be internally inspected, especially looking for the following: pitting on the bottom plates especially in way of the suction bells, galvanic cupped thinning of the side shell plating in way of the web frames longitudinals, cracked tie plates, undercut welds in way of brackets and longitudinals, cracks in way of hard bracket ends, condition of piping, expansion joints, valves, extension rods and universal joints, corrosion and cracks in way of the deck heads, testing of heating coils if any, and corrosion and cracks in way of ladders and platforms. All ballast tanks are to be internally inspected and hydrostatically tested. All hatch covers are to be closely inspected for cracks, corrosion and pitting holes, gasket condition, gasket channel condition, and closing appliances. All hatch coamings are to be closely inspected for cracks, corrosion and pitting holes, condition of compression bars, rain channels, non-return drain valves, and closing appliances. All hatches are to be tested for weather tightness. For tankers this would include access hatches, cleaning accesses, and gauging accesses. The above inspections and tests are to be carried out by the Club surveyors, class surveyor reported tests and inspections are not acceptable unless witnessed by Club surveyors." - American Club.

5. The Preliminary Report should be sent by email to the Club, copied to the member, usually within 48 to 72 hours of the survey. It should be checked by one of the directors before it goes out.

6. The final report should be completed in the normal timescales for any survey report that we produce. It should be checked by one of the directors before it goes out.

7. The final report should be sent by email to the Club and also to the member. The member should be asked if he needs a hard copy. A copy should be provided to Accounts in London for filing.

8. The Club needs to be sent two hard colour copies (and the member if he requests). The best way for us to do this without incurring time and costs is for London office to send out a batch. Therefore please give clear information to London on what is required, address etc.

9. Some clubs (eg Steamship) want the report in Word format so do check the instructions.

10. If an item on the report is not completed, say so, and if it is significant, list it in the recommendations. In particular, if tanks or holds cannot be inspected or tested, list the ones not done on the recommendation list so that they it can done at a follow up.

The above have been agreed with the American Club in particular.

October 2005

Technical Bulletin # 3

Loss prevention information

1. Slow Speed Two Stroke Engines

The main operating problems involve camshafts including starting and reversing gear and cam drive chains. The bearings either side of the chain drive have failed quite often. It is recommended regular inspections of the chain drive, camshaft bearings and reversing gear is carried out.

Piston and liner seizures are common but rarely result in insurance claims. Regular inspections of piston rings through the scavenge ports is recommended.

The crosshead bearing is the hardest bearing to lubricate as there is no rotation and therefore no oil film is developed.

The crankcase lubricating oil should be in good condition as it does not come into contact with the combustion process. If it is contaminated with combustion products then it shows the piston rod glands are leaking.

The Mitsubishi UEC engines using the Mitsubishi MET turbochargers have specific problems which most people in the industry have discovered to their cost. The piston crowns suffer from wastage and become cracked or holed. Cooling oil leaks into the combustion space/exhaust manifold, sometimes during manoeuvring and, when the engine is started, the oil ignites and there is a fire/explosion in the exhaust manifold and damage is sustained to the turbocharger. Mitsubishi provide a profile gauge which makes it easier to check the amount of wastage of the piston crowns and to renew them before there is a risk of cracking.

Poorly maintained fuel injectors can allow unburnt fuel to build up in the exhaust manifold with similar consequences.

Regular inspections of the piston rings through the scavenge ports can help to ensure that pistons, rings and liners are kept in good condition. Some companies do this on a monthly basis with a piston ring inspection report sent to the office accordingly.

Known operating failures have included the following:

- Water contamination of the crankcase oil due to piston rod gland seals leaking. We recommend weekly testing of lubricating oil water content.
- Poor quality fuel oil damages. We recommend that fuel oil analysis is carried out when loading large quantities of fuel oil in suspect areas.
- Scavenge fires. Regular cleaning of scavenge spaces to be carried out and piston / piston ring inspection through cylinder liner ports.
- Thrust pad failures. We recommend that inspections are carried out.
- Piston crown cracking initiated from lifting bolt holes.
- Crankcase cracking around crosshead guide webs.

2. Turbochargers

Those that have bearings lubricated from the main engine oil system are more prone to damage than those with individual dedicated oil sumps.

When lubricated from the engine oil system, there should be a facility to ensure that the turbocharger remains lubricated when the engine stops suddenly, such as a header tank with a run down facility.

The MET turbocharger uses the same oil which is in the main engine lubrication system. In the event that this oil becomes contaminated, the fine high speed plain bearings in the turbocharger, particularly the thrust bearing, are usually the first to fail. Some installations benefit from a separate filter at the lubricating oil inlet to the turbocharger, and this must be cleaned regularly. In the event of a blackout, the lubrication of the turbocharger can be a problem while it runs down to a stop with no pressurised oil supply. A header tank system with change over valves can be fitted. These latter items are optional extras.

3. Medium speed four stroke engines

Pielstick and other four stroke main engines

Crankshaft bearings are the most common area of failure which gives rise to insurance claims. Due to the design and construction of the engine, there are also particular problems such as the fretting of the water jacket assembly.

If we consult our loss records we see the following:

Fretting of water jacket/liner/crankcase assembly after around 80,000 hours – with the recommendation that the engines are stripped down at this time and the landing surfaces machined. There also comes a time when the engine alignment has to be adjusted and the engines re-chocked. Regarding alignment, and with a view to enhancing crankshaft bearing reliability, regular crankshaft deflections are important.

Cylinder liner ovality - sometimes caused by fretting and relative movement of the water jacket assembly - should be monitored regularly and can be measured from within the crankcase without having to remove the piston. Some licensees put the maximum cylinder liner ovality at 0.6mm but this is generally regarded as being too large, and I think you should use 0.2mm as a maximum.

Camshaft bearings – these are sometimes overlooked, become worn and the oil pressure to the camshaft and associated components drops, the cam followers become worn and partial seizures occur. Camshaft bearing clearances should be monitored accordingly. Some licensees recommend fitting an oil pressure gauge at the end of the lubricating oil rail for the camshaft, with a view to ensuring the pressure is always above 1 bar. If a separate auto klean filter is fitted on the camshaft lubricating oil supply line (IHI additional item) then this should be cleaned regularly to avoid starvation of the camshaft bearings.

Crankpin ovality – assuming the crankshafts are original, there will be a degree of ovality to the crankpins and this should be measured during piston removals and dealt with accordingly.

Connecting rod ovality/cracking – the connecting rods become oval after a long period in service and require machining. The serrations can also suffer from cracking and these should be carefully checked during overhauls. Checks should also be made for signs of the bottom end bearing shells fretting in their housings.

Connecting rod bolts – there is a finite life for the connecting rod bolts determined by elongation or running hours, and these should be checked and monitored accordingly.

Main bearings – on the Vee 12 engines, main bearings 3, 4 and 5 experience a greater degree of wear than the others. When inspecting a sample of main bearings, these should receive particular attention.

Oil quality – some licensees put limits for insolubles at 5%, but this is generally felt to be too high, and we would recommend that insolubles do not exceed 2.5%."

Exhaust valves – there have been numerous problems with exhaust valve failure and the consequential damage to the turbocharger from debris.

Care should be taken when overhauling the valves, to the maintenance of fuel injectors and prompt attention to rising exhaust temperatures.

Yanmar, Daihatsu and other four stroke generator engines

As with all medium speed four stroke engines, the greatest area of failure is to the crankshaft bearings. Crankpin and connecting rod ovality have often been overlooked and resulted in bottom end bearing failures.

The connecting rod bolts have a fatigue limit and should be renewed according to manufacturer's instructions.

Lubricating oil contamination has been responsible for some bearing damages and some of this has resulted from leaking cylinder liner O ring seals.

As the engines reach 15 years old and beyond, as much as possible needs to be done to enhance the reliability of the crankshaft bearings. In this respect, attention is drawn to the following:

- The need to check crankshaft crankpin ovality and to keep this within manufacturer's limits.
- The need to check connecting rod bottom end bearing housing ovality and to monitor serrations for cracking etc and to machine the connecting rods accordingly.
- Particular attention should be given to lubricating oil quality and the use of regular oil sampling and analysis.
- The fatigue life of Yanmar engine connecting rod bottom end bolts is not always clear from the maintenance manuals, and varies with engine type. As a guide, unless the maintenance manuals state otherwise, a period of 5 years or 20,000 running hours should be the maximum service life of the bolts or 1mm bolt extension after which they should be renewed.

February 2008