



Tanker Structure Co-operative Forum

Information Paper on Oil Tanker In-Service Structural Survey Regimes

SUMMARY

This paper reviews the current regime of inspection requirements for oil tankers including ESP, CAP, CAIP and CAS.

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1 Introduction

The maintenance of tankers is the responsibility of the owner/operator. The classification society rules and regulatory authorities require periodic surveys of tanker structures to ensure that minimum standards are met. As a result, over the course of its life, every tanker is subject to annual, intermediate, and Special Surveys, the scope of which are in accordance with the Enhanced Survey Program, as per IMO Res. A. 1049 (27) (2011 ESP Code).

In addition, other types of surveys have been introduced for various reasons. This paper reviews the current regime of inspection requirements for tankers including ESP, CAP, CAIP, and CAS.

2 Historical Perspective

Historically, the assessment of the structural condition of a tanker was carried out by the classification society together with owners. This was reported in the annual, intermediate, and special or renewal surveys. The special-or renewal surveys were the more extensive and definitive surveys and were due every 4 years but could, and normally were, extended to 5 years.

In the mid-1980's the industry became aware that some first generation VLCCs would be facing substantial steel renewals due to unchecked corrosion, particularly in segregated ballast and cargo/ballast tanks, at second Special Survey despite passing first Special Survey and Intermediate Surveys.

In the early 1990's the USCG became concerned over increasing fatigue cracking in US flag vessels operating in the Alaskan service. As a result, they required the operators to develop Critical Area Inspection Plans (CAIP) and perform more frequent inspections of these vessels.

By the mid-1990's fatigue cracking began to appear on VLCCs built in the mid-1980's. This cracking was attributed to the use of high tensile steel (HTS) and the failure of designers to understand the fatigue sensitivity of HTS when used in poor structural details.

Industry organizations such as ICS, INTERTANKO, and OCIMF began to put pressure on the class societies to improve survey practices to detect problems earlier and more consistently. The class societies responded by enhancing survey practices and working within IACS to produce the uniform practices that are contained in today's Unified Requirements UR Z10.1 and UR Z10.4 for single hull and double hull tankers, respectively. These enhancements included increased visual inspection, thickness measurements, and tank testing as the vessel aged, defined the concept of close-up inspection, and transposed the Enhanced Survey Program (ESP) in the class rules.

The ESP was at first introduced in January 1993 by Reg. 13G of Annex I to MARPOL 73/78 for existing oil tankers and subsequently introduced in the Chapter XI of SOLAS 74 as amended in January 1996. The ESP applies to bulk carriers and oil tankers and provides inspection requirements whose scope is based on the age of the vessel. IACS Classification

societies have extended the application of ESP survey regime to Chemical Tankers, per UR Z10.3 (1996).

ESP is applied over the entire vessel life, though its impact occurs on vessels greater than 10 years of age where the Intermediate Survey requirements are conducted to the same extent as the previous special or renewal survey except for out of water survey, pressure testing of cargo and ballast tanks and the requirements for longitudinal strength evaluation of hull girder, unless deemed necessary. For tankers over 15 years of age, survey in drydock is to be part of intermediate survey.

With the adoption of double hull regulations for new tankers, additional concerns developed over single hull vessels continuing in service. These concerns resulted in the adoption by the IMO of the Condition Assessment Scheme (CAS). CAS required single hull vessels to undergo a survey independent of the class survey and of periodical statutory surveys, and to have the results reviewed and approved by the flag administration for continued operation.

Meanwhile, the earlier concerns of the oil major charterers led to the development of Vetting Organizations (VO) to perform an assessment of tankers proposed for charter service. To help with the evaluation of structural condition, the vetting organizations encouraged the class societies to provide an independent structural evaluation service independent of the traditional class surveys. The Condition Assessment Program (CAP) matured to a point where today it provides a technical ranking on a scale of 1 to 4 with most charters requiring a CAP 1 or CAP 2 to be accepted for hire.

3 Vetting Organization Expectations

Most of the major oil companies have Vetting Organizations (VO). Each VO is charged with assessing the quality and safety of vessels and vessel operators carrying cargoes for the oil company. The techniques used by a VO to rate a tanker varies from company to company but in general each looks at many of the same attributes.

Many major oil companies require that vessels they charter of 15 years of age and above have a current CAP performed within the last 3 years with a rating of CAP 1 or CAP 2.

Other factors reviewed by the VO may include management practices and capabilities, safety record, classification record, including any outstanding recommendations or conditions of class, actions by port state or flag state authorities, vessel inspection results such as SIRE reports, and vessel age.

More recently vessel age has become a key discriminator with some companies not accepting vessels older than a specific age, e.g. 20 years for spot service; 15 years for term service.

4 Enhanced Survey Program (ESP)

IACS UR Z10.4 establishes a uniform set of requirements for Hull Surveys of Double Hull Oil Tankers subject to the Enhanced Survey Program (ESP). Requirements for Annual, Intermediate, and Special Surveys are outlined with the Special Survey being the most comprehensive. ESP defines schedule and scope as well as required preparation,

documentation, procedures, reporting, and evaluation. Many requirements become more stringent with age such as the extent of overall and close-up survey, thickness measurements, and tank testing.

The IACS UR defines that “an Overall Survey is a survey intended to report on the overall condition of the hull structure and determine the extent of additional Close-up Surveys. A Close-up Survey is a survey where the details of structural components are within the close visual inspection range of the surveyor, i.e. normally within reach of hand.”

At each Special Survey all tanks and spaces are subjected to Overall Survey. The extent of a Special Survey increases with age. An abstract of increasing requirements, for reference, is shown below in Table 1. For updated complete requirements see latest class rules.

Table 1. Abstract of Special Survey requirements

Item	Vessel age 5 years or below	Older vessels
Extent of close-up survey	<ul style="list-style-type: none"> • One WBT web frame • One COT deck transverse • One center COT transverse bulkhead • One wing COT transverse bulkhead. 	At 10+ years: <ul style="list-style-type: none"> • All web frames in all WBT's • All web frames, deck transverses, and cross ties in one cargo tank • One full web frame in each remaining cargo tank • All transverse bulkheads in all cargo and ballast tanks • The Surveyor may also require Close-up survey if structural defects are identified or if the vessel was built with reduced scantlings
Thickness measurements	<ul style="list-style-type: none"> • Required only for suspect areas • One section of deck plating of full breadth within the cargo area • Members subject to Close-up survey 	At 15+ years: <ul style="list-style-type: none"> • every deck plate, three transverse sections, and each bottom plate are to be gauged within the cargo area in addition to all wind and water strakes, suspect areas, and those requiring close-up inspection
Tank testing	<ul style="list-style-type: none"> • Ballast tank boundaries • Cargo tank boundaries facing ballast tanks • Void spaces • Pipe tunnels • Pump rooms • Cofferdams 	At 5+ years: <ul style="list-style-type: none"> • All ballast tank boundaries • All cargo tank bulkheads • Reference may be made to IACS Z10.4 and the tables contained therein for further details

ESP also requires a recheck of the longitudinal strength to assess the gauged condition of the vessel for tankers over 130 m in length after it reaches ten years. The number of sections required to be gauged increases with age.

Intermediate Survey requirements increase with age and deteriorating condition for both Close-up and Overall Surveys. For example, between five and ten years Overall Inspection is only required for representative ballast tanks to confirm that the coatings remain in good condition. After a tanker reaches ten years, the Intermediate Survey requirements are to be to the same extent as the previous Special Survey with the exception of longitudinal strength evaluation and tank testing.

4.1 Survey Planning Document

As a result of the introduction of the Enhanced Survey Program, Oil Tankers, Combination Carriers, Chemical Tankers and Bulk Carriers, require a Survey Planning Questionnaire and a Survey Program (Planning Document) to be prepared in advance of the Special Survey and the Intermediate Survey on ships over 10 years of age. (Reference IACS UR Z.10.1/5.1).

In particular, the Rules and Regulations for the Classification of Ships require a Survey Planning Questionnaire and a “Planning Document” to be prepared by the Owner prior to the commencement of the Intermediate Survey or Special Survey. The program is to include proposals for how the Survey is to be carried out, including the means of providing access for close-up survey and thickness measurement.

The “Planning Document” at Intermediate Survey for vessels over 10 years old usually consists of the Survey Program agreed for the previous Special Survey supplemented by the Executive Hull Summary of that Special Survey and later relevant survey reports (reference IACS URZ10.1/4.2.3.1).

In general a meaningful “Planning Document” includes the information useful to selecting tanks areas and structural elements to be examined as listed below (per IACS Z10.4/5.1.3):

1. basic ship information and particulars
2. main structural plans (scantling drawings) including information regarding use of high tensile steels (HTS)
3. plan of tanks
4. list of tanks with information on use, corrosion prevention and condition of coating
5. conditions for survey (e.g., information regarding tank cleaning, gas freeing, ventilation, lighting, etc.)
6. provisions and methods for access to structures
7. equipment for surveys
8. nomination of tanks and areas for close-up survey
9. nominations of sections for thickness measurement
10. nomination of tanks for tank testing
11. identification of the thickness measurement company
12. damage experience related to the ship in question
13. critical structural areas and suspect areas, where relevant

A “Planning Document” generally covers the structure within the cargo space length, peak tanks and any other water ballast tanks, enclosed spaces and open decks. The nominated tanks and spaces for overall surveys, close-up survey and location for thickness measurement are to abide by the requirements contained in class rules. Locations for special attention should be based on owner’s operational experience, fatigue analysis and previous hull defects as detailed in publications such as reference [1].

However, it should be noted that in addition to the nominated locations, further close-up surveys and/or NDT may be requested by the attending classification society surveyor(s). Additional surveys and thickness measurements should be accepted by the owners, based on the surveyor(s) judgment of conditions found. Hence, the full extent of surveys and UTMs should be discussed and agreed with the attending surveyor(s) at the time of the surveys in parallel with the information available in the “Planning Document”.

5 Condition Assessment Program for Hull Structures (CAP Hull)

5.1 Purpose

CAP evolved out of an industry request for higher standards above and beyond Class survey requirements and application of more sophisticated analysis tools to ageing tankers. CAP is an independent and thorough assessment of a vessel at a specific time based on engineering analysis, survey, and thickness measurements.

While class requirements provide a minimum standard, CAP provides a rating of Grade 1 to Grade 4, with CAP 1 being the highest rating. The grading system allows companies to be more selective and they often require a minimum Grade 2 CAP rating. Grade 2 will typically be a vessel that has no substantial corrosion and is better maintained than a vessel meeting the minimum class requirements (CAP 3).

The overall grade is typically assigned based on engineering evaluation, coating condition, thickness gaugings, general structural condition, and fatigue assessment. One essential element of CAP is the fatigue analysis of connections of longitudinal ordinary stiffeners with transverse reinforced rings and longitudinal end connections in the cargo area.

CAP may be used to document vessel condition for charterers, cargo owners, underwriters, and potential buyers. It may also be used to comply with a company’s own internal standards. CAP may also assist owners when deciding how much to invest on repairs and life extension measures.

5.2 Procedure

The CAP generally begins during the planning for Special Survey or for Intermediate survey for ships aged fifteen years or older. Some CAP providers may conduct a fatigue strength analysis and therefore require main scantling plans.

The CAP provider will conduct a record review. The CAP provider will then carry out a preliminary fatigue analysis of the connections of longitudinal stiffeners with reinforced rings and transverse bulkheads in the cargo tank region. The Survey portion typically coincides with a Special or Intermediate Survey and requires gaugings be carried out by a qualified company. The extent of gauging is generally in line with what is required at Special Survey but may require additional measurements. During the CAP Survey all hot spot locations identified during the fatigue analysis are subject to close-up Survey. Gaugings are submitted to the CAP provider and will factor into the final grade. Based on thickness measurement an “as gauged” fatigue analysis may be conducted.

Any steel renewals, repairs, or closing of outstanding requirements are completed and documented. Once a strength evaluation is carried out, the engineering analysis is complete. Fatigue, strength, gauging, and hull girder evaluation are then compiled into the final engineering report. This report, together with coating condition and visual inspection results, photographs, and a list of Survey findings and repairs, are all used to determine the final CAP rating.

5.3 Consistency between CAP Programs

While each CAP provider has a similar scope, there is no unified recommendation for how to conduct the CAP assessment. Similarly, while the grading systems are similar with a CAP 1 through CAP 4 scale, the definition of each may vary by CAP provider. An example of one CAP provider's rating definitions is below:

- **VERY GOOD CONDITION [CAP 1]:** Items examined and measured, found with only superficial reductions from "as new" or current Rule scantlings. No maintenance or repair required.
- **GOOD CONDITION [CAP 2]:** Items examined and measured, found to have deficiencies of a minor nature not requiring correction or repairs and/or found to have thicknesses significantly above class limits.
- **SATISFACTORY CONDITION [CAP 3]:** Items examined and measured either found to have deficiencies which do not require immediate corrective actions, or found to have thicknesses which, although generally above class renewal levels, have areas of substantial corrosion.
- **POOR CONDITION [CAP 4]:** Items examined and measured either found to have deficiencies which may affect the ship's potential to remain in class, or found in some areas to have thicknesses that are at or below class renewal thickness.

5.4 Key elements of CAP program

Based on a review of the current processes of the CAP providers, the following items have been identified as best practices by the TSCF.

5.4.1 Assessment of maintenance and repair

The information presented in the CAP report can be used by both the owner/operator and vetting organizations to judge the maintenance of the vessel. It assists the owner/operator in making repair decisions concerning fatigue issues, steel renewals, and coating condition.

5.4.2 Use of Photographs

The CAP process generally provides an extensive number of photographs to document the condition of the vessel. This visual evidence helps understand report findings, better communicate the condition of the vessel, and assist with decisions on maintenance and repair.

5.4.3 Additional Surveyor

Some CAP providers utilize a second surveyor so that an independent set of eyes are involved in the inspection and grading of the ship. The intention is to eliminate biases.

5.4.4 S-Curve for thickness measurement

The thickness measurements taken during a CAP survey are analyzed by producing a plot of cumulative % versus diminution level. This produces a characteristic, statistical S-curve that gives a ready visual assessment of wastage being experienced on the vessel by individual components and overall. Statistical S-curve example is shown below in Figure 1.

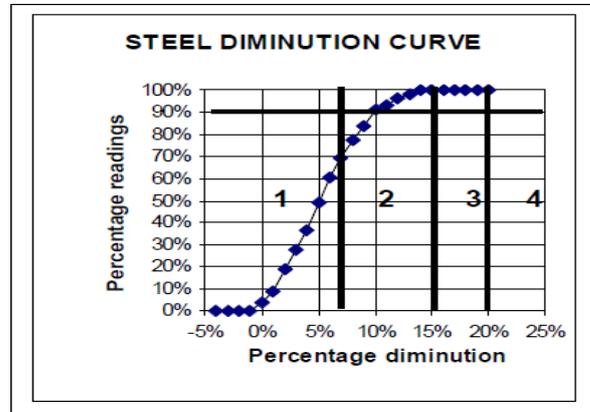


Figure 1

5.4.5 Fatigue Comparison

Fatigue is typically calculated using a uniform approach, regardless of trade route, based on North Atlantic service. If information has been collected on the in-service history of the vessel, an estimate of actual fatigue can be made against calculated fatigue life.

During the CAP process, and at the request of the owner, information can be collected and/or developed on the in-service history of the vessel. This includes information on trade routes, sea states encountered, loading conditions, etc. This information can then be used to correlate past cracking and damage reports with historical service.

5.4.6 CAP rating for Hull

The CAP process results in a score (e.g. CAP 1, CAP 2) for the vessel. In order to reach this score, individual areas are also scored. These include longitudinal strength, local strength, fatigue, materials, thickness gaugings, and coating condition.

6 Critical Area Inspection Program (CAIP)

In the early 1990's the USCG began the Critical Area Inspection Plan (CAIP) program. The CAIP program came about due to increasing concern over the number of fatigue cracks being found on US flag vessels in the Trans-Alaskan Pipeline System (TAPS) trade. TAPS tankers typically loaded crude oil in Valdez and delivered it to ports along the West Coast of the United States. The wave spectrum along most of the route in the Pacific Northwest is routinely rough. Newer, larger vessels, particularly those employing HTS for some or all of the structure, were experiencing early and numerous fatigue cracks.

The CAIP program required all vessels in the TAPS trade to undergo an annual inspection of the cargo block to inspect critical areas for fatigue cracking. Each vessel was to maintain a CAIP plan describing the critical areas. Certain vessel classes determined to have a particularly poor fatigue performance were designated 'special attention' vessels subject to

CAIP inspections every six months. Owners were expected to take steps to eliminate fatigue cracking over time and as fatigue performance improved, the inspection interval could be extended.

While the CAIP program is still in existence, almost all of the original vessels have been replaced by new double hull tankers with improved fatigue design and performance.

7 Condition Assessment Scheme (CAS)

The Condition Assessment Scheme (CAS) was introduced by the IMO in 2001. It was applicable to all single hull tankers of 15 years or older. Very few if any single hull tankers continue to operate in oil service and Regulation 20 of MARPOL Annex I effectively eliminates single hull oil tankers from their anniversary date in 2015.

8 Conclusion

This paper has reviewed the current regime of inspection requirements for oil tankers including ESP, CAP, CAIP and CAS. Latest version of applicable rules should always be checked.

References

1. TSCF “Guidance Manual for the Inspection and Condition Assessment of Tanker Structures”
2. Classification Societies – Condition Assessment Programme (CAP) requirements
3. TSCF Publication: “Condition Evaluation and Maintenance of Tanker Structures”