"Samco Raven"

IMO 9107655

<u>Crude Oil Tank Inspection Report</u>

YiuLian Dockyards (Shekou) Limited, Shenzhen, China

25-26 August 2011

Report prepared by: Andrew Cass

1. Executive Summary

The "Raven", a 301,653 dwt double hull Crude Oil Tanker, was delivered by Sumitomo Heavy Industries, Japan in June 1996. Immediately after delivery, she was redocked at Hyundai Mipo Dockyard, Korea, where the upper and lower areas of her cargo tanks were blasted and recoated with Intershield®300, an abrasion resistant aluminium pure epoxy universal primer.

The (now-called) "Samco Raven" docked in YiuLian Dockyard (Shekou), China for her third special survey and planned maintenance in August 2011, during which time the coating condition in nine of her fifteen cargo tanks was assessed.

During the 15-year in-service inspection, general condition, corrosion, blistering, detachment, adhesion and underfilm creep adjacent to damaged areas were assessed and photographic evidence taken. A summary of the results is shown below with more detailed information and a photographic record contained in the body of this report. [Note that, due to access and lighting restrictions, only areas adjacent to entrance hatches could be inspected in the upper areas of the tanks. Full inspections were carried out on the tanktops and lower bulkhead areas.]

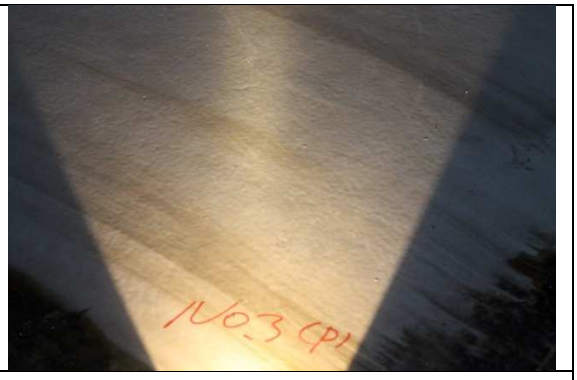
- The coating was in excellent general condition in both upper and lower areas of all nine tanks inspected
- Very little breakdown was observed on edges, weld seams, cut-outs and scallops throughout the tanks with only a small number of minor, isolated spots of corrosion.
- Blistering was observed in one small isolated area adjacent to the aft tank entrance to No.1 (S). No blistering was found in any other area in any of the other tanks.
- Adhesion to steel was measured using the penknife cross-cut method in three separate tanks with the result recorded as excellent (rating = 5/5) in each case
- Minor, isolated areas of breakdown were observed on the underside of the main deck where hot work had been carried out. The coating in surrounding areas was still intact and in excellent condition.
- No breakdown was visible directly above, at or below the cargo load lines.
- Scratch marks were visible in many tanktop areas where steel shovels had been used to remove crude oil from the cargo tanks. The coating was still fully intact and protecting the steel in each case.
- The residual layer of crude oil was removed from the tanktop surface using paint thinner in two random areas (each approx. $1m^2$) of two separate tanks. The condition of the coating after cleaning was assessed as excellent (appearance as new) and photographs taken. Film thickness in each area was measured as 353-583µm and 501-754µm.
- The coating was in excellent condition in areas surrounding bellmouths and on sharp edges around cargo wells
- Scattered mechanical damage to the coating (from the new construction stage) was observed on every tanktop. Where corrosion pits were present, underfilm creep in adjacent areas was measured as virtually nil in all cases (i.e. no loss of adhesion of the coating to the steel in areas immediately surrounding damage points).
- Total coating breakdown was recorded (as an observed percentage of the area under consideration) as **<0.1%** in all upper areas and **<0.3%** (including mechanical damages) in all lower areas

It can be concluded from the result of this inspection that Intershield®300, when correctly applied to a well-prepared substrate, provides excellent protection to the aggressive areas of cargo tanks after even 15 years in service.

Minimal repair work to mechanically damaged areas would be necessary at this third special survey in order to achieve many more years of in-service protection of the cargo tanks.

The performance of Intershield®300 on the "Samco Raven" exceeds the requirements for a coating to be in 'Good' condition (IACS Resolution A744 Rec.87) as set out in the IMO's Performance Standard for Protective Coatings for Cargo Oil Tanks of Crude Oil Tankers (MSC.288(87)).

Comments from the V.Ships France (vessel managers) superintendent supervising the dry docking are included in section 7 of this report.

	
General condition in deckead areas	Tanktop after cleaning

2. Vessel Details

Current name	Samco Raven
IMO number	9107655
Ship type	Crude Oil Tanker (Double Hull)
DWT	301,653
Builder	Sumitomo Heavy Industries, Japan (Hull no. 1189)
Delivered	June 1996
Current owner	Samco Shipholding Pte Ltd
Current manager	V.Ships France SAS

3. Coating History

The vessel was constructed using steel coated with 15 microns of the shipbuilder's standard zinc silicate shop primer and delivered without any further coating system applied to the cargo oil tanks.

A docking was carried out at Hyundai Mipo Dockyard, South Korea immediately after initial delivery at which the cargo oil tanks were fresh water washed and the upper and lower areas fully reblasted to standard Sa2½ and coated with 50 microns of an epoxy holding primer, Intergard 269.

The following coating system was then applied via airless spray:

Vessel Area	Coating Scheme
Deckheads, tranverse web frames and approx. 2m down the vertical bulkheads	2 x 150µm dft Intershield®300 (ENA300 series)
Tanktops and approx. 0.2m up the bulkheads	

No further surface preparation or coating work was carried out on the Port and Starboard slop tanks, which remained coated with the originally applied newbuilding scheme.

4. Inspection Details

Location	YiuLian Dockyards (Shekou) Limited, Shenzhen, China
Date	25-26 August 2011
In-service period	15 years
Docking reason	Class special survey; Routine maintenance
Classification	Det Norske Veritas
Attendees	Andrew Cass (International Paint, Worldwide Marine, Bus. Dev. Manager) Tian Hu (International Paint Shanghai, Technical Service Representative)
Cargo tanks inspected	No.1 (S), No.2 (C), No.3 (P), No.3 (S), No.4 (P), No.4 (C), No.4 (S), No.5 (C), No.5 (S)

5. Inspection Results

Nine cargo oil tanks were inspected over a period of two days as follows:

Date (time)	Cargo Tanks
Thu 25 Aug (am)	No.5 (S), No.5 (C)
Thu 25 Aug (pm)	No.4 (P), No.4 (C), No.4 (S)
Fri 26 Aug (am)	No.3 (P), No.3 (S)
Fri 26 Aug (pm)	No.2 (C), No.1 (S)

Due to the absence of staging and lighting in the tanks, only the upper areas adjacent to the tank entrance were inspected (apart from the upper stringer deck in No.5 Centre and Port). Full inspections were conducted on the tanktop areas.

The coating was inspected for general condition, corrosion, blistering, detachment, adhesion and underfilm creep adjacent to damaged areas. Coating breakdown in each area is given as an observed percentage of the area under consideration.

Note that, although the tanks were cleaned prior to inspection, a residual surface layer of oil gave the coating a dark appearance. This layer of oil was removed using paint thinner on random areas in two separate tanks to reveal the true appearance of the coating beneath.

The results below are reported in the order the tanks were inspected, with photographic supporting evidence provided in section 6.

<u>No. 5 Starboard C.O.Tk</u>

Upper area:

- Excellent general condition in all areas around tank access, on upper stringer deck and web frames
- No breakdown on edges, weld seams and cut-outs
- One area (approx. 1 sq.cm) of coating on deckhead damaged from hot work carried out on main deck
- No blistering
- Adhesion to steel assessed on web frame (Bay 6) using penknife cross-cut method = Excellent (rating 5/5)
- Total area breakdown <<0.1%

Lower area:

- Edges and weld seams in excellent general condition with only a few small corrosion spots
- Small pits scattered around the tanktop where corrosion had occurred at points of mechanical damage to coating or where welds had been ground at the new construction stage. Underfilm creep measured as zero (i.e. no loss of adhesion of the coating to the steel in the areas immediately surrounding corrosion pits).
- Coating still fully intact where scratch marks visible from removal of crude oil using shovels
- No blistering

- Adhesion to steel (Bay 1) = Excellent (rating 5/5)
- Total area breakdown <0.3%

No. 5 Centre C.O.Tk

Upper area:
- Excellent general condition in all areas around tank access, on upper stringer deck and web frames
- Some (very minor) breakdown on edges and weld seams on underside of main deck directly adjacent to tank entrance
- No blistering
- Total area breakdown <0.1%

Lower area:
- Edges, cut-outs and scallops in excellent condition with no breakdown observed
- Some small pits scattered around the tanktop (mainly in Bays 1 and 2) where corrosion had occurred at points of mechanical damage and on welds that had been inadequately ground at the new construction stage. Underfilm creep measured as zero (i.e. no loss of adhesion of the coating to the steel in the areas immediately surrounding corrosion pits).
- Coating still fully intact where scratch marks visible from removal of crude oil using shovels
- No blistering
- Adhesion to steel (Bay 2S) = Excellent (rating 5/5)
- Total area breakdown <0.3%

No. 4 Starboard C.O.Tk

Upper area:
- Excellent general condition in all areas around tank access
- Minor areas of breakdown on inside of one scallop, one rat-hole and on one edge immediately adjacent to tank entrance
    - No further breakdown observed on any edges, weld seams and cut-outs
- No blistering
- Total area breakdown <0.1%

Lower area:
- Excellent general condition with no breakdown observed on edges or weld seams
- Corrosion pits scattered around the tanktop as a result of mechanical damage to coating. Two pits measured at approx. 15 sq.cms. Underfilm creep (measured at multiple points) recorded as zero.
- No blistering
- Adhesion to steel (Bay 7) = Excellent (rating 5/5)
- Residual layer of oil removed from the surface of one area (approx. 1 sq.m) using paint thinner
    - Coating in excellent condition
    - DFT measurements = 501-754µm
    - [See photographs #29-31 in section 6]
- Total area breakdown <0.3%

No. 4 Port C.O.Tk

Upper area:

- Excellent general condition in tank access areas
- Some minor breakdown in areas directly adjacent to tank entrance
    - Underside of main deck where hot work has been carried out
    - One isolated area on transverse bulkhead
    - Inside one scallop
    - One small area on deckhead support bracket
- No blistering
- Total area breakdown <0.1%

Lower area:

- Edges, cut-outs and scallops in excellent condition with no breakdown observed
- A few scattered corrosion pits around the tanktop at points of mechanical damage to the coating and where welds had been insufficiently ground at the new construction stage
- No blistering observed
- Fresh mechanical damage (no corrosion) around bellmouth – Intact coating in very good condition
- Total area breakdown <0.3%

Note: Inspection abandoned before completion due to the increasing solvent odour coming from the coating work being carried out in the double bottom of the adjacent No.4 (P) water ballast tank.

No. 3 Port C.O.Tk

Upper area:

- Excellent general condition in all areas around tank entrance
- No breakdown on edges, weld seams and cut-outs
- One isolated area (approx. 50 sq.cm) of coating breakdown on transverse bulkhead directly adjacent to top of access ladder
- No blistering
- No coating breakdown observed above, at or below the (clearly visible) cargo load line
- Total area breakdown <0.1%

Lower area:

- Excellent general condition with no breakdown observed on sharp edges or weld seams
- Only a few scattered corrosion pits on the tanktop resulting from mechanical damage to coating. Underfilm creep (measured at multiple points) recorded as zero.
- No blistering
- Residual layer of oil removed from the surface of one area (approx. 1 sq.m) using paint thinner
    - Coating in excellent condition
    - DFT measurements = 353-583µm
    - Two areas (<1 sq.cm) of mechanically-damaged coating. Underfilm creep measured as zero.

    - [See photographs #63-64 in section 6]
  - One crack at the foot of the access ladder
  - Total area breakdown <0.3%

No. 3 Starboard C.O.Tk

Upper area:
  - Excellent general condition in all areas around tank entrance
  - No breakdown observed on edges, weld seams and cut-outs
  - No blistering
  - Total area breakdown <0.1%

Lower area:
  - Edges and weld seams on lower bulkhead areas and support brackets in excellent general condition with no breakdown observed
  - A few scattered corrosion pits on the tanktop resulting from mechanical damage to coating and ground welds. Underfilm creep measured as zero.
  - No blistering
  - Coating still fully intact where scratch marks visible from removal of crude oil using shovels
  - Corrosion (heavy in some areas) visible on the outer bulkhead above the area coated with Intershield®300. The coated area extended approx. 0.2m up the bulkhead, where cargoes containing high water content can exceed this level.
    - Rust scale could easily be removed using a penknife above the coated area
    - No underfilm creep was observed below the coated area (i.e. the coating was still fully adherent and protecting the substrate)
  - Total area breakdown <0.3%

No. 2 Centre C.O.Tk

Upper area:
  - Excellent general condition on deckhead, supporting brackets and upper bulkhead areas
  - Some corrosion caused by mechanical damages in tank access areas (immediate vicinity of manhole) and behind coils in adjacent bay
  - No blistering
  - Total area breakdown <0.1%

Lower area:
  - Edges, cut-outs and scallops in excellent condition with no breakdown observed
  - Tanktop area in very good general condition but significant number of corrosion pits caused by mechanical damages visible throughout the tank
    - Bay 8:
      - 1 x 8mm diameter pit (2mm creep measured)
      - 1 x 15mm pit (5mm creep)
      - 1 x 20mm pit (0mm creep)
    - Bay 7:
      - >20 x 5-200mm pits at points of heavy (distinctly shaped) mechanical damage

- Some small areas of fresh mechanical damage (no corrosion) around cargo line supports
- Coating still fully intact where scratch marks visible from removal of crude oil using shovels
- No blistering
- Total area breakdown <0.3%

No. 1 Starboard C.O.Tk

Upper area:

- Very good overall condition on deckhead, supporting brackets and upper bulkheads
- Some minor areas of breakdown observed inside one scallop and on one edge
- Transverse bulkhead directly adjacent to top of access ladder
    - Two contiguous areas of coating breakdown (approx. 130 sq.cm in total)
    - One area of scattered blisters
- Total area breakdown <0.1%

Lower area:

- Edges and weld seams on lower bulkhead areas and support brackets in excellent general condition with only a few small corrosion spots (ground weld seams on erection joints)
- Approx. 5 x 15-20mm corrosion pits observed on tanktop (adjacent to Bay 7) caused by mechanical damage to coating
    - Underfilm creep (measured at multiple points) recorded as zero
    - Repairs to damaged areas by brush application at new construction stage clearly visible in each area around the mechanical damages
- Large number of small corrosion spots caused by mechanical damage on tanktop area immediately adjacent to foot of the access ladder
- Coating around bellmouth in excellent condition with no breakdown observed
- No blistering
- Total area breakdown <0.3%

6. Photographic Report

No.5 (S) - Upper		
Photo #1	Photo #2	Photo #3
		
Excellent general condition	Areas around tank access	No breakdown on edges and weld seams
Photo #4	Photo #5	Photo #6
		
One area (approx. 1 sq.cm) of coating on deckhead damaged by hot work on main deck	No breakdown on edges or hand support	Adhesion to steel check using penknife cross-cut method (rating = 5/5)

No.5 (S) - Lower		
Photo #7	Photo #8	Photo #9
		
Tanktop	Excellent general condition	No breakdown on edges and weld seams
Photo #10	Photo #11	Photo #12
		
Corrosion pit as a result of mechanical damage No underfilm creep of coating	Scattered pits on some ground welds	Surface scratches from shovels used to remove crude oil – coating still intact

No.5 (C) - Upper		
Photo #13	Photo #14	Photo #15
		
Coating of deckheads and 2m down bulkheads	Excellent general condition	Deckhead and connecting brackets
Photo #16	Photo #17	Photo #18
		
Small number of blisters along one weld seam	Small areas of reverse burn damage on underside of main deck	Corrosion of uncoated steel below 2m level

No.5 (C) - Lower		
Photo #19	Photo #20	Photo #21
		
Tanktop	Excellent general condition	No breakdown on edges of drainage holes
Photo #22	Photo #23	Photo #24
		
Erection joint (one corrosion pit) and weld seams	Adhesion to steel check (rating = 5/5)	Surface scratches from shovels

No.4 (S) - Upper	
Photo #25	Photo #26
	
Excellent general condition	Deckhead and connecting brackets
Photo #27	Photo #28
	
One small area of breakdown on edge of bracket	Minor breakdown on inside of scallop and edge

No.4 (S) - Lower		
Photo #29	Photo #30	Photo #31
		
Removal of residual oil layer from surface of coating using paint thinners	DFT checks (501-754µm)	Appearance of coating after cleaning
Photo #32	Photo #33	Photo #34
		
No breakdown on complex weld areas	Two corrosion pits (approx. 15 sq.cm each) caused by mechanical damages No underfilm creep of coating	Adhesion to steel check (rating = 5/5)

No.4 (C) - Upper	
Photo #35	Photo #36
	
Deckhead and connecting brackets	Excellent overall condition
Photo #37	Photo #38
	
Area immediately surrounding tank entrance	Minor breakdown along stiffener and one weld seam

No.4 (C) - Lower		
Photo #39	Photo #40	Photo #41
		
Tanktop	Excellent general condition	No breakdown on scallops and edges of drainage holes
Photo #42	Photo #43	Photo #44
		
No breakdown on edges and weld seams	Corrosion pit caused by mechanical damage No underfilm creep	Erection joints

No.4 (P) - Upper		
Photo #45	Photo #46	Photo #47
		
Deckhead and supporting brackets	Excellent overall condition	Minor areas of breakdown on scallop and transverse bulkhead
Photo #48	Photo #49	
		
Reverse burn damage on underside of main deck	Small area of reverse burn damage (same area as photo #48) Excellent general condition	

No.4 (P) - Lower		
Photo #50	Photo #51	Photo #52
		
Tanktop	Excellent general condition	Supporting brackets
Photo #53	Photo #54	Photo #55
		
Area around bellmouth in very good condition	Ground weld seams	No breakdown on sharp edges and weld seams

No.3 (P) - Upper	
Photo #56	Photo #57
	
Excellent general condition	No breakdown above, at or below the cargo load line
Photo #58	Photo #59
	
Deckhead adjacent to tank access	One isloated area of breakdown adjacent to access ladder

No.3 (P) - Lower		
Photo #60	Photo #61	Photo #62
		
Tanktop	Edges and weld seams in excellent condition	No breakdown on edges of drainage holes
Photo #63	Photo #64	Photo #65
		
Oil layer removed from surface DFT checks (353-583µm) Two areas (<1 sq.cm) of mechanical damage - no underfilm creep	Appearance of coating after cleaning	Corrosion pit caused by mechanical damage No underfilm creep

No.3 (S) - Upper		
Photo #66	Photo #67	Photo #68
		
No breakdown above, at or below cargo load line	Deckhead area adjacent to tank access	Excellent general condition

No.3 (S) - Lower		
Photo #69	Photo #70	Photo #71
		
Tanktop	No breakdown on sharp edges and weld seams	Surface scratches from shovels used to remove crude oil – coating still intact
Photo #72	Photo #73	Photo #74
		
Coating scheme applied to approx. 0.2m up the bulkhead	Corrosion above the coated area	No underfilm creep below coated area

No.2 (C) - Upper	
Photo #75	Photo #76
	
Deckhead and supporting brackets	No breakdown above, at or below cargo load line
Photo #77	Photo #78
	
Excellent general condition Some corrosion behind coils visible in adjacent bay	Corrosion caused by mechanical damage immediately adjacent to tank entrance

No.2 (C) - Lower		
Photo #79	Photo #80	Photo #81
		
Tanktop in excellent general condition	No breakdown on scallops and edges of rat holes	Surface scratches from shovels
Photo #82	Photo #83	Photo #84
		
Corrosion pits caused by mechanical damage Small amount of underfilm creep (5mm)	Corrosion pit caused by mechanical damage No underfilm creep	Distinctly shaped corroded areas on tanktop caused by heavy mechanical damage

No.1 (S) - Upper		
Photo #85	Photo #86	Photo #87
		
Deckhead areas in excellent general condition	Underside of main deck	Minor breakdown inside rathole
Photo #88	Photo #89	
		
Deckhead and connecting brackets	Scattered blisters and minor breakdown adjacent to top of access ladder	

No.1 (S) - Lower		
Photo #90	Photo #91	Photo #92
		
No breakdown on sharp edges, weld seams and inside scallops	Ground welds defect-free	Tanktop in excellent general condition
Photo #93	Photo #94	Photo #95
		
Area around bellmouth in excellent condition	No breakdown on edges around cargo well	Corrosion pit caused by mechanical damage No underfilm creep Coating repairs to damaged areas by brush application visible from new construction stage

Note: The Slop Tanks were coated with the original newbuilding paint scheme – they were *not* reblasted and coated with Intershield®300 at the redocking in Korea

Slop Tank (S) - Upper		
Photo #96	Photo #97	Photo #98
		
Photo #99	Photo #100	Photo #101
		

7. Superintendent Comments

"After 15 years in service the coating is in very good condition…in fact, better than good"

"Good, Fair and Poor ratings…why is there no category for excellent?"

"Although the slop tanks may contain more aggressive cargoes, there is no comparison…the performance in the cargo tanks is obviously better"

"The tanktops are in excellent condition with very few areas of breakdown"

"Surprisingly good"

François Rascle
Technical Superintendent
V.Ships France SAS

8. Conclusion

It can be concluded from the result of this inspection that Intershield®300, when correctly applied to a well-prepared substrate, provides excellent protection to the aggressive areas of cargo tanks after even 15 years in service.

Minimal repair work to mechanically damaged areas would be necessary at this third special survey in order to achieve many more years of in-service protection of the cargo tanks.

The performance of Intershield®300 on the "Samco Raven" exceeds the requirements for a coating to be in 'Good' condition (IACS Reslution A744 Rec.87) as set out in the IMO's Performance Standard for Protective Coatings for Cargo Oil Tanks of Crude Oil Tankers (MSC.288(87)).

[End of report]