

MARINE OCCURRENCE REPORT

FIRE

IN THE ENGINE ROOM OF THE
TUG "LAWRENCE L"
AGAMEMNON CHANNEL, BRITISH COLUMBIA
19 SEPTEMBER 1997

REPORT NUMBER M97W0193

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Marine Occurrence Report

Fire

in the Engine Room of the
Tug "LAWRENCE L"
Agamemnon Channel, British Columbia
19 September 1997

Report Number M97W0193

Summary

While in Agamemnon Channel on passage from Jervis Inlet to Vancouver, running light without barges, the tug "LAWRENCE L" suffered a fire in the engine room. A solvent was poured onto the side of the main engine, for cleaning purposes, and the gases ignited. The fire spread into the fibre-board acoustic tiles and wood grounds of the deckhead covering. Fire extinguishers were used to put out the fire on and around the engine and to control the deckhead fire until the tug reached the dock at Earls Cove. Approaching the dock the fixed CO₂ system was released into the engine room without stopping the main engine or shutting off ventilation. At the dock, assistance was rendered by crews of other vessels and shore persons, and a hose was used to finally extinguish the fire in the deckhead.

Factual Information

	"Lawrence L"
Port of Registry	Vancouver
Flag	Canada
Official Number	320205
Type	Tug
Gross Tonnage	88
Length	16.15
Built	1963,
Propulsion	G M Diesel Engine
Number of Crew	4
Registered Owner	North Arm Transportation, Vancouver, B.C.

The "LAWRENCE L" is a steel tug of conventional lay-out, with the wheelhouse located over the accommodation in a deck house on the maindeck. The main access to the engine room is by ladder from inside the starboard aft side of the accommodation/galley into the after end of the engine room. There is also an escape hatch at the forward end of the engine room up onto the foredeck. The engine room deckhead is lined with sound-proofing, fibre-board acoustic tiles mounted on wood grounds. The tiles are of the type that are perforated with small holes. A storage locker and workbench are located at the forward end of the engine room.

The main engine is a high speed, V12, two stroke diesel with four turbo-chargers, two per side. The air intakes for the two turbo-chargers on each side are located above the engine in the centre of the cylinder heads. A rubber pipe connects each turbo-charger air intake to the corresponding air filter. The engine can only be stopped in the engine room either at the governor or at the side of the gearbox aft of the engine. Prior to stopping the engine, it must be first slowed to idling speed before the stop controls will operate. For fire and other emergencies the daily service fuel tank has a remotely operated quick closing valve.

The vessel was built in 1963, re-engined and reclassified as a new vessel in 1976.

Other Factual Information

On 19 September 1997, the tug "LAWRENCE L" was en route from Jervis Inlet to her home berth on the North Arm of the Fraser River and was running light without barges. During the morning watch, the skipper carried out a routine check and clean up in the engine room, with the deckhand on duty in the wheelhouse.

The skipper mixed the normal bilge cleaner/water solution in a mop bucket to clean the floor plates. He then saw caked oil on the side of the main engine and decided to clean it. To clean the engine, he poured some solvent from a half full 20 litre pail of "Standard Solvent" he found in the forward locker and splashed it on the starboard side of the engine. The time was about 1000¹ and the engine was running at 1500 rpm. The skipper turned away to get a turk's head brush and the bucket of bilge cleaner solution, when out of the corner of his eye he saw a light, which he thought was the engine room alarm light.

Turning back to the engine he saw flames on the starboard aft side of the engine and around the air intake to the starboard aft turbo-charger. The skipper used the 'stop' control on the engine governor to try and stop the engine. The engine slowed down but did not stop. He tried to reach the throttle control, located at the starboard aft corner of the engine, but the fire prevented him from getting to it.

He then decided to get help and made his way past the fire to the after ladder to the accommodation. When he opened the door, the mate was already there because the alarm in the wheelhouse had been activated. The deckhand on watch pulled the engine control back in the wheelhouse until the engine was idling.

The mate gave the skipper a 2 kg dry powder chemical fire extinguisher and he went back down to fight the fire. Now there were flames on both sides of the engine and the flames were 30 cm high on top of the engine. He discharged the extinguisher on to the starboard side for about two seconds and the fire went out; he did the same on the port side and finished off by directing the extinguisher on to the flames on top of the engine. After putting out the fire on and around the engine; he realised that the deckhead tiles and grounds were on fire so he directed the dry chemical extinguisher on to them and thought he had extinguished the fire. By this time the engine room had filled with white smoke and he had to exit.

The skipper proceeded to the wheelhouse and telephoned the owner in Vancouver, speaking to them until the cellular phone battery went dead. The tug was headed towards the dock at Earls Cove to get help.

Returning to the engine room the skipper saw more flames in the deckhead tiles. He switched off all the breakers in the panel at the bottom of the engine room ladder before directing a water extinguisher at the flames. The smoke was again quite thick, he could not get forward to stop the vent fan and he had to leave the engine room again to get some air.

A radio call for assistance was now made to the Coast Guard Radio Station asking that Breathing Apparatus sets and a hose be available at the dock. The Canadian Coast Guard Vessel "MALLARD" was tasked to assist. The ferry "QUEEN OF TSAWWASSEN" called to say they were at the dock in Earls Cove and would assist. As the tug approached the Earls Cove Dock, the skipper released the fixed Carbon Di-Oxide (CO₂) system into the engine room with the engine still running and the vents open. The mate docked the tug at 1030, while the skipper monitored the fire. A local resident who had seen the tug coming in was waiting at the head of the dock with three portable CO₂ extinguishers. After docking, the crew stopped the main engine, opened the engine

¹ All times are PDT (Coordinated Universal Time minus eight hours) unless otherwise noted.

room forward escape hatch to the foredeck and the door at the top of the after engine room ladder to allow the engine room to ventilate. Without checking the air quality, or using a Breathing Apparatus the skipper re-entered the engine room and stopped the engine. The skipper took with him a CO₂ extinguisher and used it on the deckhead fire before exiting to the deck.

The crew from the "QUEEN OF TSAWWASSEN" arrived with Breathing Apparatus and extinguishers. The skipper and the mate donned the Breathing Apparatus and carrying flashlights and water extinguishers they went down to cool down the engine room deckhead. They continued to see flames through the holes in the acoustic tiles and kept directing the extinguishers at them until the extinguishers ran out.

The crew were monitoring the boundaries of the engine room while hooking up a water hose and they found the galley bulkhead next to the engine casing was smoking. They cooled down the galley bulkhead with the hose, before sending the hose down to the engine room. The skipper and mate continued to use the hose on the deckhead until the Breathing Apparatus air supply ran out.

At 1100 the "MALLARD" arrived on scene and the crew of the "QUEEN OF TSAWWASSEN" gathered up their gear and the ferry sailed. The crew of the "MALLARD" took over from the skipper and mate. Wearing firemen's suits crewmembers from the "MALLARD" entered the tug's engine room and pulled down the burning tiles to get at the burning grounds. They successfully extinguished all the flames and the fire was confirmed as being definitely out by noon. Shortly after noon the "MALLARD" sailed, leaving the "LAWRENCE L" to be towed back to the Fraser River for repairs.

Crew Certification

The skipper had sailed on the "LAWRENCE L" since 1977. He was mate from 1979 until January 1996 when he took over as skipper. He had held a Master Home Trade, Under 350 Tons, Certificate since November 1983.

Both the skipper and the mate held a Fire Fighting Certificate, issued in 1983 for the skipper and the late 1980s for the mate, after they had taken the requisite course.

Fixed Carbon Di-Oxide (CO₂) System

The Fire Detection and Extinguishing Equipment Regulations of the Canada Shipping Act, Schedule III, Fixed Installations For Smothering By Foam, Gas, Steam Or Water, states, in part, that:

Where CO₂ is used as a smothering gas for machinery spaces, the quantity of gas available shall be sufficient to give a minimum quantity of free gas equal to the larger of the following quantities:

- (a) 40 per cent of the gross volume of the largest space, the volume to include the casing up to the level at which the horizontal area of the casing is 40 per cent or less of the horizontal area of the space concerned taken midway between the tank top and the lowest part of the casing;
- or

(b) 35 per cent of the entire volume of the largest space including the casing.

Inspection of Engine After Fire

The main engine was opened up for inspection after the tug was towed to Vancouver. The fire had severely damaged the air compressor blades and the shaft oil seals of all the turbo-chargers. The cylinders and pistons were damaged and scored by the dry powder from the extinguisher initially used to fight the fire.

Analysis

Solvents are not normally stowed in the engine room because of the danger of accidental spills and because they are a fire hazard. In this case the pouring of a solvent on the side of the hot main engine most likely created greater than normal volume of gases that ignited on the exhaust. Excess gases were also sucked into the turbo-charger intakes spreading the fire to the internals of the engine.

The fire spread rapidly into the fibre-board acoustic tiles and wood grounds on the engine room deckhead. The acoustic tiles and wood grounds had 34 years of exposure to both heat and oil mist normally present in an engine room and would require little flame contact to catch fire. The small holes in the tiles allowed the fire to reach the wood grounds behind the tiles. The holes also supplied air to the fire in the grounds allowing the fire to spread across the deckhead behind the tiles.

The main engine cannot be stopped if it is running above idle speed. When the skipper first tried to stop the engine, he could reach the stop but not the throttle control at the starboard aft corner of the engine. Consequently the engine continued to run at full speed until the deckhand in the wheelhouse cut it back to idle from the wheelhouse control. At any time after the engine was cut back from the wheelhouse it could easily have been stopped.

Release of the CO₂ with the main engine running and the vents still open had little or no effect on the fire. Because the main engine was running, most, if not all, of the CO₂ was likely carried away through the engine exhaust. The volume percentage for Fixed Gas Smothering Installations in Schedule III of the Regulations does not require the CO₂ to completely fill the engine room and casing. When the crew re-entered the engine room, they did not test the atmosphere, yet they suffered no ill effects from the re-entry. This indicates that the concentration of CO₂ in the engine room was well below the level it should have attained had the engine room been closed off and the engine stopped when the CO₂ was released.

The owners of the tug do not supply their vessels with solvent, instead they supply an approved bilge cleaner. There is no record of how or when a can of solvent was left in the engine room. It is likely that the can was left over from work done in the engine room by an outside contractor and was not subsequently removed from the space.

Findings

1. Solvent, which had been left in the engine room, was used on the side of the main engine to clean caked-on oil while the engine was running.
2. Solvent fumes were sucked into the air intakes of both starboard side turbo-chargers.
3. Solvent fumes ignited on the hot starboard engine exhaust.
4. The fire spread into the fibre-board acoustic tiles and wooden grounds in the engine room deckhead.
5. Cylinders and pistons were damaged by powder from the dry powder chemical extinguisher used to extinguish the fire in the vicinity of the main engine.
6. Continuing to run the main engine with the engine room vents open circulated air which fed the fire in the deckhead.
7. CO₂ from the tug's fixed gas smothering system was released into the engine room without stopping the main engine or shutting off the ventilation.
8. The engine room was re-entered by crew without breathing apparatus, after the release of the CO₂, and without checking atmospheric oxygen levels for safe entry.
9. The solvent was not supplied by the vessel's owners and its origins are unknown.

Causes and Contributing Factors

The direct cause of the fire was solvent gases, which were given off by solvent poured onto the side of the running main engine, and which ignited on contact with the hot engine exhaust on the starboard side of the engine.

When the grounds and the acoustic tiles covering the engine room deckhead caught fire from the flames on top of the engine, the fire spread behind the tiles, along the grounds making it impossible to extinguish the fire without pulling down the tiles to expose the grounds.

Solvent that had been left in the engine room was not removed from the space making it available for use when the skipper was cleaning the engine room.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A.

Tadros, authorized the release of this report on 26 August 1998.