

AI2017-3

**AIRCRAFT SERIOUS INCIDENT
INVESTIGATION REPORT**

**AERO ASAHI CORPORATION
JA 9678**

July 27, 2017

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board (and with Annex 13 to the Convention on International Civil Aviation) is to prevent future accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

Kazuhiro Nakahashi
Chairman
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

AIRCRAFT SERIOUS INCIDENT

INVESTIGATION REPORT

AERO ASAHI CORPORATION
AÉROSPATIALE AS332L1 (ROTORCRAFT)
JA9678

DROPPING OF OBJECT
DURING EXTERNAL CARGO SLING OPERATION
MIHAMA TOWN, MIKATA-GUN,
FUKUI PREFECTURE, JAPAN
AT AROUND 10:08 JST, MARCH 1, 2016

June 23, 2017

Adopted by the Japan Transport Safety Board

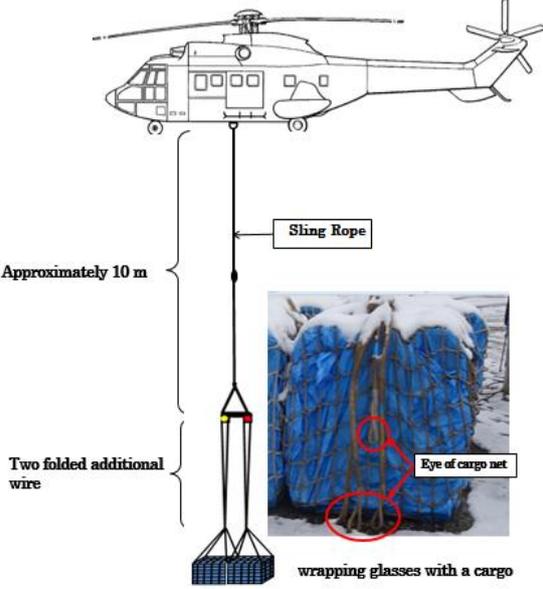
Chairman	Kazuhiro Nakahashi
Member	Toru Miyashita
Member	Toshiyuki Ishikawa
Member	Yuichi Marui
Member	Keiji Tanaka
Member	Miwa Nakanishi

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Serious Incident	On Monday, March 1, 2016, an Aérospatiale AS332L1, registered JA9678, operated by AERO ASAHI Corporation, took off from a temporary helipad at Mihama Town, Mikata-gun, Fukui Prefecture and dropped one of cargos to mountain forest, during a flight to a work site suspending two cargos by a sling.
1.2 Outline of the Serious Incident Investigation	This event fell under the category of “Case where a slung load, any other load carried external to an aircraft, was released unintentionally” as stipulated Item (IX), Article 166-4 of Ordinance for Enforcement of the Civil Aeronautics Act, which was classified as an aircraft serious incident.

	<p>The Japan Transport Safety Board designated an investigator-in-charge and an investigator on March 1, 2016, to investigate this serious incident.</p> <p>An accredited representative and an adviser of French Republic, as the state of Design and Manufacture of the rotorcraft involved in the serious incident, participated in this investigation.</p> <p>Comments were invited from parties relevant to the cause of the serious incident and the relevant State.</p>
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2 FACTUAL INFORMATION

<p>2.1 History of the Flight</p>	<p>The history of the flight was summarized below based on the statements of the captain and the operator of the onboard system (hereinafter referred to as “the operator”) and ground workers.</p> <p>At around 09:11 on March 1, 2016, an Aérospatiale AS332L1, registered JA9678, operated by AERO ASAHI Corporation, took off from a temporary helipad at Mihama Town in Mikata-gun of Fukui Prefecture, with the captain sitting in the right pilot seat and the operator in the left seat in the cabin to guide to control cargos, to transport the goods for the reconstruction work of transmission towers by external cargo sling operation.</p>	 <p>Photo 1; The serious incident rotorcraft</p>
		 <p>Diagram illustrating the sling system used for cargo transport. It shows a helicopter connected to a cargo net via a sling rope. The rope is labeled as 'Sling Rope' and is approximately 10 m long. The cargo net is labeled as 'Eye of cargo net' and is used for 'wrapping glasses with a cargo'. The diagram also indicates 'Two folded additional wire' at the bottom of the sling system.</p>
		<p>Figure 1 Image of Sling</p>
	<p>The rotorcraft was scheduled to perform twenty cargo transport</p>	

operation on the day. The rotorcraft used about 10 m long sling-rope, which has one hook painted red at one end of a rope and had other end hook painted yellow (hereinafter, referred to as “red hook” and “yellow hook”), and started a transporting cargo wrapped in a cargo net and suspended by hooks from the 11th transportation.



Photo 2: Indicator

The ground worker A placed eyes*¹ of the cargo net directly onto the hook for the 11th transportation, but by the captain instruction via radio, he added the half-folded wire of 8 m in total length between hook and cargo net from the 12th transport to make the total length of sling rope longer.

For the 13th transportation, when the rotorcraft approached to the temporary helipad, the ground worker A was still working to put additional wires through the eyes of the 2nd cargo net.

The ground worker A placed the two eyes of the additional wires of the prepared cargo net on the red hook at the same time, and after hooking the eyes of the additional wire of the 2nd cargo net prepared later one by one on the yellow, he pulled two wires hooked on the yellow hook to lock a keeper*² to make sure. At this time, the ground worker A did not check the position of the lock indicator of the keeper on the hook.

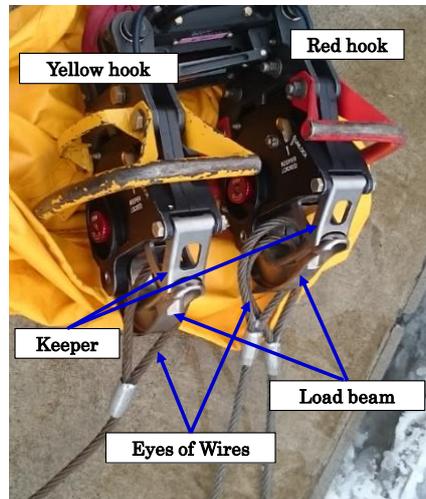


Photo 3: Hooks Condition right after the accident

The ground worker B confirmed the state of the hooks visually and sent a signal to the rotor craft. He was standing about 2m from

*¹ “An eye” means a ring shape of wire or rope at its end. (See Photo 3)

*² “A keeper” means a component of a hook preventing a wire to come off from a load beam. (See Photo 4)

the cargos and confirmed visually that the wires was placed through all eyes of the cargo net and the entire wires were getting stretched state.

The captain checked the sling cargos with a mirror and the operator visually checked them for confirmation at suspending time and during takeoff and climbing, but found no anomaly. Both of the ground workers A and B watched the takeoff condition of the rotorcraft, suspended cargos were stable and had no anomaly.

After the rotorcraft passed over the transmission tower near the site, the captain and the operator checked the Hook Condition Indicators (hereinafter, referred to as “the indicators”) to confirm that the lights were on at the indicators. During an acceleration to gain altitude (Pressure Altitude; 600 to 700 ft, Air Speed; 50 to 60 kt), the captain felt light shocks with a short noise. He checked it by a mirror, seeing one of the suspending cargos dropped as wrapped in cargo net, therefore he informed the operator that the sling cargo dropped.

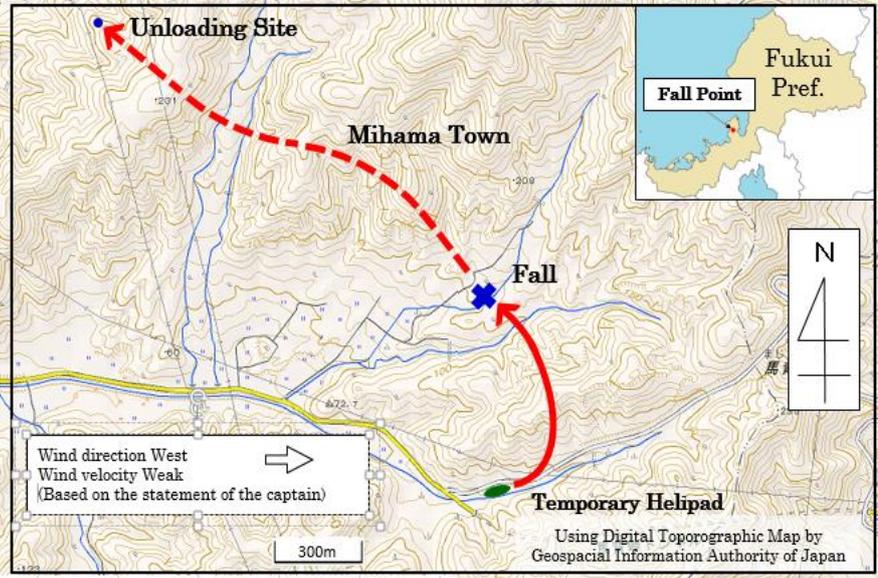
The operator saw outside of the rotorcraft and confirmed that the one of the wire’s eyes on the yellow hook was off and one cargo was dropping. At this time, all of indicators for keepers and load beams^{*3} were lighted on at the captain seat and the guiding seat.

The rotorcraft tried to find the cargo near the fall point, could not find any, returned and landed to the temporary helipad.

At the time, the keepers of both hooks were locked and the single eye remained on the load beam of the yellow hook.

The site of the serious incident occurred was in the mountain forest located about 650 m north of the temporary helipad (N35°41’15”, E136°00’05”) and the time and date of the incident was around 10:08 on March 1, 2016.

*3 “A load beam” means a hook part which suspends a cargo load directly by wiring and others.

	 <p style="text-align: center;">Figure 2; Estimated Flight Route</p>
2.2 Injuries to Persons	None
2.3 Damage to the Aircraft	None
2.4 Personnel Information	<p>Captain: Male, Age 35</p> <p>Commercial pilot certificate (Rotorcraft) January 8, 2003</p> <p>Type rating: Aérospatiale SA330 April 9, 2015</p> <p>Class 1 aviation medical certificate Validity: June 4, 2016</p> <p>Pilot Competence assessment</p> <p>Expiration date of piloting capable period: April 30, 2017</p> <p>Total flight time 3,654 hours 23 minutes</p> <p>Total flight time on the type of rotorcraft 200 hours 57 minutes</p>
2.5 Aircraft Information	<p>Aircraft Type: Aérospatiale AS332L1</p> <p>Serial number: 2231, Date of manufacture: February 18, 1988</p> <p>Certificate of Airworthiness: No.Tou-27-282</p> <p>Validity: October 2, 2016</p>
2.6 Meteorological Information	<p>According to the statement of the captain, the weather during the cargo operation was cloudy and the visibility was about 10 km with light west wind.</p>

2.7 Additional Information

(1) Hooking Mechanism

Hook has a load beam and a keeper. Hooking an eye to the load beam, keeper moved upward, then it returned to an original position and closed by a force of spring.

A load beam and a keeper has a lock mechanism, respectively.

If a thicker wire than a specified size were used, even though the case of improper wire roping*⁴, when a load paces on the load beam, the eye at the edge of the load beam automatically slips to release the improper wire roping condition.

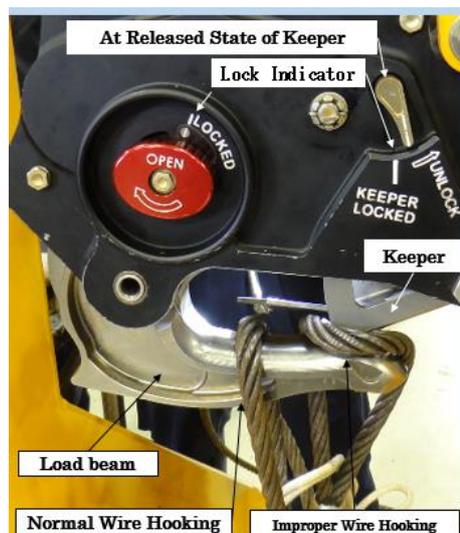


Photo 4: Improper Wire Hooking

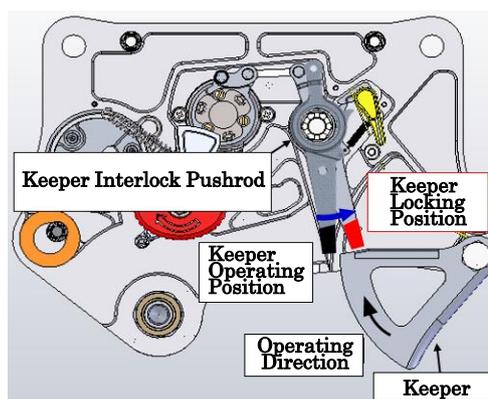


Figure 3 ; Keeper Locking Mechanism

(2) Lock Mechanism of Keeper

① Locking Mechanism

Regarding a keeper, applying a specific load (34 kg or more) or an instantaneous downward load on a load beam, an edge of a “Keeper interlock pushrod”(hereinafter, referred to as “the pushrod”) moved onto the keeper and locked. (Figure 3)

② Checking of Locking status

The instrument panel of the pilot seat and the switch box of the guiding seat have indicators to show the locking status of keeper and load beam, separately, and the captain and the operator could check the locking status by looking at each indicator. Moreover, the ground workers can check the locking status by looking at the indicator on keeper and load beam.

*⁴ “Improper wire roping” means that a roping should astraddle a load beam, instead it straddles between a load beam and a keeper, which are merely closed in contact by a force of spring.

③ Lighting of Indicator

The indicator of the keeper will be lighted on the light, when the micro-switch in contact with the pushrod is off. As shown in the right drawing of Figure 4, when the pushrod moves onto the top of the keeper, the micro-switch turns off, then the indicator turns the light on.

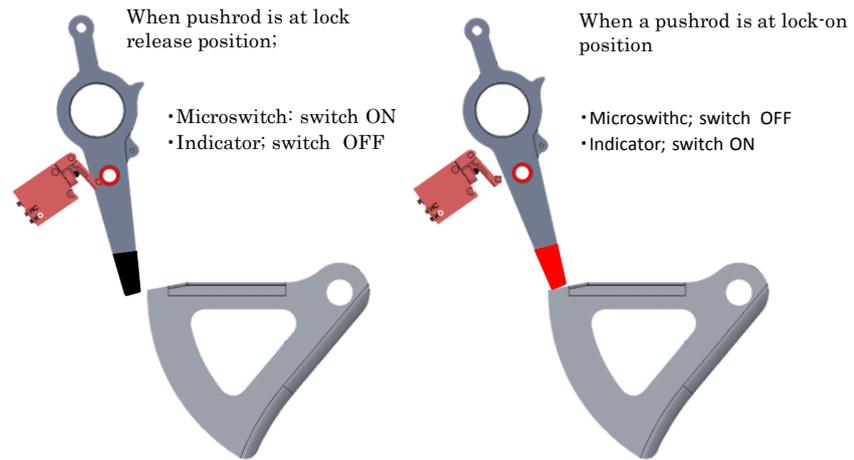
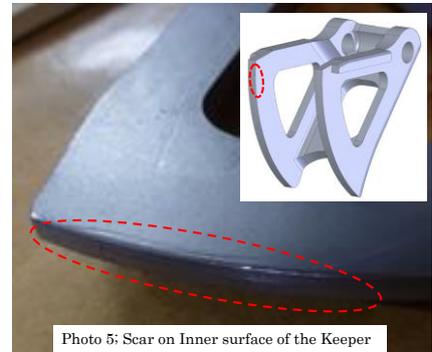


Figure 4: Operation of Indicator (Keeper)

(3) Teardown Investigation of the Hook

The result of the Hook Teardown Investigation carried out in the presence of the person who designed and developed the hook revealed a scar at the pushrod side of the inside of the keeper which generated due to the contact with a sharp edge. (Photo 5)



Besides, the hook is structured with enlarged gaps between each parts in order to prevent earth and sand from clogging.

(4) Condition of the wire

Checking the wire hooking on the yellow hook, one eye had an acute angle formed dent and the tip of the eye was bended. The result of recreating the improper wire roping to verify, was able to recreate the same dent and the



Photo 6: Condition of Improper Wire Hooking

same bent on the wire. (Photo 6)

Moreover, the wire used for the rotorcraft has an appropriate thickness.

(5) Verifying the occurrence of the serious incident

At the company, the result of the verification on the hook, determined the following facts:

① When a twisted wire are hooked on a load beam, the torsion was rewound during the process of pulling the wire and the situation that the wire only straddle over the keeper was generated.

② Under the condition of ①, if a keeper was not locked, because an eye will move the keeper upward, a space is occurred on a tip of a load beam and the improper wire roping was caused. (See Photo 4)

③ When the improper wire roping occurs, the load on the sling cargo which acts on the eye, applies on the keeper due to a horizontal force (a red arrow), it pushes the keeper to one side at the same time the eye ring is getting narrowed to push the keeper upward because of the load and is off from the hook. (Figure 5)

④ If the keeper was pushed aside to the pushrod, the gap between the toggle and the keeper is enlarged. (Figure 5)

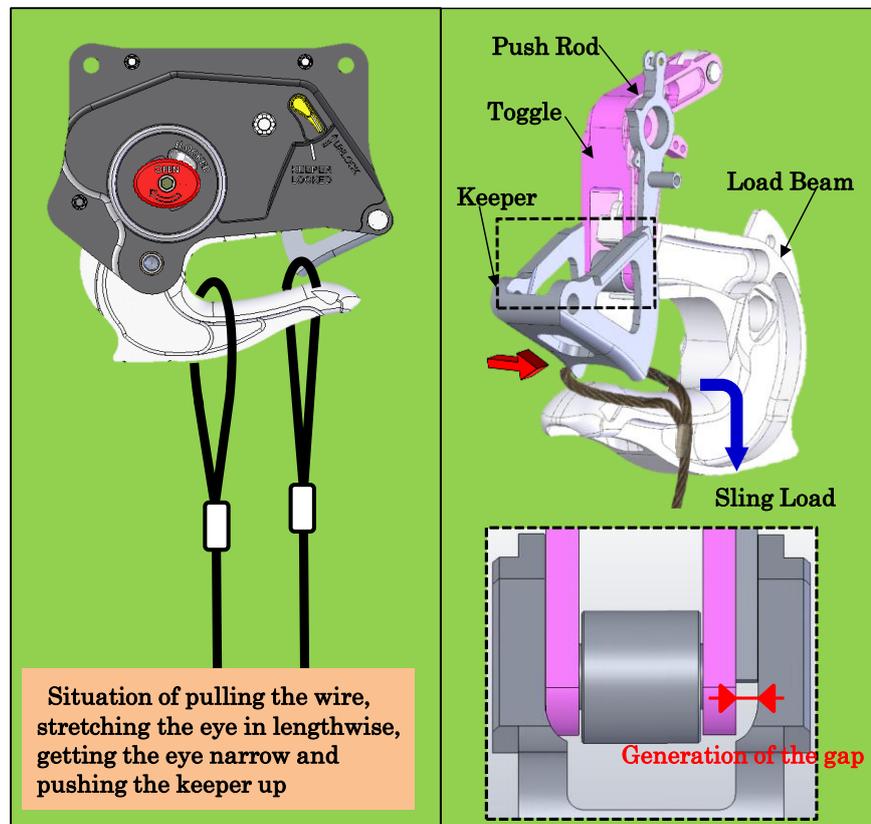


Figure 5; Gap generated by Improper Wire Hooking

	<p>⑤ In this case, because the pushrod which was moved to the lock position of the keeper due to the sling load enters in the gap created at ④ and activates the switch detecting the locking status, the keeper indicator was lighted without being locked.</p> <p>Moreover, the indicator system of the rotorcraft had no electrical issue.</p> <p>(6) Injury to persons and Damage to objects on ground</p> <p>The cargo (weight about 800 kg) fell onto a mountain forest on the flight route, however there was no injury or damage to the person or the object on ground.</p> <p>(7) Flight Route for the cargo transportation</p> <p>The rotorcraft flew on the predetermined route over a mountain area that would not cause safety issues to the ground, in line with the operational guidelines of the company. On that day, moreover, a confirmation flight was carried out before starting transport.</p>
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3. ANALYSIS

3.1 Involvement of Weather	None
3.2 Involvement of Pilots	None
3.3 Involvement of equipment	Yes
3.4 Analysis of Findings	<p>(1) Preparation work to sling the cargo</p> <p>It is somewhat likely that because the ground worker A was doing the work to put the wire through the eye of cargo net right before the approach of the rotorcraft, he did not have spare time to prepare the length of the wire hooking on the yellow hook, but the work to remove the twist of the wire was not done sufficiently. It is somewhat likely that later, the ground worker A did motion to pull down the wire hooking on the yellow hook to lock the keeper, but because the application of a load was insufficient, the keeper was not locked. Moreover, it is probable that the ground worker A did not confirm that the keeper was at the lock position or not, because the work-classified operation manual did not include the procedure to check the lock indicator position of the keeper at the hook.</p>

(2) A wire stretching and an improper wire roping

As described in 2.7(5), when the keeper was not locked, it is somewhat likely that because the wire was moving to the direction releasing the twist by a pulling of the wire during the climbing of the rotorcraft, and the keeper was moving upward at the same time to hooking the eye on the keeper, the space to hook the wire at the tip of the load beam was generated and the improper wire roping was also generated.

(3) The reason that the keeper was not locked in spite of the applying the load on

As described in 2.7(5), it is somewhat likely that because the pushrod entered into the gap generated by a horizontal force onto the keeper between the toggle and the keeper. Moreover, it is somewhat likely that the large gap between each part of the hook is involved with the pushrod getting into the gap.

(4) Lighting of the indicator

As described in (1) and (2), it is somewhat likely that because the improper wire roping occurred when the keeper was not locked, the event described in 2.7(5)④ and ⑤ had occurred and the indicator was lighted on. It is highly probable that the captain and the operator checked that all light of the indicators on the instrument panel at pilot seat and the switch box were lighted after passing over the transmission tower and they were aware that the keepers and the load beams of the yellow and the red hooks were locked.

(5) Drop of the slinging cargo

It is somewhat likely that the rotorcraft took off in spite of the unlocked keeper of the hook and an improper wire roping of the eye hooking on the hook, but because the keeper was pushed to the pushrod side due to the horizontal load by the wire and the pushrod was getting into the gap between the toggle and the keeper, and the yellow hook was holding the sling cargo right after the takeoff because the keeper could not easily open due to above condition.

It is somewhat likely that because during the acceleration to gain altitude, the keeper was pushed up to open and the improper wire roping eye was released from the keeper and dropped the sling cargo.

4. PROBABLE CAUSES

It is highly probable that the serious incident was occurred due to the dropping the object because the keeper of the hook in use opened during the flight of the rotorcraft.

Regarding why the keeper of the hook opened, it is somewhat likely that because the keeper was not locked even though a load was applied and the pushrod entered in the gap generated between the keeper and the toggle due to a horizontal load because of the occurrence of the improper wire roping at the unlocked keeper condition. Regarding why the eye of the wire resulted in the improper wire roping, it is somewhat likely that because the work-classified operation manual did not have the procedure to confirm the position of lock indicator of the keeper and the ground worker did not have enough time to prepare the wire like matching the length of the wire and removing the twist.

5. SAFETY ACTIONS

(1) Safety Action Taken by the Hook Manufacturer

① Set forth a confirmation of a keeper lock condition for cargo sling by a position of a lock release lever into Additional Flight Manual for cargo hook.

② Issue the Service Bulletin No. 159-038-00 and instruct to replace the pushrod to the one with tip of increased thickness (from the one of approximately 4 mm to the one of approximately 7 mm).

(2) Safety Action Taken by the Company

The operating procedures including safety measures are set forth on a manual right after the occurrence of the serious incident and the company is educating the relevant parties.

The main content is as follows;

① Create a manual defining the detailed checklist like “releasing the twist of the wire in advance”, “pointing and verbal checking after the visual confirmation that the lock indicators of the hook and the keeper are at the lock position” and likes, regarding the hooks which use at the time of suspending cargos and pulling up cargos together.

② Implement the education relating to ① for the ground workers.

③ Implement the education concerning ② to workers relating to the cargo transport (the pilot, the maintenance engineer, the ground crew, the business manager), make them re-recognize a seriousness of an event of dropping an object from a rotorcraft, and make them reconfirm causes of occurrences and safety measures. Moreover, implement an education with using reviews of the accident cases and the serious incident events occurred at cargo transporting works in past, to make them understand an importance to promote a prediction of risks and reliable procedures.