

Incident Summary #II-1440356-2022 (#29912) (FINAL)

SUPPORTING INFORMATION	Incident Date	September 22, 2022	
	Location	Interior	
	Regulated industry sector	Passenger ropeways - Above surface ropeway	
	Impact	Qty injuries	0
		Injury description	N/A
	Damage	Injury rating	None
		Damage description	A work carrier was reversed into the bottom station of a ski lift resulting in minor scuffing over 16" of the haul rope with no broken wires and a bent handrail on the upper deck of the carrier.
		Damage rating	Minor
Incident rating	Minor		
Incident overview	During the operation of the above ground passenger ropeway for inspection and maintenance, the work carrier attached to the ropeway was driven into the lower station terminal, with a passenger on board and without the collapsible upper rail lowered causing contact between the carrier and station damaging the work carrier.		
INVESTIGATION CONCLUSIONS	Site, system and components	<p>The ski lift at the facility is a detachable chair, above surface ropeway that transports passengers to the top of the ski hill on carriers attached to a ropeway suspended by towers. For maintenance, repairs, and inspections, a specialized work carrier, designed and provided by the lift manufacturer, is attached to the ropeway. The work carrier consists of a lower basket platform for the riders and equipment and an upper platform used for access to the lift system components. The upper platform has a handrail which is required to be manually folded down to allow for clearance at the upper and lower station structures when the carrier passes through. After riders enter the lower basket and the carrier exits a station, the riders manually raise the upper platform handrail and secure it for the work at height. The workers are always in full fall arrest harnesses and lanyards when working from height on the work carriers on the line. The handrails must be lowered prior to the work carriers entering the stations to avoid contact between the carrier and the station structure.</p> <p>The facility has a Standard Operating Guideline (SOG) for personnel to follow when working from a work carrier. The SOG is authorized by the Lift Maintenance Manager and is reviewed annually. The SOG "Working from work carrier procedure" contains the following information:</p> <ul style="list-style-type: none"> • All personnel working in the work carrier or operating the ropeway shall be fully trained in the procedure and manufacturer's recommendation. • Communication between the operator and personnel in the work carrier shall be maintained through use of VHF radios or cellular phones. (At no times are the phones to be on speaker mode used to communicate while moving the work carrier). • Personnel at the operating station shall check with personnel on the work carrier that all workers and equipment are clear of the path of the moving machinery before the ropeway is moved. The operator shall specifically confirm that all tools, lanyards, <i>and handrails</i> are clear. • An "all clear" response shall be obtained from the work carrier before moving the ropeway. If there are two or more passengers in the work carrier, the "all clear" response shall not be given until <i>each passenger</i> has checked the others for clear passage. 	

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	<ul style="list-style-type: none"> When a work carrier approaches a station, the operator shall perform an automatic stop when the carrier is two towers away from the station. The installation shall not be started again until the personnel have completed a thorough check to ensure all equipment, <i>handrails</i> and personnel are completely ready to enter the station. Only then shall the installation be started again at the request of the carrier personnel. Riders must ride in the lower part of the work carrier and watch all equipment carefully. <p>The manufacturer of the lift and work carrier provides a service manual which contains the following information:</p> <ul style="list-style-type: none"> In cases where service carrier clearance in the terminals is a concern, carriers are supplied with a modified upper basket to permit safe passage through the terminals. Lift operators and maintenance personnel must be aware of this modification. <p>The facility has a “Sheave Rating and Tower Inspection Form” that is typically completed by lift maintenance personnel each day before work on the line. The form has a check box for daily safety meeting topics to review and a place for the names and signatures of the personnel performing the work. Some of the safety meeting topics include:</p> <ul style="list-style-type: none"> A radio communication check The expected location of work Ensuring the position of equipment, <i>handrails</i>, and personnel in work carriers is correct to maintain clearance.
<p>Failure scenario(s)</p>	<p>The passenger ropeway lift was installed at the ski resort in 2002 and is used to transport people to the top of the ski runs. The lift manufacturer supplied a work carrier that can be attached to the line for personnel to inspect, repair and maintain the passenger ropeway system. The design of the work carrier requires administrative controls that require the railing of the upper work platform to be manually raised after exiting the upper and lower stations and manually lowered before entering the upper and lower stations. If the handrails are not lowered before entering the stations, they will make contact with station structures and will not pass through. The work carrier has a warning tag affixed to it instructing to always enter it into a station at a slow speed with the upper basket in the lower position.</p> <p>Other lifts at the mountain have work carriers that have fixed handrails on the upper platforms and don’t require the raising and lowering of the handrails to allow the carriers to pass through the stations without making contact. The same lift where the incident occurred had a similar incident in 2017 where contact was made between the upper handrail of a work carrier and the station. After that incident occurred, the facility requested a redesigned work carrier that would clear the stations and not require the manual lowering of the upper platform handrails. The manufacturer did not make any changes to the carrier and supplied the same style of carrier as a replacement.</p> <p>On the day of the incident, safety inspections of the lift were planned by a Technical Safety BC Passenger Ropeways Safety Officer. The inspection involves the use of the work carrier to allow travel to the individual lift towers. To accommodate this, two maintenance personnel were tasked to work with the Safety Officer and operate the lift. One of the personnel travelled inside the work carrier with the Safety Officer and the other was at the top station operating the controls for the lift. Communication between the worker in the carrier and the worker at the control station was maintained using two-way radios. Two of the workers had radios to allow for the</p>

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communications but the safety officer did not. Before the day's work began, a discussion of the day's activities took place between the workers and the safety officer but the "Tower Inspection Form" containing the daily safety meeting topics was not completed.

Inspections and tests were performed without incident on another lift that morning that also involved the use of a work carrier that required the upper platform handrails to be raised and lowered. In the afternoon work proceeded on the lift involved in the incident.

The two workers entered the work carrier, and the lift was operated to move the carrier out of the station and was stopped at the first tower up from the lower station. After the carrier was stopped, the worker and the safety officer in the carrier raised and secured the upper handrails on the carrier's upper platform.

The worker conducted a ground fault test at tower #2. The ground fault test replicates a fault of the electrical safety circuit which is protected by a fuse. The maintenance worker in the carrier believed the circuit was protected by an overload that would automatically reset and allow for continued operation of the lift. The test resulted in a blown fuse, that needed to be physically replaced, at the unmanned lower station to restore the operation of the lift. The maintenance worker exited the work carrier, climbed down tower #2 and walked the short distance back to the lower station and replaced the blown fuse. After the fuse was replaced, the worker needed to re-enter the work carrier to resume the inspection duties. Instead of walking back to the tower and climbing back into the carrier, it was decided between the maintenance worker and the lift operator, through communication over the phone, to reverse the carrier back into the lower station to allow easier access for the worker to re-enter the work carrier. The worker remained at the lower station platform and verbally called out and informed the safety officer that they would be reversing the lift back into the station. The safety officer responded with a verbal acknowledgment informing that he understood. Before moving the lift, the worker at the upper station called on the radio and asked if they were clear to turn and if all tools and lanyards were clear but did not ask if the carrier railing was lowered. The worker at the lower station verbally called to the safety officer in the carrier asking if it was clear to turn.

The safety officer responded that it was clear then the worker responded on the radio to the lift operator that everything was all clear. The lift operator at the upper control station began reversing the lift at a very slow speed while prepared to stop when instructed by the worker at the lower station over the radio. The safety officer remained in the lower platform of the work carrier and the worker at the lower station maintained visual contact with the carrier as it reversed. As the carrier approached the station the worker at the lower station was focusing on the lower part of the carrier to determine at what point it could be stopped that would allow easy re-entry into the carrier from the lower station platform. Neither the worker or the safety officer noticed that the handrail of the work carrier upper platform had not been lowered and when the carrier came into the station the handrail contacted the metal structure of the station causing the carrier to pitch upward and slip along the haul rope. When the worker at the lower station noticed that contact was made between the work carrier and the station, they immediately called a stop to the lift operator who initiated an emergency stop of the lift.

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Facts and evidence

Lift maintenance manager (Lift operator)

- They were operating the lift from the upper station and did not have any visual contact with the work carrier.
- The other worker and safety officer entered the work carrier from the lower station, and it was run up to tower #2 to conduct a ground fault test that blows a fuse at the lower station and stops the lift from operating.
- When the worker climbed down the tower and replaced the fuse at the station, they decided to run the work carrier in reverse so the worker could re-enter the carrier from the station and not have to climb the tower to re-enter it.
- The maintenance worker requested to operate the lift over the radio, and I asked if tools and lanyards were clear, but I did not ask if the handrail was down.
- The worker responded with an “all clear” and I operated the lift at a very slow speed and prepared to stop the lift when they called for a stop on the radio.
- The worker in the carrier had two radios but communication was only between myself and the maintenance mechanic. Any communication from the safety officer was relayed second hand through the maintenance mechanic.
- I am aware that the work carrier handrail needs to be lowered to clear the stations.
- A similar incident happened on the same lift in 2017 when a work carrier was driven into a station after one person exited the basket and one person remained in the basket and the carrier was driven into the station without lowering the upper handrail.
- Following that incident, they requested the manufacturer to modify the handrail on the work carrier so it would clear the station without needing to be manually lowered. The manufacturer did not change it and provided a replacement carrier with a similar design that still required the manual raising and lowering of the handrail.
- There is a standard operating guideline for the use of work carriers that employees are trained to and a daily safety meeting form that typically gets completed before work on the line.
- They did not provide the safety officer any training on the operating guideline, or site orientation. An informal safety discussion took place before the work started but the daily safety meeting form was not completed prior to work that day. It is normally filled out and taken with the maintenance personnel every time they do line work, but an annual inspection is a different situation then they normally have for “work” and didn’t feel they needed it for the inspection duties.
- Earlier that morning they had all completed an inspection on another lift that required the work carrier railings to be folded up and down.
- The railing on the work carrier is difficult to raise and lower and usually takes two people to do it so both the maintenance mechanic and the safety officer would have done it together.
- Both people in the work carrier are very experienced and have performed duties in work carriers many times including the raising and lowering of the handrails.
- There weren’t any issues that day with the radio communications and they had worked well.
- Not all lifts have work carriers that require the railings to be raised and lowered to clear the stations. Some of the older lifts are designed with clearance and the carrier railing won’t contact the stations.
- Lowering of the handrails is something that can get overlooked easily.

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- The presence of the safety officer did not add any distractions or pressure on them or the duties they performed.

Lift maintenance mechanic (Work Carrier)

- We had completed an inspection of another lift earlier that morning then in the afternoon moved over to the lift involved in the incident.
- When we got to tower #2, we raised the handrails and conducted a ground fault test. I thought the ground fault test would trip a safety that would automatically reset, but it blows a fuse that needs to be replaced so the lift can operate.
- I descended the tower and walked to the lower station to replace the blown fuse. I called the lift operator on my phone to tell him it had been reset and we were ready to turn. Then the lift operator suggested to reverse the carrier back to the station so I could re-enter more easily. Then we resumed regular radio contact.
- The safety officer was in the carrier and was close enough that I just shouted out that we would be reversing back into the station, and he acknowledged. I remained at the lower station and watched the carrier as it reversed.
- I was watching the bottom of the carrier judging how far off the ground it was so it could be stopped when I could climb back in.
- The safety officer was riding in the lower platform of the basket and neither of us realised the handrail was still up until it contacted the station at which point, I called out a stop several times to the operator.
- When the carrier contacted the station, it raised up to about a 35-degree angle and the rope ran through the grip. The safety officer was in the lower basket when this happened but was not injured in any way.
- The typical procedure when doing work on the line is review and sign off on the daily "Sheave Rating and Tower Inspection Form" with the daily safety meeting topics to review prior to starting work. We were completing "inspections" and not "work", so we did not complete paperwork for that day only an informal safety conversation before work started and we were following the safety officer's guidance for the tasks to perform.
- The handrail on the work carrier needs to be raised after it leaves the station. It is heavy and difficult to raise and must be done by reaching over the edge of the upper platform while it is at height, and you are connected to fall arrest. It is not very ergonomic and imparts physical strain on the worker as they attempt to raise it without falling off the elevated platform.
- The carrier has a warning plaque attached to the carrier that warns to lower the basket handrail before entering a station.

Safety Officer (Work Carrier)

- When visiting a site as a safety officer they don't typically sign in or complete safety orientations like if we were a regular visitor.
- They typically have safety discussions, like toolbox meetings, with the managers and operators prior to riding ropeways.
- Before working on the lift that day they had reviewed the carrier movement procedures and discussed them with the other workers at the base before entering the work carrier.
- They were asked before reversing into the station if it was clear to turn and they did a visual check and verbally replied to the worker on the ground at the return station that it was good to move.
- They have plenty of experience on work platforms and were aware that the upper rail needed to be lowered before entering the station.
- They missed the fact that the upper railing was still up and needed to be lowered before giving the ok to move.

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- They did not have any direct communication with the lift operator, it was through the other worker.
- They were paying attention and looking in the direction of travel while the lift was moving into the station and were not distracted by anything.

Manufacturer

In regard to the design considerations of the work carrier handrail, the engineering director for the manufacturer of the lift and work carrier stated:

“We have had designs in the past without railing for the upper basket, but workers generally do not like this design and feel a lot more secure with railings even if it’s one more operation to raise and lower it and with the added risk of contact in the station if forgotten.”

- They do not have any precise records of why the design decisions led to a specific rail height on the work carrier involved in the incident.
- They assume the height is to align with worker safety and building codes in North America that require a rail height between 34 and 42”.
- When asked why the design of the work carrier on the lift does not provide clearance to the workstation with the upper rails in place they stated:

“The platform height is chosen to provide an adequate access to the workers to line equipment and be able to perform regular maintenance tasks. This requirement is in contradiction with the clearance requirements in the terminals and explains why special measures like the pivoting upper basket need to be taken.”

Site observations

- The handrail of the damaged work carrier is 42” height from the upper platform.
- The clearance interference between the top of the rail and the station structure is approximately 3”.
- There is a warning tag affixed to the upper platform instructing to always enter the station at slow speed with the upper basket in the lowered position.
- Tower #2 is within visible and audible range from the lower station platform.
- Two other lifts at the facility were observed not requiring the work carriers to lower the upper platform handrails to allow the carrier to pass through the stations.

Summary

The workers performing duties that day with the work carrier and lift operation were knowledgeable and experienced. The reversing of the lift to return the carrier back to the station was not a typical work procedure. Administrative controls and documented work procedures were in place to prevent the work carrier from contacting the stations. A similar incident happened on the same lift in 2017 and an issue was identified at the time that the administrative controls and work procedure were easily overlooked, and a request was made to the manufacturer for a redesigned carrier that did not require folding handrails to provide clearance. The request was denied, and a replacement work carrier was provided that relied on the same administrative controls and work procedures.

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Causes and contributing factors

It is very likely failure to follow the administrative controls and work procedures was the cause of the incident.

The main contributing factor to the incident was:

- The system design of the work carrier from the manufacturer allows interference between the upper handrail and the station structure and relies on administrative controls and work procedures to avoid contact with the station structure.

Additional contributing factors to the incident include:

- The daily work safety review form not being completed before the work that day.
- The lift operator not specifically calling out if the handrails were clear before moving the line.



Photo 1 – A typical passenger carrier in the lower station of the lift. [RED] Area the work carrier handrail contacted the station structure when it was reversed into the station.



Photo 2 – The work carrier at the lower station. **[RED]** The area of contact between the upper handrail and the station.



Photo 3 – Upper platform of work carrier removed after the incident showing the damaged handrail. [RED]
Warning tag affixed to the work carrier platform.



Photo 4 – A different work carrier at another lift at the same facility. **[RED]** Fixed upper platform handrail that clears the station without the need to be lowered.