9 Mistakes You Don't Know You're Making That Are Keeping Your Zip Line From Success

(And How to Fix Them!)

A WHITE PAPER BY
head rush technologies

INTRODUCTION

The purpose of this white paper is to identify the nine most common mistakes seen on zip lines and eliminate them. It's important from an operational standpoint to address these factors because eliminating them will significantly decrease participant risk. The fortunate byproduct of fixing these mistakes—or preventing them in the first place—is that you will also dramatically improve throughput, rider satisfaction, and profitability. It's no secret that a single incident on your zip line involving a customer could put you out of business. You can't afford to put participants at risk, yet every day, thousands of zip line operations are doing just that.

Mitigating risk should be your highest priority, followed by iincreasing rider experience and optimizing profits. Maximizing profit in a zip line operation is dependent upon a number of factors, including regional demand, infrastructure sufficient to meet potential demand, customer satisfaction, high throughput, and safety. You also need a fun and intriguing installation and environment that will keep people coming back, compel customers to bring their friends, and build a positive reputation for your business. While most of these ingredients are indispensable in a profitable zip line operation, one might argue that the single best return on investment is simply running a safe operation.

This white paper addresses zip lines in which impact braking is employed to decelerate riders at the terminal end of the zip line. Impact Braking occurs when the rider trolley contacts a braking mechanism at elevated speeds. In impact braking, the braking mechanism is what brings the rider to a stop.

High-speed zip lines are defined as any line with an arrival over 25 mph (40 kph). High-speed lines require an automatic brake, emergency arrest device (EAD), and engineered landing area. The following is an overview of the biggest zip line mistakes you may not know you're making and how to avoid or eliminate them.

MISTAKE #1: OPERATING WITHOUT AN EMERGENCY ARREST DEVICE

High-speed zip lines are mandated by ACCT Standards for Challenge Courses and Canopy/Zip Line Tours to have both a primary brake and an emergency or backup braking solution to ensure riders are stopped safely, effectively, and reliably at the end of the line. An emergency arrest device (EAD) is just what it sounds like—it is the apparatus that stops a rider in an emergency situation, should the primary brake be compromised.

The ACCT Standard states that an EAD is required as a backup brake for all zip lines in which a participant arrives at the landing area at speeds in excess of 6 mph (10 kph) and where a participant may experience unintended and/or harmful contact with terrain, objects, or people in the landing area. Such a device shall require no action by the participant to engage, and either be completely separate from the primary brake or an integrated backup feature of a primary brake.

The purpose of an EAD is to prevent serious injury or death resulting from user error or equipment failure. Examples of primary brake failure includes:

- Operator error, such as failure to belay
- Connecting line fatigue
- Knot failure
- Rope cut at impact
- Broken lines
- Equipment failure
- Failure to reset a brake block or trolley
- Improper installation

Accidents do sometimes happen and the consequences can be unthinkable. Beyond the threat of serious injury or death to a participant, the ramifications of an accident—especially without a proper EAD—could literally cost you your entire business.

Solution:

Install an emergency arrest device on every zip line. The specific primary braking and EAD options you choose will depend on your zip line construction, speeds, location, length, budget, motivations/goals, and intended rider experience. Refer to ACCT Standards for appropriate EAD options for your zip line.

A spring pad, such as the one pictured above, is an EAD device approved by the ACCT. Always consult an engineer for installation guidelines.

Most brakes can be used as either a primary or backup brake, but must be installed as separate, stand-alone components. Spring packs may be a viable EAD option for zipSTOP and other zip line brakes, so long as they are installed and operated correctly. Although pads aren't an ACCT-approved EAD, it's always a good idea to keep terminal posts and line connections protected and/or padded as an extra precautionary measure. Please consult a zip line builder or engineer to determine the best EAD option for your particular operation.

MISTAKE #2: OPERATING WITHOUT A RIDER-ORIENTATION CONSTRAINT

EADs stop riders more abruptly than primary braking devices. They are not only uncomfortable for riders, they can be outright dangerous to riders coming into the braking area in any orientation other than forward. A rider-orientation constraint is simply a system or device to ensure riders are facing forward at all times on the zip line. To mitigate risk and liability in your zip line operation, riders must enter the braking area oriented forward, or facing the landing area.

Because high-speed arrivals create upswing upon impact with the brake trolley, arriving facing backward can place a rider's head in dangerous proximity to the zip line. Zip line brakes are designed to ensure a rider's head is the furthest away from the impact surfaces, such as the zip line cable, during braking-induced rider swing. A non-constrained rider, or a rider hung beneath a trolley without something physically keeping them in a forward-facing orientation, will inevitably pivot backwards during swing initiation even if they were facing foward at the point of brake initiation. This pivoting is due to the unequal anatomical distribution of weight as it relates to the trolley lanyard and puts the rider's head in close proximity to the zip line, sometimes impacting the line and causing injury.

The risks of not using a rider-orientation constraint include loss of revenue from unsatisfactory customer experience, legal consequences, financial impacts, and injury or death to participants.

Solution:

The Impact Trolley with pivoting handlebar is specially engineered to keep riders facing forward and out of reach of the zip line cable and impact areas.

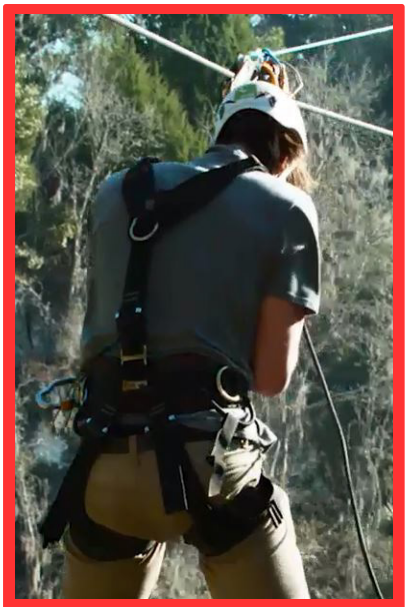
Install rider trolleys that constrain rider orientation on zip lines where arrival speed is 25 mph (40 kph) or greater. Options include passive means, such as Skyline Zipline's skyTECH Rocket, which is a trolley with a built-in chair that keeps riders facing forward without rider input. A more active option includes the new Head Rush Technologies Impact Trolley with pivoting handlebar, which is specially engineered to keep riders facing forward and out of reach of the zip line cable and impact areas.

Unlike other handlebar attachments for other rider trolleys, the Impact Trolley's T-handle has the ability to pivot and follow the rider's motions naturally during contact with the brake trolley. With other handlebars, which are often fixed and rigid, the momentum of a rider can cause the handlebar to lift the trolley off of the cable upon impact, often putting the rider's head directly in the impact zone. This causes damage to the line, faster wear to the rider trolley, augmented deceleration and upswing, and discomfort to the customer.

As we will discuss shortly, while hand braking does constrain the rider to a forward-facing orientation, is not an adequate solution for braking high-speed zip lines.

MISTAKE #3: INCREASING RISK OF BODILY INJURY TO PARTICIPANTS

When impact braking on a high-speed zip line, whether belayed or automated braking, a rider should never be able to place their hands and/or body parts into the impact area. Getting body parts caught in the impact area can cause serious injury or worse.



Allowing participants to enter the braking area backwards creates a very dangerous situation. Possible injuries could include include loss of fingers or hands, broken jaws, head trauma, severe scrapes, and in serious cases, death.

We often think of there being only one impact zone in a zip line braking scenario — the area between the rider trolley and the brake trolley/block at the moment of impact. These components collide with great force to initiate the braking process. Often not taken into consideration, another area of frequent impact occurs behind the trolley where a face, head, or other body part can collide with the rider trolley. Allowing an object or body part to enter the impact zone not only affects braking capacity, but is incredibly dangerous.

Allowing participants to enter the braking area in any orientation except facing forward and allowing the rider to be close enough to inadvertently get their hands or other body parts in the impact area creates a very dangerous situation. Possible injuries from these mistakes include loss of fingers or hands, broken jaws, head trauma, severe scrapes, or worse.

One of the most overlooked and dangerous culprits is hand braking. While many zip lines expect riders to use a gloved hand to slow themselves when approaching the landing area, this protocol introduces significant liability and risk because participants are then within reach of both the cable and impact area. In order for a rider to be close enough to touch the cable for hand braking, they are also unavoidably too close to the brake trolley, impact area, and possibly other hardware. The zip line industry doesn't currently have a regulated speed limit for hand braking, but consensus within the industry is that at a certain velocity, hand braking becomes a serious risk and liability.

Solution:

Critically assess and test your operation and determine where, specifically, participants are at risk for bodily injury on your zip lines. Even if an accident seems unlikely, you are responsible for mitigating risk and controlling your liabilities by considering the worst-case scenarios. Some of the most important safety features you can incorporate are:

- Putting distance between the rider and zip line
- Eliminating the possibility that a rider could reach out and touch the impact area
- Employing a rider trolley that ensures front-facing orientation at impact
- Removing hand-braking from the scenario
- Implementing an automated zip line brake

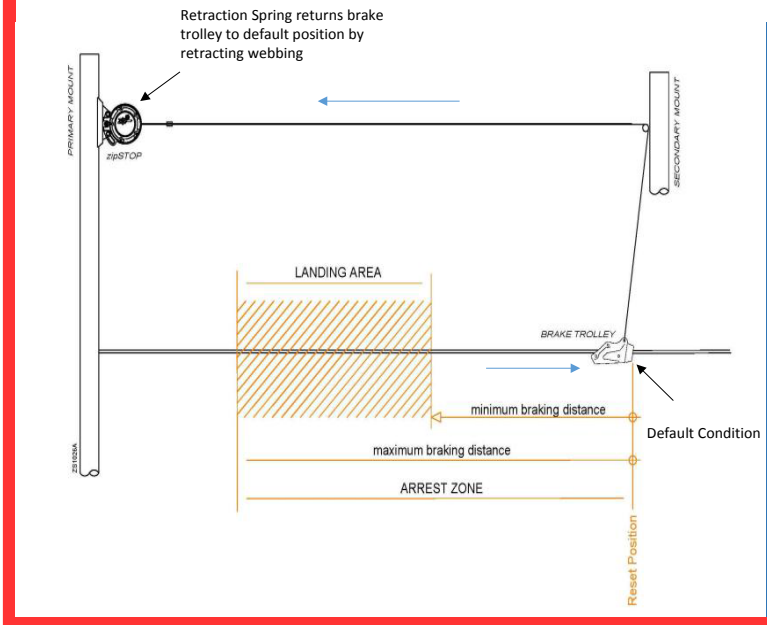
These measures will eliminate many types of common injuries including burns from hand braking and splinters from wire rope lacerations. It will also prevent the incidence of fingers being rolled over by trolleys.

MISTAKE #4: REQUIRING A STAFF MEMBER TO MANUALLY ENGAGE THE ZIP LINE BRAKE

The ideal zip line leaves the control of braking to the brake itself - in other words, the process is automated. The most effective and least error-prone way to arrest zip line riders at the end of your course is to employ an automated brake system, including a primary and an EAD. While automated brake devices won't eliminate the need for staff, they will significantly reduce the potential for human error. Some brakes, like impact belay brakes, require staff to essentially catch each participant as they make contact with the brake block. This puts the entire responsibility of safely braking riders in the hands of your operators. Should they accidentally miss the belay, a rider has no means of braking themselves and will have to be abruptly jolted, and quite possibly injured, by the EAD. The combination of human belayers on a zip line without an EAD is nothing short of a fatality waiting to happen. Are you willing to risk that your staff members will remember to reset the brake and reliably administer the brake every single time without fail?

Solution:

By implementing an automated zip line brake, your staff can be focused on disembarking riders, rather than ensuring each rider brakes safely. Having a setup that automatically resets the brake trolley and prepares for the next rider significantly increases participant throughput, with the added benefit that each rider's braking experience is a pleasant one. At the end of the day, the participants who will want to return and zip again are those who've had a positive experience the previous time around. Automated brakes can pay for themselves in a very short time and may just be one of the most overlooked strategies for ensuring a profitable and low-risk zip line operation.



The most effective and least error-prone way to arrest zip line riders at the end of your course is to employ a brake with automatic reset, like the zipSTOP Zip Line Brake depicted above.

MISTAKE #5: FAILING TO ASSESS THE BRAKE BETWEEN RIDERS

Even with the best brake available, operators need to check between riders to ensure optimal functioning. A twisted reduction line, as pictured above, could greatly impact the brake's ability to function and lead to grave injury for the rider.

Even with the best zip line brakes available, operators need to check between riders to ensure optimal functioning. Failure to check the brake setup and correct problems could result in serious injury to riders and staff.

What would happen if a rider was still on the line when the next rider launches? In this scenario, a collision between the two riders is likely. Even if the first rider does disembark safely, if there wasn't enough time for the brake to reset, the next rider could approach the landing area without a braking mechanism. This scenario is yet another compelling reason why EADs are mandated for zip line courses.

Solution:

This is an operational issue easily solved by dedicated staff training and standard operating procedures. Staff must be aware that these protocols are required—not optional—and if not followed, may cause serious accidents and significant financial and legal implications.

Even with reliable zip line brakes, proper training and procedures are imperative to mitigate risk and liability. It takes very little time for staff to assess the brake between riders, but not doing it could put your zip line operation out of business.

Staff training must include:

- Checking that the rider is properly disembarked before sending the next person
- Ensuring that the brake correctly resets between riders
- Looking to be sure no lines or hardware are out of place or tangled in the brake setup
- Checking that the impact area is clear of all ropes or debris
- Developing and enforcing use of an effective system of communicating with fellow operators so they know when it's safe to send the next person or when they need to wait until a problem is addressed.

MISTAKE #6: FAILING TO PERFORM REGULAR INSPECTIONS OF LINES, EQUIPMENT, AND HARDWARE

Regular inspections are a necessary operational protocol for all zip line brakes. Inspections may include daily, weekly, biannual and/or annual protocols depending on your brake and unique operating circumstances. Failure to complete all inspections and recertifications renders the device unsafe for operation.

The following components are usually included in self-inspections:

- Check ropes and other textiles (like brake lines or webbing) for signs of wear and fatigue and replace as recommended or necessary.
- Inspect all hardware and unit components, like the brake device, brake trolley, and pulleys, for signs of wear, damage, or debris.
- Ensure carabiners and quick links are closed and oriented properly.
- Ensure wire rope clips are properly torqued.

Failure to keep yourzip line brake operating optimally will increase your risk for rider injury, equipment damage, and poor participant experience.

Solution:

Your staff must meticulously perform all inspections of lines, equipment, and hardware. Keep inspection records on file as proof of following the expected protocol. Ensure all staff and operators are trained to complete these inspections and understand the potential consequences of not following the inspection procedures. If utilizing an automated brake, consult your operator manual for more information on required inspections.

Routinely inspect lines, equipment, and hardware. The equipment pictured above would need to be removed from operation immediately and replaced.

MISTAKE #7: FAILING TO ACKNOWLEDGE AND UNDERSTAND WHAT'S INHIBITING YOUR BRAKING

Using a brake trolley not designed specifically for impact braking can cause an unsafe or unexpected increase in braking force.

This is perhaps the most common mistake seen in zip line operations. There are many external factors that can impact the performance of your zip line brake, resulting in unsafe and uncomfortable braking for your riders:

- Using a brake trolley that is not designed specifically for impact braking
- Using incorrect ropes or lines (e.g., wrong diameter, strength, materials, etc.)
- Using incorrect hardware, like improper pulleys

The largest contributor to unexpectedly jarring braking is excess friction being applied to your line from factors that are not visible to the unaided eye. This friction can come from any of the scenarios indicated above, and can cause a deceleration of expected rider speeds. This may mean that your engineering is no longer accurate, and may render your zip line brake installation faulty. Excess friction wreaks havoc on zip lines, yet most people don't even know it exists. It is often responsible for leaving riders stranded and requiring retrievals, causing riders to fall short of the landing area, or causing rider trolleys to impact the brake at much higher velocities than expected.

While increased braking force isn't as dangerous as some of the other challenges, it greatly impacts the rider experience and operational throughputs. When a participant's ride is over, you want him to feel compelled to try it again and bring friends and family to join in the fun the next time. Abrupt braking caused by excess friction has the potential to influence whether participants ever want to zip again. A negative customer experience is not good for revenues and can damage your reputation.

Solution:

To ensure your zip line is running at optimum efficiency, you need to understand the underlying details about how every component of your line effects and impacts the others…especially the things you can't see. Our engineering team conducted extensive testing utilizing a high-speed camera. Only then were we able to actually witness all the intricacies we knew were at play. Many zip line operators are speeding up or slowing down their zip lines without even being aware how this is happening. It's necessary to carefully consider your zip line setup, the engineering, and your brake, and to understand where excess friction might be created. We recommend you begin by analyzing your hardware and accessory products to be sure they fall within the design and performance parameters of your zip line and brake. If you're using an automated brake please refer to the operator manual for more information.

Eliminating the factors that are impacting your zip line's braking force and creating undesirable friction on your line will dramatically improve the reliability, consistency, and effectiveness of your zip line brake. Riders will derive much more enjoyment from the line due to fewer rider recovery scenarios, less wait time, and a smooth, comfortable deceleration rather than an abrupt stop. Operators will also enjoy increased throughput, less time needed per tour, and an enhanced reputation, all leading to increased revenues.

MISTAKE #8: ALLOWING DIMINISHED CUSTOMER EXPERIENCE

When a rider gets stuck in the middle of a line, a retrieval may have to be performed. This process slows throughput and decreases customer satisfaction, resulting in a negative customer experience and decreased likelihood of generating return customers.

Whether customers have a positive experience at your operation depends on a number of variables:

- Do they feel safe?
- Is the experience comfortable?
- Does the operation run smoothly and quickly?
- Are your staff friendly and accommodating?

The focus of operators should be on rider safety and experience. Impact braking can be jarring and outright scary, not to mention dangerous, if not implemented correctly. It also can contribute to a host of other problems—such as arriving short of the landing platform. Riders will not leave satisfied if they needed to be retrieved because they didn't make it to the platform, made rough contact with a brake trolley, had their head impact the cable, collided with another participant, or had to pull themselves hand-over-hand to the landing platform. Even the participants behind a rider who must be retrieved have their experience diminished by having to wait for their experience to begin. Perhaps one of the greatest things that you can do to improve customer experience and increase word of mouth and return visits is to simply ensure that all riders arrive comfortably at the landing platform.

Solution:

To enhance customer experience, you need to implement strategies and protocols to maximize rider safety and focus on their enjoyment in all operational decisions. One solution to maximize customer experience is to minimize the problems stated above with the help of a qualified engineer. Rider recovery can be eliminated entirely, but it will take some work and investment. First, you must understand all the contributing factors, including:

- Too much belly, or sag, in your zip line
- Zip line trolleys that jam on the zip line with impact braking
- Too much friction or resistance in a brake
- Improper setup of pulleys, lines, and brake
- Inability to stop participants from rolling backwards on the line after contacting the brake trolley

MISTAKE #9: IMPROPERLY ENGINEERING AND INSTALLING THE LINE AND PLATFORMS

Improperly engineering your zip line and platforms is a design and installation mistake that will significantly impact return on investment, profitability, and throughput.

It is important to choose the proper components for your zip line installation. This installation uses a reduction rope that is thick, heavy, and easily becomes water-logged. This would not be an ideal rope to use with your brake, and could interfere with braking performance.

Many zip lines are simply not designed and built for high throughput from the outset. Instead, most are designed for up-front affordability, a factor that is typically at odds with optimal performance. An ideal zip line has positive angle from start to finish, allowing riders—of all shapes and sizes—to arrive comfortably at the landing platform every time without recovery efforts, regardless of wind and weather.

All zip lines have some belly or sag. Because of the weight of the zip line itself, it is impossible to eliminate all sag, even under optimal conditions. Do make every effort to eliminate as much belly as possible to minimize uphill arrival. With uphill arrival, a compromise will always exist: if the zip line is designed so that the lightest rider arrives at the landing platform with regularity, then the heaviest rider will come in with excess velocity. Conversely, if the zip line is designed so the heaviest rider arrives at a safe velocity, a lighter rider won't make it to the platform and will require recovery. Compound this equation with a head or tail wind, and you'll find yourself with significant downtime and unsatisfied customers.

Solution:

The solution to an improperly engineered zip line lies in increasing zip line tension. Making sure your zip lines have proper tension will mean more consistent arrival speeds, fewer recoveries, and increased customer satisfaction. The investment to correct the line tension issue has the potential to pay for itself quickly with improved throughput and happy customers willing to return.

Please consult with your builder or an engineer before undertaking this process. High-tension lines are only possible with larger diameter cable, which requires more significant support structures, so you will need to ensure optimal engineering and construction time.

Another simple design solution, which is often overlooked, is to separate your platform from the terminal pole. While this may seem counter-intuitive, it does allow you to make the platform as long as necessary to ensure all riders actually reach the platform. There is no definitive need to have the terminal pole be attached to the landing platform.

CONCLUSION

There are a number of hidden factors that impede the efficiency and diminish the profitability of most zip line operations. Many of these issues also put your participants at risk of serious injury. While you probably weren't even aware that many of these problems exist, you've now taken the first step by educating yourself about the problems and solutions.

For the sake of the industry, and to create positive happy zip line riders, we hope you will consider utilizing this information to improve your own zip line. We strongly encourage you to visit with your builder or engineer to see what improvements you might be able to make to increase the success of your zip line operation.

CONTACT US

Head Rush Technologies applies innovative technologies to bring new adventure recreation equipment to the climbing, zip line, adventure, and amusement industries.

Head Rush products strive to reduce the risk involved in adventure activities, while increasing your throughput and enhancing your customer experience.

For more information on how to improve your zip line installation for optimal ROI, throughput, risk reduction, and customer satisfaction, please visit **www.headrushtech.com**, or call us at **+1-720-565-6885**.