1989

Nathan D. Hale v. Boyne USA, Inc. : Brief of Appellant

Utah Court of Appeals

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IN THE UTAH COURT OF APPEALS

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NATHAN D. HALE,
Plaintiff/Appellant,

vs.

BOYNE USA, INC., dba BRIGHTON SKI RESORT,
Defendant/Respondent.

Civil No. 890717-CA

ARGUMENT CLASSIFICATION

PRIORITY SIXTEEN

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APPEAL FROM THE DISTRICT COURT OF THE THIRD JUDICIAL DISTRICT

IN AND FOR SALT LAKE COUNTY

HONORABLE JAMES S. SAWAYA

PRESIDING

APPELLANT'S BRIEF

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JURISDICTION

The Court of Appeals for the State of Utah has jurisdiction to review this final judgment from which this appeal is taken, pursuant to the provisions of Section 78-2(a)-3(2)(a) Utah Code Annotated, as amended in 1987, and Rule 3 of the Utah Rules of Appellate Procedure.

NATURE OF PROCEEDINGS

This is an appeal from the Third Judicial District Court in and for Salt Lake County, State of Utah, with the Honorable James Sawaya, Presiding.

This appeal is from a final order, entered by the Honorable James Sawaya, on June 2, 1989, holding in favor of the Defendant.

STATEMENT OF THE ISSUES

1. The Court errored in finding that the actions of Brighton violated no duty.

2. The Plaintiff's claims do not arise out nor are they an inherent risk of skiing within the meaning and definition of Utah Code Annotated, Section 78-27-53.

3. The Lower Court errored in the award of costs to Defendant.

DETERMINATIVE PROVISIONS OF THE UTAH CODE

Section 78-27-53, as amended in 1986:

INHERENT RISKS OF SKIING -- BAR AGAINST CLAIM OR RECOVERY FROM OPERATOR FOR INJURY FROM RISKS INHERENT IN SPORT.

Notwithstanding anything in Sections 78-27-37 through 78-27-43 to the contrary, no skier may make any claim against, or recover from any ski area operator for injury resulting from any of theinherent risks of skiing.

Section 78-27-52, as amended in 1979:

INHERENT RISKS OF SKIING -- DEFINITIONS

As used in this act:

(1) "Inherent risk of skiing" means those dangers or conditions which are an integral part of the sport of skiing, including, but not limited to: changing weather conditions, variations or steepness in terrain; snow or ice conditions; surface or subsurface conditions such as bare spots, forest growth, rocks, stumps, impact with lift towers and other structures and their components; collisions with other skiers; and a skier's failure to ski within his own ability.

STATEMENT OF THE CASE

NATURE OF THE CASE

This is an appeal from a Judgment in favor of the Defendant, holding that the claims of the Plaintiff arise out of an inherent risk of skiing, as well as upon the basis that the Defendant's actions violated no duty.

COURSE OF PROCEEDINGS

This action was filed in the District Court of the Third Judicial District, in and for Salt Lake County, State of Utah, with the Honorable James Sawaya, Presiding.

After two full days of trial, the Court took the matter under advisement, and then issued a Memorandum Decision holding against the Plaintiff and for the Defendant.

DISPOSITION AT TRIAL COURT

The Trial Court held that Plaintiff had no cause of action against the Defendant, and awarded the Defendant costs in the action.

STATEMENT OF THE FACTS

On February 12, 1988, Mr. Nathan D. Hale, Plaintiff/ Appellant was boarding a ski lift at the Majestic Lift, Brighton Utah, when the operator grabbed the chair, held it and then let it go with extreme momentum and force, and struck Mr. Hale in the back.

Mr. Hale sustained a permanent disability of twelve and one-half percent of the whole man, and who even at the time of trial on April 26, 1989, continued to suffer severe pain with little or no improvement since the time of the accident.

Plaintiff filed his action in the Third Judicial District Court in and for Salt Lake County, State of Utah, the Honorable James S. Sawaya Presiding.

After two full days of trial, the Court took the matter under advisement, and then in his Memorandum Decision, the Court held against Mr. Hale on two reasons, from which the Plaintiff/Appellant now appeals. (All citations to the record are found with the respective arguments.)

SUMMARY OF THE ARGUMENTS

This is a case where the Plaintiff is struck with a ski lift chair at the base of the lift, after being motioned into position by the ski lift operator.

The Lower Court held that the claims of the Plaintiff constitute an inherent risk of skiing, and furthermore, that the Defendant violated no duty.

Plaintiff/Appellant submits that the Defendant clearly violated its duties to the Plaintiff/Appellant in failing to push the stop button for the lift, and by grabbing the chair and causing the same to strike the Plaintiff/Appellant with great force and effect.

Plaintiff/Appellant submits that the statute is clear that this cause of action is not an inherent risk of skiing, especially in light of the Senate Hearings on the same, which are attached hereto in the Addendum.

Plaintiff/Appellant submits that the Defendant/ Respondent is not entitled to costs in this action.

ARGUMENT ONE

THE COURT ERRORED IN FINDING THAT THE ACTIONS OF BRIGHTON VIOLATED NO DUTY.

The Majestic Lift at Brighton Utah, is designed and maintained for beginner skiiers. According to MR. Theodore Steven Jorgensen, who was the Supervisor in charge of Brighton Ski Resort on the night in question, testified on cross examination at page 283 of the transcript as follows:

> Q. I noticed from those photographs we just had admitted that you let the tiny kids ride this left?
>
> A. That's right.
>
> Q. How old were those kids getting on do you know?
>
> A. They looked to be five, six, seven years old.

The Lift Operator, Mr. Robert Barton, was a brand new employee on the job, actually being trained at the time of the accident. He was unsure of how long he had worked, and gave conflicting testimony as to his training, and when it began. At page 157 of the transcript on cross examination, he testified as follows:

Q. You don't recall if you began your
training on the 6th or if you had completed
your training by the 6th of January, is
that what you're saying?

A. Yes.

Then on page 167 and 168 of the transcript on cross examination, he testified that he could not even remember what he had studied the year before, etc.

Q. (By Mr. Walsh) What did you study, Bob,
when you were a ski lift operator?

A. The stuff you are supposed to when you
become a ski lift operator. How to operate
the chair.

Q. Do you remember what literature you
studied?

A. Not exactly. I haven't operated chairs
for a year now.

Q. So if I understand your testimony correctly,
you operated the chair for approximately a month
and a week before this incident occurred?

A. Approximately.

Q. And for all you recall, you were being
trained all through that period of time; is
that correct?

A. Your always being trained.

Q. So the answer is yes?

A. Yes.

The supervisor, Michael W. Twede, on cross examination testified at page 210 and 211 as follows:

Q. As I understand your testimony, Mike, you were the one that hired Mr. Barton.

A. That's right.

Q. And he was the ski lift operator on the night in question, February 12, 1988.

A. That's right.

Q. And was there anyone else assisting him as the ski lift operator or attendant on that night in question?

A. We have three people that work at the base. On guy was on break and myself was with Bob at the base, but I was in the shack doing paperwork.

Then on page 212, Michael W. Twede testified that the total training that Mr. Barton received as the ski lift operator, running the lift at night, all occurred in January and February, 1988.

Q. Okay. My question is that the training he received as a ski lift operator running the lift at night all occurred in January and February, 1988, right?

A. Yes.

Mr. Hale, on the evening of February 12, 1988, was standing in line waiting to enter the ski loading area. He waited until the operator motioned for him to come forward on his skis to the loading line. All of a sudden the operator left the area where the stop button was located, and the next thing that Mr. Hale remembers is lying on the ground by the steel post which is 22 feet up the direction of the lift, where he was thrown by the lift.

At pages 18 and 19 he testified as follows:

> Q. Can you tell me what happened then, and start right here at this point, if you would, please. When you leave this point, what happens?
>
> A. I was motioned to come up.
>
> Q. You need to stand back so that the judge can see.
>
> THE COURT: That's all right. I can see.
>
> THE WITNESS: I was motioned to come up to the area of where I would be picked up by the chair lift. I went up there. I stood there. All of a sudden I started seeing an individual run over this way, and I was standing here. I turned like this, and that's the last thing I remember until I was over -- that I was over

here. That's a big pole that stands up in the ground. I was over there on the ground.

. . .

Q. Prior to being hit, did I understand you to say that the operator came in front of you?

A. Yes.

Q. Did he stop the lift before he came in front of you?

A. No, sir.

Then on page 51, Mr. Hale testified as follows:

Q. (By Mr. Walsh) Can you tell me, as the chair came around, was it coming at the same speed and struck you at the same speed as we saw here on the video?

A. No. It hit me hard enough to put me clear into that pole. When it hit me, it hit me with an impact enough to cause internal bleeding in my leg and break the blood vessels in my leg. The doctor said it hit me --

THE COURT: Never mind what the doctor said.

Q. (By Mr. Walsh) If I understand your testimony then, you are here in the position just waiting for the lift to come around and pick you up to go?

A. Yes.

Q. Did I understand you to say it didn't hit the other skier?

A. No, never to my knowledge. Never even touched him.

At the time of trial, the ski lift operator Mr. Robert W. Barton, testified that he perceived an emergency circumstance of two boys entering the restricted area, and therefore he left his post by the stop button, and ran over to the two boys.

The two boys, Jason Johnstone and Jerald A. Steinagel, testified that they had not proceeded beyond where they should have been.

At page 97, Jason Johnstone testified as follows:

Q. Let me stop you right there. When he grabbed the chair, had it already come past you?

A. It was right in front of me.

Q. If he hadn't grabbed the chair, would it have hit you?

A. No.

Q. Would it have come close to you?

A. It would have been about seven feet or eight feet away from me.

Q. And what about Jerry, would it have been that far away from him as well?

A. Yes, it would have.

Q. So he grabbed the chair with his right hand, then what happened?

A. The chair started swinging back and forth and it struck Nathan in the back of his legs. I don't know if it was his legs -- I seen it hit the back of his legs.

Q. When he grabbed the chair, did he hold it?

A. He held it. I guess there was enough power it yanked out of his hand. Then this just swung back and forth.

Then on page 310 of the transcript, Jason Johnstone when called as a rebuttal witness testified:

Q. Now, can you tell me when you came forward, did you go beyond the line here marked as B?

A. No, I didn't.

Q. Can you tell me what happened as you approached the line?

A. Okay. As we approached the line, the man standing between B and C --

Q. Here in the green on 16?

A. Yes. He came over and told us to stop.

Q. Okay.

A. And then as the chair was coming around, he grabbed the chair.

Q. Okay. Was the chair straightened out, headed toward Mr. Hale when he grabbed it, or was it before that?

A. It was coming around the corner.

Q. Okay. So it hadn't straightened out for Mr. Hale?

A. No.

Q. How long did he hold onto the chair?

A. I would say a matter of two seconds, maybe three.

Q. What happened after that?

A. He seemed to let it go or something -- it left his hand, then it struck Nate, and then I looked over and I saw Nate fall and then in a matter of a couple seconds later I looked over and the lift had been stopped.

Jason Johnson similarly testified on April 26, 1989, beginning at page 112 of the transcript:

Q. Did you observe anyone else coming in and grabbing the chair, anything like that, before the chair made contact with Nathan?

A. Yes, I did. The operator -- I observed two operators.

Q. Okay.

A. One of the operators came and he grabbed --

I guess we were a little over the line.

Q. Okay. You thought you were over the line?

A. My skis were about a foot over the line. He said to stop.

Q. Where was your person?

A. What?

Q. Was your person behind the line, meaning your feet? Where did your feet come in reference to the line?

A. My feet were at the line.

Q. Okay. And you hadn't proceeded? Your feet had not proceeded beyond the line?

A. The skis had. My feet hadn't.

At the end of the trial on the second day, the Court heard closing arguments of Counsel, both by the Plaintiff/Appellant and the Defendant/Respondent.

After all of the evidence is in, and during argument by Respondent's case, the Court made the following ruling from the bench as found on pages 370 and 371:

> THE COURT: The only question, Mr. Winegar, in all the rhetoric, is whether or not the reaction of the lift operator, in doing whatever he did, was negligent. That's what it comes down to. And I am convinced that Mr. Hale was

struck by a chair that had more momentum than normal. It had accelerated abnormally for one reason or another, and the only thing I can say is that it accelerated because the lift operator grabbed it and lifted it up somehow and it swung down and it may have been just a coincidence of circumstances that he happened to be there when that thing came down and hit him the way it did. It seems like a fairly simple case to me, quite frankly. And, you know, with Newell Knight's time and motion studies and things like that, it's all interesting, but I think it comes down to the point I am convinced that the lift operator did that. I don't know what else could have caused it. There's nobody else in the area. There's nobody else that could have touched the lift chair and caused it to accelerate, but the only question in my mind, even knowing that, is that a negligent act? I am not convinced that it is.

During the course of the trial the Judge made two different rulings bearing upon the issue above stated:

1. The Court ruled that an ordinary person could determine the standard of care without expert testimony.

2. The Court admitted Exhibit 9, which is the American National Standards Institute standards of lift operation.

As to #1 above, the Court stated on page 143, as follows:

> THE COURT: I think there is an area where the standard has to be established by expert testimony. I think the standard of due care an employee has in this situation an ordinary person, even myself, can determine what the standard of care is in a situation like this is without the benefit of an expert.
>
> Is there something in that document that says that chairlift operators also should hit the stop button before he runs out to do anything? That's just one man's opinion. I suppose that this Court is going to have to determine whether that is reasonable behavior under the circumstances. I just don't think you need an expert.

Then on page 145 and 146, the Court stated:

> THE COURT: I ruled this is not an area where expert testimony is necessary.

During the course of the trial, at two different times, the Plaintiff/Appellant put into evidence a conversation between Mr. Barton, the operator, and his supervisor, wherein the supervisor was very critical of what Mr. Barton had done, and had Mr. Barton not acted inappropriately, in grabbing the chair and not pushing the stop button, Mr. Hale would never have been injured

It is interesting to note that not only did the Defendant/Respondent fail to meet that evidence, but his witnesses did not even deny that the same occurred.

At page 99, Jason Johnson testified as follows:

> Q. Okay. Was the lift ultimately stopped?
>
> A. Not at that time. The operator stopped it.
>
> Q. The guy that pulled the chair stopped it?
>
> A. No. There was another guy. There were two operators at the lift.
>
> Q. Okay. What happened after they stopped the lift?
>
> A. The one that stopped the lift went over and asked Mr. Hale if he was all right.
>
> Q. Okay.
>
> A. And he picked him up and helped him over towards the corner of the shack.
>
> Q. Okay. What happened after that?

A. Okay. And he let him go and he started talking to the other lift operator.

Q. Let me stop you there. You have mentioned one operator. You know he worked for Brighton because he was wearing a Brighton uniform. What about the other one?

A. He was wearing a Brighton uniform also.

Q. Did you hear them discuss what occurred?

A. Yes. He told him that he wasn't supposed to grab onto the chair when it came around.

Q. Go ahead.

A. He asked him not to grab onto it. He said it probably wouldn't have hit Mr. Hale if he didn't grab onto it.

Q. Did you hear that very clearly?

A. Yes.

Q. And are you telling us, as close as you can recall, the exact words that were said?

A. Yes.

Q. What did the other operators say in response?

A. I think that's all he said.

Then on page 318, as a rebuttal Witness, Jason Johnstone testified as follows:

Q. Now, did you hear a discussion between the operator and someone else after the incident had taken place?

A. Yes, I did.

Q. And was it between two or more than two people?

A. It was between two people.

Q. And can you tell me whether both of them were wearing Brighton uniforms?

A. Yes, they were.

Q. Can you tell me what was said?

A. There was an older guy. He said to the guy that motioned to me, "stay back," that he wasn't supposed to grab the ski chair, the pole that was on the ski chair. If he wouldn't have grabbed it, it probably wouldn't have struck Nate.

Q. Are you sure that that conversation occurred?

A. Uh-huh. Yes.

When the ski lift operator, Mr. Barton, was asked if that conversation did in fact occur, he stated as follows on page 168:

Q. And do you recall on the evening of the 12th of February, Mr. Twede saying to you, "You hit the stop button first, then you go after the chair"?

A. I don't recall that.

Q. Are you saying that could have occurred, you don't remember.

A. Could have occurred, sure.

When Mr. Mike Twede was asked if he ever criticized Mr. Barton's actions, stated on page 209:

Q. Did you, at any time, criticize -- and I am talking at the time of the incident -- did you ever criticize Mr. Barton's actions in any way?

A. Not that I recall.

At no time did the Defendant/Respondent put on any testimony as to the conversations not occurring, rather the entire case of the Defendant/Respondent was to the effect that it was an emergency situation, and there is no hard and cold rule.

However, Exhibit 9, which was admitted into evidence by stipulation between the parties as the governing standard of care, clearly, and without equivocation, requires that the operator shall in every situation hit the stop button before attempting other actions.

Plaintiff/Appellant submits that there is a standard of care that has been established, not only over time, but across the Nation, and because of the same, we attached a copy of the A.N.S.I., Ex. entirety, for the purpose of assisting this Court in making its own determination as to the appropriateness of the standard of care in this action.

The copy that is part of the Addendum was borrowed from the United States Forest Service for the purpose of preparing this Brief, and certain hand written notes may not appear in Exhibit 9, as entered into evidence, but the printed matter is identical, as far as Counsel for the Appellant is aware.

In the said National publication is the following:

> 1. At page 40, at 3.3.2.3.3: ATTENDANT AND CONDUCTOR, The duties of the attendant and the conductor shall be as follows:
>
> (1) To maintain orderly passenger traffic conditions within his/her area of jurisdiction
>
> (2) To advise and assist passengers, as required
>
> (3) To maintain surveillance of his/her area of jurisdiction
>
> The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the lift immediately and advise the operator. The operator shall also be

advised of changes in weather, ground, or snow surface conditions.

2. At page 58, at 4.3.2.3.3: ATTENDANT. The duties of the attendant shall be as follows:

(1) To maintain orderly psssenger traffic conditions within his/her area of jurisdiction

(2) To advise and assist passengers, as required

(3) To maintain surveillance of his/her area of jurisdiction

The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

According to Exhibit 9, the operator has a duty to stop the lift, if a passenger "might" be endangered. The language is in terms of "shall" meaning must, and there is no exception noted.

At trial, Exhibit 9 was referred to as the A.S.N.I. standard of care, both by the Plaintiff and the Defendant throughout.

The Defendant/Respondent, at page 270, just as an example referred to the A.S.N.I. standard, as it applies to this case:

Q. On the ANSI standards, who is an operator?
A. The person who is in control of the lift.
Q. Which one would that be?
A. That would be the person loading next to the stop button.
Q. Who are the attendants?
A. The attendants are the persons on the top, the ticket taker, someone shoveling, things like that.

Then on cross-examination, Mr. Theodore S. Jorgensen, who is the individual in charge of the entire operation at Brighton, testified beginning on page 272

Q. Steve, when you talk about the ANSI standards, you're making reference, are you not, to Exhibit 9, which has already been admitted?
A. That's the ANSI .77 code.
Q. That would be the standards that you made reference to when you talk about the ANSI standards?
A. Yes, sir.

Q. Now, the ANSI standards indicate that there's a cardinal rule of hitting the button first if you have a person in threat of being hit by the lift, do you not?

A. I've never read that page.

Q. I draw your attention to page 58 and by way of reference I am talking about 4.3.2.3.3 Would you read that paragraph right there on page 58 to the Court please.

A. "The operator shall be advised of any unusual or improper occurrances. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground or snow surface conditions."

Q. Are you familiar with that rule?

A. Yes, sir.

On the back cover of Exhibit 9, is the following:

AMERICAN NATIONAL STANDARDS

The standard in this booklet is one of more than 10,000 standards approved to date by the American National Standards Institute.

The Standards Institute provides the machinery for creating voluntary standards. It serves to eliminate duplication of standards activities and to weld conflicting standards into single, nationally accepted standards under the designation "American National Standards."

Each standard represents general agreement among maker, seller, and user groups as to the best current practice with regard to some specific problem. Thus the completed standards cut across the whole fabric of production, distribution, and consumption of goods and services. American National Standards by reason of Institute procedures, reflect a national consensus of manufacturers, consumers, and scientific, technical, and professional organizations, and governmental agencies. The completed standards are used widely by industry and commerce and often by municipal, state, and federal governments.

The Standards Institute, under whose auspices this work is being done, is the United States clearinghouse and coordinating body for voluntary standards activity on the national level. It is a federation of trade associations, technical societies, professional groups, and consumer organizations. Some 1000 companies are affiliated with the Institute as company members.

The American National Standards Institute is the United States member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Through these channels U.S. standards interests make their positions felt on the international level. American National Standards are on file in the libraries of the national standards bodies of more than 60 countries.

Plaintiff/Appellant submits that the Court made a finding from the Bench at the end of the case, and found that the lift operator had in fact grabbed the chair, and that the chair thereafter struck Mr. Hale with extreme force. Note the transcript at pages 370 and 371.

At the same time at page 370, the Judge stated that "The only question, Mr. Winegar, in all of the rhetoric, is whether or not the reaction of the lift operator, in doing whatever he did was negligent."

The Court has already ruled at this point that the Court does not need expert testimony to determine the negligence of the Defendant, and precluded the Plaintiff/Appellant from putting on evidence by way of expert testimony. Note pages 145 and 146:

> THE COURT: I ruled this is not an area where expert testimony is necessary.

The Defendant/Respondent's expert witness, Mr. Newell Knight testified that had the operator hit the button instead of grabbing the chair, Mr. Hale would have not been thrown into the ski lift post, as the subject chair would have come to a complete stop some twelve (12) feet in front of the said steel post.

Plaintiff/Appellant submits that it is quite obvious that Mr. Hale would have been confronted with the chair coming at the normal speed, <u>at worse</u>, had the operator hit the stop button, instead of grabbing the chair.

Moreover, the lift begins to immediately slow down once the botton is pushed.

Note on page 281 of the transcript, Mr. Theodore S. Jorgensen, the one in charge of Brighton Ski Resort, testified as follows, on cross-examination:

> Q. (By Mr. Walsh) From the moment that button is pushed the lift starts slowing down, doesn't it?

A. Yes, it does.

At another time in the trial Mr. Theodore S. Jorgensen stated that their first priority at the lift was to stop the chair. Note page 187.

The Defendant/Respondent wanted the lower Court to believe that this was a unique circumstance, that it constituted an emergency situation.

However, as borne out at the time of trial, what occurred here with the boys allegedly coming in too soon was just what they expect and just what they train for.

At page 204 of the transcipt, Mr. Michael W. Twede, the one who hired and trained the operator, Mr. Barton, testified for the Defense as follows:

> Q. Did part of the training include being aware of the possibility of premature skiers coming into the loading zone?
>
> A. Yes. That's one of the main things they stress to my employees, to watch for people who are coming out too soon or too late.

Plaintiff/Appellant respectfully submits that the failure to push the stop button was a negligent act, which was all the more serious and aggravated by the grabbing of the chair, cocking the same and with all of the force and effect unleashing the same on the back of Mr. Hale.

Even assuming that there is an emergency, with assuming that the button is not pushed and the chair is left alone, the chair would have merely come to the boys, would have riden up the side of the first boy, and then proceeded towards Mr. Hale. Note page 280 of the transcipt with Mr. Theodore S. Jorgensen testifying.

Hence, had the operator done absolutely nothing, Mr. Hale would not have been damaged for life.

Had the operator merely pushed the botton, Mr. Hale would not be damaged for life.

It is only when you fail to comply with the National Standard in not pushing the button as required, compounded with cocking the chair and unleashing the same on Mr. Hale, do we have the actions that permanently destroyed Mr. Hale's wellbeing.

Plaintiff/Appellant respectfully submits that the lower Courts determination that there was no "breach of duty" is error, and should be reversed.

A R G U M E N T   T W O

THE PLAINTIFF'S CLAIMS DO NOT ARISE OUT OF NOR ARE THEY AN INHERENT RISK OF SKIING WITHIN THE MEANING AND DEFINITION OF UTAH CODE ANNOTATED, SECTION 78-27-53.

The Lower Court in its Memorandum Decision stated on the first page, ' . . .the Plaintiff's claims arise out of and are an inherent risk of skiing within the meaning and definition of Utah Code Ann. Section 78-27-23."

Section 78-27-23 states as follows, as amended in 1986:

> INHERENT RISKS OF SKIING -- BAR AGAINST CLAIM OR RECOVERY FROM OPERATOR FOR INJURY FROM RISKS INHERENT IN SPORT.
>
> Notwithstanding anything in Sections 78-27-37 through 78-27-43 to the contrary, no skier may make any claim against, or recover from any ski area operator for injury resulting from any of the inherent risks of skiing.

The term "inherent risks of skiing" is a term of art, and is specifically defined by the State Legislature, at 78-27-52 as follows:

> INHERENT RISKS OF SKIING -- DEFINITIONS.
>
> As used in this act:
>
> (1) "Inherent risks of skiing" means those dangers or conditions which are an integral part of the sport of skiing, including, but not limited to: changing weather conditions,

> variations or steepness in terrain; snow or ice conditions; surface or subsurface conditions such as bare spots, forest growth, rocks, stumps, impact with lift towers and other structures and their components; collisions with other skiers; and a skier's failure to ski within his own ability.

Counsel for the Plaintiff/Appellant, respectfully submits that the definition of "inherent risks of skiing" absolutely does not contemplate the claim of the Plaintiff/Appellant.

Rather the language seems very clear that the intent of the Legislature was to make the skier responsible for getting down the mountain, but did not change anything in reference to the negligence of the ski resort.

Counsel has attached to this brief the Certified Transcript of the Senate Hearings on the said legislation, and has made the total transcript part of the addendum hereto.

Counsel will highlight the debate regarding the subject bill, as it appears on the official transcript:

Page 1

President: If you are skiing down the hill and run into it, that's an impact, I think we say.

Page 3

Finlinson: . . .This kind of law does not prohibit the individual from being successful or successfully bringing a claim against the operator if the operator was, in fact, negligent or there were some other reasons for the action.

. . .It does say that the skier is responsible for the inherent risks of skiing and we define "inherent risks of skiing" as those items or conditions that are related, that the skier would encounter on the way down the hill as he is skiing down the hill, those are items that we say have become his responsibility. We indicate still that the operator has the responsibility to notify the skier of the limitations and he has a responsibility to post those properly. He has the responsibility to operate his ski area in a non-negligent manner.

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Finlinson: The main thrust of Senate Bill #146 is to, I think, clarify the Utah laws so that the skier assumes the responsibility for the inherent risks of skiing. To be his responsibility once he is at the top of the hill basically to make sure that he gets down to the bottom safely. The ski areas still have that responsibility for making sure that he is able to get to the top of the hill safely and to make sure that they don't operate in a negligent manner. What we are trying to say is that when an individual has an accident on the hill as a result of his own fall, or his not being able to cope with the weather conditions, the ski conditions, or the fact that he looses control and collides with a lift tower, that he has to assume that responsibility.

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Carling: . . .we are looking at 90-day limitation on inherent risks of skiing rather than ordinary negligence, which would be the same as anybody elses negligence.

Jeffs: . . .we ought not have the 90-day limitation on the guy who gets dumped out of a chair lift because of faulty equipment. That is another type of area and this Bill does not treat that so that I agree with the Carling amendment.

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Finlinson: What we are attempting to do is to say, very simply, that the skier assumes the responsibility basically for getting down the mountain under his own power, we are not attempting to change that, we are just clarifying the law so that the skier is responsible for those inherent risks of playing this sport. We are not trying to change the ground rules as far as the other liability questions. We are just clarifying the law to make sure that the law says that the skier is responsible for getting down the mountain under his own power. That was the basic thrust of what this Bill does.

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Barton: . . .I don't think this Bill would alter any type of situation where, if the ski resort was actually at fault for causing injury to somebody, I still think suit can be made. I don't think it precludes this. It is just the inherent risks of skiing and where there are so many chances for somebody to break an ankle or even twist ligaments, it happens many many times during each day, and I just think we are going to have to take them off the hook or its not going to be profitable for them.

As noted in the Addendum, Senator Finlinson was the sponsor of this legislation, and he repeatedly stated in the debate that the bill only contemplates the responsibility of the skier in getting down the hill.

Counsel for the Plaintiff/Appellant respectfully submits that there is no question that the Honorable James S. Sawaya errored when he concluded, ". . .that the Plaintiff's claims arise out of and are an inherent risk of skiing within the meaning and definition of Utah Code Ann., Section 78-27-53."

A R G U M E N T   T H R E E

THE LOWER COURT ERROR IN THE AWARD OF COSTS TO DEFENDANT.

In this case, the Defendant/Respondent submitted an unverified Memorandum of Costs and mailed the same on a Thursday, June 1, 1989, which according to the time for mailing, the same are deemed received on Monday, June 5, 1989.

The Honorable James Sawaya apparently had the same delivered to him, along with the Findings, Conclusions and Judgment, because he signed the same on June 2, 1989.

After the June 5, 1989 receipt, Counsel for the Plaintiff/Appellant filed Objections to the same, not knowing that the Court had already signed the same, and Counsel submitted the same on June 8, 1989.

The unverified MEMORANDUM OF COSTS is as follows:

> Todd S. Winegar, being duly sworn, hereby verifies that to affiant's knowledge the items below are correct, and that the disbursements have been necessarily incurred in this action:

Transcript of deposition of Nathan Hale	$273.35
Transcript of deposition of Dr. Gordon Kimball	$125.50
Transcript of depositions of Mike Veenendall and Jerry Steinagel	$193.40

Transcript of deposition of Dick Cummock	$174.20
Expert testimony of Newell G. Knight	$1356.25
Total Costs	$2122.70

RESPECTFULLY SUBMITTED this 1st day of June, 1989.

CHRISTENSEN, JENSEN & POWELL, P.C.

TODD S. WINEGAR /s/

Todd S. Winegar
Attorneys for Defendant

Counsel for the Plaintiff/Appellant submits that the Court errored in awarding the costs, as outlined.

First: The Memorandum of Costs was unverified. The beginning of the same starts out "Todd S. Winegar, being duly sworn, hereby verifies that to affiant's knowledge the items below are correct, and that the disbursements have been necessarily incurred in this action."

However, the same was never verified at the end, as it states "RESPECTFULLY SUBMITTED this 1st day of June, 1989. CHRISTENSEN, JENSEN & POWELL, /s/ Todd S. Winegar, Attorneys for Defendant."

At no time did Counsel swear that the contents of the same true and correct, and hence the same were never verified.

Rule 54(d)(2) Utah Rules of Civil Procedure is very clear on this point:

(2) HOW ASSESSED. The party who claims his costs must within five days after the entry of judgment serve upon the adverse party against whom costs are claimed, a copy of a memorandum of the items of his costs and necessary disbursements in the action, and file with the Court a like memorandum thereof duly verified stating that to affiant's knowledge the items are correct, and that the disbursements have been necessarily incurred in the action or proceeding.

The Supreme Court for the State of Utah, has held that an unverified Memorandum of Costs, does not entitle the claimant to an award of costs. Note Walker Bank & Trust Co., v. New York Terminal W. Co., 10 Utah 2d 210, 350 P.2d 626 (1960).

This Court has always taken the position that the award of costs was strictly statutory, and so there has been a strict construction of the rule. Nelson v. Arrowhead Freight Lines Limited, 99 Utah 129, 104 P.2d 225 (1940) and Openshaw v. Openshaw, 80 Utah 9, 12 P.2d 365 (1932).

Plaintiff/Appellant submits that the general rule is that Under Rule 54(d) costs has meant monies paid into the Court. Frampton v. Wilson, 605 P.2d 771, (Utah, 1980).

Defendant/Respondent has made no claim for any monies paid into the Court.

Depositions are typically only allowed as "costs" when the litigationis so complex and the issues are difficult to resolve. Note Highland Constr. Co. v. Union Pac. R. R., 683 P.2d 1042. (Utah, 1984).

However, such is not the case here, as Judge Sawaya stated on page 371, wherein the Court stated, "It seems like a fairly simple case to me, quite frankly."

The appellate courts here in Utah, have consistently held that expert testimony from experts is not taxable costs. Note Stevens v. Stevens, 754 P.2d 952, (Court of Appeals, 1988), and Hatanaka v. Struhs, 738 P.2d 1052 (Utah App. 1987).

In this case the Defendant/Respondent paid no monies into the Court, in a very simple case. They filed a claim for many depositions, and for expert witness expenses, which expenses stem from the testimony of Mr. Newell Knight, whom the Court did not rely on for determination of the issues. Note page 371 of the transcript.

Hence, Plaintiff/Appellant respectfully submits that the lower court errored in the granting of costs, first because the Memorandum of Costs was not verified as per the rule, and secondly because the same are not taxable.

CONCLUSION

Plaintiff/Appellant agrees with Judge Sawaya, that this matter is a very simple matter.

Plaintiff/Appellant was not injured coming down the hill, or doing any "skiing", but rather was boarding a lift.

All sides agree on what the standard of care is, and that is the American National Standard Institute, which states with no exception, that you push the button if you think that the skier "might" be in danger.

Whether it be the boys or Mr. Hale, the operater should have pushed the button, but instead fails to do that, and then severely compounds the problem by grabbing the chair, and holding it, until the lift pulls it out of his hands, and slams it into Mr. Hale.

The people in charge at the time of the event criticized the operator for acting negligently, which was unrefuted.

Everyone agrees that the operator did not push the button, and the Court stated that it was convinced that the operator had grabbed the chair and that it struck Mr. Hale with force beyond that of the normal speed.

Mr. Hale has a twelve and one-half percent permanent partial disability and is entitled to be made whole.

Plaintiff/Appellant respectfully submits that the Lower Court errored in holding for the Defendant/Respondent, and awarding them costs.

Plaintiff/Appellant requests that this Court reverse the Lower Court, and remand with instructions to enter judgment for the Plaintiff/Appellant as prayed.

Respectfully submitted this 15th day of June, 1990.

JOHN WALSH
ATTORNEY AT LAW

CERTIFICATE OF DELIVERY

I hereby certify that I caused to be delivered four (4) true and correct copies of the APPELLANT'S BRIEF, by delivering the same to TODD S. WINEGAR, CHRISTENSEN, JENSEN, & POWELL, P.C., ATTORNEYS AT LAW, 510 Clark Leaming Building, 175 South West Temple, Salt Lake City, Utah, 84101, this 15th day of June, 1990.

JOHN WALSH
ATTORNEY AT LAW

American National Standard

for passenger tramways — aerial tramways and lifts, surface lifts, and tows — safety requirements —

ANSI B77.1-1982

american national standards institute, inc.
1430 broadway, new york, new york 10018

ANSI®
B77.1-1982
Revision of
ANSI B77.1-1976
and B77.1a-1978

American National Standard for Passenger Tramways — Aerial Tramways and Lifts, Surface Lifts, and Tows — Safety Requirements —

Secretariat

National Ski Areas Association

Approved July 16, 1982

American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not a part of American National Standard B77.1-1982.)

This standard deals with passenger transportation systems that use cables or ropes in the system for power transmission. These systems include reversible aerial tramways, detachable and fixed grip aerial lifts, surface lifts, and tows.

This standard is a revision of American National Standard Safety Requirements for Aerial Passenger Tramways, ANSI B77.1-1976 and ANSI B77.1a-1978. The format of this edition is different from previous editions, in that each tramway type is covered in its own section. The purpose of this revised format is to separately present the basic requirements for each tramway. Section 1 provides the scope and general definitions for tramways covered in this standard. Section 7 addresses wire rope and strand requirements.

This standard had its inception in 1956. At that time, the industry dealing with recreational passenger transportation had reached such proportions that safeguards were required for the protection of the public and progress of the industry. At the request of the Eastern Ski Area Operators Association, one of the original sponsors of the project, a general conference was held in New York City. As a result of that conference, American National Standards Committee B77, composed of operators, users, authorities having jurisdiction, designers, and manufacturers of aerial tramways, was established to develop safety requirements. The first standard was approved by ANSI on June 8, 1960, and revisions were developed and approved in 1970, 1973, and 1976. This present revision brings the standard up to date with the latest developments in the field.

Because of the diverse nature of the industries that may use this standard, it is recommended that authorities having jurisdiction consider an effective date of one year from the approval date of the standard. The "effective date" of this standard is a criterion selected by the committee and not by the American National Standards Institute.

Suggestions for the improvement of this standard will be welcome. They should be sent to the National Ski Areas Association, P.O. Box 2883, Springfield, Mass. 01101.

This standard was approved for submittal to ANSI by American National Standards Committee on Aerial Passenger Tramways, B77. Committee approval of the standard does not necessarily imply that all the committee members voted for its approval or the approval of every requirement in the standard. At the time it approved this standard, the B77 Committee had the following members:

Stanley Judge, Chairman
Sam Bonasso, Secretary

Organization Represented	*Name of Representative*
American Society of Civil Engineers	James L. Ellis
American Society of Mechanical Engineers	Erwin S. Focht
American Society for Testing and Materials	Don Christianson Harold M. Greenblatt
Association of Recreational Tramway Authorities	(Representation Vacant) Gordon R. Linebaugh (Alt)
Association of Ski Area Consultants	Mel Borgersen
Bethlehem Steel Corporation	Louis A. Stanzione William M. Schwenke (Alt)
Borvig Corporation	Boris Vilhar
CTEC, Inc	Jan W. Leonard
California Division of Occupational Safety and Health	D. A. Swerrie
Canadian Standard Z-24	Robert N. McLellan (nonvoting observer)
Colorado Tramway Safety Board	Richard L. Kasel
Institute of Electrical and Electronics Engineers	John R. Fetcher
International Organization for Transportation by Rope – North American Continental Section	Selden L. Hannah
Jackson Hole Ski Corporation	Bruce L. Nurse

Organization Represented	*Name of Representative*
Kendall Insurance Company	LeRoy W. Schultz
Lift Engineering and Manufacturing Company	Jan Kunczynski
Massachusetts Tramway Safety Board	Channing B. Murdock
Michigan Tramway Safety Board	LaVern O. Trepp
Midwest Ski Areas Association	Walter T. Stopa
Montana Tramway Council	William J. Plummer
National Ski Areas Association	Sepp Gmuender
	Paul G. Karow
National Ski Areas Association Insurance Program	Richard L. Williams
National Ski Patrol System	Harry G. Pollard
New Hampshire Tramway Safety Board	Albert W. Currier
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Pacific Northwest Ski Areas Association	Nelson Bennett
Paulsen Wire Rope Corporation	A. B. Whitlock, Jr
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Norman L. Sothan
T. R. Sowder
Paul Wyss

Contents

American National Standard for Passenger Tramways — Aerial Tramways and Lifts, Surface Lifts, and Tows — Safety Requirements —

1. General Requirements

1.1 Scope. This document establishes a standard for the design, manufacture, construction, operation, and maintenance of passenger tramways. For this standard, passenger tramways include:

(1) Reversible aerial tramways (single and double)

(2) Detachable and fixed grip aerial lifts (gondola lifts, chair lifts, and similar equipment)

(3) Surface lifts (T-bar lifts, J-bar lifts, platter lifts, and similar equipment)

(4) Tows (wire and fiber rope tows)

1.2 Purpose. The purpose of this standard is to develop a system of principles, specifications, and performance criteria that will meet the following objectives:

(1) Reflect the current state of the art of tramway design, operation, and maintenance

(2) Be acceptable for adoption by government agencies and others

It is recognized that certain dangers and risks are inherent in machines of this type and in their operation. This system is intended to result in tramways that are designed, constructed, operated, and maintained in a manner that minimizes danger and exposure to risk to passengers and operators and to encourage improvements in productivity, efficiency, development, and progress consistent with the objectives.

Such a system with these stated objectives constitutes a safety standard.

1.2.1 Other Classifications. Tramway configurations that do not fall within the categories specified in 1.1, but fall within the general category of passenger tramways, should be evaluated by the authority having jurisdiction based upon the design engineer's specifications and the applicable provisions of this standard.

1.2.2 New Materials and Methods for Passenger Tramways. Adoption of technological improvements in materials and advances in techniques is essential to enable the industry to keep pace with progress. If a designer or manufacturer proposes to use materials or methods not covered by this standard, those materials, methods, or both, shall be clearly identified and complete design and test information shall be provided to the purchaser or owner and the authority having jurisdiction (see 1.5).

1.2.3 Exceptions. Strict application of the provisions of this standard may not be appropriate in every instance. Wherever it may be proposed to depart from the provisions of this standard, the authority having jurisdiction may grant exceptions from the literal requirements or permit the use of other devices or methods that provide features comparable to those included in this standard.

1.2.4 Installations

1.2.4.1 Existing Installations. Existing installations and those with design review completed by the authority having jurisdiction prior to the effective date of this standard need not comply with the new or revised requirements of this edition, except where specifically required by the authority having jurisdiction. Existing tramways, when removed or reinstalled, shall be classified as new installations (see 1.2.4.2). A tramway modification shall be defined by and meet the requirements of the authority having jurisdiction. Operation and maintenance shall be in compliance with this standard.

1.2.4.2 New Installations. New installations and those with design review completed by the authority having jurisdiction after the effective date of this standard shall comply with the new or revised requirements of this edition.

1.2.5 Interpretation of Standard. In cases where additional explanation or interpretation of this standard is required, such requests should be referred to Standards Committee B77, the National Ski Areas Association, P.O. Box 2883, Springfield, Mass. 01101.

1.3 Reference to Other Codes and Standards. The design, installation, operation, and maintenance of passenger tramways and their components that are not covered by this standard should conform to standards or codes published by the agencies listed below. Unless otherwise specified, the designer shall select codes or standards of these agencies. To the extent that they are available, applicable codes or standards shall be selected to cover all features, including, but not limited to, allowable unit stresses and properties of materials. Each code or standard should be of the most recent issue, and the designer shall state which code or standard he has followed.

American Association of State Highway and Transportation Officials
American Concrete Institute
American Gear Manufacturers Association
American Institute of Steel Construction
American Institute of Timber Construction
American Insurance Association
American National Standards Institute[1]
American Society for Testing and Materials
American Society of Civil Engineers
American Society of Mechanical Engineers
American Welding Society
Institute of Electrical and Electronics Engineers
National Forest Products Association
Society of Automotive Engineers

Features not covered by this standard, recognized codes, special codes, or regulating requirements shall be handled in accordance with sound engineering judgment to the satisfaction of the authority having jurisdiction.

1.4 Definitions

1.4.1 **Shall and Should.** In this standard, the word "shall" denotes a mandatory requirement, and the word "should," a recommendation.

1.4.2 **Authority Having Jurisdiction.** The phrase "authority having jurisdiction" means any government agency empowered to oversee the design, manufacture, construction, operation, maintenance, and use of passenger tramways. Where no such agency exists, the owner of the tramway shall be considered the authority having jurisdiction.

1.4.3 **Approved.** The word "approved" means "approved by the authority having jurisdiction."

1.4.4 **Passenger Tramways.** Passenger tramways include all devices that carry, pull, or push passengers along a level or inclined path (excluding elevators) by means of a haul rope or other flexible element that is driven by a power unit remaining essentially at a single location.

1.4.4.1 **Reversible Aerial Tramways.** Reversible aerial tramways are those tramways on which the passengers are transported in cable-supported carriers and are not in contact with the ground or snow surface, and in which the carriers reciprocate between terminals.

1.4.4.1.1 **Single-Reversible Tramways.** Single-reversible tramways are those tramways having a single carrier, or single group of carriers, that moves back and forth between terminals on a single path of travel. This type is sometimes called a "to-and-fro" aerial tramway.

1.4.4.1.2 **Double-Reversible Tramways.** Double-reversible tramways are those tramways having two carriers, or two groups of carriers, that oscillate back and forth between terminals on two paths of travel. This type is sometimes called a "jigback" aerial tramway.

1.4.4.2 **Aerial Lifts.** Aerial lifts are those tramways on which passengers are transported in gondolas or on chairs and that circulate between terminals without reversing the travel path.

1.4.4.2.1 **Detachable Grip Lifts.** Detachable grip lifts are aerial lifts on which carriers alternately attach to and detach from a moving haul rope. The tramway system may be monocable or bicable.

1.4.4.2.2 **Fixed Grip Lifts.** Fixed grip lifts are aerial lifts on which carriers remain attached to a haul rope. The tramway system may be either continuous or intermittent circulating, and either monocable or bicable.

1.4.4.3 **Surface Lifts.** Surface lifts are those tramways on which the passengers are propelled by means of a circulating overhead wire rope while remaining in contact with the ground or snow surface. Transportation is limited to one direction. Connection between the passengers and the wire rope is by means of a device attached to and circulating with the haul rope, known as a "towing outfit." Surface lifts include T-bars, J-bars, and platters.

1.4.4.3.1 **T-Bar Lifts.** T-bar lifts are those lifts on which the device between the haul rope and passengers forms the shape of an inverted "T," propelling passengers located on both sides of the stem of the "T."

1.4.4.3.2 **J-Bar Lifts.** J-bar lifts are those lifts on which the device between the haul rope and passenger is in the general form of a "J," propelling a single passenger located on the one side of the stem of the "J."

1.4.4.3.3 **Platter Lifts.** Platter lifts are those lifts on which the device between the haul rope and passenger is a single stem with a platter (or disk) attached to the lower end of the stem, propelling the passenger astride the stem of the platter (or disk).

1.4.4.4 **Tows.**

1.4.4.4.1 **Fiber Rope Tows.** Fiber rope tows are those tramways on which the passengers grasp the circulating fiber rope and are thus propelled while supported by the ground or snow surface. The haul rope

[1] See Section 8 for applicable American National Standards.

remains adjacent to the passenger track at an elevation that permits passengers to maintain their grasp on that rope throughout that portion of the tow length that is designed to be traveled.

1.4.4.4.2 Wire Rope Tows. Wire rope tows are those tramways on which the passengers grasp a handle attached to a circulating wire rope and are propelled by that rope while remaining in contact with the ground or snow surface. The haul rope remains adjacent to the track of the passengers at an elevation that permits them to maintain their grasp on the handle throughout that portion of the tow length that is designed to be traveled.

1.4.5 Monocable and Bicable Systems

1.4.5.1 Monocable System. A monocable system is a system that uses a single haul rope to both support and control motion of the carriers.

1.4.5.2 Bicable System. A bicable system is a system that uses separate cables to support and control motion of the carriers.

1.4.6 Rope and Strand

1.4.6.1 Rope. Unless otherwise specified, the term, "rope," shall mean wire rope, which consists of several strands twisted together. (The terms "rope," "wire rope," and "cable" are interchangeable, except where, by the context, the general term "cable" refers to either a wire rope or strand used as a track cable.)

1.4.6.2 Strand. Unless otherwise specified, the term, "strand," shall mean wire strand, consisting of several wires twisted together (as compared with wire rope, which consists of several strands twisted together).

1.4.7 Fiber Rope. A fiber rope is a stranded or braided rope made from natural or synthetic fibers.

1.4.8 Track Cable Saddle. A track cable saddle is a component designed to directly support a track cable.

1.4.9 Sheaves. Sheaves are pulleys or wheels grooved for rope.

1.4.9.1 Haul Rope Sheaves. Haul rope sheaves are sheaves that support or hold down the haul rope at towers or terminals. (The angle of rope deflection is usually small.)

1.4.9.2 Rollers. Rollers are sheaves of small diameter used to guide or restrain the rope from leaving its proper alignment.

1.4.9.3 Terminal Sheave. A terminal sheave is a haul rope sheave at a terminal that rotates continuously when the haul rope is moving and deflects the haul rope by an angle of 10 degrees or more.

1.4.9.3.1 Deflection Sheave. A deflection sheave is a terminal sheave that deflects the haul rope at least 10 degrees but less than 150 degrees.

1.4.9.3.2 Bull Wheel. A bull wheel is a terminal sheave that deflects the haul rope 150 degrees or more. When under power, the sheave is referred to as a drive sheave (or drive bull wheel); when acting as a movable tensioning device, it is referred to as a tension sheave (or tension bull wheel); and when acting simply as a fixed return for the haul rope, it is referred to as a fixed return sheave (or fixed return bull wheel).

1.4.9.4 Counterweight Sheave. A counterweight sheave is a sheave used in the counterweight roping system that is active during normal operations.

1.4.9.5 Diameter of Sheaves. Wherever the term "diameter" is used in specifying sheaves, it refers to the diameter at the bottom of sheave grooves (tread diameter).

1.4.10 Safety Gate. A safety gate is a type of automatic stopping device that, when actuated by a passenger's weight, contact, or passage, will automatically stop the tramway.

1.4.11 Grips

1.4.11.1 Haul Rope Grips. Haul rope grips are those devices by which carriers are attached to the haul rope.

1.4.11.2 Fixed Grips. Fixed grips are those devices that remain on the haul rope during normal operation.

1.4.11.3 Detachable Grips. Detachable grips are those devices that are removed or detached from the haul rope at stations or terminals during normal operation.

1.4.12 Gondola. A gondola is an enclosed carrier used on an aerial lift.

1.4.13 Chair. A chair is an open or partially enclosed carrier used on an aerial lift.

1.4.14 Capacity

1.4.14.1 Design Capacity. The design capacity is the capacity established by the designer as the optimum operating capability of the equipment in the direction specified.

1.4.14.2 Operational Capacity. The operational capacity is the capacity for which the installation has been tested and approved.

1.4.15 Qualified Engineer. A qualified engineer is an engineer who, by training, or experience, or both, is qualified to design, survey, supervise construction, supervise maintenance, or perform inspections, as the case may require, of tramways, and who meets the requirements of the authority having jurisdiction.

1.4.16 Supervisor. A supervisor is the individual in responsible charge of passenger tramway operations and personnel.

1.4.17 Operator. An operator is the individual in charge of a tramway.

1.4.18 Attendant. An attendant is the individual assigned to particular duties or functions in the operation of a tramway.

1.4.19 Conductor. A conductor is an attendant assigned to duties or functions in an enclosed carrier.

1.4.20 Stops

Chg 1986 1.4.20.1 **Emergency Stop.** An emergency stop is a condition in which the service brake shall be applied and power shall be removed from the prime mover or auxiliary power unit, whichever is in use.

Removing power from the prime mover shall mean:

(1) **Electric Motor.** Automatic, full-load rated mechanical disconnect device operates to shut down the motor.

(2) **Internal Combustion Engine.** Engine shuts down.

1.4.20.2 **Normal Stop.** A normal stop is a condition in which the tramway shall be decelerated and stopped in a smooth controlled fashion.

1.4.21 Overhauling. Overhauling is an operating condition in which unbalanced loading is sufficient to overcome line and drive friction and create a torque, acting to produce rotation of drive sheave in either direction when all brakes and the prime mover are inactive.

2. Reversible Aerial Tramways

This section covers the class of aerial tramways wherein the cable-supported carriers reciprocate between the terminals. The types of tramway usually referred to as "to-and-fro" (single reversible) tramways and "jigback" (double reversible) tramways fall within this class. The former term refers to a tramway wherein a single car or line of cars moves back and forth between the terminals on a single path of travel. The latter term refers to a tramway wherein two cars or two lines of cars oscillate back and forth between the terminals on two paths of travel.

A tramway in this class may be either monocable or bicable. A bicable tramway incorporates standing tracks, usually made of wire cable, on which the carriers ride. A monocable tramway uses a hauling or traction wire rope to support as well as propel the carriers.

2.1 Design and Installation

2.1.1 General

2.1.1.1 **Design Passenger Weight.** For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77 kg).

2.1.1.2 **Location.** In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the lift type and location:

(1) Electric power lines and their supports
(2) Railways
(3) Highways
(4) Structures
(5) Rock and earth slides, cave-ins, washouts, etc
(6) Snow creep and avalanches
(7) Wind action
(8) Icing
(9) Ski slopes and trails
(10) Rivers and gullies
(11) Buried installations, including pipelines
(12) Crossing or close proximity to other aerial tramways
(13) Control of air space below, above, and adjacent to the installation
(14) Carrier height above ground or surface

2.1.1.3 **Width of Clearing.** The clearing shall be wide enough to prevent interference with the tramway by adjacent vegetation. Such clearings shall be protected, if necessary, to avoid washouts that might endanger the installation. Potentially dangerous trees shall be cleared far enough back to avoid their falling on the tramway.

2.1.1.4 **Path of Rope.** Terminals and towers shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration. Clearing shall be accomplished so that cabins or carriers will not come in contact with trees or vegetation during operating surges of the line, or under maximum design wind conditions, or both. In no case shall trees or vegetation extend within 5 feet (1.5 meters) of any portion of the haul or track cable or carrier under normal (nonsurge) operating conditions.

2.1.1.4.1 **Vertical Clearances.** In the deceleration areas at the terminals and intermediate stations, under the most adverse loading conditions, a minimum space of 5 feet (1.5 meters) shall exist between the lower edge of the carrier or ropes and the terrain or other possible obstacles, including snow pack. Whenever the clearance is less than 15 feet (4.5 meters), no surface transportation shall be permitted beneath the tramway. Whenever the clearance is less than 8 feet (2.4 meters), provision shall be made to prevent access to the area beneath the tramway by unauthorized persons.

At any point along the line between the deceleration areas at the terminals and intermediate stations, the minimum distance between the carrier and the design maximum snow depth or other obstacles, under conditions of maximum sag, shall be provided as follows:

(1) 10 feet (3 meters)

(2) 15 feet (4.5 meters) where unauthorized persons have access to the area beneath the lift line

(3) 20 feet (6 meters) where skiing is permitted beneath the lift line

(4) 25 feet (7.6 meters) where public transportation is permitted beneath the lift line

2.1.1.4.2 Horizontal Clearances. The minimum distance between two passing carriers, each swung 10 degrees inward from the vertical, shall be 2 feet 6 inches (0.8 meter) or the following, whichever is greater:

$$0.02\,(X)\,(1 - X/S) \qquad \text{(Eq 1)}$$

where

S = the slope length of the span, in feet (meters)

X = the slope distance, in feet (meters), from the point of the carriers passing to the nearest tower or track rope supporting structure

The distance between haul ropes (or track cables), for the purpose of these checks, shall be considered as equal to the gage of the line.

2.1.1.4.3 Track Cable Saddles (Bicable Systems). Towers and terminals shall be arranged so as to keep the track cable in the saddles under the most adverse operating and nonoperating conditions. These provisions shall not interfere with any track cable movement or any track cable brake operation. Maximum wind velocity and other design limits used for structures under nonoperating conditions and the limiting values intended for operating conditions shall be specified by the designer.

2.1.1.4.4 Haul Rope Sheave Units (Bicable Systems). Haul rope sheave units are generally of the support type. "Depression" or "hold-down" sheave units not covered by this standard shall be subject to the requirements of 1.2.2.

2.1.1.4.5 Fair Leads (Bicable Systems). All line sheave units, including both high- and low-tower roller assemblies, shall be provided with fair leads or guides to accomplish the following:

(1) Permit the unobstructed passage of a carrier gripped to the haul rope, regardless of the position of the haul rope guided by the fair leads, as the carrier approaches the sheave assembly.

(2) Return the haul rope to the sheave groove when it has been lifted in normal operations or for other reasons.

(3) Provide the rope guidance necessary beneath sheave assemblies and adjacent structures to prevent entanglement of the haul rope as it is returned by the carrier to normal operating position from any location it may assume due to deropement or other displacement.

2.1.1.4.6 Intermediate Structures (Bicable Systems). Auxiliary intermediate structures shall be provided to support sheave units as required to maintain a minimum clearance of 8 feet (2.4 meters) between the haul rope and the ground or snow profile.

2.1.1.4.7 Path of Rope Adjustment. Terminals and towers containing provision for change in height of rope or track supports, or both, shall be used only with the approval of the authority having jurisdiction.

2.1.1.5 Capacity and Speed

2.1.1.5.1 Capacity. The maximum design capacity of each carrier in pounds and kilograms shall be posted conspicuously in each carrier and at each loading area. (See also 2.1.1.10(1).)

2.1.1.5.2 Speed. The maximum carrier speed shall be 2000 feet per minute (10.2 meters per second). This speed shall be reduced to a maximum of 800 feet per minute (4.1 meters per second) across towers if track cable saddles permit carriage wheel flanges to contact any part of the saddle or retaining clips, if used. Speed shall also be reduced appropriately when saddle radius introduces a radial acceleration in excess of 6.7 feet (2 meters) per second squared. When there is no conductor in a carrier, the foregoing maximum clear-span speed shall be reduced 25% and the across-tower speeds shall be reduced 30%.

2.1.1.6 Structures and Foundations. All structures and foundations shall be designed and installed in conformance with applicable criteria listed in 1.3. Applied design loads shall consider dead, live, snow, wind, and dynamic loads due to normal operations and for foreseeable abnormal conditions.

Structures and foundations located in snow creep areas shall be designed for such conditions and loads or be protected by snow breakers or shears.

2.1.1.6.1 Structures. When bolted to foundations, structures shall be bolted with double nuts, lock nuts, or equivalent means of locking nuts.

On bicable systems, torsional displacement of towers under the most adverse conditions shall be limited to a value that will not cause deropement of the track cable from the saddle.

2.1.1.6.2 Foundations. In determining the resistance of earth to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage should be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on solid rock. Foundations on rock shall be firmly anchored to solid rock unless designed as gravity foundations.

The top of concrete shall be not less than 6 inches (15 cm) above finished grade unless specific direction for protection of foundation and structural steel below grade is provided by the designer.

The design of the foundation shall incorporate a factor of safety of 2 in resisting overturning and, concurrently, 2 against sliding, under dead load and live load conditions; the factor shall be reduced to 1.5 under the dead and live loadings plus wind acting simultaneously.

2.1.1.7 Communications. A permanently installed two-way voice communication system shall be provided between the prime mover and auxiliary power unit control point, drive machinery building, loading stations, and unloading stations. The power for this system shall be independent of the primary power and the communication system shall be functional and audible during a power failure.

Audio indicators (bells, etc) shall be audible over all ambient noise levels, and visual indicators (e.g., LEDs) shall be visible even in bright sunlight.

An additional system of two-way voice communication from operating room to all carriers and to opposite terminal platform shall be provided where carriers are attended by a conductor.

2.1.1.8 Internal Combustion Engine Installation

2.1.1.8.1 Fuel Storage. Fuel tanks shall be of adequate capacity to permit uninterrupted operation during the normal operating period. Where internal combustion engines are located in weatherproof equipment rooms or buildings, fuel tanks shall be located at least 5 feet (1 5 meters) from the outside of the rooms or buildings for surface tanks or in an underground installation. The fill pipe shall be capped and locked, and located to avoid toxic fumes and fire hazard during refueling. Stopcocks shall be provided on fuel lines at points where the lines enter the building in underground installations or where the lines leave the tanks for aboveground installations.

Integrally mounted fuel tanks are permissible on auxiliary engines located in other than weathertight rooms.

In all respects, the installation shall comply with American National Standard for Stationary Combustion Engines and Gas Turbines, ANSI/NFPA 37-1979.

NOTE: Integrally mounted steel fuel tanks may be located within or beneath weathertight buildings supported on, or enclosing, combined drive-tension carriages, provided that the end of the fill pipe is located beyond the sides of the building, has a locked fill cap, and is in such a location as to avoid toxic fumes and fire hazard during refueling.

Liquid fuels shall be stored and handled in accordance with American National Standard Flammable and Combustible Liquids Code, ANSI/NFPA 30-1981 and ANSI/NFPA 37-1979. Liquefied petroleum gas installations shall be made in accordance with American National Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58-1979.

2.1.1.8.2 Exhaust Systems. Exhausts shall be designed and installed to discharge to the atmosphere so that precipitation does not enter the system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields.

2.1.1.8.3 Gear Shifts. Where gear shift levers are used, provisions shall be made to prevent accidental shifting of levers into speed ratios exceeding design or accidentally into reverse gear during public operation. Gears of manual transmissions shall not be shifted when the lift is moving.

2.1.1.9 Loading and Unloading Areas. Platforms, ramps, and related units comprising the loading and unloading areas are integrally related to safe operation. They shall be designed and installed in conformance with applicable criteria listed in 1.3.

Platforms shall be provided with sufficient space to accommodate passengers waiting to embark and passengers disembarking the carriers. Provisions shall be made for separation of incoming and outgoing passengers. Railing shall be provided to guide passengers safely to and from the carriers. The platforms should be as level as possible. Steps should be avoided, where possible.

Guide rails with curved ends shall be provided so that entrance and exit of carriers to and from the platforms can be accomplished smoothly and with minimum impact when carriers are deflected from the vertical 10 degrees laterally and, simultaneously, 10 degrees longitudinally.

2.1.1.10 Signs. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point (see 2.3.6). All such signs shall be prominently placed, and those pertaining to the tramway operations shall be adequately lighted for night operation.

Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons and locked.

The sign "Men Working on Lift" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the auxiliary or prime mover when men are working on the passenger tramway. See 2.1.1.13 for additional requirements.

The following information shall be prominently posted on the interior of each carrier:

(1) The maximum capacity of each carrier in pounds and kilograms and number of passengers. (This shall also be posted at each loading area.)

(2) Instructions for procedure in emergencies.

2.1.1.11 Evacuation. Aerial tramways shall be provided with approved means to evacuate passengers from stranded carriers. Where the tramway passes over terrain to which access by foot is difficult, or where cabin height makes descent by escape rope impractical, an independently driven rescue system shall be installed. Where the tramway passes over terrain easily accessible by foot, escape by rope and winch directly from the cabin shall be permitted. Where this method is adopted, this escape apparatus shall be carried in the cabin at all times. Emergency electrical lighting facilities shall be provided to accommodate all evacuation conditions.

All nonmetallic rope used for evacuation shall be of synthetic polyester fiber, such as Dacron or equal, or of a hard lay nylon with a minimum diameter of 7/16 inch (11 mm) and a minimum breaking strength, when new, of 5000 pounds (2268 kg). No natural fiber or polypropylene ropes shall be used.

These ropes shall be carefully stored when not in use and shall be examined after each complete lift evacuation and prior to each season of operation, both summer and winter, to ascertain that they are in satisfactory condition.

Carabiners, if used, shall be of the locking type.

2.1.1.12 Tests and Inspection

Chg 1988 **2.1.1.12.1 Acceptance Tests and Inspection.** Before a new or relocated aerial tramway is opened to the public, it shall be given thorough inspection and tests by qualified personnel to verify compliance with the plans and specifications of the designer. The designer or manufacturer shall propose and submit a load test procedure.

It shall be the responsibility of the owner to see that the following conditions have been met:

(1) Tightness of all structural connections

(2) Lubrication of all moving parts

(3) Alignment and clearances of all open gearing

(4) Installation and alignment of all drive components

(5) Position and freedom of movement of counterweights or other tensioning means and carriages

(6) Haul rope alignment at entrance to bull wheels

(7) Operation of all electrical components, including circuit protection and grounding

2.1.1.12.2 Reversible Aerial Tramway Inspection. Inspection of a reversible aerial tramway shall also cover:

(1) Track cable and haul rope sags under the most adverse static loadings.

(2) Alignment of track cable saddles and haul rope sheave units.

(3) Evacuation equipment and procedures, including an actual test at the most difficult location.

(4) Towers and terminals, for correct location and installation in accordance with plans and specifications. Terminal and tower cable working points shall be documented by an "as built" survey, and any variation from the design drawings shall be noted and approved by the engineer responsible for design.

(5) Thorough operating tests under full loading and any partial loadings that may provide the most adverse operating conditions. Test load per carrier shall be 110% of the design live load. The functioning of all push-button stops, automatic stops, limit switches, selected deropement switches, and communications shall be checked. Acceleration and deceleration rates shall be satisfactory under all loadings (see 2.1.2.4). Motive power and all braking (see 2.1.2.5) shall be proved adequate under the most adverse loadings. The tests shall include at least 6 hours of continuous operation with empty carriers to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tensioning systems, and other related defects.

2.1.1.13 Safety of Operating and Maintenance Personnel. Provision shall be incorporated in the tramway design to render the system inoperable when necessary for the protection of personnel working on the tramway. See 2.1.1.10 for placement of applicable warning signs.

2.1.2 Terminals and Stations

2.1.2.1 Power Units

2.1.2.1.1 Prime Mover. All prime movers shall have capacity to handle the most unfavorable design loading conditions, including the starting of a fully loaded tramway.

Where manual multispeed transmissions are used on either the prime mover or auxiliary power unit, gears shall not be shifted when the tramway is moving.

Where reverse capability is provided on the prime mover or auxiliary power unit for any tramway, provisions shall also be made to prevent accidentally shifting into reverse whenever the tramway is operating.

2.1.2.1.2 Auxiliary Power Unit. An auxiliary power unit with an independent power source shall be provided that can be readily used to move the carrier(s) to a terminal in the event of failure of the primary power unit. A single auxiliary power unit shall not be used except to unload passengers and for maintenance purposes. The auxiliary engine shall not depend upon the mechanical integrity of the prime mover to drive the unit.

2.1.2.2 Speed Reducers and Gearing. All speed reducers and gearing shall have the capacity for starting a tramway under the most unfavorable design loading conditions and without exceeding design rating. They shall have a service factor appropriate for the application, and they shall comply with the following standards of the American Gear Manufacturers Association (AGMA),[2] as applicable:

Surface Durability (Pitting) of Spur Gear Teeth, AGMA 210.02, 1965

Surface Durability (Pitting) Formulas for Straight Bevel and Zerol Bevel Gear Teeth, AGMA 212.02, 1964 (R1974)

Information Sheet for Surface Durability (Pitting) of Spur, Helical, Herringbone and Bevel Gear Teeth, AGMA 215.01, 1966 (R1974)

Design Practice Rating for Surface Durability of Spiral Bevel Gears for Enclosed Drives, AGMA 216.01A, 1966

Rating the Strength of Spur Gear Teeth, AGMA 220.02, 1966

Rating the Strength of Helical and Herringbone Gear Teeth, AGMA 221.02, 1965

Rating the Strength of Straight Bevel and Zerol Bevel Gear Teeth, AGMA 222.02, 1964

Rating the Strength of Spiral Bevel Gears for Enclosed Drives, AGMA 223.01A, 1966

Practice for Enclosed Speed Reducers or Increasers Using Spur, Helical, Herringbone and Spiral Bevel Gears, AGMA 420.04, 1975

Practice for Gearmotors Using Spur, Helical, Herringbone and Spiral Bevel Gears, AGMA 460.05, 1971

Practice for Spur, Helical and Herringbone Gear Shaft-Mounted Speed Reducers, AGMA 480.06, 1977

2.1.2.3 Bearings, Clutches, Couplings, and Shafting. Bearings, clutches, and couplings shall be selected on the basis of the manufacturer's published recommendations for the particular use. If published data are not available for the specific use, the manufacturer's approval shall be obtained. Bearings, clutches, and couplings of special design should have the approval of a qualified mechanical engineer.

Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings, when required.

All shafting shall be designed in accordance with accepted standard practices.

2.1.2.4 Acceleration and Speed Control. Acceleration and speed controls are prime considerations for this type of tramway in order to avoid discomfort to the passengers caused by undue longitudinal swinging of the carrier or by excessive acceleration or deceleration, and in order to start and stop the carriers smoothly and safely.

In addition, the following requirements shall be incorporated in the design:

(1) Provision shall be made for smooth deceleration of the tramway prior to the actuation of one of the automatic drive terminal brakes described in 2.1.2.5. The operation of the drive sheave brake or track cable brake shall not result in deceleration exceeding 7 feet (2.1 meters) per second squared under the most adverse design conditions.

(2) Carrier(s) shall be brought to a stop for loading and unloading, and provision shall be made to keep the carrier(s) stationary during loading and unloading periods. The control room shall contain, in full view of the operator, indicators that will show the location of the carrier(s) at all times. The lift is to be started at its lowest point of speed range after any type of stop.

(3) Provision shall be made for an overhauling load so that the system shall always operate at a controlled speed not exceeding design speed by more than 6%. The energy developed by the overhauling load shall be dissipated in a satisfactory manner without using the brakes specified under 2.1.2.5.

2.1.2.5 Brakes. All braking systems shall be capable of operation to comply with daily inspection required by 2.3.2.4.3(4). Emergency brake controls shall be located and the brake activated in a manner that deceleration will begin within 3 seconds after the operator or attendant reacts to the stimulus to apply the brake. Stopping distances and deceleration rates specified for service and emergency brakes are measures of braking capability and are intended for the brake under maximum loading and without assistance from other braking devices or regenerative braking from the drive or other devices.

Each reversible aerial tramway shall have the brakes designated in 2.1.2.5.1 through 2.1.2.5.3.

2.1.2.5.1 Service Brake. An automatic brake shall stop and hold the tramway system under maximum load when power is shut off or when the tramway is stopped for any reason. This brake shall be applied to a drive shaft so that there is no clutch, or similar device, between the brake and the drive sheave.

The brake shall be automatically applied by springs, weights, or other approved forms of stored energy. In all cases, the brake shall be normally in the applied position. It shall be held open for operation of the tramway by a device that is automatically cut out when power is shut off or the tramway is stopped. This device shall be placed in operation before the

[2] Available from American Gear Manufacturers Association, Standards Department, 1901 North Fort Myer Drive, Arlington, VA 22209.

tramway is started. This brake shall decelerate the tramway at a minimum rate of 1 foot (0.3 meter) per second squared when operating under the most unfavorable condition of overhauling load and at full speed.

2.1.2.5.2 Overspeed Device. If the speed of the tramway can exceed the rated speed by more than 10%, an automatic overspeed device shall be provided that will interrupt the power to the prime mover and actuate the service brake or a similar independent brake.

2.1.2.5.3 Emergency Brake. An emergency brake shall be located on the main drive sheave with controls within reach of the operating attendant. It shall be applied automatically if the speed of the haul rope exceeds the design speed by more than 15% or if the carriers travel beyond their stopping position in either terminal.

Actuation of this brake shall be automatic and the braking force applied by springs, weights, or other approved forms of stored energy. This brake shall stop the tramway at a maximum deceleration rate of 7 feet (2.1 meters) per second squared. It shall have capability to decelerate a tramway operating at full speed and under the most unfavorable condition of overhauling load at 1.5 feet (0.5 meter) per second squared.

A qualified engineer shall furnish a written procedure to be followed and specify the auxiliary equipment necessary for periodic testing and adjustment of the holding power of the emergency brake on the drive sheave. Such testing shall be accomplished as part of normal maintenance during the operating season, but shall be performed when the tramway is not open to the public.

2.1.2.6 Location of Machinery

2.1.2.6.1 General. Moving machine parts that normally may be in reach of personnel shall be fitted with safety guards conforming to American National Standard Safety Standard for Mechanical Power Transmission Apparatus, ANSI B15.1-1972.

Protection against static electricity shall be provided. Fire-fighting device(s) shall be available.

2.1.2.6.2 Machinery Not Housed in a Machine Room. Provisions shall be made to keep the public away from the machinery. All power units, all components of the drive train, and all safety devices, such as backstops, brakes, relays, and the like, shall be protected from the weather.

2.1.2.6.3 Machinery Housed in a Machine Room. The machine room shall be well-ventilated. It shall have a permanently installed lighting system, adequate for proper machinery maintenance and safety of operating personnel. The arrangement of the machinery shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (46 cm) shall be maintained. Means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

2.1.2.7 Sheaves in Terminals and Stations

2.1.2.7.1 General. All sheaves, including their mountings and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers of the bearings.

When unlined sheave grooves are used for wire rope, they should be V-shaped and shall have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

2.1.2.7.2 Haul Rope Terminal Sheaves (Bull Wheels and Deflection Sheaves). Haul rope terminal sheave frames shall be designed to retain the rope in the event of the failure of a sheave, shaft, or mounting. In instances where the sheave is cantilevered, the design working stresses shall be not more than 60% of those otherwise allowable.

The minimum diameter of the terminal sheaves shall be 72 times the nominal diameter of the haul rope, provided that no gripping device passes around the sheave. The minimum diameter of the terminal sheaves shall be 96 times the nominal diameter of the haul rope, in cases where gripping devices pass around the sheave. The sheave assembly shall be designed to retain the haul rope in the event of a deropement from the sheave. A flange extension of 1-1/2 times the rope diameter (measured from the bottom of the rope groove) shall be deemed adequate for retention when the provisions of 2.1.2.7.4 are fully complied with.

Haul rope terminal sheaves that act as driving, braking, or holding sheaves shall be so designed that the haul rope does not slip in the sheave groove. The design coefficient of friction for a particular sheave liner shall not exceed the following values:

Sheave Liner	*Coefficient of Friction*
Steel or cast iron grooves	0.070
Leather	0.150
Rubber, neoprene, or others	0.205

2.1.2.7.3 Counterweight Rope Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard. The minimum diameters for these sheaves shall be as indicated in Table 2-1.

Condition A is applicable where rope bending around sheaves is of major importance. This condition shall be used as a minimum design criterion for track cable counterweight ropes.

Condition B is applicable where rope bending around sheaves is important, but some sacrifice in rope life is acceptable to achieve reduction in weight, economy in design, etc.

Condition C is applicable to sheaves that should not rotate due to any tension sheave movement but should rotate only due to counterweight adjustment.

In the case of a locked coil track cable passing over a sheave or roller chain and connected directly to a counterweight, the radius of curvature of the sheave or the roller chain shall not be less than 100 times the cable diameter or 1200 times the greater dimension of the cross section of the largest wire of the cable, whichever is greater.

Provisions shall be made to assure that all counterweight sheaves rotate freely.

Table 2-1
Minimum Diameters for Counterweight Ropes Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard

	Sheave Diameter		
Rope Type	Condition A	Condition B	Condition C
6 × 7	72*d*	42*d*	24*d*
6 × 19	45*d*	**30*d***	20*d*
6 × 37	27*d*	**18*d***	12*d*

NOTE: *d* equals the nominal rope diameter.

2.1.2.7.4 Haul Rope Line Sheaves. The requirements of 2.1.3.3 are applicable to haul rope line sheaves used in terminals and stations, with the following exceptions:

(1) Sheaves that carry no load other than the weight of the rope and carriers

(2) Sheaves that are located in such a way that the weight of carriers is either wholly or partially supported on tracks or by other means

(3) Sheaves that are located in such a way that carriers attached to the cable are not passing onto the sheaves

In such cases, the design shall be modified to meet the requirements of the particular installation.

2.1.2.8 Tension Sheave Carriages. The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion under normal operation.

2.1.2.8.1 Rigid-Mounted Carriages. For all carriage arrangements other than those whose motion is vertical, the mounting that travels under the action of the counterweight shall be supported on rigid straight rails by means of wheels.

2.1.2.8.2 Rigid-Mounted Carriages with Vertical Motion. For carriage arrangements with vertical motion, guides shall be provided for the carriages.

2.1.2.9 Counterweight and Tensioning Systems

2.1.2.9.1 Counterweights. Counterweights or other suitable devices shall be provided to determine and regulate the tension of all haul ropes. Counterweights, when used, shall be arranged to move freely up and down. Enclosures for counterweights shall be provided where necessary to prevent snow or ice from accumulating under and around the counterweights and intefering with their free movement. When a counterweight is contained in a structural frame, guides shall be provided to protect the frame and to ensure free movement of the counterweight. Where snow enclosures are not required, guardrails or enclosures shall be provided to prevent unauthorized persons from coming in contact with or passing under counterweights.

The counterweight, or other suitable device, shall have sufficient travel to take care of all normal operating changes in loading and temperature. Counterweights, if used, shall determine and regulate the tension during all operating periods. Where counterweights or other devices are used for track cables, the same provisions shall apply.

Friction and other forces developed in the tension system composed of the movable carriage, counterweight sheaves, reeving, and guide system shall be included in calculating haul rope tension for all conditions of loading. Carriage and counterweight movement shall be evident in normal operation or the resistance to movement shall be measured and its magnitude approved by the engineer responsible for design.

Chg 1988 **2.1.2.9.2 Counterweight Ropes.** Counterweight ropes shall have a minimum factor of safety of 6, when new. The factor of safety is equal to the nominal breaking strength of the rope (see 7.1.3) divided by the maximum static design tension. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account shall be the basis for determining factor of safety.

Counterweight ropes shall be adjusted so that the counterweight will reach the end of its travel before the attached tension sheave carriage comes within 6 inches (15 cm) of the end of its travel.

See 7.3 for additional requirements.

2.1.2.10 Anchoring Devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion. The diameter of a drum for track cable anchorage shall be not less than 65 times the cable diameter or 600 times the greatest cross-sectional dimension of the outside wire diameter; cable shall be secured with a minimum of three wraps on the bollard and two clamps (see 2.1.2.7.3).

Sections of ropes bent around thimbles, sheaves, or other anchorage devices not meeting the minimum diameters specified by Condition C in 2.1.2.7.3, or permanently deformed or damaged sections, shall not be relocated or reused as a part of the section under load.

Wire ropes or strands, and their connections, used to anchor, tension, or otherwise secure terminal structures, shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

2.1.2.11 Manual and Automatic Stops. All stop circuits and switches shall conform to the requirements of 2.2.1.7.

2.1.2.11.1 Manual Stop Devices. The following manual stop devices shall be installed and be conspicuously and permanently marked:

(1) A stop device at each terminal platform

(2) A stop device on the conductor's control console in each carrier when a conductor is required in the carrier (see 2.1.4.4.2(1))

(3) A stop device at the operator's station

2.1.2.11.2 Automatic Stop Devices. The following automatic stop devices shall be installed:

(1) A device(s) that will be actuated in the event manual or automatic controls fail to reduce tramway speeds to design values at critical control points along the line.

(2) A device(s) that will stop the tramway before the carrier reaches its limit of travel. An adequate bumper system shall also be installed.

(3) A device(s) that will stop the tramway before any counterweight, other tensioning device, or tension sheave carriage reaches either end of its travel or when the tensioning system exceeds its range of normal operating travel. When pneumatic or hydraulic tensioning systems are used, pressure sensing devices shall also be incorporated that will stop the tramway system in case the operating pressure goes outside the design pressure range. Such pressure sensing devices shall be located close to the actual tensioning device. It shall not be possible to isolate the pressure sensor from the actual tensioning device.

(4) A device(s) that will be actuated by the application of a track cable brake. These devices shall activate both the service and emergency brakes.

(5) A device(s) that will stop the tramway in the event a carrier door is not closed.

2.1.3 Line Structures

2.1.3.1 Towers. The design of the tower structure and foundation shall be in accordance with the requirements of 2.1.1.6. Where guyed towers are used and guys intersect the ground within or near ski runs, the guys shall be marked for visibility, preferably with boards painted with black and yellow stripes.

Means shall be provided for ready access from the ground to all tower tops. This requirement will be fulfilled if the tower structure is safe to climb. Otherwise, means such as permanent ladders or light, portable ladders shall be provided. The latter, if used, shall be in at least sufficient quantity to be available at each point where attendants are stationed.

Towers shall be identified with successive numbers clearly visible when looking up the tramway line.

2.1.3.2 Guards and Clearances. Suitable guards shall be provided to prevent the carriers from contacting intermediate towers or other fixed objects.

On bicable tramways with track rope brakes, the guards shall be designed to limit swing to that permitted by the relationship between brake and saddle. If open windows are used on the tower side, a clearance of at least 18 inches (46 cm) shall be maintained at the window height when the carrier is swung inward the maximum amount permitted by the design.

On unattended carriers, the windows on the tower side shall be kept closed or screened.

2.1.3.3 Haul Rope Sheaves and Mounts

NOTE: The requirements in 2.1.3.3 and 2.1.3.3.1 through 2.1.3.3.3 apply generally to sheaves that support or hold down the haul rope at towers on a monocable system, but where applicable shall also apply to the haul rope of a bicable system. These requirements shall apply to both sides of each tramway.

The diameter of a haul rope sheave shall be not less than 10 times the nominal diameter of the haul rope for metallic sheaves or 8 times for sheaves with elastomer treads.

2.1.3.3.1 Maximum Allowable Sheave Load. The maximum allowable load per sheave should be determined by the tramway designer.

2.1.3.3.2 Sheave and Sheave Unit Design. Sheave flanges shall be as deep as possible, considering other features of the system. At the same time, rope grips shall be designed in relation to the sheave groove so as not to contact sheave flanges during normal operations, taking into consideration the anticipated amount of wear of the sheave liner groove. Grips shall be allowed to contact sheave flanges adjacent to the haul rope when the carrier swings, provided that this is considered in the design of grips and sheaves. Furthermore, rope grips, sheave flanges, and hanger guides shall be designed so that hangers cannot be caught behind guides, and so that ropes and grips cannot be deroped from sheaves if the carrier is swinging within design limits as it approaches or passes the tower.

Suitable guards of sufficient strength to resist the lateral forces caused by deropement shall be installed to prevent the rope from falling into a dangerous position within the tower structure.

Construction of the entire sheave unit shall be such that the rope cannot become entangled in the sheave unit in the event the rope leaves the sheave toward the outside.

On each sheave unit, rope-catching devices shall be installed to prevent the rope from moving excessively in the direction of the load on the sheave unit in the event of deropement. These devices shall be located less than one-half the diameter of the sheaves from the normal operating position of the rope and shall extend a minimum of two rope diameters beyond the sheave flange. They shall be designed to permit the passage of the rope and grips after deropement.

On each sheave unit, suitable deropement switch devices shall be installed and maintained that will stop the lift in case of deropement.

If the gage of the haul rope system is varied at any point along the line, the horizontal departure at any one tower shall be provided for in the design, so that deropement cannot occur by virtue of such a departure.

Sheave mounts or mounting frames shall be designed to be adjustable, allowing the sheave units to be aligned and held in the plane of the rope.

See also 2.1.1.4–2.1.1.4.7 for effect of tower height and location on sheave units.

2.1.3.3.3 Haul Rope Retention. Provisions shall be made to retain the haul rope in the line sheave groove under all anticipated conditions of loading. This criterion will be met if any of the following conditions is fulfilled:

(1) Condition A: Under the most adverse design loading conditions (excluding dynamic effects), the minimum load of the haul rope on a group of support sheaves at a tower shall be not less than the largest of the following values: 100 pounds (45 kg) per sheave; or 300 pounds (136 kg) per tower group; or a value in pounds equal to two-thirds the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to the sum of the adjacent span lengths expressed in meters of slope length).

When cable elevation at the tower in question lies below a straight line joining cable elevations at the adjacent tower, the haul rope shall not leave the group of sheaves under either of the following conditions:

(a) When the haul rope tension is 1.5 times its maximum design value at the point, using unloaded carriers in adjacent spans or with no carriers in adjacent spans.

(b) When a rope is under tension of the counterweight alone (bare rope) or with any arrangement or number of empty carriers on the line.

The minimum load of the haul rope on a group of hold-down sheaves at a tower under the most adverse loading conditions shall be not less than the larger of the following values: a value in pounds (kilograms) equal to the dead plus live load of the carrier or a value in pounds equal to the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to 1.5 the sum of the adjacent span lengths expressed in meters of slope length). In no case shall this load be less than 225 pounds (102 kg) per passenger.

(2) Condition B: Combination sheave units that incorporate support and hold-down sheaves shall be designed with the retaining sheaves always in contact with the haul rope. When retaining sheaves are mounted to deflect, to allow passage of a carrier grip, such deflection shall not occur until the sheave is loaded to one-half of the maximum design sheave loading. The retaining sheaves shall have the same maximum design loading as the other support or hold-down sheaves on the tower. If the design satisfies loading requirements in Condition A, nothing in this paragraph shall preclude the use of rollers or guides opposite the tower sheaves that do not necessarily contact the rope.

(3) Condition C: For line structures where the carrier is either wholly or partially supported or depressed on tracks or by other means, in lieu of retaining the haul rope in the sheave groove, the following design criteria shall be fulfilled without exceeding the maximum allowable loads:

Under the most adverse loading conditions, the load of the carrier onto the track when fully engaged shall be not less than the largest of the following values: 450 pounds (205 kg), the design gross load per carrier, or a value in pounds equal to two-thirds of the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to the sum of the adjacent span lengths expressed in meters of slope length).

The carrier shall not leave the track if the design cable tension is increased by 50% or decreased by 33%.

2.1.3.4 Track Cable Saddles and Mounts. The radius of a track cable saddle shall be determined by the one of the following criteria that requires the largest radius:

(1) That it be large enough to minimize bending stresses in the cable. In any event, the radius shall be equal to at least 1200 times the largest dimension of the outer wire of the cable.

(2) That it be large enough to provide smooth transition of the carrier trucks from span to span.

(3) That it be large enough to reduce the bearing pressure to a value that will permit proper lubrication of the cable to facilitate sliding in the saddle groove.

(4) That it be large enough so that the radial acceleration of the carrier is not greater than 6.7 feet (2.0 meters) per second squared calculated as follows:

V^2/R is not greater than 6.7 feet (2.0 meters) per second squared

where
V = Carrier speed in feet per second
R = Radius of shoe in feet

The minimum pressure on the saddle shoes shall be not less than 1.5 times the pressure required to hold the rope in contact with the shoes when a wind force of 6 pounds per square foot (287 newtons per square meter) is applied upwards on the rope, parallel to the reaction on the tower.

The saddle shall be long enough to ensure that under maximum loading conditions the cable will not come into contact with the end of the saddle groove.

Saddles shall be designed so that the track cable brake, if any, may function at the time the carrier is passing the saddle without derailment of the trucks.

Saddles shall permit free passage of the carrier trucks even when the carrier is swinging laterally to its design limit as it approaches or passes the tower.

If the gage of the tramway is varied at any point along the line, horizontal departure at any one tower shall be kept to a minimum to avoid derailment of the carrier trucks as they pass over the saddle.

See also 2.1.1.4–2.1.1.4.7 for the effect of height and location of towers on saddles.

2.1.4 Line Equipment

2.1.4.1 Haul Rope. See Section 7 for basic wire rope design and installation requirements.

2.1.4.1.1 Factor of Safety. Haul ropes shall have a minimum static factor of safety of 5, when new. Static factor of safety is equal to the nominal breaking strength (see 7.1.3) divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

2.1.4.1.2 Factor of Safety for Spliced Haul Rope with an Independent Wire Rope Center. Where a spliced haul rope with an independent wire rope center is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

2.1.4.2 Track Cable. See Section 7 for basic requirements for all track cables. Track cables consisting of one strand made up entirely of round wires (commonly called "Smooth Coil Track Strand") shall not be permitted. Wire rope, if used as track cables, shall have an independent wire rope or strand center.

2.1.4.2.1 Factor of Safety. Track cables shall have a minimum static factor of safety of 3 and a minimum dynamic factor of safety of 2.5, when new. Dynamic loads shall include the load imposed upon the track cable due to application of track cable brakes.

2.1.4.2.2 Track Strand Installation. *Track strand is easily damaged.* The designer of the tramway shall provide detailed information concerning handling and installation of the track strand. These instructions shall be consistent with the track strand manufacturer's recommendations. Any handling after installation shall be in accordance with this advice.

2.1.4.3 Track Cable Trucks (Bicable Systems)

2.1.4.3.1 Wheels. On bicable systems, the weight of the loaded carrier and haulage rope reactions shall be distributed to carriage wheels so that the load on any wheel shall not exceed that recommended for the track cable or the wheel liner material for the wheel diameter selected. In no event shall the load per wheel exceed 1/80 of the minimum design tension in the track cable when track strand is used with unlined sheaves or 1/60 with resilient liner material. If wire rope is used as a track cable, the load per wheel shall not exceed 1/40 of the minimum design tension in the track cable.

The carriage shall be equipped with a device that will, as far as possible, hold the carriage on the track cable should the wheels derail. In areas where icing conditions may exist, the carriage shall be equipped with ice scraping devices that cannot contact the track cable under normal anticipated operating conditions.

2.1.4.3.2 Track Cable Brakes. Each carrier on a reversible aerial tramway using the bicable system shall be equipped with a brake that will grip the track cable. The brake shall be capable of stopping and holding a fully loaded carrier at the point of maximum gradient of the track cables.

The brake shall function automatically in case of a haul rope failure. It shall be capable of being manually applied by the carrier conductor. The track cable brake shall provide smooth stops without damage to the track cable, carrier, or structures, under all design conditions and shall conform to the requirements of 2.1.1.4.3. Application of the track cable brake shall automatically disconnect or stop the primer mover.

The track cable brake may be omitted if two or more haul ropes are used, or if the profile of the tramway is such that an uncontrolled carrier will not reach abnormal speeds or crash into a terminal.

2.1.4.4 Carriers. The carrier and all components shall be designed by qualified engineers in accordance with accepted practices of design. If the design has not had prior successful use for passenger transportation, its adequacy shall be verified by test loadings, trial operations, and tests under repeated loadings.

2.1.4.4.1 Hanger. The hanger shall be securely attached to the track cable trucks or haul rope grip and to the cabin in such a manner that it cannot work loose. Haul rope grips if used shall conform to the requirements of 4.1.4.2 and 4.3.3.1.1.

The hanger shall be of sufficient length vertically that under the worst condition of longitudinal swing the top of the cabin cannot strike the haul rope, the track cables, or the bottom of a tower saddle. In any event, the carrier must be able to swing longitudinally without interference to an angle of 15 degrees from the vertical at the most adverse locations.

The hanger shall be equipped, in the proximity of the carriage, with a chair or platform that can be attached for the inspection of the carriage or of the ropes.

Sway dampers designed to reduce the longitudinal sway of the carrier shall be used if recommended by the tramway designer. Where used, they shall operate smoothly and without danger of deropement of the track cable trucks or the haul rope.

2.1.4.4.2 Cabin. Enclosed passenger cabins shall be ventilated. They shall be equipped with doors that fill the entire entrance opening. Each door shall be provided with a lock located in such a manner that it can be unlocked only by authorized persons or by automatic means.

All windows shall be of shatterproof material.

Means of emergency evacuation of passengers shall be provided. For cabins having a capacity of more than six passengers, the evacuation equipment shall be located in the carrier.

The maximum capacity of each cabin, both in pounds and kilograms and in the number of passengers, shall be posted in a conspicuous place in each cabin.

(1) Each carrier having a capacity of seven or more passengers shall be served by a conductor.

(2) Cabin floor space available to passengers shall be not less than 2.5 square feet (0.23 square meter) per person for the first 15 passengers and 2.0 square feet (0.19 square meter) per passenger thereafter.

A cabin door key shall be placed under glass, posted to prohibit use except under specified emergency conditions.

(3) Other configurations. Open and semiopen carriers shall be considered special types and shall meet applicable requirements for gondola or open carriers.

2.1.5 Provisions for Operating Personnel. Operator and attendant stations shall be located to provide visual surveillance of the line and station. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed: (1) the communications and controls required of the station, (2) the operating instructions and emergency procedures, and (3) a fire extinguisher. This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry.

The operator shall be located where he/she can observe the tramway in operation. The operator's controls and communicating devices shall be within reach without leaving his/her position.

2.1.6 Operational and Maintenance Manuals

2.1.6.1 Operational Manual. The designer of each tramway shall prepare an operational manual for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

2.1.6.2 Maintenance Manual. The designer of each tramway shall prepare a maintenance manual for each installation. The manual shall describe recommended maintenance procedures, including:

(1) Types of lubricants required and frequency of application

(2) Definitions and measurements to determine excessive wear

(3) Recommended frequency of service to specific components

2.2 Electrical Design and Installation

2.2.1 General Design and Installation Testing. Prior to operation of newly installed tramways or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this standard and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), or solenoid or relay noise at levels and frequencies that could initiate loss of control.

2.2.1.1 Applicable Codes. All electrical systems shall comply with American National Standard National Electrical Code, ANSI/NFPA 70-1981 and American National Standard National Electrical Safety Code, ANSI C2-1981.

2.2.1.2 Location. All electrical power transmission wiring located near or proposed to cross over tramways shall comply with the applicable requirements of ANSI C2-1981.

2.2.1.3 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

2.2.1.4 Voltage Limitations for Overhead Circuits. Signal, communication, and control circuits may be supported between the towers that support the tramway. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

2.2.1.5 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

2.2.1.5.1 Control Wiring Classification. All control wiring shall be Class 1 in accordance with Article 725 Parts A and B of ANSI/NFPA 70-1981.

2.2.1.5.2 Communication Wiring. All communication wiring and systems are excluded from the requirements in Article 725-5 of ANSI/NFPA 70-1981.

2.2.1.5.3 Insulation. All control wiring is excepted from the requirements of Article 725-16 of ANSI/NFPA 70-1981. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

2.2.1.5.4 Exterior Lighting and Snowmaking Circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18 meters) of the tramway centerline, shall be ground fault protected.

2.2.1.6 Grounding

2.2.1.6.1 Structures. All metallic structures shall be connected to a common conductor. Electrical continuity of all metal parts of the structures shall be assured by mechanical connection.

2.2.1.6.2 Drive Terminal Structure. The drive terminal structure shall have one point referred as a ground point, as defined in ANSI/NFPA 70-1981. All direct-current and alternating-current electrical systems shall be referenced to this point. If an electrical prime mover is used, the electric service grounding electrode conductor shall terminate at this point. Under the worst case conditions, the resistance from the ground point to any grounded point within the tramway system shall not exceed 50 ohms. The grounding system for the tramway shall not be used as a grounding system for any other system not related to the tramway system.

To ensure that the 50-ohm grounding requirement is met under all conditions of soil, moisture, temperature, and circulating ground and air currents, all terminal and line structures shall be bonded together with a bonding conductor.

2.2.1.6.3 Haul Rope Grounding. Grounding sheaves or equivalent means shall be provided at one location for the purpose of grounding track cables and haul ropes, as applicable, for static electrical discharge. For the haul rope on reversible tramways, bicable aerial systems, or monocable systems with an isolated or insulated haul rope incorporated in the operating circuitry, no means of grounding are required.

2.2.1.6.4 Lightning Protection. If lightning protection is provided, it shall follow the American National Standard Lightning Protection Code, ANSI/NFPA 78-1980.

2.2.1.7 Operating Control Circuits. If, for any reason, the operator has lost control of the tramway while using the normal or operating control circuitry, the control circuitry shall be designed to allow the attendant/operator to stop the tramway with the emergency stop circuit. Any one of the following six conditions shall be considered a loss of control of a tramway:

(1) Tramway will not *slow down* when given the command to do so

(2) Tramway will not *stop* when given the command to do so

(3) Tramway *overspeeds* beond control settings and/or maximum design speed

(4) Tramway *accelerates* faster than normal design acceleration

(5) Tramway *self-starts* or *self-accelerates* without the command to do so

(6) Tramway *reverses* direction unintentionally and without the command to do so

Control circuits shall not have anything across or parallel with the contacts of switches, relays, or safety devices including solid state devices monitoring the circuits or devices, unless it can be shown that any failure mode of the device placed across the switch does not defeat the purpose of the switch.

Each control circuit shall be tested for circuit integrity at its most remote terminal on a daily basis. An inadvertent ground or power failure shall stop the tramway.

2.2.1.7.1 Emergency Stop Circuit. All tramway control systems shall include a normally energized electrical circuit that, when interrupted, effects an emergency stop (see 1.4.20.1). The emergency stop shall have priority over all other control stops or commands. This circuit shall include a manual stop device at each attendant/operator station in close proximity to loading and unloading areas, main control panel, and machine room. These emergency stop switches shall be red.

When there is only one stop circuit, it shall be classified as the emergency stop circuit.

2.2.1.7.2 Normal Stop Circuit. All tramway systems shall include a normally energized electrical circuit that, when interrupted, effects a normal stop (see 1.4.20.2).

2.2.1.7.3 Operating Circuitry. All tramway systems shall contain a normally de-energized circuit that, when energized, causes the system to start, accelerate to and run at designated speeds and, when de-energized, causes the system to stop.

All start/run and speed control switches shall be conspicuously and permanently marked with the proper function.

All stop switches shall be of the manually reset type and be positively opened mechanically and their opening shall not be dependent upon springs.

chg 1986 **2.2.1.7.4 Bypass Circuits.** Bypass circuits may be installed for emergency conditions. Controls to bypass any portion of the operating control circuitry shall be locked and may be operated only by the tramway supervisor or his/her designated representative. Operation of the bypass shall require the physical effort of the person activating it to maintain the bypass condition (momentary contacts).

Bypass circuits shall be provided with a warning light to clearly indicate the bypass circuit is in use. The tramway shall be maintained under close visual surveillance when the safety circuits are bypassed.

2.2.1.8 Electrical Prime Mover and Power Circuits

chg 1988 **2.2.1.8.1 Electrical Prime Mover.** All tramway systems equipped with electrical prime movers (electrical motors) shall have phase loss protection on all power phases.

2.2.1.8.2 DC (Direct Current)-Powered Drives. All DC electronic speed regulated drives and DC-powered electric motors shall shut down in the event of:

(1) Field loss
(2) Speed feedback loss
(3) Overspeed
(4) Overcurrent
(5) SCR misfiring

2.2.2 Night Lighting. For nighttime operation, operating tramways shall be provided with lighting facilities. Lighting shall be provided at loading and discharge areas.

2.2.2.1 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

2.2.2.2 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp operating characteristics.

2.2.2.3 Location. Lights shall be mounted on substantial poles or standards. Tramway tower and terminal structures may be used for supporting lights subject to the following requirements:

(1) Approval shall be obtained from a qualified engineer.

(2) The service conductors to each tramway tower or terminal structure shall be underground or in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the tramway line.

(3) A separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure.

(4) All metallic raceways on a tower or terminal structure shall be grounded.

(5) The lighting installation shall not conflict with other requirements of this standard and shall not interfere with operations of the tramway in any manner.

2.2.2.4 Emergency Lighting. Emergency lighting shall be provided in the event of electric power failure to permit:

(1) Regular unloading of tramway facilities
(2) Emergency evacuation of carriers

2.3 Operation and Maintenance

2.3.1 General and Personnel Safety. This subsection covers the requirements for operation and maintenance of reversible aerial tramways. Many requirements are listed elsewhere in Section 2, since they also regulate installation and design. It is imperative that operating and maintenance personnel be familiar with applicable provisions of this section.

Operation and maintenance of aerial tramway equipment can be dangerous to personnel performing these tasks. Procedures for performing these functions shall require precautionary measures necessary to assure the safety of the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

2.3.2 Operation

2.3.2.1 Personnel. Reversible aerial tramways shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. One or more persons familiar with emergency procedures shall be on the site at all times when the facility is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific tramway.

2.3.2.1.1 Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for safe operation, and shall have the authority to deny access to the tramway to any person who in the supervisor's opinion is not fit or competent to use the tramway without danger to that person, to others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the tramway under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

2.3.2.1.2 Operators. An operator shall be in charge of each tramway. This operator shall be trained and experienced in normal operational and emergency procedures.

2.3.2.1.3 Attendants. An attendant shall be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view.

2.3.2.1.4 Conductors. A conductor shall be trained for duty in connection with enclosed carriers, including loading and unloading procedures, communications, and the use of door locks and keys. The conductor shall be familiar with load limits and applicable safety regulations, well-versed in the use of any safety switches under his/her control, and thoroughly drilled in the use of emergency evacuation equipment and procedures.

2.3.2.1.5 First Aid. One or more persons trained to administer first aid shall be available at all times when a tramway is operating and transporting passengers. There shall be ready access to first aid supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

2.3.2.2 Minimum Operating Personnel. The following personnel are the minimum that shall be required:

(1) An operator shall be in charge of the tramway.

(2) One attendant shall be on duty at each loading/unloading platform or station.

(3) A conductor shall be in each carrier having capacity of seven or more passengers (see 2.1.4.4.2(1)). A conductor may also act as a platform or station attendant.

2.3.2.3 Duties of Operating Personnel

2.3.2.3.1 Supervisor. The duties of the supervisor shall be as follows:

(1) To determine that all tramways are operational and that all operating personnel are trained, equipped, and fit to perform their duties

(2) To discontinue operations on any tramway due to physical, weather, personnel, or other reasons

(3) To enforce operational, maintenance, and safety rules

2.3.2.3.2 Operator. The duties of the operator shall be as follows:

(1) To assume responsible charge of the tramway

(2) To assign and supervise all attendants in his/her tramway

(3) To maintain an operational log book as required in 2.3.5.1

(4) To advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation

2.3.2.3.3 Attendant and Conductor. The duties of the attendant and conductor shall be as follows:

(1) To maintain orderly passenger traffic conditions within his/her area of jurisdiction

(2) To advise and assist passengers, as required

(3) To maintain surveillance of his/her area of jurisdiction

The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the tramway immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

2.3.2.4 Operational Procedures. The required operational procedures as set forth in 2.3.2.4 and 2.3.2.5 shall be supplemented by specific requirements as specified in the designer's operational manual (see 2.1.6.1).

2.3.2.4.1 Control of Passengers. Each tramway shall have a definite method for marshaling passengers for safe loading and unloading. Fences and gates may be required to implement the system.

2.3.2.4.2 Daily Preoperational Inspection. Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:

(1) A visual inspection of each terminal, station, and the entire length of the tramway

(2) Assurance that tension carriage, counterweights, or other tensioning devices are functional and have adequate travel with clearance at both ends of travel

(3) Operation of all manual and automatic switches in terminals, stations, and loading and unloading areas

(4) Operation of all braking systems

(5) Operation of communication systems

(6) Operation of the tramway, including a visual inspection of all ropes and carriers

For those tramways having primary-power internal combustion engines, the fuel quantity shall be determined to be sufficient to conduct the anticipated period of operation without refueling. For those installations having auxiliary internal combustion engines, the fuel supply shall be adequate to unload the tramway. During refueling, power units shall be shut down.

Tramways having auxiliary power units shall have the auxiliary engine(s) checked during this inspection and operated at least once each week.

Loading and unloading facilities shall be inspected and, if necessary, cleared of ice and snow to permit the safe ingress and egress of passengers. Mechanical features of the carriers shall be inspected and checked for correct operation.

2.3.2.5 Operational Requirements

2.3.2.5.1 General. The supervisor and operator of each tramway shall review the requirements of 2.1 and Section 7 of this standard to ascertain that original design and installation conditions have not been altered in such a manner as to violate the requirements of the standard.

2.3.2.5.2 Starting. No tramway shall be started except at the direction of or following clearance by the operator. Tramways while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance or emergency operation.

2.3.2.5.3 Stops. After any stop of a tramway, the operator shall determine the cause of the stop and not restart until clearance has been obtained from all attended stations.

2.3.2.5.4 Damage to Carriers. Should any carrier become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked and not used for passengers until repaired or replaced. It shall be removed from the line when feasible.

2.3.2.5.5 Hazardous Conditions. When wind or icing conditions are such that operation is hazardous to passengers or equipment, according to predetermined criteria based upon the area's operational experience and the designer's design considerations, the tramway shall be unloaded and the operation discontinued. If necessary under the predetermined criteria, a device(s) shall be installed at an appropriate location(s) to ascertain wind velocity and direction when tramways are operated. No tramway shall operate when there is an electrical storm in the immediate vicinity. Should such conditions develop while the tramway is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to discharge all passengers. When such shutdown has been caused by an electrical storm, grounding of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to resumption of passenger operations.

2.3.2.5.6 Evacuation. Provisions shall be made for the emergency evacuation of reversible aerial tramways (see 2.1.1.11). These shall include a detailed plan of evacuation, equipment necessary for evacuation, and adequate training of personnel. Evacuation drills shall be conducted at established intervals not to exceed one each 12 calendar months, and such drills recorded in the operational log of each tramway (see 2.3.5.1).

2.3.2.5.7 Termination of Daily Operations. Procedures shall be established for terminating daily operations in such a manner that passengers will not be left on the tramway after it has been shut down. Loading ramps, as required, shall be closed during off-hours and so marked.

2.3.2.5.8 Operational Log. A daily operation record shall be maintained as required under 2.3.5.1.

2.3.3 General Maintenance. Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance requirements of the designer (see 2.1.6.2) shall be followed. Maintenance records shall be kept (see 2.3.5.3).

A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:

(1) All wire ropes and cables (see 7.4.1 and 7.4.2)
(2) Line sheave units, sheaves, bearings, and liners
(3) Bull wheels, bearings, and liners
(4) Counterweight or tensioning systems
(5) Drive system, including bearings and couplings
(6) Braking systems
(7) Electrical control systems
(8) Communication systems
(9) Carriers

2.3.4 Inspections

2.3.4.1 General Inspection. Each facility shall be inspected annually, or after each 2,000 hours of operation, whichever comes first, by a tramway specialist independent of the owner. The inspection shall verify preservation of original design integrity and cover the requirements of this standard for maintenance, operation, required self-inspections, and recordkeeping. Items found either deficient or in noncompliance shall be noted. A report signed by the specialist shall be filed with the owner.

2.3.4.2 **Wire Rope and Strand Inspection.** Inspection of wire rope and strand shall comply with 7.4.1 and 7.4.2.

2.3.5 **Records**

2.3.5.1 **Operational Log.** A log book shall be maintained for each tramway. Daily entries shall be made, giving the following minimum information:

(1) Date

(2) Names and duty stations of operating personnel

(3) Operating hours and purpose of operations

(4) Temperature, wind, and weather conditions

(5) Record of compliance with daily operational inspection

(6) Position and condition of the tension carriage, counterweights, or other tensioning devices

(7) Accidents, malfunctions, or abnormal occurrences during operation

(8) Signature of operator

2.3.5.2 **Wire Rope and Cable Log.** A log book shall be maintained for each tramway, giving the following information on each rope and cable:

(1) Approved specification

(2) Copy of certified test report

(3) Date installed

(4) Splicing certificate for each splice or laid in strand

(5) Record of lubrication, including type of lubricant and date applied

(6) Record of maintenance inspections (see 7.4.1(2))

(7) Report of wire rope and cable inspection (see 7.4.1 and 7.4.2)

(8) Report of accidents or injury to rope

(9) Documentation of end attachment (see 7.3.2.4)

2.3.5.3 **Maintenance Log.** A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

2.3.6 **Passenger Conduct**

2.3.6.1 **Dexterity and Ability.** A passenger who uses a tramway shall be presumed to have sufficient physical dexterity to negotiate the tramway.

2.3.6.2 **Embarkation and Disembarkation.** A passenger shall get on and get off a tramway at designated areas.

2.3.6.3 **Riding.** Passengers, while riding a tramway, shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the tramway. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person.

3. Detachable Grip Aerial Lifts

This section covers the class of aerial tramways in which the carriers circulate around the system, alternately attaching and detaching from the moving haul rope. The carriers travel from one terminal to the other along one path and return along another path, making U-turns in both terminals. This section does not include tramways wherein the passengers are in contact with the ground or snow during the trip.

The tramways covered by this section are of the bicable or monocable type. The carriers may be open chairs, cars, or gondolas.

3.1 Design and Installation

3.1.1 **General**

3.1.1.1 **Design Passenger Weight.** For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77 kg).

3.1.1.2 **Location.** In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the lift type and location:

(1) Electric power lines and their supports

(2) Railways

(3) Highways

(4) Structures

(5) Rock and earth slides, cave-ins, washouts, etc

(6) Snow creep and avalanches

(7) Wind action

(8) Icing

(9) Ski slopes and trails

(10) Rivers and gullies

(11) Buried installations, including pipelines

(12) Crossing or close proximity to other aerial tramways

(13) Control of air space below, above, and adjacent to the installation

(14) Carrier height above ground or surface

3.1.1.3 **Width of Clearing.** The clearing shall be wide enough to prevent interference with the lift by adjacent vegetation. Such clearings shall be protected, if necessary, to avoid washouts that might endanger the installation. Potentially dangerous trees shall be cleared far enough back to avoid their falling on the lift.

3.1.1.4 **Path of Rope.** Terminals and towers shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration. Clearing shall be accomplished so that cabins or carriers will not come in contact with trees or vegetation during operating surges of the line, or under maximum design wind conditions, or both. In no case shall trees or vegetation extend within 5 feet (1.5 meters) of any portion of the haul or track rope or carrier under normal (nonsurge) operating conditions.

3.1.1.4.1 Vertical Clearances. Where skiing is permitted beneath the lift line, or at points where ski trails cross under a lift line, a minimum vertical distance of 13 feet (4.0 meters) between the design maximum snow depth and the top of the carrier seat shall be maintained under conditions of maximum sag.

Whenever the clearance is less than 15 feet (4.5 meters), no public transportation shall be permitted beneath the lift. Whenever the clearance is less than 8 feet (2.4 meters) for gondolas and empty chairs or 10 feet (3 meters) for chairs carrying foot passengers, provision shall be made to prevent access by unauthorized persons to the area beneath the lift. Under the most adverse loading conditions, a minimum space of 5 feet (1.5 meters) shall be maintained between the lower edge of carriers or ropes and the terrain or other possible obstacles, including snow.

3.1.1.4.2 Horizontal Clearances. The minimum distance between passing carriers, each swung 10 degrees inward from the vertical, shall be the greater of the following:

(1) 2 feet 6 inches (0.8 meter)

(2) 1/2% of the span length (applies to gondolas only)

The distance between haul ropes (or track cables) for the purpose of these checks, shall be considered as equal to the gage of the line.

External structures, posts, or obstructions other than lift structural components shall be at least 48 inches (122 cm) clear of either edge of a loaded passenger seat of an open cabin or carrier hanging in a vertical position except for control consoles which may have a clearance of 30 inches (76 cm).

3.1.1.4.3 Path of Rope Adjustment. When terminals, towers, or both contain provisions for a change in height of rope or track supports in order to meet normal changes in operational requirements, such provision shall be controlled as follows:

(1) The designer's operational manual shall provide complete instructions for proper procedures and sequences for making adjustments.

(2) Where range of adjustments allows possible operator error resulting in improper sheave loading, a system of readily verifying proper profile positioning without the use of tools shall be incorporated into the installation.

3.1.1.4.4 Track Cable Saddles (Bicable Systems). Towers and terminals shall be arranged so as to keep the track cable in the saddles under the most adverse operating and nonoperating conditions. These provisions shall not interfere with any track cable movement or any track cable brake operation. Maximum wind velocity and other design limits used for structures under nonoperating conditions and the limiting values intended for operating conditions shall be specified by the designer.

3.1.1.4.5 Haul Rope Sheave Units (Bicable Systems). Haul rope sheave units are generally of the support type. "Depression" or "hold-down" sheave units not covered by this standard shall be subject to the requirements of 1.2.2.

3.1.1.4.6 Fair Leads (Bicable Systems). All line sheave units, including both high and low tower roller assemblies, shall be provided with fair leads or guides to accomplish the following:

(1) Permit the unobstructed passage of a carrier gripped to the haul rope, regardless of the position of the haul rope guided by the fair leads, as the carrier approaches the sheave assembly.

(2) Return the haul rope to the sheave groove when it has been lifted in normal operations or for other reasons.

(3) Provide the rope guidance necessary beneath sheave assemblies and adjacent structures to prevent entanglement of the haul rope as it is returned by the carrier to normal operating position from any location it may assume due to deropement or other displacement.

3.1.1.4.7 Intermediate Structures (Bicable Systems). Auxiliary intermediate structures shall be provided to support sheave units as required to maintain a minimum clearance of 8 feet (2.4 meters) between the haul rope and the ground or snow profile.

chg 1986 chg 1988 **3.1.1.5 Capacity and Speed.** Rope speed shall not exceed 900 feet per minute (4.5 meters per second). Smooth acceleration of the carrier shall be accomplished from and to full rope speed. Provisions shall be made to space the carriers at prescribed intervals never less than that contemplated in the design.

The designer shall specify the design capacity in each direction.

3.1.1.6 Structures and Foundations. All structures and foundations shall be designed and installed in conformance with applicable criteria listed in 1.3. Applied design loads shall include dead, live, snow, wind, and dynamic loads due to normal operations and for foreseeable abnormal conditions.

Structures and foundations located in snow creep areas shall be designed for such conditions and loads or be protected by snow breakers or shears.

3.1.1.6.1 Structures. When bolted to foundations, structures shall be bolted with double nuts, lock nuts, or equivalent means of locking nuts.

On bicable systems, torsional displacement of towers under the most adverse conditions shall be limited to a value that will not cause deropement of the track cable from the saddle.

3.1.1.6.2 Foundations. In determining the resistance of the earth to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage should be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on solid rock. Foundations on rock shall be firmly anchored to solid rock unless designed as gravity foundations.

The top of concrete shall be not less than 6 inches (15 cm) above finished grade unless specific direction for protection of foundation and structural steel below grade is provided by the designer.

The design shall have factors of safety of 2 in resisting overturning, and concurrently 2 against sliding, under dead load and live load conditions; the factors shall be 1.5 under these loadings plus the wind acting simultaneously.

3.1.1.7 Communications. A permanently installed two-way voice communication system shall be provided between the prime mover and auxiliary power unit control point, drive machinery building, loading stations, and unloading stations. The power for this system shall be independent of the primary power source and the communication system shall be functional and audible during a power failure.

Audio indicators (bells, etc) shall be audible over all ambient noise levels, and visual indicators (e.g., LEDs) shall be visible even in bright sunlight.

3.1.1.8 Internal Combustion Engine Installation

3.1.1.8.1 Fuel Storage. Fuel tanks shall be of adequate capacity to permit uninterrupted operation during the normal operating period. Where internal combustion engines are located in weatherproof equipment rooms or buildings, fuel tanks shall be located at least 5 feet (1.5 meters) from the outside of the rooms or buildings for surface tanks or in an underground installation. The fill pipe shall be capped and locked, and located to avoid toxic fumes and fire hazard during refueling. Stopcocks shall be provided on fuel lines at points where the lines enter the building in underground installations or where the lines leave the tanks for aboveground installations.

Integrally mounted fuel tanks are permissible on auxiliary engines located in other than weathertight rooms.

In all respects, the installation shall comply with American National Standard for Stationary Combustion Engines and Gas Turbines, ANSI/NFPA 37-1979.

NOTE: Integrally mounted steel fuel tanks may be located within or beneath weathertight buildings supported on, or enclosing, combined drive-tension carriages, provided that the end of the fill pipe is located beyond the sides of the building, has a locked fill cap, and is in such a location as to avoid toxic fumes and fire hazard during refueling.

Liquid fuels shall be stored and handled in accordance with American National Standard Flammable and Combustible Liquids Code, ANSI/NFPA 30-1981 and ANSI/NFPA 37-1979. Liquefied petroleum gas installations shall be made in accordance with American National Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58-1979.

3.1.1.8.2 Exhaust Systems. Exhausts shall be designed and installed to discharge to the atmosphere so that precipitation does not enter the system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields.

3.1.1.8.3 Gear Shifts. Where gear shift levers are used, provisions shall be made to prevent accidental shifting of levers into speed ratios exceeding design or accidentally into reverse gear during public operation. Gears of manual transmissions shall not be shifted when the lift is moving.

3.1.1.9 Loading and Unloading Areas. Platforms, ramps, and related units comprising the loading and unloading areas are integrally related to safe operation. They shall be designed and installed in conformance with applicable criteria listed in 1.3.

Handrails, safety nets, or ramps shall be provided where needed for the protection of the passengers and operating personnel.

Carriers passing loading and unloading areas shall not vary in height above the area greater than 4 inches (10 cm) under the most adverse conditions of design loadings and rope tensions.

Carriers entering a terminal structure shall have the clearances required for line structures (see 3.1.3.2). In moving through the loading and unloading areas, the platform clearances between carriers and structures or fixed objects shall be sufficient to accommodate passenger movement and to permit clearance of operating personnel in the area.

3.1.1.9.1 Additional Requirements – Loading Areas for Chair Lifts. Loading areas shall have sufficient level length to permit passengers to load safely. The minimum length shall be 8 feet (2.4 meters).

Towers adjacent to loading areas shall be protected to prevent the ski tips of passengers from becoming entangled in the towers.

chg 1983 **3.1.1.9.2 Additional Requirements – Unloading Areas for Chair Lifts.** Unloading areas shall have sufficient length to permit passengers to unload safely. A minimum length of 8 feet (2.4 meters) shall be provided. The entering end of this section shall be fitted with inclined guards to prevent ski tips of unwary passengers from being caught under the edges of the platform.

Ramps sloping downward from the exit of the unloading area shall not be steeper than 40%.

3.1.1.10 Signs. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point (see 3.3.6). All such signs shall be prominently placed, and those pertaining to the lift operations shall be adequately lighted for night operation.

Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons and locked.

The sign "Men Working on Lift" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the auxiliary or prime mover when men are working on the aerial lift. See 3.1.1.13 for additional requirements.

3.1.1.10.1 Additional Signs for Gondola Lifts. The following information shall be prominently posted on the interior of each carrier:

(1) The maximum capacity of each carrier in pounds and kilograms and number of passengers. (This shall also be posted at each loading area.)

(2) Instructions for procedure in emergencies.

3.1.1.10.2 Additional Signs for Detachable Chair Lifts. The following signs shall be posted:

(1) "Prepare to Unload" (not less than 50 feet (15 meters) ahead of unloading area)

(2) "Keep Ski Tips Up" (ahead of any point where skis may come in contact with a platform or the snow surface)

(3) "Unload Here"

(4) "Safety Gate" (if applicable)

(5) "Remove Pole Straps from Wrists" (at loading area)

Signs shall also be visible at all points of downhill loading, listing downhill capacity of lift.

3.1.1.11 Evacuation. Aerial tramways shall be provided with approved means to evacuate passengers from stranded carriers.

All nonmetallic rope used for evacuation shall be of synthetic polyester fiber, such as Dacron or equal, or of a hard lay nylon with a minimum diameter of 7/16 inch (11 mm) and a minimum breaking strength, when new, of 5000 pounds (2268 kg). No natural fiber or polypropylene ropes shall be used.

These ropes shall be carefully stored when not in use, and they shall be examined after each complete lift evacuation and prior to each season of operation, both summer and winter, to ascertain that they are in satisfactory condition.

Carabiners, if used, shall be of the locking type.

3.1.1.12 Tests and Inspection

chg 1988 **3.1.1.12.1 Acceptance Tests and Inspection.** Before a new or relocated aerial tramway is opened to the public, it shall be given thorough inspection and tests by qualified personnel to verify compliance with the plans and specifications of the designer. The designer or manufacturer shall propose and submit a load test procedure.

It shall be the responsibility of the owner to see that the following conditions have been met:

(1) Tightness of all structural connections

(2) Lubrication of all moving parts

(3) Alignment and clearances of all open gearing

(4) Installation and alignment of all drive components

(5) Position and freedom of movement of counterweights or other tensioning means and carriages

(6) Haul rope alignment at entrance to bull wheels

(7) Operation of all electrical components, including circuit protection and grounding

3.1.1.12.2 Aerial Lift Inspection. Inspection of an aerial lift shall also cover:

(1) Track cable and haul rope sags under the most adverse static loadings.

(2) Alignment of track cable saddles and haul rope sheave units.

(3) Evacuation equipment and procedures, including an actual test at the most difficult location.

(4) Towers and terminals, for correct location and installation in accordance with plans and specifications. Terminal and tower cable working points shall be documented by an "as built" survey, and any variation from the design drawings shall be noted and approved by the engineer responsible for design.

(5) Thorough operating tests under full loading and any partial loadings that may provide the most adverse operating conditions. Test load per carrier shall be 110% of the design live load. The functioning of all push-button stops, automatic stops, limit switches, selected deropement switches, and communications shall be checked. Acceleration and deceleration rates shall be satisfactory under all loadings (see 3.1.2.4). Motive power and all braking and backstops (see 3.1.2.5) shall be proved adequate under the most adverse loadings. The tests shall include at least 6 hours of continuous operation with empty carriers to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tensioning systems, and other related defects.

(6) All transfer, launching, and grip-testing equipment shall be thoroughly checked both before and during the continuous run test.

3.1.1.13 Safety of Operating and Maintenance Personnel. Provision shall be incorporated in an aerial lift design to render the system inoperable when necessary for the protection of personnel working on the lift. See 3.1.1.10 for placement of applicable warning signs.

3.1.2 Terminals and Stations

3.1.2.1 Power Units

3.1.2.1.1 Prime Mover. All prime movers shall have capacity to handle the most unfavorable design loading conditions, including the starting of a fully loaded lift.

Where manual multispeed transmissions are used on either the prime mover or auxiliary power unit, gears shall not be shifted when the lift is moving.

Where reverse capability is provided on the prime mover or auxiliary power unit for any lift, provisions shall also be made to prevent accidentally shifting into reverse whenever the lift is operating.

The lift shall be started at its lowest point of speed range after any type of stop.

3.1.2.1.2 Auxiliary Power Unit. An auxiliary power unit with an independent power source shall be provided that can be readily used to unload the line in the event of failure of the primary power unit. This unit shall be electrically wired to meet the requirements of 3.2.1.7.1 so that it can be stopped by the emergency stop circuit at all loading and unloading stations and terminals in use. As a minimum, the auxiliary power unit shall be capable of starting and moving a fully loaded line in a forward direction at not less than 100 feet per minute (0.5 meters per second) or at an average speed in feet per minute equal to 1/60 the slope length of the lift in feet (meters per second equal to 1/3600 the slope length of the lift in meters), whichever is greater. The auxiliary engine shall not depend upon the mechanical integrity of the prime mover to drive the unit.

No lift shall be operated using a single power unit without an operable auxiliary power unit, except to unload passengers and for maintenance purposes, unless the following requirements are met:

(1) All brakes and backstop devices shall be functional with the auxiliary drive.

(2) All control circuits, safety gates, and stop switches shall be functional and control the auxiliary drive.

(3) Temperature and weather conditions shall be such that a two-hour waiting period in the carrier would not be injurious to passengers.

(4) Evacuation gear and personnel shall be immediately available in sufficient number and quantity to evacuate the entire lift in a two-hour period. Demonstration of this capability shall be required before authorization is granted to use the auxiliary power unit for passenger operations.

(5) If downhill capacity is desired, 3.1.2.4 shall be complied with.

3.1.2.2 Speed Reducers and Gearing. All speed reducers and gearing shall have the capacity for starting a lift under the most unfavorable design loading conditions and without exceeding design rating. They shall have a service factor appropriate for the application and they shall comply with the standards of the American Gear Manufacturers Association (AGMA), listed in 2.1.2.2.

Chg 1988 **3.1.2.3 Bearings, Clutches, Couplings, and Shafting.** Bearings, clutches, and couplings shall be selected on the basis of the manufacturer's published recommendations for the particular use. If published data are not available for the specific use, the manufacturer's approval shall be obtained. Bearings, clutches, and couplings of special design, if used, should have the approval of a qualified mechanical engineer.

Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings, when required.

All shafting shall be designed in accordance with accepted standard practices.

Chg 1986 **3.1.2.4 Acceleration and Speed Control.** The drive equipment shall be designed to accelerate the line smoothly and to avoid severe oscillation or undulation under any loading condition.

The rate of the carrier's acceleration to and deceleration from the design rope speed shall not endanger the carrier or the passengers. The interval between carriers shall be controlled by automatic carrier spacers or other suitable devices. Unbalanced loading shall be controlled to the extent required by the design through the use of automatic carrier counters or other suitable devices.

The drive shall be capable of rotating the unloaded system at reduced speed for rope inspection and equipment maintenance. This reduced-speed operation may be obtained by the use of the auxiliary engine.

On installations in which a forward overhauling condition exists:

(1) Provisions shall be made for an overhauling load so that the system shall operate at a controlled speed not exceeding design speed by more than 6%. The energy developed by the overhauling load shall be dissipated in a satisfactory manner without using the brakes specified under 3.1.2.5.

Where the provision made for an overhauling load consists of regenerative capability or a similar characteristic in the prime mover itself, the auxiliary power unit shall have a comparable capability.

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Table 3-1
Required Stopping Devices

Lift Category	Service Brake	Emergency Brake	Bull Wheel or Cable Backstop	Drive Train Backstop	Retarding Device (See 3.1.2.4)
Self braking A lift that decelerates, stops, and remains stopped within the service brake performance requirements without a braking device	Not required	Required	Not required	Not required	Not required
Nonoverhauling A lift that will not accelerate in either direction when it is not driven, but is not self-braking	Required	Required	Not required	Not required	Not required
Overhauling, reverse direction A lift that will accelerate in the reverse direction when it is not driven	Required*	Required	Required	Required	Not required
Overhauling, forward A lift that will accelerate in forward direction when it is not driven	Required	Required	Required	Required	Required

*A service brake is not required if the overhauling, reverse direction lift will meet the service brake stopping requirements under the most unfavorable design loading conditions.

(2) Provision shall be made for slowing and stopping the lift drive automatically if the line speed exceeds the design speed by more than 10%. The service brake (see 3.1.2.5.1) shall slow and stop the lift automatically if the line speed exceeds the design speed by more than 10%, and the emergency brake shall automatically slow and stop the lift if the line speed exceeds the design speed by more than 15%. The lift shall be started at its lowest point of speed range after any type of stop.

Where the lift is not rated for downhill passenger traffic, the following number of loaded carriers, loaded no more closely than 4 times the minimum carrier spacing, shall be permitted for the carrying of authorized persons downhill; the requirements for slowing and stopping the lift drive automatically as set forth in 3.1.2.4(2) shall be waived.

Total Number of Carriers on Lift (Both Sides)	*Maximum Number of Loaded Carriers on Downhill Rope*
Less than 60	2
60 to 120	3
Over 120	4

For the purpose of this section only, the term "authorized persons" is defined to include all persons, whether employees of the lift owner or not, who are authorized by the owner or the owner's representatives to be carried on the lift.

All installations in which downhill traffic is either limited or not permitted shall be so identified with clearly visible signs at loading or unloading areas, and this information shall be further contained in operating instructions posted in these areas.

Chg 1986 **3.1.2.5 Brakes.** The lift shall have the brakes and backstops designated in Table 3-1.

The service brake, emergency brake, and backstops shall be independent systems, such that failure of one system will not impair the function of the other systems, and all service brakes and emergency brakes shall have the braking force applied by springs, weights, or other approved forms of stored energy.

The service brake, emergency brake, and backstops shall be designed to assure operation under all anticipated conditions, including weather.

All braking systems shall be capable of operation to comply with daily inspection required by 3.3.2.4.3(4). All backstops shall be disengageable as required for the individual testing of brakes. Stopping distances specified under performance requirements for brakes shall be achieved by the particular brake without the aid of other braking devices or drive regeneration, etc.

3.1.2.5.1 Service Brake. The controls shall be arranged at each station such that the brake begins decelerating the lift within 3 seconds after the operator or attendant reacts to the stimulus to apply the brake. The controls to the brake shall not be located in a position that would require the operator or attendant to pass through the path of moving carriers in order to operate the controls.

This brake can be located at any point in the drive train so that there is no clutch, or similar device, between the brake and the drive sheave.

The application of the brake shall automatically stop the drive shaft when the brake is applied. The brake shall be in a normally applied position.

The service brake shall be an automatic brake to stop and hold the lift under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall be adjusted such that it will stop the lift from full speed, with the design loading condition most unfavorable to stopping, in a distance not exceeding the larger of (1) 10 feet (3 meters) or (2) a distance in feet (meters) equal to $V^2/8000$ where V is the lift speed in feet per minute ($1.5V^2$ where V is the lift speed in meters per second).

A qualified engineer shall furnish a written procedure to be followed and shall specify the auxiliary equipment necessary for periodic testing and adjustment of the holding torque of the service brake.

At a frequency and by a method to be determined by the qualified engineer, and during the acceptance testing, the brake shall demonstrate the ability to produce the torque specified in the testing procedure.

Chg 1986 **3.1.2.5.2 Emergency Brake.** The controls shall be arranged such that the brake begins decelerating the lift within 3 seconds after an operator or attendant reacts to the stimulus to apply the brake. The controls to the brake shall not be located in a position that would require the operator or attendant to pass through the path of moving carriers in order to operate the controls.

The brake shall operate on the drive sheave assembly.

Application of the emergency brake shall automatically stop any prime mover. This brake shall act automatically when the speed of the haul rope exceeds the design value by 15% in the forward direction on an overhauling lift, or a reverse rotation exceeding that which normally activates the bull wheel or cable backstop.

The emergency brake shall be an automatic brake to stop and hold the lift under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall be adjusted so that it will stop the lift from full speed, with the design loading condition most unfavorable to stopping, in a distance not exceeding the larger of (1) 10 feet (3 meters) or (2) a distance in feet (meters) equal to $V^2/8000$ where V is the lift speed in feet per minute ($1.5V^2$ where V is the lift speed in meters per second).

A qualified engineer shall furnish a written procedure to be followed and shall specify the auxiliary equipment necessary for periodic testing and adjustment of the holding torque of the emergency brake.

At a frequency and by a method to be determined by the qualified engineer, but at least during the acceptance testing, the brake shall demonstrate the ability to produce the torque specified in the testing procedure.

Chg 1986 **3.1.2.5.3 Bull Wheel or Cable Backstop.** The backstop shall act directly on the drive sheave assembly or on the haul rope. When it has been determined that, under the most adverse design loading condition, haul rope slippage will not occur, the backstop may be located at the return sheave assembly. However, the backstop shall not be located at other than the drive station unless its location will not decrease the factor of safety of the haul rope below the minimum permissible value whenever the backstop is statically engaged.

Under the most unfavorable design loading condition, the backstop shall automatically prevent reverse rotation of the lift for more than 3 feet (0.9 meter).

A qualified engineer shall furnish a written procedure for testing. Performance of the backstop device shall be demonstrated during the load test (see 3.1.1.12.2(5)).

Chg 1986 **3.1.2.5.4 Drive Train Backstop.** This backstop can be located at any point in the drive train so that there is no clutch, or similar device, between the backstop and the drive sheave, and shall be rated for the maximum design load.

Under the most unfavorable design loading condition, the backstop shall automatically prevent reverse rotation of the lift before the drive bull wheel reverses 1 degree based on the theoretical reduction ratio (the gear backlash motion shall not be included in the 1 degree limit).

A qualified engineer shall furnish a written procedure for testing.

3.1.2.6 Location of Machinery

3.1.2.6.1 General. Moving machine parts that normally may be in reach of personnel shall be fitted with safety guards conforming to American National Standard Safety Standard for Mechanical Power Transmission Apparatus, ANSI B15.1-1972.

Protection against static electricity shall be provided. Fire-fighting device(s) shall be available.

3.1.2.6.2 Machinery Not Housed in a Machine Room. Provisions shall be made to keep the public away from the machinery. All power units, all components of the drive train, and all safety devices, such as backstops, brakes, relays, and the like shall be protected from the weather.

3.1.2.6.3 Machinery Housed in a Machine Room. The machine room shall be well-ventilated. It shall have a permanently installed lighting system, adequate for proper machinery maintenance and safety of operating personnel. The arrangement shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (46 cm) shall be maintained. Means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

3.1.2.7 Sheaves in Terminals and Stations

3.1.2.7.1 General. All sheaves, including their mountings and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers of the bearings.

When unlined sheave grooves are used for wire rope, they should be V-shaped and shall have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

chg 1986 chg 1988 **3.1.2.7.2 Haul Rope Terminal Sheaves (Bull Wheels and Deflection Sheaves).** Haul rope terminal sheave frames shall be designed to retain the rope in the event of the failure of the sheave, shaft, or mounting. In instances where the sheave is cantilevered, the design working stresses shall be not more than 60% of those otherwise allowable.

The minimum diameter of terminal sheaves shall be 72 times the nominal diameter of the haul rope. The sheave assembly shall be designed to retain the haul rope in the event of a deropement from the sheave. A flange extension of 1-1/2 times the rope diameter (measured from the bottom of the rope groove) shall be deemed adequate for retention.

Haul rope terminal sheaves that act as driving, braking, or holding sheaves shall be so designed that the haul rope does not slip in the sheave groove. The design coefficient of friction for a particular sheave liner shall not exceed the following values:

Sheave Liner	*Coefficient of Friction*
Steel or cast iron grooves	0.070
Leather	0.150
Rubber, neoprene, or others	0.205

Table 3-2
Minimum Diameters for Counterweight Rope Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard

	Sheave Diameter		
Rope Type	Condition A	Condition B	Condition C
6 × 7	72d	42d	24d
6 × 19	45d	30d	20d
6 × 37	27d	18d	12d

NOTE: d equals the nominal rope diameter.

3.1.2.7.3 Counterweight Rope Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard. The minimum diameters for these sheaves shall be as indicated in Table 3-2.

Condition A is applicable where rope bending around sheaves is of major importance. This condition shall be used as a minimum design criterion for track cable counterweight ropes.

Condition B is applicable where rope bending around sheaves is important, but some sacrifice in rope life is acceptable to achieve reduction in weight, economy in design, etc.

Condition C is applicable to sheaves that should not rotate due to any tension sheave movement but should rotate only due to counterweight adjustment.

In the case of a locked coil track cable passing over a sheave or roller chain and connected directly to a counterweight, the radius of curvature of the sheave or the roller chain shall be not less than 100 times the cable diameter or 1200 times the greater dimension of the cross section of the largest wire of the cable, whichever is greater.

Provisions shall be made to assure that all counterweight sheaves rotate freely.

3.1.2.7.4 Haul Rope Line Sheaves. The requirements of 3.1.3.3 are applicable to haul rope line sheaves used in terminals and stations, with the following exceptions:

(1) Sheaves that carry no load other than the weight of the rope and carriers

(2) Sheaves that are located in such a way that the weight of carriers is either wholly or partially supported on tracks or by other means

(3) Sheaves that are located in such a way that carriers attached to the cable are not passing onto the sheaves

In such cases, the design shall be modified to meet the requirements of the particular installation.

3.1.2.8 Tension Sheave Carriages. The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion under normal operation.

3.1.2.8.1 Rigid Mounted Carriages. The sheave carriage shall be supported from the ground by a rigid structure. The mounting that travels under the action of the counterweight shall be supported on rigid, straight rails by means of wheels. Torsional loads due to driving torque, braking torque, or reactions of a backstop shall be considered, and the structure and carriage shall adequately transmit these loads to the foundations.

3.1.2.8.2 Mechanical Stops for Rigid Mounted Carriages. Mechanical stops shall be provided to prevent overtravel of the carriage and the tension sheave. These stops and the terminal structure shall be designed to resist, at normal design stresses, an unbalanced horizontal force on the bull wheel applied in the direction of the opposite terminal and equal in magnitude to 30% of the counterweight reaction on the bull wheel.

3.1.2.9 Counterweight and Tensioning Systems

3.1.2.9.1 Counterweights. Counterweights or other suitable devices shall be provided to determine and regulate the tension of all haul ropes. Counterweights, when used, shall be arranged to move freely up and down. Enclosures for counterweights shall be provided where necessary to prevent snow or ice from accumulating under and around the counterweights and interfering with their free movement. When a counterweight is contained in a structural frame, guides shall be provided to protect the frame and to ensure free movement of the counterweight. Where snow enclosures are not required, guardrails or enclosures shall be provided to prevent unauthorized persons from coming in contact with or passing under counterweights.

The counterweight, or other suitable device, shall have sufficient travel to take care of all normal operating changes in loading and temperature. Counterweights, if used, shall determine and regulate the tension during all operating periods. Where counterweights or other devices are used for track cables, the same provisions shall apply.

Friction and other forces developed in the tension system composed of the movable carriage, counterweight sheaves, reeving, and guide system shall be included in calculating haul rope tension for all conditions of loading. Carriage and counterweight movement shall be evident in normal operation or the resistance to movement shall be measured and its magnitude approved by the engineer responsible for design.

Chg 1988 **3.1.2.9.2 Counterweight Ropes.** Counterweight ropes shall have a minimum factor of safety of 6, when new. The factor of safety is equal to the nominal breaking strength of the rope (see 7.1.3) divided by the maximum static design tension. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account shall be the basis for determining factor of safety.

Counterweight ropes shall be adjusted to that the counterweight will reach the end of its travel before the attached tension sheave carriage comes within 6 inches (15 cm) of the end of its travel.

See 7.3 for additional requirements.

Chg 1988 **3.1.2.9.3 Counterweight Winches.** Winches that are used for counterweight system take-up and remain a permanent part of the system shall have a factor of safety of 6 against their ultimate capacity. They shall have a positive lock against release. Where this factor of safety cannot be established by manufacturer's endorsement, a safety device shall be installed on the counterweight rope ahead of the winch that will keep the tensioning system intact in the event of failure or release of the winch.

3.1.2.10 Anchoring Devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion. The diameter of a drum for track cable anchorage shall be not less than 65 times the cable diameter or 600 times the greatest cross-sectional dimension of the outside wire diameter; cable shall be secured with a minimum of three wraps on the bollard and two clamps (see 3.1.2.7.3).

Sections of ropes bent around thimbles, sheaves, or other anchorage devices not meeting the minimum diameters specified by Condition C in 3.1.2.7.3, or permanently deformed or damaged sections, shall not be relocated or reused as a part of the section under load.

Wire ropes or strands, and their connections, used to anchor, tension, or otherwise secure terminal structures, shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

3.1.2.11 Manual and Automatic Stops. All stop circuits and switches shall conform to the requirements of 3.2.1.7.

3.1.2.11.1 Manual Stop Devices. Manual stop devices that will stop the prime mover and apply the service brake shall be installed in all attendants' and operators' stations, in machine rooms, and out-of-doors in proximity to all loading and unloading areas. All manual stop devices shall be conspicuously and permanently marked.

Chg 1986 **3.1.2.11.2 Automatic Stop Devices.** The following automatic stop devices shall be installed:

(1) A device(s) that will stop the lift in the event a carrier grip does not engage the haul rope properly at every grip attachment point.

(2) A device(s) that will stop the lift in the event a carrier does not disengage the haul rope properly at every grip disengaging point. This device shall actuate both the service brake and the emergency brake.

(3) A device(s) that will stop the lift before any counterweight, other tensioning device or tension sheave carriage reaches either end of its travel or when the tensioning system exceeds its range of normal operating travel. When pneumatic or hydraulic tensioning systems are used, pressure sensing devices shall also be incorporated that will stop the lift system in case the operating pressure goes outside the design pressure range. Such pressure sensing devices shall be located close to the actual tensioning device. It shall not be possible to isolate the pressure sensor from the actual tensioning device.

3.1.3 Line Structures

3.1.3.1 Towers. The design of the tower structure and foundation shall be in accordance with the requirements of 3.1.1.6. When guyed towers are used and guys intersect the ground within or near ski runs, the guys shall be marked for visibility, preferably with boards painted with black and yellow stripes.

Means shall be provided for ready access from the ground to all tower tops. This requirement will be fulfilled if the tower structure is safe to climb. Otherwise, means such as permanent ladders or light, portable ladders shall be provided. The latter, if used, shall be in at least sufficient quantity to be available at each point where attendants are stationed.

Towers shall be identified with successive numbers clearly visible when looking up the lift line.

Where towers are designed to permit variations in rope height, sheave unit supports shall be guided and attached so as to prevent misalignment by rotation during normal operation.

3.1.3.2 Guards and Clearances. All towers shall be equipped with guards to prevent contact of any parts of the carriers with a tower structure or tower machinery and to maintain minimum clearance between carriers and tower structures; however, such guards or minimum clearance shall not be required if contact does not occur when the carrier is swung laterally 15 degrees from the vertical position. Minimum clearance is specified in the following paragraph.

A carrier shall be capable of swinging 8 degrees laterally before engaging a guard or encroaching upon the following minimum clearance with a tower structure:

(1) On detachable chair lifts: 12 inches (30 cm) between the innermost point on chair structure and the tower clearance line or surface.

(2) On gondola lifts with open windows on the tower side: 18 inches (46 cm) between the innermost point of cabin and the tower clearance line or surface.

Guards may be placed to limit the swing of carriers between 8 and 15 degrees as required to maintain the above clearance.

Guards shall be shaped and located so that a 30-degree lateral swing from vertical shall not place any part of the loaded or empty carrier on the inner side of the guard. Guard configuration shall provide for reversal of carrier travel direction during testing or other special operating conditions and shall preclude entanglement when a carrier is swung laterally 15 degrees.

On all towers, with or without guards, when a carrier is swung longitudinally by 15 degrees, there shall be no contact between any obstruction and any part of the carrier.

3.1.3.2.1 Special Requirements for Chair Lifts Used for Skiing. The following clearance requirements shall be met to prevent entanglement of skis with tower structure. Clearance is here defined to mean the distance between inner limit of passenger seat and clearance line or surface of tower.

With the chair swinging in laterally 10 degrees from the vertical position, or to the limit permitted by the guards, if any, if clearance is less than 24 inches (61 cm) from any open frame tower or 18 inches (46 cm) from any closed tubular tower, tip deflectors shall be provided on each side where passengers wearing skis are allowed, to keep the skis from being caught in the structure. Such deflectors shall be at least 72 inches (183 cm) in height, extending 36 inches (91 cm) above and 36 inches (91 cm) below average foot level.

3.1.3.2.2 Clearances and Designation of Tubular Towers. A tubular tower with permanent ladder rungs shall be considered as an open-frame tower, unless it can be demonstrated that ski tips cannot be caught in the ladder, in which case the tower may be considered as a closed-tubular tower.

3.1.3.3 Haul Rope Sheaves and Mounts

NOTE: The requirements in 3.1.3.3 and 3.1.3.3.1 through 3.1.3.3.3 apply generally to sheaves that support or hold down the haul rope at towers on a monocable system, but where applicable shall also apply to the haul rope of a bicable system. These requirements shall apply to both sides of each aerial lift.

The diameter of a haul rope sheave shall be not less than 10 times the nominal diameter of the haul rope for metallic sheaves or 8 times for sheaves with elastomer treads.

3.1.3.3.1 Maximum Allowable Sheave Load. The maximum allowable load per sheave should be determined by the lift designer.

3.1.3.3.2 Sheave and Sheave Unit Design. Sheave flanges shall be as deep as possible considering other features of the system. At the same time, rope grips shall be designed in relation to the sheave groove so as not to contact sheave flanges during normal operations, taking into consideration the anticipated amount of wear of the sheave liner groove. Grips shall be allowed to contact sheave flanges adjacent to the haul rope when the carrier swings, provided that this is considered in the design of grips and sheaves. Furthermore, rope grips, sheave flanges, and hanger guides shall be designed so that hangers cannot be caught behind guides, and so that ropes and grips cannot be deroped from sheaves if the carrier is swinging within design limits as it approaches or passes the tower.

Suitable guards of sufficient strength to resist the lateral forces caused by deropement shall be installed to prevent the rope from falling into a dangerous position within the tower structure.

Construction of the entire sheave unit shall be such that the rope cannot become entangled in the sheave unit in the event the rope leaves the sheave toward the outside.

On each sheave unit, rope-catching devices shall be installed to prevent the rope from moving excessively in the direction of the load on the sheave unit in the event of deropement. These devices shall be located less than one half the diameter of the sheaves from the normal operating position of the rope and shall extend a minimum of two rope diameters beyond the sheave flange. They shall be designed to permit the passage of the rope and grips after deropement.

On each sheave unit, suitable deropement switch devices shall be installed and maintained that will stop the lift in case of deropement.

If the gage of the haul rope system is varied at any point along the line, the horizontal departure at any one tower shall be provided for in the design so that deropement cannot occur by virtue of such a departure.

Sheave mounts or mounting frames shall be designed to be adjustable, allowing the sheave units to be aligned and held in the plane of the rope.

See also 3.1.1.4–3.1.1.4.7 for effect of tower height and location on sheave units.

3.1.3.3.3 Haul Rope Retention. Provisions shall be made to retain the haul rope in the line sheave groove under all anticipated conditions of loading. This criterion will be met if any of the following conditions is fulfilled:

(1) Condition A: Under the most adverse design loading conditions (excluding dynamic effects), the minimum load of the haul rope on a group of support sheaves at a tower shall be not less than the largest of the following values: 100 pounds (45 kg) per sheave; or 300 pounds (136 kg) per tower group; or a value in pounds equal to two-thirds the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to the sum of the adjacent span lengths expressed in meters of slope length).

When cable elevation at the tower in question lies below a straight line joining cable elevations at the adjacent tower, the haul rope shall not leave the group of sheaves under either of the following conditions:

(a) When the haul rope tension is 1.5 times its maximum design value at the point, using no carriers in adjacent spans.

(b) When a rope is under tension of the counterweight alone (bare rope) or with any arrangement or number of empty carriers on the line.

The minimum load of the haul rope on a group of hold-down sheaves at a tower under the most adverse loading conditions shall be not less than the larger of the following values: a value in pounds equal to the dead plus live load of the carrier; or a value in pounds equal to the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to 1.5 the sum of the adjacent span lengths expressed in meters of slope length). In no case shall this load be less than 225 pounds (102 kg) per passenger.

(2) Condition B: Combination sheave units that incorporate support and hold-down sheaves shall be designed with the retaining sheaves always in contact with the haul rope. When retaining sheaves are mounted to deflect, to allow passage of a carrier grip, such deflection shall not occur until the sheave is loaded to one-half of the maximum design sheave loading. The retaining sheaves shall have the same maximum design loading as the other support or hold-down sheaves on the tower. If the design satisfies loading requirements in Condition A, nothing in this paragraph shall preclude the use of rollers or guides opposite the tower sheaves that do not necessarily contact the rope.

(3) Condition C: For line structures where the carrier is either wholly or partially supported or depressed on tracks or by other means, in lieu of retaining the haul rope in the sheave groove, the following design criteria shall be fulfilled without exceeding the maximum allowable loads.

Under the most adverse loading conditions, the load of the carrier onto the track when fully engaged shall be not less than the largest of the following values: 450 pounds (205 kg); or the design gross load per carrier; or a value in pounds equal to two-thirds of the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to the sum of the adjacent span lengths expressed in meters of slope length).

The carrier shall not leave the track if the design cable tension is increased by 50% or decreased by 33%.

3.1.3.4 Track Cable Saddles and Mounts (Bicable Systems). The radius of a track cable saddle shall be determined by the one of the following criteria that requires the largest radius:

(1) That it be large enough to minimize bending stresses in the cable. In any event, the radius shall be equal to at least 1200 times the largest dimension of the outer wire of the cable.

(2) That it be large enough to provide smooth transition of the carrier trucks from span to span.

(3) That it be large enough to reduce the bearing pressure to a value that will permit proper lubrication of the cable to facilitate sliding in the saddle groove.

(4) That it be large enough so that the radial acceleration of the carrier is not greater than 6.7 feet (2.0 meters) per second squared calculated as follows:

V^2/R is not greater than 6.7 feet (2.0 meters) per second squared

where

V = Carrier speed in feet per second
R = Radius of shoe in feet

The minimum pressure on the saddle shoes shall be not less than 1.5 times the pressure required to hold the rope in contact with the shoes when a wind force of 6 pounds per square foot (287 newtons per square meter) is applied upwards on the rope, parallel to the reaction on the tower.

The saddle shall be long enough to ensure that under maximum loading conditions the cable will not come into contact with the end of the saddle groove.

Saddles shall permit free passage of the carrier trucks even when the carrier is swinging laterally to its design limit as it approaches or passes the tower.

If the gage of the lift is varied at any point along the line, horizontal departure at any one tower shall be kept to a minimum to avoid derailment of the carrier trucks as they pass over the saddle.

See also 3.1.1.4–3.1.1.4.7 for the effect of height and location of towers on saddles.

3.1.4 Line Equipment

3.1.4.1 Haul Rope. See Section 7 for basic wire rope design and installation requirements.

chg 1986 **3.1.4.1.1 Factor of Safety.** Haul ropes shall have a minimum static factor of safety of 5, when new. Static factor of safety is equal to the nominal breaking strength (see 7.1.3) divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

3.1.4.1.2 Factor of Safety for Spliced Haul Rope with an Independent Wire Rope Center. Where a spliced haul rope with an independent wire rope center is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

3.1.4.2 Track Cable. See Section 7 for basic requirements for all track cables. Track cables consisting of one strand made up entirely of round wires (commonly called "Smooth Coil Track Strand") shall not be permitted. Wire rope, if used as track cables, shall have an independent wire rope or strand center.

3.1.4.2.1 Factor of Safety. Track cables shall have a minimum static factor of safety of 3 and a minimum dynamic factor of safety of 2.5, when new.

3.1.4.2.2 Track Strand Installation. *Track strand is easily damaged.* The designer of the lift shall provide detailed information concerning handling and installation of the track strand. These instructions shall be consistent with the track strand manufacturer's recommendations. Any handling after installation shall be in accordance with this advice.

3.1.4.3 Haul Rope Grip

3.1.4.3.1 General. The rope grip shall be of a type that has been proved to give satisfactory service by the industry. The manufacturer shall permanently affix a unit identification and size marking to each grip. Each grip shall be nondestructively tested before public use.

The rope grip shall be designed to pass smoothly over and under line sheaves that have flanges of adequate depth to discourage the haul rope from leaving the sheaves.

The design shall incorporate provisions to accommodate a 10% reduction in haul rope diameter. The designer's instructions shall provide details for the proper initial setting of the grip and a method to assure an operator or inspector that the grip has not reached an operational limit of the clamping components.

3.1.4.3.2 Slippage. The rope grip shall be designed and maintained during use so as to resist a force that tends to slide it along the haul rope, that is, a minimum of 3 times the force required to move a carrier along a properly lubricated haul rope at its steepest incline, under the most adverse conditions of carrier loading. The grip shall automatically adjust to maintain this gripping force with a 3% reduction in haul rope diameter.

The grip designer shall specify the proper grip installation and testing procedures, and, for clamping type grips, the minimum force below which the grip should not slip on the rope and a maximum force above which the grip should slip on the rope.

chg 1986 **3.1.4.3.3 Strength.** The strength of the grip shall be based on the following criteria:

(1) A factor of safety of 6 shall exist in all parts of the grip wherein stress is proportional to the dead and live load of the carrier. This factor of safety is defined

as follows: With the grip in its operating position (gripping the rope or equivalent), a downward load, equal to the dead load of the carrier plus 6 times the design live load, shall not cause any part of the grip to fail.

(2) Those parts whose stress is not changed by application of live load shall be designed on the basis of an allowable stress of not more than the yield point divided by 3.0. In the design of springs, where used, the allowable stress may be increased if load tests are conducted by an approved testing laboratory to provide assurances that the fatigue life of the actual spring is more than ample for the various applied loads.

(3) For stresses caused by lateral loading, such as centrifugal force, the provisions of 3.1.4.6.2 shall apply.

(4) The material of which the grip is made shall be selected or selected and treated to obtain optimum impact resistance.

(5) Special attention shall be paid to fatigue considerations. A grip that has not been proved in service should be subjected to fatigue tests.

(6) Grips made up of cast parts shall be proof-loaded with forces equal to the gripping force and 3 times dead plus live load.

By inspection, confirmation shall be obtained that the grip and its parts meet the foregoing criteria.

3.1.4.3.4 Maximum Loads. The maximum total vertical load on a single grip shall not exceed 1/14 of the minimum tension in the haul rope.

Where two grips are used for a single carrier, the foregoing requirement may be applied to each grip, provided that:

(1) The two grips are independent of each other (that is, articulated in such a manner that they are independently loaded)

(2) The clear length of haul rope between the two grips equals or exceeds one-half rope lay

3.1.4.3.5 Positive Attachment. A detachable grip shall be designed and constructed in such a manner that it grips the haul rope positively without damaging the haul rope and in such a manner that it cannot become accidentally uncoupled, even by rope vibrations.

Provision shall be made to preclude a grip attaching to the haul rope at the splice unless the designer stipulates that the grip will function properly at that point and gives maximum and minimum permissible rope diameter variations through the splice length including the point of strand tucks.

chg 1988 **3.1.4.3.6 Incorrect Attachment.** At each carrier launching position (any area where a grip is designed to attach to the haul rope), devices shall be installed that will stop the lift if any grip incorrectly attaches to the haul rope (see 3.1.2.11.2(1)).

chg 1988 3.1.4.3.7 Add section

Upon clamping to the haul rope or haul-carrying rope, the carrier velocity and rope speed shall not vary sufficiently to introduce unduly either passenger discomfort or mechanical wear.

3.1.4.4 Track Cable Truck Wheels (Bicable Systems). On bicable systems, the weight of the loaded carrier and haulage rope reactions shall be distributed to carriage wheels, so that the load on any wheel shall not exceed that recommended for the track cable or the wheel liner material for wheel diameter selected. In no event shall the load per wheel exceed 1/80 of the minimum design tension in the track cable when track strand is used with unlined sheaves or 1/60 with resilient liner material. If wire rope is used as a track cable, the load per wheel shall not exceed 1/40 of the minimum design tension in the track cable.

The carriage shall be equipped with a device that will, as far as possible, hold the carriage on the track rope should the wheels derail. In areas where icing conditions may exist, the carriage shall be equipped with ice scraping devices that cannot contact the track cable under normal anticipated operating conditions.

3.1.4.5 Carriers for Detachable Gondola Lifts. The carrier and all components shall be designed by qualified engineers in accordance with accepted practices of design. If the design has not had prior successful use for passenger transportation, its adequacy shall be verified by test loadings, trial operations, and tests under repeated loadings.

3.1.4.5.1 Hanger. The hanger shall be securely attached to the track cable trucks or haul rope grip and to the cabin in such a manner that it cannot work loose.

The hanger shall be of sufficient vertical length that, under the worst condition of longitudinal swing, the top of the cabin cannot strike the haul rope, the track cables, or the bottom of a tower saddle. In any event, the carrier shall be able to swing longitudinally without interference to an angle of 15 degrees from the vertical at the most adverse locations.

Sway dampers designed to reduce the longitudinal sway of the carrier shall be used if recommended by the lift designer. Where used, they shall operate smoothly and without danger of deropement of the track cable trucks or the haul rope.

3.1.4.5.2 Gondola. Fully enclosed passenger cabins shall be ventilated. They shall be equipped with doors that fill the entire entrance opening. Each door shall be provided with a lock located in such a manner that it can be unlocked only by authorized persons or by automatic means.

All windows shall be of shatterproof material.

Means of emergency evacuation of passengers shall be provided. For cabins having a capacity of more than six passengers, the evacuation equipment shall be located in the carrier.

The maximum capacity of each cabin, both in pounds and kilograms and in the number of passengers, shall be posted in a conspicuous place in each cabin.

(1) Each carrier having a capacity of seven or more passengers shall be served by a conductor. If passengers are to remain standing, floor space of 2.5 square feet (0.23 square meter) per person shall be available; the width of cabin seats shall be at least 18 inches (46 cm) per person.

(2) All carriers shall be clearly identified with numbers located on each end of each carrier.

(3) Semiopen carriers shall meet applicable requirements for enclosed gondolas and open chairs.

3.1.4.6 Carriers for Detachable Chair Lifts

3.1.4.6.1 Vertical Loads. With respect to vertical loads, chair lift carriers shall be designed to support a vertical load 4 times the design load without permanent deformations of the assembly or component parts.

3.1.4.6.2 Horizontal Loads. With respect to horizontal loads, such as centrifugal loads that stress the hangers as they pass around terminals, the parts of the assembly, including hangers and grips, shall be designed with a factor of safety of 3.6 with respect to the yield point of the material(s). For this purpose, the applied load is to be taken as the computed force considered as a static load.

chg 1988 **3.1.4.6.3 Identification.** All carriers shall be clearly identified with successive numbers visible to the operator and attendant.

3.1.4.6.4 Chair Safety Details. Each chair shall be equipped with a railing at each side, to a height of not less than 4 inches (10 cm) above the seat for a distance of not less than 12 inches (30 cm) from the back of the seat.

For summer operation, each chair shall be equipped with a restraining device that will not open under forward pressure.

chg 1968 **3.1.4.6.5 Hanger Testing.** The designer or manufacturer shall identify for the owner hanger components and critical parts that require testing and develop criteria for testing these parts (see 3.3.4.3).

3.1.5 Provisions for Operating Personnel. Operator and attendant stations shall be located to provide visual surveillance of the line and station. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed: (1) the communications and controls required of the station; (2) the operating instructions and emergency procedures; and (3) a fire extinguisher. This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry.

The operator shall be located where he/she can observe the lift in operation. All primary lift controls and communications shall be immediately available to him/her. Loading and unloading areas shall have lift-stopping devices located convenient to the attendants assigned to those areas.

3.1.6 Operational and Maintenance Manuals

3.1.6.1 Operational Manual. The designer of each lift shall prepare an operational manual for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

3.1.6.2 Maintenance Manual. The designer of each lift shall prepare a maintenance manual for each installation. The manual shall describe recommended maintenance procedures, including:

(1) Types of lubricants required and frequency of application

(2) Definitions and measurements to determine excessive wear

(3) Recommended frequency of service to specific components

3.2 Electrical Design and Installation

3.2.1 General Design and Installation Testing. Prior to operation of newly installed tramways or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this standard and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), or solenoid or relay noise at levels and frequencies that could initiate loss of control.

3.2.1.1 Applicable Codes. All electrical systems shall comply with American National Standard National Electrical Code, ANSI/NFPA 70-1981 and American National Standard National Electrical Safety Code, ANSI C2-1981.

3.2.1.2 Location. All electrical power transmission wiring located near or proposed to cross over tramways shall comply with the applicable requirements of ANSI C2-1981.

3.2.1.3 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

3.2.1.4 Voltage Limitations for Overhead Circuits. Signal, communication, and control circuits may be supported between the towers that support the tramway. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

3.2.1.5 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

3.2.1.5.1 Control Wiring Classification. All control wiring shall be Class 1 in accordance with Article 725 Parts A and B of ANSI/NFPA 70-1981.

3.2.1.5.2 Communication Wiring. All communication wiring and systems are excluded from the requirements in Article 725-5 of ANSI/NFPA 70-1981.

3.2.1.5.3 Insulation. All control wiring is excepted from the requirements of Article 725-16 of ANSI/NFPA 70-1981. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

3.2.1.5.4 Exterior Lighting and Snowmaking Circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18 meters) of the tramway centerline, shall be ground fault protected.

3.2.1.6 Grounding

3.2.1.6.1 Structures. All metallic structures shall be connected to a common conductor. Electrical continuity of all metal parts of the structures shall be assured by mechanical connection.

3.2.1.6.2 Drive Terminal Structure. The drive terminal structure shall have one point referred to as a ground point, as defined in ANSI/NFPA 70-1981. All direct-current and alternating-current electrical systems shall be referenced to this point. If an electrical prime mover is used, the electric service grounding electrode conductor shall terminate at this point. Under the worst case conditions, the resistance from the ground point to any grounded point within the tramway system shall not exceed 50 ohms. The grounding system for the tramway shall not be used as a grounding system for any other system not related to the tramway system.

To ensure that the 50-ohm grounding requirement is met under all conditions of soil, moisture, temperature, and circulating ground and air currents, all terminals and line structures shall be bonded together with a bonding conductor.

3.2.1.6.3 Haul Rope Grounding. Grounding sheaves or equivalent means shall be provided at one location for the purpose of grounding track cables and haul ropes, as applicable, for static electrical discharge. For the haul rope on reversible tramways, bicable aerial systems or monocable systems with an isolated or insulated haul rope incorporated in the operating circuitry, no means of grounding are required.

3.2.1.6.4 Lightning Protection. If lightning protection is provided, it shall follow the American National Standard Lightning Protection Code, ANSI/NFPA 78-1980.

3.2.1.7 Operating Control Circuits. If, for any reason, the operator has lost control of the tramway while using the normal or operating control circuitry, the control circuitry shall be designed to allow the attendant/operator to stop the tramway with the emergency stop circuit. Any one of the following six conditions shall be considered a loss of control of a tramway:

(1) Tramway will not *slow down* when given the command to do so

(2) Tramway will not *stop* when given the command to do so

(3) Tramway *overspeeds* beyond control settings and/or maximum design speed

(4) Tramway *accelerates* faster than normal design acceleration

(5) Tramway *self-starts* or *self-accelerates* without the command to do so

(6) Tramway *reverses* direction unintentionally and without the command to do so

Control circuits shall not have anything across or parallel with the contacts of switches, relays, or safety devices including solid state devices monitoring the circuits or devices, unless it can be shown that any failure mode of the device placed across the switch does not defeat the purpose of the switch.

Each control circuit shall be tested for circuit integrity at its most remote terminal on a daily basis. An inadvertent ground or power failure shall stop the tramway.

3.2.1.7.1 Emergency Stop Circuit. All tramway control systems shall include a normally energized electrical circuit, that, when interrupted, effects an emergency stop (see 1.4.20.1). The emergency stop shall have priority over all other control stops or commands. This circuit shall include a manual stop device at each attendant/operator station in close proximity to loading and unloading areas, main control panel, and machine room. These emergency stop switches shall be red.

When there is only one stop circuit, it shall be classified as the emergency stop circuit.

3.2.1.7.2 Normal Stop Circuit. All tramway systems shall include a normally energized electrical circuit that, when interrupted, effects a normal stop (see 1.4.20.2).

3.2.1.7.3 Operating Circuitry. All tramway systems shall contain a normally de-energized circuit that, when energized, causes the system to start, accelerate to and run at designated speeds and, when de-energized, causes the system to stop.

All start/run and speed control switches shall be conspicuously and permanently marked with the proper function.

All stop switches shall be of the manually reset type and be positively opened mechanically and their opening shall not be dependent upon springs.

3.2.1.7.4 Bypass Circuits. Bypass circuits may be installed for emergency conditions. Controls to bypass any portion of the operating control circuitry shall be locked and may be operated only by the tramway supervisor or his/her designated representative. Operation of the bypass shall require the physical effort of the person activating it to maintain the bypass condition (momentary contacts).

Bypass circuits shall be provided with a warning light to clearly indicate the bypass circuit is in use. The tramway shall be maintained under close visual surveillance when the safety circuits are bypassed.

3.2.1.8 Electrical Prime Mover and Power Circuits

3.2.1.8.1 Electrical Prime Mover. All tramway systems equipped with electrical prime movers (electrical motors) shall have phase loss protection on all power phases.

3.2.1.8.2 DC (Direct Current)-Powered Drives. All DC electronic speed regulated drives and DC-powered electric motors shall shut down in the event of:

(1) Field loss

(2) Speed feedback loss

(3) Overspeed

(4) Overcurrent

(5) SCR misfiring

3.2.2 Night Lighting. For nighttime operation, operating tramways shall be provided with lighting facilities. Lighting shall be provided at loading and discharge areas.

3.2.2.1 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

3.2.2.2 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp operating characteristics.

3.2.2.3 Location. Lights shall be mounted on substantial poles or standards. Tramway tower and terminal structures may be used for supporting lights subject to the following requirements:

(1) Approval shall be obtained from a qualified engineer.

(2) The service conductors to each tramway tower or terminal structure shall be underground or in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the tramway line.

(3) A separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure.

(4) All metallic raceways on a tower or terminal structure shall be grounded.

(5) The lighting installation shall not conflict with other requirements of this standard and shall not interfere with operations of the tramway in any manner.

3.2.2.4 Emergency Lighting. Emergency lighting shall be provided in the event of electric power failure to permit:

(1) Regular unloading of tramway facilities

(2) Emergency evacuation of carriers

3.3 Operation and Maintenance

3.3.1 General and Personnel Safety. This subsection covers the requirements for operation and maintenance of detachable aerial lifts. Many requirements are listed elsewhere in Section 3, since they also regulate installation and design. It is imperative that operating and maintenance personnel be familiar with applicable provisions of this section.

Operation and maintenance of aerial tramway equipment can be dangerous to personnel performing these tasks. Procedures for performing these functions shall require precautionary measures necessary to assure the safety of the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

3.3.2 Operation

3.3.2.1 Personnel. Detachable grip aerial lifts shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. One or more persons familiar with emergency procedures shall be on the site at all times when the facility is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific lift.

3.3.2.1.1 Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for safe operation, and shall have the authority to deny access to the lift to any person who in the supervisor's opinion is not fit or competent to use the lift without danger to that person, to others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the lift under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

3.3.2.1.2 **Operators.** An operator shall be in charge of each lift. This operator shall be trained and experienced in normal operational and emergency procedures.

3.3.2.1.3 **Attendants.** An attendant shall be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view.

3.3.2.1.4 **Conductors.** A conductor shall be trained for duty in connection with enclosed carriers, including loading and unloading procedures, communications, and the use of door locks and keys. The conductor shall be familiar with load limits and applicable safety regulations, well-versed in the use of any safety switches under his/her control, and thoroughly drilled in the use of emergency evacuation equipment and procedures.

3.3.2.1.5 **First Aid.** One or more persons trained to administer first aid shall be available at all times when a lift is operating and transporting passengers. There shall be ready access to first aid supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

3.3.2.2 **Minimum Operating Personnel.** The following personnel are the minimum that shall be required:

(1) An operator shall be in charge of each aerial lift

(2) One attendant shall be on duty at each loading area

(3) One attendant shall be on duty at each unloading area

(4) A conductor shall be in each carrier having a capacity of seven or more passengers (see 3.1.4.5.2(1)).

NOTE: An operator may serve concurrently as an operator and an attendant at a loading or unloading area that may be adjacent to the operator's station unless the duties of that area preclude his/her maintaining reasonable surveillance of the entire lift operation.

3.3.2.2.1 **Exceptions.** An intermediate station used for both loading and unloading may be manned by a single attendant at the loading area when both the loading and unloading can be kept under surveillance by the attendant.

3.3.2.2.2 **Additional Requirements.** Additional attendants shall be assigned to handle carriers at terminals and stations as required by the specific design and installation.

3.3.2.3 **Duties of Operating Personnel**

3.3.2.3.1 **Supervisor.** The duties of the supervisor shall be as follows:

(1) To determine that all lifts are operational and that all operating personnel are trained, equipped, and fit to perform their duties

(2) To discontinue operations on any lift due to physical, weather, personnel, or other reasons

(3) To enforce operational, maintenance, and safety rules

3.3.2.3.2 **Operator.** The duties of the operator shall be as follows:

(1) To assume responsible charge of the lift

(2) To assign and supervise all attendants on his/her lift

(3) To maintain an operational log book as required in 3.3.5.1

(4) To advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation

3.3.2.3.3 **Attendant and Conductor.** The duties of the attendant and the conductor shall be as follows:

(1) To maintain orderly passenger traffic conditions within his/her area of jurisdiction

(2) To advise and assist passengers, as required

(3) To maintain surveillance of his/her area of jurisdiction

The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

3.3.2.4 **Operational Procedures.** The required operational procedures as set forth in 3.3.2.4 and 3.3.2.5 shall be supplemented by specific requirements as specified in the designer's operational manual (see 3.1.6.1).

3.3.2.4.1 **Control of Passengers.** Each lift shall have a definite method for marshaling passengers for safe loading and unloading. Fences and gates may be required to implement the system.

3.3.2.4.2 **Daily Preoperational Inspection.** Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:

(1) A visual inspection of each terminal, station, and the entire length of the lift

(2) Assurance that tension carriage, counterweights, or other tensioning devices are functional and have adequate travel with clearance at both ends of travel

(3) Operation of all manual and automatic switches in terminals, stations, and loading and unloading areas

(4) Operation of all braking systems

(5) Operation of communication systems

(6) Operation of the lift, including a visual inspection of all ropes and carriers

For those lifts having primary-power internal combustion engines, the fuel quantity shall be determined to be sufficient to conduct the anticipated period of operation without refueling. For those installations having auxiliary internal combustion engines, the fuel supply shall be adequate to unload the lift. During refueling, power units shall be shut down.

Lifts having auxiliary power units shall have the auxiliary engine(s) checked during this inspection and operated at least once each week.

Loading and unloading facilities shall be inspected and, if necessary, cleared of ice and snow to permit the safe ingress and egress of passengers. Mechanical features of the carriers shall be inspected and checked for correct operation.

3.3.2.5 Operational Requirements

3.3.2.5.1 General. The supervisor and operator of each lift shall review the requirements of 3.1 and Section 7 of this standard to ascertain that original design and installation conditions have not been altered in such a manner as to violate the requirements of the standard.

3.3.2.5.2 Starting. No lift shall be started except at the direction of or following clearance by the operator. Aerial lifts while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance or emergency operation.

3.3.2.5.3 Stops. After any stop of a lift, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

3.3.2.5.4 Damage to Carriers. Should any carrier become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked and not used for passengers until repaired or replaced. It shall be removed from the line when feasible.

3.3.2.5.5 Hazardous Conditions. When wind or icing conditions are such that operation is hazardous to passengers or equipment, according to predetermined criteria based upon the area's operational experience and the designer's design considerations, the lift shall be unloaded and the operation discontinued. If necessary under the predetermined criteria, device(s) shall be installed at appropriate location(s) to ascertain wind velocity and direction when aerial lifts are operated. No lift shall operate when there is an electrical storm in the immediate vicinity. Should such conditions develop while the lift is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to discharge all passengers. When such shutdown has been caused by an electrical storm, grounding of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to resumption of passenger operations.

3.3.2.5.6 Evacuation. Provisions shall be made for the emergency evacuation of aerial lifts (see 3.1.1.11). These shall include a detailed plan of evacuation, equipment necessary for evacuation, and adequate training of personnel. Evacuation drills shall be conducted at established intervals not to exceed one each 12 calendar months, and such drills recorded in the operational log of each lift (see 3.3.5.1).

3.3.2.5.7 Termination of Daily Operations. Procedures shall be established for terminating daily operations in such a manner that passengers will not be left on the lift after it has been shut down. Loading ramps, as required, shall be closed during off-hours and so marked.

3.3.2.5.8 Operational Log. A daily operation record shall be maintained as required under 3.3.5.1.

3.3.3 General Maintenance. Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance requirements of the designer (see 3.1.6.2) shall be followed. Maintenance records shall be kept (see 3.3.5.3).

A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:

(1) All wire ropes and cables (see 7.4.1 and 7.4.2)

(2) Line sheave units, sheaves, bearings, and liners

(3) Bull wheels, bearings, and liners

(4) Counterweight or tensioning systems

(5) Drive system, including bearings and couplings

(6) Braking systems

(7) Electrical control systems

(8) Communication systems

(9) Carriers

Detachable rope grips shall be disassembled for inspection, adjustment, and replacement of worn parts at intervals not to exceed those recommended by the designer.

3.3.4 Inspections and Testing

3.3.4.1 General Inspection. Each facility shall be inspected annually, or after each 2,000 hours of operation, whichever comes first, by a tramway specialist independent of the owner. The inspection shall verify preservation of original design integrity and cover the requirements of this standard for maintenance, operation, required self-inspections, and recordkeeping. Items found either deficient or in noncompliance shall be noted. A report signed by the specialist shall be filed with the owner.

3.3.4.2 Wire Rope and Strand Inspection. Inspection of wire rope and strand shall comply with 7.4.1 and 7.4.2.

Chg 1988 **3.3.4.3 Hanger Testing.** Hanger critical parts shall be tested against an acceptance criteria established by the designer or manufacturer or, in cases where the designer or manufacturer is no longer in business and the original criteria is no longer applicable, by a qualified engineer.

Every carrier hanger shall be visually inspected every year against a criteria developed by the original equipment manufacturer or a qualified engineer. The inspection shall be documented as part of the lift logs.

The hanger shall be uniquely identified by the manufacturer or the owner. The test sampling method shall uniquely identify the parts tested and assure a rotating minimum test sample on each lift of 10 hangers or 10% of the total hangers per year, whichever is the greater.

If the hanger critical parts are tested by an agency other than the original equipment manufacturer, then the original equipment manufacturer shall receive a copy of the test procedure and the test results. In all cases, the owner shall receive a copy of the test procedure and the test results.

3.3.5 Records

3.3.5.1 Operational Log. A log book shall be maintained for each lift. Daily entries shall be made, giving the following minimum information:

(1) Date
(2) Names and duty stations of operating personnel
(3) Operating hours and purpose of operations
(4) Temperature, wind, and weather conditions
(5) Record of compliance with daily operational inspection
(6) Position and condition of the tension carriage, counterweights, or other tensioning devices
(7) Accidents, malfunctions, or abnormal occurrences during operation
(8) Signature of operator

3.3.5.2 Wire Rope and Cable Log. A log book shall be maintained for each lift, giving the following information on each rope and cable.

(1) Approved specification
(2) Copy of certified test report
(3) Date installed
(4) Splicing certificate for each splice or laid in strand
(5) Record of lubrication, including type of lubricant and date applied
(6) Record of maintenance inspections (see 7.4.1(2))
(7) Report of wire rope and cable inspection (see 7.4.1 and 7.4.2)
(8) Report of accidents or injury to rope
(9) Documentation of end attachment (see 7.3.2.4)

3.3.5.3 Maintenance Log. A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

3.3.6 Passenger Conduct

3.3.6.1 Dexterity and Ability. A skier or foot passenger who uses a lift shall be presumed to have sufficient skiing ability or physical dexterity to negotiate the lift.

3.3.6.2 Embarkation and Disembarkation. A passenger shall get on and get off a lift at designated areas.

3.3.6.3 Riding. Passengers, while riding an aerial lift, shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the lift. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person.

3.3.6.4 Downhill Skier. Each skier should maintain control of speed and course as he/she is getting on or getting off the lift.

4. Fixed Grip Aerial Lifts

This section covers the class of aerial tramways wherein the carriers circulate around the system, remaining attached to the haul rope. The carriers travel from one terminal to the other along one path and return along another path, making U-turns in both terminals. This section does not include tramways wherein the passengers are in contact with the ground or snow during the trip.

The tramways covered by this section are of the monocable type. The carriers may be open chairs, cars, or gondolas.

4.1 Design and Installation

4.1.1 General

4.1.1.1 Design Passenger Weight. For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77 kg).

4.1.1.2 Location. In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the lift type and location:

(1) Electric power lines and their supports
(2) Railways
(3) Highways
(4) Structures
(5) Rock and earth slides, cave-ins, washouts, etc
(6) Snow creep and avalanches
(7) Wind action
(8) Icing
(9) Ski slopes and trails
(10) Rivers and gullies
(11) Buried installations, including pipelines
(12) Crossing or close proximity to other aerial tramways (see Note)
(13) Control of air space below, above, and adjacent to the installation
(14) Carrier height above ground or surface

NOTE: Where aerial lifts cross one another, the following conditions shall be met:

(1) The crossover shall be made in such a manner that no complete deropement, failing to be retained by the rope-catching device (see 4.1.3.3.2), of a single tower of either lift will cause contact of the moving rope or carriers of one lift with the rope or carriers of the other lift under any design condition of loading.

In lieu of the above, the crossover may occur at a tower that is common to each lift.

(2) Any deropement of the upper lift shall cause both lifts to stop and a deropement of the lower lift that reduces the clearance between the two lifts shall cause both lifts to stop.

(3) The minimum vertical clearance between the haul rope of the lower lift and the top of the chair seat of the upper lift shall be 10 feet (3 meters) under the most adverse loading conditions.

4.1.1.3 Width of Clearing. The clearing shall be wide enough to prevent interference with the lift by adjacent vegetation. Such clearings shall be protected, if necessary, to avoid washouts that might endanger the installation. Potentially dangerous trees shall be cleared far enough back to avoid their falling on the lift.

4.1.1.4 Path of Rope. Terminals and towers shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration. Clearing shall be accomplished so that cabins or carriers will not come in contact with trees or vegetation during operating surges of the line, or under maximum design wind conditions, or both. In no case shall trees or vegetation extend within 5 feet (1.5 meters) of any portion of the haul rope or carrier under normal (nonsurge) operating conditions.

4.1.1.4.1 Vertical Clearances. Where skiing is permitted beneath the lift line, or at points where ski trails cross under a lift line, a minimum vertical distance of 13 feet (4 meters) between the design maximum snow depth and the top of the carrier seat shall be maintained under conditions of maximum sag.

Whenever the clearance is less than 15 feet (4.5 meters), no public transportation shall be permitted beneath the lift. Whenever the clearance is less than 8 feet (2.4 meters) for gondolas and empty chairs or 10 feet (3 meters) for chairs carrying foot passengers, provision shall be made to prevent access by unauthorized persons to the area beneath the lift. Under the most adverse loading conditions, a minimum space of 5 feet (1.5 meters) shall be maintained between the lower edge of carriers or ropes and the terrain or other possible obstacles, including snow.

4.1.1.4.2 Horizontal Clearances. The minimum distance between passing carriers, each swung 10 degrees inward from the vertical, shall be the greater of the following:

(1) 2 feet 6 inches (0.8 meter)
(2) 1/2% of the span length (applies to gondolas only)

The distance between haul ropes for the purpose of these checks shall be considered as equal to the gage of the line.

External structures, posts, or obstructions other than lift structural components shall be at least 48 inches (122 cm) clear of either edge of a loaded passenger seat of an open cabin or carrier hanging in a vertical position except for control consoles which may have a clearance of 30 inches (76 cm).

4.1.1.4.3 Path of Rope Adjustment. When terminals, towers, or both contain provisions for a change in height of rope or track supports in order to meet normal changes in operational requirements, such provision shall be controlled as follows:

(1) The designer's operational manual shall provide complete instructions for proper procedures and sequences for making adjustments.

(2) Where range of adjustments allows possible operator error resulting in improper sheave loading, a system of readily verifying proper profile positioning without the use of tools shall be incorporated into the installation.

4.1.1.5 Capacity and Speed. The maximum carrier speed relative to the surface of loading and unloading platforms during loading or unloading operations shall not exceed the values shown in Table 4-1. The designer shall specify the design capacity in each direc-

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Table 4-1
Maximum Relative Carrier Speed, in Feet per Minute (Meters per Second), for Chair Lifts with Fixed Grips

Passenger Type	Single Chair	Double Chair	Triple Chair	Other Chairs
Skiers	600 (3.0)	550 (2.8)	500 (2.5)	450 (2.3)
Foot passengers	350 (1.8)	300 (1.5)	275 (1.4)	250 (1.3)

tion. The speeds listed in Table 4-1 may be increased if a lift is slowed or stopped for loading and unloading, but in no case shall the speed exceed 700 feet per minute (3.6 meters per second).

4.1.1.6 Structures and Foundations. All structures and foundations shall be designed and installed in conformance with applicable criteria listed in 1.3. Applied design loads shall include dead, live, snow, wind, and dynamic loads due to normal operations and for foreseeable abnormal conditions.

Structures and foundations located in snow creep areas shall be designed for such conditions and loads or be protected by snow breakers or shears.

4.1.1.6.1 Structures. When bolted to foundations, structures shall be bolted with double nuts, lock nuts, or equivalent means of locking nuts.

4.1.1.6.2 Foundations. In determining the resistance of the earth to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage should be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on solid rock. Foundations on rock shall be firmly anchored to solid rock unless designed as gravity foundations.

The top of concrete shall be not less than 6 inches (15 cm) above finished grade unless specific direction for protection of foundation and structural steel below grade is provided by the designer.

The design shall have factors of safety of 2 in resisting overturning, and concurrently 2 against sliding, under dead load and live load conditions; the factors shall be 1.5 under these loadings plus wind acting simultaneously.

4.1.1.7 Communications. A permanently installed two-way voice communication system shall be provided between the prime mover and auxiliary power unit control point, drive machinery building, loading stations, and unloading stations. The power for this system shall be independent of the primary power source and the communication system shall be functional and audible during a power failure.

Audio indicators (bells, etc) shall be audible over all ambient noise levels and visual indicators (e.g., LEDs) shall be visible even in bright sunlight.

4.1.1.8 Internal Combustion Engine Installation

4.1.1.8.1 Fuel Storage. Fuel tanks shall be of adequate capacity to permit uninterrupted operation during the normal operating period. Where internal combustion engines are located in weatherproof equipment rooms or buildings, fuel tanks shall be located at least 5 feet (1.5 meters) from the outside of the rooms or buildings for surface tanks or in an underground installation. The fill pipe shall be capped and locked, and located to avoid toxic fumes and fire hazard during refueling. Stopcocks shall be provided on fuel lines at points where the lines enter the building in underground installations or where the lines leave the tanks for aboveground installations.

Integrally mounted fuel tanks are permissible on auxiliary engines located in other than weathertight rooms.

In all respects, the installation shall comply with American National Standard for Stationary Combustion Engines and Gas Turbines, ANSI/NFPA 37-1979.

NOTE: Integrally mounted steel fuel tanks may be located within or beneath weathertight buildings supported on, or enclosing, combined drive-tension carriages, provided that the end of the fill pipe is located beyond the sides of the building, has a locked fill cap, and is in such a location as to avoid toxic fumes and fire hazard during refueling.

Liquid fuels shall be stored and handled in accordance with American National Standard Flammable and Combustible Liquids Code, ANSI/NFPA 30-1981 and ANSI/NFPA 37-1979. Liquefied petroleum gas installations shall be made in accordance with American National Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58-1979.

4.1.1.8.2 Exhaust Systems. Exhausts shall be designed and installed to discharge to the atmosphere so that precipitation does not enter the system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields.

4.1.1.8.3 Gear Shifts. Where gear shift levers are used, provisions shall be made to prevent accidental shifting of levers into speed ratios exceeding design or accidentally into reverse gear during public operation. Gears of manual transmissions shall not be shifted when the lift is moving.

4.1.1.9 Loading and Unloading Areas. Platforms, ramps, and related units comprising the loading and unloading areas of all aerial tramway types are integrally related to safe operation. They shall be designed and installed in conformance with applicable criteria listed in 1.3.

Handrails, safety nets, or ramps shall be provided where needed for the protection of the passengers and operating personnel. The haul rope shall approximately parallel the platform.

Chairs passing loading and unloading areas shall not vary in height above the area greater than 4 inches (10 cm) under the most adverse conditions of design loadings and rope tensions.

Intermediate unloading and loading stations, when located in tandem to permit simultaneous unloading and loading at an intermediate station, shall be separated by an adequate distance that will permit the safe exit of the unloading passenger and the reloading of the vacated carrier. In no case shall the distance in feet (meters), from the unloading point to the loading point, be less than 8 times the maximum rope speed in feet (meters) per second. Provisions shall be made to provide safe egress from and ingress to these areas. When either area of the combined station is not in operation, a sign shall be so displayed (see 4.1.1.10) and the ingress closed.

4.1.1.9.1 Loading Areas. Loading areas shall have sufficient level length to permit passengers to load safety. The minimum length shall be 8 feet (2.4 meters).

Towers adjacent to loading areas shall be protected to prevent the ski tips of passengers from becoming entangled in the towers.

4.1.1.9.2 Unloading Areas. Unloading areas shall have sufficient length to permit passengers to unload safely. A minimum length of 8 feet (2.4 meters) shall be provided that is inclined along the direction of carrier travel not more than 10% downward or upward. The entering end of this section shall be fitted with inclined guards to prevent ski tips of unwary passengers from being caught under the edges of the platform. The point where passengers should disembark shall be clearly identified (see 4.1.1.10.2).

Ramps sloping downward from the exit of the unloading area shall not be steeper than 40%.

When a lift and unloading area are designed for passengers to disembark in close proximity to the upper terminal bull wheel, normally designated as "bull wheel unloading," the following requirements shall be met:

(1) The beginning of the exit ramp shall be so situated that the combination of the ramp slope and the distance from the point of tangency of the bull wheel to the top of the ramp shall be such that the passengers shall clear the carrier as they ski down the ramp under the most adverse conditions of snow friction.

(2) A safety gate shall be required to stop the lift in the event a passenger fails to unload. Provision shall be made to unload passengers from the carrier in this event without either lift reversal or carrying passengers beyond the downhill end of the unloading area.

(3) The discharge ramp shall be clearly identified by a pronounced break having a minimum gradient of 12%.

(4) There shall be a sign clearly identifying the unloading point: "Unload Here."

(5) There shall be no impediment to unobstructed passage of persons inadvertently failing to unload.

(6) Any ramp on the return side shall be required to have proper protection for ski tips of passengers who actuate the safety gate and pass around to this ramp.

4.1.1.10 Signs. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point (see 4.3.6). All such signs shall be prominently placed, and those pertaining to the lift operations shall be adequately lighted for night operation.

Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons and locked.

The sign "Men Working on Lift" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the auxiliary or prime mover when men are working on the passenger tramway. See 4.1.1.13 for additional requirements.

4.1.1.10.1 Additional Signs for Fixed Grip Gondolas. The following information shall be prominently posted on the interior of each carrier:

(1) The maximum capacity of each carrier in pounds and kilograms and number of passengers. (This shall be also posted at each loading area.)

(2) Instructions for procedure in emergencies.

4.1.1.10.2 Additional Signs for Fixed Grip Chair Lifts. The following signs shall be posted:

(1) "Prepare to Unload" (not less than 50 feet (15 meters) ahead of unloading area)

(2) "Keep Ski Tips Up" (ahead of any point where skis may come in contact with a platform or the snow surface)

(3) "Unload Here"

(4) "Safety Gate" (if applicable)

(5) "Remove Pole Straps from Wrists" (at loading area)

Signs shall also be visible at all points of downhill loading, listing downhill capacity of lift.

4.1.1.11 Evacuation. Aerial tramways shall be provided with approved means to evacuate passengers from stranded carriers.

All nonmetallic rope used for evacuation shall be of synthetic polyester fiber, such as Dacron or equal, or of a hard lay nylon with a minimum diameter of 7/16 inch (11 mm) and a minimum breaking strength, when new, of 5000 pounds (2268 kg). No natural fiber or polypropylene ropes shall be used.

These ropes shall be carefully stored when not in use, and they shall be examined after each complete lift evacuation and prior to each season of operation, both summer and winter, to ascertain that they are in satisfactory condition.

Carabiners, if used, shall be of the locking type.

4.1.1.12 Tests and Inspection

chg 1988 **4.1.1.12.1 Acceptance Tests and Inspection.** Before a new or relocated aerial tramway is opened to the public, it shall be given thorough inspection and tests by qualified personnel to verify compliance with the plans and specifications of the designer. The designer or manufacturer shall propose and submit a load test procedure.

It shall be the responsibility of the owner to see that the following conditions have been met:

(1) Tightness of all structural connections

(2) Lubrication of all moving parts

(3) Alignment and clearances of all open gearing

(4) Installation and alignment of all drive components

(5) Position and freedom of movement of counterweights or other tensioning means and carriages

(6) Haul rope alignment at entrance to bull wheels

(7) Operation of all electrical components, including circuit protection and grounding

4.1.1.12.2 Aerial Lift Inspection. Inspection of an aerial lift shall also cover:

(1) Haul rope sags under the most adverse static loadings.

(2) Alignment of haul rope sheave units.

(3) Evacuation equipment and procedures, including an actual test at the most difficult location.

(4) Towers and terminals for correct location and installation in accordance with plans and specifications. Terminal and tower cable working points shall be documented by an "as built" survey, and any variation from the design drawings shall be noted and approved by the engineer responsible for design.

(5) Thorough operating tests under full loading and any partial loadings that may provide the most adverse operating conditions. Test load per carrier shall be 110% of the design live load. For chair lifts wherein loaded chairs can pass around the terminal (see 4.1.2.11.2(1)), the test shall include passing a loaded carrier with 110% of the design live load around the bull wheel at full speed. The functioning of all push-button stops, automatic stops, limit switches, selected deropement switches, and communications shall be checked. Acceleration and deceleration rates shall be satisfactory under all loadings (see 4.1.2.4). Motive power and all braking and backstops (see 4.1.2.5) shall be proved adequate under the most adverse loadings. The tests shall include at least 6 hours of continuous operation with empty carriers to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tensioning systems, and other related defects.

4.1.1.13 Safety of Operating and Maintenance Personnel. Provision shall be incorporated in an aerial lift design to render the system inoperable when necessary for the protection of personnel working on the lift. See 4.1.1.10 for placement of applicable warning signs.

4.1.2 Terminals and Stations

4.1.2.1 Power Units

4.1.2.1.1 Prime Mover. All prime movers shall have capacity to handle the most unfavorable design loading conditions, including the starting of a fully loaded lift.

Where manual multispeed transmissions are used on either the prime mover or auxiliary power unit, gears shall not be shifted when the tramway is moving.

Where reverse capability is provided on the prime mover or auxiliary power unit for any lift, provisions shall also be made to prevent accidentally shifting into reverse whenever the lift is operating.

The lift shall be started at its lowest point of speed range after any type of stop.

4.1.2.1.2 Auxiliary Power Unit. An auxiliary power unit with an independent power source shall be provided that can be readily used to unload the line in the event of failure of the primary power unit. This unit shall be electrically wired to meet the requirements of 4.2.1.7.1 so that it can be stopped by the emergency stop circuit at all loading and unloading stations and terminals in use. As a minimum, the auxiliary power unit shall be capable of starting and moving a fully loaded line in a forward direction at not less than 100 feet per minute (0.5 meter per second) or at an average speed in feet per minute equal to 1/60 the slope length of the lift in feet (meters per second equal to 1/3600 the slope length of the lift in meters), whichever is greater. The auxiliary engine shall not depend upon the mechanical integrity of the prime mover to drive the unit.

No lift shall be operated using a single power unit without an operable auxiliary power unit, except to unload passengers and for maintenance purposes, unless the following requirements are met:

(1) All brakes and backstop devices shall be functional with the auxiliary drive.

(2) All control circuits, safety gates, and stop switches are functional and control the auxiliary drive.

(3) Temperature and weather conditions are such

that a two-hour waiting period in the carrier would not be injurious to passengers.

(4) Evacuation gear and personnel are immediately available in sufficient number and quantity that the entire lift can be evacuated in a two-hour period. Demonstration of this capability shall be required before authorization is granted to use the auxiliary power unit for passenger operations.

(5) If downhill capacity is desired, 4.1.2.4 shall be complied with.

4.1.2.2 Speed Reducers and Gearing. All speed reducers and gearing shall have the capacity for starting a lift under the most unfavorable design loading conditions and without exceeding design rating. They shall have a service factor appropriate for the application and they shall comply with the standards of the American Gear Manufacturers Association (AGMA), listed in 2.1.2.2.

Chg 1988 **4.1.2.3 Bearings, Clutches, Couplings, and Shafting.** Bearings, clutches, and couplings shall be selected on the basis of the manufacturer's published recommendations for the particular use. If published data are not available for the specific use, the manufacturer's approval shall be obtained. Bearings, clutches, and couplings of special design, if used, should have the approval of a qualified mechanical engineer.

Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings when required.

All shafting shall be designed in accordance with accepted standard practices.

4.1.2.4 Acceleration and Speed Control. The drive equipment shall be designed to accelerate the line smoothly and to avoid severe oscillation or undulation under any loading condition.

The drive shall be capable of rotating the unloaded system at reduced speed for rope inspection and equipment maintenance. This reduced-speed operation may be obtained by the use of the auxiliary engine.

On installations in which a forward overhauling condition exists:

(1) Provisions shall be made for an overhauling load so that the system shall operate at a controlled speed not exceeding design speed by more than 6%. The energy developed by the overhauling load shall be dissipated in a satisfactory manner without using the brakes specified under 4.1.2.5.

Where the provision made for an overhauling load consists of regenerative capability or a similar characteristic in the prime mover itself, the auxiliary power unit shall have a comparable capability.

(2) Provision shall be made for slowing and stopping the lift drive automatically if the line speed exceeds the design speed by more than 10%. The service brake (see 4.1.2.5.1) shall slow and stop the lift automatically if the line speed exceeds the design speed by more than 10%, and the emergency brake shall automatically slow and stop the lift if the line speed exceeds the design speed by more than 15%. The lift shall be started at its lowest point of speed range after any type of stop.

Design values of line speed pertain to the design speed for the particular condition of operation (that is, winter operation with skiers, summer operation with foot passengers).

Where the lift is not rated for downhill passenger traffic, the following number of loaded chairs, loaded no more closely than every fourth chair, shall be permitted for the carrying of authorized persons downhill; the requirements for a safety gate (4.1.2.11.2(1)) beyond the downhill unloading area and for slowing and stopping the lift drive automatically as set forth in 4.1.2.4(2) shall be waived.

Total Number of Carriers on Chair Lift (Both Sides)	*Maximum Number of Loaded Carriers on Downhill Rope*
Less than 60	2
60 to 120	3
Over 120	4

For the purpose of this section only, the term "authorized persons" is defined to include all persons, whether employees of the lift owner or not, who are authorized by the owner or the owner's representatives to be carried on the lift.

All installations in which downhill traffic is either limited or not permitted shall be so identified with clearly visible signs at loading or unloading areas, and this information shall be further contained in operating instructions posted in these areas.

4.1.2.5 Brakes. The lift shall have the brakes and backstops designated in Table 4-2.

The service brake, emergency brake, and backstops shall be independent systems, such that failure of one system will not impair the function of the other systems, and all service brakes and emergency brakes shall have the braking force applied by springs, weights, or other approved forms of stored energy.

The service brake, emergency brake, and backstops shall be designed to assure operation under all anticipated conditions, including weather.

All braking systems shall be capable of operation to comply with daily inspection required by 4.3.2.4.3(4). All backstops shall be disengageable as required for the individual testing of brakes. Stopping distances specified under performance requirements for brakes shall be achieved by the particular brake without the aid of other braking devices or drive regeneration, etc.

Table 4-2
Required Stopping Devices

Lift Category	Service Brake	Emergency Brake	Bull Wheel or Cable Backstop	Drive Train Backstop	Retarding Device (See 4.1.2.4)
Self braking A lift that decelerates, stops, and remains stopped within the service brake performance requirements without a braking device	Not required	Required	Not required	Not required	Not required
Nonoverhauling A lift that will not accelerate in either direction when it is not driven, but is not self-braking	Required	Required	Not required	Not required	Not required
Overhauling, reverse direction A lift that will accelerate in the reverse direction when it is not driven	Required*	Required	Required	Required	Not required
Overhauling, forward A lift that will accelerate in forward direction when it is not driven	Required	Required	Required	Required	Required

*A service brake is not required if the overhauling, reverse direction lift will meet the service brake stopping requirements under the most unfavorable design loading conditions.

4.1.2.5.1 Service Brake. The controls shall be arranged at each station such that the brake begins decelerating the lift within 3 seconds after the operator or attendant reacts to the stimulus to apply the brake. The controls to the brake shall not be located in a position that would require the operator or attendant to pass through the path of moving carriers in order to operate the controls.

This brake can be located at any point in the drive train so that there is no clutch, or similar device, between the brake and the drive sheave.

The application of the brake shall automatically stop the drive shaft when the brake is applied. The brake shall be in a normally applied position.

The service brake shall be an automatic brake to stop and hold the lift under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall be adjusted so that it will stop the lift from full speed, with the design loading condition most unfavorable to stopping, in a distance not exceeding the larger of (1) 10 feet (3 meters) or (2) a distance in feet (meters) equal to $V^2/8000$ where V is the lift speed in feet per minute ($1.5\ V^2$ where V is the lift speed in meters per second).

A qualified engineer shall furnish a written procedure to be followed and specify the auxiliary equipment necessary for periodic testing and adjustment of the holding torque of the service brake.

At a frequency and by a method to be determined by the qualified engineer, and during the acceptance testing, the brake shall demonstrate the ability to produce the torque specified in the testing procedure.

4.1.2.5.2 Emergency Brake. The controls shall be arranged such that the brake begins decelerating the lift within 3 seconds after an operator or attendant reacts to the stimulus to apply the brake. The controls to the brake shall not be located in a position that would require the operator or attendant to pass through the path of moving carriers in order to operate the controls.

The brake shall operate on the drive sheave assembly.

Application of the emergency brake shall automatically stop any prime mover. This brake shall act automatically when the speed of the haul rope exceeds the design value by 15% in the forward direction on an overhauling lift, or a reverse rotation exceeding that which normally activates the bull wheel or cable backstop.

The emergency brake shall be an automatic brake to stop and hold the lift under the most unfavorable design loading condition. The rate of application of this brake shall be adjustable. This brake shall be adjusted so that it will stop the lift from full speed, with the design loading condition most unfavorable to stopping, in a distance not exceeding the larger of (1) 10 feet (3 meters) or (2) a distance in feet (meters) equal to $V^2/8000$ where V is the lift speed in feet per minute ($1.5V^2$ where V is the lift speed in meters per second).

A qualified engineer shall furnish a written procedure to be followed and specify the auxiliary equipment necessary for periodic testing and adjustment of the holding torque of the emergency brake.

At a frequency and by a method to be determined by the qualified engineer, but at least during the acceptance testing, the brake shall demonstrate the ability to produce the torque specified in the testing procedure.

4.1.2.5.3 Bull Wheel or Cable Backstop. The backstop shall act directly on the drive sheave assembly or on the haul rope. When it has been determined that, under the most adverse design loading condition, haul rope slippage will not occur, the backstop may be located at the return sheave assembly. However, the backstop shall not be located at other than the drive station unless its location will not decrease the factor of safety of the haul rope below the minimum permissible value whenver the backstop is statically engaged.

Under the most unfavorable design loading condition, the backstop shall automatically prevent reverse rotation of the lift for more than 3 feet (0.9 meter).

A qualified engineer shall furnish a written procedure for testing. Performance of the backstop device shall be demonstrated during the load test. (See 4.1.1.12.2(5)).

4.1.2.5.4 Drive Train Backstop. This backstop can be located at any point in the drive train so that there is no clutch, or similar device, between the backstop and the drive sheave, and shall be rated for the maximum design load.

Under the most unfavorable design loading condition, the backstop shall automatically prevent reverse rotation of the lift before the drive bull wheel reverses 1 degree based on the theoretical reduction ratio (the gear backlash motion shall not be included in the 1 degree limit).

A qualified engineer shall furnish a written procedure for testing.

4.1.2.6 Location of Machinery

4.1.2.6.1 General. Moving machine parts that normally may be in reach of personnel shall be fitted with safety guards conforming to American National Standard Safety Standard for Mechanical Power Transmission Apparatus, ANSI B15.1-1972.

Protection against static electricity shall be provided. Fire-fighting device(s) shall be available.

4.1.2.6.2 Machinery Not Housed in a Machine Room. Provisions shall be made to keep the public away from the machinery. All power units, all components of the drive train, and all safety devices, such as backstops, brakes, relays, and the like shall be protected from the weather.

4.1.2.6.3 Machinery Housed in a Machine Room. The machine room shall be well-ventilated. It shall have a permanently installed lighting system, adequate for proper machinery maintenance and safety of operating personnel. The arrangement shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (46 cm) shall be maintained. Means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

4.1.2.7 Sheaves in Terminals and Stations

4.1.2.7.1 General. All sheaves, including their mountings and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers of the bearings.

When unlined sheave grooves are used for wire rope, they should be V-shaped and shall have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

4.1.2.7.2 Haul Rope Terminal Sheaves (Bull Wheels and Deflection Sheaves). Haul rope terminal sheave frames shall be designed to retain the rope in the event of the failure of the sheave, shaft, or mounting. In instances where the sheave is cantilevered, the design working stresses shall be not more than 60% of those otherwise allowable.

The minimum diameter of terminal sheaves shall be 72 times the nominal diameter of the haul rope, provided that no gripping device passes around the sheave. The minimum diameter shall be 96 times the nominal haul rope diameter in cases where gripping devices pass around the sheave. The sheave assembly shall be designed to retain the haul rope in the event of a deropement from the sheave. A flange extension of 1-1/2 times the rope diameter (measured from the bottom of the rope groove) shall be deemed adequate for retention when the provisions of 4.1.2.7.4 are fully complied with.

Table 4-3
Minimum Diameters for Counterweight Rope Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard

Rope Type	Sheave Diameter		
	Condition A	Condition B	Condition C
6 × 7	72*d*	42*d*	**24*d***
6 × 19	45*d*	30*d*	**20*d***
6 × 37	27*d*	18*d*	12*d*

NOTE *d* equals the nominal rope diameter

Haul rope terminal sheaves that act as driving, braking, or holding sheaves shall be so designed that the haul rope does not slip in the sheave groove The design coefficient of friction for a particular sheave liner shall not exceed the following values

Sheave Liner	*Coefficient of Friction*
Steel or cast iron grooves	0 070
Leather	0 150
Rubber, neoprene, or others	0 205

4 1 2 7 3 Counterweight Rope Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard The minimum diameters for these sheaves shall be as indicated in Table 4 3

Condition A is applicable wl ere rope bending around sheaves is of major importance

Condition B is applicable where rope bending around sheaves is important, but some sacrifice in rope life is acceptable to achieve reduction in weight, econ omy in design, etc

Condition C is applicable to sheaves that should not rotate due to any tension sheave movement but should rotate only due to counterweight adjustment

Provisions shall be made to assure that all counterweight sheaves rotate freely

4 1 2 7 4 Haul Rope Line Sheaves The requirements of 4 1 3 3 are applicable to haul rope line sheaves used in terminals and stations, with the following exceptions

(1) Sheaves that carry no load other than the weight of the rope and carriers

(2) Sheaves that are located in such a way that the weight of carriers is either wholly or partially supported on tracks or by other means

(3) Sheaves that are located in such a way that carriers attached to the cable are not passing onto the sheaves

In such cases, the design shall be modified to meet the requirements of the particular installation

Guide sheaves shall be located in order to prevent misalignment of rope entering and leaving the drive and return sheaves Such sheaves shall be as close as practicable to the drive and return sheaves, but not farther than one diameter of the drive or return sheave from the point of tangency Shoes, rollers, or sheaves shall be placed on the opposite side of the rope adjacent thereto to prevent deropement in that direction

These requirements apply to all installations except floating tension sheave carriages (see 4 1 2 8 2)

4.1.2.8 Tension Sheave Carriages The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion under normal operation

4 1.2.8 1 Rigid Mounted Carriages The sheave carriage shall be supported from the ground by a rigid structure. The mounting that travels under the action of the counterweight shall be supported on rigid, straight rails by means of wheels Torsional loads due to driving torque, braking torque, or reactions of a backstop shall be considered, and the structure and carriage shall adequately transmit these loads to the foundations

Mechanical stops shall be provided to prevent over travel of the carriage and the tension sheave These stops and the terminal structure shall be designed to resist, at normal design stresses, an unbalanced horizontal force on the bull wheel applied in the direction of the opposite terminal and equal in magnitude to 30% of the counterweight reaction on the bull wheel

4 1 2 8 2 Floating Tension Sheave Carriages The sheave mounting shall be installed and operated so that the haul rope, in every case, considering every possibility of overloading, remains in the center of the sheave groove The lateral tilt of the sheave shall not exceed 2 degrees from the horizontal when in a stationary position, and when the up-going and down-going unloaded carriers are equidistant from the sheave

To prevent excessive lateral tilt in case a loaded carrier passes around the sheave the counterweight or anchor cables shall be connected to at least two points on the mounting frame of the sheave The connections of the counterweight or anchor cables to the sheave frame and the support points of the cables shall be spaced a minimum of 70% of the pitch diameter of the sheave and increased as necessary to limit the allowable lateral tilt of the sheave to a maximum of 6 degrees from the static position when passing a carrier with full design load

The design shall incorporate provision for adjustment to control the position of the haul rope entering the terminal sheave

4 1 2 9 Counterweight and Tensioning Systems

4 1 2 9 1 Counterweights Counterweights or other suitable devices shall be provided to determine and regulate the tension of all haul ropes. Counterweights, when used, shall be arranged to move freely up and down. Enclosures for counterweights shall be provided where necessary to prevent snow or ice from accumulating under and around the counterweights and interfering with their free movement. When a counterweight is contained in a structural frame, guides shall be provided to protect the frame and to ensure free movement of the counterweight. Where snow enclosures are not required, guardrails or enclosures shall be provided to prevent unauthorized persons from coming in contact with or passing under counterweights.

The counterweight, or other suitable device, shall have sufficient travel to take care of all normal operating changes in loading and temperature. Counterweights, if used, shall determine and regulate the tension during all operating periods.

Friction and other forces developed in the tension system composed of the movable carriage, counterweight sheaves, reeving, and guide system shall be included in calculating haul rope tension for all conditions of loading. Carriage and counterweight movement shall be evident in normal operation or the resistance to movement shall be measured and its magnitude approved by the engineer responsible for design.

Chg 1988 **4.1.2.9.2 Counterweight Ropes.** Counterweight ropes shall have a minimum factor of safety of 6, when new. The factor of safety is equal to the nominal breaking strength of the rope (see 7.1.3) divided by the maximum static design tension. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account shall be the basis for determining factor of safety.

Counterweight ropes shall be adjusted so that the counterweight will reach the end of its travel before the attached tension sheave carriage comes within 6 inches (15 cm) of the end of its travel.

See 7.3 for additional requirements.

Chg 1988 **4.1.2.9.3 Counterweight Winches.** Winches that are used for counterweight system take-up and remain a permanent part of the system shall have a factor of safety of 6 against their ultimate capacity They shall have a positive lock against release. Where this factor of safety cannot be established by manufacturer's endorsement, a safety device shall be installed on the counterweight rope ahead of the winch that will keep the tensioning system intact in the event of failure or release of the winch.

4.1.2.10 Anchoring Devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion.

Sections of ropes bent around thimbles, sheaves, or other anchorage devices not meeting the minimum diameters specified by Condition C in 4.1.2.7.3, or permanently deformed or damaged sections, shall not be relocated or reused as a part of the section under load.

Wire ropes and their connections, used to anchor, tension, or otherwise secure terminal structures, shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

4.1.2.11 Manual and Automatic Stops. All stop circuits and switches shall conform to the requirements of 4.2.1.7.

4.1.2.11.1 Manual Stop Devices. Manual stop devices that will stop the prime mover and apply the service brake shall be installed in all attendants' and operators' stations, in machine rooms, and out-of-doors in close proximity to all loading and unloading areas. All manual stop devices shall be conspicuously and permanently marked.

4.1.2.11.2 Automatic Stop Devices. The following automatic stop devices shall be installed:

(1) Automatic stopping devices beyond each unloading area. For actuating devices of the suspended type, the suspended portion shall be strong enough to cause release of the actuating devices in use under the most adverse conditions, and each side shall be detachable and shall interrupt the safety circuit when detached. The location of the automatic stop device shall be in accordance with the following:

(a) Intermediate stations: Required only when traffic is not permitted beyond the intermediate station. The device shall automatically stop the lift in the event a passenger rides beyond the intended point of unloading.

(b) Terminal unloading areas – uphill and downhill: If danger to passengers or equipment would result in the event the passenger entered or passed around a terminal at full speed, the device shall be so located that the distance from the stopping device to the first obstruction or tangent of the bull wheel, whichever is less, is 150% of the distance required to stop with the lift operating at maximum speed and the most unfavorable loading condition.

If no danger to passengers or equipment would result in the event the passenger entered or passed around the terminal at full speed, the device shall be so located that the lift is stopped before the passenger passes beyond an unloading area on the opposite side of the lift from the normal unloading point and adjacent to the terminal, under conditions of maximum speed and the most unfavorable loading condition.

(2) Automatic stopping devices to stop the lift if

the rope leaves the bull wheel or departs from its normal running position.

(3) A device(s) that will stop the lift before any counterweight, other tensioning device or tension sheave carriage reaches either end of its travel or when the tensioning system exceeds its range of normal operating travel. When pneumatic or hydraulic tensioning systems are used, pressure sensing devices shall also be incorporated that shall stop the lift system in case the operating pressure goes outside the design pressure range. Such pressure sensing devices shall be located close to the actual tensioning device. It shall not be possible to isolate the pressure sensor from the actual tensioning device.

4.1.3 Line Structures

4.1.3.1 Towers. The design of the tower structure and foundation shall be in accordance with the requirements of 4.1.1.6. Where guyed towers are used and guys intersect the ground within or near ski runs, the guys shall be marked for visibility, preferably with boards painted with black and yellow stripes.

Means shall be provided for ready access from the ground to all tower tops. This requirement will be fulfilled if the tower structure is safe to climb. Otherwise, means such as permanent ladders or light, portable ladders shall be provided. The latter, if used, shall be in at least sufficient quantity to be available at each point where attendants are stationed.

Towers shall be identified with successive numbers clearly visible when looking up the lift line.

Where towers are designed to permit variations in rope height, sheave unit supports shall be guided and attached so as to prevent misalignment by rotation during normal operation.

4.1.3.2 Guards and Clearances. All towers shall be equipped with guards to prevent contact of any parts of the carriers with a tower structure or tower machinery and to maintain minimum clearance between carriers and tower structures; however, such guards or minimum clearance shall not be required if contact does not occur when the carrier is swung laterally 15 degrees from the vertical position. Minimum clearance is specified in the following paragraph.

A carrier shall be capable of swinging 8 degrees laterally before engaging a guard or encroaching upon the following minimum clearance with a tower structure:

(1) On chair lifts: 12 inches (30 cm) between the innermost point on chair structure and the tower clearance line or surface.

(2) On gondola lifts with open windows on the tower side: 18 inches (46 cm) between the innermost point of cabin and the tower clearance line or surface.

Guards may be placed to limit the swing of carriers between 8 and 15 degrees as required to maintain this clearance.

Guards shall be shaped and located so that a 30-degree lateral swing from vertical shall not place any part of the loaded or empty carrier on the inner side of the guard. Guard configuration shall provide for reversal of carrier travel direction during testing or other special operating conditions and shall preclude entanglement when a carrier is swung laterally 15 degrees.

On all towers, with or without guards, when a carrier is swung longitudinally by 15 degrees, there shall be no contact between any obstruction and any part of the carrier.

For chair lifts, the following clearance requirements shall be met to prevent entanglement of skis with tower structure. Clearance is here defined to mean the distance between inner limit of passenger seat and clearance line or surface of tower.

With the chair swinging in laterally 10 degrees from the vertical position, or to the limit permitted by the guards, if any, if clearance is less than 24 inches (61 cm) from any open frame tower or 18 inches (46 cm) from any closed tubular tower, tip deflectors shall be provided on each side where passengers wearing skis are allowed, to keep the skis from being caught in the structure. Such deflectors shall be at least 72 inches (183 cm) in height, extending 36 inches (91 cm) above and 36 inches (91 cm) below average foot level.

A tubular tower with permanent ladder rungs shall be considered as an open-frame tower, unless it can be demonstrated that ski tips cannot be caught in the ladder, in which case the tower may be considered as a closed-tubular tower.

4.1.3.3 Haul Rope Sheaves and Mounts

NOTE: The requirements in 4.1.3.3 and 4.1.3.3.1 through 4.1.3.3.3 apply generally to sheaves that support or hold down the haul rope at towers on a monocable system. These requirements shall apply to both sides of each aerial lift.

The diameter of a haul rope sheave shall be not less than 10 times the nominal diameter of the haul rope for metallic sheaves or 8 times for sheaves with elastomer treads.

4.1.3.3.1 Maximum Allowable Sheave Load. The maximum allowable load per sheave should be determined by the lift designer.

4.1.3.3.2 Sheave and Sheave Unit Design. Sheave flanges shall be as deep as possible considering other features of the system. At the same time, rope grips shall be designed in relation to the sheave groove so as not to contact sheave flanges during normal operations, taking into consideration the anticipated amount of wear of the sheave liner groove. Grips shall be allowed to contact sheave flanges adjacent to the haul rope when the carrier swings, provided that this is considered in the design of grips and sheaves. Furthermore, rope grips, sheave flanges, and hanger guides shall be designed so that hangers cannot be caught behind guides, and so that ropes and grips cannot be deroped from sheaves if the carrier is swinging within design limits as it approaches or passes the tower.

Suitable guards of sufficient strength to resist the lateral forces caused by deropement shall be installed to prevent the rope from falling into a dangerous position within the tower structure.

Construction of the entire sheave unit shall be such that the rope cannot become entangled in the sheave unit in the event the rope leaves the sheave toward the outside.

On each sheave unit, rope-catching devices shall be installed to prevent the rope from moving excessively in the direction of the load on the sheave unit in the event of deropement. These devices shall be located less than one-half the diameter of the sheaves from the normal operating position of the rope and shall extend a minimum of two rope diameters beyond the sheave flange. They shall be designed to permit the passage of the rope and grips after deropement.

On each sheave unit, suitable deropement switch devices shall be installed and maintained that will stop the lift in case of deropement.

If the gage of the haul rope system is varied at any point along the line, the horizontal departure at any one tower shall be provided for in the design, so that deropement cannot occur by virtue of such a departure.

Sheave mounts or mounting frames shall be designed to be adjustable, allowing the sheave units to be aligned and held in the plane of the rope.

See also 4.1.1.4–4.1.1.4.3 for effect of tower height and location on sheave units.

4.1.3.3.3 Haul Rope Retention. Provisions shall be made to retain the haul rope in the line sheave groove under all anticipated conditions of loading. This criterion will be met if any of the following conditions is fulfilled:

(1) Condition A: Under the most adverse design loading conditions (excluding dynamic effects), the minimum load of the haul rope on a group of support sheaves at a tower shall be not less than the largest of the following values: 100 pounds (45 kg) per sheave; or 300 pounds (136 kg) per tower group; or a value in pounds equal to two-thirds the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to the sum of the adjacent span lengths expressed in meters of slope length).

When cable elevation at the tower in question lies below a straight line joining cable elevations at the adjacent tower, the haul rope shall not leave the group of sheaves under either of the following conditions:

(a) When the haul rope tension is 1.5 times its maximum design value at the point, using unloaded carriers in adjacent spans

(b) When a rope is under tension of the counterweight alone (bare rope) or with any arrangement or number of empty chairs or hangers on the line

The minimum load of the haul rope on a group of hold-down sheaves at a tower under the most adverse loading conditions shall not be less than the larger of the following values: a value in pounds equal to the dead plus live load of the carrier; or a value in pounds equal to the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to 1.5 the sum of the adjacent span lengths expressed in meters of slope length). In no case shall this load be less than 225 pounds (102 kg) per passenger.

(2) Condition B: Combination sheave units that incorporate support and hold-down sheaves shall be designed with the retaining sheaves always in contact with the haul rope. When retaining sheaves are mounted to deflect, to allow passage of a carrier grip, such deflection shall not occur until the sheave is loaded to one-half of the maximum design sheave loading. The retaining sheaves shall have the same maximum design loading as the other support or hold-down sheaves on the tower. If the design satisfies loading requirements in Condition A, nothing in this paragraph shall preclude the use of rollers or guides opposite the tower sheaves that do not necessarily contact the rope.

(3) Condition C: For line structures where the carrier is either wholly or partially supported or depressed on tracks or by other means, in lieu of retaining the haul rope in the sheave groove, the following design criteria shall be fulfilled without exceeding the maximum allowable loads.

Under the most adverse loading conditions, the load of the carrier onto the track when fully engaged shall be not less than the largest of the following values: 450 pounds (205 kg); or the design gross load per carrier; or a value in pounds equal to two-thirds of the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to the sum of the adjacent span lengths expressed in meters of slope length).

The carrier shall not leave the track if the design cable tension is increased by 50% or decreased by 33%.

4.1.4 Line Equipment

4.1.4.1 Haul Rope. See Section 7 for basic wire rope design and installation requirements.

Chg 1986 **4.1.4.1.1 Factor of Safety.** Haul ropes shall have a minimum static factor of safety of 5, when new. Static factor of safety is equal to the nominal breaking strength (see 7.1.3) divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

4.1.4.1.2 Factor of Safety for Spliced Rope with an Independent Wire Rope Center. Where a spliced haul rope with an independent wire rope center is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

4.1.4.2 Haul Rope Grip

4.1.4.2.1 General. The rope grip shall be of a type that has been proved to give satisfactory service by the industry. The manufacturer shall permanently affix a unit identification and size marking to each grip. Each grip shall be nondestructively tested before public use.

The rope grip shall be designed to pass smoothly over and under line sheaves that have flanges of adequate depth to discourage the haul rope from leaving the sheaves.

The design shall incorporate provisions to accommodate a 10% reduction in haul rope diameter. The designer's instructions shall provide details for the proper initial setting of the grip and a method to assure an operator or inspector that the grip has not reached an operational limit of the clamping components.

4.1.4.2.2 Slippage. The rope grip shall be designed and maintained during use so as to resist a force, that tends to slide it along the haul rope, that is, a minimum of 3 times the force required to move a carrier along a properly lubricated haul rope at its steepest incline, under the most adverse conditions of carrier loading. The grip shall automatically adjust to maintain this gripping force with a 3% reduction in haul rope diameter.

The grip designer shall specify the proper grip installation and testing procedures, and, for clamping type grips, the minimum force below which the grip should not slip on the rope and a maximum force above which the grip should slip on the rope.

Chg 1986 **4.1.4.2.3 Strength.** The strength of the grip shall be based on the following criteria:

(1) A factor of safety of 6 shall exist in all parts of the grip wherein stress is proportional to the dead and live load of the carrier. This factor of safety is defined as follows: With the grip in its operating position (gripping the rope or equivalent), a downward load, equal to the dead load of the carrier plus 6 times the design live load, shall not cause any part of the grip to fail.

(2) Those parts whose stress is not changed by application of live load shall be designed on the basis of an allowable stress of not more than the yield point divided by 3.0. In the design of springs, where used, the allowable stress may be increased if load tests are conducted by an approved testing laboratory to provide assurances that the fatigue life of the actual spring is more than ample for the various applied loads.

(3) For stresses caused by lateral loading, such as centrifugal force, the provisions of 4.1.4.4.2 shall apply.

(4) The material of which the grip is made shall be selected or selected and treated to obtain optimum impact resistance.

(5) Special attention shall be paid to fatigue considerations. A grip that has not been proved in service should be subjected to fatigue tests.

(6) Grips made up of cast parts shall be proof-loaded with forces equal to the gripping force and 3 times dead plus live load.

By inspection, confirmation shall be obtained that the grip and its parts meet the foregoing criteria.

4.1.4.2.4 Maximum Loads. The maximum total vertical load on a single grip shall not exceed 1/14 of the minimum tension in the haul rope.

Where two grips are used for a single carrier, the foregoing requirement may be applied to each grip, provided that:

(1) The two grips are independent of each other (that is, articulated in such a manner that they are independently loaded)

(2) The clear length of haul rope between the two grips equals or exceeds one-half rope lay

Chg 1988 **4.1.4.2.5 Grip Testing.** The designer or manufacturer shall develop criteria for testing hanger grips and clips for the owner and comply with 4.3.4.3.

4.1.4.3 Carriers for Fixed Grip Gondolas. The carrier and all components shall be designed by qualified engineers in accordance with accepted practices of design. If the design has not had prior successful use for passenger transportation, its adequacy shall be verified by test loadings, trial operations, and tests under repeated loadings.

4.1.4.3.1 Hanger. The hanger shall be securely attached to the haul rope grip and to the cabin in such a manner that it cannot work loose.

The hanger shall be of sufficient vertical length that, under the worst condition of longitudinal swing, the top of the cabin cannot strike the haul rope. In any event, the carrier shall be able to swing longitudinally without interference to an angle of 15 degrees from the vertical at the most adverse locations.

Sway dampers designed to reduce the longitudinal sway of the carrier shall be used if recommended by the lift designer. Where used, they shall operate smoothly and without danger of deropement of the haul rope.

4.1.4.3.2 Gondola. Fully enclosed passenger cabins shall be ventilated. They shall be equipped with doors that fill the entire entrance opening. Each door shall be provided with a lock located in such a manner that it can be unlocked only by authorized persons or by automatic means.

All windows shall be of shatterproof material.

Means of emergency evacuation of passengers shall be provided. For cabins having a capacity of more than six passengers, the evacuation equipment shall be located in the carrier.

The maximum capacity of each cabin, both in pounds and kilograms and in the number of passengers, shall be posted in a conspicuous place in each cabin.

(1) Each carrier having a capacity of seven or more passengers shall be served by a conductor. If passengers are to remain standing, floor space of 2.5 square feet (0.23 square meter) per person shall be available; the width of cabin seats shall be at least 18 inches (46 cm) per person.

(2) All carriers shall be clearly identified with numbers located on each end of each carrier.

(3) Semiopen carriers shall meet applicable requirements for enclosed gondolas and open chairs.

4.1.4.4 Carriers

4.1.4.4.1 Vertical Loads. With respect to vertical loads, chair lift carriers shall be designed to support a vertical load 4 times the design load without permanent deformations of the assembly or component parts.

Chg 1986 **4.1.4.4.2 Horizontal Loads.** With respect to horizontal loads, such as centrifugal loads that stress the hangers as they pass around terminals, the parts of the assembly, including hangers and grips, shall be designed with a factor of safety of 3.6 with respect to the yield point of the material(s). For this purpose, the applied load shall be taken as the computed force considered as a static load.

When safety stops are not provided to prevent the passage of loaded chairs around the bull wheels, lift components such as chairs, hangers, grips, bull wheels, guides, etc, shall be designed to withstand, with a factor of safety of 2 with respect to the yield point of the materials involved, the stresses developed when a loaded carrier passes around the bull wheel at full speed. Certification of a test shall be provided by the manufacturer that a loaded carrier with twice the design load had been passed around the bull wheel at full speed of a chair of identical design and fabrication without any yielding of the chair tested.

4.1.4.4.3 Identification. All carriers shall be clearly identified with successive numbers visible to the operator and attendant.

4.1.4.4.4 Chair Safety Details. Each chair shall be equipped with a railing at each side, to a height of not less than 4 inches (10 cm) above the seat for a distance of not less than 12 inches (30 cm) from the back of the seat.

For summer operation, each chair shall be equipped with a restraining device that will not open under forward pressure.

4.1.4.4.5 Hanger Testing. The designer or manufacturer shall identify for the owner hanger components and critical parts that require testing and develop criteria for testing these parts (see 4.3.4.4).

4.1.5 Provisions for Operating Personnel. Operator and attendant stations shall be located to provide visual surveillance of the line and station. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed: (1) the communications and controls required of the station, (2) the operating instructions and emergency procedures, and (3) a fire extinguisher. This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry.

The operator shall be located where he/she can observe the lift in operation. All primary lift controls and communications shall be immediately available to him/her. Loading and unloading areas shall have lift-stopping devices located convenient to the attendants assigned to those areas.

4.1.6 Operational and Maintenance Manuals

4.1.6.1 Operational Manual. The designer of each lift shall prepare an operational manual for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

4.1.6.2 Maintenance Manual. The designer of each lift shall prepare a maintenance manual for each installation. The manual shall describe recommended maintenance procedures, including:

(1) Types of lubricants required and frequency of application

(2) Definitions and measurements to determine excessive wear

(3) Recommended frequency of service to specific components, including relocation of fixed grips

4.2 Electrical Design and Installation

4.2.1 General Design and Installation Testing. Prior to operation of newly installed tramways or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this standard and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), solenoid or relay noise at levels and frequencies that could initiate loss of control.

4.2.1.1 Applicable Codes. All electrical systems shall comply with American National Standard National Electrical Code, ANSI/NFPA 70-1981 and American National Standard National Electrical Safety Code, ANSI C2-1981.

4.2.1.2 Location. All electrical power transmission wiring located near or proposed to cross over tramways shall comply with the applicable requirements of ANSI C2-1981.

4.2.1.3 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

4.2.1.4 Voltage Limitations for Overhead Circuits. Signal, communication, and control circuits may be supported between the towers that support the tramway. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

4.2.1.5 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

4.2.1.5.1 Control Wiring Classification. All control wiring shall be Class 1 in accordance with Article 725 Parts A and B of ANSI/NFPA 70-1981.

4.2.1.5.2 Communication Wiring. All communication wiring and systems are excluded from the requirements in Article 725-5 of ANSI/NFPA 70-1981.

4.2.1.5.3 Insulation. All control wiring is excepted from the requirements of Article 725-16 of ANSI/NFPA 70-1981. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

4.2.1.5.4 Exterior Lighting and Snowmaking Circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18 meters) of the tramway centerline, shall be ground fault protected.

4.2.1.6 Grounding

4.2.1.6.1 Structures. All metallic structures shall be connected to a common conductor. Electrical continuity of all metal parts of the structures shall be assured by mechanical connection.

4.2.1.6.2 Drive Terminal Structure. The drive terminal structure shall have one point referred to as a ground point, as defined in ANSI/NFPA 70-1981. All direct-current and alternating-current electrical systems shall be referenced to this point. If an electrical prime mover is used, the electric service grounding electrode conductor shall terminate at this point. Under the worst case conditions, the resistance from the ground point to any grounded point within the tramway system shall not exceed 50 ohms. The grounding system for the tramway shall not be used as a grounding system for any other system not related to the tramway system.

To ensure that the 50-ohm grounding requirement is met under all conditions of soil, moisture, temperature, and circulating ground and air currents, all terminal and line structures shall be bonded together with a bonding conductor.

4.2.1.6.3 Haul Rope Grounding. Grounding sheaves or equivalent means shall be provided at one location for the purpose of grounding haul ropes, as applicable, for static electrical discharge.

4.2.1.6.4 Lightning Protection. If lightning protection is provided, it shall follow the American National Standard Lightning Protection Code, ANSI/NFPA 78-1980.

4.2.1.7 Operating Control Circuits. If, for any reason, the operator has lost control of the tramway while using the normal or operating control circuitry, the control circuitry shall be designed to allow the attendant/operator to stop the tramway with the emergency stop circuit. Any one of the following six conditions is considered a loss of control of a tramway.

(1) Tramway will not *slow down* when given the command to do so

(2) Tramway will not *stop* when given the command to do so

(3) Tramway *overspeeds* beyond control settings and/or maximum design speed

(4) Tramway *accelerates* faster than normal design acceleration

(5) Tramway *self-starts* or *self-accelerates* without the command to do so

(6) Tramway *reverses* direction unintentionally and without the command to do so

Control circuits shall not have anything across or parallel with the contacts of switches, relays, or safety devices including solid state devices monitoring the circuits or devices, unless it can be shown that any failure mode of the device placed across the switch does not defeat the purpose of the switch.

Each control circuit shall be tested for circuit integrity at its most remote terminal on a daily basis. An inadvertent ground or power failure shall stop the tramway.

4.2.1.7.1 Emergency Stop Circuit. All tramway control systems shall include a normally energized electrical circuit, that, when interrupted, effects an emergency stop (see 1.4.20.1). The emergency stop shall have priority over all other control stops or commands. This circuit shall include a manual stop device at each attendant/operator station in close proximity to loading and unloading areas, main control panel, and machine room. These emergency stop switches shall be red.

When there is only one stop circuit, it shall be classified as the emergency stop circuit.

4.2.1.7.2 Normal Stop Circuit. All tramway systems shall include a normally energized electrical circuit that, when interrupted, effects a normal stop (see 1.4.20.2).

4.2.1.7.3 Operating Circuitry. All tramway systems shall contain a normally de-energized circuit that, when energized, causes the system to start, accelerate to and run at designated speeds and, when de-energized, causes the system to stop.

All start/run and speed control switches shall be conspicuously and permanently marked with the proper function.

All stop switches shall be of the manually reset type and be positively opened mechanically and their opening shall not be dependent upon springs.

Chg 1986 **4.2.1.7.4 Bypass Circuits.** Bypass circuits may be installed for emergency conditions. Controls to bypass any portion of the operating control circuitry shall be locked and may be operated only by the tramway supervisor or his/her designated representative. Operation of the bypass shall require the physical effort of the person activating it to maintain the bypass condition (momentary contacts).

Bypass circuits shall be provided with a warning light to clearly indicate the bypass circuit is in use. The tramway shall be maintained under close visual surveillance when the safety circuits are bypassed.

4.2.1.8 Electrical Prime Mover and Power Circuits

chg 1988 **4.2.1.8.1 Electrical Prime Mover.** All tramway systems equipped with electrical prime movers (electrical motors) shall have phase loss protection on all power phases.

4.2.1.8.2 DC (Direct Current)-Powered Drives. All DC electronic speed regulated drives and DC-powered electric motors shall shut down in the event of:

(1) Field loss
(2) Speed feedback loss
(3) Overspeed
(4) Overcurrent
(5) SCR misfiring

4.2.2 Night Lighting. For nighttime operation, operating tramways shall be provided with lighting facilities. Lighting shall be provided at loading and discharge areas.

4.2.2.1 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

4.2.2.2 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp operating characteristics.

4.2.2.3 Location. Lights shall be mounted on substantial poles or standards. Tramway towers and terminal structures may be used for supporting lights subject to the following requirements:

(1) Approval shall be obtained from a qualified engineer.

(2) The service conductors to each tramway tower or terminal structure shall be underground or in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the tramway line.

(3) A separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure.

(4) All metallic raceways on a tower or terminal structure shall be grounded.

(5) The lighting installation shall not conflict with other requirements of this standard and shall not interfere with operations of the tramway in any manner.

4.2.2.4 Emergency Lighting. Emergency lighting shall be provided in the event of electric power failure to permit:

(1) Regular unloading of tramway facilities
(2) Emergency evacuation of carriers

4.3 Operation and Maintenance

4.3.1 General and Personnel Safety. This subsection covers the requirements for operation and maintenance of fixed grip aerial lifts. Many requirements are listed elsewhere in Section 4, since they also regulate installation and design. It is imperative that operating and maintenance personnel be familiar with applicable provisions of this section.

Operation and maintenance of aerial lift equipment can be dangerous to personnel performing these tasks. Procedures for performing these functions shall require precautionary measures necessary to assure the safety of the personnel involved. Implementation of the procedures intended for the protecton of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

4.3.2 Operation

4.3.2.1 Personnel. Fixed grip aerial lifts shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. One or more persons familiar with emergency procedures shall be on the site at all times when the facility is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific lift.

4.3.2.1.1 Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for safe operation, and shall have the authority to deny access to the lift to any person who in the supervisor's opinion is not fit or competent to use the lift without danger to that person, to others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the lift under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

4.3.2.1.2 Operators. An operator shall be in charge of each lift. This operator shall be trained and experienced in normal operational and emergency procedures.

4.3.2.1.3 Attendants. An attendant shall be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view.

4.3.2.1.4 First Aid. One or more persons trained to administer first aid shall be available at all times when a lift is operating and transporting passengers. There shall be ready access to first aid supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

4.3.2.2 Minimum Operating Personnel. The following personnel are the minimum that shall be required:

(1) An operator shall be in charge of each aerial lift

(2) One attendant shall be on duty at each loading area

(3) One attendant shall be on duty at each unloading area

NOTES:

(1) An operator may serve concurrently as an operator and an attendant at a loading or unloading area that may be adjacent to the operator's station unless the duties of that area preclude his/her maintaining reasonable surveillance of the entire lift operation.

(2) An intermediate station used for both loading and unloading may be manned by a single attendant at the loading area when both the loading and unloading can be kept under surveillance by the attendant.

4.3.2.3 Duties of Operating Personnel

4.3.2.3.1 Supervisor. The duties of the supervisor shall be as follows:

(1) To determine that all lifts are operational and that all operating personnel are trained, equipped, and fit to perform their duties

(2) To discontinue operations on any lift due to physical, weather, personnel, or other reasons

(3) To enforce operational, maintenance, and safety rules

4.3.2.3.2 Operator. The duties of the operator shall be as follows:

(1) To assume responsible charge of the lift

(2) To assign and supervise all attendants on his/her lift

(3) To maintain an operational log book as required in 4.3.5.1

(4) To advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation

4.3.2.3.3 Attendant. The duties of the attendant shall be as follows:

(1) To maintain orderly passenger traffic conditions within his/her area of jurisdiction

(2) To advise and assist passengers, as required

(3) To maintain surveillance of his/her area of jurisdiction

The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

4.3.2.4 Operational Procedures. The required operational procedures as set forth in 4.3.2.4 through 4.3.2.5 shall be supplemented by specific requirements as specified in the designer's operational manual (see 4.1.6.1).

4.3.2.4.1 Control of Passengers. Each lift shall have a definite method for marshaling passengers for safe loading and unloading. Fences and gates may be required to implement the system.

4.3.2.4.2 Daily Preoperational Inspection. Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:

(1) A visual inspection of each terminal, station, and the entire length of the lift

(2) Assurance that tension carriage, counterweights, or other tensioning devices are functional and have adequate travel with clearance at both ends of travel

(3) Operation of all manual and automatic switches in terminals, stations, and loading and unloading areas

(4) Operation of all braking systems

(5) Operation of communication systems

(6) Operation of the lift including a visual inspection of all ropes and carriers

For those lifts having primary-power internal combustion engines, the fuel quantity shall be determined to be sufficient to conduct the anticipated period of operation without refueling. For those installations having auxiliary internal combustion engines, the fuel supply shall be adequate to unload the lift. During refueling, power units shall be shut down.

Auxiliary power units shall be checked during this inspection and operated at least once each week.

Loading and unloading areas shall be inspected and prepared for the safe ingress and egress of passengers. Carriers shall be cleared of ice to the extent necessary to permit safe operation and mechanical features shall be inspected and checked.

4.3.2.5 Operational Requirements

4.3.2.5.1 General. The supervisor and operator of each tramway shall review the requirements of 4.1 and Section 7 of this standard to ascertain that original design and installation conditions have not been altered in such a manner as to violate the requirements of the standard.

4.3.2.5.2 Starting. No lift shall be started except at the direction of or following clearance by the operator. Aerial lifts while operating for the public shall be started at the operator's station only. Capability for starting from other stations may be provided for maintenance or emergency operation.

4.3.2.5.3 Stops. After any stop of a lift, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

4.3.2.5.4 Damage to Carriers. Should any carrier become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked and not used for passengers until repaired or replaced. It shall be removed from the line when feasible.

4.3.2.5.5 Hazardous Conditions. When wind or icing conditions are such that operation is hazardous to passengers or equipment, according to predetermined criteria based upon the area's operational experience and the designer's design considerations, the lift shall be unloaded and the operation discontinued. If necessary under the predetermined criteria, device(s) shall be installed at appropriate location(s) to ascertain wind velocity and direction when aerial lifts are operated. No lift shall operate when there is an electrical storm in the immediate vicinity. Should such conditions develop while the lift is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to discharge all passengers. When such shutdown has been caused by an electrical storm, grounding of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to resumption of passenger operations.

4.3.2.5.6 Evacuation. Provisions shall be made for the emergency evacuation of aerial lifts (see 4.1.1.11). These shall include a detailed plan of evacuation, equipment necessary for evacuation, and adequate training of personnel. Evacuation drills shall be conducted at established intervals not to exceed one each 12 calendar months, and such drills recorded in the operational log of each lift (see 4.3.5.1).

4.3.2.5.7 Termination of Daily Operations. Procedures shall be established for terminating daily operations in such a manner that passengers will not be left on the lift after it has been shut down. Loading ramps, as required, shall be closed during off-hours and so marked.

4.3.2.5.8 Operational Log. A daily operation record shall be maintained as required under 4.3.5.1.

4.3.3 Maintenance

4.3.3.1 General. Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance requirements of the designer (see 4.1.6.2) shall be followed. Maintenance records shall be kept (see 4.3.5.3).

A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:

(1) All wire ropes and cables (see 7.4.1)
(2) Line sheave units, sheaves, bearings, and liners
(3) Bull wheels, bearings, and liners
(4) Counterweight or tensioning systems
(5) Drive system, including bearings and couplings
(6) Braking systems
(7) Electrical control systems
(8) Communication systems
(9) Carriers

4.3.3.2 Rope Grips. The initial installation and each relocation of a clamp-type grip shall be field-checked by a method established by the designer to provide assurance that the requirement of the first sentence of 4.1.4.2.2 has been met and that the maximum slippage resistance is not exceeded. All grips shall be moved at least once every 24 calendar months. The grips should be moved a uniform distance each time and in the same direction. A grip should never be installed or allowed to migrate closer than a distance of 20 haul rope diameters from a splice tuck or rope repair tuck. The designer's instructions shall be followed if they are more restrictive than these requirements. Movements shall be recorded in the maintenance records (see 4.3.5.2 and 4.3.5.3).

As each grip is relocated, the haul rope shall be examined for deterioration at or near the grip location. The initial location and each subsequent relocation shall be marked by a spray paint or other marking on the rope to identify slippage. A qualified engineer shall supply information to the owner to enable him/her to identify excessive slippage.

4.3.4 Inspections and Testing

4.3.4.1 General Inspection. Each facility shall be inspected annually, or after each 2,000 hours of operation, whichever comes first, by a tramway specialist independent of the owner. The inspection shall verify preservation of original design integrity and cover the requirements of this standard for maintenance, operation, required self-inspections, and recordkeeping. Items found either deficient or in noncompliance shall be noted. A report signed by the specialist shall be filed with the owner.

4.3.4.2 Wire Rope Inspection. Inspection of wire rope shall comply with 7.4.1.

Chg 1986 **4.3.4.3 Grips and Clips Testing.** All grips or clips shall be tested against an accepted criteria established by the designer or manufacturer or in cases where the designer or manufacturer is no longer in business and the original criteria is no longer applicable, by a qualified engineer.

The grip shall be uniquely identified by the manufacturer or the owner. The test sampling method shall identify the parts tested to assure a rotating minimum test sample on each lift of 10 grips or 10% of all the total grips per year, whichever is the greater, or all grips every 6 years or 6,000 hours, whichever comes first.

If the grips are tested by an agency other than the original equipment manufacturer, then the original lift manufacturer shall receive a copy of the test procedure and results. In all cases, the owner shall receive a copy of the test procedure and the test results.

4.3.4.4 Hanger Testing. Hanger critical parts shall be tested against an acceptance criteria established by the designer or manufacturer or in cases where the designer or manufacturer is no longer in business and the original criteria is no longer applicable, by a qualified engineer.

Every chair hanger shall be visually inspected every year against a criteria developed by the original equipment manufacturer or a qualified engineer. The inspection shall be documented as part of the lift logs.

The hanger shall be uniquely identified by the manufacturer or the owner. The test sampling method shall uniquely identify the parts tested and assure a rotating minimum test sample on each lift of 10 hangers or 10% of the total hangers per year, whichever is the greater.

If the hanger critical parts are tested by an agency other than the original equipment manufacturer, then the original equipment manufacturer shall receive a copy of the test procedure and the test results. In all cases, the owner shall receive a copy of the test procedure and the test results.

4.3.5 Records

4.3.5.1 Operational Log. A log book shall be maintained for each lift. Daily entries shall be made, giving the following minimum information:

(1) Date
(2) Names and duty stations of operating personnel
(3) Operating hours and purpose of operations
(4) Temperature, wind, and weather conditions
(5) Record of compliance with daily operational inspection
(6) Position and condition of the tension carriage, counterweights, or other tensioning devices
(7) Accidents, malfunctions, or abnormal occurrences during operation
(8) Signature of operator

4.3.5.2 Wire Rope and Cable Log. A log book shall be maintained for each lift giving the following information on each rope and cable.

(1) Approved specification
(2) Copy of certified test report
(3) Date installed
(4) Splicing certificate for each splice or laid in strand
(5) Record of lubrication, including type of lubricant and date applied
(6) Record of maintenance inspections (see 7.4.1(2))
(7) Report of wire rope and cable inspection (see 7.4.1 and 7.4.2)
(8) Report of accidents or injury to rope
(9) Documentation of end attachment (see 7.3.2.4)

4.3.5.3 Maintenance Log. A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced, and the condition of the components. A record shall be kept of replacement of components.

4.3.6 Passenger Conduct

4.3.6.1 Dexterity and Ability. A skier or foot passenger who uses a lift shall be presumed to have sufficient skiing ability or physical dexterity to negotiate the lift.

4.3.6.2 Embarkation and Disembarkation. A passenger shall get on and get off a lift at designated areas.

4.3.6.3 Riding. Passengers, while riding an aerial lift, shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the lift. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person.

4.3.6.4 Downhill Skier. Each skier should maintain control of speed and course as he/she is getting on or getting off the lift.

5. Surface Lifts

This section covers the class of tramways wherein passengers are transported uphill on the surface by means of devices propelled by a main overhead travelling wire rope. These tramways are normally monocable type, and the rope is usually supported on intermediate towers on both the uphill and downhill side. Either fixed or detachable grips may be used.

5.1 Design and Installation

5.1.1 General

5.1.1.1 Design Passenger Weight. For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77 kg).

5.1.1.2 Location. In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the lift type and location:

(1) Electric power lines and their supports
(2) Railways
(3) Highways
(4) Structures
(5) Rock and earth slides, cave-ins, washouts, etc
(6) Snow creep and avalanches
(7) Wind action
(8) Icing
(9) Ski slopes and trails
(10) Rivers and gullies
(11) Buried installations, including pipelines
(12) Crossing or close proximity to aerial tramways
(13) Control of air space below, above, and adjacent to the installation

5.1.1.2.1 Ski Track Gradient. The maximum permissible grade of the ski track shall be 100% for surface lifts using single passenger towing outfits and 80% for surface lifts using towing outfits for more than one passenger. No reverse grades shall be permitted except for very gradual inclines at loading and unloading areas.

5.1.1.2.2 Cross Slope. The cross slope of a ski track shall not exceed 5% for surface lifts using towing outfits for more than one passenger, except at unloading areas. For single-passenger surface lifts, the cross slope shall not exceed 5% except at towers and unloading areas. The cross slope at towers shall not exceed 10% and shall slope away from the centerline of the lift.

5.1.1.2.3 Ski Slopes and Trails. No ski traffic shall be allowed to cross the uphill surface lift line except at approved locations.

5.1.1.3 Width of Clearing. The clearing shall be wide enough to prevent interference with the lift by adjacent vegetation. Such clearings shall be protected, if necessary, to avoid washouts that might endanger the installation. Potentially dangerous trees shall be cleared far enough back to avoid their falling on the lift.

5.1.1.3.1 Track Clearing. A minimum track width shall be cleared and maintained in such a manner that no rocks, stumps, or other obstructions project above the snow surface from the point where the passenger embarks on the lift to the point beyond the safety gate where the passenger would stop, under the most adverse conditions. The minimum total snow track width shall be 2 feet 6 inches (0.8 meter) times the design number of passengers per carrier. In no case shall the track clearing width be less than 6 feet (1.8 meters).

5.1.1.3.2 Ski Track Width. A minimum skiable track width of 2.5 feet (0.8 meter) times the design number of passengers per carrier, but not less than 4 feet (1.2 meters), shall be maintained free of obstructions through the length of the track clearing described in 5.1.1.3.1.

5.1.1.4 Path of Rope. Terminals and towers shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration. Clearing shall be accomplished so that carriers will not come in contact with trees or vegetation during operating surges of the line, or under maximum design wind conditions, or both. In no case shall trees or vegetation extend within 5 feet (1.5 meters) of any portion of the haul rope or carrier under normal (nonsurge) operating conditions.

5.1.1.4.1 Vertical Clearances. Terminals and towers shall be located so that, under the most adverse conditions, the towing outfit will not lift a passenger from the snow surface. Also, under the most adverse conditions, the haul rope shall be high enough to clear a passenger's head by at least 2 feet (0.6 meter), and keep down-coming, empty towing outfits clear of the snow. The down-coming, empty towing outfits shall clear a passenger's head by at least 2 feet (0.6 meter) at any area where the passengers cross the path of such outfits.

The towers shall be of such a height and so located that if the up-going haul rope comes off the supporting sheaves of one tower, the towers (or terminal) on either side will support the rope clear of the design ski track by a minimum of 2 feet (0.6 meter).

5.1.1.4.2 Path of Rope Adjustment. When varying snow depths of the uphill ski track require changing of sheave heights, these changes shall be controlled within minimum and maximum tolerances established by the designer. This control shall be provided as prescribed below.

When terminals, towers, or both contain provisions for a change in height of rope or track supports in order to meet normal changes in operational requirements, such provisions shall be controlled as follows:

(1) The designer's operational manual shall provide complete instructions for proper procedures and sequences for making adjustments.

(2) Where range of adjustments allows possible operator error resulting in improper sheave loading, a system of readily verifying proper profile positioning without the use of tools shall be incorproated into the installation.

5.1.1.5 Capacity and Speed. The speed of the lift and the spacing of the towing outfits shall be such that the minimum loading intervals designated in 5.1.1.5.1 and 5.1.1.5.2 are maintained.

For lifts with detachable grips, means shall be provided to maintain the minimum distance between successive skiers that was used in the design of the lift. Skiers shall not be loaded until the skier(s) ahead has traveled this minimum distance from the loading point. Automatic launching devices shall meet these requirements when timed to release to meet the minimum loading interval.

5.1.1.5.1 Single-Passenger Carriers. The minimum loading interval shall be 3 seconds plus the time required to extend the towing outfit to such a point that the passenger starts to move.

5.1.1.5.2 Multiple-Passenger Carriers. The minimum loading interval shall be 4 seconds plus the time required to extend the towing outfit to such a point that the passengers start to move.

5.1.1.6 Structures and Foundations. All structures and foundations shall be designed and installed in conformance with applicable criteria listed in 1.3. Applied design loads shall include dead, live, snow, wind, and dynamic loads due to normal operations and for foreseeable abnormal conditions.

Structures and foundations located in snow creep areas shall be designed for such conditions and loads or be protected by snow breakers or shears.

5.1.1.6.1 Structures. When bolted to foundations, structures shall be bolted with double nuts, lock nuts, or equivalent means of locking nuts.

5.1.1.6.2 Foundations. In determining the resistance of the earth to motion of the foundation, the subsoil conditions at the site shall be considered, including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage should be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on solid rock. Foundations on rock shall be firmly anchored to solid rock unless designed as gravity foundations.

The top of concrete shall be not less than 6 inches (15 cm) above finished grade unless specific direction for protection of foundation and structural steel below grade is provided by the designer.

The design shall have factors of safety of 2 in resisting overturning and concurrently 2 against sliding under dead load and live load conditions; the factors shall be 1.5 under these loadings plus wind acting simultaneously.

5.1.1.7 Communications. A permanently installed two-way voice communication system shall be provided between the prime mover control point, drive machinery building, loading stations, and unloading stations. The power for this system shall be independent of the primary power source and the communication system shall be functional and audible during a power failure.

Audio indicators (bells, etc) shall be audible over all ambient noise levels, and visual indicators (e.g., LEDs) shall be visible even in bright sunlight.

NOTE: Voice communication systems are not required for those conveyances qualifying for operation by a single operator, as defined in 5.3.2.2.1.

5.1.1.8 Internal Combustion Engine Installation

5.1.1.8.1 Fuel Storage. Fuel tanks shall be of adequate capacity to permit uninterrupted operation during the normal operating period. Where internal combustion engines are located in weatherproof equipment rooms or buildings, fuel tanks shall be located at least 5 feet (1.5 meters) from the outside of the rooms or buildings for surface tanks or in an underground installation. The fill pipe shall be capped and locked, and located to avoid toxic fumes and fire hazard during refueling. Stopcocks shall be provided on fuel lines at points where the lines enter the building in underground installations or where the lines leave the tanks for aboveground installations.

In all respects, the installation shall comply with American National Standard for Stationary Combustion Engines and Gas Turbines, ANSI/NFPA 37-1979.

NOTE: Integrally mounted steel fuel tanks may be located within or beneath weathertight buildings supported on, or enclosing, combined drive-tension carriages, provided that the end of the fill pipe is located beyond the sides of the building, has a locked fill cap, and is in such a location as to avoid toxic fumes and fire hazard during refueling.

Liquid fuels shall be stored and handled in accordance with American National Standard Flammable and Combustible Liquids Code, ANSI/NFPA 30-1981 and ANSI/NFPA 37-1979. Liquefied petroleum gas installations shall be made in accordance with American National Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58-1979.

5.1.1.8.2 Exhaust Systems. Exhausts shall be designed and installed to discharge to the atmosphere so that precipitation does not enter the system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields.

5.1.1.8.3 Gear Shifts. Where gear shift levers are used, provisions shall be made to prevent accidental shifting of levers into speed ratios exceeding design or accidentally into reverse gear during public operation. Gears of manual transmissions shall not be shifted when the lift is moving.

5.1.1.9 Loading and Unloading Areas. Platforms, ramps, and related units comprising the loading and unloading areas of surface lifts are integrally related to safe operation. They shall be designed and installed in conformance with applicable criteria listed in 1.3.

Loading areas shall be of sufficient length and grade to permit the passenger to embark safely.

Unloading areas shall be of sufficient length and grade to permit the disembarking passenger to leave the towing outfit safety. The snow profile of this area shall contain an approximately level section followed by a downgrade to assist the passenger skiing away from the towing device.

The distance between unloading area and upper terminal guides shall be sufficient to allow towing outfits to become retracted and to permit their oscillations to diminish adequately before entering the terminal.

5.1.1.10 Signs. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point (see 5.3.6). All such signs shall be prominently placed, and those pertaining to the lift operations shall be adequately lighted for night operation.

Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons and locked.

The sign "Men Working on Lift" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the prime mover when men are working on the lift. See 5.1.1.12 for additional requirements.

The following signs shall be posted:

(1) "Prepare to Unload" (not less than 50 feet (15 meters) ahead of unloading area)

(2) "Stay in Track"

(3) "Unload Here"

(4) "Safety Gate"

(5) "Remove Pole Straps from Wrists" (at loading area)

5.1.1.11 Tests and Inspection

5.1.1.11.1 Acceptance Tests and Inspection. Before a new or relocated surface lift is opened to the public, it shall be given thorough inspection and tests by qualified personnel to verify compliance with the plans and specifications of the designer. The designer or manufacturer shall propose and submit a load test procedure.

It shall be the responsibility of the owner to see that the following conditions have been met:

(1) Tightness of all structural connections

(2) Lubrication of all moving parts

(3) Alignment and clearances of all open gearing

(4) Installation and alignment of all drive components

(5) Position and freedom of movement of counterweights or other tensioning means and carriages

(6) Haul rope alignment at entrance to bull wheels

(7) Operation of all electrical components, including circuit protection and grounding

5.1.1.11.2 Surface Lift Inspection. Inspection shall also cover:

(1) Alignment of haul line sheave units.

(2) Haul rope sags.

(3) Retraction of towing outfits.

(4) Towers, bents, and terminals for correct location and installation in accordance with plans and specifications. Terminal and tower cable working points shall be documented by an "as built" survey, and any variation from the design drawings shall be noted and approved by the engineer responsible for design.

(5) Thorough operating tests. The functioning of all push-button stops, automatic stops, safety gates, limit switches, selected deropement switches, and communication devices shall be checked. Braking shall be proved adequate (see 5.1.2.5.1 and 5.1.2.5.2). The tests shall include a period of continuous, full-speed operation with empty carriers of sufficient duration to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tensioning systems, and other related defects.

Chg 1985 **5.1.1.12 Safety of Operating and Maintenance Personnel.** Provision shall be incorporated in the surface lift design to render the system inoperable when necessary for the protection of personnel working on the lift. See 5.1.1.10 for placement of applicable warning signs.

5.1.2 Terminals and Stations

5.1.2.1 Power Units

5.1.2.1.1 Prime Mover. All prime movers shall have capacity to handle the most unfavorable design loading conditions, including the starting of a fully loaded lift.

Where manual multispeed transmissions are used on the prime mover, gears shall not be shifted when the lift is moving.

Where reverse capability is provided on the prime mover, provisions shall also be made to prevent accidentally shifting into reverse whenever the lift is operating.

5.1.2.1.2 Auxiliary Power Unit. An auxiliary power unit shall not be required.

5.1.2.2 Speed Reducers and Gearing. All speed reducers and gearing shall have the capacity for starting a lift under the most unfavorable design loading conditions and without exceeding design rating. They shall have a service factor appropriate for the application and they shall comply with the standards of the American Gear Manufacturers Association (AGMA), listed in 2.1.2.2.

5.1.2.3 Bearings, Clutches, Couplings, and Shafting. Bearings, clutches, and couplings shall be selected on the basis of the manufacturer's published recommendations for the particular use. If published data are not available for the specific use, the manufacturer's approval shall be obtained. Bearings, clutches, and couplings of special design, if used, should have the approval of a qualified mechanical engineer.

Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings when required.

All shafting shall be designed in accordance with accepted standard practices.

5.1.2.4 Acceleration and Speed Control. Acceleration of a drive shall be regulated with regard to lift type, profile, speed, and use.

5.1.2.5 Brakes. All braking systems shall be capable of operation to comply with daily inspection required by 5.3.2.4.3(4).

Each surface lift shall have the brakes designated in 5.1.2.5.1 and 5.1.2.5.2.

5.1.2.5.1 Backstop Brake. A backstop brake shall be provided to automatically prevent reverse rotation of the lift under maximum load.

5.1.2.5.2 Service Brake. Unless an unloaded lift operating at maximum speed will stop in 25 feet (7.6 meters) or the distance $d = V^2/18\,000$ where d is the stopping distance in feet and V is the lift speed in feet per minute, whichever is greater, an automatic brake shall be provided to assure this stopping distance. This brake shall be applied by springs, weights, or other approved forms of stored energy when any stop circuit is interrupted. If the prime mover is an internal combustion engine, the compression of the engine may serve as a brake when this unit is not declutched by activation of the stop circuit. When the motive power is an internal combustion engine, a positive system shall be provided to stop the lift.

5.1.2.6 Location of Machinery

5.1.2.6.1 General. Moving machine parts that normally may be in reach of personnel shall be fitted with safety guards conforming to American National Standard Safety Standard for Mechanical Power Transmission Apparatus, ANSI B15.1-1972.

Protection against static electricity shall be provided.
Fire-fighting device(s) shall be available.

5.1.2.6.2 Machinery Not Housed in a Machine Room. Provisions shall be made to keep the public away from the machinery. All power units, all components of the drive train, and all safety devices, such as backstops, brakes, relays, and the like shall be protected from the weather.

5.1.2.6.3 Machinery Housed in a Machine Room. The machine room shall be well-ventilated. It shall have a permanently installed lighting system adequate for proper machinery maintenance and safety of operating personnel. The arrangement shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (46 cm) shall be maintained. Means shall be provided to heat the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

5.1.2.7 Sheaves in Terminals and Stations

5.1.2.7.1 General. All sheaves, including their mountings and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers of the bearings.

When unlined sheave grooves are used for wire rope, they should be V-shaped and shall have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

Chg 1986 **5.1.2.7.2 Haul Rope Terminal Sheaves (Bull Wheels and Deflection Sheaves).** Haul rope terminal sheave frames shall be designed to retain the rope in the event of the failure of the shaft or mounting. In instances where the sheave is cantilevered, the design working stresses shall be not more than 60% of those otherwise allowable.

The minimum diameter of terminal sheaves shall be 72 times the nominal diameter of the haul rope, pro-

Table 5-1
Minimum Diameters for Counterweight Rope Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard

	Sheave Diameter		
Rope Type	Condition A	Condition B	Condition C
6 × 7	72*d*	42*d*	**24*d***
6 × 19	45*d*	30*d*	**20*d***
6 × 37	27*d*	18*d*	12*d*

NOTE: *d* equals the nominal rope diameter.

vided that no gripping device passes around the sheave. The minimum diameter shall be 80 times the nominal haul rope diameter in cases where gripping devices pass around the sheave. In the latter case, means shall be provided to guide towing outfits into, around, and out of terminal sheaves and to prevent the towing outfits from swinging excessively while passing around the sheave. The sheave assembly shall be designed to retain the haul rope in the event of a deropement from the sheave.

Haul rope terminal sheaves that act as driving, braking, or holding sheaves shall be so designed that the haul rope does not slip in the sheave groove.

5.1.2.7.3 Counterweight Rope Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard. The minimum diameters for these sheaves shall be as indicated in Table 5-1.

Condition A is applicable where rope bending around sheaves is of major importance.

Condition B is applicable where rope bending around sheaves is important, but some sacrifice in rope life is acceptable to achieve reduction in weight, economy in design, etc.

Condition C is applicable to sheaves that should not rotate due to any tension sheave movement but should rotate only due to counterweight adjustment.

Provisions shall be made to assure that all counterweight sheaves rotate freely.

5.1.2.7.4 Haul Rope Line Sheaves. The requirements of 5.1.3.3 are applicable to haul rope line sheaves used in terminals and stations, with the following exceptions:

(1) Sheaves that carry no load other than the weight of the rope and carriers

(2) Sheaves that are located in such a way that the weight of carriers is either wholly or partially supported on tracks or by other means

(3) Sheaves that are located in such a way that carriers attached to the cable are not passing onto the sheaves

In such cases, the design shall be modified to meet the requirements of the particular installation.

Guide sheaves shall be located in order to prevent misalignment of rope entering and leaving the drive and return sheaves. Such sheaves shall be as close as practicable to the drive and return sheaves, but not farther than one diameter of the drive or return sheave from the point of tangency. Shoes, rollers, or sheaves shall be placed on the opposite side of the rope adjacent thereto to prevent deropement in that direction.

These requirements apply to all installations except floating tension sheave carriages (see 5.1.2.8.2).

5.1.2.8 Tension Sheave Carriages. The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion under normal operation.

5.1.2.8.1 Rigid Mounted Carriages. The sheave carriage shall be supported from the ground by a rigid structure. The mounting that travels under the action of the counterweight shall be supported on rigid, straight rails by means of wheels. Torsional loads due to driving torque, braking torque, or reactions of a backstop shall be considered, and the structure and carriage shall adequately transmit these loads to the foundations.

Mechanical stops shall be provided to prevent overtravel of the carriage and the tension sheave. These stops and the terminal structure shall be designed to resist, at normal design stresses, an unbalanced horizontal force on the bull wheel applied in the direction of the opposite terminal and equal in magnitude to 30% of the counterweight reaction on the bull wheel.

5.1.2.8.2 Floating Tension Sheave Carriages. A floating tension sheave carriage may be used and operated with a lateral tilt of more than 6 degrees if it is of the type that has proved to give satisfactory service in the industry. Otherwise, the provisions of 5.1.2.8.1 shall apply. In any event, adequate control measures shall be taken to prevent the rope from riding on the flanges or derailing from the terminal sheave and the tower sheaves on the nearest line tower.

5.1.2.9 Counterweight and Tensioning Systems

5.1.2.9.1 Counterweights. Counterweights or other suitable devices shall be provided to determine and regulate the tension of all haul ropes. Counterweights, when used, shall be arranged to move freely up and down. Enclosures for counterweights shall be provided where necessary to prevent snow or ice from accumulating under and around the counterweights and interfering with their free movement. When a counterweight is contained in a structural frame, guides shall be provided to protect the frame and to ensure free movement of the counterweight. Where snow enclosures are not required, guardrails or enclosures shall be provided to prevent unauthorized persons from coming in contact with or passing under counterweights.

The counterweight, or other suitable device, shall have sufficient travel to take care of all normal operating changes in loading and temperature. Counterweights, if used, shall determine and regulate the tension during all operating periods.

Friction and other forces developed in the tension system composed of the movable carriage, counterweight sheaves, reeving, and guide system shall be included in calculating haul rope tension for all conditions of loading. Carriage and counterweight movement shall be evident in normal operation or the resistance to movement shall be measured and its magnitude approved by the engineer responsible for design.

5.1.2.9.2 Counterweight Ropes. Counterweight ropes shall have a minimum factor of safety of 6, when new. The factor of safety is equal to the nominal breaking strength of the rope (see 7.1.3) divided by the maximum static design tension. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account shall be the basis for determining factor of safety.

Counterweight ropes shall be adjusted so that the counterweight will reach the end of its travel before the attached tension sheave carriage comes within 6 inches (15 cm) of the end of its travel.

See 7.3 for additional requirements.

Chg 1988 **5.1.2.9.3 Counterweight Winches.** Winches that are used for counterweight system take-up and remain a permanent part of the system shall have a factor of safety of 6 against their ultimate capacity. They shall have a positive lock against release. Where this factor of safety cannot be established by manufacturer's endorsement, a safety device shall be installed on the counterweight rope ahead of the winch that will keep the tensioning system intact in the event of failure or release of the winch.

5.1.2.10 Anchoring Devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion.

Sections of ropes bent around thimbles, sheaves, or other anchorage devices not meeting the minimum diameters specified by Condition C in 5.1.2.7.3, or permanently deformed or damaged sections, shall not be relocated or reused as a part of the section under load.

Wire ropes or strands, and their connections, used to anchor, tension, or otherwise secure terminal structures, shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

5.1.2.11 Manual and Automatic Stops. All stop circuits and switches shall conform to the requirements of 5.2.1.7.

5.1.2.11.1 Manual Stop Devices. Manual stop devices that will stop the prime mover and apply the service brake shall be installed in all attendants' and operators' stations, in machine rooms, and out-of-doors in close proximity to all loading and unloading areas. Unattended stop devices shall be designated by a sign reading "Emergency Stop Switch" or equivalent. All manual stop devices shall be conspicuously and permanently marked.

Chg 1988 **5.1.2.11.2 Automatic Stop Devices.** The following automatic stop devices shall be installed:

(1) Devices beyond each unloading area. For actuating devices of the suspended type, the suspended portion shall be strong enough to cause release of the actuating devices in use under the most adverse conditions, and each side shall be detachable and shall interrupt the safety circuit when detached. The location of the device shall be in accordance with the following:

(a) Intermediate unloading stations: Required only when skiers are not permitted beyond the intermediate unloading station. The device shall automatically stop the lift in the event a skier or an unretracted towing outfit passes beyond the intended point of unloading.

(b) Terminal unloading areas: Always required. The device shall automatically stop the lift in the event a skier or an unretracted towing outfit passes beyond the safety gate. The gate shall be so located that the distance from the stopping device to the first obstruction or point of reversal of direction of the towing outfits is 150% of the distance required to stop the empty lift operating at maximum speed.

A device shall be installed on the down side of surface lifts to stop the lift in the event a towing outfit fails to retract. This device shall be located as near to the upper terminal as practical, but in no event be further downhill than opposite to the unloading area.

(2) Devices to stop the lift before any counterweight or tension sheave carriage reaches either end of its travel.

5.1.3 Line Structures

5.1.3.1 Towers. The design of the tower structure and foundation shall be in accordance with the requirements of 5.1.1.6. Where guyed towers are used and guys intersect the ground within or near ski runs, the guys shall be marked for visibility, preferably with boards painted with black and yellow stripes.

Means shall be provided for ready access from the ground to all tower tops. This requirement will be fulfilled if the tower structure is safe to climb. Otherwise, means such as permanent ladders or light, portable ladders shall be provided. The latter, if used, shall be in at least sufficient quantity to be available at each point where attendants are stationed.

Towers shall be identified with successive numbers clearly visible when looking up the lift line.

Where towers are designed to permit variations in rope height, sheave unit supports shall be guided and attached so as to prevent misalignment by rotation during normal operation.

5.1.3.2 Guards and Clearances. A minimum clearance of 36 inches (91 cm) shall be maintained between the tower at uphill ski track level and the vertical plane of the upward traveling cable. With respect to the downward traveling cable, a minimum clearance of 24 inches (61 cm) shall be provided between the towing outfit in its normal position and the tower. A definite need for additional clearance arises when it is proposed to transport more than two skiers per towing outfit.

5.1.3.3 Haul Rope Sheaves and Mounts

NOTE: The requirements in 5.1.3.3 and 5.1.3.3.1 through 5.1.3.3.4 apply generally to sheaves that support or hold down the haul rope at towers on a monocable system. These requirements shall apply to both sides of each lift.

The diameter of a haul rope sheave shall be not less than 10 times the nominal diameter of the haul rope for metallic sheaves or 8 times for sheaves with elastomer treads.

5.1.3.3.1 Maximum Allowable Sheave Load. The maximum allowable load per sheave should be determined by the lift designer.

5.1.3.3.2 Sheave and Sheave Unit Design. Sheave flanges shall be as deep as possible considering other features of the system. At the same time, rope grips shall be designed in relation to the sheave groove so as not to contact sheave flanges during normal operations taking into consideration the anticipated amount of wear of the sheave liner groove. Grips shall be allowed to contact sheave flanges adjacent to the haul rope when the carrier swings, provided that this is considered in the design of grips and sheaves. Furthermore, rope grips, sheave flanges, and hanger guides shall be designed so that hangers cannot be caught behind guides, and so that ropes and grips cannot be deroped from sheaves if the carrier is swinging within design limits as it approaches or passes the tower.

Suitable guards of sufficient strength to resist the lateral forces caused by deropement shall be installed to prevent the rope from falling into a dangerous position within the tower structure.

Construction of the entire sheave unit shall be such that the rope cannot become entangled in the sheave unit in the event the rope leaves the sheave toward the outside.

On each sheave unit, rope-catching devices shall be installed to prevent the rope from moving excessively in the direction of the load on the sheave unit in the event of deropement. These devices shall be located less than one-half the diameter of the sheaves from the normal operating position of the rope and shall extend a minimum of two rope diameters beyond the sheave flange. They shall be designed to permit the passage of the rope and grips after deropement.

On each sheave unit, suitable deropement switch devices shall be installed and maintained that will stop the lift in case of deropement.

If the gage of the haul rope system is varied at any point along the line, the horizontal departure at any one tower shall be provided for in the design so that deropement cannot occur by virtue of such a departure.

Sheave mounts or mounting frames shall be designed to be adjustable, allowing the sheave units to be aligned and held in the plane of the rope.

See also 5.1.1.4–5.1.1.4.2 for effect of tower height and location on sheave units.

5.1.3.3.3 Haul Rope Retention. Provisions shall be made to retain the haul rope in the line sheave groove under all anticipated conditions of loading. This criterion will be met if any of the following conditions is fulfilled:

(1) Condition A: Under the most adverse design loading conditions (excluding dynamic effects), the minimum load of the haul rope on a group of support sheaves at a tower shall be not less than the largest of the following values: 100 pounds (45 kg) per sheave; or 300 pounds (136 kg) per tower group; or a value in pounds equal to two-thirds the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to the sum of the adjacent span lengths expressed in meters of slope length).

When cable elevation at the tower in question lies below a straight line joining cable elevations at the adjacent tower, the haul rope shall not leave the group of sheaves under either of the following conditions:

(a) When the haul rope tension is 1.5 times its maximum design value at the point, using unloaded carriers in adjacent spans or, in the case of detachable systems, no carriers in adjacent spans

(b) When a rope is under tension of the counterweight alone (bare rope) or with any arrangement or number of empty chairs or hangers on the line

The minimum load of the haul rope on a group of hold-down sheaves at a tower under the most adverse loading conditions shall be not less than the larger of the following values: a value in pounds equal to the dead plus live load of the carrier; or a value in pounds equal to the sum of the adjacent span lengths expressed in feet of slope length (a value in kilograms equal to

1.5 the sum of the adjacent span lengths expressed in meters of slope length). In no case shall this load be less than 225 pounds (102 kg) per passenger.

(2) Condition B: Combination sheave units that incorporate support and hold-down sheaves shall be designed with the retaining sheaves always in contact with the haul rope. When retaining sheaves are mounted to deflect, to allow passage of a carrier grip, such deflection shall not occur until the sheave is loaded to one-half of the maximum design sheave loading. The retaining sheaves shall have the same maximum design loading as the other support or hold-down sheaves on the tower. If the design satisfies loading requirements in Condition A, nothing in this paragraph shall preclude the use of rollers or guides opposite the tower sheaves that do not necessarily contact the rope.

5.1.3.3.4 Additional Requirements. When single sheaves are used for other than guide sheaves, which normally carry no load other than the weight of the rope and carriers, the sheave diameter should be not less than 20 times the nominal rope diameter. The sheaves for the return rope shall be installed in a manner to prevent a passanger from contacting the rope or being hit by one of the returning towing outfits. All line sheaves shall be so guarded that towing devices or attachments cannot become entangled in the sheaves or sheave supports while traveling in either a forward or reverse direction. If unloading is permitted ahead of any intermediate tower, the layout of the unloading area shall satisfy the requirements of 5.1.1.9, and the tower shall be guarded to prevent the released towing devices from becoming entangled with it.

5.1.4 Line Equipment

5.1.4.1 Haul Rope. See Section 7 for basic wire rope design and installation requirements.

ch 1986 **5.1.4.1.1 Factor of Safety.** Haul ropes shall have a minimum static factor of safety of 5, when new. Static factor of safety is equal to the nominal breaking strength (see 7.1.3) divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

5.1.4.1.2 Factor of Safety for Spliced Haul Rope with an Independent Wire Rope Center. Where a spliced haul rope with an independent wire rope center is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

5.1.4.2 Fixed and Detachable Haul Rope Grips

5.1.4.2.1 General. The rope grip shall be of a type that has been proved to give satisfactory service by the industry. The manufacturer shall permanently affix a unit identification and size marking to each grip. Each grip shall be nondestructively tested before public use.

The rope grip shall be designed to pass smoothly over and under line sheaves that have flanges of adequate depth to discourage the haul rope from leaving the sheaves.

The design shall incorporate provisions to accommodate a 10% reduction in haul rope diameter. The designer's instructions shall provide details for the proper initial setting of the grip and a method to assure an operator or inspector that the grip has not reached an operational limit of the clamping components.

5.1.4.2.2 Slippage. The rope grip shall be designed and maintained during use so as to resist a force, that tends to slide it along the haul rope, that is, a minimum of 2 times the force required to move a carrier along a properly lubricated haul rope at its steepest incline, under the most adverse conditions of carrier loading. The grip shall automatically adjust to maintain this gripping force with a 3% reduction in haul rope diameter.

The grip designer shall specify the proper grip installation and testing procedures and, for clamping-type grips, the minimum force below which the grip should not slip on the rope and a maximum force above which the grip should slip on the rope.

ch 1986 **5.1.4.2.3 Strength.** The strength of the grip shall be based on the following criteria:

(1) A factor of safety of 6 shall exist in all parts of the grip wherein stress is proportional to the dead and live load of the carrier. This factor of safety is defined as follows: With the grip in its operating position (gripping the rope or equivalent), a downward load, equal to the dead load of the carrier plus 6 times the design live load, shall not cause any part of the grip to fail.

(2) Those parts whose stress is not changed by application of live load shall be designed on the basis of an allowable stress of not more than the yield point divided by 3.0. In the design of springs, where used, the allowable stress may be increased if load tests are conducted by an approved testing laboratory to provide assurances that the fatigue life of the actual spring is more than ample for the various applied loads.

(3) The material of which the grip is made shall be selected or selected and treated to obtain optimum impact resistance.

(4) Special attention shall be paid to fatigue considerations. A grip that has not been proved in service should be subjected to fatigue tests.

(5) Grips made up of cast parts shall be proof-loaded with forces equal to the gripping force and 3 times dead plus live load.

By inspection, confirmation shall be obtained that the grip and its parts meet the foregoing criteria.

5.1.4.2.4 Maximum Loads. The maximum total vertical load on a single grip shall not exceed 1/14 of the minimum tension in the haul rope.

5.1.4.2.5 Positive Attachment of Detachable Grips. A detachable grip shall be designed and constructed in such a manner that it grips the haul rope positively without damaging the haul rope and in such a manner that it cannot become accidentally uncoupled, even by rope vibrations.

Provision shall be made to preclude a grip attaching to the haul rope at the splice unless the designer stipulates that the grip will function properly at that point and gives maximum and minimum permissible rope diameter variations through the splice length including the point of strand tucks.

5.1.4.3 Carriers

5.1.4.3.1 General. The bar, platter, or other device in contact with the skier shall be so designed that the passenger can embark and disembark safely. Devices that envelop the passenger, such as a strap, are prohibited.

The length of the towing outfit shall permit the shortest passenger to remain in firm contact with the uphill track and to satisfy the requirements of 5.1.1.4.1.

5.1.4.3.2 Loads. With respect to vertical loads, the surface lift carriers shall be designed to support a vertical load 4 times the design load without permanent deformations of the assembly or component parts.

5.1.4.3.3 Vertical Clearances. When a towing outfit is swung longitudinally by 15 degrees from the vertical position, or when it is in its most extreme operating condition, whichever is more severe, there shall be clearance in the vertical plane between the towing outfit or hanger and any obstruction, such as sheaves, guards, etc.

5.1.4.3.4 Additional Requirements for Retractable Towing Outfits. Retraction of a towing outfit shall be so controlled that it may be released from a fully extended position without causing injury to passengers or damage to the towing outfit, or causing such violent oscillations as to expose any part of the towing outfit to entanglement with the haul rope, sheaves, other structures, or equipment.

5.1.5 Provisions for Operating Personnel. Operator and attendant stations shall be located to provide visual surveillance of the line and station. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed: (1) the communications and controls required of the station; (2) the operating instructions and emergency procedures, and (3) a fire extinguisher. This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry.

The operator shall be located where he/she can observe the lift in operation. All primary lift controls and communications shall be immediately available to him/her. Loading and unloading areas shall have lift-stopping devices located convenient to the attendants assigned to those areas.

5.1.6 Operational and Maintenance Manuals

5.1.6.1 Operational Manual. The designer of each lift shall prepare an operational manual for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

5.1.6.2 Maintenance Manual. The designer of each lift shall prepare a maintenance manual for each installation. The manual shall describe recommended maintenance procedures, including:

(1) Types of lubricants required and frequency of application

(2) Definitions and measurements to determine excessive wear

(3) Recommended frequency of service to specific components, including relocation of fixed grips, if applicable

5.2 Electrical Design and Installation

5.2.1 General Design and Installation Testing. Prior to operation of newly installed tramways or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this standard and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), solenoid or relay noise at levels and frequencies that could initiate loss of control.

5.2.1.1 Applicable Codes. All electrical systems shall comply with American National Standard National Electrical Code, ANSI/NFPA 70-1981 and American National Standard National Electrical Safety Code, ANSI C2-1981.

5.2.1.2 Location. All electrical power transmission wiring located near or proposed to cross over tramways shall comply with the applicable requirements of ANSI C2-1981.

5.2.1.3 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

5.2.1.4 Voltage Limitations for Overhead Circuits. Signal, communication, and control circuits may be supported between the towers that support the tramway. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

5.2.1.5 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

5.2.1.5.1 Control Wiring Classification. All control wiring shall be Class 1 in accordance with Article 725 Parts A and B of ANSI/NFPA 70-1981.

5.2.1.5.2 Communication Wiring. All communication wiring and systems are excluded from the requirements in Article 725-5 of ANSI/NFPA 70-1981.

5.2.1.5.3 Insulation. All control wiring is excepted from the requirements of Article 725-16 of ANSI/NFPA 70-1981. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

5.2.1.5.4 Exterior Lighting and Snowmaking Circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18 meters) of the tramway centerline, shall be ground fault protected.

5.2.1.6 Grounding

5.2.1.6.1 Structures. All metallic structures shall be connected to a common conductor. Electrical continuity of all metal parts of the structures shall be assured by mechanical connection.

5.2.1.6.2 Drive Terminal Structure. The drive terminal structure shall have one point referred to as a ground point, as defined in ANSI/NFPA 70-1981. All direct-current and alternating-current electrical systems shall be referenced to this point. If an electrical prime mover is used, the electric service grounding electrode conductor shall terminate at this point. Under the worst case conditions, the resistance from the ground point to any grounded point within the tramway system shall not exceed 50 ohms. The grounding system for the tramway shall not be used as a grounding system for any other system not related to the tramway system.

To ensure that the 50-ohm grounding requirement is met under all conditions of soil, moisture, temperature, and circulating ground and air currents, all terminal and line structures shall be bonded together with a bonding conductor.

5.2.1.6.3 Haul Rope Grounding. Grounding sheaves or equivalent means shall be provided at one location for the purpose of grounding haul ropes, as applicable, for static electrical discharge.

5.2.1.6.4 Lightning Protection. If lightning protection is provided, it shall follow the American National Standard Lightning Protection Code, ANSI/NFPA 78-1980.

5.2.1.7 Operating Control Circuits. If, for any reason, the operator has lost control of the tramway while using the normal or operating control circuitry, the control circuitry shall be designed to allow the attendant/operator to stop the tramway with the emergency stop circuit. Any one of the following six conditions is considered a loss of control of a tramway:

(1) Tramway will not *slow down* when given the command to do so

(2) Tramway will not *stop* when given the command to do so

(3) Tramway *overspeeds* beyond control settings and/or maximum design speed

(4) Tramway *accelerates* faster than normal design acceleration

(5) Tramway *self-starts* or *self-accelerates* without the command to do so

(6) Tramway *reverses* direction unintentionally and without the command to do so

Control circuits shall not have anything across or parallel with the contacts of switches, relays, or safety devices including solid state devices monitoring the circuits or devices, unless it can be shown that any failure mode of the device placed across the switch does not defeat the purpose of the switch.

Each control circuit shall be tested for circuit integrity at its most remote terminal on a daily basis. An inadvertent ground or power failure shall stop the tramway.

5.2.1.7.1 Emergency Stop Circuit. All tramway control systems shall include a normally energized electrical circuit, that, when interrupted, effects an emergency stop (see 1.4.20.1). The emergency stop shall have priority over all other control stops or commands. This circuit shall include a manual stop device at each attendant/operator station in close proximity to loading and unloading areas, main control panel, and machine room. These emergency stop switches shall be red.

When there is only one stop circuit, it shall be classified as the emergency stop circuit.

5.2.1.7.2 Normal Stop Circuit. All tramway systems shall include a normally energized electrical circuit that, when interrupted, effects a normal stop (see 1.4.20.2).

5.2.1.7.3 Operating Circuitry. All tramway systems shall contain a normally de-energized circuit that, when energized, causes the system to start, accelerate to and run at designated speeds and, when de-energized, causes the system to stop.

All start/run and speed control switches shall be conspicuously and permanently marked with the proper function.

All stop switches shall be of the manually reset type and be positively opened mechanically and their opening shall not be dependent upon springs.

Chg 1986 **5.2.1.7.4 Bypass Circuits.** Bypass circuits may be installed for emergency conditions. Controls to bypass any portion of the operating control circuitry shall be locked and may be operated only by the tramway supervisor or his/her designated representative. Operation of the bypass shall require the physical effort of the person activating it to maintain the bypass condition (momentary contacts).

Bypass circuits shall be provided with a warning light to clearly indicate the bypass circuit is in use. The tramway shall be maintained under close visual surveillance when the safety circuits are bypassed.

5.2.1.8 Electrical Prime Mover. All DC (direct-current) electronic speed regulated drives and DC-powered electric motors shall shut down in the event of:

(1) Field loss
(2) Speed feedback loss
(3) Overspeed
(4) Overcurrent
(5) SCR misfiring

5.2.2 Night Lighting. For nighttime operation, operating tramways shall be provided with lighting facilities. The entire path of travel, including the loading and discharge areas, shall be lighted.

5.2.2.1 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

5.2.2.2 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp operating characteristics.

5.2.2.3 Location. Lights shall be mounted on substantial poles or standards. Tramway towers and terminal structures may be used for supporting lights subject to the following requirements:

(1) Approval shall be obtained from a qualified engineer.

(2) The service conductors to each tramway tower or terminal structure shall be underground or in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the tramway line.

(3) A separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure.

(4) All metallic raceways on a tower or terminal structure shall be grounded.

(5) The lighting installation shall not conflict with other requirements of this standard and shall not interfere with operations of the tramway in any manner.

5.2.2.4 Emergency Lighting. Emergency lighting shall be provided in the event of electric power failure to permit regular unloading of tramway facilities.

5.3 Operation and Maintenance

5.3.1 General and Personnel Safety. This subsection covers the requirements for operation and maintenance of all types of surface lifts. Many requirements are listed elsewhere in Section 5, since they also regulate installation and design. It is imperative that operating and maintenance personnel be familiar with applicable provisions of this section.

Operation and maintenance of surface lift equipment can be dangerous to personnel performing these tasks. Procedures for performing these functions shall require precautionary measures necessary to assure the safety of the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of carrier clearances or design live loads.

5.3.2 Operation

5.3.2.1 Personnel. Surface lifts shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. One or more persons familiar with emergency procedures shall be on the site at all times when the facility is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific lift.

5.3.2.1.1 Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for safe operation, and shall have the authority to deny access to the lift to any person who in the supervisor's opinion is not fit or competent to use the lift without danger to that person, to others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the lift under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

5.3.2.1.2 Operators. An operator shall be in charge of each lift. This operator shall be trained and experienced in normal operational and emergency procedures.

5.3.2.1.3 Attendants. An attendant shall be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view.

5.3.2.1.4 **First Aid.** One or more persons trained to administer first aid shall be available at all times when a lift is operating and transporting passengers. There shall be ready access to first aid supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

5.3.2.2 **Minimum Operating Personnel.** The following personnel are the minimum that shall be required:

(1) An operator shall be in charge of each surface lift.

(2) One attendant shall be on duty at each loading area.

(3) One attendant shall be on duty at each unloading area.

NOTE: An operator may serve concurrently as an operator and an attendant at a loading or unloading area that may be adjacent to the operator's station unless the duties of that area preclude his/her maintaining reasonable surveillance of the entire lift operation.

The above regulations for minimum operating personnel may be modified in the following cases:

(1) Surface lifts may be operated with a single operator at the loading station provided the following conditions are met:

(a) The length of the lift, measured from the loading area to the safety gate, shall not exceed 800 feet (245 meters)

(b) The entire tow path and the entire haul rope system shall be visible to the operator

(c) The lift shall have a clearly identified stop switch located at the unloading area, in addition to the required safety gate (see 5.1.2.11.2)

(d) The operator shall have all lift controls immediately available

(e) The restarting of the lift following actuation of a safety or stopping device shall be impossible until clearance is assured and the safety or stopping device(s) has been reset by an authorized person

(f) There shall be no obstructions at the top bull wheel area that could come into contact with a passenger who might fail to unload

(2) Surface lifts provided with television surveillance of sections of the tow path and designated unloading stations not visible to the operator do not require an unloading attendant, provided conditions (c) through (f) are enforced and the unloading areas of the lift meet the requirements of 5.1.1.9.

NOTE: When specifically approved, platter lifts with single-passenger hangers do not require either an unloading attendant or television surveillance providing conditions (c) through (f) are enforced and the unloading area of the lift meets all manufacturer's design specifications.

5.3.2.3 **Duties of Operating Personnel**

5.3.2.3.1 **Supervisor.** The duties of the supervisor shall be as follows:

(1) To determine that all lifts are operational and that all operating personnel are trained, equipped, and fit to perform their duties

(2) To discontinue operations on any lift due to physical, weather, personnel, or other reasons

(3) To enforce operational, maintenance, and safety rules

5.3.2.3.2 **Operator.** The duties of the operator shall be as follows:

(1) To assume responsible charge of the lift

(2) To assign and supervise all attendants on his/her lift

(3) To maintain an operational log book as required in 5.3.5.1

(4) To advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation

5.3.2.3.3 **Attendant.** The duties of the attendant shall be as follows:

(1) To maintain orderly passenger traffic conditions within his/her area of jurisdiction

(2) To advise and assist passengers, as required

(3) To maintain surveillance of his/her area of jurisdiction

The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the lift immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

5.3.2.4 **Operational Procedures.** The required operational procedures as set forth in 5.3.2.4 through 5.3.2.5 shall be supplemented by specific requirements as specified in the designer's operational manual (see 5.1.6.1).

5.3.2.4.1 **Control of Passengers.** Each lift shall have a definite method for marshaling passengers for safe loading and unloading. Fences and gates may be required to implement the system.

5.3.2.4.2 **Daily Preoperational Inspection.** Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:

(1) A visual inspection of each terminal, station, and the entire length of the lift

(2) Assurance that tension carriage, counterweights, or other tensioning devices are functional and have adequate travel with clearance at both ends of travel

(3) Operation of all manual and automatic switches in terminals, stations, and loading and unloading areas

(4) Operation of all braking systems

(5) Operation of communication systems

(6) Operation of the lift, including a visual inspection of all ropes and carriers

For those lifts having internal combustion engines, the fuel quantity shall be determined to be sufficient to conduct the anticipated period of operation without refueling. During refueling, power units shall be shut down.

Loading and unloading areas shall be inspected and prepared for the safe ingress and egress of passengers. The lift or tow track shall be inspected and, if necessary, tracks shall be established. Tracks shall be established beyond the safety gate for a distance necessary for passengers to stop should the passenger pass through the safety gate (see 5.1.1.3.1). The towing seats shall be cleared of ice to the extent necessary to permit safe operation.

5.3.2.5 Operational Requirements

5.3.2.5.1 General. The supervisor and operator of each lift shall review the requirements of 5.1 and Section 7 of this standard to ascertain that original design and installation conditions have not been altered in such a manner as to violate the requirements of the standard.

5.3.2.5.2 Starting. No lift shall be started except at the direction of or following clearance by the operator.

5.3.2.5.3 Stops. After any stop of a lift, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

5.3.2.5.4 Damage to Towing Outfits. Should any towing outfit become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked and not used for passengers until repaired or replaced. It shall be removed from the line when feasible.

5.3.2.5.5 Hazardous Conditions. When wind or icing conditions are such that operation is hazardous to passengers or equipment, according to predetermined criteria based upon the area's operational experience and the designer's design considerations, the lift shall be unloaded and the operation discontinued. No lift shall operate when there is an electrical storm in the immediate vicinity. Should such conditions develop while the lift is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to discharge all passengers. When such shutdown has been caused by an electrical storm, grounding of control circuits and haul ropes that are used as conductors in communication systems is permissible. Such grounding shall be removed prior to resumption of passenger operations.

5.3.2.5.6 Termination of Daily Operations. Procedures shall be established for terminating daily operations in such a manner that passengers will not be left on the lift after it has been shut down. Loading ramps, as required, shall be closed during off-hours and so marked.

5.3.2.5.7 Operational Log. A daily operation record shall be maintained as required under 5.3.5.1.

5.3.3 Maintenance

5.3.3.1 General. Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance requirements of the designer (see 5.1.6.2) shall be followed. Maintenance records shall be kept (see 5.3.5.3).

A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:

(1) All wire ropes and cables (see 7.4.1)

(2) Line sheave units, sheaves, bearings, and liners

(3) Bull wheels, bearings, and liners

(4) Counterweight or tensioning systems

(5) Drive system, including bearings and couplings

(6) Braking systems

(7) Electrical control systems

(8) Communication systems

(9) Towing outfits

5.3.3.2 Fixed Rope Grips – Additional Requirements. All fixed grips shall be moved at least once every 24 calendar months. The grips should be moved a uniform distance each time and in the same direction. A fixed grip should never be installed or allowed to migrate closer than a distance of 20 haul rope diameters from a splice tuck or rope repair tuck. The designer's instructions shall be followed if they are more restrictive than these requirements. Movements shall be recorded in the maintenance records (see 5.3.5.2 and 5.3.5.3).

As each grip is relocated, the haul rope shall be examined for deterioration at or near the grip location. A qualified engineer shall supply information to the owner to enable him/her to identify excessive slippage.

5.3.3.3 Detachable Rope Grips – Additional Requirements. Detachable rope grips shall be disassembled for inspection, adjustment, and replacement of worn parts at intervals not to exceed those recommended by the designer.

5.3.4 Inspections

5.3.4.1 General Inspection. Each facility shall be inspected annually, or after each 2,000 hours of operation, whichever comes first, by a tramway specialist independent of the owner. The inspection shall verify preservation of original design integrity and cover the requirements of this standard for maintenance, operation, required self-inspections, and recordkeeping. Items found either deficient or in noncompliance shall be noted. A report signed by the specialist shall be filed with the owner.

5.3.4.2 **Wire Rope Inspection.** Inspection of wire rope shall comply with 7.4.1.

5.3.5 **Records**

5.3.5.1 **Operational Log.** A log book shall be maintained for each lift. Daily entries shall be made giving the following minimum information:

(1) Date
(2) Names and duty stations of operating personnel
(3) Operating hours and purpose of operations
(4) Temperature, wind, and weather conditions
(5) Record of compliance with daily operational inspection
(6) Position and condition of the tension carriage, counterweights, or other tensioning devices
(7) Accidents, malfunctions, or abnormal occurrences during operation
(8) Signature of operator

5.3.5.2 **Wire Rope and Cable Log.** A log book shall be maintained for each lift giving the following information on each rope:

(1) Approved specification
(2) Copy of certified test report
(3) Date installed
(4) Splicing certificate for each splice or laid in strand
(5) Record of lubrication, including type of lubricant and date applied
(6) Record of maintenance inspections (see 7.4.1(2))
(7) Report of wire rope inspection (see 7.4.1)
(8) Report of accidents or injury to rope
(9) Documentation of end attachment (see 7.3.2.4)

5.3.5.3 **Maintenance Log.** A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

5.3.6 **Passenger Conduct**

5.3.6.1 **Dexterity and Ability.** A skier who uses a lift shall be presumed to have sufficient skiing ability and physical dexterity to negotiate the lift.

5.3.6.2 **Embarkation and Disembarkation.** A passenger shall get on and get off a lift at designated areas.

5.3.6.3 **Riding.** Passengers, while riding a lift, shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the lift. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person.

Skiers, when using a surface lift, shall not willfully place in an uphill track any object that can cause another skier to fall.

5.3.6.4 **Downhill Skier.** Each skier should maintain control of speed and course as he/she is getting on or getting off the lift.

6. Tows

This section covers the class of tramways wherein passengers grasp the circulating natural- or synthetic-fiber hauling rope or a device attached to the circulating wire hauling rope and are propelled uphill. On such devices, the uphill rope spans without intermediate support from the loading to the unloading area. The downhill rope may have intermediate supports.

6.1 Design and Installation

6.1.1 **General**

6.1.1.1 **Design Passenger Weight.** For purposes of design, a passenger shall be considered as having a weight of 170 pounds (77 kg).

6.1.1.2 **Location.** In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent for tows:

(1) Electric power lines and their supports
(2) Structures
(3) Rock and earth slides, cave-ins, washouts, etc
(4) Snow creep and avalanches
(5) Wind action
(6) Icing
(7) Ski slopes and trails
(8) Rivers and gullies
(9) Buried installations, including pipelines
(10) Crossing or close proximity to aerial tramways and lifts

6.1.1.2.1 **Ski Track Gradient.** The maximum grade of a ski track shall be regulated for the use intended. In no case shall the grade exceed that recommended by the tow design engineer or the supplier. No reverse grades shall be permitted except for very gradual inclines at loading and unloading areas.

6.1.1.2.2 **Cross Slope.** The cross slope of a ski track shall not exceed 5% except at unloading areas, and, on wire rope tows, any cross slope shall be away from the tow.

6.1.1.3 **Width of Clearing.** The clearing shall be wide enough to prevent interference with the tow by the adjacent vegetation. Such clearings shall be protected, if necessary, to avoid washouts that might endanger the installation. Potentially dangerous trees shall be cleared far enough back to avoid their falling on the tow.

6.1.1.3.1 Track Clearing. A minimum track width of 3 feet (1 meter) on each side of the centerline of the uphill track shall be cleared and maintained in such a manner that no rocks, stumps, or other obstructions project above the snow surface from the point where the passenger embarks on the tow to the point beyond the safety gate where the passenger would stop, under the most adverse conditions.

6.1.1.3.2 Ski Track Width. A minimum skiable track width of 4 feet (1.2 meters) shall be maintained free of obstructions through the length of the track clearing described in 6.1.1.3.1.

6.1.1.4 Path of Rope. Terminals and towers shall be designed and installed to provide the clearances as herein specified and to minimize surge of the line under operating conditions. Local wind conditions shall be taken into consideration. Clearing shall be accomplished so that tow handles will not come in contact with trees or vegetation during operating surges of the line, or under maximum design wind conditions, or both. In no case shall trees or vegetation extend within 5 feet (1.5 meters) of any portion of a wire haul rope or tow handle under normal (nonsurge) operating conditions. Vegetation may extend over the rope provided it does not obscure the operator's and/or attendant's view of the tow.

6.1.1.4.1 Vertical Clearances. At no point between the loading and discharge areas shall the rope exert a downward force greater than 35 pounds (16 kg), or an upward force greater than 30 pounds (14 kg), when held at a height of 2 feet (0.6 meter) above the snow surface by a single passenger.

(1) Fiber rope tows: When the down-coming rope is less than 7 feet (2.1 meters) above the ski track, protective fencing or other approved means shall be provided to prevent persons from coming in contact with the down-coming rope.

(2) Wire rope tows: Towing devices shall not contact the ground or snow surface at any point along the tow.

6.1.1.4.2 Horizontal Clearances. There shall be a minimum distance of 3 feet (0.9 meter) between the up-going rope and any pole located between the loading and discharge areas.

6.1.1.4.3 Other Clearances. The distances between up-going and down-coming ropes shall be:

(1) Fiber rope tows: There shall be a minimum distance of 5 feet (1.5 meters) between the up-going rope and the down-coming rope poles for 50 feet (15 meters) uphill of the loading area.

(2) Wire rope tows: At all points the distance between the up-going and down-coming ropes shall exceed twice the projection of any towing device attached to the haul rope, but, in no event, shall be less than 4 feet 6 inches (1.4 meters). The uphill track shall be so located that a passenger cannot be struck by a down-coming towing device.

6.1.1.5 Capacity and Speed

6.1.1.5.1 Capacity. The loading interval and capacity shall be regulated to suit the design limitations of the equipment as well as the slope gradient and the ability of the skiers to load and leave the tow safely.

6.1.1.5.2 Fiber Rope Tows. The rope speed shall not exceed 1500 feet per minute (7.6 meters per second).

6.1.1.5.3 Wire Rope Tows. The rope speed shall not exceed 400 feet per minute (2 meters per second).

6.1.1.6 Structures and Foundations. All structures and foundations shall be designed and installed in conformance with applicable criteria listed in 1.3. Applied design loads shall include dead, live, snow, wind, and dynamic loads due to normal operations and for foreseeable abnormal operations.

Structures and foundations located in snow creep areas shall be designed for such conditions and loads or be protected by snow breakers or shears.

6.1.1.6.1 Structures. When bolted to foundations, structures shall be bolted with double nuts, lock nuts, or equivalent means of locking nuts.

6.1.1.6.2 Foundations. In determining the resistance of the earth to motion of the foundation, the subsoil conditions at the site shall be considered including any buoyancy due to groundwater that may be present. If the resistance of the soil is not practically determinable, the foundation or anchorage should be designed as a gravity anchor, using a coefficient of friction appropriate to the general character of the soil. Bottoms of foundations shall be below the normal frost depth unless resting on solid rock. Foundations on rock shall be firmly anchored to solid rock unless designed as gravity foundations.

The top of concrete shall be not less than 6 inches (15 cm) above finished grade unless specific direction for protection of foundation and structural steel below grade is provided by the designer.

The design shall have factors of safety of 2 in resisting overturning and concurrently 2 against sliding under dead load and live load conditions; the factors shall be 1.5 under these loadings plus wind acting simultaneously.

6.1.1.6.3 Anchorages. All structures shall be supported on sills or other supports that, however temporary, are capable of carrying the loads imposed by structural and machine elements under static or operating conditions without shifting or settlement that will impair the operation of the tow.

Anchors may be natural objects or devices installed in a manner capable of withstanding tensions and uplift imposed by tow installation (see 6.1.2.10).

The design shall have a factor of safety of 2 in resisting overturning, sliding, or withdrawal under dead and live load.

6.1.1.7 Communications. A permanently installed two-way voice communication system shall be provided between the prime mover control point, loading stations, and unloading stations. The power for this system shall be independent of the primary power source.

Audio indicators (bells, etc) shall be audible over all ambient noise levels, and visual indicators (e.g., LEDs) shall be visible even in bright sunlight.

NOTE: Voice communication systems are not required for those conveyances qualifying for operation by a single operator, as defined in 6.3.2.2.

6.1.1.8 Internal Combustion Engine Installation

6.1.1.8.1 Fuel Storage. Fuel tanks shall be of adequate capacity to permit uninterrupted operation during the normal operating period. Where internal combustion engines are located in weatherproof equipment rooms or buildings, fuel tanks shall be located at least 5 feet (1.5 meters) from the outside of the rooms or buildings for surface tanks or in an underground installation. The fill pipe shall be capped and locked, and located to avoid toxic fumes and fire hazard during refueling. Stopcocks shall be provided on fuel lines at points where the lines enter the building in underground installations or where the lines leave the tanks for aboveground installations.

In all respects, the installation shall comply with American National Standard for Stationary Combustion Engines and Gas Turbines, ANSI/NFPA 37-1979.

Liquid fuels shall be stored and handled in accordance with American National Standard Flammable and Combustible Liquids Code, ANSI/NFPA 30-1981, and ANSI/NFPA 37-1979. Liquefied petroleum gas installations shall be made in accordance with American National Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58-1979.

6.1.1.8.2 Exhaust Systems. Exhausts shall be designed and installed to discharge to the atmosphere so that precipitation does not enter the system. Exhaust stacks within reach of personnel shall be equipped with guards or heat shields.

6.1.1.8.3 Gear Shifts. Where gear shift levers are used, provisions shall be made to prevent accidental shifting of levers into speed ratios exceeding design or accidentally into reverse gear during public operation. Gears of manual transmissions shall not be shifted when the tow is moving.

6.1.1.9 Loading and Unloading Areas. Platforms, ramps, and related units comprising the loading and unloading areas of tows are integrally related to safe operation. They shall be designed and installed in conformance with applicable criteria listed in 1.3.

Loading areas shall be nearly level. The area shall be free of obstructions and fenced in a manner to guide passengers to the loading point.

Unloading areas shall be nearly level or graded to form a ramp inclined downward in the direction of travel and outward from the line of the uphill track to provide movement away from the tow.

6.1.1.10 Signs. All signs for instruction of the public shall be bold in design with wording short, simple, and to the point (see 6.3.6). All such signs shall be prominently placed, and those pertaining to the tow operations shall be adequately lighted for night operation.

Entrances to all machinery, operators', and attendants' rooms shall be posted with a sign to exclude the entry of unauthorized persons and locked.

The sign "Men Working on Tow" or a similar warning sign shall be hung on the main disconnect switch and at control points for starting the prime mover when men are working on the tow. See 6.1.1.12 for additional requirements.

The following signs shall be posted:

(1) "No Loose Scarves"
"No Loose Clothing"
"No Long Hair Exposed"
(at loading area)

(2) "Stay in Track"

(3) "Unload Here"

(4) "Safety Gate"

6.1.1.11 Tests and Inspection

6.1.1.11.1 Acceptance Tests and Inspection. Before a new or relocated tow is opened to the public, it shall be given thorough inspection and tests by qualified personnel to verify compliance with the plans and specifications of the designer. The designer or manufacturer shall propose and submit a load test procedure.

It shall be the responsibility of the owner to see that the following conditions have been met:

(1) Tightness of all structural connections

(2) Lubrication of all moving parts

(3) Alignment and clearances of all open gearing

(4) Installation and alignment of all drive components

(5) Position and freedom of movement of counterweights or other tensioning means and carriages

(6) Haul rope alignment at entrance to bull wheels

(7) Operation of all electrical components, including circuit protection and grounding

6.1.1.11.2 Tow Inspection. Inspection shall also cover:

(1) Horizontal and vertical clearances (see 6.1.1.4.1–6.1.1.4.3).

(2) Terminals for correct location and installation in accordance with plans and specifications.

(3) Thorough operating tests. The functioning of all push-button stops, safety gates, etc, shall be checked. Braking shall be proved adequate (see 6.1.2.5.1 and 6.1.2.5.2). The tests shall include full-speed operation for as long as required to check for overheating of moving parts, excessive vibration or deflection of mechanical or structural components, free movement of tensioning systems, and other related defects.

(4) Rope twist and spiraling.

(5) Condition of haul rope splice.

6.1.1.12 Safety of Operating and Maintenance Personnel. Provision shall be incorporated in a tow design to render the system inoperable when necessary for the protection of personnel working on the tow. See 6.1.1.10 for placement of applicable warning signs.

6.1.2 Terminals and Stations

6.1.2.1 Power Units

6.1.2.1.1 Prime Mover. All prime movers shall have capacity to handle the most unfavorable design loading conditions, including the starting of a fully loaded tow.

Where manual multispeed transmissions are used on the prime mover, gears shall not be shifted when the tow is moving.

Where reverse capability is provided on the prime mover, provisions shall also be made to prevent accidentally shifting into reverse whenever the tow is operating.

6.1.2.1.2 Auxiliary Power Unit. An auxiliary power unit shall not be required.

6.1.2.2 Speed Reducers and Gearing. All speed reducers and gearing shall have the capacity for starting a tow under the most unfavorable design loading conditions and without exceeding design rating. They shall have a service factor appropriate for the application.

6.1.2.3 Bearings, Clutches, Couplings, and Shafting. Bearings, clutches, and couplings shall be selected on the basis of the manufacturer's published recommendations for the particular use. If published data are not available for the specific use, the manufacturer's approval shall be obtained. Bearings, clutches, and couplings of special design, if used, should have the approval of a qualified mechanical engineer.

Provision shall be made for adjustment and lubrication of all bearings, clutches, and couplings when required.

All shafting shall be designed in accordance with accepted standard practices.

6.1.2.4 Acceleration and Speed Control. Acceleration of a drive shall be regulated with regard to tow type, profile, speed, and use.

6.1.2.5 Brakes. All braking systems shall be capable of operation to comply with daily inspection required by 6.3.2.4.2(4).

Each tow shall have the brakes designated in 6.1.2.5.1 and 6.1.2.5.2.

6.1.2.5.1 Backstop Brake. A brake to automatically prevent reverse rotation of the tow shall be on all tows having an average grade in excess of 15%. If it can be demonstrated that the tow will not roll back (if declutched) under the most adverse loading, a backstop shall not be necessary.

6.1.2.5.2 Service Brake. Unless an unloaded tow operating at maximum speed will stop in 25 feet (7.6 meters) or less, an automatic brake shall be provided to assure this stopping distance. This brake shall be applied by springs, weights, or other approved forms of stored energy when any stop circuit is interrupted. When the motive power is an internal combustion engine, a positive system shall be provided to stop the tow.

6.1.2.6 Location of Machinery

6.1.2.6.1 General. Moving machine parts that normally may be in reach of personnel shall be fitted with safety guards conforming to American National Standard Safety Standard for Mechanical Power Transmission Apparatus, ANSI B15.1-1972.

Protection against static electricity shall be provided.

Fire-fighting device(s) shall be available.

6.1.2.6.2 Machinery Not Housed in a Machine Room. Provisions shall be made to keep the public away from the machinery. All power units, all components of the drive train, and all safety devices, such as backstops, brakes, relays, and the like shall be protected from the weather.

6.1.2.6.3 Machinery Housed in a Machine Room. The machine room shall be well-ventilated. It shall have a permanently installed lighting system adequate for proper machinery maintenance and safety of operating personnel. The arrangement shall permit proper maintenance. A door with a suitable lock shall be provided, and the design shall keep the public away from the machinery. When a passageway is provided between machines or machinery and walls, a minimum passageway width of 18 inches (46 cm) shall be maintained. Means shall be provided to heat

Table 6-1
Minimum Diameters for Counterweight Rope Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard

	Sheave Diameter		
Rope Type	Condition A	Condition B	Condition C
6 × 7	72*d*	42*d*	24*d*
6 × 19	45*d*	30*d*	20*d*
6 × 37	27*d*	18*d*	12*d*

NOTE: *d* equals the nominal rope diameter.

the machine room unless the designer or manufacturer certifies in writing that the drive machinery is rated for operation in an unheated room.

6.1.2.7 Sheaves in Terminals and Stations

6.1.2.7.1 General. All sheaves, including their mountings and frames, shall be designed to withstand static and dynamic loads. Sheave bearings and mountings shall be selected, designed, and installed in accordance with the recommendations of the manufacturers of the bearings.

When unlined sheave grooves are used for wire rope, they should be V-shaped and shall have rounded bottoms with a radius equal to approximately 55% of the rope diameter.

When lined sheave grooves are used, the allowable bearing pressures of the liner material shall not be exceeded.

6.1.2.7.2 Haul Rope Terminal Sheaves for Wire Rope Tows (Bull Wheels and Deflection Sheaves). Haul rope terminal sheave frames shall be designed to retain the rope in the event of the failure of the shaft or mounting. In instances where the sheave is cantilevered, the design working stresses shall be not more than 60% of those otherwise allowable.

The minimum diameter of terminal sheaves shall be 72 times the nominal diameter of the haul rope, provided that no gripping device passes around the sheave. The minimum diameter shall be 80 times the nominal haul rope diameter in cases where gripping devices pass around the sheave. In the latter case, means shall be provided to guide towing outfits or towing handles into, around, and out of terminal sheaves and to prevent the towing outfits or towing handles from swinging excessively while passing around the sheave. The sheave assembly shall be designed to retain the haul rope in the event of a deropement from the sheave.

Haul rope terminal sheaves that act as driving, braking, or holding sheaves shall be so designed that the haul rope does not slip in the sheave groove.

Provisions shall be made to permit adjustment of the terminal sheaves to control the rotation of the haul rope and towing devices.

6.1.2.7.3 Haul Rope Terminal Sheaves for Fiber Rope Tows (Bull Wheels and Deflection Sheaves). Sheaves shall be designed and arranged to prevent unnecessary stress, wear, or disfiguration of the fiber haul rope. They shall be of sufficient strength and properly balanced to prevent excessive vibration at any operating speed. A suitable method shall be provided to retain the rope in the terminal in the event of a deropement from the sheave.

6.1.2.7.4 Counterweight Rope Sheaves and Sheaves Not Specifically Covered Elsewhere in This Standard. The minimum diameters for these sheaves used with wire rope shall be as indicated in Table 6-1.

Condition A is applicable where rope bending around sheaves is of major importance.

Condition B is applicable where rope bending around sheaves is important, but some sacrifice in rope life is acceptable to achieve reduction in weight, economy in design, etc.

Condition C is applicable to sheaves that should not rotate due to any tension sheave movement but should rotate only due to counterweight adjustment.

Provisions shall be made to assure that all counterweight sheaves rotate freely.

6.1.2.7.5 Haul Rope Line Sheaves. The requirements of 6.1.3.3 are applicable to haul rope line sheaves used in terminals and stations, except sheaves that carry no load other than the weight of the rope and carriers.

In the event auxiliary terminal guide sheaves are required, they shall be sized and located, have sufficient guides, and be otherwise designed to present no operational hazard to passengers, operating personnel, or mechanical elements of the tow.

6.1.2.8 Tension Sheave Carriages. The available travel of the tension sheave and carriage shall be adequate for the maximum limits of motion under normal operation.

The idler terminal sheave may be supported by a rigid structure or carried in a floating manner. The assembly shall not be subject to collapse in the event of deropement and the subsequent retaining of the rope by the structure or sheave mounting.

6.1.2.9 Counterweight and Tensioning Systems

6.1.2.9.1 Tensioning Ropes. Tensioning ropes shall have a minimum factor of safety of 6, when new. The factor of safety is equal to the nominal breaking strength of the rope (see 7.1.3) divided by the maximum static design tension. On arrangements involving rope reeving, the maximum design static tension with sheave friction taken into account, shall be the basis for determining factor of safety.

6.1.2.9.2 Tensioning Devices for Wire Rope Tows. An approved mechanical or hydraulic tensioning system shall be provided to ensure that the haul rope tension does not exceed a value of one-fifth its nominal breaking strength under the most unfavorable accumulation of stress due to loading, operating, temperature, and like considerations. A visual means of verifying this restriction shall be provided.

6.1.2.9.3 Tensioning Devices for Fiber Rope Tows. All installations shall have provisions for adjusting and maintaining proper rope tension.

6.1.2.9.4 Counterweight Winches. Winches that are used for counterweight or tensioning system take-up and remain a permanent part of the system shall have a factor of safety of 6 against their ultimate capacity. They shall have a positive lock against release. Where this factor of safety cannot be established by manufacturer's endorsement, a safety device shall be installed on the counterweight rope ahead of the winch that will keep the tensioning system intact in the event of failure or release of the winch.

6.1.2.10 Anchoring Devices. All anchoring end connections shall be above finished grade. Any portion of an anchorage below ground shall be protected against loss of strength due to corrosion.

Sections of ropes bent around thimbles, sheaves, or other anchorage devices not meeting the minimum diameters specified by Condition C in 6.1.2.7.4, or permanently deformed or damaged sections, shall not be relocated or reused as a part of the section under load.

Wire ropes or strands, and their connections, used to anchor, tension, or otherwise secure terminal structures, shall be designed with a minimum factor of safety of 6. Where adjusting devices are used in the arrangement, the devices shall be capable of being securely locked or removed during operation.

6.1.2.11 Manual and Automatic Stops. All stop circuits and switches shall conform to the requirements of 6.2.1.7.

6.1.2.11.1 Manual Stop Devices. Manual stop devices that will stop the prime mover and apply the service brake shall be installed in all attendants' and operators' stations, in machine rooms, and out-of-doors in close proximity to all loading and unloading areas. Unattended stop devices shall be designated by a sign reading "Emergency Stop Switch" or equivalent. All manual stop devices shall be conspicuously and permanently marked.

6.1.2.11.2 Automatic Stop Devices. The following automatic stop devices shall be installed:

(1) Devices beyond each unloading area. For actuating devices of the suspended type, the suspended portion shall be strong enough to cause release of the actuating devices in use under the most adverse conditions, and each side shall be detachable and shall interrupt the safety circuit when detached. The location of the device shall be in accordance with the following:

(a) Intermediate unloading stations: Required only when skiers are not permitted beyond the intermediate unloading station. The device shall automatically stop the tow in the event a skier passes beyond the intended point of unloading.

(b) Terminal unloading areas: Always required. The device shall automatically stop the lift in the event a skier passes beyond the safety gate. The gate shall be so located that the distance from the stopping device to the first obstruction or point of reversal of direction of the towing outfits is 150% of the distance required to stop the empty lift operating at maximum speed.

(2) For fiber rope tows, a device (safety gate) that actuates the automatic stop and encircles the up-going rope.

6.1.3 Line Structures

6.1.3.1 Towers

6.1.3.1.1 Fiber Rope Tows. The intermediate supports for return fiber rope sheaves shall be in accordance with the requirements of 6.1.1.6. When guys or braces are used, they shall be clearly marked and conform to the clearance requirements of 6.1.1.4.2 and 6.1.1.4.3.

There shall be no spikes, hooks, or other projections on a tower for a distance of 7 feet (2.1 meters) above the snow surface.

6.1.3.1.2 Wire Rope Tows. There shall be no intermediate line structures on a wire rope tow having towing devices attached to the rope. When towing devices are not permanently attached, line tower structures shall be permitted between the loading and discharge points to carry the return rope only; provisions of 6.1.1.4.3(2) and 6.1.3.1.1 are applicable. Guyed towers shall be permitted if these towers and their guys are clearly marked and protected from public access.

6.1.3.2 Guards and Clearances. Moving parts (other than the up-going haul rope) that are less than 7 feet (2.1 meters) above the snow surface shall be guarded in such a manner as to prevent accidental contact by the public or skiers using the tow. Persons shall be prevented from passing under the counterweight or tensioning system, or contacting any attachments thereto, by fences or guards.

6.1.3.3 Haul Rope Sheaves and Mounts. The diameter of a haul rope sheave shall be not less than 10 times the nominal diameter of the haul rope for metallic sheaves or 8 times for sheaves with elastomer treads.

The return rope sheaves shall be mounted high enough on the intermediate towers to hold the rope at least 7 feet (2.1 meters) above the snow surface of the tow path. The sheaves shall also be 7 feet (2.1 meters) clear above the snow surface of the tow. The sheave mountings shall be sufficiently strong to prevent failure under the most adverse design load conditions. If the vertical component of the rope tension is not sufficient to hold the rope in the sheave groove at all times, then an approved device shall be used to prevent deropement from the sheave. This applies to both sheaves supporting the rope and those holding it down. (See 6.1.3.1.2 for limitations for wire rope tows.)

6.1.4 Line Equipment

6.1.4.1 Haul Rope. See Section 7 for basic wire rope design and installation requirements.

6.1.4.1.1 Factor of Safety. Haul ropes shall have a minimum static factor of safety of 5, when new. Static factor of safety is equal to the nominal breaking strength (see 7.1.3) divided by the computed maximum tension caused by design loads, including the effects of friction, but excluding dynamic loads, in the section of rope that is most highly stressed.

Where a spliced haul rope with an independent wire rope center is used, the nominal strength of an equivalent wire rope with a fiber core shall be used.

6.1.4.1.2 Special Requirements for Haul Ropes for Fiber Rope Tows. The haul rope shall be natural- or synthetic-fiber rope having a special lay or braid to minimize twist and manufactured for use with a ski tow. Fiber ropes shall be reeled in a manner that minimizes twist, and the manufacturer's instructions for unreeling and installation shall be followed.

Splices shall be made by qualified personnel in accordance with the manufacturer's recommendations. All splices shall be long or transmission splices.

Sheave adjustment or other means shall be provided to regulate rotation of the up-going rope and limit spiraling to one complete revolution in 200 feet (61 meters) of travel not to exceed 3 revolutions in the total uphill length of any tow.

The minimum factor of safety shall be 5, based upon the manufacturer's catalog breaking strength of the new rope divided by the maximum full-load static tension in the haul rope.

6.1.4.2 Tow Handles

6.1.4.2.1 Fiber Rope Tows. Towing outfits and rope grippers shall not be permitted.

6.1.4.2.2 Wire Rope Tows. Provisions shall be made for attaching towing handles to the haul rope. Such devices shall be designed to prevent sliding along the haul rope when subject to twice the pull required to move a passenger along the ski track at the steepest point. The device shall be designed to preclude entangling gloves or clothing, or pinching fingers between the device and the haul rope. Attaching the device to the haul rope shall in no way impair the strength of the haul rope. The devices shall be relocated on the haul rope in accordance with the manufacturer's recommendations, but, in no case, less frequently than once annually.

6.1.5 Provisions for Operating Personnel. Operator and attendant stations shall be located to provide visual surveillance of the line and station. When enclosed, they shall be heated, ventilated, and lighted as required to perform the function of the station. They shall contain, inside the station when enclosed: (1) the communications and controls required of the station, (2) the operating instructions and emergency procedures, and (3) a fire extinguisher. This does not preclude additional communications and controls located outside the enclosed station. All enclosed stations shall be locked to prevent unauthorized entry.

When the tow is operated by an operator without the use of other attendants, the operator shall be located where he/she can observe the full length of the tow, including loading and unloading. The operator shall have the primary tow controls immediately available.

When attendants are on duty on a tow, suitable means of communication between the operator and attendants shall be provided. Each attendant shall have a stopping device located so that it is available to him/her.

6.1.6 Operational and Maintenance Manuals

6.1.6.1 Operational Manual. The designer of each tow shall prepare an operational manual for use with each installation. The manual shall describe the function and operation of the components and provide instructions for the correct usage of the installation.

6.1.6.2 Maintenance Manual. The designer of each tow shall prepare a maintenance manual for each installation. The manual shall describe recommended maintenance procedures, including:

(1) Types of lubricants required and frequency of application

(2) Definitions and measurements to determine excessive wear

(3) Recommended frequency of service to specific components, including relocation of fixed grips, if applicable

6.2 Electrical Design and Installation

6.2.1 General Design and Installation Testing. Prior to operation of newly installed tows or after any modification thereafter of the electrical system, the electrical system shall be tested and shown to meet the requirements of this standard and the test results shall be recorded. Design of all electronic controls and drives shall consider minimum sensitivity to electrical noise and electrical emissions, such as noise spikes from power lines and lightning, radio transmitters, thyristors (SCR), solenoid or relay noise at levels and frequencies that could initiate loss of control.

6.2.1.1 Applicable Codes. All electrical systems shall comply with American National Standard National Electrical Code, ANSI/NFPA 70-1981 and American National Standard National Electrical Safety Code, ANSI C2-1981.

6.2.1.2 Location. All electrical power transmission wiring located near or proposed to cross over tows shall comply with the applicable requirements of ANSI C2-1981.

6.2.1.3 Protection. All transformer stations and other high voltage electrical equipment shall be marked with conspicuous warning signs and shall be protected so as to prevent unauthorized persons from entering the area or coming in contact with any portion of the equipment or wiring. All power equipment shall be protected against overloads by circuit breakers or fuses.

6.2.1.4 Voltage Limitations for Overhead Circuits. Signal, communication, and control circuits may be supported between the towers that support the tow. Voltage on overhead or exposed circuits shall be limited to 50 volts with the exception of the intermittent ring-down circuits for telephone systems.

6.2.1.5 Wiring. All wiring shall be in accordance with the designer's specifications and applicable codes.

6.2.1.5.1 Control Wiring Classification. All control wiring shall be Class 1 in accordance with Article 725 Parts A and B of ANSI/NFPA 70-1981.

6.2.1.5.2 Communication Wiring. All communication wiring and systems are excluded from the requirements in Article 725-5 of ANSI/NFPA 70-1981.

6.2.1.5.3 Insulation. All control wiring is excepted from the requirements of Article 725-16 of ANSI/NFPA 70-1981. The designer shall specify conductor size, type, and insulation suitable for the electrical and mechanical requirements of the application.

6.2.1.5.4 Exterior Lighting and Snowmaking Circuits. All ungrounded exterior lighting and snowmaking circuits, mounted on or within 60 feet (18 meters) of the tow centerline, shall be ground fault protected.

6.2.1.6 Grounding

6.2.1.6.1 Structures. All metallic structures shall be connected to a common conductor. Electrical continuity of all metal parts of the structures shall be assured by mechanical connection.

6.2.1.6.2 Drive Terminal Structure. The drive terminal structure shall have one point referred to as a ground point, as defined in ANSI/NFPA 70-1981. All direct-current and alternating-current electrical systems shall be referenced to this point. If an electrical prime mover is used, the electric service grounding electrode conductor shall terminate at this point. Under the worst case conditions, the resistance from the ground point to any grounded point within the tow system shall not exceed 50 ohms. The grounding system for the tow shall not be used as a grounding system for any other system not related to the tow system.

To ensure that the 50-ohm grounding requirement is met under all conditions of soil, moisture, temperature, and circulating ground and air currents, all metallic terminal and line structures shall be bonded together with a bonding conductor.

6.2.1.6.3 Haul Rope Grounding. Grounding sheaves or equivalent means shall be provided at one location for the purpose of grounding haul ropes, as applicable, for static electrical discharge.

6.2.1.6.4 Lightning Protection. If lightning protection is provided, it shall follow the American National Standard Lightning Protection Code, ANSI/NFPA 78-1980.

6.2.1.7 Operating Control Circuits. If, for any reason, the operator has lost control of the tow while using the normal or operating control circuitry, the control circuitry shall be designed to allow the attendant/operator to stop the tow with the emergency stop circuit. Any one of the following six conditions is considered a loss of control of a tow:

(1) Tow will not *slow down* when given the command to do so

(2) Tow will not *stop* when given the command to do so

(3) Tow *overspeeds* beyond control settings and/or maximum design speed

(4) Tow *accelerates* faster than normal design acceleration

(5) Tow *self-starts* or *self-accelerates* without the command to do so

(6) Tow *reverses* direction unintentionally and without the command to do so

Control circuits shall not have anything across or parallel with the contacts of switches, relays, or safety devices including solid state devices monitoring the circuits or devices, unless it can be shown that any failure mode of the device placed across the switch does not defeat the purpose of the switch.

Each control circuit shall be tested for circuit integrity at its most remote terminal on a daily basis. An inadvertent ground or power failure shall stop the tow.

6.2.1.7.1 Emergency Stop Circuit. All tow control systems shall include a normally energized electrical circuit, that, when interrupted, effects an emergency stop (see 1.4.20.1). The emergency stop shall have priority over all other control stops or commands. This circuit shall include a manual stop device at each attendant/operator station in close proximity to loading and unloading areas, main control panel and machine room. These emergency stop switches shall be red.

When there is only one stop circuit, it shall be classified as the emergency stop circuit.

6.2.1.7.2 Normal Stop Circuit. All tow systems shall include a normally energized electrical circuit that when interrupted effects a normal stop (see 1.4.20.2).

6.2.1.7.3 Operating Circuitry. All tows shall contain a normally de-energized circuit that, when energized, causes the system to start, accelerate to and run at designated speeds and, when de-energized, causes the system to stop.

All start/run and speed control switches shall be conspicuously and permanently marked with the proper function.

All stop switches shall be of the manually reset type and be positively opened mechanically and their opening shall not be dependent upon springs.

Chg 1986 **6.2.1.7.4 Bypass Circuits.** Bypass circuits may be installed for emergency conditions. Controls to bypass any portion of the operating control circuitry shall be locked and may be operated only by the tow supervisor or his/her designated representative. Operation of the bypass shall require the physical effort of the person activating it to maintain the bypass condition (momentary contacts).

Bypass circuits shall be provided with a warning light to clearly indicate the bypass circuit is in use. The tow shall be maintained under close visual surveillance when the safety circuits are bypassed.

6.2.1.8 Electrical Prime Mover. All DC (direct current) electronic speed regulated drives and DC-powered electrical motors shall shut down in the event of:

(1) Field loss

(2) Speed feedback loss

(3) Overspeed

(4) Overcurrent

(5) SCR misfiring

6.2.2 Night Lighting. For nighttime operation, tows shall be provided with lighting facilities. The entire path of travel, including the loading and discharge areas, shall be lighted.

6.2.2.1 Illumination. Lights shall be located in a manner to provide generally uniform illumination.

6.2.2.2 Types. Lamps shall be of a type suitable and rated for minimum temperatures of the location. Fixtures shall be designed to maintain proper lamp operating characteristics.

6.2.2.3 Location. Lights shall be mounted on substantial poles or standards. Tow towers and terminal structures may be used for supporting lights subject to the following requirements:

(1) Approval shall be obtained from a qualified engineer.

(2) The service conductors to each tow tower or terminal structure shall be underground or in rigid raceways. No wiring shall be supported between towers and no open wiring shall pass over or under the tow line.

(3) A separate enclosed disconnect or circuit breaker shall be required for each tower or terminal structure.

(4) All metallic raceways on a tower or terminal structure shall be grounded.

(5) The lighting installation shall not conflict with other requirements of this standard and shall not interfere with operations of the tow in any manner.

6.2.2.4 Emergency Lighting. Emergency lighting shall be provided in the event of electric power failure to permit regular unloading of the tow.

6.3 Operation and Maintenance

6.3.1 General and Personnel Safety. This subsection covers the requirements for operation and maintenance of all types of tows. Many requirements are listed elsewhere in Section 6, since they also regulate installation and design. It is imperative that operating and maintenance personnel be familiar with applicable provisions of this section.

Operation and maintenance of tow equipment can be dangerous to personnel performing these tasks. Procedures for performing these functions shall require precautionary measures necessary to assure the safety of the personnel involved. Implementation of the procedures intended for the protection of the public and operating and maintenance personnel shall be the responsibility of the owner, supervisor, and the individual worker.

Passengers and operating personnel shall be cautioned or prevented, as required, from transporting objects or materials that may encroach upon limitations of clearances or design live loads.

6.3.2 Operation

6.3.2.1 Personnel. Tows shall be operated by trained and competent personnel, and the owner shall be responsible for their supervision and training. One or more persons familiar with emergency procedures shall be on the site at all times when the facility is in regular operation. All personnel shall practice good housekeeping, with particular emphasis on avoiding the development of any condition that might contribute to personal injury. Personnel shall comply with the operational rules and safety regulations of the specific tow.

6.3.2.1.1 Supervisors. One individual shall be in responsible charge of all operating personnel and attendants. This individual shall be responsible for safe operation, and shall have the authority to deny access to the tow to any person who in the supervisor's opinion is not fit or competent to use the tow without danger to that person, to others, or to the equipment. The supervisor shall also have the authority to prohibit operation of the tow under adverse weather or operational conditions. Although he/she may delegate authority to others, the supervisor has the final responsibility.

6.3.2.1.2 Operators. An operator shall be in charge of each tow. This operator shall be trained and experienced in normal operational and emergency procedures.

6.3.2.1.3 Attendants. An attendant shall be assigned to particular duties under direction of the operator. The attendant shall be familiar with operational and emergency procedures pertaining to his/her assignment. This training shall include instruction for observation of any potentially dangerous operational or mechanical developments within his/her view.

6.3.2.1.4 First Aid. One or more persons trained to administer first aid shall be available at all times when a tow is operating and transporting passengers. There shall be ready access to first aid supplies and equipment, including provisions for transporting an injured person to an enclosed and, if required, heated shelter.

6.3.2.2 Minimum Operating Personnel. A single operator may operate a tow provided the following conditions are met:

(1) The length of the tow, measured from the loading area to the safety gate, shall not exceed 800 feet (245 meters)

(2) The entire tow is clearly visible to the operator from the loading area to the safety gate at top

(3) The operator can start the tow while maintaining the surveillance required in condition (2)

(4) The restarting of the tow following actuation of a safety or stopping device(s) shall be impossible until clearance is assured and the safety or stopping device(s) has been reset by an authorized person

(5) If television surveillance of the uphill track and the unattended loading or unloading area is provided, conditions (1) and (2) need not apply

(6) If conditions (1), (2) and (3) are met, one operator can operate more than one tow providing they are driven by a single drive unit, and the stopping and starting controls for each tow are clearly marked and within his/her reach

If these conditions are not met, an additional attendant(s) is required. Each attendant shall be furnished with a stopping device and shall be able to communicate with the operator.

NOTE: One attendant may be permitted to serve the unloading of more than one tow, where such an attendant is normally required by other sections of this standard, provided the following conditions are met:
(1) All unloading areas shall be visible to the attendant and shall be within a 90-degree cone of sight of the attendant's station.
(2) The distance from the attendant's station to the most distant safety gate point at the unloading area shall not exceed 100 feet (30 meters) and shall be readily accessible.
(3) Whenever the attendant must leave his/her station, all tows under the attendant's surveillance shall be stopped.
(4) The attendant cannot serve as an operator on any of these tows.
(5) All safety gates shall be effective and shall comply with the requirements of 6.1.2.11.2.

6.3.2.3 Duties of Operating Personnel

6.3.2.3.1 Supervisor. The duties of the supervisor shall be as follows:

(1) To determine that all tows are operational and that all operating personnel are trained, equipped, and fit to perform their duties

(2) To discontinue operations on any tow due to physical, weather, personnel, or other reasons

(3) To enforce operational, maintenance, and safety rules

6.3.2.3.2 Operator. The duties of the operator shall be as follows:

(1) To assume responsible charge of the tow

(2) To assign and supervise all attendants on his/her tow

(3) To maintain an operational log book as required in 6.3.5.1

(4) To advise the supervisor of any condition or occurrence that may adversely affect the safety of the operation

6.3.2.3.3 Attendant. The duties of the attendant shall be as follows:

(1) To maintain orderly passenger traffic conditions within his/her area of jurisdiction

(2) To advise and assist passengers, as required

(3) To maintain surveillance of his/her area of jurisdiction

The operator shall be advised of any unusual or improper occurrences. Should a condition develop in which continued operation might endanger a passenger, the attendant shall stop the tow immediately and advise the operator. The operator shall also be advised of changes in weather, ground, or snow surface conditions.

6.3.2.4 Operational Procedures. The required operational procedures as set forth in 6.3.2.4 through 6.3.2.5 shall be supplemented by specific requirements as specified in the designer's operational manual (see 6.1.6.1).

6.3.2.4.1 Control of Passengers. Each tow shall have a definite method for marshaling passengers for safe loading and unloading. Fences and gates may be required to implement the system.

6.3.2.4.2 Daily Preoperational Inspection. Prior to transporting passengers, a daily inspection shall be conducted. As a minimum, the inspection shall consist of the following:

(1) A visual inspection of each terminal, station, and the entire length of the tow

(2) Assurance that tension carriage, counterweights, or other tensioning devices are functional and have adequate travel with clearance at both ends of travel

(3) Operation of all manual and automatic switches in terminals, stations, and loading and unloading areas

(4) Operation of all braking systems

(5) Operation of communication systems

(6) Operation of the tow, including a visual inspection of all ropes and carriers

For those tows having internal combustion engines, the fuel quantity shall be determined to be sufficient to conduct the anticipated period of operation without refueling. During refueling, power units shall be shut down.

Loading and unloading areas shall be inspected and prepared for the safe ingress and egress of passengers. The tow track shall be inspected and, if necessary, tracks shall be established. Tracks shall be established beyond the safety gate for a distance necessary for passengers to stop should the passenger pass through the safety gate (see 6.1.1.3.1).

6.3.2.5 Operational Requirements

6.3.2.5.1 General. The supervisor and operator of each tow shall review the requirements of 6.1 and Section 7 of this standard to ascertain that original design and installation conditions have not been altered in such a manner as to violate the requirements of the standard.

6.3.2.5.2 Starting. No tow shall be started except at the direction of or following clearance by the operator.

6.3.2.5.3 Stops. After any stop of a tow, the operator shall determine the cause of the stop, and not restart until clearance has been obtained from all attended stations.

6.3.2.5.4 Damage to Wire Rope Tow Handles. Should any tow handle become damaged or otherwise rendered unfit for passenger transportation during normal operation, it shall be clearly and distinctively marked, and not used for passengers until repaired or replaced. It shall be removed from the line when feasible.

6.3.2.5.5 Hazardous Conditions. No tow shall operate when wind or icing conditions may endanger passengers or equipment or when there is an electrical storm in the immediate vicinity. Should such conditions develop while the tow is in operation, loading of passengers shall be terminated, and operation shall be continued only as long as necessary to discharge all passengers.

6.3.2.5.6 Termination of Daily Operations. Procedures shall be established for terminating daily operations.

6.3.2.5.7 Operational Log. A daily operation record shall be maintained as required under 6.3.5.1.

6.3.3 Maintenance

6.3.3.1 General. Foundations and all structural, mechanical, and electrical components shall be inspected regularly and kept in a state of good repair. The maintenance requirements of the designer (see 6.1.6.2) shall be followed. Maintenance records shall be kept (see 6.3.5.2).

A written schedule for systematic maintenance shall be developed and followed. The schedule shall establish specific frequencies for periodic lubrication, inspection, and adjustment. The schedule shall include, but not be limited to, the following:

(1) All fiber ropes and wire ropes and cables

(2) Line sheave units, sheaves, bearings, and liners

(3) Bull wheels, bearings, and liners

(4) Counterweight or tensioning systems

(5) Drive system, including bearings and couplings

(6) Braking systems

(7) Electrical control systems

(8) Communication systems

(9) Tow handles

6.3.3.2 Additional Requirements for Wire Rope Tow Handles. All wire rope tow handles shall be moved at least once every 24 calendar months. The tow handles should be moved a uniform distance each time and in the same direction. The designer's instructions shall be followed if they are more restrictive than these requirements. Movements shall be recorded in the maintenance records (see 6.3.5.2).

As each tow handle is relocated, the haul rope shall be examined for deterioration at or near the tow handle location.

6.3.3.3 Fiber Rope. Operation and replacement of fiber ropes shall be in accordance with 6.1.4.1.2.

6.3.3.4 Wire Rope. No haul rope shall be permitted to remain in service when broken wires are visible on the exterior portions of the strands.

6.3.4 General Inspection. Each facility shall be inspected annually, or after each 2,000 hours of operation, whichever comes first, by a tow specialist independent of the owner. The inspection shall verify preservation of original design integrity and cover the requirements of this standard for maintenance, operation, required self-inspections, and recordkeeping. Items found either deficient or in noncompliance shall be noted. A report signed by the specialist shall be filed with the owner.

6.3.5 Records

6.3.5.1 Operational Log. A log book shall be maintained for each tow. Daily entries shall be made giving the following minimum information:

(1) Date
(2) Names and duty stations of operating personnel
(3) Operating hours and purpose of operations
(4) Temperature, wind, and weather conditions
(5) Record of compliance with daily operational inspection
(6) Position and condition of the tension carriage, counterweights, or other tensioning devices
(7) Accidents, malfunctions, or abnormal occurrences during operation
(8) Signature of operator

6.3.5.2 Maintenance Log. A signed complete log shall be maintained wherein the actual execution of maintenance work shall be recorded daily. The log shall state components serviced and the condition of the components. A record shall be kept of replacement of components.

6.3.6 Passenger Conduct

6.3.6.1 Dexterity and Ability. A skier who uses a tow shall be presumed to have sufficient skiing ability and physical dexterity to negotiate the tow.

6.3.6.2 Embarkation and Disembarkation. A passenger shall get on and get off a tow at designated areas.

6.3.6.3 Riding. Passengers while riding a tow shall not throw or expel therefrom any object, nor shall any passenger do any act or thing that shall interfere with the operation of the tow. Passengers shall not willfully engage in any type of conduct that may contribute to, or cause, injury to any other person.

Skiers, when using a tow, shall not willfully place in an uphill track any object that can cause another skier to fall.

6.3.6.4 Downhill Skier. Each skier should maintain control of speed and course as he/she is getting on or getting off the tow.

7. Wire Rope and Strand Requirements

7.1 Physical Properties

7.1.1 Specification. Wire rope or track strand shall be specified by the designer. The specification shall include the following:

(1) Diameter
(2) Diameter tolerance
(3) Number and arrangement of wires
(4) Strength grade
(5) Type of core or wire rope
(6) Lay of wire rope or strand, or both
(7) Nominal breaking strength

This specification shall also state that the rope or strand member shall comply with all provisions of 7.1.

This specification shall be referred to herein as the "approved specification." Copies of the approved specification shall be furnished to the manufacturer, owner, and authority having jurisdiction.

Track strand in which the outer shaped wires are supported by a layer comprised solely of round wires shall not be used.

Only wire rope and track strand that are the subject of and in compliance with an approved specification shall be installed on a tramway.

7.1.2 Diameter Tolerances

7.1.2.1 Wire Rope. Wire rope designed with a diameter to be measured in inches has a tolerance of −0% undersize and +5% oversize. Wire rope designed with a diameter to be measured in millimeters has a tolerance of −1% undersize and +4% oversize. Measurements are made on new wire rope when the rope is tensioned between 10% and 20% of nominal breaking strength.

7.1.2.2 Track Strand. The diameter tolerances of track strand shall be as shown on the approved specification.

7.1.3 Nominal Breaking Strengths

7.1.3.1 Wire Rope. The strength of the wire rope on which the designer shall base the calculation for factor of safety shall be not more than the nominal breaking strength listed in 7.1.3.1.1, 7.1.3.1.2, and Table 7-1 for the diameter, classification, and grade selected by the designer.

7.1.3.1.1 Bright (Uncoated) or Drawn Galvanized Wire Rope, Fiber Core (FC). Nominal breaking strengths of galvanized ropes manufactured from wire galvanized at finished size shall be taken as 90% of the bright wire nominal breaking strengths shown in Table 7-1.

In a test, an acceptable rope shall not break under a tension less than 97-1/2% of its nominal breaking strength.

Certain types of tramways may require wire rope diameters other than the fractional sizes shown in Table 7-1, in order to be compatible with the equipment design. Nominal breaking strengths for ropes having nominal diameters between those listed in Table 7-1 shall be determined by the following formula:

Table 7-1
Wire Rope Nominal Breaking Strength in Tons of 2000 Pounds

Diameter		Classification									
		6 X 7		6 X 19 or 6 X 37 (single operation)							
		Improved Plow Steel (IP)		Improved Plow Steel (IP)				Extra-Improved Plow Steel (EIP)		Extra Extra-Improved Plow Steel (EEIP)	
inches	mm	Bright Fiber Core	Galvanized Fiber Core	Bright Fiber Core	Galvanized Fiber Core	Bright Independent Wire Rope Center	Galvanized Independent Wire Rope Center	Bright Fiber Core	Bright Independent Wire Rope Center	Bright Fiber Core	Bright Independent Wire Rope Center
3/16	4.76	1.50	1.35	1.55	1.40	1.67	1.50	1.70	–	–	–
1/4	6.35	2.64	2.38	2.74	2.47	2.94	2.65	3.02	3.40	3.33	3.74
5/16	7.94	4.10	3.69	4.26	3.83	4.58	4.12	4.69	5.27	5.16	5.80
3/8	9.52	5.86	5.27	6.10	5.49	6.56	5.90	6.71	7.55	7.39	8.31
7/16	11.10	7.93	7.14	8.27	7.44	8.89	8.00	9.09	10.2	10.0	11.2
1/2	12.70	10.3	9.27	10.7	9.63	11.5	10.4	11.8	13.3	13.0	14.5
9/16	14.30	13.0	11.7	13.5	12.2	14.5	13.0	14.9	16.8	16.4	18.5
5/8	15.90	15.9	14.3	16.7	15.0	17.9	16.1	18.3	20.6	20.2	22.7
3/4	19.00	22.7	20.4	23.8	21.4	25.6	23.0	26.2	29.4	28.8	32.3
7/8	22.20	30.7	27.6	32.2	29.0	34.6	31.1	35.4	39.8	39.0	43.8
1	25.40	39.7	35.7	41.8	37.6	44.9	40.4	46.0	51.7	50.7	56.9
1-1/8	28.60	49.8	44.8	52.6	47.3	56.5	50.9	57.9	65.0	63.6	71.4
1-1/4	31.70	61.0	54.9	64.6	58.1	69.4	62.5	71.0	79.9	78.2	87.9
1-3/8	34.90	73.1	65.8	77.7	69.9	83.5	75.2	85.4	96.0	93.9	106
1-1/2	38.10	86.2	77.6	92.0	82.8	98.9	89.0	101	114	111	125
1-5/8	41.30	–	–	107	96.3	115	104	118	132	130	145
1-3/4	44.40	–	–	124	112	133	120	136	153	149	169
1-7/8	47.60	–	–	141	127	152	137	155	174	171	192
2	50.80	–	–	160	144	172	155	176	198	193	217
2-1/8	54.00	–	–	179	161	192	173	197	221	217	244
2-1/4	57.10	–	–	200	180	215	194	220	247	242	272

$$NBS = \frac{nbs \times D^2}{d^2} \quad \text{(Eq 2)}$$

where

NBS = Nominal breaking strength of size required
nbs = Nominal breaking strength of closest nominal size listed in Table 7-1
D = Nominal diameter of size required
d = Nominal diameter of closest nominal size listed in Table 7-1

7.1.3.1.2 Bright (Uncoated) or Drawn Galvanized Wire Rope, Independent Wire Rope Center (IWRC). Nominal breaking strengths of ropes manufactured from wire galvanized at finished size shall be taken as 90% of the bright wire nominal breaking strengths as shown in Table 7-1.

In a test, an acceptable rope shall not break under a tension less than 97-1/2% of its nominal breaking strength.

7.1.3.2 Track Strand. The strength of strand on which the designer shall base all calculations shall not be more than the nominal breaking strength shown on the approved specification. The calculated nominal breaking strength shall not exceed the following values for individual wires:

Bright (Uncoated) round wires	150 tons/in^2 (210 kg/mm^2)
Galvanized round wires	140 tons/in^2 (200 kg/mm^2)
Shaped wires	130 tons/in^2 (180 kg/mm^2)

The actual tensile strength of the single wire shall not vary from the calculated tensile strength by more than +12%, −2-1/2%.

7.1.4 Torsion Requirements

7.1.4.1 Wire Torsion Values for Wire Rope. Wire torsional value shall be determined by either of the two following methods:

(1) Wires shall be tested prior to fabrication into strand or rope

(2) Wires shall be removed from a rope after fabrication and tested

Whichever of these methods is used, the wires shall meet the applicable torsional values shown in Table 7-2. For galvanized wire, see Table 7-3.

Wire torsion tests are not required for counterweight ropes.

7.1.4.2 Wire Torsion Values for Track Strand. These values shall be as shown on the approved specification.

7.2 Testing

7.2.1 Testing Procedures. Before operation, a certified test report covering the tests required herein shall be provided from a testing laboratory in the United States. Unless otherwise specified, the manufacturer of the wire rope or track strand is responsible for performance of all testing requirements in this standard.

Copies of the tests shall be furnished to the owner, manufacturer, and authority having jurisdiction.

7.2.1.1 Sampling – Wire Rope and Track Strand. A sample long enough to provide 9 feet (2.7 meters) of free length shall be cut from each manufactured length to be used for the rope breaking strength test and diameter measurement.

If tensile and torsion tests are to be performed on wires removed from the finished rope, a second sample, 3 feet (0.9 meter) long, shall be cut.

When wires are tested prior to fabrication, the same density of sampling shall be employed and adequate records shall be kept by the manufacturer to enable identification of such wires with the actual rope produced.

7.2.1.2 Examination of Diameter – Wire Rope and Track Strand. The diameter shall be measured on the long sample (9 feet, 2.7 meters) at the center

Table 7-2
Torsion Values for Main Rope Wires

Wire Diameter (inch)	Revolutions in a Gage Length of 8 Inches* — Improved Plow Steel	Extra-Improved Plow Steel	Extra-Extra-Improved Plow Steel
Wires Tested Prior to Fabrication of Rope			
0.000–0.079	(2.36/*d*)–2	(2.20/*d*)–2	(2.20/*d*)–2
0.080–0.159	(2.36/*d*)–2	(1.92/*d*)–2	(1.92/*d*)–2
Wires Removed from Rope after Fabrication			
All diameters	(2.24/*d*)–2	(2.16/*d*)–8	(2.16/*d*)–8

NOTE: d equals diameter of wire in inches.
*To convert to torsions (revolutions) in $100d$, multiply values by $12.5d$.

Table 7-3
Torsion Value Reductions for Wire Galvanized at Finished Size

Wire Diameter (inch)	Torsions, as Percentage of Torsions of Bright or Drawn Galvanized Wire
0.039–0.079	50%
0.080–0.119	40%
0.120 and larger	30%

NOTES:
(1) These torsions are for wire galvanized at finished size unless the manufacturer is claiming bright strength, in which case torsions for bright wire shall apply.
(2) Wires of 0.039-inch diameter and smaller are normally drawn galvanized.

of its length and 3 feet (0.9 meter) on each side of center. The average of these three measurements shall be the diameter of the wire rope or track strand being inspected.

7.2.1.3 Ultimate-Strength Tests. An ultimate-strength test shall be made on a complete rope or strand. The tests shall be made on the long sample (see 7.2.1.1).

7.2.1.4 Wire Tensile Tests. Samples for tensile tests may be obtained prior to or after fabrication. In either case, the density of samples shall be not less than six wires of each size in the rope except for the center wires. At least two samples of the center wire will be required.

The free length of wire shall be not less than 10 inches (25 cm). The speed of the head during the test shall be not more than 1 inch (2.5 cm) per minute.

For track strand, the density and test parameters shall be negotiated with the manufacturer.

When wire tensile tests are performed on wires prior to fabrication, the same sample density shall be employed and adequate records shall be kept by the manufacturer to enable identification of such wires with the actual rope produced.

This test is not required for counterweight ropes.

7.2.1.5 Wire Torsion Tests. When wire torsion tests are performed on wires prior to fabrication, adequate records shall be kept by the manufacturer to enable identification of such wire with the actual rope produced.

Wire torsion tests are not required for counterweight ropes.

7.2.1.5.1 Test Procedure. From each short sample, a minimum of one specimen of each size of main wires from each strand shall be taken. The total number of specimens shall be not less than 15% of the total number of main wires. Wires for the torsional test shall be hand-straightened. The free length of wires in the testing machine before the test shall be 8 inches ± 1/16 inch (20.32 cm ± 0.16 cm). One clamp in the testing machine shall be movable parallel to the axis of the tested wire, and an axial tensile force in accordance with Table 7-4 shall be applied to keep the tested wire straight during the test. The tested wire shall be twisted by either of two methods. Both clamps may be rotated in opposite directions or one clamp may be rotated while the other is held stationary at a uniform rate of not more than 60 revolutions per minute. In either case, the total rotations shall be counted.

7.2.1.5.2 Alternate Test Procedure. Because the number of revolutions in the torsional test is proportional to the free length, the inspector may approve a free length before the test of 4 inches ± 1/16 inch (10.16 cm ± 0.16 cm) for wires up to 0.040 inch (0.10 cm) in diameter or of 6 inches ± 1/16 inch (15.24 cm ± 0.16 cm) for wires not more than 0.060 inch (0.15 cm) in diameter. The wire specimens with a free length of 4 inches (10.16 cm) shall not break when twisted one-half the number of revolutions shown in Table 7-2. The wire specimens with a free length of 6 inches (15.24 cm) shall not break when twisted three-fourths the number of revolutions shown in Table 7-2. Testing shall be done in the same manner as described in 7.2.1.5.1.

7.2.1.5.3 Ductility Test for Track Strand Wires. Wires for track strand shall withstand one 90-degree bend over a round mandrel whose diameter is three times the largest dimension of the wire being tested. (For round wires, this is equal to three times the wire diameter; for shaped wires, it is three times the longest possible diagonal dimension.) The wire shall be bent in the same plane as it will bend when in the rope. The test shall be performed prior to fabrication. The wire shall not split or crack when so tested.

Table 7-4
Tensile Force on Wires during Torsional Test

Wire Diameter		Tensile Force	
From (inch)	To (inch)	Minimum (pounds)	Maximum (pounds)
0.000	0.009	0.5	1.0
0.010	0.014	1.0	2.0
0.015	0.019	1.5	3.0
0.020	0.029	2.0	4.0
0.030	0.039	3.0	6.0
0.040	0.049	4.0	8.0
0.050	0.059	5.0	10.0
0.060	0.069	6.0	12.0
0.070	0.079	7.0	14.0
0.080	0.089	8.0	16.0
0.090	0.099	9.0	18.0
0.100	0.109	10.0	20.0
0.110	0.119	11.0	22.0
0.120	0.129	12.0	24.0
0.130	0.139	13.0	26.0
0.140	0.149	14.0	28.0
0.150	0.159	15.0	30.0
0.160	and up	16.0	32.0

7.2.2 Test Reports

7.2.2.1 Wire Rope. The test reports for wire rope shall include the following:

(1) Complete description of wire rope furnished for the test, including number and arrangement of wires, strength grade, type of core, and nominal breaking strength

(2) Actual rope diameter

(3) Actual breaking strength of complete rope

(4) Actual breaking strength and size of wires tested

(5) Actual torsions of wires tested

7.2.2.2 **Track Strand.** The test reports for track strand shall include the following:

(1) Complete description including number and arrangement of wires, strength, grade, and nominal breaking strength

(2) Actual strand diameter

(3) Actual breaking strength of complete strand

(4) Actual tensile strengths and sizes of individual wires

7.2.3 Rejects and Retests

7.2.3.1 **Rejects.** If only one test sample is supplied from a manufactured length, and any test specimens taken from this sample fail to pass any specified tests, all reels or coils of strand or rope from that manufactured length shall be rejected.

If a separate test sample is furnished from each piece of strand or rope that is reeled or coiled for shipment, failure of any test specimens to pass any specified tests shall be cause for rejection of only the particular reel or coil from which the faulty specimens have been taken.

7.2.3.2 **Retests.** In tensile or torsion tests of wires, one wire may fall below the requirement, but by not more than 20% below. In such a case, six additional wires of the same size shall be tested, all of which shall pass.

In tensile test of the wire rope or track strand, if the strength falls below the requirement, one retest shall be made on a sample from the same reel or coil and shall pass for acceptance.

Where the test specimen breaks in the jaws of the machine or at a terminal, the results may be discarded and another specimen tested without considering it a retest.

7.3 Connections

7.3.1 Splices

7.3.1.1 **Haul Ropes.** Splicing shall be performed by an experienced splicer. The minimum length of the splice shall be 1200 times the nominal rope diameter. The tails, or lengths of the rope strands tucked into the core of the rope on splicing, shall be a minimum of 30 times the nominal rope diameter in length.

When two or more contiguous long splices occur in a rope, they shall be separated by an undisturbed length of rope that is a minimum of 2400 times the nominal rope diameter.

No type of connection other than the conventional "long" splice shall be used in a haul rope.

(1) Reversible bicable systems: Splicing of haul ropes on reversible bicable systems shall not be permitted, with the following two exceptions:

(a) The infrequent case that this rule would result in a shipping package that is too large to handle by existing means of transportation

(b) When two haul ropes are used, either of which would sustain the maximum load with a static factor of safety of 5 if the other haul rope were broken

(2) Wire rope tows: Sleeve-type splices or wedge-splice handles shall not be permitted except when installed in accordance with the lift manufacturer's instructions. This type of splice shall be replaced annually.

7.3.1.2 **Counterweight Ropes.** No splices shall be permitted in counterweight ropes.

7.3.1.3 **Track Cables.** Track cable couplings shall not be used. No splices shall be permitted in wire rope used as track cables.

7.3.2 End Connections

7.3.2.1 **Haul Rope (Bicable Systems).** End connections shall be capable of developing the full strength of the rope to which they are attached. (See 7.3.2.4.)

7.3.2.2 **Counterweight Ropes.** End connections shall be designed to not fail or slip under a tension equal to 80% of the nominal strength of the rope. (See 7.3.2.4.) If and when counterweight ropes are attached directly to bicable track cables, the torsion of a counterweight rope or ropes under tension shall not be permitted to pass on to the track cable or cables.

7.3.2.3 **Track Cables.** Rope and cable sockets shall be designed so that they shall not be stressed beyond the yield point of the material used when the ropes or cables they anchor are under tensions equal to their nominal breaking strength.

The method of attachment shall be one currently in practice in the United States or established by tests, and shall develop at least 90% of the nominal breaking strength of the cable.

7.3.2.4 **Types and Methods.** Some common end attachments and information concerning their attachment follow:

(1) Poured sockets

(a) Zinc, if used, shall be of ASTM Grade B-6 High Grade (or higher) and shall be attached in accordance with the procedure in American Petroleum Institute API-RP9B or American National Standard for Wire Rope for Mines, ANSI M11.1-1980.

(b) Resin, if it has been proved suitable, shall be attached in accordance with the manufacturer's instructions.

(c) Field socketing by means of zinc or resin shall be performed by or under the supervision of a

Table 7-5
Proof Loading of End Connections

End Connection	When Used On			
			Track Cable	
	Haulage	Counterweight	Strand	Rope
Swaged socket	Not required	Not required	Not applicable	Not required
Poured socket	Required	Required	Not required	Required
Wedge socket	Not required	Not required	Not applicable	Not required
Plug-type	Required	Required	Not applicable	Required
Clips and thimbles	Not required	Not required	Not required	Not required
Mechanical thimble splices:				
Flemish thimble splice with swaged metal sleeve(s)	Not required	Not required	Not applicable	Not applicable
Fold-back or return loop with thimbles and swaged metal sleeve(s)	Required	Required	Not applicable	Not applicable
Wedges and thimbles	Not applicable	Not applicable	Not required	Not applicable
All other	Required	Required	Not applicable	Required

competent person or facility (see note).

(2) Swaged sockets: Swaged sockets shall be attached by a competent person or facility (see note) using fittings of a design in general acceptance and in common use by wire rope manufacturers and with attention to the following minimum particulars:

(a) Rope shall be inserted to the bottom of the hole.

(b) The bottom of the hole shall be one rope diameter beyond the swaged section.

(c) Critical dimensions: Outside diameter before swaging; outside diameter after swaging; inside diameter; depth of hole.

(d) Swaged sockets shall be applied only to wire rope having a steel center in the section or rope inserted to the bottom of the hole. Fiber core rope shall have the fiber core removed from this section and a strand or IWRC of the proper diameter installed before swaging.

NOTE: An acceptable method of establishing the competence of a facility or person is to perform a breaking strength test of a length of IWRC wire rope prepared in a manner that will be used in the working assembly. The minimum breaking strength for this test specimen shall be 97-1/2% of the nominal strength of the rope tested. The purpose of this test is to establish the *ability* of the facility or person to make a proper connection. The test does not preclude any requirement for a proof-load of the working assembly.

(3) Wire rope clips and thimbles

(a) Wire rope clips and thimbles shall be limited to bicable haul ropes, counterweight ropes, and guys.

(b) Wire rope clips shall be of forged steel.

(c) Wire rope clips and thimbles shall be used in number and spacings stipulated by the wire rope clip manufacturer.

(d) Wire rope clips of the single saddle type shall be installed with the U bolt against the "dead end" and the saddle against the "live end."

(e) Torque values and retightening procedures shall conform to the instructions of the wire rope clip manufacturer.

(f) The radius of curvature of the rope in combination with the correct clip application shall be designed to achieve a minimum attachment efficiency of 80%.

(g) Sections of rope that are permanently deformed or damaged by the application of wire rope clips or that are bent around thimbles, sheaves, or other anchoring devices not meeting the minimum diameters specified in condition C of 2.1.2.7.3, 3.1.2.7.3, 4.1.2.7.3, and 5.1.2.7.3, shall not be relocated and reused as part of the section under load.

(4) Mechanical thimble splices. Mechanical thimble splices are of two types:

(a) Flemish thimble splices with swaged metal sleeve(s)

(b) Fold-back, or return loop, with thimble and swaged metal sleeve(s)

Proof-loading of any end connection to 40% of nominal rope breaking strength shall be required in accordance with Table 7-5.

Documentation shall be provided by the facility or person for any end connection stating that it has been fabricated in accordance with the provisions of ANSI B77.1-1982. This document shall become a part of the wire rope log.

7.4 Operation and Maintenance

Chg (1983) **7.4.1 Wire Rope.** Wire rope maintenance shall include the following:

(1) Lubrication. The type of lubricant and the frequency of lubrication shall be as recommended by the rope manufacturer or designer. Ropes that have little or no motion, such as counterweight ropes and

guys, shall require special consideration for protection against corrosion

(2) Inspection In addition to the required daily operational inspection, all ropes, including track cables, shall be subject to detailed inspections at regularly established intervals, not to exceed 1 year or 2,000 hours of operation, whichever comes first, or immediately after any accident possibly affecting the integrity of the wire rope or cable This inspection shall be made by a competent wire rope or track strand inspector who may be an employee of the owner For the purpose of this requirement, a competent inspector is a person who by his knowledge, experience, and training in the field of rope or strand application is capable of judging the current condition of the wire rope or track strand Splices and fixed grip locations shall be given close attention in haul ropes End connections and saddle areas of track cables shall also require close attention

A written and signed report indicating that the rope or strand has not met retirement criteria per 7 4 1 1 and is satisfactory for continued use shall be included in the wire rope log (see 2 3 5 2, 3 3 5 2, 4 3 5 2, 5 3 5 2) and available to the general inspector (see 2 3 4 3 3 4 4 3 4, 5 3 4)

Chg 1986 **7 4 1 1 Replacement or Repair of Wire Rope** If an inspection indicates that a rope is damaged so as to make it unsafe the rope shall be repaired or replaced Repair of wire rope shall conform to the requirements of 7 3 1

No rope shall be permitted to remain in service if the number of broken wires in the length of one rope lay exceeds that listed in the following table Snagged or nicked wires may count as a broken wire

Rope Type	*Maximum Number of Broken Wires*	
	In One Strand	*In All Strands*
6 X 7	2	4
6 X 19	4	6
6 X 37	6	10

In addition to broken wires, the following criteria shall be used by the inspector in deciding upon retirement or repair of the rope

(1) More than one valley break in one lay Breaks that occur in the valleys between strands indicate some abnormal condition possibly fatigue and breakage of other wires not readily visible

(2) Abrasion, scrubbing, or peening causing loss of more than one third of the original diameter of the outside wires

(3) Evidence of rope deterioration from corrosion

(4) Severe kinking severe crushing or other damage resulting in distortion of the rope structure

Table 7-6
Minimum Acceptable Wire Rope Diameter in Service

Nominal Rope Diameter (inches)	Nominal Rope Diameter (mm)	Minimum Acceptable Diameter (inches)	Minimum Acceptable Diameter (mm)
1/4	6 350	0 235	5 969
3/8	9 525	0 352	8 954
1/2	12 700	0 470	11 938
9/16	14 288	0 529	13 431
5/8	15 875	0 588	14 923
3/4	19 050	0 705	17 907
7/8	22 225	0 822	20 892
1	25 400	0 940	22 876
1-1/8	28 575	1 058	26 861
1-1/4	31 750	1 175	29 845
1-3/8	34 925	1 293	32 830
1-1/2	38 100	1 410	35 814
1-5/8	41 275	1 527	38 799
1-3/4	44 450	1 645	41 783
1 7/8	47 625	1 762	44 768
2	50 800	1 880	47 752

(5) Evidence of any heat damage Sources could be a burn from a torch or an arc caused by contact with electrical wires, natural electrical charges, or fires of any nature

(6) Reduction from nominal diameter to a diameter less than shown in Table 7 6 (This table is based on 94% of original nominal rope diameter) For diameters of unlisted sizes, multiply the original nominal diameter by 0 94 This procedure includes wear of the outer wires

(7) Evidence of pitting from corrosion or development of any broken wires in the vicinity of attached fittings

(8) A significant increase in the lay length after the rope has broken in

(9) A significant increase in rate of rope stretch after original constructional stretch has been removed This shall be determined from records showing the movement of the tension carriage This final stretching indicates deterioration of the rope and is accompanied by a further reduction in rope diameter and a further increase in lay length

(10) The condition of the main haul rope splices At the time of inspection all tucks of all splices shall be located The splice shall be properly repaired or replaced if more than the allowable number of broken wires are found at the tucks, if there is any sign of slipping, if significant distortion of the rope at the tucks has occurred, or if horns have pulled apart and permitted the outside strands to distort

If the haul rope damage is local it is permissible to splice in a section of rope of the same size and construction Splices often can be corrected by proper repair

Damage confined to one or two haul rope strands may be repaired by replacement of the damaged strand or strands to permit the rope to be continued in service. This type of repair is permitted under the conditions specified in 7.4.1.2.

If operating equipment contacting the rope is the cause of damage, it should be corrected immediately and proper repairs made.

All ropes shall be inspected for their full length. In the case of moving haul ropes, the inspection shall be made by slowly moving the rope past a fixed inspection station. Frequent stops shall be made to permit detailed inspection and make necessary measurements. The rope shall be stopped to examine the splice in detail.

The inspector shall be positioned sufficiently close to the rope to visually observe and physically examine it.

Retirement of a rope from service shall be decided on the basis of the foregoing criteria, general conditions, and the history of the rope. Regardless of these and other considerations, no rope shall be permitted to remain in service when it has diminished in diameter to under the acceptable dimensions listed in Table 7-6. The prescribed method for measuring the rope diameter and ascertaining the actual dimensions shall be in accordance with the recommendations of the wire rope manufacturer.

7.4.1.2 Repairs (Patch). In the event that damage occurs to the haul rope and such damage is confined only to one or two strands of the rope, replacement of the damaged strand or strands will be permitted and the rope may be continued in service under the following conditions:

(1) A competent wire rope splicer shall verbally advise the owner, prior to the placing of the rope back in operation, that a suitable replacement strand was available and that all other conditions were such that he was able to make a proper repair to the rope by the use of this method.

(2) The minimum length of the new piece of strand shall be at least 360 times the nominal rope diameter between end tucks, and the length of tail tucked into the core at each end shall be at least 30 times the nominal rope diameter.

(3) The repaired area shall be outside of an existing splice, and the closest tuck shall be at least 96 times the nominal rope diameter from the nearest tuck in an existing splice. When the repair involves laying-in two strands, the tuck position for one strand shall be at least 96 times the nominal rope diameter from the tuck position of the second strand. If the calculated distance from the closest tuck of a laid-in strand(s) is less than 96 times nominal rope diameter distance from the closest tuck in an existing splice, the laid-in strand(s) shall be run into the splice. The tuck(s) shall be at the normal point(s) of tuck, in the existing splice.

(4) The repaired area shall be inspected at the completion of the repair and once weekly for a period of six weeks of operation to ensure that there is no interference with the grips and the newly laid-in strand(s) during grip migration. Thereafter, it shall be subject to routine wire rope inspection. The wire rope shall be removed from operation immediately if core collapse, pulling, high stranding, or other significant distortions occur.

(5) Documents showing splice diagrams and diagrams of laid-in strand(s) shall be prepared for the owner by the splicer. A copy shall be placed in the wire rope log for that rope.

7.4.2 Track Cable

7.4.2.1 Special Inspection and Maintenance. At an interval established by the tramway designer, the track strand shall be moved so as to place a different section of strand over the saddles, and the strand shall be carefully checked for abrasion, wire breaks, corrosion, and other damage. This provision shall also apply to wire rope if used as track cable.

When track strand is moved, it shall be moved a distance approximately equal to the longest arc of contact plus 15 feet (4.6 meters).

After movement, each section moved off a saddle shall be given an additional detailed inspection prior to operation.

Lubrication type and frequency shall be as recommended by the track strand manufacturer or designer. Lubrication at saddles and other points of support shall require special consideration.

NOTE: When wire rope is used as track cable, refer to 7.4.1(2) and 7.4.1.1 for inspection criteria.

chg 1988 **7.4.2.2 Track Strand Broken Wires.** If a wire in a track strand is broken, the strand and tramway manufacturers shall be contacted immediately, and an opinion shall be obtained regarding repair or other corrective action.

If two adjacent wires within one lay are broken, the tramway shall be shut down. The strand shall be replaced or repaired to the satisfaction of the strand manufacturer, tramway manufacturer, or a qualified engineer.

Any repairs shall be in accordance with explicit instructions from the strand manufacturer.

If more than two broken wires occur within one lay, the tramway shall be shut down, and the track strand shall be replaced.

Track strand shall be retired from service when there is any indication that exterior wire may come out of lock or when the reduction in nominal metallic cross section, due to wire breaks, wear, or corrosion, amounts to 10% in any length of 200 strand diameters or 5% in any length of 30 strand diameters. Repeated breaks in the same wire shall count as a single break.

8. Revision of American National Standards Referred to in This Document

When the following standards referred to in this document are superseded by a revision approved by the American National Standards Institute, the revision shall apply:

American National Standard Safety Standard for Mechanical Power Transmission Apparatus, ANSI B15.1-1972

American National Standard National Electrical Safety Code, ANSI C2-1981

American National Standard for Wire Rope for Mines, ANSI M11.1-1980

American National Standard Flammable and Combustible Liquids Code, ANSI/NFPA 30-1981

American National Standard for Stationary Combustion Engines and Gas Turbines, ANSI/NFPA 37-1979

American National Standard for the Storage and Handling of Liquefied Petroleum Gases, ANSI/NFPA 58-1979

American National Standard National Electrical Code, ANSI/NFPA 70-1981

American National Standard Lightning Protection Code, ANSI/NFPA 78-1980

Appendix

(These Appendixes are not a part of American National Standard B77.1-1982, but are included for informational purposes only.)

Appendix A

International System of Units (SI) Metric Conversion Factors

The aerial tramway industry is an international industry. Manufacturers and authorities having jurisdiction may be involved in using a variety of dimensional factors in describing their equipment. The following* is offered as assistance.

To Convert From	*To*	*Multiply By*
Acceleration		
feet per second^2	meter per second^2 (m/s^2)	3.048 000 E−01
inches per second^2	meter per second^2 (m/s^2)	2.540 000 E−02
feet per minute^2	meter per minute^2 (m/m^2)	1.828 800 E+00
Angle		
degree (angle)	radian (rad)	1.745 329 E−02
minute (angle)	radian (rad)	2.908 882 E−04
second (angle)	radian (rad)	4.848 137 E−06
Area		
feet^2	meter^2 (m^2)	9.290 304 E−02
inch^2	meter^2 (m^2)	6.451 600 E−04
Bending Moment or Torque		
pound-foot•inch	newton meter (N•m)	1.129 848 E−01
pound-foot•foot	newton meter (N•m)	1.355 818 E+00
Bending Moment or Torque per Unit Length		
pound-foot•foot/inch	newton meter per meter (N•m/m)	5.337 866 E+01
pound-foot•inch/inch	newton meter per meter (N•m/m)	4.448 222 E+00
Force		
kip (1000 lbf)	newton (N)	4.448 222 E+03
pound-force (lbf avoirdupois)	newton (N)	4.448 222 E+00
Force per Unit Length		
pound-foot/foot	newton per meter (N/m)	1.459 390 E+01
pound-foot/inch	newton per meter (N/m)	1.751 268 E+02
Length		
foot	meter (m)	3.048 000 E−01
inch	meter (m)	2.540 000 E−02
mile (statute)	meter (m)	1.609 3 E+03

*Based on the American National Standard Metric Practice, ANSI Z210.1-1976/ASTM E380-76/IEEE 268-1976.

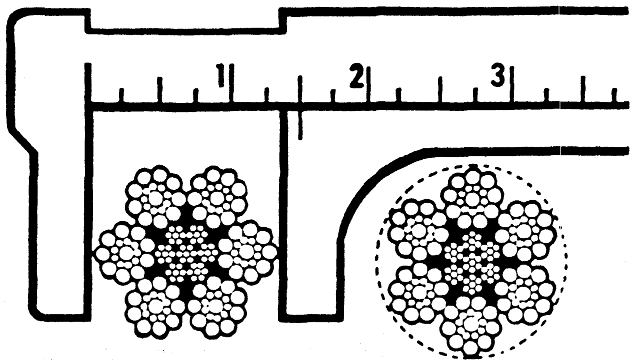
To Convert From	To	Multiply By
Mass		
pound (lb avoirdupois)	kilogram (kg)	4.535 924 E-01
ton (short, 2000 lb)	kilogram (kg)	9.071 847 E+02
Mass per Unit Area		
$pound/foot^2$	kilogram per $meter^2$ (kg/m^2)	4.882 428 E+00
$pound/inch^2$	kilogram per $meter^2$ (kg/m^2)	7.031 000 E+02
Mass per Unit Length		
pound/foot	kilogram per meter (kg/m)	1.488 164 E+00
pound/inch	kilogram per meter (kg/m)	1.785 797 E+01
Mass per Unit Volume		
$pound/foot^3$	kilogram per $meter^3$ (kg/m^3)	1.601 846 E+01
$pound/inch^3$	kilogram per $meter^3$ (kg/m^3)	2.767 990 E+04
Temperature		
degree Fahrenheit	degree Celsius	$t_{°C} = (t_{°F} - 32)/1.8$
degree Fahrenheit	kelvin (K)	$t_K = (t_{°F} + 459.67)/1.8$
Velocity		
feet/hour	meter per second (m/s)	8.466 667 E-05
feet/minute	meter per second (m/s)	5.080 000 E-03
feet/second	meter per second (m/s)	3.048 000 E-01
inch/second	meter per second (m/s)	2.540 000 E-02
Volume		
$feet^3$	$meter^3$ (m^3)	2.831 685 E-02
gallon (US dry)	$meter^3$ (m^3)	4.404 884 E-03
$inch^3$	$meter^3$ (m^3)	1.638 706 E-05
$yard^3$	$meter^3$ (m^3)	7.645 549 E-01
Volume per Unit Time		
$feet^3$/minute	$meter^3$ per second (m^3/s)	4.719 474 E-04
$feet^3$/second	$meter^3$ per second (m^3/s)	2.831 685 E-02
$inch^3$/minute	$meter^3$ per second (m^3/s)	2.731 177 E-07

Multiplication Factor	Prefix	Symbol
$1000 = 10^3$	kilo	k
$100 = 10^2$	hecto	h
$10 = 10^1$	deka	da
$0.1 = 10^{-1}$	deci	d
$0.01 = 10^{-2}$	centi	c
$0.001 = 10^{-3}$	milli	m

Appendix B

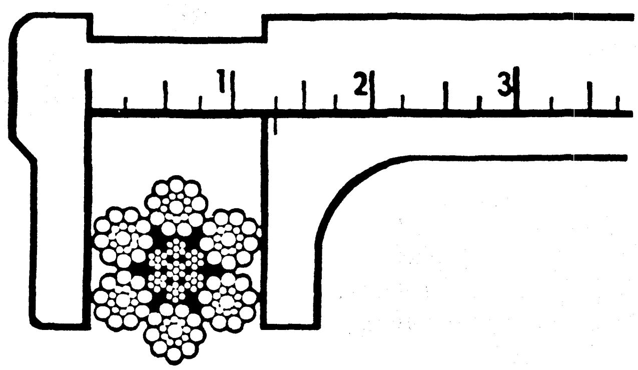
Measuring the Diameter of Wire Rope

It is quite easy and not uncommon to mismeasure the diameter of a wire rope. Fig. B1* provides the two possible ways of measuring the rope.



CORRECT WAY
(This position gives correct diameter)

(a)



INCORRECT WAY
(This position does not give correct diameter)

(b)

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*Reprinted from the American National Standard for Wire Rope for Mines, ANSI M11.1-1980.

Fig. B1
Measuring the Diameter of Wire Rope

Index

(Numbers refer to sections in this standard.)

This index is intended as a supplement to the table of contents to aid the reader in finding particular subjects or requirements described in this standard. It is not all-inclusive, but rather is directed to the most commonly encountered topics and most frequently used lift types.

American National Standards

The standard in this booklet is one of more than 10,000 standards approved to date by the American National Standards Institute.

The Standards Institute provides the machinery for creating voluntary standards. It serves to eliminate duplication of standards activities and to weld conflicting standards into single, nationally accepted standards under the designation "American National Standards."

Each standard represents general agreement among maker, seller, and user groups as to the best current practice with regard to some specific problem. Thus the completed standards cut across the whole fabric of production, distribution, and consumption of goods and services. American National Standards, by reason of Institute procedures, reflect a national consensus of manufacturers, consumers, and scientific, technical, and professional organizations, and governmental agencies. The completed standards are used widely by industry and commerce and often by municipal, state, and federal governments.

The Standards Institute, under whose auspices this work is being done, is the United States clearinghouse and coordinating body for voluntary standards activity on the national level. It is a federation of trade associations, technical societies, professional groups, and consumer organizations. Some 1000 companies are affiliated with the Institute as company members.

The American National Standards Institute is the United States member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Through these channels U.S. standards interests make their positions felt on the international level. American National Standards are on file in the libraries of the national standards bodies of more than 60 countries.

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1979 GENERAL SESSION

SB 146, INHERENT RISKS OF SKIING
By Senator Fred W. Finlinson

We hereby certify that the attached transcript, with corrections noted in pencil, is a verbatim record of the discussion regarding SB 146, INHERENT RISKS OF SKIING, by Senator Fred W. Finlinson, which occurred in the Senate Chamber on February 16, 1979 (Disk 184, Disk 185, and on February 19, 1979 (Disk 187, Disk 188), on file in the Senate Office.

Sophia C. Buckmiller
Secretary of the Senate

Joan B. Thomas
Administrative Assistant and Minute Clerk

November 8, 1989
Date certified

1979 GENERAL SESSION OF SENATE
February 16, 1979

SENATE BILL #146 - DISK #184

President: Senate Bill #146.

Secretary: Senate Bill #146, Inherent Risks of Skiing by Senator Finlinson and others. The report, Mr. President, your Committee on Business, Labor, and Economic Development which was referred Senate Bill #146, Inherent Risks of Skiing by Senator Finlinson and others, has carefully considered the Bill and reports the same out favorably. Respectfully, Senator Arnold Christensen, Committee Chairman.

Finlinson: I move the adoption of Committee Report.

President: You heard the motion to adopt the Committee Report. Discussion. All in favor of the motion say aye.

Group: Aye.

President: Oppose, no. Motion carries the Bill before us. Senator Finlinson.

Finlinson: Mr. President, if you would turn, and have the rest turn to page two on line seven, there is an amendment that needs to be made. On page two, line seven, just before the word "lift" you add the two words "impact with." So the sentence would, the line would then read "growth, rocks, stumps, impact with lift towers, and other structures, etc."

President: Question on the Finlinson amendment?

~~Asay~~ Bunnell: Mr. President, what is the meaning of this?

Finlinson: It means if you bumped into it, that's an impact.

~~Asay~~ President: If you are skiing down the hill and run into it, that's an impact, I think we say. That's on line seven, page two, after the word "stumps" add the two words "impact with." Is that correct?

Finlinson: Yes, but it is after the comma and before the word "lift" you put "impact with," so we are then talking about impact with lift towers and other structures.

President: Discussion on that amendment. All in favor of the amendment say aye.

Group: Aye.

President: Opposed, no. The motion carries. Is there further discussion on Senate Bill #146?

Finlinson: Yea, I better take just a minute. It is really such a good Bill that maybe I ought to do that. The ski industry of the state of Utah is a fairly significant and important industry and adds a lot to the economy of the state. We have found in the ski industry, and I want you to know that I represent an area that includes four of the finest ski resorts in the state, which include Brighton, Solitude, as well as Alta and Snowbird, that with the involvement of the rise of litigation, that ski operators in the areas that are operating ski areas have found an increasing problem with product liability or liability insurance for their areas. It is now a fact that 4% of the cost of the ticket that you buy for your ski ticket and your ski pass now goes into the rise to meet the cost of liability insurance. There are only two companies now in the state of Utah that offer liability insurance for ski operators.

In Vermont, a few years ago, an individual who was a new beginning skier, went up the lift with a companion who was a little better skier, and on the way down, on one of the trails, he got the tip of his ski caught in some brush or a twig or something and caused him to fall, and he fell and hit his head and he ended up suing the operator for failing to keep the twigs out of his way, I guess, and the ~~manifest~~ Net effect was that ultimately the Court in the State of Vermont awarded to him a jury verdict of 1.5 million dollars.

As a result of this kind of potential risk, which is really intensified here in the state of Utah because we don't have the opportunity to groom our trails, because of the terrain, in the manner that a lot of the resorts do back East, and because of that, that has created potential problems for our ski areas. So as a result, many of the ski area states, that have ski resorts, have moved in a position of modifying and clarifying in their law that the ski area is responsible for injuries that come from the inherent risks of skiing. Those people then who are injured from the inherent risks would not be able to maintain an action or a claim if that is, in fact, where the injury was caused from. This kind of law does not prohibit the individual from being successful or successfully bringing a claim against the operator if the operator was, in fact, negligent or there were some other reasons for the action. That is the basic thrust of what Senate Bill #146 does.

I just got a card here and I am going to have to summarize first, Senator Asay, before you get up. It does say that the skier is responsible for the inherent risks of skiing and we define "inherent risks of skiing" as those items or conditions that are related, that the skier would encounter on the way down the hill as he is skiing down the hill, those are items that we say have become his responsibility. We indicate still that the operator has the responsibility to notify the skier of the limitations and he has a responsibility to post those properly. He has the responsibility to operate his ski area in a non-negligent manner.

We have two other problems that this Bill deals with, and that is the requirement that if a person intends to bring a claim against the ski operator, that he should give notice to the ski operator of his intent to sue. This 90-day notice requirement is very similar to the 90-day notice requirement that we have on the books now in relationship to bringing a case against a governmental entity. That 90-day notice is an important feature. In many of our ski resorts the employees that work in that area only will work for a season and then they move on and it is sometimes very difficult to find those people. That is the reason that we have included a notice requirement.

We also have a statute of limitation on here that would indicate that after a two-year period, from the date of the occurrence of the injury, then that is the date that we draw the line and from that day after the two years then the person would be barred. This would be attached to the statute of limitations that we have in many other different areas in the law. That is the basic thrust of Senate Bill #146.

President: Senator Asay.

Asay: Mr. President, I hesitate to stand here and debate a bill with my majority leader, knowing that he can cut me down one way or another but . . . . I feel a real sense of responsibility to you, my colleagues, to bring the other side of this issue to you as you have done to me on so many of the different bills that have come before us.

Senator Finlinson makes this Bill look like it is just a simple bill and we ought to just let it slip through. This is the kind of legislation that I call a sneaky legislation, not any reflection towards the sponsor, but that there is nothing on the books pertaining to it. There is nothing in the Code now, and with most of the bills we vote for, why we feel some safeguard in that there is something on the books now, but this is brand new legislation, nothing to refer to. So I feel that, so that you can, so as you would really feel you ought to pertaining to the people that you represent, that I need to bring now, to your attention, what this Bill really consists of and I consider it, this is what I consider special legislation or special interest legislation for a very small minority of the people of the state of Utah, namely the ski resorts. So let me read a little from the title and I won't read the whole Bill, well it's very short, just so that you get the idea that it is overwhelmingly in favor of the ski operator and nothing in favor of the skier. I just feel very strongly on that point.

Okay, "an act relating to the sport of skiing, recognizing the inherent risks involved in that sport, declaring that any person engaging in that sport shall be precluded from making any claim against or recovering from any ski area operator for injury resulting from risks inherent in that sport." Okay, you see that part of the title is completely in favor of the ski operator.

Let's go on down. "It is the purpose . . ." I am reading from line 26 of page one. "It is the purpose of this act, therefore, to clarify the law in relating to ski injuries and the risks inherent in that sport, to establish as a matter of law that certain risks are inherent in that sport and to provide that as a matter of public policy, no person engaged in that sport shall recover from a ski operator for injuries resulting from those inherent risks."

Now, let's go to the inherent risks and this is the thing that really throws you because you recognize that when you go skiing, why there are certain risks involved. Some years ago I took my only son skiing for the first time, he was about 16 years old, and he wanted to go skiing and so he said, "Dad, let's go." I said, "well, we don't have any skis." And he said, "well, I know where we can rent some." Anyway to make a long story short, we went skiing and he brought his dad home with a couple of broken legs. Well, I recognized inherent risks of skiing and there was no thought in my mind to sue the ski operator for my negligence and my bad judgment in going skiing for the first time without any lesson or anything. But now look what it left of the inherent risks to skiing in favor of the ski operator. This is at the top of page two, "inherent risks to skiing means those dangers or conditions which are an integral part of the sport of skiing, . . ." Okay, if we stop there why everything would have been fine, but it goes on, ". . .including, but not limited to . . ." In other words, the list can go on, there is just no end to it, " . . . changing weather conditions . . ." No problem there, that was actually what caused my problem, but you can call that an act of god, " . . . changing weather conditions . . .," no problem, ". . . variations or steepness in terrain . . .," no problem there, " . . . snow or ice conditions, surface or subsurface conditions, such as bare spots . . . .." Now I think there could be some liability there, if you got to the top of the ski lift and there was a bare spot there and in getting off the lift and down to where the snow starts, why you keeled over a few times, I think that the ski area operator ought to have some liability that there is no bare spots in getting from the lift to where the slope starts. Okay, " . . . forest grove . . .," no problem, ". . . rocks, stumps, lift towers . . . .," okay, he has amended that to include, " . . . impact with lift towers and other structures and their components, collision with other skiers and the skier's failure to ski within his own ability . . .," and so on, it goes on and on, but everything in favor now of the ski operator.

Then down on line 19 in the middle of page two, section three, "notwithstanding anything in Section 78-27-37 to the contrary, no skier shall make any claim against or recover from any ski operator for injury resulting from any of the inherent risks of skiing." In other words, there is no way that you could bring suit against a ski operator. So I am saying they don't even need any insurance if this Bill passes. That is their insurance because their [illegible] it is just open. Let me read you in contrast to what the state of Washington has in their Code. "Because of the inherent risks in the sport of skiing, all persons using the ski hill shall exercise reasonable care for their own safety." You see, it is kind of half way, reasonable care for their own safety. "However, the primary duty shall be on the person skiing down hill to avoid any collision with any person or object below him or her." Okay, that is understandable, that its the primary duty of the person who is skiing. Okay, subsection six of this section, "notwithstanding any person skiing on other than improved trails or slopes within the area, shall be responsible for any injuries or losses resulting from his or her actions." This is saying that if you don't stick to the designated trails and slopes, if you go off on your own somewhere, that you are entirely held responsible, but as long as you do stick to the regular slopes, why you have some protection. This is the protection that Washington gives to their skiers.

"Every tramway, ski lift or commercial ski mobile operator shall maintain liability insurance of not less than $100,000 per person per accident, and of not less than $200,000 per accident." So what I am saying here if we pass a special interest legislation for the ski operators, then when will we pass such legislation for the amusement parks and for the swimming pools and on and on. There is no end to it, you see. It just is not a Bill concerned with the health, education, and welfare of the people of Utah. Its a Bill concerned with the profit of the ski operators in the state of Utah, and that's as I see it just pure and simple and so I urge you to vote against this kind of legislation.

Jeffs: Mr. President.

President: Senator Jeffs.

Jeffs: I am a skier, all my children are skiers, I love to ski and basically I agree with the purpose of this statute, and I have told that to the ski operators. There comes a time when you feel like maybe there is a little over-reaching. I don't think it is inappropriate, as the first part of this Bill does, to have a statutory provision so the courts will not misunderstand that it says, "that a skier assumes the normal risks of skiing." That should be implicit in the law. I would be surprised if our Utah Supreme Court wouldn't rule that. What is of concern to the ski operators is that there has been a New Hampshire case where that Court imposed liability in a surprising situation. I don't blame them for wanting to say, well, at least let's get a statute so that won't happen here. So that I support basically the premise of the Bill. But there are two things that I think are over-reaching.

The first one, is section five where you are required to give them notice 90 days after the accident. It is entirely possible that somebody would be hospitalized during that 90-day period and by the language of that section, it specifically provides that if you fail to bring, give the notice, the ski operator notice 90 days after the occurrence, you are through. You have no claim. So we really have a 90-day statute of limitations, so that I would move this body to merely remove section five, subsection one, from the Bill to accomplish that.

Now the other one, and I will speak to that too, is section two, and that is the two-year statute of limitations. The problem with this one is this, generally speaking under Utah law, historically we have had a four-year statute of limitation for these kinds of claims. What we have been doing is piece mealing a little bit, changing so that people have to learn that if you are going to sue a doctor it is different than it is for the others, if you are going to sue now a ski lift operators, it's different. We are going to get to the point where a man is going to have to [CONSULT a] ~~console the~~ lawyer before he even thinks about what to do, because it will be too late. It is going to be all over. My motion would be to remove all of section five from the Bill.

President: You heard the motion to remove section five from the Bill. Discussion of that amendment.

Finlinson: Mr. President?

President: Yes.

Finlinson: I don't think it is fair for Senator Dean not to allow me to have the microphone.

Jeffs: He was trying to take it away from him.

Finlinson: In defense of the Bill the way it is on a 90-day notice requirement, I would like to first of all remind this body that we use this 90-day notice requirement in a number of other categories. We use it in inter-governmental immunity sections, and any time you wish, you have been injured or harmed by a city or municipality or even the state, and you intend to bring action, you are required to give them that 90-day notice requirement. We use that same 90-day notice requirement in relationship to the other, uh, in malpractice with doctors it is required to give that notice provision. So we have used the 90-day notice requirement before. The reason why it is especially meaningful in this area again, as I mentioned before, is the need to be able to find out, as the ski operator, who of your employees were involved in the particular action. By the end of the summer or within that 90-day period they are gone, and if you don't have that notice you may not be able to get the valid information. I don't know whether he wanted to divide his motion and perhaps that, I have got a good speech on number two and maybe the best thing to do is take it all at once and let it go wherever it is going to fall.

With the statute of limitation problem, in the books now we have a statute of limitation of one year if you are going to sue the entities as far as the governmental immunities. What we are trying to do with the statute of limitation is cut off the long tails, that's a term in the insurance industry, of potential liability risks coming in. The longer that period is the harder it is for the industry to determine the rate process for the liability insurance and by having an identifiable period of time you will be able to calculate on an actuarial basis the claims that will probably be submitted and charge a fair premium. The longer that tail is, the longer that period is, the higher the premium has to be charged and the more the skier has to pay as he goes out to buy his pass in order to ski. I think the two year period is reasonable because when the ski industry accidents are pretty identifiable when they happen. You know that they have happened and you ought to be able to make up your mind within the two-year time frame whether you are going to sue or not sue. So I would resist the dead amendment to strike out the provisions of section five.

Senator Jeffs did you intend to amend the title also?

Jeffs: Yes.

Finlinson: In your motion.

Jeffs: Yes. If I may close argument, if I can on that.

President: I think that others want to speak, I just want to check out the title so we go on your memory and we don't have to go do it again.

Would you want to say what you want to, I think you have to wipe out quite a bit of the title.

Jeffs: Yes, to make the motion you would have to strike on the center of line 13 after the colon . . .

President: Take the colon out and put a period and strike the rest.

Jeffs: Take the colon out, put a period, and strike the rest of the title.

President: That's part of your motion, okay. Now, Senator Carling.

Carling: Mr. President, Senator Waddingham just looked at me and looked at the clock and I say amen with what Senator Finlinson said, I think there is a real reason to leave this legislation as it is and I am not going to say anything further. I think that it needs to leave ____________.

February 16, 1979

SENATE BILL #146 - DISK #185

President: Any further discussion Senator Kimball.

Kimball: Senator Finlinson in his resistance to that amendment, because I feel his explanation is adequate.

President: Discussion on the amendment. Senator Asay.

Asay: Let me read the ~~line~~ language here again and see how strong it is ~~and incidental referred to~~ in this amendment we refer to. It says, "any claim against a ski area operator arising out of any injury to a skier shall be forever barred, unless that ski area operator is notified of that injury within 90 days." That is strong language in favor of the ski area operators.

President: Senator Jeffs.

Jeffs: Yes, I do need to respond to two things that Senator Finlinson said. He said there is a 90-day provision with regard to cities, and that used to be true, but caused so much trouble we amended that in the statute and it is now one year. As to the notice in the medical malpractice cases, that is a notice that you have to give before you commence your suit but it is not one like this. This one if you fail to give the notice immediately after the injury, you don't have a claim. In that one you have to give notice before you start your lawsuit, so it's the opposite end of the statute of limitations and that one is a 60 day and we have a bill coming through the legislature to try and correct the problems that are being created by that one.

President: Further discussion on the Jeffs' amendment. I'll call for the question. All in favor of the Jeffs' amendment say aye.

Group: Aye.

President: Opposed, no.

Group: No.

President: Motion fails.

Finlinson: ~~Correction~~ Question on the Bill.

President: Question~~s~~ called for on Senate Bill #146. On second reading the ~~only~~ question is, shall it be read a third time. Rol~~e~~l call vote.

Secretary: Asay.

Asay: No.

See Journal for vote.

Secretary: Bangeter.

Bangeter: Yes.

Secretary: Barlow.

________: Not here.

Secretary: Barton.

________: Not here.

Secretary: Black.

Black: Aye.

Secretary: Bowen.

Secretary: Bullen.

Bullen: Aye.

Secretary: Barton.

Barton: Aye.

Secretary: Carling.

Carling: Aye.

Secretary: Christensen. Cornaby.

Cornaby: Aye.

Secretary: Farley.

Farley: Aye.

Secretary: Finlinson.

Finlinson: Aye.

Secretary: Halverson. Jeffs.

Jeffs: Aye.

Secretary: Jensen.

Jensen: Aye.

Secretary: Jones. Kimball.

Kimball: Aye.

Secretary: Matheson.

Matheson: Aye.

Secretary: Pace.

Pace: Aye.

Secretary: Pugh.

Pugh: Aye.

Secretary: Ranstrum. Sandburg.

Sandburg: Aye.

Secretary: Snow.

Snow: Aye.

Secretary: Sowers.

Sowers: Aye.

Secretary: Swan.

Swan: Aye.

Secretary: Waddingham.

Waddingham: Aye.

Secretary: Wayment.

Wayment: Aye.

Secretary: Mr. President.

President: Aye.

Secretary: Bangeter.

Bangeter: Aye.

President: Senate Bill #146 on a second reading calendar receives 23 aye votes, 1 nay vote, with 5 being absent, receives a constitutional majority and placed along the third reading calendar.

February 19, 1979

SENATE BILL #146 - DISK #187

President: . . . #146.

Secretary: Senate Bill #146, Inherent Risks of Skiing by Senator Finlinson and others.

Finlinson: Mr. President.

President: Yes, Senator Finlinson.

Finlinson: The main thrust of Senate Bill #146 is to, I think, clarify the Utah laws so that the skier assumes the responsibility for the inherent risks of skiing. To be his responsibility once he is at the top of the hill basically to make sure that he gets down to the bottom safely. The ski areas still have that responsibility for making sure that he is able to get to the top of the hill safely and to make sure that they don't operate in a negligent manner. What we are trying to say is that when an individual has an accident on the hill as a result of his own fall, or his not being able to cope with the weather conditions, the ski conditions, or the fact that he loses control and collides with a lift tower, that he has to assume that responsibility. As I mentioned earlier, this kind of legislation has been introduced now in most skiing states. It has the full support of the U.S. Ski Association, which represents the general skiing public and so it is supported by the skiing public and again I would urge its favorable consideration.

President: Senator Jeffs.

Jeffs: Yes, Mr. President. I expressed to this body my concern the other day about section five, subsection one and two, namely that I expressed my support for the basic language of the Bill, namely that the skier should assume responsibility for his own carelessness on the hill. Let me point out to you, however that in section 5.1 this Bill goes beyond that. It says "any claim against a ski area operator arising out of any injury to the skier shall forever be barred unless he files a claim within 90 days." I think that is over-reaching and that we ought not to do that. While I am willing to allow the two year statute of limitations over in sub. two, I think we ought not to require the 90-day notice because that will wipe too many out, but in addition to that I think the ski operators are in a position to protect themselves, you remember that Senator Finlinson indicated that the reason for the 90 days last time was that we had a need, they had a need as operators because they have seasonal employees, to have employees available to testify. That can easily be solved by the operators merely having instructions to their own employees that when there is an accident they are to report their name and the date of the thing and their address. They don't need to have that problem because they can solve it that way, so that I would move that we remove subsection one, which is the 90-day provision and we bracket out, on line 28 of page 2, after the number 5 all of the rest of the language on that page and over on page 3 on line 2 bracket out the parenthesis 2, so that there would be a two-year statute of limitations but we would not have that onerous 90-day notice provision where a man may be in the hospital.

I have had an experience of having a man in the hospital, unable to communicate about his claim and finding out after he got out of the hospital he lost his rights.

President: You heard the motion by Senator Jeffs to amend the discussion on the amendment. Senator Jones.

Jones: Senator Jeffs, I should first declare a past conflict of interest, because I have served until about two years ago on the Board of Snowbird Ski Resort. When I was invited to serve on that board, which I felt very happy about because I like skiing and my family likes skiing, it took me about 3 or 4 months to decide that I would dare to serve on that board since even the limited access to the directors, the liability access, gave me great pause because I have seen and I took some, I had my attorney research the liability access and there were so many liabilities sort of damocles type of things hanging over a ski resort that I felt very cautious. I finally, because I have so many children and my wife and I both ski we finally decided to run that risk. It is a tenuous risk clear through to the board of directors.

I would speak to the body of the senators against this because your saying that you would choose to expand or at least to eliminate this cut-off of liability. I think in the total picture in our state, one of our major industries, if you will, is skiing, resorts and skiing. I sat on that board for several years, in my experience the kinds of liability suits that were preferred against Snowbird, and I don't speak for the whole industry, but for against Snowbird, I felt extremely uncomfortable about the kind of things that they were being sued for. That is, I felt that they were not fair.

I remember a case where a doctor, of all people, came down and there were signs there, and he turned right instead of left and fell into a creek and was badly injured and he sued for a very large amount of money because his earning power was high and he said that there should have been a sign right where he turned. Well, you can't have signs all over the hill telling you to turn left instead of right, there is a creek here and there is a creek there.

So I feel that this is a good Bill, that it is going to limit the liability and expand our ability as a state to have a peculiarly appropriate kind of industry to Utah that would do better. I happen to know from sitting on the board that the financial position of Snowbird isn't what a lot of us might consider. They are not coining money, they are not making huge profits. These are enormous expenditures. The payback is a long time and one of the real dangers in making this kind of an investment is this very kind of liability, you never get sued for $100,000 it is always $1,000,000 or $2,000,000 or some large amount of money it seems. I feel very uncomfortable about trying to open more avenues to sue ski resorts.

It does seem to me that 90 days is long enough for a man to communicate or a woman to communicate, Senator Frances Farley, it's long enough for a woman to communicate to their attorney that they think they have a claim and that all they would have to do is file a notice that they have a pending claim. I think that 90 days is adequate, it is a real problem because the ski season is a limited season and if something happens in the middle of the season, January or February, these young people that work there and who could be witnesses very often are, they float around, they drift a lot, I talked to them often and they are not where you can locate them. It doesn't matter if they give their name and address, they go from place to place, they very often, a lot of them that I know don't have any contact with their parents. So, it just seems to me that for all the reasons that have been mentioned before and from my personal experience from the liability point of view and from the witness point of view, this Bill is a good Bill and I would resist the amendment motion.

Carling: Mr. President.

President: Senator Carling.

Carling: Mr. President, I agree with all Senator Jones has indicated, Senator Jeffs indicated that the problem he sees with the sections they are all-inclusive, I propose a substitute amendment and I think if you accept this amendment its accepting the philosophy of the Bill and going to just this one area, I would move that on line 29 after the line skier we insert the words, "from the inherent risks of skiing," which limits any modification as to notification to the acts as specifically included in this one act that we are talking about, as a substitute amendment in order to clear up the question he is talking about.

President: Will you say that once again please.

Carling: Line 29, page 2, line 29 after the word "skier" on page 2, line 29, "from the inherent risks of skiing."

Jeffs: I would accept that.

President: You heard the motion, any further discussion?

___________: Are you sure that is on page two?

___________: No its not, its on page three, line 29.

___________: ________________________________ take care of a bill.

President: Yes, the suggested amendment is still before us, with this . . .

___________: Its the substitute, so this would be the substitute is before us at the present time. If the substitute passes, of course, take care _____

_________ of Jeffs.

Jeffs: Mr. President, I think to make that complete we have to do the same wording down in section 2, subsection 2, over on page 3 after, on line 3 after the words here insert the same words.

Carling: I will accept that as part of my substitute amendment. Thank you.

President: Is there further discussion? Senator Jones.

Jones: To the Carling amendment, Senator Carling the thing that in my personal experience is so hard to determine and as they open the door here when you say that that inherent risk is, what is the inherent risk of skiing, in other words if you are skiing down and there is not a sign there . . .

Carling: Its defined in the Bill, that is what the whole Bill is about.

Jones: Well, that's, I think this clause is intended to cut off, is it not, a cut off clause, and you're opening a door that allows the interpretation of whether it is an inherent risk of skiing or negligence of the ski resort operators, where they didn't put an example there was no sign here. You can't go over the entire hill, and put a sign everywhere there is a cliff or a rock or a tree and so when you say inherent skiing and he skis down and hits a hole, a creek or something.

Carling: The whole purpose of the act is for the inherent risks of skiing, in section one at the top of the page defines inherent risks of skiing and so that's why I think that if we are looking at this Bill in a 90-day limitation we are looking at 90-day limitation on inherent risks of skiing rather than ordinary negligence, which would be the same as anybody elses negligence.

Jeffs: Mr. President, if I may speak also on that, I agree with what Senator Carling has said, and you noticed when I said at first what I was concerned about is that we ought not have the 90-day limitation on the guy who gets dumped out of a chair lift because of faulty equipment. That is another type of area and this Bill does not treat that so that I agree with the Carling amendment.

President: Is there further discussion on the Carling substitute amendment? Any other call for the amendment, all in favor of the Carling amendment say aye.

Group: Aye.

President: Opposed, no. Motion carried. Is there further discussion on Senate Bill 146 as amended.

Asay: Mr. President.

President: Senator Asay.

Asay: Could I make a parting shot at this Bill?

President: If Senator Bowen will let you.

Asay: I was going to make a parting shot the other day but I heard a train coming and I had to get out of the way. Senator Finlinson, could I ask you a couple of questions on this Bill?

Finlinson: Certainly.

Asay: Thank you. I was just kidding about this train bit.

Finlinson: I hope I got it going again today Senator.

Asay: Yea. I was just kidding about the train, it was more like a steam roller. I couldn't believe that I was the only dissenting vote on this Bill and it just makes me feel kind of dumb, like I don't know what is really going on. It seems so plain to me and so I think maybe if I can just ask you a few questions, why we can get this straightened out and make it unanimous. Okay?

Finlinson: I have got Senator Jeffs convinced that it's a good Bill now.

Asay: You have got Senator Carling as your engineer, give me just a couple of questions here. Now I can understand plain english alright, I don't have any problem there, but it is this legal stuff that really gets me in a bind, and so you need to help me out with that.

In your summary the other day and I tried to pick it up today and I didn't quite get the same thing, but in your summary the other day it came over to me that the need for this kind of legislation is to protect the financial security of the people in the state of Utah who are engaged in the skiing industry. Is that about the main thrust of the Bill, would you say?

Finlinson: Not really, you have a broad picture and the broad picture is the ski industry is fairly important to the state of Utah because it employs a tremendous amount of people, it brings in a lot of tourists that ski and spend dollars in the state of Utah and it creates jobs for people that work. In addition, we have to have those kinds of things in order for the skiing public in the state of Utah, which I participate in, we have to have those kinds of resorts in order for us to ski, because most of us don't have the stamina or not the willingness to get to the top of the mountain under our own power, so it is those kinds of broad implications to us.

Now, in the operating of those ski resort areas, they are now finding, as a lot of people are finding in this country today, that liability questions are causing a very increasing part of the management costs that they have to meet and one of the tremendous areas in skiing, they don't have product liability like you would be faced if you were a manufacturer, but you have the increasing area of skiers filing claims against the resorts for injuries that they received while they are skiing and this is the area that is causing part of the problem and part of the increasing costs of their liability insurance plus their legal costs that they have in defending when a claim is presented against them.

What we are attempting to do is to say, very simply, that the skier assumes the responsibility basically for getting down the mountain under his own power, we are not attempting to change that, we are just clarifying the law so that the skier is responsible for those inherent risks of playing this sport. We are not trying to change the ground rules as far as the other liability questions. We are just clarifying the law to make sure that the law says that the skier is responsible for getting down the mountain under his own power. That was the basic thrust of what this Bill does. As we make that change that will have a, hopefully a good impact on the kinds of costs that are incurred in the liability insurance that they have to go out and buy in order to make sure that they can operate their resort. That's where the fiscal impact comes back to the benefit of the ski resort. If they can include those costs down then that will prevent or hopefully, because we have a very competitive skiing market within this state, that will keep those rates down, the price that we have to pay when we go out to buy a pass to get up the mountain, that will help us in that area.

Asay: Okay, then I am still trying to see where the people of the state will benefit from this Bill. So you are indicating that there will be a substantial savings then because with these inherent risks taken out of the liability, why the insurance costs will be considerably less. I haven't been skiing for a long while so I don't know what a couple of passes, what does a monthly pass at your favorite ski resort cost.

Finlinson: It's a heck of a lot of dollars, I think an all-day pass, $12.00 for the tram, if you wanted to ride on just the chairs, I think it is about $8.00 if you just ride on the chairs. I think the other resorts are now pretty much in that same category.

Asay: Around $12.00 a day.

Finlinson: Well, that would be the high and that is the one involved with the tram. The other would be $9.00 to $10.00. I want to indicate again, Senator Asay, that our lift rate structure across the state when you compare to what you would be paying if you were ~~skating~~ skiing at Sun Valley or over in Colorado, they have longer lines and higher lift prices. The skiing public is getting a pretty good deal now, and this is a device that helps maintain that they can continue to have a pretty fair break.

Asay: Okay, so can we round that off at about say an average of $10.00 for a daily pass?

Finlinson: You could probably do that, but it might be a little bit high.

Asay: You indicated the other day that the cost of insurance is running about 4% so if you take 4% of the $10.00 that is saving the skier about $.40. If he goes, how often would the average skier go skiing in a season. Not Fred Finlinson, but I mean the average skier in the State of Utah. How many times would he go skiing?

Finlinson: I don't know, it is pretty hard to say what an average skier is, when I was a lot younger, I was able to be up there three or four times a week. We have some people that ski every week, sometimes three or four times a day. It is just a real mix, I don't know that we have an average skier.

Asay: Well, I am trying to determine what the savings would be to the average skier then in the State of Utah if this Bill goes through, I am trying to make sure that it has some benefit for the people of the state rather than just for the ski people. I am just concerned about that. Has there been a boycott of the skiers about the high rates that the ski people are charging them and there is a danger of loosing this industry if we don't pass this Bill? Is this the problem?

Finlinson: No, the impact, Senator Asay, on the individual skier and the ticket that he is going to get is probably, for all intense purposes, fairly insignificant, but when you look at the profit structure of the area, the operator that has to cover all of the costs that he has to do in order to keep that lift running so people can get up, then it becomes in the aggregate amount, the amount that he has to go out and pay for insurance to cover against this potentiality that he might get sued, it is significant then to his overall profit structure. A lot of our resorts aren't really in a very profitable structure and you have year-round costs and you have revenues that come in for five months, so being able to hold the line on the costs for the operator of the resort becomes very critical and that is when this becomes an integral element.

Asay: Okay, that brings it back to the fact then that, and I recognize that the ski operator has a great investment there, after all he owns a mountain, I suppose he owns it.

Finlinson: Well, no some of them do and some don't. A lot of them they don't even own the land because it belongs to the Forest Service and they have to get down, and one of the reasons I think why we do have a low rate structure, Senator Asay, in the state of Utah is that a lot of our resorts are on forest property and as a part of the rate-making process, the operators have to have their rates reviewed by the Forest Service.

Asay: Okay, but it still comes back to this question that I have that the Bill is actually to protect the financial security of the ski operator, so that, in other words, most businesses, when they have increased overheads, and all, of insurance or whatever, they merely pass that on to the consumer and there is no real problem there, I am wondering if there would be a boycott on the industry if the skiers would quit going to the mountains to ski if there was an increase in the rate. I don't see the real advantage to the public. But the real danger that I see here, Senator Finlinson, and I don't know why I can see it and apparently no one else can, and that is that this is brand new legislation, there is just nothing like it on the books anywhere and I had my intern search for two days trying to find something in other states and the only thing that he could even come close to was the State of Washington, and it is so different than what this proposal is that there is hardly any comparison. It outlines that they do have a responsibility and it outlines that they have an amount to cover the skiers and whatnot, but now we are trying to do away with that and so the thing that I am really afraid of and I suppose that I could declare a conflict of interest and change my vote to aye with this thought in mind that yesterday I talked to my brother-in-law who is in the roofing business, and has been for nearly 25 years. Hetten Roofing Company, a great guy, but he could be wealthy today, Senator Finlinson, if he didn't have such high, exorbitant insurance costs. If this Bill passes why I think it ought to be ~~siege~~ cinch to pass a bill outlining the inherent risks of roofing and keep him from paying those high insurance costs and he can start making some profit and I think if we keep this up we could probably even do away with the Industrial Commission. This could be great, you know. Protecting the financial interests of those who are in business to make profit, I just don't understand how we can do it for one industry and not for another. I will be very surprised if this Bill passes if Lagoon doesn't come and want to pass a Bill stating that on the back of your tickets to the fun house will be the inherent risks of going in the fun house and we don't have any liability when you go in there because these risks are outlined here and there may not be room on the ticket to outline them all, but that doesn't matter, they are still covered. You see that is what this Bill is indicating. So I am just wondering what precedence this will set, not only for our state and the businesses here, but for other states, they will pick this up and say boy this passed with a unanimous vote in Utah and that is the greatest skiing state in the Union and let's everybody do it. Can you see the dangers? How come I can see that danger and no one else can?

Finlinson: Senator Asay I am not asking you to make this unanimous.

Asay: Okay, I know it does not matter . . .

Finlinson: I want you to know that there are 11 states now that have passed some form of legislation related to limiting the skier's ability to recover from the inherent risks of skiing. Eight now are still considering that same kind of legislation, the State of Colorado is considering it and so is California. Oregon and Washington have already passed, this is a concern that I think is legitimately brought to the legislature, we have to consider each bill on its merits, if your brother-in-law in the heating industry wants to come and present a claim . . .

Asay: Roofing.

Finlinson: We will give consideration to it. It may not pass, but this legislature has already brought in legislation in 1976 to help the doctors with the malpractice problem. In 1977 we assisted the manufacturers in granting them reform of the tort laws related product liability and the insurance costs they were having with product liability cases. This year the ski area operators have a legitimate claim, they have brought it to us and to have us consider it on the merits and if you feel like, on the merits, this is a good piece of legislation, I solicit your vote. If you don't feel it, I encourage you to vote your conviction and vote against it as you did last time.

Asay: Thank you, just let me make a closing statement then and I appreciate the time that we have taken here.

I don't know why my intern could not find anything else pertaining to the other states, but one thing

I am convinced of that none of the other states have anything this ironclad and the fact that it is so overwhelmingly in favor of the ski operator, as I indicated in my first opening remarks when I expressed concern ~~of~~ over this Bill, there is no question that what we need some kind of legislation to protect against the dishonest individual that is ~~sure~~ going to take advantage of these people, as it is in malpractice suits and all, no question about that . . .

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Asay: ~~Continued. . . .~~ but the thing is so lopsided it just turns me off. I cannot support it. I just cannot support it. Mr. President, the prosecution rests.

President: Senator Barton is standing, do you have a comment on this Bill?

Barton: I would just like to say I don't know if this will straighten out any questions that Senator Asay has, but in my business I pay an awful high insurance bill. Really there are not that many risks that if I had a business, in my business if I had something that made risks for people I can imagine what my insurance bill would be, but I think the question here is inherent risks and I think there has been abuses of it in several cases, not only with skiing but with other things, people have done things on purpose to take advantage of suing. I don't think this Bill would alter any type of a situation where, if the ski resort was actually <u>at fault</u> for causing injury to somebody, I still think suit can be made. I don't think it precludes this. It is just the inherent risks of skiing and where there are so many chances for somebody to break an ankle or even twist ligaments, it happens many many times during each day, and I just think we are going to have to take them off the hook or it's not going to be profitable for them. Thank you.

President: Question~~s~~ ~~have~~ has been called for on Senate Bill #146 on third reading, the question is shall Senate 146 pass. Role call vote.

Secretary: Asay.

Asay: No.

Secretary: Bangerter.

Bangerter: Aye.

Secretary: Barlow.

Barlow: Aye.

Secretary: Barton.

Barton: Aye.

Secretary: Black.

__________: ____.

Secretary: Bowen.

Bowen: Aye.

Secretary: Bullen.

Bullen: Aye.

Secretary: ~~Benlow~~ Bunnell.

~~Benlow:~~ Bunnell: Aye.

Secretary: Carling.

Carling: Aye.

Secretary: Christensen.

Christensen: Aye.

Secretary: Cornaby.

Cornaby: Aye.

Secretary: Farley.

Farley: Aye.

Secretary: Finlinson.

Finlinson: Aye.

Secretary: Halverson.

Halverson: Aye.

Secretary: Jeffs. Jensen. Jones.

Jones: Aye.

Secretary: Kimball.

Kimball: Aye.

Secretary: Matheson. Pace. Pugh.

Pugh: Aye.

Secretary: Ranstrum.

Ranstrum: Nay.

Secretary: Sandburg. Snow. ~~Sowers~~ SOWARDS.

~~Sowers~~ SOWARDS: Aye.

Secretary: Swan.

Swan: Aye.

Secretary: Waddingham. Wayment. Mr. President.

President: Aye.

Secretary: Matheson.

Matheson: Aye.

President: Black is aye, Jeffs is aye, Jensen is aye. Senate Bill #146 on third reading count, final passage receives 23 aye votes, 2 nay votes, 4 being absent, receives a constitutional majority and referred to the House for further action. Senator Asay you picked up one convert.