beneficial designs

What is…
Trail Access Information?

The purpose of this document is to explain the objective trail attributes that must be made available to the public to provide Trail Access Information (TAI) to trail users of all abilities. Trail Access Information on trail signage, as required under the ABA Standards and the US Forest Service Guidelines, represents the best practice for providing objective trail information. Until TAI is established as the norm for describing trails, this critical trail information will continue to be unavailable for the many potential trail users who require such information for access. All entities involved in the public disclosure of trail information should begin collecting the TAI data specified in this document and seek creative and effective ways of providing Trail Access Information to assist all trail user groups in determining which trails will meet their specific needs.

Introduction

People of varying abilities need access to information prior to hiking a trail. While trail ratings such as easy, moderate, or difficult may be useful to some specific trail user groups, these labels are subjective and omit essential information about the actual conditions of a trail. What is easy to one person may be difficult or impossible to another. Trail descriptions must allow each person to determine the level of difficulty for themselves, which requires objective information about actual trail conditions.

Although public trails are intended to provide access and enjoyment to anyone who desires to use them, a lack of objective trail information restricts trail use and excludes many potential trail users. Families pushing strollers need to know the minimum tread width and surface quality to make sure they can make it down a trail. Mountain bike users want to know specific features that will provide the desired level of challenge. Equestrian trail users need to know surface information, overhead clearance, and allowed user groups. Motor vehicle users must know minimum clearance width, cross slope, and grade to be able to safely negotiate trails.

Hiking a trail without knowledge of actual conditions can be dangerous or life-threatening for trail users with disabilities. Such individuals rely on objective trail information to make decisions regarding the trails they will hike and the means by which they will hike them, and may not even consider using a trail that is not objectively described.

Consider the person who uses a wheelchair and travels hours to hike a trail, only to find out that the width of the trail will not accommodate their adaptive device. What would happen if the surface material suddenly changes halfway down a trail and becomes so soft that a hiker can no longer move their wheelchair? Or imagine a person who simply refuses to participate in a hike with friends and family because of fear of unknown conditions. Undisclosed trail characteristics can prevent trail use and endanger trail users.

The US Access Board and the US Forest Service have developed a solution to this problem by **requiring trailhead signage to disclose objective trail characteristics**—regardless of the level of access afforded by a particular trail. Such Trail Access Information (TAI) provides an objective description of each trail as the basis for informed decisions. The data enables any trail user to determine whether or not they can access a trail based on their own personal abilities. Without TAI, potential trail users are left unaware of trail conditions and their ability to hike the trail.

The 2015 Architectural Barriers Act (ABA) Accessibility Standards and the 2013 US Forest Service Trail Accessibility Guidelines require Trail Access Information (TAI) to be included in new trailhead signage. Disclosure of TAI represents the best practice for providing access to trails and avoiding discrimination on the basis of disability.

The purpose of this document is to explain TAI and how to obtain such information. Until TAI is established as the standard method of trail description, this critical trail information will continue to be neglected, along with the many potential trail users who rely on it. All entities involved in the public disclosure of trail information should begin collecting the data specified in this document and seek creative and effective ways of providing TAI for all.

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Trail Access Information (TAI)

In order to avoid discrimination on the basis of disability and adequately inform all potential trail users of actual trail conditions, objective trail information must be documented and disclosed to the public. At a minimum, the following Trail Access Information (TAI) should be **disclosed on trailhead signage,** as specified in the Architectural Barriers Act (ABA) Accessibility Standards and the US Forest Service Trail Accessibility Guidelines:

1. Length of the trail or trail segment
2. Surface type and quality[1]
3. Typical and minimum tread width
4. Typical and maximum running slope (grade)
5. Typical and maximum cross slope
6. A statement that the posted information reflects the condition of the trail when it was constructed or assessed, including the date of the construction or assessment.

Figure 1 illustrates how TAI can be displayed along with general information, such as park name, trail name, and allowed and prohibited trail uses. Figure 2 illustrates additional information specified in Clause 7.4.11.2 of the 2013 US Forest Service Trail Accessibility Guidelines:

> Where more extensive trail information is provided (*e.g.,* an aerial map of the trail and related facilities), the location of specific trail features and obstacles that do not comply with the technical provisions in 7.4 should be identified and a profile of the trail grade should be included.

In addition to the requirement for TAI on trailhead signage, TAI should be included in trail apps and interactive online trail maps in order to enable spatial analysis of trail and feature data by all potential trail users.

Refer to Annex A and B for a summary of ABA Standards and US Forest Service Trail Accessibility Guidelines requirements for trails and trail signage. Entities subject to the ADA must abide by these requirements for providing access to trails and trail information.

Trail Park

Trail Name

Trail Use:	**Hiking**
	Bikes
	Equestrians
	No motor vehicles
Length:	**3.5 mi** (5.6 km)
Running Slope (Typical):	**10.4%**
Running Slope (Maximum):	**45.0%**
Cross Slope (Typical):	**5.8%**
Cross Slope (Maximum):	**29.0%**
Tread Width (Typical):	**27 in** (68.7 cm)
Tread Width (Minimum):	**6 in** (15.2 cm)
Surface Type:	**Soil**
Surface Quality:	**Firm**

Trail conditions may have changed since September of 2017, when this trail was last assessed.

Figure 1 Simple TAI Disclosure Sample

Trail Park

Trail Name

Trail Use:	**Hiking**
	Bikes
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	No motor vehicles
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Tread Width (Typical):	**27 in** (68.7 cm)
Tread Width (Minimum):	**6 in** (15.2 cm)
Surface Type:	**Soil**
Surface Quality:	**Firm**
Obstacles	**6-in rocks, rock steps**

Running Slope Profile

Trail conditions may have changed since September of 2017, when this trail was last assessed.

Figure 2 Additional TAI Disclosure

[1] Trail quality represents surface firmness and stability. Although absent from ABA Standards and US Forest Service trailhead signage requirements, firmness and stability is required for an accessible trail. **A lack of firmness and stability is the greatest barrier to access for hikers who must use wheelchairs for mobility.**

Trail summary data fields

In order to provide Trail Access Information (TAI) for a trail, the following summary attributes must be disclosed. This information can be produced by station and feature data collected on the trail and explained in the next section.

1. Trail name
2. Length (mi)
3. Typical running slope (grade) (%)
4. Maximum running slope (grade) (%)
5. Typical cross slope (%)
6. Maximum cross slope (%)
7. Typical tread width (in)
8. Minimum tread width (in)
9. Surface type
10. Typical surface quality
    paved, hard, firm, soft, very soft, or a Rotational Penetrometer reading (in)
11. Worst surface quality
12. Obstacle type 1–3*
    rock, rut, root, etc.—non-compliant with accessibility requirements
13. Obstacle type 1–3 typical magnitude (in)*
14. Obstacle type 1–3 maximum magnitude (in)*
15. Date assessment was completed
16. Type of assessment
    Universal Trail Assessment Process (UTAP)
    High-Efficiency Trail Assessment Process (HETAP)
    Any other process should be specified and described
17. Profile of the trail running slope (grade)
    provide placeholder for graphic image file or interactive profile

*Three separate obstacle types are recommended, though more obstacles may be identified. For each obstacle type, the typical and maximum magnitude should be disclosed. Section 7.4.11.2 of the 2013 US Forest Service Trail Accessibility Guidelines also requires the location of trail features and obstacles not compliant with accessibility requirements to be identified when more extensive trail information is provided, such as a map.

Trail data needed for Trail Access Information

The provision of Trail Access Information (TAI) requires documentation of objective trail attributes, including trail length, running slope, cross slope, tread width, surface type, surface firmness and stability, and obstacles. The following information explains the data collection necessary for TAI summary data.

Universal Trail Assessment Process (UTAP)

The Universal Trail Assessment Process (UTAP), a proven method of trail assessment, whether manual, semi-automated, or automated, divides each trail into segments for assessment. Within a single segment, the trail is evaluated at reference points along the best path of travel that are referred to as stations.

Segments

Segments are the building blocks of trails and are necessary for the assembly and rerouting of trails and TAI. Before assessment, each endpoint or intersection within the trail system is labeled as a unique node, which divides the trail network into irreducible sections of trail, or segments. Each segment is named according to the starting and ending node. A single trail may be composed of only one segment or an assembly of multiple segments. Segments may be associated with more than one trail where multiple trails overlap.

Stations

Stations are the building blocks of segments. Each station point contains trail attribute data **which remain consistent from that station point up to, but not including, the next station point.** Depending on the mode of collection, stations can be collected as data points and converted to line data on the backend, or collected simply as line data. However a station is recorded, each station is associated with the starting location point.

Station attributes

Station points capture an objective description of a portion of the trail, and include the following attributes. The items in bold are required to meet ABA and US Forest Service requirements for Trail Access Information (TAI).

1. Date of station collection
2. Identification of the trail or trail segment in which the station was collected
3. GPS location for spatial analysis in GIS applications
4. Photo reference looking forward along trail from each station (or 360-degree photo)
5. Elevation
6. **Length,** which represents the distance from the beginning of the station point to the next station, or the length of the station line
7. Cumulative distance from the beginning of the trail or trail segment to the current station (sum of all previous station lengths)
8. **Running slope** (grade)

9. **Cross slope**
10. **Tread width**
11. **Surface type**
12. Surface firmness and stability[1]

Collecting stations

A new station point is collected wherever one or more of the trail attributes has significantly changed, or when a maximum station length is reached. Depending on the type of trail being measured, a maximum station length of 25 feet is recommended, with shorter intervals increasing accuracy and detail. A turn may require shorter station intervals in order to map out the curve of the trail while a long, paved trail might allow intervals of 100 feet if trail attributes do not change.

Stations should be collected at the beginning, end, and throughout a trail or trail segment. Stations throughout the trail should, at the least, be established whenever

- there is a visual change in the trail direction of approximately 15 degrees or more
- there is a change in the running slope of 5% or more, uphill or downhill, or the running slope exceeds or transitions a specific design threshold, such as 5%, 8.3%, 10%, or 12%
- there is a change in the cross slope of approximately 5% or more, or the cross slope exceeds or transitions a specific design threshold, such as 2% (1:48 or 2.1%) or 5%
- there is a significant change in the width of the usable trail tread, or the tread width reduces below or transitions a specific design threshold, such as 32, 36, or 48 inches
- the surface type changes
- the surface firmness and stability changes
- the previous station is about to go out of sight
- the trail splits or intersects another trail.

Feature data

Throughout the station collection, additional, separate data points representing trail features or obstacles are collected within the trail bed zone or outside the trail tread, in the visual field zone. A new station may also be recorded at each feature if desired. Any features encountered within the trail bed zone should be documented as feature points with the following attributes:

1. Feature type
2. Identification of the trail or trail segment in which the feature was collected
3. GPS location
4. Photo(s)
5. Length (always measured parallel with path of travel)
6. Width (always measured perpendicular to path of travel)
7. Height (above ground surface)
8. Depth (below ground surface)
   Remaining tread width

[1] **A lack of firmness and stability is the greatest barrier to access for hikers who must use wheelchairs for mobility.**

Data collection methods

The following information explains trail assessment methods that can objectively document the station and feature data necessary for Trail Access Information.

Tools

At a minimum, a linear measurement wheel, a digital level, and a tape measure are required to collect Trail Access Information (TAI). The digital level should be approximately 24 inches long to represent the stance of most trail users who wheel or walk on trails. Feet should ideally be installed at both ends of the level, allowing the measurement of an average running slope or cross slope over 24 inches. Without feet, the tool can teeter on uneven surfaces.

A GPS unit and camera allow trail data to be spatially and visually documented and analyzed within GIS applications. At the end of every station, length must be recorded for the completed station and then the measurement wheel can be reset to zero to begin measuring the new station length if desired.

How to measure

Measuring running slope

Station running slope is measured at the beginning of each station. A digital level is placed on the best path of travel, parallel to the path of travel. Running slope is measured in percent, representing rise over run. This can be done using a visual clinometer or a digital level.

Measuring cross slope

Station cross slope is measured at the beginning of each station. A digital level is placed on the best path of travel, perpendicular to the path of travel. Cross slope must be measured in percent, representing rise over run. To identify drainage problems, a positive value can be assigned for an out-slope that drains surface water to the downhill side of the trail. Negative values indicate the trail has an in-slope to drain water towards the uphill or bank side of the trail.

Measuring tread width

Station tread width is measured at the beginning of each station. A tape measure is placed across the full trail tread at ground level, perpendicular to the direction of the trail. Vegetation and ground obstacles, such as bushes and rocks, often define the edge of the trail tread. Border areas of the trail bed that are outside of the trail tread are not considered part of the trail tread width.

Measuring surface characteristics

The predominant surface material and quality throughout the station should be recorded at the beginning of each station. If the material or quality changes, a new station should be recorded.

Surface characteristics should be recorded under dry or “usual” conditions. Ideally, surface should be measured in both dry and wet conditions, noting any significant difference. However, if the surface is usually wet, it should be measured according to its “usual” (i.e., wet) condition.

Surface quality is determined by firmness and stability, which is collected at the beginning of each station. Firmness and stability may be measured in multiple ways:

1. **Foot and Heel Test**

   In this method, firmness and stability is recorded in one of five categories: Paved, Hard, Firm, Soft, or Very Soft.

   The person making the measurement stands on the surface with a flat foot and leans all body weight onto one foot. If the surface is indented, it is considered Soft. If the person sinks into the surface as they lean, the surface is Very Soft. If the surface does not indent, the surface is either Hard or Firm.

   Next, the person again stands on the surface with all body weight on one foot. Next, the person leans all body weight on the edge of their heel and then twists the heel against the surface. Typically, if the heel leaves an indention or footprint on the surface, the surface is Firm. If there is no indentation or footprint from the heel, the surface is Hard.

2. **Rotational Penetrometer**

   The Rotational Penetrometer is an instrumented surface indenter (ISI), which is an objective measurement device for measuring trail surface firmness and stability. It assesses surface firmness and stability by measuring the surface displacement resulting from a calibrated spring pressing an indenter into the surface. The indenter assembly is lowered onto the test surface and locked in place. The precision spring is released and the displacement of the indenter into the surface is measured with a precision caliper to determine surface firmness. The indenter is then twisted back and forth. The additional penetration of the indenter determines the surface stability. Typically, the Rotational Penetrometer is used to objectively measure each surface type and quality identified with the foot and heel test, rather than making the measurements at each station. The Rotational Penetrometer is available from the developer, Beneficial Designs—www.beneficialdesigns.com.

   The following is not intended as a full set of instructions, but only as a brief overview. Detailed operating instructions should be obtained from the manufacturer’s user’s manual. Additional instructions beyond these overview steps are necessary to collect accurate and reliable information about a trail surface.

   1. Position the device on the surface to be tested.
   2. Stand on the surface reference plates, making sure your weight is evenly distributed on both feet.
   3. Gently lower the penetrator assembly onto the test surface, lock the position of the assembly, and zero the caliper reading.
   4. Slowly release the spring force and allow the indenter to push into the surface being tested. Record the distance the indenter has moved into the surface as the firmness reading.

5. Rotate the indenter through four 90-degree rotations. Record the distance the indenter has moved into the surface as the stability reading.

Each surface type is measured in five different locations, discarding the highest and lowest combined firmness and stability readings, and the remaining readings are averaged. Typically, it will be easiest to go back and measure each surface type and quality after data obtained from the trail assessment has been analyzed to identify how much of each surface type and quality exists on the trail.

See “Objective firmness and stability” below for RP firmness and stability ratings according to objective displacement values.

Measuring features

At a minimum, a tape measure should be used to document the dimensions of each feature on and above the trail tread, along with the remaining tread width. Section 7.4.11.2 of the US Forest Service Trail Accessibility Guidelines states that the location of “specific trail features and obstacles that do not comply with the technical provisions in 7.4” should be identified “[w]here more extensive trail information is provided (e.g., an aerial map of the trail and related facilities).” Non-compliant features and obstacles typically include tread obstacles (changes in level), openings, and protruding objects, though any potential barrier or hazard may be included. A GPS unit should be used to document the location of each feature.

Analysis

The list of trail characteristics in Figure 1 and Figure 2 represent the minimum amount of Trail Access Information (TAI) required to adequately inform a potential trail user of trail conditions. The following table provides the formulas for determining typical running slope, typical cross slope, and typical tread width, based on the collection data. These trail characteristics, which are required by both the 2015 ABA Standards and the 2013 US Forest Service Trail Accessibility Guidelines, are essential for each trail user to be able to determine their personal ability to use the trail.

Although complicated at first glance, the typical value formulas simply calculate a weighted average and can be automated in a data spreadsheet. For example, to calculate the weighted average running slope, each station length is multiplied by that station's running slope. These values are added up and the sum is then divided by the total length of the trail or trail segment.

Running Slope (Typical)	$\frac{\sum (R \times L)}{\sum L}$	R = Station running slope (average if using a clinometer) L = Station length
Cross Slope (Typical)	$\frac{\sum (C \times L)}{\sum L}$	C = Station cross slope L = Station length
Tread Width (Typical)	$\frac{\sum (W \times L)}{\sum L}$	W = Station tread width L = Station length
Surface Firmness (Typical)	$\frac{\sum (F \times L)}{\sum L}$	F = Station firmness L = Station length
Surface Stability (Typical)	$\frac{\sum (S \times L)}{\sum L}$	S = Station stability L = Station length

Typical obstacle magnitude represents an unweighted average.

Maximum, minimum, or worst values for trail attributes are based on the most extreme absolute value collected along the entire trail or trail segment.

Spatial analysis

While the above list of information is essential, it is also recommended to provide further information through online interactive maps, charts, and trail profiles that spatially display running slope, cross slope, tread width, surface type, surface firmness and stability, and obstacle data. Allowing a user to control data symbology and attribute thresholds while visualizing the location of actual trail characteristics and features will provide enhanced capabilities in determining which parts of the trail are personally accessible. Being able to

visually analyze the location of all trail conditions is the ideal solution to the need for objective trail information.

Station attributes (grade, cross slope, tread width, surface type, surface firmness and stability), can be split into individual layers to produce a multi-layer trail line. Each layer can be isolated and reviewed with color combinations that identify the different data thresholds, as shown in **Figure 3.** In the sample map, areas where the trail tread width is 60 inches or greater are shown in cyan, tread widths less than 60 inches but greater than or equal to 36 inches are shown in orange, while values less than 36 inches are shown in magenta. Alternatively, the user could also be provided the ability to manually set the thresholds and color parameters to visually identify the exact conditions suitable to their personal needs. If the individual decided that they were capable of traversing through a tread width of 20 inches, they could set tread widths 20 inches or more to cyan, with intermediate and extreme thresholds customized as well.

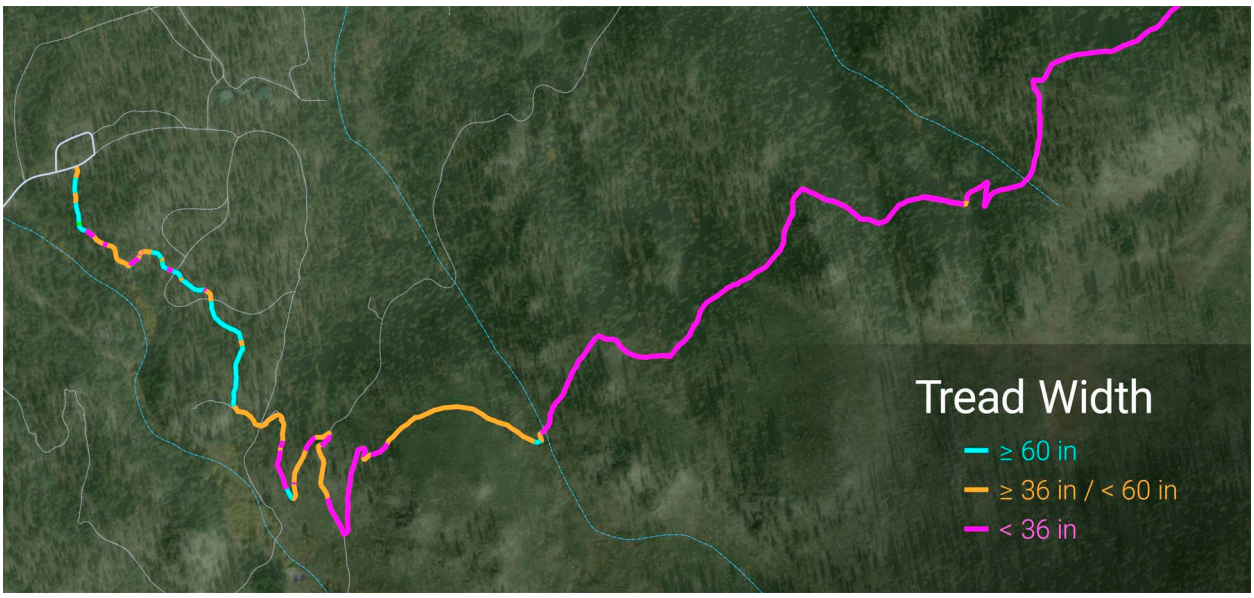

Figure 3 Sample of trail station data map

Station photos can be linked to corresponding station lines, allowing users to visually preview the trail before arrival. Panorama photos may also be utilized and stitched together to provide a 360-degree trail simulation. Photogrammetry and LiDAR technology might also be used, which could be combined with the station data to produce a three-dimensional simulation of the trail, along with color identification of trail attribute values.

Feature data may also be displayed as data points along the trail. These points can include all feature attributes and photos to provide a comprehensive preview of the obstacle or object.

By displaying station and feature data visually and spatially across a trail map, users will understand the location of all documented conditions and features throughout the trail. This allows users to determine which parts of a trail they will be able to hike or at which point they will need extra assistance.

Interpretation

Each trail attribute affects the level of access to a trail in different ways for different people. The following narrative discusses the meaning and significance of each of these trail attributes as related to trail access.

Running slope (grade)

Running slope definition

Running slope, or grade, is defined by the U.S. Access Board[1] as "the lengthwise slope of a trail, parallel to the direction of travel." The running slope of a trail is measured "as a ratio of vertical distance to horizontal distance, or rise to run." For example, a 10% slope would represent 1 foot of rise measured over 10 feet of horizontal distance, or 1 foot divided by 10 feet (0.10 or 10%).

Running slope information

Steeper running slopes can be more difficult to navigate due to additional effort required to climb uphill and potential increased speed caused by downhill segments. For this reason, gradual slopes are easier to navigate, while steeper slopes require shorter segments with resting intervals at the beginning and end of the slope (2015 ABA Standards 1017.8).

Clause 1017.7 of the 2015 ABA Standards specifies the following intervals for an accessible experience along steeper segments of a trail. Trail running slopes exceeding these guidelines may be more difficult or inaccessible for many trail users.

Running Slope of Trail Segment		Maximum Length of Segment
Steeper Than	**But Not Steeper Than**	
1:20 (5%)	**1:12 (8.33%)**	**200 feet (61 m)**
1:12 (8.33%)	**1:10 (10%)**	**30 feet (9 m)**
1:10 (10%)	**1:8 (12%)**	**10 feet (305 cm)**

Cross slope

Cross slope definition

Cross slope is the slope perpendicular to the path of travel and is defined by the U.S. Access Board[1] as "the side-to-side slope of a trail tread." The cross slope of a trail is measured "as a ratio of vertical distance to horizontal distance, or rise to run." For example, a 5% slope would represent 1 inch of rise measured over 20 inches of horizontal distance, or 1 inch divided by 20 inches.

[1] *Guide to the ABA Accessibility Standards, Outdoor Developed Areas,* accessed 19 June 2024 from https://www.access-board.gov/aba/guides/chapter-10-outdoor/#running-slope-101771

Cross slope information

While a certain amount of cross slope is necessary for proper drainage to keep water off the trail, excessive cross slopes can increase the difficulty of traversing a trail. When the cross slope exceeds 1:48 (2.1%), wheelchair users and other hikers must exert extra effort against the force of gravity in order to maintain lateral balance. In addition, a severe cross slope can cause a wheelchair or adaptive bike user to be directed laterally in the downhill direction. Abrupt changes in cross slope greater than 5% over a distance of 24 inches can cause stumbling or falling for various trail users, especially those using wheelchairs.

According to clause 1017.7.2 of the ABA Standards, a maximum cross slope of 1:48 (2.1)% is required for trails compliant with ABA trail requirements. If drainage is necessary for a trail with a surface other than concrete, asphalt, or boards, a maximum of 1:20 (5%) cross slope is permitted. Cross slopes that exceed 1:20 (5%) will be increasingly difficult or inaccessible for many trail users.

Tread width

Tread width definition

The tread width is the clear width of the trail, perpendicular to the path of travel. The tread width includes the usable trail surface and the area above the trail in which the trail user travels.

Tread width information

The width of the trail tread determines who can access the trail. People using wheelchairs, assistive bikes, strollers, wagons, or walkers may not be able to pass through areas where the tread width reduces to less than 36 inches (or 32 inches over a distance greater than 24 inches). People with visual impairment may not be able to detect objects that protrude into the trail above ground level. Before hiking a trail, each trail user should determine beforehand for themselves the minimum tread width they can safely navigate.

Clause 1017.3 of the ABA Standards specifies a minimum clear tread width of 36 inches for trails compliant with ABA trail requirements. This clearance must be maintained up to a height of 80 inches (see 1017.9 and 307). Objects may only protrude into the tread width outside the minimum 36-inch clearance. Such protruding objects generally may not protrude more than 4 inches at a height of more than 27 inches and up to 80 inches from the ground. Objects 27 inches and below may protrude any amount, but may not reduce the minimum 36 inches of tread width.

Surface

Surface definitions

The type of surface material affects certain trail requirements, such as maximum obstacle height (ABA Standards 1017.5) and maximum cross slope (ABA Standards 1017.7.2). Although the type of trail surface material may vary widely, two qualities are essential in determining the accessibility of a trail surface: firmness and stability.

According to the U.S. Access Board, "a firm trail surface resists deformation by indentations."[1] The FHWA states, "Firmness is the degree to which the surface resists deformation by indentation when, in this case, a person walks or wheels across it. A firm surface would not compress significantly under the forces exerted as a person walks or wheels on it."[2]

According to the U.S. Access Board, "stable surfaces resist movement"[3] and "a stable trail surface is not permanently affected by expected weather conditions and can sustain normal wear and tear from the expected uses between planned maintenances."[1] The FHWA states, "Stability is the degree to which the surface remains unchanged by contaminants or applied force, so when the contaminant or force is removed, the surface returns to its original condition. A stable surface would not be significantly altered by a person walking or maneuvering a wheelchair on it."[2]

Surface information

Trail surface material may range from concrete to sand, with various types being affected differently by trail use, the surrounding environment, and climate. The difficulty and accessibility of a trail are directly affected by the firmness and stability of the surfacing material on the trail. While some users may prefer trail surfaces to be slightly softer than hard, travel across a softer surface will generally be more difficult for all trail users and may exclude people with disabilities. The FHWA states the following:

> Soft surfaces, such as dry sand or pea gravel, are more difficult for all users to negotiate and present particular hazards for those using wheeled devices including road bicycles, walkers, and wheelchairs not designed for rugged terrain[4]....When a person walks or wheels across a surface that is not firm and stable, energy that would normally cause forward motion instead deforms or displaces the surface, so the energy is lost through slipping.[2]

Therefore, as the firmness and stability of a trail surface worsens, the energy required to use that trail will increase, creating a more difficult and sometimes inaccessible pathway. **Soft surfaces are the greatest barrier to trail access for hikers using mobility devices.**

Clause 302.1 of both the 2010 ADA Standards for Accessible Design and the 2015 ABA Accessibility Standards requires the surface of an accessible route to be stable, firm, and slip resistant. The ABA Standards trail surface requirements, however, do not specify slip resistance. The U.S. Access Board states, "slip resistance is not required for the surface of trails because leaves, dirt, ice, snow, and other surface debris and weather conditions are part of the

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[1] *Guide to the ABA Accessibility Standards, Outdoor Developed Areas,* accessed 19 June 2024 from https://www.access-board.gov/aba/guides/chapter-10-outdoor/#surface-10172

[2] "15.4.2 Surface firmness, stability, and slip resistance" in *Designing Sidewalks and Trails for Access: Part II of II: Best Practices Design* Guide, accessed 19 June 2024 from https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/sidewalks215.cfm#sur1

[3] "Chapter 3: Floor and Ground Surfaces" in *Guide to the ADA Standards,* accessed 25 July 2019 from https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/guide-to-the-ada-standards/single-file-version#floor.

[4] "15.4.1 Surface material" in *Designing Sidewalks and Trails for Access: Part II of II: Best Practices Design* Guide, accessed 19 June 2024 from https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/sidewalks215.cfm#sur

natural environment that would be difficult, if not impossible, to avoid."[1]

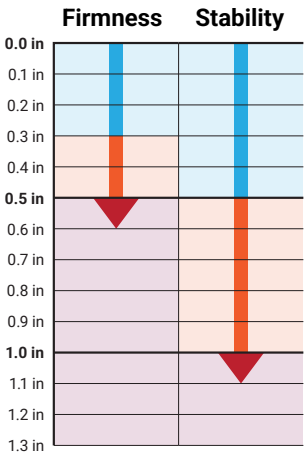
Objective firmness and stability

Although firmness and stability are somewhat subjective terms, an objective method of recording firmness and stability levels may be used on trail surfaces. Funded by the National Institutes of Health, the Rotational Penetrometer (RP), an instrumented surface indenter (ISI), was developed by Beneficial Designs to enable mobile surface testing that provides accurate firmness and stability data of any surface type. The RP measures surface firmness by pressing an indenter into the ground surface with a specified amount of force. The distance the indenter penetrates into the surface is then recorded for a firmness reading. The stability of the surface is then measured by rotating the indenter back and forth while the force is applied and then recording the amount the indenter penetrates into the surface.

The following tables[2] provide an objective standard for firmness and stability ratings. This standard is based on the displacement measured by the Rotational Penetrometer and research conducted with human subjects walking on different trail surfaces measured with the RP.

Surface Rating for Firmness	Indenter Penetration
Firm	0.3 in or Less
Moderately Firm	Greater than 0.3 in to 0.5 in
Not Firm	Greater than 0.5 in

Surface Rating for Stability	Indenter Penetration
Stable	0.5 in or Less
Moderately Stable	Greater than 0.5 in to 1.0 in
Not Stable	Greater than 1.0 in



[1] *Guide to the ABA Accessibility Standards, Outdoor Developed Areas,* accessed 19 June 2024 from https://www.access-board.gov/aba/guides/chapter-10-outdoor/#measuring-surface-firmness-and-stability

[2] Preliminary data was reported in a research report entitled *Improved Engineered Wood Fiber (EWF) Surfaces for Accessible Playgrounds,* which is posted on the U.S. Access Board website: https://www.access-board.gov/research/exterior-services/engineered-wood-fiber/playground-surfaces-2003/

Obstacles

Tread obstacles (changes in level), openings, protruding objects, or any other feature not compliant with ABA or US Forest Service trail requirements could all be classified as obstacles and should be documented, as they can be a barrier or hazard to a user on the trail. While some features might not be categorized as a tread obstacle, opening, or protruding object, any feature that reduces the minimum required tread width is an obstacle.

Tread obstacles

A tread obstacle specifically refers to a vertical change in level. The FHWA defines a change in level as "a difference in vertical elevation between two adjacent surfaces."[1] The U.S. Access Board defines a tread obstacle as "anything that interrupts the evenness of the tread surface."[2]

Changes in level are a potential tripping hazard to all trail users. Such obstacles pose a higher risk for tripping and falling to people who have difficulty in lifting their feet, such as the elderly or children, as well as to those who use wheeled devices or assistive technology, such as canes, wheelchairs, or adaptive sports equipment. Rocks, roots, steps, or uneven transitions between adjacent surfaces can unexpectedly interrupt the evenness of the trail tread surface.

Tread obstacles may not be visibly different in height compared to the surrounding surface, but may nevertheless represent a potential hazard to trail users unaware of the difference in surface. For example, a rock located within soft dirt, though not totally visible, would interrupt the evenness of the tread surface and possibly cause tripping or injury.

Paved or hard trail surfaces, including concrete, asphalt, and boards, should be free of vertical changes in level above 0.5 inches. If the trail surface material is a substance other than concrete, asphalt, or boards, the ABA Standards permit a maximum vertical obstacle height of 2.0 inches (1017.5).

Stricter requirements for vertical changes in level on accessible routes are found in both the ADA Standards and the ABA Accessibility Standards (303), which specify a maximum vertical change in level of 0.25 inches and a maximum overall vertical height of 0.5 inches, with a maximum 1:2 (50%) beveled slope for changes in level above 0.25 inches and up to 0.5 inches. Clause R302.6.2 of the Public Right-of-Way Accessibility Guidelines also applies these requirements for shared use paths. These stricter requirements can prevent tripping of trail users who are using rollerblades, walkers and other users with limited mobility.

[1] "15.4.3.1 Changes in level" in *Designing Sidewalks and Trails for Access: Part II of II: Best Practices Design* Guide, accessed 19 June 2024 from https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/sidewalks215.cfm#cha1

[2] *Guide to the ABA Accessibility Standards, Outdoor Developed Areas,* accessed 19 June 2024 from https://www.access-board.gov/aba/guides/chapter-10-outdoor/#tread-obstacles-10175

Openings

Openings are defined as "gaps in the surface of a trail."[1] Openings are also a potential risk along any path. Such gaps in the trail surface can catch canes, wheels, or feet and can occur between boardwalk planks, within cracks in a rock surface, or in grates installed within the trail tread.

While it is ideal to keep openings outside the trail tread, ADA and ABA standards permit openings that do not allow the passage of a sphere more than 0.5 inches in diameter (302.3). It is also recommended (and required by the US Forest Service) to align elongated openings in trails perpendicular to the path of travel so as to avoid wheelchair casters or bicycle wheels getting caught within the openings.

Protruding objects

The 2013 US Forest Service Trail Accessibility Guidelines defines a protruding object as

> A constructed feature such as a sign that extends into the trail tread more than 4 inches (100 mm) between 27 inches (685 mm) and 80 inches (2030 mm) above the trail tread. Accessibility guidelines for protruding objects do not apply to naturally occurring objects, such as tree branches, or rock ledges.[2] However, safety regulations or Forest Service construction and maintenance standards may define clear space and limit overhangs of natural protruding objects.

The ADA and ABA standards allow post-mounted protruding objects, such as signs, to overhang the circulation path 12 inches maximum. However, it is best practice to only apply this allowance to post-mounted objects that can only be approached from the front.[3]

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[1] *Guide to the ABA Accessibility Standards, Outdoor Developed Areas,* accessed 19 June 2024 from https://www.access-board.gov/aba/guides/chapter-10-outdoor/#openings-10176

[2] Whether or not a protruding object is a naturally occurring object, it should be collected during an assessment.

[3] "4.1.3 Protruding objects" in *Designing Sidewalks and Trails for Access: Part II of II: Best Practices Design* Guide, accessed 19 June 2024 from https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/sidewalks204.cfm#pro

Annex A: 2015 ABA Accessibility Standards

Summary of select requirements for trails and trailhead signs

Surface 1017.2	**Firm** and **Stable**		
Clear Tread Width 1017.3	**36 in** min		
Passing Spaces 1017.4	Where clear tread width < 60 in, **passing space** every 1000 ft max, either:		
	1) **60 in by 60 in** min		
	2) **T-shaped turning space** (arms & base extend 48 in min beyond intersection)		
	If full trail does not comply, passing space **at end of compliant trail segment**		
Tread Obstacles 1017.5	Asphalt, concrete, boards:	**0.5 in** vertical max	
	Other surface:	**2.0 in** vertical max	
Openings 1017.6	Shall not allow passage of a sphere more than **0.5 in** in diameter		
Running Slope 1017.7.1	**> 1:12 (8.33%) not more than 30%** of the total length of the trail		
	> 1:20 (5%) requires **resting interval** at top and bottom of segment		
	Steeper than	**But not steeper than**	**Max Segment Length**
	> 1:20 (5%)	≤ 1:12 (8.33%)	200 ft
	> 1:12 (8.33%)	≤ 1:10 (10%)	30 ft
	> 1:10 (10%)	≤ 1:8 (12%)	10 ft
Cross Slope 1017.7.2	**1:20 (5%)** max (if surface is asphalt, concrete, boards: **1:48 (2.1%)** max)		
Resting Intervals 1017.8	Length: **60 in** min		
	Width within trail tread: **≥ widest segment** of trail tread leading to resting interval		
	Width adjacent to trail tread: **36 in** min		
	Slopes on asphalt, concrete, boards: **1:48 (2.1%)** max		
	Cross slope on other surface: **1:20 (5%)** max		
	If adjacent to trail tread, 304.3.2 **T-shaped turning space** (vert. alignment nominally planar)		
Protruding Objects 1017.9	**No protrusion** into 36-in clear tread width		
	4 in max into circulation path (above 27 in, up to 80 in)		
	12 in max into circulation path if post-mounted (above 27 in, up to 80 in)		
	80 in min vertical clearance		
Trailhead Signs 1017.10 *See F216.3 for scoping requirements. If the sign designates the name of the trail, only the name of the trail is required to comply with the visual character requirements in 703.5.*	Trail information signs at trailheads shall include the following:		
	1) **Length** of the trail or trail segment		
	2) **Surface type**		
	3) Typical and minimum **tread width**		
	4) Typical and maximum **running slope**		
	5) Typical and maximum **cross slope**		

For complete definitive guidelines, visit https://www.access-board.gov/aba/

The above requirements are part of the 2013 US Access Board outdoor developed areas supplement to the ABA Accessibility Guidelines, which was adopted as part of the ABA Standards in 2015. Although these additional requirements currently apply to facilities designed, built, altered, or leased with federal funds, and have no legal effect on entities subject to the ADA, the US Access Board intends to develop requirements for outdoor developed areas subject to the ADA as well (see 78 FR 59476).

Annex B: 2013 US Forest Service Trail Accessibility Guidelines

Summary of select requirements for trails and trailhead signs

Surface 7.4.1	**Firm** and **Stable**		
Clear Tread Width 7.4.2	**36 in** min (if exception condition: **32 in** min)		
Passing Spaces 7.4.5	Where clear tread width < 60 in, **passing space** every 1000 ft max, either:		
	1) **60 in by 60 in** min		
	2) **T-shaped turning space** (arms/base 48 in min beyond intersection; vert. alignment nominally level)		
	If full trail does not comply, passing space **at end of any compliant trail segments**		
Tread Obstacles 7.4.6	Surface is paved or elevated above natural ground:		**0.5 in** vertical max
	Other surface:		**2.0 in** vertical max
Openings 7.4.7	Max passage of sphere **0.5 in** in diameter (if exception condition: **0.75** max)		
	Where possible, elongated openings perpendicular to dominant direction of travel		
Running Slope 7.4.3.1	**> 1:12 (8.33%) not more than 30%** of the total length of the trail		
	> 1:20 (5%) requires **resting interval** at top and bottom of segment		
	Steeper than	**But not steeper than**	**Max Segment Length**
	> 1:20 (5%)	≤ 1:12 (8.33%)	200 ft
	> 1:12 (8.33%)	≤ 1:10 (10%)	30 ft
	> 1:10 (10%)	≤ 1:8 (12%)	10 ft
Cross Slope 7.4.3.2	**1:20 (5%)** max (if surface is paved or elevated above natural ground: **1:48 (2%)** max		
Resting Intervals 7.4.4	Length: **60 in** min		
	Width within trail tread: **≥ widest segment** of trail tread leading to resting interval		
	Width adjacent to trail tread: **36 in** min		
	Slopes **1:20 (5%)** max (if surface is paved or elevated above natural ground: **1:48 (2%)** max)		
	If adjacent to trail tread, ABA 304.3.2 **T-shaped turning space** (vert. alignment nominally level)		
Protruding Objects 7.4.8	**No protrusion** into 36-in clear tread width		
	4 in max into trail tread (above 27 in, up to 80 in, including signs)		
Trailhead Signs 7.4.11 *See additional 7.4.11 subclauses for clear space and reach range requirements*	**New trail information signs at trailheads shall include the following:**		
	1) **Length** of the trail or trail segment		
	2) **Surface type**		
	3) Typical and minimum **tread width**		
	4) Typical and maximum **running slope**		
	5) Typical and maximum **cross slope**		
	6) **Statement** that the posted information reflects the condition of trail when constructed/assessed		
	7) **Date** of the construction or assessment of trail		
	If extensive trail information is provided (e.g., an aerial map of the trail and related facilities):		
	1) Location and identification of **specific trail features** and obstacles that do not comply with 7.4		
	2) **Profile** of the trail grade		

For complete definitive guidelines, visit https://www.fs.usda.gov/managing-land/national-forests-grasslands/accessibility/resources