3-62

ACCESSIBLE PEDESTRIAN SIGNALS: SYNTHESIS AND GUIDE TO BEST PRACTICE

FINAL REPORT

Prepared for
National Cooperative Highway Research Program
Transportation Research Board
National Research Council

Janet M. Barlow, M.Ed., COMS
Billie Louise Bentzen, Ph.D., COMS
Lee S. Tabor, Registered Architect
Accessible Design for the Blind
P.O. Box 1212, Berlin, MA 01503

May 2003

ACKNOWLEDGMENT OF SPONSORSHIP

This work was sponsored by the American Association of State Highway and Transportation Officials, in cooperation with the Federal Highway Administration, and was conducted in the National Cooperative Highway Research Program, which is administered by the Transportation Research Board of the National Research Council.

AUTHOR ACKNOWLEDGMENTS

The authors wish to express their appreciation to all who generously contributed their time and efforts in providing information, specifications and photographs, and for those who gave permission for us to use case study information from their jurisdictions. We are also grateful for content suggestions made by members of the NCHRP 3-62 Panel and for editorial review by David Harkey and Herman Huang.

ILLUSTRATION CREDITS

Photographs by Janet Barlow and Billie Louise Bentzen except as noted.
Lee Tabor: cover illustration, all drawings (except for Appendix drawings).
Doug Barlow: 1-1, 1-2, 1-3, 9-1.
Lukas Franck: 5-2, 7-9, 10-3, 10-6, 11-2, 11-3, 11-5.
Campbell: 5-6, 12-2, 12-1, 12-21; Novax: 5-3; Panich 5-4;
Georgetown brochure: 5-7; Talking Signs: 5-8; Relume: 5-9.

Photographs and drawings in Chapter 15, APS Manufacturers, from respective manufacturer's brochures and web sites: Campbell Company, Georgetown Electric, Ltd., Mallory Sonalert Products, Inc., Novax Industries, Inc, Bob Panich Consultancy Pty. Ltd., Polara Engineering, Prisma Teknik AB, Relume Corporation, Talking Signs Inc., U.S. Traffic Corporation, Wilcox Sales Company.

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Introduction to

Accessible Pedestrian Signals: Synthesis and Guide to Best Practice

Content of synthesis

This document provides background information on how pedestrians who are blind or visually impaired cross streets, and how Accessible Pedestrian Signals assist this process. Past research is reviewed, as are rules and regulations that pertain to APS. A short review of international APS use is included.

Various types of APS and their features are discussed at length. Practical advice is given on where and how to install APS under actual field conditions.

A list of APS devices currently available in the U.S. is included. A product matrix summarizes the availability of APS features by product.

Purpose of synthesis

The purpose of this document is to be a resource to those who wish to use and advocate the use of APS. It is also a best practice guide for those in U.S. state and local governments who design, specify, and install APS.

Sources of information

Information about research on Accessible Pedestrian Signals has been obtained from individuals and organizations in the U.S. and a number of foreign countries with long histories of using APS.

Product information has been obtained from manufacturers, installers, and user organizations.

Interviews have provided information on how APS have performed in the field, past and present.

Chapter 1 — Accessible Pedestrian Signals and Travel by Pedestrians who are Blind or Visually Impaired

Summary

This chapter provides a definition of accessible pedestrian signals and an overview of their use. It also provides demographic information about individuals who are blind and visually impaired, and types of vision loss.

Travel techniques are explained and the effect of changes in traffic control and signalization on the travel of pedestrians who are blind or visually impaired is discussed.

Chapter contents

This chapter includes information on

- Accessible Pedestrian Signals
- Blindness and Vision Loss
- How people who are blind or visually impaired travel
- How people who are blind or visually impaired cross streets
- Changes in the travel environment
- Effect of signalization changes

Accessible Pedestrian Signal (APS)

What is an APS

Accessible Pedestrian Signal - a device that communicates information about pedestrian timing in nonvisual format such as audible tones, verbal messages, and/or vibrating surfaces. (MUTCD 2000, Section 4A.01)

Other terms

APS are known by different names in different countries:

- Acoustic signals
- Audio-tactile signals
- Audible pedestrian signals
- Audible pedestrian traffic signals
- Audible traffic signals
- Audible crossing indicators

Major functions of APS

APS can provide information to pedestrians about:

- Existence of and location of the pushbutton
- Beginning of the walk interval
- Direction of the crosswalk and location of the destination curb
- Clearance interval
- Intersection geometry through maps, diagrams, or speech
- Intersection street names in Braille, raised print, or speech
- Intersection signalization

Use in US

Although audible crossing indicators have been available for over 25 years, they have not been commonly installed in the United States. This is probably attributable to two factors:

- Noise pollution and consequent community opposition
- Disagreement among blind people on the need for and effectiveness of audible pedestrian signals

More recently, changes in intersection design and signalization have affected the traditional street crossing techniques used by blind pedestrians, making the pedestrian phase harder to recognize without seeing the visual pedestrian signal. In addition, it has become essential to cross during the pedestrian phase at many intersections.

The following programs and regulations have led to increased installation of APS:

- The Americans with Disabilities Act of 1990, requiring state and local governments to provide access to their programs, including use of public rights-of-way
- TEA-21, directing that audible pedestrian signals, where appropriate, be included in new transportation plans and projects
- Millennium Edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) providing specifications for accessible pedestrian signals and accessible pushbuttons.

Use in other countries

In Japan, Australia and some European countries, APS have been routinely installed at many intersections for at least 20 years.

Information about policies in these countries is included in Chapter 4, International Practice.

Blindness and vision loss

Definitions

Visual impairment: a functional limitation in seeing, including both those with:

- "non-severe limitation" ("difficulty seeing words and letters") and
- those with "severe limitation" ("unable to see words and letters").

Legal blindness: a level of visual impairment that has been defined by law to determine eligibility for benefits.

Legal blindness refers to central visual acuity of 20/200 or less in the better eye with the best possible correction, as measured on a Snellen vision chart, or a visual field of 20 degrees or less.

Vision correctable to 20/20 with at least 180-degree field is considered 'normal vision'. A person who is legally blind sees at approximately 20 feet what a person with 20/20 vision sees at 200 feet, or is able to see no more than a 20-degree field without scanning.

Types of vision loss

General types of vision loss

- Reduced acuity
- Restricted fields
- Total blindness or light perception

Reduced acuity can refer to a large range of functional vision from vision tested as 20/20 to totally blind. Lighting and contrast affect functional vision and are not reflected in the clinical measurements.

The general category of restricted fields can be further divided into central field loss and peripheral field loss.

Reduced acuity

The picture below represents a street crossing as it might be seen by a person with general reduced visual acuity. An overall loss of acuity, sensitivity to glare, and loss of contrast sensitivity is common in the elderly population.

FIG. 1-1.
A STREET CROSSING AS MIGHT BE SEEN BY A PERSON WITH GENERAL REDUCED VISUAL ACUITY.

Blindness and vision loss

Central field loss

Individuals with a central field loss usually will have difficulty seeing pedestrian signals, some signs, and details directly in front of them. Central field loss is typical of macular degeneration, the leading cause of blindness in those over 60.

FIG. 1-2.
A STREET CROSSING AS MIGHT BE SEEN BY A PERSON WITH CENTRAL FIELD LOSS.

Peripheral field loss

Individuals with peripheral field loss, sometimes referred to as tunnel vision, may see details directly in front of them clearly, but have difficulty with objects and signs off the side. In addition, depth perception is often impaired.

Glaucoma and retinitis pigmentosa are the main causes of peripheral field loss.

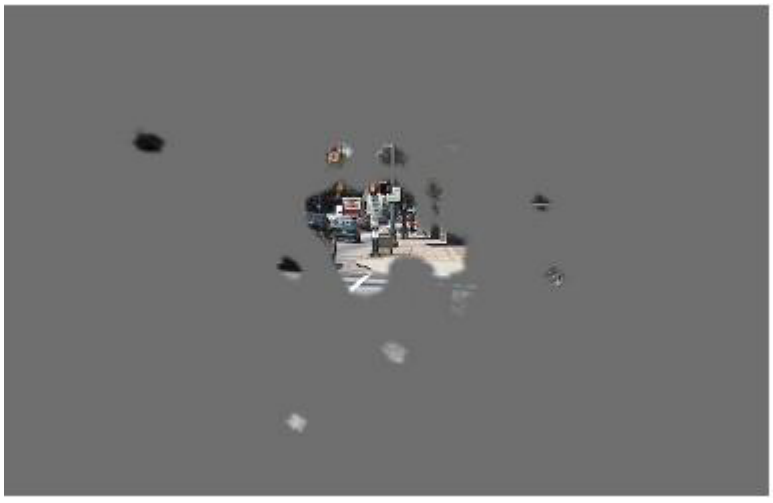


FIG. 1-3.
A STREET CROSSING AS MIGHT BE SEEN BY A PERSON WITH PERIPHERAL FIELD LOSS.

Blindness and vision loss

Decrease in attentional field

Research by Brabyn, Haegerström-Portnoy, Schneck, and Lott (2000), demonstrated that over age 60-65 the prevalence of problems detecting objects in the peripheral visual field increases dramatically. This is known as a decrease in attentional field, and it may be present with or without other types of visual impairment. By age 90, 40% of people have an attentional field of less than 10 degrees left and right. Thus, if they are looking at a pedhead, they are unlikely to be visually aware of vehicles that may be disobeying the signal, or turning across their path of travel, until it is too late to take appropriate action

Total blindness or light perception

Individuals who are considered totally blind usually cannot see any difference in light and dark. Individuals who have light perception may be able to tell if it is dark or light and the direction of a bright light source, but do not have vision that is useable for discerning objects or the travel path.

Prevalence of blindness

Some degree of vision impairment affects 8.3 million (3.1%) Americans of all ages. (Adams, Hendershot, & Marano, 1999).

Approximately 3% of individuals age 6 and older, representing 7.9 million people, have difficulty seeing words and letters in ordinary newspaper print even when wearing glasses or contact lenses. This number increases to 12% among persons age 65 and older (3.9 million) (McNeil, 2001). Approximately 1.3 million Americans are legally blind.

By 2010, projections are that there will be 20 million visually impaired persons over 45.

Area of residence

Most persons who have a vision impairment live in metropolitan areas (70%), but they are less likely to live in metropolitan areas than are persons without visual impairments (78%) (Schmeidler & Halfmann, 1998b; based on 1994 NHIS-D).

33% live in cities, 37% live in suburbs, 28% live in non-metropolitan areas (e.g., small towns) and 1% live in farm areas (Schmeidler & Halfmann, 1998b).

In comparison to the general population, persons who are visually impaired are over-represented in cities and non-metropolitan areas and somewhat under-represented in the suburbs (i.e., 48% of general population live in suburbs) (Schmeidler & Halfmann, 1998b).

This information is included here to clarify that people who are visually impaired or blind do not cluster in the same area of town or same type of area.

How people who are blind or visually impaired travel

Several choices

People who are blind or visually impaired have choices when it comes to traveling. At any given time, they can travel using a human guide, holding onto someone's arm; use a long, white cane to identify and avoid obstacles; use a dog guide, use special optical or electronic aids, or use no additional aid. The choice of tools depends on the extent and nature of visual impairment, personal preference, lighting, and familiarity with the area.

In order to travel independently, people with visual impairments use whatever vision they have, auditory and tactual clues, and other information they know about an area to keep track of their location and make travel decisions.

Sighted guide

At one time or another, most people who are blind will rely on the human guide technique in which a person with sight serves as a guide to a person who is blind.

Long white cane

Many individuals who are blind or visually impaired use a long white cane as a mobility device. In the most common technique, the cane is extended and swung back and forth across their body in rhythm with their steps to provide information about the environment in front of them.

Dog guide

Dog guides are carefully trained service animals used as travel tools by less than 10% of people who are blind. The dog responds to commands of its handler, such as right, left and forward. Dog guides move in response to directions from their handlers, who must know where they are going and make decisions about the proper time to begin a street crossing. Dog guides disobey commands only to avoid danger.

No aid

Not all persons considered blind use a long white cane or dog guide. People who are visually impaired often rely on their remaining sight and auditory and tactile cues in their surroundings for orientation and travel.

How people who are blind or visually impaired travel

Orientation and mobility training

Many pedestrians who are visually impaired or blind have received orientation and mobility training, provided by an Orientation and Mobility Specialist (O&M specialist). An Orientation and Mobility Specialist usually has an undergraduate or graduate degree in teaching travel skills to persons who have visual impairments.

Orientation is the ability to understand where one is located in space and Mobility is being able to travel thorough that space safely. The goal of most O&M training is to prepare a person who is visually impaired to travel in a variety of environments and to assess new intersections and travel new routes.

Orientation is not provided for every route that a person who is blind needs to travel.

How people who are blind or visually impaired cross streets

Traditional techniques

Techniques and cues used in crossing streets are diverse and vary by the type of location and by the individual and his or her level of vision. Individuals who are blind or visually impaired often travel to unfamiliar areas and intersections and gather information from available sources.

Detecting the street

The first information needed by pedestrians who are blind is **"Have I arrived at a street?"** People who are blind or visually impaired use a combination of cues to recognize the street edge. These may include:

- Curb or the slope of the ramp
- End of building line and open sound of the intersection
- Sound of traffic on the street beside them (the parallel street)
- Sound of traffic stopping on the street they are approaching (the perpendicular street)
- Presence of pedestrians
- Presence of an intersecting sidewalk

Identifying the street

The next information needed for decision-making at unfamiliar intersections is: **"Which street is this?"**

- This information is only occasionally provided in any accessible format.
- Pedestrians who are visually impaired develop a mental map and keep track of where they are within that map, usually by counting blocks and street crossings.
- Where necessary, and available, assistance may be sought from other pedestrians.

Analyzing intersection geometry

The next information needed is: **"What is the geometry of this intersection?"** including:

- Is my destination curb straight in front of me, or must I angle to the left or right to reach it?
- How many streets intersect here?
- How wide is this street?
- Should I expect to encounter any islands or medians as I cross this street?
- Am I standing within the crosswalk?

This information may be immediately available to pedestrians having full vision, but it may not be possible for pedestrians who are blind to determine this information by listening to traffic patterns. Incorrect or missing information for any of these questions may result in missing the destination curb or median.

How people who are blind or visually impaired cross streets

Analyzing the traffic control system

Next, pedestrians with visual impairments need to **identify the type of traffic control system** at this intersection:

- Is this a signalized intersection?
- Do I need to push a button to actuate the walk interval? If so, where is the button?
- Is the button close enough to the crosswalk that I will have time to position myself correctly at the crosswalk, facing my destination curb, before the onset of the walk interval?
- Which button controls the walk interval for the street I want to cross?
- Does it stop traffic on one street, or all traffic?
- Do cars still turn during the walk interval?
- Is there a second button on the median that I must push?
- Will there be a surge of parallel traffic telling me the walk interval has begun? Will I be able to hear it over other, concurrent traffic sounds?

Techniques for gathering this information include listening to traffic patterns through several light cycles, and searching the sidewalk area for poles with pushbuttons. This task has become difficult or impossible at many intersections. Missing information for any of these questions may result in failure to use pedestrian push buttons and crossing at times other than the pedestrian phase.

Identifying the crossing interval

After determining the geometry of the intersection, aligning to face towards the destination curb, determining that the intersection is signalized and having pushed a button, where necessary, pedestrians who are blind need to know**: "When does the walk interval begin?"**

In the most common technique utilized for crossing at signalized intersections, pedestrians who are blind begin to cross the street when there is a surge of traffic on the street parallel to their direction of travel.

Maintaining crossing alignment

Once the pedestrian who is blind has begun to cross the street, the next question is: **"Am I headed straight towards my destination curb?"**

- Traffic going straight ahead on the parallel street provides helpful auditory guidance to many persons if it is present. In addition, pedestrians who are blind may use traffic waiting on the perpendicular street as a partial alignment cue.
- Turning traffic can make it difficult to hear and align with the traffic traveling straight through the intersection.

In the absence of traffic on the parallel street, pedestrians who are blind are more likely to veer toward or away from the intersection.

Changes in the travel environment

Types of changes

In the past twenty years, significant changes in intersection geometry, signalization, driver behavior, and the technology of automobiles have affected the ability of blind travelers in the United States to use the above-mentioned techniques.

Intersection design changes

- Wider streets require more precise alignment.
- Wide radius turns make alignment more difficult and increase crosswalk length.
- Curb ramps and depressed corners make street detection and alignment difficult.
- Medians and islands complicate wayfinding and alignment.
- Slip lanes and splitter islands require crossing in gaps in traffic even at signalized intersections.
- Crosswalk alignment is not consistent.
- Curb extensions, also called bulb-outs or intersection chokers, sometimes complicate wayfinding.
- Raised crosswalks may obliterate the sidewalk/street boundary.
- Tabled intersections may also obliterate the sidewalk/street boundary.

Driver behavior and technology of autos

- Aggressive drivers are moving faster and less likely to stop for pedestrians.
- The technology of cars, including electric cars, has become quieter, making them harder for pedestrians who are visually impaired to hear.
- In many areas there is less pedestrian traffic and less awareness of pedestrians by drivers.

Signalization changes

Intersection signalization has become more complex.

The techniques which worked at pretimed lights controlled by mechanical controllers are not adequate for intersections which change minute by minute in response to vehicular and pedestrian actuation. These changes affect the ability of pedestrians who are blind or visually impaired to recognize the pedestrian phase.

Effect of signalization changes

Pedestrian actuation

Pedestrian actuation requires the blind pedestrian to locate and push a pushbutton, then cross on the next pedestrian phase, to be assured of having enough time. Blind pedestrians have two types of problems at these locations:

- They have traditionally waited through a light cycle to assess and refine their heading by listening to vehicular trajectories, before crossing at the next pedestrian phase. At a pedestrian actuated intersection, that is not possible because blind pedestrians then have to locate and push the button again (and re-establish their heading).
- At a location with little vehicular traffic, even if pedestrians who are blind know there is a pushbutton and use it, they may not be able to detect the onset of the walk interval if there is not a vehicle traveling straight ahead on the street parallel to their crossing.

Vehicular actuation

Vehicular actuation allows the cycle to skip phases, so pedestrians with visual impairments cannot accurately predict when in the cycle the pedestrian phase will begin. Right-turn-on-red makes it harder to determine the surge of traffic at the onset of vehicular green on the street parallel to the crossing direction. Blind travelers must wait to hear a car traveling straight across the intersection to determine that the light has changed, so they frequently are delayed in initiating crossings while they determine that parallel traffic flow has begun.

In addition, some locations do not include a pedestrian phase, and at times when vehicular volume is low, there may not be enough time to cross the street.

Exclusive pedestrian phase

Exclusive pedestrian phases eliminate the traffic surge concurrent with the onset of the walk interval, thus removing the most reliable cue to the onset of the walk interval; exclusive pedestrian phases where right turn on red is permitted may never sound to blind pedestrians like they have a walk interval.

Exclusive pedestrian phases eliminate traffic parallel to the pedestrian's crossing direction, thus making it more likely that serious veering will occur.

Leading pedestrian interval

Leading pedestrian intervals are undetectable to pedestrians who are visually impaired; by the time they hear concurrent parallel traffic and initiate a crossing, not only will they have minimal crossing time, but also drivers will not be expecting them to initiate a crossing.

Split phase timing

Where there is split phase timing, the surge of left turning cars may be mistaken by blind pedestrians as indicating the onset of the walk interval and blind pedestrians may cross into the paths of left turning vehicles.

Chapter 2 — Research

Summary

This chapter reviews the research literature documenting:

- Problems experienced at intersections by pedestrians who are blind, that may be ameliorated by the use of APS
- Problems blind pedestrians experience with the most common APS in use in the US today
- The effect of APS features on street crossing by blind pedestrians
- The effect of APS on general pedestrian and vehicular traffic flow

Additional chapter contents

This chapter also provides information about the following current research projects:

- Research on problems/need for APS
- Blind Pedestrians' Access to Complex Intersections
- Guidelines for Accessible Pedestrian Signals
- Comparison of two types of APS
- Interfacing Accessible Pedestrian Signals (APS) and Traffic Signal Controllers
- Accessible Pedestrian Signals – Curriculum Development
- Wayfinding Technologies for People with Visual Impairments: Research and Development of an Integrated Platform
- Comparison of APS signal technologies

Introduction to APS research

Early devices not research-based

Although APS have been widely used in Japan and Sweden since the 1960s, the early development of APS in those countries was not, as far as these authors have been able to ascertain, based on research.

Nor is there any research basis for the APS most commonly used in the U.S. today.

Key early research

The first substantial research on APS appears to have been done in 1976 by Frank Hulscher, an electrical engineer with the Department of Motor Transport, New South Wales, Australia. Hulscher's research was the basis for the well developed, fully standardized, and highly successful APS system in use in Australia today.

Substantial research on APS in the U.S. began with a project undertaken by the San Diego Association of Governments in 1988. The results of this project were the basis for a policy of implementing standard signals at those intersections in San Diego where a city access committee recommended APS, following a systematic evaluation including use of a rating scale.

Other research

Other notable research has been conducted since 1980 in the U.S. and elsewhere that helps us understand:

- Street crossing problems experienced by pedestrians who are blind, that may be ameliorated by APS
- Problems blind pedestrians experience with the most common APS in use in the U.S. today
- The effect of APS features on street crossing by blind pedestrians
- The effect of APS on general pedestrian and vehicular traffic flow

Crossing problems that may be ameliorated by APS

Key research

Survey of blind pedestrians and orientation and mobility specialists

In 1998, the American Council of the Blind (ACB) and the Association for Education and Rehabilitation of the Blind and Visually Impaired (AER) conducted surveys having similar questions to determine problems experienced by blind pedestrians during street crossings.

- ACB survey (Carroll, J. & Bentzen, B.L. 1999) – surveys administered orally, in groups, to 158 pedestrians who are visually impaired
- AER survey (Bentzen, B.L., Barlow, J.M. & Franck, L. 2000) – mailed to 1000 orientation and mobility specialists. 349 surveys returned.

Crossing with and without APS (Talking Signs®)

In research by The Smith-Kettlewell Eye Research Institute (SKERI) in 1997, (Crandall, W.F., Bentzen, B.L., & Myers, L. 1998; and Crandall, W.F., Bentzen, B.L., Myers, L. & Brabyn, J. 2001), 20 blind participants made a total of 80 crossings at 4 fixed-time signalized intersections in downtown San Francisco, both with and without Talking Signs. The data on crossings without Talking Signs indicate problems experienced in the absence of APS.

Pedestrian crashes

In the survey conducted by the American Council of the Blind (ACB), 12 of 158 respondents had been struck by a car at an intersection, and 45 had had their long canes run over.

Locating the crosswalk

On 19% of street crossings in SKERI research, participants requested assistance in locating the crosswalk. Participants were permitted to begin a crossing from any location that satisfied them, whether or not it was actually within the crosswalk lines.

It is common for pedestrians who are blind, if they do not need to locate and push a button, to cross from the position at which they have first encountered the curb line.

Crossing problems that may be ameliorated by APS

Identifying the crossing interval

In the surveys conducted by ACB and AER, many respondents indicated that they or their students sometimes had difficulty knowing when to begin crossing: ACB – 91%; AER – 98%

Reasons were:

- Surge of traffic was masked by right turning traffic;
- Traffic flow was intermittent;
- Intersection was too noisy; and
- Surge of traffic was too far away.

In the AER survey, 79% of respondents indicated that blind students sometimes had difficulty determining the onset of the walk interval at intersections having exclusive pedestrian phasing. On 24% of trials in SKERI research, where APS information was not available, blind pedestrians requested assistance in knowing when to start crossing. On 34% of trials on which they independently initiated crossings, they began crossing during the flashing or steady DON'T WALK.

Establishing correct heading

In the AER survey, 66% of O&M specialists who responded indicated that their students sometimes had difficulty establishing a heading toward the destination corner, the most important reasons being that traffic was intermittent or the intersection was offset. In the ACB survey, 79% of respondents indicated that they sometimes have difficulty figuring out where the destination corner is.

On 52% of crossings in SKERI research, where APS information was not available, blind pedestrians were not facing directly toward the opposite corner when they started their crossing; they were facing somewhat toward or away from the center of the intersection.

Understanding intersection geometry

In the ACB survey, 85% of respondents indicated that they were sometimes confused by unexpected features such as medians or islands.

On 54% of crossings in SKERI research, where APS information was not available, blind pedestrians did not know whether the intersection they had just crossed was a 4-way intersection or a "T"-shaped intersection.

Pedestrians who are blind need to understand the shapes of intersections they are crossing because intersection geometry is a good predictor of the probability of the timing, volume and direction of turning traffic.

Crossing problems that may be ameliorated by APS

Understanding intersection signalization

On 50% of trials in the SKERI research, where APS information was not available, participants were not able to obtain sufficient information from traffic sounds and other clues to identify whether an intersection was signalized or had stop signs.

Understanding the type of traffic control is necessary for pedestrians who are blind or visually impaired to make good judgments about what timing strategy they will use when crossing a street.

Problems with pushbuttons

Blind pedestrians experience a number of problems with pushbuttons.

In the ACB and AER surveys, many respondent indicated that they or their students had difficulty with pushbuttons: ACB – 90%; AER – 94%.

Reasons were:

- They couldn't tell whether they needed to push a button;
- They had difficulty locating the button;
- They couldn't tell which crosswalk was actuated by the button; and
- The pushbutton was so far from the crosswalk that they couldn't push the button and then return to the crosswalk and establish a heading before the walk interval began.

Common problems with APS in the U.S.

Key research

ACB and AER surveys noted in above section

Uslan, Peck and Waddell (1988), in research in Huntington Beach, CA, compared crossings by blind pedestrians at three intersections having "bird call" signals and one control intersection without APS.

Problems with volume

ACB and AER surveys reported the experience of pedestrians with visual impairments in using APS that had "bird call" signals, bells and buzzers. There were problems both with APS being considered too quiet and too loud.

	APS Considered to be TOO QUIET	APS Considered to be TOO LOUD
ACB Survey	71% *	45% *
AER Survey	52%	24%

* Totals do not add to 100%. Some respondents sometimes found APS to be too quiet, and at other times found them to be too loud.

Uslan et al. (1988) found that at one intersection with split phase timing, where the bird call signals for parallel crosswalks had separate timing, three of 15 blind participants initiated their crossings with the signal for the parallel crosswalk, walking into the path of left-turning vehicles. This is an example of a specific type of problem with signal volume.

Common problems with APS in the U.S.

Problems with ambiguity

ACB and AER surveys looked particularly at data from blind pedestrians and O&M specialists from California, whose experience with APS is almost exclusively with "bird call" signals that are intended to provide unambiguous information regarding which street has the walk interval. Many respondents indicated that they or their students sometimes did not know which crosswalk had the walk interval. ACB – 68%; AER – 72%

Reasons were:

- They forgot which signal was associated with which crossing direction;
- They didn't know which direction they were traveling; and
- The intersection was not aligned with primary compass directions.

Uslan et al. (1988) found that on many trials blind participants failed in their attempts to cross streets because of indecision regarding the pole or button, even though all participants were fully familiar with the "bird call" signal, they knew what to listen for at each intersection, and they could listen through as many cycles as they desired. Sometimes participants first located the incorrect button and subsequently located and pushed the correct button after waiting and listening through one or more cycles.

Confusion of tones with other sounds

AER and ACB surveys confirmed that blind pedestrians really do confuse the sounds of birds with APS sounds.

	Crossed the street with an actual bird	Didn't cross because they thought the signal was a bird
ACB Survey	71%	45%
AER Survey	11%	10%

Problems with beaconing

ACB and AER surveys indicated that pedestrians who are blind are sometimes not able to localize the sound of an APS in order to use it for guidance across the street. ACB – 6%; AER – 39%.

Problems locating pushbuttons

Uslan et al. (1988) found that the major problems 27 legally blind participants had with "bird call" type APS, were in locating the pole and the pushbutton, and determining which pushbutton was for which crosswalk. Participants traveling with dog guides experienced the most difficulty locating the pole.

As noted above, AER and ACB surveys also identified problems with locating the pushbuttons.

Common problems with APS in the U.S.

Confusion across intersections

When APS are too loud, and are at intersections that are close together, the APS for one intersection may be heard from another, leading some pedestrians to incorrectly think they have the walk interval. The surveys indicated the extent of this problem. ACB – 19%; AER 25%.

Effect of APS features on street crossings

Introduction

Research on the effect of particular APS features on the ability of pedestrians who are blind or visually impaired to make safe, efficient street crossings has been limited to a very few of the many variables that can affect crossing by blind pedestrians. Variables that have been somewhat systematically investigated are limited to:

- The WALK signal tone;
- The locator tone repetition rate;
- The structure and content of speech messages; and
- The necessary volume for locator tones.

Limited applicability of results

In most experiments, the WALK indication has sounded during the entire crossing time. Yet, in the field, the WALK indicator usually sounds only for the four to seven seconds of the walk interval.

In a typical installation, the APS sounds simultaneously from both ends of the crosswalk. The typical delay while blind pedestrians recognize the onset of the walk interval and determine that it is safe to begin crossing, even when the intersection has an APS, means that they are seldom more than half way across a crosswalk when the APS ceases to provide the WALK indication. This means that they may never hear the sound coming from the APS on the destination corner, so it cannot be used for directional guidance. Recent and on-going research is manipulating the source of the WALK signal as a means to improve beaconing.

Much of the research that has been conducted has looked at the effect of the WALK signal on the speed and accuracy with which blind pedestrians make crossings. That is, the effectiveness of the signal as a beacon. However at most intersections the APS WALK signal needs only to inform the user of the onset and end of the walk interval.

Background

In order to interpret the results of APS research, it is helpful to understand something about the hearing of blind pedestrians, the characteristics of vehicular sound, and the human ability to understand speech in noisy environments.

Hearing and blind pedestrians

A majority of persons who are severely visually impaired are age 65 or older, and typically have some amount of upper frequency hearing loss. In addition, the incidence of hearing loss in people with visual impairments is higher than for the general population because a number of causes of blindness also result in hearing loss.

Upper frequency hearing loss results in a decrease in the ability to localize sound and to understand speech, particularly in noisy environments (Wiener & Lawson, 1997).

Effect of APS features on street crossings

Characteristics of traffic sound

The sound produced by vehicular traffic is concentrated in the low frequencies, especially for vehicles that are accelerating from a stop; and the noise produced by accelerating vehicles is approximately 10 dB louder than that of vehicles traveling at a constant rate of speed.

The mean intensity of accelerating traffic, measured from the position of a pedestrian waiting to cross streets in residential and small business areas, was found by Wiener and Lawson (1997) to be 89 dB, equal to the maximum APS volume permitted by the MUTCD. The 89 dB maximum in the MUTCD is based on OSHA limits.

Understanding speech in noise

Listeners with normal hearing require that speech be 15 dB louder than background noise for intelligibility to reach 90% (Killion, 1999), yet MUTCD limits the output of APS to 5 dB above ambient sound except when special actuation requests a louder beaconing signal for a single pedestrian phase.

Early research on WALK signal characteristics

Staffeldt (1968), in research cited by Hulscher (1976), conducted extensive testing of audible beacons at intersections and found that an 880 Hz signal was most detectable in a background of traffic noise.

Hulscher (1976) found that, because of the masking of high frequency signals by predominantly low frequency traffic noise, and because a majority of blind pedestrians have some upper frequency hearing loss, the optimal fundamental frequency of the WALK tone should be between 300 Hz and 1000 Hz, and the tone should be comprised of multiple short bursts of sound to aid localization.

San Diego (1988) laboratory measurements of a "birdcall" signal from Nagoya Electric Works of Japan found that neither signal was highly directional, however the chirp was more detectable than the cuckoo. The chirp was produced by a continuous frequency variation with a fundamental frequency base of 2800 Hz and the cuckoo consisted of two frequencies with a combined frequency base of 1100 Hz (Currently available "birdcall" signals may vary from this manufacturer's standard.)

Effect of APS features on street crossings

Comprehensive research on the effect of one APS

Crandall and colleagues (Crandall et al., 1998; Crandall et al., 2001) compared the street crossing of 20 blind pedestrians at four intersections in downtown San Francisco without APS to crossings of the same intersections with the remote infrared audible sign technology, Talking Signs®. The intersections had pretimed signalization and no pushbuttons.

The following measures were made.

- Safety
  - Began crossing during the walk interval
- Precision
  - Began crossing within the crosswalk
  - Were facing the destination corner when they began crossing
  - Ended the crossing within the crosswalk
- Independence
  - Finding the crosswalk
  - Deciding when to cross
  - Completing the crossing
- Knowledge
  - Knew intersection shape (4-way or "T")
  - Knew type of traffic control (signal or stop sign)

Participants were significantly more successful on eight of the nine measures when using APS than when not using APS. Nineteen of 20 participants were more successful when using APS than when not using APS. The only measure on which there was no significant difference was independence in completing the crossing. Nineteen of 20 participants were more successful when using APS than when not using APS; one participant was equally successful under both conditions

Recent research on WALK signal characteristics

Laroche, Giguère and Poirier (1999) compared localization of cuckoo and chirp signals to localization of four four-note melodies varying in fundamental frequencies, harmonics, note duration, and temporal separation between notes. In combined objective and subjective testing, the chirp and a melody with minimal harmonics were found to be less localizable than the cuckoo and the other three melodies.

Laroche, Giguère and Leroux (2000) compared the typical birdcall sounds used in Canada with a cuckoo having a lower fundamental frequency, and the melody that was recommended as a result of their 1999 research. The chirp was found to result in significantly greater veering and longer crossing time than any of the other signals, which did not differ from each other.

Effect of APS features on street crossings

Research on source of WALK signal

Stevens (1993) and Tauchi, Sawai, Takato, Yoshiura and Takeuchi (1998) tackled the problem of improving localization of WALK signals (beacons) by varying the source of the sound. They found that blind pedestrians could cross more quickly and with less veering when the WALK signal alternated back and forth from one end of the crosswalk to the other.

Laroche et al. (2000) confirmed the superiority and subjective preference for an alternating signal for beaconing at a simulated quiet intersection but found no advantage of the alternating signal when data were collected at an intersection with steady traffic on both streets. This was true for all tones tested (chirp, cuckoo, low cuckoo, and melody). It may have been that blind participants had such good directional information from vehicular sound that the APS were essentially irrelevant to their crossing.

Research on locator tones

Bentzen, Barlow, & Gubbé (2000), compared the speed of blind pedestrians on locating and walking to an APS with a locator tone (880 Hz square wave, with multiple harmonics, 3 ms attack time, 15 ms sustained tone) at three repetition rates and three loudness levels relative to traffic sound along an eight lane artery in Los Angeles. Best performance was with a repetition rate of 1/sec and loudness of 2-5 dBA above ambient sound measured at 1 m from the locator tone speaker.

Effect of APS features on street crossings

Research on speech message structure and wording

Several APS systems in the U.S. are capable of producing directly audible speech messages, either from a speaker that is integrated into the pushbutton housing, or from a speaker at the pedhead.

- Current standards for speech message wording are minimal (MUTCD 4E.06), and many APS are being installed with speech messages that include much more information than is addressed in MUTCD
- Some messages are confusing or ambiguous.

Bentzen, Barlow and Franck (2002) conducted research to obtain information from stakeholders regarding the structure and content of speech messages for APS WALK messages and for "pushbutton messages" that are available during the flashing and steady DON'T WALK intervals only. WALK messages convey that the WALK signal is on, and provide the name of the street being crossed. Pushbutton messages provide intersection and crosswalk identification information, and may also provide information about unusual intersection signalization and geometry.

The research utilized an expert panel of stakeholders, who prepared a survey comprised of sample messages to rate, and items to determine respondent understanding of messages. The survey was administered to people who are visually impaired, O&M specialists, transportation engineers, and APS manufacturers.

Recommended model messages are contained in Chapter 6 – APS WALK Indications and Chapter 7 – Other APS features.

Effect of Speech Messages

Van Houten, Malenfant, Van Houten and Retting (1997) found that redundant information conveyed by audible pedestrian signals increases the attention of all pedestrians to turning traffic and may contribute to a reduction in pedestrian-vehicular conflicts and crashes at signalized intersections. Research in Clearwater, Florida, with prototype speech message technology in which speech messages were broadcast from the pedhead, indicated that voice messages can be used to increase the attention of all pedestrians to turning vehicles and to decrease pedestrian/motor vehicle conflicts at signalized intersections.

When the pedestrian push button was pressed, the message was "Please wait for WALK signal."

The message "Look for turning vehicles while crossing [street name]" began 200 msec before WALK signals were illuminated.

The signal also gave participants who were blind precise information about the onset of the walk interval and which street had the walk interval.

Effect of APS features on street crossings

Research in the U.K.

Wilson (1980) conducted a pre- and post- APS installation study of adult non-disabled pedestrian behavior at one intersection. Key results were as follows.

- For pedestrians using the pushbutton, delay in beginning crossings was reduced by 20%, from 2.7 sec to 2.1 sec.
- For pedestrians who arrived at the crossing during the flashing or steady DON'T WALK and who waited to cross until the onset of the walk interval, the proportion who failed to complete their crossings before the onset of opposing traffic was reduced by one-half, from 22% to 11%.

The time taken to cross by persons who started during the walk interval decreased by about 5%; crossing time for other pedestrians was unchanged.

Experience of a New Zealand engineer

Hulscher (1976) cites a personal communication from Leith (1975) in which Leith estimated that delay in beginning crossings for all pedestrians was reduced an average of 2-3 seconds, for all pedestrians, by the use of APS.

Other issues

There are a number of other variables that can affect the ability of APS users to hear, recognize, and localize WALK and locator tones, to effectively use pushbuttons, to determine which crosswalk has the walk interval, and to complete crossings to a destination corner quickly and without undue veering.

Other variables that have had little or no research include:

- Effect of variations in WALK signal and source of sound on ability to determine which crosswalk has the walk interval;
- Effect of type of speaker on intelligibility of speech APS messages;
- Effect of speaker housing on localizability of tone;
- Effect of height of speaker on speed and accuracy of crossing,
- Effect of different locations of two speakers on one corner on ability to determine which crosswalk has the walk interval;
- Effect of APS characteristics on crossing by pedestrians who are deaf-blind; and
- Advantages and disadvantages of different devices from the perspective of pedestrians with disabilities, other pedestrians, APS neighbors, and transportation engineers and installers.

Other effects of APS

Issues for research

Some research has addressed effects of APS on the general pedestrian cohort, on drivers, and on APS neighbors. Issues that need to be researched include the following.

- General pedestrian cohort
  - Initiation of crossing during walk interval
  - Completion within pedestrian phase
  - Pedestrian crashes
  - Variation in effects attributable to age
  - Variation in effects attributable to other disabilities
- Drivers
  - Driver behavior
  - Vehicular flow
- APS neighbors
  - Acceptance
  - Vandalism

Current Research:
Blind Pedestrians' Access to Complex Intersections

Funding

National Eye Institute of the National Institutes of Health - Bioengineering Research Partnership

Time frame

June 2000- May 2005

Summary

The research study titled *Blind Pedestrians' Access to Complex Intersections*, a 5-year study that began in June 2000, includes a major task to examine a number of issues related to APS.

Objectives of APS task:

- Determine the optimal characteristics of push-button locator and WALK signal tones,
- compare different APS technologies,
- and to carry out a demonstration project using an optimal APS technology.
- During the first two years of this project, which have just ended, the focus of the research has been on determining optimal characteristics for the visually impaired traveler with respect to optimal characteristics of tone signals for detection and beaconing in the presence of vehicular noise
- Signal strategies to enable correct determination of which crosswalk has the WALK signal and the most positive impact on alignment and veering.
- Height of the audible signal, and
- Effect of locator tone on crossing accuracy

Prototype APS technology manufactured by Novax, having the optimal characteristics as determined by testing in years 1 and 2 and part of year 3, will be tested at two intersections in each of four cities several times over a period of the subsequent three years.

Research organizations

Western Michigan University, Vanderbilt University, Boston College, Johns Hopkins, University of North Carolina Highway Safety Research Center

Contact

Billie Louise (Beezy) Bentzen
Boston College, Dept. of Psychology
140 Commonwealth Avenue, Chestnut Hill, MA 02467-3807
978-838-2307 - bbentzen@accessforblind.org

Current Research:
Project 3-62 Guidelines for Accessible Pedestrian Signals

Funding

National Cooperative Highway Research Program (NCHRP)

Time frame

October 2001 – September 2004

Summary

Objectives:

- Develop guidelines on the functional requirements and the installation of APS devices, and
- Produce training materials that will facilitate the application of the guidelines.

The guidelines will explain the:

- Functional intent of APS devices, various means of meeting this intent through tones,
- Verbal messages, transmitted messages and/or tactile indicators,
- Circumstances under which APS devices should be installed, and
- Installation, positioning and orientation of APS devices for optimal use by pedestrians who have visual or visual and hearing impairment, as well as pedestrians who use wheelchairs.

Research organizations

University of North Carolina Highway Safety Research Center,
Accessible Design for the Blind

Contact

David Harkey
University of North Carolina Highway Safety Research Center
730 Airport Road, CB#3430, Chapel Hill, NC 27599
919-962-8705 - david_harkey@unc.edu

Current Research: Comparison of two types of APS

Funding	Veterans Administration
Time frame	April 2001 – April 2003
Summary	This project in Atlanta will evaluate two types of APS, comparing crossings with each of two types of accessible pedestrian signals (receiver-based and pushbutton integrated) and a crossing without accessible signals. Measures will include the speed and accuracy of crossing, as well as self-reported levels of confidence and comfort in using each device. Data will be collected at two intersections of four-lane roadways on fifty participants who are totally blind or have no useable vision.
Research organizations	Veterans Administration Research and Development Center, Center for the Visually Impaired
Contact	Mike Williams Department of Veterans Affairs, Medical Center Research and Development Center 1670 Clairmont Road, Decatur GA 30033 404-321-6111 x 7981 - williams.michael@atlanta.va.gov

Current Research: Interfacing Accessible Pedestrian Signals (APS) and Traffic Signal Controllers

Funding	US Access Board
Time frame	Feb 2002 – January 2003
Summary	Objective: To create a highly readable technical report that provides detailed APS product information specifically focused on the interfacing of APS devices and traffic signal controllers. The research activities will: ▪ Provide a detailed description of available APS technologies which provide tone, speech, vibrotactile, directional and/or mapping features for blind pedestrians; ▪ Provide a detailed description of traffic signal controllers (and manufacturers) currently used in the U.S. and those that may be expected in the near future; and ▪ Provide detailed information on how the APS devices interface with each traffic signal controller including wiring requirements, power requirements, interaction with conflict monitoring technology, special product installations, pedestrian signal head requirements, and lessons learned from existing installations.
Research organization	University of Massachusetts, Amherst
Contact	David Noyce University of Wisconsin-Madison 1210 Engineering Hall, 1415 Engineering Drive Madison, WI 53706 608-265-1882 - noyce@engr.wisc.edu

Current Research:
Accessible Pedestrian Signals – Curriculum Development

Funding	Easter Seals Project ACTION
Time frame	February 2002 – February 2004
Summary	Objectives: To provide information about Accessible Pedestrian Signals to O&M specialists, dog guide instructors, travel instructors, traffic engineers and planners, as well as people with disabilities through the development of training modules on APS. This project will ▪ Develop a series of curriculum modules on Accessible Pedestrian Signals (APS) ▪ Conduct two national conferences on the topic. The curriculum will be piloted at two conferences in 2003, one on the west coast, and one on the east coast of the U.S. The conferences will include hands-on experience with APS, simulation activities during street crossings, videos of APS crossings, case studies, small group problem-solving sessions, and use of a participant workbook. It is planned that each conference will have equal numbers of mobility practitioners and traffic engineers as well as participation from people with disabilities.
Research organizations	Western Michigan University, Accessible Design for the Blind, University of Massachusetts, Amherst
Contact	William Wiener Senior Associate Dean, The Graduate College 263-W Walwood Hall, Western Michigan University Kalamazoo, MI 49008-5242 616 387-8212 - william.wiener@wmich.edu

Current Research:
Wayfinding Technologies for People with Visual Impairments: Research and Development of an Integrated Platform

Funding

National Institute on Disability and Rehabilitation Research (NIDRR)

Time frame

December 2001 – November 2006

Summary

This project will focus on wayfinding research and development with a national team led by Sendero Group.

Objective--to create a GPS core platform that is accessible to individuals who are blind or visually impaired, around which other wayfinding technologies will be tested and incorporated including

- GPS cell phones,
- Indoor and outdoor navigation,
- Location specific signs,
- Complex intersection geometry information, and
- Signal information.

The research component of the proposal will inform and evaluate ongoing development activities. The proposed research, all involving human subjects, addresses:

- Assessment of user needs in connection with large-scale and small-scale orientation,
- Indoor wayfinding,
- Wayfinding outdoors and in the transition between indoors and outdoors, with an emphasis on the user interface,
- Analysis of the information needed for efficient travel through traffic intersections and roundabouts and evaluation of different ways of displaying that information, and
- Assessment of veering performance, one key aspect of small-scale orientation.

Research organizations

Sendero Group, Univ. of California, Santa Barbara, Western Michigan University, University of Minnesota, Carnegie-Mellon University

Contact

Michael May, President and CEO, Sendero Group, LLC
1118 Maple Lane, Davis, CA 95616-1723
530-757-6800 - MikeMay@SenderoGroup.com

Current Research: Comparison of APS signal technologies

Funding

New Jersey Office of Highway Traffic Safety, New Jersey Department of Transportation (NJDOT), The Seeing Eye, Edwards and Kelcey

Time Frame

Winter 2001 – Spring 2003

Goal is to continue as ongoing demonstration project with funding from other sources

Summary

A project is underway to evaluate APS devices with six different types of WALK indications at five intersections in Morristown, NJ. With one exception, purchased by NJDOT, the devices have been supplied by the manufacturers. All devices were installed by NJDOT maintenance personnel in Spring 2002.

Volunteers from among the 265 blind students who train each year at The Seeing Eye are visiting the installations and completing a survey after examining each APS. Devices and type of WALK indication are being rated from favorite to least favorite. The evaluation and report on which devices are preferred by travelers who are blind (mostly dog guide users), is expected to be completed in Fall 2003.

In addition, traffic engineers, DOT personnel, orientation and mobility specialists, and individuals who are blind are invited to visit to see the variety of technology now available.

Research Organizations

Edwards and Kelcey, The Seeing Eye

Contact

Lukas Franck
Director of Community Instruction, The Seeing Eye
PO Box 375, Morristown, NJ 07963-0375
973-539-4425 - lfranck@seeingeye.org

Chapter 3 — US Rules and Regulations Related to APS

Summary

This chapter includes an overview of standards development in the US and a summary of current standards and requirements in the *Manual on Uniform Traffic Control Devices* (MUTCD) and the Americans with Disabilities Act (ADA) as of the date of publication.

The *Draft Public Rights-of-Way Accessibility Guidelines* were made available by the Access Board for public comment on June 17, 2002. Some changes can be expected as a result of the rule-making process.

Additional references

The Appendix includes the portions of the following references pertaining to APS.

- *Manual on Uniform Traffic Control Devices 2000*
- *Draft Public Rights-of-Way Accessibility Guidelines* (June 17, 2002)
- *Building a True Community: Final Report--Public Rights-of-Way Access Advisory Committee* (PROWAAC Report)

APS in the US

APS but no regulations

Although there are reports of audible pedestrian signals in the US as early as 1920, they were not included in US standards and regulations until MUTCD 2000.

- Common devices were bells or buzzers designed by engineers in response to a request from individuals who were blind.
- Earliest reported installations were near schools for the blind.

APS first mass marketed

Mid 1970's

- Cuckoo/chirp pedhead mounted signals, based on a Japanese system, were marketed in the US
- Other types of devices developed in Europe and Australia (see Chapter 4 International Practice, Sweden and Australia) were unknown in the US.

Controversy over their use

Complaints about noise of the signals from residents living near installations

Disagreements among two main consumer groups of blind people over the need for APS

- American Council of the Blind (ACB) supported use of APS to provide additional information
- National Federation of the Blind (NFB) opposed all use of APS

Changes in traffic and signalization

As discussed in Chapter 1, changes in traffic and signalization affected the ability of pedestrians who are blind to cross streets using traffic sounds.

More requests for APS

With the changes in signalization, and their effect on travel by pedestrians who are blind or visually impaired, advocacy in favor of APS increased.

- Position of NFB, which had opposed all APS, changed to state that there are some locations were APS are needed.
- The professional organization of orientation and mobility specialists, Division 9 (O&M) of the Association for Education and Rehabilitation of the Blind and Visually Impaired advocated for APS
- New types of devices became available which addressed some of the noise concerns
- A number of cities established a formal process for acting on requests for APS

Federal policy developments

Section 504 of the Rehabilitation Act of 1973 required non-discrimination in federally funded programs.

Americans with Disabilities Act of 1990 (ADA) - civil rights legislation requiring programs and facilities to be accessible to persons with disabilities

Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and **Transportation Equity Act for the 21st Century (TEA-21)** of 1998 call for mainstreaming pedestrian projects into the planning, design and operation of the nation's transportation system.

Summary of legislation

Section 504 of the Rehabilitation Act of 1973

Requires nondiscrimination on the basis of disability in programs and activities receiving or benefiting from federal financial assistance

"No qualified handicapped person shall…be denied the benefits of…any program or activity that receives or benefits from Federal financial assistance administered by the DOT."

Transportation Equity Act for the 21st Century

The Transportation Equity Act for the 21st Century (TEA-21) states that pedestrian safety considerations should be included in new transportation plans and projects. Section 1202 (g)(2) directs that they "…shall include the installation, where appropriate, and maintenance of audible traffic signals and audible signs at street crossings."

- Required that FHWA develop guidance on pedestrian and bicycle facility design.

Americans with Disabilities Act of 1990

ADA is a civil rights law with five parts

- Title I – Employment
- Title II – Public services - State and local government programs
- Title III - Public accommodations – public and commercial facilities
- Title IV – Telecommunications – telephone services
- Title V – Miscellaneous
- Guidelines for implementation of each part were developed by agencies charged with that responsibility.
- Under titles II and III of the ADA, the US Access Board develops and maintains accessibility guidelines for buildings, facilities, and transit vehicles.
- The ADA Accessibility Guidelines (ADAAG) serve as the basis of standards issued by the departments of Justice (DOJ) and Transportation (DOT) to implement the ADA.

ADA and Public Rights-of-Way

Title II requires state and local government programs and properties to be accessible to persons with disabilities.

- Guidelines implementing the Americans with Disabilities Act were published in 1991, however a section on Public Rights-of-Way has still not been issued as a Final Rule.
- Access to pedestrian travel on public rights-of-way is considered to be a program provided by state and local governments, and therefore must be accessible under Part II of the ADA.
- The fact that there are not specific guidelines does not absolve municipalities and states from the responsibility to provide street crossings that are accessible to persons with disabilities, including visual impairments.

Developing standards and guidelines

Current

Standards and guidelines on APS in the US are rapidly developing in response to research demonstrating that access to public rights-of-way is severely limited by lack of accessible pedestrian signal information at some intersections and that this lack of information can lead to unsafe crossings by pedestrians who are blind. It is also changing in response to recent and on-going research projects that may provide more definitive information on which to base technical specifications for APS equipment and its installation.

Existing standards, recommendations and draft guidelines include differences in language, recommendations, and requirements that reflect the changing state-of-the-art.

Current standards, guidance and recommendations are included in:

- MUTCD
- (ADA) *Draft Public Rights-of-Way Accessibility Guidelines*

MUTCD

The MUTCD 2000, Revision 1, 23 CFR 655 Subpart F, contains two sections on Accessible Pedestrian Signals, Part 4E.06, Accessible Pedestrian Signals, and Part 4E.08, Accessible Pedestrian Signal Detectors. (Available at www.fhwa.mutcd.gov; entire sections are included in the Appendix.) .

The Federal Highway Administration publishes the MUTCD, with revisions made on a continuous basis. Changes to the MUTCD are published in the *Federal Register* as a Notice of Proposed Rulemaking; they then follow Federal rulemaking procedures. FHWA has major input from the independent National Committee on Uniform Traffic Control Devices.

Developing standards and guidelines

ADA draft guidelines

Minimum guidelines and requirements for implementing the ADA in public rights-of-way are expected to be issued as a Notice of Proposed Rule-Making by the US Access Board in 2003.

Draft Public Rights-of-Way Accessibility Guidelines based on the report of the Public Rights-of-Way Access Advisory Committee (PROWAAC) were published on June 17, 2002 for comment. (The *Draft Public Rights-of-Way Accessibility Guidelines* are included in the Appendix.)

- PROWAAC was chartered by the Access Board in 1999 to develop recommendations to the Access Board for minimum guidelines and requirements for accessible public rights-of-way.
- Had 37 members representing disability organizations, public works departments, transportation and traffic engineering groups, design professionals and civil engineers, government agencies, and standards-setting bodies.
- PROWAAC recommendations were published in January 2001 as *Building a True Community: Final Report—Public Rights-of Way Access Advisory Committee.* (Available at www.access-board.gov; a copy of the APS sections is included in the Appendix.)

Manual on Uniform Traffic Control Devices - MUTCD

Where required

MUTCD offers guidance regarding factors to consider in an engineering study in deciding whether an APS is needed. Factors include:

- "Potential demand for APS
- A request for APS
- Traffic volumes during times when pedestrians might be present; including periods of low traffic volumes or high turn-on-red volumes
- Complexity of traffic signal phasing.
- Complexity of intersection geometry".

Avoidance of ambiguity

Several statements address ambiguity

- "Information provided by an APS shall clearly indicate which pedestrian crossing is served by each device."
- "When used, verbal message shall provide a clear message of the walk interval and to which crossing it applies."
- "Provision of different sounds for crosswalks in different directions has been found to give ambiguous information to blind pedestrians."
- "Pushbuttons should clearly indicate which crosswalk signal is actuated by each pushbutton."
- "In choosing audible tones, possible extraneous sources of sound should be considered."

WALK indication

Standards:

- If APS have tones, they shall have a tone for the walk interval
- WALK tones shall have a faster repetition rate than an associated pushbutton locator tone.
- Shall operate day and night.
- If used, the speech message for a WALK signal shall be the term "WALK sign."… which may be followed by the name of the street to be crossed. "Vibrotactile devices, where used, shall indicate that the walk interval is in effect, and for which direction it applies, through the use of a vibrating directional arrow or some other means." Vibrotactile pedestrian devices "should be located next to, and on the same pole as, the pedestrian pushbutton, if any, and adjacent to the intended crosswalk."

Volume

Volume: Audible tones "shall be audible from the beginning of the associated crosswalk."

- WALK tones should be no louder than the locator tone except when there is optional activation to provide a louder signal tone for a single pedestrian phase.
- WALK signals and locator tones should respond to ambient sound, be no more than 5dB louder than ambient sound, and be 89 dB max
- Locator tones should be audible 6 to 12 feet from the pushbutton or to the building line, whichever is less.

Pedestrian pushbuttons

Pushbuttons

- Shall activate both the walk interval and the accessible pedestrian signals
- Should contrast with the housing
- May have locator tones
- Locator tones shall be easily locatable
- Locator tones shall repeat at one-second intervals and shall have a duration of 0.15 sec max

At locations with pretimed or nonactuated signals, pushbuttons may be used to activate the APS.

Location of pushbuttons

Pushbuttons should be located

- adjacent to a level all-weather surface,
- on an accessible route to the curb ramp
- within 1.5 m (5 ft) of the crosswalk extended,
- within 3 m (10 ft) of the edge of the curb, shoulder, or pavement

Where two APS pushbuttons are located on the same corner, the pushbuttons should be separated by a distance of at least 3m (10 ft).

Pushbutton signage

Tactile arrows

- should be oriented parallel to the associated crosswalk
- should have high visual contrast

Name of the street in Braille may be provided.

Audible beaconing

The audible tones may be made louder for the subsequent pedestrian phase, up to a max of 89dB, by holding down the pushbutton for a minimum of 3 seconds.

- may also alternate back and forth across the crosswalk to provide optimal beaconing.

Other

APS "…shall not be limited in operation by the time of day or day of week."

When used, APS shall be used in combination with pedestrian signal timing.

A speech message when the WALK signal is not on shall be the term "Wait."

If the pedestrian clearance time is sufficient only to cross from the curb to a median (of sufficient width for pedestrians to wait) and accessible pedestrian detectors are used, an additional accessible pedestrian detector should be provided in the median.

Revisions

The MUTCD is revised on a continuous basis, following Federal regulatory procedures. Users should check current provisions on the MUTCD website at www.fhwa.mutcd.gov.

ADA Draft Public Rights-of-Way Accessibility Guidelines

Where required

Guidelines will apply to new construction and alterations

"Each crosswalk with pedestrian signal indications shall have a signal device which includes audible and vibrotactile indications of the walk interval."

Walk indication

Specifications of the WALK indication:

- Shall be both audible and vibrotactile
- Audible indication shall be by voice or by tone
- Tones shall consist of multiple frequencies with dominant component at 880 Hz; duration of 0.15 seconds, repeated at intervals of 0.15 seconds

Volume

Measurement of the volume for walk indication and locator tone

- Tone or voice volume measured at 36 inches from the APS, shall be 2dB minimum and 5dB maximum above ambient noise level
- APS shall be responsive to ambient noise level changes

Pedestrian pushbuttons

Pushbuttons shall

- Be integral with the APS device
- Have locator tones that operate during the flashing and steady Don't Walk intervals.
- Have locator tones that repeat at one-second intervals for a duration of 0.15 sec max
- Shall require 5 lbf maximum force
- Shall be operable with one hand, and not require grasping, twisting or pinching
- Shall be installed with the control face facing the intersection and parallel to the direction of the crosswalk it serves
- Shall be 2 inches minimum across, and contrast visually with housing

Location of pushbuttons

Pushbuttons shall be

- Located at a level landing connected to the pedestrian access route
- 60 inches maximum from the crosswalk line extended
- 120 inches maximum and 30 inches minimum from the curb line
- 120 inches minimum from other pedestrian signal devices at the crossing

ADA Draft Public Rights-of-Way Accessibility Guidelines

Pushbutton signage

Tactile and visual signs on the face of the device or its housing or mounting shall indicate crosswalk direction and the name of the street containing the crosswalk served by the pedestrian signal.

Signage shall

- Comply with ADA Accessibility Guidelines (ADAAG) 703.2 specifications for Braille and raised print
- Include a tactile arrow aligned parallel to the crosswalk direction and specifications for arrow size; arrow shall contrast with the background
- Where provided, graphic indication of the crosswalk shall be tactile and characters shall contrast with background

Audible beaconing

Not specifically mentioned although 'additional features' are permitted

Other

Extended button press permitted to activate additional features; buttons of devices with additional features shall be marked with symbol comprised of three Braille dots forming an equilateral triangle.

Revisions

- Public comment period ended October 28, 2002
- Notice of Proposed Rule-making anticipated spring 2003, followed by a public comment period
- Review by Office of Management and Budget
- Notice of Final Rule
- Adoption as regulation by Department of Transportation, Federal Highway Administration

The development of rights-of-way guidelines can be monitored on the U.S. Access Board's website at www.access-board.gov. The Board also maintains a toll-free technical assistance line at 800/872-2253 (V); 800/993-2822 (TTY).

Chapter 4 — International Practice

Summary

The information in this chapter is based on visits made during the past two years by the authors of this report to four countries whose use of APS has been long term, extensive, systematic, and positively accepted by blind pedestrians and traffic engineers.

Many other countries have a long history of using Accessible Pedestrian Signals. This chapter is not an attempt to review all international experience.

Information gathered

During trips to Japan, Sweden, Australia, and Denmark, the authors met with traffic engineers, orientation and mobility specialists, APS manufacturers and representatives of consumer groups to discuss accessible pedestrian signals. Installations were observed and photographed. At times the authors, both of whom have unimpaired vision, traveled under blindfold and crossed unfamiliar intersections using typical orientation and mobility techniques and the accessible signals.

Chapter contents

This chapter summarizes information gathered during visits to the following countries:

- Japan
- Australia
- Sweden
- Denmark

Japan

Functioning of pedestrian signals

FIG. 4-1. "RED MAN, GREEN MAN" TYPE SIGNAL IS USED IN JAPAN.

Pedestrian Signal

- A 'red man, green man' signal is used
- Pedestrian Signal timing
- WALK or 'green man' timing is figured based on walking time of 1 meter per second and is calculated to the center line of the intersection.
- Flashing DON'T WALK timing was reported to be based on a walking speed of 1 meter per second, however this timing seemed to average about 3 seconds regardless of the width of streets.

- Mr. Sugimoto at the Japanese National Police Agency (JPNA), which manages all intersections, stated that intersection timing always includes a pedestrian phase, and at locations with vehicular actuation, pedestrian buttons are provided to lengthen the phase and/or actuate an audible signal.
- Many intersections have pretimed signalization.

Intersection geometry

Streets are generally wide. Driving is on the left.

Even where there is a very wide median it is not considered or used as pedestrian refuge.

Most intersections have pedestrian crosswalks; a fence is typically used where crossing is prohibited.

At areas with high levels of pedestrian traffic, there may be exclusive pedestrian phasing. Most intersections with exclusive pedestrian phasing have audible signals.

Japan has very few non-signalized turn lanes or pork chop type islands.

Tactile Ground Surface Indicators, such as bar tiles and 'dot tiles' (called detectable warning in the US) are ubiquitous in urban areas and have been in use since the 1960s. There was often a bar tile leading toward the crosswalk, with dot tiles at the edge of the street. However, the tiles, locations, and installation varied greatly.

Japan

Installation example

FIG. 4-2.
AT THIS INTERSECTION A CHAIN FENCE IS USED WHERE CROSSING IS PROHIBITED

Number of APS

Japan has 170,000 signalized intersections. Of those, 10,570 intersections have audible pedestrian signals.

There are a variety of APS systems, most with sound broadcast from the pedestrian signal head. A number of melodies and tones are used to indicate the WALK interval. The tone or melody varies from municipality to municipality; each is allowed to choose its own. JPNA has developed a receiver-based system called PICS.

- 7978 intersections have bird chirps from the pedhead during the Walk interval
- 2592 intersections have melodies from the pedhead during the Walk interval
- 300 intersections in 20 cities have an infrared APS system (PICS-A) compatible with The Smith-Kettlewell/Talking Signs® standard as developed and evaluated under the direction of JPNA

FIG. 4-3.
PEDHEAD WITH APS SPEAKER IS MOUNTED ON A MAST ARM OVERHANGING THE CROSSWALK BELOW.

Japan

Functioning of broadcast APS

Cuckoo/chirp

- Most common sounds for a walk interval.
- Alternating signal now the recommended signal and costs a 'trivial amount' more than non-alternating. Usually use birdcalls; and are beginning to install alternating signals with different sounds, (chirp and chirp-chirp) on different sides of the street.

Melody

- Variety of melodies broadcast into the intersection, with a change in melody during the clearance interval.
- Often quite loud; sometimes possible to hear the melody of a crossing of an intersection from a block away

Speech message

- Message was "Walk" and the street name in Japanese
- Speaker in the pedestrian signal head may be pointed straight down toward the pedestrian below.

Other characteristics

- Very few APS had locator tones at the pushbutton.
- APS may have a sound for the pedestrian clearance interval
- Yokohama used sound like that of an emergency vehicle
- Some APS in Tokyo used increased repetition rate of cuckoo or chirp during the clearance interval

FIG. 4-4. JAPANESE PEDHEAD WITH APS SPEAKER POINTING STRAIGHT DOWN TOWARD THE PEDESTRIAN BELOW.

- Fairly common in Tokyo to center the APS speaker over the crosswalk on mast arm extending from the pole
- APS sound is usually turned off at 8:00 pm because residents nearby are bothered by noise.

Functioning of PICS System

PICS system is being developed, evaluated and installed under the direction of JPNA.

- Communicates from an infrared transmitter called an "IR station," and short range radio transmitter installed at the intersection, to a receiver carried by pedestrians.
- There are two types of PICS systems.

Japan

PICS-A speech system

PICS-A speech system provides pedestrian traffic signal information and location information for bus stops and public facilities through a speech message to visually impaired pedestrians. As the traveler approaches within 10 meters of the intersection where the PICS-A system is installed, an FM radio message is received by the hybrid radio/IR receiver in either a speech or vibration mode. The vibration alerts users to the presence of the transmitted signal. The speech message identifies the intersection. When pedestrians arrive at a corner and are within the crosswalk with the receiver aimed toward the infrared transmitter on the opposite corner, they receive IR speech information about the status of the pedestrian signal. A third function extends the pedestrian phase when a button on the receiver is pushed.

FIG. 4-5.
THE PICS-A SYSTEM IS SHOWN WITH FOUR INFRARED TRANSMITTERS MOUNTED ON A HORIZONTAL MAST ARM

PICS-B image system

The PICS-B image system extends green lights and provides route guidance and information about the surrounding area on a visual display to people with mobility or hearing impairments. Portable receivers (transceivers) are pointed at "IR stations" located near pedestrian traffic signals to extend the pedestrian signal timing, make emergency contacts, and obtain route guidance and information of surrounding area. A visual display provides information to the pedestrians.

Comments

The authors found the variety of overhead speakers loudly broadcasting musical sounds or birdcalls to be confusing and distracting. Although these systems have been in use in Japan for about 40 years, there is growing concern about the noise pollution they cause.

The PICS-A system provided signal and directional guidance quite efficiently. Radio transmitted information was useful for general intersection information on approach. A large array of transmitters is required for this system, as shown in Figure 4-5.

- The standard receiver is hand-held and can hang on a neck cord or be put in a pocket when not in use.
- A head-mounted receiver is under development by Mitsubishi Precision Corp. The authors used this receiver at one intersection and found it effective.

Japan

Sources of information

Kunio Kurachi, Mitsubishi Precision Co., Ltd, Tokyo

Takabun Nakamura, Okayama Prefectural University, Okayama

Hirohiko Ohkubo, Mitsubishi Precision Co., Ltd., Tokyo

Michiko Shimizu, Orientation and mobility specialist, Tokyo

Osamu Sueda, Rehabilitation Engineering Society of Japan and University of Tokushima Mikio Sugimoto, National Police Agency, Government of Japan, Tokyo

Masaki Tauchi, Okayama Prefectural University, Okayama

Australia

Functioning of pedestrian signals

Pedestrian signals

- Red and green man signals with the red man flashing during flashing Don't Walk interval
- All Pedestrian pushbuttons were located in a very standardized location, on side of crosswalk away from the parallel street, aligned with the crosswalk line, about 0.5 to 1.0 m from the curb line. Most fixed timed intersections in downtown Sydney had pushbuttons with audible and vibrotactile features.

Pedestrian signal timing

- Walk and flashing Don't Walk were similar to US system, with clearance interval timed at 1meter per second.

Intersection Geometry

FIG. 4-6. SIGNALIZED LEFT TURN LANE WITH APS MOUNTED CLOSE TO THE CROSSWALK LOCATIONS. THREE APS ARE ON THE SPLITTER ISLAND, ONE FOR EACH CROSSING.

Streets can be wide and complex, sometimes with narrow medians and left turn slip lanes. (Driving is on the left.) Slip lanes were sometimes signalized.

Roundabouts are used extensively and orientation and mobility specialists and blind travelers state that roundabouts are a barrier to travel.

Detectable warnings or "TGSI's" (tactile ground surface indicators) are used to define the edge of the street on the curb ramp, but not consistently installed from state to state. Edge of TGSI is aligned perpendicularly to the crosswalk direction, which is intended to provide additional directional information to blind pedestrians.

Number of APS

Each state is responsible for its own area.

Overall number was not available

APS have been fairly extensively installed in areas where there is pedestrian traffic since the 1980s.

Australia

APS functioning

Pushbutton integrated type of signal is used. The pushbutton and sound are standardized nationally.

There are several APS manufacturers in the Australian market but the pole mounted control box overhead was the only visible difference. All pushbuttons looked identical, whether they had APS or not, and all with audio-tactile features functioned identically.

FIG. 4-7.
THIS APS HAS A TACTILE ARROW WITHIN A LARGER VISIBLE ARROW. OTHER FEATURES INCLUDE A LOCATOR TONE AND AUDIBLE AND VIBROTACTILE WALK INDICATION

Locator tone

Locator tone has a repetition rate of once every 2 seconds.

WALK indicator:

- Fast repetition of low frequency thumping sound during the WALK interval.
- May have the capability to be set so that the WALK sound is limited to 8 seconds even when the WALK indication is longer.

Alert tone: "Alert tone" at the beginning of the WALK indication is set to sound at 14 db above ambient.

Additional information

- All devices respond to ambient sound, both for the locator tone and the WALK indication.
- Vibrotactile information at the arrow panel pulses at the same rate as the audible tone.
- Placement was quite standardized at line of the crosswalk away from the center of the intersection. Orientation of face of the APS varied; see Figure 4-9. Speaker for the APS is the face of the arrow so sound is emanating from face of unit. Orientation of the device can make a difference in hearing the APS when approaching or from the street.
- APS are sometimes turned off at night due to neighbors' complaints about noise.

Australia

Comments

The standardized location of the pushbutton, with each pushbutton located beside the waiting location for the crossing, provided a clear indication of which crossing the APS was indicating. There was no need for different sounds for different directions of travel. Even on porkchop type islands with three devices sounding, it was possible to distinguish the location and crossing being signaled.

Installation examples

FIG. 4-8.
TYPICAL APS LOCATION IN RELATION TO THE CROSSWALK AND SIDEWALK. AUSTRALIAN CURB RAMP STANDARDS ALLOW A STEEPER FLARE THAN ALLOWED BY US STANDARDS.

FIG. 4-9.
INSTALLATION OF TACTILE ARROWS WAS NOT CONSISTENT AND PROVIDED MISLEADING INFORMATION IN SOME CASES.

Sources of information

George Carnazolla, Transport SA, Adelaide

Gayle Clark, Orientation and mobility specialist, Guide Dogs Association of SA and NT, Inc., Adelaide

Susan Lockhart, Orientation and Mobility specialist, Sydney

Murray Mountain, Access Design Solutions, Melbourne

Bob and Jelena Panich, Bob Panich Consultancy, Ryde (Sydney)

Stephen Purtill, Specifications and Standards, VIC Roads, Melbourne

John Samperi, Signal Engineer

Roley Stuart, Client Services Manager, Guide Dogs Association of SA and NT, Inc., Adelaide

Jack Vankuyk, Traffic Signals Supervisor, RTA Operations, Sydney

Sweden

Functioning of pedestrian signals

Pedestrian Signals

Sweden uses a "red man, green man" symbol signal.

Use of a flashing or clearance interval seems to be a local decision. In Göteborg, there is no flashing interval, while in Skövda, a flashing 'red man' is used. Pedestrian actuation is common and the location of the pushbutton is fairly standard, approximately 0.5-1.0 m from the curb line and near the farthest crosswalk line from the center of the intersection.

Pedestrian Signal timing

WALK interval is timed according to width of the street using 1 meter per second, with a change interval of about 4 seconds.

Pedestrians rarely had to cross more than two lanes without coming to an island or median.

Intersection Geometry

In cities, streets were generally narrow, with lots of islands. In general, medians or islands separated traffic. Most right turn lanes were signalized.

Arterials typically have bicycle lanes on both sides of the street. Bicycle lanes are usually signalized separately, using small ball signals and separate pushbutton actuation.

There are no curb ramps as such; all curbs at corners are typically 3-4 cm high, which is said to be acceptable to persons with mobility impairments.

FIG. 4-10.
THIS INTERSECTION IN GÖTEBORG, SWEDEN HAS A BIKE LANE (SEEN ON LEFT SIDE OF PHOTO) WITH ITS OWN SIGNAL HEAD, AND A PEDESTRIAN CROSSWALK AND SIGNAL (ON RIGHT SIDE OF PHOTO).

Number of APS

Overall number was not available.

APS are fairly extensively installed in downtown areas. Further out, signals are installed at the request of persons who are blind or visually impaired and may be installed only on some crosswalks of the intersection, depending on the request.

APS have been in use in Sweden since the 1960s.

Sweden

APS functioning

There is no Swedish standard for APS, however, most APS have a ticking sound that repeats at 60 pulses per minute for the locator tone and 600 per minute for the WALK interval.

The APS is placed on a signal pole or stub pole near the edge of the crosswalk furthest from the intersection, about 0.5 meter from the curb.

Signal volume is typically set to be audible 3 meters from the pole. Signals respond to ambient sound, within a range set by the installer. APS can also be set to a constant volume.

Each intersection had a number of APS and pedestrian signal heads because there was an APS on each island/median; many medians had an additional pedhead as well.

APS differentiated from standard pedestrian pushbutton by different colored panels on the side of the device

FIG. 4-11. THIS STREET CROSSING IN GÖTEBORG, SWEDEN, INCLUDES TWO ISLANDS AND NUMEROUS APS (LOCATED IN THE PHOTO BY CIRCLES OR HALF-CIRCLES).

A raised tactile arrow on top of the device points across the crosswalk. At median locations where the signal actuated a simultaneous WALK for pedestrians crossing in both directions from the median, arrowheads were on both ends of shaft.

Signals were of a type that could include vibrotactile information through a separate button on the bottom of the device, however, that feature was not commonly provided.

Sweden

Additional information

FIG. 4-12 AND 4-13. THE APS DISPLAYS A TACTILE MAP ON ONE SIDE.

Most devices had a crosswalk map feature on the side of the device. The maps were correctly installed, however, Kaj Nordquist of the Swedish Blind Association, stated that most blind people in Sweden only traveled on familiar routes so the tactile maps were not used much. He stated that orientation to new routes is generally available to blind citizens of Sweden.

Comments

Although there were a number of APSs at each intersection, it was possible to locate the devices, and use the WALK indication of the device to cross efficiently.

Because of the precise location of each APS, the information provided was unambiguous as to which crosswalk had the walk interval.

A pedestrian waiting to cross could always be within arm's reach of the APS, so there was no question regarding which APS was sounding during the walk interval.

Sources of Information

Jan Lund, Prismateknik, Tibro

Roger Peterson, Prismateknik, Tibro

Bengt Ekdahl, Traffic Engineering, Göteborg

Kaj Nordquist, Swedish Blind Society, Stockholm

Denmark

Functioning of pedestrian signals

Pedestrian Signals

Red man, green man symbol

Pedestrian Signal timing

Length of the WALK interval varies by time of day. WALK interval usually calculated using a walking speed formula of 1.3 meters per second, but up to 1.5 meter per second can be used.

No flashing clearance interval

Fixed timed signals in most of central business district

Intersection Geometry

Streets typically were narrow (by US standards) with a great deal of pedestrian and bicycle traffic. Streets included wide bike lanes, often slightly raised from the street level.

No unsignalized right turn lanes for cars, but there are right turn lanes for bicycles.

Curbs are typically 3-4 cm high, which is said to be acceptable to persons with mobility impairments.

Detectable warning surfaces installed in some locations at the curb, usually in a one-foot band. No detectable warnings at edges of cut-through medians.

Number of APS

Very common in central business districts; outside of central business districts APS are installed at the request of the Danish Blind Association and only at requested crosswalks of the intersections.

Installation Example

FIGS. 4-14 & 4-15. THE TACTILE ARROW ON THE APS IN DENMARK WAS ON TOP OF THE DEVICE WHICH WAS LOCATED ON A POLE NEAR THE CROSS-WALK LINE. MOST INTERSECTIONS WERE FIXED TIMED SO NO PUSHBUTTON WAS INCLUDED ON THIS DEVICE.

Denmark

APS functioning

Most installations have audible signals coming from devices at pushbutton height, whether they have pushbuttons or the signals are fixed timed; overhead beaconing speaker devices are currently installed in combination with pushbutton locator tones, at a few trial locations.

Signals must conform to a national standard

Locator tone and WALK indication

- Both are 880 Hz square or saw-tooth wave tones.
- Locator tone is pulsed at 30/minute and WALK indication pulsed faster. The Danish standard requires that the WALK indication be five times the rate of the locator tone.
- The pulse length of the locator tone is 400 ms and the pulse length of the WALK tone is 200 ms.

Volume

- All APSs respond to ambient sound, unless special permission is received to set the signal to a constant low level.
- Although standard for setting the volume is that the signal should be audible 3 meters from the pole, the signal was quite often audible as far as 10 meters from the pole.
- The installer determines volume by listening.

Additional information

Location

- Located consistently at the end of the crosswalk line so locator tone could be used to line up for crossing.
- Consistency of location is considered very important; the APS is installed no more than 0.6 meter from the curb line and the horizontal distance from the crosswalk line is not more than 0.3 m.
- Stub poles are installed if signal poles are not available in the appropriate location.

Crosswalk information

- All APS devices have a bar aligned with the crosswalk, functioning as an arrow, on top of device.
- A knob on the end of the bar indicates the far side of the street and additional knobs indicate the number of islands or medians that will be encountered prior to the far side.

(continued)

Denmark

FIG. 4-16.
DANISH APS WITH TACTILE BAR MOUNTED ON THE TOP. THE BAR IS ALIGNED WITH THE CROSSWALK, AND TWO KNOBS AT THE END OF THE BAR INDICATE A MEDIAN AND THE FAR SIDE OF THE STREET.

Other

- In general there is no need to push a button, as most intersections have pre-timed pedestrian phases.

On most equipment, the pushbutton is located on the backside of the APS, toward the pole, with sufficient space for fingers to reach between the APS and the pole.

Comment

Locator tone was same tone as the WALK interval tone, and at the same intensity. Repetition rates at some locations in Copenhagen did not seem to conform to the published standard.

At a multi-leg intersection, the APS were very usable for crossing and alignment.

- APS were very consistently located in relation to the crosswalk.
- Directional bar (arrow) was useful, as were crosswalk maps on the side of the signals.
- Medians were cut-through, without detectable warnings, but the sound of the APS on the median gave some information about the median location.

The representative of the blind society mentioned concerns regarding noise levels of signals.

Contact

Mohammed Abazza, Traffic Engineer, Copenhagen

Neils Christian Johanneson, Siemens

Inge Kyhl, Orientation and mobility specialist, Institute for the Blind and Partially Sighted in Denmark

Mehta Rohe, Danish Blind Association

Jørn Vammen, Signals Engineer, Danish Department of Transportation

Chapter 5 – Types of APS

Summary

A number of devices are available which provide WALK and DON'T WALK information. All products produce a sound, vibration, or both, during the walk interval.

- Currently available products are of four design types, plus various combinations, categorized by the location and type of WALK indication provided.

Additional information

Additional information on APS features is provided in other chapters:

- Chapter 6 provides detailed information about Walk indications
- Chapter 7 provides information on other APS features
- The matrix entitled "Accessible Pedestrian Signals: Product Features" in Chapter 16 shows the features of each product; manufacturer contact information is also given there

Chapter contents

Information about the following APS types is included in this chapter:

- Pedhead-mounted
- Pushbutton-integrated
- Vibrotactile-only
- Receiver-based

Pedhead-mounted APS

Prevalence

The type of APS that has been most commonly installed in the U.S. has a speaker mounted inside or in the vicinity of the pedhead.

Function

Typical functioning of pedhead-mounted devices:

- The APS emits a sound such as a bell, buzz, birdcall (typically a chirp or cuckoo), speech message, or some other tone during the walk interval of the signal only.
- Sound is directly audible, that is, it is heard by everyone in the vicinity; users do not require receivers to hear the sound.
- May include automatic volume adjustment.

FIG. 5-1. APS UNIT MOUNTED ON TOP OF PEDHEAD.

WALK indication

Sound, usually a cuckoo, chirp, or beep, is emitted during the walk interval only

Vibrotactile information

Not available, except as a separate component sold by one manufacturer

Locator tone

Not typically available; some manufacturers sell the locator tone speakers as a separate component

Installation

As typically installed in the US, pedhead-mounted APS are attached to the pedestrian signal head and aimed toward the opposite curb.

- Intended to act as a beacon across the street
- Relatively loud as a consequence
- Sound from both ends of the crosswalk simultaneously

Pedhead speakers may be aimed in various directions; some cities in California have experimented with aiming the speaker down toward the waiting location and reducing the volume

Pedhead-mounted APS

Installations examples

FIG. 5-2. EXAMPLE OF PEDHEAD-MOUNTED APS SPEAKER AIMED AT PEDESTRIAN WAITING LOCATION.

FIG. 5-3. EXAMPLE OF PEDHEAD-MOUNTED APS SPEAKER AIMED TOWARD CENTER OF CROSSWALK.

Tone volume

While pedhead-mounted APS have typically been installed with volume adjusted to be heard across the street, tone volume and speaker alignment can be adjusted so WALK indications are audible only from the vicinity of the waiting area for the associated crosswalk. In most installations, louder signals are a disadvantage. Loud WALK indications coming simultaneously from both ends of a crosswalk are of little or no value in providing beaconing information

A tone that is loud enough to be heard across the street:

- May be irritating to other persons in the vicinity
- May mask traffic sounds that provide critical safety information for blind pedestrians.

Signals of the pedhead-mounted type, with tones currently used, have not proven to be localizable and do not provide directional information that many people hope for (Carroll, J. & Bentzen, B.L. 1999).

Options

Additional options include:

- Audible beaconing
- Locator tone speaker or pushbutton with vibrotactile indications are available from one manufacturer of pedhead-mounted speakers.

Limitations

Speakers must be carefully located so that they are above the end of the crosswalk they signal, or they provide ambiguous information about which crosswalk has the walk interval.

Recommend-ations

Devices should be responsive to ambient sound (automatic volume adjustment feature); some devices sold in the US are not.

Draft Public Rights-of-Way Accessibility Guidelines require locator tones at pushbuttons.

Pushbutton-integrated APS

Prevalence

Common in Europe and Australia, now available in US; many recent installations are of this type

Function

Pushbutton integrated APS systems have a speaker integrated into the pushbutton housing.

- Sound comes from the pedestrian pushbutton housing, rather than a speaker mounted at the pedhead.
- Provide a locator tone, a walk interval tone or speech message, and a raised arrow, which should be oriented parallel to direction of travel on the crosswalk
- Sound is directly audible, that is, it is heard by everyone in the vicinity; users do not require receivers to hear the sound
- Include automatic volume adjustment

FIG. 5-4. PUSHBUTTON-INTEGRATED APS

WALK indication

The WALK indication may be a different tone, a rapid repetition of the locator tone, or a speech message.

Vibrotactile information

Vibrotactile information

- Is typically provided in this type of signal by a button or arrow that vibrates to indicate the WALK signal
- Is useful for confirmation of which signal is sounding at a particularly noisy intersection
- Makes WALK signal information accessible to persons who have hearing loss in addition to visual impairment.

Locator tone

The locator tone is a quiet, repeating tone that:

- Notifies pedestrians with visual impairments that it is necessary to push a button to actuate a pedestrian phase,
- Aids in location of the pushbutton, and
- Aids in homing in on the opposite corner when crossing the street.

Tones used in the US vary, however the repetition rate is standardized at once per second. The duration of the tone is 0.15 sec maximum, so that it is not mistakable for a vehicle back-up tone that usually sounds during approximately half of its cycle length.

Pushbutton-integrated APS

Installation

When pushbutton-integrated APS are consistently mounted on poles at the ends of crosswalks, and near the crosswalk line furthest from the center of the intersection, they provide unambiguous information about which crosswalk has the walk interval.

Pushbutton-integrated APS must be oriented on poles very precisely so the arrow is aligned in the same direction as the crosswalk whose signal is actuated by that pushbutton.

Installation examples

FIGS. 5-5 AND 5-6. TWO EXAMPLES OF PUSHBUTTON-INTEGRATED APS WITH AUDIBLE AND VIBROTACTILE OUTPUT. BOTH HAVE LOCATOR TONES AS WELL AS WALK INDICATIONS.

Tone volume

These signals, in their typical mode of operation and installation, are intended to be loud enough to be heard only at the beginning of the crosswalk, although the locator tone on the opposite curb becomes audible as the pedestrian approaches it.

Options

Additional options include:

- Pushbutton information message with street name, geometry, and signalization information
- Braille labels
- Tactile map of the crosswalk
- 'Alert tone' at the onset of the walk interval
- Actuation tone and light
- Audible beaconing

Limitations

Potential limitations include:

- Extra wiring needed in order to install to the pushbutton
- Poles on which to locate the device should be close to the crosswalk location lines extended and the curb (or curb ramp)

Recommendations

Draft Public Rights-of-Way Accessibility Guidelines require audible and vibrotactile indication of the walk interval

Vibrotactile-only APS

Prevalence

Installed in some locations in the US in response to concerns about noise and misleading information provided by pedhead-mounted signals.

Function

This type of APS provides only vibration at the pedestrian pushbutton. The arrow or button vibrates when the WALK signal is on.

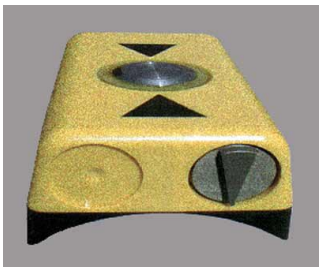


FIG. 5-7. BOTTOM VIEW OF A VIBROTACTILE APS SHOWING A RAISED ARROW THAT VIBRATES.

WALK indication

Vibration of an arrow or pushbutton on the device

Locator tone

No sound is generated with this device

Installation

This device replaces the typical pushbutton.

Vibrotactile devices must be oriented on poles very precisely so the arrow is aligned in the direction of travel on the crosswalk whose signal is actuated by that pushbutton.

The device must be installed close to the crossing departure location in order for blind or deaf-blind pedestrians to stand with a hand on the device while aligned and ready to begin crossing.

Limitations

Problems and limitations to this type of device:

- Information about the walk interval is only available to pedestrians who are familiar with the intersection and the signal.
- The pushbutton must be installed very precisely next to the crosswalk where users who need the vibrotactile information can stand, prepared to cross, with a hand on the vibrating surface.
- For the APS to be of value, the person who is blind or visually impaired must know the APS is there and know where to look for it.
- In a crowded location, it may be difficult for the blind pedestrian to get to the pushbutton and to keep his/her hand on the device while waiting.

Vibrotactile-only APS

Recommendations

Although there is some interest in signals of this type because they are silent and do not disturb others, the PROWAAC recommendations opposed signals that were only vibrotactile because they are not available to those who are unfamiliar with the intersection. (PROWAAC X02.5.2.2 B)

PROWAAC and the *Draft Public Rights-of-Way Accessibility Guidelines* require that all signals provide vibrotactile and audible information. Vibrotactile information is useful in combination with audible information, when the APS are well located, for confirmation at particularly noisy intersections and for persons who are hearing impaired.

Receiver-based APS

Prevalence

Installed for street crossing use in a few experimental locations in the US.

Remote infrared audible signage (RIAS) system is being installed extensively in Japan

Function

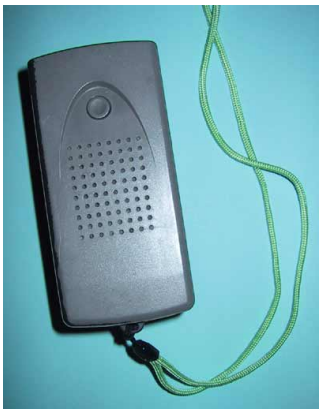


FIG. 5-8. REMOTE INFRARED AUDIBLE SIGN RECEIVER

A receiver-based system provides information to a receiver carried by the user. Users scan with receivers for pedestrian signal information as they approach the street and after they stop at the street edge. When receivers are oriented in the direction of pedestrian signals, a prerecorded message that corresponds to the status of the signal, is received.

Two types of receiver-based systems exist:

- Remote infrared audible signs (RIAS)
- Light emitting diode (LED)

Receiver-based systems:

Provide clear unambiguous information and directional guidance at atypical intersections where there are more than four crosswalks, and when direct signals, such as tones, may overlap and therefore be unclear or misleading.

- Information is only available to individuals who have the receivers; not audible to others

WALK indication

A speech WALK message or vibration is provided to the handheld receiver to indicate the walk interval

Vibration message has not been standardized.

WALK indication is only received when standing within the limits of the crosswalk at the intersection.

- RIAS: users can pick up a repeating message stating the name of the street and the status of the cycle. For example, " WAIT — Grove Street," or " WALK sign — Grove Street."
- LED signals: provide WALK or WAIT message only.

Vibrotactile information

Receiver-based systems can be adapted for vibrotactile use by deaf-blind pedestrians

Locator tone

No locator tone

Receiver-based APS

Installation

For RIAS, transmitters are located in or on top of the pedhead housing.

LED systems respond to a particular brand of LED pedhead, in which the specially equipped receiver detects the pulsing of the LED indication.

Installation examples

FIG. 5-9.
THE PULSING OF THE LEDS IN THE PEDHEAD ACTIVATES A SPEECH MESSAGE IN A HANDHELD RECEIVER.

FIG. 5-10.
PEDHEAD-MOUNTED APS UNITS TRANSMIT SPEECH MESSAGES TO A HANDHELD RECEIVER.

Tone volume

Located on the handheld receiver or headset, adjustable by user

Receiver-based APS

Options

Additional options RIAS can provide:

- Orientation messages - As users approach an intersection, they pick up a message that includes the name of the street on which they are traveling, the direction of travel, the block they are on, and the name of the intersecting street they are approaching.
- Information about intersection signalization and geometry, and information about nearby landmarks such as public buildings and transit stops.
- Information for other tasks such as identifying bus stops, identifying public restrooms, identification and wayfinding in public buildings, wayfinding in transit stations, and real-time bus arrival information.
- May be engineered for output in other languages.

For LED systems, message content is limited to the pre-recorded messages or vibration signals set in the receiver. Receivers are dedicated to pedestrian signal information.

Limitations

Receiver-based APS systems do not benefit other pedestrians. Such systems require users to obtain, carry, maintain and use receivers; this raises issues of distribution and maintenance, as well as concerns relating to availability to non-residents.

No locator tone.

Recommendations

PROWAAC does not recommend that travelers "be required to carry a single, function-specific receiver in order to access intersection information" (X02.5.2.3 discussion). The best use of a receiver-based system at this time is to supplement APS having directly audible and vibrotactile information.

Chapter 6 – APS WALK Indications

Summary

The indication of the walk interval is the most critical information provided by the APS. There are a number of APS available and different devices and WALK indications may be needed for different situations. This chapter provides information about the considerations in choosing WALK indications, characteristics of different types of WALK indications, and recommended usage that may assist in choosing the appropriate WALK indication. A discussion of WALK indication volume, the use of audible beaconing, and suggested criteria for audible beaconing are included.

APS technology is changing rapidly and additional choices or features may become available. Those making purchasing decisions should consider the background information provided here which will be helpful in evaluating new technology.

Additional information

The other features of the device chosen can also affect the usability of the APS and the pedestrians' understanding of the WALK indication. Various features and their use are explained in detail in Chapter 7.

Poor installation can result in ambiguous WALK information from any APS. Additional information on installation is provided in Chapters 8 through 13.

The matrix in Chapter 16 identifies WALK indications and features currently available on different manufacturers' devices.

Chapter contents

This chapter covers

- Major considerations in determining the WALK indication.
- Locations of WALK indications
- WALK indication, provided by:
  - Tones
  - Speech messages
  - Vibrating surfaces
  - Messages to receiver hardware
- WALK indication volume
- Use of audible beaconing

WALK indication

Criteria

APS indication of the walk interval:

- Must be unambiguous with regard to which street has the walk interval.
- Must be audible from the beginning of the associated crosswalk
- Should be no louder than the associated quiet locator tone unless a louder beaconing feature is actuated for a single pedestrian phase
- Should have a much faster repetition rate than the locator tone, when tones are used to indicate the walk interval

Above criteria are based on

- MUTCD 4E.06
- *Draft Public Rights-of-Way Accessibility Guidelines* 1106.2.3.1 Tones, 1106.2.3.2 Volume, 1106.3.2 Locator Tone, 1106.3.4 Optional Features
- PROWAAC X02.5.1.3(G) Separation, X02.5.2.2(A) Crosswalk Indication, X02.5.2.2(D) Walk Interval Tone, and X02.5.2.2(G) Volume

At this time there are a number of APS available that meet the above criteria. The following sections discuss these requirements further.

Major considerations

Four attributes

The WALK indicator should be:

- Readily detectable in the presence of ambient vehicular sound
- Highly localizable
- Uniquely recognizable as a WALK signal
- Unambiguous with regard to which crosswalk has the walk interval

Readily detectable

High detectability essential for usability

- Pedestrians who are visually impaired must be able to hear the WALK indication clearly, over varying types and intensities of traffic sound.
- While the signal needs to be detectable, it is desirable to have a sound that is not irritating to individuals in the area of the signal.

Detection of WALK signals in ambient traffic sound

- Vehicular sounds are concentrated in the lower frequencies.
- The most detectable signals are those that are concentrated in frequencies different from those of traffic sound
- Factors that aid signal detection in ambient traffic sound
  - Multiple, sharp onsets
  - Large frequency component at about 880Hz

Less detectable signals

- Both the commonly used cuckoo and chirp are less detectable than more rapidly repeating tones in 880Hz range, and speech messages
- Pedestrians with visual impairments who have age-related upper frequency hearing loss may have difficulty hearing signals having a fundamental frequency above 1kHz.

Highly localizable

High localizability helps users:

- Determine which signal is sounding
- Use the signal for alignment information (in locations with audible beaconing)
- Travel more directly toward the signal during their crossings.

Characteristics of highly localizable tones

- Not pure tones
- Multiple harmonics or frequencies required—high and low
- Large frequency component at about 880Hz

Major considerations

Uniquely recognizable

Where the walk interval is conveyed by tones, the tones should not be confusable with other tones in the street environment, such as vehicle backup warning beepers.

The most common tones used currently are the bird sounds like cuckoo and chirp.

- The 'chirp' sound is similar to the sounds made by several birds in the U.S. and is also mimicked by mockingbirds.
- Pedestrians who are blind have crossed streets with actual bird chirps, or failed to cross with APS tones because they were perceived to be actual birds.
- The cuckoo indication has not been reported to have been confused with birds in the U.S.

Vehicle backup beepers are not tightly specified in the U.S. but typically have a repetition rate of once every 1 to 2 seconds, and the beep is typically about half the length of the repetition rate. For APS WALK indications that consist of tones (excluding the cuckoo and chirp), the repetition rate in the U.S. is typically 8 to10 repetitions per second. The cuckoo and the chirp have a typical repetition rate of once every 1 to 2 seconds with a very short duration of the tones.

Speech messages for the walk interval must be recognizable as a WALK message and not confused with pushbutton messages or other voices at an intersection. This can partially be accomplished by use of standardized wording for speech messages. In addition, the speech message must be understandable.

Major considerations

Unambiguous information

It is critical that pedestrians recognize which street is being signaled and begin their crossings within the walk interval. Unfortunately, the most common solution used in the US is ambiguous. Surveys of pedestrians who are blind and the authors' evaluation of typical overhead pedhead-mounted signals have revealed that they frequently provide ambiguous information about the crosswalk being signaled.

When the APS sound for both streets comes from the same general location, it is difficult to discriminate which street the tone or speech message applies to. The pedestrian who is blind waits to cross while standing approximately at the curb line, and may be 10 to 15 feet or more from the device speaker. The mounting of speakers does not provide clear indications of which street is being signaled, unless the speakers are mounted on two separate poles, at least 10' apart, and aligned with the crosswalk they signal.

The use of different tones for each direction requires pedestrians to know their direction of travel, and to know which tone is associated with which travel direction *in a particular jurisdiction.* (See discussion of tones on page 6-9.) While in many situations, traffic movements also help clarify the signal status, beginning to cross with the wrong signal can be a fatal mistake.

One factor that particularly affects ambiguity is location of the speakers for the WALK indication. This is discussed in the next section.

Installation as well as device selection can affect the ambiguity of the information provided by the WALK indication. Chapter 9, Designing Installations, provides more information on deciding what features would be necessary or appropriate at a particular location.

Location of WALK Indications

Separation of sound sources

Ambiguity can be addressed by careful location of signal sounds. The best solution is location of the speakers precisely beside or above the end of associated crosswalks, and at least 3 m (10 ft) from another APS on the same corner, so it is clear from the source of the sound which crosswalk is being signaled.

Ideal placement

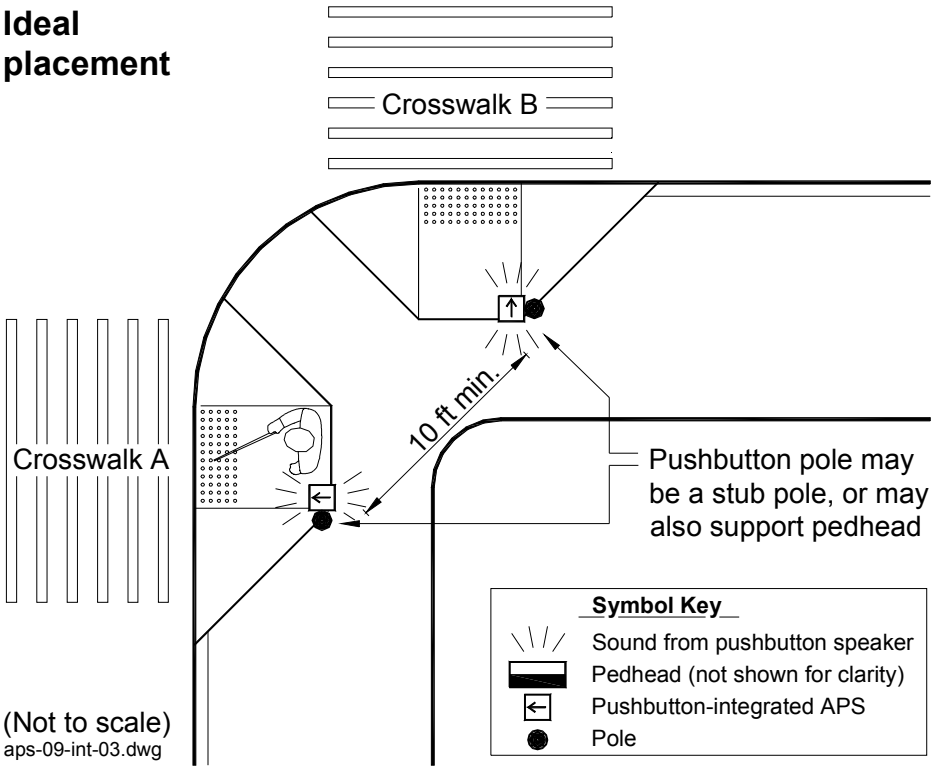


FIG. 6-1. IDEAL PLACEMENT FOR PUSHBUTTON-INTEGRATED APS.

Speech messages, if sound sources cannot be separated

If the APS must be located with two pushbuttons on the same pole or in locations that are not separated by at least 3m (10 ft), one alternative recommended by PROWAAC is that APS have speech messages. To provide unambiguous information such APS require:

- A tactile arrow aligned with the associated crosswalk;
- A pushbutton message available during the flashing and steady DON'T WALK, that identifies the intersection and the crosswalk associated with that pushbutton; and
- A WALK message that includes the name of the street being signaled at the onset of the walk interval. (Otherwise the speech message is not useful to those unfamiliar with the area.)

Location of WALK Indications

Possible additional solutions

Further developments in technology which may provide clarification of which crosswalk is being signaled, may include

- Alternating the WALK signal from one end of the crosswalk to the other
- Having the WALK signal come from the far end of the crosswalk only
- Developments in handheld receivers

Methods of providing WALK indications

WALK indication is critical

The WALK indication provides critical safety information.

It can be provided by use of

- Tones,
- Speech messages,
- Vibrating surfaces, or
- Messages to receiver hardware

Each of these methods has advantages and disadvantages that relate to particular intersection geometry and signalization, signal volumes, pushbutton and speaker location and other factors.

Methods can be combined, for example, use of tones and a vibrating surface to indicate the WALK phase.

Tones

Description

The WALK indication of many APS is provided by an audible signal such as a beep, buzz, percussive sound, or cuckoo/chirp.

Basic issues

Tones consisting of multiple frequencies, high and low, with a large component at 880 Hz have been found to be highly detectable and localizable in the presence of traffic sound. Frequencies above 1kHz are difficult for persons with age related upper-frequency hearing loss to detect. However for persons with normal hearing, the presence of multiple higher harmonics aids localization.

Consistency in use of a particular tone for a WALK signal is greatly to be desired, however, there is insufficient research to support technical specifications for a particular tone at this time.

Issues included in this section, that should be considered in the use of audible tones for the WALK indication are:

- MUTCD guidance on choosing audible tones
- Associating tones with direction of travel
- Problems with audible tones

MUTCD on WALK tones

MUTCD 2000 (4E.06) says that WALK tones should not be confusable with other sounds in the environment, including:

- Wind
- Rain
- Vehicle back-up warnings
- Birds

The WALK indication should also be different from a pushbutton locator tone; the pushbutton locator tone is defined by both repetition rate and duration of the sound (see Pushbutton Locator tone, page 7-2).

MUTCD guidance in 4E.06 also recommends that care should be exercised at locations where it may be difficult to determine which APS is sounding or where an unsignalized lane may be mistaken for a signalized one due to a loud beaconing APS. Some of the issues mentioned in the MUTCD guidance regarding tones can be more successfully addressed by careful installation and volume adjustment, rather than by choosing different tones.

More discussion of this issue is in the following sections and in the section on designing installations.

Tones

Associating tones with direction of travel

Some audible pedestrian signals utilize two different tones that are associated with two different crossing directions. The most common tones used are the bird sounds like "cuckoo" and "chirp." The repeating cuckoo sound is normally used for north/south crosswalks, and the repeating chirp is normally used for east/west crosswalks. This has been the recommended signal in California and Canada.

The use of two tones for crossings in two different directions has been assumed to provide unambiguous information about which crosswalk has the WALK signal. However, research since 1988 has documented that such a system is often ambiguous.

- For two different sounds to be useful, users must remember which sound goes with which direction, and know their direction of travel. At intersections that are not aligned according to the primary compass coordinates, installers may be inconsistent in how signals are installed and information from paired audible tones may be ambiguous, except to frequent users of those intersections.
- In areas where the street system is curvilinear or otherwise irregular, it may not be apparent to a pedestrian who is blind that a heading has changed.
- Pedestrians may not know the compass orientation of a route of travel.

Several surveys (San Diego Association of Governments, 1988, American Council of the Blind, 1998, ITE Journal, 2000) have documented that blind pedestrians are often unsure which crosswalk is being signaled by a cuckoo or a chirp. MUTCD 4E.06 points out that the provision of different sounds for non-concurrent pedestrian phases has been found to provide ambiguous information, and PROWAAC (X02.5.2.2 (A)) would not permit the use of two different tones as the sole indication of which crosswalk has the walk interval.

If two tones are used, the best way to make them unambiguous is to install them so the source of each WALK tone is localized in the area of the pedestrian waiting to cross the associated crosswalk, and speakers on a corner are separated by a minimum of 10 feet (MUTCD 4E.08).

Use of additional tones

Some APS products have the capability of producing more than two different tones to accommodate intersections having more than two intersecting streets. But note that

- It is difficult to interpret the use of additional tones without specific instruction.
- Unfamiliar or non-standard tones are not useful to pedestrians who are not familiar with a given intersection.

Tones

Use of a single tone for crossings in all directions

In Europe and Australia, tones are used successfully to indicate the walk interval from pushbutton integrated APS. There is some variability in the tones used. Typically, the tone for WALK is the same tone as the locator tone, repeated at a faster repetition rate, usually 5 to 10 times faster. The same tone is used for all crossing directions.

The standardized location of the pushbutton in relation to the crosswalk makes it obvious to users which crosswalk has the walk interval. In all locations, pedestrians are beside the appropriate APS when they are waiting to cross, normally within arm's reach of the APS, and at some distance from the APS for another crosswalk.

Other issues

Other issues besides specific tone may increase the value for directional alignment and beaconing more than the tone, per se. For example, the presence of a quiet locator tone on the opposite curb during the clearance interval may make more difference in the ability of users to home in on the destination corner, than the choice of a particular WALK tone that normally ceases to sound when the pedestrian is only part way across the crosswalk.

Speech messages

Description

A speech message is provided during the walk interval, usually from a speaker located at the pushbutton, which states something like: 'Maple Street, WALK sign is on to cross Maple.'

Basic issues

Some systems have the capability of utilizing directly audible speech messages to provide information about the status of the signal cycle. As for other WALK indications, the speech WALK message must be detectable, localizable, and recognizable.

For use as a WALK indication, a speech message must also be correctly understood by all users.

The following sections discuss some issues and problems to be considered in the use of directly audible speech messages:

- Associating speech messages with street to be crossed
- Need to know street name
- Cognitive complexity
- Which street should be named
- Understanding speech in noise
- Conveying necessary information
- Using recommended messages
- Recording messages
- Maintaining signals with speech messages

MUTCD on speech messages

MUTCD provides minimal information regarding speech WALK messages. It states that: "The verbal message that is provided at regular intervals throughout the timing of the walk interval shall be the term " WALK sign," which may be followed by the name of the street to be crossed" (MUTCD 4E.06)

Associating speech messages with street to be crossed

Speech messages from pushbutton integrated APS seem very user-friendly and have become popular in the US market. Such messages can communicate to all pedestrians which street has the walk interval.

However, the words and their meaning must be correctly understood by all users in the context of the street environment where they are used. Use of speech messages will not automatically solve all ambiguity problems that were discussed earlier in this chapter.

Draft Public Rights-of-Way Accessibility Guidelines allow the WALK indication to be provided by 'voice' but do not provide additional specifications. PROWAAC recommended the use of a speech WALK message to clarify to which crosswalk the signal applies, if signals for two directions cannot be separated by more than 10 feet. (X02.5.1.3G)

Speech messages

Need to know street name

Pedestrians have to know the names of streets they are crossing in order for speech WALK messages to be unambiguous. In getting directions to travel to a new location, travelers do not always get the name of each street to be crossed. They may only know that they have to cross four streets before looking for their destination. Therefore, the APS has to give the user the name of the street controlled by the pushbutton.

This can be done by means of a pushbutton information message during the flashing or steady DON'T WALK intervals. See Page 7-6 for a description of pushbutton information messages.

Cognitive complexity

Most APS that can provide speech WALK messages, can also provide a pushbutton information message that clarifies which street the pushbutton and signal controls. In addition, they may have the option of Braille labels.

The user must combine the information from the pushbutton information message or Braille label, the tactile arrow, and the speech WALK message, in order to correctly respond to the WALK messages, particularly if there are two pushbuttons on a pole. All may be necessary to correctly identify the street and crossing time at an unfamiliar intersection.

This complex process is much more cognitively demanding and liable to result in errors than the simple system adopted decades ago in Australia and several European countries, in which the source of a WALK tone is in the immediate vicinity of where pedestrians are standing to initiate the crossing associated with that tone.

Which street should be named?

A survey of travelers who are visually impaired, orientation and mobility specialists, and transportation engineers (Report on Speech Messages, Bentzen et. al., 2002) noted a difference in 'naming' of streets in speech messages. A message stating "Howard Street, WALK sign" was generally understood by engineers to indicate that the WALK sign was on for traffic traveling alongside Howard Street, while pedestrians who were blind or visually impaired and orientation and mobility specialists consistently interpreted it to mean that the WALK sign was on to cross Howard Street. WALK messages must contain the name of the street being crossed, or they may lead to misinterpretation by pedestrians who are blind or visually impaired.

Recommended messages are included in the section on Model messages on page 6-15.

Speech messages

Understanding speech in noise

Most APS currently available deliver the message from a speaker located at the pushbutton. Locating the APS speaker as close as possible to the crossing location is desirable.

Most pedestrians with visual impairments also have some degree of age-related upper-frequency hearing loss, limiting their understanding of speech in traffic conditions.

It will not be possible to make speech messages from APS loud enough to be intelligible in all ambient traffic conditions by most people unless they are also loud enough to potentially cause hearing loss in people in the immediate vicinity of the loud speakers.

In even moderate traffic conditions people who have age-related or other hearing losses, people who are not native English speakers, and people with cognitive disabilities are likely to miss hearing or to misunderstand some words, possibly resulting in misunderstanding entire messages.

In locations where speech messages have been broadcast from a pedhead-mounted speaker, there has been difficulty making the speech information intelligible in the presence of traffic sounds. Increasing the volume of a speech message so it can function as an audible beacon is likely to result in decreased intelligibility of the speech message.

Conveying necessary information

Speech messages need to provide accurate information in a clear, concise, and standardized manner, so pedestrians will know what to expect from the messages and be more likely to understand them.

- Messages should *not* be worded in a way that seems to provide a 'command' to the pedestrian. For example, 'Cross Howard Street now' would not be an appropriate message.
- Messages should *not* tell users that it is "Safe to cross." It is always the pedestrian's responsibility to check actual traffic conditions.
- The term 'WALK sign' has been established as the most appropriate message to inform the pedestrian of the WALK indication. MUTCD states that: Standard: When verbal messages are used to communicate the pedestrian interval, they shall provide a clear message that the walk interval is in effect, as well as to which crossing it applies. The verbal message that is provided at regular intervals throughout the timing of the walk interval shall be the term "WALK sign," which may be followed by the name of the street to be crossed.

Model speech messages are provided in the next section.

Speech messages

Model messages

Speech messages for the walk interval of directly audible APS should follow these model messages (Bentzen, Barlow and Franck, 2002).

- Model message for the walk interval, applicable to most intersections: **"Howard. WALK sign is on to cross Howard."**
- Model WALK message for intersections having an exclusive pedestrian phase: **"WALK sign is on for all crossings."**

Messages for actual installations should be developed on the basis of these models. Word order should not be changed. Where complete sentences are used in the models, they should be used in actual messages for the same situations. In the model messages, such words as street, avenue and road are not used. In some locations they may be needed to avoid ambiguity.

Recording messages

To be understood, speech messages must be carefully recorded, in a clear voice, with excellent diction, and moderate pacing.

There is no clear preference between use of a male or female voice. For persons with unimpaired hearing, a female voice will be understood somewhat better than a male voice because the frequency spectrum of the male voice is closer to that of traffic. For the large number of people who are visually impaired who also have age-related or other upper-frequency hearing loss, a female voice may not be as easy to understand as a male voice.

Maintaining signals with speech messages

Replacement of signals having speech messages necessitates custom recording rather than off-the-shelf substitution of components.

The speech message, as well as the associated pushbutton message or Braille label, is intersection and crossing specific. Manufacturers of APS with speech messages can provide replacement message 'cards' or provide software for the installer to record the speech messages. Care must be taken in the installation and/or replacement of signals to assure that the street name in any WALK message is the name of the street being crossed.

Vibrating Surfaces

Description

The push button, a second button on the push button housing, or a raised arrow on the housing vibrates during the walk interval.

Indication of the walk interval with a vibrating surface is commonly provided on pushbutton integrated signals, in addition to the audible indication.

Basic issues

The vibration may be:

- Synchronous with the pulsing of the audible signal (slow during DON'T WALK, and faster during WALK);
- Present only during the walk interval.

The vibrating surface:

- Lets pedestrians who are deaf-blind know when the walk interval is in effect,
- Can help all pedestrians confirm that the pushbutton they have actuated is the one that now has the walk interval, and
- May provide confirmation of the walk interval at a particularly noisy intersection.

Vibrotactile signals:

- Are useful only when the vibrating surface is close enough to the curb ramp, near the curb line, so pedestrians who are blind can be aligned and prepared for crossing while still keeping their hand on the signal
- May be difficult for pedestrians who are blind to locate, or to wait with their hand on the pushbutton
- If they are vibratory only, are useful only to persons who know they exist and know where to find them.

Recommended use

Although signals that only provide vibratory information only have been installed in some locations, PROWAAC recommended that vibrotactile indications should be used only in combination with audible messages, either tones or speech messages.

Draft Public Rights-of-Way Accessibility Guidelines require all devices in newly signalized installations or alterations where there are pedestrian signals, to have audible and vibrotactile indications of the walk interval.

Messages to receiver hardware

Description

WALK indications of receiver-based systems can be provided by speech messages or by vibration of the handheld receiver. The pedestrian who is blind must have a receiver and point it at the pedhead to receive the verbal or vibratory message.

Basic issues

There are currently two technologies that provide speech messages to personal receivers.

- Remote infrared audible signage (RIAS) is a system in which unique messages that are recorded in a transmitter are transmitted by infrared light to receivers.
- LED pedestrian signals provide a system that can be pulsed to call up a limited selection of speech messages that are recorded in receivers.

If used, the speech messages must contain the words 'WALK Sign" and may also contain the name of the street to be crossed (MUTCD 4E.06).

Precise installation

When the pedhead-mounted transmitters in RIAS systems, and LED pedestrian signal heads are installed and maintained precisely in line with the associated crosswalk, they are both capable of providing very precise directional information to users without adding to noise pollution. If installed so that they are not within the crosswalk, or are not aimed directly across the crosswalk, the installation can lead to ambiguity about which crosswalk has the walk interval, and to incorrect information about the location of the opposite corner.

Recommended use

PROWAAC recommended that the best use of receiver-based systems is to supplement APS having directly audible information, as receiver-dependent systems are accessible only to those persons who own, maintain and are currently using the appropriate receiver.

Draft Public Rights-of-Way Accessibility Guidelines require audible and vibrotactile indications of the walk interval provided by a signal device located at the intersection.

Volume of WALK indication

Problems with loud audible signals

Loud overhead audible signals have been problematic to neighbors of APS installations.

In addition, the loud sound of the signal may prevent pedestrians who are visually impaired from:

- Hearing critical traffic sounds used for alignment
- Determining that cars have stopped
- Hearing cars that may be turning across their path
- Localizing on the signal source

Guidance on loudness

The WALK indication should normally be audible only from the beginning of the crosswalk, not across the intersection (MUTCD 4E.06, *Draft Public Rights-of-Way Accessibility Guidelines* 1106.2.3.2, PROWAAC X02.5.2.2.(G)). Draft guidelines require the WALK indication to be 5dB maximum above ambient sounds when measured 36 inches from the device.

PROWAAC recommended an exception for intersections where audible beaconing is needed, when the audible beaconing is activated. (See the following section on audible beaconing for further explanation). *Draft Public Rights-of-Way Accessibility Guidelines* does not address this issue.

The guidance on loudness reflects a change from the expectations regarding setting the volume typical of previous installation of APS in the US.

Sound volume levels

The pushbutton locator tone and WALK indication are to be between 2dB to 5 dB above ambient noise levels and should respond to ambient sound; the MUTCD specifies a maximum volume of 89dB. The system is to be adjusted so the sound is audible no more than 6 to 12 feet from the sound source, or at the building line, whichever is less.

Volume should be individually adjusted at each APS installation for satisfactory performance.

Audible beaconing

Description

Use of an audible signal in such a way that blind pedestrians can home in on the signal from the opposite corner as they cross the street.

PROWAAC defined audible beacon as: "a permanently fixed source emitting sound for directional orientation".

Basic issues and information

A minority of crosswalks require audible beaconing, in which the sound source provides directional orientation. Where audible beaconing is required, the WALK signal is normally louder than any associated locator tone.

MUTCD and PROWAAC recommendations are that the beaconing be called up by special actuation, rather than the APS functioning in the louder mode all the time. The recommended form of special actuation is an extended button press (holding the pushbutton in for a longer period of time). For further discussion, see the Chapter 7 section titled "Extended button press".

On-going research may refine these recommendations.

Ways to provide beaconing

Beaconing can be provided in several ways, any of which are initiated for a single cycle by an extended button press. (MUTCD 4E.08 and PROWAAC 2.5.1.2F & 2.5.2.3A,B).

- The volume of the WALK tone and the subsequent locator tone for one signal cycle may be increased;
- The audible WALK signal may be alternated back and forth from one end of the crosswalk to the other, or
- The signal may come from the far end of the crosswalk only.

Installing audible beacons

Audible beacons speakers must be oriented in line with the relevant crosswalk.

- If the speaker is not carefully oriented, the signal may give ambiguous information about which street has the walk interval, and ambiguous information for traveling straight across the street.
- Beaconing is enhanced by the presence of a locator tone that users can home in on as they approach the destination corner, island or median having an accessible pushbutton.

See Chapter 9, Designing Installations, for additional recommendations regarding audible beaconing.

Audible beaconing

Criteria for use of audible beaconing

Not all crosswalks at an intersection may need beaconing; beaconing may actually cause confusion if used at all crosswalks at some intersections.

Audible beaconing may be needed at:

- Intersections having skewed crosswalks or irregular geometry such as multiple legs.
- Crosswalks longer than 70 feet, unless they are divided by a median that has another APS with a locator tone
- Crosswalks where APS are requested by individuals with severe veering problems.

Beaconing on demand

PROWAAC recommends that beaconing be available on demand rather than as a constant feature of the device to address noise pollution concerns.

Locations where beaconing is not appropriate

Audible beaconing is not appropriate at locations with free right turns or split phasing, due to possibility of confusions. See discussion on pages 9-5 and 9-8. Other methods of providing directional guidance, such as tactile guide strips, should be considered at those types of locations

Chapter 7 – Other APS Features

Summary

This chapter describes Accessible Pedestrian Signal features other than the WALK indication. It reviews features currently available. APS technology is changing rapidly and new features are being introduced.

The matrix entitled "Accessible Pedestrian Signals: Product Features" in Chapter 16 lists the features of each product available at time of publication.

Chapters 9 through 12 under "Choosing and Installing APS," provide more information on evaluating features for use at a particular location.

Chapter contents

The following APS features are discussed:

- Pushbutton locator tone
- Tactile arrow
- Pushbutton information message
- Automatic volume adjustment
- Alert tone
- Actuation indicator
- Tactile map
- Braille and raised print information
- Extended button press
- Passive pedestrian detection
- Remote activation
- Clearance interval tones

Pushbutton locator tone

Description

A pushbutton locator tone is "A repeating sound that informs approaching pedestrians that they are required to push a button to actuate pedestrian timing and that enables pedestrians who have visual disabilities to locate the pushbutton." (MUTCD 2000; 4E.08)

The pushbutton locator tone is referred to by different names in manufacturer's brochures. These include:

- pole locator
- locator signal
- locator tone
- locating tone
- locator audible

Additional information

Pushbutton locator tones typically sound during the flashing and steady DON'T WALK intervals. A slowly repeating tone or ticking sound is adjusted to be heard no more than 6 to 12 feet (2 to 4 meters) from the push button or to the building line, whichever is less. The locator tone informs pedestrians of the need to push a button, and provides an audible cue to the location of the pushbutton, as well as the destination corner.

In available products, the pushbutton locator tone varies from a click sound to a beep type tone. However, some aspects are standardized by language in the MUTCD 2000. The tone shall repeat at 1 second intervals and shall have a duration of 0.15 seconds or less.

The pushbutton locator tone typically has automatic volume control. A microphone or sensing device is installed in the APS device or in the pedhead to monitor intersection sound levels and adjust the volume of the locator tone, as well as the WALK indication volume. The locator tone is to be adjusted to between 2dB and 5dB above ambient sound levels, measured 36 inches from the pushbutton.

The web site at www.walkinginfo.org includes a sample locator tone.

References

MUTCD 4E.08

Draft Public Rights-of-Way Accessibility Guidelines 1106.3.2 Locator tone

PROWAAC X02.5.1.2D and X02.5.1.5

Pushbutton locator tone

How used

Pedestrians who are blind who are unfamiliar with an intersection will approach the intersection.

- Upon hearing the locator tone, or two locator tones if there are two pushbuttons, they will realize that the signal is actuated.
- They will probably continue to the curb or curb ramp location, determine their location and alignment, and listen to traffic to become familiar with the intersection layout and sounds.
- If the pushbutton is not in reach, they will return to the pushbutton locator tone that they believe to be the pushbutton for their crossing.
- After reaching the pushbutton and checking the arrow alignment to ascertain that the arrow is aligned parallel to the crosswalk they want to use, indicating that it is the correct pushbutton, they will push the button and return to realign to cross the intersection.
- They may find it necessary to repeat the process if they don't feel they are realigned appropriately when the pedestrian phase begins.
- As they cross the street, they will begin listening for the pushbutton locator tone for the APS on the opposite side of the street and may home in on it as they reach the last lane of traffic.

Tactile arrow

Description

Most APS devices that are integrated into the pushbutton incorporate a raised (tactile) arrow that helps users know which crosswalk is actuated by the pushbutton. This provides confirmation that is similar to the printed sign and arrow commonly provided for pedestrians who are sighted.

The arrow may be part of the pushbutton, above the pushbutton or on top of the device. On some devices, this arrow also vibrates during the walk interval.

FIG. 7-1.
THIS APS HAS A LARGE, HIGH CONTRAST, TACTILE ARROW ABOVE THE PUSHBUTTON. THE ARROW VIBRATES RAPIDLY DURING THE WALK INTERVAL.

FIG. 7-2.
THE TACTILE ARROW IS LOCATED ON TOP OF THIS APS HOUSING. AN OPTION IS TO HAVE THE ARROW VIBRATE DURING THE WALK INTERVAL.

FIG. 7-3.
THE VIBRATING TACTILE ARROW ABOVE THE PUSHBUTTON ON THIS APS IS SUPERIMPOSED ON A LARGER VISUAL ARROW.

Tactile arrow

Additional information

It is important that the arrow points in the direction of travel on the crosswalk, as it indicates which crosswalk is controlled by that pushbuton. Arrows on available devices are either on the face of the device or on top of the device (see photos).

Tactile arrows do not enable accurate alignment by many persons who are blind. However, those that work best have a relatively long shaft and are oriented so that they can be read with the hand held in a horizontal position.

For arrows on the face of the device, the alignment is determined by the installation of the pushbutton on the pole. Those on the top of the pushbutton integrated APS are typically glued into place after the pushbutton is installed and their alignment can be adjusted separately from the pushbutton.

To align the arrow properly, the installer needs to understand that pedestrians are expecting the arrow to be aligned with the direction of travel across the crosswalk to provide information about the crosswalk alignment. The purpose is not to point toward the beginning of the crosswalk, or the curb ramp location. Misalignment of the arrow by a few degrees can direct a blind pedestrian into the center of the intersection.

References

Pushbutton and arrow should be within 5 feet of the crosswalk lines extended, (MUTCD 4E.08), aligned in the direction of pedestrian travel controlled by the pushbutton (MUTCD 4E.08; *Draft Public Rights-of-Way Accessibility Guidelines* 1106.4.1, PROWAAC X02.5.1.4 (A)).

Arrows should have good visual contrast with their background so that all users, including those having low vision, will see them readily (MUTCD 4E.08, *Draft Public Rights-of-Way Accessibility Guidelines* 1106.4.1).

How used

Pedestrians who are blind will use tactile arrows to determine and confirm which crosswalk the pushbutton controls and the general direction of travel on the crosswalk and will use other clues from traffic sounds to confirm their alignment and crossing direction.

They will typically proceed in as straight a line as possible from the device to the curb of the perpendicular street in the direction of the arrow, which means the APS should be as close as possible to the extension of the crosswalk lines.

Pushbutton information message

Description

A pushbutton information message is a speech message that provides additional information when the pedestrian pushbutton is pushed, and is a feature available on some pushbutton-integrated APS. This message may provide the name of the street that the pushbutton controls, as well as other intersection geometry or signalization information.

This message is referred to by different names in the information from manufacturers. These include:

- Voice on location
- Informational message
- Verbal message
- Additional message
- Instructional/location message

Additional information

The pushbutton information message is provided from a speaker located at the pushbutton, during the flashing and steady Don't Walk intervals only. The message is intended to be audible when standing at the pushbutton location. Pedestrians may be required to press the pushbutton for approximately three seconds (see extended button press) to call up this additional speech message.

The pushbutton message, in conjunction with the tactile arrow, can clarify the street names and the crosswalk controlled and signaled by the device. To do so, the pushbutton message must indicate which street is actuated by the pushbutton, and the arrow must point in the direction of travel of that crosswalk.

A message that includes only the intersection street names, without clarifying which street is actuated by the pushbutton, does not provide unambiguous information. See recommendations, below, for pushbutton message wording.

Some devices respond to the extended button press by providing more than one additional feature, so the extended button press may activate the audible beaconing feature as well as provide additional information.

Limitations on use

An APS pushbutton should not be used for landmark information or to inform pedestrians with visual impairments about detours or temporary traffic control, according to recent research (Bentzen et al. 2002).

Pushbutton information message

When to use

PROWAAC X02.5.1.4 A recommends requiring that unambiguous information be provided at pushbuttons indicating which WALK signal is requested by that pushbutton. The MUTCD says that unambiguous information should be provided (MUTCD 4E.08). PROWAAC (X02.5.1.4 C) also recommends requiring intersection identification information at each APS. Pushbutton messages are a good way to provide this information.

Pushbutton message wording

Pushbutton information messages should be developed according to the following models (Bentzen et al 2002). The full report, *Determining Recommended Language for Speech Messages used by Accessible Pedestrian Signals*, is available on the Accessible Intersections page of the web site of the Institute of Transportation Engineers, www.ite.org:

- Model pushbutton message: **"Wait to cross Howard at Grand."**
- Model pushbutton message for intersections having an exclusive pedestrian phase with right turns-on-red prohibited: **"Wait to cross Howard at Grand. Wait for red light for all vehicles."**
- Model pushbutton message for intersections having an exclusive pedestrian phase with right turns-on-red permitted: **"Wait to cross Howard at Grand. Wait for red light for all vehicles. Right turn on red permitted."**
- Model pushbutton message for angled crosswalks: **"Wait to cross Howard at Grand. Crosswalk angles right."**
- Model pushbutton message for crosswalks to medians where a second button push is required: **"Wait to cross Howard at Grand. Short WALK phase. Raised [or cut-through] median with second pushbutton."**
- Model pushbutton message for signalized crosswalks to splitter islands: **"Wait to cross right turn lane to island for Howard and Grand crosswalks."**
- Model pushbutton message for crosswalks at "T" intersections: **"Wait to cross Howard at Grand."** (Not different from standard intersection identification message.)

Use "Street," "Avenue," etc., where needed, to avoid ambiguity.

Keep the word order illustrated in the above model messages.

Where model messages have complete sentences, sentences should be complete, for best comprehension.

Pushbutton information message

How used

Pedestrians who are unfamiliar with the intersection, or who wish to confirm their location, will:

- Locate and depress the pushbutton for approximately three seconds;
- Stand beside the pushbutton speaker to listen to the speech message play; and
- Push the button again, if desired, to hear the message repeated.

At a location with two pushbuttons on a pole and a speech WALK message, it is particularly important that users understand and recognize the street name.

Automatic volume adjustment

Description

Many accessible pedestrian signals have volume control that is automatically responsive to ambient (background) sound.

- A louder signal is produced when vehicle and other noise at an intersection is high (as during rush hour or construction).
- A quieter sound is produced when traffic volume is lower, (as during night-time hours).
- A microphone continuously samples the noise levels and varies the volume in response to the existing sound levels.
- The microphone may be incorporated into the pushbutton housing, or located at the pedhead.

Automatic volume adjustment is also known as automatic gain control (AGC), or ambient sound adjustment.

Additional information

Some signals can be pre-set to vary volume within particular ranges.

- Most signals with automatic volume control have a minimum limit placed at about 30 dB and a maximum limit at about 90 dB.
- A signal that is 2-5 dB above ambient sound, as perceived at the departure curb, is loud enough to inform pedestrians who are blind that the walk interval has begun. If the microphone is installed at the pedhead, and the pedhead is set back from the curb, the volume as sensed by the microphone is not as loud as that perceived by pedestrians waiting at the curb. Therefore, at each installation, the setting must be adjusted depending on the location of the microphone in relation to pedestrians waiting to cross.
- Some APS allow the installer to set the range of the locator tone and the WALK indication separately; others are set the same.
- Some APS have adjustments for microphone sensitivity as well as volume.

References

MUTCD 4E.06

Draft Public Rights-of-Way Accessibility Guidelines 1106.2.3.2, 1106.3.2,

PROWAAC X02.5.2.2G

How used

Automatic volume adjustment provides flexibility and allows APS to adjust so they are not disturbing to neighbors. This is also helpful to blind or visually impaired pedestrians, as the APS does not drown out essential traffic sounds necessary for crossing.

Alert tone

Description	A very brief burst of high frequency sound, rapidly decaying to a 500 Hz WALK tone, is used by one manufacturer to alert pedestrians to the exact onset of the walk interval.
Additional information	An alert tone may be particularly useful if the WALK tone is not easily audible in some traffic conditions. As used in Australia, the alert tone is 14dB above the ambient sound level. Australian engineers believe the alert tone encourages faster initiation of crossing, decreasing the likelihood of conflict between pedestrians and turning vehicles. When crossings are initiated faster, pedestrians also clear the intersection faster. Example of an alert tone is on the web site at www.walkinginfo.org.
Reference	Not mentioned in *Draft Public Rights-of-Way Accessibility Guidelines*, MUTCD or PROWAAC.
How used	An alert tone may be particularly helpful in locations with high ambient noise levels to alert pedestrians to start of a speech WALK message, or of a WALK indication that is hard to hear over traffic sound.

Actuation indicator

Description

Either a light, a tone, a voice message, or both audible and visual indicators may indicate to pedestrians that their desire to cross has been communicated to the controller.

Additional information

- Several APS devices emit an audible click or beep when the pushbutton is pushed. One provides a speech confirmation message.
- If there is a light, it is at or near the pushbutton and remains illuminated until the WALK indication is illuminated. A light is helpful to persons with low vision, but persons who are blind require a tone.
- In some devices, this indicator is triggered by the device itself, meaning "A pedestrian has pushed the button." In others, the indicator is triggered by the controller, meaning "The controller has received a request for a pedestrian timing."

FIG. 7-4.
A RED ACTUATION LIGHT IS NEAR THE PUSHBUTTON.

FIG. 7-5.
A RED ACTUATION INDICATOR LIGHT IS ABOVE THE PUSHBUTTON.

References

MUTCD 4E.07 (pilot light)

PROWAAC X02.5.1.2 PROWAAC recommends an audible and visual indication that the button press has occurred.

How used

The indicator assures pedestrians that the device is working, thereby encouraging pedestrians to wait until the onset of the walk interval.

Tactile map

Description

One manufacturer's pushbutton-integrated signal can incorporate a raised schematic map showing what will be encountered as the pedestrian negotiates the crosswalk controlled by that pushbutton.

Additional information

Map information includes:

- Number of lanes to be crossed;
- Whether these are vehicular or bicycle lanes or trolley tracks;
- Which direction traffic will be coming from in each lane; and
- Whether there is a median.

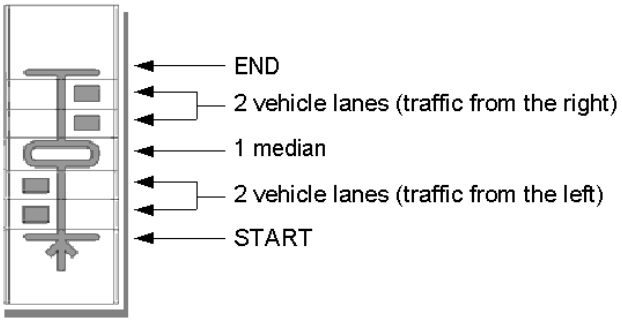


FIGURE 7-6. THIS TACTILE MAP FROM A SWEDISH APS IS READ FROM THE BOTTOM TO TOP SHOWING LANES AS PEDESTRIANS WOULD REACH THEM.

This map is made up of changeable 'slugs' inserted in the side of the pushbutton housing. It must be set up for each crosswalk of the intersection. The map information shows just the crosswalk controlled by that signal, not the entire intersection.

Symbols used are not standardized in the US, but one manufacturer has developed a standard set that is used in other countries.

References

Draft Public Rights-of-Way Accessibility Guidelines state that 'where provided, graphic indication of the crosswalk shall be tactile'. Also requires that the figures contrast with the background.

PROWAAC X02.5.1.4D recommends map indications that are similar to the Swedish symbols

How used

- Pedestrians unfamiliar with the intersection or crossing hear the locator tone and locate the pushbutton and map.
- Standing facing the crossing, they 'read' the map and learn how wide the street is, and what they will encounter in the crosswalk, before they begin to cross.
- They can also learn whether the pedestrian signal controlled by that pushbutton provides a crossing time for the entire crossing or just to a median or island. If the signal is just for a portion of the street, the map indication will end on a 'median' graphic, indicating that there is another crossing, either controlled or uncontrolled.

Braille and raised print information

Description

Some manufacturers will provide the name of the associated street in Braille above the pushbutton, as an option.

FIG. 7-7. BRAILLE LARGE PRINT STREET NAME ARE ON A SIGN ABOVE THE PUSHBUTTON.

Additional information

Although this may be helpful to some pedestrians who are blind, many would not locate the Braille because of the lack of a standardized location for such information.

- Many individuals who are blind do not read Braille, however, those who do would prefer Braille information to confirm which street is controlled by the pushbutton.
- Some individuals who do not read Braille may be able to read large print, or raised print.
- The street name on a device should be the name of the street whose crosswalk is controlled by the pushbutton.

PROWAAC suggested that providing intersection identification information in an audible format may be useful to the greatest number of users.

FIG. 7-8. A RAISED PRINT AND BRAILLE SIGN IS MOUNTED VERTICALLY ON A ROUND POLE TO THE RIGHT OF AN APS. THE SIGN READS "GEORGE ST. 275-339R".

Braille and raised print information

References

Draft Public Rights-of-Way Accessibility Guidelines require street name information in raised characters on the face of the device or its housing or mounting.

MUTCD 4E.08 states: "Name of the street …may also be provided in accessible format…."

PROWAAC X02.5.1.4C recommended that signs at APS include the street name in Braille and raised print.

How used

Braille information and/or raised print information, in combination with the tactile arrow

- Can help pedestrians learn or confirm the street name which is controlled by the pushbutton, and
- Can help pedestrians choose which of two pushbuttons to press to cross the desired street.

Extended button press

Description

Extended button press is an option on many APS that actuates additional accessibility features. Most require the pushbutton to be pressed for between one second and three seconds to activate the features. (The length of time will be standardized as soon as on-going research indicates the optimal length.)

Other names for this feature in manufacturers' literature include:

- BAT – Button actuated timer
- Extended push
- Extended button press

Features called

Possible features called by the extended button press include:

- The accessible WALK indication;
- Providing a pushbutton message identifying the intersection and the crosswalk, at the pushbutton, during the DON'T WALK or flashing DON'T WALK;
- Providing a pushbutton message with intersection signalization and geometry information, at the pushbutton, during the DON'T WALK or flashing DON'T WALK;
- Audible beaconing by increasing the volume of the WALK tone and the associated locator tone for one signal cycle, so a blind pedestrian can use the sound from the opposite side of the street to provide directional guidance;
- Audible beaconing by alternating the audible WALK signal back and forth from one end of the crosswalk to the other;
- Audible beaconing by providing the WALK indication from the far side of the street only, at an elevated volume for one signal cycle; and
- Providing extended crossing time.

Any or all of these features would be called by pressing and holding the same button that is used by all pedestrians.

Extended button press

Additional information

Some systems have used an additional pushbutton to actuate the accessible signal. APS should be actuated by the same button used by all pedestrians.

Pedestrians who are not aware of local practice may not be aware that a signal is APS equipped, and may not be able to call the accessible signal or take advantage of the additional features, because they may not press the button long enough. However, PROWAAC recommended that "Additional features which may be required to make a specific intersection accessible shall be brought up by a longer press of the push button." And "An additional button should not be used to bring up additional accessibility features. All accessible features available are to be actuated in the same way. Thus, for a given signal, an extended button press could request more than one additional feature."

FIG. 7-9. CONTRARY TO PROWAAC RECOMMENDATIONS, THE PHOTO SHOWS AN ADDITIONAL BUTTON USED TO BRING UP ADDITIONAL ACCESSIBLE FEATURES. THE LOWER SIGN READS "BLIND ONLY."

Education needed

Individuals who are blind have a limited familiarity with these recommendations. Locations that use such a system should provide educational materials and information to individuals who are blind or visually impaired in the community to assure that they can take advantage of the features.

References

Draft Public Rights-of-Way Accessibility Guidelines
1106.3.4 Optional Features

PROWAAC X02.5.2.3

MUTCD 4E.08

Extended button press

How used

Use will depend on the feature(s) called by the extended button press. See the section on audible beaconing (in Chapter 6, APS Walk Indications), and pushbutton information message (in this chapter) for further discussion of the use of those features. The intent is to allow individuals who are blind to have some choice in the use of the accessible features.

- As the extended button press feature is more commonly installed, it would be expected that pedestrians who are blind or visually impaired might hold the button longer at unfamiliar intersections in order to determine what features are installed and decide how they want to cross the street.
- The extended button press allows pedestrians to decide if they want all the possible accessible features at an intersection.
- Pedestrians may decide if they want audible beaconing at a location, which many may find necessary only at certain times and with certain traffic patterns.
- Individuals who are unfamiliar with an intersection can get intersection information but the message is not played every time the button is pressed, which some believe would be annoying.

Passive pedestrian detection

Description

Passive pedestrian detection is available to call the WALK indication and can extend the clearance interval. Authors are not aware of US installations that include audible signals as well as visual signals, but this technology is known to be in use in the United Kingdom, Australia, New Zealand and the Netherlands.

One pushbutton integrated APS provides the option of triggering the pushbutton locator tone through sensors (piezo-electric, infrared, or microwave) when the pedestrian enters the detection zone.

FIG. 7-10. (LEFT) DETAIL OF APS AT MIDBLOCK CROSSING IN AUSTRALIA. SIGN READS "PUSH BUTTON THEN WAIT ON RED MAT."

FIG. 7-11. (RIGHT) THIS MIDBLOCK CROSSING HAS SENSORS IN A SPECIFIC AREA OF THE SIDEWALK. A RED MAT AREA IS LABELLED "PUSH BUTTON THEN WAIT HERE.":

References

MUTCD 4E.08

Draft Public Rights-of-Way Accessibility Guidelines 1106.3.4 Optional Features

How used

While passive detection of pedestrians for activating the locator tone may be helpful in reducing noise near the intersections, pedestrians who are blind may not be approaching the crosswalk or intersection within the detection zone. They also may not know about it unless they are familiar with the intersection.

Example of passive pedestrian detection

PUFFIN crossings

An example of passive pedestrian detection technology is the "Pedestrian User-Friendly Intelligent (PUFFIN) crossing in use in England since 1993 (Department of Transport, 1993). PUFFIN crossings employ pedestrian detectors for both the pedestrian waiting area and the crosswalk.

PUFFIN waiting area detectors

Waiting area detectors consist of either

- Pressure mats with piezo-electric sensors, infrared or microwave detectors mounted on the signal pole, or
- Video cameras serving remote sensor software.

How used

For such detectors to be effective, pedestrians who are visually impaired must be able to locate the push button, the precise waiting area, and the crosswalk.

The following sequence occurs:

- Pedestrian presses a pushbutton to actuate the walk interval
- Detectors confirm the presence of pedestrians standing near the crossing, then
- If the pedestrian leaves before the onset of the walk interval, the call for the pedestrian phase is canceled.

PUFFIN crosswalk detectors

Crosswalk detectors are microwave or infrared sensors that respond to pedestrians moving in the crosswalk. As long as a pedestrian is detected in the crosswalk

- A preset extension is added to the pedestrian clearance interval;
- Late-starting or slow-moving pedestrians have more time to clear the intersection before vehicular traffic resumes; and
- Driver waiting time is reduced if the pedestrian crosses in a gap in traffic instead of waiting for the pedestrian phase.

In Adelaide, Australia, installation of passive pedestrian detection in the crosswalk, for extending crossing time, is now standard at intersections where there is a newly installed APS.

Remote activation

Description	At least one manufacturer offers the option of a handheld pushbutton that sends a message to the APS to call the pedestrian phase. It operates on a limited range radio frequency (such as a garage door opener or car door unlock device) within 100 feet.
Additional information	Manufacturer's information does not clarify how the device would differentiate between locations at the intersection or if using the device would place a pedestrian call for all crossings of the intersection.
Reference	Not mentioned in MUTCD, *Draft Public Rights-of-Way Accessibility Guidelines* or PROWAAC
How used	Pedestrians could place a pedestrian call as they approach the intersection, without having to travel to the pushbutton location. This would make it unnecessary to deviate from the travel path and may be particularly an advantage for wheelchair users.

Clearance interval tones

Description

A tone or other message sounds during the pedestrian clearance interval, at a different rate, tone, or with a different speech message, than the WALK interval indicator. This is not the same as the APS reverting to the locator tone during the flashing DON'T WALK and DON'T WALK interval.

Clearance interval information is sometimes provided by APS in Japan and in some parts of Canada.

- In Japan, a variety of alternatives are available including a European emergency vehicle "ba-boo" sound, and various melodies.
- In Canada, it may be provided by a tone that repeats at a faster rate than the WALK signal. For example, if the WALK signal is a "cuckoo" at 1 time per second, during the clearance interval the "cuckoo" is sounded 2 times per second.

Additional information

Advantages:

- Lets pedestrians who are visually impaired who have begun to cross the street know that the clearance interval prevails, that is, that they do not yet have to fear the onset of perpendicular traffic; and
- Because it comes from loudspeakers at both ends of crosswalks, they may be able to home in on it as they complete their crossing.

Disadvantages:

- The sound is relatively loud, possibly masking the sound of critical traffic movement; and
- The clearance interval sound might be mistaken for the WALK signal.

It is particularly important that pedestrians who are blind not mistake a clearance interval signal for a WALK signal, as they could begin crossing late in the clearance interval when they would not have enough time to complete crossing before the onset of perpendicular traffic.

References

PROWAAC X02.5.2.2 G.

MUTCD states that the APS shall indicate the walk interval.

How used

This feature is not currently used in the US and is not recommended due to the potential confusion of the walk interval with the clearance interval.

Developing features

Integrated information devices

Personal pagers, cellular telephones, and other mobile digital communications devices could potentially receive transmitted pedestrian signal messages. The increased use of these devices suggests that there may be other technologies and methods to provide information to pedestrians and for pedestrians to call the walk interval in the future.

Development is ongoing on an integrated handheld computer type device to provide geographic, GPS, intersection layout and real-time signal information to pedestrians who are blind. Communication of a pedestrian call is also being investigated. However, such technology is in the very early development stages

Pedestrian countdown information

Pedestrian signal heads that provide pedestrian countdown information have recently been installed in many municipalities.

Provision of the countdown information to individuals who are blind or visually impaired in an audible verbal message format has been discussed. However, the provision of audible information during the clearance interval, as discussed in the section on clearance interval information, may mask traffic sounds that are important, or may be confused with the walk interval. In fact, a pedestrian who is blind is usually moving as quickly as possible to cross the street, and knowing the length of time left may not provide any additional information.

Pedestrian countdown information is unlikely to provide any advantage to the individual who is blind or visually impaired. Any provision of audible countdown information should be carefully evaluated before installation. At this time, it is not recommended

Chapter 8 – Where to Install APS

Summary

In making their facilities and street crossings accessible, state DOT's and municipalities must make decisions about where APS should be installed. Because of funding and other issues, it is often necessary to prioritize installations. This chapter provides information about procedures and rating systems used in some locations.

Chapter contents

This chapter includes discussions on the following subjects

- Where are APS required
- Where are APS needed
- Prioritizing APS installations
- Rating Scales

Examples of rating scales used by some municipalities are included in the Appendix.

Where are APS required?

Current practice

Currently in the US, APS are typically installed upon request along a specific route of travel for a particular individual or group of individuals who are blind or visually impaired. Various states and municipalities have established policies on installation of APS, some of which are not in accord with ADA requirements.

Requirements

The Rehabilitation Act (1973) requires nondiscrimination in all federally assisted programs, services and activities; this means that they are to be available and usable to people with disabilities (Section 504). The ADA requirements for Federal, State and local governments extend and increase the existing requirements in Section 504 of the Rehabilitation Act. The ADA requirements are more stringent and require public facilities to be accessible regardless of the funding source.

Title II of the ADA requires municipalities and states to make their 'programs' accessible. Pedestrian circulation is considered a program, and APS may be necessary to provide access to certain types of intersections. Some municipalities have considered the addition of APS at intersections as part of their ADA transition plan.

The ADA is a civil rights law, guaranteeing non-discrimination in the provision of public programs and facilities. It requires effective communication with persons with disabilities and, in order to meet this requirement, cities must respond to requests for APS from pedestrians who are blind by providing access to the information provided to sighted pedestrians by visual pedestrian signals if they are present.

ADA Accessibility Guidelines are minimum guidelines that must be applied to new construction or reconstruction and to alterations, renovation, or additions. Current Guidelines do not specifically address public rights-of-way or accessible pedestrian signals. (See section below on rulemaking.) However, the lack of guidelines or technical specifications does not alter the obligation to make pedestrian signal information accessible to persons who are unable to see existing pedestrian signals.

Where are APS required?

ADA transition plans

Title II requires public entities to take several steps designed to achieve ADA compliance.

"A public entity may not deny the benefits of its programs, activities, and services to persons with disabilities because existing facilities are inaccessible.

- State and local governments of 50 employees or more were required to prepare a self-evaluation plan to identify program access issues (Rehabilitation Act (1973), section 504).
- From this, a transition plan was to be developed to modify inaccessible services, policies and practices. This includes removing barriers and inaccessible features.
- Transition plan work was to have been completed by January 1995.
- If work was not completed by that date, those entities are out of compliance.
- Many states and localities are out of compliance and this makes them more susceptible to lawsuits.
- Ways of complying with the law are to have an ongoing transition plan for improving existing facilities and providing a citizen's request program for accessible parking, curb ramps, Accessible Pedestrian Signals (APS) and removing sidewalk and street crossing barriers." (Barbara McMillen, FHWA Office of Civil Rights, 9/2002)

As part of their compliance with ADA, municipalities should establish a plan to prioritize and make decisions about installation of APS at 'unaltered' intersections:

- Where a request for APS is received, and
- Where insufficient information for street crossing using non-visual clues exists.

Rulemaking on Public Rights-of-Way

Draft Public Rights-of-Way Accessibility Guidelines were published on June 17, 2002 for comment. These Draft Guidelines require APS at all newly constructed or reconstructed intersections where visual pedestrian signals are installed. (See Chapter 3, US Rules and Regulations Related to APS.)

A Notice of Proposed Rulemaking on Public Rights-of-Way, based on the draft is expected to be published by the Access Board in 2003.

Where are APS required?

Prioritizing

The remainder of this chapter provides information about establishing a prioritization plan for installation of APS.

The information in the following sections is not intended for application to new or reconstructed intersections; APS should be installed wherever pedestrian signals are installed in new construction or reconstruction projects, in accord with the *Draft Public Rights-of-Way Accessibility Guidelines.*

The ADA does not require wholesale reconstruction and renovation, but it does require municipalities to begin to address and prioritize retrofitting facilities to newer standards.

Where are APS needed?

MUTCD Guidance

MUTCD, section 4E.06 recommends: "The installation of accessible pedestrian signals at signalized intersections should be based on an engineering study, which should consider the following factors:

- Potential demand for accessible pedestrian signals.
- A request for accessible pedestrian signals.
- Traffic volumes during times when pedestrians might be present; including periods of low traffic volumes or high turn-on-red volumes.
- The complexity of traffic signal phasing.
- The complexity of intersection geometry."

Additional considerations

Too little traffic is as great a problem for pedestrians who are blind as is too much traffic. In the absence of APS, blind pedestrians must be able to hear a surge of traffic parallel to their direction of travel in order to know when the walk interval begins.

Locations that may need APS include those with:

- Intersections with vehicular and/or pedestrian actuation
- Very wide crossings
- Major streets at intersections with minor streets having very little traffic (APS may be needed for crossing the major street)
- T- shaped intersections
- Non-rectangular or skewed crossings
- High volumes of turning vehicles
- Split phase signal timing
- Exclusive pedestrian phasing, especially where right-turn-on-red is permitted
- A leading pedestrian interval

Where these conditions occur, it may be impossible for pedestrians who are visually impaired or blind to determine the onset of the walk interval by listening for the onset of parallel traffic, or to obtain usable orientation and directional information about the crossing from the cues that are available.

Prioritizing APS installations

Existing intersections

As discussed previously, this prioritization information is to be used in prioritizing existing intersections for retrofit with APS either in response to requests, or in updating an ADA transition plan.

Establishing priorities

Prioritization schemes should place only limited emphasis on factors related to frequency or likelihood of use by blind pedestrians. The information provided by APS may be necessary at any time, along any route, to residents, occasional travelers, and visitors. Intersections having high pedestrian volumes are likely to have pedestrians whose vision is sufficiently impaired that they have difficulty using conventional pedestrian signals.

Of greater importance are factors related to determining whether sufficient acoustic information exists — at all times — to permit safe crossing at a particular intersection.

Rating scales

Several rating scales have been developed, some of which have been utilized for over 20 years. These rating scales are used in different ways in different cities.

- In some locations, they were developed as warranting schemes and APS were not installed unless the intersection met a required minimum number of points.
- Other cities use rating scales only to aid in prioritization.

Generally, points are assigned to specific intersection features, as well as proximity to services for all pedestrians, such as transit, government offices, or shopping. San Diego, Los Angeles, Portland, Oregon, and Maryland Department of Transportation use point rating scales as part of their process. Their scales are included as examples in the Appendix and information about their process is discussed in this chapter.

After a request for an APS is made by an individual who is blind or by an organization representing or serving individuals who are blind or visually impaired, the intersection is evaluated using a rating scale.

Individual crossings

Systems developed most recently rate each crossing at an intersection rather than the whole intersection.

- The developers of these schemes have recognized that certain crossings of an intersection may not be problematic, while other crossings of the same intersection may not have sufficient auditory information.
- This change reflects recent developments in types of APS available as well, which may allow installation on particular crosswalks of an intersection without providing confusing cues to individuals at other crosswalks.

Prioritizing APS installations

Who evaluates?

Systems for determining the priority of APS installations usually involve participation of one or more representatives of three groups of experts: traffic engineers, orientation and mobility specialists, and pedestrians who are blind.

Different persons in different jurisdictions carry out the evaluation.

- In San Diego, a traffic engineer and an orientation and mobility specialist rate separate aspects of the intersections.
- In Los Angeles and Portland, the rating is conducted jointly by an orientation and mobility specialist and the traffic engineering department staff member.
- In Maryland, the DOT engineer determines the rating.

Prioritizing based on ratings

In San Diego and Portland, the ratings are reviewed by an advisory committee of stakeholders, including blind citizens, that assists the traffic engineering department in prioritizing the installations.

Intersections with the highest number of points are generally considered highest priority, however, date of request, plans for other construction at the intersection in question, and other issues may affect priority of the installation.

Research on a rating scale

As part of NCHRP Project 3-62, a prioritization rating scale will be validated.

After completion of this project, the rating scale will be available for use by jurisdictions involved in prioritization decisions.

Rating scales

Concept

In most schemes, each crosswalk of the intersection is evaluated separately. Items and point values assigned differ on the rating scales now available.

Rating scale items typically include

- pedestrian usage,
- intersection and traffic conditions, and
- a number of special conditions.

A rating scale used in developing a transition plan may be slightly different than one used to determine responses to individual requests.

Pedestrian usage

Pedestrian usage

- Proximity to alternate crossings
- Proximity to transit stops
- Proximity to key facilities used by all pedestrians
- Proximity to facility for persons who are blind
- Need to cross – frequency of use by requestor

Intersection and traffic conditions

Intersection and traffic conditions

- Intersection configuration
- Width of crossing
- Traffic signal phasing
  - Leading or lagging vehicular turn phasing
  - Leading pedestrian interval
  - Split phasing
  - Exclusive pedestrian phasing
- Traffic volume
- Vehicle speed
- Presence of pedestrian push buttons
- Right turning traffic

Special conditions

Special conditions

- Pedestrian accident records
- Unique circumstances
- Poor visibility of pedestrians (obstructions, parking lanes, curved street, crosswalk location)
- Orientation and mobility instructor comment/evaluation

Rating scales

Prioritizing individual requests

A rating scale used in prioritizing requests for APS at specific crosswalks may include factors such as:

- Number of requests for APS at crosswalk
- Frequency of use by pedestrians requesting APS

It may be appropriate for a jurisdiction, in response to an individual request in an area with extremely low pedestrian counts, to install an APS specifically meeting the requirements of that individual. That APS may not otherwise conform to requirements for new construction, or for installation in a more traveled pedestrian area.

Examples

Examples of rating scales currently in use are in the Appendix. A rating scale will be validated as part of NCHRP 3-62 and will be available by winter 2004.

Chapter 9 — Designing Installations

Summary

Accessible Pedestrian Signal (APS) installations require engineering, including detailed drawings and specifications. Complex intersections require complex decisions and the use of engineering judgment.

Decisions about type of device, device features, and where and how to install the APS may be affected by a number of factors that must be considered in designing the installation.

Additional information

Additional information on designing installations is in the following chapters

- Chapter 10 discusses installation in new construction and reconstruction situations
- Chapter 11 provides information and recommendations for retrofitting an intersection with an APS and provides recommended characteristics of APS for use in various situations
- Chapter 12 discusses specifying device components and provides drawings showing recommended APS placement and orientation.

Chapter contents

This chapter discusses general principles for making installation decisions, and how decisions may be affected by:

- Need for audible beaconing
- Signal phasing
- Intersection geometry

Installation decisions

Introduction

Each installation requires engineering judgment. In planning for APS installation, consider the following in determining the type of APS and where and how to install it:

- General principles
- Need for audible beaconing
- Signal phasing
- Split phasing
- Actuated turn phasing
- Exclusive pedestrian phasing
- Rest-in-walk
- Intersection geometry
- Unsignalized right turn lanes and splitter islands
  - Signalized right turn lanes
  - Medians

More latitude in specifications may be applied when the APS is an addition to an existing intersection. ADA requires new construction to meet the guidelines, while it requires additions to meet the guidelines to the maximum extent feasible. Understanding basic considerations is necessary to designing usable installations in both new and retrofit situations.

Principles

General principles in the decision.

- Provide information to pedestrians about the presence and location of pushbuttons if pressing a button is required to actuate pedestrian timing.
- Provide unambiguous information about the WALK indication and which crossing is being signaled.
- Use audible beaconing only where necessary:
  - Put as little additional sound in the environment as possible;
  - Avoid disturbance of neighbors; and
  - Allow pedestrians who are blind or visually impaired to hear the traffic sounds, as well as the APS.

Type and features

In many cases, a municipality or state will wish to purchase one type of APS device for all installations. However, there are engineering and design decisions in installation of APS as well as in the choice of equipment. When retrofitting intersections with APS, it may be necessary to use different types of APS, or different options on the same type of device, to provide unambiguous information at different intersections.

In new construction or reconstruction, where the APS can be located consistently, it is possible to use a standardized device and mounting location.

Installation decisions

Device location

Device locations are critical to functioning of the APS and need to be planned. The APS may provide ambiguous information if located incorrectly, just as pedestrian or vehicular signal heads can provide ambiguous, or even dangerous, information if located incorrectly.

Considerations for locating pushbuttons and speakers

When locating pushbuttons and speakers, consider their relation to:

- Crosswalks and pedestrian waiting location; and
- Curb ramps and level landings.

Consider the following factors:

- Location of mounting pole
- Type and shape of mounting pole.

Research currently underway will provide additional information about separation of poles, use of different types of devices, and speaker locations. More guidance will be provided at the completion of NCHRP Project 3-62, of which this guide is part.

Relation to crosswalk and pedestrian waiting location

Pedestrians who are blind or visually impaired must be able to quickly and accurately perceive which crosswalk is being signaled by an audible WALK indication. The use of two different sounds for crossing in two different directions has not proven to provide unambiguous information. (See section in Chapter 2 and Chapter 6).

Unless the sound sources are separated by at least 10 feet and located appropriately in relation to the crosswalk, it is difficult to discriminate which device is sounding. (See additional information on speaker location on page 6-6.)

Location in relation to curb ramps and landings

At pedestrian-actuated crossings, the pushbutton should be located close to the level landing of the curb ramp serving that crossing, for the convenience of all pedestrians using the pushbutton. For this reason, PROWAAC recommended specific locations for pushbuttons:

- "When located at a curb ramp [having the required level landing at the top], the push button shall be placed within 24 inches (610 mm) horizontally of the top corner of the curb ramp, on the side furthest from the center of the intersection of the roadway.
- When located at a transition ramp, the push button shall be placed adjacent to the lower landing. (PROWAAC X02.5.1.3(F))"

PROWAAC recommended APS zones are included in Figures X02.5 A, X02.5 B, and X02.5 C in the Appendix document EXISTING PROWAAC GUIDANCE ON APS.

Audible beaconing

Need for audible beaconing

The need for audible beaconing may affect type of device to be installed and installation location. Not all manufacturers' devices are capable of providing audible beaconing. The need for beaconing should be evaluated and considered early in the design of the installation.

A minority of crossings is likely to require beaconing and not all crosswalks at an intersection may need beaconing. Beaconing may actually cause confusion if used at some locations.

See page 6-19, Audible beaconing, for discussion of determining the need for audible beaconing. Criteria for use of beaconing are on page 6-20.

Recommended characteristics - APS installations where beaconing is needed

Recommended characteristics for APS at intersections where beaconing is needed. (in connection with either pretimed or actuated pedestrian signalization):

- Pushbutton is needed;
- Locator tone is needed;
- WALK signal may come either from pushbutton-integrated device, or from pedhead-mounted APS aimed diagonally down and out, into the center of crosswalk indicated by that WALK signal;
- In normal operation, WALK signal should be quiet, 2-5dBA above ambient sound;
- Extended button press should result in a louder WALK signal followed by a louder locator tone (Max. 89 dBA) for the subsequent pedestrian phase only. (Length of time of extended button press is being determined by research; currently 3 sec is typical)
- Sound should be increased only for the requested crosswalk.

Alternatively, beaconing may be provided by means of an alternating or far-side-only WALK signal followed by a louder locator tone for that pedestrian phase.

Recommended installation of audible beacons

Location of all speaker components of the APS within the width of the crosswalk is essential, as users will direct their travel toward the source of the sound.

See drawing on page 12-19 for specifications on location of speakers.

Signal phasing considerations

Introduction

Some signalization schemes, such as exclusive pedestrian phasing and split phasing, need careful adjustment and consideration to avoid confusing pedestrians who are blind. Crossings with pedestrian signals that rest-in-walk may need special treatment.

These issues must be considered in the design phase in determining type of device and location. In addition, careful adjustment of APS volume after installation is essential.

Split phasing

At a location with split phasing, an APS that can be heard from the parallel crosswalk provides incorrect, confusing, and dangerous information. It is critical that the WALK indication be audible only from the ends of the crosswalk being signaled so pedestrians do not begin to cross at a time when vehicles are turning across their path in a protected vehicular movement.

This can be accomplished by locating the APS very close to the crossing location so pedestrians can readily determine which is their signal. Careful adjustment of the APS volume at all times of the day and night is critical, as well as careful aiming of the speakers. Audible beaconing may not be appropriate at locations with split phasing, due to the possibility of confusion of signals.

Suggested strategies:

- A pushbutton integrated system with carefully set volume, or a pedhead mounted APS with very careful placement and adjustment, to be heard only at the crossing location (see photos and discussion in Chapter 12)
- A pushbutton that actuates the audible WALK indication only for the crosswalk that received the pedestrian call.

Signal phasing considerations

Actuated turn phasing

In some timing plans for actuated turn phasing, traffic in one direction may be held longer to allow the opposing traffic to complete left turning movements. In many such cases, the pedestrian phases on parallel crosswalks begin at different times. An APS that can be heard from the parallel crosswalk provides incorrect, confusing, and dangerous information and could mislead a pedestrian to cross when vehicles are turning across their path in a protected vehicular movement.

Strategies:

- A pushbutton integrated system with carefully set volume, or a pedhead mounted APS with very careful placement and adjustment, to be heard only at the crossing location (see photos and discussion in Chapter 12)
- A pushbutton that actuates an audible WALK indication only for the crosswalk that received the pedestrian call.
- Having the audible WALK indication sound only during that part of the walk interval that is common to both of the parallel lanes, provided that the pedestrian clearance time remains long enough to enable pedestrians crossing with audible cues to cross the street.

Signal phasing considerations

Exclusive pedestrian phasing

Exclusive pedestrian phasing (also known as scramble phasing) makes it difficult for pedestrians who are blind or visually impaired to recognize the onset of the walk interval, particularly at locations where right on red is permitted. In addition, there is no vehicular flow to aid in crossing straight to the destination corner.

Ongoing research is evaluating strategies for APS installation at intersections with exclusive pedestrian phasing.

In some locations, pedhead mounted APS have been installed on all corners and two different sounds for different crossing directions have been set to sound during the WALK indication. This is not recommended, as it is confusing to all pedestrians, and the assumption of pedestrians who are blind may be that the signals are broken.

A pushbutton information message, followed by a WALK tone, will be used in a pilot project in Morgantown, West Virginia, at an intersection with exclusive pedestrian phasing, in association with a WALK tone. The pushbutton information message will be modeled after

> "Wait to cross Howard at Grand. Wait for red light for all vehicles. Right turn on red permitted."

During the walk interval, all pushbutton-integrated devices at the intersection will emit the same, rapidly repeating, tone. Only one APS may be installed on some corners, with a modified tactile arrow installed on the top of the device, with arrows pointing in two directions. See Morgantown case study in Chapter 14.

An experimental location in San Diego provides eight pushbutton integrated APS with speech pushbutton information messages, and speech WALK messages ("WALK sign is on for all crossings") and a tactile guide strip within each crosswalk.

Rest-in-walk

At locations where the pedestrian signal to cross the minor street rests-in-walk, the WALK indication would sound constantly for that crossing. In many locations, that might prove to be irritating to neighbors.

Some APS manufacturers provide a limit switch that limits the length of the audible WALK indication to seven or eight seconds, but recalls the audible and vibrotactile indications of the WALK, if the button is pressed when there is adequate clearance time remaining. Availability of that feature should be investigated in the installation planning.

Intersection geometry considerations

Effect on APS

An APS that is audible from the wrong crossing location may lead a visually impaired pedestrian to begin to cross at the incorrect time and place. Geometry such as unsignalized and signalized right turn lanes, and medians have been recognized as situations of concern in language in the MUTCD.

The type of APS may not be as important as the location of the sound source and volume of the APS WALK indication. These issues must be considered in the design phase in determining type of device and location.

Also, careful adjustment of APS volume after installation is essential.

Unsignalized right turn lanes and splitter islands

An unsignalized right turn lane can pose a problem if the APS for crossing the center of the intersection is too loud. Pedestrians who are unaware of the existence of an unsignalized right turn lane may reach the curb, hear the APS sounding and cross the unsignalized lane, thinking that it is signalized.

This concern is the reason MUTCD 4E.06 urges careful selection of tones at locations with free right turns. However, tone selection does not really provide a solution; volume of the sound and placement of the speaker are the important issues.

The APS must be adjusted so it is only heard from the location where the pedestrian is waiting to cross and only audible for the crosswalk being signaled. It is generally not appropriate to use audible beaconing where there are splitter islands because the volume cannot be controlled precisely enough; there will always be occasions when a signal for one crossing will be audible from another. As discussed in the section on split phasing, volume and placement of the sound source are critical considerations in designing and installing the APS.

Signalized right turn lanes

Where crosswalks from corners to splitter islands are signalized, the signals to cross to the island may not be concurrent with parallel traffic movements. Those signals should be located precisely by the associated crosswalks and should be equipped with pushbutton integrated APS with careful volume adjustment. Pedestrians waiting on the island must not confuse the WALK indication for the turn lane with the WALK indication for the through lanes of the intersection. Pedestrians approaching the corner need guidance to the crosswalk location, which can be provided by the locator tone combined with curb ramp location.

(continued)

Intersection geometry considerations

Signalized right turn lanes (continued)

Because signalized right turn lanes are relatively uncommon, and because blind pedestrians can create gaps in traffic by actuating such signals, installation of APS at signalized right turn lanes should be given high priority.

APS in locations with signalized turn lanes are quite common in Sweden and Australia. See Chapter 4, International Practice, for photos of installations.

Medians

If the pedestrian clearance time is sufficient only to cross to a median having an additional pushbutton, it is very important that the pushbutton on that median be an APS with a locator tone. This may inform the pedestrian who is visually impaired that a second button press is needed to complete the crossing, and will aid in location of the median and the pushbutton. If only one APS device is on the median, the pushbutton should have a double-ended arrow.

If pedestrian phases for the two halves of the street are timed separately, two pushbutton-integrated APS are needed on the median, separated by as much distance as possible, and located as close to each crossing departure location as possible. In addition to the locator tone of an APS, a fence and offset crosswalks are used in European and Australian cities to alert all pedestrians about the need to stop on the median and wait for the next pedestrian phase.

FIG. 9-1. AT THIS MEDIAN ISLAND IN IRELAND, AN APS IS PROVIDED FOR EACH CROSSING, A FENCE PREVENTS PEDESTRIANS FROM CONTINUING STRAIGHT ACROSS THE STREET, REQUIRING THE PEDESTRIAN TO TURN AND WALK TO THE OTHER CROSSWALK LOCATION AND PUSHBUTTON.

Chapter 10 —
New Construction or Reconstruction

Summary

Installation of Accessible Pedestrian Signals (APS) in locations that are new construction or reconstruction are expected to meet new construction guidelines. This chapter reviews those guidelines and provides drawings and installation examples.

Additional information

The following chapters have related information:

- Chapter 9 discusses general principles and
- Chapter 12 discusses specifying device components and provides drawings showing recommended APS placement and orientation.

Chapter contents

In this chapter:

Device requirements in new construction

Draft guidelines

Draft Public Rights-of-Way Accessibility Guidelines were published on June 17, 2002. While the guidelines have not been published as a final rule, they provide the most comprehensive guidance available at this time.

APS Characteristics

The *Draft Guidelines* for new construction and reconstruction require the following:

- APS devices integral with the pushbutton
- Audible and vibrotactile indications of the walk interval
- WALK indication by tone or voice (speech)
- Pushbutton locator tone where there are pushbuttons
- Tactile and visual signs on the face of the device or its housing
- Signs are to include a tactile arrow indicating the crosswalk direction and the name of the street.

Optional features

The *Draft Guidelines* state that an extended button press shall be permitted to activate additional features. However, no information is provided which specifies what those features may include.

PROWAAC recommended the following possible responses to an extended button press:

- "sound beaconing by increasing the volume of the WALK tone and the associated locator tone for one signal cycle, so a blind pedestrian might be able to use the sound from the opposite side of the street to provide alignment information;
- sound beaconing by alternating the audible WALK signal back and forth from one end of the crosswalk to the other;
- providing extended crossing time; and
- providing a voice message with the street names at the intersection." (PROWAAC X02.5.2.3 Optional Features)

Location in new construction

Location in new construction

Draft Public Rights-of-Way Accessibility Guidelines specify that APS devices shall be located as follows:

- At a level landing connected to the pedestrian access route,
- 60 inches maximum from the crosswalk line extended,
- 120 inches maximum and 30 inches minimum from the curb line, and
- 120 inches minimum from other pedestrian signal devices at the crossing with an exception to that distance for devices installed on medians.
- Control face of the device is to be installed to face the intersection, parallel to the direction of the crosswalk it serves.

MUTCD recommended locations

MUTCD-recommended locations are substantially the same as required in new construction and reconstruction by the *Draft Public Rights-of-Way Accessibility Guidelines*. See Chapter 3 for details.

APS locations

Ideal placement

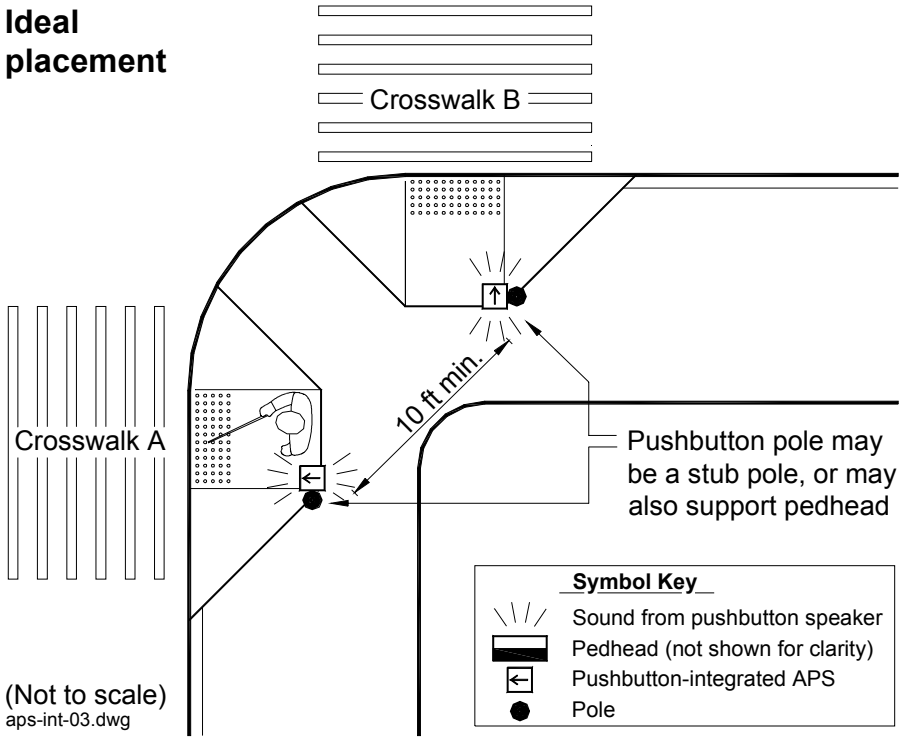


FIG. 10-1. IDEAL PLACEMENT FOR PUSHBUTTON-INTEGRATED APS.

Location in new construction

APS locations

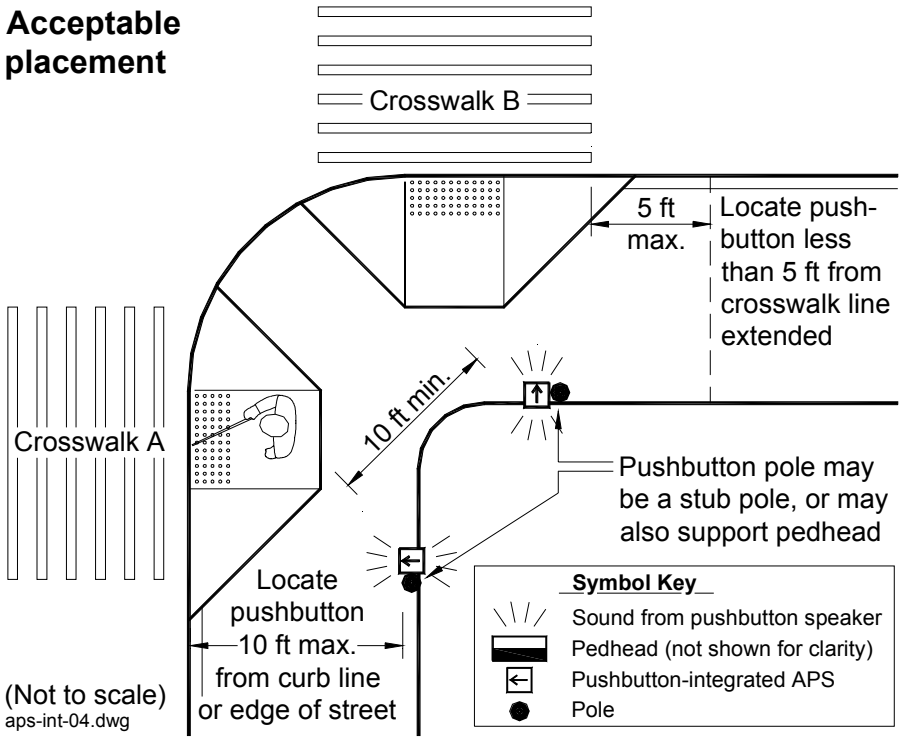


FIG. 10-2. ACCEPTABLE PLACEMENT FOR PUSHBUTTON-INTEGRATED APS.

APS recommended characteristics and installation examples

Recommended characteristics – APS installation in new construction

Recommended characteristics for APS devices in new construction:

- Pushbutton-integrated APS
- Pushbutton locator tone
- Quiet WALK signal — 2-5dBA above ambient sound

Recommended installation

- Tactile arrow should point in the direction of travel on the crosswalk
- Face of the device toward the intersection
- APS should be within 5 feet of the extension of the crosswalk lines and within 10 feet of the curb
- Precise location of the APS is very important to prevent ambiguity about which crosswalk is being signaled
- The sound source for two pushbutton-integrated APS on the same corner should be a minimum of 3 m (10 ft) apart

Location details

FIG. 10-3.
THE FACE OF THE DEVICE SHOULD BE ORIENTED TOWARD THE INTERSECTION

APS recommended characteristics and installation examples

Location details

FIG. 10-4. THE APS SHOULD BE WITHIN 5 FEET OF THE CROSSWALK LINE EXTENDED.

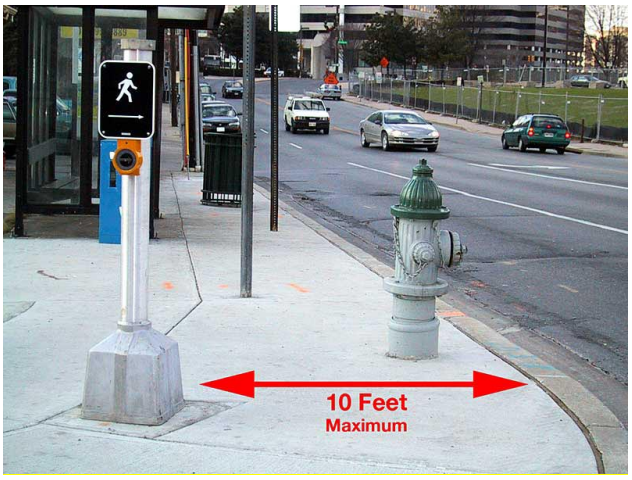


FIG. 10-5. THE APS SHOULD BE WITHIN 10 FEET OF THE CURB

Installation Example

FIG. 10-6. APS INSTALLED IN THIS RECONSTRUCTION LOCATION IN ACCORDANCE WITH THE *DRAFT GUIDELINES* BESIDE A LEVEL LANDING, WITHIN 5 FEET OF THE CROSSWALK LINE EXTENDED AND LESS THAN 10 FEET FROM THE CURB. THE CONTROL FACES AND PUSHBUTTONS FACE THE INTERSECTION.

Chapter 11 — Retrofitting an Intersection with an APS

Summary

When installing Accessible Pedestrian Signals (APS) at existing intersections, constraints of the intersection and signalization may affect the ability to meet new construction guidelines. New construction guidelines should be followed to the maximum extent feasible. The following sections provide guidance to assist the engineer/designer in understanding the effect of varying locations and different actuation on the usability of the information provided by APS

Additional information

Additional information that should be considered in designing APS retrofits is in the following chapters:

- Chapter 9 discusses general principles
- Chapter 10 reviews new construction guidelines
- Chapter 12 discusses specifying device components and provides drawings showing recommended APS placement and orientation.

Chapter contents

Retrofitting intersections with APS – alterations or additions

- Addition of APS to an existing intersection
- Effect of type of actuation on device features
  - Pushbutton actuated
  - Not pushbutton actuated
- Pole Location

Addition of APS to an existing intersection

Application of new construction guidelines

In retrofit situations, the ADA requires that new construction guidelines be followed to the maximum extent feasible, where compliance with new construction guidelines is technically infeasible. The determination of technical infeasibility will vary depending on the scope of the project and the existing situation.

The new construction guidelines, as described in Chapter 10, should be applied as much as possible given the constraints of the project and the site.

The following sections provide guidance to assist the engineer/designer in understanding the effect of varying locations and different actuation on the usability of the information provided by APS.

Avoiding ambiguity

The goal of the new construction location requirements and guidelines is to provide unambiguous information about which crosswalk has the WALK indication, and to make pushbuttons accessible to and usable by all pedestrians, including those with visual and mobility impairments. Poor location and installation can render APS unusable by a pedestrian who is blind or mobility impaired, or provide dangerous or incorrect information.

Pedhead-mounted and pushbutton-integrated APS in the US have typically been mounted on the same pole as the pedestrian signals for that crosswalk, regardless of whether the pedhead is the one closest to that crosswalk.

In Australia and some European countries, it is common to install a separate stub pole to mount pushbutton-integrated devices in a consistent location in relation to crosswalks. This consistent location makes it easy to determine which device the WALK indication is coming from, and, therefore, provides unambiguous information regarding which crosswalk has the walk interval. The *Draft Guidelines for Accessible Public Rights-of-Way* implement that strategy in new construction in the U.S.

Issues to consider

In designing retrofit installations, an understanding of the effect of certain intersection features on APS use will be helpful in making decisions. These include:

- Type of pedestrian phase actuation
- Existing pole location

Chapter 9 provides general principles to consider in APS installation. Chapter 12 provides information on specifications for installation.

Effect of type of actuation on device features

Effect of type of actuation on device features

The individual who is blind or visually impaired has different information needs that relate to the method used to actuate the pedestrian phase. Different device features may be appropriate for situations with:

- Pushbutton-actuated pedestrian timing
- Pedestrian timing that does not require pushbutton actuation
  - Pretimed pedestrian phase,
  - Pedestrian phase on recall,
  - Passive pedestrian detection.

APS at pushbutton actuated intersections

Pushbutton-actuated pedestrian timing

Pushbutton-actuated pedestrian timing requires a pedestrian to locate the pushbutton and push it to request the pedestrian phase. A pedestrian who is blind needs to know a button-press is required to actuate a pedestrian timing, and needs to be able to find the pushbutton easily. The most appropriate way to convey that information is with a locator tone at the pushbutton. In addition, pedestrians who are blind need access to information about the beginning of the walk interval.

A pushbutton-integrated APS, or pedhead-mounted APS with a locator tone, should be selected if an intersection has pedestrian actuation at any time.

Draft Public Rights-of-Way Accessibility Guidelines require APS with a locator tone where there are pedestrian pushbuttons. As well, the MUTCD 4E.08 guidance states that "pushbuttons should be audibly locatable."

Location of pushbuttons for actuated signals

To be useful to pedestrians who are visually impaired, pushbuttons must be installed as near the crosswalk as possible, preferably on the sidewalk within the width of the crosswalk connection or adjacent to the crosswalk, and as close to the curb as possible. Pedestrians who are blind must locate and push the pushbutton, then align themselves to cross as discussed in Chapter 1.

Even with an accessible signal, a pedestrian who is blind or visually impaired may not cross on the first WALK indication, but may need to listen to traffic and the accessible signal for a cycle to confirm their alignment, the signal functioning, and traffic direction before pushing the pushbutton again, realigning and crossing on the following pedestrian phase.

Additional information on pushbutton locations is on pages 12-5 through 12-10.

Recommended characteristics - APS at push-button-actuated intersections

APS devices at pushbutton-actuated intersections where beaconing is not needed should have:

- Pushbutton locator tone and tactile arrow at the pushbutton; and
- Quiet WALK signal — 2-5dBA above ambient sound.
- Either pushbutton-integrated APS, or a pedhead-mounted APS with the WALK indication speaker aimed down toward the waiting location.

APS at pushbutton actuated intersections

Recommended installation at pushbutton-actuated intersections

Installation recommendations:

- The sound source for two pushbutton-integrated or pedhead-mounted APS on the same corner should be a minimum of 3 m (10 ft) apart.
- Precise location of the APS is very important to prevent ambiguity about which crosswalk is being signaled.
  - Pedhead-mounted APS speakers must be above the waiting location of the crosswalk being signaled (See drawings and discussion on pages 12-17 to 12-22).
  - Pushbutton-integrated APS must be located close to the crosswalk (see drawings and discussion on pages 12-12 to12-16)
- If it is not possible to mount two APS on the same corner a minimum of 10 feet apart, an APS providing a speech message during the walk interval, as well as a pushbutton message, is recommended. See pages 11-11, 11-12 and figures 12-25 and 12-26 for installation locations.

APS where pedestrian timing is not pushbutton actuated

Pedestrian timing

When pedestrian timing is pre-timed, on-recall, or is called by passive pedestrian detection, pedestrians do not need to locate the pushbutton at the intersection.

Disadvantages of pushbuttons

When an APS pushbutton is added, pedestrians who are blind must sometimes deviate from their course of travel to push the button. They then lose some of the orientation gained as they approached the intersection. Orientation must be re-established using other, sometimes less reliable or efficient, clues before they are prepared to cross the street. This is so time-consuming in some cases that blind pedestrians are not ready to cross at the onset of the walk interval.

Also, the pushbutton and locator tone may indicate to blind pedestrians that they must push a button to call a pedestrian phase, when this is, in fact, not required.

New construction

Draft Public Rights of Way Accessibility Guidelines require audible and vibrotactile indication of the WALK. Vibrotactile indication is available only on pushbutton-integrated APS. For newly constructed or reconstructed intersections, the pushbutton pole should be properly located and the audible and vibrotactile indications should be installed so pedestrians who need vibrotactile information can wait for crossing with a hand on the vibrator.

See Chapter 10 for new construction installation requirements.

Retrofit

When retrofitting an intersection with an APS, strict adherence to the guidelines may require extensive construction. Many downtown areas with wide sidewalks have pretimed pedestrian phases. Poles are rarely located in optimal locations for installation of pushbutton integrated devices with audible and vibrotactile WALK indications.

Installation of such devices in poor locations may provide misleading and dangerous information.

Other options

It may be appropriate to consider other options when the addition of the APS is the only change planned at an intersection with pretimed signals. Unless there is good justification for using a pushbutton from an engineering perspective, a pushbutton at intersections with pretimed phasing is not necessarily desirable from the perspective of pedestrians who are blind. If a pushbutton cannot be installed in a location where the vibrotactile information associated with the pushbutton is usable, it makes little sense to install a pushbutton with vibrotactile indications.

(continued)

Other options (continued)

A pedhead mounted APS without a pushbutton or locator tone may be more appropriate. WALK message and volume levels should be carefully determined to avoid confusion to pedestrians and to prevent disturbance to neighbors. Unless audible beaconing is determined to be necessary, the APS speaker should be oriented toward the waiting location of the pedestrian. Use of a small mast arm to locate the APS optimally over the crosswalk location should be considered.

FIG. 11-1.
MAST ARM IS USED IN THIS INSTALLATION IN TORONTO, CANADA TO POSITION PEDESTRIAN SIGNAL HEAD AND SPEAKER CLOSER TO THE CROSSWALK.

Recommended characteristics - APS at pretimed intersections where beaconing is not needed

APS installations at pretimed intersections where beaconing is not needed should have:

- No locator tone;
- Quiet WALK signal 2-5dBA above ambient sound;
- Either pushbutton-integrated APS, or a pedhead-mounted APS aimed down toward the waiting location

Recommended installation at pretimed intersections with no beaconing

- Precise location of APS very is important to prevent ambiguity about which crosswalk is being signaled.
- Sound source for either pushbutton-integrated or pedhead-mounted APS on the same corner should be a minimum 3m (10 ft) apart.
- Pedhead mounted APS must be above the waiting location of the crosswalk being signaled (See drawings and discussion on pages 12-17 to 12-22).

Pole location

Existing pole location

When the only change is addition of an APS, existing pole location at the intersection often restricts the location of APS components, such as pushbuttons, speakers, and tactile arrows, which can affect the device features needed.

Location of pushbuttons and tactile arrows and location of speakers must be carefully engineered to provide accessible and usable information to pedestrians with disabilities.

- Consideration of these issues in designing the installation and ordering devices is needed to avoid providing ambiguous information. Before ordering devices, the designer needs to look at the poles available and determine locations where devices will be installed.
- Pole location may affect the type of WALK indication to be used.
  - Location of two APS on one pole requires either speech WALK indications or additional mast arms or other provisions to separate the sounds.
  - APS loudspeakers may be located at the pushbutton location or on the pedhead. The location of these speakers can be critical.

Three options

If there are no poles at the recommended locations, in retrofit situations, options to consider, in order of decreasing desirability (from the standpoint of ambiguity), include:

- Repositioning of pedestrian signals and poles, or the addition of stub pole(s) and associated conduit and wiring
- Use of pedhead mounted speakers, possibly with mast arms or other provision to locate the WALK tone speakers as near to the associated crosswalk as possible
- Two APS on a pole with speech messages (see page 11-11 for recommended characteristics; see page 6-15 for recommended wording of speech messages)

Repositioning pedestrian signals and poles or the addition of stub poles

Repositioning poles may be considered a major change in some renovation projects, but may be less difficult when the addition of the APS is part of the upgrading of the curb ramp. The optimal choice is positioning speakers and pushbuttons on poles that are located closest to the crosswalk. Possible ways to accomplish this should be strongly considered before other options are explored.

FIG. 11-3.
APS ARE POSITIONED APPROPRIATELY AT THIS INTERSECTION BY THE ADDITION OF A STUB POLE FOR ONE CROSSWALK. THE STUB POLE HOLDING THE APS FOR THE CROSSWALK AT RIGHT IS SIMPLY BOLTED IN. THE OTHER APS IS MOUNTED ON THE POLE THAT SUPPORTS THE PEDHEAD.

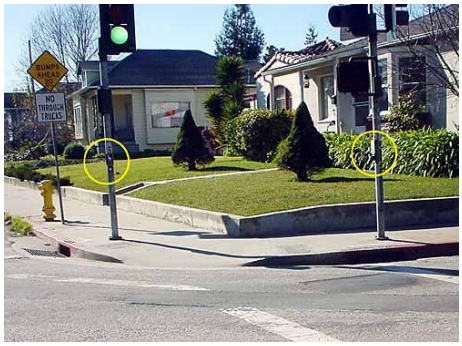


FIG. 11-2.
WELL LOCATED PEDESTRIAN SIGNAL POLES PROVIDE APS AUDIBLE INDICATIONS FROM THE OPTIMAL LOCATION, CLOSE TO THE PEDESTRIAN WAITING AREA.

In some locations, the addition of stub poles may be fairly simple. Jurisdictions seem to have different requirements for the wiring. The wires to pushbuttons are low voltage wires and it may be possible to run the wires in a sawcut to a pushbutton pole installed with bolts. Looking at the wiring and the use of stub poles in unconventional ways may provide solutions to the problems.

Pole location

Positioning pedhead mounted speakers

If the pole is not close enough to the crosswalk location, pedhead mounted speakers may be mounted to extend from the pole to provide the appropriate separation of sounds. (See figure 11-1.) Provision of the WALK information at the proper crossing location, even when pushbutton and poles cannot be relocated, may provide some auditory guidance to the pedestrian who is blind about the crosswalk location. This type of installation may not provide the best location for tactile arrows and signs. If a pushbutton is used, the pushbutton should also provide a locator tone and tactile arrow.

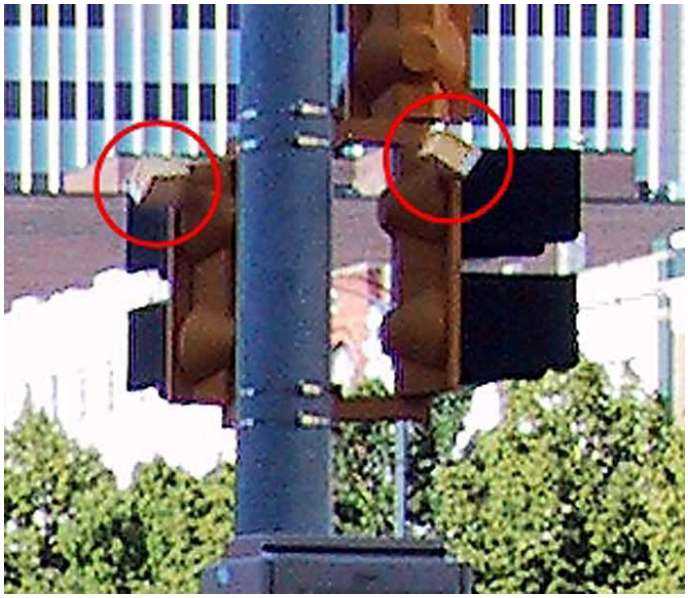


FIG. 11-4. TWO PEDHEAD-MOUNTED SPEAKERS, AIMED AT RIGHT ANGLES TO EACH OTHER, ARE SEPARATED BY THE WIDTH OF THE PEDHEADS AND THE MOUNTING POLE. EVEN MORE DISTANCE IS PREFERRED.

In Figure 11-4, the speakers are positioned on the outside of the pedheads, which somewhat separates the sounds, although more separation is preferred. In these photos the speakers are aimed across the street. The speakers may be aimed directly down in most instances. When audible beaconing is needed, the speaker may be aimed toward the center of the street.

Pole location

Two APS on the same pole

Many jurisdictions use a standard design of two pedheads and pushbuttons on one pole. In new or reconstructed intersections, separate poles should be provided at the end of each crosswalk, for the pushbutton to provide unambiguous APS information, and to be maximally useful to all pedestrians. Where two APS pushbuttons are mounted on two separate poles at a corner, their arrows can readily be aligned with each crosswalk. Correct alignment can be difficult to accomplish with two APS on the same pole, particularly at larger radius intersections.

If two pushbuttons must be on the same pole, it is essential that speakers be located as close as possible to the pedestrian waiting location and fit the recommendations below for installations of two APS on one pole.

- A speech WALK message is needed, so the user can determine which street has the WALK indication. Therefore, an APS that is capable of providing a speech WALK message is needed in those locations (see discussion of WALK indications on pages 6-12 to 6-15); and
- A pushbutton message and tactile arrow are also needed so pedestrians can know the direction of the crosswalk served by that pushbutton, and the name of the street to be crossed. Without the pushbutton message, the name of the street in the WALK message may still be ambiguous to pedestrians who are unfamiliar with the intersection.

Recommended characteristics - APS where two pushbuttons are on the same pole

APS at intersections where two APS pushbuttons are on the same pole should have:

- Pushbutton locator tone, sounding for each device;
- Speech WALK indication, 2-5dBA above ambient sound;
- Pushbutton information message to provide intersection and crosswalk identification information; and
- Tactile arrow on each device aligned in direction of travel on the crosswalk

Speech messages should follow the recommendations for wording, and the APS should be positioned within 10 feet of the curb.

See drawings in Figures 12-25 and 12-26.

Recommended Installation - Two APS on one pole with speech messages

FIG. 11-5. EXAMPLE OF PUSHBUTTON INFORMATION MESSAGES AND SPEECH WALK MESSAGES FOR TWO APS LOCATED ON THE SAME POLE

Chapter 12 — APS Installation Specifications

Summary

Installation of Accessible Pedestrian Signal (APS) components affects the usability of the devices. Use this chapter to determine where to locate various components.

Additional information

Additional information on designing installations is in the following chapters:

- Chapter 9 discusses general principles
- Chapter 10 discusses installation in new construction and reconstruction situations
- Chapter 11 provides information and recommendations for retrofitting an intersection with an APS and provides recommended characteristics of APS for use in various situations

Chapter contents

Specifications for installation of APS components

- Location of controller boards and wiring
- Location of pushbuttons, tactile arrows, vibrating surfaces, and signs
- Location of speakers and microphones
- Pushbutton-integrated
- Pedhead-mounted

Specification for installation of APS Components

APS components

APS devices may include some or all of the following components:

- Controller boards and wiring
- Pushbuttons, tactile arrows, vibrating surfaces and signs
- Speakers and microphones

All may be integrated into one unit or these may be separate components to be sited and installed. Location and installation of the components can affect usability.

FIG. 12-1. INSTALLER POSITIONING THE APS CONTROLLER BOARD INSIDE THE BACK OF THE PEDESTRIAN SIGNAL HEAD.

Location of controller boards and wiring

Wiring

All APS currently on the market are wired to the pedestrian signal indications. The addition of APS does not change the signal timing.

Pushbutton-integrated devices generally require an extra set of wires to the pushbutton to power the audible indications. APS with actuation indicators may need to receive an actual signal from the controller that the call has been accepted. If conduit is not adequate for extra wiring, plans for installation may require conduit and wiring replacement.

Some APS manufactured abroad initially required 110 volt AC power to the push button rather than DC power. These manufacturers now supply APS models to the US market that are adapted to provide DC power to the pushbutton. It may be necessary to specify that devices meet US requirements.

Traffic signal controllers

APS devices work with current controllers used in the US. In the past year, some controller conflicts have been reported, mainly related to a change in voltage that leads to the MMU override. These have been addressed by the manufacturers and seem to be solved.

The Access Board has funded a project to investigate problems. Many issues reported seem to be incorrect installation or sound adjustment problems. The final project report should be available in 2003.

Developing technology

Two manufacturers are developing APS that can be adjusted by engineering staff using pocket computers or PDA type devices. These involve simpler wiring, and post-installation adjustment can be done from the sidewalk, with no need to open the APS, pedhead, or controller.

Location of controller boards and wiring

Mounting APS controller boards

Some APS have a controller board that is completely contained within the device. Other pushbutton-integrated APS require a separate controller board that is mounted in the pedhead. The controller board often includes voice or sound chips and switches to control volume, microphone response and other features.

Some types of pedheads do not have adequate space to mount the APS controller boards required by some types of pushbutton integrated devices:

- Incandescent, 12 inch over/under pedheads may require replacement. Manufacturers generally can supply a separate box for the APS controller, if needed.
- APS controller boards can be mounted in the controller. However, the correct gauge wires must be calculated to drive the speakers when wiring is extended across the street/intersection. Wiring that is adequate to drive the speakers when run from the pedhead to the pushbutton is not adequate to allow the full range of volume when run for longer distances, such as across the intersection.

FIG. 12-2.
CONTROLLER BOARD MOUNTED BEHIND 18 INCH PEDESTRIAN SIGNAL HEAD.

FIG. 12-3.
EXTERNAL MOUNT FOR CONTROLLER BOARD IS VISIBLE ON THE LEFT SIDE OF THE PEDESTRIAN SIGNAL HEAD.

Pushbuttons, tactile arrows, vibrating surfaces and signs

Need for detailed engineering drawings and specifications

Engineering drawings for installations should include location of pushbuttons, tactile arrows, vibrating surfaces, and signs of the APS devices. The location of these features affects the safety and usability of the devices.

Height of pushbuttons

The pushbutton must be within accessible reach range of a level landing for use from a wheelchair and no higher than 42 inches measured from the landing. Without detailed specifications, pushbuttons may be installed in locations that are 'convenient' to the installer, but not usable by pedestrians.

FIG. 12- 4.
THIS PUSHBUTTON MAY BE 42 INCHES FROM THE BOTTOM OF THE POLE, BUT IT IS ALMOST 60 INCHES ABOVE THE LANDING, NOT ACCESSIBLE TO A WHEELCHAIR USER AND NOT LIKELY TO BE LOCATED BY A PERSON WHO IS BLIND.

FIG. 12-5.
NOT ONLY IS THE PUSHBUTTON IN THE BUSHES, CONSTRUCTION BARRIERS HAVE BEEN STORED AGAINST THE POLE, PREVENTING PEDESTRIANS FROM REACHING THE PUSHBUTTONS.

Vibrating surfaces

Vibration-only devices are not recommended. However, many APS have vibrating surfaces that can be useful in confirming the audible WALK indication and in providing WALK signal information to pedestrians with visual impairment plus hearing loss. If used, designers/engineers and installers must remember that the vibrating surface will be usable only if they are installed within the width of the crosswalk or very near the crosswalk, and near the curb line. Pedestrians must be able to wait to cross while keeping a hand on the vibrating surface.

Location of the tactile arrow

If poles are located too far away from the center of the intersection, outside the extension of the crosswalk lines, the pedestrian who is blind may attempt to cross at a location that is not within the crosswalk area. As discussed in Chapter 7, pedestrians may align with the tactile arrow and proceed to the curb from that location.

FIG. 12-6. IF PEDESTRIANS PROCEED DIRECTLY TO THE CURB FROM THE PUSHBUTTON IN THIS PHOTO, THEY WILL BE WELL OUTSIDE THE CROSSWALK AREA WHEN BEGINNING THEIR CROSSING.

This installation is more than five feet from the crosswalk lines extended. While the arrow does clarify which street the device controls, it provides misleading information as well.

Stub poles or other solutions should be evaluated to position the arrow more appropriately. If the pole location cannot be adjusted, moving the speaker for the WALK indication to a location closer to the crosswalk, by use of a mast arm, might help the pedestrian who is blind recognize the appropriate crossing location.

Orientation of tactile arrow

FIG. 12-7. DIRECTION OF THE CAST-IN-PLACE ARROW ON THIS DEVICE MUST BE SPECIFIED WHEN ORDERING.

The tactile arrow must be oriented parallel to the direction of the crosswalk controlled by the pushbutton.

Arrows on several manufacturers' devices are positioned by the installer. However, with some devices, the direction of arrow is specified when ordering the units. Pole location in relation to the crosswalk can affect the arrow direction.

Shape and type of mounting pole

US municipalities use a great variety of poles for mounting of pedheads and pushbuttons. When the tactile arrow is part of the pushbutton and located on the face of the pushbutton integrated device, the orientation of the device on the pole determines whether the tactile arrow is aligned with the crosswalk.

FIG. 12-8.
WELL LOCATED APS ON A SQUARE POLE.

FIG. 12-9.
POORLY LOCATED APS ON A ROUND POLE POINTS INTO THE INTERSECTION.

12-10.
A MOUNTING BRACKET OR SHIM IS NEEDED ON THIS SQUARE POLE TO ORIENT THE ARROW PROPERLY. WITHOUT IT, THE ARROW POINTS TO THE CENTER OF THE INTERSECTION.

Most pushbutton integrated devices are designed to be installed on round poles. Poles that are not round may require a special mounting bracket or shim to orient the arrow correctly.

Additional information on installation is included in Chapter 13.

Wooden poles

In areas where pushbuttons are installed on wooden poles, the wiring usually runs on the outside of the pole. A mounting bracket is needed on some devices for wiring the pushbutton. The bracket needs to be ordered with the APS.

FIG. 12-11.
MOUNTED ON THE WOODEN POLE, AN ADDITIONAL MOUNTING BRACKET IS INSTALLED TO ALLOW THE WIRES TO RUN FROM CONDUIT INTO THE TOP OF THE PUSHBUTTON-INTEGRATED DEVICE.

FIG. 12-12.
TYPICAL INSTALLATION WITHOUT EXTRA MOUNTING PLATE, WITH WIRE RUNNING FROM INSIDE METAL POLE INTO THE BACK OF THE DEVICE.

Pedestrians who are blind in Charlotte, NC have expressed concerns about nails and staples that are common in wooden poles and the hazard in having to use their hands to locate the button. There has been some investigation there into designing a shield for the pole area near the pushbutton to solve that problem.

Wooden poles
(continued)

FIG. 12-13.
WOODEN POLE WITH NAILS AND STAPLES THAT ARE TYPICAL AND SOURCE OF CONCERN.

FIG. 12-14.
COATED CANVAS SHIELD USED IN CHARLOTTE NC.

Stub poles

The use of stub poles for mounting pedestrian pushbuttons is common in some areas of the US. This provides an opportunity to site the pushbutton where it is most usable to pedestrians and may improve pedestrian compliance with pushbutton use.

FIG. 12-15.
A STUB POLE IS USED TO SITE THE PUSHBUTTON BESIDE THE SIDEWALK.

Stub pole examples

FIG. 12-16.
STUB POLE EXAMPLE.

FIG. 12-17.
STUB POLE INSTALLED NEAR SIDEWALK SIGNAL BOX SIMPLIFIES WIRING AND LOCATES PED PUSHBUTTON BY THE CROSSWALK.

FIG. 12-17A.
DETAIL OF BOLTS.

Braille labels and signs

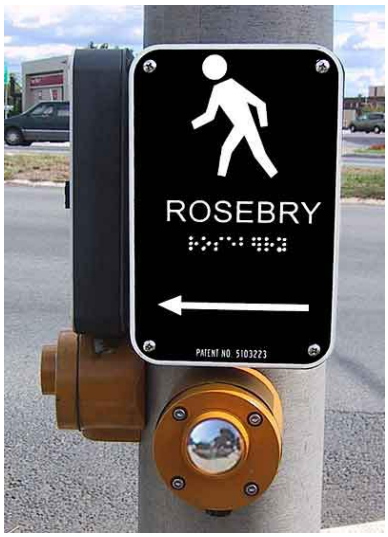


FIG. 12-18.
BRAILLE LABEL IS BELOW THE RAISED PRINT STREET NAME.

Before ordering APS with Braille labels on the faceplate, you must know:

- The location of the pole
- Which side of the pole the APS will be mounted on

The direction of face plate and associated arrow is determined when the raised dots of Braille are added. Braille is generally just punched into the metal plate.

APS microphones and speakers

Engineering drawings

Engineering drawings and specifications should include location and orientation of all microphone and speaker components. The following section illustrates some good and poor placement of pushbutton-integrated and pedhead-mounted speakers.

Microphone location

Some APS require installation of microphones to monitor the ambient sound; this is part of the automatic sound adjustment feature.

The microphones are measuring the sound levels to adjust the volume at the waiting location. If the microphone is mounted too far from the intersection, it will not adequately sample and adjust the volume levels. The WALK indication is likely to be too quiet for a pedestrian who is waiting at the curb, prepared to cross, to hear above the sound of traffic.

APS speakers

Speakers for APS may be pedhead mounted or pushbutton-integrated. There are different issues to be considered, depending on the speaker location. Separate drawings are provided to indicate locations of pushbutton integrated speakers and pedhead mounted speakers.

Some manufacturers also provide options to have a speaker at the pedhead in addition to a speaker at the pushbutton location.

Pushbutton-integrated speakers

Specifications for pushbutton-integrated speakers

Engineering drawings should show the location and orientation of the pushbutton and speakers of pushbutton-integrated devices.

Sound dispersion from pushbutton-integrated speakers

The speaker is usually built into the pushbutton-integrated device. Different devices have slightly different speaker locations, which may affect the volume settings and mounting of the device.

If possible, particularly in a location with audible beaconing, the devices should have speakers oriented toward the street as well as the sidewalk and pedestrian waiting location. Beaconing is unlikely to be successful when provided by a device without speaker openings on the curb side. The addition of a pedhead-mounted speaker may need to be considered in that situation; some manufacturers sell optional add-on speakers. One manufacturer provides baffles for use to control direction of sound, when needed.

Photos of speaker grilles on different devices

SPEAKER GRILLES MAY BE ON THE SIDE OF THE DEVICE (FIG. 12-19 ON LEFT), ON THE BACK NEAR THE POLE (FIG. 12-20 MIDDLE), OR ON THE FRONT AND SIDE OF DEVICE (FIG. 12-21 ON RIGHT).

Pushbutton-integrated speakers

H-frame for pushbuttons

An H-frame is used for mounting pushbuttons in some northwestern states. Some APS devices will not work properly when mounted in that configuration. The type of device and location of speaker components should be considered. The arrow of the APS is often part of the pushbutton and will not be oriented properly in the H-frame. In addition, the design of the frame makes it difficult to hear the sound of the locator tone from both the approach direction and the crossing direction. .

It can be helpful for pedestrians who are blind to hear the locator tone as they complete their street crossings (the WALK indication is seldom still sounding by that time). In this type of mounting, the pushbutton locator tone is not audible from the street because the speaker is aimed back toward the building line.

FIG. 12-22. THE SPEAKER FOR THE LOCATOR TONE IS ORIENTED TOWARD THE BUILDING LINE, RATHER THAN TOWARD THE STREET [IN THE LOCATION SHOWN IN THE PHOTO, THE WALK INDICATION COMES FROM AN OVERHEAD SPEAKER]; AND ONE OF THE ARROWS POINTS TOWARD THE POLE AND THE OTHER DEVICE, AS WELL AS TOWARD THE STREET, BUT IT WOULD BE HARD TO USE THE ARROW FOR DIRECTION WHEN STANDING ON THE SIDEWALK SIDE OF THE POLE.

If two pushbutton-integrated APS in H-frames are mounted on a single pole, they will provide ambiguous WALK indications because the APS closest to each crosswalk will be indicating the perpendicular crosswalk, not the closest crosswalk.

Drawings: Location of pushbutton-integrated devices and speakers

The drawings on the following pages illustrate proper and improper positioning of pushbutton-integrated devices and speakers.

Pushbutton-integrated speakers

Ideal placement of APS

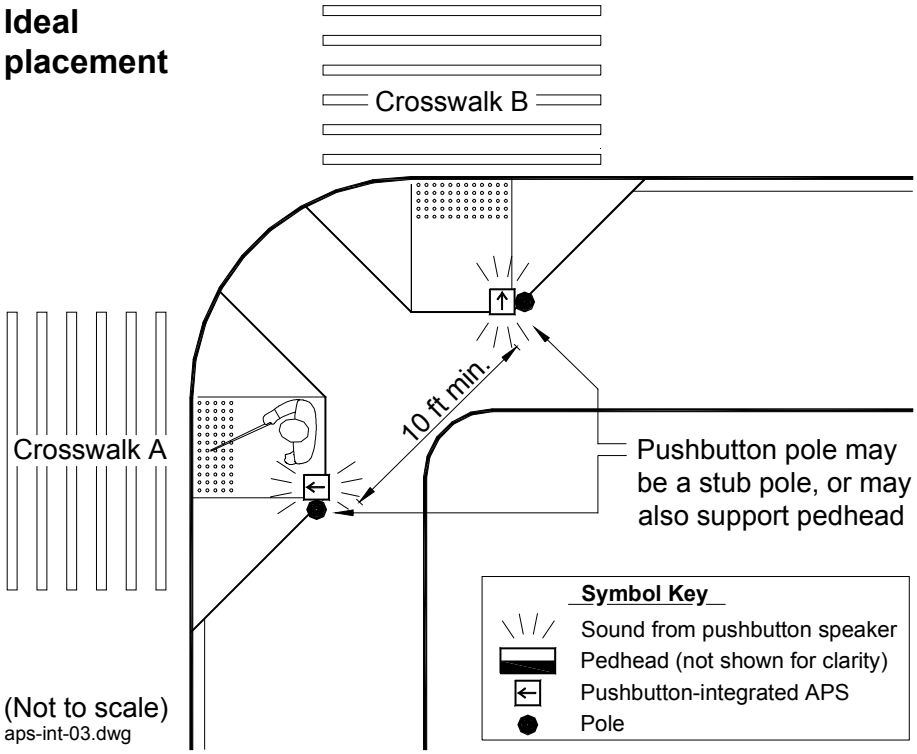


FIG.12-23. IDEAL PLACEMENT FOR PUSHBUTTON-INTEGRATED APS.

Acceptable placement of APS

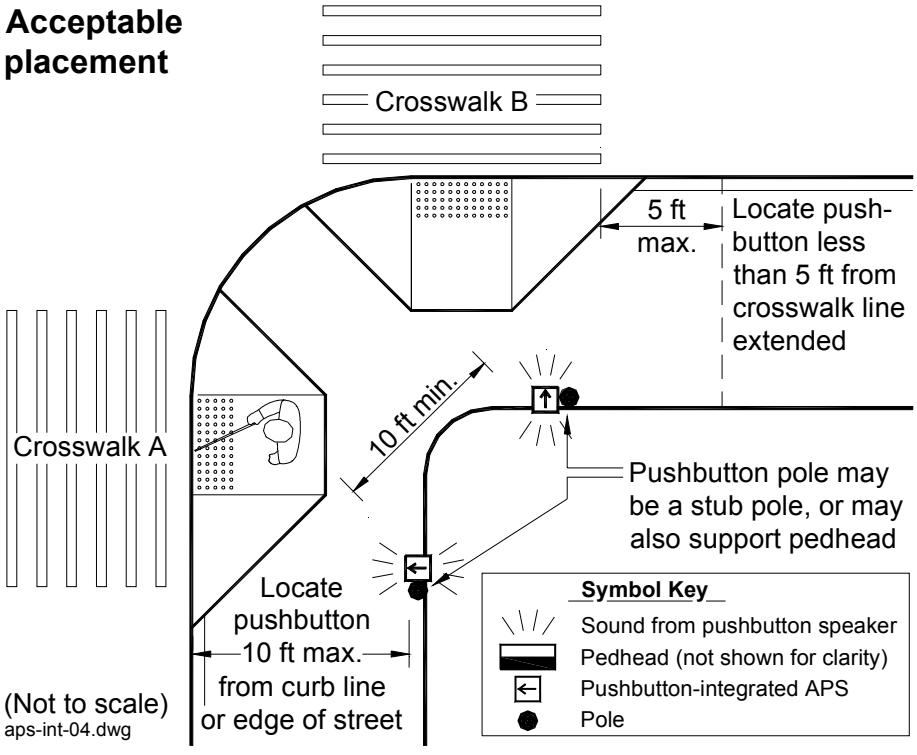


FIG. 12-24. ACCEPTABLE PLACEMENT FOR PUSHBUTTON-INTEGRATED APS.

Pushbutton-integrated speakers

Acceptable placement of speakers when separation cannot be achieved

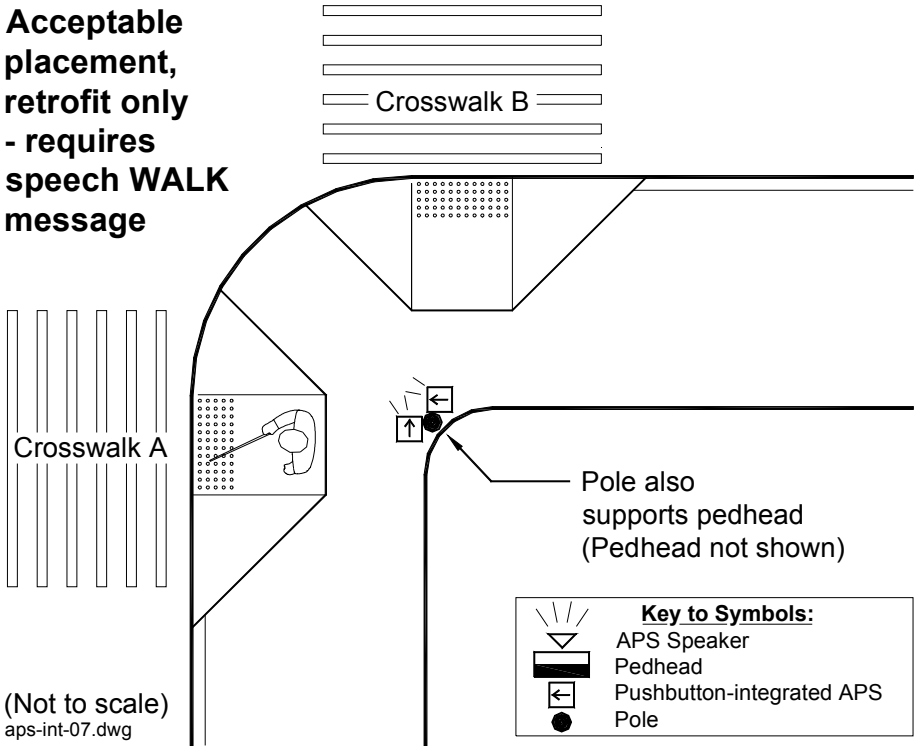


FIG. 12-25. ACCEPTABLE PLACEMENT FOR PUSHBUTTON-INTEGRATED APS, RETROFIT ONLY, IF APS CANNOT BE SEPARATED. NEED SPEECH PUSHBUTTON INFORMATION MESSAGE AND WALK MESSAGE TO PREVENT AMBIGUITY.

Acceptable placement for retrofit only

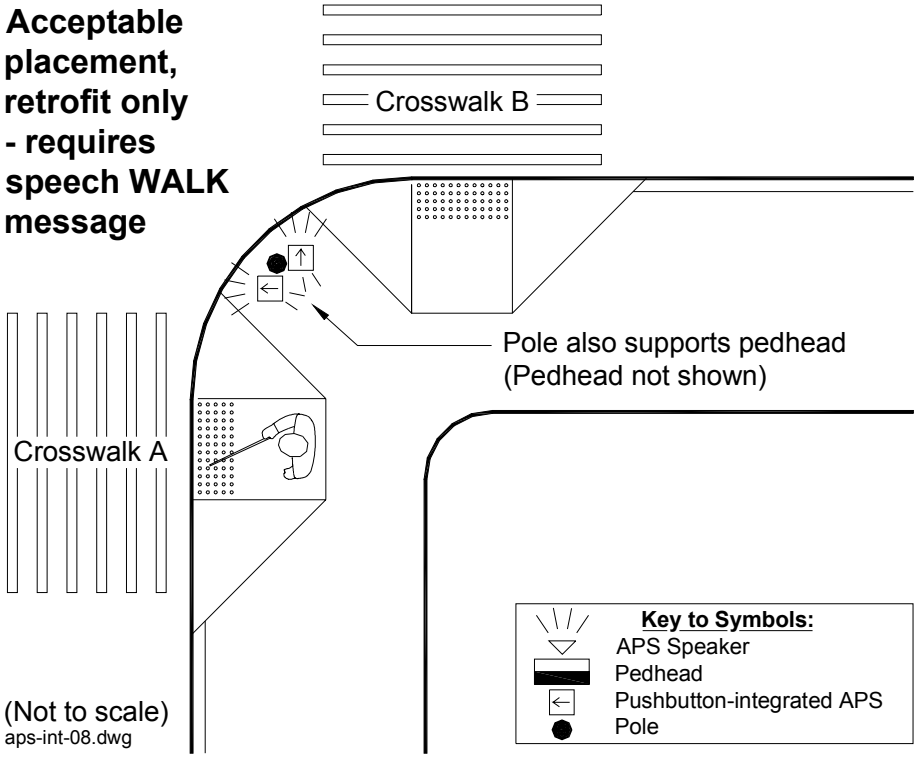


FIG. 12-26. ACCEPTABLE PLACEMENT FOR PUSHBUTTON-INTEGRATED APS, RETROFIT ONLY, IF APS CANNOT BE SEPARATED. NEED SPEECH PUSHBUTTON INFORMATION MESSAGE AND SPEECH WALK MESSAGE TO PREVENT AMBIGUITY.

Pushbutton-integrated speakers

Unacceptable placements of speakers

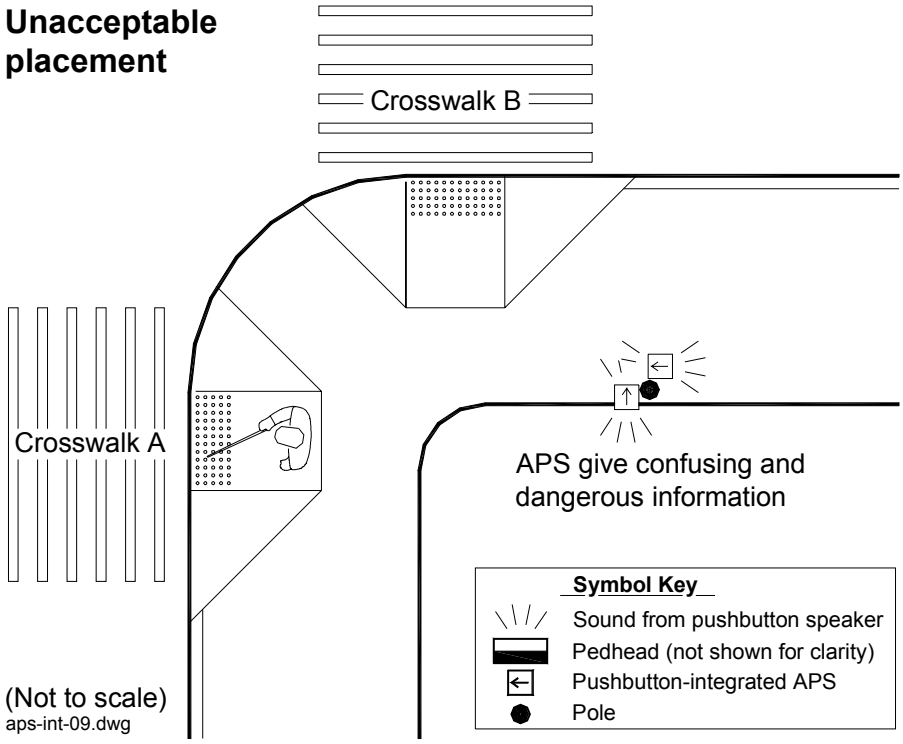


FIG. 12-27. UNACCEPTABLE PLACEMENT FOR PUSHBUTTON-INTEGRATED APS (PROVIDE AMBIGUOUS INFORMATION).

Unacceptable placement

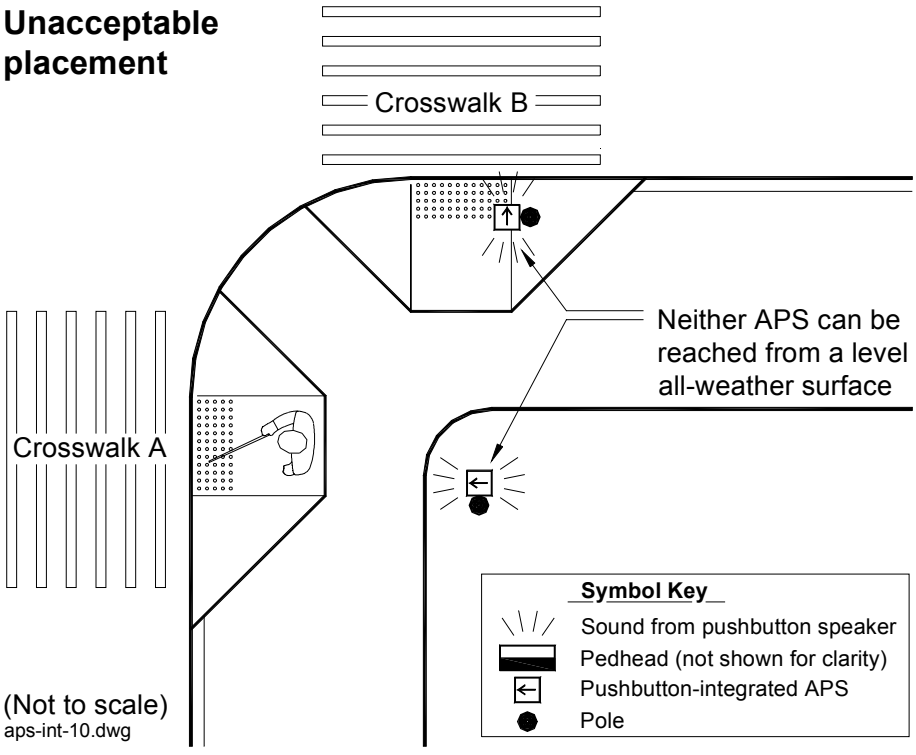


FIG. 12-28. UNACCEPTABLE PLACEMENT FOR PUSHBUTTON-INTEGRATED APS (NOT REACHABLE FROM LEVEL ALL-WEATHER SURFACE).

Pedhead-mounted speakers

Specifications for pedhead-mounted speaker location

Specifications for pedhead-mounted speakers must clearly indicate the pedhead location and the speaker location for each crosswalk. Specifications of the angle of the speaker may also be necessary.

Sound from pedhead-mounted speakers

The sound from pedhead-mounted speakers is not very useful for providing guidance about the location of the opposite curb. Unless audible beaconing is needed, speakers should be aimed down toward the pedestrian waiting location.

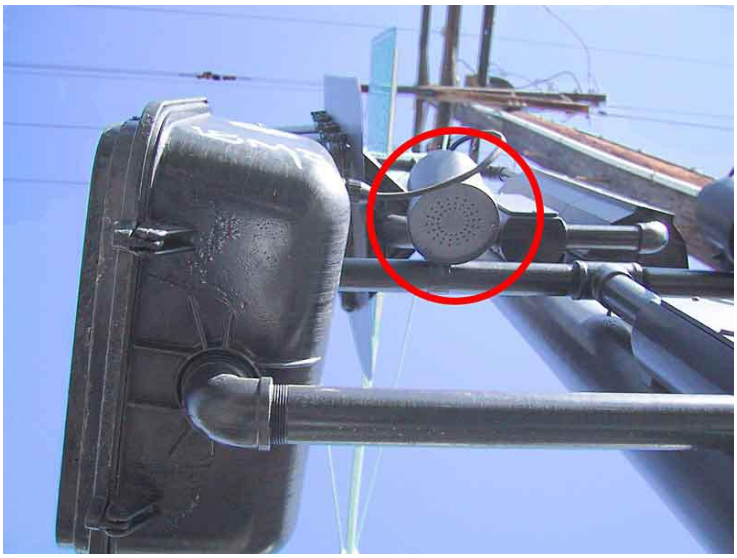


FIGURE 12- 29 SPEAKER ATTACHED TO PEDHEAD SUPPORT IS AIMED STRAIGHT DOWN.

Speakers may be aimed toward the center of the street at crosswalks where beaconing is needed. For pedhead-mounted speakers, sound will travel farther the more nearly horizontal the radiation pattern of the speaker is.

- Where beaconing is not needed, speakers can be oriented down toward the location of pedestrians waiting to cross the associated crosswalk, to minimize noise in neighborhoods.
- Where beaconing is needed, the speaker must be oriented out into the middle of the associated crosswalk. Therefore it will produce more noise in the neighborhood.

Pedhead-mounted speakers

Speaker location

FIG. 12-30.
THE PEDHEAD FOR THE N/S CROSSWALK IS LOCATED OVER THE PUSHBUTTON FOR THE E/W CROSSWALK. THE SPEAKER LOCATED ON THE SIDE OF THE PEDHEAD, AND DIRECTLY OVER THE WAITING AREA TO CROSS E/W, SOUNDS FOR THE N/S CROSSWALK. IT IS VERY EASY TO BE CONFUSED, SINCE THE SOUND FOR THE E/W CROSSWALK IS LOCATED DIRECTLY ABOVE THE N/S CROSSWALK WAITING AREA.

FIG. 12-31.
IN A SIMILAR SITUATION, THIS PEDESTRIAN SIGNAL HEAD FOR THE E/W CROSSWALK IS DIRECTLY OVER THE WAITING LOCATION FOR THE N/S CROSSWALK, HOWEVER IN THIS INSTANCE THE APS MOUNTED ON THAT PEDHEAD IS PROPERLY WIRED TO SOUND FOR THE N/S CROSSWALK.

Drawings: Location of pedhead-mounted speakers

The drawings on the following pages illustrate proper and improper positioning of pedhead-mounted devices and speakers.

Pedhead-mounted speakers

Recommended placement — no beaconing

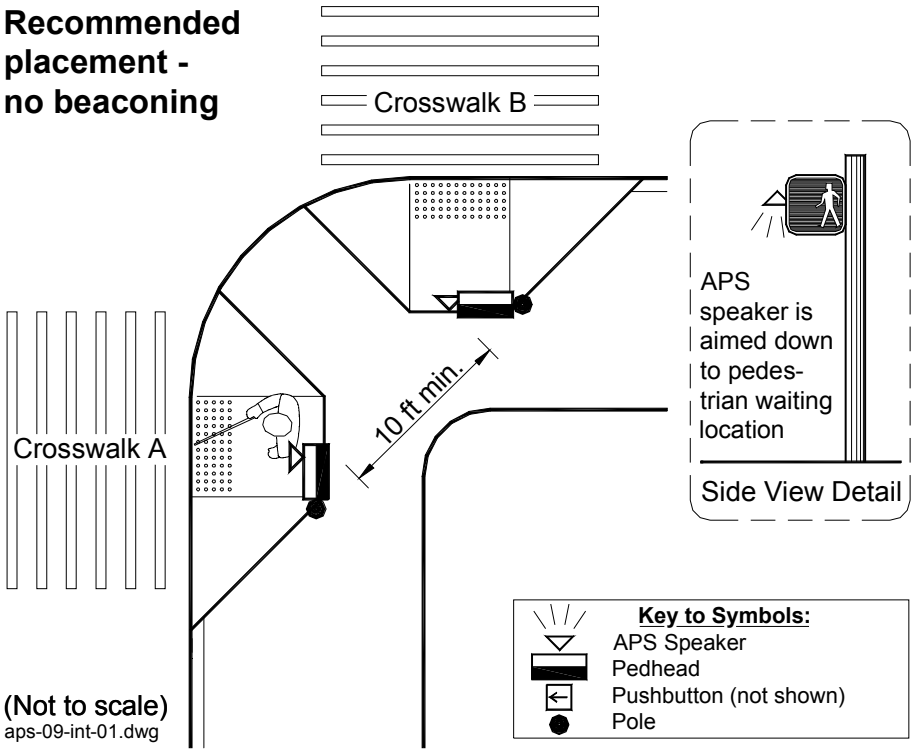


FIG. 12-32. RECOMMENDED PLACEMENT FOR PEDHEAD-MOUNTED APS AT PRETIMED SIGNALS; NO BEACONING.

Recommended placement — with beaconing

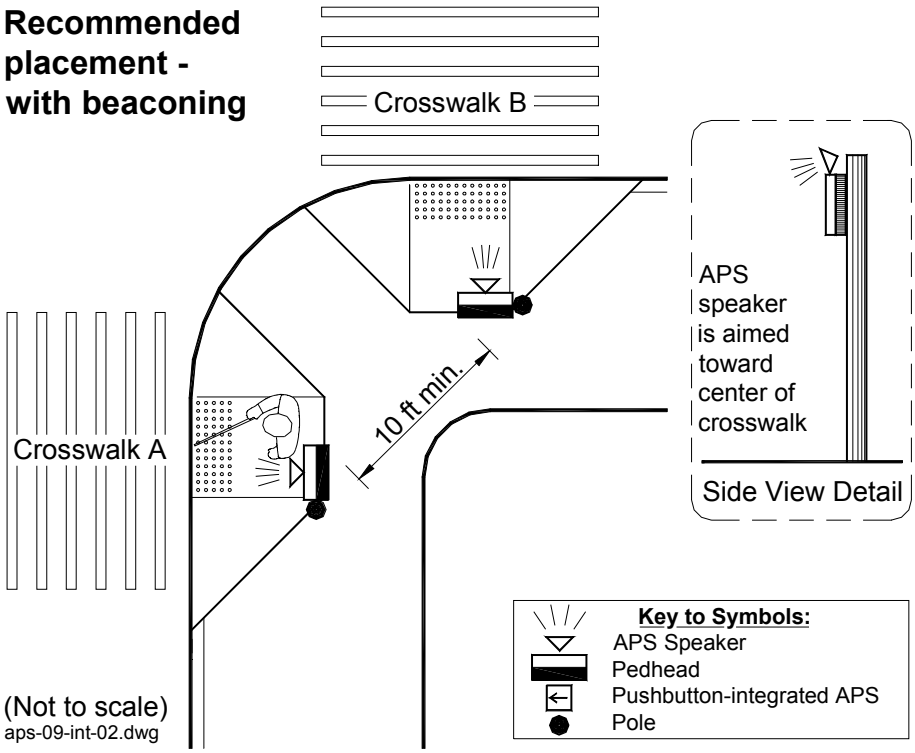


FIG. 12-33. RECOMMENDED PLACEMENT FOR PEDHEAD-MOUNTED APS WHERE BEACONING IS NEEDED.

Pedhead-mounted speakers

Possibly acceptable placement

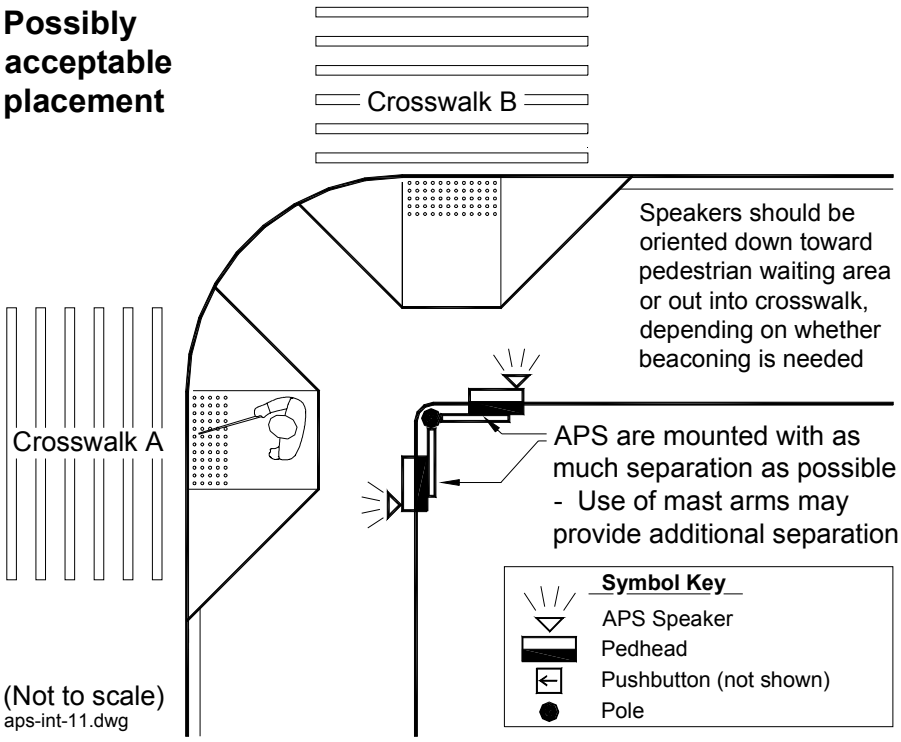


FIG. 12-34. POSSIBLY ACCEPT-ABLE PLACEMENT FOR PEDHEAD-MOUNTED APS ON THE OUTSIDE OF THE PEDHEADS. PROVIDE AS MUCH SEPARATION AS POSSIBLE.

Possibly acceptable placement with mast arms

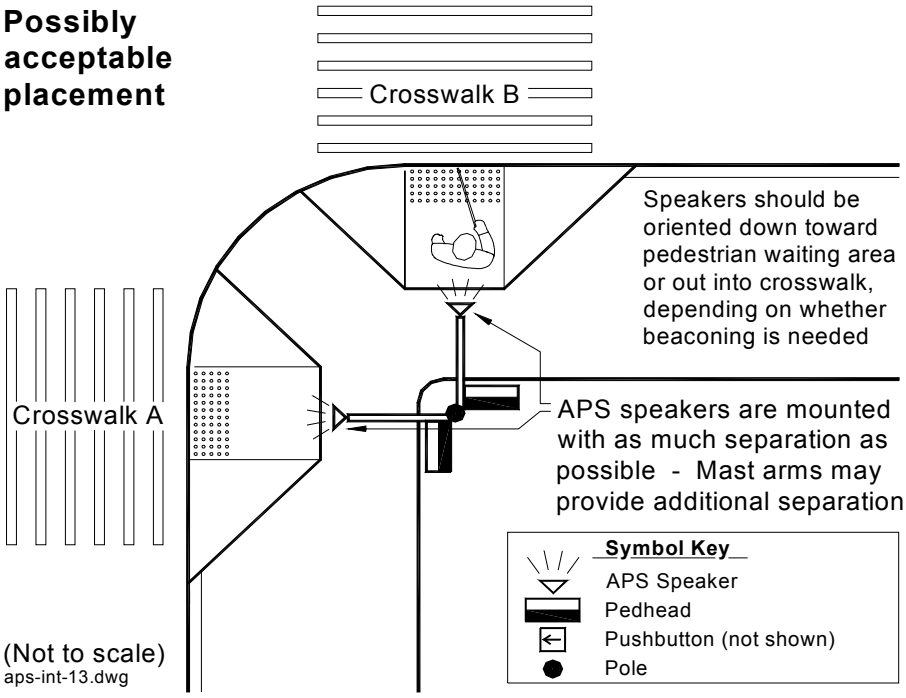


FIG. 12-35. POSSIBLY ACCEPT-ABLE PLACEMENT FOR PEDHEAD-MOUNTED APS USING MAST ARMS TO PROVIDE ADDITIONAL SEPARATION.

Pedhead-mounted speakers

Unacceptable placement of pedhead-mounted speakers

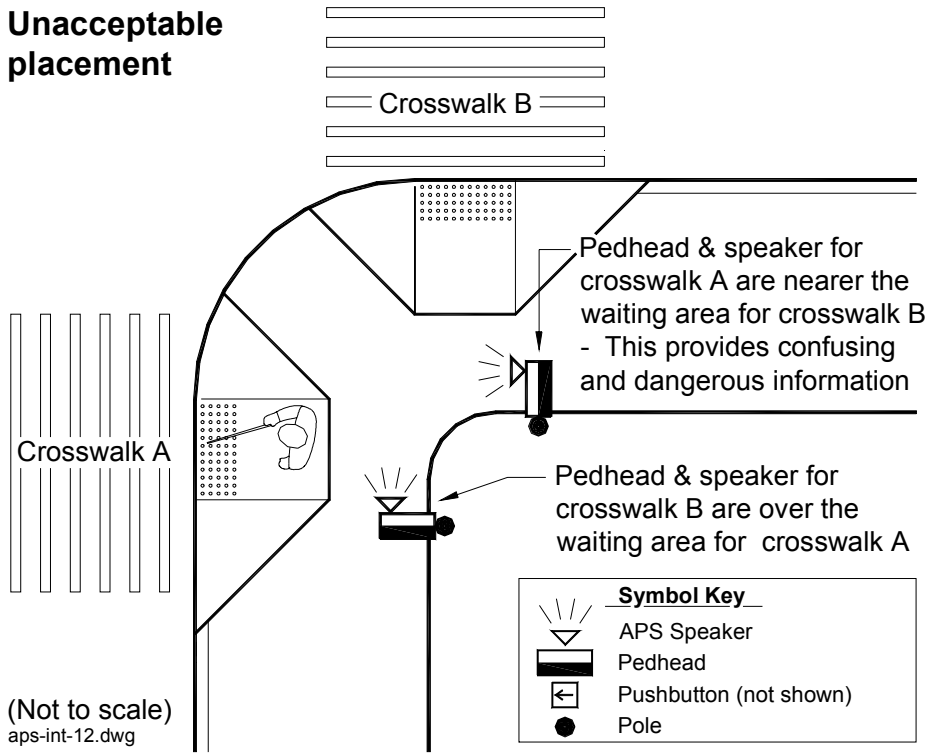


FIG. 12-36. UNACCEPTABLE PLACEMENT FOR PEDHEAD-MOUNTED APS, REGARDLESS OF HOW SPEAKERS ARE AIMED.

Unacceptable placement of pedhead-mounted speakers

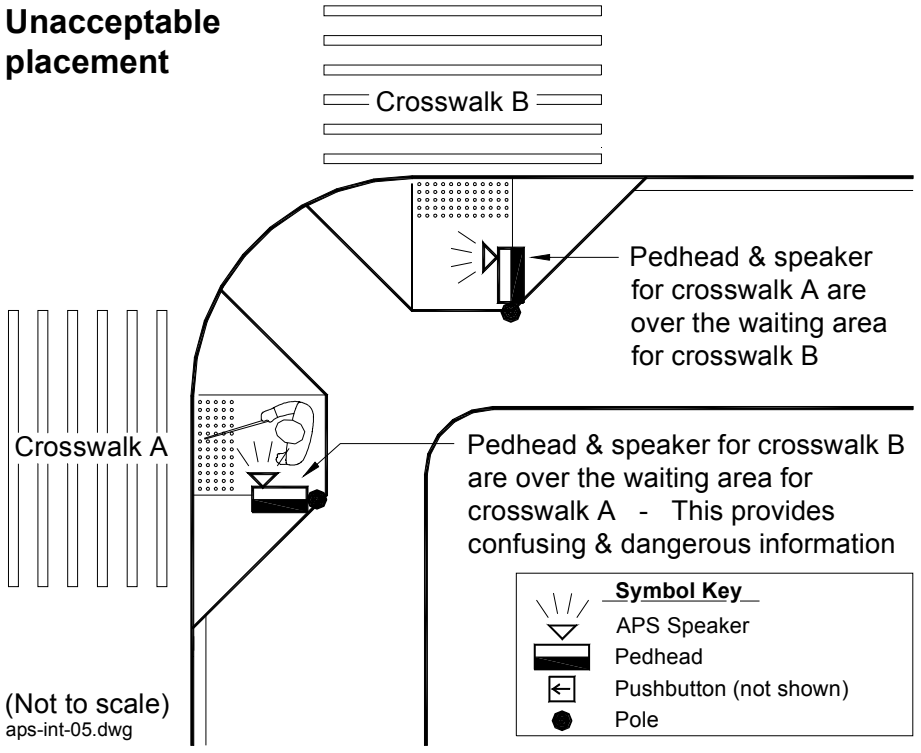


FIG. 12-37. THESE APS PLACEMENTS ARE UNACCEPTABLE, REGARDLESS OF HOW SPEAKERS ARE AIMED.

Unacceptable placement for pedhead-mounted speakers

Unacceptable placement

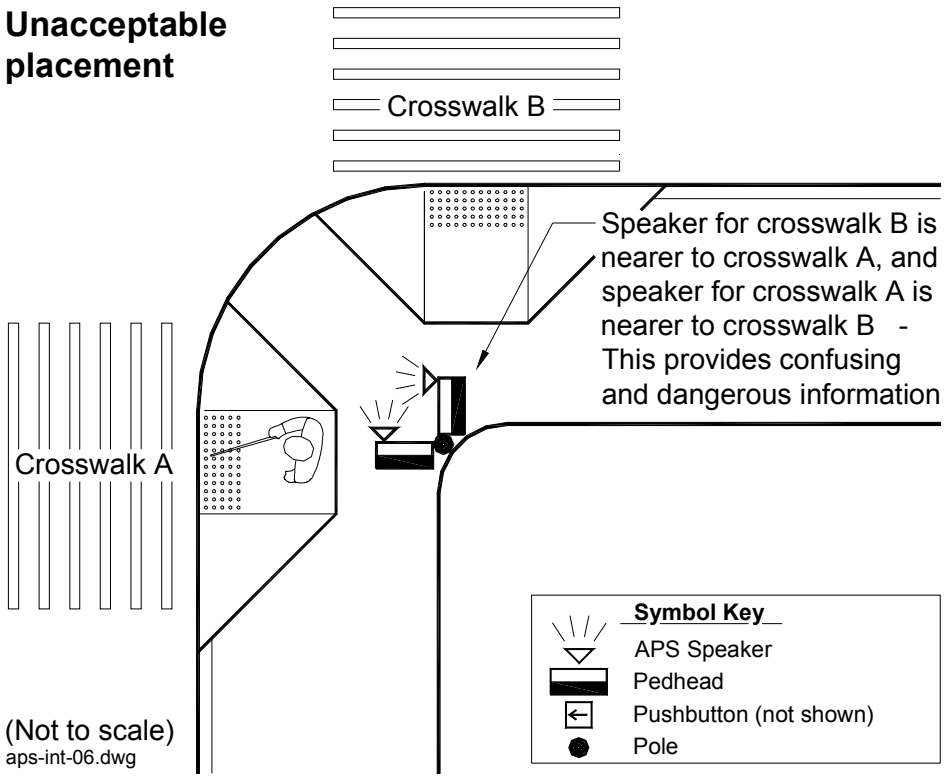


FIG. 12-38. THESE APS PLACEMENTS ARE UNACCEPTABLE, REGARDLESS OF HOW SPEAKERS ARE AIMED.

Chapter 13 — Field Adjustments

Summary

The success of Accessible Pedestrian Signal (APS) installations cannot be assured by even the most careful planning. Field adjustments are almost always required to provide the most benefit for all users.

APS products offer a wide variety of standard and optional features, and the technology is changing rapidly. In addition, conditions vary in the field. Intersection and crosswalk geometry may be unusual, traffic control equipment and associated wiring may be old and unable to be adapted as anticipated, and site conditions, including other infrastructure on the corner, may be challenging.

The goal of this chapter is to inform installers, and those who evaluate this work, of criteria that are critical to the successful performance of APS.

Chapter contents

In this chapter:

Adjustment of installations

Introduction

Devices should be carefully adjusted in the field and evaluated after installation to be sure they are working properly from an engineering perspective and from the perspective of pedestrians who are visually impaired.

- If the APS has been added in response to a request from a pedestrian who is blind or visually impaired, that individual should also be involved in evaluation after installation.
- Because installers may be unfamiliar with new types of APS devices, extra supervision and attention will be required during the first few installations by any crew or contractor.
- Even when carefully specified, installations sometimes do not match the specifications because installers do not understand that failure to exactly follow specifications may lead to an installation that cannot be accessed by pedestrians who use wheelchairs, or that could cause a pedestrian who is blind to push the wrong pushbutton, to veer into the center of the intersection, or mistake which crosswalk has the walk interval and start crossing at an unsafe time.
- The sound level of the speakers must be carefully set and evaluated at the time of installation, and then checked at a time with different traffic volumes to assure that settings are correct.

Setting and evaluating sound levels

Where should the sound be audible from?

In general, installers have a tendency to set volume levels of devices too loud.

- The WALK indicator must be audible from the beginning of the crosswalk (MUTCD 4E.06 Standard)
- MUTCD (4E.06 and 4E.08 Guidance) states that the locator tone and WALK tone of an APS should be at the same volume (except by special actuation, providing a louder tone for a single pedestrian phase) and specifies that the locator tone should be audible 6 to 12 feet from the pushbutton, or to the building line, whichever is **less**.

Three settings

Most devices require setting:

- Microphone sensitivity or automatic gain control (AGC) sensitivity,
- Volume of the pushbutton locator tone, and
- Volume of the WALK indication.

The microphone sensitivity or AGC controls how the other tones/message volumes respond to ambient noise levels.

Volume level considerations

The correct setting will vary depending on whether there are buildings close to the APS, and the presence of split phasing or of slip lanes

- When buildings are close to the APS, the sound reflected from the buildings will make the sound seem louder. The reflected sound may also influence the microphone and automatic gain control such that the APS will sound louder for the same setting than if the APS was in an open area.
- At intersections having split phasing, APS at parallel crosswalks must not be audible across the street (at the other crosswalk), or users may begin crossing with the wrong WALK signal. Check this at times of low ambient sound as well as at times with normal sound.
- APS at intersections having turn lanes that are channelized by a splitter island must not be audible from the corners of the intersection, before crossing the turn lane. If APS are too loud, pedestrians who are blind may believe the turn lane is signalized, or that the intersection crosswalk extends all the way to the corner. If the volume is too loud, pedestrians might assume that they have a WALK indication to begin crossing, when, in fact, they may be entering an uncontrolled, or yield or stop sign controlled, slip lane, or a separately signalized turn lane.

Setting and evaluating sound levels

How loud should the sound be?

Sound should be between 30 dB minimum and 89 dB maximum. At no time should sound be more than 5 dB above ambient sound (except by special actuation for audible beaconing). [MUTCD 4E.06 and 4E.08 Guidance; and PROWAAC 2.5.2.2 G]

Draft Public Rights of Way Accessibility Guidelines specify that the sound level should be between 2 and 5 dBA above ambient sound, measured 36 inches from the pole.

Manufacturers typically set a maximum and minimum output level on APS devices. The maximum should be 89 dBA, as required by OSHA regulations.

The setting of the automatic volume adjustment, also called microphone sensitivity, or automatic gain control (AGC), must be adjusted by the installer to provide output at one of a number of ranges between the maximum and minimum. The number and width of ranges varies by manufacturer.

Automatic volume adjustment

Pre-set automatic volume adjustment or automatic gain controls cannot assure that the volume meets the criterion for distance at which the APS should be audible. Similar automatic volume adjustment settings on APS by different manufacturers may seem to provide quite different loudness, as judged by listeners.

- Automatic volume adjustment technology used by different manufacturers varies in the rate of sampling of ambient sound and in the speed with which output adjusts to changes in ambient sound.
- Some APS, and some installations will be more subject to responding to their own noise than others. For example, as the WALK signal continues throughout the walk interval, the signal may get louder and louder in response to its own noise.
- Different tones or speech will seem louder or quieter depending on their frequency content, although they may measure the same on the dBA scale.

Setting and evaluating sound levels

Measuring the sound level

Because of the short duration of pushbutton locator tone and WALK tone pulses, conventional analog or digital sound level meters are not able, in the crosswalk environment, to accurately measure the absolute sound level (dBA) of APS tones, or the sound level of APS tones relative to ambient sound.

At present, setting and evaluation of APS sound level is typically done by ear. The locator tone and WALK indication should be audible within 10 to 12 feet of the device. It is critical for the WALK indication to be audible at the crosswalk waiting location.

Most APS installations evaluated by the authors during 2001-2002 have been set louder than was optimal either for blind pedestrians or APS neighbors.

Measuring sound where audible beaconing is needed

At crosswalks where audible beaconing is needed, sound pressure level (dB) should be evaluated from the middle of the street, when the loud WALK indication has been called, to be sure beaconing will be provided throughout the crossing. However, OSHA limits the maximum output of APS to 89dB, and most manufacturers pre-set this maximum. Therefore, at exceptionally wide crossings, and when and where there is high ambient sound, there may be a distance in the middle of the crosswalk where the beaconing is not readily heard.

Setting and evaluating sound levels

Microphone location and effect on perceived loudness

APS devices that respond to ambient sound have microphones to pick up the ambient sound.

- Microphones for pedhead type devices are typically in or on the pedhead, incorporated into the APS.
- Pushbutton integrated devices may have microphones at the pedhead or the microphones may be incorporated into the pushbutton housing.

Microphone location

An APS microphone should be mounted as close as possible to the position of the pedestrian who is waiting to cross the associated crosswalk, because sound pressure is halved for each doubling of the distance from the sound source in a free field.

The farther from that ideal position the microphone is for a given APS device, the greater will be the following problems.

- The ambient traffic sound when a microphone is located on a signal pole 10 feet from the curb line will be quieter at the microphone than at the street; therefore the resulting output will be quieter than it would be if the ambient sound were measured near the street.
- The WALK indicator, if it comes from the same pole location, may already be too quiet because the ambient sound level has been measured too far from waiting pedestrians, and it will be quieter still when its sound reaches the ears of pedestrians waiting at the crosswalk because the sound has traveled farther to reach them.
- If the microphone is closer to the intersecting street than to the street the pedestrian is waiting to cross, or the microphone is oriented toward the intersecting street, it will respond to the traffic sound on that street instead of the street the pedestrian is waiting to cross. This may result in WALK signals that are too loud or too quiet as perceived by pedestrians waiting to cross.

Ideal microphone location

The best location for the microphone is as close as possible to the position of pedestrians who are waiting to cross the associated street. This results in pedestrians being clearly able to hear APS signals with no need to set the automatic volume adjustment so high that sound levels will be too high at 36 inches from the source, or that APS neighbors will be annoyed.

Installation of speakers and microphones

Confirming speaker location and orientation

Speaker location and orientation need to be checked against the specifications. Installers should make no change in speaker location or orientation without checking with the responsible signal engineer.

Poorly located speakers can result in:

- Ambiguous information about which crosswalk has the WALK interval;
- Failure of blind pedestrians to begin or end crossings within the crosswalk; and
- Veering of blind pedestrians outside the crosswalk, possibly into conflicting traffic.

See discussion and examples in Chapter 12 for more information.

Speaker location

Incorrect speaker location can make a difference in ability of pedestrians who are visually impaired or blind to discern which APS is sounding.

- Each APS speaker at a corner must always be closest to the crosswalk it signals.
- For pedhead-mounted APS, speakers should not be automatically located on the pedhead that signals the same crosswalk. The pedhead closest to one crosswalk may signal the perpendicular crosswalk. In this case, speakers must be mounted on the pedhead for the perpendicular crosswalk. See discussion on page 12-17 and Figures 12-32 – 12-38 in Chapter 12.

Speaker orientation

The speakers should be adjusted so the pushbutton locator tone can be heard by a pedestrian approaching the corner from both the sidewalk side and the street. However, it is most critical that the APS WALK indication can be heard at the beginning of the crosswalk.

Specifications for installations should include speaker orientation. See discussion in Chapter 12.

Precise orientation of the APS speaker is especially critical at locations with audible beaconing. If a speaker or transmitter is oriented even a few degrees out of alignment with the associated crosswalk, pedestrians may inadvertently travel out of the crosswalk, perhaps into the path of vehicular traffic.

Installation of pushbuttons, vibrating surfaces, signage and tactile arrows

Reach range of pushbuttons

Pushbuttons must be within accessible reach range of a level landing for use from a wheelchair and no higher than 42 inches measured from the landing

Pushbutton location

Pushbuttons should be within reach from a level landing, within 5 feet of the crosswalk lines extended and within 10 feet of the curb. See specification information in Chapter 12.

Vibrotactile information

Vibrotactile WALK information should be provided during the associated walk interval by each APS equipped with a vibrating surface.

If two pushbutton-integrated APS with vibrating surfaces are installed on the same pole, they may both vibrate during both walk intervals if they are not properly insulated from the pole and spaced apart from each other.

Orientation of tactile arrows

The tactile arrow must be oriented parallel to the direction of the cross-walk controlled by the pushbutton.

Installer should check that arrow direction and pushbutton information message agree. APS have accidentally been installed with the message providing notification about the wrong street.

FIG. 13-1.
APS IS MISALIGNED WITH THE ARROW POINTING INTO THE BUSHES. THE FLUTED POLE MADE CORRECT ALIGNMENT MORE DIFFICULT. THE INSTALLER SAID HE HAD TO PUT IT THAT WAY BECAUSE HE DIDN'T HAVE ANY SHIMS; HE DIDN'T SEEM TO BE CONCERNED BECAUSE IT WASN'T SPECIFIED.

Speech messages

When sound chips with the recorded speech message are part of the device or its control board, the installer must take care to install the proper device and control board in each location.

Follow up on installations

Evaluation

After installation is complete, at each corner for each device:

- Evaluate and adjust the locator tone volume
- Evaluate and adjust the WALK indication volume
- Evaluate and set the sensitivity level of the automatic volume adjustment.
- Confirm proper functioning of the WALK indicators
- Check height and location of pushbutton
- Check the tactile arrow
- Check optional features
- Check audible beaconing
- Recheck the functioning at a later time.

Locator tone volume

Evaluate and adjust locator tone volume

- Approach intersection along sidewalk from both directions and note when the pushbutton locator tone is audible. If there are two pushbutton locator tones at the corner, each should be audible. The pushbutton locator tone should be audible when 10 to 12 feet from pushbutton, or at the building line, whichever is closer to the pushbutton.
- Approach corner from crosswalk and note when the pushbutton locator tone is audible. The pushbutton locator tone should be audible when 10 to 12 feet (or approximately one lane) from pushbutton.
- Listen through several cycles at times when traffic is noisy and quieter.
- Adjust the locator tone volume as necessary.

WALK indication volume

Evaluate and adjust the volume of the WALK indication:

- Stand at the curb or end of the curb ramp at the crosswalk and listen for the WALK indication. It should be audible from the crossing location.
- Confirm that the WALK indication for each crosswalk sounds closer than the WALK indication for the perpendicular crosswalk.
- Listen through several cycles at times when traffic is noisy and quieter
- Adjust the WALK indication volume as necessary.

Automatic volume adjustment

Evaluate and set the sensitivity level of the automatic volume adjustment

- If volumes are adequate in quiet conditions, but do not increase enough or quickly enough when ambient noise increases, the microphone sensitivity, or automatic gain control, may need to be increased.
- Increase the microphone sensitivity in approximate 20% steps until the response is as desired.
- It might be necessary to readjust the volume of the locator tone and WALK indications after the microphone is adjusted.

Follow up on installations

Confirm proper functioning of the WALK indication

Determine if the vibrating surface, speech messages or other features of the WALK indication work properly:

- Press the button and wait for the WALK indication. The tactile arrow or vibrating surface should vibrate rapidly only during the WALK.
- The WALK indication (tone or speech message) should sound for the duration of the walk interval, unless there is a special setting due to a 'rest-in-walk' situation.
- If the WALK indication is a speech message, confirm that it refers to the correct street and is appropriately worded.

Check height and location of the pushbutton

Confirm that pushbutton height and location conform to specifications and can be reached by a person in a wheelchair, from a level landing.

Check tactile arrow

Examine the tactile arrow.

- Check that it is aligned in the direction of travel on the crosswalk.
- Confirm that it points to the street that is controlled by that pushbutton.

Check optional features

Confirm that optional features, if ordered, are present and functioning correctly.

- Press the pushbutton for an extended button press and see if the pushbutton information message plays and accurately identifies the intersection and crosswalk, and that other information, if provided, is accurate
- Confirm that a tactile map accurately represents the crossing features.
- Confirm that Braille dots are raised, not depressed. If possible, request that a person who reads Braille confirm that it is the correct label.

Check audible beaconing

If the intersection requires audible beaconing,

- Press the pushbutton for an extended button press and confirm that the sound is boosted during the following pedestrian phase for the WALK tone and for the locator tone.
- Walk across the street during the pedestrian phase and evaluate placement and aim of devices to provide sound in the crosswalk area.

Re-check device functioning at a later time

Follow-up during the first few weeks after installation, checking device functioning and volume at different times of day to assure proper functioning.

Designate a person and phone number to call and report malfunctioning devices. Share that information with agencies serving individuals who are blind and organizations of individuals who are blind in the community.

Follow up on installations

Repairing an APS after a crash

It is essential that all maintenance personnel understand the functioning of the APS and consider it during repairs.

One municipality had a problem when the pole of the APS was knocked down in an accident and the repair team replaced the pole with the APS oriented toward the wrong street. The speech message and arrow didn't match up; the speech was saying WALK sign is on to cross Harford Road (at the correct time) but the arrow on that device pointed toward Taylor Avenue.

FIGURE 13-2: APS WAS REPLACED ON THE POLE, BUT THE TACTILE ARROW POINTS TO THE CENTER OF THE INTERSECTION, RATHER THAN BEING ALIGNED WITH THE DIRECTION OF TRAVEL ON THE CROSSWALK.

In another instance, an APS was damaged by a car that left the roadway. The APS was just strapped back onto the pole with no attention to the alignment of the tactile arrow. The APS continued to function, but was pointing to the center of the intersection, rather than being aligned with the appropriate crosswalk.

Chapter 14 — US Case Studies

Summary

This chapter describes experiences of US cities that have installed Accessible Pedestrian Signals. Some of these cities have a long history of installing APS; others have more recently installed APS at one or two intersections.

Each case study includes information on the municipality's history of APS installation, process and procedures, types of devices installed, dates installed, installation, maintenance, and evaluation issues, and contact information.

Cities included

This chapter includes reports from the following jurisdictions:

- Montgomery County, Maryland
- Portland, Oregon
- Newton, Massachusetts
- New Jersey Department of Transportation, Washington, New Jersey
- West Virginia Division of Highways, Morgantown, West Virginia
- Dunedin, Florida
- Maryland Department of Transportation
- Charlotte, North Carolina
- Atlanta, Georgia

Case Study – Montgomery County, Maryland

History and background

The intersection of Fenton Street and Wayne Avenue is the first of eleven locations in the Silver Spring Central Business District (CBD) to be equipped with Accessible Pedestrian Signals (APS) under a pilot program initiated by the County Executive.

Process and procedure

There is no formal procedure to request APS. A committee was formed, in coordination with the Montgomery County Commission on Persons with Disabilities, to make decisions about type and features of APS to be installed.

Most signalized intersections in the county are on state roads, so final decisions of the State Highway Administration on APS policy will affect installation at those locations.

Funding

Costs for the pilot project are absorbed as part of the traffic engineering department budget. Additional line item for APS installation was requested in budget but was not funded.

Description of intersection

These traffic signals are being rebuilt as part of the redevelopment of the CBD. Fenton Street and Wayne Avenue was the first one to be rebuilt, and hence the first to receive APS. All intersection legs are 4 lanes wide. Fenton Street runs approximately north/south and Wayne Avenue runs east/west. There is a leading left turn phase from westbound Wayne to Southbound Fenton.

Date installed

September 2001

APS type and features

Pushbutton-integrated devices from Polara Engineering.

Intersection is pre-timed, with walk intervals associated with each crossing being provided each cycle, but the APS are actuated (audible and vibrotactile WALK indications are not provided unless the pushbutton is pushed).

APS features:

- Speech WALK message
- Vibrotactile WALK indication
- Pushbutton locator tone
- Automatic volume adjustment in response to ambient sound
- Raised arrow oriented in the direction of travel on the crosswalk
- Speech pushbutton information message.

(continued)

Case Study – Montgomery County, Maryland

APS type and features (continued)

The locator tone is constant except when the speech WALK message or pushbutton information message is activated.

- Speech WALK message: 'WALK sign is on to cross Fenton Street' (or Wayne Avenue)
- Pushbutton information message, provided after three second depression of pushbutton:
  - Includes both street names
  - Clarifies to which crossing the button applies
  - Example: "Crossing Wayne Ave at Fenton St"

APS installation

Devices are installed on all four corners, using stub poles for all in order to place the pushbuttons and APS at the top of the ramp for each direction, separated by at least 10 feet.

FIG. 14-1. (LEFT) PUSHBUTTON-INTEGRATED APS LOCATED ON A STUB POLE BESIDE THE LEVEL LANDING OF THE CURB RAMP.

FIG 14-2. (RIGHT) PEDESTRIAN WITH DOG GUIDE AT AN APS LOCATED IN LINE WITH CROSSWALK.

Each pole is approximately five feet tall with a substantial base; locations vary somewhat but are generally located:

- Within 5 feet of the crosswalk lines extended
- 6-10 feet from the curb, (except on NW corner where further construction is planned and those poles were located farther from the curb)

'The Polara control unit and the microphone, which monitors sound for the automatic volume adjustment, are typically installed inside 18-inch pedestrian traffic signal heads. At this location with 12-inch pedestrian signal heads, the control units were installed in an exterior box attached to the top of the pedestrian traffic signal heads. The microphone was attached to the box, which located it much higher than usual; however, that placement seems acceptable.

Case Study – Montgomery County, Maryland

Installation issues	There were no real problems with the installation, however, locating the poles and APS properly in relation to the curb ramp and as recommended in the MUTCD is difficult. While it may be less of a problem in new construction, it requires thought and planning, and extra poles, conduit, wiring and construction in retrofit situations.
Maintenance	Except for some minor adjustments after installation, there have been no maintenance issues or failures.
Evaluation	No formal evaluation has been conducted. Committee members visited the installation and were generally pleased with the functioning.
Contact	Bruce Mangum, Senior Engineer Transportation Systems Management Section Division of Public Works and Transportation Montgomery County Maryland 101 Monroe Street, 11th Floor Rockville, MD 20850 Phone; 240-777-8778 - Fax: 240-777-8750 E-mail: bruce.mangum@montgomerycountymd.gov

Case study – Portland, Oregon

History and background

The City of Portland has had some form of audible pedestrian signal for over 20 years. In installing these devices, staff worked closely with the requester to identify specific needs.

- In the late 1970's City staff installed buzzer-like devices at three intersections on request basis. These buzzers were inexpensive devices purchased from a local electronics store. The buzzer was only activated with a normal pedestrian push button call.
- During the late 1980's the City began using an inexpensive Mallory chime as an audible device. It was installed in some fixed timed intersections as well as actuated intersections.
- By 1995 the City had ten signalized intersections with audible devices.
- In 1996 the City decided that a more formal policy was necessary and a process was implemented, which was revised in 1999 by a Citizens Advisory Committee.

During the past five years the City has greatly expanded its program. By mid-2003, the City had 53 signalized intersections with some form of audible signal.

The City of Portland was awarded a Pedestrian Project Award for 2003 from ITE and the Partnership for a Walkable America. The award was for the Elderly and Mobility category for Portland's project to retrofit existing signals with APS.

FIG. 14-3.
APS MOUNTED OVER 12 FEET HIGH ON THE POLE BROADCAST SPEECH MESSAGES AT THIS LOCATION IN PORTLAND. CITY ENGINEERS EXPRESSED CONCERNS ABOUT INTELLIGIBILITY OF THE MESSAGE.

Case study – Portland, Oregon

Process and procedure

A formal policy was established in 1996.

- City staff assembled a stakeholders group, which included representation from the Oregon Council of the Blind, the National Federation of the Blind, the Oregon Commission for the Blind, Independent Living Resources, and other groups representing both the visually impaired community and mobility instructors.
- The policy was developed over a series of three meetings (see City of Portland procedures and evaluation form in Appendix D).

Key points of policy:

- Audible signals are installed only on a request basis.
- The intersection has to have some unique or unusual characteristics that warrant the addition of an audible signal.
- Referral to a mobility specialist is required; this service is provided through an agreement with Oregon Commission for the Blind. In some instances the crossing problems may be related to a lack of user skills that might be better addressed by further training.

In mid-1999 the requests for audible signals outstripped City resources for the program. A citizens advisory committee (CAC) was activated to review and rank the requests.

- The CAC and City staff started with a ranking process similar to that used in the City of Los Angeles.
- Staff applied the criteria to ten intersections on the request list. CAC made some revisions to the scoring criteria (See Appendix D).
- Scoring materials were developed. The electrician responsible for the installations and a mobility instructor from the Oregon Commission for the Blind meet the requester at the candidate intersection to better understand the user's needs and concerns. After agreeing that some sort of audible signal is a viable solution, the City staff person and mobility instructor complete field aspects of the scoring form. Information such as volumes and accidents is gathered by office staff from existing City records and added to the scoring form.
- CAC meets semi-annually to rank the requests.

Funding

From 1996 through 2000, the City used approximately $150,000 in general transportation funds to install APS. That funding source for APS has been lost. To continue with new installations, the City received over $200,000 in transit mobility funds from the local transit agency. However, that grant expires in July 2004 and no replacement funding source has been identified yet.

Case study – Portland, Oregon

APS types and features

Pedhead-mounted at numerous intersections. Pushbutton-integrated at two intersections.

Pedhead-mounted device manufactured by Novax and Mallory

Pedhead-mounted APS features

- Walk indication – cuckoo/chirp, beep, chime

Extended button press to call accessible features on some devices (no locator tone is used.)

Pushbutton-integrated devices, manufactured by Polara Engineering and Campbell Company, have been installed recently with locator tones and additional features.

The City of Portland has also evaluated the Vibrawalk pushbutton manufactured by Novax Industries

FIG. 14-4.
VIBRAWALK PUSHBUTTON INSTALLED IN PORTLAND INCLUDES A LOCATOR TONE. THE ARROW VIBRATES DURING THE WALK INTERVAL AND WALK INDICATION IS PROVIDED FROM PUSHBUTTON OR SPEAKER MOUNTED ON THE PEDHEAD.

Special features

Portland staff has worked with manufacturers on developing features:

- After 1996, in deference to requests of members of the National Federation of the Blind, a technology was used that requires the user to hold the button for at least one second to place a call for an audible signal to make the technology 'refuseable'. Button Activated Timer (BAT), from Novax Industries of British Columbia, requires that the button be depressed for at least one second to call the audible indication.
- Staff worked with Novax and McCain to take the speaker and electronics out of the exterior Novax housing and mount them directly in the pedhead to afford more protection from vandalism and place the speaker closer to the users' ears.

In 1999, the CAC and City staff expressed a desire to find lower cost options so that more intersections could be treated. City staff received approval from the CAC to install lower cost Mallory devices. Since the Mallory device has neither automatic volume adjustment nor Button Activated Timer, city staff is careful to use the device only in locations that are that are not close to residences.

Date installed

Between 1970's and present

Case study – Portland, Oregon

Installation

Installation varies greatly from intersection to intersection. Portland transportation engineering staff reports that the largest problem faced is with existing infrastructure. The aging transportation system makes installing new wires in old, undersized conduits a challenge. Location of existing poles also poses a problem. As intersections evolve throughout their life span, poles for pushbutton locations are often located in areas that are less than desirable for accessible pedestrian installations.

Obstructions, such as utility and sign poles, also are a significant challenge. These obstacles often make placement of pushbutton locations difficult, translating into higher installation costs.

Proximity of poles, in relation to one another, also has to be taken to account. Volume level of the "WALK" cue and locator tone must be loud enough to tell pedestrians to go, but quiet enough to not give a false "WALK" cue to someone at a conflicting ped lane. This can be difficult at intersections with odd configurations, such as islands with separately actuated ped lanes.

Maintenance

Maintenance of equipment has been almost a non-issue. There have been few maintenance problems although it should be noted that most of the equipment with electronics mounted in the pedhead or pushbutton, is relatively new. These installations are only one to six years old so there is not a long maintenance history on those devices.

Evaluation

Portland tested a variety of WALK indications

- Earliest sounds for the WALK were a buzzer and Mallory chime.
- A trial installation used voice messages. The voice message typically said "The WALK light is now on to cross 41st Street". Although equipped with ambient sound adjustment to increase the output as background noise increased, the voice message was often difficult to hear.
- Tones seem to be better for cutting through background noise in an urban street environment. After the initial test with voice and tones, the City decided to use the cuckoo and chirp sounds.

Community Response/reactions:

- Buzzer - Staff received some calls regarding the annoying sound and usually responded by placing some sort of baffling material around the buzzer.
- Mallory chime - The chime was a more pleasing sound and the City seldom received any noise complaints, even though the chime was installed in some fixed time intersections

Case study – Portland, Oregon

Contacts

Bill Kloos, Signal and Street Lighting Manager
Portland Department of Transportation
1120 SW 5th Avenue / Suite 800
Portland, OR 97204-1971
Phone: 503-823-5382
E-mail: Bill.Kloos@pdxtrans.org

Jason McRobbie, District Electrician
Portland Department of Transportation
1120 SW 5th Avenue / Suite 800
Portland, OR 97204-1971
Phone: 503-823-1773
E-mail: Jason.McRobbie@pdxtrans.org

Case study – Newton, Massachusetts

History and background

APS were installed at the major intersection in Newton, Massachusetts in 2001, as part of a major signalization up-grade project, and at the recommendation of the Mayor's Committee for People with Disabilities (Mayor's Committee). This is Newton's first experience with this signal type.

Process and procedure

New construction and signal up-grades

When new signals are installed in Newton, the Mayor's Committee considers whether they should have accessible pedestrian signals. Their recommendation is then referred to the departments of Public Works and Planning. For example, when signalization at an intersection is being upgraded from a flashing beacon to full signalization, input is obtained from the Mayor's Committee.

Handling individual requests

Individual requests are referred simultaneously to the Mayor's Committee and to the Traffic Council. The Traffic Council is required to respond to requests by making a decision within 12 weeks.

Consultation with local agency for the blind

The City Traffic Engineer also consults with an orientation and mobility specialist at the Carroll Center for the Blind regarding the need for APS and for suggestions regarding the most appropriate type of APS for a particular intersection.

Funding

APS in Newton were funded jointly by Public Works and Planning, with a portion of the cost being covered through the Community Development Block Grant program.

The City of Newton currently has $10,000/yr earmarked for APS.

Description of intersection

The APS were installed at a complex intersection with high pedestrian as well as vehicular traffic counts. At this intersection, three crosswalks share the same exclusive pedestrian phase timing:

- One is a mid-block arterial crossing;
- One is a minor street intersecting the arterial in a "T", near the mid-block crossing;
- The other is across a third street that enters the arterial diagonally, close to the "T" intersection of the minor street.

Because of abundant turning traffic during all vehicular phases, there is no safe crossing time for pedestrians except during the exclusive pedestrian phase.

Case study – Newton, Massachusetts

APS type and features

Pushbutton-integrated APS manufactured by Bob Panich Consultancy.

APS Features:

- WALK indication – audible rapidly repeating tones
- Vibrotactile WALK indication
- Pushbutton locator tone
- Tactile arrow
- Alert tone
- Automatic volume adjustment in response to ambient sound.

APS installation

FIG. 14-5. (LEFT) PANICH APS AT MID-BLOCK CROSSING, NEWTON, MASS. APS SHOULD HAVE BEEN MOUNTED ON SIDE OF POLE CLOSEST TO CROSSWALK, WITH ARROW PARALLEL TO CROSSWALK RATHER THAN POINTING UP.

FIG. 14-6. (RIGHT) PANICH APS FOR CROSSING THE STEM OF A "T" INTERSECTION.

APS installation

FIG. 14-7. PANICH APS ON STUB POLE IN NEWTON, MASS. ARROW ORIENTED PARALLEL TO CROSSWALK.

At another intersection at which APS were installed, a stub pole was installed in order to locate the pushbutton properly for one crosswalk.

Case study – Newton, Massachusetts

Installation issues

Installation presented no technical difficulties.

Initially the signal volume was set so loud at one location that the WALK signal was audible from a nearby intersection, possibly leading pedestrians at that intersection to believe they had the walk interval when they did not. The volume was turned down several months after the APS were installed.

Although the basic requirement in Newton for conduit in public rights-of-way is a 36" trench, actual construction may be less than 36" depending on site conditions. It is important that such an installation be based on direct field knowledge, rather than be designed in the shop.

Maintenance

No maintenance, except for volume adjustment, has been necessary since the audio-tactile pushbuttons were installed. Weather does not seem to affect their performance, and there has been no vandalism.

Evaluation

The APS have been well-received by blind users, and there have been no objections from neighbors.

The APS are in a small business area, not close to any residences.

Contact

Roy Lamotte
City Traffic Engineer
City of Newton, MA
Phone; 617-796-1020
E-mail: rlamotte@ci.newton.ma.us

Case study – New Jersey DOT - Washington, New Jersey

History and background

The New Jersey Department of Transportation has been sensitive to the needs of the visually impaired. The first vibratory (with raised directional arrow) pushbuttons in New Jersey were installed in 1992 at the Rowan College signalized pedestrian crossing across Route 322. As of August 2000, NJDOT had installed APS devices at four intersections. The devices at the location described and pictured here, Route 31 and Route 57, were installed in the fall of 2000. NJDOT has recently installed APS devices at other intersections and expects to install more devices.

Study underway

A project is underway for the installation and evaluation of four types of APS devices at intersections in Morristown, NJ. The study is funded by NJ Highway Traffic Safety and is being conducted by Edwards and Kelcey in cooperation with The Seeing Eye. More information is provided in Chapter 2.

Process and procedure

There is no formal process for deciding to install an APS.

These APS devices were installed at the request of a blind person in conjunction with reconstruction of the intersection. An orientation and mobility specialist provided information used in making a decision about type of APS selected.

Funding

The APS signals are funded under the general state fund with no special funding sources.

The cost of the devices was $400.00 per device to NJDOT, plus installation by NJDOT forces. NJDOT went out to bid for the devices.

Date installed

Fall 2000

Description of intersection

Route 31 and Route 57, major intersection of four-lane undivided road and two and three lane road with parking lane at the edge of small downtown CBD. There are four traffic islands with signalized crossings to the islands. Pushbuttons were installed at all crossings for a total of twelve devices at the intersection.

Case study – New Jersey DOT - Washington, New Jersey

APS type and features

Pushbutton-integrated APS manufactured by Polara

APS features:

- Vibrotactile WALK indication only
- Pushbutton locator tone
- Raised arrow
- Braille street name
- Actuation indicator – tone

APS Installation

FIG. 14-8.
INSTALLATION OF TWO PUSHBUTTONS ON A SINGLE POLE (ONLY A SINGLE PUSH-BUTTON IS VISIBLE IN THE PHOTO). WHILE THE PUSH-BUTTON IS IN LINE WITH THE CROSSWALK, THE PEDESTRIAN MUST TRAVEL OVER 10 FEET BEFORE REACHING THE STREET AND THE BEGINNING OF THE CROSSWALK.

APS were installed at all crosswalks to provide the signal information at all possible crossings used by the blind person. It is a state standard to put two push buttons on the same pole, with no stand-alone pole for the APS. This meant that some devices were located a distance from the beginning of the crosswalk. Because the indication was vibrotactile only, the walk interval was lengthened to provide time for a pedestrian who is visually impaired to reach the departure curb after the WALK began.

These devices were installed as a retrofit before various recommendations and guidelines were issued. Currently, recommendations of the Public Rights-of-Way Access Advisory Committee (PROWAAC) and draft Public Rights-of-Way Accessibility Guidelines state that devices should provide audible and vibrotactile information about the walk interval. These APS are vibrotactile only, so do not conform to these recommendations. MUTCD and PROWAAC recommendations also encourage installation of devices on two poles separated by at least 3 meters. If separation is not possible, PROWAAC recommends speech messages for the walk interval. Vibrotactile indication was used here.

Installation issues

No major installation issues

Case study – New Jersey DOT - Washington, New Jersey

Maintenance

There have been no reported maintenance problems except the vibrating arrows on a couple of devices have gotten stuck and stopped vibrating.

There has been no vandalism.

Evaluation

There are no reports of complaints or comments received from the general public or individuals in the community. In some other installations, there have been complaints due to the locator tone increasing due to the traffic noise and bothering the people that live close to the intersection.

There were complaints at first from the blind woman using the device regarding placement of the devices and ability to line up and cross while keeping her hand on the vibrating arrow. She was trained to use the APS by the mobility specialist and was able to use them adequately.

FIG. 14-9: APS MOUNTED ON SIGNAL POLE FOR CROSSING SIGNALIZED RIGHT TURN LANE. PEDESTRIAN WHO IS BLIND IS WAITING WITH HER HAND ON THE PUSHBUTTON FOR THE VIBROTACTILE WALK INDICATION. AFTER THE WALK INDICATION BEGINS, SHE MUST TURN, AND CROSS THE SIDEWALK BEFORE BEGINNING TO CROSS THE STREET.

Placement is problematic for a device that is vibrotactile only. In order to keep her hand on the device, the user must stand back from the crosswalk, and turn toward it after the WALK indication begins.

There has been no research or evaluation regarding the APS either before or after the installations.

Contacts

Tim Szwedo
Traffic Safety and Engineering
NJ Dept. of Transportation
P.O. Box 613
Trenton, NJ 08625
Phone: (609) 530-2601
E-mail: Timothy.Szwedo@dot.state.nj.us

Paul Vetter
Director, Traffic Engineering
Edwards and Kelcey
E-mail: pvetter@ekmail.com

Case study – West Virginia Division of Highways - Morgantown, West Virginia

History and Background

APS were installed in 2002, at the request of blind citizens. These are the first APS that have been installed in the state.

Process and Procedure

Morgantown does not have a process or procedure for determining which intersections will be equipped with APS. Typically, all traffic signal installations in West Virginia are installed by contract under the purview of the West Virginia Division of Highways.

Funding

This demonstration project was fully funded by the West Virginia Division of Highways.

Description of intersections

APS were installed at two intersections in the downtown area of Morgantown that have pedestrian actuation, and exclusive pedestrian phasing with right turns on red permitted.

APS type and features

Pushbutton-integrated APS manufactured by Prisma Teknik (model TS-903).

APS features:

- WALK indication for crossing in both directions is fast repetition of the pushbutton locator tone
- Pushbutton locator tone
- Automatic volume adjustment in response to ambient sound
- Tactile map of crossing

Signals are being modified to include pushbutton information messages modeled after "Wait to cross Willey St. at High St. Wait for red light for all vehicles. Right turn on red permitted."

APS installation

Two pushbuttons have been mounted on some corners so the standard single arrow can be correctly oriented in the same direction as each crosswalk. This was necessary where the two crosswalks at a corner were not at right angles to each other.

Since these locations used exclusive pedestrian phases, a right-angle, double ended arrow was installed so that a single pushbutton could be located on one corner or quadrant, controlling the WALK signal for two crossing directions. The right angle arrow will be installed where both crossings are 90 degrees from a particular quadrant.

(Continued)

Case study – West Virginia Division of Highways - Morgantown, West Virginia

APS installation
(continued)

FIG. 14-10. MOUNTING OF TWO PRISMA PUSHBUTTON UNITS ON A SINGLE POLE. SEE ARROWS ON INSERT DETAIL FOR THE ORIENTATION OF THE TACTILE ARROW ON THE TOP OF EACH UNIT. BOTH DEVICES MAKE THE SAME SOUND DURING THE WALK INDICATION, WHICH IS ACCEPTABLE IN THIS INSTALLATION SINCE THERE IS EXCLUSIVE PEDESTRIAN PHASING.

Installation issues

Wiring of the APS was little different than typical (non-APS) pushbuttons.

APS are mounted to signal uprights using two quarter-inch stainless steel screws. In the future, stainless steel bands may be placed at the top and bottom sections of APS in high-vandalism areas.

Diligence is needed in the initial design of a complete intersection, so as to correctly locate APS according to the MUTCD.

Maintenance

- No weather-related maintenance issues.

Cabinets and signals are well guarded against transient voltage surges, including high-speed surges that are accompanied by lighting.

To date, APS have been installed at six intersections in West Virginia. At one intersection in downtown Charleston, in a high vandalism area, three APS have been knocked off the signal upright.

Case study – West Virginia Division of Highways - Morgantown, West Virginia

Evaluation

- APS have performed as expected according to manufacturer's literature.

Negative comments have been received from nearby businesses about the noise level of the locator tone. The entrance to one business is less than 10 feet from the pole on which two APS are mounted.

Blind users have objected to the location of some APS units (in some cases at a distance of about 20 feet from the crosswalk).

Positive comments have been received about proactive installation of APS.

Contacts

Barry Warhoftig
Traffic Engineering Division
West Virginia Div. of Highways
Building 5, Room 550
1900 Kanawha Blvd, E.
Charleston, WV 25305
Phone: 304 558-3722
E-mail:
BWarhoftig@ dot.state.wv.us

Bruce Kenney
Traffic Engineering Division
West Virginia Div. of Highways
Building 5, Room 550
1900 Kanawha Blvd, E.
Charleston, WV 25305
Phone: 304 558-3063
E-mail: Bkenney@dot.state.wv.us

Case study – Dunedin, Florida

History and background

There are two intersections in downtown and one at Patricia Avenue and Beltrees in Dunedin where APS have been installed at the request of citizens who are blind.

The City of Dunedin was awarded the Inspired Leadership Award for 2003 from the Florida Alliance for Assistive Services and Technology (FAAST) for the APS installations.

Process and procedure

Requests for APS are received by the City of Dunedin ADA Coordinator and reviewed and recommended by the City Manager appointed ADA Committee.

APS were requested by one person who is blind and who has limited hearing in one ear as well. She consulted with an orientation and mobility specialist and requested pushbutton-integrated devices and worked with the engineer on installation details.

Funding

The intersection modifications were part of a redevelopment project.

Description of intersections

One of the intersections downtown, Douglas & Main is a fairly small square intersection of two-lane streets with a pushbutton actuated exclusive pedestrian phase.

The other intersection downtown at Broadway & Main is a more complex intersection where a very busy state road intersects with the city's Main Street.

The third intersection at Patricia and Beltrees is a T intersection of a minor street with very busy street with a right turn lane.

APS type and features

Pushbutton-integrated devices from Polara Engineering

APS features

- Speech WALK message:
  - At Douglas and Main (with exclusive pedestrian phasing): "WALK sign is on"
  - At Broadway & Main: "WALK sign is on to cross Main" and "WALK sign is on to cross Broadway"
- Vibrotactile WALK indication
- Pushbutton locator tone
- Actuation indicator – tone
- Tactile arrow
- Extended button press – increased the volume of the WALK indication and locator tone

Case study – Dunedin, Florida

APS installation

FIG. 14-11. TWO PUSHBUTTONS ARE LOCATED ON FLUTED POLE AT THIS LOCATION WITH EXCLUSIVE PEDESTRIAN PHASING. TACTILE ARROW OF EACH DEVICE POINTS IN THE DIRECTION OF TRAVEL ON THE CROSSWALK.

Two APS were mounted on each pole.

At one crossing APS were about 15 feet back from the crosswalk location, and approximately 5 feet toward the intersection from the extension of the crosswalk lines. Volume of locator tone and WALK message was quite loud

At the Patricia and Beltrees location, APS were installed on only one crosswalk, to cross the through street, as needed and requested by the person who lived near the intersection.

Installation issues

Installers stated that they had difficulties with figuring out the new devices but seemed to work fine after they figured them out.

Fluted poles were used in the redesign which made it difficult to align the tactile arrow.

Maintenance

No maintenance issues have been reported except for need to adjust volume levels.

Evaluation

Installation caused complaints from patrons of a restaurant/bar on one corner with outdoor seating. Locator tone was loud enough to hear from over 30 feet away.

The woman who requested the installation was initially unhappy with some parts of the installation. Original plans included a stub pole close to the crosswalk but that was not installed at first. Even with the signal adjusted to the maximum volume, she was unable to hear the WALK indication when she was standing at the crosswalk location. A stub pole was later installed which allows a reduction in volume of the device and diminishes problems for neighbors as well.

Case study – Dunedin, Florida

Contacts

Barbara Fidler, ADA Coordinator
City of Dunedin
542 Main Street
Dunedin, FL 34698
Phone: 727-298-3010 v/tdd
Fax: 727-298-3012
E-mail: bfidler@dunedinfl.net

Michael Gust, P.E.
Division Dir. of Traffic Control
City of Dunedin, Traffic Division
822 Lake Haven Road
Dunedin, FL 34698
Phone: 727-298-3224
Fax: 727-298-3219
E-mail: mgust@dunedinfl.net

Case study – Maryland DOT

History and Background

During the 1980's and 90's, Maryland installed some APS of the cuckoo/chirp type at locations throughout the state, including Montgomery County, Frostburg, Lutherville, and Towson.

Maryland DOT, in response to concerns about mobility for persons who are visually impaired through unique intersections, such as roundabouts, and the addition of the APS section to the MUTCD, convened a committee in November 2000 to develop criteria for installation and prioritization plans for installation of APS.

The committee consisted of representatives of the visually impaired community, traffic engineers, orientation and mobility specialists, local ADA coordinators and DOT staff

The goals of the committee included:

- Identify factors affecting mobility of the visually impaired through intersections
- Identify and reconcile differences of approach to mobility issues within the visually impaired community
- Develop a rating and prioritizing process for APS

Process and Procedure

The committee developed a prioritization checklist (see Appendix D). This checklist has been used on approximately 40 intersections to date, with scores ranging from 14 to 46 out of a possible total of 60. While each crossing receives a rating, the highest rating for any crossing is used for the intersection.

At this time, Maryland is considering any intersection with a rating greater than 36 to be a high priority. Eleven intersections are rated at this level and have either had APS installed or are under design for installation.

Funding

Maryland considers an APS to be a traffic control device and as such funding is from traffic control, highway construction and Federal funds.

Case study – Maryland DOT

Type of APS used

Pushbutton-integrated APS manufactured by Polara Engineering

APS features:

- Speech WALK message, with option of cuckoo/chirp if desired for specific location
- Vibrotactile WALK indication
- Pushbutton locator tone
- Actuation indicator – speech WALK message
- Pushbutton information message
- Locator tone
- Automatic volume adjustment in response to ambient noise levels

Maryland is also testing and evaluating equipment from other manufacturers.

Description of intersection

Installation Example 1, Loch Raven and Taylor, is a large intersection with right turn islands, heavy traffic volumes and left turn lanes on all approaches.

APS installation, Example 1 – Loch Raven & Taylor

Existing poles were used at this location with channelizing islands and uncontrolled right turn lanes in three of the four quadrants.

FIG. 14-12. TWO APS ARE MOUNTED ON THE EXISTING POLE ON THIS ISLAND.

FIG. 14-13. APS AS SEEN FROM RIGHT-TURN LANE CROSSING.

WALK indication is a speech message. The volume levels of the APS were carefully adjusted to prevent the WALK indication from being audible to pedestrians before they crossed the right turn lane. The speaker is blocked on the side away from the intersection. However, wind, humidity and large trucks can affect the sound levels and the signals may be audible from the sidewalk under certain conditions. In this case, the person who requested the signals is familiar with the geometry.

Case study – Maryland DOT

Description of intersection

Installation Example 2, Loch Raven and Glen Keith, is an intersection with low side street volumes. The APS is to cross the major street (Loch Raven) only. There are no pedestrian indications to cross the minor (Glen Keith) so APS were not installed for those crossings. The major street is quite wide, with a median island and a stop sign controlled service road along the west side of Loch Raven. Again, the volumes needed to be carefully adjusted. Vehicular signal pole was used for one APS but others were located close to the crosswalk on pedestrian signal poles.

APS installation,

Example 2 – Loch Raven & Glen Keith

FIG. 14-14 APS INSTALLED ON PEDESTRIAN SIGNAL POLE

FIG. 14-15: [ABOVE] VIEW ACROSS LOCH RAVEN TOWARD TWO MEDIAN ISLANDS AND STOP SIGN CONTROLLED SERVICE ROAD.

FIG. 14-16. APS INSTALLED ON SIGNAL POLE BESIDE CROSSWALK WAITING LOCATION.

Case study – Maryland DOT

Installation issues

Mr. Paulis of the Office of Traffic and Safety states that the location of pushbuttons and other APS equipment is of high importance in providing a properly operating system for pedestrians who are visually impaired. In many cases, it is not desirable to only use existing poles for the installation of APS. The installation of additional pedestal poles is often necessary to insure the proper location of APS relative to crosswalks and curb cuts.

Adjustment of initial volume levels for use has been an issue. Obtaining the proper balance between the needs of the persons who are visually impaired and surrounding development while not presenting misleading information to pedestrians has proved to be difficult. Complicating the process are uncontrollable factors, that is, traffic noise and weather conditions such as wind and rain.

Maintenance

There have been some failures of the control boards, but these may not be excessive when considering that the equipment is a new and relatively recent design and the growing pains associated with new technology.

Evaluation

No formal evaluation has been conducted of installations. Most individuals who have requested the installations seem to be pleased.

Contacts

Edward T. Paulis, Jr., Office of Traffic and Safety
Maryland State Highway Administration
7491 Connelley Drive
Hanover, MD 21076
Phone: 410-787-4092
E-mail: epaulis@sha.state.md.us

Case Study – Charlotte, North Carolina

History and background

Charlotte began installing pushbutton-integrated APS in 1999 after discussion with the Charlotte/Mecklenburg Advocacy Council of People with Disabilities Committee. Approximately twelve intersections with forty-two pushbutton-integrated APS devices are now installed. Before that, pedhead-mounted APS had been installed upon request; current staff are not sure when those devices were installed or how the decision was made to install them. They state that they are replacing current "chirpers" with pushbutton-integrated devices.

Orientation and Mobility specialists helped evaluate APS products in advance and made recommendations to engineers.

FIG. 14-17. AN EARLY POLARA INSTALLATION IN CHARLOTTE

Process and procedure

APS are requested by citizens and installed after review by staff of Metrolina Association for the Blind. In general, devices are installed in the order of request, depending on how much construction is involved.

The Charlotte/Mecklenburg Advocacy Council for People with Disabilities Committee and the Metrolina Association for the Blind serve as liaisons between the person who is visually impaired and the city.

Funding

City council approved $95,000 in a restricted fund that is carried over year to year for purchase of equipment. The installation cost is covered in the normal budget. The public and individuals who are blind were involved in making the request for funding and getting it approved.

Case Study – Charlotte, North Carolina

APS type and features

Pedhead-mounted devices before 1999

Pushbutton-integrated devices from Polara Engineering since July 1999

APS features (pushbutton-integrated device installations):

- Speech WALK indication
- Vibrotactile WALK indication
- Raised tactile arrow
- Pushbutton locator tone
- Actuation indicator
- Pushbutton information message
- Automatic volume adjustment in response to ambient sound

Installation issues

The first generation Polara device did not accommodate pre-timed or "ped recall" locations. It was designed to look for a logic common signal from the controller. Using instructions provided by Polara, city technicians in the signal shop modified the printed circuit board, including adding a resistor and two jumpers. This being done, the devices were usable in these situations.

A simple jumper setting has addressed this problem with the newer Polara product. The first generation Polara (installed at four locations) was also more labor intensive to install. Installers drilled holes in the top of the device to accept conduit on wood pole locations.

The newer version Polara Navigator has addressed all installation concerns.

FIG. 14- 18. RECENT POLARA NAVIGATOR INSTALLATION.

When it is necessary to install new poles to locate the device more appropriately, it takes longer and more funds, because traffic engineering has to coordinate with various departments to fix curb ramps and work around other utilities. Installation can be time-consuming when a new pole is needed.

Case Study – Charlotte, North Carolina

Maintenance

No problems reported

In early installation where two devices were on the same metal pole, it was possible to feel the vibration during walk on both devices at the same time (separate walk phases). This was solved by insulating between the device and pole. A speaker problem was resolved by improving the installation method through efforts between the City Electronics Tech and the manufacturer.

Evaluation

The Public Service Department has no complaints regarding the devices. However, staff of Metrolina Association for the Blind received some complaints about the noise level of the locator tones, especially in residential areas. The volume can easily be adjusted.

The City of Charlotte placed in the top ten U.S. cities in the Accessible America contest a year ago and in the top seven this past year. Metrolina Association for the Blind has provided very favorable input and review of this project. Communication between all agencies involved has made this project a success.

Contacts

Tamara (Tammy) Drozd, Signal System Specialist
City of Charlotte NC
600 East Fourth Street, Charlotte, NC, 28202-2858
Phone: 704-336-4385 - Fax: 704-336-4400
E-mail: tdrozd@ci.charlotte.nc.us

Case Study – Atlanta, Georgia

History and background

Atlanta has installed APS upon specific request since 1992. Until April 2003, all devices installed had been pedhead-mounted devices. The city is evaluating pushbutton-integrated devices as part of a research project. There have been requests by citizens who are blind for devices with pushbutton locator tones at pushbutton actuated locations, however the city has not installed them generally to date.

Process and procedure

Individuals who are blind or visually impaired make a request to the traffic engineering department. The engineer evaluates the intersection and current timing and signalization. He may meet the blind person and an orientation and mobility specialist (usually from the Center for the Visually Impaired) at the intersection to discuss the problems.

Requests are prioritized by date of request and volume of traffic.

If the request is for an APS at a signalized intersection and devices are in stock, they can usually be installed in less than a month.

Funding

City traffic engineering funds, however, some private developers have paid for street improvements as part of a development project.

APS type and features

FIG. 14-19. PEDHEAD-MOUNTED SPEAKER MOUNTED ON THE POLE AS TYPICALLY INSTALLED IN ATLANTA.

Pedhead-mounted devices from IDC/U.S. Traffic are installed at approximately 15 intersections.

APS features:

- Walk indication -Cuckoo/chirp
- No pushbutton locator tone
- No automatic volume adjustment

Atlanta has recently installed pushbutton-integrated APS from Polara Engineering and a receiver-based system from Relume as part of a research project.

Date installed

1992 to present

Case Study – Atlanta, Georgia

Installation issues

Pedhead-mounted devices are simple to wire and install on the pole or on the pedhead.

Signal shop found the pushbutton-integrated device to be very difficult to install, requiring additional wiring and careful adjustment. After installation, the control unit of one APS was malfunctioning and the device was not sounding; manufacturer replaced the unit.

Maintenance

Many pedhead-mounted units have been installed for five to ten years or more without problems. Recently, two units failed two consecutive times until engineers found that water was getting into the devices, probably through the speaker holes. They recommend double checking the seals and mounting the speakers under the pedheads to protect them from the impact of heavy rain.

In general, Atlanta's department considers pedhead-mounted devices very reliable and serviceable. Vandalism has not been a problem.

Evaluation

The traffic engineering department has received some complaints about noise levels of pedhead-mounted speakers (ones currently installed do not have automatic volume adjustment), but complaints have usually stopped a couple weeks after installation. At times, they have adjusted the volume after installation.

The city looked at pushbutton-integrated devices with locator tones to address concerns of persons who are blind about finding the pushbuttons. However, the signal maintenance department prefers to install the pedhead-mounted devices, as long as there are no complaints.

Contacts

Santana Herrera, Traffic Systems Engineer
City of Atlanta Traffic and Transportation
68 Mitchell Street, SW
4900 City Hall South, Atlanta, GA 30303
Phone: 404-330-6501
E-mail: sherrera@ci.atlanta.ga.us

Chapter 15 — APS Manufacturers

Summary

Information on Accessible Pedestrian Signal manufacturers (APS) was obtained directly from manufacturers and is accurate as of March 2003. APS product offerings are constantly changing. Be sure to confirm features, functioning, and installation requirements of APS with the manufacturer before purchase.

Description of types and features of APS, and how the features are used by pedestrians who are blind can be found in Chapters 5, 6, and 7. If the manufacturer uses a different term for a feature, the manufacturer's term is also listed in parentheses.

The APS Product Matrix in Chapter 16 summarizes information about features.

Chapter contents

APS information from the following manufacturers is included:

- Campbell Company
- Georgetown Electric, Ltd.
- Mallory Sonalert
- Novax Industries Corporation
- Bob Panich Consultancy
- Polara Engineering
- Prisma Teknik
- Relume
- Talking Signs, Inc.
- U.S. Traffic Corporation
- Wilcox Sales

Campbell Company

Type of APS

Pushbutton integrated
- iQ APS

Pedhead mounted speaker optional or available.

Photos

FIG. 15-1. THE CAMPBELL IQ APS HAS A LARGE, CONVEX PUSHBUTTON WITH A SMALL INDENTATION IN THE CENTER SO THAT IT CAN BE ACTUATED WITH A HEAD-STICK USED BY A PERSON HAVING NO LIMB DEXTERITY. THE LARGE ARROW ABOVE THE PUSHBUTTON IS VIBROTACTILE.

FIG. 15-2. CAMPBELL APS H-FRAME VERSION IS USED IN SOME NORTHWESTERN CITIES SO THAT THE PUSHBUTTON CAN BE MOUNTED ON THE SIDE OF THE POLE AWAY FROM THE STREET. HOWEVER, THE H-FRAME BLOCKS THE SOUND FROM THE SIDES OF THE APS, MAKING IT LESS USABLE FOR HOMING IN ON THE LOCATOR TONE.

Standard features

WALK indication
- Speech message
- Cuckoo
- Chirp
- Vibrotactile arrow

Other
- Pushbutton Locator tone (locator signal)
- Automatic volume adjustment
- Separate volume control for locator tone and WALK signal
- Actuation indicator –LED and tone or speech message (acknowledgement message)
- Pushbutton information message
- Intelligent Pedestrian Sensor Circuit for use with an independent sensor or controller.

Campbell Company

Optional features

WALK indication

- Other tones as requested
- Additional speaker to direct walk cycle information to pedestrian waiting area that is at a distance from the pushbutton
- Fixed WALK message length, or WALK message can be on during the full walk interval
- Alternating signal
- Far-side only signal

Other

- Tactile Arrow
- Pushbutton information message (instructional message)
- Extended button press
- Braille street name
- Passive pedestrian detection
- Clearance interval message
- Alert tone (WALK onset tone)

Installation notes

- Driver unit mounts in the pedhead and slaves to WALK/DON'T WALK signal. Driver unit may also be mounted outside the pedhead in a separate enclosure if desired.
- 4 pair #24 stranded wire is run from pedhead to pushbutton unit.
- Microphone for automatic volume adjustment is mounted in a 3 in. diameter parabolic bowl (sound dish) used to gather sound samples and direct them to the microphone used in adjusting the ambient gain control.
- Installer adjusts volume range.

Comments

Available in H-frame or standard configuration

A variety of pushbutton mountings and signs available.

Manufacturer

Campbell Company, Boise, Idaho

Georgetown Electric

Type of APS

Two types:
- Vibrotactile only - VIPB98
- Pushbutton integrated - VIPB99

Photo

FIG. 15-3.
THE VIBROTACTILE ARROW IS LOCATED ON THE BOTTOM OF THE GEORGETOWN APS.

Standard features

WALK indication
- VIPB98 - Vibrating mechanism on underside of casing
- VIPB99 – Vibrating mechanism on underside of casing and audible beeping WALK indication, 2 per second

Other
- VIPB98 - Tactile arrow on vibrating mechanism
- VIPB99 – Clicking locator tone at 1/sec (locator audible)
- Tactile arrow

Optional features

Choice of curved or flat back for mounting

Installation notes

VIPB99 requires another circuit connection to the DON'T WALK / WALK (locator tone activated by the DON'T WALK and vibrator activated by the WALK) and a 25.2 AC, 450 mA step-down transformer to bring the voltage from the 110/120 VAC source down to 24 VAC. Power is brought from WALK /green lead to the pushbutton.

Transformer is not supplied with the APS.

Comments

No automatic volume adjustment.

Pushbutton does not meet PROWAAC minimum size recommendation of at least two inches.

Manufacturer

Georgetown Electric, Ltd., Wilmington, DE

Mallory Sonalert

Type of APS

Pedhead mounted
- VSB 110-1
- VSB 110-2

Photo

FIG. 15-4.
THE MALLORY SONALERT IS A COMPONENT THAT IS USUALLY MOUNTED INSIDE A PEDESTRIAN SIGNAL HEAD.

Standard features

WALK indication
- Cuckoo - 800 Hz and 1200 Hz, every 1.5 secs
- Chirp – 2000 Hz, every 1 sec

Optional features

NA

Installation notes

Usually mounted inside the pedestrian signal head, wired to the WALK indication.

Comments

No automatic volume adjustment.

Mallory also sells sound generators in various beeps, siren and chime sounds; these are not recommended sounds for use as APS

Manufacturer

Mallory Sonalert Products, Inc., Indianapolis, IN

Novax Industries

Type of APS

Pedhead mounted
- DS 100 APS
- DS 2000 APS

Additional components available for DS 2000 with functions of pushbutton and vibrating arrow integrated

PHOTOS

FIG. 15-5. (LEFT) THE DS 100 AND DS 2000 ARE BOTH MOUNTED ON PEDESTRIAN SIGNAL HEADS.

FIG. 15-6. (RIGHT) THE VIBRAWALK IS USED WITH THE DS 2000 TO PROVIDE A LOCATOR TONE AND A VIBROTACTILE ARROW.

Standard features

WALK indication

DS 100

Two or four tones standard
- Cuckoo – alternating high and low frequency - 1 sec repetition rate with 0.2 sec duration, 1100 Hz
- Chirp (peep-peep)- varying frequency tone - 1 sec repetition rate with 0.2 sec duration, 2800 Hz
- Two additional custom tones.

DS 2000
- Two or four tones standard
- Cuckoo, peep, short beep, and long beep or custom speech message
- Maximum Walk Timer for "Rest-In-Walk intersections"
- Concurrent or Alternating Beaconing Sounds

Other

DS 100 and DS 2000
- Automatic volume adjustment (dynamic volume compensation)
- External sound adjustment screw

Novax Industries

Optional features

WALK indication

DS 100

- Speech messages up to 15 seconds long

DS 2000

- Speech messages up to 32 seconds long
- Vibrating tactile arrow

Other

DS 2000

- Pushbutton actuation, with or without extended button press
- Pushbutton locator tone - speaker for mounting at pushbutton height or higher - 800 Hz shaped square wave or 50 ms "click" repeated once per second
- Tactile arrow
- Actuation indicator (Pedestrian Acknowledge device, PAD or Button lamp indicator, BLI)
- Clearance interval message
- Pushbutton information message (Pedestrian Acknowledge)
- Separate volume settings for locator tone and WALK signal
- Sound inhibit – disables signal at sensitive periods, during complex traffic phases or as required
- Internal sound adjustment available for security

Installation notes

3 wire 18 gauge -120 VAC derived from WALK and DON'T WALK indicator

Range of response to ambient sound is set by installer

Comments

Internal board and speaker unit available that mounts in the pedhead.

Manufacturer

Novax Industries, Inc., New Westminster, BC, Canada

Bob Panich Consultancy

Type of APS

Pushbutton integrated
- BPC APS

Standard features

WALK indication
- Tone – 500 Hz with a repetition rate of 8.5 Hz - series of rapid thump sounds
- Vibrating arrow

Other
- Pushbutton Locator tone (locating tone) – 880 Hz with a repetition rate of 1 Hz for US market or 1000 Hz with a repetition rate of .55 Hz for Australian market
- Tactile arrow
- Automatic volume adjustment
- Alert tone (transitional tone) – brief burst of 3500 tone, decreasing exponentially to 700 Hz, and then going to 500 Hz WALK tone
- Three standard settings for automatic gain control (volume)

FIG. 15-7.
PANICH PUSHBUTTON-MOUNTED APS WITH LARGE CONCAVE PUSHBUTTON, VERY LARGE, HIGH CONTRAST ARROW ABOVE THE PUSHBUTTON, AND SMALL VIBROTACTILE ARROW WITHIN THE PRINT ARROW.

Optional features

WALK indication
- Cuckoo and chirp or other sounds
- Speech message as WALK indication
- Fixed WALK message length of 8, 16 or 32 seconds or WALK message can be on during the full walk interval

Other
- Actuation indicator (demand indicator/demand tone) - light and tone
- Long button press – allows pedestrians to request a WALK tone at 12 dB above the sound of the locator tone (Higher volume demand, HVD)

Installation notes

Driver unit is mounted in a housing on the pole near the pedhead, wired to the pedhead.

Automatic gain control level is set during installation.

Comments

Complies with specifications of the Australian standard; standard pushbutton in Australia

Manufacturer states that they will provide other features as needed.

Manufacturer

Bob Panich Consultancy Pty. Ltd., Ryde, NSW, Australia

Polara Engineering

Type of APS

Pushbutton integrated

- Navigator APS

Photos

FIG. 15-8. POLARA NAVIGATOR APS MOUNTED ON A STUB POLE.

FIG. 15-9. THE NAVIGATOR APS HAS A LARGE PUSH-BUTTON THAT INCLUDES A VIBROTACTILE ARROW. A SMALL DEPRESSION IN THE ARROW ENABLES PUSHBUTTON OPERATION WITH A HEAD STICK.

Standard features

WALK indication

- Speech message – recorded by manufacturer or customer
- Cuckoo – 1250 Hz and 1000 Hz .6 sec duration, 1.8 sec interval
- Chirp – 2700 to 1700 Hz .2 sec duration, 1.8 sec interval
- Vibrating tactile arrow

Other

- Pushbutton Locator tone
- Automatic volume adjustment - 60 dB range
- Actuation indicator—tone and light
- Extended button press which can be used to activate a pushbutton message, actuate APS or request a louder WALK signal and locator tone for subsequent clearance interval

Optional features

WALK indication

- WALK tones or speech messages as requested
- Fixed WALK message timing or WALK message can be on during full walk interval

Other

- Pushbutton information message (voice on location)
- Braille street name on the face plate
- Face plate with informational sign

Polara Engineering

Installation notes	Four pairs of 18-22 gauge wires must run from the control unit to the Navigator pushbutton unit. Control unit mounts in pedhead. The installer sets separate volume controls for WALK message and locator tone volumes.
Comments	Manufacturer is developing a model that operates with only two wires from the intersection traffic control cabinet to the pushbutton and is programmable after installation by an engineer using a handheld PDA type device. The new model will have the capability to synchronize sounds, alternate sounds, mute all sounds except the activated crosswalks, to verbally countdown pedestrian clearance interval or present a signal at the far end of the crosswalk only.
Manufacturer	Polara Engineering, Fullerton, CA

Prisma Teknik

Type of APS

Pushbutton integrated

- Several models with different features: TS-907, TS-903F, TS-904, TS-908
- Additional pedhead mounted beaconing speaker (TS-995) available

Photos

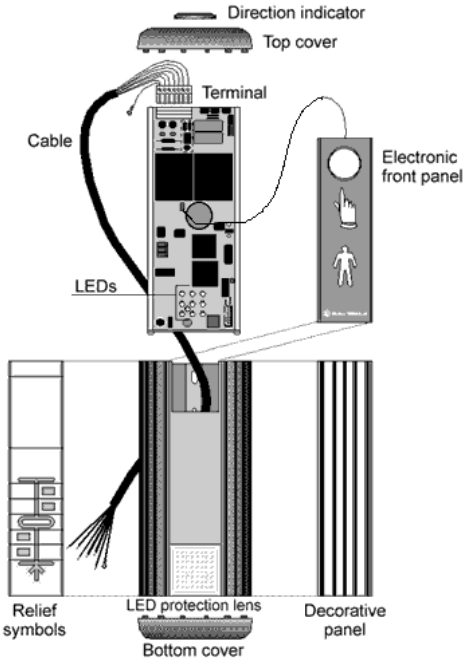


FIG. 15-10. (LEFT) EXPLODED DIAGRAM OF PRISMA APS SHOWING MODULAR CONSTRUCTION. THE VIBROTACTILE ARROW ON THE TOP COVER CAN BE PLACED IN ANY ORIENTATION.

FIG. 15-11. (RIGHT) PRISMA TS-907, WITH ELECTRONIC FRONT PANEL ACTUATION, ACTUATION INDICATOR, TACTILE ARROW, AND TACTILE CROSSWALK MAP.

Standard features

<u>WALK indication</u>

Rapidly repeating percussive tone.

<u>Other</u>

- Pushbutton locator tone
- Tactile arrow
- Automatic volume adjustment within range of 55- 95 dB
- Actuation indicator - light and tone
- Crosswalk tactile map (Braille map)
- Fault indicator

Prisma Teknik

Optional features

WALK indication

- 10 different WALK tones available by setting dip switch
- Vibrating button or arrow on bottom or top of device
- Speech WALK message
- Additional beaconing speaker for mounting at overhead location

Other

- 10 different locator tones available by setting dip switch.
- Pushbutton information message 1- 16 seconds
- Night switch to change to less obtrusive sound
- Double-ended arrow available for use on medians
- Right-angle arrow available for use with exclusive pedestrian phasing, where there is a single pushbutton on a corner

Installation notes

Volume min/max levels are adjustable by installer.

Comments

- Tactile arrow is mounted horizontally on top of device, allowing some latitude in placement of APS on pole, while still making it possible to align the arrow parallel with the associated crosswalk.
- Manufacturer is developing a model that is programmable on the street, using a PDA-type device. The new model will have these additional features:
  - Long button press to request louder walk signal followed by louder locator tone for the subsequent clearance interval.
  - High-contrast tactile arrow.

Relume

Type of APS

Receiver based

Photos

FIG. 15-12.
THE PULSING OF THE LEDS IN THE RELUME PEDHEAD ACTIVATES A SPEECH MESSAGE IN A HANDHELD RECEIVER.

FIG. 15-13.
RELUME PERSONAL RECEIVER PLAYS A RECORDED SPEECH MESSAGE WHEN TRIGGERED BY THE RELUME PEDHEAD.

Standard features

WALK indication

- Directional speech message or vibrotactile indication at the receiver; message type is chosen by user.
- Speech - Prerecorded speech message says "Proceed with caution' during the walk interval if user is standing within the width of the crosswalk lines extended, and aiming the receiver toward the opposite corner.
- Vibrotactile – continuous low frequency vibration during walk interval

Other

- WAIT message during don't walk phases—says "Wait" and there is a pulsing tone during the flashing DON'T WALK
- Vibrotactile – DON'T WALK is continuous high frequency vibration; flashing DON'T WALK is interrupted vibration.

Optional features

NA

Installation notes

- Pedestrian signal heads must be Relume LED heads.
- Pedhead must be carefully positioned to transmit information only within the width of the crosswalk.

Relume

Comments

Speech message recorded in personal receiver is triggered by pulsed light from the Relume LED pedestrian signal display.

- Speech message during walk is not in language specified in MUTCD.
- Device has an approximately 15 degree field to pick up signal.

Pedestrians who are blind must have access to receivers.

Pedestrians must know where the Relume pedheads are installed, or they are unlikely to search for or use the available information.

Manufacturer

Relume Corporation, Troy, MI

Talking Signs

Type of APS

Receiver based

Photos

Fig. 15-14.
Talking Signs
remote infrared
audible sign receiver

Fig. 15-15.
PEDHEAD-MOUNTED APS UNITS TRANSMIT SPEECH MESSAGES TO A HANDHELD RECEIVER.

Standard features

WALK Indication

- Highly directional speech message transmitted by remote infrared light, to handheld receiver—repeats "WALK sign" and the name of the street to be crossed

Other

- WAIT message during Flashing DON'T WALK or DON'T WALK —repeats "Wait" and the name of the street to be crossed.
- Orientation message with wider transmitter range, available to pedestrians before they reach the intersection, provides street identification, signalization and/or directional information.

Optional features

- Additional landmark information can be included in the orientation message, as this information is received before users reach the intersection, and it does not interfere with their ability to hear or attend to traffic and signal information when they are at the crosswalk.
- Developments in the technology and installation may include radio transmitted speech or vibratory information to alert travelers to locations where transmitters are installed. This technology, developed under the direction of the Japan National Police Agency, is compatible with the Smith-Kettlewell/Talking Signs® standard.

Installation notes

Transmitter providing signal information must be carefully positioned to provide information only within the width of the crosswalk.

Talking Signs

Comments

- Infinitely variable messages recorded in transmitters
- Receivers usable for many wayfinding tasks where transmitters are installed
- Pedestrians must know where the TS transmitters are installed, or they are unlikely to search for or use the available information
- Pedestrians who are blind must have access to receivers

How Talking Signs works

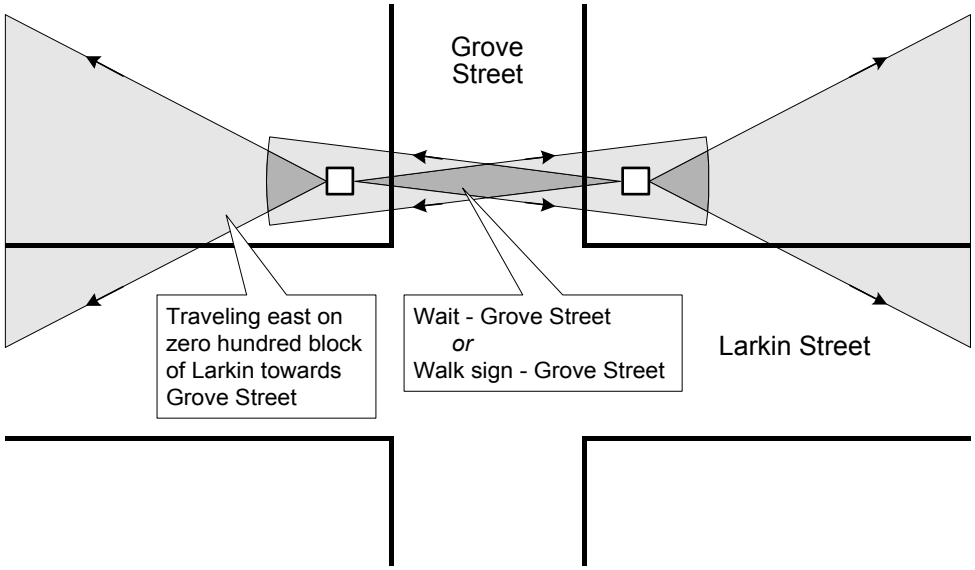


FIG. 15-16.
A BIRD'S EYE VIEW OF TALKING SIGNS® INFRARED TRANSMITTER SYSTEM FOR INTERSECTIONS.

The above illustration shows how the Talking Signs infrared transmitter delivers messages to the pedestrian who is carrying a receiver.

Wide beam tells:

- Direction of travel — "traveling east"
- Present location — "on zero hundred block of Larkin"
- Intersecting street — "towards Grove Street"

Narrow beam tells:

- Crossing condition and intersecting street —
  "Wait — Grove Street"
  "WALK sign — Grove Street"
- Safe crosswalk zone

Manufacturer

Talking Signs Inc., Baton Rouge, LA

U.S. Traffic Corporation

Type of APS

Pedhead mounted
- Model APS-10

Photos

FIG. 15-17.
PEDHEAD-MOUNTED APS FROM U.S. TRAFFIC CORPORATION.

Standard features

WALK indication—tones
- Cuckoo - 0.6 seconds duration,
  Frequency Base 1,100 Hz ± 20%,
  Frequency Deviation +120 Hz ± 20%
- Chirp (peep-peep) - 0.2 seconds duration,
  Frequency Base 2,800 Hz ± 20%

Other

Volume adjustment - self-switching to one of two output levels depending on ambient noise conditions

Optional features

NA

Installation notes

Speaker is mounted on the pedhead, wired to the WALK indication.

Comments

Manufacturer is developing a device that provides audible countdown information.

Manufacturer

U.S. Traffic Corporation, Santa Fe Springs, CA

Wilcox Sales

Type of APS

Pedhead mounted

- PS/A 10

Photos

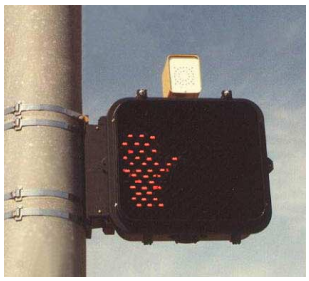


FIG. 15-18.
WILCOX APS UNIT MOUNTED ON PEDHEAD.

FIG. 15-19.
WILCOX APS UNITS FOR PEDHEAD MOUNTING. SHOWN IN FLAT BLACK AND FEDERAL YELLOW HOUSING.

Standard features

WALK indication
Tones – cuckoo and chirp

Other
NA

Optional features

NA

Installation notes

Fixed volume is adjusted by installer.

Comments

No automatic volume adjustment.

Wilcox is also developing an audible sign using same speaker technology.

Manufacturer

Wilcox Sales Company, Claremont, CA

Chapter 16 — APS Product Matrix

Summary

This chapter contains a product matrix (or chart) that lists various types of Accessible Pedestrian Signal products available in the United States and their associated WALK indication and other features, as discussed earlier in Chapters 5, 6, and 7.

Products of eleven (11) manufacturers are listed. Each of these manufacturers is discussed in more detail in Chapter 15.

Chapter contents

This chapter includes:

- Matrix of Accessible Pedestrian Signal Functions
- APS Manufacturer Contact Information

Matrix of Accessible Pedestrian Signal Functions	Campbell	Georgetown	Mallory	Novax	Panich	Polara	Prisma	Relume	Talking Signs	U.S. Traffic	Wilcox
TYPE											
Pedhead mounted	O		X	X			O			X	X
Pushbutton integrated	X	X		O	X	X	X				
Vibrotactile		X									
Receiver based								X	X		
WALK INDICATIONS											
Tones	X	X	X	X	X	X	X			X	X
Speech messages	X			O	O	X	X	X	X		
Vibrating surface	O	X		O	X	X	O	O			
Message to receiver								X	X		
Audible beaconing	O			X		X	O				
OTHER FEATURES											
Pushbutton locator tone	X	X		O	X	X	X				
Tactile arrow	O	X		O	X	X	X				
Pushbutton information message	X			O		O	O				
Automatic volume adjustment	X			X	X	X	X			X	
Alert tone	O				X						
Actuation indicator	X			O	O	X	X				
Tactile Map							X				
Braille & raised print information	O					O					
Extended button press	O			O	O	X					
Passive sensor circuit	X										
Clearance interval tones	O			X		O					

Notes: X = Standard feature; O = Optional feature.
Some manufacturers produce multiple APS products.
Features indicated in the matrix above may represent more than one product.

APS manufacturer contact information

These manufacturers offer Accessible Pedestrian Signal products.

Campbell Company
221 West 37th Street, Suite C
Boise, Idaho 83714
Phone: (877) 345-1727, (208) 345-7459
Fax: (208) 345-7481
Web: www.pedsafety.com

Georgetown Electric, Ltd.
2507 West Second Street
Wilmington, DE 19805
Phone: (302) 652-4835
Fax: (302) 652-6447
Web: NA,
E-Mail: vipb98@aol.com

Mallory Sonalert Products, Inc.
4411 South High School Road
Indianapolis, IN 46214
Phone: (317) 612-1000
Fax: (317) 612-10
www.mallory-sonalert.com

Novax Industries, Inc
658 Derwent Way
New Westminster, BC
V3M5P8 Canada
Phone: (604) 525-5644
Fax: (604) 525-2739
Web: www.novax.com

Bob Panich Consultancy Pty. Ltd.
48 Church Street
P.O. Box 360
Ryde, NSW 2112, Australia
Phone: 61 2 9809 6499
Fax: 61 2 9809 6962
Web: www.bobpanich.com.au

Polara Engineering
4115 Artesia Avenue
Fullerton , CA 92833-2520
Phone: (888) 340-4872
Phone: (714) 521-0900
Fax: (714) 522-8001
Web: www.polara.com

Prisma Teknik AB
P.O. Box 5, S-543 21
Tibro, Sweden
Phone: (46) 504 150 40
Fax: (46) 504 141 41
Web: www.prismateknik.com

Prisma Teknik US distributor:
Eagle Traffic Control Systems
8004 Cameron Road
Austin, TX 78754
Phone: (512) 837-8310
Fax: (512) 837-0196
E-Mail: info@eagletcs.com

Relume Corporation
64 Park Street
Troy, MI 48083
Phone: 888-7RELUME, (248) 585-2640
Fax: (248) 585-1909
Web: www.relume.com

Talking Signs Inc.
812 North Blvd.
Baton Rouge, LA 70802
Phone: (888) 825-5746
Fax: (504) 344-2811
Web: www.talkingsigns.com

U.S. Traffic Corporation
9603 John Street
Santa Fe Springs, CA 90670
Phone: (562) 923-9600, (800) 733-7872
Fax: (562) 923-7555
Web: www.ustraffic.net

Wilcox Sales Company
1738 Finecroft Drive
Claremont, CA 91711-2411
Phone: (909) 624-6674
Fax: (909) 624-8207
Web: www.wilcoxsales.com

Appendices

Summary

The Appendices include:

- APS guidelines
- Policies and rating scales for intersection selection
- Technical references and references cited
- Glossary of terms used in the text

EXISTING MUTCD GUIDANCE on APS

The Millennium Edition of the MUTCD (December 28, 2001 version) contains two sections that pertain to APS. Both sections are reproduced below.

- **Section 4E.06, "Accessible Pedestrian Signals,"** provides standards on audible tones, verbal messages, and vibrotactile devices.

- **Section 4E.08, "Accessible Pedestrian Signal Detectors,"** addresses pushbutton design, placement, and locator tones for APS.

Section 4E.06 Accessible Pedestrian Signals

Support:

The primary technique that pedestrians who have visual disabilities use to cross streets at signalized intersections is to initiate their crossing when they hear the traffic in front of them stop and the traffic alongside them begin to move, corresponding to the onset of the green interval. This technique is effective at many signalized intersections. The existing environment is often sufficient to provide the information that pedestrians who have visual disabilities need to operate safely at a signalized intersection. Therefore, many signalized intersections will not require any accessible pedestrian signals.

Guidance:

If a particular signalized intersection presents difficulties for pedestrians who have visual disabilities to cross safely and effectively, an engineering study should be conducted that considers the safety and effectiveness for pedestrians in general, as well as the information needs of pedestrians with visual disabilities.

Support:

The factors that might make crossing at an intersection difficult for pedestrians who have visual disabilities include: increasingly quiet cars, right turn on red (which masks the beginning of the through phase), continuous right-turn movements, complex signal operations, traffic circles, and wide streets. Further, low traffic volumes might make it difficult for pedestrians who have visual disabilities to discern signal phase changes.

Local organizations, providing support services to pedestrians who have visual and/or hearing disabilities, can often act as important advisors to the traffic engineer when consideration is being given to the installation of devices to assist such pedestrians. Additionally, orientation and mobility specialists or similar staff also might be able to provide a wide range of advice. The U.S. Access Board's Document A-37, "Accessible Pedestrian Signals," provides various techniques for making pedestrian signal information available to persons with visual disabilities.

Accessible pedestrian signals provide information in non-visual format (such as audible tones, verbal messages, and/or vibrating surfaces).

Information regarding detectors for accessible pedestrian signals is found in Section 4E.08.

Standard:

When used, accessible pedestrian signals shall be used in combination with pedestrian signal timing. The information provided by an accessible pedestrian signal shall clearly indicate which pedestrian crossing is served by each device.

Under stop-and-go operation, accessible pedestrian signals shall not be limited in operation by the time of day or day of week.

Guidance:

The installation of accessible pedestrian signals at signalized intersections should be based on an engineering study, which should consider the following factors:

A. Potential demand for accessible pedestrian signals.

B. A request for accessible pedestrian signals.

Traffic volumes during times when pedestrians might be present; including periods of low traffic volumes or high turn-on-red volumes.

C. The complexity of traffic signal phasing.

D. The complexity of intersection geometry.

Support:

Technology that provides different sounds for each non-concurrent signal phase has frequently been found to provide ambiguous information.

Standard:

When choosing audible tones, possible extraneous sources of sounds (such as wind, rain, vehicle back-up warnings, or birds) shall be considered in order to eliminate potential confusion to pedestrians who have visual disabilities.

Guidance:

Audible pedestrian tones should be carefully selected to avoid misleading pedestrians who have visual disabilities when the following conditions exist:

A. Where there is an island that allows unsignalized right turns across a crosswalk between the island and the sidewalk.

B. Where multi-leg approaches or complex signal phasing require more than two pedestrian phases, such that it might be unclear which crosswalk is served by each audible tone.

C. At intersections where a diagonal pedestrian crossing is allowed, or where one street receives a WALKING PERSON (symbolizing WALK) signal indication simultaneously with another street.

Standard:

When accessible pedestrian signals have an audible tone(s), they shall have a tone for the walk interval. The audible tone(s) shall be audible from the beginning of the associated crosswalk. If the tone for the walk interval is similar to the pushbutton locator tone, the walk interval tone shall have a faster repetition rate than the associated pushbutton locator tone.

Support:

A pushbutton locator tone is a repeating sound that informs approaching pedestrians that they are required to push a button to actuate pedestrian timing, and that enables visually-impaired pedestrians to locate the pushbutton.

Guidance:

The accessible walk signal tone should be no louder than the locator tone, except when there is optional activation to provide a louder signal tone for a single pedestrian phase.

Automatic volume adjustment in response to ambient traffic sound level should be provided up to a maximum volume of 89 dB. Where automatic volume adjustment is used, tones should be no more than 5 dB louder than ambient sound.

Standard:

When verbal messages are used to communicate the pedestrian interval, they shall provide a clear message that the walk interval is in effect, as well as to which crossing it applies.

The verbal message that is provided at regular intervals throughout the timing of the walk interval shall be the term "walk sign," which may be followed by the name of the street to be crossed.

A verbal message is not required at times when the walk interval is not timing, but, if provided:

A. It shall be the term "wait."

B. It need not be repeated for the entire time that the walk interval is not timing.

Option:

Accessible pedestrian signals that provide verbal messages may provide similar messages in languages other than English, if needed, except for the terms "walk sign" and "wait."

Support:

A vibrotactile pedestrian device communicates information about pedestrian timing through a vibrating surface by touch.

Standard:

Vibrotactile pedestrian devices, where used, shall indicate that the walk interval is in effect, and for which direction it applies, through the use of a vibrating directional arrow or some other means.

Guidance:

When provided, vibrotactile pedestrian devices should be located next to, and on the same pole as, the pedestrian pushbutton, if any, and adjacent to the intended crosswalk.

Section 4E.08 Accessible Pedestrian Signal Detectors

Support:

An accessible pedestrian signal detector is a device designated to assist the pedestrian who has visual or physical disabilities in activating the pedestrian phase.

Option:

Accessible pedestrian signal detectors may be pushbuttons or passive detection devices. Pushbutton locator tones may be used with accessible pedestrian signals.

Standard:

At accessible pedestrian signal locations with pedestrian actuation, each pushbutton shall activate both the walk interval and the accessible pedestrian signals.

Guidance:

At accessible pedestrian signal locations, pushbuttons should clearly indicate which crosswalk signal is actuated by each pushbutton. Pushbuttons and tactile arrows should have high visual contrast (see the Department of Justice's Americans with Disabilities Act Standards for Accessible Design, 1991). Tactile arrows should point in the same direction as the associated crosswalk. At corners of signalized locations with accessible pedestrian signals where two pedestrian pushbuttons are provided, the pushbuttons should be separated by a distance of at least 3 m (10 ft). This enables pedestrians who have visual disabilities to distinguish and locate the appropriate pushbutton.

Pushbuttons for accessible pedestrian signals should be located as follows:

A. Adjacent to a level all-weather surface to provide access from a wheelchair, and where there is an all-weather surface, wheelchair accessible route to the ramp;

B. Within 1.5 m (5 ft) of the crosswalk extended;

C. Within 3 m (10 ft) of the edge of the curb, shoulder, or pavement; and

D. Parallel to the crosswalk to be used (see Figure 4E-2).

If the pedestrian clearance time is sufficient only to cross from the curb or shoulder to a median of sufficient width for pedestrians to wait and accessible pedestrian detectors are used, an additional accessible pedestrian detector should be provided in the median.

Standard:

When used, pushbutton locator tones shall be easily locatable, shall have a duration of 0.15 seconds or less, and shall repeat at 1-second intervals.

Guidance:

Pushbuttons should be audibly locatable. Pushbutton locator tones should be intensity responsive to ambient sound, and be audible 1.8 to 3.7 m (6 to 12 ft) from the pushbutton, or to the building line, whichever is less. Pushbutton locator tones should be no more than 5 dB louder than ambient sound.

Pushbutton locator tones should be deactivated during flashing operation of the traffic control signal.

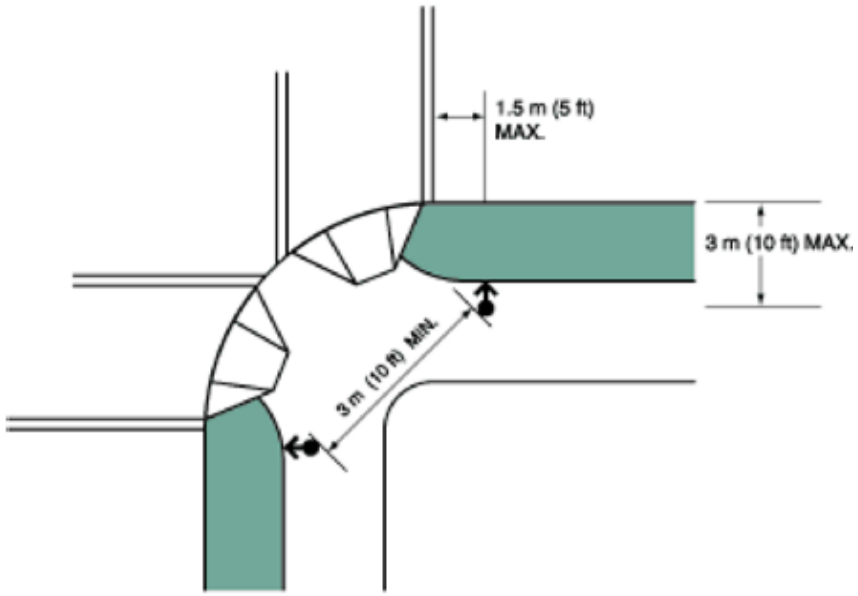
Option:

At locations with pretimed traffic signals or nonactuated approaches, pedestrian pushbuttons may be used to activate the accessible pedestrian signals.

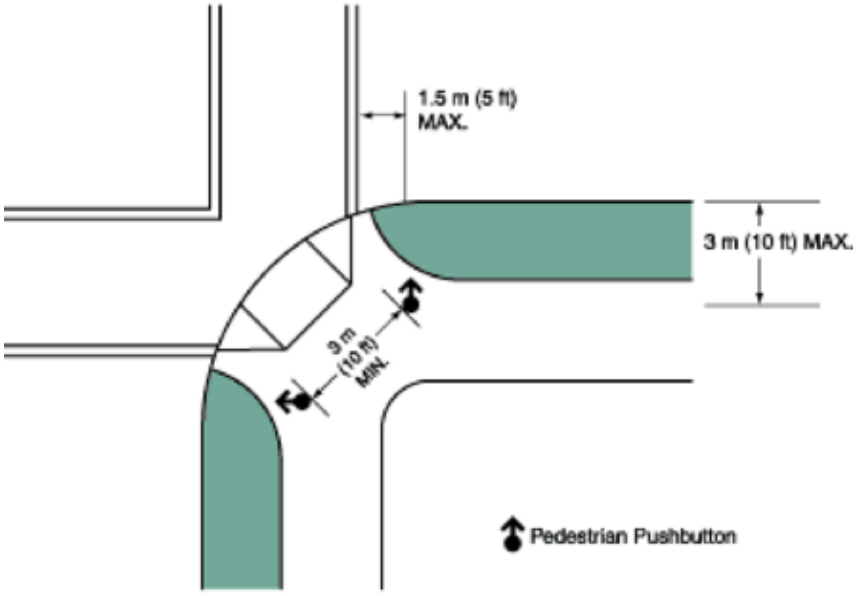
The audible tone(s) may be made louder (up to a maximum of 89 dB) by holding down the pushbutton for a minimum of 3 seconds. The louder audible tone(s) may also alternate back and forth across the crosswalk, thus providing optimal directional information.

The name of the street to be crossed may also be provided in accessible format, such as Braille or raised print.

Figure 4E-2. Recommended Pushbutton Locations for Accessible Pedestrian Signals



Two Curb-Cut Ramps



One Curb-Cut Ramp

EXISTING PROWAAC GUIDANCE on APS

The Public Rights-of-Way Access Advisory Committee (PROWAAC) released its recommendations to the U.S. Access Board in January 2001. Part III, Section X02.5 addresses pedestrian street crossings. Sections X02.5.1 and X02.5.2 specifically address pedestrian signal push buttons and accessible pedestrian signals, respectively. Both sections are reproduced below.

X02.5.1 Pedestrian signal push buttons.

X02.5.1.1 General. Where new traffic signals with pedestrian controls are installed, they shall comply with this section.

X02.5.1.2 Features. Push buttons shall have the following features.

(A) Size. Push buttons shall be a minimum of 2 inches (51mm) across in at least one dimension.

(B) Maximum force. The force required to activate push buttons shall be no greater than 3.5 pounds (15.5N).

(C) Operation. Push buttons shall be operable with a closed fist.

(D) Locator tone. There shall be a locator tone complying with X02.5.1.5.

(E) Visual contrast. Push buttons shall have a visual contrast with the body background of at least 70 percent.

(F) Indicator. There shall be a visible and audible indicator that the button press has occurred.

Advisory: *A long button press (e.g., 3 seconds) may bring up the accessible features or additional accessibility features of the individual device. An additional button should not be used to bring up additional accessibility features. All accessible features available are to be actuated in the same way. Thus, for a given signal, a long button press could request more than one additional feature. Possible additional features include: 1) sound beaconing by increasing the volume of the WALK tone and the associated locator tone for one signal cycle, so a blind pedestrian might be able to use the sound from the opposite side of the street to provide alignment information; 2) sound beaconing by alternating the audible WALK signal back and forth from one end of the crosswalk to the other; 3) providing extended crossing time; and 4) providing a voice message with the street names at the intersection.*

(G) Signage. Signage accompanying push buttons shall comply with Section X02.5.1.4.

Discussion: These specifications are intended to make pedestrian push buttons accessible. The recommended change to a reduced maximum operating force is based in part, on the preamble to proposed ADAAG309 Operable Parts (p 62262, 2nd col): “Information indicates that most control buttons of keys can meet a 3.5 maximum pounds of force and a maximum stroke depth of

1/10 inches." The closed fist requirement is based on the Access Board's design guidelines: "Devices that can be operated by a closed fist acting on any point on the surface will be most usable by pedestrians who have mobility impairments." The provision of visual contrast and a locator tone enable blind or visually impaired pedestrians to locate the push button. The visible and audible indicator informs both visually impaired and sighted individuals that the request for a walk signal has been received.

X02.5.1.3 Push button location. The location of push buttons shall be in accordance with the following minimum requirements.

(A) Adjacent to landing. The push button shall be mounted adjacent to a clear ground space or a landing on the pedestrian access route leading to the crosswalk. The clear ground space shall be at least 32 inches by 54 inches (815 by 1370mm), shall slope no more than 1:48 in any direction, and shall be provided with a stable, firm and slip resistant surface from which to operate controls. This clear ground space may overlap entirely with the pedestrian access route.

(B) Proximity to approach. Where a parallel approach to the push button is provided, controls shall be within 10 inches (255 mm) of the clear ground space, measured horizontally, and centered on it. Where a forward approach is provided, controls shall abut and be centered on the clear ground space.

(C) Direction of control face. The control face of the push button shall be parallel to the direction of the crosswalk controlled by the push button, and no closer than 30 inches (760mm) to the curb line.

(D) Mounting height. The centerline of the push button shall be mounted 42 inches (1070mm) above the clear ground space for approach.

(E) Close to crosswalk. The push button shall be mounted no further than 5 feet (1.5m) from the extension of the crosswalk lines, and within 10 feet (3m) of the curb line, unless the curb ramp is longer than 10 feet (3m).

(F) Proximity to curb or transition ramp. When located at a curb ramp, the push button shall be placed within 24 inches (610mm) of the top corner of the curb ramp, on the side furthest from the center of the intersection of the roadway. When located at a transition ramp, the push button shall be placed adjacent to the lower landing.

Advisory: *It should be noted that for information in vibrotactile format to be useable, the pole must be located so the user is able to keep a hand on the button while aligned at the top of the curb ramp or at the crosswalk. Note: vibrotactile information alone is not allowed.*

(G) Separation. Where there are two accessible pedestrian signals on the same corner, the push buttons shall be mounted on poles separated by at least 10 feet (3 meters).

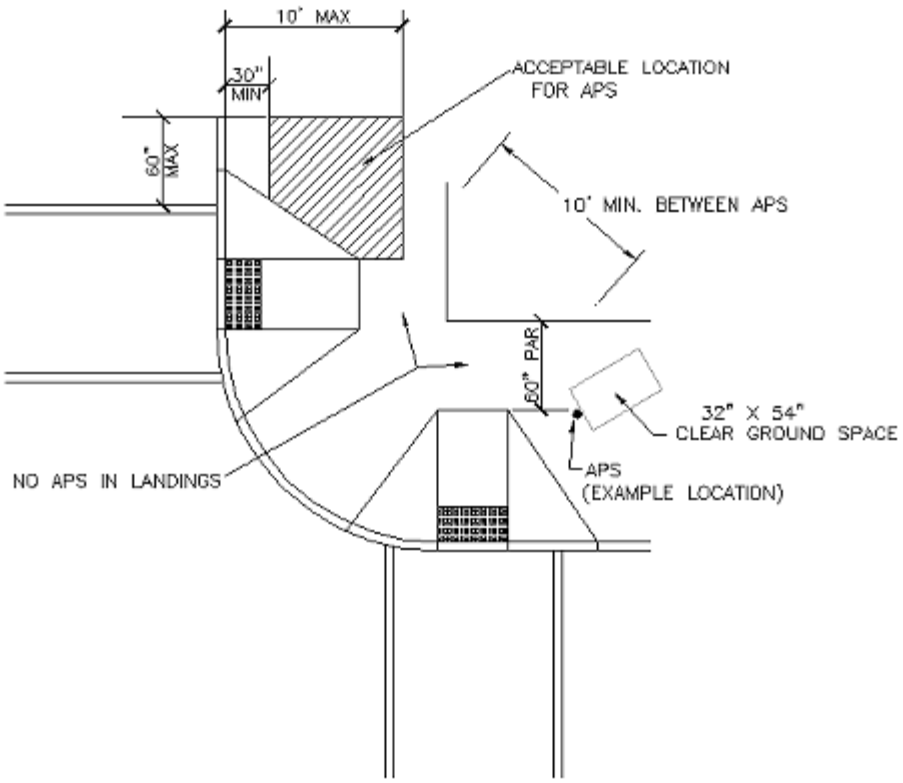


Figure X02.5 A Curb Ramp APS Zones

Curb ramps at an intersection with APS zones indicated in plan.

EXCEPTION: If the requirement for separation cannot be met due to location requirements (A) through (G), two accessible pedestrian signal-related push buttons may be installed on a single pole. If installed on the same pole, the APS must be equipped to provide speech-transmitted data or other technology that delivers an unambiguous message about which crosswalk has the walk signal indication.

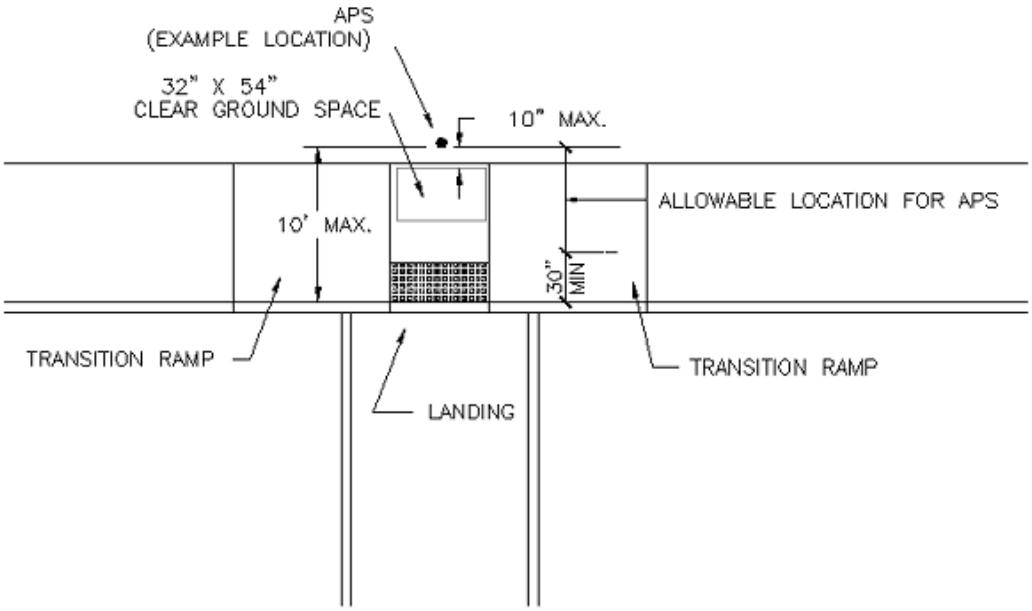


Figure X02.5 B Transition Ramp APS Zones

Transition ramps at an intersection with APS zones indicated in plan.

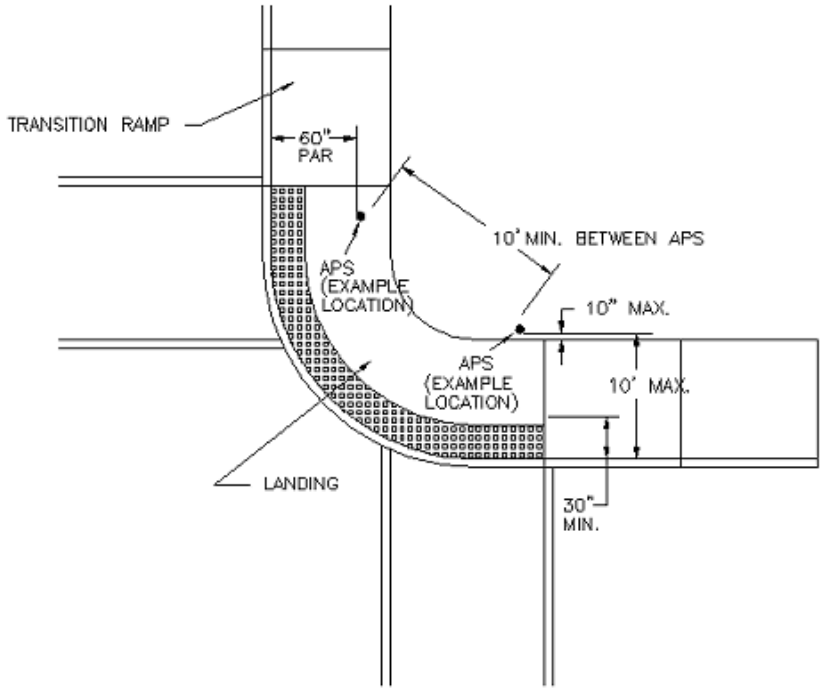


Figure X02.5 C Shared Curb Ramp APS Zones

Shared ramp at an intersection with APS zones indicated in plan.

Discussion: *Requirements for push button location were discussed in detail by the subcommittee and are essentially the same as requirements proposed by FHWA for inclusion in the Manual on Uniform Traffic Control Devices (MUTCD) in December 1999. The committee's intent is to standardize some elements of pedestrian push button location to make the push button more accessible to pedestrians who are blind or who have vision impairments. Locating the pedestrian push buttons at some distance from the crosswalk, which is common now, makes it difficult for a pedestrian, particularly a blind pedestrian or a pedestrian using a mobility aid, to push the button and return to the crosswalk location in time for the walk phase. Users of wheelchairs and mobility aids need to be able to push the button from a level surface. The control face of the push button or the push button housing will include a tactile arrow to inform a blind pedestrian about the direction of the crosswalk, so the location and direction of the control must be aligned with the crosswalk. Since the APS will provide an audible indication of the walk interval from the pedestrian push button, the blind pedestrian must be able to discern which signal is sounding at each phase. This is much harder if both APS are on the same pole, since using only different tones to distinguish the directions is prohibited in Section X02.5.2.2 (A). The separation is intended to allow the blind pedestrian to determine which APS is sounding through sound localization while standing at the curb preparing to cross the street. While the separation is not required for call buttons that are not associated with an APS or locator tone, routinely separating the call buttons will result in a more uniform and predictable location, and will facilitate future APS and/or locator tone installation.*

X02.5.1.4 Push Button Signage.

(A) Tactile arrow. Where there is a push button, there shall be a tactile arrow pointing in the direction of pedestrian travel controlled by the button. The arrow shall be raised at least 1/32 inch (0.8 mm), 1 1/2 inches (38mm) in length. Stroke width shall be between 10 percent minimum and 15 percent maximum the length of the arrow. The arrowhead shall be open and at 45 degrees to the shaft. The arrowhead shall be no more than 33 percent of the length of the arrow shaft.

Advisory: *If the curb ramp is not aligned with the crosswalk, the arrow will point in the direction of travel, not in the direction of the curb ramp orientation.*

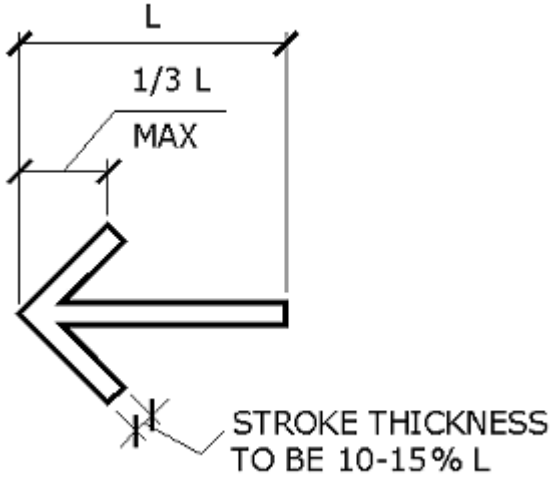


Figure X02.5 D Tactile Arrow

Diagrammatic view of arrow illustrating proportional relationships.

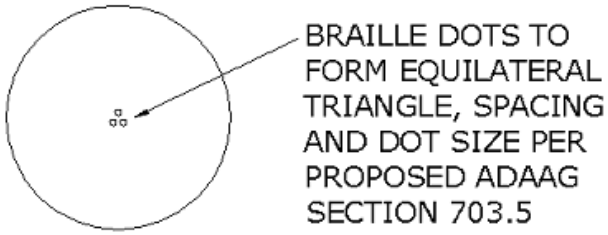


Figure X02.5 E APS Symbol

Diagram of three Braille dots forming an equilateral triangle centered on the face of a 2" pushbutton.

(B) Universal symbol. Controls are to include a universal tactile and visual symbol (if established by the Access Board) that will go on or at the push button indicating the presence or absence of an accessible pedestrian signal at a crosswalk.

Discussion: *For the universal tactile and visual symbol, the committee suggests application of three dots in a triangle on the button as close to the center as practicable.*

(C) Street name. Street name information shall be provided at pedestrian push buttons. The accessible street name information provided at a pedestrian push button shall include the street name (or a reasonable abbreviation) in grade 2 Braille and in tactile raised letters complying with Section X02.3 and Section X02.5.1.4. The sign shall be located immediately above the push button mechanism and parallel to the crosswalk controlled by the button. The street name shall be the name of the street whose crosswalk is controlled by the push button.

Advisory: *While this is in contrast to the convention in visual street naming, where the street name is parallel to the street itself in order to be visible to drivers and pedestrians, it is not in contrast to visual signs adjacent to pedestrian push buttons which indicate which street is controlled by the push button.*

Audible signage may be provided in addition to Braille and tactile signage. Audible signage can provide auxiliary information about the intersection, which can be of great value to persons with visual impairments and to persons benefiting from redundancies.

Discussion: *The arrow and street name information at the push button will provide information accessible to blind pedestrians, now typically provided to sighted pedestrians by signage, to clearly indicate which crosswalk is controlled by the push button. The arrow must be oriented parallel to the crosswalk to give this information clearly; the specifications of the arrow are to make it more easily distinguishable by touch.*

(D) Crosswalk mapping. Where a map of a crosswalk is associated with a push button, the map shall be visual and tactile. Maps shall have at least 70 percent visual contrast, light-on-dark or dark-on-light. The characters and/or symbols shall be raised 1/32 inch (0.8mm) minimum. The crosswalk shall be represented by a vertical line, with the departure end of the crosswalk at the bottom of the map. The map shall be on the side of the push button housing that is furthest from the street to be crossed.

Advisory: *The above elements should be arranged at a push button as follows : symbol on the push button, arrow on or immediately above the push button, and signage above the arrow.*

X02.5.1.5 Locator tone. Where provided, locator tones shall meet the following requirements.

(A) Volume. Volume of the locator tone shall be at least 2 dB and no more than 5 dB greater than the ambient noise level and shall be responsive to level changes. At installation, signal system is to be adjusted to be audible at no more than 5 to 12 feet (1.5 - 3.7m) from the system or at building line, whichever is closer.

EXCEPTION: At locations with audible beaconing, in response to a long button press, the locator tone loudness may increase during the pedestrian clearance interval to allow the user to hear the tone on the opposite side of the intersection (see Section X02.5.2.3 (B)).

(B) Repetition. The locator tone shall be 0.15 seconds maximum in duration and repeat at one second intervals. Sound shall operate during the DON'T WALK and flashing DON'T WALK pedestrian clearance interval of the signal.

(C) Availability. The locator tone shall be audible whenever people are in the vicinity.

Advisory: *The locator tone may be initiated by a passive detector such as an infrared detector, and therefore sound only when pedestrian presence triggers the device.*

(D) Deactivation. The locator tone shall be deactivated during periods in which the pedestrian signal system is inactive.

Discussion: *A locator tone notifies pedestrians who are blind or visually impaired of the need to push a button to request a WALK signal. It also indicates the location of the push button. These specifications are the same as the specifications in the proposed MUTCD for the locator tone.*

Research need: *A variety of tones are currently utilized as locator tones. The above specifications describe the repetition rate of the tone, however the exact nature of the tone is not specified. Research is recommended to determine the most localizable tone in the presence of traffic sounds.*

X02.5.2 Accessible pedestrian signals (APS).

X02.5.2.1 General. Where new traffic signals are installed, accessible pedestrian signals (APS) shall be provided when any of the following conditions are present:

(A) Actuation. An accessible pedestrian signal shall be provided where the timing of pedestrian phases is affected by push button actuation.

(B) Lead pedestrian interval. An accessible pedestrian signal shall be provided where the signal includes a leading pedestrian interval (LPI).

Advisory: *Without an accessible pedestrian signal, a blind pedestrian listening for a parallel*

traffic surge at a crosswalk with LPI may miss the walk interval and enter the crosswalk without enough time to complete the crossing before the signal changes.

(C) Pretimed signal. An accessible pedestrian signal that is available at the option of the user shall be provided where there is a pretimed traffic signal that presents pedestrian signal indication information. In this instance, a push button shall be provided that actuates the accessible pedestrian signal.

Discussion: *The primary technique that people who are blind or visually impaired have used to cross streets at signalized locations is to initiate their crossing when they hear the traffic alongside them begin to move, corresponding to the onset of the green interval. The effectiveness of this technique has been reduced by several factors including: increasingly quiet cars, the availability of right turn on red (which masks the beginning of the through phase), complex signal operations and wide streets. Further, low traffic volumes make it difficult for pedestrians who are blind or visually impaired to discern signal phase changes. The increasing use of actuated signals, at which the pedestrian must push a button and cross during the pedestrian phase, requires blind pedestrians to locate the pedestrian push button and to cross only at the proper time during that phase. These changes in signalization make it necessary to provide the pedestrian signal information in an accessible format. In responding to a request for an accessible pedestrian signal at an existing intersection, the jurisdiction may find it useful to work closely with the blind pedestrian(s) who will be using the intersection and with an orientation and mobility specialist.*

X02.5.2.2 Required features. Where accessible pedestrian signals are provided, they shall comply with the following requirements.

(A) Crosswalk indication. Accessible pedestrian signals shall clearly indicate which crosswalk has the walk interval. The use of two different tones as sole indication of which crosswalk has the walk interval is not permitted.

Advisory: *When walk interval information is broadcast from the push button housing, then separation of the push buttons combined with the required signage is a good means to provide crosswalk-specific information. A speech message may also be used to provide this information. The MUTCD specifies the wording of such a speech message. Remote infrared audible signs (RIAS), which are inherently directional, are another good way to clearly indicate which crosswalk has the walk interval. Additional strategies that may provide unambiguous information are an alternating audible signal or an audible signal from the far end of the crosswalk; however, this type of beaconing is not generally recommended; see X02.5.2.3 (B), Audible Beaconing.*

(B) Walk indication. When indicating the walk interval, the accessible pedestrian signal shall deliver the indication in audible and in vibrotactile format. Signals providing accessible information in vibrotactile format only are not permitted.

(C) Locator tones. Where an accessible pedestrian signal is controlled by a push button, there shall be an associated locator tone.

(D) Walk interval tone. When an APS uses audible tones, it shall have a specific tone for the walk interval. If the same tone is used for the push button locator tone, the walk interval tone shall have a faster repetition rate than the associated locator tone. The two signals shall be distinguishable either by tone and/or by repetition rate. A voice message may be used for the WALK indication.

Where the APS provides signal information using tones, the tone shall consist of multiple frequencies with a large component at 880 Hz. The walk tone shall have a repetition rate of 5 Hz minimum and a duration of 0.15 seconds maximum.

Advisory: *Frequencies above 1 kHz are difficult for persons with an age related hearing loss to detect. Multiple frequencies will assist a larger population group of vision and hearing impaired persons.*

(E) Operating period. Under stop-and-go operation, APS shall not be limited in operation by time of day or day of week.

Advisory: *Information access must not be abridged by day or time. Rather than disconnect a device for periods of time, volume should modulate in response to ambient levels.*

(F) Activation. Actuating a single APS on an intersection is not intended to activate all other devices at all other crosswalks.

(G) Volume. Tones shall be at least 2dB and no more than 5dB greater than the ambient noise level and shall be sensitive to level changes. The walk tone shall be no louder than the locator tone. At installation, the signal system should be adjusted to be audible at no more than 5 to 12 feet (1.5 to 3.7m) from the system or at building line whichever is closer. If an audible tone is provided, the audible tone(s) shall be audible from the beginning of the associated crosswalk. Audible information shall be provided at the departure curb only.

EXCEPTION: Where audible beaconing is provided, the opposite beacon may be audible at the departure curb. A louder walk interval audible tone and subsequent pedestrian clearance interval tone may be provided after a long button press at intersections where audible beaconing is needed.

Advisory: *The APS specifications and sound levels recommended here are intended to provide precise information about the onset of the walk interval. Using special actuation as specified below, they may also function as audible beacons, giving assistance in alignment and crossing within the crosswalk.*

X02.5.2.3 Optional Features.

(A) Prolonged push button press. Additional features which may be required to make a specific intersection accessible shall be brought up by a prolonged press of the push button.

Advisory: *A long button press (e.g., pushing the pushbutton for 3 seconds) may bring up the accessible features or additional accessibility features of the individual device. An additional button should not be used to bring up additional accessibility features. All accessible features available are to be actuated in the same way. Thus, for a given signal, a long button press could request more than one additional feature. Possible additional features include: 1) sound beaconing by increasing the volume of the WALK tone and the associated locator tone for one signal cycle, so a blind pedestrian might be able to use the sound from the opposite side of the street to provide alignment information; 2) sound beaconing by alternating the audible WALK signal back and forth from one end of the crosswalk to the other; 3) providing extended crossing time; and 4) providing a voice message with the street names at the intersection.*

(B) Audible Beaconing. Where provided, audible beaconing signals shall be provided during the walk interval. Audible beaconing may be provided during the pedestrian clearance interval, if no conflicting traffic movements are permitted.

Advisory: *Audible beaconing is usually not needed. Beaconing may be needed at intersections that are wide, have low parallel traffic volume, or have skewed crosswalks. Where beaconing is desired as an additional accessibility feature, it should be actuated by depressing the push button for a longer period of time.*

> *Where beaconing is provided, it will be most effective if it functions only for that crosswalk where the push button was actuated. The area of definite audibility in the direction of travel should be detectable within one-third of the width of the crosswalk from the entrance to the crosswalk. Beaconing may be provided by the increase in the locator tone (see Section X02.5.1.5 (A.)).*

Discussion: *The technology of accessible pedestrian signals has developed in recent years. There are now four types of APS available in the United States. Overhead signals mounted on the pedestrian signal indication have been most commonly used, but problems noted include: difficulties identifying which signal is associated with which crosswalk and which signal is associated with which intersection; noise complaints from neighbors; and difficulty by blind pedestrians in hearing traffic above the loud sound of the APS.*

Signals in which sound comes from the pedestrian push button and include a locator tone and vibrotactile information, are used extensively in Europe and Australia and are now available in the United States. There are also signals that are vibrotactile only, but that system is not recommended by the committee. Sound transmitted to a receiver carried by the blind pedestrian, using RIAS or Light Emitting Diode (LED) technology, has also been used to provide information about the status of the walk signal and to provide additional information about the location and the nature of the intersection. RIAS systems provide a beaconing effect by means of the directional sensitivity of the receiver units.

The features and specifications listed above are currently appropriate given the technology and research available. Future technological developments may lead to additional alternatives. The committee wished to open the door to new technologies, but was interested in clarifying some features that most members considered essential in an APS. The committee did not want

travelers to be required to carry a single, function-specific receiver in order to access intersection information.

While sound beaconing is an alternative that may assist a blind pedestrian in aligning at a difficult crosswalk, the committee did not feel that the use of beaconing at all intersections is necessary. There are concerns that loud overhead APS may mask traffic sounds that are useful to the blind pedestrian, and subject residents who live near the APS to unacceptable noise levels. Nearby residents have objected to audible signals in the past where they used two different sounds in a beaconing manner to alert users. By providing tones with volume that modulates to ambient noise levels, noise intrusion beyond the intended hearing range is minimized and termination of the tone during night hours is unnecessary.

***Research need:** A variety of tones, speech messages, or melodies are currently utilized to indicate the walk interval. Research is recommended to determine the most localizable tone in the presence of traffic sounds. The committee felt there was enough information to provide basic specifications for the walk interval tones. Research now being conducted by the National Institutes of Health on accessible pedestrian signals will compare usability of overhead and pedestrian button mounted speakers for orientation and alignment and provide additional information regarding the use of tones, speech messages, or alternating signals for localization.*

X02.5.3 Other pedestrian signals and timing controls.

X02.5.3.1 Other pedestrian signals and timing controls not specifically described elsewhere shall comply with the requirements of this section.

***Advisory:** When a dedicated phase for left-turning auto traffic precedes the through movement and the walk interval, it increases the difficulty for persons using auditory cues to accurately determine the appropriate time to start crossing. It is easier to determine the appropriate time to start when the through movement occurs first and the left-turning movement afterward.*

X02.5.3.2 Mid-block crosswalks. Reserved.
***Research need:** The committee had a lengthy discussion about how best to notify blind and visually impaired pedestrians of the availability of a mid-block crosswalk. The committee discussed requiring a push button with a locator tone at mid-block unsignalized crosswalks. The button would initiate a speech message notifying the user of the unsignalized condition. However, the committee was concerned about diluting the meaning of a locator tone. The committee decided that a guidance surface would be preferable to a locator tone. However, at this time the information necessary to fully specify the texture, placement, material, contrast or other characteristics of guidance surfaces is not available. As this research is completed, requirement for a detectable surface may be appropriate.*

X02.5.3.3 Near side pedestrian signals. Reserved.
***Discussion:** Providing pedestrian signal indication on the near side of the crosswalk is of direct benefit to persons with low vision and to persons benefited by redundancies. Use of larger devices and signage which is visible at near side curbs is encouraged.*

DRAFT PUBLIC RIGHTS-OF-WAY ACCESSIBLITY GUIDELINES ON APS

On June 17, 2002, the U.S. Access Board released draft guidelines that were available for public comment until October 28, 2002. These draft guidelines are based on the PROWAAC recommendations, but differ in several areas. Section 1106 addresses accessible pedestrian signals and is reproduced below.

Comments were submitted in writing or at a public meeting held in Portland, Oregon, on October 8, 2002. Comments are available at www.access-board.gov. The Access Board will prepare a proposed rule based on its review of the comments received. The proposed rule will also be made available for public comment.

1106 Accessible Pedestrian Signal Systems

1106.1 General. Pedestrian signal systems shall comply with 1106.

1106.2 Pedestrian Signal Devices. Each crosswalk with pedestrian signal indication shall have a signal device which includes audible and vibrotactile indications of the WALK interval. Where a pedestrian pushbutton is provided, it shall be integrated into the signal device and shall comply with 1106.3.

1106.2.1 Location. Pedestrian signal devices shall be located 60 inches (1525 mm) maximum from the crosswalk line extended, 120 inches (3050 mm) maximum and 30 inches (760 mm) minimum from the curb line, and 120 inches (3050 mm) minimum from other pedestrian signal devices at a crossing. The control face of the signal device shall be installed to face the intersection and be parallel to the direction of the crosswalk it serves.

EXCEPTION: The minimum distance from other signal devices shall not apply to signal devices located in medians and islands.

1106.2.2 Reach and Clear Floor or Ground Space. Pedestrian signal devices shall comply with 308. A clear floor or ground space complying with 305 shall be provided at the signal device and shall connect to or overlap the pedestrian access route.

1106.2.3 Audible Walk Indication. The audible indication of the WALK interval shall be by voice or tone.

1106.2.3.1 Tones. Tones shall consist of multiple frequencies with a dominant component at 880 Hz. The duration of the tone shall be 0.15 seconds and shall repeat at intervals of 0.15 seconds.

1106.2.3.2 Volume. Tone or voice volume measured at 36 inches (915 mm) from the pedestrian signal device shall be 2 dB minimum and 5 dB maximum above ambient noise level and shall be responsive to ambient noise level changes.

1106.3 Pedestrian Pushbuttons. Pedestrian pushbuttons shall comply with 1106.3.

1106.3.1 Operation. Pedestrian pushbuttons shall comply with 309.4.

1106.3.2 Locator Tone. Pedestrian pushbuttons shall incorporate a locator tone at the pushbutton. Locator tone volume measured at 36 inches (915 mm) from the pushbutton shall be 2 dB minimum and 5 dB maximum above ambient noise level and shall be responsive to ambient noise level changes. The duration of the locator tone shall be 0.15 seconds maximum and shall repeat at intervals of one second. The locator tone shall operate during the DON'T WALK and flashing DON'T WALK intervals only and shall be deactivated when the pedestrian signal system is not operative.

1106.3.3 Size and Contrast. Pedestrian pushbuttons shall be a minimum of 2 inches (51 mm) across in one dimension and shall contrast visually with their housing or mounting.

1106.3.4 Optional Features. An extended button press shall be permitted to activate additional features. Buttons that provide additional features shall be marked with three Braille dots forming an equilateral triangle in the center of the pushbutton.

1106.4 Directional Information and Signs. Pedestrian signal devices shall provide tactile and visual signs on the face of the device or its housing or mounting indicating crosswalk direction and the name of the street containing the crosswalk served by the pedestrian signal.

1106.4.1 Arrow. Signs shall include a tactile arrow aligned parallel to the crosswalk direction. The arrow shall be raised 1/32 inch (0.8 mm) minimum and shall be 1-1/2 inches (38 mm) minimum in length. The arrowhead shall be open at 45 degrees to the shaft and shall be 33 percent of the length of the shaft. Stroke width shall be 10 percent minimum and 15 percent maximum of arrow length. The arrow shall contrast with the background.

1106.4.2 Street Name. Signs shall include street name information aligned parallel to the crosswalk direction and complying with 703.2.

1106.4.3 Crosswalk Configuration. Where provided, graphic indication of crosswalk configuration shall be tactile and shall comply with 703.5.1.

Intersection Rating Scales

[San Diego] AUDIBLE PEDESTRIAN TRAFFIC SIGNALS FOR THE BLIND
INTERSECTION EVALUATION PROCEDURE Policy no. 200-16 rev. 8-81

BACKGROUND

Audible pedestrian traffic signals are used in conjunction with standard pedestrian activated traffic signals to emit two distinct audible signals that resemble bird calls; one for the north-south walk direction and another for the east-west walk direction. They are used to assist blind and visually impaired persons and other disabled persons of all ages to cross at designated streets and intersections.

PURPOSE

The purpose of this evaluation policy is to set forth factors to be used by the Committee for the Removal of Architectural Barriers (CRAB) in developing a priority listing of signalized intersection candidates to be retrofitted with audible devices that will provide guidance for the blind community and visually impaired persons and other disabled persons of all ages to cross certain streets.

POLICY

It is the policy of the City Council that the retrofitting of existing traffic signals with audible devices shall be based on factors established herein and that such measurements and computations as may be required in determining priority rating of candidate locations shall be the responsibility of CRAB.

It should be noted that in special situations, an audible traffic signal should not be installed because of the adverse affect it could have on pedestrian safety as a result of the overall traffic circulation pattern of an area, or unusual geometric conditions where audible signals would not provide the safety benefits necessary for the blind or visually impaired individuals to cross a street. It should also be noted that some traffic signals cannot be retrofitted with audible traffic signals without major costly modifications. Retrofitting of traffic signals with audible devices shall be subject to approval by the City Engineer.

Important: Audible signals are utilized to help properly trained blind and visually impaired travelers recognize when a walk signal is operating in a given direction. An audible signal may enhance the safety of blind travelers in two ways:

1. Lessens the chance of a blind pedestrian misjudging when the walk phase is operating, thereby lessening the chance of accidentally crossing against a signal.

2. Helps blind pedestrians recognize immediately when the walk phase begins, permitting them to cross the street in a timely fashion, thereby lessening the chance of being in the intersection when the signal changes.

However, it is important to recognize that the audible signal does not and cannot assure the blind pedestrians that there will be no potential traffic conflicts while crossing when the audible signal is operating. In particular, the blind traveler should be aware of at least four possible conflicts.

1. Vehicles may be still clearing the intersection when the audible signal comes on.

2. Vehicles may fail to stop for the red light. This is particularly common for motorists attempting to enter on a yellow light.

3. Motorists may stop and make a right turn on red while watching traffic on their left but may fail to notice pedestrians on their right.

4. Vehicles may have right and left turns on the same phase as the pedestrian.

Because of these potential conflicts, it is important that the blind or visually impaired traveler exercise due caution for his or her well-being when crossing a street, whether or not it is equipped with an audible signal. It is especially important that blind and visually impaired travelers be properly trained by orientation and mobility specialists in safe travel techniques on the public right-of-way.

EVALUATION PROCEDURE (See attached "Evaluation Form.")

The following basic considerations and evaluation factors shall be utilized to determine whether a location is eligible to be a candidate for audible signals and to determine its relative position on the priority list. Evaluation and scoring of factors will be conducted by an evaluation team consisting of an orientation-mobility specialist, a visually impaired/blind traveler and a traffic engineer. Candidate locations will be provided by the overall Committee for the Removal of Architectural Barriers. Candidate locations will be evaluated by means of the sample evaluation sheet attached.

I. BASIC CONSIDERATIONS:

Audible signals normally will be considered for installation only if the following conditions are met:

A. Intersections must be signalized.

B. Signals must be susceptible to retrofitting.

C. Signals should be equipped with pedestrian signal actuations. (See also section on "Signals Without Pedestrian Actuations.")

D. Location must be suitable to installation of audible signals, in terms of surrounding land use, noise level and neighborhood acceptance.

E. There must be a demonstrated need for the audible signal device.

II. EVALUATION FACTORS

The following factors shall be used to establish a priority listing for potential audible traffic signal candidates. Candidates will be arranged in priority order of those with the highest total points (60 points maximum) on top and then in descending order. Individual factors will be scored 1 to 5, with 1 for the lowest point evaluation, to 5 for the highest. The scoring of factors will be conducted by an evaluation team consistent of a mobility specialist, a visually impaired/blind traveler and a traffic engineer. Candidate locations will be provided by the Committee at large.

A) Intersection Safety

1. Accident Records: Past pedestrian accident experience at the intersection will be used as an indication of potential safety performance. Points will be based on pedestrian accidents reported by the Police Department.

Pedestrian Accidents	Period	Points
1	4 years	1
2	"	2
3	"	3
4	"	4
5 or more	"	5

2. Intersection Configuration: The number of approaches to an intersection and their geometric configuration (offset, skewed, etc.) affect the ability of the blind and visually impaired persons crossing the roadway. In particular, traffic at 3-leg intersections tends not to provide adequate audible clues for the blind to permit them to effectively judge the signal phase.

Configuration	Points
4-leg right angle intersection	1
3-leg tee intersection	2
3 or 4-leg skewed intersection	3
4-leg offset intersection	4
Other complex or multiple leg intersections	5

Note: Intersections with 5 or more legs will require special design.

3. Width of Crossing: Wider streets are more difficult for blind travelers to cross. If each leg of the intersection has a different width, points will be assigned on the basis of the widest street on which pedestrians are permitted to cross. Crossing width will be measured at the point pedestrians normally cross the street. Islands and medians will be included in the total crossing distance even if they are equipped with separate pedestrian signal actuators. Blind pedestrians have difficulties interpreting traffic clues at medians and islands. Efforts should be made to permit the blind to cross in one continuous movement. In such cases, signal timing

should be extended to accommodate the full crossing. Divided streets with or without a pedestrian signal actuator in the median will be handled as a single crossing, with the width measured across the entire street.

Width of crossing	Points
40 feet or less	1
41 to 52 feet or less	2
53 to 68 feet	3
69 to 78 feet	4
70 feet or more	5

4. Vehicle Speed: The speed of approaching traffic reflects the ability of approaching traffic to stop for a pedestrian clearing the intersection as the lights change. Audible signals help blind pedestrians get a timely start at the beginning of the walk phase, thereby permitting clearing the intersection in a timely manner. Points are assigned on the basis of the 85 percentile speed on the fastest approach leg. More points are assigned on the basis of higher speeds.

Speed Range	Points
0-25 mph	1
26-30	2
31-35	3
36-40	4
41 or over	5

B) Pedestrian Usage

Blind pedestrians share many characteristics with the sighted population in that they go to public places, business, social, educational and medical facilities. At the same time they have special needs. For example, they may have a greater reliance on public transportation than sighted persons. Audible signals should be placed with the view of improving mobility of blind persons and making more facilities accessible to them. Proximity of signals to these facilities may assure a greater degree of utilization.

1. Proximity to facilities for blind or visually impaired: This includes the Department of Rehabilitation, Social Security offices, Blind Service Center, Blind Recreation Center and other similar blind oriented facilities. Special consideration may be given to senior citizens complexes or public housing facilities that have one or more blind or visually impaired persons in residence. Points are assigned on the basis of blocks or distance (1 block equals 400 feet) from proposed audible signal site to subject facility. The closer the two are, the more points are assigned.

Proximity	Points
4 to 6 blocks	1
3 blocks	2
2 blocks	3
1 block	4
At subject facility	5

2. Proximity to key facilities utilized by all pedestrians (blind and sighted.): This includes medical, educational, social, recreational, shopping, commercial, business, public and governmental facilities. Points are assigned on the basis of blocks or distance (1 block equals 400 feet) from proposed audible signal site to subject facility. In case of multiple facilities, points will be assigned on the basis of the closest facility.

Proximity	Points
4 to 6 blocks	1
3 blocks	2
2 blocks	3
1 block	4
At subject facility	5

3. Access to public transit: Because blind and visually impaired persons rely heavily upon public transportation (bus or trolley), special consideration will be given to those proposed audible signal sites that have heavy general use, serves any of the facilities indicated above (Ref. B-1 and B-2), or serves as a transfer point and serves 2 or more transit routes within a one-block walking distance.

a) Number of transit stops and/or transit routes within one block of proposed audible signal site.

Number of Routes and Stops	Points
1-2 routes and 1 stop	1
3 or more routes and 1 stop	2
1-2 routes and 2 stops	3
3 or more routes and 2 stops	4
2 or more routes and more than 2 stops	5

b) Passenger usage is based upon the total passengers boarding and debarking each day at a transit stop or transfer point within a one-block walking distance.

Passengers boarding and debarking each day	Points
100-249	1
250-499	2
500-999	3
1000-1499	4
1500 and over	5

C) Traffic Conditions

Vehicle volumes, traffic distribution, traffic congestion and flow characteristics may assist or impede the blind traveler in crossing an intersection. Blind pedestrians can function best when crossing signalized intersections that are at right angles with a moderate but steady flow of traffic through the intersection on each leg and with a minimum of turning movements (right or left turns). Traffic that stops on each leg during each signal cycle is particularly helpful. Traffic that is either light, or very heavy, or erratic in its flow makes it difficult for the blind traveler to pick up audible clues as to whether the light is red or green. In such cases, audible signals will assist in determining when it is possible to cross the street. Points may be assigned by the evaluation team based upon their perception of the relative importance of each of these factors (which are not necessarily dependent upon the total average daily traffic). Candidate locations may score up to a maximum of 5 points for each of the following factors depending upon overall traffic distribution.

	Heavy traffic flow	Vehicles per hour	Points
1.	Approach traffic on all legs is in excess of 2000 vehs/hr during any peak hour.	2000-2999	1
		3000-3999	2
		4000-4999	3
		5000-5999	4
		6000 and over	5

	Light traffic flow	Vehicles per hour	Points
2.	Approach traffic on all legs is less than 900 vehs/hr during any one-hour period between 6 AM and 6 PM	800-899	1
		700-799	2
		600-699	3
		500-599	4
		6000 and over	5

	Uneven traffic flow	Points
3.	Platoons or approach traffic flow may not coincide with the signal phasing on any leg, thus making it difficult for blind travelers to detect and determine the appropriate signal phase.	0-5

D) Mobility Evaluation

Each intersection being considered for audible signals should be evaluated by an orientation and mobility specialist. Based on the judgment of the O-M specialist and the evaluation team, additional points may be assigned based on observed or special conditions not adequately covered by any of the previous factors.

	Points
1. Mobility and miscellaneous factors	0-5

Signals Without Pedestrian Actuations

Signalized intersections without pedestrian actuations may be considered for evaluation under this priority system, provided the following conditions are met:

1. There must be a demonstrated problem or need that can be alleviated by the installation of an audible signal.

2. The evaluation team must unanimously concur with the need.

3. Appropriate pedestrian actuation buttons and circuits must be provided as part of the audible signal installation.

Audible Signals at New Signal Installations

Audible signals will normally not be installed as part of a new signal installation. However, new signal locations will be eligible for retrofitting on a priority basis along with other existing signal locations covered under this policy.

AUDIBLE PEDESTRIAN TRAFFIC SIGNALS FOR THE BLIND
INTERSECTION EVALUATION PROCEDURE
Policy Number 200-16
[Obtained from SDCC, San Diego, California]

AUDIBLE TRAFFIC SIGNAL EVALUATION FORM

LOCATION: _____

DATE: _____ **DAY:** _____ **BY:** _____

		YES	NO
I.	Basic Considerations:		
A.	Intersection is signalized	_____	_____
B.	Signals are susceptible to retrofitting	_____	_____
C.	Signals are equipped with pedestrian actuations *	_____	_____
D.	Location is suitable for audible signals	_____	_____
E.	There is a demonstrated need for audible signals	_____	_____

		POINTS
II.	Evaluation Factors (max 5 points for each):	
A.	Intersection safety	
1.	Accident records	_____
2.	Intersection configuration	_____
3.	Width of crossing	_____
4.	Vehicle speed	_____
B.	Pedestrian usage	
1.	Proximity to facilities for the blind	_____
2.	Proximity to other key facilities	_____
3.	Access to public transit	
(a)	presence of transit stops	_____
(b)	passenger usage	_____
C.	Traffic conditions	
1.	Heavy traffic flow	_____
2.	Light traffic flow	_____
3.	Uneven traffic flow	_____
D.	Mobility Evaluation	
1.	Mobility and other miscellaneous factors	_____
	Total points (60 points maximum)	_____

Comments: _____
_____
_____
_____

** Ref. Section on "Signals Without Pedestrian Actuations."*

LOS ANGELES DEPARTMENT OF TRANSPORTATION
ADAPTIVE DEVICE STUDY

WORKSHEET FOR LADOT ADAPTIVE DEVICE STUDY
(from Gallagher, B.R. and de Oca, P. (1998))

Circle the number of points corresponding to each question and fill in the appropriate blanks.

Pedestrian usage	
Proximity to facility for blind people	Points
>6 blocks	0
4-6 blocks	2
3 blocks	4
2 blocks	6
1 block	8
Adjacent to facility	10
Proximity to alternative crossings	Points
Adaptive device within 1,000 feet	0
Good crossing location within 299 feet	0
Good crossing location within 200-599 feet	3
Good crossing location within 600-999 feet	4
Good crossing location within 1,000 feet	5
Need to cross	Points
Occasionally	0
Regularly to run errands	2
Daily for work or school	3
High volume of blind pedestrians	4
Proximity to transit stops and routes within a block	Points
No stops	0
1-2 routes and 1 stop	1
3+ routes and 1 stop	2
1-2 routes and 2 stops	3
3+ routes and 2 stops/2 routes and 3+ stops	4
3+ routes and 3+ stops	5
Intersection safety and traffic conditions	
Pedestrian accidents	Points
Number of pedestrian accidents in 3 years:	
Configuration of intersection	Points
4-leg right angle	0
3- or 4-leg skewed intersection	2
4-leg offset intersection (crossing stem)	3
3-leg T (crossing major street)/ 4-leg offset (crossing major street)	4
More than 4 legs/unusual geometry	5
Width of street to cross	Points
40 feet or less	0
41-59 feet	1
60-79 feet	2
80-99 feet	3
100-119 feet	4
120+ feet	5

(continued on next page)

Intersection safety and traffic conditions (continued) Points

Vehicle speed

0-25 MPH	0
26-30	1
31-35	2
36-40	3
41-45	4
45+	5

Traffic volumes (total surge volume per cycle, 6 am-6 pm)	Points (heavy hour)	Points (light hour)
<1 car	10	10
<2 cars	8	8
<3 cars	6	6
<4 cars	4	4
<5 cars	2	2
≥5 cars	0	0

Other items

Based on the judgment of the evaluation team, additional points are assigned to special conditions

(circle any that apply)	Points
Heavy right-turn volume	2
Right-turn island	3
Right-turn signals	3
Complex phasings	3
Only one crosswalk, opposed phasing	5
Other (circle value and explain below)	1 2 3 4 5

Final recommendation

Scores

Pedestrian usage:
(10 points required)

Intersection safety and traffic conditions:
(20 points required)

Is an adaptive device recommended for this intersection: Yes/No

What kind of adaptive device is suggested?

Comments by orientation and mobility instructor:_____

City of Portland Procedures for Installing Audible Pedestrian Traffic Signals

Revised December 19, 1996

The City of Portland will consider the installation of audible pedestrian traffic signals to provide crossing assistance at signalized intersections, but only where needed. To be considered for audible signals, the location must first meet the following basic criteria:

1. The intersection must already be signalized.

2. The location must be suitable to the installation of audible signals, in terms of safety, noise level, and neighborhood acceptance.

3. There must be a demonstrated need for an audible signal device. The need is demonstrated through a user request.

4. The location should have unique characteristics (i.e. a unique intersection configuration).

Once the above criteria above met, the following procedures will be followed:

1. The audible signal should be activated by a pedestrian signal push button with at least a one second-delay to activate the sound.

2. In the event that number acceptable requests exceeds Bureau of Traffic Management funding, the Bureau will appoint a committee representing the effected communities to assist the Bureau in prioritizing and recommending future audible signal installations.

3. The Portland Office of Transportation should coordinate with Driver and Motor Vehicle Services (DMV) on driver education, specifically on pedestrian issues and the white cane law.

4. When appropriate, the Bureau of Traffic Management will refer people who request audible signal information and installations to facilities and agencies that provide mobility training.

5. Once an audible pedestrian traffic signal is installed, City staff will take steps to publicize and educate the effected communities on the location and operation of the audible signal device. The City will notify Neighborhood Associations of new installations.

Contact: Bill Kloos, Signal System Manager, 823-5382

AUDIBLE PEDESTRIAN SIGNAL EVALUATION FACTORS

City of Portland, Oregon
May 2000

The following factors shall be used to prioritize potential audible pedestrian signal (APS) locations. An evaluation team comprised of city staff and a mobility specialist will conduct the scoring of factors. The person making the request will be consulted during the course of the evaluation to better determine the pedestrian's needs.

A. PEDESTRIAN USAGE

1. Proximity to facilities for the elderly and/or disabled: This includes, but is not limited to, the Oregon Commission for the Blind, Vision NW, Independent Living Resources, and senior retirement complexes. Points are assigned on the basis of blocks (1 block equals 200 feet) from proposed audible signal site to subject facility. The closer the two are, the more points are given.

Proximity	Points
4 – 6 blocks	2
3 blocks	4
2 blocks	6
1 block	8
less than 1 block	10

2. Proximity to key destinations: This includes, but is not limited to, medical, educational, social, recreational, commercial, and public facilities. Points are assigned on the basis of blocks (1 block equals 200 feet) from the proposed audible signal site to subject facility. The closer the two are, the more points are given. In case of multiple facilities, points will be given on the basis of the closest facility.

Proximity	Points
4 – 6 blocks	2
3 blocks	4
2 blocks	6
1 block	8
less than 1 block	10

3. Proximity to transit stops/routes: Because many visually impaired people rely on public transportation, points will be given for the number of transit stops and/or routes within one block of the proposed audible signal site.

Number of routes and stops	Points

1 – 2 routes and 1 stop	4
1 – 2 routes and 2 stops	6
3 or more routes and 3+ stops	8

4. Need to cross: The more frequent the usage of the audible signal, the more points are given. This information must be provided by the requestor.

Need	Points
Occasionally (approximately 1x per week)	2
Regularly (approximately 3x per week)	4
Daily	6
High (justify below)	8

_____

_____

_____

5. Alternate crossing location: The presence of a good installing an audible signal. The further away a good crossing location is from the proposed audible signal site, the more points are given.

Proximity	Points
Good crossing within 400 feet	1
Good crossing within 401 – 600 feet	2
Good crossing within 601 – 800 feet	3
Good crossing within 1000 feet	4

6. Pedestrian accidents in past 4 years: Past pedestrian accident experience at the intersection will be used as an indicator of potential safety. Based on reported accident information, the higher the occurrence of accidents the higher number of points given.

Pedestrian Accidents	Points
1	2
2	4
3	6
4	8
5+	10

B. INTERSECTION CONDITIONS

1. Intersection Configuration: The number of approaches to an intersection and their geometric configuration (offset, skewed, etc.) affect the ease or difficulty of crossing for the visually impaired. In particular, traffic at 3-leg intersections tends not to provide adequate audible clues for the visually impaired to permit them to effectively judge the signal phases.

Configuration	Points
4 leg right angle intersection	1
3 leg tee intersection	2
3 or 4 leg skewed intersection	3
4 leg offset intersection	4
Other complex or unusual intersection	5

2. Width of crossing: Wider streets present more crossing difficulties for those who are visually impaired. If each leg of the intersection has a different width, the widest street measurement will be used. Crossing width will be measured at the point pedestrians normally cross the street. The wider the crossing, the more points will be given.

Width of crossing	Points
40 feet or less	1
41 – 52 feet	2
52 – 68 feet	3
69 – 78 feet	4
79 + feet	5

3. Traffic Volume: Traffic volume may impede or assist visually impaired pedestrians. Optimal crossing conditions occur when crossing right angle signalized intersections with a moderate but steady flow of traffic through the intersection on each leg with a minimum of turning movements. Traffic that is either light, very heavy, or erratic in its flow makes it difficult to pick up audible clues as to whether the light is red or green. In such cases, audible signals can assist in determining when it is possible to safely cross the street. Traffic volume will be separated into different classifications, and points will be given per each classification.

A. Heavy traffic flow: Approach traffic on all legs is in excess of 2000 vehicles per hour during any peak hour.

Vehicles per hour	Points
2000 – 2999	1
3000 – 3999	2
4000 – 4999	3
5000 – 5999	4
6000 +	5

B. Light traffic flow: Approach traffic on all legs is less than 900 vehicles per hour during any one hour period between 6 AM and 6 PM

Vehicles per hour	Points
800 – 899	1
700 – 799	2
600 – 699	3
500 – 599	4
under 500	5

C. MOBILITY EVALUATION

1. Based upon evaluation by city staff and mobility instructor. 0 – 10 points may be assigned based on the following comments:

_____
_____
_____

Additional points may be assigned for unique circumstances as described below:

_____
_____
_____

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APS SUMMARY EVALUATION FORM
City of Portland

LOCATION:_____
_____

PED LANES:_____

DATE:_____

CRITERIA:	POINTS:
Pedestrian Usage	
1. Proximity to facilities for the visually impaired	_____
2. Proximity to key destinations	_____
3. Proximity to transit stops/routes	_____
4. Need to cross	_____
5. Alternate crossing location	_____
6. Pedestrian accidents last 4 years	_____
A. Intersection Conditions	
1. Configuration	_____
2. Width	_____
3. Volume	_____
B. Mobility Evaluation	
1. Mobility and miscellaneous factors	_____
Comments:	
_____	
_____	
TOTAL POINTS:	_____

DRAFT

ACCESSIBLE PEDESTRIAN SIGNALS (APS) Rev. April 10, 2001

Maryland State Highway Administration (SHA) – An Interim Practice

Background

Beginning in the mid 1980's, Maryland SHA installed a few APS, primarily on request and as a means to study and experiment with new methods and techniques of traffic control. These installations initially were in the Frostburg, Lutherville and Towson areas.

In October, 2000 a committee was formed to develop criteria for the installation of APS. The committee was formed primarily in anticipation of the issuance of the MUTCD 2000 and the report to the U.S. Access Board by its Public Rights-of–Way Access Advisory Committee. Both of these publications were released in late 2000 and early 2001.

The committee formed by SHA met on November 21, 2000. The committee invitees were:

- Traffic Engineers from 4 metropolitan counties
- ADA representatives from 4 metropolitan counties
- American council of the Blind (ACB)
- National Federation of the Blind (NFB)
- American Foundation for the Blind (AFB)
- Governor's Office
- Maryland Department of Transportation (MDOT)
- Maryland State Highway Administration (SHA)
- Orientation and Mobility Specialists (OMS)

The primary outcomes of this meeting were:

1. A discussion and listing of criteria affecting the installation of APS; and

2. Creation of a sub-committee to develop a document for prioritizing the installation of APS

This sub-committee met on November 29, 2000 and consisted of representatives from the NFB and ACB, MDOT, SHA, a County Traffic Engineer and an Orientation and Mobility Specialist. During the meeting, a list of criteria concerning the need or priority for installation of APS and their relative weights was developed. This material is to be used in a manner similar to that currently employed when studying any Traffic Control device.

Maryland's Values

The Maryland State Highway Administration's Mission Statement is, "To provide our customers with a safe, well-maintained and attractive highway system that offers mobility and supports Maryland's communities, economy and environment." One of the goals in support of this mission is to improve safety for all pedestrians, consistent with the providing of a safe and efficient highway system.

We are committed to the principles included in the Manual on Uniform Traffic Control devices (MUTCD), the Transportation Equity Act for the 21st Century (TEA 21), and the American Disabilities Act (ADA).

APS – Criteria affecting installation

The installation of APS has generated significant discussion among those working in the area of providing, maintaining and improving pedestrian safety. In addition, there is a substantial difference of philosophy and approach to the issue by two major organizations representing the blind and visually impaired community.

Several communities have adopted warrants and procedures for determining when and the conditions under which APS are to be installed. These currently include the State of California; the Cities of San Diego and Fountain Valley, California; Portland, Oregon and other communities. Many APS have been installed in other locations based on request, and in the interest of experimentation, research and study. In addition, efforts are currently being conducted by others, both for local communities and the U.S. Access Board, and as part of publishing the MUTCD 2000.

In general, all of the procedures used include some common factors, whether those factors are used as warrants or used to determine priority of installation. In fact, there seems to be substantial agreement among the various procedures. The factors used include several items under the general categories of (1) intersection safety, (2) pedestrian usage and (3) traffic volumes. In addition, other factors such as ambient noise, unusual or unexpected intersection features, and a mobility evaluation participated in by a mobility and orientation specialist are often included.

There is general agreement on a some items, such as:

- A crosswalk must be signalized with pedestrian indications for APS to be considered
- Leading Pedestrian Indications (LPI) call for APS
- Educational efforts for users is essential
- An APS does not insure that a potential conflict will not exist while the pedestrian is crossing. Examples are:

    - Vehicles may not stop for a red light
    - A motorist may fail to see the pedestrian
    - A pedestrian may fail to hear an oncoming car

The approach developed by the sub-committee basically follows that used by others, except that the list of criteria is somewhat shorter than normally used elsewhere. Many of the factors used by others were felt to be overlapping or not overly relevant to the use of APS.

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DRAFT - Mar 13, 2001

WORKSHEET FOR EVALUATING THE INSTALLATION OF ACCESSIBLE PEDESTRIAN SIGNALS (APS)

Date:

Location:

FACTOR	Sub-FACTOR	**Applicable condition** (select one condition within each sub-factor)	Points	
Intersection Safety				
	Intersection Configuration			
		4 – leg	2	
		4 - leg skewed	4	
		4 - leg offset	6	
		3 - leg, crossing main street	8	
		mid-block signal, 5-leg, or unusual geom.	10	
				LEG: North / South / East / West
	Number of pedestrian accidents (Source: MSHA statistics)			
		< than statewide average	0	
		> than statewide average	2	
	Width of Crossing			
		< 50'	2	
		51' - 75'	5	
		76' - 95'	7	
		> 96'	10	

Traffic signal Phasing

2 phase	2
split phasing	6
Right turn signal	8
Double Right Turn	8
continuous RTOR permitted	10
wide median/ped. crosses 1/2 ea. phase	10

Traffic Volumes

0 vehicles on cross st./any 5 min period	15
average < 1 vehicles per cycle	10
1 vehicle queue per cycle	8
2 vehicle queue per cycle	4
> 2 vehicle queue per cycle	0

Vehicle Speed (operating)

0 - 30 mph	1
31 -45	3
> 45 mph	5

<u>Pedestrian Usage</u>

Proximity to facility used by all Peds

> 6 blocks	0
3 - 5 blocks	2
1 - 2 blocks	4
At facility	6

Access to Transit Routes and Stops

single stop and single route	2
multi stop and/or multi route	6

Transit passengers within one block (per day)

10 to 50	2
51 to 150	4
> 150	6

TOTAL POINTS

OTHER FACTORS
(these and others are to be discussed under comments)

Need to Cross

Alternative Crossings available

Free Right Turn (no signal)

Traffic Back up through intersection

Leading Pedestrian Indication (LPI)

High ambient noise

Comments

Orientation & Mobility Specialist:

Traffic Engineer:

Requestor:

Other:

A:\APSworkbook,Mar13,01draft

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Glossary

In the following list, MUTCD refers to definitions taken from Section 4A.02 Definitions Relating to Highway Traffic Signals of the *Manual on Uniform Traffic Control Devices* (2000).

Accessible pedestrian signal (APS). A device that communicates information about pedestrian timing in nonvisual format such as audible tones, verbal messages, and/or vibrating surfaces. (MUTCD)

Actuated operation. A type of traffic control signal operation in which some or all signal phases are operated on the basis of actuation. (MUTCD)

Actuation. Initiation of a change in or extension of a traffic signal phase through the operation of any type of detector. (MUTCD)

Actuation indicator. Either a light, a tone, a voice message, or both audible and visual indicators that indicate to pedestrians that the button press has been accepted.

Alert tone at onset of walk interval. A very brief burst of high frequency sound, rapidly decaying to a 500 Hz WALK tone, to alert pedestrians to the exact onset of the walk interval.

APS. See *Accessible pedestrian signal.*

Audible beacon. Use of a sound source to provide directional orientation and alignment information.

Automatic volume adjustment. An APS volume control that is automatically responsive to ambient (background) sound; automatic gain control.

Braille street name. Provision of the name of the associated street in Braille above the APS pushbutton.

Button actuated timer (BAT). See *Extended button press*.

Clearance interval indicator. Tones sounding during the pedestrian clearance interval that are differentiated from the walk interval indicator (tones).

Controller unit. That part of a controller assembly that is devoted to the selection and timing of the display of signal indications. (MUTCD)

Crosswalk. (a) that part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway, and in the absence of a sidewalk on one side of the roadway, the part of a roadway included within the extension of the lateral lines of the sidewalk at right angles to the centerline; (b) any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface. (MUTCD)

Crosswalk map. See *Tactile map*.

Cycle Length. The time required for one complete sequence of signal indications. (MUTCD)

Detectable warning. A standardized surface feature built in or applied to walking surfaces or other elements to warn visually impaired people of hazards on a circulation path.

Detector. A sensing device used for determining the presence or passage of vehicles or pedestrians. (MUTCD)

Extended button press. On APS, holding the ped button down between 1-3 sec. may activate special features, including audible beaconing and extended pedestrian clearance interval.

Fixed time operation. See *Pretimed operation.*

Flashing (flashing mode). A mode of operation in which a traffic signal indication is turned on and off repetitively. (MUTCD)

Full-actuated operation. A type of traffic control signal operation in which all signal phases function on the basis of actuation. (MUTCD)

Intersection. (a) the area embraced within the prolongation or connection of the lateral curb lines, or if none, the lateral boundary lines of the roadways of two highways that join one another at, or approximately at, right angles, or the area within which vehicles traveling on different highways that join at any other angle may come into conflict; (b) the junction of an alley or driveway with a roadway or highway shall not constitute an intersection. (MUTCD)

Interval. The part of a signal cycle during which signal indications do not change. (MUTCD)

Interval sequence. The order of appearance of signal indications during successive intervals of a signal cycle. (MUTCD)

Locator signal. See *Pushbutton locator tone*.

Long button press. See *Extended button press.*

Long cane. A cane individually prescribed to provide safety and orientation information to persons who are blind or visually impaired; typically much longer than a support cane and not intended for support; typically has a white, reflective surface.

Major street. The street normally carrying the higher volume of vehicular traffic. (MUTCD)

Minor street. The street normally carrying the lower volume of vehicular traffic. (MUTCD)

Passive pedestrian detection. A feature that uses sensors (piezo-electric, infrared, microwave, or video camera serving remote sensor software) to trigger, cancel, or lengthen pedestrian timing, or to trigger the pushbutton locator tone when the pedestrian enters the detection zone.

Pedestrian. People who travel on foot or who use assistive devices, such as wheelchairs, for mobility.

Pedestrian change interval. An interval during which the flashing UPRAISED HAND (symbolizing DONT WALK) signal indication is displayed. When a verbal message is provided at an accessible pedestrian signal, the verbal message is "wait." (MUTCD)

Pedestrian clearance time. The time provided for a pedestrian crossing in a crosswalk, after leaving the curb or shoulder, to travel to the center of the farthest traveled lane or to a median. (MUTCD)

Pedestrian phase (or ped phase). The cycle of pedestrian timing consisting of three parts: (1) The walk interval (WALK sign); (2) the pedestrian clearance interval (flashing DON'T WALK); and the pedestrian change interval (steady DON'T WALK).

Pedestrian signal head. A signal head, which contains the symbols WALKING PERSON (symbolizing WALK) and UPRAISED HAND (symbolizing DON'T WALK), that is installed to direct pedestrian traffic at a traffic control signal. (MUTCD)

Pedhead. See *Pedestrian signal head*.

Permissive mode. A mode of traffic control signal operation in which, when a CIRCULAR GREEN signal indication is displayed, left or right turns may be made after yielding to pedestrians and/or oncoming traffic. (MUTCD)

Preemption control. The transfer of normal operation of a traffic control signal to a special control mode of operation. (MUTCD)

Pretimed operation. A type of traffic control signal operation in which none of the signal phases function on the basis of actuation. (MUTCD)

Priority control. A means by which the assignment of right-of-way is obtained or modified. (MUTCD)

PROWAAC. Public Rights of Way Access Advisory Committee of the U.S. Access Board, that includes advocates, engineers, architects, and public works officials.

Protected mode. A mode of traffic control signal operation in which left or right turns may be made when a left or right GREEN ARROW signal indication is displayed. (MUTCD)

Pushbutton. A button to activate pedestrian timing. (MUTCD)

Pushbutton locator tone. A repeating sound that informs approaching pedestrians that they are required to push a button to actuate pedestrian timing and that enables pedestrians who have visual disabilities to locate the pushbutton. (MUTCD)

Pushbutton message. A speech message that provides additional information when the APS pedestrian pushbutton is pushed.

Remote activation. A handheld pushbutton device allowing a pedestrian to send a message over a short distance to call the ped phase.

Semiactuated operation. A type of traffic control signal operation in which at least one, but not all, signal phases function on the basis of actuation. (MUTCD)

Signal head. An assembly of one or more signal faces together with the associated signal housings. (MUTCD)

Signal indication. The illumination of a signal lens or equivalent device. (MUTCD)

Signal phase. The right-of-way, yellow change, and red clearance intervals in a cycle that are assigned to an independent traffic movement or combination of movements. (MUTCD)

Signal section. The assembly of a signal housing, signal lens, and light source with necessary components to be used for providing one signal indication. (MUTCD)

Signal timing. The amount of time allocated for the display of a signal indication. (MUTCD)

Signal warrant. A threshold condition that, if found to be satisfied as part of an engineering study, shall result in analysis of other traffic conditions or factors to determine whether a traffic control signal or other improvement is justified**.** (MUTCD)

Steady (steady mode). The continuous illumination of a signal indication for the duration of an interval, signal phase, or consecutive signal phases. (MUTCD)

Tactile. An object that can be perceived using the sense of touch.

Tactile arrow (aligned in direction of travel). A raised (tactile) arrow in an APS pushbutton that helps users know which crosswalk is actuated by the pushbutton.

Tactile map. A raised schematic map (located on an APS pushbutton housing) that shows what will be encountered as the pedestrian negotiates the crosswalk controlled by that push button.

Traffic control signal (traffic signal). Any highway traffic signal by which traffic is alternately directed to stop and permitted to proceed. (MUTCD)

Vibrotactile pedestrian device. A device that communicates, by touch, information about pedestrian timing using a vibrating surface. (MUTCD)

Walk interval. An interval during which the WALKING PERSON (symbolizing WALK) signal indication is displayed. When a verbal message is provided at an accessible pedestrian signal, the verbal message is "walk sign." (MUTCD)