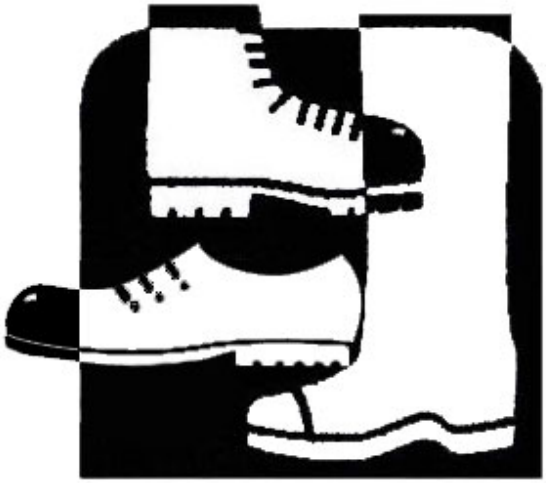
Foot Protection



Training Guide

LEATHER FACTS

Grain: The smooth outer layer is the best and largest piece of leather on the animal. Used for better shoes, stay nicer looking longer and give more durability.
Middle Split: This layer has no tensile strength and is used for very poor quality leather.
Flesh Split: The bottom layer is used mainly for gloves, apparel and accessories. Many people refer to this layer as “suede”

LEATHER CUTS

Side: Side leather is the strongest portion of an animals hide. In this area the fibers are more tightly woven and make the leather longer wearing.
Shoulder: Shoulder hide is less uniform in density and appearance. Less durable but more affordable leather.
Belly: The belly area yields the thinnest and least durable leather.
All areas of the hide are graded during cutting, separated in to A, B or C grades in size and shape.

SOLING SYSTEM

UPPERS

Full grain leather: The outer layer is printed or smoothly finished, breathable water resistant and bears a high abrasion resistance. The lower layer provides strength and has high moisture absorption capabilities.
Pull up leather: A full grain smoothly finished leather and oil tanned. The lower layer provides strength and absorption capabilities.
Crazy horse leather: is a type of Pull up leather. Oil is applied under pressure at high temperature to achieve a rugged finish.
Nubuck leather: The outer layer is lightly buffed, has a silky feel and is oil tanned for water resistance. The lower layer provides strength and absorption capabilities.
Buffalo leather: Less durable and cheaper than cowhide. If it doesn't say what kind of leather it is, then it is probably Water Buffalo.
Split leather: Suede layer has less durable and less breathable due to the stamping but is very cheap since multiple layers can be achieved from a single hide.
Action leather: A dry-processed synthetic leather of which PU coated split leather.

LINERS

Textile: Textiles inserts ensure optimal climate management within the shoe. Ventilating, lightweight and fashionable appeal.
Nylon mesh: Nylon mesh is an opened woven textile construction. Lightweight and maximum ventilation for cooling system.
Cambrelle: A non-woven synthetic fabric, comfort and abrasion resistance. Prevents the build up of bacteria that can cause mildew, rot and odor.
Cordura: Cordura offers outstanding durability and excellent resistance to tear and puncture.
Gore-Tex: A waterproof and breathable fabric. Outstanding moisture absorption and transfer. Thermally balancing.
Nappa leather: Smooth finished upper layer. Lower layer provides strength and excellent absorption.

SAFETY TOECAP MATERIALS

Steel toecaps: Manufactured from high carbon steel and heat treated for maximum impact protection.
Aluminium toecaps: Manufactured from aluminium alloys to create light weight, hi-impact toe cap protection.
50 % lighter than traditional steel toecaps.
Composite Toecaps: Manufactured from non-metallic composite materials to create light weight.
Over 25% lighter than traditional steel toecaps.

SAFETY TOECAP CLASSES

Safety Range: 200 Joule rated safety toe caps are recommended for use in Agriculture, Mining and Quarrying, Bush undertakings, Building and Construction, Waterfront, Heavy Engineering, Freezing Works and Meat works.
Protective Range: 100 Joule rated safety toe caps are recommended for use in Light Engineering, Transport, Storage, Communications and Light woodworking.

INSOLE

The insole is the interior bottom of a shoe which sits directly beneath the foot. Removable, replaceable and extra insoles are often added for comfort. Insoles are also sometimes referred to as footbeds, inner soles or innersoles.
Polyurethane (PUR): Excellent breathability, smooth rubbery feel, superior abrasion resistance and impact protection.
Ethylene Vinyl Acetate (EVA): A closed cell foam, lightweight, durability, abrasion resistance and impact absorbtion.
Polyethylene (PE): A foamed polyethylene of closed cell construction. Laminated to other materials for increased reinforcement.
Poly Vinyl Chloride (PVC): A polyvinylchloride foam compound. Odorless and water resistance.

MIDSOLE

The middle layer between the outsole and the insole of a shoe providing stability, flexibility, cushioning and durability to the foot.
Foam: Particularly suitable for use as a midsole material for an athletic shoe, comprises polyethylene modified by an elastomer modifier and cross-linked, preferably using a peroxide cross-linking agent, to form a closed cell foam material which has superior strength properties, improved energy return and reduced sensitivity to temperature change.
Paperboard: A wood fiber, water resistance and permeability.
Fiberboard: Good folding strength, stability, strong water resistance, fair elasticity and economy.
Stainless Steel: safety midsole plates for safety footwear.

OUTSOLE

The outsole is the layer in direct contact with the ground.
Natural Rubber (NR): Excellent slip-resistance even at wet conditions.
Nitrile Rubber (NBR): Excellent resistance to oils, abrasion, and ripping. Heat resistance up to 300°C
Polyurethane (PUR): Excellent impact absorption. Lightweight and flexible. Heat resistance up to 130°C
Thermo Plastic Urethane (TPU): Superior grip and abrasion resistance. Resistant to temperatures up to 130°C Will not mark floors. Lighter than PU and Rubber.
Poly Vinyl Chloride (PVC): Ease of processing and low cost has led to its increasing share of the footwear market. It is a good choice for casual or waterproof shoes and boots but does not have the traction or durability needed for high performance footwear.

SIZING CHART

Men				4	5	6	7	8	9	10	11
Women	3	4	5	6							
Length (mm)	220.0	228.5	237.0	245.5	254.0	262.5	271.0	279.5	288.0	296.5	305.0

What should I know when I buy footwear for work?

Good footwear should have the following qualities:

- The inner side of the shoe must be straight from the heel to the end of the big toe
- The shoe must grip the heel firmly
- The forepart must allow freedom of movement for the toes
- The shoe must have a fastening across the instep to prevent the foot from slipping when walking
- The shoe must have a low, wide-based heel; flat shoes are recommended

People buying footwear for work should take the following advice:

- Do not expect that footwear which is too tight will stretch with wear
- Have both feet measured when buying shoes. Feet normally differ in size
- Buy shoes to fit the bigger foot
- Buy shoes late in the afternoon when feet are likely to be swollen to their maximum size
- Ask a doctor's advice if properly fitting shoes are not available
- Consider using shock-absorbing insoles where the job requires walking or standing on hard floors

When selecting footwear, one should remember that tight socks or stockings can cramp the toes as much as poorly-fitted shoes. Wrinkled socks, or socks that are too large or too small, can cause blisters. White woollen or cotton socks may be recommended since colored socks cause skin allergies in some people.

What should I know about the fit and care of safety footwear?

Fit:

- Walk in new footwear to ensure it is comfortable.
- Boots should have ample toe room (toes should be about 12.5 mm from the front)
- Make allowances for extra socks or special arch supports when buying boots.
- Boots should fit snugly around the heel and ankle when laced.
- Lace up boots fully. High-cut boots provide support against ankle injury

Care:

- Use a protective coating to make footwear water-resistant.
- Inspect footwear regularly for damage.
- Repair or replace worn or defective footwear.
- Electric shock resistance of footwear is greatly reduced by wet conditions and with wear

AMERICAN PROTECTIVE FOOTWEAR SELECTION

ANSI Z41 divides protective footwear into the following six classes:

Section 1: Impact and Compression Resistance (I/C)

Provides a test for a shoe's capacity to protect the toe area of the foot against falling or rolling objects. There are three levels of protection: Class 30, 50, and 75. Class 75 is the highest level and is recommended for most applications.

Section 2: Metatarsal (Mt)

Provides standards for the protection of the upper foot (metatarsal bones) and toe areas. Designed to prevent or reduce injuries when the toe and metatarsal areas of the foot are exposed to drop hazards. There are three levels of protection: Class 30, 50 and 75. Class 75 is the highest level and is recommended for most applications.

Section 3: Conductive Footwear (Cd)

Conductive footwear is designed to discharge static electricity from your body through your shoes into grounded floors. Floors must be grounded so that a charge can be dissipated. Conductive footwear is designed and manufactured to minimize static electricity and to reduce the possibility of ignition of volatile chemicals, explosives, or explosive dusts.

Warning - Conductive footwear may NOT be worn near open electrical circuits or highly charged objects of any kind that require Electrical Hazard (NON-conductive) footwear.

Section 4: Electrical Hazard Protective Sole and Heel (EH)

The sole construction of Electrical Hazard footwear is designed to reduce the hazards due to the contact of the sole with electrically energized parts and to provide secondary electrical hazards protection on substantially insulated surfaces.

The soles of electrical hazards footwear are designed to reduce the potential of electrical shock when soles are exposed to open circuits (600 volts AC or less).

Warning - Electrical Hazard non-conductive footwear may not be worn near explosives or in other environments that require Conductive footwear.

Section 5: Sole Puncture Resistant Protective Device (PR)

Footwear includes a sole puncture resistant protective device. This reduces the possibility of puncture wounds to the soles of the feet by objects that could penetrate the outsoles of the footwear. The protective plate must be an integral part of the shoe.

Section 6: Static Dissipative (SD)

Footwear designed to reduce the accumulation of excess static electricity by conducting body charge to ground, while maintaining a high enough level of electrical resistance.

Hazard Types/Area	Impact & Compression	Metatarsal	Conductive	Electrical Hazard	Puncture Resistance	Static Dissipative
Falling objects	Required	Recommended				
Rolling objects	Required	Recommended				
Sharp objects a) glass/nails/rocks or other sharp objects	Required				Required	
Explosion Resulting from a) black powder b) volatile substances c) dust (cotton grain elevators)	Required		Required	Do not use		Do not use
Electrical Hazards a) open circuits/dry environment b) dielectric/non-conductive footwear open circuits (600V or less AC)	Required		Do not use	Required		Do not use
Electronic components	Required					Recommended

Note:

Required - To meet the requirements of ANSI Z41 Standard a protective toe cap is required

Do not use - Use in this area is dangerous and may result in severe injury.

Recommended - The results of a Hazard Assessment may or may not require this special feature

Requirements of ANSI Z41

The ANSI standard incorporates a coding system that manufacturers use to identify the portions of the standard with which the footwear complies. The identification code must be legible (printed, stamped, stitched, etc.) on one shoe of each pair of protective footwear.

ANSI Z41 PT 99
F I/75 C/75
Mt/75 EH
PR

Line #1: ANSI Z41 PT 99:
This line identifies the ANSI standard. The letters PT indicate the protective toe section of the standard. This is followed by the last two digits of the year of the standard with which the footwear meets compliance (1999).

Line #2: F I/75 C/75:
This line identifies the applicable gender [M (Male) or F (Female)] for which the footwear is intended. It also identifies the existence of impact resistance (I), the impact resistance rating (75, 50 or 30 foot-pounds), compression resistance (C) and the compression resistance rating (75, 50 or 30 which correlates to 2500 pounds, 1750 pounds, and 1000 pounds of compression respectively).

Lines 3 & 4: Mt Cd EH PR & SD:
Lines 3 and 4 are used to reference additional sections in the standard. They are use to designate metatarsal (Mt) resistance and rating, conductive (Cd) properties, electrical hazard (EH), puncture resistance (PR) and static dissipative (SD) properties, if applicable. Line 4 is only used when more than three sections of ANSI Z41 apply.

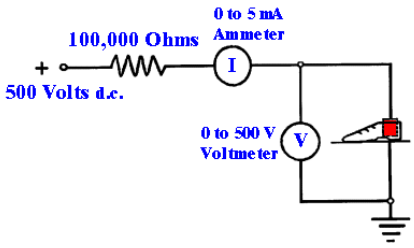
The purpose of metatarsal footwear is to prevent or reduce the severity of injury to the metatarsal and toe areas. The existence of metatarsal resistance (Mt) and the rating (75, 50 or 30 foot-pounds) is identified.

Conductive (Cd) footwear is intended to protect the wearer in an environment where the accumulation of static electricity on the body is a hazard. It is designed to dissipate state electricity from the body to the ground. The electrical resistance must range between zero and 500,000 ohms.

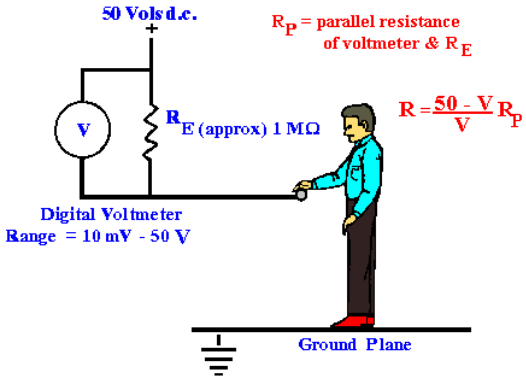
Electrical hazard (EH) footwear is manufactured with non-conductive electrical shock resistant soles and heals. It is intended to provide a secondary source of protection against accidental contact with live electrical circuits, electrically energized conductors, parts or apparatus. It must be capable of withstanding the application of 14,000 volts at 60 hertz for one minute with no current flow or leakage current in excess of 3.0 milliamperes, under dry conditions.

The purpose of sole puncture resistant (PR) protective footwear is to reduce the possibility of injury caused by sharp objects that may penetrate the soles of the footwear. The puncture resistant device must be an integral part of the footwear and must be constructed into the shoe during the manufacturing process. The footwear must withstand a minimum force of 270 pounds. Devices constructed of metal must pass the corrosion resistance testing and show no sign of corrosion after being exposed to a five percent salt solution for 24-hours. The puncture resistant footwear must show no signs of cracking after being subjected to 1.5 million flexes.

Static dissipative (SD) footwear is designed to reduce the accumulation of excess static electricity by conducting body charge to ground while maintaining a sufficiently high level of resistance. There are two static dissipative classifications Type I and Type II. Both types have a lower limit of resistance of 10^6 ohms. Type I footwears electrical resistance must not exceed 10^8 ohms, which is generally considered acceptable for semi-conductor applications. Type II footwears electrical resistance must not exceed 10^9 ohms and has applications in work environments less demanding than Type I.



Conductive footwear is defined by ANSI Z41-1999 as any **unworn** footwear having a resistance of zero (0) to five hundred thousand (500,000) Ohms. The main points to note in this section of the standard are that
1. The footwear is to "unworn" when tested.
2. The voltage is to be 500 Volts.
3. The probe is 2.5 inches in diameter and is all metal.
4. The resistance of this type footwear is between 0 and 500,000 Ohms.
5. There are no sub-classifications of conductive footwear in this standard after 1999.



Static Dissipative Footwear is defined by ANSI Z41-1999 as any footwear when tested **while being worn** by a person and having a resistance from the person's hand to a ground plane of one MegOhm to 1000 MegOhms. The main points to note in this section of the standard are that
1. The footwear is to be worn by a person when tested.
2. The voltage is to be 50 Volts.
3. The measurement is between the person's hand and a ground plane.
4. The resistance of this type footwear is between 1 MegOhm and 1000 MegOhms.
5. There are two sub-classifications of Static Dissipative footwear in this standard after 1999.
6. The measurement circuit calls for an unspecified current limit of the power supply.

In Z41, Conductive footwear is tested at 500 Volts with a 5 lb. metal probe only. This is similar to ESD S9.1 which uses a shot filled sock in the shoe on an aluminum insert and measured at 100 Volts.

In Z41, Static dissipative footwear is tested in combination with the person on a grounded plane at 50 Volts. This is similar to ESD S97.1 which tests the resistance of the combination of the person, footwear and floor.

ASTM F2413-05 Requirements

The ASTM F2413-05 standard covers minimum requirements for the design, performance, testing and classification of protective footwear. The following is an example of an ASTM marking that may be found on protective footwear:

ASTM F2413-05
M I/75/C/75/Mt75
PR
CS

Line #1: ASTM F2413-05:
This line identifies the ASTM standard it indicates that the protective footwear meets the performance requirements of ASTM F2413 issued in 2005.

Line #2: M I/75 C/75 Mt75:
This line identifies the gender [M (Male) or F (Female)] of the user. It also identifies the existence of impact resistance (I), the impact resistance rating (75 or 50 foot-pounds), compression resistance (C) and the compression resistance rating (75 or 50 which correlates to 2500 pounds. and 1750 pounds of compression respectively). The metatarsal designation (Mt) and rating (75 or 50 foot-pounds) is also identified.

Lines 3 & 4: PR CS
Lines 3 and 4 are used to identify footwear made to offer protection from other specific types of hazards referenced in the standard. They are used to designate conductive (Cd) properties, electrical insulation properties (EH), footwear designed to reduce the accumulation of excess static electricity (SD), puncture resistance (PR), chain saw cut resistance (CS) and dielectric insulation (DI), if applicable. Line 4 is only used when more than three sections of the ASTM standard apply.

Conductive (Cd) footwear is intended to provide protection for the wearer against hazards that may result from static electricity buildup and to reduce the possibility of ignition of explosives or volatile chemicals. The footwear must facilitate electrical conductivity and the transfer of static electricity build up from the body to the ground. The electrical resistance must range between zero and 500,000 ohms.

Electrical shock resistant (EH) footwear is manufactured with non-conductive electrical shock resistant soles and heals. The outsole is intended to provide a secondary source of electric shock resistance protection to the wearer against the hazards from an incidental contact with live electrical circuits, electrically energized conductors, parts or apparatus. It must be capable of withstanding the application of 14,000 volts at 60 hertz for one minute with no current flow or leakage current in excess of 3.0 milliamperes, under dry conditions.

Static dissipative (SD) footwear is designed to provide protection against hazards that may exist due to excessively low footwear resistance, as well as maintain a sufficiently high level of resistance to reduce the possibility of electric shock. The footwear must have a lower limit of electrical resistance of 10^6 ohms and an upper limit of 10^8 ohms.

Puncture resistant (PR) footwear is designed so that a puncture resistant plate is positioned between the insole and outsole. It is an integral and permanent part of the footwear. Devices constructed of metal must pass the ASTM B117 Practice for Operating Salt Spray (Fog Apparatus) corrosion resistance testing. The device must show no sign of corrosion after being exposed to a five percent salt solution for 24-hours. The puncture resistant footwear must show no signs of cracking after being subjected to 1.5 million flexes and have a minimum puncture resistance of 270 pounds.

Chain saw cut resistant (CS) footwear is designed to provide protection to the wearers feet when operating a chain saw. It is intended to protect the foot area between the toe and lower leg. This footwear must meet the ASTM F1818 Specification for Foot Protection for Chainsaw Users standard.

Dielectric insulation (DI) footwear is designed to provide additional insulation if accidental contact is made with energized electrical conductors, apparatus or circuits. It must meet the minimum insulation performance requirements of ASTM F1117 (Specification for Dielectric Footwear) and be tested in accordance with ASTM F1116 (Test Method for Determining Dielectric Strength of Dielectric Footwear).

Add-On Devices
An important point to remember is that neither the ANSI nor ASTM standard allows for the use of add-on type devices - strap-on foot, toe or metatarsal guards - as a substitute for protective footwear.

EUROPEAN STANDARD FOOTWEAR CLASSIFICATION

CE EN346-1

- Protective Footwear.
- Lower protection.
- Toecaps tested to 100 joules.
- P classification.

PB Basic protection. 100 joule

P1 100 joule toecap protection. Closed seat region (fully enclosed heel) Antistatic properties. Energy absorption of seat region.

P2 100 joule toecap protection. Closed seat region (fully enclosed heel) Antistatic properties. Energy absorption of seat region. Plus water penetration and water absorption resistance.

P3 100 joule toecap protection. Closed seat region (fully enclosed heel) Antistatic properties. Energy absorption of seat region. Water penetration and water absorption resistance. Plus penetration resistance. Cleated outsole.

CE EN345-1

- Safety Footwear.
- Highest protection.
- Toecaps tested to 200 joules.
- S classification.

SB Basic safety protection. 200 joule

S1 200 joule toecap protection. Closed seat region (fully enclosed heel) Antistatic properties. Energy absorption of seat region.

S2 200 joule toecap protection. Closed seat region (fully enclosed heel) Antistatic properties. Energy absorption of seat region. Plus water penetration and water absorption resistance.

S3 200 joule toecap protection. Closed seat region (fully enclosed heel) Antistatic properties. Energy absorption of seat region. Water penetration and water absorption resistance. Plus penetration resistance. Cleated outsole.

S4 200 joule toecap protection. All rubber or all polymeric footwear with antistatic properties. Energy absorption of seat region.

S5 200 joule toecap protection. All rubber or all polymeric footwear with antistatic properties. Energy absorption of seat region. Plus penetration resistance. Cleated outsole.

Additional Safety Features

- Should these products offer some extra protective feature, then the appropriate symbol would be added.

P Penetration resistance offered by a steel midsole: 1100 Newtons.

C Conductive footwear

A Antistatic footwear. Range 100k to 1000m

HI Insulation against heat

CI Insulation against cold

E Heel energy absorption: 20 joules

WRU Water penetration and water absorption resistant uppers

HRO Heat resistant outsole up to 300°C

ORO Oil resistant outsole

United States

Most safety shoes have symbols on the outside, to indicate the protection the shoe offers. Examples are:

-  **Green Triangle** indicates that it is a class 1 toe cap with puncture resistant sole
-  **Yellow Triangle** indicates that it is a class 2 toe cap with puncture resistant sole
-  **White Square (with ohm symbol)** indicates electrical protection
-  **Yellow Square (with SD)** indicates anti-static protection
-  **Red Square (with C)** indicates electrically conductive
-  **Fir Tree** indicates protection against chain-saws

Europe

The International Organization for Standardization provides the European standard for Safety footwear.
The current one is **ISO 20345: 2004** previously **BS EN 345-1: 1993** The codes applicable to European safety footwear are:

Protected Area	Type of Protection	Code
Steel Toe	Basic Impact 200 joules including compression 15,000 newtons	SB
	200 joule toecap protection. Closed seat region (fully enclosed heel). Antistatic properties. Energy absorption of seat region.	S1
	200 joule toecap protection. Closed seat region (fully enclosed heel). Antistatic properties. Energy absorption of seat region. Water penetration and water absorption resistance.	S2
	200 joule toecap protection. Closed seat region (fully enclosed heel). Antistatic properties. Energy absorption of seat region. Water penetration and water absorption resistance. Sole penetration resistance. Cleated outsole.	S3
Additional protections	Outsole resistance to hot contact: up to 300 °C	HRO
	Penetration resistance offered by a steel midsole: 1100 newtons	P
	Heel energy absorption: 20 joules	E
	Water penetration-resistant uppers	WRU
Electrical resistance	Conductive: Maximum resistance 100 kΩ	O
	Antistatic: Range of 100 kΩ to 1000 MΩ	A
Hostile environments	Insulation against cold	CI
	Insulation against heat	HI

There is also EN ISO 20346: 2004 for protective footwear (must comply to basic safety requirements but toe cap impact resistance requirement is lower - 100 Joules) & EN ISO 20347: 2004 for Occupational Footwear (must comply to basic safety requirements with anti static or slip resistant properties. This standard does not require a protective toe cap)

Asia

Safety shoe standards in Asia are:

- Australia: AS/NZS 2210.3: 2009
- China: GB 21148 & An1, An2, An3, An4, An5
- India: JAS-ANZ ISO 9001: 2000
- Indonesia: SNI 0111: 2009
- Japan: JIS T8101
- Korea: KS No.7419
- Malaysia: SIRIM MA 1598: 1998
- Singapore: SS 513-1: 2005
- Thailand: TIS 523-2011

FOOT vs SHOE

The length of a foot is commonly defined as the distance between two parallel lines that are perpendicular to the foot and in contact with the most prominent toe and the most prominent part of the heel. Foot length is measured with the subject standing barefoot and the weight of the body equally distributed on both feet.

The sizes of the left and right feet are often slightly different. In this case, both feet are measured, and purchasers of mass-produced shoes are advised to purchase a shoe size based upon the larger foot because, contrary to the reality of foot sizes, most manufacturers do not sell pairs of shoes in non matching sizes.

Each size of shoe is considered suitable for a small interval of foot lengths. The inner cavity of a shoe must typically be 15–20 mm longer than the foot, but this relation varies between different types of shoes.

Determining if Foot Protection is Necessary or Required

- Falling or rolling objects
- Punctures
- Stubbing or banging
- Chemical or corrosive contact
- Electrical shock
- Burns
- Slips and falls

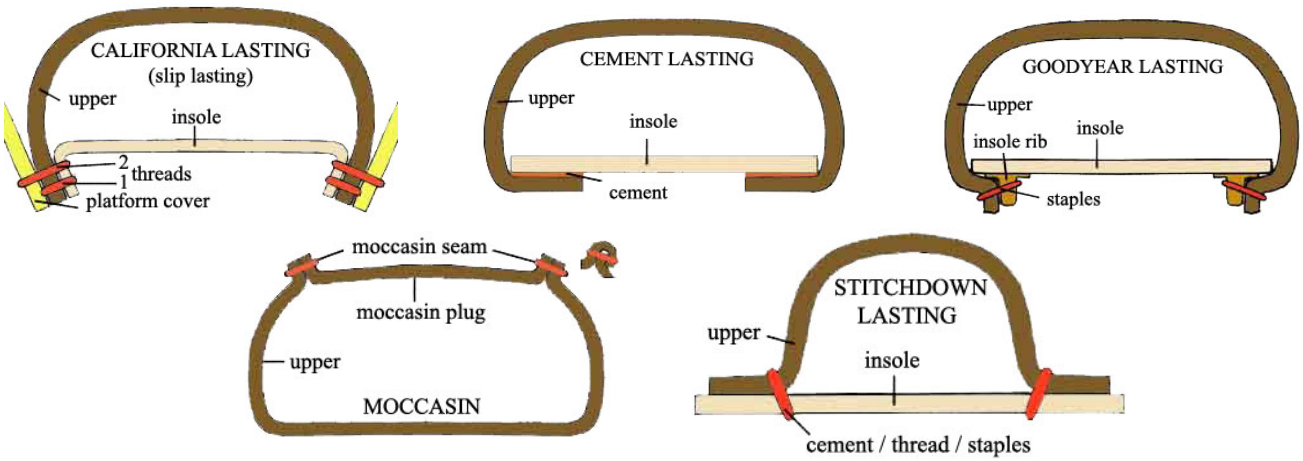
What's Involved in Performing a Hazard Assessment?

- The frequency of the employees' exposure to foot injury
- The employer's accident experience
- The severity of any potential injury that could occur
- The customary practice in the industry

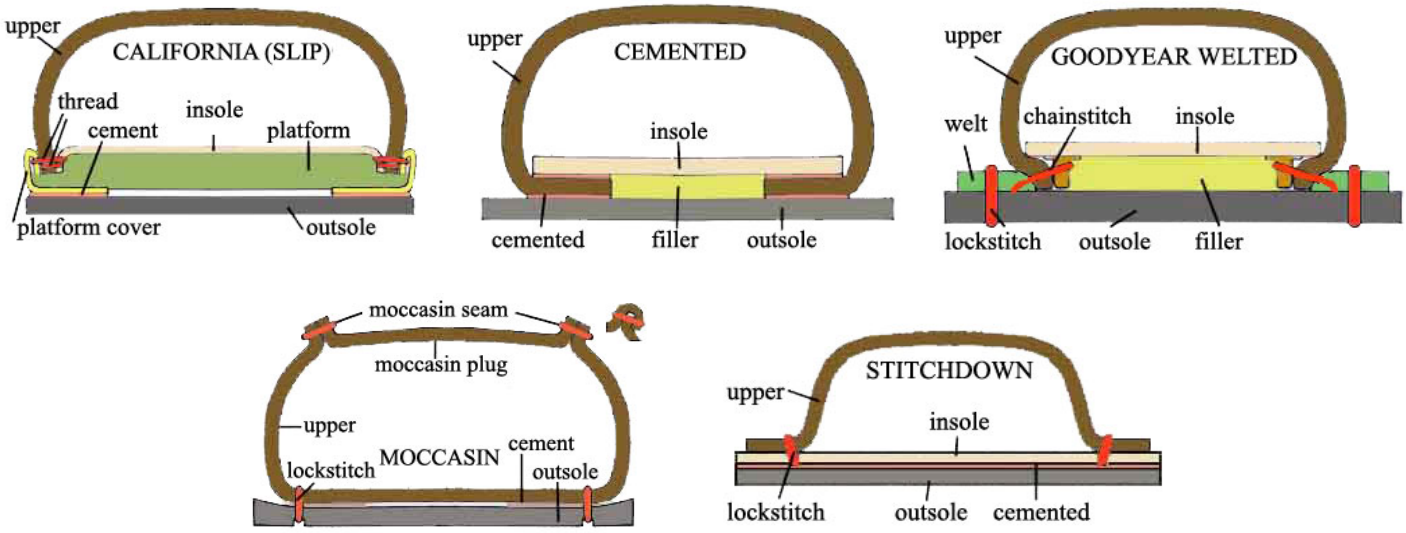
Determining Type of Footwear based on the hazard assessment

- Steel-toed shoes to resist impact
- Metatarsal guards to resist impact above the toes
- Reinforced flexible metal soles or inner shoes to protect against punctures (assuming there's no risk of electrical contact)
- Sandals and open-toed shoes are prohibited in laboratories (including art studios), and food service areas (for safety and hygienic reasons)
- For falling objects, use footwear with steel toes
- Use metatarsal guards if there is the hazard to the metatarsal region above the toes
- Wear chemical resistant footwear (e.g., rubber, neoprene) in areas with potential chemical or corrosive splashes. Check the MSDS to match footwear with individual chemicals
- Replace worn footwear

LASTING CONSTRUCTIONS



SOLE CONSTRUCTIONS



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SWAT

Ways to tie shoes