

Transcript of CPSC Podcast 2020 – CPSC Bicycle Regulations and U.S. and International Standards

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Hi, my name is Sylvia Chen, and I want to welcome you to this podcast presentation today.

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As CPSC's Director of International Programs, Richard O'Brien stated, design of safe products at the outset is critical. CPSC is a United States federal government agency charged with protecting the public from unreasonable risks of injury or death associated with the use of consumer products under the agency's jurisdiction. We have developed this podcast series not only to inform about regulations, standards, and other safety requirements, but also to emphasize the importance of designing products with safety considerations in mind, and to offer best practices for enhancing safety in a variety of common consumer products.

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The series covers seven common consumer products and the requirements for keeping consumers safe, focusing on products affecting millions of consumers, such as electronics, apparel, bicycles, mattresses, infant and toddler products, carriages and strollers, and toys. In this podcast series, you can expect to learn about the key hazards and risks of the product, important design and manufacturing considerations, regulations and standards that CPSC uses to ensure product safety, best practices you can employ, and what resources are available to assist you in understanding and implementing the requirements.

The podcasts include English and Chinese slide decks, and Chinese narration to make this important safety information as accessible as possible. Additionally, CPSC has established a dedicated email box, where listeners can send in any questions at their convenience, in English or Chinese. Our staff will monitor and respond to your questions. Transcripts in English are available on this site.

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The slides used in this podcast are not a comprehensive statement of legal requirements or policy, and thus, should not be relied upon for that purpose. You should consult official versions of U.S. statutes and regulations, as well as published CPSC guidance when making decisions that could affect the safety and compliance of products entering U.S. commerce. Note that references are provided at the end of the presentation.

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And now, I would like to introduce our first presenter: Mr. Vince Amodeo.

Mr. Amodeo was a mechanical engineer with the U.S. Consumer Product Safety Commission at its National Product and Evaluation Center. His presentation is about CPSC bicycle regulations

and international bicycle standards. In the second half of the podcast, Ms. Caroleene Paul will give a presentation on bicycle instant data and studies. Ms. Paul is a mechanical engineer at the CPSC's National Product Testing and Evaluation Center. Now, I will hand the mike over to Mr. Amodeo.

Hi, I'm Vince Amodeo. Today, I'm going to go over the CPSC bicycle regulation and compare it with U.S. and international bicycle standards.

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Here is an overview of what we are discussing today:

- CPSC bicycle regulations
- Bicycle voluntary standards
- Bicycle usage conditions
- A comparison of test requirements and CPSC bicycle regulation compared to the voluntary standards
- And a few selected bicycle recalls.

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The CPSC bicycle regulation is found at 16 C.F.R. Part 1512.

This is the mandatory standard for bicycles sold in the United States, which was originally codified in 1978.

The purpose of the CPSC bicycle regulation is to reduce the risk of injury from bicycles sold to consumers in the United States.

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All bicycles that are sold in the United States must be certified to the CPSC bicycle regulation.

Certification of all bicycles designed or intended primarily for children 12 years of age or younger must be based on testing conducted by a third party conformity assessment body whose accreditation has been accepted by the CPSC.

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Since 1978, when the CPSC bicycle regulation was first established, there have only been minor changes to the regulation.

The CPSC bicycle regulation does not address:

- Bicycle usage conditions. Bicycle usage conditions are usage based on intended terrain and type of riding.
- It also does not address technical improvements in bicycle design since 1978. This includes disc brakes, electric motor assist, and integrated shift/brake levers.
- It does not address the use of modern materials, such as composite fiber.

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The CPSC bicycle regulation sets basic requirements for mechanical safety systems found on all bicycles, regardless of intended use. It includes specific requirements for sidewalk bicycles, which are bicycles with a maximum saddle height of less than 635 millimeters. It also includes requirements for two or three wheeled bicycles with electric assist motors that are less than 750 watts 1 horsepower with functioning pedals and a maximum speed of 20 miles per hour when operated solely on electric power.

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Here's an overview of the requirements that are in the CPSC bicycle regulation Part 1512. It includes all the major systems for bicycles.

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There are other organizations that also have bicycle standards. These are U.S. organizations and international organizations, such as ISO and CEN.

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ASTM is the major U.S. standards organization body that has bicycle standards. ASTM F2043 13 is the standard classification for bicycle usage.

This defines usage conditions for bicycle design. It includes graphical icons for placement on bicycles, aftermarket components, and instructional material to provide retailers and consumers with an indication of the intended usage condition of bicycles or aftermarket components.

ASTM F2043 13 defines six usage conditions that I will go over.

There are other usage conditions, such as BMX, young adult, and electrically powered assisted cycles.

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There are quite a few ASTM bicycle standards.

There are several general standards, such as the one I had just mentioned: the standard classification for bicycle usage.

There's also standards for manually operated front wheel retention systems for bicycles, standard bicycle serial numbers, and standard specification for bicycle grips.

There are several standards for bicycle forks. There is a test method and test specifications.

The test method goes over the procedure for the test. The test specifications go over the requirements for that specific use condition.

F2273 sets the test methods for bicycle forks. Similarly, with frames for bicycles, there's a test method, F2711 08.

Then there are several standard specifications for various conditions for bicycle frames.

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The European bicycle community has two bicycle standards established under CEN. These are EN 15194 for electric powered assisted cycles, and EN 16054 for BMX bicycles.

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ISO is the major international standards organization for bicycles sold in Europe and across the world.

ISO 8098 covers bicycles for young children, which have saddle heights less than 635 millimeters. This is similar to ASTM Condition 0.

ISO 4210 is a rather new and expanded bicycle standard, which goes into more depth than the old 4210.

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I'm now going to cover what ASTM F2043 sets up for bicycle usage conditions.

Condition 0 is similar to sidewalk bicycles, which are intended for children age three and up and under 80 pounds. These bikes should be used with parental supervision.

This slide shows the icon that ASTM F2043 established for use on Condition 0 bicycles. Generally, this icon is shown on children's bicycle user manuals. It can also be placed on the bicycle as a sticker so the consumer knows the intended usage.

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Condition 1 is generally for road bikes, also considered racing bicycles. This is the icon that ASTM 2043 has created for these bikes. Condition 1 bicycles are generally used on paved surfaces and are intended to maintain contact with the ground.

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Condition 2 is for hybrid or gravel type bicycles, where the bike may lose contact with the ground occasionally, but is not intended for very high jumps.

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Condition 3 is generally for mountain bicycles that can do jumps and drops up to 24 inches.

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Condition 4 is for downhill bicycles or bicycles that are intended to be used on rough trails with jumps of up to four feet.

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Condition 5 is for very extreme mountain bicycles with downhill grades of over 40 kilometers per hour and extreme jumping.

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EN 16054 also has a standard for BMX type bicycles, but there are no icons associated with this standard.

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And they also have 4210 for young adult bicycles.

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EN 15194 has requirements for electric-powered assisted bicycles.

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I'm now going to compare a few bicycle standard requirements.

Again, the CPSC bicycle regulation 16 CFR 1512 is the mandatory requirement for bicycles, sidewalk bicycles, and electric bicycles. However, it does not set requirements for various use conditions for bicycles. Again, these are the minimum test requirements that all bicycles sold in the United States must meet.

ASTM, CEN and ISO have voluntary bicycle standards. These are generally based on bicycle components. They also establish the requirements based on the bicycle's intended use.

The requirements established in ASTM, the CEN, and ISO may be more appropriate than CPSC's general test requirements to ensure that the bicycles and bicycle components meet the demands of the user.

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I'm going to cover a couple examples of the differences between CPSC's regulation and the international or voluntary regulations. Here's an example of CPSC's test retirement for handlebar strength.

The CPSC test requirement is 2,000 newtons, or 450 pounds for bicycles, and 1,000 newtons and 225 pounds for sidewalk bicycles. In comparison, EN and ISO establish requirements based on usage conditions that may be different than the CPSC's requirements.

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For example, for Condition 1, CPSC's requirement is 2,000 newtons and 450 pounds, regardless of use condition. ISO establishes different test requirements for different usage conditions, which can range from 500 newtons for Condition 0 to 1,600 newton or higher for other usage condition.

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Example 2 is a test requirement for fork bending fatigue. We can see that CPSC does not have a requirement for fork bending fatigue, whereas international voluntary standards do have a fork bending fatigue test.

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This table shows that CPSC does not have a requirement for fork bending fatigue, while ASTM, EN, and ISO have various test requirements for fork bending fatigue.

So, as you can see, if you're designing a fork, it may be appropriate to use an ASTM or ISO test requirement to make sure that your bicycle meets the intended usage condition.

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Example 3 is about fork and frame assembly test requirements.

In the CPSC fork and frame assembly test, the fork and frame assembly must be tested for strength by application of a load of 890 N (200 lbf) or at least 39.5 J (350 in-lb) of energy, whichever results in the greater force, in accordance with the frame test.

The fork and frame assembly static load test is only done for CPSC requirements.

ASTM, CEN and ISO have fork and frame assembly horizontal loading fatigue test and fork and frame assembly falling mass impact test requirements that CPSC's test does not require.

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This table shows the fork and frame assembly horizontal fatigue test requirements.

Again, you can see here that CPSC does not have this test. However, if you are designing a bicycle for sale in the U.S. or anywhere in the world, you should consider using ASTM, EN, or ISO test requirements to design your bicycle forks and frames.

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The following tables have a list of bicycle recalls conducted by the CPSC.

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Just to wrap up what we've been talking about, we've covered the CPSC bicycle test requirements as well as international and U.S. voluntary standard requirements.

As you can see, there are several differences in what the CPSC requires for sale and what voluntary standards and international standards require for testing.

In many cases, those differences could mean that a bicycle may fail under its intended use condition if it is not designed appropriately. Therefore, you should seriously look at whether or not designing your bike to just meet CPSC requirements will be enough.

Perhaps you should consider using an ASTM or ISO test requirement to design your bicycle to make sure that it meets the intended usage condition.

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Thank you. And now I'd like to turn the mike over to Caroleen Paul who will give a talk on CPSC bicycle instant data and case studies.

Thank you. As Vince mentioned, my name is Caroleen Paul, and I am a mechanical engineer here at the CPSC. This presentation will talk about how the CPSC gathers data on bicycle accidents and gives examples of a few case studies of actual incidents.

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CPSC gathers information on bicycle accidents through two main methods. The first is the National Electronic Injury Surveillance System, also known as NEISS.

The second method is in-depth investigations conducted by our CPSC investigators.

NEISS collects injury data from emergency departments across the United States. About 100 hospitals participate, and they code actual incidents that come into their emergency departments with specific product codes. For example, the product code for bicycles and accessories is 5040 and the product code for mountain bicycles is 5033. These hospitals are specifically chosen to be a national probability sample so when this data comes to us, we can then use it to calculate national estimates for how many incidents occurred across the United States.

We also get information on bicycle accidents that are reported to us. Then we send our investigators to ask the victims questions. The investigators then write up detailed reports called "in-depth investigation incident reports" or "IDIs". IDIs provide very good specific information on incidents, but they cannot be used to make national estimates.

Between these two methods, we get an idea of what's happening nationally, and we get specific information on what actually occurred.

We also have a report from our epidemiologic department on bicycle injuries seen in hospital emergency departments in 2013. Now, this report goes over how many injuries there were. For instance, in 2013, there were 531,000 injuries associated with bicycles and accessories seen in emergency departments. Over 90% of these resulted from the person riding the bicycle. And more than half are described as falls from the bike.

In terms of in-depth investigations, they provide detailed information on incidents. There were 302 IDIs from January 2007 to January 2017.

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There are many components to a bicycle. Any one of these components can fail and cause a bicycle incident.

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For example, the top component failures based on the IDIs that we've investigated include pedals, wheels, bicycle frames, forks, brakes, stems, crank arms, and handlebars.

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As I mentioned before, IDIs provide specific information on bicycle incidents. Many of the same descriptions come up in the investigations with the likely failure type of the bicycle.

These type descriptions include words like "something detached or loosened". The likely failure type associated with that description is usually something related to the assembly of the bicycle, or the maintenance of the bicycle.

Others include descriptions such as "something cracked", "came apart", "deformed", or "fractured."

There is also the "structural" failure type. This type is very important to us, because a structural failure is usually related to the design of the bicycle, which is usually something that can be addressed through voluntary standards.

Finally, the "overall malfunction" description comes up quite often. That is an unknown failure type.

I am now going to go over some actual IDIs that were conducted in the past.

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Let's look at IDI 050211CCC1472. This IDI number allows us to reference the actual investigation.

In this case, a 25 year old female flipped over her bicycle's handlebars because her left pedal detached. This was serious enough for her to be taken to the hospital via ambulance.

Another IDI, 090521CNE4429, involved a 19 year old male. The right clipless pedal of his racing bike fractured during a competition. This caused the victim to fall to the pavement with lacerations and contusions to his right knee.

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Here, we have wheel related incidents that are typical IDIs.

Both cases involved the front wheel separating from the suspension fork.

The first case was a 16 year old male who was just riding his bike. I believe this was the first time he used the bike. For unknown reasons, the wheel detached from the fork, and the victim flew over the handlebars.

In the other case, the same thing occur with an 11 year old male (except he had been riding his bike for a while). He was riding over a speed bump and the front wheel detached and wedged in the bike. This caused the bike to stop suddenly and the victim flipped over the handlebars.

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Next, we have some frame related incidents.

In the first case, the bike's aluminum frame broke in half while an 8 year old male was riding it. He was thrown over the handlebar and onto a gravel driveway.

In this other incident, a 20 year old male was on a bicycle and the frame at the head tube fractured in half. Again, the person was thrown over the handlebar and received multiple lacerations.

In the ID that ends with "2105" the bicycle was recalled under the number 00 030.

Sometimes when you have a structural problem, it ends up being part of the design, which can lead to recalls.

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These next IDIs involve fork related incidents.

In the first IDI, the fork came apart. As you can see in the picture, it came apart pretty catastrophically. A 20 year old male was riding the bicycle at the time. He was thrown over the handlebars, hit the pavement, and received some serious injuries.

In the second IDI, the fork on the bike broke. The accident involved a 14 year old male whose head and face struck the pavement, which resulted in a broken jaw.

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These next IDIs relate to the brakes on the bicycle.

On the first one, the front wheel locked up when the brakes were applied, which cases the bike to stop suddenly. A 17 year old female was riding a bike at the time. In this case, she was thrown off the bike onto a concrete picnic table, fractured both her arms, and was hospitalized for three days.

In the second IDI, a 25 year old male was riding a bicycle and lost control while attempting to apply the brakes. He ended up falling onto the pavement with head lacerations and road rash.

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These next IDIs are related to the stem of the bike. This is where the handlebars attach.

In the first IDI, a 13 year old male was riding the bicycle and the stem fractured. As you can see in the picture, it's a material failure. This victim fell to the ground and had minor abrasions to his hands and arms.

In the second IDI the victim, a 52 year old male, turned the handlebars, and his bike didn't respond. This caused a crash and the victim severely fractured his leg.

In the last one, an 18 year old male was riding a bicycle when the stem cracked. He fell to the pavement and got a wrist and elbow fracture.

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Next, we have a crank arm. These are the parts that the pedals attach to on your bicycle. This is where you transfer torque and power to the bicycle.

In this first IDI, a 15 year old male was riding a bicycle, and the crank arm fractured. Again, this is some type of material failure. The accident caused the victim to fall and receive a head injury and a broken arm.

The other IDI was a left crank arm fracture. Again, some type of material failure. In this case, the 35 year old victim fell to the pavement and had abrasions and a laceration.

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Now, we have some handlebar related incidents.

The first one was a 57 year old female who was riding and her handlebar just suddenly collapsed, making her lose control of the bike. This caused her to fall, and she needed surgery to treat a broken ankle.

In another incident, an 11 year old male was riding a bicycle, when, again, his handlebars became loose and he lost control of the bicycle, fell over, and had injuries to the face.

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So, those were just a few examples of the hundreds of IDIs we have.

Next we are going to look at specific case studies of failures and what the manufacturers did to correct them.

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In our first case, we have a fork failure. This particular product was a road bike with a carbon fork.

This material isn't covered in the CPSC regulations. This is all through voluntary standards. Innovations in bicycle design are areas where a lot of problems can arise.

In this case, a road bike with a carbon fork had an issue where the disc brake mount was fracturing.

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The manufacturer redesigned the aluminum disc brake, as well as the carbon fibers layups in the fork where the dismount is attached, to rectify the bike's failure.

All of this was done to reduce the stress to that area. To validate the design, the manufacturer had the redesign fork tested to the fork test requirements in EN 14764.

EN 14764 is for city and trekking bikes.

This is a case where the voluntary standards can really help the manufacturer make sure that they design a safe bicycle.

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Our second case is a frame failure with a folding bicycle. As you can see, the aluminum frame could fracture at the frame hinge.

And as you can see in these photos, this was a catastrophic failure in the material.

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To rectify the material failure, the manufacturer modified the welding process at the subject area. The manufacturer increased the thickness and increased the strength where the fractures occurred.

In addition, the manufacturer improved the quality control process to ensure that the frame met specifications before the bike was assembled and put together.

And finally, to validate the design change and address the problem, the manufacturer tested the frame to the frame fatigue and impact test requirements in EN 14764.

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And lastly, this is a seat post failure.

This particular product is a mountain bicycle that is called a 29er because the wheels are 29 inches in diameter. The issue in this case was a carbon seat post that could fracture.

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The manufacturer rectified the material failure by modifying the carbon fiber layering to cover the transition area that was failing. Essentially, this strengthened that area.

To validate the design change and address the problem, the redesign seat post was tested to the seat post fatigue test requirements in EN 14766.

In addition, the manufacturer conducted an in-house static load testing to ensure the strength of the product.

In this case, the manufacturer recognized the failure. Then, not only did the manufacturer find the requirement in the voluntary standard that actually addressed this problem, they did their own in-house testing.

These are all good practices to make sure that you manufacture bikes to be as safe as possible.

In conclusion, these are just some examples of the many components that can and have failed on bicycles.

We at the CPSC encourage all manufacturers to learn from the recalls and past the corrective actions. We also encourage you to look at all the different standards out there, mandatory and voluntary standards, and apply them in best practices to prevent future incidents. Thank you.

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Thank you, and we hope you enjoyed this podcast. If you have any questions on the presentation, please do not hesitate to submit your questions in English or Chinese to the mailbox mentioned earlier: CPSCinChina@cpsc.gov. This mailbox is routinely monitored.

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We also wish to remind viewers that CPSC has many technical documents and resources available in Chinese. The conclusion of this presentation provides many links to resources viewers may find useful.

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We encourage viewers to check out CPSC's Regulatory Robot, available in English, Chinese, and several other languages. The Regulatory Robot is an automated tool that can help identify safety requirements for many different types of products. Many companies have found this tool to be extremely helpful.

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Finally, please see the following links for resources specific to bicycles and information covered in today's podcast. Thank you for downloading this presentation.