Human Powered Vehicle Challenge (HPVC) Safety Check

Illustrations of Safe and Unsafe elements
Outline

• Rollover Protection System (RPS)
• Harness/seat belt
• Steering System
• Braking System
• Sharp Edges, protrusions, pinch points
• Screws
• Welded joints
Rollover Protection System (RPS)

- Must clear the helmet of tallest rider
- Must prevent rider from contact with ground
- Protection on sides and top of vehicle

Satisfactory Composite RPS
→ Side & top protection

Satisfactory RPS
→ Clears helmet by several inches
Unsatisfactory RPS
→ Helmet touches ground

Satisfactory RPS
→ No side contact

Note: In an accident, flailing legs and arms could still contact the ground
Unsatisfactory RPS
→ Insufficient RPS height

RPS → Single Post

Unsatisfactory RPS
→ Inadequate Protection
Harness/Seat Belt

- Satisfactory shoulder strap
  - Width and attachment

- Unsatisfactory lap belt
  - Too narrow
  - Should be 46 mm wide

- Good attachment method
  - Bolted to frame

- Good harness system
Steering System

• No looseness

• All components structurally sound and securely attached

• Tie rods with adequate stiffness
Tie Rods

Tie rods should be strong and stiff enough to prevent buckling. Tubes, particularly larger diameter tubes, work well.

Poor Tie Rod design
⇒ Long, small-diameter rod
⇒ Prone to buckling

Good Tie Rod design
⇒ Tubular with adequate diameter
Braking System

Unsatisfactory adjustment
→ Lever touches handlebar

Unsatisfactory
→ No front brake
→ Front brake provides much more braking force than rear brake

Satisfactory adjustment
→ Thumb fits between lever and handlebar
Open Tube Ends

- Open tube ends must be closed
  - Handlebar plugs must be installed
  - Plastic or metal plus work well

Good solution
  - Handlebar end plug
  - Plastic tube plug

Unsatisfactory
  - Open tubes will fail safety
Open Tube Ends

Acceptable
- Securely tape foam plug
- Securely tape tennis ball or similar
- Ensure safety accommodations are obvious to speed up your safety check

Marginally Satisfactory
- Tape open ends securely

ASME Setting the Standard
Screws

Suspension screw missing nut

Unsatisfactory
- More than 3 threads exposed

Best
- Less than 3 threads exposed

Marginally Acceptable
- Tubing covers screw
- Better than tape

Acceptable
- Second nut

Nuts/screws must be properly secured.
- Proper torque
- Thread locking compound
- Locking device or lockwire
Sharp Edges

Unsatisfactory
→ Sharp edges just in front of seat

Better
→ Corners rounded
Welds

Poor penetration, one side weld

Unsatisfactory weld
- Poor penetration
- Weld on one side only
- Seat/Harness attachment is safety critical component!

Unsatisfactory weld
- Poor penetration
- Visible gaps

Seat Harness attachment is safety critical component!
Contact Information

Questions about safety can be directed to the HPVC forum:

https://groups.google.com/forum/#!categories/asme-hpvc/design-and-safety

Or email can be sent to hpvcasme@gmail.com
Thanks to Mark Archibald

Mark Archibald created this set of slides after serving as the safety judge at the HPVC East 2016. Mark is a professor at Grove City College and is the past Chief Judge and past Chair of the HPVC. He is a wealth of knowledge about human powered vehicles and we greatly appreciate his contributions.