

Caster Technology

Choosing the right fit for your ergonomic needs.

CASTER CONCEPTS

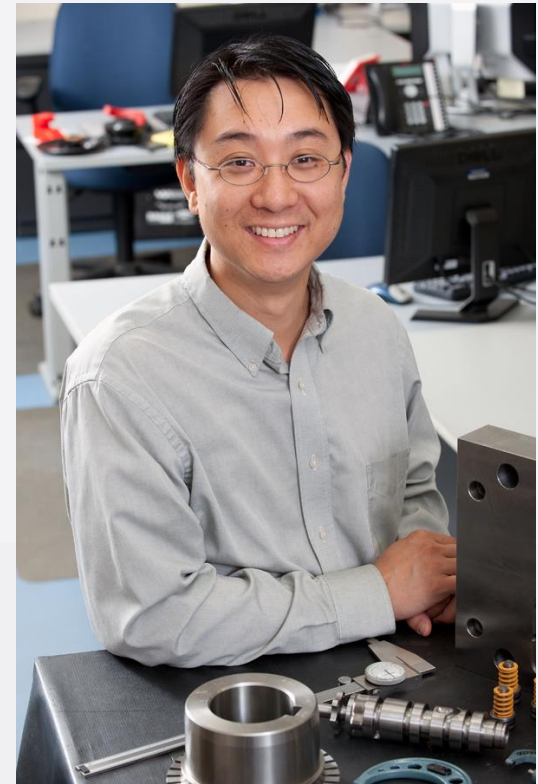
Beyond Standard.

Dr. Elmer Lee
Head of Engineering



Personal Background

- Head of Engineering at CCI since 2005
- Ph.D. Mechanical Engineering
- Research was in Robotics and Automation
- Also run a separate engineering/manufacturing company called Conceptual Innovations



Who We Are

- Leader in Industrial Caster Design and Manufacturing
 - HQ in Albion, MI
 - Manufacturer in the US
- Innovative with patented products that address
 - Leading cause of injury in the workplace
 - 2nd most common illness in the workplace
- We have the honor of serving the largest manufacturers in the world
- Employs about 100 people
- Primarily sales in North America
- www.casterconcepts.com



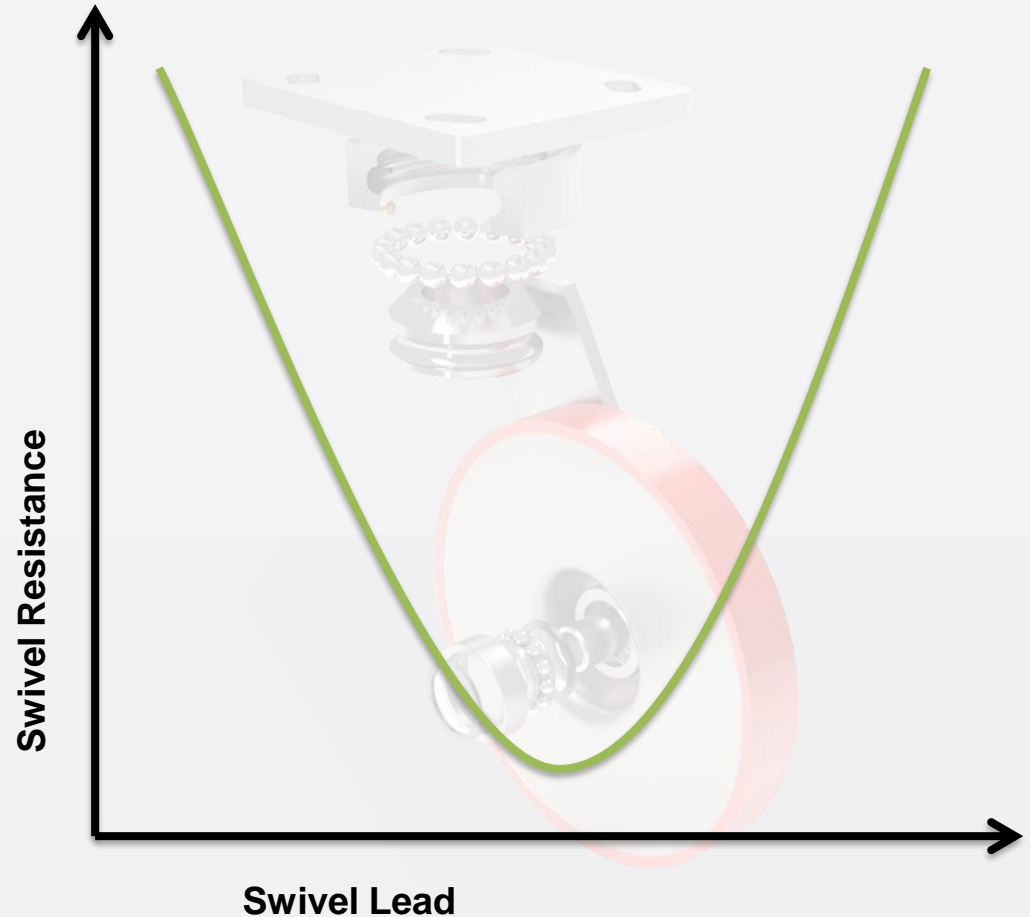
Parts of a Caster that Effect Ergonomics

- Swivel Lead
- Swivel Section
- Wheel Tread
- Wheel Bearing



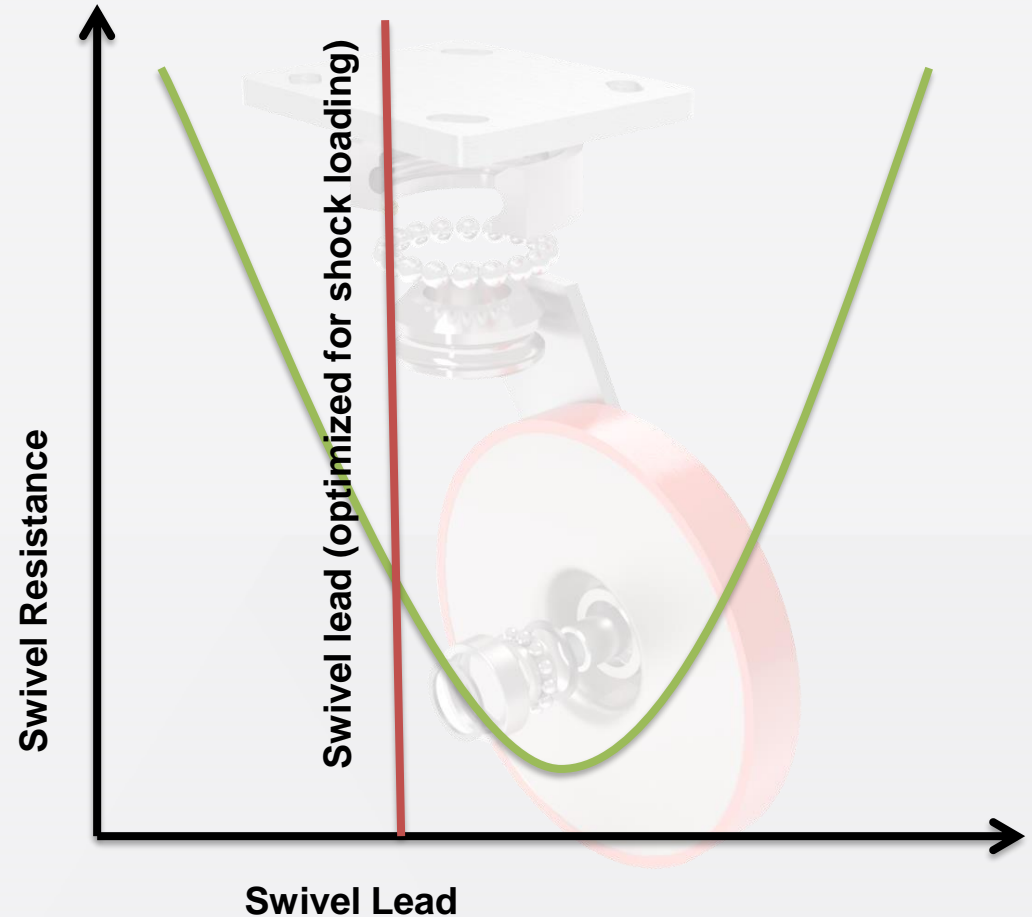
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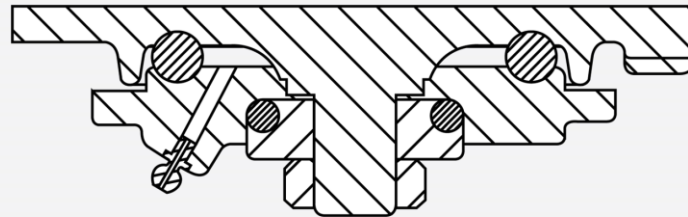
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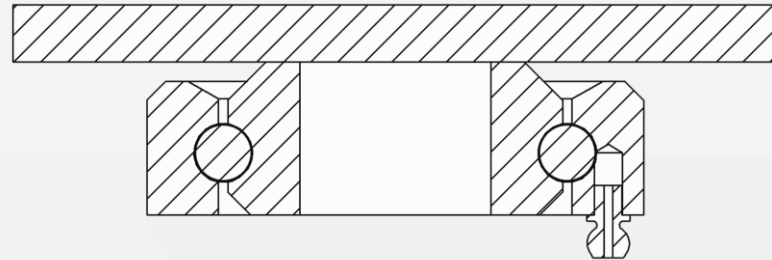
Swivel Bearing Types

3 Types of Swivel Sections in Industrial Casters

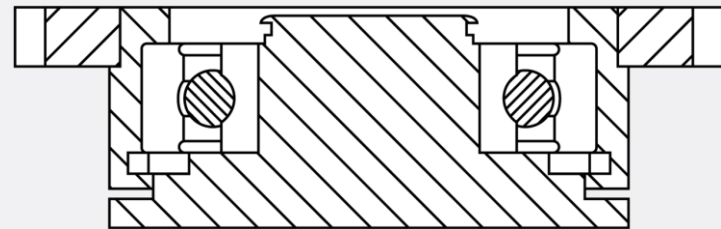
- Kingpin



- Kingpinless



- Precision Ball Bearing



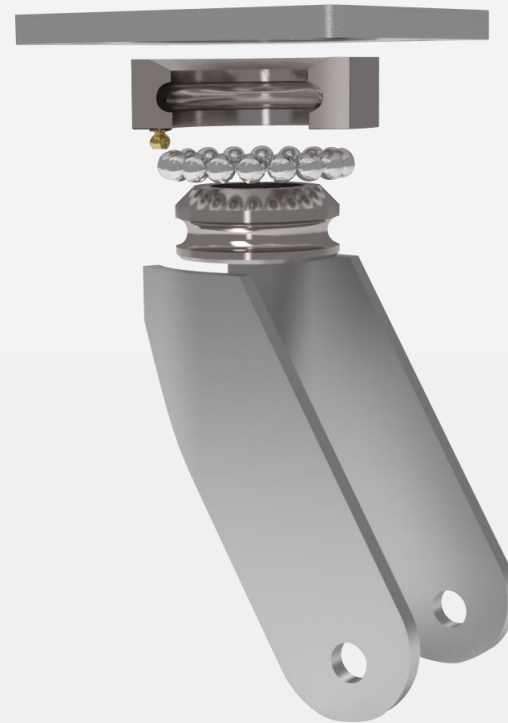
Kingpin Swivel Section

- Middle Kingpin holds load
- Raceway are typically not machined and not hardened
- Inexpensive to assemble
- Requires annual greasing
- Kingpin nut can be adjusted



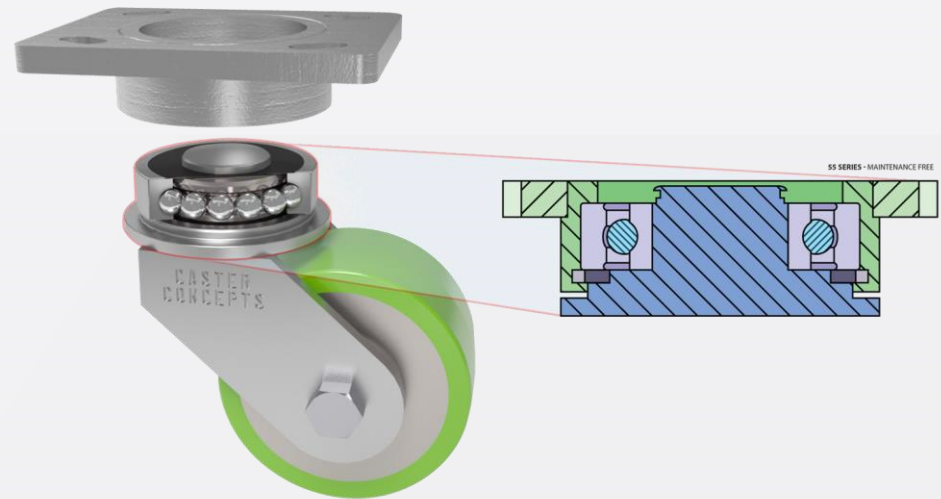
Kingpinless Swivel Section

- Harden machined raceway
- But not precision ground so can have some play in the bearing
- Requires annual greasing



Precision Ball Bearing

- Precision ground hardened raceways
- Very smooth rolling
- Requires no maintenance
- Can be more expensive than previous designs
- Greatest Ergo benefit



Summary of Swivel Sections

- Kingpin: (Pro - Inexpensive, Con – Low shock load, high friction)
- Kingpinless: (Cost is moderate, good shock load, medium friction)
- Precision Ball Bearing: (Cost is higher, moderate shock load, low friction)

	Kingpin	Kingpinless	Precision B B
Cost	\$	\$\$	\$\$\$
Friction	High	Medium	Low
Shock Load	Low	Medium	Medium
Maintenance Expenses	High	Medium	None



Parts of a Caster that Effect Ergonomics

- Swivel Lead
- Swivel Section
- **Wheel Tread**
- Wheel Bearing



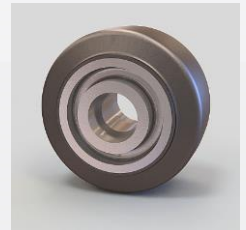
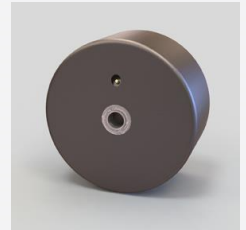
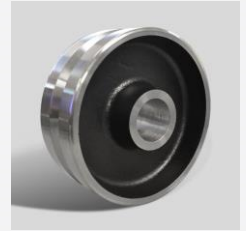
Tread Functional Concerns

- Rollability
- Load Carrying Capability
- Cost
- Wear
- Floor protection



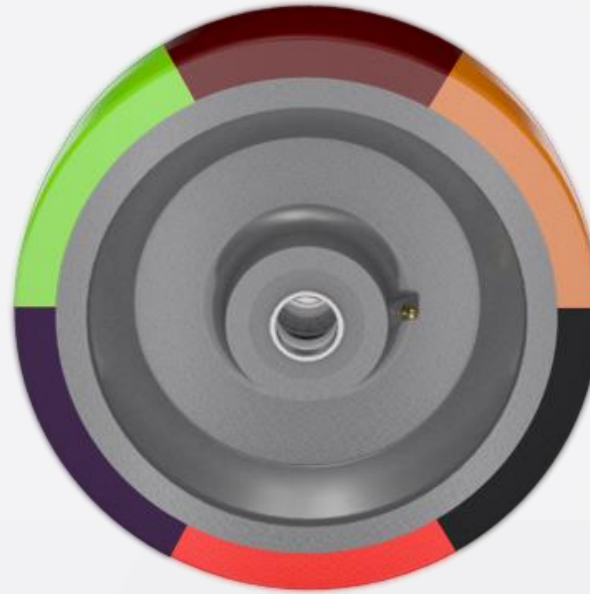
Tread Types Comparison

- Steel – Very low rolling resistance, but very harsh on concrete and other surfaces. Typically only used on steel rails or track
- Plastic – Nylon, polycarbonate, UHMW – moderately hard, picks up debris and thus causes it to wear faster.
- Rubber – Typically 60A - 80A in hardness. Can withstand higher temperatures. Doesn't have as good as wear resistance as poly. Can't carry as much load. Made in larger batches because of the manufacturing process so more difficult to get custom sizes.
- Polyurethane – Typically 70A to 70D. Great debris rejection and wear resistance. Good load carrying capabilities. Very good floor protection.



Polyurethane Treads

- Different Chemistry
 - MDI
 - TDI
 - XDI
 - NDI
 - PPDI
 - TODI
 - PTMEG



Each have a variety of different durometer, different curative, additives and catalyst.

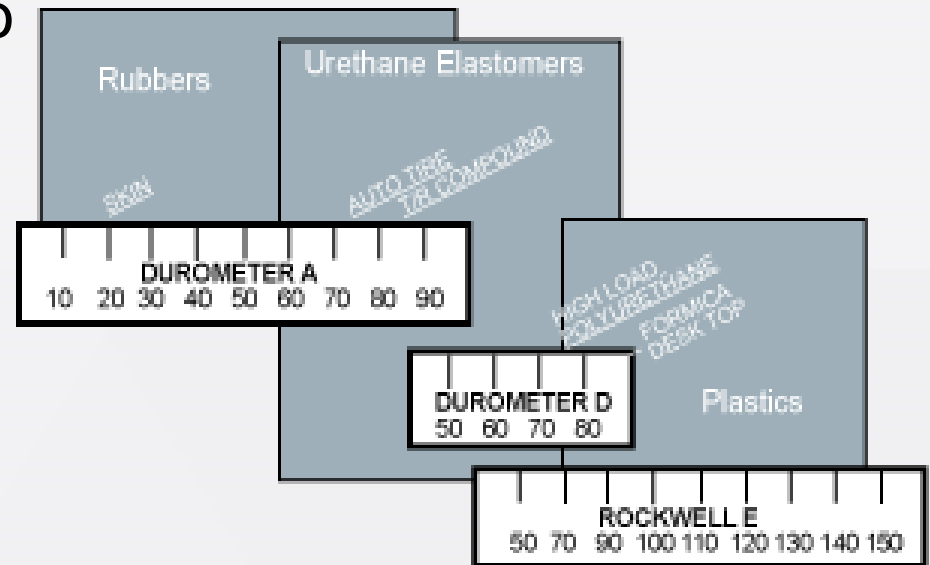


Polyurethane Material Properties

- Durometer – Hardness (70A to 70D)
- Tear/Abrasion Resistance

Properties Important to Ergo

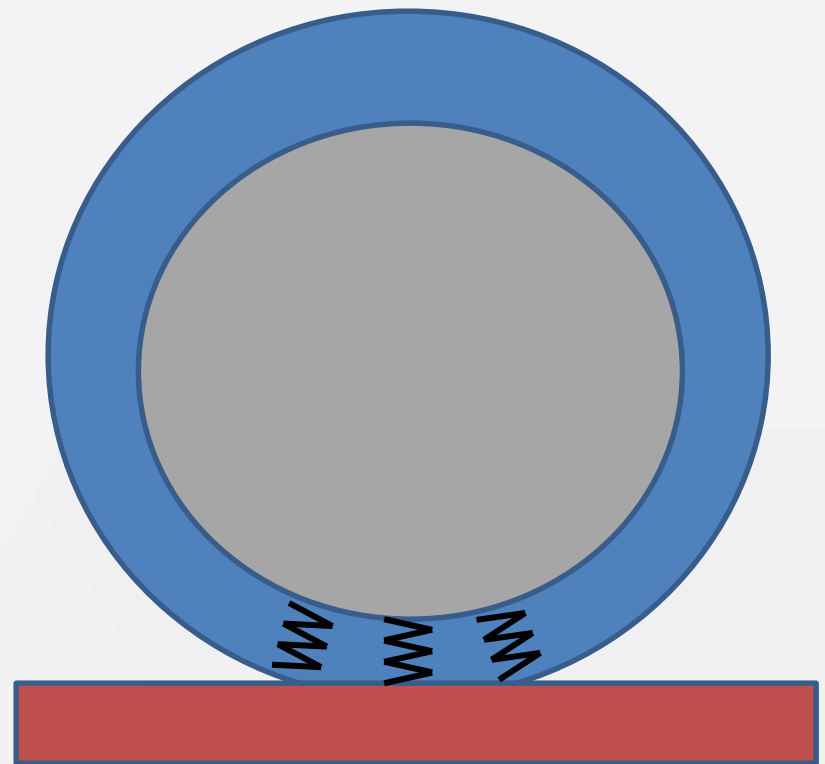
- Coefficient of Friction
- Rebound – 40% to 75%
- Heat Generation



Sources of Friction from Polyurethane Treads

- Rolling Deformation

- Hardness (durometer)
- Rebound
 - Heat Generation
- Wheel Diameter
- Tread Thickness



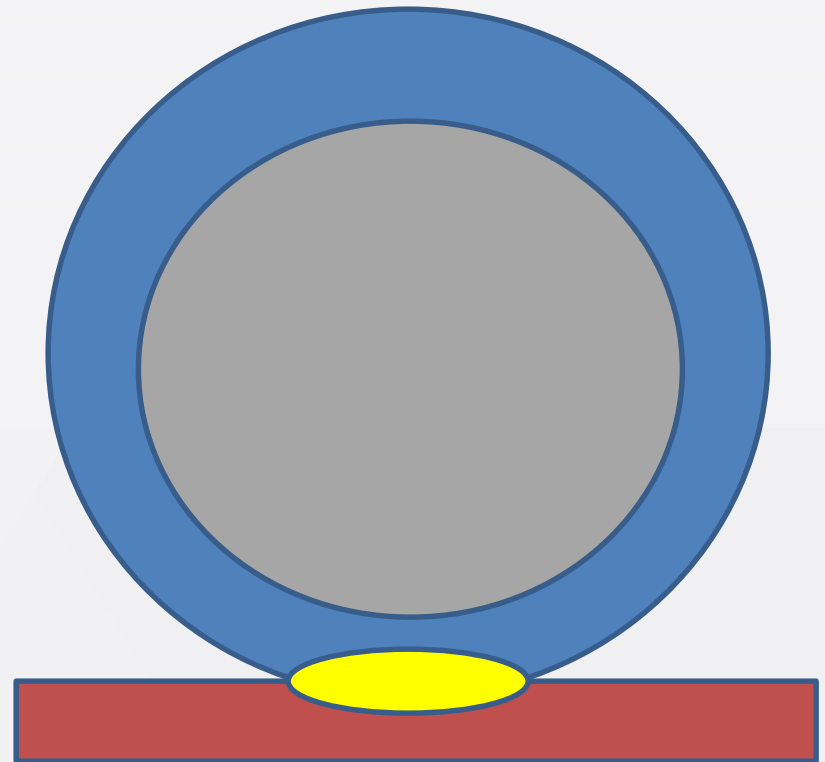
Sources of Friction from Polyurethane Treads

- Swivel Scrubbing

- Flat Spot Size

- Tread Thickness
 - Durometer
 - Wheel diameter

- Coefficient of Friction



Parts of a Caster that Effect Ergonomics

- Swivel Lead
- Swivel Section
- Wheel Tread
- **Wheel Bearing**



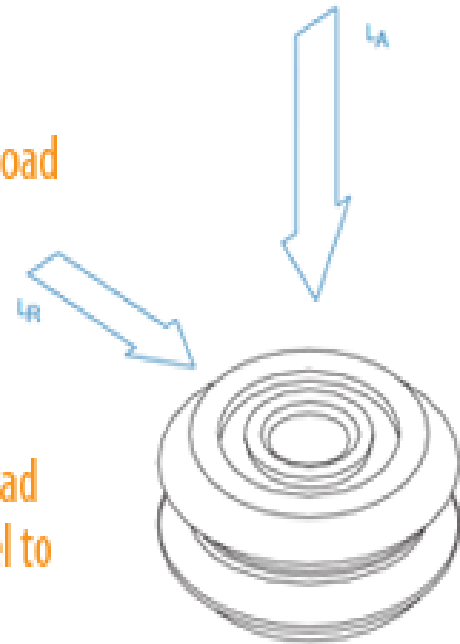
Wheel Bearing Function

- Radial Load
- Axial Load
- Rollability
- Wear Resistance

Radial and Axial Loading

L_R : Radial load refers to the load applied in a direction perpendicular to the axis of rotation.

L_A : Axial load refers to the load applied in a direction parallel to the axis of rotation.



Wheel Bearing Type

- Sliding Element Bearings
 - Plain Bore – high load, slow speed, requires constant greasing
 - Bushing – high load, slow speed, inexpensive
- Roller Element Bearings
 - Roller Bearings – moderate load, low speed, no side load
 - Deep Groove Ball Bearings – moderate load, moderate speed, some side load
 - Tapered Bearing – high load, moderate speed, high side load



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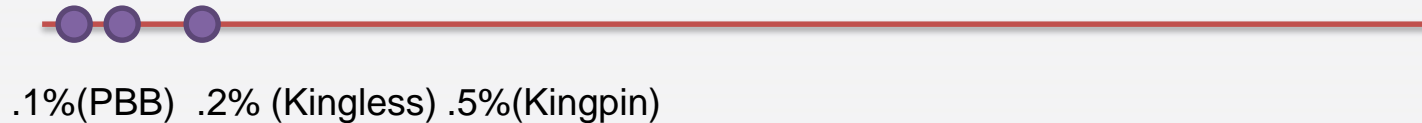
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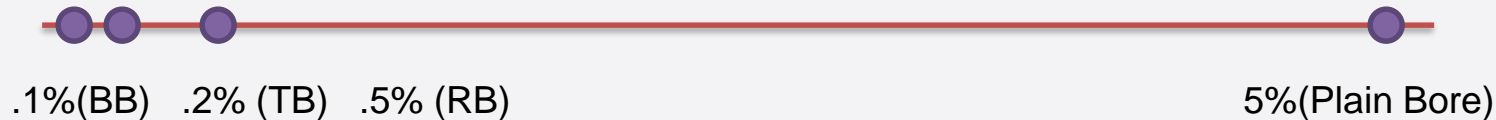


Sources Of Friction In Swivel Casters

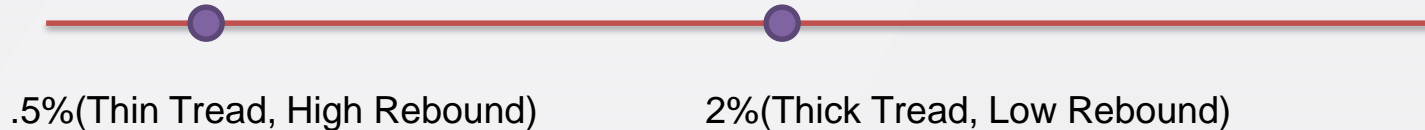
- Swivel Bearing Friction - 0.1% to 0.5% of total load



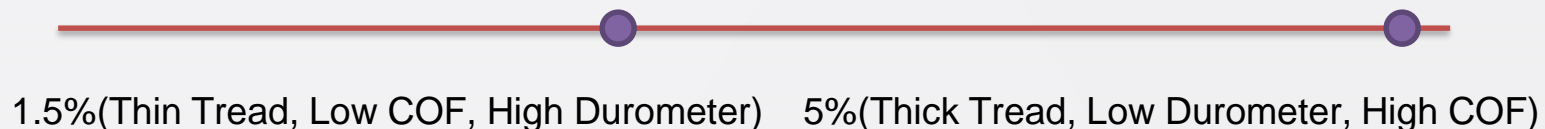
- Wheel Bearing - .1% to 5% of total load



- Rolling Surface Deflection - .5% to 2% of total load

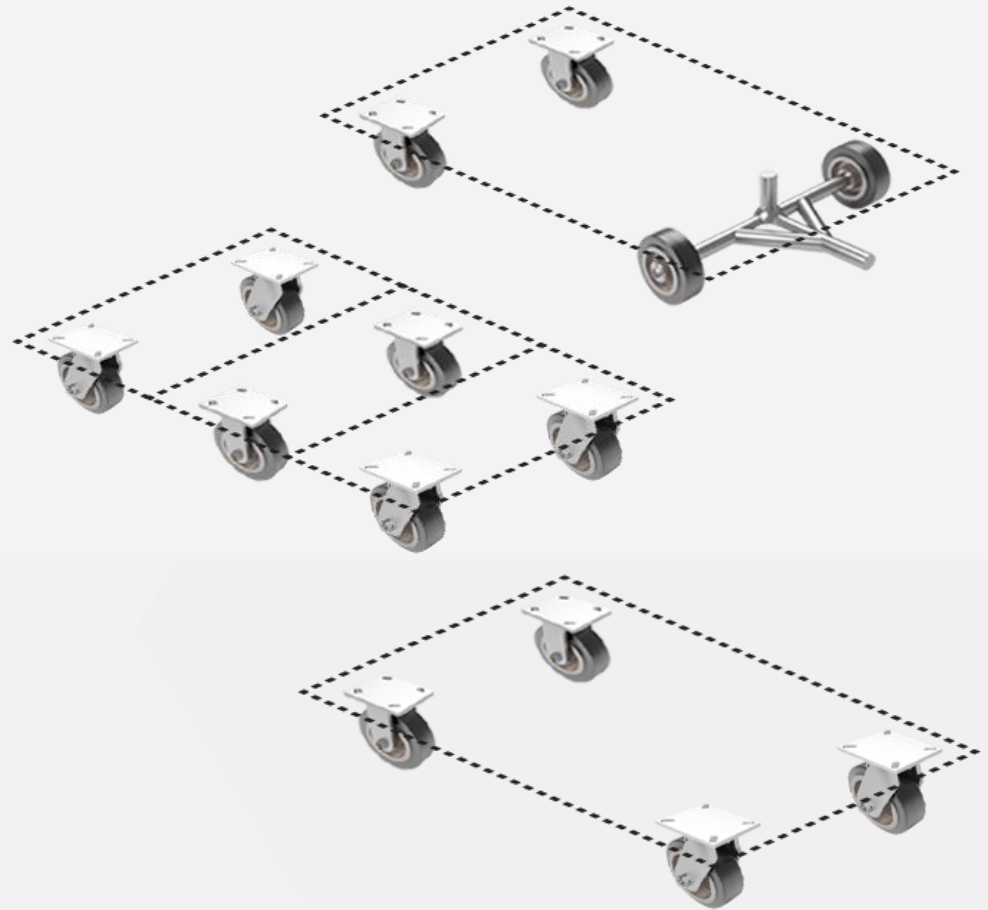


- Wheel Scrub – 1% to 10% of total load



Different Cart Design

- Wagon Steer
- Diamond/6 Wheel
- Standard 2 Swivel/2 Rigid



New Technology

Twergo

Patented force reducing, productivity increasing wheels.



CasterShoX

Patented CasterShoX absorption unit with unparalleled noise reduction.



For more information on TWERGO visit:

<http://www.casterconcepts.com/solutions/twergo/>

For more information on CasterShoX visit:

<http://www.casterconcepts.com/castershox-casters/>



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Sources Of Friction In Swivel Casters

- Swivel Bearing Friction - 0.1% to 0.5% of total load



.1%(PG) .2% (Kingless) .5%(Kingpin)

- Wheel Bearing - .1% to 5% of total load



.1%(BB) .2% (TB) .5% (RB) 5%(Plain Bore)

- Rolling Surface Deflection - .5% to 2% of total load



.5%(Thin Tread, High Rebound) 2%(Thick Tread, Low Rebound)

- Wheel Scrub – 1% to 10% of total load



1.5%(Thin Tread, Low COF, High Durometer) 5%(Thick Tread, Low Durometer, High COF)



Ergo Guidelines

For The Best Ergonomic Results:

- Spec casters with load capacities 2X the required carry capacity
- Choose the polyurethane wheel with the maximum rebound, minimum COF at the hardness required to carry load
- Always choose ball bearings in the wheel, if no side load
- Choose precision ground ball bearings swivel section, if you have budget



Thank You!

Dr. Elmer Lee

Head of Engineering

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Beyond Standard.

Caster Testing

- Auto Ergo Cart
- Dyno to quantify poly performance
- Static Load testing with swivel test
- Static Load testing with footprint test
- Finite Element Modeling to improve heat generation predictions for thicker tread poly

For more information visit:

<http://www.casterconcepts.com/support/white-paper/>

