PRODUCT FAILURE ANALYSIS
TIRES AND WHEELS

Issue date: September 1, 2015 V8

PRODUCT FAILURE CODES

A01: GENERAL MOUNTING DIFFICULTIES

Always to be checked before mounting a tire on a wheel

Wrong rim size	Rim size MUST be appropriate for tire size
Rim sizes not according to norms	Only rims with approved contour to be used
Rim damaged / out of shape Lock/side rings/adv. band out of shape	Only use undamaged / not deformed rims and / or components
Lock/side rings/adv. band not compatible brand	Only use appropriate / compatible rings

Tools and information needed to guarantee a good mounting

Type of press	Right tooling in good working order
Type/condition of tools	Right tooling in good order/condition
Mounting method	Proven / approved methods
Untrained operations	Trained people

A03: STEELBAND SIZE TOO BIG

Appearance

No or slight marks on steelband
after demounted from wheel

Possible cause

- Steelband too big
- Wrong tire size

Actions

- Check if tire size is the right size needed

Warranty

Yes, if the wheel size matches band size

A04: STEELBAND SIZE TOO SMALL

Appearance

Damaged steelband

Possible cause

- Tire size to small for rim
- Steelband size to small

Actions

- Check if tire size is the correct for the wheel
- Check rim for deformation and damages

Warranty

Yes, if tire size matches wheel size, and there are no damages found

A05: STEELBAND OVAL

Appearance

Steelband Oval

Possible cause

- Tire dropped on floor

Actions

- Handle PON with care, avoid damage during transport

Warranty

None

A06: BROKEN STEEL BAND (STB) OR BEADS

Appearance

Cracks in Steelband or Beads

Possible cause

- Steelband too small
- Bad mounting
- Rim deformed/damaged
- Rim too big

Actions

- Check wheel(size, damages, deformation)

Warranty

Yes, if the defect is not caused
by the wheel or mounting

B: GENERAL COSMETIC COMPLAINTS

Appearance

Poor aspect of the delivered tyre, superficial damages, ...

Possible cause

- Poor manipulation at production,
  improper handling at loading / unloading, ...

Actions

- None

Warranty

Depending on the origin of the aspect defect

Comment

The performance and lifetime of the product will not be affected

B01: PAINT (COLOUR, GLOSS…)

Appearance

Inconsistent, with noticeable visual changes

Possible Cause

- Issues with paint mixing, preparation of site, or application

Actions

- None

Warranty

Condition related

Comment

The performance and lifetime of the product will not be affected

B02: PAINT PEELING OFF

Appearance

Paint visually coming off of the item

Possible Cause

- Issues with paint mixing, preparation of site, or application

Comment

The performance and lifetime of the product will not be affected

B03: WELD OF RIM/WHEEL/NAVE PLATE

Appearance

Weld inconsistent, not finished,
gaps or burn through

Possible Cause

- Operator or equipment malfunction

Warranty

Yes, if found to be from a manufacturing issue, and not impact or damage

Comment

Remove affected wheel from service

B04: DEBURRING (SHARP EDGES)

Appearance

Burrs appear after rough cutting of metal, and are jagged and sharp

Possible Cause

- Human error, deburring function not performed

Warranty

Possibly, depending on the aspect of the issue

Comment

In most instances, this can be corrected easily with a buffing tool

B05: STAMPED MARKINGS

Appearance

Stamped markings are; incorrect for the product, not ledgeable or missing completely.

Possible Cause

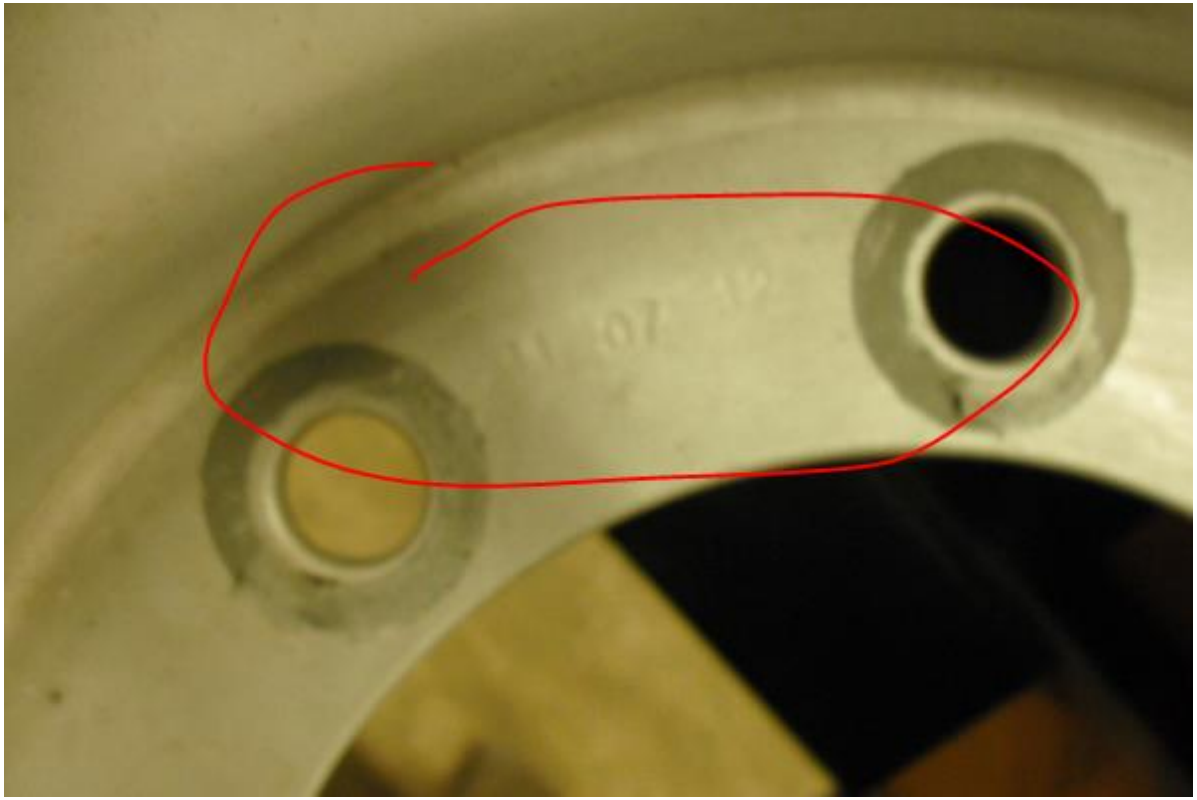
- Operator or equipment not functioning properly

Warranty

OE products are the only consideration

Comment

Will not affect the performance or lifetime of the product



C: HEEL AND BASE FAILURES

C01: SPINNING ON RIM

Appearance

Damaged band / bead or heel

Possible Cause

- Tire slippage occurs when the tire moves on the wheel
- Can occur during braking or while running (jack rabbit starts/hot shifting)
- Slippage can be detected by marking the tire and rim at the same spot with chalk or paint
- Safety issue due to decreased braking ability of the truck
- When slippage occurs the tire must be removed, and it is possible that new wheels need to be mounted as well
- In all cases of tire/rim slippage, the tire must be demounted to analyze the causes

Actions

- Remove tires from service

Warranty

Yes if the spinning is a result of bad manufacturing

C02: BONDING TO STEEL FAILURE

Appearance

Cracks between rubber and steel band
or wheel if mold on
Rubber detached from steel band or wheel

Possible cause

- Overload
- Insufficient adhesion agent
- Welding on steel band
- Contamination of bonding surface

Actions

- Fit the appropriate tire size for the specified load
- Do not weld on the steel band

Warranty

Yes if the failure is not caused by an overload, damage or other Customer modification

C04: BEADS BREAKING OUT

Appearance

Circular cracks in heel. This kind of damage is detected during the first period of tire utilization

Possible cause

- Bad pressing, or mounting
- Bonding failure

Actions

- Use supporting ring for pressing operation, and correct mounting tools for pneumatic tires
- Avoid over pressing

Warranty

Yes if the failure is not caused by improper installation

C05: EXC. WEAR OF BASE ABOVE RIM HOOKS OR BEADS

Appearance
Cracks in heel above rim hooks

Possible cause

- Overload
- Soft rubber from middle layer in heel or bead area

Actions

- None

Warranty

Condition related, if there are no signs of overload or under inflation

C06: RADIAL CRACKS STARTING IN BASE

Appearance

Radial cracks Starting in base, and widening towards tread

Possible cause

- Overload

Actions

- None

Warranty

Condition related

C07: BROKEN HEEL

Appearance

Circular cracks in heel

Possible cause

- Very intensive axial force
- Bonding failure in heel

Actions

- None

Warranty

Condition related

C08: BONDING FAILURE BASE TO MIDDLE LAYER

Appearance

Separation between heel and middle layer

Possible cause

- Insufficient adhesion

Actions

- None

Warranty

Yes

C10: BROKEN OR WORN OUT NOSE

Appearance

Nose worn out or broken

Possible cause

- Too high lateral force
- Nose damaged during mounting
- Overload (combined drive / steer tire)

Actions

- Use appropriate mounting tools,
  (mounting cone, mounting paste, etc…)

Warranty

Condition related

C11: DELAMINATION IN HEEL

Appearance

Heel drops out of tire
(smooth surfaces are visible)

Possible cause

- Bonding failure between rubber layers in heel (issues during tire building process)

Actions

- None

Warranty

Yes

D01: CIRCOMFERENTIAL CRACK

Appearance

Crack around circumference of tire

Possible cause

- Short mold or mold heat dispersion problem causing flow issue

Actions

- None

Warranty

Yes

D02: SIDEWALL DAMAGE

Appearance

Light to severe wear or damage of the sides of tire

Possible cause

- The sides of the tire get damaged by the OTT. The OTT rubber is harder then the tire rubber. Result is that the sidewall of the tire gets worn
- Tire pressure too low – underinflated tires will bulge more and wear sidewalls
- Interference between wings and tire carcass, check for debris
- Bad alignment between front and rear tire, check nave plate spacing
- Bent wheel or nave plate will cause misalignment
- General damage to the sidewalls of the tire

Actions

- Check tire pressure
- Check rim condition
- Check alignment between front and rear tire
- Check wheel offset

Warranty

Situation related, application related damages as described above will not be covered in claim.

D03: BROKEN MIDDLE LAYER

Appearance

Middle layer damaged/broken

Possible cause

- Bad middle layer compound

Actions

- None

Warranty

Yes, if the cause is not impact damage

D04: RADIAL CRACKS STARTING IN MIDDLE LAYER

Appearance

Radial cracks

Possible cause

- Overload

Actions

- Check axle loads for both loaded and empty conditions
- Check if the truck has been equipped with extra weight or special attachments
- Reduce the carried load, if possible
  Note: steer tire overload occurs when a truck is carrying loads that are significantly less than what it is rated to carry
- Use proper tire size (larger, wider), or use a “high load” compound
- Possibility to use larger forklift?

Warranty

Condition related

D05: PERMANENT DEFORMATION

Appearance

A permanent abnormality
in the construction of the tire

Possible cause

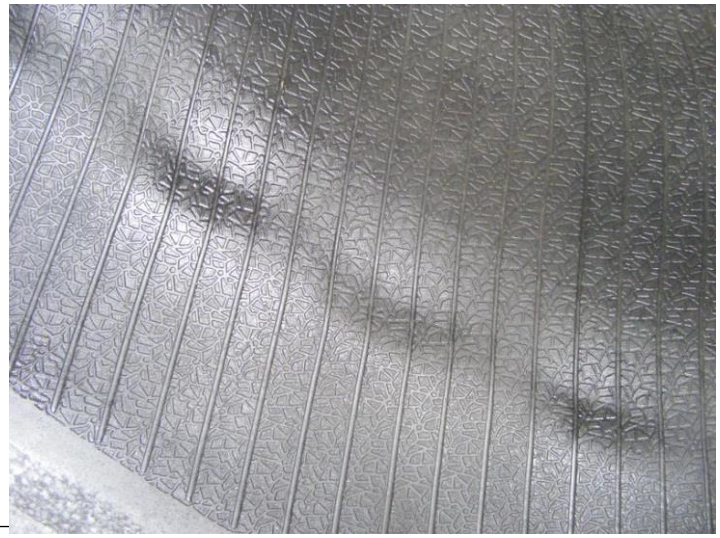
- A lapse in manufacturing methods
or materials

Actions

- None

Warranty

Yes



D06: BONDING FAILURE MIDDLE LAYER

Appearance

Circular separation in the middle layer, between tread and middle layer

Possible cause

- Poor preparation or contamination between middle layer rolling and tread layer rolling at production

Actions

- None

Warranty

Yes

D07: AIR BUBBLE AT INSIDE CASINGS

Appearance

Bubble appearing out at sidewall

Possible cause

- Penetration of the inside air through the inner liner, carcass and ending at side wall
- Bonding failure between plies
- Layers of casing come apart
- Tire deflection too high due to under inflation (or over load) causing heat build up and resulting in a separation between plies
- Impact damage and air permeation at impact site

Actions

- Regular monitoring of inflation pressure (also check if operators are not reducing the inflation pressure to increase comfort)

Warranty

Yes (if not caused by under inflation, overload or impact)

D08: LAYERS OF CASING APART

Appearance

Casing appears to be coming apart in layers.

Possible cause

- Precured rubber during tire building process
- Contamination between the layers
- Impact damage

Actions

- Avoid impacts if applicable

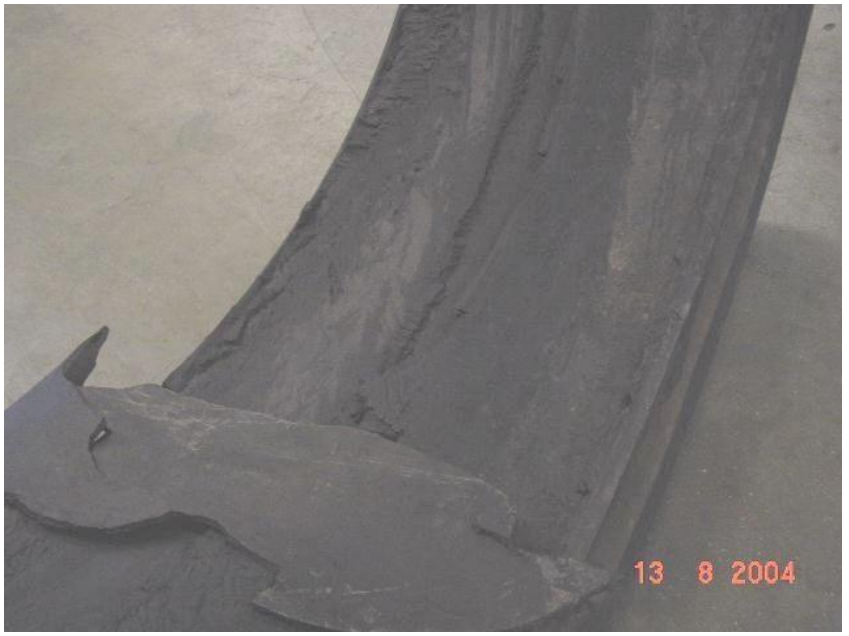
Warranty

Yes, if related to a manufacturing defect

D09: LAMINATION IN CENTRE (PRECURE)

Appearance

Separation between rubber layers (layers of rolled rubber visible)



Possible cause

- Precure due to too high temperature during middle layer rolling

Actions

- None

Warranty

Yes

D10: TIRECORD COMING OUT

Appearance

Tire cord visible at inside of tire

Possible cause

- Insufficient inner liner thickness

Actions

- None

Warranty

Yes

D11: AIR LEAKAGE

Appearance

Noticeable leakage either audible or visual

Possible cause

- Porous liner

Actions

- None

Warranty

Yes, if not a wheel or valve issue

Air leakage shown by, adding soapy water to the tire's sidewall

D12: THERMAL EXPLOSION MIDDLE LAYER

Appearance

Noticeable separation in the sidewall.

Possible cause

Heat build-up due to:

- Excessive speeds - WDAS
- Long distances
- Excessive loads
- Ambient/floor temperature
- Heat from brake drums

Actions

- Recommend appropriate compound
- Do not overload -
- Change size
- Limits (Max: +140°- Min: -40°F)
- Use appropriate compound
- Use low heat build up compound
- Replace with alternative solid (twin mounting or PON)
- Recommend pneumatic tires

Warranty

Yes on standard and premium tires (3-stage tires):
Solideal, Magnum…

Comment

No warranty on Budget tires (2 layer tires). Budget tires are made only for low intensity applications

E: TREAD RELATED FAILURES

ACTIONS: COMPENSATION IS SITUATION RELATED

E01: IMPACT DAMAGE RESILIENT TIRES

Appearance

Cracks on tread lugs
Rubber pieces pulled out of treads

Possible cause

- Impact damage

Actions

- Customer training, customer awareness

Warranty

None

E01: IMPACT DAMAGE PNEUMATIC TIRES

Appearance

Cracks on tread surfaces
Cracks at inner layer

Possible cause

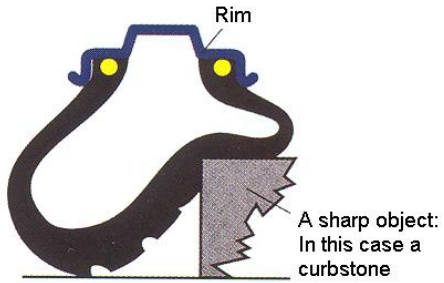
- Impact damage
  See pictures

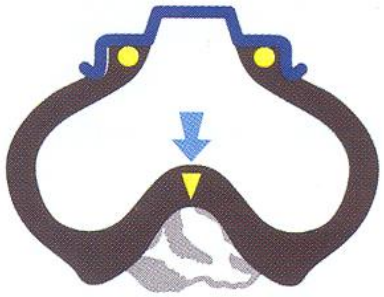
Actions

- Customer awareness

Warranty

None





E02: CHUNKING

Appearance

Rubber chunks pulled out of the tread

Possible cause

- Driving on aggressive soils
- Driving on soils contaminated with oil or chemicals
- Curing issue
- Compound mixing issue

Actions

- None

Warranty

Yes if manufacturing related

E03: LUG CRACKING OR BREAKING OUT

Appearance

Pieces of lugs breaking and or cracking at the basis

Possible cause

- Application related (hitting a foreign object)

Actions

- Operator awareness

Warranty

None

E04: UNEVEN WORN LUGS

Appearance

Lugs are worn in an uneven manner from front to back, side to side, or grooved

Possible cause

- Application related wear due to roading, loading and operation, or other(see rail application photo).

Actions

- Operator awareness
- Select appropriate tread profile in the case of WEX for rails. Smooth tire for the one in contact with the rail or roller

Warranty

None

E05: TAPERED WEAR

Appearance

Lugs are more worn
at one side then at the other

Possible cause

- Wrong camber angle
- Wrong steering angle
- Axle misalignment (damaged)
- Unequal or improper inflation pressure
- Different compounds/treads/ brands/OD on axle
- Application (turning preference)
- Dual mounting

Actions

- Check camber angle
- Check steering angle
- Check alignments
- Monitor inflation pressure
- Never mount different tires on 1 axle
- Rotate tires left/right
- Turn tires on wheels if necessary

Warranty

None

E06: ABNORMAL FAST WEAR

Appearance

Worn tire

Possible cause

- Compound
- Application

Actions: information needed

- Run hours (very important)
- Application
- Under foot conditions
- Previous experience: Brand

Warranty

Situation related

E07: PEELING OFF IN SHEETS

Appearance

The tread surfaces are peeling off

Possible cause

- Improper temperature/pressure during building or molding

Actions: information needed

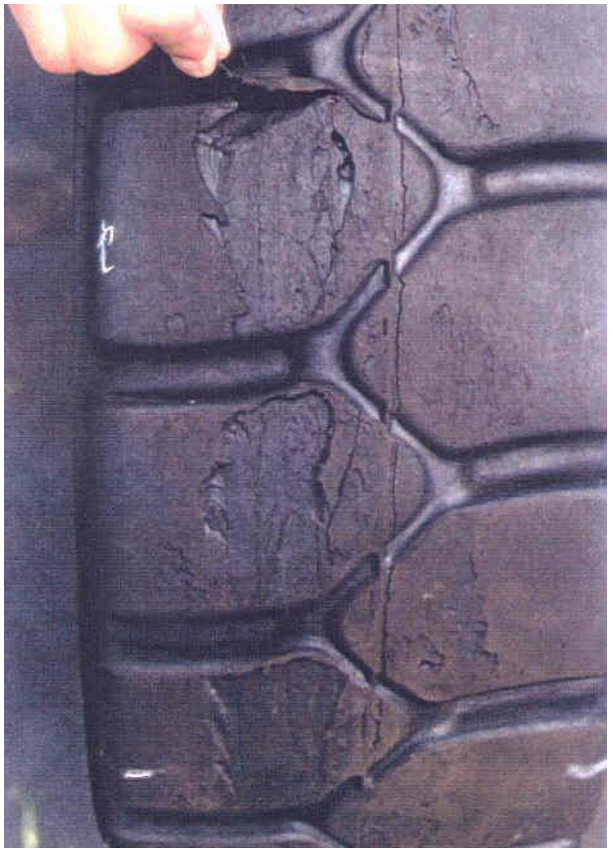
- None

Warranty

Yes

Comment

If the damage is not too severe the lifetime and performance is not affected



E08: OUT OF ROUND

Appearance

Tire is not perfectly fitted on rim
Steel band not concentric
to tread (PON)

Possible cause

- Bad pressing
- Beads not proper installed
- Mold defect (core not centered correctly) (PON)

Possible cause

- Bad pressing
- Beads not proper installed
- Mold defect (core not centered correctly) (PON)

Warranty

Situation related

E09: SOFT OR DISCOLOURED SPOT (BLISTER)

Appearance

Tread splitting (middle layer compound peeking through tread after short time or use on solid tires
Blisters and soft spots on pneumatic tires

Possible cause

- Excessive rubber in middle layer at tire building process
- Hot spot in mold, or mold release contamination

Actions

- None

Warranty

Yes for soft spot
Situation related for discoloured spot

E10: FLASH CRACKING

Appearance

The flash starts to separate after only a few hours of use

Possible cause

- Mold release agent trapped between flash

Actions

- None

Warranty

Yes

Comment

If the crack is not severe the performance and lifetime will not be affected, the product can be used

E11: RADIAL CRACKS

Appearance

Radial cracks

Possible cause

- Overload

Actions

- Check axle loads for both loaded and empty conditions
- Check if the truck has been equipped with extra weight or special attachments
- Reduce the carried load, if possible
- Note: steer tire overload occurs when a truck is carrying loads that are significantly less than what it is rated to carry
- Use proper tire size (larger, wider), or use a “high load” compound
- Possibility to use larger equipment?

Warranty

None

E13: FLAKEY TREAD

Appearance

Cracks in middle of tread

Possible cause

- Green tire outside diameter too big compared to mold

Actions

- None

Warranty

Yes

E14: TREAD DELAMINATION

Appearance

Tread peeling off in layers

Possible cause

- Delamination (precure) between tread rubber layers due to too high temperature at tread rolling

Actions

- None

Warranty

Yes

G: ON A COMMERCIAL BASIS

ACTIONS: COMPENSATION IS SITUATION RELATED

H: OTHER FAILURE CODES

ANYTHING THAT DOES NOT SUIT THE CURRENTLY DEFINED FAILURE CODES

H02: DESIGN FAILURE

Appearance

Visually this product could appear fine, but performance would be compromised

Possible cause

- Human error in drawing, calculation or product to purpose

Actions

- None

Warranty

Yes, and the product would likely be recalled

H08: BEAD LEAKS

Appearance

Tire leaking air from the bead area, this may be realized visually or audibly

Possible cause

- Inconsistencies in the bead area

Actions

- None

Warranty

Yes, provided the leak is caused by a manufacturing issue and not the consequence of mounting or a wheel issue

H09: VIBRATIONS

Appearance

There may not be any visual indication of a vibration issue

Possible cause

- Flat spots or inconsistencies on the tread face

Actions

- Educate operator about flat spotting tires

Warranty

Condition related, provided the vibration is caused by a manufacturing issue and not the consequence of mounting or a wheel issue

H10: WEATHER CHECKING

Appearance

Small cracks at sidewalls or between the lugs

Possible cause

- To long exposed to sun light and/or ozone

Actions

- Store tires in a protected environment: dark and dry place, away from ozone. If equipment is idle for long periods, place it on blocks, cover the tires with a dark covering and reduce the internal air pressure

Warranty

None

I: WHEEL RELATED CLAIMS

I01: OFFSET

Appearance

Nave plate attached
in wrong position in wheel

Possible cause

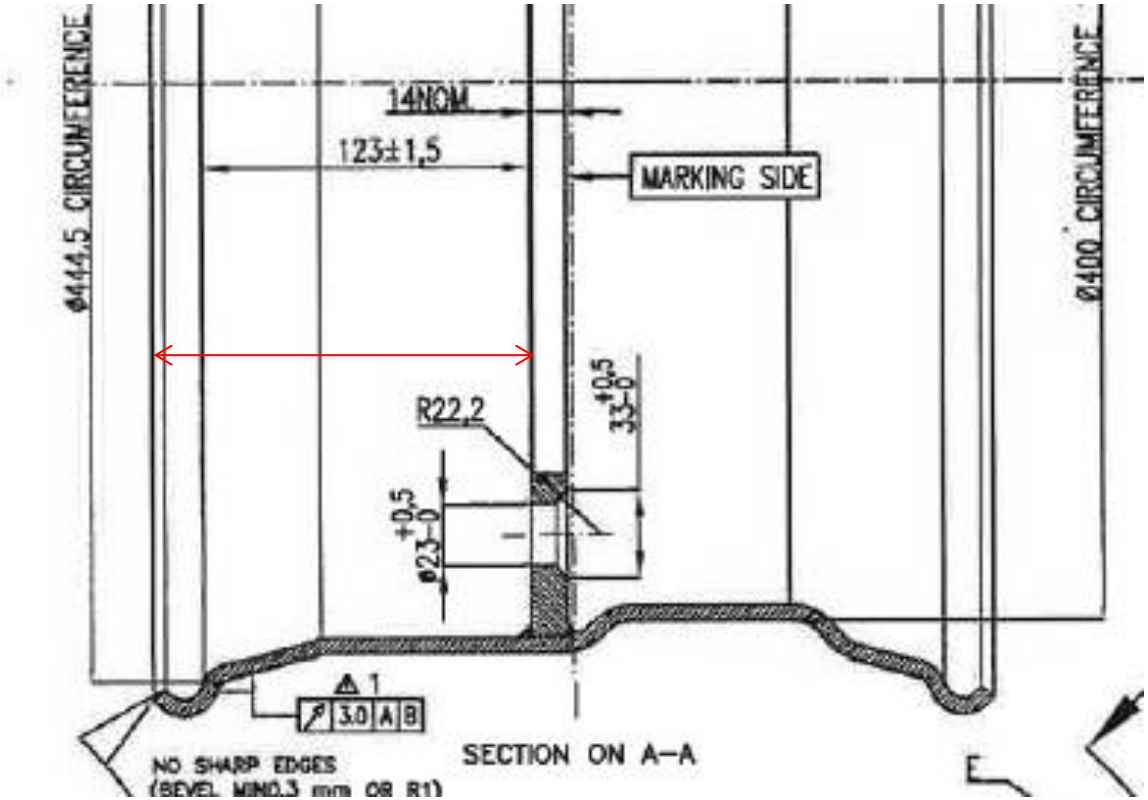
- Improper installation distance of nave plate, caused by miscommunication or human error

Actions

- None

Warranty

Yes



I02: RIM WIDTH

Appearance

Rim width is incorrect, and doesn't meet ETRTO, Tire & Rim Association specifications

Possible cause

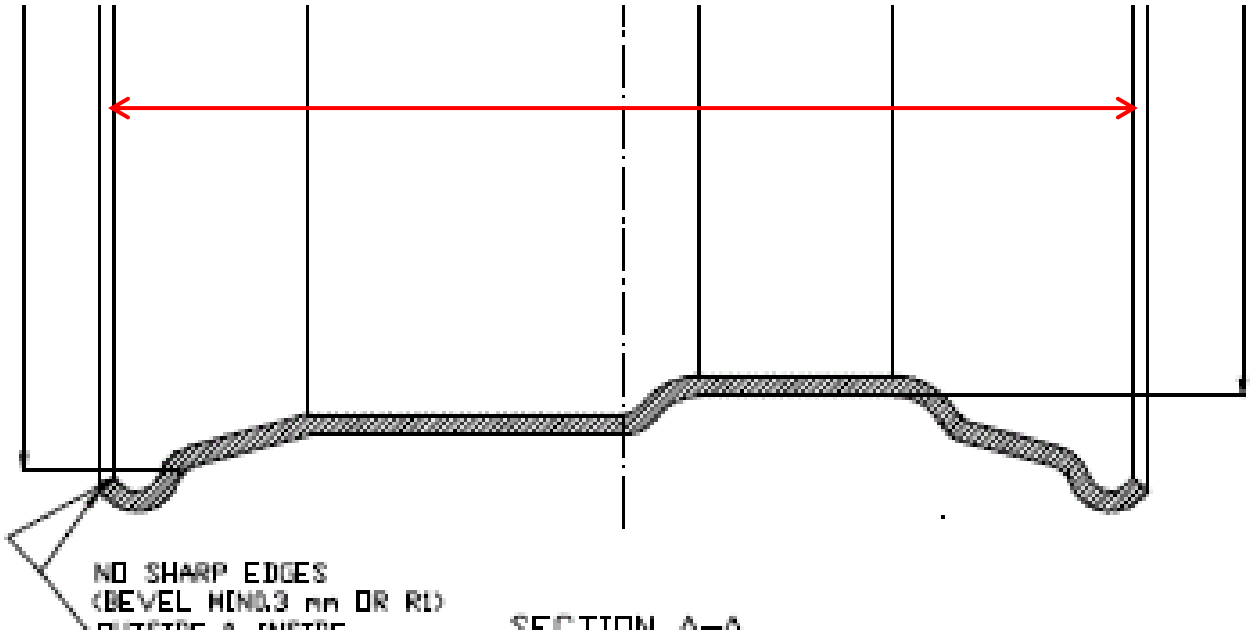
- Incorrect metal width used to form rim

Actions

- None

Warranty

Yes



I03: RIM DIAMETER

Appearance

Rim diameter is incorrect,
and doesn't meet ETRTO, Tire & Rim Association specifications

Possible cause

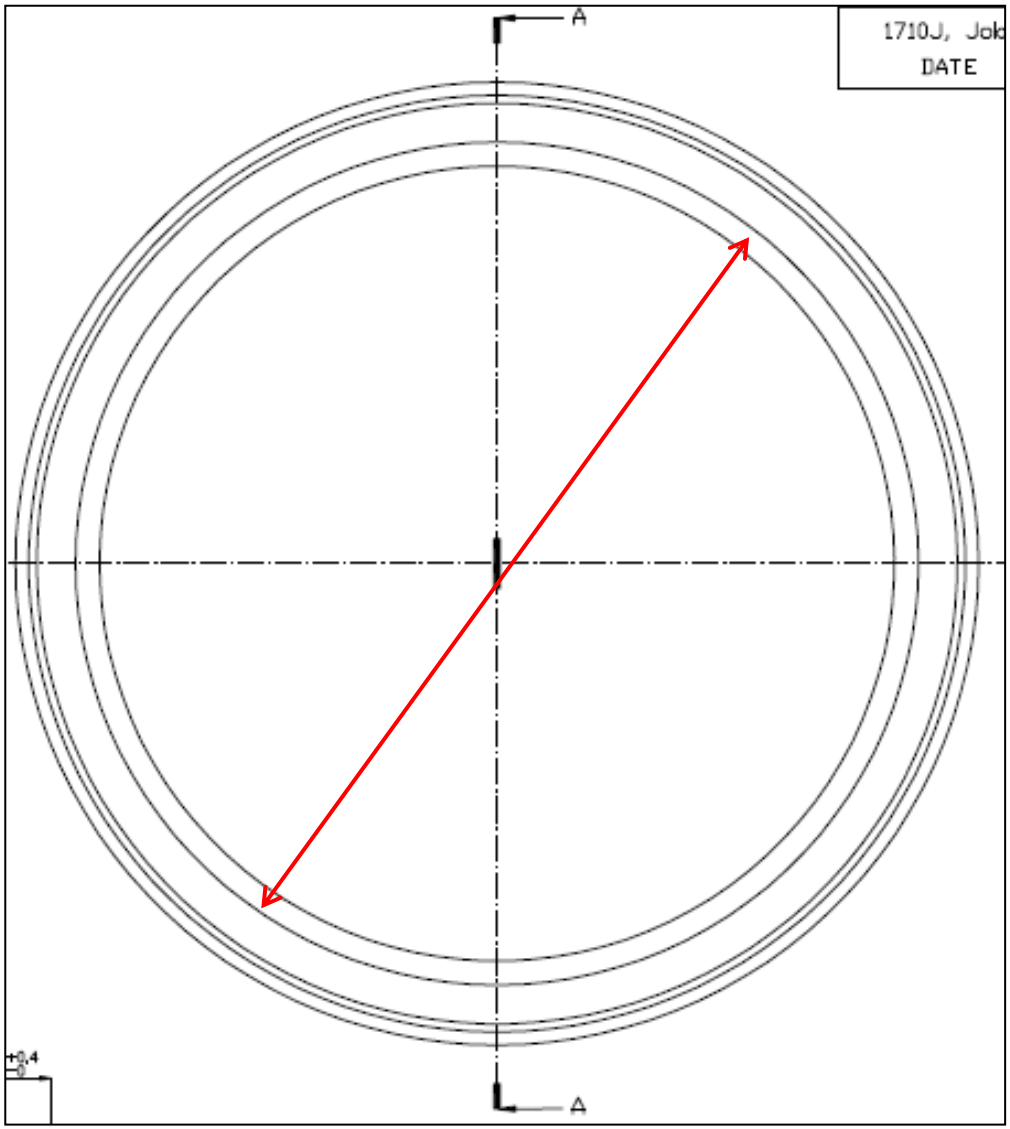
- Incorrect metal width used to form rim or joint related issue at time of welding

Actions

- None

Warranty

Yes



I04: PILOT DIAMETER

Appearance

Pilot hole is incorrect size, and does not fit the hub, or is sloppy on the hub

Possible cause

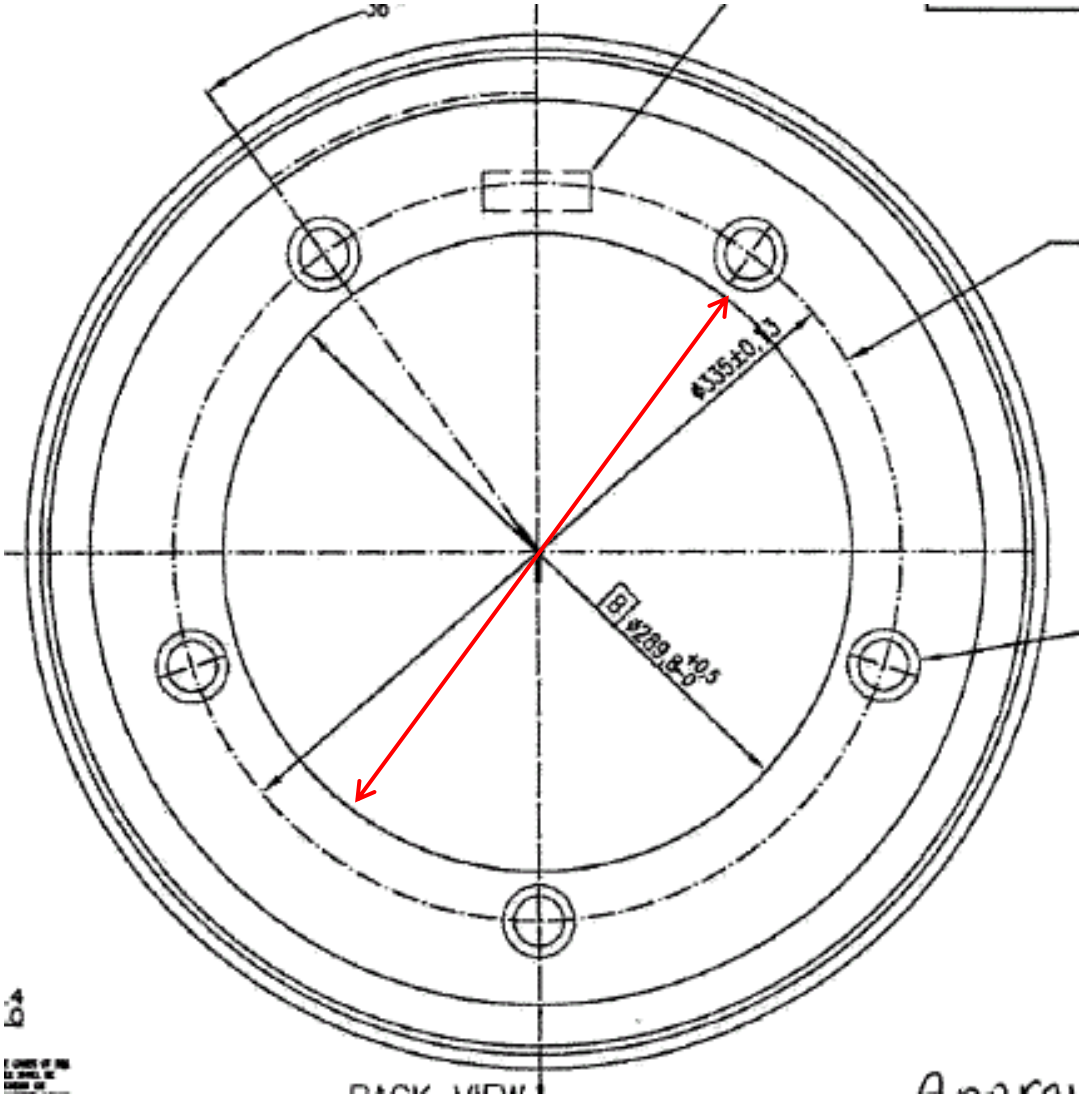
- Incorrect diameter machined on pilot hole, human error or miscommunication

Actions

- None

Warranty

Yes



I05: NAVE THICKNESS

Appearance

Incorrect nave plate thickness used against drawing

Possible cause

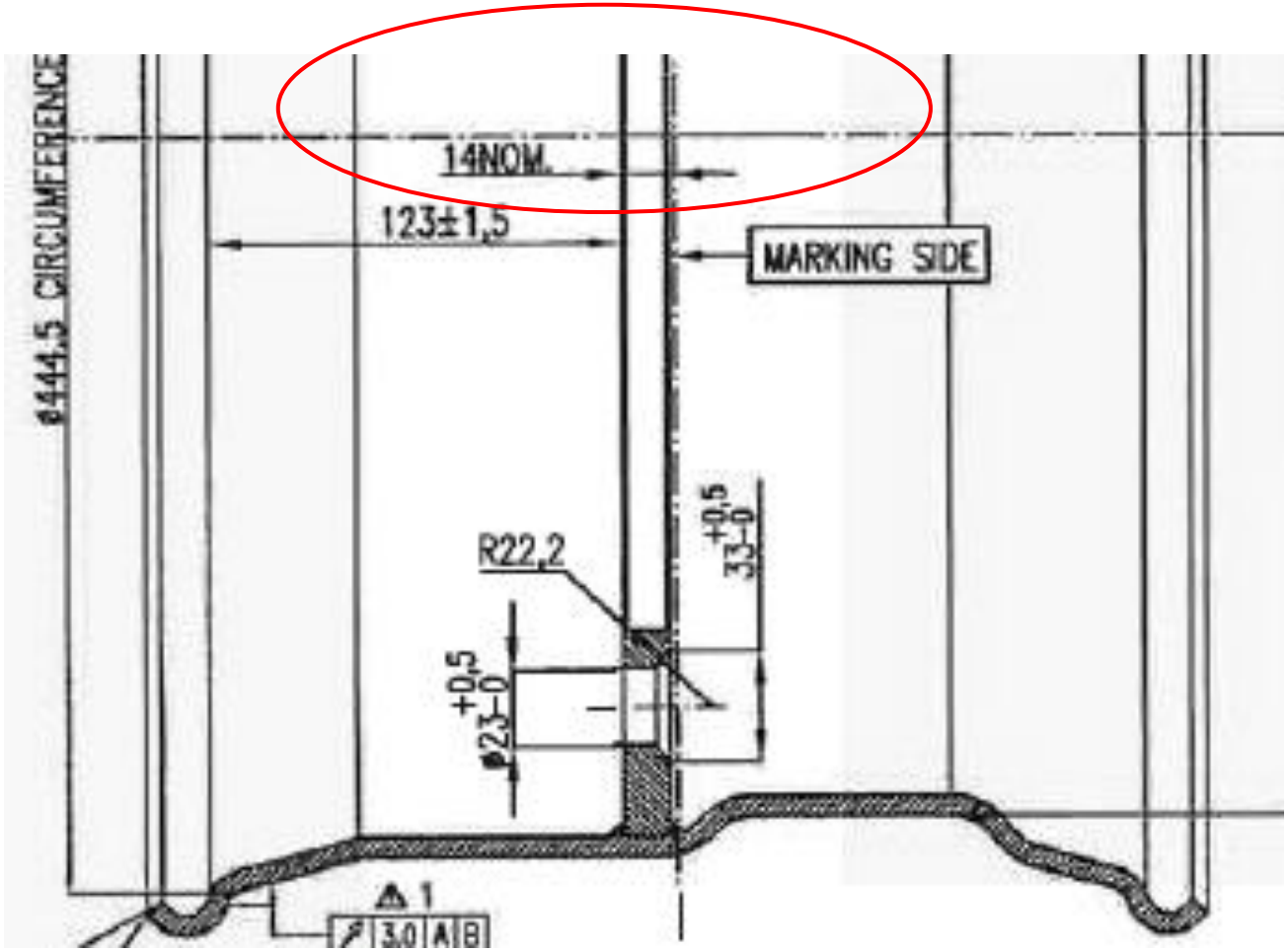
- Incorrect nave thickness due to human error or miscommunication

Actions

- None

Warranty

Yes



I06: HOLE PCD

Appearance

Bolt circle dimension is out of specification.

Possible cause

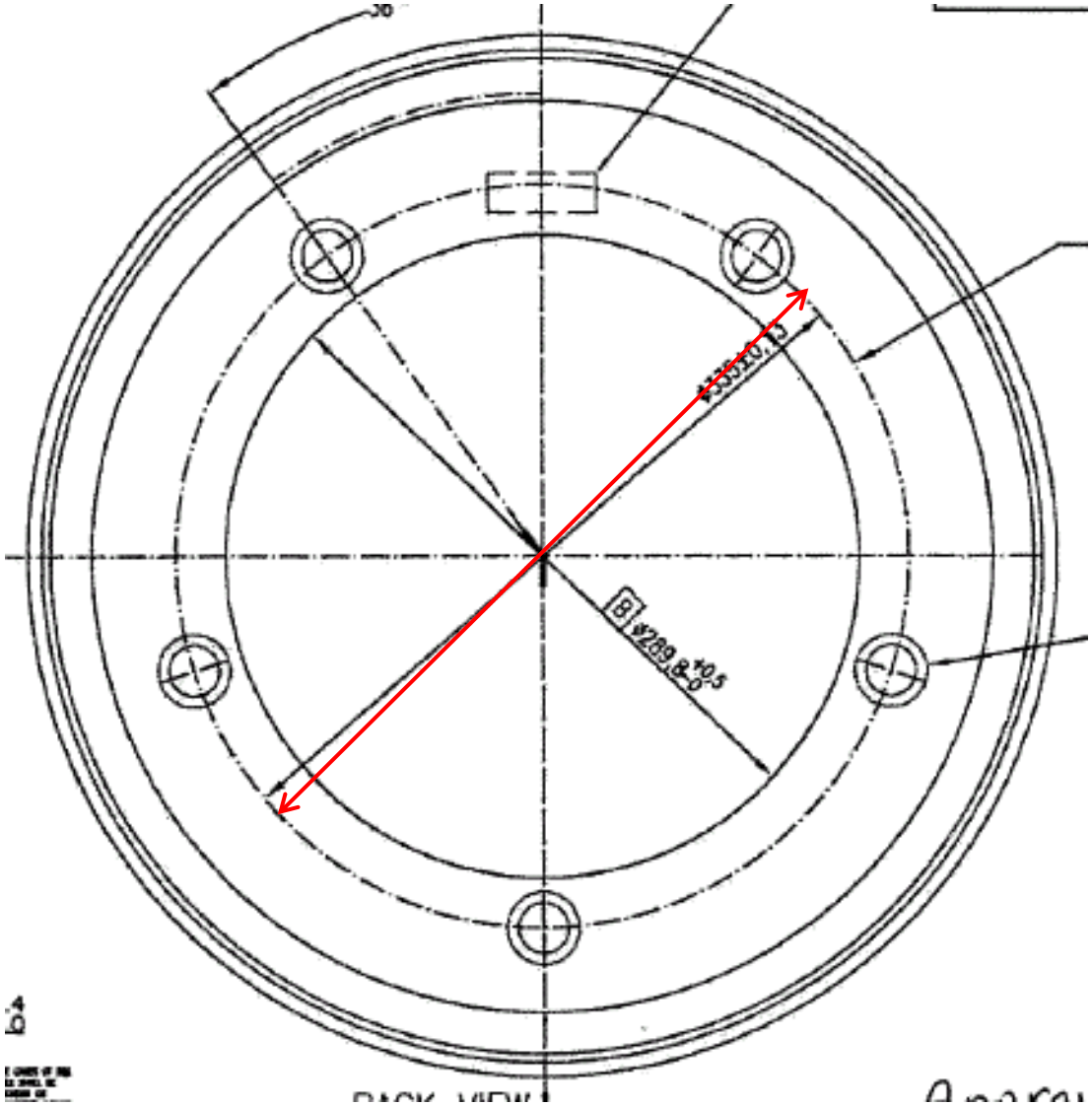
- Error in machining process

Action

- None

Warranty

Yes



I07: HOLE DIAMETER

Appearance

Incorrect mounting hole diameter

Possible cause

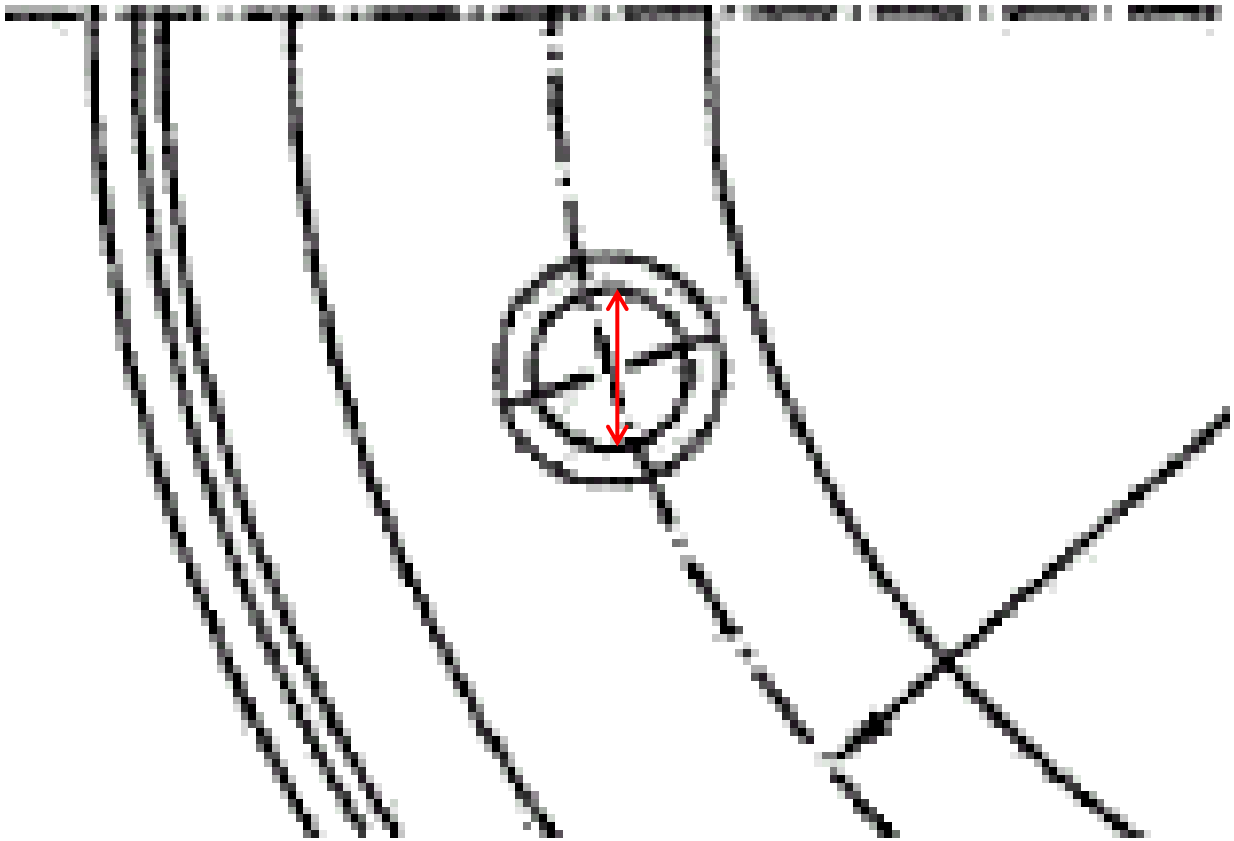
- Human error, wrong boring bit used

Actions

- None

Warranty

Yes, possible rework if originally made too small



I08: COUNTERSINK DIAMETER

Appearance

Countersink too deep
or too shallow affects o.d.

Possible cause

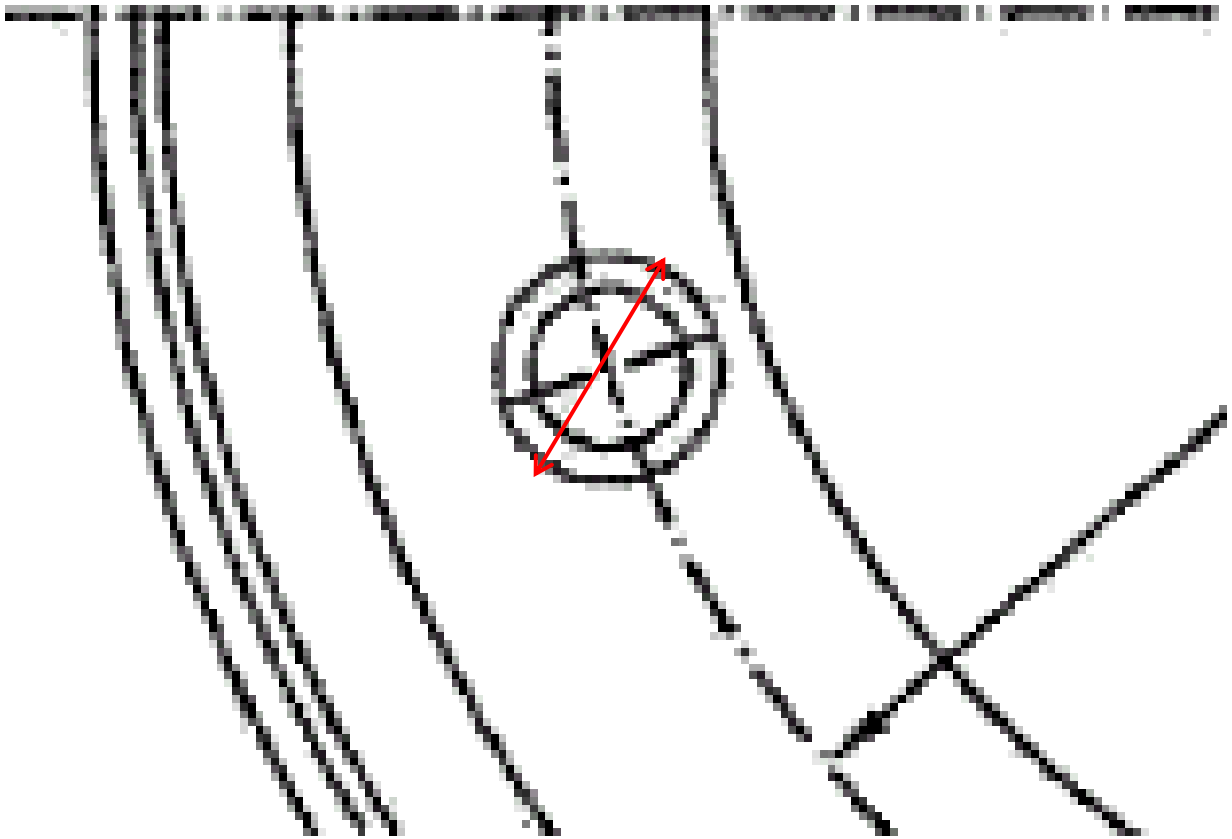
- Human error

Actions

- None

Warranty

Yes, possible rework if originally made too shallow



I09: SKIMMING DIAMETER

Appearance

Skimming diameter wrong o.d. or depth

Possible cause

- Human error, or miscommunication with OE

Actions

- None

Warranty

Yes, possible rework in some cases

I10: TYPE OF CHAMFER

Appearance

Wrong chamfer, or no chamfer used

Possible cause

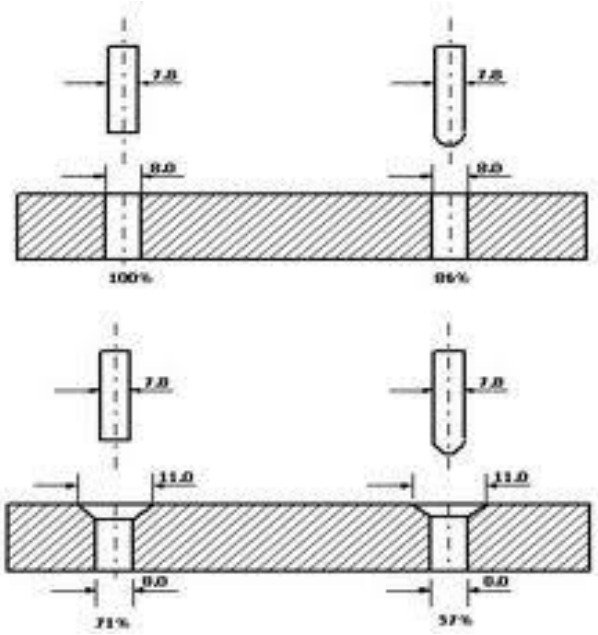
- Human error, or miscommunication with OE

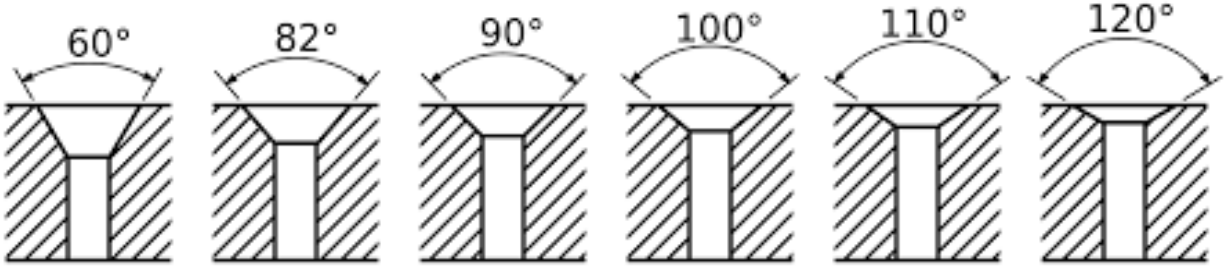
Actions

- None

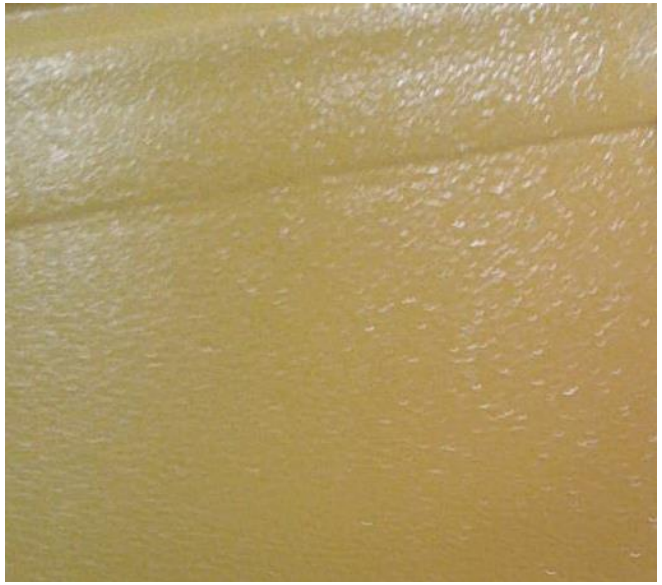
Warranty

Yes, situation related, possible to rework in some cases





I11: PAINT THICKNESS



Appearance

Paint appears too thick or too thin in coverage

Possible cause

- Spray gun malfunction or operator error/training

Actions

- None

Warranty

Situation related

I12: OVALITY

Appearance

Rim is not round, but shaped like an egg

Possible cause

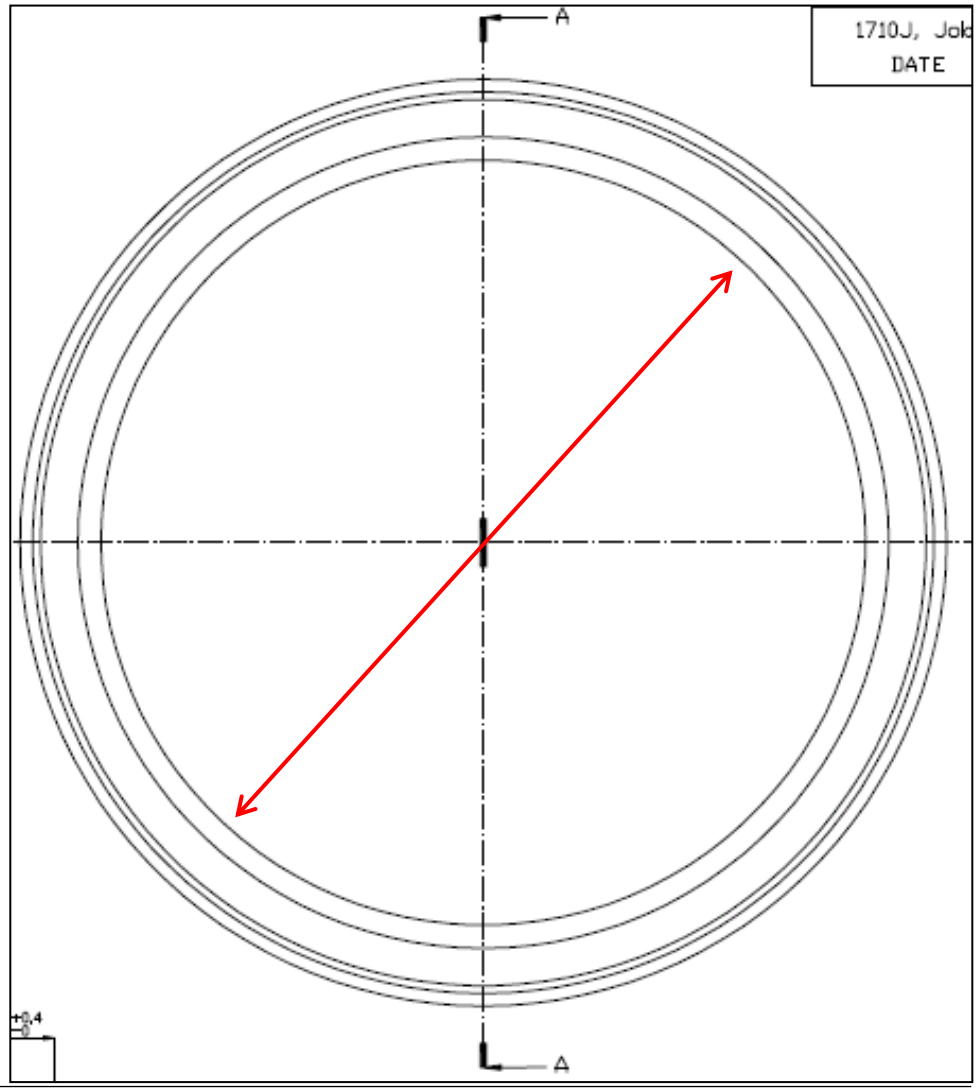
- Rim not sized properly

Actions

- None

Warranty

Yes



I14: ECCENTRICITY OF HOLE TO PILOT

Appearance

Bolt circle or hole not concentric to pilot hole

Possible cause

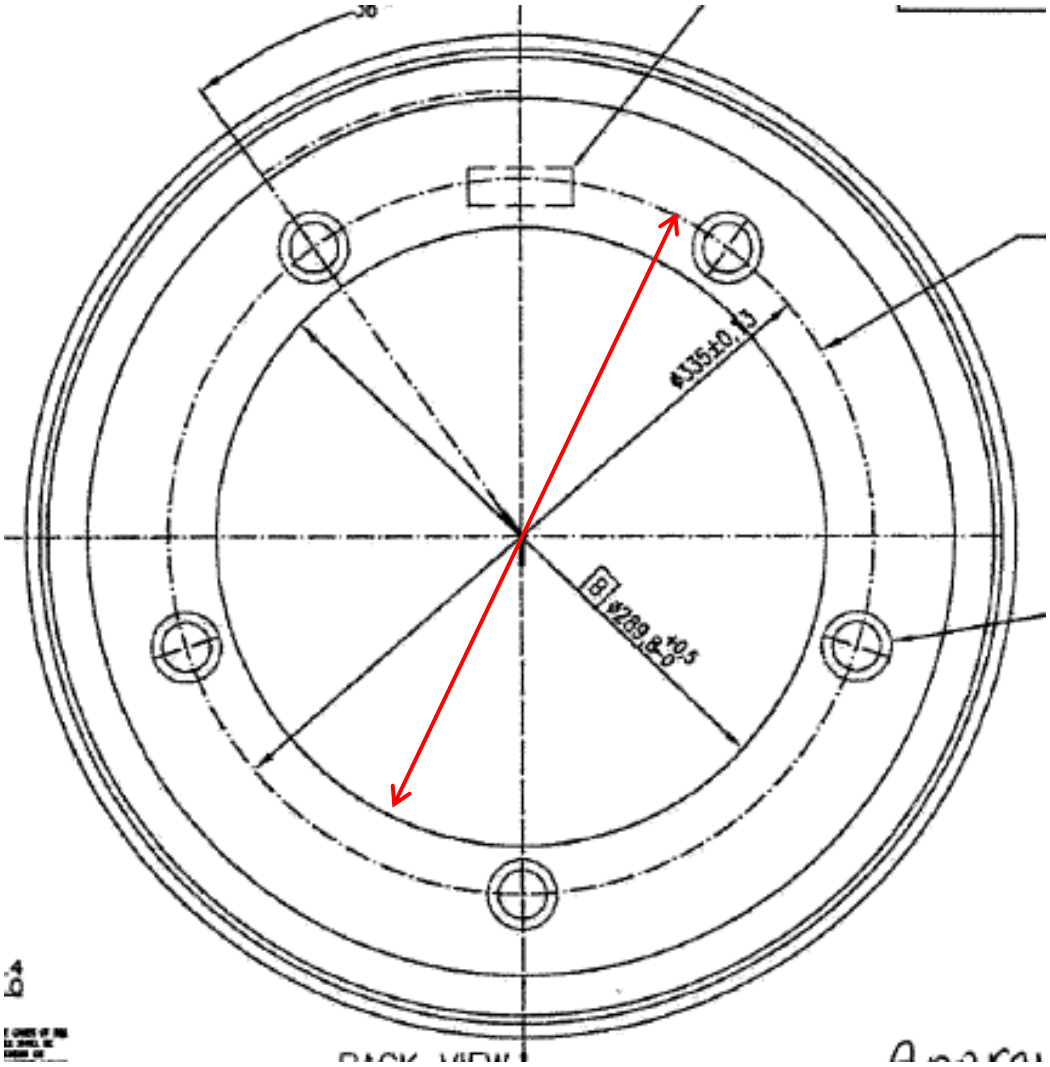
- Human error

Actions

- None

Warranty

Yes



I15: ECCENTRICITY PILOT PCD TO RIM

Appearance

Pilot hole is not centered within the rim

Possible cause

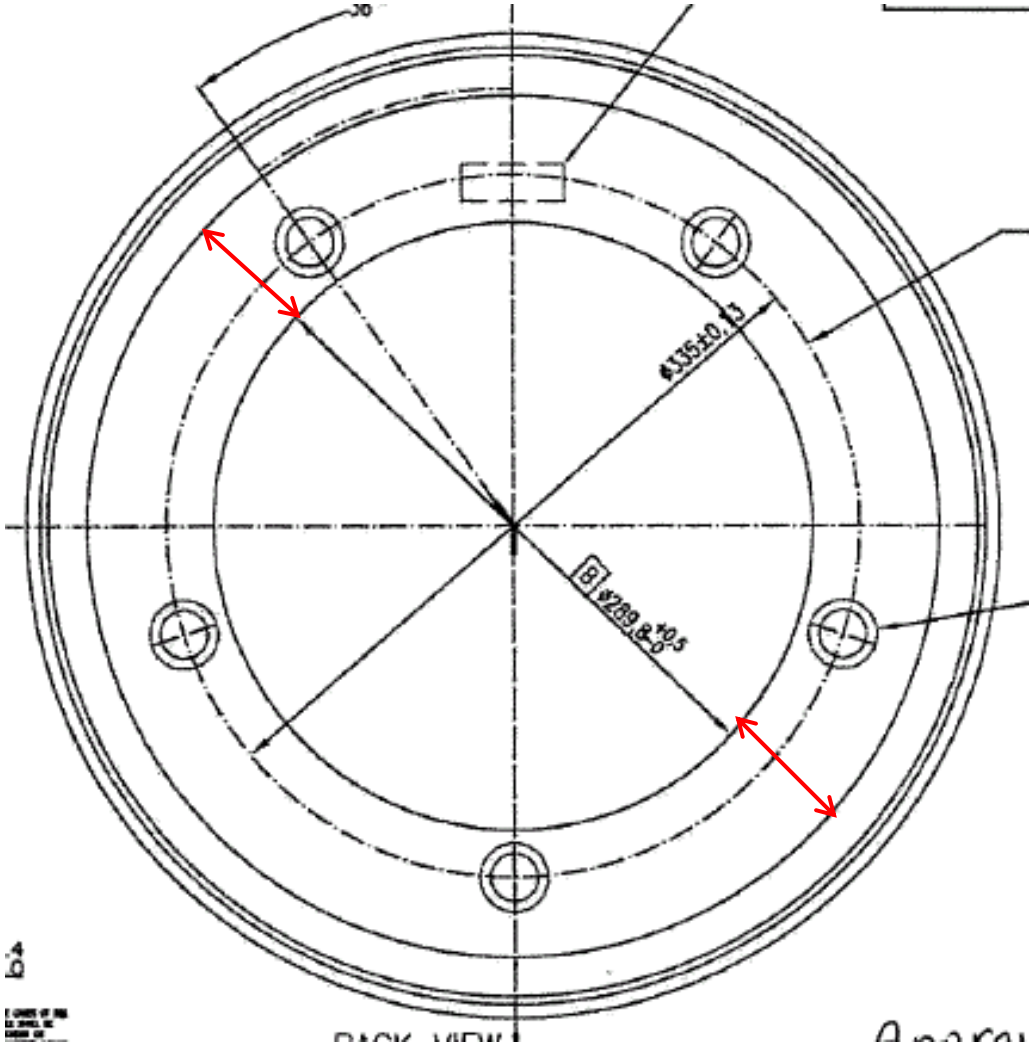
- Pilot not drilled in center of nave, or nave not welded concentric to rim

Actions

- None

Warranty

Yes



Z: OTHER CHARGES

ACTIONS: COMPENSATION IS SITUATION RELATED

NOT CLAIMABLE

ENVIRONMENTAL CONDITIONS

Chemical Exposure

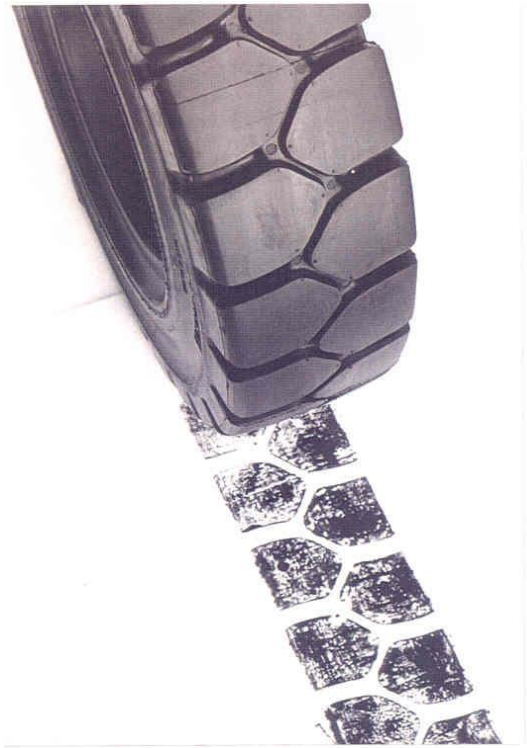
- Solvents, Oils
- Cleaning Chemicals
- Steam
- Animal Fats
- Salt

Good housekeeping and floor maintenance programs are a must!

NOT CLAIMABLE

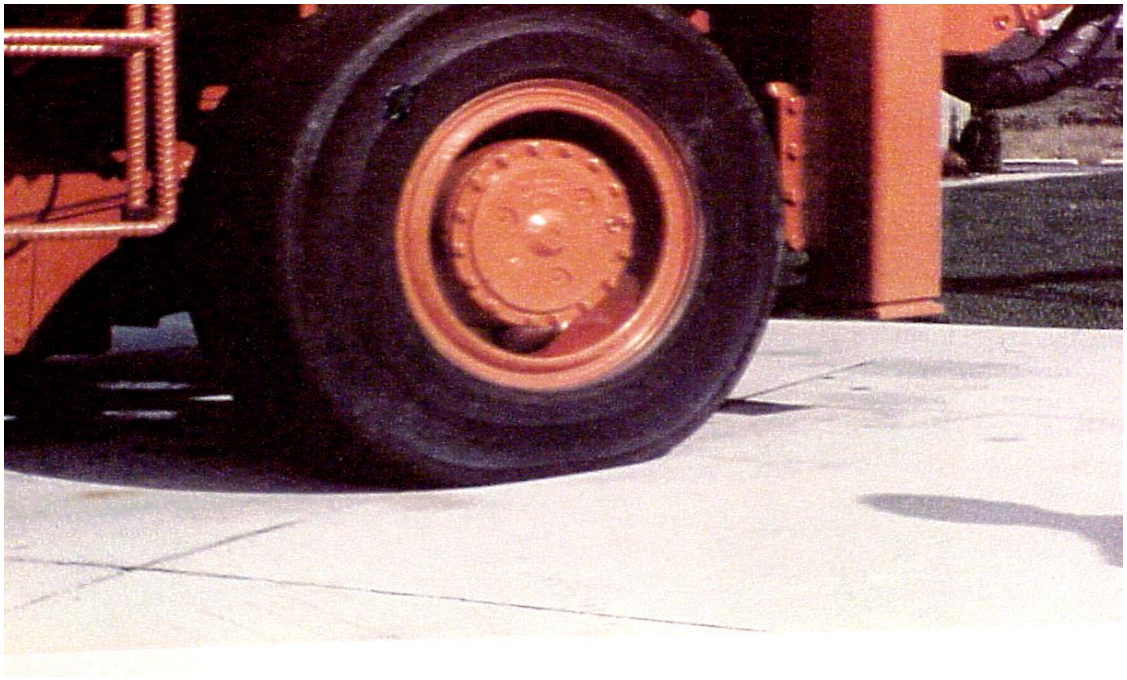
MARKING THE FLOOR

- Tires that contain carbon black can mark floors.
- Recommend non-marking tires and a static strap (or other method of discharging static electricity)
- Non-Marking tires will not mark the floor, but dirt that collects on them will
- Good housekeeping and floor maintenance programs are a MUST!



NOT CLAIMABLE

FLAT SPOTTING



- Occurs when a truck has been kept idle for a while
- The tire shows a flat spot, causing a vibration when starting to roll again
- Disappears when the tire has reached its normal running temperature
- Avoid/minimize stand still of trucks under load
- If there is repetitive bouncing on one tire only, it may be due to a manufacturing defect (porosity, bad distribution of rubber layers, etc.) or an “out of round” condition as a result of spinning the tires
- Flat spots may also be the result of skid-braking, hot shifting, and towing or dragging the machine