TIRE & WHEEL SAFETY AWARENESS
OBJECTIVES

Increase YOUR Awareness On:

- Industry Injuries & fatalities.
- Pyrolysis
- Damaged & Abused Tires
- Wheel Information & Tracking
- Damaged Wheels.
- Tire Smart Practices Video
- Safety Instructions - Working with tires & Wheels
- Tire Maintenance For Your Own Car or Light Truck.
A 3200lbs car traveling at 90 KPH and hits a brick wall, it would produce over 300,000 lbs of force.

It only takes 9lbs of force to fracture a human bone.

It only takes 300lbs of force to fracture a human skull.

26.5 x 25 tire at 90 psi has 373,650 ft/lbs of stored energy.
Investigation into the main cause of a fatal tire explosion during oxy-acetylene cutting of wheel studs on 21 April 2004 in a workshop at Malta No. 3 Mine in Mpumalanga

16 July 2004

Rev: 00

Christo Grobler Consulting Engineer cc
PYROLYSIS
Pyrolysis

- Another less frequent, but potentially catastrophic tire and rim failure mode is gaseous explosion. Tires can explode from ignition of gaseous vapors resulting from chemical reactions within the tire.

- The rubber liner of some tires will begin to Pyrolysis (decompose) at about 250°C. One product of rubber Pyrolysis is an explosive vapor. The auto-ignition temperature of this vapor in one case was 428°C. It only takes a small amount of rubber liner to Pyrolysis to create enough explosive vapor that when ignited creates an explosive pressure that will rupture the tire.

- Definitions – Pyrolysis: The decomposition of a substance by heat.
  - Auto-Ignition: The self-ignition or spontaneous combustion temperature of a substance (usually fuel) without the help of a spark or flame.
Case Study 1

- An accident that occurred at an Ontario natural resources firm would appear to have been caused by Pyrolysis and ignition by localized heating of the rim. A welder had partially deflated a tire to about 30 psi, and began to weld a steel rim to seal a leak. A six inch weld on the rim was made. This area was quenched with water and inspected and found to still leak. A second weld of about six inches was made, and as the welder began the third pass, the tire exploded. The explosion resulted in the welder fatality.
Case Study 2

- Another heat source that can initiate rubber liner Pyrolysis is wheel fires. In this case, the rear wheels caught fire due to overheated brakes (emergency brake remaining engaged). When one tire exploded, eyewitnesses reported a large fireball that erupted skywards. The force of the explosion blew the demountable flange off the rim, and fragments of rubber were hurled up to 100m.

The other tire which caught fire did not explode was found, upon examination, to have a partly Pyrolysis inner liner. This tire was probably close to exploding.
Pyrolysis

STUDY CONDUCTED BY: STANDARDS TESTING LABS. INC @S.T.L. INC.
Tire Over-Heating Information

If a tire is suspected of being over-heated (Smell burning rubber) the scoop or truck should be parked immediately, roped off and let sit for “several hours” and do not approach the tire and wheel until the tire and wheel assembly cools down. The risk of explosion is greatest soon after the vehicle is stopped. When the machine is stopped cooling air does not circulate. Once the tire has cooled down it should be deflated and removed and sent for a proper inspection.

Besides tires that are under-inflated and or over-loaded, another cause of heat buildup in the tire could be caused by overheating or seized brakes. External heat transferred from the hub to the wheel and tire.

Another damage that can cause tire separation is an impact break to the tire. This happens when the tire runs over debris such as large chunks of muck while loaded and causes the tire to over-deflect causing the casing to break. The tire doesn’t always fail immediately; it could fail sometimes on the next shift depending on the severity of the impact damage.
BASIC TIRE INFORMATION & REMOVAL REASONS
High Tensile Strength Steel Bead Core

- Rugged foundation for the tire
- Anchors tire firmly and airtight to rim and provides desired stiffness just above bead area
- Withstands radial forces resulting from inflation pressure
- Cushions and protects tough bead wires during manufacturing and after mounting on rim
Steel Cord Radial Body and Sidewall Reinforcements

- Immensely strong wire cords run bead to bead, containing air pressure and forming main body of the tire
- Deep steel body ply turnup on outside helps resist separation and penetration
- Endures repeated flexing for better ride
- Continuously transmits powerful torque forces from bead to tread
- Reduces internal stresses during operation for extended tire life
• Unique curved lug and groove design for maximum traction

• Radial design lower rolling resistance gives improved fuel mileage

• Steel belts increase tread stiffness for long running life

• Added rubber in shoulder area for increased cut protection

• Specially formulated sidewall compounds resist weathering, cracking, gouging

• Improved flotation from radial type construction, together with smoother ride for less equipment damage, reduced operator fatigue
Bias ply off-road tires have extremely strong steel wire beads -- up to four beads, depending on tire size.

Bead core components maintain proper tire to rim fitment.
Nylon Cord Body

• Multiple plies of tough nylon cord make up tire carcass
• Transmits bending forces and forms basic container for inflation pressure
• No steel sidewall area protection as in radial tires

BIAS PLY
Hard Rock Lug XT-8 Bias Type Tread and Sidewall

• Provides good traction and long wear for bias type tire
• Thick sidewall and shoulder areas contribute to hotter running, lower TMPH than radials
• No working steel belts
• Flotation not as good as radial
• Less fuel mileage than radial
### BASIC OFF ROAD TIRE PROBLEM

<table>
<thead>
<tr>
<th>Tires Type</th>
<th>Normal Running Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Tires</td>
<td>65-68% of their rated load</td>
</tr>
<tr>
<td>Over the Road Truck Tires</td>
<td>92-98% of their rated load</td>
</tr>
<tr>
<td>Off Road Tires</td>
<td>100% +++ of their rated load</td>
</tr>
</tbody>
</table>

*Trust. Fountain Tire*
# COMMON TIRE REMOVAL CAUSES

<table>
<thead>
<tr>
<th>REMOVAL CAUSE</th>
<th>OPERATING FACTORS</th>
<th>TIRE FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREAD CUTS</td>
<td>* UNDERFOOT CONDITIONS</td>
<td>* TREAD PATTERN</td>
</tr>
<tr>
<td></td>
<td>* PROPER INFLATION</td>
<td>* CUSTOMIZED CODE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* CONSTRUCTION</td>
</tr>
<tr>
<td>SIDEWALL CUTS</td>
<td>* UNDERFOOT CONDITIONS</td>
<td>* SIDEWALL COMPOUND</td>
</tr>
<tr>
<td></td>
<td>* HAUL WIDTH</td>
<td>* CONSTRUCTION</td>
</tr>
<tr>
<td>IMPACT BREAKS</td>
<td>* UNDERFOOT CONDITIONS</td>
<td>* INFLATION PRESSURE</td>
</tr>
<tr>
<td></td>
<td>* PROPER INFLATION</td>
<td>* TIRE LOAD</td>
</tr>
<tr>
<td></td>
<td>* TIRE LOADING</td>
<td></td>
</tr>
<tr>
<td>WEAR OUT</td>
<td>* UNDERFOOT CONDITIONS</td>
<td>* TREAD COMPOUND</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* CONSTRUCTION</td>
</tr>
</tbody>
</table>

[Trust. Fountain Tire]
OPERATING CONDITIONS
EXCESSIVE WATER

- Water Acts as a Lubricant for Rubber.
- Over Watering Leads to Cuts in Tires.
- Limit Watering to Control Dust.
- Wet Tires Cut more Easily than Dry Tires.
Debris May Not All Be Visible
POOR OPERATING CONDITIONS
SIDEWALL DAMAGE

Parking Truck To Close to Cement Wall.

Must Try & Avoid Heavy Pressure Against Sidewall.
Toro 40D
Heavy build up of ore.
Must be cleaned to avoid tire damage.
OPERATING CONDITIONS

DEBRIS

November 2010
OPERATING CONDITIONS
TIRE REMOVAL REASON
Impact Breaks
TIRE REMOVAL REASON
Over deflection Run Flat / Overload
Effect of Tire Overload / Underinflation

TIRE LIFE vs TIRE OVERLOAD

% LOAD

% TIRE LIFE

80 100 120 140 160

Trust. Fountain Tire
Correct Tire Inflation

Note: A Tire is determined to run flat when operated below 80% of the recommended cold inflation pressure and should be removed from service.

<table>
<thead>
<tr>
<th>Tire Size</th>
<th>Equipment Type</th>
<th>Cold Inflation Pressure</th>
<th>Tire Capacity Kilos</th>
<th>80 % Removal Factor PSI</th>
<th>80 % Removal Factor Tire Capacity Kilos</th>
<th>Operating Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.5-25</td>
<td>R1700G</td>
<td>100</td>
<td>19.125</td>
<td>80</td>
<td>17,000</td>
<td>10 KPH</td>
</tr>
<tr>
<td>26.5-25</td>
<td>R1700G</td>
<td>100</td>
<td>17.786</td>
<td>80</td>
<td>15,810</td>
<td>15 KPH</td>
</tr>
</tbody>
</table>
Correct Tire Inflation

- Assures load carrying ability
- Reduces incidence of run low or run flat
- Reduces incident separation failures due to over deflection
- Reduces impacts and tread cutting due to over inflation
- Saves money
Wheel Information & Tracking
Wheel Assemblies

One Piece Wheel
Wheel Assemblies

FS/EM-EV-MEV 3 PIECE - Loader, articulated dump truck, crane and underground earthmover or mining applications.

FEATURES

1. FULLY MACHINED GUTTER SECTION
2. THICKER, HOT FORMED BACKSECTION AND FLANGE

BENEFITS

1. UNIFORM LOCK RING AND O-RING FIT AND SEAL ELIMINATING LOCK RING & O-RING EJECTIONS.
2. LONG SERVICE LIFE, IMPROVED TIRE BEAD STABILITY AND LESS MOVING PARTS THAN STANDARD.

5 PIECE EM RIMS AVAILABLE IN 25", 29" AND 49" RIM DIAMETERS. MORE SIZES UNDER DEVELOPMENT
Wheel Assemblies
5 Piece Wheel

MOUNTING MAINTENANCE

CLEAN* (INSPECT)

LUBRICATE** (INSPECT)

CLEAN* AND LUBRICATE** TIRE SEAT (INSPECT)

CLEAN* (INSPECT)

GIVE SPECIAL ATTENTION TO LOCK RING GROOVE
CLEAN INSPECT FOR FRACTURES AND REPAINT
LUBRICATE TIRE SEAT AND O-RING GROOVE**

NOMENCLATURE

LOCK RING RING GROOVE
O-RING GROOVE
VALVE HOLE
BACK FLANGE RETAINER

GUTTER SECTION
CENTER SECTION
RIM BASE
BACK SECTION
Why track and maintain rims?

- 26.5-25 (ST-8B) tire at 90 psi has 373,650 ft/lbs of stored energy.
Visual Rim Inspection

- Gutter section
- Back section
- Puller nuts
- Stud holes
- Bolting plate weld
- Rim base welds
- General condition
- Run flat
- Check last NDE
Magnetic Particle Inspection

- Bolting plate welds
- Gutter section
- Rim base welds
- Rim base adjacent to bolting plate
- Back section
Rim Tracking

INCO LHD and HAULAGE TRUCK RIM REPORTING SYSTEM

OPERATIONS
- Rim and Repair Data
- Add a New Rim
- Scrap a Rim
- Historical Information
- View Last Rim Numbers

REPORTING
- View / Print Rim Details
- Print Rim Repair Reports
- Scraped Rim Reports

DATABASE MAINTENANCE
- Modify Main Selections
### Rim Repair Information

<table>
<thead>
<tr>
<th>Date (DD/MM/YY)</th>
<th>Code</th>
<th>Description</th>
<th>Supplier</th>
<th>Pk Slip ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 26, 1997</td>
<td>20</td>
<td>INCO - MPI</td>
<td>INCO</td>
<td></td>
</tr>
<tr>
<td>October 29, 1997</td>
<td>40</td>
<td>Sandblast, Inspect, Paint</td>
<td>NORTH SHORE</td>
<td></td>
</tr>
<tr>
<td>October 29, 1997</td>
<td>110</td>
<td>Install Support Band</td>
<td>NORTH SHORE</td>
<td></td>
</tr>
<tr>
<td>October 29, 1997</td>
<td>240</td>
<td>Fillet Weld</td>
<td>NORTH SHORE</td>
<td></td>
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<tr>
<td>February 25, 1998</td>
<td>10</td>
<td>Visual Inspection</td>
<td>NORTH SHORE</td>
<td></td>
</tr>
<tr>
<td>April 30, 1998</td>
<td>10</td>
<td>Visual Inspection</td>
<td>NORTH SHORE</td>
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</tr>
<tr>
<td>September 18, 1998</td>
<td>10</td>
<td>Visual Inspection</td>
<td>NORTH SHORE</td>
<td></td>
</tr>
<tr>
<td>March 30, 1999</td>
<td>12</td>
<td>Remove For Repair</td>
<td>NORTH SHORE</td>
<td></td>
</tr>
<tr>
<td>April 15, 1999</td>
<td>20</td>
<td>INCO - MPI</td>
<td>INCO</td>
<td></td>
</tr>
<tr>
<td>May 7, 1999</td>
<td>40</td>
<td>Sandblast, Inspect, Paint</td>
<td>NORTH SHORE</td>
<td></td>
</tr>
<tr>
<td>May 7, 1999</td>
<td>60</td>
<td>Install New Centre</td>
<td>NORTH SHORE</td>
<td></td>
</tr>
<tr>
<td>May 7, 1999</td>
<td>110</td>
<td>Install Support Band</td>
<td>NORTH SHORE</td>
<td></td>
</tr>
<tr>
<td>May 7, 1999</td>
<td>145</td>
<td>Plug Weld T/L Valve Hole</td>
<td>NORTH SHORE</td>
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<tr>
<td>May 20, 1999</td>
<td>280</td>
<td>Delivered to Tire Supplier</td>
<td>NORTH SHORE</td>
<td>2000</td>
</tr>
<tr>
<td>February 15, 2000</td>
<td>10</td>
<td>Visual Inspection</td>
<td>NORTH SHORE</td>
<td></td>
</tr>
</tbody>
</table>
ST8B WHEEL

• Portion of rim cut with torches to be able to get at the nuts with a socket.

• The tire was not deflated !!!!
50 TON TRUCK (BENT FLANGE)

- Tire was removed from truck with severely bent flange.
- The tire was not deflated !!!!!
SAFETY INSTRUCTIONS

WORKING WITH TIRES AND WHEELS
DEMOUNTING

• PRECAUTION
  - Always exhaust all air
  - from a single tire and from both tires of a dual assembly prior to removing any rim components or wheel components such as nuts and rim clamps.

• REASON FOR PRECAUTION
  - A broken rim and or component under pressure can blow apart and cause serious injury or death.
  - When you remove the lugs, if the tire is under pressure, the assembly may fly apart with explosive force.
DEMOUNTING

• **PRECAUTION**
  - Remove valve core completely, this will assure all air is exhausted the tire.
  - Remove both cores from a dual assembly.
  - Run a piece of wire through stem to be sure it’s not plugged.

• **REASON FOR PRECAUTION**
  - Foreign material may clog valve stem during deflation.
  - Ice may form as the air leaves the tire, this may clog the valve stem.
DEMOUNTING

• **PRECAUTION**
  - Always stand clear during deflation.

• **REASON FOR PRECAUTION**
  - *If the assembly bursts, the operators should be far from the explosive force.*
DEMOUNTING

- **PRECAUTION**
  - Use approved eye protection.

- **REASON FOR PRECAUTION**
  - To protect eyes from dust and dirt when exhausting air from the tire.
INSPECTION

• PRECAUTION
  - Check rim components for:
    * Cracks
    * Badly worn
    * Damaged / Bent
    * Severely rusted

• REASON FOR PRECAUTION
  - Parts that are cracked, damaged or excessively rusted will be weakened.
  - Bent or repaired parts may not seat properly on rim base.
INSPECTION

• PRECAUTION
  - Never under any circumstances, attempt to rework, weld, heat or braze any rim components that are crack broken or damaged.

• REASON FOR PRECAUTION
  - Heating may weaken a component.
  - It may then be unable to withstand forces of inflation or operation.
INSPECTION

• **PRECAUTION**
  - Do not re-inflate a tire that has been run flat or under inflated until a proper inspection of:
    * tire, tube and flap
    * Rim and wheel assembly
  - If the tire is less than 80% of it’s recommended air pressure, the tire should be recognized as flat or going flat.

• **REASON FOR PRECAUTION**
  - Components can be damaged or dislocated when a tire is run flat or under inflated.
  - The tire may be weakened do to over deflection and extreme heat build up.
## INFLATION

<table>
<thead>
<tr>
<th>TIRE SIZE</th>
<th>EQUIPMENT TYPE</th>
<th>RECOMMENDED OPERATING PRESSURE</th>
<th>80% REMOVAL FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.5R25** L-5 SMOOTH</td>
<td>ST8B WAGNER SCOOP</td>
<td>100 PSI</td>
<td>80 PSI</td>
</tr>
<tr>
<td>17.5R25** L-5 SMOOTH</td>
<td>3.5 YARD SCOOP</td>
<td>94 PSI</td>
<td>75 PSI</td>
</tr>
<tr>
<td>15.5R25* L-2 LUG</td>
<td>REAR MINECAT</td>
<td>35 PSI</td>
<td>28 PSI</td>
</tr>
<tr>
<td>12x16.5 LUG 10 PLY</td>
<td>FRONT MINECAT</td>
<td>35 PSI</td>
<td>28 PSI</td>
</tr>
<tr>
<td>16.9x24 G-2 LUG 10 PLY</td>
<td>FRONT MANITOU FORKLIFT</td>
<td>35 PSI</td>
<td>28 PSI</td>
</tr>
<tr>
<td>13/70x18 AIRCRAFT</td>
<td>REAR MANITOU FORKLIFT</td>
<td>55 PSI</td>
<td>44 PSI</td>
</tr>
</tbody>
</table>
MOUNTING AND INFLATING

- **PRECAUTION**
  - Never sit on or stand in front of a tire and rim assembly that is being inflated.
  - Make sure all workers are away from the line of trajectory.

- **REASON FOR PRECAUTION**
  - Components may not be seating properly and can fly apart with explosive force.
MOUNTING AND INFLATING

• PRECAUTION
  - Never attempt to weld on an inflated tire and rim assembly.

• REASON FOR PRECAUTION
  - Heat from welding will cause a drastic rise in pressure, this can result in an explosion with the force of a bomb.
  - Welding will weaken the steel molecules of the rim and its components.
OPERATION

• PRECAUTION
  - Always inspect rims and wheels for damage during circle checks.

• REASON FOR PRECAUTION
  - Early detection of potential rim failures may prevent serious injury.
OPERATION

• PRECAUTION
  - Never modify a rim without prior approval from the manufacturer.
  - Never heat, weld or braze a rim or wheel.

• REASON FOR PRECAUTION
  - Modification or heating can severely weaken the rim.
  - It may not withstand inflation or operation.
SERVICING TIRE AND RIM ON MACHINE

• PRECAUTION
  - Before loosening nuts and or clamps. Always secure a tire and rim assembly with a sling, tire handler or other support equipment.

• REASON FOR PRECAUTION
  - Unsecured assemblies may fall when fasteners are removed.
STORING OF NEW AND USED TIRES

- **PRECAUTION**
  - Tires should be stored by laying down flat, or if left standing must be blocked and safely secured.

- **REASON FOR PRECAUTION**
  - Tires left standing can fall and cause serious injury.
TIRE MAINTENANCE FOR YOUR OWN CAR OR LIGHT TRUCK
Maintaining Proper Inflation

When properly inflated, the air in your tires supports 95 percent of the weight of your vehicle. Maintaining proper air pressure is a crucial step in proper vehicle maintenance. Proper air pressure:

- increases your safety by providing better handling and control
- increases the life of your tires by reducing uneven tire wear
- reduces fuel consumption and exhaust emissions
- reduces your chance of dangerous accidents caused by tire failure

Check your owner's manual for the level recommended for your vehicle and check your tire pressure today.

Things to Remember when Checking Air Pressure

- Tires are permeable and lose air on an on-going basis. This is more pronounced in warm weather when the heat causes the surface material of the tire expand, allowing more air to escape.
- For most accurate results, check your tire pressure when your tires are cold - that is, when your vehicle has been driven less than 2 km or has sat still for approximately three hours.
- Check your owner's manual to find the recommended tire pressure for your vehicle.
- A visual inspection will not show you if your tires are over or under inflated. To avoid unnecessary fuel consumption and tire wear, check them every month with a reliable pressure gauge.
- When checking the air pressure of your tires, remember to check the spare as well.
NEVER TAKE CHANCES!
ASK THE EXPERTS!
QUESTIONS???
Thank You