The Making of the Safest Middle-European Winter Tire
Preview WinterContact TS 860™

Prof. Dr. Burkhard Wies, Head of Tire Line Development WW

www.continental-tires.com
Vision Zero
World Map of Road Traffic Fatalities

- 1973: safety seat belt
- 1978: ABS
- 1982: airbag
- 1985: front passenger airbag
- 1995/96: ESC, EBA, Euro NCAP
- 1998: ACC
- 2001: LDW

Traffic Fatalities [mio.]


actual ww. 2014: 1.2m
Traffic Fatalities in the European Union
Total Numbers

Development over time since 2010

Source: http://ec.europa.eu/roadsafety

Traffic Fatalities

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>31,500</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>30,700</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>28,100</td>
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<tr>
<td>2013</td>
<td>26,000</td>
<td></td>
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<tr>
<td>2014</td>
<td>25,700</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td>15,750</td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
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<tr>
<td>2017</td>
<td></td>
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<tr>
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<td></td>
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<tr>
<td>2019</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: http://ec.europa.eu/roadsafety
## Traffic Fatalities in the European Union

### Fatality Rate per EU-State for 2010 and 2014

Traffic fatality rate per member state (per 1 mio. inhabitants) for 2010 and 2014

<table>
<thead>
<tr>
<th>Country</th>
<th>2010</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU Average</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>MT</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>NL</td>
<td>100</td>
<td>100</td>
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<tr>
<td>UK</td>
<td>80</td>
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<td>60</td>
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<td>GR</td>
<td>20</td>
<td>20</td>
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<td>IE</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>AT</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>SE</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>CY</td>
<td>4</td>
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<td>IT</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>EU</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: [http://ec.europa.eu/roadsafety](http://ec.europa.eu/roadsafety)

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Traffic fatalities in the European Union (per 1 mio. inhabitants)

- **below 40**
- **40 to below 60**
- **60 to below 80**
- **80 to below 100**
- **100 and more**

Source: [http://ec.europa.eu/roadsafety](http://ec.europa.eu/roadsafety)
Global NCAP
“# Stop the Crash”

Targets

› Create awareness of leading crash avoidance technology in emerging markets
› Increase customer demand for vehicles to be equipped with these technologies

Technology

› Tire pressure and tread depth
› ESC, AEB, motorcycle ABS
Global NCAP
“# Stop the Crash”

Streets of safety – vision zero: The long way to zero road deaths

The situation
Highest traffic safety risk:

43%

180

30

50

Less fatal accidents 1980-2010

Germany

Switzerland

Greece

-75%

-70%

-20%

Urban casualties by traffic usage:

Did you know?
The road death rate in Europe almost doubles from summer to winter.

Our vision

Zero fatalities, injuries, accidents

Innovative technologies will make it possible to one day drive a car without any accidents in all vehicle categories and markets of this world.

In some countries, Vision Zero came true already:

But still, only few European countries have zero road fatalities.

Still, Europe leads the ranking with the fewest fatalities.

Our contribution

Tire

Creating the safest and most reliable tires.

Automotive

Intelligent, state-of-the-art systems to brake, steer & control.

Driver

Knowledge, attitude and awareness.

Infrastructure

Improving driving conditions, consulting with community, transport & infrastructure planners.

Did you know?

Every year, 1.24 million road deaths worldwide could be prevented.

Continental

TechnikForum 2015
# Continental’s Contribution for More Safety on Wintry Roads

## Historical and Actual Portfolio of Continental Winter Tires

<table>
<thead>
<tr>
<th>Year</th>
<th>Tires</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>MS 14, TS 729, TS 730, Conti Viking Stop 4000, CWV 1</td>
</tr>
<tr>
<td>1977</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td></td>
</tr>
</tbody>
</table>

- **Continental Middle-European**
- **Continental Nordic**

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**TechnikForum 2015**
Requirements of a Winter Tire
Target Conflicts in the Winter Tire Development

- Wet Grip
- Noise
- Rolling Resistance
- Snow Performance
- Ice Performance
- Handling
### Highest Recommendation in Press Tests
**ContiWinterContact TS 850**

#### Test Wins in 2015

<table>
<thead>
<tr>
<th>Test Magazine</th>
<th>Test Winner</th>
<th>Test Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Bild</td>
<td>2015 Test Sieger</td>
<td>ContiWinterContact™ TS 850 185/60 R 15 T</td>
</tr>
<tr>
<td>ADAC</td>
<td>Test</td>
<td>CONTINENTAL ContiWinterContact TS 850 Dimension: 205/55 R 16 91 H Rollen-Label C/C/72</td>
</tr>
<tr>
<td>motor</td>
<td>Gut (2.0)</td>
<td>TestWinner</td>
</tr>
<tr>
<td>ACE Test</td>
<td>Test Sieger</td>
<td>Test Details</td>
</tr>
<tr>
<td>Teknikens Värld</td>
<td>Test Sieger</td>
<td>Test Details</td>
</tr>
<tr>
<td>Auto</td>
<td>21/2015</td>
<td>Test Details</td>
</tr>
</tbody>
</table>

#### Statistics

Excellent product platform:

- **48 test wins** in the last 4 years
- **61 out of 68 tests** with highest recommendation (90%)
WinterContact TS 860
Product Highlights

› Improved wet performance by high filled silica compound
› Improved snow handling due to increased number of blocks with 3D groove structure as additional grip edge
› Improved low µ surface grip by multi channel sipe technology with drainage effect
› EU label (rolling resistance/ wet/ noise) : C/ B/ 2 waves
## Development Focus of WinterContact TS 860

**Safety on all Surfaces**

<table>
<thead>
<tr>
<th>Performance</th>
<th>Safe wet braking</th>
<th>Safe snow handling</th>
<th>Safe on low µ surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Cool Chili™</td>
<td>Snow Curve+</td>
<td>Liquid Layer Drainage™</td>
</tr>
<tr>
<td>Feature</td>
<td>Maximum traction silica compound</td>
<td>Flexible polymer matrix</td>
<td>Winter performance resins</td>
</tr>
</tbody>
</table>
Compounds
The Chili-Family: Specialist for Specific Applications

Micro-flexibility for interlocking with the dry road
Max. force transmission for short braking distances

Maximum grip combined with minimal rolling resistance at high handling level

Maximum wet grip combined with excellent winter performance on snow and ice
Components of Winter Compounds

- Rapeseed oil
- Synthetic rubber
- Natural rubber
- Carbon black
- Butadiene rubber
- Sulfur
- Ozone protecting wax
- Anti-ageing agent
- Zinc oxide
- Resins
- Stearic acid
- Accelerator
- Activator
- Silica
- MES oil
### Mixing Technology of High Filled Compounds

**Cool Chili**

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Types of mixing</th>
</tr>
</thead>
</table>
| Mixing is the distribution and dispersion of at least one component in another component whereas these components are different in chemical structure, aggregates, viscosity and particle size. |› dispersive  
› distributive |
Mixing Technology of High Filled Compounds

Dispersive Mixing

Shape and size of particle are changed by shear forces
Mixing Technology of High Filled Compounds
Distributive Mixing

Shape and size of particle remain unchanged
Mixing Technology of High Filled Compounds
Incorporation by Laminar Mixing

By shear and elongational flow the contact surfaces of the materials increase

Material A  Material B
Mixing Technology of High Filled Compounds
Rotor Shape (Tangential)

rotor tips pass
Mixing Technology of High Filled Compounds
Rotor Shape (Intermeshing)

rotor tips intermesh
Mixing Technology of High Filled Compounds
Comparison of Tangential and Intermeshing Mixers

<table>
<thead>
<tr>
<th>mixer type</th>
<th>tangential</th>
<th>intermeshing</th>
</tr>
</thead>
<tbody>
<tr>
<td>energy input</td>
<td>O</td>
<td>++</td>
</tr>
<tr>
<td>cooling efficiency</td>
<td>O</td>
<td>++</td>
</tr>
<tr>
<td>dispersion efficiency</td>
<td>O</td>
<td>++</td>
</tr>
<tr>
<td>loading efficiency</td>
<td>++</td>
<td>O</td>
</tr>
</tbody>
</table>

Intermeshing mixer is more effective but less efficient
Mixing Technology of High Filled Compounds

Compound trends for mixing

› Dispersion level for high filled compounds
› Fine tuning of chemical reactions
› Efficient energy input

Cool Chili™

- maximum traction silica compound
- flexible polymer matrix
- winter performance resins

› Realized by applying a customized tandem mixing process
Mixing Technology of High Filled Compounds

Tandem Mixing

Technology Driver
› Continental is the leading tire manufacturer in tandem mixing

Reliable
› 10 years of experience in tandem mixing technology
› Increasing number of competitors follow Continental’s mixing approach
› Customized tandem process for latest material concepts

Tandem Mixer

1. ram
2. chimney
3. mixer chute to add raw material
4. mixing chamber/ two rotors
5. discharger
6. second mixing chamber with two rotors
Mixing Technology of High Filled Compounds

Tandem Mixer Technology

Customized processing

› Optimized tandem process enhances the material related borderlines for fillers

› Compounds are tweaked to ensure optimized and stable processing behaviour throughout further processing
Mixing Technology of High Filled Compounds

Tandem Mixer Technology

Exceeding material related borderlines in mixing
  › Dispersion of a high filled compound

Dispersion level with **conventional mixing** technology

Dispersion level with a **tandem mixing** process
Performance of WinterContact TS 860
The European Tire Label

- Wet braking [WGI]
- Rolling resistance (cr)

TS 860 vs TS 850

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Development Focus of WinterContact TS 860
Safety on all Surfaces

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<td></td>
<td>multi channel sipe design</td>
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safe on low μ surfaces
Pattern of WinterContact TS 860
Safety on Snow Surfaces

Directional pattern concept

› No circumferential grooves
› Increased numbers of block edges
Pattern of WinterContact TS 860
Safety on Snow Surfaces

Directional pattern concept

› No circumferential grooves
› Increased numbers of block edges
› High numbers of sipes which have a total length of 2.5 m in the footprint
Pattern of WinterContact TS 860
Changes in Structure Factor

block edges

sipe edges

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Pattern of WinterContact TS 860
The 3D Groove Structure

Technology
› Increased number of grip edges
› More grip
› Higher transmission forces on snowy surfaces
## Development Focus of WinterContact TS 860

**Safety on all Surfaces**

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- **Safe wet braking**
- **Safe snow handling**
- **Safe on low µ surfaces**

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**Cool Chili™**

- 3D-groove structure
- Flexible polymer matrix
- Winter performance resins

**Snow Curve+**

- 3D-groove structure
- Flexible polymer matrix
- Winter performance resins

**Liquid Layer Drainage™**

- Multi channel sipe design
- Safe on low µ surfaces
Development Focus of WinterContact TS 860
The Multi Channel Sipe

1952
Simple sipe

1975
Caught sipe

1989
Open sipe

1994
Deep sipe

1998
CLS-sipe

1999
Honeycomb sipe

2004
Grip-sipe

2012
Adaptive sinus sipe

2015
Multi channel sipe

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New Sipe Technology of WinterContact TS 860
Safety on Low $\mu$ Surfaces

Directional pattern concept

- No circumferential grooves
- Increased numbers of block edges
- High numbers of sipes which have a total length of 2.5 m in the footprint
- New sipe technology
New Sipe Technology of WinterContact TS 860
Safety on Low µ Surfaces

Measures to decrease liquid layer

› Increase of contact area
› Increased number of block edges
› Reduction of liquid layer due to sipes ("wiping effect")
› Removal of water in sipes due to increased drainage effect by multi channel sipe technology

\[
\mu = \frac{F_R}{F_N} = \eta \frac{v \cdot A}{h} \cdot \frac{1}{F_N}
\]

- \( F_R \): friction force
- \( F_N \): normal force
- \( \eta \): viscosity of water layer
- \( v \): sliding velocity
- \( A \): contact area
- \( h \): height of liquid layer
Development Focus of WinterContact TS 860
Liquid Layer Drainage by Multi Channel Sipes

Technology
› Vertical channels guide the water flow to the horizontal drainage system
› The water is removed from the contact area to the pattern grooves
Development Focus of WinterContact TS 860
Liquid Layer Drainage by Multi Channel Sipes

Continental®

TechnikForum 2015
## Development Focus of WinterContact TS 860

**Safety on all Surfaces**

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</tr>
<tr>
<td></td>
<td></td>
<td>matrix</td>
</tr>
<tr>
<td></td>
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<td>winter performance</td>
</tr>
<tr>
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<td>resins</td>
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<td>3D-groove structure</td>
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<tr>
<td></td>
<td>**Liquid Layer</td>
<td>multi channel</td>
</tr>
<tr>
<td></td>
<td>Drainage™</td>
<td>sipe design</td>
</tr>
</tbody>
</table>

**Cool Chili™** features a 3D-groove structure for improved snow curve and maximum traction.

**Snow Curve+** includes a silica compound and flexible polymer matrix for enhanced winter performance resins.

**Liquid Layer Drainage™** offers a multi channel sipe design for improved drainage and safety on low µ surfaces.
WinterContact TS 860
Tire Size Portfolio for 2016

14"

- 155/65 R 14 75T TL TS 860
- 165/65 R 14 79T TL TS 860
- 165/70 R 14 81T TL TS 860
- 165/70 R 14 85T TL XL TS 860
- 175/65 R 14 82T TL TS 860
- 175/70 R 14 84T TL TS 860
- 185/60 R 14 82T TL TS 860
- 185/65 R 14 86T TL TS 860

15"

- 165/65 R 15 81T TL TS 860
- 175/60 R 15 81T TL TS 860
- 185/55 R 15 86H TL XL TS 860
- 185/60 R 15 84T TL TS 860
- 185/60 R 15 88T TL XL TS 860
- 185/65 R 15 88T TL TS 860
- 185/65 R 15 92T TL XL TS 860
- 195/55 R 15 85H TL TS 860
- 195/60 R 15 88T TL TS 860
- 195/60 R 15 88H TL TS 860
- 195/65 R 15 91T TL TS 860
- 195/65 R 15 91H TL TS 860
- 195/65 R 15 95T TL XL TS 860
- 205/65 R 15 94T TL TS 860
- 205/65 R 15 94H TL TS 860

16"

- 195/55 R 16 87H TL TS 860
- 205/55 R 16 91T TL TS 860
- 205/55 R 16 91H TL TS 860
- 205/55 R 16 91H TL FR TS 860
- 205/55 R 16 94H TL XL TS 860
- 205/55 R 16 94H TL XL FR TS 860
- 205/55 R 16 94V TL XL FR TS 860
- 215/55 R 16 93H TL TS 860
- 215/55 R 16 97H TL XL TS 860

17"

- 225/45 R 17 91H TL FR TS 860
- 225/45 R 17 94H TL XL FR TS 860
- 225/45 R 17 94V TL XL FR TS 860
- 225/50 R 17 98H TL XL FR TS 860
- 225/50 R 17 98V TL XL FR TS 860

36 articles
Thank you for your attention!