



P.O. Box 1749
Halifax, Nova Scotia
B3J 3A5 Canada

Item No. 11.5.1
Halifax Regional Council
July 21, 2015
September 8, 2015

TO: Mayor Savage and Members of Halifax Regional Council

SUBMITTED BY: Original Signed by Director

Eddie Robar, Director – Halifax Transit

DATE: June 16, 2015

SUBJECT: Winter Tires for Halifax Transit Buses

INFORMATION REPORT

ORIGIN

Response to petition submitted to Regional Council on April 14, 2015 – Winter Tires for Halifax Transit Buses.

LEGISLATIVE AUTHORITY

Board Public Passenger Motor Carrier Act Regulations made under subsection 27(1) of the Motor Carrier Act.

BACKGROUND

During the winter of 2014/2015, Halifax experienced extreme weather conditions consisting of heavy snowfall, flash-freezing and ice build-up on roads. As a result of difficult driving conditions experienced by Halifax Transit Operators, the Amalgamated Transit Union Local (ATU) 508, on behalf of employees, placed an ad in the Metro News stating that Halifax Transit is not outfitting buses with winter tires and initiated an online petition for the procurement of winter tires for Halifax Transit Buses. This report, requested by Regional Council is a response to the petition and will provide an overview of the technical specifications, availability and considerations in selecting tires for Transit buses. In addition, the report will address measures currently used to ensure the safety of Halifax Transit Operators and the commuting public.

DISCUSSION

During the summer of 2014, Halifax Transit proactively surveyed a number of Transit properties across Canada that experience winter weather conditions (Appendix C). This survey revealed that the technical specifications written by Halifax Transit for “all-season mud/snow-rated transit-application tires” are the standard used across the Country. Common practices to maximize public and employee safety during winter conditions were also examined. One such practice, as indicated below, is to increase minimum tread depth to improve traction during the winter months. In November 2014, Halifax Transit’s Minimum Tread Depth Policy was amended and tires were removed at 8/32nds of an inch instead of the legislated 4/32nds during the winter months of 2014/2015. The policy was communicated to all operations and maintenance staff during November 2014 and remained in effect from January 2015 to April 2015.

The survey, contained in Appendix C also found that winter tires are not available to the Canadian market for Transit vehicles; further it was determined that:

- No properties use a homologated winter tire therefore no transit tires bare a “three-peak snowflake” on the tire, rather are marked with an “M&S” symbol on the tire meaning they are Mud and Snow tires. Existing winter tires for trucks/buses are not available in the sizes required by Halifax Transit;
- No properties use an “M&S” rated tire on the steer axle (front) due to legislated requirements;
- Only a few of these properties are outfitting their fleets with an aggressive snow directional tread pattern on the rear axles only (Whistler and RTC);
- Other properties are using mud/snow-rated tread designs (non-directional) on rear axles but raising the minimum tread-depth during the winter season; Halifax Transit has adopted this practice;
- Whistler uses a ribbed front tire (not M&S rated) but “regrooves” the tire tread (see Appendix A). Legislation dictates that Halifax Transit may not alter the design of tread patterns;
- Many properties are piloting new tread designs on rear and middle axles (articulated buses) due to dissatisfaction with their current design; Halifax Transit will be piloting directional treads over the course of the Bridgestone contract; and
- Few properties including Longueuil were investigating the availability of winter tires for buses and found reports of winter tires in Scandinavia.

Technical Specifications

Due to legislated requirements, Halifax Transit cannot outfit the front axles of buses with retreaded or recapped tires (Appendix B). Therefore, the written specifications for front tires are different than those for rear tires; this is mainly due to the fact that manufacturers provide a limited selection of first-line mud/snow-rated tires for a transit-application. Transit-application tires are designed typically with sidewall protection and wear indicators which are required to monitor the wear that occurs from the rubbing of tires against curbs. Tires with wear indicators are used where available and/or possible.

Centre and rear axles on buses may be outfitted with retreaded tires; therefore rear/centre tires may be retread with an aggressive design intended for mud/snow/ice conditions. The technical requirements specified in RFT 14-099 – Standing Offer to Supply and Deliver and/or Lease Transit Tires were written to comply with legislated requirements as well as sizing requirements, as per bus manufacturers. The technical specifications are provided below:

Table 1: Halifax Transit Tire Specifications

Bus Type	Size	Position	# of buses	Front Axle (Steer)	Middle/Rear Axle (Drive)
40' buses – Classic (1994 to 1996)	12R22.5 (old style of tires)	Front and Rear Axles	12	Ribbed	Mud/Snow Tread
40' buses – conventional	305/70R22.5	Front and Rear Axles	249	Ribbed	Mud/Snow Tread
60' buses - conventional	305/70R22.5	Front and Rear Axles	47	Ribbed	Mud/Snow Tread
60' buses - conventional	385/55R22.5	Centre Axle		N/A	Mud/Snow Tread
30' buses – Access-A bus	LT225/75R16	Front and Rear Axles	38	Mud/Snow	Mud/Snow Tread
35' buses – Metro-X	245/70R19.5 255/70R22.5	Front and Rear Axles	16	Ribbed	Mud/Snow Tread

As shown in Table 1, Access-A buses have mud/snow tires on all axles due to the availability in both first-line tires and retreaded tires. Therefore, this report will focus on the conventional transit buses which account for 80% of Halifax Transit's fleet which require the sizes 305/70R22.5 (steer and drive) and 385/65R22.5 (centre axle for articulated buses only).

Halifax Transit undertook an industry scan in preparing for RFT 14-099 – Standing Offer to Supply and Deliver and/or Lease Transit Tires, to ensure the technical specification used during winter months are sufficient. Representatives of Goodyear Tire, Bridgestone, Michelin, Nokian Tyres, Coast Tire and GCR Tire were contacted about product availability; the findings are summarized as follows:

- Michelin, Bridgestone and Goodyear all offer ribbed tires for urban-transit applications with sidewall protection and wear indicators. None offer first-line Mud & Snow tires for the size 305/70R22.5;
- Michelin and Bridgestone offer a directional tread; XDS2 and BDR-W that are popular for transit buses and are available in the required width to retread tires in the size 305/70R22.5;
- Other Mud & Snow rated treads are available by all three tire manufacturers mentioned above in the required width by Halifax Transit buses;
- All models mentioned above are within the technical specifications written by Halifax Transit;
- It was determined that Nokian Tyres manufacture first line winter tires in sizes more popular in Europe; 315/70R22.5 but these do not meet the Board Public Passenger Motor Carrier Act Regulations (please see Appendix B);
- To consider the feasibility of outfitting the Halifax Transit fleet with winter tires, both major bus manufacturers (New Flyer and Novabus) were contacted. Both engineering teams declined the use of 315/70R22.5 tires on low-floor buses due to the potential of tires touching vehicle components; this is due to the tire being wider. (Please see Appendix D); and
- A recent press release from Continental indicated that a new winter tire would be available to the Canadian market: HDW2 SCANDANAVIA, however this tire is offered in the size 315/80R22.5, which would also not be approved by bus manufacturers due to the width of the tire (Please see Appendix F);

Conclusions

Halifax Transit Maintenance staff concludes that steer (first-line) tires in the required sizes for Halifax Transit buses in a mud/snow tread are not available and new treads do exist for drive tires that will

enhance the performance of buses in snow/ice conditions. The selection of drive tire treads was carefully undertaken by conducting site visits in order to discuss the different features associated with each tire tread. As a result, Halifax Transit is confident that the recommendation to outfit buses with R192 on front axles and BDR-HG retread tires on rear axles is the best option for Halifax Transit buses to cope with extreme winter conditions. The safety of the public and employees, is Halifax Transit's first priority in the selection of tires.

Action Plan

- Use BDR-HG tread on drive tires, higher or equal ratings than the BDR-W (Whistler drive tire) for snow/ice conditions.(See Appendix E);
- Pilot BDR-W (directional tread design) on 5 (five) to 10 (ten) buses to explore the financial/operational impacts and effectiveness during the winter;
- Provide education to Halifax Transit Bus Operators, conducted by the tire manufacturer ,on tire features to eliminate negative perceptions;
- Ongoing investigation of best practices/tires for winter conditions; and
- Continue piloting aggressive tires for 385/65R22.5 (middle axle, articulated buses) and develop technical specifications for a quotation of mud and snow tires for this purpose.

FINANCIAL IMPLICATIONS

Halifax Transit concludes first-line tires in a mud/snow traction tread are not available for the required size for Halifax Transit buses. The only financial implications are as follows:

- Raising the minimum tread depth is approximately \$35,000 per year;
- Directional tread designs may render higher maintenance costs due to the limited ability to rotate the tires and reaching lower mileages. These costs must be investigated and will be the outcome of a pilot to be conducted over the course of a three year period with Bridgestone; and
- All costs relating to these initiatives have been absorbed in operational budgets.

COMMUNITY ENGAGEMENT

N/A

ATTACHMENTS

Appendix A: Definitions
Appendix B: Legislative requirements - Tires
Appendix C: Winter Tire Survey
Appendix D: E-mail Correspondence with Tire Manufacturers and Bus Manufacturers; 315/70R22.5
Appendix E: Brochure; Bandag BDR – HG, Bandag BDR – W and Michelin XDS2
Appendix F: Press release; HDW2 SCANDANAVIA

REFERENCES AND LINKS

- merriam-webster.com
- the automotivedictionary.org
- <http://drivesmartbc.ca/equipment/what-does-ms-mean>
- <http://specialreports.torontoobserver.ca/no-snow-tires-on-ttc-buses-riders-at-risk/>
- <http://www.cbc.ca/news/canada/nova-scotia/halifax-transit-union-asks-for-snow-tires-on-city-buses-1.2890633>

A copy of this report can be obtained online at <http://www.halifax.ca/council/agendasc/cagenda.php> then choose the appropriate meeting date, or by contacting the Office of the Municipal Clerk at 902.490.4210, or Fax 902.490.4208.

Report Prepared by: Jacqueline Niklas/Business Analyst 902.490.8669

Report Approved by: Wendy Lines/Manager – Bus Maintenance 902.490.3241

Appendix A

Definitions

Winter Tire – Tires that have undergone a performance-based test for passenger and light truck vehicles in snow conditions, attaining a traction index equal to greater than 10% of that of a reference tire

Mud & Snow Tire – *Defined by Drive Smart BC* as a tire or tire tread that possesses certain physical characteristics such as:

- Multiple pockets or slots in at least one tread edge that extend towards the tread center at least 1/2 inch from the footprint edge
- Measured perpendicularly to the tread centerline and has a minimum cross-sectional width of 1/16 inch
- Edges of pockets or slots at angles between 35 and 90 degrees from the direction of travel
- Contact surface void area will be a minimum of 25% based on mold dimensions

Retread - to bond a new tread to the prepared surface of (a worn tire)

Tire Casing - The main body of the tire exclusive of the tread, tube, etc.

Regroove – To cut into the original tire tread (altering the design of the tread)

Sidewall - The sides of a tire casing

First-line tires – New tires, not used and not altered from the original intended design

Figure 1: M&S Tire Markings (current Halifax tire)



Figure 2: Winter Tire Markings



Figure 3: Regrooved Tire



Appendix B

Legislated Requirements

The Board Public Passenger Motor Carrier Act Regulations made under subsection 27(1) of the Motor Carrier Act – Appendix C; Commercial Vehicle Component Performance Standards document (No. 14 – Tires and Wheels) states:

- (g) no tire shall have been regrooved or recut below the original new tire groove depth, other than a tire specifically designed for recutting and marked as being so designed;
- (h) no front tire shall have been altered by the addition of material to produce a new tread surface;
- (i) no tire shall be of a smaller size than the vehicle manufacturer's specified minimum size or be sufficiently oversized to contact any vehicle component;

Appendix C

Winter Tire Survey and Survey Responses

During July and August of 2014, Halifax Transit Maintenance staff contacted several cities/municipalities in order to further understand the availability of winter tires for transit buses as well as other means of mitigating winter conditions. Other properties were also contacted during the winter of 2014/2015. The properties that responded were:

- Durham Region
- London, ON
- RTC (Quebec)
- Saint John Transit
- Whistler, BC
- RTL (Longueil)
- Winnipeg

The survey included the following questions:

- 1) What tire are you using currently during the winter time on conventional 40 ft. and 60 ft. buses?
Any special retread design?
- 2) Do you take any special measures during the winter time to reduce the risk of sliding/slipping?
(I.e. Chains/studs)?

The results of the survey are displayed on Page 9.

Location	Halifax	Longueuil	St. John Transit	London	Winnipeg	Durham	RTC	Whistler
Description of Program	All-season tires year round, transit application tires. Only new steer tires and recap drive tires on all buses. Centre artic tires are cut more aggressively to increase traction during snowy conditions.	All-season tires year round, transit application tires. Only new steer tires and recap drive tires on all buses. Centre artic tires are cut more aggressively to increase traction during snowy conditions.	All-season tires year round, transit application tires. Ribbed tires on both front and rear axles.	All-season tires year round, transit application tires. Only new steer tires and recap drive tires on all buses. Centre artic tires are cut more aggressively to increase traction during snowy conditions.	All-season tires year round, transit application tires. Only new steer tires and recap drive tires on all buses. Centre artic tires are cut more aggressively to increase traction during snowy conditions.	All-season tires year round, transit application tires. Only new steer tires and recap drive tires on all buses. Centre artic tires are cut more aggressively to increase traction during snowy conditions. Minimum tread depth is increased during winter.	All-season tires year round, transit application tires. Only new steer tires and recap drive tires on all buses. Centre artic tires are cut more aggressively to increase traction during snowy conditions. Minimum tread depth is increased during winter.	All-season tires year round, transit application tires. Only new steer tires and recap drive tires on all buses. Minimum tread depth is increased during winter.
Model (305/70R22.5)	X InCity Z (ribbed) for front tires and XDN2 for rear tires.	X InCity Z (ribbed) for front tires and XDE2 for rear tires.	Bridgestone R192 (ribbed) for front tires and rear tires.	R192 (ribbed) for front tires. Rear tread is unknown.	XZU2 or X InCity Z (ribbed) for front tires. Rear tread is unknown.	XZU2 or X InCity Z (ribbed) for front and rear tires. R192 (ribbed) for front and rear tires.	XZU2 (XInCityZ) for front tires. ATD tread from Oliver and XDS2 for rear tires (directional).	Bridgestone R192 (ribbed) front tires and BDR-W (directional) retread on rear tires
Model (385/55R22.5)	Bandag Gripper Deep	Marangoni retread RSSY3	N/A	Special retread, unknown	N/A	N/A	XDN2 retread	N/A
Notes	Minimum tread depth is 8/32" during winter for all conventional buses. Will pilot directional treads during the winter of 15/16.	Tried to find winter tires for buses but could only find some in Scandinavia	Testing a new recap tire because current tires are not satisfying needs as winter conditions worsen.			No complaints about either tires used. Remove front tires at 9/32" and move them to the rear until 6/32" during the winter. Put the transmission retarder on a "gentle" setting.	No safety concerns. Remove tires on 40ft buses at 7/32" during winter. Regroove the front tires for more traction.	No safety concerns. Remove tires on 40ft buses at 7/32" during winter. Regroove the front tires for more traction.

Appendix D

E-mail Correspondence with Tire Manufacturers and Bus Manufacturers

On January 12, 2015 a Nokian Tyres representative wrote to Halifax Transit Maintenance staff:

"We believe Nokian has a good solution for your application. We have the steer tire and traction tire for your application.

We have 315/70R22.5 size is little bit wider tire. It is very good, because the foot print is larger, so in general it usually give better traction and last longer in kilometer. It is simple more tread on the ground. See attach file it will explain why example simple like shoes + all technical data.

Do you accept the size 315/70R22.5 is a dimension more popular size in Europe than 305/70R22.5?

Also you have better chance to be supply correctly by using this size 315/70R22.5 and you are less dependent with only few tire maker (almost no demand into this size= big picture world)."

On January 13th, 2015, the Nova Bus Engineering team responded to the request to outfit buses with 315/70R22.5 as follows:

"After investigating here are my findings and recommendation;

The 315/70 R22.5 Nokian tires are slightly too big for our bus.

The Nokian tires require mounting on approved 9 in width rims, our wheels are only 8.25 in.

The Nokian tires need a rear tire minimal dual spacing of 351mm; our current wheels have a spacing of 336.5mm. The rear tires would rub one another on lateral steering loads.

The width of the Nokian tires are 312 to 315 mm (depending on model), the Michelin Incity width is 312mm. No problem.

The Nokian tires have a load index of 154/150 @ 130 psi . The Michelin Incity load index is 153/150 @ 130 psi. No problem

The Nokian tires have an outside diameter of 1032mm (Hakkapelitta Truck, NTR-831) and 1014mm (NOKIAN NTR45). The Michelin Incity has an outside diameter of 1002.5 mm. The added 15mm in diameter will cause tire rubbing in the front wheelhouse under tight steering & roll.

We do mount Bridgestone R192 that have an outside diameter of 1011mm and Continentals HSU1 with an outside diameter of 1018 mm.

Tire rubbing is not a recommended practice, and the DOT inspectors will snag any contact issues. We mount tires of similar size to the Nokian NRT45 without any complaints.

With 315/70 R22.5 Tires, rubbing will occur under specific conditions and we cannot recommend the dual mounting on "non-approved" wheel size.

I don't know in what conditions theses tires will run and it's difficult to approve a tire size that might have a rubbing issue. On the other hand this mounting might be acceptable under the customer's duty cycle.

To further, I would first recommend trying a waiver from Nokian for the dual mounting (wheel size & spacing). If accepted for the duty cycle of Halifax, then I would recommend trying a set of NOKIAN NRT 45 to evaluate the rubbing issues and if acceptable to the customer and Nokia, proceed with the tire model.

Sorry I cannot provide a black or white answer on this one. It's close to being an acceptable solution."

On January 13th, 2015, New Flyer staff responded to the request to outfit buses with 315/70R22.5 as follows:

"I forwarded your inquiry to NF Engineering and they have stated that 315 tire size is not approved for the D40 LF / D60LF or Xcelsior application. There are concerns regarding tire contact to certain suspension and or structural area(s) of the vehicle during turning events."

Appendix E

Tire/Tread Product Brochures

BANDAG Tire & Retread Technology
Select Tread Product Guide



**FEBRUARY 2013
UNITED STATES**



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APPLICATION SPECIFIC ADVANTAGE PROGRAM (ASAP)

With a commitment to deliver the best possible tire performance the commercial trucker can expect, Bandag continues with the Application Specific Advantage Program (ASAP). The specific tire performance needs of fleets, in given applications, will provide the foundation from which the Bandag tread product line continues.

This methodology moves Bandag from an internally, product driven development approach to an externally, customer-centered approach. Application Specific product strategy starts with the fleet customer by identifying needs within specific market segments and developing products that commercially and technically fit those needs.

ASAP is also about being best-in-class... that is best-in-class performance for a specific wheel position. When combined with Bandag's commitment to research and development and a substantial commercial and dedicated testing program, our ability to deliver durability and reliability is unsurpassed.

The pages of this tread guide allow you to see the ASAP strategy from beginning to end. Once the application has been defined, then the wheel position is recognized, as well as the specific vehicle configuration. It is at this point specific products can be identified that will best meet the fleet customer's need based on specific performance characteristics.

PERFORMANCE CHARACTERISTICS

Product rankings were assigned to each tread product based on its performance relative to the other tread products within that category (application/position/configuration). Ranking scores were assigned based on previous performance testing; if testing was not available, tire/tread knowledge and technical expertise were used to assign a ranking. While the ranking of each tread product should be used as a guide for a purchasing decision, the ranking information should not be construed as absolute.

OVER-THE-ROAD ALL POSITIONS	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
BDV	A+	C	D	C	D
FCR Rib	B+	A	D	B	A
FCR Rib w/MilEdges®	B+	A	B	A	A

Treadwear testing shows a combination ranking of both dedicated (controlled) and commercial testing of the specific tread product. All testing is run to wear out or when the wear rate of the product has normalized over time where projections can be made.

The A, B, C and D positioning displays the corresponding ranking of the tread product.

Traction and Rolling Resistance testing was conducted according to industry standard test procedures. Every possible measure was used during testing to ensure accurate test results. We have also ranked these products in a A, B, C and D ranking with A being the top ranking parameter. All rankings of a tread product are comparable to similar products within the product matrix of the Bandag tread line.

THE BANDAG TREAD DESIGN NAMING CONVENTION

- A process for naming new tread products
- Know wheel position and application immediately

Example: BDR-AS = Bandag - **D**rive - **R**egional - **A**ll Season

IDENTIFIER:	WHEEL POSITION:	APPLICATION:	SPECIFIC QUALIFIER:
B = Bandag	D = Drive	L = Linehaul	AS = All Season
	R = Rib	LT = Light Truck	HT = High Torque
	T = Trailer	M = Mixed Service	SA = Spread Axle
		R = Regional	UWB = Ultra Wide Base
		V = Urban	W = Winter
		X = On/Off Road	WB = Wide Base
		Y = Severe Service	HG = High Grip



OVER-THE-ROAD

Fleets operating in long haul/line-haul or regional operations that exceed a radius of 200 miles. In over-the-road applications, turning and scrubbing are reduced based on the points of travel. Although this application may see some city service, the bulk of these operations have reduced turning and slow tire wear rates. This application may include both single and tandem axle configurations.

(Note that the differentiation point between Regional Over-the-road and Intra-city Pickup & Delivery is the type of service the operation truly sees.) There are some gray areas based on the application service. Therefore, on occasion, tires are mixed between these two applications.

BDV

Built specifically for urban fleets with improved tread wear and wet braking traction through superior tread design. Solid shoulders withstand punishing corners and curbs.

CONVENTIONAL



SIZE	WIDTH	DEPTH
190	190mm	22/32
200	200mm	22/32
210	210mm	22/32
220	220mm	22/32
230	230mm	22/32
240	240mm	22/32
250	250mm	22/32
260	260mm	22/32
270	270mm	22/32

FCR™ Rib

This specially compounded, high mileage tread provides great traction while still allowing fuel efficiency in an all position setting.

CONVENTIONAL

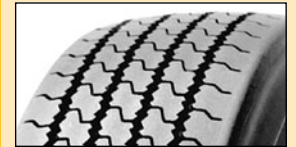


SIZE	WIDTH	DEPTH
7	7-20/32	16/32
8	8	16/32
8.5*	8-10/32	16/32
9*	8-20/32	16/32
230	230mm	16/32
240	240mm	16/32

Ultra All-Position™

This low void ratio tread will put more rubber on the road for increased tread life and improved traction.

CONVENTIONAL



SIZE	WIDTH	DEPTH
190	190mm	18/32
200	200mm	18/32
210	210mm	18/32
220	220mm	18/32
230	230mm	18/32
240	240mm	18/32

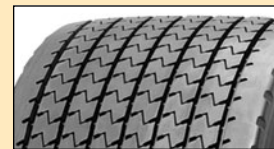
OVER-THE-ROAD ALL POSITION

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
BDV	A+	C	D	C	D
FCR Rib	B+	A	D	B	A
FCR Rib w/MilEdges	B+	A	B	A	A
Ultra All-Position	B+	B	B	B	C
BRR-UWB	A	B	D	B	A
BRX	C	C	C	C	C

BRR-UWB

Features a deeper tread for more miles before removal and straight grooves for excellent water evacuation. Ideal for higher scrub trailer applications.

WIDE BASE



SIZE	WIDTH	DEPTH
390	390mm	16/32

BRX™

Designed to provide uniform wear in various applications.

TANDEM AXLE



SIZE	WIDTH	DEPTH
190	190mm	22/32
200	200mm	22/32
210	210mm	22/32
220	220mm	22/32
230	230mm	22/32
240	240mm	22/32
250	250mm	22/32

MegaTrek™

This is a deep aggressive tread design with solid shoulders that gives outstanding tread wear in over-the-road truckload and LTL applications.

TANDEM AXLE



SIZE	WIDTH	DEPTH
200	200mm	26/32
210	210mm	26/32
220	220mm	26/32
230	230mm	26/32
240	240mm	26/32

Ultra Drive™

A deep, all-weather tread with stone penetration protectors. Slotted shoulders and unique blading provide excellent traction.

TANDEM AXLE



SIZE	WIDTH	DEPTH
200	200mm	26/32
210	210mm	26/32
220	220mm	26/32
230	230mm	26/32
240	240mm	26/32
250	250mm	26/32
260	260mm	26/32

BDR-HG

Over-the-road tandem axle drive tread holds traction as tread wears. Unique high grip design and long wearing compound deliver outstanding traction and mileage.

TANDEM AXLE



SIZE	WIDTH	DEPTH
210	210mm	27/32
220	220mm	27/32
230	230mm	27/32
240	240mm	27/32
250	250mm	27/32
260	260mm	27/32

BDR-HT3

Designed specifically for high torque, single-axle tractors in LTL situations.

SINGLE AXLE



SIZE	WIDTH	DEPTH
210	210mm	28/32
220	220mm	28/32
230	230mm	28/32
240	240mm	28/32

B710 FuelTech®

Fuel-efficient tread designed for tandem-axle drive applications in long-haul and regional service. Complements the Bridgestone M710™ Ecopia™ drive tire.

TANDEM AXLE



SIZE	WIDTH	DEPTH
210	210mm	25/32
220	220mm	25/32
230	230mm	25/32
240	240mm	25/32

EPA SmartWay® Verified and CARB Compliant.

BDR-AS™

Designed to give your trucks unstoppable traction in almost any weather condition. Overlapping lugs provide lots of gripping power.

TANDEM AXLE



SIZE	WIDTH	DEPTH
170	170mm	22/32
180	180mm	22/32
190	190mm	22/32
200	200mm	22/32
210*	210mm	22/32
220*	220mm	22/32
230	230mm	22/32
240	240mm	22/32

FuelTech® Drive

Using a special tread compound, this tread design can deliver better fuel economy while its generous depth can help to increase tread wear and traction.

TANDEM AXLE



SIZE	WIDTH	DEPTH
200	200mm	24/32
210	210mm	24/32
220	220mm	24/32
230	230mm	24/32
240	240mm	24/32

EPA SmartWay® Verified and CARB Compliant.

FCR™ Drive

This specially compounded, high mileage tread provides great traction while still allowing for excellent fuel efficiency in the drive position.

TANDEM AXLE



SIZE	WIDTH	DEPTH
8	8	20/32
8.5	8-10/32	20/32
9	8-20/32	20/32
230	230mm	20/32

B835 FuelTech®

Fuel-efficient wide base tread for tandem-axle drive applications in long-haul service. Complements Bridgestone Greatec™ M835™ Ecopia™ wide base drive tire.

WIDE BASE



SIZE	WIDTH	DEPTH
390	390mm	23/32
400	400mm	23/32

EPA SmartWay® Verified and CARB Compliant.

BDR-UWB

Delivers new tire performance at a fraction of new tire costs.

WIDE BASE



SIZE	WIDTH	DEPTH
380	380mm	24/32
390	390mm	24/32

OVER-THE-ROAD DRIVE

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
MegaTrek	A+	B	B	B	B
Ultra Drive	A+	B	B	B	C
BDR-HG	A+	A	A	A	C
BDR-HT3	A+	B	B	C	C
B710 FuelTech	B	B	B	B	A+
BDR-W	A	B	A	A	C
BDR-AS	B+	B	A	A	C
BDR-AS w/MilEdges	B+	B+	A+	A+	C
FuelTech Drive	B	B	B	B	A+
FCR Drive	B+	B	D	B	B+
B835 FuelTech	B	B	B	B	A
BDR-UWB	A	B	B	B	B
BDL	C	C	C	C	C
BTT2	D	C	C	C	C

BTT2™

A proven traction tread designed to provide adequate tread depth for drive tires on Class 8 tractors ready to be traded.

TANDEM AXLE



SIZE	WIDTH	DEPTH
210	210mm	14/32
220	220mm	14/32
230	230mm	14/32

BDR-W

Directional drive tread design for extremely aggressive winter traction.

TANDEM AXLE

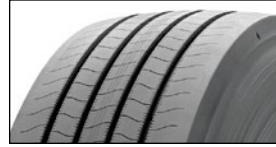


SIZE	WIDTH	DEPTH
200	200mm	23/32
210	210mm	27/32
220	220mm	27/32
230	230mm	27/32
240	240mm	27/32
250	250mm	27/32
260	260mm	27/32

B197 FuelTech®

Fuel-efficient tread designed for single- & tandem-axle trailer & dolly applications in long-haul & regional service. Complements Bridgestone R197™ Ecopia™ trailer tire.

WIDE BASE



SIZE	WIDTH	DEPTH
210	210mm	11/32
220	220mm	11/32
230	230mm	11/32

EPA SmartWay® Verified and CARB Compliant.

FCR™ Trailer

A specially compounded, high mileage shallow tread designed for today's trailers. Great traction while still allowing for excellent fuel efficiency.

SINGLE/TANDEM



SIZE	WIDTH	DEPTH
7*	7-20/32	11/32
8*	8	11/32
8.5*	8-10/32	11/32
9*	8-20/32	11/32
220*	220mm	11/32
230*	230mm	11/32
240*	240mm	11/32

EPA SmartWay® Verified and CARB Compliant.

FuelTech® Trailer

Using a special compound this tread can deliver excellent fuel economy, and its generous depth increases tread wear and traction.

SINGLE/TANDEM



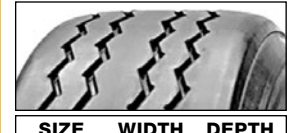
SIZE	WIDTH	DEPTH
200	200mm	12/32
210	210mm	12/32
220	220mm	12/32
230	230mm	12/32

EPA SmartWay® Verified and CARB Compliant.

ECL™ ST-M

For on-highway multi-axle applications. Outside ribs enable this tread to withstand extra stress and punishment put on tires during turns & cornering.

SINGLE/TANDEM/SPREAD/WIDE BASE



SIZE	WIDTH	DEPTH
7	NA	16/32
8	NA	16/32
8.5	NA	16/32
9	NA	16/32
10.5	NA	16/32
290	NA	16/32
300	NA	16/32
310	NA	16/32
315	NA	16/32
320	NA	16/32
340	NA	16/32

BDL™

Designed for a wide range of applications. Tie bars stabilize shoulders for even, uniform wear. Open lug design delivers off-road traction.

TANDEM AXLE



SIZE	WIDTH	DEPTH
190	190mm	20/32
200	200mm	20/32
210	210mm	20/32
220	220mm	20/32
230	230mm	20/32

BTL-SA™

Designed specifically for spread axle & multi-axle applications. This design provides serious protection from casing damage caused by twisting, scraping or scrubbing.

SINGLE/TANDEM SPREAD



SIZE	WIDTH	DEPTH
200	200mm	16/32
210	210mm	16/32
220	220mm	16/32
230	230mm	16/32
240	240mm	16/32

B135 FuelTech®

Fuel-efficient wide base tread for tandem-axle trailer applications in long-haul & regional service. Complements Bridgestone R135™ Ecopia™ wide base trailer tire.

WIDE BASE



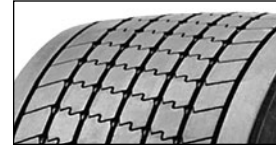
SIZE	WIDTH	DEPTH
390	390mm	11/32
400	400mm	11/32

EPA SmartWay® Verified and CARB Compliant.

BTR-UWB

For on-highway applications. Outside ribs enable this tread to withstand the extra stress and punishment put on tires during turns & cornering.

WIDE BASE



SIZE	WIDTH	DEPTH
380	380mm	11/32
390	390mm	11/32

InterTransit Rib™

A lightweight rib tread in two sizes, radial or bias, to accommodate casings used on intermodal trailers.

INTERMODAL - Radial or Bias



SIZE	WIDTH	DEPTH
200	200mm	11/32
210	210mm	11/32

InterTransit Rib™ Bias

SIZE	WIDTH	DEPTH
180	180mm	11/32
190	190mm	11/32

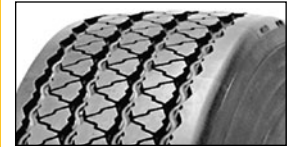
OVER-THE-ROAD TRAILER

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
B197 FuelTech	B	C	C	C	A+
FCR Trailer	A	D	C	C	B+
FCR Trailer w/ MilEdges	A	A	D	B	B+
FuelTech Trailer	B	D	C	C	A+
ECL ST-M	A	D	D	C	B
BTL-SA	A	D	D	C	B
B135 FuelTech	B	D	D	D	A
BTR-UWB	A	C	D	C	B+
InterTransit Rib Radial	C	B	D	B	C
InterTransit Rib Bias	C	B	D	B	C
BTL	C	C	C	C	C

BTL™

Angled 5-rib design prevents stone holding. Rounded shoulders for scrubbing resistance.

SINGLE/TANDEM



SIZE	WIDTH	DEPTH
200	200mm	11/32
210	210mm	11/32
220	220mm	11/32
230	230mm	11/32

PICKUP & DELIVERY | ALL POSITION



PICKUP & DELIVERY

Refers to intra-city service which operates within a 200 mile radius; high turning and high scrubbing are characteristics which accelerate wear as compared to like tires in over-the-road applications. There is increased braking and high torque on these tires usually caused by sudden starts and stops. Tandem axle, single axle, and straight truck vehicle configurations are used in this application.

BDV

Built specifically for urban fleets with improved tread wear and wet braking traction through superior tread design. Solid shoulders withstand punishing corners and curbs.

CONVENTIONAL



SIZE	WIDTH	DEPTH
190	190mm	22/32
200	200mm	22/32
210	210mm	22/32
220	220mm	22/32
230	230mm	22/32
240	240mm	22/32
250	250mm	22/32
260	260mm	22/32
270	270mm	22/32

Ultra All-Position™

This low void ratio tread will put more rubber on the road for increased tread life and improved traction.

CONVENTIONAL

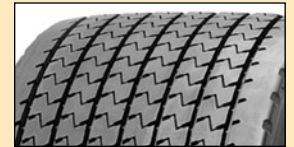


SIZE	WIDTH	DEPTH
190	190mm	18/32
200	200mm	18/32
210	210mm	18/32
220	220mm	18/32
230	230mm	18/32
240	240mm	18/32

BRR-UWB

Features a deeper tread for more miles before removal and straight grooves for excellent water evacuation. Ideal for higher scrub trailer applications.

WIDE BASE



SIZE	WIDTH	DEPTH
390	390mm	16/32

PICKUP & DELIVERY ALL POSITION

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
BVD	B+	C	D	C	D
Ultra All-Position	B	B	B	B	C
BRR-UWB	A	B	D	B	A
BRX	C	C	C	C	C

BRX™

Designed to provide uniform wear in various applications.

SINGLE/TANDEM/STRAIGHT



SIZE	WIDTH	DEPTH
190	190mm	22/32
200	200mm	22/32
210	210mm	22/32
220	220mm	22/32
230	230mm	22/32
240	240mm	22/32
250	250mm	22/32



Ultra Drive™

A deep, all-weather tread with stone penetration protectors. Slotted shoulders and unique blading provide reliable traction.

SINGLE/TANDEM/STRAIGHT



SIZE	WIDTH	DEPTH
200	200mm	26/32
210	210mm	26/32
220	220mm	26/32
230	230mm	26/32
240	240mm	26/32
250	250mm	26/32
260	260mm	26/32

BDR-HT3

Designed specifically for high torque, single-axle tractors in LTL situations.

SINGLE AXLE



SIZE	WIDTH	DEPTH
210	210mm	28/32
220	220mm	28/32
230	230mm	28/32
240	240mm	28/32

BDR-W

Directional drive tread design for extremely aggressive winter traction.

SINGLE/TANDEM/STRAIGHT



SIZE	WIDTH	DEPTH
200	200mm	23/32
210	210mm	27/32
220	220mm	27/32
230	230mm	27/32
240	240mm	27/32
250	250mm	27/32
260	260mm	27/32

BDR-AS™

Designed to give your trucks unstoppable traction in almost any weather condition. Overlapping lugs provide lots of gripping power.

SINGLE/TANDEM/STRAIGHT



SIZE	WIDTH	DEPTH
170	170mm	22/32
180	180mm	22/32
190	190mm	22/32
200	200mm	22/32
210*	210mm	22/32
220*	220mm	22/32
230	230mm	22/32
240	240mm	22/32

PICKUP & DELIVERY DRIVE

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
Ultra Drive	A+	B	B	B	C
BDR-HT3	A+	B	B	C	C
BDR-W	A	B	A	A	C
BDR-AS	B+	B	A	A	C
BDR-AS w/MilEdges	B+	B+	A+	A+	C
BDL	C	C	C	C	C
BTT2	D	C	C	C	C

BDL™

Designed for a wide range of applications. Tie bars stabilize shoulders for even, uniform wear. Open lug design delivers off-road traction.

SINGLE/TANDEM/STRAIGHT



SIZE	WIDTH	DEPTH
190	190mm	20/32
200	200mm	20/32
210	210mm	20/32
220	220mm	20/32
230	230mm	20/32

BTT2™

A proven traction tread designed to provide adequate tread depth for drive tires on Class 8 tractors ready to be traded.

SINGLE/TANDEM/STRAIGHT



SIZE	WIDTH	DEPTH
210	210mm	14/32
220	220mm	14/32
230	230mm	14/32



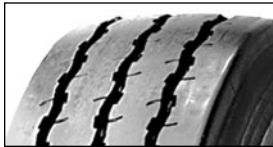
ON/OFF ROAD

Tires utilized in this application are used approximately 70% on the road, with the remaining usage in conditions similar to those encountered by severe service off-road applications. Mining, logging, construction and waste operations are typical of the end-users found in this application. The wide range of vehicle types and configurations that operate within this application are looking for a tire product that combines both over-the-road and severe service characteristics.

BRM2™

Extra wide uninterrupted shoulder for maximum durability with a smooth sidewall for optimal performance in tight turns.

CONVENTIONAL



SIZE	WIDTH	DEPTH
250	250mm	26/32
260	260mm	26/32
270	270mm	26/32
280	280mm	26/32

BRM-WB

This rib-lug design, provides better wear across multiple wheel positions. Solid shoulders combat severe scrubbing. Wide grooves and voids enhance traction.

WIDE BASE



SIZE	WIDTH	DEPTH
290	290mm	20/32
320	320mm	20/32
340	340mm	20/32
365	365mm	20/32
390	390mm	20/32

BRM

For pickup and delivery industries. Molded from a revolutionary rubber compound that provides significant improvement in wear.

CONVENTIONAL

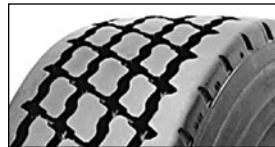


SIZE	WIDTH	DEPTH
190	190mm	26/32
200	200mm	26/32
210	210mm	26/32
220	220mm	26/32
230	230mm	26/32
240	240mm	26/32
250	250mm	26/32
260	260mm	26/32
270	270mm	26/32
280	280mm	26/32

BRX™

Designed to provide uniform wear in various applications.

CONVENTIONAL



SIZE	WIDTH	DEPTH
190	190mm	22/32
200	200mm	22/32
210	210mm	22/32
220	220mm	22/32
230	230mm	22/32
240	240mm	22/32
250	250mm	22/32

BDM2

Directional drive tread designed to provide maximum traction and long treadwear in on/off road applications such as waste/refuse hauling.

SINGLE/TANDEM



SIZE	WIDTH	DEPTH
210	210mm	32/32
220	220mm	32/32
230	230mm	32/32
240	240mm	32/32
250	250mm	32/32
260	260mm	32/32
270	270mm	32/32
280	280mm	32/32

BDM

For both the refuse and construction industries. Molded from a revolutionary rubber compound that provides significant improvement in wear.

SINGLE/TANDEM



SIZE	WIDTH	DEPTH
190	190mm	26/32
200	200mm	26/32
210	210mm	26/32
220	220mm	26/32
230	230mm	26/32
240	240mm	30/32
250	250mm	32/32
260	260mm	32/32
270	270mm	32/32
280	280mm	32/32

ECL™ SST

Ideal for on/off road and heavy load spread-axle or multi-axle fleets. Handles the tortuous routes of tough applications.

CONVENTIONAL

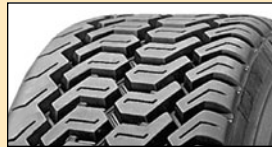


SIZE	WIDTH	DEPTH
6	NA	15/32
7	NA	15/32
8	NA	15/32
8.5	NA	15/32
9	NA	15/32
9.5	NA	15/32
10.5	NA	15/32

WBD-A™

This deep, asymmetric and aggressive tread design is specially designed for waste fleets where there is constant turning in a single direction.

WIDE BASE - Radial/Bias



SIZE	WIDTH	DEPTH
290	290mm	25/32
300	300mm	25/32
315	315mm	25/32
340	340mm	25/32
365	365mm	25/32
390	390mm	25/32

BDX™

An aggressive traction, drive-axle tread engineered for hard-working on/off road trucks.

SINGLE/TANDEM



SIZE	WIDTH	DEPTH
210	210mm	24/32
220	220mm	24/32
230	230mm	24/32
240	240mm	24/32
250	250mm	24/32

ON/OFF ROAD ALL POSITION

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
BRM2	A+	D	D	D	C
BRM-WB	B	B	C	C	C
BRM	A	C	D	C	C
BRX	C	C	C	C	C

DRIVE

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
BDM	A	C	C	C	D
BDM2	A	C+	B	C+	D
WBD-A	A	A	C	B	D
BDX	C	C	C	C	C

TRAILER

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
ECL SST	A	D	D	C	C

**BDY2®**

Designed for enhanced traction on unimproved surfaces. Ideal for severe service applications such as logging and oil field usage.

SINGLE/TANDEM

SIZE	WIDTH	DEPTH
210	210mm	32/32
220	220mm	32/32
230	230mm	32/32
240	240mm	32/32

BDY1

This drive tread is designed for severe service conditions that harbor extreme cutting and chipping such as mining and logging.

SINGLE/TANDEM - Radial/Bias

SIZE	WIDTH	DEPTH
200	200mm	30/32
210	210mm	30/32
220	220mm	30/32
230	230mm	30/32
240	240mm	30/32
250	250mm	30/32

BDY1s

This drive tread is designed for severe service conditions that demand a balance of cut resistance and highway performance.

SINGLE/TANDEM - Radial/Bias

SIZE	WIDTH	DEPTH
200	200mm	30/32
210	210mm	30/32
220	220mm	30/32
230	230mm	30/32
240	240mm	30/32
250	250mm	30/32
270	270mm	30/32

ECL™ SST

Ideal for on/off road and heavy load spread-axle or multi-axle fleets. Handles the tortuous routes of tough applications.

CONVENTIONAL

SIZE	WIDTH	DEPTH
6	NA	15/32
7	NA	15/32
8	NA	15/32
8.5	NA	15/32
9	NA	15/32
9.5	NA	15/32
10.5	NA	15/32

BRX™

Designed to provide uniform wear in various applications.

CONVENTIONAL

SIZE	WIDTH	DEPTH
190	190mm	22/32
200	200mm	22/32
210	210mm	22/32
220	220mm	22/32
230	230mm	22/32
240	240mm	22/32
250	250mm	22/32

WBSS™

Deep drive tread for wide base casings in severe service applications.

WIDE BASE - Radial/Bias

SIZE	WIDTH	DEPTH
345	345mm	30/32
355	355mm	30/32
365	365mm	30/32
390	390mm	30/32

**SEVERE SERVICE
DRIVE**

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
BDY2	B	A	A	B+	D
BDY1	B	B	B	B	D
BDY1s	B	B	B	B	D
WBSS	B	B	B	B	D

TRAILER

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
ECL SST	A	D	C	C	D
BRX	C	C	C	C	C



ISR™

Exceptionally deep tread puts extra rubber to work for long wear in forklift and other industrial applications.

SWITCHER - Radial/Bias

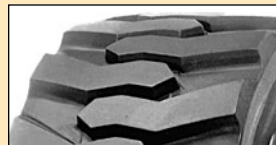


SIZE	WIDTH	DEPTH
3	6	24/32
6	7	30/32
7	7-20/32	36/32
8	8	36/32

BDC™

The choice for skid steer applications. Features a deep undertread for improved foreign material penetration resistance, as well as stone damage protection.

SKID STEER - Radial/Bias



SIZE	WIDTH	DEPTH
220	220mm	26/32
240	240mm	26/32
275	275mm	26/32

LIGHT TRUCK

This application is predominantly delivery vans and trucks whose routes vary based on location from rural to inter-city. Turning, braking and frequent stopping cause these tire products to experience rapid wear rates. Most applications operate on secondary or better highway conditions.

MetroMax™ Rib

Designed for all-wheel positions in light commercial applications that deal with severe inner city driving conditions as well as highway usage.

CONVENTIONAL/RECREATIONAL



SIZE	WIDTH	DEPTH
140	140mm	13/32
150	150mm	13/32
160	160mm	13/32
170	170mm	13/32
180	180mm	13/32
195	195mm	16/32
205	205mm	16/32
210	210mm	16/32

BDLT

Delivers relentless traction and responsive handling in all weather conditions, without sacrificing tread wear.

CONVENTIONAL/RECREATIONAL



SIZE	WIDTH	DEPTH
140	140mm	16/32
150	150mm	16/32
160	160mm	16/32
170	170mm	16/32
180	180mm	16/32
190	190mm	16/32
200	200mm	16/32
210	210mm	16/32

LIGHT TRUCK

	TREND WEAR	WET TRACTION	SNOW TRACTION	ICE TRACTION	ROLLING RESISTANCE
MetroMax Rib	A	B	B	A	B
BDLT	C	A	A	A	C

**To contact Bridgestone Customer Support
call 855-389-3460, or visit www.bandag.com.**



Appendix F

Press Release; HDW2 SCANDANAVIA

Mar 12, 2015 |

http://www.continental-corporation.com/www/pressportal_us_en/themes/press_releases/4_rubber_group/truck_tires/pr_2010_04_15_truckworld_hdw2_er

Sneak Peek Exclusive at Truck World: HDW2 SCANDINAVIA

Apr 15, 2010

- Continental offers new winter drive tire designed for the Canadian market
- Tire features special winter tread for optimized traction
- Innovative two-phase tread pattern wears down for summer use

Truck World, April 15, 2010: Optimum grip and great traction on winter roads are just two advantages of Continental's new HDW2® SCANDINAVIA truck tire. Providing up to ten percent more grip on snow-covered roads, this new Continental winter tire for heavy trucks will help Canadian fleets keep the roads safe and deliveries on time in extreme weather conditions. Get a sneak peek at the HDW2 SCANDINAVIA, only at Truck World!

Snow, ice, dry and wet conditions – the severe winter of 2009 has shown that the quality of truck tires plays an important role in the safety of fleet operations. For drivers in Canada who routinely experience some of the most extreme winter driving conditions on our planet, a new tire is being unveiled for a “sneak peek” at Truck World – the Continental HDW2® SCANDINAVIA.

Designed with 20-ply construction to handle heavy loads in the Canadian market, the newly designed HDW2 SCANDINAVIA is a heavy long-haul tire for the drive axle. This tire position is particularly challenging in winter operations, as it has to simultaneously offer steady drive power transmission, directional control in corners and transfer of the complete effort from the brakes or truck retarder. The HDW2 SCANDINAVIA meets these demands with top marks.

Every aspect of the tire's tread has been specially engineered to provide greater traction and optimum grip, even on a compacted layer of snow and extreme conditions. Special tread geometry with numerous, three-dimensional lateral sipes on the single-direction pattern provide more gripping edges on the road surface than a traditional drive tire. These sipes also support the tread blocks against forces from the drive train, retarder and wheel brake system to achieve the best possible traction and braking force transfer. The HDW2 SCANDINAVIA's particularly dense tread geometry and a new tread compound with micro-meshing effect also help to provide optimum handling. The handling of the HDW2 SCANDINAVIA has proven itself in Continental tests, where it achieved up to 10 percent more grip on snow-covered roads than the previous generation HDW winter tire.

The HDW2 SCANDINAVIA's tread is not only ideal for winter, but a two-phase pattern developed by Continental allows the tread to wear down to a positive proportion for summer. This two-phase tread is also optimized for low rolling resistance, allowing operators to enjoy fuel economy that is greater than traditional winter tires.

The HDW2 SCANDINAVIA also features an open shoulder for ideal grip and directional control. An additional 3/32nds of tread depth than the previous product ensures extended mileage while maintaining good traction values. The increased wear volume of the new tire extends the total mileage to avoid premature removal and reduce overall operating costs.

The HDW2 SCANDINAVIA's innovative casing technology includes a four-ply triangular belt casing with newly designed steel cord bead, as well as a larger air volume for increased load reserves and additional comfort.

All of these advanced tire technologies have come together to form the first of Continental's new generation of truck tires optimized for winter use. Come to the “Untamed Innovation Tour” mobile exhibit at Truck World, booth #3759, to see the new Continental HDW2

SCANDINAVIA tire before it reaches the market this fall in size 315/80R22.5.

