TRANSPORT
CERTIFICATION SERVICES

Factory 14/69 Acacia Road
Ferntree Gully Victoria 3156

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Tuesday, 17 February 2009
Att: Mr. Greg Wharton
Sales Follow Up Systems Pty Ltd
1c Ailsa Street,
Box Hill, VIC 3128
Phone: 9897 3511 – Fax: 9897 3822
Email: gw@salesfollowup.com.au

**RE: P 0548 WHEEL RIM COVERS**

**Your ref: WHEEL COVERS DRIVER BUS LINES REGO SA SB68BX**

Dear Greg,

The following report has been carried out to assess the suitability of the wheel rim advertising covers described in this report.

The executive summary outlines the actions of the analysis report:

Analysis of the wheel rim temperature, differential of the wheel rim as supplied by the OEM in an open style, as opposed to that of the fully covered style as tested.

Should you require further assistance, in this or any other matter, please do not hesitate to contact the undersigned.

Yours sincerely

Phillip J Hodges
*Mech Eng.*

# Analysis of Engineering Report

"Without Prejudice"

## Background

We have been requested by Sales Follow Up Systems Pty Ltd to carry out an evaluation of the Wheel Rim Covers, regarding the impact on the Route Bus Wheel Rim temperature differential as described in this report. The test vehicle has a GVM ≥ 16000 kg. The rear rim only was tested as the front wheel rim was not suitable to take the wheel rim disc due to not having the correct mounting lip on the rim assembly.

## Summary

Transport Certification Services has reviewed the brake temperatures during operation and found that the operating temperatures are under the standard brake operating temperature, operating range would be approximately 125 degrees Celsius. This is deemed acceptable when compared to the operating temperatures of a brake fade test that can see brake block (lining) increase in heat above 350 degrees Celsius. The test results from TUV NORD RDW-SPE-0655 & TZ-028438-A0-260_Engl were used and adopted. The principles covered under the FMVSS 121 test procedures from the USA were referenced in compiling this report. The physical testing was carried out on the LHR wheel assembly however brake temperature testing was carried out on all four rims.

**Temperature Data as Collected on the 17/02/2009:**

1. The test area ambient temperature on the day was approximately 30 + degrees Celsius.

2. The test data was taken in the field when the vehicle was operating on a normal bus route in the Box Hill to Doncaster area,( which included the Eastern freeway.)

3. The road vehicle tested is a Denning Route Bus, South Australian Registration SB68BX.

4. The nominal brake operating range under a controlled brake test in severe conditions can exceed 350 degrees Celsius before brake fade occurs.

5. The temperature range on the tested vehicle ranged from 29 degrees to 50.2 degrees Celsius on the covered wheel rim and 28.1 degrees Celsius to 57.8 degrees Celsius on the open wheel rim. Based on this data the covered wheel rim has a average temperature differential of 1.7 degrees Celsius ( refer charts and graphs below)

This is deemed acceptable and within the normal operating range for the brake linings performance capability.

6. Brake test data confirms the brake lining temperatures are within the operating range of standard brake materials. The calculated mean temperature is 350 C

7. The details below are a summary of the temperature range achieved under a controlled testing of Heavy Commercial brake applications.

8. The vehicles have been analysed for braking performance under brake fade conditions. Outlined below are some results of the brake fade findings. The bus tested at Box Hill revealed low possibility of brake fade in relation to the temperature findings. The following explanation has been adopted from a TUV NORD and FMVSS Survey carried out to record brake performance in commercial vehicles in severe stop start conditions. The TUV NORD Test was carried out on a DAF CF75.

9. The example of the brake performance is within the criteria of ADR 35/01. Example of the performance curves are listed below.

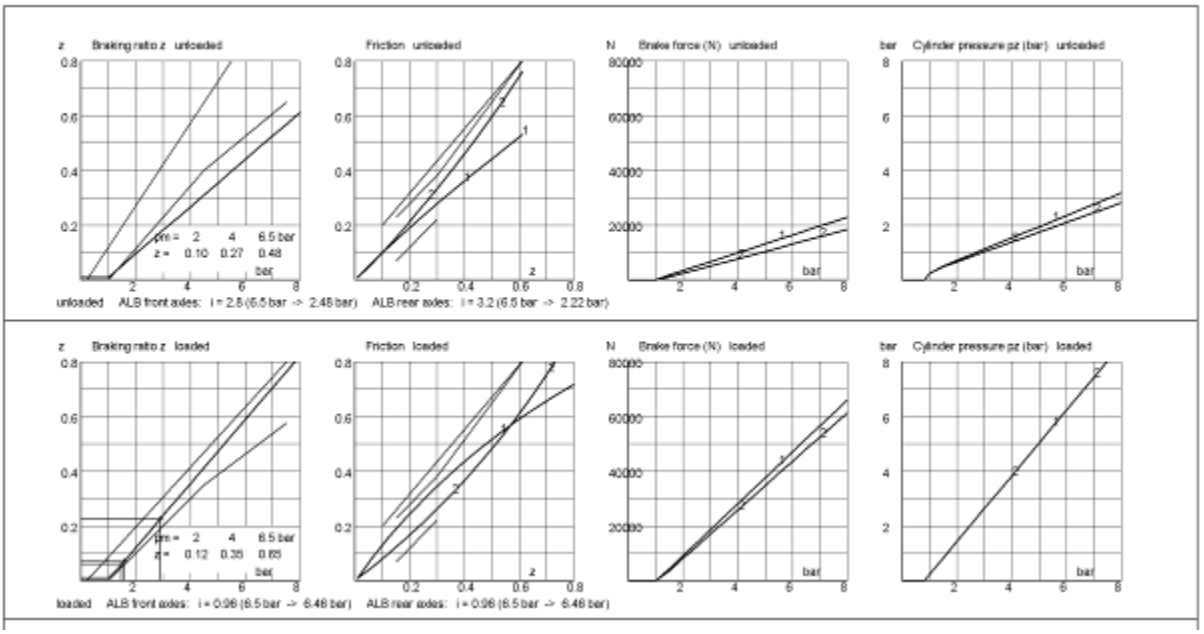


Table: Braking Force / Axle Weight / Friction

| | Axle | A 1 | A 2 | A 1 | A 2 | A 1 | A 2 |
|---|---|---|---|---|---|---|---|
| pM bar | | FBr (N) | FBr (N) | N (N) | N (N) | u | u |
| | | | | | | | |
| 0.0 | 0.01 | 0 | 0 | 58869 | 98091 | 0.01 | 0.01 |
| 1.0 | 0.01 | 0 | 0 | 58869 | 98091 | 0.01 | 0.01 |
| 2.0 | 0.12 | 9224 | 8226 | 63386 | 93574 | 0.16 | 0.10 |
| 3.0 | 0.24 | 18711 | 17068 | 68135 | 88825 | 0.28 | 0.20 |
| 4.0 | 0.35 | 28199 | 25950 | 72884 | 84076 | 0.40 | 0.32 |
| 4.5 | 0.41 | 32943 | 30381 | 75259 | 81701 | 0.45 | 0.38 |
| 5.0 | 0.47 | 37687 | 34813 | 77634 | 79326 | 0.50 | 0.45 |
| 6.0 | 0.59 | 47174 | 43675 | 82383 | 74577 | 0.58 | 0.60 |
| 6.5 | 0.65 | 51918 | 48106 | 84758 | 72202 | 0.62 | 0.68 |
| 7.0 | 0.71 | 56662 | 52537 | 87132 | 69828 | 0.66 | 0.76 |
| 8.0 | 0.82 | 66150 | 61399 | 91882 | 65078 | 0.73 | 0.95 |
| | | | | | | | |
| 0.0 | 0.01 | 0 | 0 | 39239 | 29431 | 0.01 | 0.01 |
| 1.0 | 0.01 | 0 | 0 | 39239 | 29431 | 0.01 | 0.01 |
| 2.0 | 0.10 | 3426 | 2457 | 39931 | 28739 | 0.10 | 0.10 |
| 3.0 | 0.18 | 6678 | 5116 | 40626 | 28044 | 0.17 | 0.19 |
| 4.0 | 0.27 | 9931 | 7774 | 41322 | 27348 | 0.25 | 0.29 |
| 4.5 | 0.31 | 11558 | 9103 | 41670 | 27000 | 0.29 | 0.35 |
| 5.0 | 0.35 | 13184 | 10433 | 42017 | 26653 | 0.32 | 0.40 |
| 6.0 | 0.44 | 16437 | 13091 | 42713 | 25957 | 0.39 | 0.51 |
| 6.5 | 0.48 | 18064 | 14421 | 43061 | 25609 | 0.43 | 0.57 |
| 7.0 | 0.53 | 19690 | 15750 | 43408 | 25262 | 0.46 | 0.63 |
| 8.0 | 0.61 | 22943 | 18409 | 44104 | 24566 | 0.53 | 0.76 |

Left Hand Side

Right Hand Side


**BLACK: (Letter Code: M)** Medium torque compound designed to be a good, all purpose low-c
**Temperature Range:** 100º F - 900º F, 38º C - 482º C

**BLUE 9012: (Letter Code: E)** Medium/High torque brake compound. Low pad and rotor wear v
modulation. #1 selling pad material for SCCA.
**Temperature Range:** 250º F - 1000º F, 121º C - 538º C

**HT 10: (Letter Code: S)** Intermediate to high torque with a smooth initial bite. Excellent modula
pedal, good release characteristics.
**Temperature Range:** 300º F - 1600º F, 149º C - 871º C

**HT 14: (Letter Code: V)** Very high torque with aggressive initial bite. Excellent modulation and
characteristics. Designed for cars with extremely high deceleration rates and down force. Super
material.
**Temperature Range:** 300º F - 1600º F, 149º C - 871º C

**HT 15: (Letter Code: R)** Very high torque with a smooth initial bite. Excellent linear torque to ap
relationship. Designed for cars with extremely high deceleration rates and limited down force.
**Temperature Range:** 300º F - 1600º F, 149º C - 871º C

**Extract of SUMMARY OF THE FMVSS 121 (DYNAMOMETER PORTION)**

Terminology:

**Average deceleration rate** = the change in velocity per unit time (▯v / ▯t), starting from the beginning of deceleration [§5.4][change in velocity or time is usually measured as “delta,” not that diamond sign]

**Brake retardation force** = (sum of brake forces / sum of GAWRs relative to chamber pressure) and corresponds to Column 1 of Table II in the regulation [§5.4.1]

**IBT** = initial drum temperature at the start of braking

**A. Burnish** [ref. §S6.2.6]: (total number of applications = 400)

- Make 200 stops from 40 mph at 10 ft/$s^2$ with 315$^o$ F 5 IBT 5,385$^o$ F
- Make 200 stops from 40 mph at 10 ft/$s^2$ with 450$^o$ F 5 IBT 5,500$^o$ F

(To increase IBT to the desired initial temperature, conduct stops from 40 mph at 10 ft/$s^2$. To decrease the IBT rotate the drum or disc at 30 mph).

**B. Brake Retardation Force.** [§ 5.4.1.1] (Total applications = 7)
With 125$^o$ F :5 IBT 5,200$^o$ F, and beginning with 20 psi chamber pressure:

- Decelerate from 50 to 15 mph at 9 $ft^2$. Record average torque.
- Increase chamber pressure by 10 psi, rotate the drum or disc until the temperature drops into the specified range and repeat (six times).

Total of seven decelerations at 20, 30, 40, 50, 60, 70, 80 psi.

**NOTE:** The 40 psi value in the above sequence is currently used for TMC RP 628.

**C. Brake Power.** [§ 5.4.2] (Total applications = 11)
Begin with 125$^o$ F 5 IBT 5,200$^o$ F for the first application.

- Conduct 10 decelerations from 50 to 15 mph at 9 ft/$s^2$ at equal intervals of 72 s counting from the start of deceleration of the previous application. (Line pressure not to exceed 100 psi for any application)
- After last deceleration and running at 20 mph, decelerate to stop at 14 ft/$s^2$

**D. Brake Recovery.** [§ 5.4.3] (Total applications = 20)

Begin 2 minutes after completing 5.4.2.

- Make 20 stops from 30 mps at 12 ft/$^2$ with (20 psi □ line air pressure □ 85 psi) for no anti-lock system or (12 psi □ line pressure) for an anti-lock system.

**TOTAL NUMBER OF BRAKE APPLICATIONS = 438,** including the burnishing stops

The term “fade” refers to a reduction friction co-efficient at elevated interfacial temperature, such that it requires more force to retard the vehicle when the brakes get hot. This characteristic is important to control in vehicles that normally run with hot brakes (buses, trucks in mountainous terrain, garbage trucks that stop once every 20 seconds, etc.).

Information related to fade is present in certain parts of the FMVSS 121 data. For example, consider the "Brake Power" segment of the procedure [§ 5.4.2], summarized as follows.

Begin with 125° F ≤ IBT ≤ 200° F for the first application. Then,

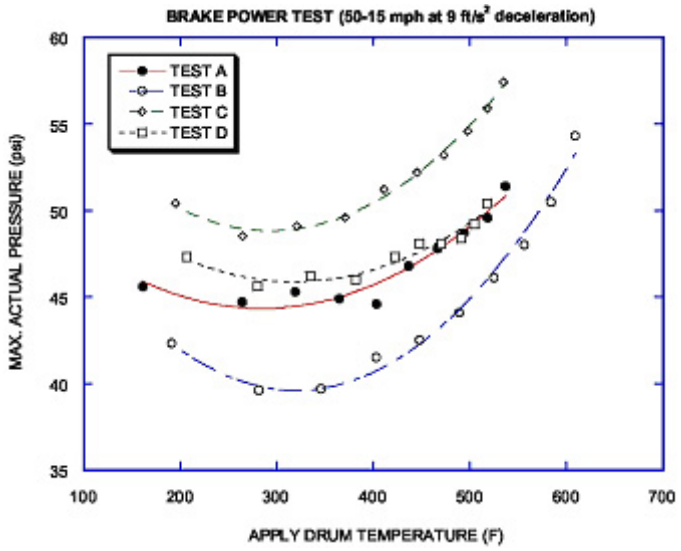
- Conduct 10 decelerations from 50 to 15 mph at 9 ft/s$^2$ at equal intervals of 72 s counting from the start of deceleration of the previous application. (Line pressure not to exceed 100 psi for any application.)
- After last deceleration and running at 20 mph, decelerate to a stop at 14 ft/s$^2$.

FMVSS 121 dynamometer "brake power" test data for several lining materials can be mathematically represented as a second-degree poly nominal of the form:

$$MP = m_o + m_1 T + m_2 T_2 \qquad (1)$$

Where T = brake temperature (°F), MP = maximum air line pressure (psi), and the m's are co-efficient to fit the data to a curve.

**Figure 10. Plot of actual brake power data for several RP 628 tests.**




[d]

The parameters calculated for four actual lining tests (plotted in Fig. 10) are shown in Table 3. The correlation co-efficient (R) is one measure of how closely the data fits the curve. In this case, the fit is reasonably good (R = 1.000 is a perfect fit). Taking the first derivative of

equation (1), above, and setting it equal to zero allows us to compute the minimum value for each curve. These range between 285° and 320° F. Warm drums (around 300° F) require less pressure to brake than either cooler or hotter drums.

**Table 3. Second-Degree Curve Fits to Brake Power Test Data.**

| 2nd degree fit to data | A | B | C | D |
|---|---|---|---|---|
| $m_o$ | 52.65 | 56.35 | 61.19 | 56.42 |
| $m_1$ | -0.0584 | -0.1047 | -0.0842 | -0.0664 |
| $m_2$ | 0.000103 | 0.000164 | 0.000143 | 0.000104 |
| R (correlation coefficient) | 0.972 | 0.994 | 0.996 | 0.971 |

While the mathematical parameters in Table 3 replicate the four curve shapes very well, they do not provide a direct sense of the fade performance. On the other hand, the difference between the minimum value, which falls at about 300° F, and the value at 500° F indicates how much more line pressure is needed to account for the fade-induced frictional fall-off at higher temperatures. Table 4 shows these values. On that basis, lining C has the most fade and lining D has the least.

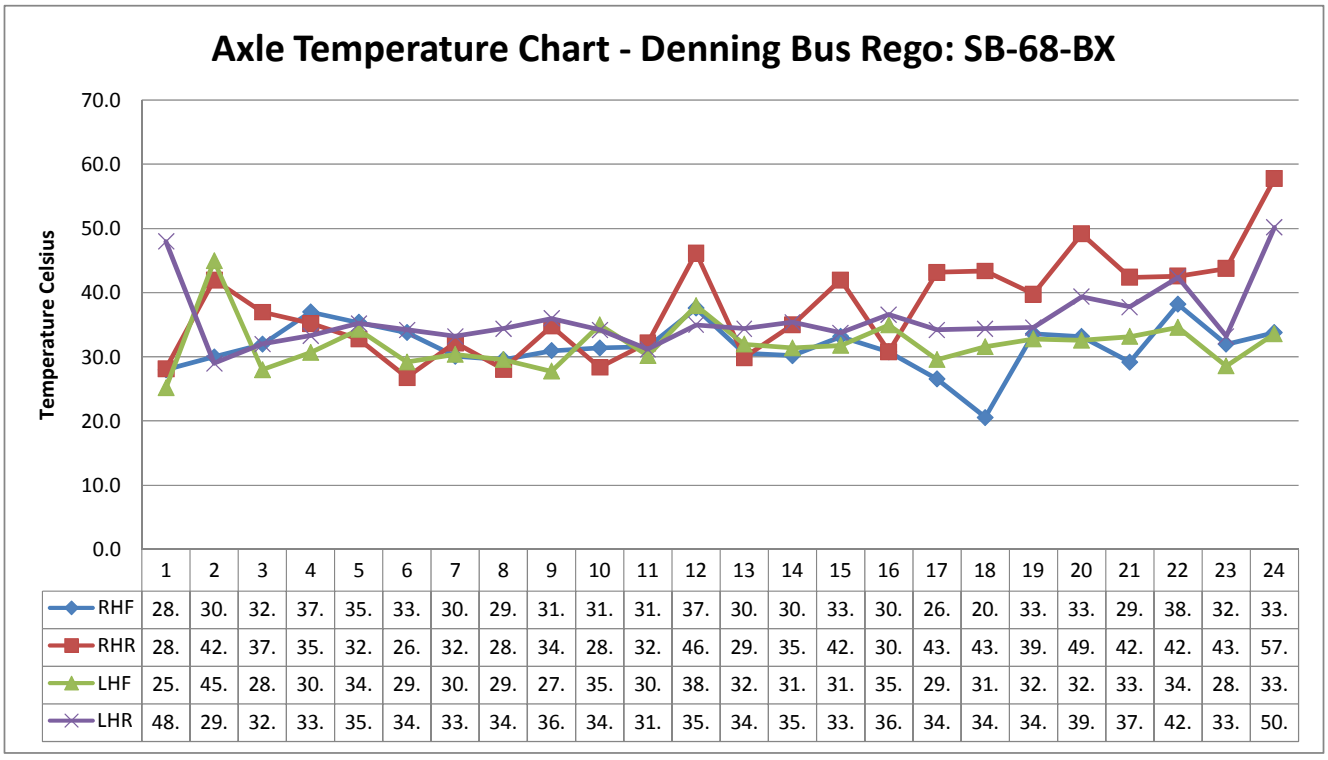
**Table 4. One Possible Measure of Fade.**

| Lining | Pressure at 300° F (psi) | Pressure at 500° F (psi) | Difference in pressure (psi) |
|---|---|---|---|
| **A** | 45.1 | 49.1 | 4.0 |
| **B** | 42.0 | 45.0 | 3.0 |
| **C** | 50.1 | 54.9 | 4.8 |
| **D** | 47.3 | 49.3 | 2.0 |

A range of only 2.8 psi between the four different linings is not very big, and requires accurate calibration of the testing equipment. Clearly, a wider range of data, encompassing ‘good’ and ‘bad’ linings, must be examined. Dynamometer test data can be used to indicate fade, but the additional calculations might be too involved to include within a simple and understandable lining code number.

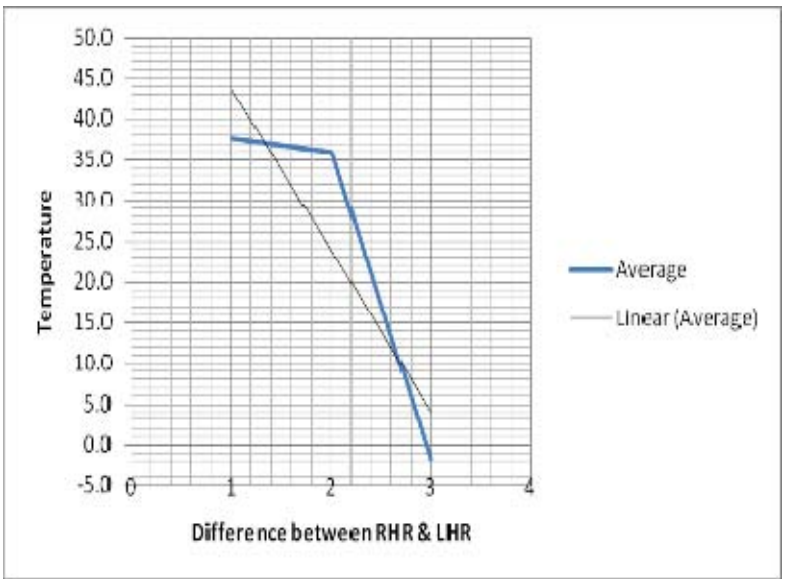
Temperature test data results. Denning SA Registration number SB-68-BX.

| | Temperature | | | |
|---|---|---|---|---|
| Test | Front RHF | Rear RHR | Front LHF | Rear LHR |
| 1 | 28.0 | 28.2 | 25.2 | **48.0** |
| 2 | 30.0 | 42.0 | 45.0 | **29.0** |
| 3 | 32.0 | 37.0 | 28.0 | **32.0** |
| 4 | 37.0 | 35.2 | 30.7 | **33.3** |
| 5 | 35.4 | 32.8 | 34.3 | **35.2** |
| 6 | 33.8 | 26.8 | 29.2 | **34.2** |
| 7 | 30.1 | 32.2 | 30.4 | **33.2** |
| 8 | 29.6 | 28.1 | 29.6 | **34.4** |
| 9 | 31.0 | 34.8 | 27.8 | **36.0** |
| 10 | 31.4 | 28.4 | 35.0 | **34.2** |
| 11 | 31.6 | 32.2 | 30.2 | **31.2** |
| 12 | 37.6 | 46.2 | 38.0 | **35.0** |
| 13 | 30.6 | 29.9 | 32.0 | **34.4** |
| 14 | 30.2 | 35.0 | 31.4 | **35.4** |
| 15 | 33.2 | 42.0 | 31.8 | **33.8** |
| 16 | 30.8 | 30.8 | 35.0 | **36.6** |
| 17 | 26.6 | 43.2 | 29.6 | **34.2** |
| 18 | 20.6 | 43.4 | 31.6 | **34.4** |
| 19 | 33.6 | 39.8 | 32.8 | **34.6** |
| 20 | 33.2 | 49.2 | 32.6 | **39.4** |
| 21 | 29.2 | 42.4 | 33.2 | **37.8** |
| 22 | 38.2 | 42.6 | 34.6 | **42.4** |
| 23 | 32.0 | 43.8 | 28.6 | **33.2** |
| 24 | 33.8 | 57.8 | 33.6 | **50.2** |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RHF | 28. | 30. | 32. | 37. | 35. | 33. | 30. | 29. | 31. | 31. | 31. | 37. | 30. | 30. | 33. | 30. | 26. | 20. | 33. | 33. | 29. | 38. | 32. | 33. |
| RHR | 28. | 42. | 37. | 35. | 32. | 26. | 32. | 28. | 34. | 28. | 32. | 46. | 29. | 35. | 42. | 30. | 43. | 43. | 39. | 49. | 42. | 42. | 43. | 57. |
| LHF | 25. | 45. | 28. | 30. | 34. | 29. | 30. | 29. | 27. | 35. | 30. | 38. | 32. | 31. | 31. | 35. | 29. | 31. | 32. | 32. | 33. | 34. | 28. | 33. |
| LHR | 48. | 29. | 32. | 33. | 35. | 34. | 33. | 34. | 36. | 34. | 31. | 35. | 34. | 35. | 33. | 36. | 34. | 34. | 34. | 39. | 37. | 42. | 33. | 50. |

| | Rear RHR | Rear LHR | Difference |
|---|---|---|---|
| | 28.2 | **48.0** | 19.8 |
| | 42.0 | **29.0** | -13.0 |
| | 37.0 | **32.0** | -5.0 |
| | 35.2 | **33.3** | -1.9 |
| | 32.8 | **35.2** | 2.4 |
| | 26.8 | **34.2** | 7.4 |
| | 32.2 | **33.2** | 1.0 |
| | 28.1 | **34.4** | 6.3 |
| | 34.8 | **36.0** | 1.2 |
| | 28.4 | **34.2** | 5.8 |
| | 32.2 | **31.2** | -1.0 |
| | 46.2 | **35.0** | -11.2 |
| | 29.9 | **34.4** | 4.5 |
| | 35.0 | **35.4** | 0.4 |
| | 42.0 | **33.8** | -8.2 |
| | 30.8 | **36.6** | 5.8 |
| | 43.2 | **34.2** | -9.0 |
| | 43.4 | **34.4** | -9.0 |
| | 39.8 | **34.6** | -5.2 |
| | 49.2 | **39.4** | -9.8 |
| | 42.4 | **37.8** | -4.6 |
| | 42.6 | **42.4** | -0.2 |
| | 43.8 | **33.2** | -10.6 |
| | 57.8 | **50.2** | -7.6 |
| Average | 37.7 | 35.9 | -1.7 |




RDW

Test report nr.: RDW-SPE-0655

# TEST REPORT

**TESTCENTRE**

Statement regarding the cooling behaviour of brakes, after mounting wheelcovers

| | | | |
|---|---|---|---|
| 0.1 | Make of vehicle | : | DAF |
| 0.2 | Vehicle type | : | CF75 |
| 0.3 | Wheelcover make and type | : | Rigidisc, 22.5 Inch |
| 0.5 | Name and address of the manufacturer | : | Rigidisc Media Inc.<br>2604 Northampton Ave.<br>Orlando Florida, FL32828<br>USA |
| 0.6 | If applicable, name and address of manufacturer's representative | : | Rigidisc Media Inc.<br>Wolfhezerweg 120-18<br>6874 AW Wolfheeze<br>Netherlands |

General : The device complies with the requirements laid down by RWTUV, Essen, Deutschland as provided by manufacturers representative:
see Documentation (1 page )

Tests : The tests are carried out in accordance with the above mentioned requirements. See annexes to this report no.: annex 1 to 3

Conclusion : The type of wheelcover complies with the requirements, and there are no objections to granting the approval.

Test date(s) : 11-12-2006

By : A. van Leussen

Agreed : Technical specialist tests,

Testcourse/Centre
Talingweg 76
8218 NX Lelystad

Lelystad, 18 December 2006
Head Test Centre,

RDW J.P.M. Laumen

**Test report nr.: RDW-SPE-0655**

**RDW TEST CENTRE LELYSTAD** **Annex: 1**

**Braketest : ~~Unladen~~/laden(*) without wheelcover**

| Vehicle specifications: (see vehicle specification sheet) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Make: | : | DAF | | Type | : | CF75 | |
| ~~Nat./EC/ECE~~ (*) | : | - | | Cat | : | N3 | |
| VIN: | : | XLRAE75PC0E516962 | | Place | : | Lelystad | |
| Roadsurface | : | Asphalt | | Weather condition | : | Rainy | |
| Windforce | : | 8 | m/s | Winddirection | : | S - SW | |
| Barometicpress. | : | 1013 | mbar | Temperature | : | 6.9 | °C |
| Humidity | : | 94.6 | % | Remarks :- | | | |
| Static measurements: | | | | | | | |
| Weights(mass): laden (incl. 1 pers.) | | | | unladen (incl. - pers.) | | | |
| Axle 1 : | 6190 | | kg | Axle 1 : | - | kg | |
| Axle 2 : | 6055 | | kg | Axle 2 : | - | kg | |
| Axle 3 : | - | | kg | Axle 3 : | - | kg | |
| Axle 4 : | - | | kg | Axle 4 : | - | kg | |
| Total : | 12245 | | kg | Total : | - | kg | |

| Adjustment of LSD (unladen/laden)(*) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ax.1:inlet.Pres. | | | | | | | | | |
| Cil. Pres. | | | | | | | | | |
| Ax.2:Inlet.Pres | | | | | | | | | |
| Cil. Pres | | | | | | | | | |
| Ax.3:Inlet.Pres. | | | | | | | | | |
| Cil. Pres | | | | | | | | | |
| Trailer. Pres. | | | | | | | | | |

*) strike out what is not applicable

Remark: pressure in bar

date: 11-12-2006

Initial:

wp5120d.r04/1:1/e

RDW

Test report nr.: RDW-SPE-0655

**RDW TEST CENTRE LELYSTAD** Annex: 2

**Braketest : ~~Unladen~~/laden(*) with wheelcover**

| Vehicle specifications: (see vehicle specification sheet) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Make: | : | DAF | | Type | : | CF75 | |
| ~~Nat./EC/ECE~~ (*) | : | - | | Cat | : | N3 | |
| VIN: | : | XLRAE75PC0E516962 | | Place | : | Lelystad | |
| Roadsurface | : | Asphalt | | Weather condition | : | Rainy | |
| Windforce | : | 9 | m/s | Winddirection | : | S – SW | |
| Barometicpress. | : | 1012 | mbar | Temperature | : | 7.6 | °C |
| Humidity | : | 94.9 | % | Remarks :- | | | |
| Static measurements: | | | | | | | |
| Weights(mass): laden (incl. 1 pers.) | | | | unladen (incl. - pers.) | | | |
| Axle 1 : | 6190 | kg | | Axle 1 : | - | kg | |
| Axle 2 : | 6055 | kg | | Axle 2 : | - | kg | |
| Axle 3 : | - | kg | | Axle 3 : | - | kg | |
| Axle 4 : | - | kg | | Axle 4 : | - | kg | |
| Total : | 12245 | kg | | Total : | - | kg | |

| Adjustment of LSD (unladen/laden)(*) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ax.1:inlet.Pres. | | | | | | | | | |
| Cil. Pres. | | | | | | | | | |
| Ax.2:Inlet.Pres | | | | | | | | | |
| Cil. Pres | | | | | | | | | |
| Ax.3:Inlet.Pres. | | | | | | | | | |
| Cil. Pres | | | | | | | | | |
| ~~Trailer Pres.~~ | | | | | | | | | |

*) strike out what is not applicable

Remark: pressure in bar

date: 11-12-2006

Initial:

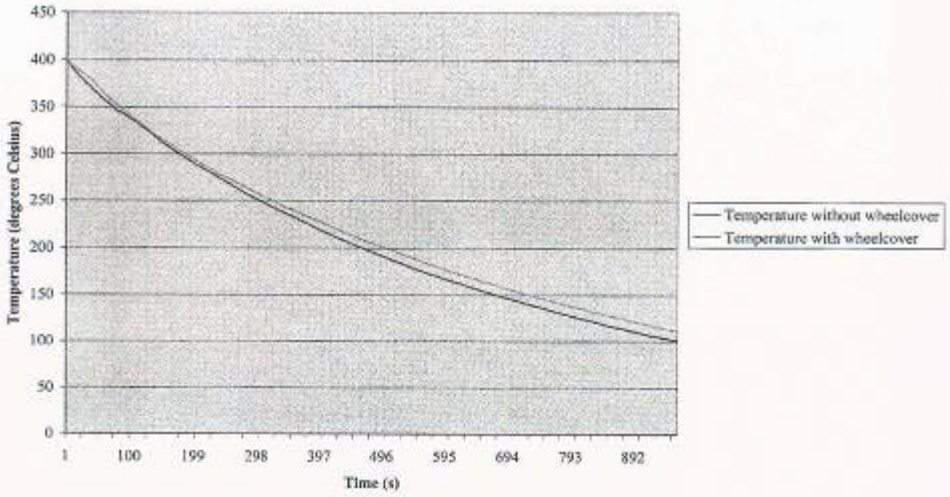
wp51204.r04/1:1/e

RDW

Test report nr.: RDW-SPE-0655

Test Data:

**Temperature against Time at 80 km/h**




- The temperature of the brakepads with cover is 11°C higher than without covers in the same time.
- The temperature of the wheelcoversurface is at 450°C brakepadtemperature 20°C, and at 100°C brakepadtemperature 14°C.
- Minimum space between disc(1) and adapter (2) is 3 mm, see photo 2 on page 5.
- Height between ground and wheelcover 205 mm, see photo 4 on page 6. The mounted tyres during the test were : Bridgestone R227, 295/80 R22.5 152/148M.
- 10 holes in the outher ring adapter with a diameter of 40mm, see photo 1 on page 5.
- 10 holes in the disc fixed on the adapter with a diameter of 85 mm x 60 mm, see photo 6 on page 7.

RDW

Date: 11-12-2006

Initial:

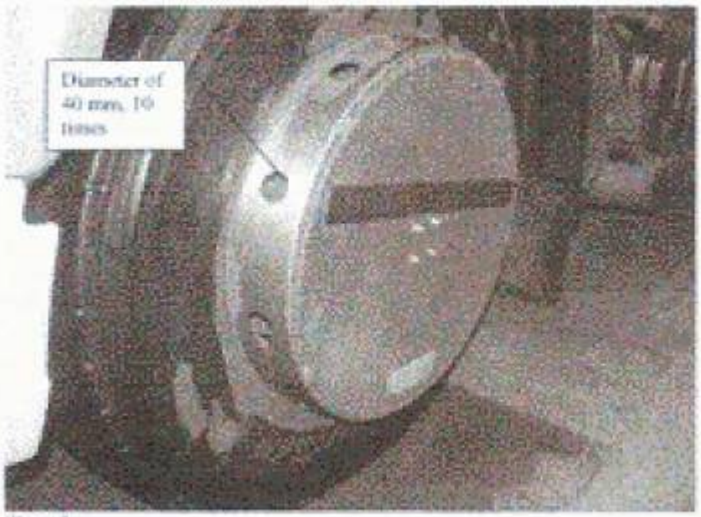



Photo 1

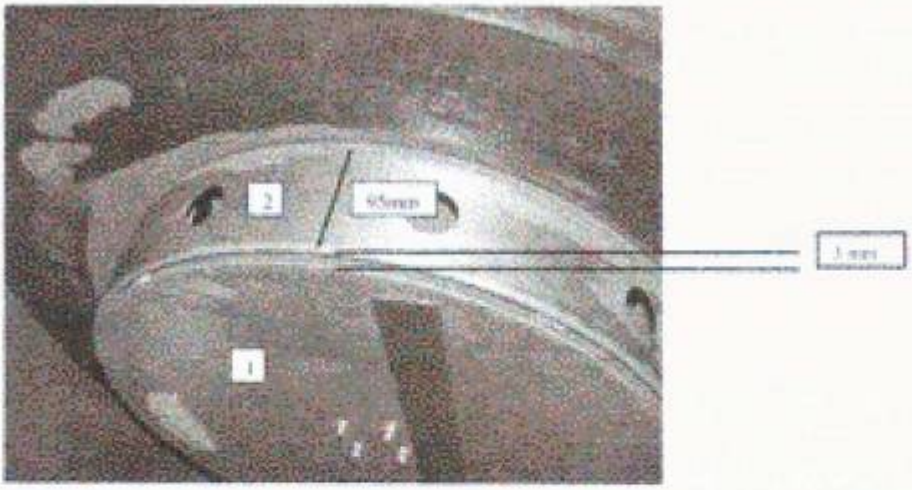



Photo 2

Date: 11-

Initial

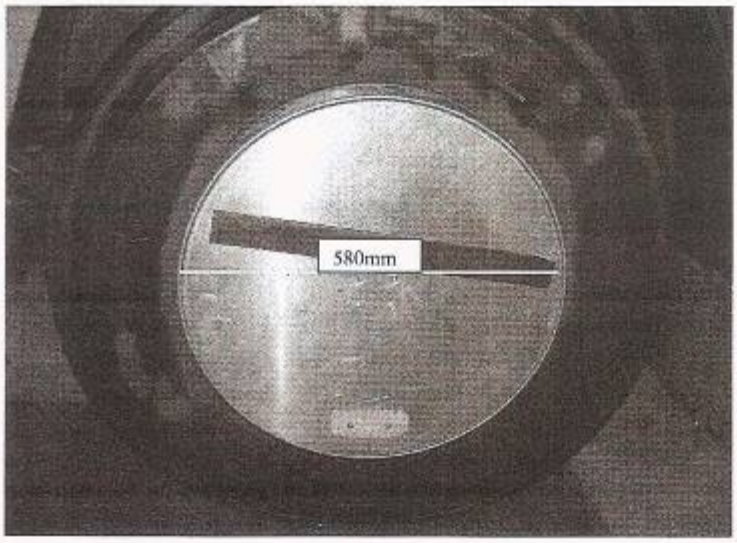



Photo 3

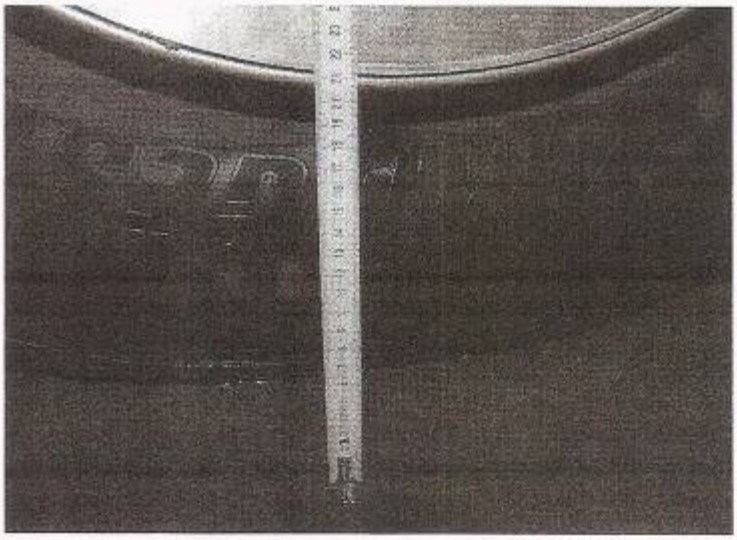


Photo 4

Date: 11-12-2006

Initial:

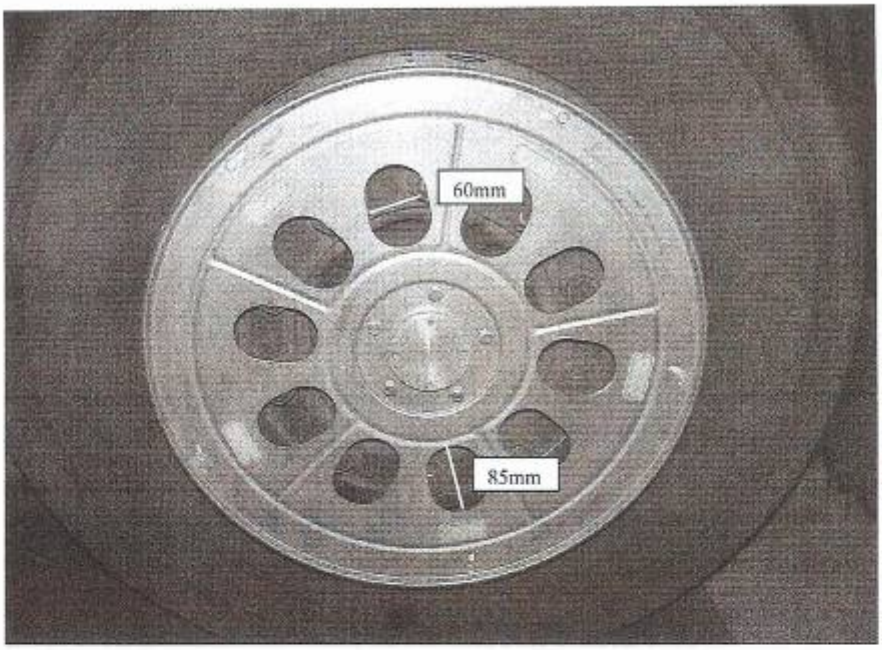



Photo 6

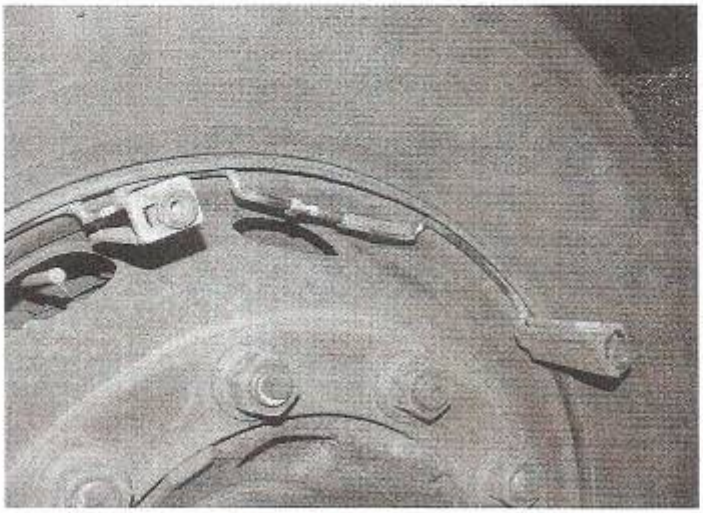


Photo 7

RDW

Date: 11-12-2006

Initial:

Test report nr.: RDW-SPE-0655

**RDW / TESTCENTRE** **ANNEX: 3**
**Testequipment execution testing**

| USED TESTEQUIPMENT order nr. :VR 129718 | |
|---|---|
| **Description** | **Registration number** |
| Scale | OPS 08 |
| Pressure meter | |
| Speed measuring equipment | GPS 02 |
| Decelleration meter | VYF 78 |
| Pedalforce meter | |
| Temperature meter | TEM 41 / TEM 31 / TEM 32 |
| Tirepressure meter | MAN 43 |
| Force measurement equipment | |
| Dynometer | VTR 12 |
| Time measure testequipment | STW 18 |
| Angle meter | |
| Reactiontime measure testequipment | |
| Engine rev. meter | |
| Braketest bench | |
| Hydr. parkingbrake pull equipment | |
| Recorder(s) | RCH 13 / OPS 011 |
| Noise measure testequipment | |
| Torque measurement equipment | |
| Dynamic fatique testequipment | |
| Length measurement equipment | CLASS II |
| Amplifier | |
| Filter | |
| Supply | SUP 26 / SUP 55 |
| | |
| | |
| | |
| | |
| | |

**Remarks:**

date: 11-12-2006

Initial:

wp5101a.r01/1:1/e

**IFM**
Institut für Fahrzeugtechnik und Mobilität
Institute for vehicle technology and mobility

TÜV NORD Mobilität

# Expert Technical Statement

with respect to the occurence of a possible endangerment
in the sense of §19/2 StVZO

**No.: TZ-028438-A0-260_Engl**

| | |
|---|---|
| Vehicle Part : | **SPECIAL HUBCAPS**<br>(hubcaps disengaged from wheel rotation) |
| type: | **RIGIDISC B&T-Line** |
| of Manufacturer: | **Rigidisc Media Inc.**<br>**Wolfhezerweg 120-18**<br>**6874 AW Wolfheze**<br>**Niederlande** |

## 1. Range of Application

The special hubcaps described in paragraph 2 are being used exclusively on wheels of categorie N (trucks) and D (busses) with maximum speed of 100 km/h and with a wheel size of 22,5 inches
while observing the prescription described in paragraph 4

**Instructions to Vehicle Keeper**

**An acceptance test of the part is not being considered as required**
However, for proof of the part's adherence to prescriptions, it is recommended to always keep this expert technical statement in the vehicle to enable its presentation to authorized persons upon demand.

If desired by the vehicle keeper, an entry into the vehicle documents can be made. For this purpose, the vehicle must be presented to an officially recognized expert. The vehicle title and this confirmation must also be submitted at that time.

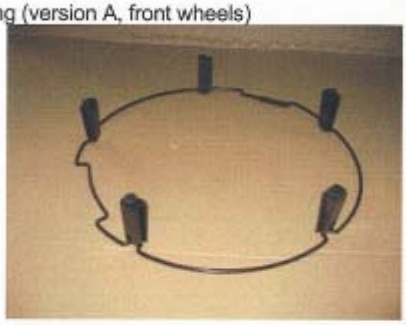
TÜV NORD

**Expert Technical Statement**
**No.** : **TZ-028438-A0-260_Engl** Page **2** of **5**

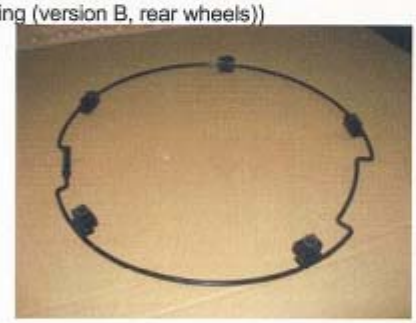
Customer : Rigidisc Media Inc.
Type : RIGIDISC B&T-line
Type of Part : Special Hubcaps 04.01.2008

**2. Description of parts (see photos)**
Three-part special hubcaps consisting of attachment ring, cover disc and advertising disc as well as attachment parts in different versions being part of the delivery.

cover disc with bearing unit and attachment ring (version A, front wheels)

cover disc with bearing unit and attachment ring (version B, rear wheels))

advertising disc

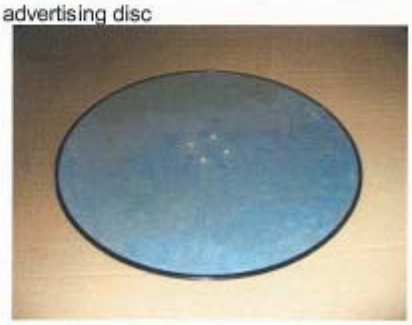


foto of mounting

- **Cover Disc** with bearing unit
  outer diameter 595 mm, material : stainless steelplate with thickness 0,8 mm
  in 2 versions A and B:

  A: with height of 100 mm for front axles
  B: with height of 44 mm für rear axles

- **attachment ring** for attachment at the flange of steel wheels with size 22,5 inches.
  steel wire whelded design, powder coated in two versions (see fotos)
  A- height 95 mm
  B- height 39 mm

- **advertising plate**
  material: alloy, outer diameter 560 mm with with edge-protective adhesive tape

**2.1 Marking:**

Type label sticker
at backside of advertising plate


**2.2 Technical Data of Special Hubcaps:**

The fixing of the attachment ring to the wheel is made by a spread nut with counter nut as a clambing seat in the rim flange. During the mounting process, the attachment disc will automatically center itself onto the wheel. Final adjustment can be made by using the long holes in the cover disc. The cover disc is screwed onto the attachment ring by means of 5 screws. The advertising plate is screwed by means of 4 screws onto the rotating flange of the bearing unit.
On the backside of the advertising plate an excenter weight is mounted which disconnects the disc from wheel rotation and –in normal operation- only allows pendulum motion.

## 3. Tests and Test Results

Test basis are the prescription of StVZO as well as the directives issued for this.
In particular, the following tests were conducted:

- Directive 74/483/EEC – Exterior Surfaces
- Attachment
- Corrosion test according to DIN 50021
- Comparison testing of brake cooling (RDW-SPE-0655)
- Strength endurance test Type 1(roller test stand):
  8000 km at speed of 120 km/h normal operation – no rotation
- Strength endurance test Type 2 (roller test stand):
  3300 km at speed of 120 km/h with locked plate and excenter weight of 300 g
- crack detection

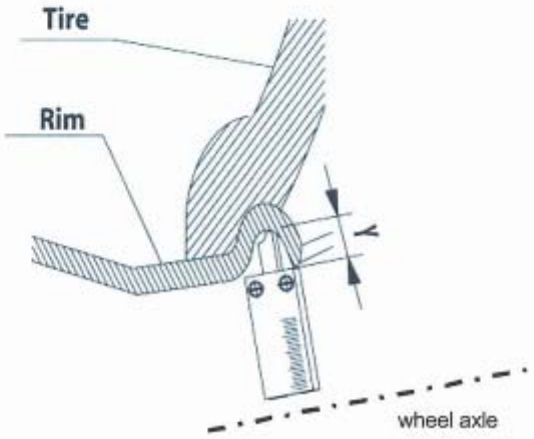
### Test Results:

All of the tests listed above have been concluced with positive test results.
No damages were found on tested parts.
The fixation of the parts is save and endurable.

## 4. Requirements

4.1 For attachment purposes, the mounting instructions must be observed. Only those attachment means that were part of the delivery may be used.

4.2 The inner height "Y" of the rim flange may not be less than 4 mm measured perpendiculary to the wheel axle otherwise a save fixation is not possible. (see painting)



TÜV NORD

**Expert Technical Statement**

| **No.** | : **TZ-028438-A0-260_Engl** | Page **5** of **5** |
|---|---|---|
| Customer | : Rigidisc Media Inc. | |
| Type | : RIGIDISC B&T-line | |
| Type of Part | : Special Hubcaps | 04.01.2008 |

4.3 For the mounting the special hubcaps the following general restrictions are valid:
- The special Hubcaps may not extend externally more than 30 mm beyond the external chassis walls
- The maximum width of the car may not be more than 2,55 m after mounting the Hubcaps

4.4 No retro-reflecting foil may be bonded to the exterior disc.

4.5 The tools for mounting must be kept in the vehicle at all times (tire change, air pressure controls)

4.6 An operation with snow chains is not permitted.

## 5. Summarization

There are no technical objections against the attachment of the described special hubcaps to steel wheels of N and O vehicles (trucks / busses) with size 22,5 inches. On account of the simple mounting and the distinct attachment position, it is not considered necessary to conduct an acceptance test.
**An endangerment to traffic participants in the sense of §19, paragraph 2 StVZO is not being exptected.**
**In regard to §30c StVZO (exterior sufaces) the tested Hubcabs are an improvement compared with common systems.**

Essen, Germany, 04.01.2008

IFM TÜV NORD Mobilität DIN EN ISO/IEC 17025 KBA-P00004-96

**Institut für Fahrzeugtechnik und Mobilität**
Fachgebiet: Räder – Reifen – Fahrwerk – Tuning
***Institute for Vehicle Technology and Mobility***
*subject: wheels – tires – suspension - tuning*

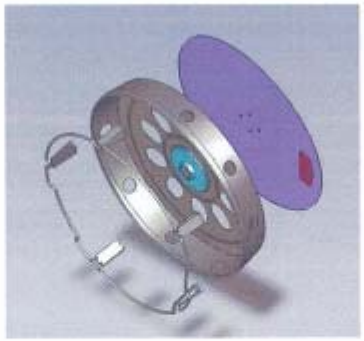
Dipl.-Ing. Ulrich

# INSTRUCTIONS

**Important Warnings**

- Always check the condition of all parts before mounting the Rigidiscs to the wheels. The Rigidiscs should not be installed if any part is missing or damaged.
- Incorrect installation, installation with worn or damaged parts or installation with parts that are not original will result in loss of warranty and liability.
- Avoid contact with sidewalks.
- Do not mount additional profiles to the faceplate.
- Always follow the rules and regulations of local governing authorities.
- Always follow the instructions as given by your car, wheel and tire manufacturer.
- Check and clean the Rigidisc installation and parts in regular intervals (e.g. Every 3 weeks).
- Only use original Rigidisc parts when replacing worn or damaged components.

**NOT FOLLOWING THESE INSTRUCTIONS RESULTS IN LOSS OF WARRANTY**



**Rigidisc-Media Inc.**

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Finance & Administration — 2604 Northampton Ave | Orlando, FL 32828 | USA — T: +1 407 2735402 | F: +1 407 3820303

# INSTRUCTIONS

**Rigidisc Installation;**

A. Verify that you have all the parts as shown on the parts list and there are no signs of wear or damage.
B. Remove hubcaps, design caps, wheel covers and/or ornamental fittings.
C. Thoroughly clean the wheel groove (fig. 1).
D. Place the mounting ring assembly in the wheel groove (fig. 2), make sure that balancing weights are located in the offset portion and do not contact the ring (fig. 3).
E. Expand the ring assembly by turning the elongated nut (fig. 4) until the ring fits tightly in the groove and cannot move. Check this by trying to move the ring (fig. 5)
F. Secure the ring assembly by tightening the locknut to the elongated nut (fig. 6)
G. Place the bracket over the ring (fig. 7) and make sure that the wheel bolts are accessible through the openings of the bracket (fig's 8 and 9).
H. Secure the bracket with the 5 washer rings and bolts (fig. 10).
I. Mount the faceplate with the washer rings and security bolts (fig. 11).
J. Check the system as follows:
    a) Make sure that the Rigidisc does not stick out beyond the body of the vehicle.
    b) Turn the faceplate by hand to make sure that the Rigidisc can spin freely. Repeat the installation steps if a knocking or interference sound is heard while turning the faceplate.
    c) Leave the window open during the first test drive and listen for any sounds coming from the Rigidisc. They should operate quietly. Always re-check the installation if a sound can be heard.

In case of doubt and for more information please email info@rigidisc.com

**Additional;**

- In order to facilitate checking tire pressure and filling tires, we recommend using valve extensions (fig. 12).
- For wheel balancing we recommend using balancing powder.



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RIGIDISC™


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## Conclusion

Transport Certification Services has concluded that the average temperature differential of 1.7 degrees Celsius as recorded from the left hand side rear Covered Wheel Rim to the right hand side rear Wheel Rim (in favour of the covered wheel rim) does not exceed nor impede the performance parameters of either the Rim temperature or the Brake Block temperatures or performance.

The test results from both TUV NORD and TCS have proven that the vehicles brake temperature increase does not affect the braking performance of the vehicle or any mechanical components of the brake system i.e. brake linings and brake drums/discs.

The WHEEL RIM COVERS as supplied for testing purposes are deemed to be suitable, as they were proven not to adversely impede on the braking temperatures of the donor vehicle.

Installation to the rims is to comply exactly as per the installation manual as attached to this report.

*Signed:*

Phillip J Hodges
*Mech. Eng.*

***Registered Engineering Signatory:***

***Victoria VASS D001***
***Queensland MA2239***
***South Australia 2003/08213/01***
***Western Australia***
***Tasmania***
***Northern Territory***