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COMMERCIAL VEHICLE WHEELS AND RIMS

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COMMERCIAL VEHICLE WHEELS AND RIMS

The design of the multi-piece rim for commercial vehicles was patented in 1912 and has been little changed over the years. The first disc wheel was introduced by Budd - USA. 1917.

In the 1960's commercial wheel and rim development made significant progress with testing of tubeless design to reduce weight and improve tyre performance, and as we move along, in the 1980's considerable research has been initiated to find new materials for wheel construction.

Notwithstanding the fact that the wheel has been in existance some 5 000 years and there is little change in commercial wheel design since 1912, there is much confusion over the terms "wheel" and "rim" in the industry. Please remember a rim is not a wheel and a wheel is not a rim.

A rim supports the tyre and is a continuous circle without a centre. A wheel is the combination of a rim and a disc centre permanently attached to each other, and fixed to a hub by studs and nuts.

This paper covers wheel types in current use, aluminium wheels and pointers for their use,problems with multi-piece rims and high pressure tyre needs, general service information and the application of wide singles.

COMMERCIAL VEHICLE WHEELS AND RIMS

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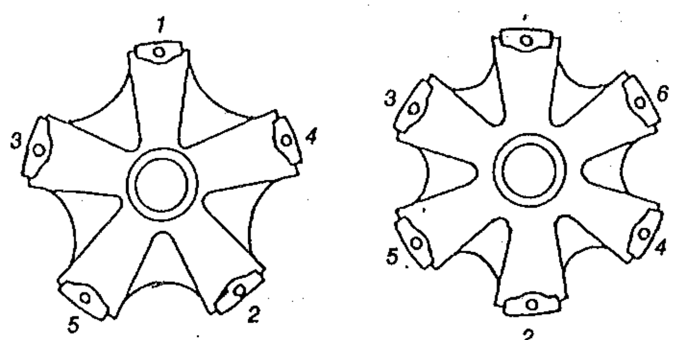
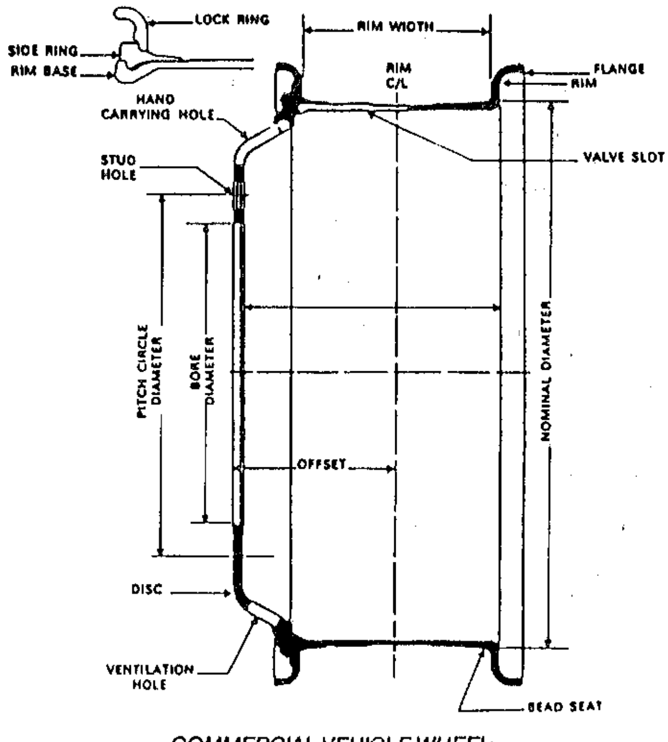
1. WHEEL TYPES

On heavy commercial vehicles there are basically two (2) types of wheels used. The disc type and the cast spoke wheel. In Australia, about 80% of wheels on trucks are the cast spoke type. Where the tyres are mounted on separate rims and the tyre/rim assembly is bolted on the spokes.

1.1 Illustrations



CAST SPOKE WHEEL



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One of the drawbacks of the disc wheel is its weight. Every kilo that the truck's engine must haul that isn't payload decreases the operating efficiency of the truck. By reducing component weight, the operational payload of a truck is increased. The advantage of using a disc wheel comes from the ability to mount tyre, rim and wheel as one unit against a machined hub so that it's easy to align and balance the total assembly.

The advantage of the cast spoke demountable rim is that there is no fixed heavy centre and thus there is less weight to handle when changing tyres. The disadvantage of the spider (cast spoke) rim is that it does not run so truly - particularly if great care is not taken to centre the rim on the hub before the lugs are tightened. It is possible to mount a rim off-centre on a spider with a resulting alarming "wobble" resulting in uneven tyre wear.

1.2 Tyre and Wheel Balancing

Commercial Vehicle Wheels aren't plain round things really, although wheel makers try to make them as nearly round as is possible, they are not a true circle.

The increased speed capability of modern commercial vehicles, combined with fast freeway systems, has led to a growing necessity for balanced tyre and rim assemblies. Vibration set up by front tyre and wheel assembly imbalance is transmitted through the cab mounts to the driver and is particularly noticeable on cab-over-engine mounted vehicles. Rear wheel vibration can be transmitted to driver and passengers through the suspension, transmission and chasis components. On most heavy vehicles vibration problems can be eliminated by balancing the front wheels only.

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The wheel is a vital component of the rolling assembly and must, therefore, be manufactured to desirable tolerances. Lateral run-out or wobble is measured on the vertical face of the rim flange to coincide with the positioning of the tyre bead. Wobble or lateral run-out should not exceed 1,8mm for all sizes of commercial vehicle rims.

Lift or radial run-out is the maximum difference between the high and low points of a truly mounted rotating wheel and is again measured on <u>both</u> tyre bead locations. Radial run-out as establised by the Tyre & Rim Association is:

1.2.1 All Diameters with rim section to 7,50 width = 1,8mm.

1.2.2 All Diameters with rim section to 8" wide and above = 2,0mm.

Where problems arise at higher speeds and cannot be solved by careful balancing, not more that 225 grammes of weight should be used. It may also be necessary to match the tyre and rim for maximum concentricity.

This may be achieved by locating and marking the low spot on the tread crown of the fitted tyre before stripping the assembly, then by locating and marking the averaged high spot obtained on the two (2) rim bead seats. The tyre can then be refitted to the wheel for optimum tyre and wheel concentricity by aligning the tyre low spot mark and the rim high spot mark adjacent to each other. Careful balancing at this stage will ensure that maximum balance and concentricity of the tyre and wheel assembly has been attained.

For the great majority of vehicles, and most types of operation, a simple front wheel static balance correction will suffice and the full tyre and wheel matching procedure should be required only for 'problem' vehicles.

As tyre technology overcomes the problem of getting down to low run-out tolerances, wheel manufacture will also have to move into tighter specifications. When the accepted tolerances of each of the components in the rotating mass are achieved then other sources of vibration are generated. One of these is the non-uniformity within the rim structure.

Variations of the radial "spring" rate of the rim around its circumference give rise to periodic radial forces in the vehicle suspension, as the assembly rotates. In a similar manner, a varying lateral or axial force may be generated by lateral non-uniformities. Raw material supply is the area for action to overcome this harmonics problem and is the subject of current discussion with the steel manufacturers.

2. NEW MATERIALS : ALUMINIUM

Cast aluminium wheels have been around for a long time as fitment to motor vehicles. Their popularity stems mainly from their pleasing variety of styles and design shapes.

Appearance is also a factor for many operators of heavy commercial vehicles, but the reduction in tare weight achieved against a similar steel wheel or about 18 - 20kg per wheel and better tyre performance, are the principal reasons of interest., Load strength and durability is achieved by the use of aluminium forgings, with much of the background experience coming from the use of aluminium forgings in aircraft and aerospace industries, over some thirty-five (35) years.

Forging of aluminium wheels (97% aluminium) for heavy commercial vehicles involves a giant press in the 8 000 ton range. Under forging pressure, metal follows the contour of the part, thus providing strength at the greatest stress points. It is highly resistant to corrosion, prolonging wheel life and eye appeal.

Tyre performance is improved because concentricity of the wheel is restricted to within ,50mm, compared to 2,0mm for a steel wheel, and aluminium runs cooler because of its natural ability to dissipate heat faster.

2.1 Testing of Aluminium Wheels

Aluminium wheels from the production line are tested under road conditions on a dynamometer. Top load plus side cornering stress are the two (2) most critical in measuring the wheel's ability to hold up under prolonged service. McKay has conducted a dynamic cornering fatigue test on an 8,25 x 22,5 forged aluminium tubeless truck wheel with most pleasing results. Details are:

Test carried out	:	Dynamic cornering fatigue test				
Min cycles required	:	100,000				
Bending moment	:	17,700mm	(1067mm ARM)			
Shaft deflection	:	Start :	7mm	1,000 cycles	=	7mm
Nut torque	:	Start :	500nm	1,000 cycles	=	500nm
Maximum cycles actually run	:	3,000,000				

Inspection revealed no failure or potential failure of wheel.

Extended field usage has confirmed that aluminium as a material for heavy commercial vehicle wheels is quite satisfactory if the wheel design is good and if the manufacturing procedures have been performed properly.

To further extend the advantages of aluminium, spoke wheels are now an engineered product. At this stage their use is designed for steel tubeless rims pending the proving of a suitable adaptor to reduce the 22,5" diameter down to 20" , and attach to the 28° angle ramp. This is the most critical area on a spoke wheel assembly.

To provide adequate metal thickness around the rim stud, special rim clamps are required for aluminium spoke wheels.

2.2 Corrosion

Due to aluminium's natural resistance to corrosion, forged aluminium disc wheels do not need to be painted for most operating conditions. However, certain environments can lead to corrosion. Some of these are:

Livestock Haulage, Salt, Chloride compounds used for snow removal and highly Alkaline materials.

And if the air used for tubeless tyres is not dry, the areas of the wheel covered by the tyre can corrode severely. This factor also applies to steel wheels.

Maintenance against corrosion is best achieved with frequent cleaning with steam or a high pressure hose. The use of a mild detergent will speed the cleaning process.

2.3 Wheel Mounting

Because of the extra thickness (gauge) of the nave centre of aluminium as compared with steel (22mm V 13mm), the length of the stud will, in most instances, need to be increased to accommodate aluminium wheels. Similarly, the type of wheel nut in service needs to be confirmed as being suitable for aluminium.

For wheels drilled for mounting on the European spigot mounting system, the hub spigot should be checked to ensure the spigot surface is long enough for mounting and support of the wheel. Recommeded spigot lengths are:

Front 10mm : Dual wheels 32mm.

The length of the pilot spigot which centres the wheel is most important for aluminium wheels. On a single wheel, or an outside dual, it should extend about half way through the wheel. Full support through the entire wheel is not required of the pilot spigot, but sufficient length to support all wheels is necessary.

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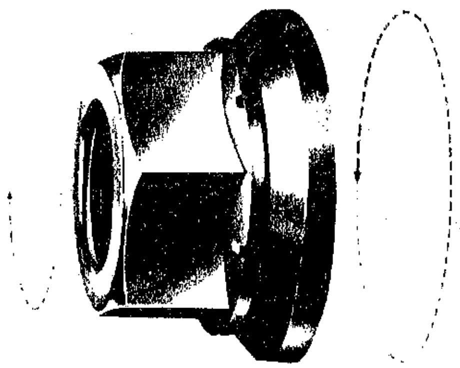
Proper torque for mounting cap nuts used on spigot mounted wheels is 700 - 800nm, on high horsepower, high brake efficient vehicles normally equipped with 22m Metric Studs.

Make sure all wheel cap nuts are fully torqued and check them often. If the wheel is loose, the stud holes will pound out. If some cap nuts are tight and others loose, the wheel may develop cracks, or studs may break.

There are many types of nuts and studs in use with spigot hub mountings but for aluminium wheels the two (2) piece cone lock cap nut is the only type recommended. The use of one piece flanged lock nuts may significantly reduce the service life of the wheel.

Cap nuts



A cap nut with an integral, flat swivel washer.
(M 22 type)

It should be particularly noted that all integral cone cap nuts are right hand threads for attaching wheels to all positions. Longer studs are acceptable as the nuts will not bottom out.

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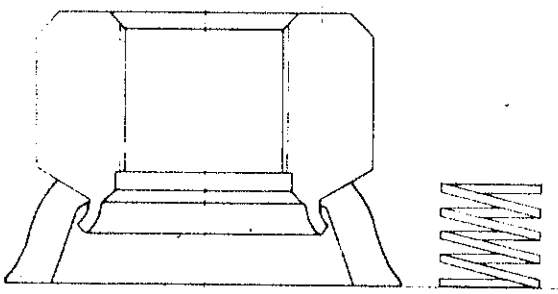
Clamping force losses are primarily caused by wear of the nut seats. The flat seat of the cone lock nut provides a more positive mating, hence less wear. Laboratory tests by Motor Wheel Engineering Department, USA, show that nut clamping force loss after five (5) remountings of both front and dual fittings was 14%. This compares with losses of 21% - 29% for the standard budd double cap nut system. In addition the effective clamp force per nut is up to 75% greater at the same torque loading, with a broader torque range.

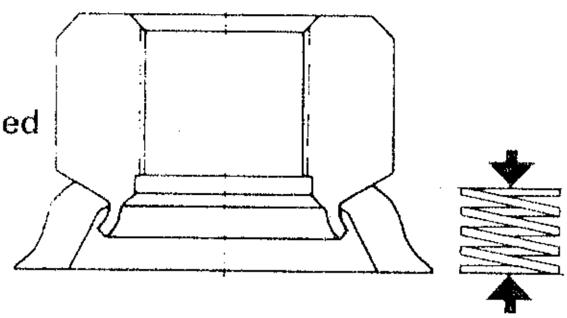
Here is how it works:*

Loose condition



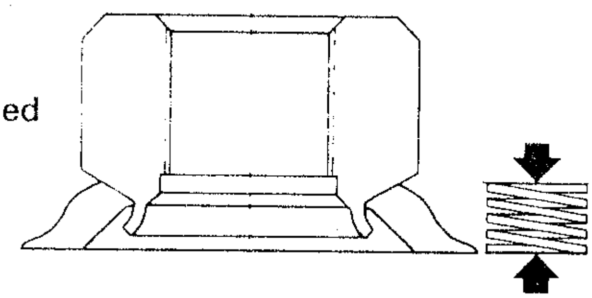
The Cone Lock Nut can be compared to an unloaded coil spring before torquing.

Partially tightened condition.



The most important benefit of the Belleville washer effect comes during the normal "seating-in" process when paint, dirt and surface irregularities wear away. Torque loss is minimized as the spring-like cone continues to exert pressure between the nut and wheel surface..This keeps wheels from loosening and breaking.

Fully tightened condition



Under maximum torque, the nut acts like a compressed coil spring, exerting maximum pressure against the face of the wheel and evenly distributing clamping pressure. This can also be compared to the effect of a lock washer.

*The drawings are exaggerated to demonstrate the principle. The cone lock nut washer does not visibly "flex" under torque.

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2.4 CLAMP-TORQUE COMPARISON

	80% of yield stress N/mm^2	Corresponding clamp force kgf	Corresponding clamp torques required (Nm)		Clamp torques commonly recommended Nm
			DRY	LUB	
$^7/8$in BSF T grade	510	15130	850	680	380 - 550
$^7/8$in BSF V grade	640	19180	1080	865	400 - 620
$^7/8$in UNF T grade	510	16690	815	655	450 - 550
$^7/8$in UNF V grade	640	21180	1030	830	480 - 600
22mm MF 9,8 grade	510	16180	765	615	480 - 540
22mm MF 10,9 grade	640	20530	970	780	550 - 690

Generation of enough clamping force to hold wheels by frictional contact against dynamic forces is essential - particularly with spigot-located wheels. On the basis that the frictional force in the threads to ensure nut-tightness is generated at about 80 per cent yield of a typical stud, the corresponding tightening torques need to be greater than are mostly recommended.

Studs of V-grade steel and those with metric fine threads need to be taken to only 70 per cent yield stress to achieve acceptable nut security, but to give adequate clamping friction on spigot wheels the nuts have to be tightened to at least 780Nm (570 lb-ft) and that implies tightening to about 80 per cent of yield again. Even then it is impossible to hold a spigot wheel if there is oil or grease on its faces.

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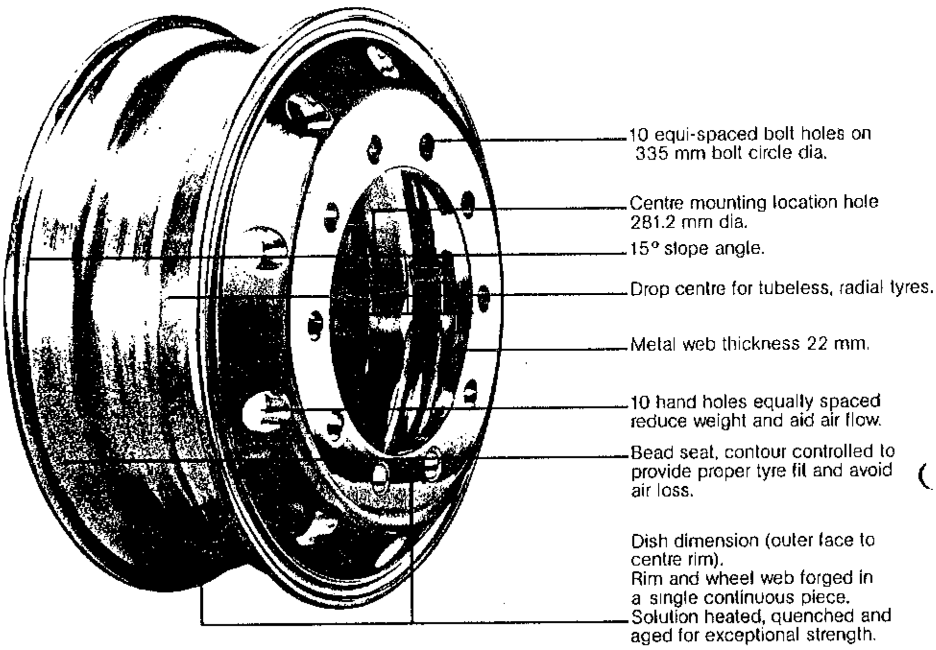
2.5 CLAMP FORCES PER STUD ((10,9 grade METRIC) FOR SPIGOT WHEELS)

Clamp force at 80% yield kgf	Typical clamp forces kgf	Clamp forces needed to take dynamic and braking loads		
		DRY	PAINT	OILY
20530	14210 to 18160	12270	16360	24540

2.6 European Spigot Mounting Wheel



2.7 Aluminium Disc Wheel : Load Rating

Tubed	Tubeless	PR	Max Tyre Load	Design Rim	Max with Load
9,00R20	10R22,5	14	2,600kg	7,50 x 22,5	3,100kg
10,00R20	11R22,5	16	3,000kg	8,25 x 22,5	3,250kg
10,00R22	11R24,5	16	3,200kg	8,25 x 24,5	3,260kg
11,00R20	12R22,5	16	3,260kg	9,00 x 22,5	3,750kg

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3. MULTI-PIECE RIMS AND HIGH PRESSURE TYRES

The higher air pressures now being used in radial ply tyres and the development of extra-ply rated bias ply tyres to carry bigger loads has become a serious problem for two (2) piece demountable rims and two (2) piece disc wheels where the disc is fixed inboard of the rim gutter. The problem exists irrespective of rim manufacturer.

Rim ovality is so serious that many servicemen have to deflate the tyre to get the rim over the spoked hub and find that two (2) piece rims bind to the hub after periods of road service. Many a truck operator has experienced scalloped tread wear or rapid tyre wear on the outer ribs of front tyres after changing to high ply rated radials. Some have gone so far as to bend axles and changing tyre brands in an attempt to fix the problem.

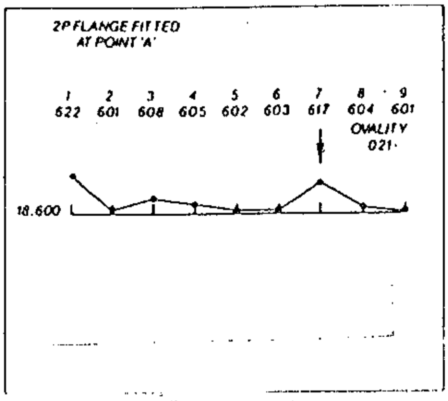
The higher air pressures required for high load needs causes distortion of the two (2) piece rim when the tyre is inflated. This distortion or "ovality" is due to the particular construction of the two (2) piece rim, where the split flange allows symmetrical deflection under load.

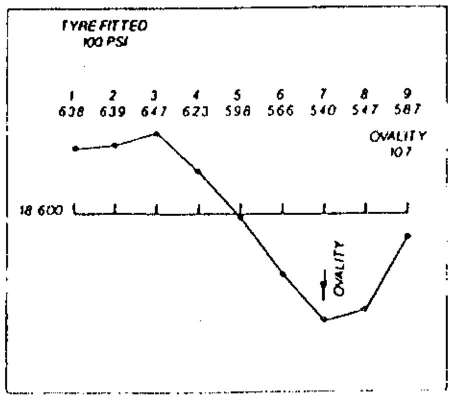
Whilst tolerances in rim seating, without tyres fitted, vary slightly between brands, with 700kPa (100 psi) inflation in the tyre there is an obvious problem. The following graphs of popular rim makes show the ovality of each rim with no tyre fitted compared to a tyre fitted and inflated to 100 PSI. The same tyre fitted to a three (3) piece rim presents no problem.

The worst situation is when the ovality stops the rim running fully up on the 28° bevel on a spider hub. The fixing lugs can be tightened up leaving the rim with a noticeable wobble as it rolls and the chance of working loose as it flexes in service.

In case of the three (3) piece rim the endless flange or side ring prevents the rim from becoming oval, no matter which position the gap in the locking ring is located. Our graph confirms that even at high pressure, the symmetry of the rim is constant.

7,50,20 2 PIECE DEMOUNTABLE RIM : BRAND 'A'





Without a tyre fitted rim ovality on, this rim is minimal at ,021". (See above Graph).

However, with a tyre fitted and inflated to 100psi - 700kPa, rim diameter changed to a minimum at one point of 18,540" and a maximum of 18,647".

The hub diameters on five (5) popular makes of spiders ranging from 18,500" to 18,550", this rim would not slide up into position without the tyre being deflated.

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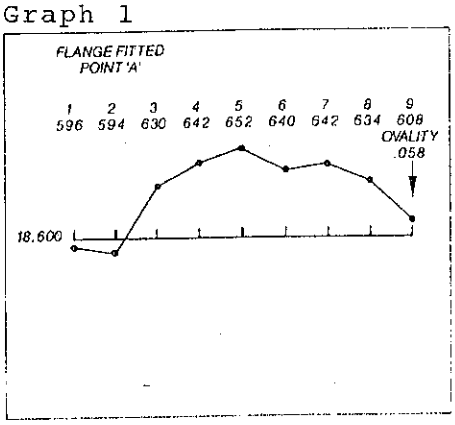
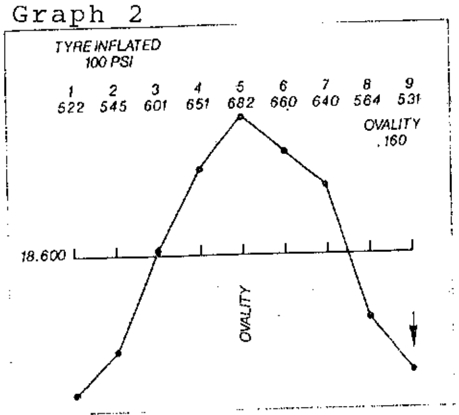
7,50-20 2 PIECE DEMOUNTABLE RIM : BRAND 'B'

Graph 1



Graph 2



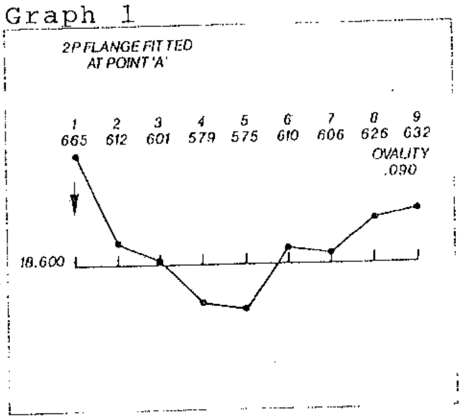
Graph 1 shows the rim without tyre and with lock ring gap fitted at maximum rim diameter varied from 18,594" to 18,652" - the resultant ovality being ,058".

Graph 2 shows the same rim with tyre fitted and inflated to 100psi - 700kPa. Rim diameter variations moved to 18,522" and 18,682" at maximum. Ovality increased to ,160".

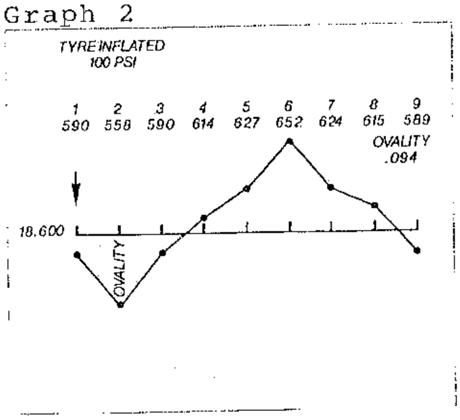
A cross check of five (5) popular makes of spider hubs shows that minimum diameters range from 18,500" to 18,550", therefore this rim would bind on at least three (3) of the five (5) hubs checked.

7,50-20 2 PIECE DEMOUNTABLE RIM : BRAND 'C'

Graph 1



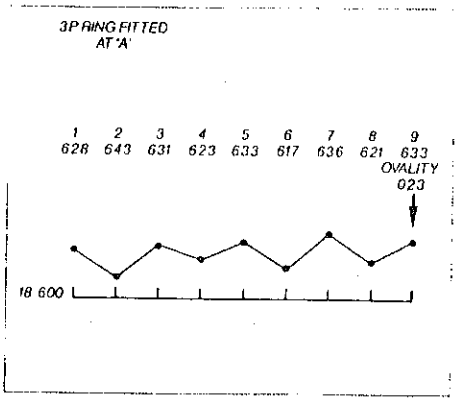
Graph 2

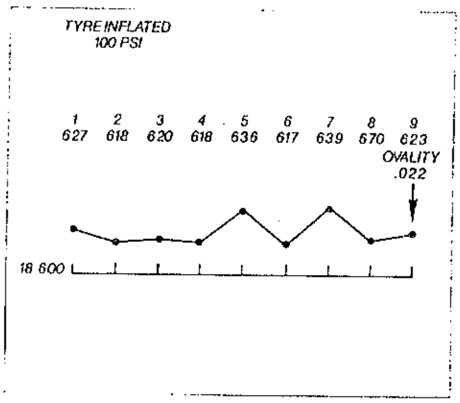


Graph 1 shows the two (2) piece rim without tyre fitted and with lock ring gap fitted at maximum. Rim diameter varied from maximum 18,665" to minimum 18,575".

Graph 2 shows the change in rim diameter after the tyre has been fitted and inflated to 100psi - 700kPa. Minimum 18,558". This rim would be a tight fit on some hubs.

7,50-20 3 PIECE DEMOUNTABLE RIM

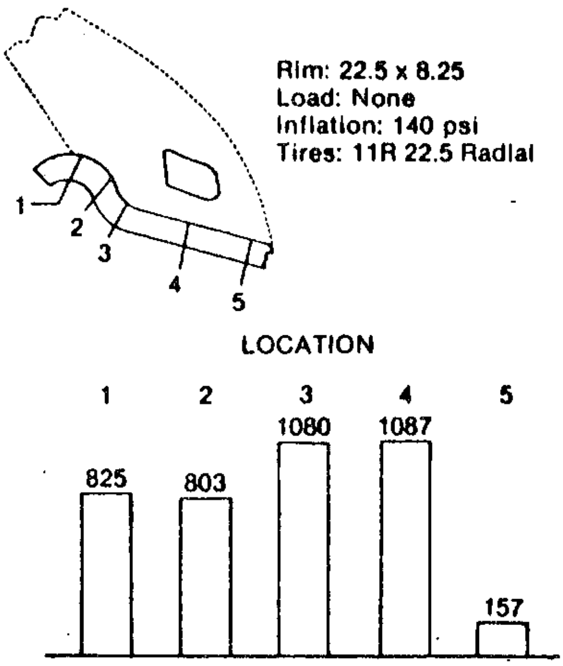


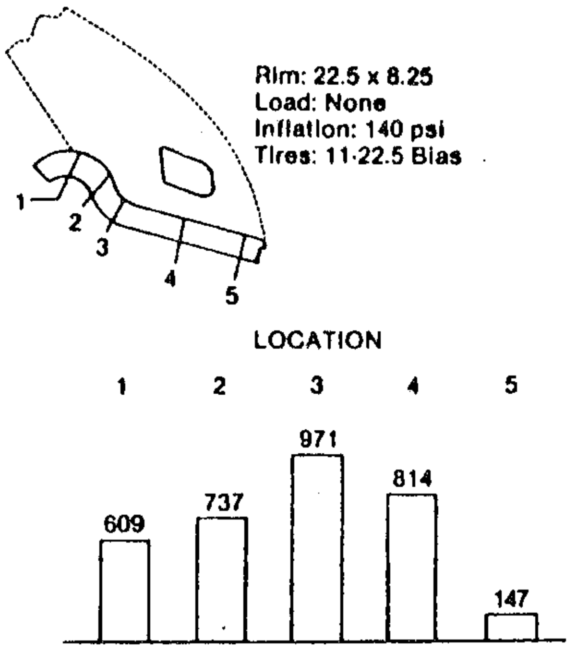


Rim diameter in the standard and inflated conditons is almost constant and with minimum tolerance at 18,617" would have no difficulty in sliding on to a hub where the minimum-maximum diameters ranged between 18,500" to 18,550".

3.1 Wheel and Rim Loading : Tyre Construction Effects

The key constructional effect is the carcass construction of bias ply or radial ply tyres. Additional influences on the wheel are aspect ratio, bead construction, and rim/tyre fitment. Figure 1 shows the bias tyre load distribution and figure 2 shows the radial tyre load distribution on the 15° drop centre rim.





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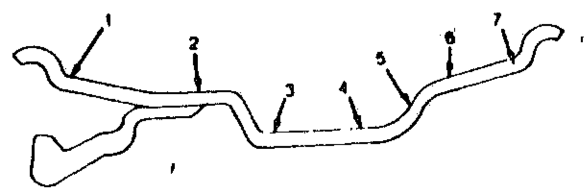
The bias tyre bead is more massive and the sidewall is much stiffer. As a result, the tyre loading is bead dependent causing more of the total force into the bead seat. Conversely the radial tyre has a smaller bead and a flexible sidewall which causes the lower sidewall to load the rim. These two (2) basic load differences cause much different stress in the rim. In general, the well stresses and disc stress are higher with the radial tyres since the loading is greater on the flange of the rim. In multipiece rims the stress in the bead seat area is higher with a bias tyre. A very stiff bias tyre with multiple plies of wires will severely reduce the fatigue life of the rim and as a result many rims are not approved for this tyre construction.

The load and inflation affect the rim differently. Most of the rim stress is due to the inflation pressure. The dependency upon inflation at various locations is given in the illustration below. The load affects mainly the rim well and not the bead seat. The load effect is generally confined to the footprint of the tyre or $\pm$ 30° from the centre of the loading. Some locations show the effect of tyre construction on this loading by having a double peak with bias tyres and only a single peak with radial tyres. In general, inflation pressure causes the mean stress and this stress is generally the one of most concern to the rim designer.

Gage Positions

Inflation dependency
in drop centre rim



Position	% Of Stress Due To Inflation
1	90-100
2	38-42
3	76-84
4	70-87
5	68-78
6	55-85
7	50-100

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4. WIDE SINGLE TYRES AND FRONT WHEEL FITMENT

The application of wide singles has seen rapid progress over the last three (3) years, and all the indications are that their use will be further extended over the next five (5) years in line with changes in the road laws.

The Ralph McKay Commercial Wheel and Rim Manual covers the variety of fitments for wide singles in considerable detail. There is, however, one (1) application that needs further explanation, and that is the fitment to front wheels.

Whilst it may be generally possible to produce wide single rims in the required offset to comply with track width and overall width requirements of the road law for almost every heavy commercial vehicle, there are other safety factors which should not be overlooked.

In some vehicles overall track width can be maintained, but extreme turns on one (1) lock may interfere with the drag link unless angle is reduced and turning circle increased. Track cannot be increased to maintain existing turning circle as this will increase the load on the outer wheel bearings and impose stresses in the stub axles, unless these have been designed to take the extra loading.

Wide single tyres have considerably greater ground contact area which requires increased assistance from the power steering gear in dry park conditions. All power steering fitments are not rated to handle the additional drag of the added tyre mass involved and should be qualified when wide singles are to be fitted.

The increased rotating mass of the assembly could affect ADR brake certification and increase impact loads fed back into the suspension and steering systems.

On the other hand, several of the heavy commercial vehicle manufacturers readily approve the fitment of wide singles for many of their models, but this should not be taken to be a blanket approval for every model in the range.

Wide single tyres can be readily fitted to drive wheels and trailers, but when it comes to front wheel application, we strongly recommend consultation with the Engineering Services Department of the truck manufacturer concerned.

5. SPACER BANDS FOR CAST-SPOKE (SPIDER) WHEELS

Spacer bands are designed to provide the required clearance between duals on a cast spoke wheel assembly to conform with the minimum dual wheel spacing for a given tyre size, as set down by the Tyre and Rim Association. Their function is to render adequate lateral strength with the minimum amount of weight.

Dual spacing is the distance from centre line to centre line of tyre tread of the two (2) tyres in a dual assembly and automatically allows for the spacing between the tyres fitted. Additional spacing is required where chains are fitted for special service conditions.

The sum of the offsets of the two (2) rims used, plus the width of the spacer band, equals the dual spacing or centre line to centre line of the tyre assembly.

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The following sets out the spacing achieved with rims of a given offset using varying spacer band widths, as well as the minimum dual spacing set down by Tyre and Rim Association.

McKay Part No	Rim Size	Offset (MM)	Dual Spacing Achieved with Spacer Band Width			
			3 5/8"	4"	4¼"	4½"
18315	750 x 22,5	108,2	308 MM	318 MM	324 MM	331 MM
18316	825 x 22,5	117,7	--	335 MM	341 MM	348 MM
18492	825 x 22,5	111,7	--	325 MM	331 MM	338 MM
T & R Assoc Minimum Dual Spacing : Tyre Size						
	10 R 22,5	290				
	11 R 22,5	320				
	12 R 22,5	345				
	11/70 R 22,5	335				

NOTE: With tyre and rim changes on a spider hub assembly it may be necessary to change the spoke end adaptor clamp.

The variety of spacer bands in general use has been limited to the corrugated and channel types. In the interests of weight reduction some markets have seen the introduction of a new lightweight corrugated band with a flanged edge. Compared with the corrugated 4" band supplied by McKay, the weight saving is 1,36kg per band. McKay 3,86kg : new lightweight 2,5kg.

McKay tests showed no noticeable structural strength variation between the standard corrugated band and the new lightweight.

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The main disadvantage of the lightweight in service, is that it takes a permanent set of 1 - 1,5mm at approx 20,73kg/M, then solid resistance with no spring back. In effect, this means there could be less spring tension on the clamps.

The standard McKay corrugated type yields on to the hub with the corrugations acting as two (2) shorter concave columns, retaining spring back similar to two (2) Belville washers back to back, to assist in keeping the total assembly tight.

The principal point for consideration, therefore, is the regular re-checking of the clamp torque levels where lightweight spacers are used.

GENERAL DATA TYRES FOR TRUCKS, BUSES AND TRAILERS USED IN NORMAL HIGHWAY SERVICE TYRES MOUNTED ON TYPE I, II AND III RIMS AND WIDE BASE BRITISH PRACTICE RIMS

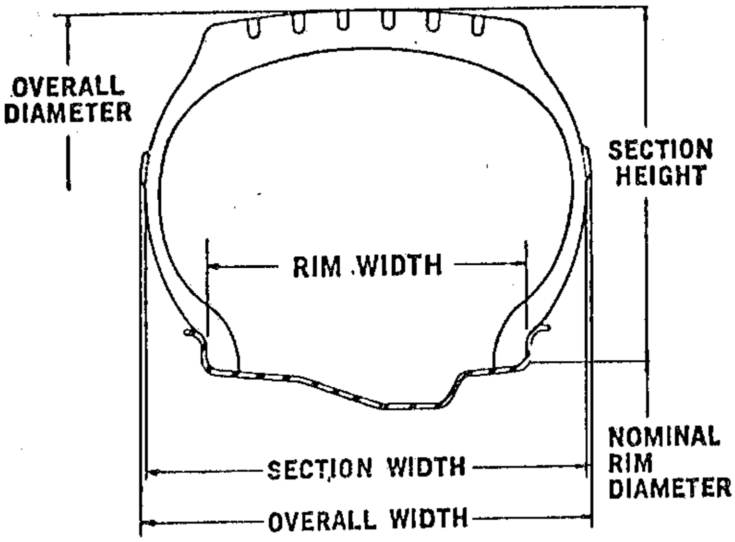
TYRE SIZE DESIGNATION	DESIGN RIM WIDTH CODE	RIM WIDTH	DESIGN NEW TYRE: SECTION WIDTH	OVERALL DIAMETER: HIGHWAY TREAD	OVERALL DIAMETER: HEAVY TREAD	OVERALL DIAMETER: TRACTION TREAD	*MINIMUM DUAL SPACING	TR TUBE VALVE	MIN FLAP WIDTH
DIAGONAL									
7.00-15	5.50	140	199	777		792	226	75A	145
7.00-17	5.50	140	199	828		843	226	75A	145
7.00-20	5.50	140	199	904		919	226	76A	145
7.50-15	6.00	152	215	808		825	244	75A/76A	145
7.50-17	6.00	152	215	859		876	244	75A/76A	145
7.50-18	6.00	152	215	884		901	244	177A/175A	145
7.50-20	6.00	152	215	935		952	244	177A/175A	145
8.25-15	6.50	165	236	847	855	865	269	78A/77A	145
8.25-17	6.50	165	236	898	906	915	269	78A/77A	145
8.25-20	6.50	165	236	974	982	992	269	77A/175A	145
9.00-15	7.00	178	259	892	904	911	295	78A/175A	165
9.00-16	7.00	178	259	917	929	936	295	76A	145
9.00-20	7.00	178	259	1019	1031	1038	295	175A/78A	165
9.00-24	7.00	178	259	1120	1132	1139	295	175A	165
10.00-15	7.50	191	278	927	940	946	318	78A	165
10.00-20	7.50	191	278	1054	1067	1073	318	78A/179A	201
10.00-22	7.50	191	278	1104	1118	1123	318	78A	201
11.00-20	8.00	203	293	1085	1099	1104	335		203
11.00-22	8.00	203	293	1135	1150	1155	335	78A	203
11.00-24	8.00	203	293	1186	1201	1206	335		203
12.00-20	8.50	216	315	1125		1146	361	78A	198
DIAGONAL AT RESTRICTED SPEED									
13.00-20	9.00	229	340	1177		1200	390	179A	226
14.00-20	10.00	254	375	1241		1266	425	179A	229
14.00-24	10.00	254	375	1343		1368	425	179A	229
RADIAL									
7.50R15	6.00	152	208	778			245	75A	170
8.25R15	6.50	165	230	836	844		275	77A	175
8.25R20	6.50	165	230	963	970		275	77A/175A	145
9.00R20	7.00	178	255	1020	1028		305	78A/175A	165
10.00R20	7.50	191	272	1051	1061		325	78A/179A	201
11.00R20	8.00	203	287	1080	1090		343	78A	203
12.00R20	8.50	216	315	1125		1136	361	78A, 464	216

NOTES: 1. Approved rims.
2. Permissible Practice—In order to provide for design differences, manufacturing tolerances and 24 hour inflation growth:
(a) Overall new tyre widths may exceed the above new tyre section widths by 4%.
(b) Overall diameters of new tyres may exceed the above design new tyre overall diameters by 4% of the difference between the design new tyre overall diameters and the nominal rim diameters.
3. Tube size designation is the same as tyre size designation.
4. *When chains are used, additional spacing may be required.

GENERAL DATA TYRES FOR TRUCKS, BUSES AND TRAILERS USED IN NORMAL HIGHWAY SERVICE MOUNTED ON 15° DROP CENTRE RIMS

TYRE SIZE DESIGNATION: DIAGONAL PLY	TYRE SIZE DESIGNATION: RADIAL PLY	DESIGN RIM WIDTH CODE	RIM WIDTH	DESIGN NEW TYRE: SECTION WIDTH	OVERALL DIAMETER: HIGHWAY TREAD	OVERALL DIAMETER: HEAVY TREAD	OVERALL DIAMETER: TRACTION TREAD	*MINIMUM DUAL SPACING	†**TR TUBE VALVE	†*MIN FLAP WIDTH
TRUCK-BUS										
8-19.5	8R19.5	6.00	152	203	859		876	235	300	185
8-22.5	8R22.5	6.00	152	203	935		952	235	300	180
9-22.5	9R22.5	6.75	171	229	963	982	992	260	300	193
10-22.5	10R22.5	7.50	191	254	1020	1031	1038	290	300	193
11-22.5	11R22.5	8.25	210	279	1051	1067	1073	320	300	201
11-24.5	11R24.5	8.25	210	279	1104	1118	1123	320	300	198
12-22.5	12R22.5	9.00	229	300	1080	1099	1104	345	300	216
12-24.5	12R24.5	9.00	229	300	1135	1150	1155	345	300	216

DEFINITIONS



NEW TYRE DIMENSIONS

The dimensions of an unloaded new tyre mounted on its measuring rim at the recommended inflation pressure and allowed to stand for a minimum of 24 hours at normal room temperature before readjustment of the pressure back to its original level.

MAXIMUM TYRE DIMENSIONS IN SERVICE

Inflated tyre dimensions including growth in service to be used by vehicle manufacturers in designing for tyre clearances.

RIM WIDTH

The linear distance between the flanges of the rim.

MEASURING RIM

The rim specified by the relevant Sub-Committee for the measurement of the tyre.

RECOMMENDED RIM

The rim which gives the best fitment of the tyre for all conditions and types of service.

PERMITTED RIM

Any rim, in addition to the recommended rim, whose fitment can be permitted. Check with tyre and wheel manufacturers to confirm the suitability of the tyre/wheel assembly for the intended service.

THEORETICAL RIM

A rim having a width of specified ratio to the nominal section width.

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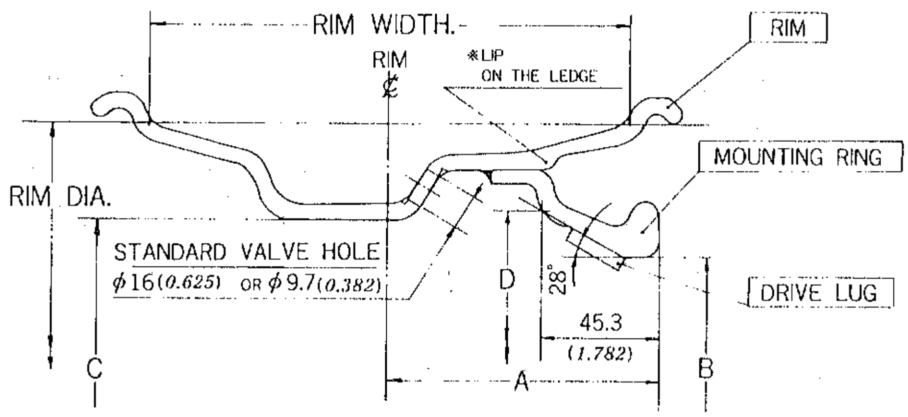
6. DEMOUNTABLE TUBELESS RIMS AND CLAMP SECURITY:

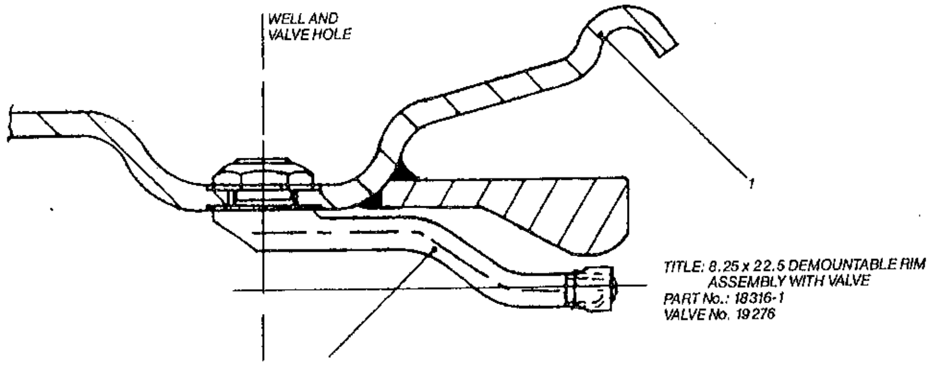
The rim diameter at the bead seat of a demountable tubeless rim is approximately 63,5mm (2,5") greater than at the rim well. The well diameter is nominally the same as the 20" standard rim it replaces. viz: Tubeless 22,5" - Conventional 20".

Because of this increased diameter a special adaptor ring is attached to allow the rim to be secured to the 28° bevel ramp of the spider.

TUBELESS RIM WHEELS. (DEMOUNTABLE) UNIT:mm *(inches)*



Early field experience obtained from the range of imported rims being sold into the aftermarket indicated serious safety problems were being encountered in the mounting to spider hubs and resulted in McKay taking an entirely different approach in adapter ring design for its "Freightmate" range of tubeless rims.



McKay research confirmed that the field problems were the result of excessive and irregular torque being applied when tightening the spider assembly, and this effectively expanded the adaptor ring into a hexagon. The adaptors were generally fabricated with a high degree of run-out and the torque expansion created extra run-out growth with consequent clamping problems. In fact the run-out was so extreme that in many che.ks the interference fit of rim to ramp was only 28% of the circle. The machined adaptor has an effective 94%, In these adverse conditions the clamps were clamping the hub and not the assembly. The result, loose wheels.

The McKay freightmate range for spider assemblies has a fully machined, heavy gauge adaptor, submerged arc welded on both sides with a run-out tolerance down to 15° to ensure continuous interference fit at the mounting ramp. The bolt-up ledge face is fully blocked to give more tensile strength when high torque loading is applied. This means that clamping is more secure and wheel wobble is virtually eliminated if the correct tightening procedures are adopted. The adaptor rings on most imported tubeless rims are of the open gutter type and welded on one (1) side only.

In the case of the wide single range, the finished assembly is machined after fabrication, thus providing the ultimate in uniformity.

The correct fitting of the front clamp assembly is vital to safety. For a better understanding of this, we show RIGHT and WRONG illustrations.

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WRONG :

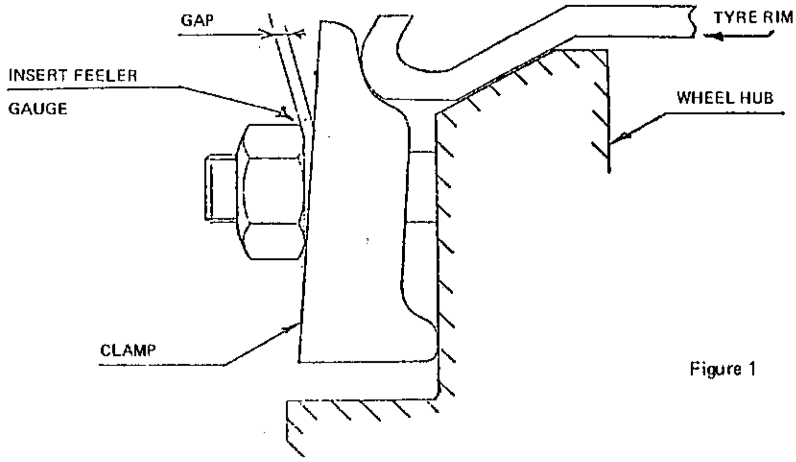
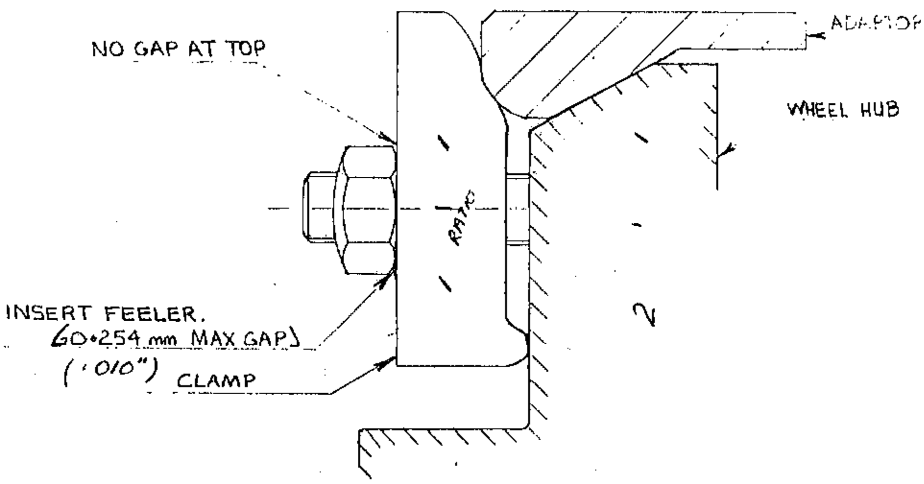
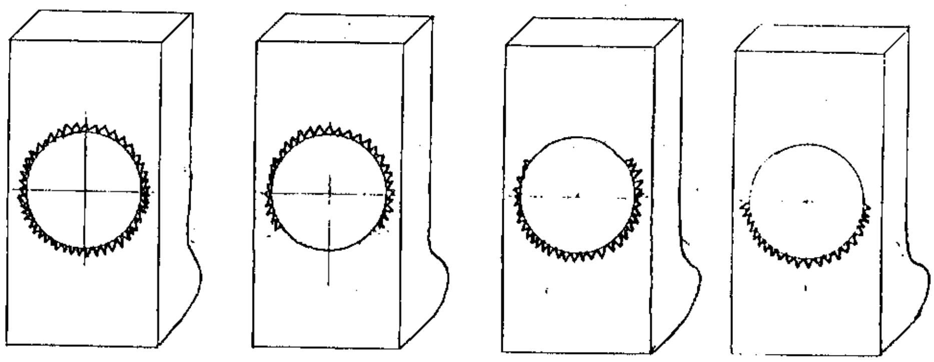


Figure 1

RIGHT :



CHECK BEARING OF NUT TO CLAMP TO ENSURE CORRECT FITMENT



VERY GOOD ✓ GOOD ✓ WRONG X WRONG X

IN GENERAL THE TOP HALF SHOULD SHOW BEARING
I.E CLAMP WHEEL. NOT TOE OF CLAMP.

C449

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7. DELETERIOUS EFFECTS OF LIQUID BALANCERS AND SEALANTS

The use of Liquid Balancers and Sealants in Pneumatic Tyres has been promoted by various manufacturers over the last decade. Their success or otherwise, as a Balance Correction or as an Air Sealant, is not of concern to us. However, their use in tubeless truck tyres and consequential damage to the rim is of serious concern.

McKay has handled several rims of many makes which have failed in service after a very short service life and, which, in each instance, the operator had used a Liquid Balancer. Samples were submitted for testing to assess the causes for such premature failure, and the results confirmed that the presence of cracking in the inner section of the rim and severe degradation of the total surface enclosed by the tyre was entirely due to the use of Liquid Balancing Materials.

Upon viewing under a binocular microscope at magnifications up to X40, the surfaces were clearly indicative of a progressive fatigue failure with the fatigue crack having initiated from the heavily scaled, corroded surface and progressing almost completely through the section before breaking through to the external rim face. The rims concerned had not completed the service life of the initial tread of a new radial truck tyre.

Several fatigue cracks had formed, apparently from corrosion pits in the surface. The failure occurred at a logical location - at a stress concentrating corner of the rim well or the side furthest from the weld reinforcement and where the bending and flexing stresses, when the wheel is in service, would be expected to concentrate.

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It was apparent that the corrosion pitting was due mainly to the nature of the Anti-Lear Sealant combined with humidified air. The pits formed appeared to be the nucleation for the eventual fatigue failure. The material is not water based, but is water soluble, and tends to "Activate" the surface, leading to corrosion, if the clear liquid is removed. The liquid layer would be spun off during service.

Once the paint had been affected and/or breaks had appeared in the paint film, corrosion would take place rapidly under the service conditions expected to be encountered by the rim.

The above findings were confirmed by three (3) independent laboratory checks. In summary, the conclusions were:

a. The rim cracking had resulted from a combination of corrosion and progressive fatigue.

b. The fatigue cracking appeared to have initiated from corrosion pits at the internal surfaces of the wheel rim.

c. The presence of the compound on the internal surfaces had contributed to the corrosion which had been severe enough to remove any paint that had been present and cause scaling and flaking of the metal.

As a result of these findings, Ralph McKay Limited will not warrant any wheel or rim where Liquid Balancers and/or Sealants are used.