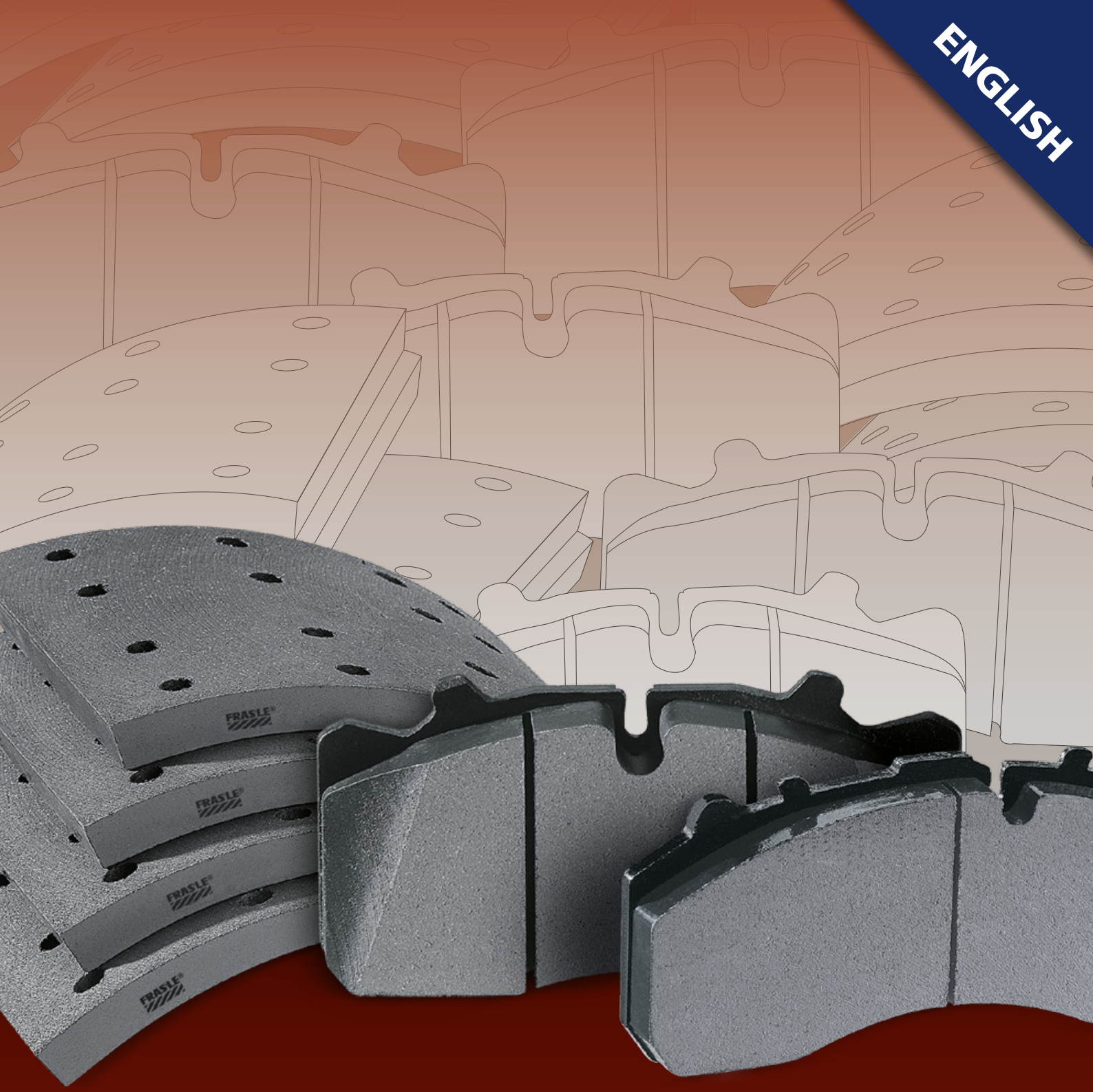
ENGLISH



FRAS-LE®

TECHNICAL MANUAL
HEAVY DUTY

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A WORLD CLASS COMPANY

International Leadership and Technology

Established in 1954, Fras-le is engaged in the manufacturing of friction materials. Its business – Safety in Motion Control - makes of it the largest company in Latin America and one of the leading companies in the world in the field.. It was the first friction material manufacturer in Brazil to obtain the ISO 9001 Certification. Fras-le has also achieved the ISO 14001 and the ISO TS 16949. These certifications confirm the company's constant concern with quality, technology and environment.

Fras-le provides products with the quality of original equipment to ensure safety, efficiency and quality to OEM companies and the Aftermarket. In its advanced Research and Development Center – one of the best equipped labs in the world – Fras-le has a chemical, physical and pilot lab that enable it to develop high-performance products. With its plant in the State of Rio Grande do Sul, distribution center in Argentina, and trade offices in the United States, Chile, Mexico, Germany, The Arab Emirates, South Africa and China, the company maintains a trained team to meet the needs of customers located throughout more than 70 countries on five continents where the company is present. Fras-le is a Randon Group company.

High Technology

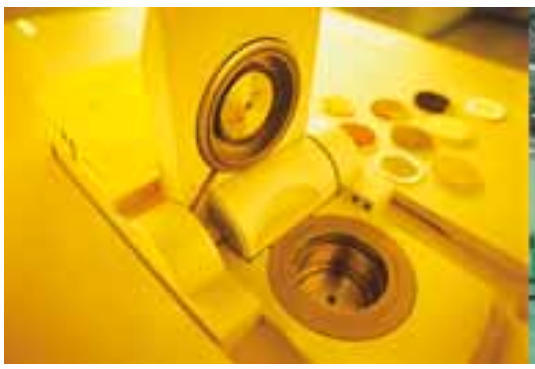
Fras-le has the largest and best equipped lab in Latin America to test its products, which are then delivered to test fields, race courses and roads, where they are approved and released for production. The entire process is followed up by Fras-le`s and OEM companies` engineers to ensure that the final product complies with the required specifications.

Research Lab

The Chemical Research Lab is in charge of analyzing the raw-materials for the development of new products and the improvement of existent material. At Fras-le, more than 135 different types of raw-materials are used in the production line. Specific methods of analysis are employed in new alternative raw-materials until coming to the compounds that make up the products.

Quality Assured by Raw-Materials

The raw-materials lab is responsible for analyzing over 135 different types of raw-materials accepted into the company. It also supports production system processes and develops new suppliers. These are the most important tasks carried out by the raw-materials lab, which also develops, certifies and audits the processes used by the suppliers in order to maintain their already proven qualification levels as Fras-le`s suppliers. The lab plays a very important role for Fras-le to gain market share, as it assures the quality of its products. This means that the raw-materials, the productive process and the tests are crucial for the safety of the products in any of their applications.



Assessment

All products being developed and those in the production lines are tested in the Physical Lab, which integrates the Research and Development Center. Different pieces of equipment simulate real working conditions of raw-materials in their different applications, being instrumental in the improvement of the products until they reach the final quality required by consumers.

The lab operates in three working shifts, continually running tests and assessing their results. The lab includes the entire process of Fras-le`s products, from development to assessment of the products in the market, from the initial tests to the final user through specific tests.

More than 120 different types of trials are carried out monthly in this Research and Development Center which offers the most complete testing structure in Latin America.

In Pilot Production, Quality is Assured.

In the Pilot Lab, samples are produced from customers` new needs and requests, especially OEM companies of vehicles. Experiments with new formulations are carried out. If approved, they go through all test phases until they reach the regular production lines. The Pilot Lab controls all features associated to the development of these products.

At the beginning, Fras-le has not only absorbed technology from well-known manufacturers of friction materials in the world, both European and North-American , but has also improved the global production modus operandi. State-of-the-art equipment and the company's own culture and experience are the basic ingredients of Fras-le`s philosophy: that of developing high quality products that reflect the tradition of its brand in the market. In addition to developing its own technology, Fras-le also maintains agreements and partnerships

Motion Control: Fras-le`s Mission

In addition to research, development of materials and products, test fields are also very important to maintain quality levels. During tests, products applied to vehicles go through all situations they will possibly face when operating in real situations, on the most diversified road conditions. The performance of the products is also strictly followed-up by technicians who visit customers on a permanent basis. These technicians give lectures, courses and instruct retailers` clerks, mechanics and drivers so that they can use the products safely.

FRICTION MATERIALS FEATURES

The coefficient of friction is the most important factor in friction materials. Its value must be kept constant within a certain temperature range.

A high coefficient of friction does not necessarily mean quality in friction materials. Using the brake too hard is sometimes as dangerous as lack of brake. The friction stability is a crucial factor that depends on temperature, speed, pressure and external factors. Lack of brake is not necessarily caused by the friction material, but may be caused by a failure in the hydraulic or air system.

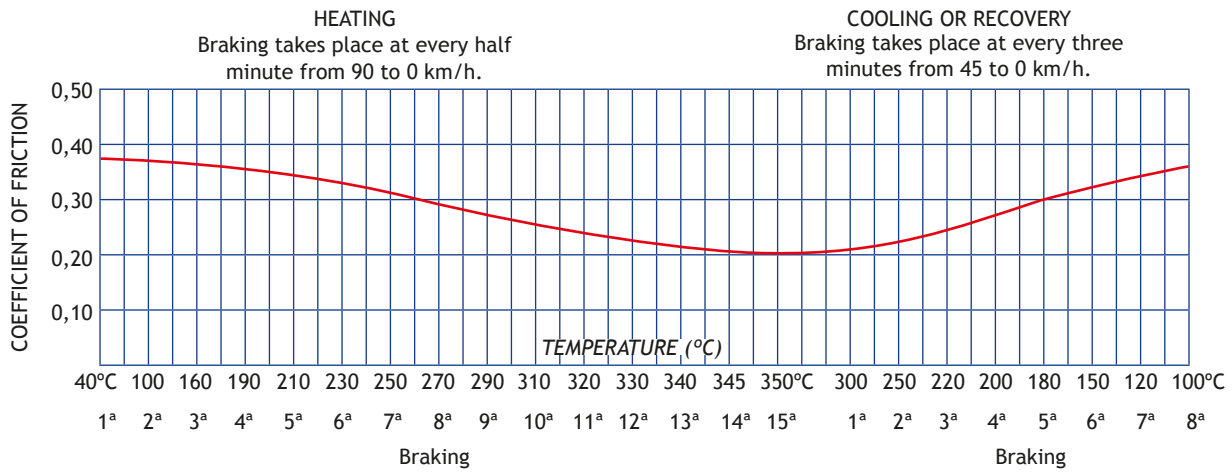
Please see below the most important features involving friction materials:

Mechanical Strength

Friction material must have a mechanical strength sufficient to stand the efforts inherent to the application it is designed for. Among mechanical efforts, we highlight Compression (rubbing against the friction surfaces) and Shearing (which results from tangential forces caused by rotation movements).

Dimensional Stability

Every friction material that been heated and then cooled should keep its shape and dimensions appoximately unaltered.



Durability

The useful life of friction materials is a very important factor that depends on the quality of the friction material selected for a certain application. One of the factors that determines the durability of friction materials is temperature.

Friction materials are bonded by organic resins that impose limitations on their working temperature. If the brakes or clutches are constantly used in high temperatures, wear on friction materials accelerates. Durability is also affected by the geometry of the brake and clutch, cast material and finish of the braking surfaces. A good quality friction material must be also a thermal insulator to protect the deepest parts from the high temperatures generated during brake and cluck applications. Wear on friction materials is necessary to renew the friction surface, otherwise glazing may occur. On the other hand, this renewal should not happen too quickly, at the risk of affecting the durability of friction materials.

Sometimes, complaints about durability are due to problems related to the dimension of the brake (if the drum heats too much, the working conditions have not been properly designed).

STOPPING DISTANCE

People react differently to obstacles or to diverse situations on traffic. When they are walking on roads, they may react differently and unexpectedly from when they are walking on streets. Therefore, it is necessary to get familiarized with the driver`s behavior when driving on different roads.

Braking a vehicle basically depends on three factors: the vehicle, the road and the driver. A higher or lower braking efficiency basically depends on the combination of these three factors.

Please see below a table that shows stopping distances in relation to the vehicle's speed:

SPEDD in km/h	STOPPING DISTANCE IN METERS	
	GOOD BRAKES	BAD BRAKES
20	3,1	4,0
30	6,9	9,0
40	12,3	16,0
50	19,3	25,0
60	27,7	36,0
70	37,8	49,0
80	49,3	64,0
90	62,5	81,0
100	77,2	100,0

BRAKING SYSTEMS

Pneumatic Disc Brakes for Commercial Vehicles

They consist of floating brakes designed for use in trucks and buses as a service brake, parking brake and auxiliary brake on the rear axle and on the front axle. Brake is activated mechanically through a diaphragm cylinder or a spring cylinder, mounted onto the cover of the brake frame.

The complete disc brake, including the brake cylinder, consists on two subassemblies:

A) Brake frame;
B) Brake support.

Mounting brake cylinder on brake frame results in a very compact unit.

Brake cylinder is mounted onto brake frame with the help of a flange and its activating rod is located in the brake lever. Lever and axle form an integrated unit. When cylinder is pressed, activating rod rotates the brake lever which, due to its special profile, moves away providing constant linear movement. This linear movement of the brake lever pushes the activating mechanism towards the brake disk.

Brake activating mechanism is a device whose adjustment is automatic, progressive and variable, compensating pad wear and providing constant clearance, regardless the strength applied.

With the purpose of enhancing time intervals for pad replacement, the unit uses brake pads with a large wearable thickness. Brake design allows pads to be replaced quick and easy. This enables optimization of mounting conditions, for example, a good observation angle of the assembly.

Compressed Air Brakes

Because of the versatility of this fluid, it is used for heavy vehicles, where the hydraulic system is not recommended, due to the high pressure demanded for braking efficiency. Consequently, hydraulic system would present a limited lifespan on its sealing, resulting in frequent changes, besides likely dangerous leakage. The driver can control, through the brake pedal, the pressure that will be exerted on the pneumatic cylinders (Figure 01).

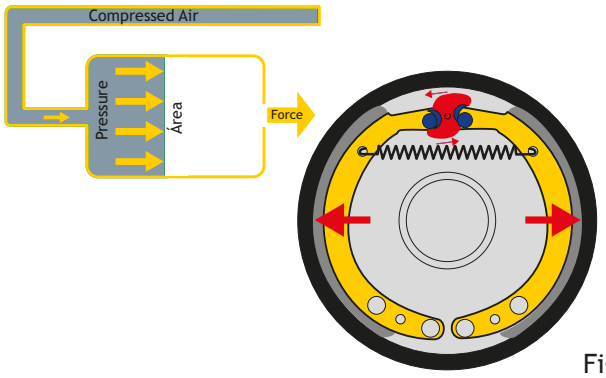


Fig. 01

Motor Brakes

Their actuation takes place on the motor exhaust system, by partial obstruction of gas release, by means of a butterfly valve. Thus, motor offers resistance to vehicle displacement.

Retarders

Retarder is a braking mechanism whose function is to reduce or stabilize a vehicle speed, especially down slope without stopping it.

Retarders can be placed between the engine (motor) and the gearbox (primary retarders) or between the gearbox and the traction axles (secondary retarders).

There are two basic conceptions for retarding brake mechanism:

a) Hydrodynamic retarder
b) Electromagnetic retarder

CONSERVING SPRINGS AND BRAKE SHOES

It has been observed that many technicians in charge of fleet maintenance do not pay enough attention to the warping state of the brake shoes. Because of this, we present two jigs to help keep the brake shoes in good condition.

Warped brake shoes lead to vibrations, which are noticed as noise.

Deformed brake shoes can cause brake linings to break when they are being riveted. When system is working, brake shoe warping takes to ineffectiveness of braking, or chatter, and it may even cause brake linings to be loosened.

Professionals can easily avoid these problems by periodically checking the brake shoes. See drawing (Figure 04). It shows what parts are necessary to control warped brake shoes. The drawing (Figure 06) shows the order to put parts to assemble the jig.

In the drawing (Figure 02), you can see a part to control brake shoe radius. Note that the distance marked between the dots (letters) indicates dimensions to be checked by the jig, ranging from one model to another according to brake shoe dimensions of each vehicle. Another important point to check is the housing for the brake shoe anchorage bolts, which should not present any deformations.

Brake shoe return springs should be checked, so that they can fully return when brake is released. It is mandatory that return springs be replaced whenever any clearance is perceived between the brake shoe and the expander, because such clearances can cause vibration and noises.

Rivet fixing holes should be checked. Its oval shape or an increase of its diameter may cause loose linings because of braking effort.

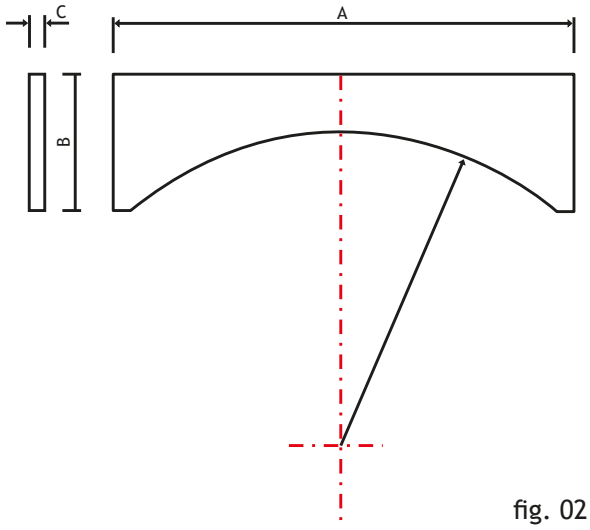


fig. 02

STOCKING BRAKE LININGS

Brake linings are manufactured in accordance with technical specifications for each vehicle. There are hundreds of different presentations for brake systems and linings are manufactured so as to meet performance requirements of the vehicles as well as their specific designs.

Each brake system has specific curvature for its brake shoes, and brake linings are manufactured so that they fit this curvature perfectly.

To prevent any deformation on the friction material, once it would make it difficult or even impossible to assemble it correctly on the brake shoes, it is recommended that such material be always stocked with parts placed side by side (see Figure 03).

Never stock linings by piling them one over the other with their curvature facing down (or up), since the weight of the pile tends to deform the parts that are at the bottom (see Figure 04).

fig. 03

fig. 04

SELECTING LININGS

We manufacture linings for each kind of vehicle, considering its building characteristics and its usage.

Therefore, for city vehicles, road transporting vehicles and passenger vehicles, we offer different linings that aim at a better performance in each condition.

Make sure you are using the correct lining for your case, consulting the Application Catalog and checking the reference identification stamped on the lining. This reference is usually on the side of the linings.

Never mix linings of different makes and quality, because each compound has a peculiar chemical characteristic and their combination without technical orientation may lead to unpredictable consequences.

RIVETING

Here are some steps that establish the correct procedure for riveting linings onto shoe brakes for auto-vehicles:

1- Check for geometry of brake shoe as for distortions / flaws such as: base warping, welding break between grooves and base, diameter of holes, etc.;

2- Make sure brake lining to be riveted is the one recommended by manufacturer of the vehicle;

3- Check for brake drum conditions as for wearing, grooves and thermal cracks. Should it be necessary, part is machined or simply replaced by a new one. Pay special attention to machining brake drums, because linings should be thicker (oversized), “X” or “XX”, compatible with the new diameter of the drum;

4- Brake drum machining should comply with dimensions allowed by the manufacturer. This dimension is stamped on the brake shoe. It is important that both drums of same axle be the same diameter. It is convenient to remember that brake drum grinding reduces its mechanical strength and its thermal capacity;

5- It is very important that vehicle be assembled on all its axles with brake linings of the same make and quality;

6 - Before riveting, check laying between the lining and the brake shoe. A 0.25 mm clearance (maximum) is acceptable between the brake shoe and the lining, along sides and ends of the assembly, except for the pair of grooves, where up to 0.64 mm clearance is acceptable (Figure 05);

7- Make sure rivets have correct rod diameter, head size, shape, length and material. For this purpose, we have a catalog for brake lining application where we recommend the perfect kind of rivet as per brake assembler specification;

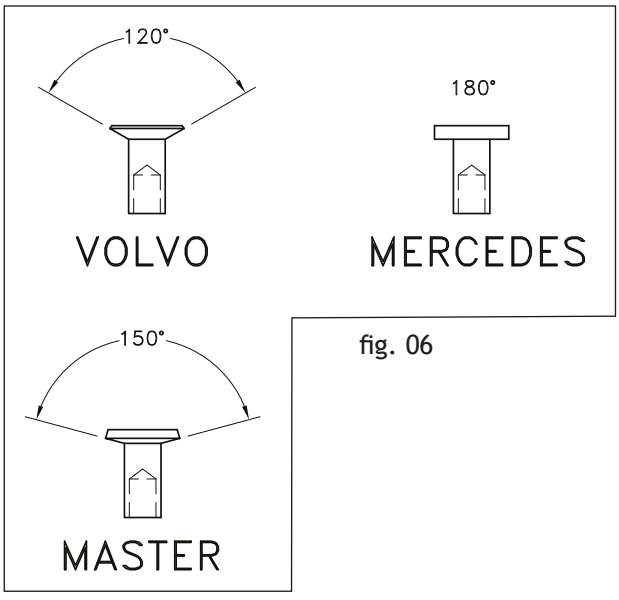


fig. 06

8- It is recommended that brass or brass steel be used because of its mechanical, resistance and expansion properties;

9- It is recommended that semi-tubular or tubular rivets be used, due to better riveting;

10- For drum brakes of large vehicles, which need rivets whose diameter range from 6.2 to 8.0 mm, it is considered that free length for good riveting is 4.5 to 5.5 mm. This dimension is usually given as follows: 0.75 x rivet diameter (Figure 06);

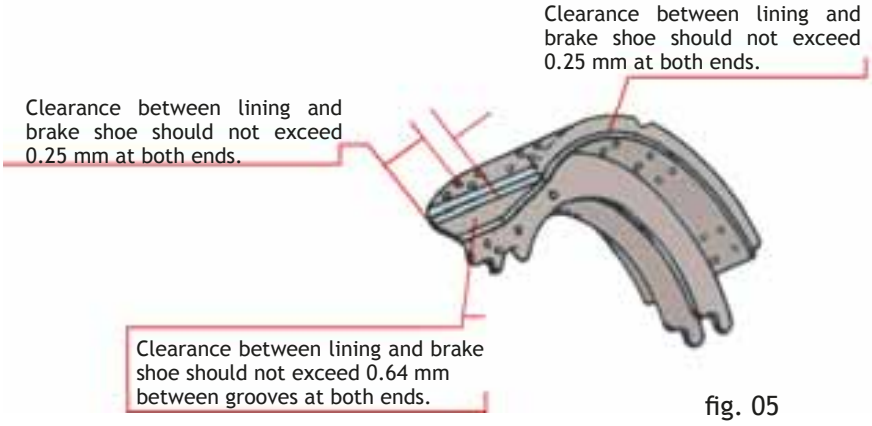


fig. 05

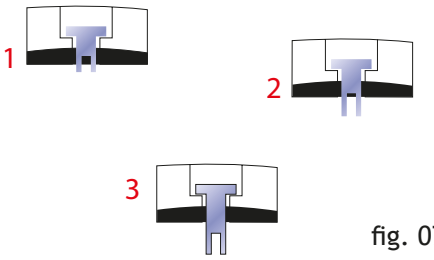


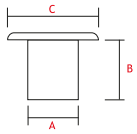
fig. 07

1. Free length for riveting is too short.
2. Free length for riveting is correct.
3. Free length for riveting is too long.

Below, you will find a table for rivets, presenting main gauges and their respective dimensions.

Rivet

TIPO DE REBITE	DIMENSÕES - mm			DIMENSÕES - mm		
	A	B	C	A	B	C
4 - 3	3.6	4.8	8.0	9/64	3/16	5/16
4 - 4	3.6	6.4	8.0	9/64	1/4	5/16
4 - 5	3.6	8.0	8.0	9/64	5/16	5/16
4 - 6	3.6	9.5	8.0	9/64	3/8	5/16
4 - 7	3.6	11.0	8.0	9/64	7/16	5/16
5 - 4	3.6	6.4	9.5	9/64	1/4	3/8
5 - 5	3.6	8.0	9.5	9/64	5/16	3/8
5 - 6	3.6	9.5	9.5	9/64	3/8	3/8
5 - 7	3.6	11.0	9.5	9/64	7/16	3/8
6 - 16	6.0	16.0	16.0		5/8	5/8
7 - 3	4.8	4.8	9.5	3/16	3/16	3/8
7 - 4	4.8	6.4	9.5	3/16	1/4	3/8
7 - 5	4.8	8.0	9.5	3/16	5/16	3/8
7 - 6	4.8	9.5	9.5	3/16	3/8	3/8
7 - 7	4.8	11.0	9.5	3/16	7/16	3/8
7 - 8	4.8	13.0	9.5	3/16	1/2	3/8
7 - 10	4.8	16.0	9.5	3/16	5/8	3/8
7 - 12	4.8	19.0	9.5	3/16	3/4	3/8
8 - 8	4.8	13.0	13.0	3/16	1/2	1/2
8 - 10	4.8	16.0	13.0	3/16	5/8	1/2
8 - 12	4.8	19.0	13.0	3/16	3/4	1/2
8 - 14	4.8	22.0	13.0	3/16	7/8	1/2
8 - 16	4.8	25.0	13.0	3/16	1	1/2
10 - 6	6.4	9.5	13.0	1/4	3/8	1/2
10 - 8	6.4	13.0	13.0	1/4	1/2	1/2
10 - 10	6.4	16.0	13.0	1/4	5/8	1/2
10 - 12	6.4	19.0	13.0	1/4	3/4	1/2
10 - 14	6.4	22.0	13.0	1/4	7/8	1/2
10 - 16	6.4	25.0	13.0	1/4	1	1/2
11 - 5	4.0	8.0	8.0	5/32	5/16	5/16
13 - 10	8.0	16.0	16.0	5/16	5/8	5/8
13 - 12	8.0	19.0	16.0	5/16	3/4	5/8
13 - 14	8.0	22.0	14.0	5/16	7/8	9/16
13 - 16	8.0	25.0	14.0	5/16	1	9/16
8 x 15	8.0	15.0	16.0			
8 x 16	8.0	16.0	16.0			
8 x 18	8.0	18.0	16.0			
8 x 20	8.0	20.0	16.0			
8 x 22	8.0	22.0	16.0			
VOLVO	6.2	19.0	12.5			



11 - Riveting machine should be a device that enables controlling pressure exerted over the rivet. Activation may be either hydraulic or pneumatic;

12 - Make sure brake shoe and lining contact faces are clean;

13 - Inserting the rivet should be easy, not offering any resistance;

14 - Make sure rivet head does not have any cracks which may impair its resistance (Figure 08);

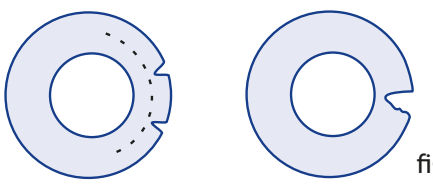


fig. 08

15 - Before installing brake linings on brake shoes, check compressed height of the rivet. Press rivet in the riveting machine and measure distance “A” (Figure 09);

Brake Drum Grinding

MARCA DO VEÍCULO	REFERÊNCIA DA LONA FRAS-LE	TIPO DE REBITE
AGRALE	287	4 - 4
	2006-T, 2080-T	4 - 5
	2042-A, FD/71, FD/72	7 - 6
	FD/77	10 - 8
CARRETAS e 3º EIXOS	4514-F, 4515-C, 4515-G, 4717, CA/32, CA/33, FD/81	10 - 10
	SV/223, SV226	10 - 12
	4195-B	10 - 14
CHRYSLER	2026-AT	4 - 5
	659-B, 2042-A, 2060, FD/72, FD/73	7 - 6
	4564-A	7 - 8
	4514-F	10 - 10
FIAT	FI/95	7 -
	FI/92, FI/93, FI/94, FI117	10 -
	4514-F, 4515-C, 4524-B, FN/116	10 - 10
	FI/115	13 -
FNM	4514-F, 4515-C, 4524-B, FN/116	10 - 10
	FN/106, FN/107	13 - 14
FORD	2026-AT, 2026-T, FD/78	4 - 5
	2032, 2042, 2042-A, 2060, FD/71, FD/72, FD/73, FD/74	7 - 6
	4564-A, FD/75, FD/76	7 - 8
	FD/79, FD/80	10 -
	4505-A, FD/77	10 - 8
	4514-F, 4515-G 4710, FD/83, FD/84, FD/85, FD/86, FD/87, FD/88	10 - 10
GM	2095	4 - 5
	2039	5 - 5
	659-B, 2032, FD/72, FD/74, VW256, VW257	7 - 6
	CB/36, FD/75	7 - 8
	4514-F, 4524-B, 4707, CB/53, CB/54 FD/83, FD/84, FD/85, FD/86	10 - 10
INTERNATIONAL	659-B	7 - 6
	4514-F, 4515-C, 4524-B, 4707, 4720	10 - 10
IVECO	4515-G, CA/32, FD/86, FD/87, FD/88	10 - 10
MARCOPOLO	FD/72	7 - 6
	FD/77	10 - 8
MB	MB/157	4 - 5
	MB/155	7 - 6
	4515	8 - 10
	MB/188, MB/190, MB/191	8 x 20
	FD/77	10 - 8
	MB/161, MB/164, MB/167, MB/176, MB/177, MB/179, MB/180, MB/181, MB/182	13 - 10
	MB/183, MB/184, MB/185	8 - 20
PUMA	2026-AT	4 - 5
	FD/72	7 - 6
SCANIA	SV/222, SV/223, SV/224, SV/226, SV/227, SV/228, SV/229, SV/230, SV/231	10 - 12
VOLVO	VV/288, VV/289, VV/290	VOLVO
	VV/296, VV/298, VV/299, VV/300, VV/303, VV/304	10 - 10
VW	VW/256, VW/257	7 - 6
	FD/80, FI/117	10 -
	FD/77	10 - 8
	4514-G, 4524-B, 4710, FD/83, FD/84, FD/86, FD/87, FD/88, FI/118, FI/119	10 - 10
	VW/225	13 -

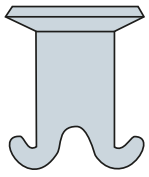


fig. 09

16 - Rivet should fill holes in the lining and in the brake shoe (Figure 10);

17 - Tubular length of the rivet should be deep enough to prevent riveting punch from finding any resistance (Figure 11);

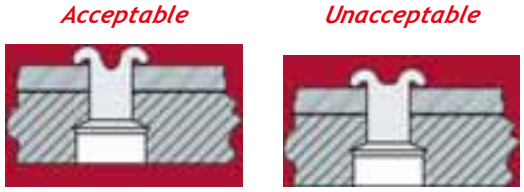


fig. 10

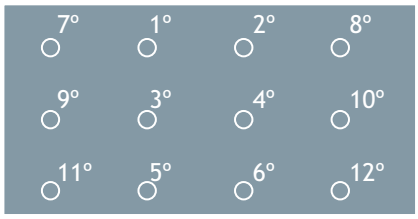


fig. 11

18 - Install rivets on the holes and perform as per sequence (Figure 12);

Unacceptable

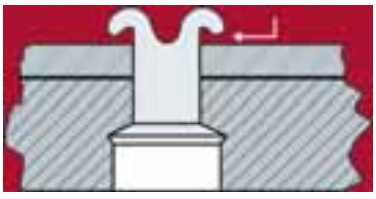


fig. 12

19 - Riveting force should not be brisk but slow, within approximately 2 seconds, keeping the pressure for 1 second. This operation aims at preventing any cracks on the brake linings and clearances between them and the brake shoe;

20 - After riveting, maximum clearance admitted is 0.10 mm, whereas none of the areas for laying rivets should present any clearances. It may be admitted at the corners;

21 - Loose rivets are not acceptable (Figure 13)
Checking limit:
-Minimum: rivet moves when forced manually;
-Maximum: rivet moves when hit a small hammer.

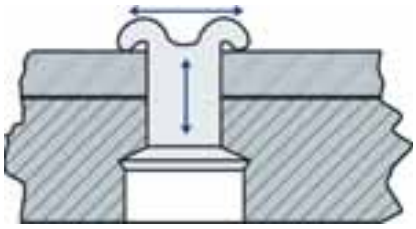
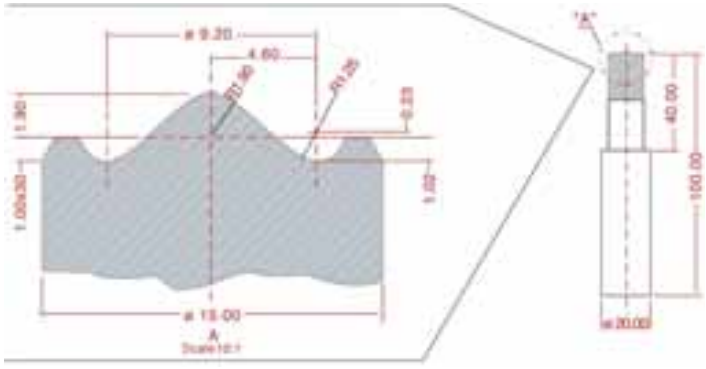


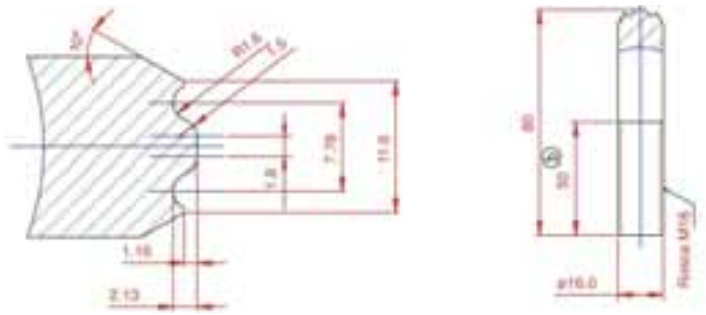
fig. 13

22-Riveting strength recommended for 6.2 and 8.0 diameter rivets, either semi-tubular, in brass or brass steel, ranges from 1,700 to 2,400 kgf, ehwreas strength will be larger according to the larger diameter of the rivet body.

Drawing of riveting punch for 8.0 mm diameter rivet



Drawing of riveting punch for 6.3 mm diameter rivet



WEAR INDICATOR

The wear indicator has the main function to facilitate the identification of useful life of a brake lining, that is, so far as it can be used. Below this indicator (recess) are the rivets, that can damage the drum if the brake lining is used more than this limit. (figure)

Perform periodic verifications on the brake linings making the change when the wear of the brake lining be on the same level of the recess from de wear indicator.
NOTE: Do not forget to check the drum diameter when changing the brake linings. Always use rivets indicated by the manufacturer.

BRAKE DRUMS

Brake drum quality is essential because brake lining performance depends on them. New drums can be made with cast iron with correct specifications (easy casting and molding, excellent machining, good resistance to wearing, good shock absorbing capacity, shock and compression resistance), so that they can resist mechanical efforts and high temperatures. Therefore, it is up to every brake drum manufacturer to develop their products so as to favor heat dissipation and reduce expansion, because of radial pressure and temperature increase. They must come from idoneous casting companies so that its composition does not present any dirt or foreign bodies, what impairs performance and lifespan.

Used drums should be periodically remachined. Cracks, thermal fissures and wrinkles should be removed by machining, whenever they can be identified by touch. Drums in a bad state shorten lifespan of the linings. On the other hand, drums can only be machined up to safety limit recommended by manufacturers.

Some special attention should be paid when stocking the drums, so that they do not present any deformation arising from irregular stocking. Their stocking should not be arranged in piles, putting one inside the other, because weight of the pile, associated to room temperature variations (that makes them expand and contract), will cause units on the bottom of the pile to become oval or cone shaped. Correct stocking is performed by placing drums with their bottoms or openings coinciding two by two, insulated from the ground with a platform to protect from humidity (Figure 14).

The protecting film that comes with the drums should not be removed until it is assembled onto the vehicle. Direct exposure to deforming, oxidizing or greasy agents should be avoided. They should be cleaned preferably with industrial alcohol.

These drums are not recommended: when they present wrinkles, cracks, extremely thin, broken, oval shape, wavy surfaces, hard points, cone shapes and high or low centers (Figure 15).

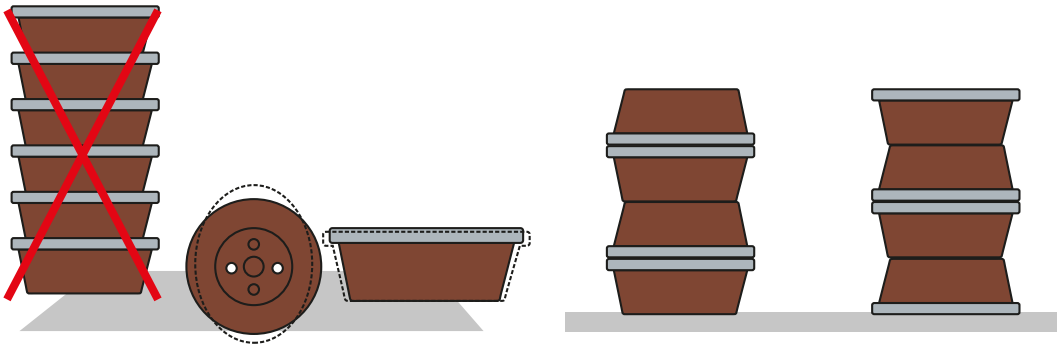


fig. 14

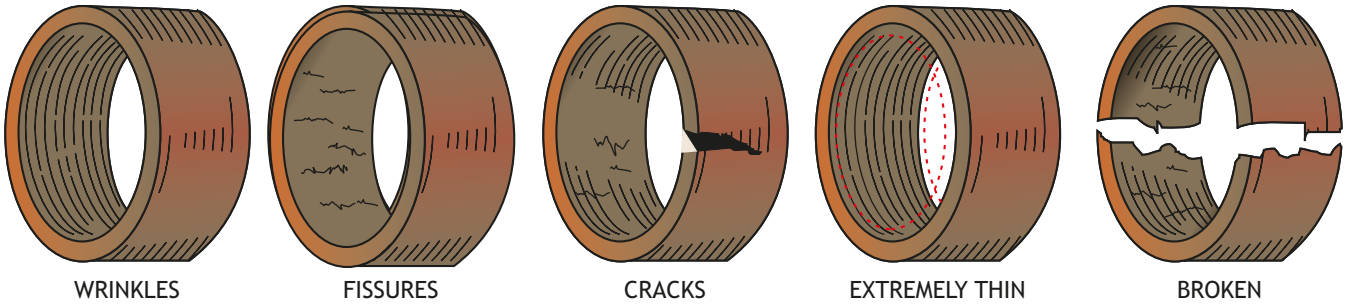


fig. 15

Normal usage of brake systems always takes to wear on drums friction-traveling course. However, whenever drum surface wear is noticed by touch, it is recommended that friction-traveling course be machined. By following these procedures, we will keep the friction-traveling course, as uniform as possible and system performance will be optimized.

Linings are manufactured in several thicknesses for the same reference or model. These different thicknesses are to be used according to the increase in the diameter of the drum because of wearing and/or machining.

In order to know which thickness to be used on machined drum is correct, it is necessary to know the diameter after machining. Thus, in a very simple way, we can show, in the example, how to measure internal diameter of the drums, with a variation of one single “quote X” checked with a pressure gauge.

In the drawing below (Figure 16), you can check all the parts necessary to assemble a gauge.

Now you will find out how to assemble it, by simply following the schematic below (Figure 17).

To obtain this result, you will have to follow these procedures: assemble locknut C on rod A and then rod B and finally rod B on part A’s thread. Doing so, you have the device required to measure internal diameter of the brake drum, without forgetting that “quote X” is the measure you are looking for. Do not forget to perform thermal treatment at ends 01 and 02.

Summarizing:

Sum of standard measures:	378 mm
For 410 mm drums	x = 32 mm
For 408 mm drums	x = 30 mm
For 418 mm drums	x = 40 mm

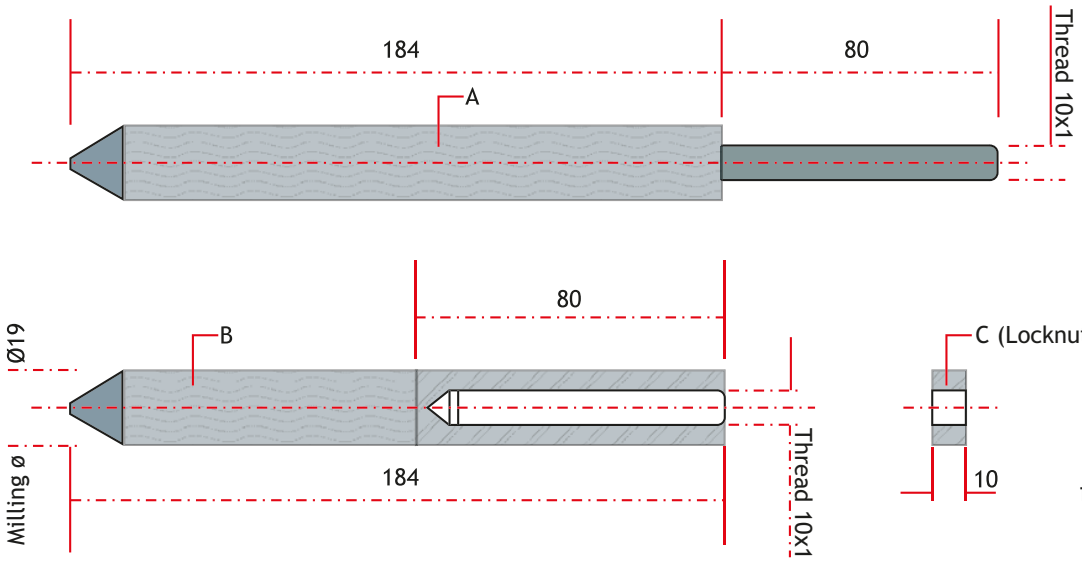
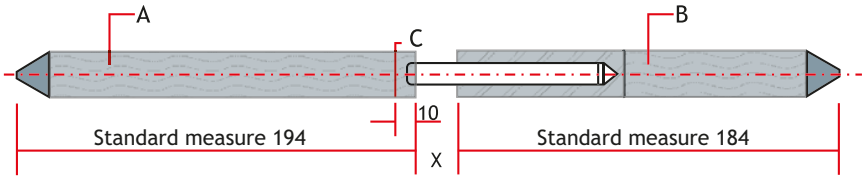


fig. 16



x-measure to be confirmed on the gauge according to dimension or variation of the drum.

fig. 17

BRAKE DRUM GRINDING

For the first oversize of the drums, linings of the first oversize (X) must be used and for the second oversize when recommended by the manufacturers, linings of the second oversize should be used. Standard linings should never be used on remachined drums (first and second over sizes), since there will not be full contact between linings and brake drums, resulting in ineffectiveness, glazing and/or noise, because of the overheating of the lining surfaces contacting the drum.

Vehicle Brand	Diameter of the Drums - mm		
	Normal Linning	Linning with One Oversize (x)	Linning with Two Oversizes (xx)
AGRALE	325,0	327,0	
CARRETAS	381,0	384,2	387,4
	413,0	416,2	
	419,0	422,2	
FIAT	381,0	384,2	387,4
	394,0	397,2	
	419,0	422,2	
FORD	305,0	306,6	
	308,0	309,6	
	325,0	327,0	
	330,0	333,2	
	356,0	359,2	
	381,0	384,2	387,4
	394,0	397,2	
	406,0	409,2	
	419,0	422,2	
GM	356,0	359,2	
	381,0	384,2	387,4
	394,0	397,2	
	406,0	409,2	
	419,0	422,2	
INTERNATIONAL	406,0	409,2	
	419,0	422,2	
IVECO	381,0	384,2	387,4
	419,0	422,2	
MARCOPOLO	325,0	327,0	
	330,0	331,6	
MB	280,0	281,8	
	300,0	301,0	302,0
	304,0	305,0	306,0
	325,0	327,0	
	408,0	410,0	412,0
	410,0	412,0	414,0
	418,0	420,0	422,0
PUMA	330,0	331,6	
SCANIA	413,0	416,2	
VOLVO	394,0	397,2	
	410,0	412,0	414,0
VW	325,0	327,0	
	381,0	384,2	387,4
	394,0	397,2	
	419,0	422,2	

ADJUSTMENT OF THE LININGS

It is important to keep correct adjustment of the linings as to the drums. Only by doing so, can one assure quick response, effective braking and total usage of friction material. Adjustment should be uniform on all wheels. That way, vehicle will not present any tendency to pull to any side during braking and usage will be complete and homogeneous. Special care must be given so that linings do not abrade the drums, because this will increase brake temperature (larger wear, smaller effectiveness) and even cause glazing or swelling (increase of volume with occasional wheel blocking).

To facilitate adjustment tasks, there are some adjusters in the market that can adjust, through an automatic mechanism, the distance between the linings and brake drums (Figure 18).

Please find below the description for replacing linings for brakes that have these adjusters and for the torque test, to evaluate whether the functioning and mechanism of these adjusters are in perfect condition.

Brake linings should be adjusted so that they do not touch drums when vehicle runs freely. Because of a possible ovalization of the drums, resulting from wearing and efforts that are subject to, this adjustment should be performed with the respective axle up.

With the vehicle touching the ground, it is not possible to check for contact points of the drum with the linings during break-in.

On those combined units (truck + tractor trailer), when adjusting tractor-trailer linings, it is necessary to adjust truck linings. It is very common to find in the market a practice that consists on leaving the truck brake linings intentionally farther than the tractor-trailer, so that the truck will have to brake less. This practice is harmful to the safety of the assembly and it may cause several problems.

RELIEF VALVES OR FAST DISCHARGE

Whenever brake pedal is released after braking, these valves have the function of releasing the air that is inside brake chambers quickly. Otherwise, brakes will be applied for longer than necessary, generating unwanted wear and heat. For so, operation of these valves should be checked periodically and whenever there are any problems of overheating.

BRAKE SHOE RETURN SPRINGS

These springs get tired with usage, especially when they are exposed to excessive heat. When they lose their tension, they end up allowing constant contact of the linings with the brake drums, and this may even cause, besides unnecessary heating and wearing, self-blocking (by the action of the lining contacting drums at high rotation).

PREDOMINANCE

Do not make any changes on the original adjustment of pressure gauge valve that connects tractor-trailer to the truck. Should you have any questions, consult vehicle manufacturer either contacting company directly or through its service agencies.

REPLACING BRAKE LININGS

In order to replace brake linings, follow these steps:

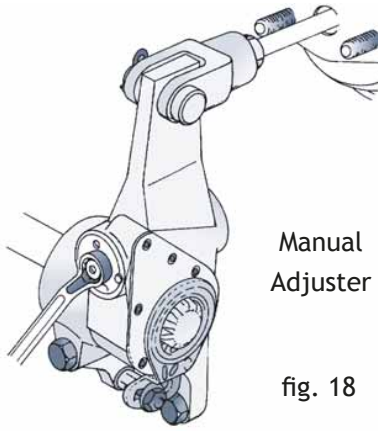
1. Rotate six-headed threadless bolt of the brake automatic adjuster counter clockwise, until S-cam is totally retrieved. During the operation, you will hear a peculiar noise, which is perfectly normal.

It is not necessary to remove the bolt from the cylinder rod neither loosen setscrew from control arm.

2. Replace linings, assemble drum and check clearance between linings and drums (it should be larger than specified).

Rotate six-headed threadless bolt clockwise, until linings touch brake drum. Open clearance between linings and drum rotating six-headed bolt again for ¾ turn counter clockwise. This is a pre adjustment of the clearance. (Figure 24).

3. Perform some brakings before you release the vehicle, so that the automatic brake adjuster performs the fine adjustment of the clearance to the specified value.



Manual Adjuster

fig. 18

TORQUE TEST

With brake relieved and without removing vehicle adjuster, place a torquemeter on the six-headed threadless bolt, rotate torquemeter counter clockwise and monitor internal conical coupling so that it does not come off at torque lower than 18 Nm (1.8 kgm).

A peculiar noise takes place when this test is carried out. Repeat operation three times with each lever. Should coupling come off at a lower torque, replace or recover automatic adjuster.

DISC GRINDING

Brake disc friction surfaces act directly on pad lifespan. Cracks, thermal fissures and grooves should be removed by machining these surfaces every time they can be felt by touch. On the other hand, brake discs should only be machined up to the safety limit recommended by the manufacturer. It is recommended that discs be replaced whenever actual thickness of the part is similar to or lower than dimension stamped on the disc.

COMMON BRAKE FAILURES

PROBLEM	CAUSE	CORRECTION
Low Pedal	Excessive clearance on pedal traveling course.	Adjust initial clearance.
	Excessive clearance between lining and drum.	Adjust clearance.
	Worn out linings.	Replace linings.
Brisk braking	Defective drums either cracked or ovalized.	Replace drums.
	Spring brakes present alterations.	Use original spring brakes.
	Oil or grease on friction surfaces.	Replace linings and clean drum with industrial alcohol.
	Brake valve is clogged.	Use original valves.
	Brake system adjustment.	Check for correct adjustment.
Frequent Disadjustment	Brake system adjustment.	Perform full adjustment and check for brake shoe laying.
	Brake fluid is dirty.	Perform fluid change and check for clogged valve vents and cylinders.
	Linings are worn out and do not meet specifications.	Replace linings for proper ones.
	Drum is worn out, scratched or cracked.	Replace drum.
Premature Wear	Wheel riser has been removed making it possible for foreign bodies to get in between the lining and the drum.	Install wheel risers.
	Excessive adjustment.	Adjust allowing clearance recommended by manufacturer.
	Improper linings for route.	Replace linings for proper ones.
Tractor-trailer makes an “L”	Linings used on the truck are different from those used on the tractor-trailer.	Install linings of the same kind on the assembly.
	Throttle is used excessively, overheating linings on the tractor-trailer and causing lower efficiency of the brakes.	Dose brake usage.

CAUSES FOR BRAKE OVERHEATING

Operational

City traffic in large cities requires brakes to be used more frequently, many times associated to an aggressive driving behavior, caused by stress;

Mountain regions also require brakes to be used more intensively when good driving rules such as using motor brake correctly, going downhill on proper gear, etc. are not respected;

Transporting excessive load increases kinetic energy of the vehicle considerably, causing heat to concentrate on the brakes during braking;

Speeding or performing certain speed that is not compatible with traffic or road conditions also stresses out the brake usage, generating more heat concentration on them;

When referring to coupled assemblies: truck + tractor-trailer, the improper and abusive use of the brakes through the throttle forces the brake system of the implements, concentrating excessive heat on the brakes and even resulting into serious consequences;

Ignoring motor brakes when going down slopes or when stopping the vehicle causes service brakes to be used more intensively, generating excessive heating that could have easily been avoided.

Disrespecting minimum distance recommended to be kept from vehicle riding in the front, and which is variable according to the speed being employed, leads to a frequent use of the service brakes.

Maintenance

It is important to point out that all the above-mentioned are highly harmful, even when they apply to vehicles in good state. Should they have any defective or deregulated parts, whether that means on vehicle suspension or its brakes, risks of accidents just multiply.

Correct maintenance of brakes is essential for safety and life span of every component. Do not forget that the brakes are an assembly and not an isolated element and they should be checked as an assembly.

Most trucks are equipped with a valve that allows a differential of pressure between brake circuits of the truck and the tractor-trailer; that is, it allows a slightly different pressure to be exerted on the tractor-trailer compared to the one being exerted on the truck (within 0.15 and 0.6 bar, depending on vehicle manufacturer). Some of these valves allow adjustments and others don't. This adjustment frequently reaches something from 1 to 1.5 bar (which is often done inadvertently) and this causes brakes to be used more than they should be and, consequently, become overheated.

TROUBLESHOOTING

PROBLEM	CAUSE	CORRECTION
VEHICLE DOES NOT COME TO A HALT	Brake governor not adjusted.	Adjust brake governor.
	Master cylinder presents internal leakage.	Perform another repair or replace defective assembly.
	Air intake filters are obstructed.	Replace filters.
	Leakage of fluid or compressed air (low pressure).	Replace damaged components.
	Circle is obstructed.	Unblock air passage.
	Pneumatic-hydraulic chamber has torn diaphragm.	Repair chamber, replace diaphragm bed.
	Clip piston or wheel cylinder blocked.	Perform another repair or replace defective assembly.
	Brake drum is not adjusted.	Adjust drum brakes.
	-Improper linings or pads. -There is grease or oil on the linings or pads. -Pad or lining glazing. -Linings or pads are not laying.	Replace linings or pads.
	Vehicle has been overloaded.	Carry load according to specified limits.
	Pedal valve is defective.	Identify defect and repair it.
	Compressor is defective.	Check for defect and repair it.

Friction materials (pads and linings) are responsible for wheel deceleration. Therefore, any damage or nonconformity on the material will jeopardize stopping distance directly.

Whenever there is any kind of disadjustment on the drum brakes, pressurization becomes slower, pedal has a longer traveling course and, therefore, vehicle has trouble to come to a halt. Should that happen, adjust brakes correctly. There may be other reasons causing failure and difficulties on depressing brakes on the wheels.

NOTE: Should the vehicle be carrying some overload or an excessive number of passengers, it means more effort from the driver and braking system, which will not allow a safe braking with a smaller stopping distance.

PROBLEM	CAUSE	CORRECTION
VEHICLE WHEELS ARE BLOCKED	Relief vents for compressed air on valves is obstructed.	Repair relief valves.
	Relief vents for compressed air on valves is obstructed.	Unblock relief vents for compressed air on valves.
	Pneumatic hydraulic chamber rod does not return. Pneumatic hydraulic chamber spring is broken.	Replace chamber.
	Hoses or pipes are obstructed.	Unblock channels, replacing damaged components.
	Low pressure on spring brake chamber.	Check compressor governor and piping conditions.
	Parking brake has been pre activated.	Repair or replace spring brake.
	Brake shoe return spring is wear. Over adjustment of drum brake.	Replace springs. Adjust brakes carrectly.
	Brake pistons are blocked.	Replace internal repair when casing does not present any internal corrosion. Otherwise, replace, hydraulic assembly.
	Ovalized drum.	Grind or replace brake drum.
	Pedal valve is blocked.	Repair or replace valve.

Incorrect adjustment on regulator can cause wheel blocking.

PROBLEM	CAUSE	CORRECTION
VEHICLE PULLS TO ONE SIDE	Tire conditions are unequal.	Use tires with identical conditions on each axle.
	Disc thickness is unequal.	Use discs with the same thickness.
	One of the brakes presents fluid obstruction.	Check brake activation and eliminate obstruction by replacing defective part.
	Linings or pads of different make.	Replace linings and pads.
	Different drum diameter.	Use drums with the same diameter.
	Brake blocking in one side.	Check defective component and perform maintenance.
	Brake adjustment is unequal.	Adjust brakes correctly.
	Drum brake springs have uneven loads.	Perform new repair on springs.
	Oil or grease in one of brakes.	Repair leakage, clean components and replace contaminated friction material.

Whenever there are any differences between LH side and RH right side of front axle, whether on suspension or on brakes, this can cause side pulls. The first step to avoid such problem is to always have brakes serviced axle by axle and keeping the same condition on both sides. Some factors that may contribute for defects and that aren't part of brake systems:

- Tires have been gauged with different calipers or have different conditions.
- Steering wheel alignment is irregular (convergence and caster brake are non conformant with specification).
- Front wheel hub rolling bearings are damaged or loose.
- Front suspension or steering wheel bar are damaged or loose.

PROBLEM	CAUSE	CORRECTION
VEHICLE DOES NOT STAND STILL	Parking brake-activating valve is defective.	Repair or replace brake-activating valve.
	Parking brake cable is damaged.	Replace cable.
	There is grease or oil on the linings.	Replace linings.
	Brakes are misadjusted.	Adjust brakes correctly.
	Parking brake spring is weak or broken.	Repair spring brake.
	Parking brake linings are inappropriate.	Replace linings.

Using non-genuine springs, linings and diaphragms prevent parking brake assembly from working properly.

PROBLEM	CAUSE	CORRECTION
BRISK BREAKINGS	Pedal valve is defective.	Repair or replace valve.
	Pneumatic-hidraulic chamber rod is blocked.	Repair or replace chamber.
	Improper linings or pads.	Replace linings or pads.

Brakes are designed to perform safe and comfortable brakings. When pedal is depressed, effect cannot be aggressive.

PROBLEM	CAUSE	CORRECTION
BRAKE NOISES	Compressor is defective.	Find defect and repair it.
	Safety valve is triggering.	Replace valve.
	Drum surface presents imperfections.	Gring or replace drum.
	Return springs of brake drums are weak or broken.	Replace springs of drum brakes.
	Brake shoe radius and drum radius are not coincident.	Correct radius of brake shoes and brake drums.
	Total wear of linings or pads. Improper linings or pads.	Replace linings or pads.

Countless factors can cause noises on the vehicle. Among them, we point out the ones that are most common when caused by the brakes.

HEAVY LININGS - CONVERSION TABLE

FRAS-LE	LONAFLEX	BENDIX	BOSCH	THERMOID	COBREQ
659-B	L-510	HQ-123	BE 0410	659B	
2026-AT	L-529		BE 0386		
2026-T	L-189	HQ-104	BE 0104	2026T	
2032	L-110				
2039	L-146	HQ-119	BE 0409		
2042	L-147		BE 0378		
2042-A	L-533	HQ-105	BE 0105	TH-99	0435
2060	L-202		BE 0408		
4195-B	L-378	BNA-328	BE 0328	TH-4195B	4195B
4375	L-587				
4480	L-885				
4354-A	L-588				
4514-F	L-136-A	BNA-312	BE 0312	TH-4514	4514T
4514-G	L-136-K	BNA-335	BE 0335	TH-157	4514GD
4515	L-157		BE 0388		
4515-C	L-157-A	BNA-313	BE 0313	TH-4515	4515T
4515-G	L-157-O	BNA-306	BE 0306	TH-151	4515FC
4524-B	L-502	BNA-301	BE 0301	TH-54	4524FT
4564-A	L-140		BE 0389		
4707	L-641		BE/BD 0390	TH-205	
4710	L-640	BNA-389	BE/BD 0391	TH-191	4710T
4718	L-639		BE/BD 0392	TH-4718	4718T
4720	L-642		BE/BD 0393		
CA/32	L-638	BNA-329	BE/BD 0329	TH-4516	4644T
CA/33	L-636		BE/BD 0394	TH-204	4533T
CA/36	L-635				
CB/36	L-361	HQ-102	BE 0411	TH-15	
CB/53	L-142	BNA-310	BE 0310	TH-152	
CB/54	L-144	BNA-311	BE 0311	TH-153	
FD/58	L-562		BE 0418	TH-258	0822T
FD/59	L-559		BE 0419	TH-259	0821T
FD/71	L-535		BE 0395		0470T
FD/72	L-577	HQ-115	BE 0115	TH-93	0428
FD/73	L-534	HQ-120	BE 0412	TH-72 / 73	
FD/74	L-523	HQ-114	BE 0114	TH-697C	0413A
FD/75	L-524	BNA-309	BE 0309	TH-92 / 112	1252
FD/76	L-488		BE 0124		
FD/77	L-219		BE/BD 0396	TH-202	0811T
FD/78	L-658		BD 0413		
FD/80	L-661	BNA-304	BE 0304	TH-117	0440
FD/81	L-637	BNA-385	BE 0385	TH-187	
FD/82	L-655		BE 0397		
FD/83	L-728	BNA-308	BE 0308	TH-150	0463T
FD/84	L-220	BNA-371	BE 0371	TH-167	0464T
FD/85	L-221	BNA-376	BE 0376	TH-175	0466T
FD/86	L-222	BNA-372	BE 0372	TH-174	0812T
FD/87	L-223	BNA373	BE/BD 0373	TH-165	0814T
FD/88	L-224	BNA-374	BE/BD 0374	TH-166	0815T
FI/117	L-627	BNA-305	BE 0305	TH-122	0448
FI/118	L-225	BNA-375	BE 375	TH-171	
FI/119	L-226	BNA-380	BE 0380	TH-170	
FN/107	L-103-A		BE 0398		
IV/158	L-736				
MB/157	L-115		BE 0414		

FRAS-LE	LONAFLEX	BENDIX	BOSCH	THERMOID	COBREQ
MB/161	L-101			TH-18	0322
MB/164	L-102			TH-19	0319
MB/176	L-348	BNA-321	BE 0321	TH-22	0111
MB/177	L-652-B	BNA-314	BE 0314	TH-141	
MB/179	L-633	BNA-322	BE 0322	TH-37A	
MB/180	L-501	BNA-323	BE 0323	TH-37	0326
MB/181	L-509	BNA-324	BE 0324	TH-38	0327
MB/182	L-652	BNA-316	BE 0316	TH-136	0132T
MB/183	L-651	BNA-315	BE/BD 0315	TH-134	0133T
MB/184	L-552	BNA-319	BE/BD 0319	TH-133	0134T
MB/185	L-551	BNA-317	BE/BD 0317	TH-132	0135T
MB/186	L-522	HQ-125	BE 0125	TH-74 / 75	0422
MB/187	L-522-E	HQ-126	BE 0126	TH-131	0422A
MB/188	L-227	BNA-370	BE/BD 0370	TH-164	0137T
MB/190	L-131	BNA-336	BE/BD 0336	TH-148	0140T
MB/191	L-133	BNA-337	BE/BD 0337	TH-142	0141T
MB/193	L-586		BE/BD 0399	TH-161	0124T
MB/194	L-511				
MB/195	L-512				
SV/223	L-107	BNA-325	BE/BD 0325	TH-12	0461
SV/224	L-311	BNA-326	BE/BD 0326	TH-11	0462
SV/226	L-497	BNA-327	BE/BD 0327	TH-67	0418
SV/227	L-499	BNA-338	BE/BD 0338	TH-143	0710
SV/228	L-307		BE/BD 0400	TH-178	0711
SV/229	L-308	BNA-392	BE/BD 0401	TH-180	0712
SV/230	L-309	BNA-387	BE/BD 0402	TH-179	0713
SV/231	L-310	BNA-388	BE/BD 0403	TH-181	0714
TR/311	L-546				
TR/313	L-576				
TR/315	L-596				
TR/328	L-679				
TR/330-S/F					
TR/348	L-1044				
TR/368	L-1047				
VV/288	L-663	BNA-330	BE/BD 0330	TH-4517	0471T
VV/289	L-664	BNA-331	BE/BD 0331	TH-4518	0472T
VV/290	L-665	BNA-339	BE/BD 0339	TH-155	0720T
VV/296	L-709	BNA-377	BE 0377	TH-198	0721T
VV/298	L-710		BE 0404	TH-199	0722T
VV/299	L-711	BNA-378	BE 0378	TH-200	0723T
VV/300	L-712	BNA-379	BE 0379	TH-201	0724T
VV/303	L-733		BE 0405 / BD 0416	TH-206	
VV/304	L-734		BE 0406 / BD 0417	TH-207	
VV/306	L-224		BE 0420		
VV/307	L-640				
VV/308	L-223				
VW/255	L-141		BE 0407	TH-144	0810
VW/256	L-540	BX-302	BE 0302	TH-145	
VW/257	L-541	BX-303	BE 0303	TH-146	

Proving Grounds

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