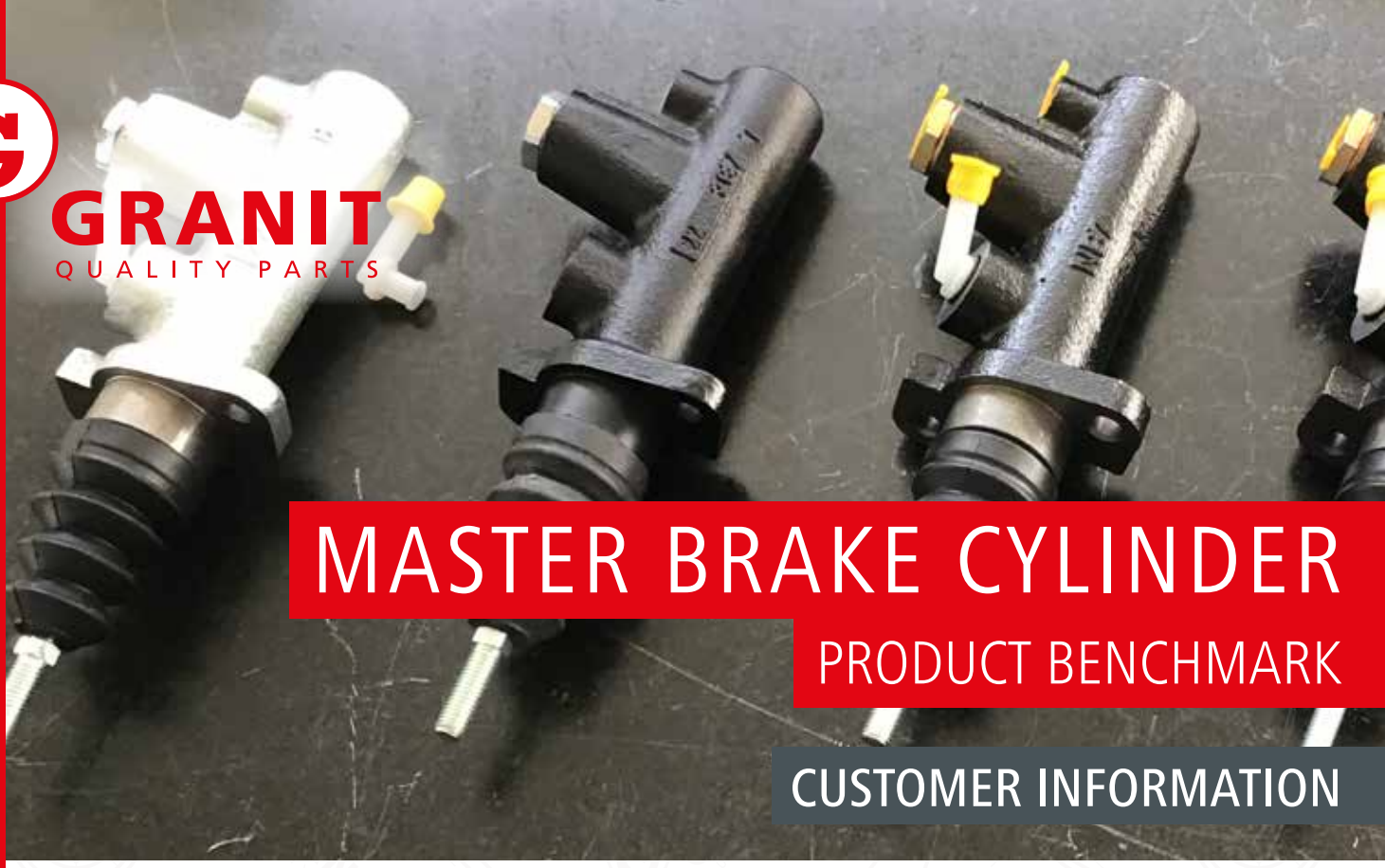
GRANIT
QUALITY PARTS



MASTER BRAKE CYLINDER

PRODUCT BENCHMARK

CUSTOMER INFORMATION

TEST REPORT NO. 2022-01/1203 PM-30544

Steinbeis-Transferzentrum Werkstoff- und Bauteilprüfung (WBP)

The following were compared:

Master brake cylinder

71706025	GRANIT PARTS
S.37645	Market companion
738H22860.1.2	Original equipment manufacturer

Comparison of features

- Visual assessment
- Comparison of functional dimensions
- Determination of roughness parameters
- Compression test of the installed piston springs
- Functional test/bleeding of the brake system

FOREWORD

In this benchmark, GRANIT's master brake cylinders (hereinafter referred to as MBCs) are subjected to a comparative analysis with those of a market competitor and an original equipment manufacturer. In addition to the general overall impression, the MBC mainly depends on the functional dimensions and the roughness of the cylinder bore. In order to be able to draw a final comparison with regard to functionality, the force of the piston return spring and a practical function test were also included.

TEST RESULTS:

VISUAL ASSESSMENT

This test examines the general workmanship of the MBC as well as the overall impression of the product, including packaging. The first overall impression is particularly important for safety-relevant components and allows conclusions to be drawn about professional production.
From the outside, the MBC of the three suppliers are all very well made.
The individual components were neatly assembled and the holes located in the cylinder, for example the connections of the brake lines, etc., were cleanly made.
No machining residues are visible. The surface treatments - painting, or rather the galvanic zinc coating - are uniform and do not show any damage.

COMPARISON OF FUNCTIONAL DIMENSIONS

Only dimensions that are within the permissible tolerance guarantee perfect functionality and allow smooth assembly.

All functional dimensions of the three MBCs are identical and are within the tolerance zone. No deviations were found.

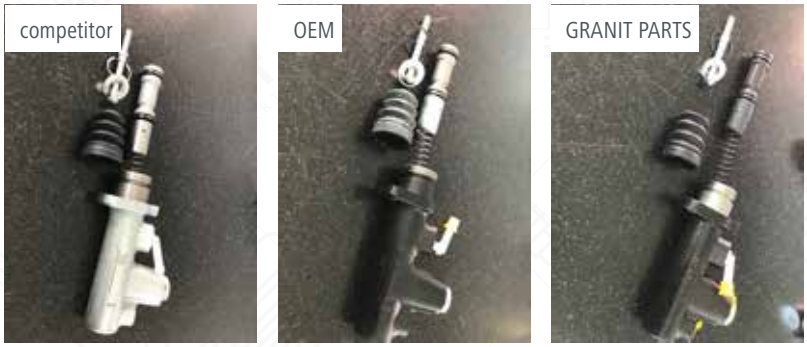


Figure 1: The master brake cylinders from the three suppliers. Dismantled MBC. Visual assessment and dimensional comparison of the installed components.

Figure 2: Brake piston.

DETERMINATION OF THE ROUGHNESS PARAMETERS

During braking, the seals of the brake piston move along the axis of the cylinder. The two seals are permanently in contact with the cylinder running surface. The rougher the surface of the cylinder, the faster the seals on the piston will wear.

This would have a negative impact on the function of the master brake cylinder and thus on the braking effect.

The roughness values were determined offset by 90° to the machining direction at three positions of the cylinder. This direction corresponds to the operating direction of the brake piston in the cylinder.

The following values were determined on the cylinder running surfaces of the three suppliers:

RESULTS:

	Area 1	Area 2	Area 3
competitor	44.4483 µm	59.5299 µm	64.6066 µm
OEM	21.7623 µm	22.6371 µm	21.3226 µm
GRANIT PARTS	15.1947 µm	14.7500 µm	14.5971 µm

The roughness values of the cylinder running surface of the MBC from the market competitor are significantly higher than those of the original equipment manufacturer and GRANIT PARTS.

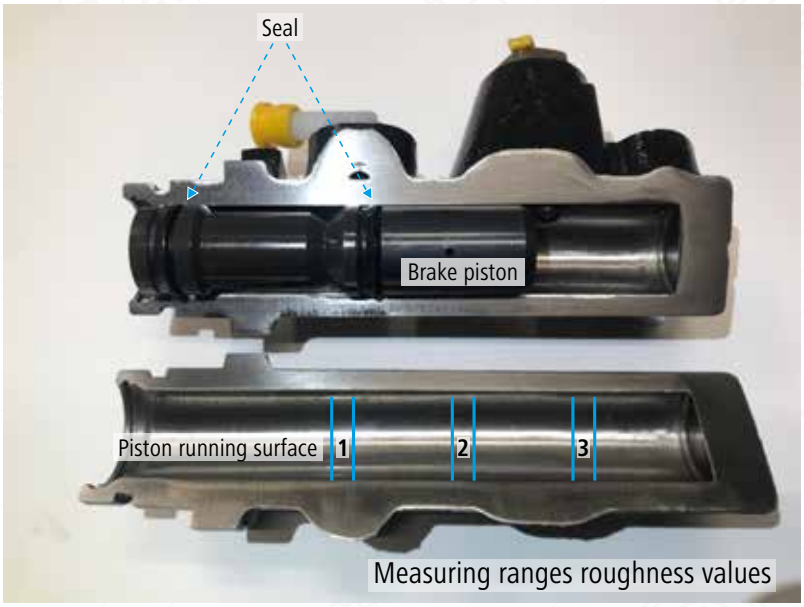


Figure 3: Interior view of the cylinder. Ranges of measurements for the roughness values on the functional surfaces of the two piston seals.

Manufacturer/Supplier	Measuring range	Measured roughness value Ra	Measured roughness value Rz	Measured roughness value Rmax	Measured roughness value Rsm
GRANIT	1	0.1658 µm	1.5957 µm	2.1639 µm	15.1947 µm
	2	0.1488 µm	1.3878 µm	2.5449 µm	14.7500 µm
	3	0.1863 µm	1.7515 µm	2.6879 µm	14.5971 µm
OEM	1	0.1790 µm	1.6376 µm	1.2564 µm	21.7623 µm
	2	0.2119 µm	1.8026 µm	2.1158 µm	22.6371 µm
	3	0.2409 µm	2.4189 µm	2.0547 µm	21.3226 µm
competitor	1	0.4035 µm	4.4468 µm	4.1639 µm	44.4483 µm
	2	0.5056 µm	6.0913 µm	6.5449 µm	59.5299 µm
	3	0.5532 µm	6.0285 µm	2.5569 µm	64.6066 µm

Figure 4: General overview of the roughness parameters.

COMPRESSION TEST OF THE INSTALLED PISTON SPRINGS

There is a strong compression spring in the front area of the master brake cylinder. This spring causes the piston to return to its initial position after each braking operation. The spiral spring must have a certain force for this and must not lose this over the long term.

This was determined by means of a compression test. The more the spring is compressed (travel), the more counterforce it must apply. The results and the proportional progression of the values can be displayed using a force-displacement diagram.

All three springs have approximately the same course and can therefore be described as equivalent.

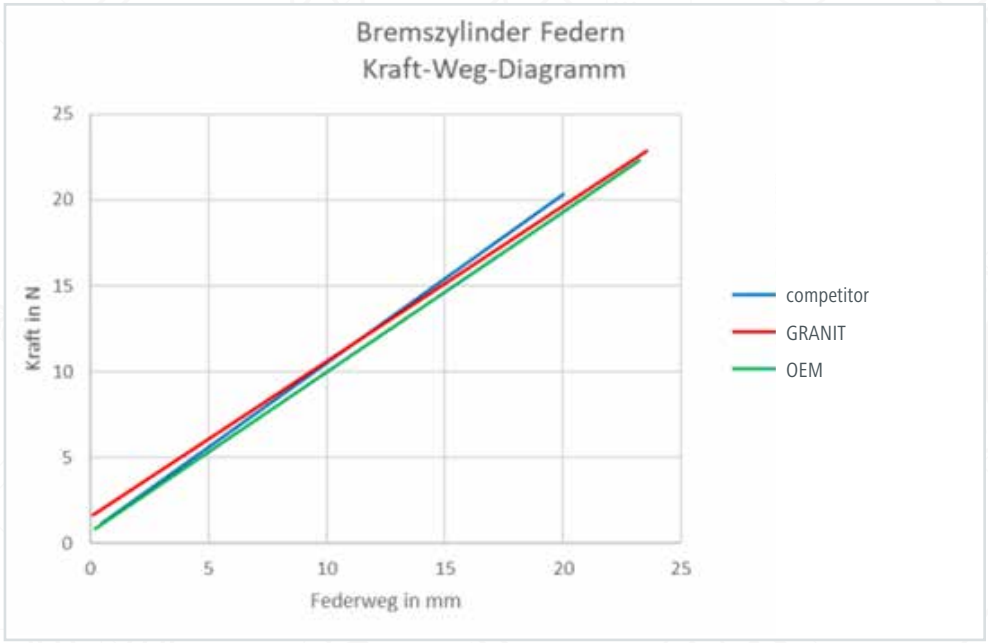


Figure 5: Determination of the spring force.

FUNCTIONAL TEST/BLEEDING OF THE BRAKE SYSTEM

During this test, the hydraulic function of the MBC is checked. For this purpose, the test object was examined using a test device for leaks, pressure build-up and the possibility of venting.

The test setup consists of a master brake cylinder mount with an actuating lever and a wheel brake cylinder with a pressure gauge. The tightness was assessed visually. Venting was performed in the same way as for normal commissioning. Based on the system pressure that could be built up, the venting process could be evaluated perfectly up to complete venting.

Figure 6: Test setup.

The mounting of the MBC and the assembly of the brake hoses could be done without any problems. The threaded holes provided for attaching the brake hoses were made professionally and cleanly by all manufacturers. The subsequent venting of the three MBCs was also carried out smoothly. All three MBCs are in accordance with the function.

Figure 7 and 8: Possible pressure build-up before venting and after venting.

CONCLUSION:

- The master brake cylinder of the market competitor has significantly higher roughness on the cylinder running surface than the products of the OEM and GRANIT.
- Due to this roughness, it can be assumed that the seals of the brake piston as friction partners to the cylinder running surface are subject to increased wear and thus have a considerably reduced service life. This can lead to leaks or even complete failure of the master brake cylinder.
- The two master brake cylinders from the OEM and GRANIT are to be considered equivalent. Due to the large price difference, GRANIT impresses here with an attractive price-performance ratio.