

BST.



TECHNICAL DOCUMENT

BMW SWINGARM RANGE

BMW S1000RR / M1000RR

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1. PURPOSE

The purpose of this document is to highlight the test procedures followed to qualify a carbon fibre monocoque swingarm. The document then goes further to report the technical data for Blackstone Tek's (BST) BMW S1000RR/M1000RR Swingarm.

2. BLACKSTONE TEK BACKGROUND

Blackstone Tek (BST) is the internationally recognized leader in the design and manufacture of carbon composite wheels and structural parts for the motorcycle and automotive industry. With decades of experience and thousands of motorcycle wheels on the roads today, BST is uniquely positioned to develop, manufacture, and supply safe and reliable carbon composite structural components.

All products produced by BST are manufactured using Carbon Fibre which is pre-impregnated with an epoxy resin. Each product is made up of a combination of multiple types of carbon- in weave and modulus of fibre. These materials are accurately and precisely placed in the desired position and orientation to ensure an optimal structure.

Following the layup of the fibre plies, the products are cured in a pressure and temperature-controlled process. This ensures the consolidation of all the layers, resulting in a strong and rigid monocoque structure. These products are then inspected by a full CT scan and geometrically scrutinized to ensure the absence of any structural defects which would jeopardize the structural integrity of the product.

Swingarms produced by BST have been documented to provide the following benefits:

- Quicker acceleration
- Later Braking
- Improved Handling
- Optimized stiffness
- Composite Resilience Offering Long Service Life

BST is a supplier to many OEM manufacturers. BST is audited and certified by TUV Rheinland, in accordance with ISO9001:2015 standard, the manufacturing process retains full material traceability throughout.

3. THE BMW SWINGARM RANGE

The carbon fibre swingarm has been developed to meet the high-performance aftermarket requirements of Blackstone Tek for the BMW S1000RR and M1000RR platforms. The design focuses on reduced mass, improved stiffness, and precise dimensional control to enhance handling, stability, and overall vehicle dynamics under both road and track conditions.

Each swingarm is individually serialized to ensure full traceability. To guarantee compliance with Blackstone Tek's stringent quality standards, a 100% inspection rate is applied throughout production. The following inspections are performed on every swingarm:

- Visual cosmetic inspection
- Dimensional inspection and alignment verification
- Structural integrity assessment

The swingarm design is fully characterized to confirm that all performance targets defined during the development phase are met. These targets include weight reduction, torsional stiffness, bending stiffness, and fatigue durability, all of which are critical to rear-end stability and power transfer.

The carbon-fibre swingarm is engineered and validated to meet applicable international structural and safety requirements for motorcycle chassis components. Testing and validation procedures are conducted to ensure the swingarm can withstand the loads and stresses encountered during aggressive street use and high-performance riding.

4. SWINGARM CHARACTERIZATION

Through the characterization process the design's suitability and relevant inspection criteria can be determined. The properties of primary concern are the mass at various production points and the structural stiffness of the swingarm

4.1 BENDING STIFFNESS MEASUREMENT

Bending stiffness is important to the handling of the motorcycle- too high and the rear of the bike bounces, too low and the stability is negatively affected. Bending stiffness governs the radial absorption beyond the maximum absorption of the suspension assembly.

The swingarm is placed in the testing adaptor and connected with a pin to an actuator. At this point, a load is gradually applied in mm increments. The deflection of the swingarm is measured and this generates a deflection vs load applied value which is known as radial or bending stiffness in N/mm

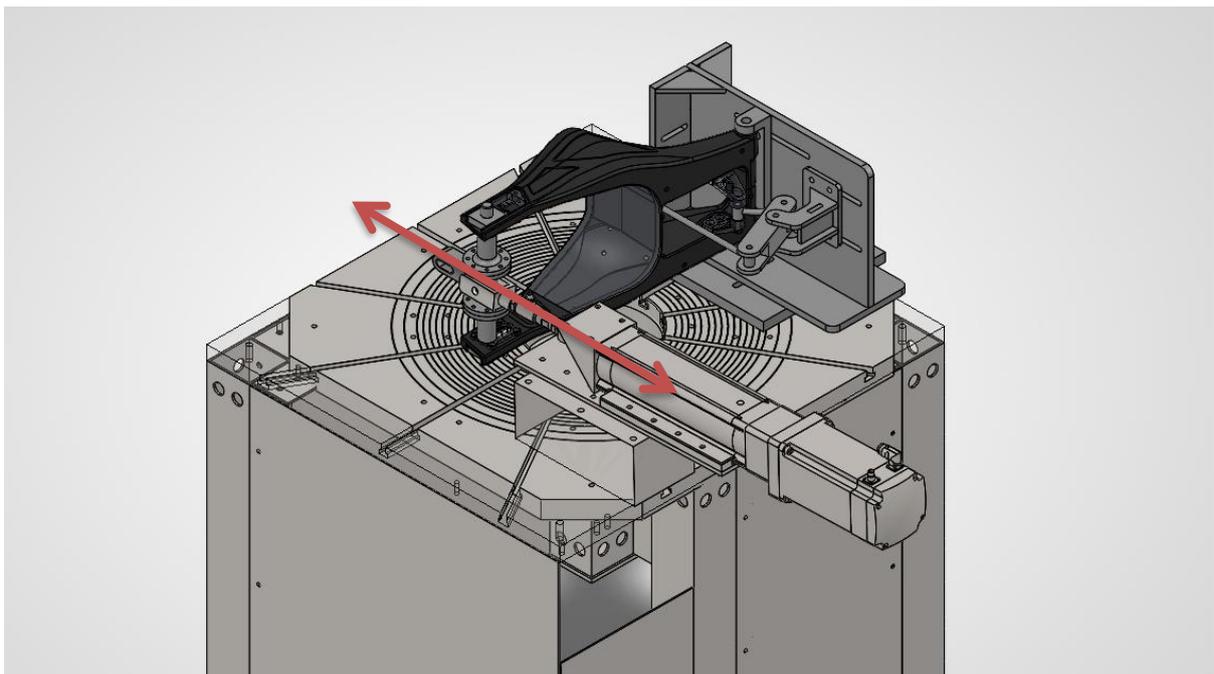


Fig. 01 Bending Stiffness Experiment



4.2 TORSIONAL STIFFNESS MEASUREMENT

Torsional stiffness is important to the handling of the motorcycle- too high will result in a nervous twitchy response, too low and the bike will feel unresponsive ("flat tyre" feeling) as the swingarms low torsional stiffness absorbs too much energy during rapid corner changes.

BST, through unique design and development methods with on-bike prototype testing, has found the sweet spot in that scale, offering a torsional stiffness that is neither too high nor too low, providing the ultimate riding experience.

Torsional stiffness is calculated through the application of a known load through an actuator whilst a pivot deflection is recorded in angular increments. The final stiffness value is measured in $\text{Nm}/^\circ$.

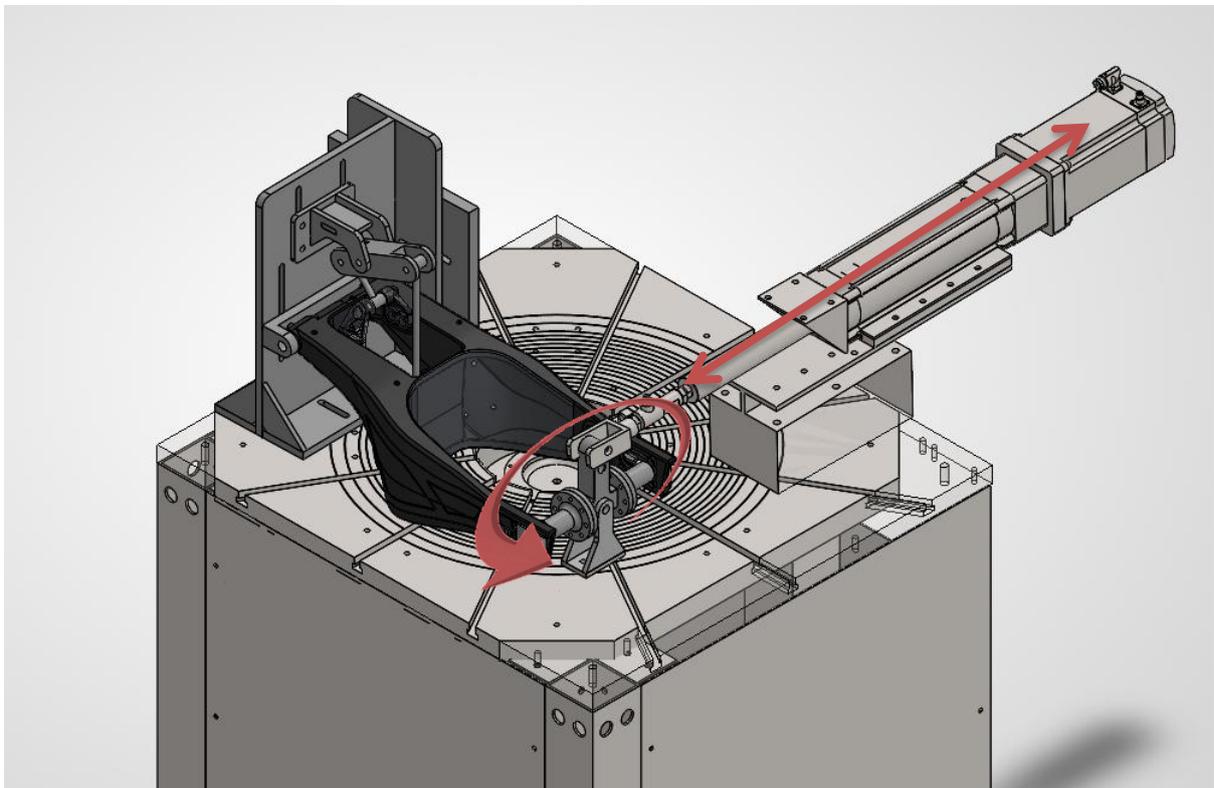


Fig. 02 Torsional Stiffness Experiment



4.3 BENDING FATIGUE TEST

In the Bending/Radial fatigue test, the vertical forces acting on the swingarm during operation are simulated. This test was done in consideration of the fatigue life of the component as well as the max applied static load of the vehicle. The test is run for 100 000 cycles.

The swingarm is mounted to the test adaptor in the same way that the radial stiffness test is measured. It is connected to an actuator that applies both max positive and max negative loads to ensure equal fatigue distribution.

The actuator is connected to a load cell in line with the mount pin to ensure the load is accurately applied, there is a small variation in the load during operation which is inconsequential and accounted for in the safety factor of the design. The actuator extends and retracts at a rate of 60mm per second.

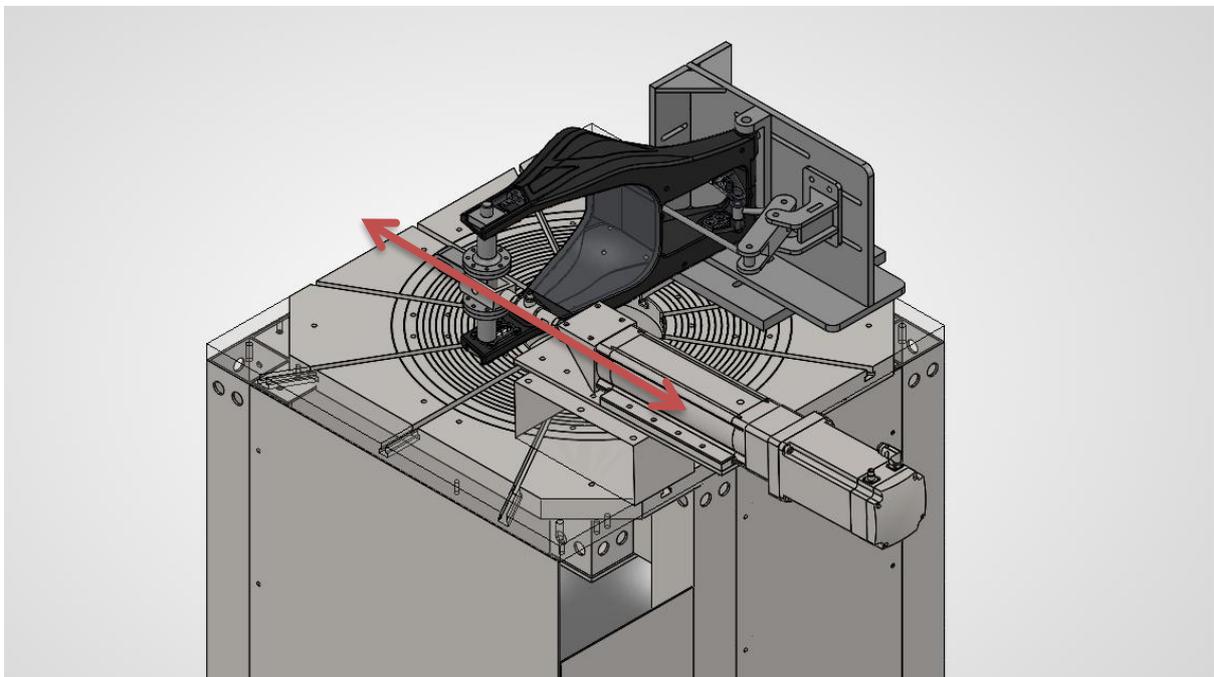
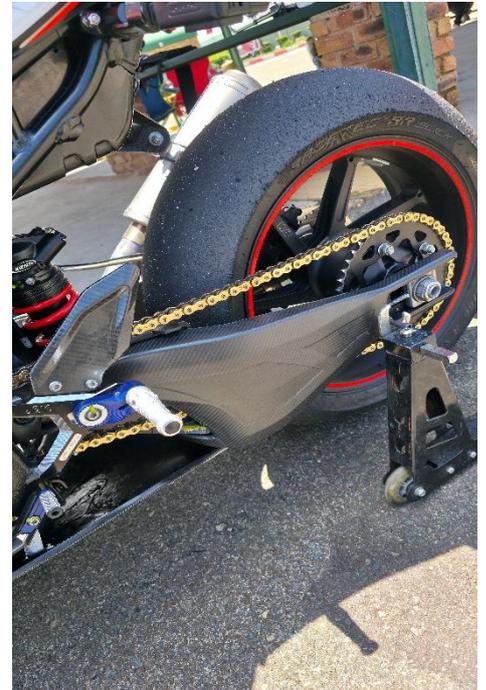


Fig. 03 Bending Stiffness Experiment



4.4 ALTERNATING TORSION FATIGUE TEST

In the alternating torsion fatigue test, the torsional forces acting through the swingarm and the resultant forces acting at the swingarm frame mount are simulated.

This test was done in consideration of the fatigue life of the component as well as the max applied static load of the vehicle. The test is run for 100 000 cycles.

The swingarm is attached to the test rig in the operating orientation while an adaptor mounts the wheel center position to the test bed. This forces a purely torsional load with near zero lateral displacement.

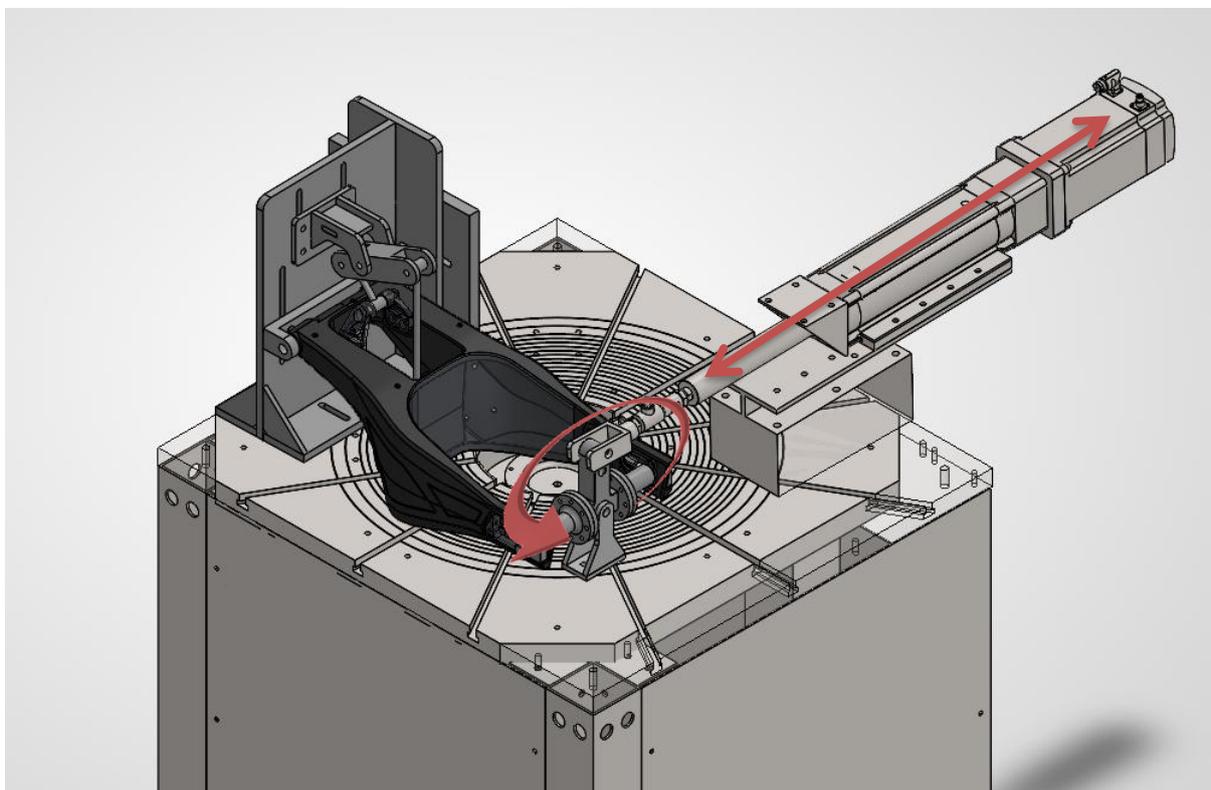


Fig. 04 Torsional Fatigue Experiment

5. BMW SWINGARM TEST RESULTS

Below is a summary of the characterization and test results that the swingarm design has been subjected to.

TABLE 1 SWINGARM:

SWINGARM	STATIC LOAD RATING	BIKE SERIES
21017-10000-16-000	280kg	BMW S1000RR
21021-10000-16-000	280kg	BMW M1000RR

TABLE 2 SWINGARM SHIPPING DIMENSIONS:

SWINGARM	PACKAGED WEIGHT	BOXING SIZE
21017-10000-16-000	5.00kg	741mm x 391mm x 318mm
21021-10000-16-000	5.00kg	741mm x 391mm x 318mm

6. SWINGARM TESTING

TABLE 3 BENDING FATIGUE TEST:

SWINGARM	APPLIED LOAD	REQUIRED LOAD	CYCLES	PASS/FAIL
21017-10000-16-000	6377.00 N	6376.50 N	100 000	PASS
21021-10000-16-000	6377.00 N	6376.50 N	100 000	PASS

TABLE 4 ALTERNATING TORSION FATIGUE TEST:

SWINGARM	APPLIED LOAD	REQUIRED LOAD	CYCLES	PASS/FAIL
21017-10000-16-000	2060 Nm	2060 Nm	100 000	PASS
21021-10000-16-000	2060 Nm	2060 Nm	100 000	PASS

TABLE 5 RADIAL STIFFNESS TEST:

SWINGARM	MAX APPLIED LOAD	STIFFNESS VALUE	PASS/FAIL
21017-10000-16-000	650kg	2640 Nm/°	PASS
21021-10000-16-000	650kg	2640 Nm/°	PASS

TABLE 6 TORSIONAL STIFFNESS TEST:

SWINGARM	MAX APPLIED LOAD	STIFFNESS VALUE	PASS/FAIL
21017-10000-16-000	200kg	452.5 Nm/°	PASS
21021-10000-16-000	200kg	452.5 Nm/°	PASS