Comparative test wire feeder systems

For laser welding / brazing of visible seams in the automotive sector

ABICOR BINZEL® LASER SYSTEMS

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Introduction

Increasing demands on know-how and welding equipment

Global development now demands more than ever before alternative materials, drive systems and manufacturing processes in automotive construction – and lightweight materials are in greater demand than ever before. In addition, there is the enormous economic pressure to produce faster and faster, with consistent quality and preferably reduced costs. Anyone who wants to keep up with today's tough competition needs to rethink. Aluminum and aluminum alloys are also being used more and more frequently.

Similarly, manufacturers and end users expect constantly increasing quality from their vehicles or the means of transport they use, such as motorbikes, automobiles, commercial vehicles, trucks, trains or airplanes. Both technical and optical properties play a decisive role in this regard.

In order to be able to meet these increasing demands and expectations, or even to surprise the customer, the developers, designers, production managers, plant engineers, project managers, purchasers, etc. are challenged with all their creativity and know-how.

A decisive purchase criterion in this context is the visual appearance, which confronts the designers and developers again and again with major challenges. During production and further processing the visually attractive design with corners, edges, curves, ledges and grooves places the highest demands on the joint at the workpiece and on the weld seam in terms of:

- Accessibility
- Strength
- Producibility
- Dimensional accuracy
- Surface quality
- etc.

Especially for visible seams roof seam, tailgate, doors and depending on the manufacturer, also side sealing channels, the strength in combination with the surface quality of the weld/brazed seam plays a decisive role.

It is essential that the weld/braze seam meets the necessary mechanical and technical requirements for the connection width, seam thickness, seam width, penetration depth etc. In addition, the optical requirements for the seam surface, seam characteristics, seam connection, etc. must be met. In this context, the appearance of the seam has a great influence on the further work steps and the related costs.

Visible seams are usually prepared for the painting process after joining, whereby the optical seam quality is a decisive cost factor. Depending on the quality requirements, the seam may have to be reworked (grinded) more, less or even not at all.

It is a major goal to eliminate this reworking step as far as possible. To achieve this, smooth and constant wire feeding during laser joining of aluminum components in car body construction with minimised and consistent reaction times is indispensable.

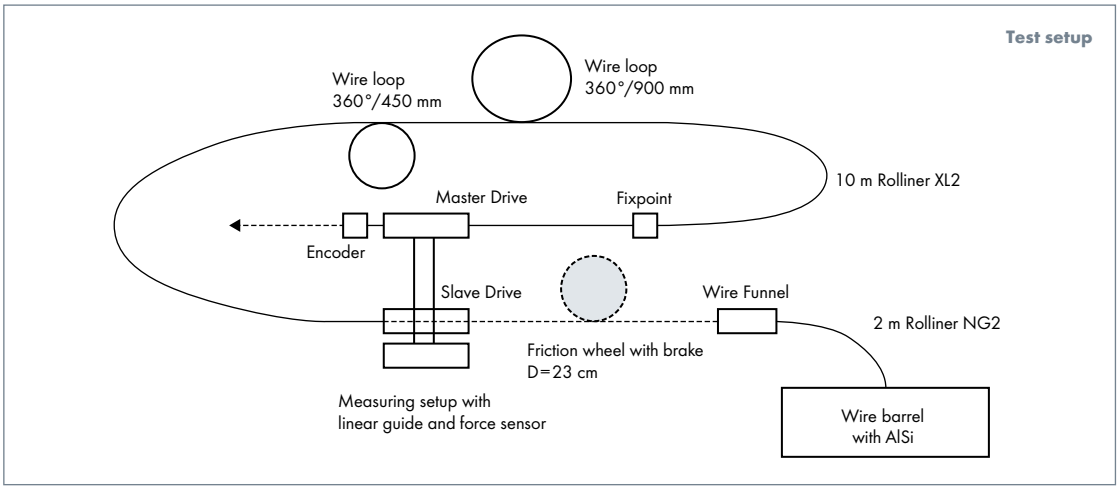
Specifically for this requirement, we have a report from an independent test laboratory1 that was commissioned by a leading premium car manufacturer. This company wanted to analyse the wire feeding systems for laser joining from three different manufacturers in detail and determine test results with regard to constant wire feeding, load due to tensile force and general performance.

On the following pages we present the results of the laboratory tests. Finally, we explain the wire feeding system **(Master-Feeder-System MFS-V3.1)** of Alexander Binzel Schweisstechnik GmbH & Co. KG with all its components and technical features.

[1] Test report of the B.I.G. MC dated 26.01.2021: „WIRE FEEDING OF ALUMINUM WIRE WITH THREE DIFFERENT FEEDING SYSTEMS UNDER ONE DEFINED TEST CONDITION"

Test description, test conditions & criteria

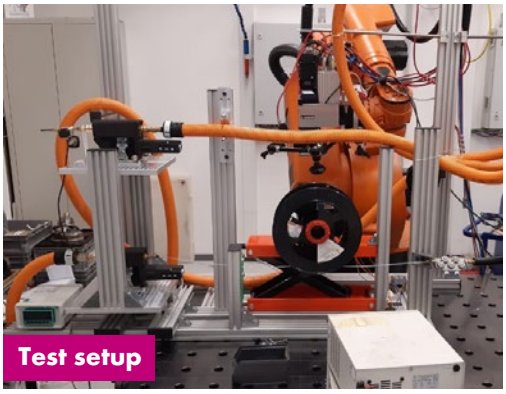
Three wire feeding systems in a comparative test – test setup



Source: Test setup from the original test report[1]

Task:
Comparison of the leading wire feeding systems for laser applications in the joining of aluminum in car body construction. Focus on tensile force and wire feed continuity at different force loads in the area of the roof seam, tailgate, doors and side sealing channels.

Challenge:
Continuous and process-reliable wire feeding and wire positioning for very soft AlSi12 aluminum wires as well as the related high demands on seam quality in terms of durability and surface quality.


Test setup

Explanation of the test criteria:

Constant wire feeding:	Decisive for smooth, even seam surface (Less/no rework = reduced costs)
Tensile force/power intake:	Essential to compensate for process and keep process stability as high as possible
Influence of process fluctuations:	Decisive for the process capability of a process
Test laboratory:	B.I.G. MC in Berlin
Wire:	1.6 mm, AlSi12
System configuration:	2 x drives, 14 m wire feeding section (Rolliner XL2), drum, total 1170° bends/radii at Ø 900 mm, 450 mm, Wire brake with Ø 230 mm, 5-roller wire straightening section
Laboratory/equipment:	Device with load cell, braking system, encoder for speed measurement

View the original test report here: www.binzel-abicor.com/uploads/Content/Germany/PDF-Files/PDF_Testreports_MFS_V3_1/2020_Test_Report_Wire_Feeder_EN.pdf

Wire feeding systems:
1. MFS-V3.1 / Manufacturer 1 (Alexander Binzel Schweisstechnik GmbH & Co. KG)
2. Product / Manufacturer 2
3. Product / Manufacturer 3

The confirmation letter of the testing laboratory stating that „Manufacturer 1" is the wire feeding system MFS-V3.1 of Alexander Binzel Schweisstechnik GmbH & Co. KG can be viewed here: www.binzel-abicor.com/uploads/Content/Germany/PDF-Files/PDF_Testreports_MFS_V3_1/confirmation_wire_feeding_test_BINZEL_BIG_MC.pdf

[1] Test report of the B.I.G. MC dated 26.01.2021: „WIRE FEEDING OF ALUMINUM WIRE WITH THREE DIFFERENT FEEDING SYSTEMS UNDER ONE DEFINED TEST CONDITION"

Test procedure

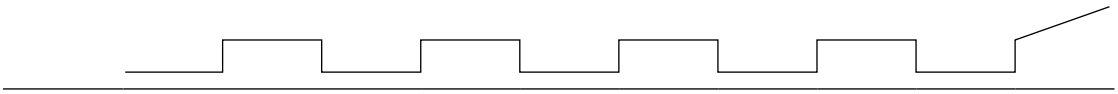
Simulation of different loads indicates fluctuations in the systems

In order to simulate the system load in car body production with aluminum in an application-oriented and reproducible manner, the test system was exposed to different loads in various stages using a wire brake. The wire was deliberately braked in order to determine exactly how the system reacts to these fluctuations. Finally, the system was braked to the maximum braking force of 1000 N using the braking device.

The test procedure was carried out at a wire feeding speed of 2.5 m/min, 5 m/min and 7.5 m/min with all three different wire feeding systems. Therefore, the load diagram was the same in all sections for all three tests.

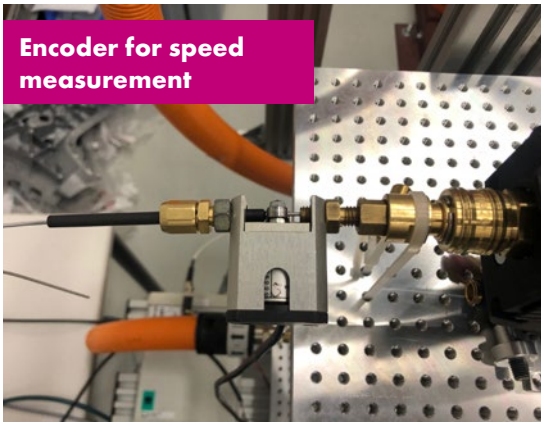
Load diagram

	Range 1	Range 2	Range 3	Range 4	Range 5	Range 6	Range 7	Range 8	Range 9	Range 10
Description of the different load ranges	Wire feeding with minimum load due to laying of liner	Short-term load: 2 seconds	Wire feeding with minimum load due to laying of liner	Short-term load: 2 seconds	Wire feeding with minimum load due to laying of liner	Longer load: 6 seconds	Wire feeding with minimum load due to laying of liner	Longer load: 6 seconds	Wire feeding with minimum load due to laying of liner	Constantly increasing load until collapse of constant feed

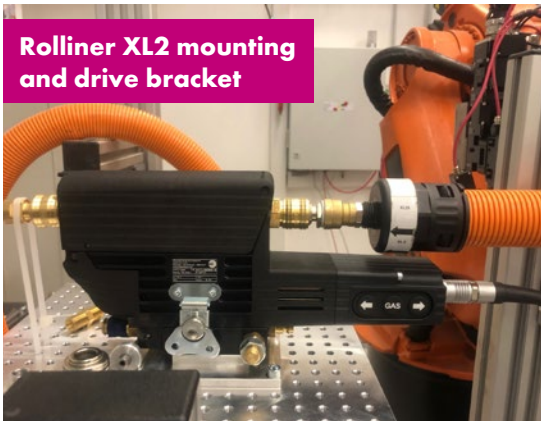


During all test runs, the wire feeding speed and the power intake at the load cell were measured and documented.

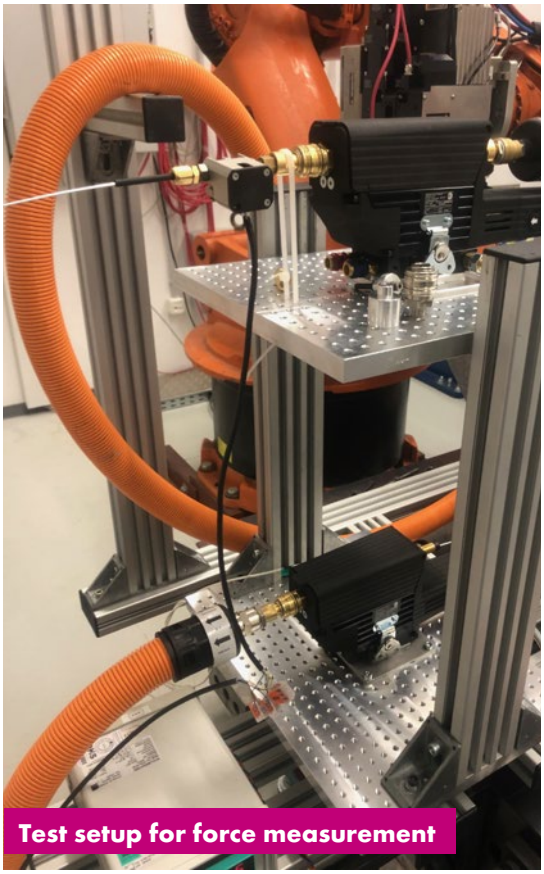
Test setup in the test laboratory



Encoder for speed measurement



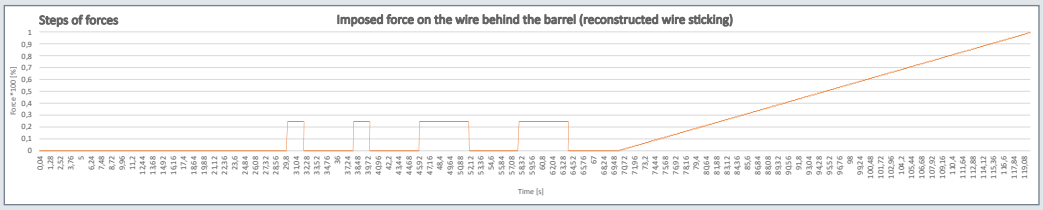
Rolliner XL2 mounting and drive bracket



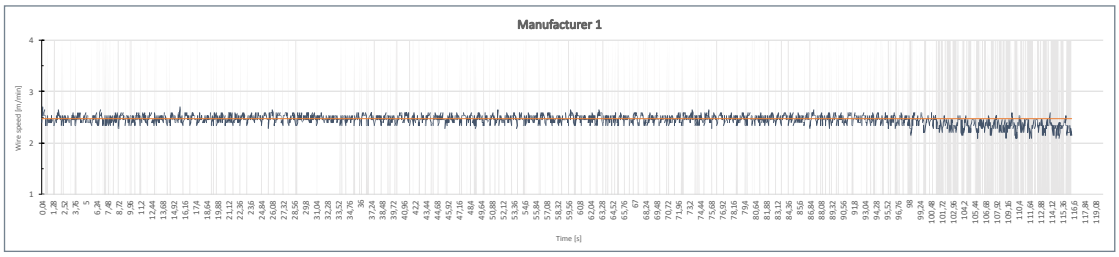
Test setup for force measurement

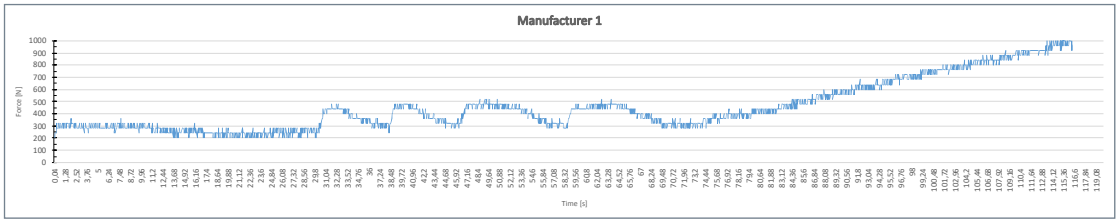
Test results
Results at 2.5 m/min

Braking force interval over time at wire feeding speed of 2.5 m/min for all three tests



MFS-V3.1/ Manufacturer 1 (Alexander Binzel Schweisstechnik GmbH & Co. KG)

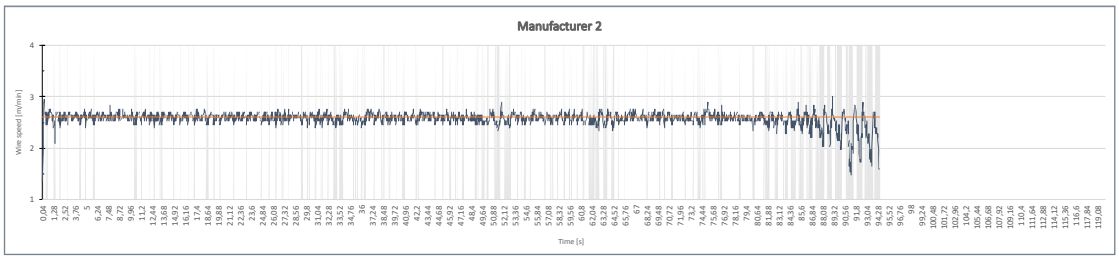




Source: Test setup from the original test report[1]

Very good power transmission with very constant wire feeding speed at max. braking force.

Product/ Manufacturer 2



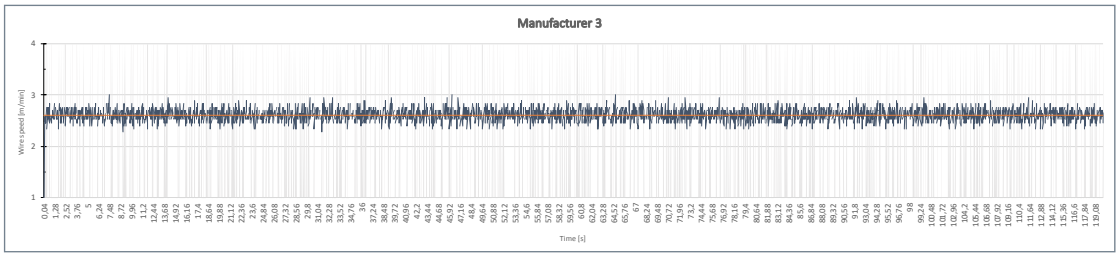
Source: Test setup from the original test report[1]

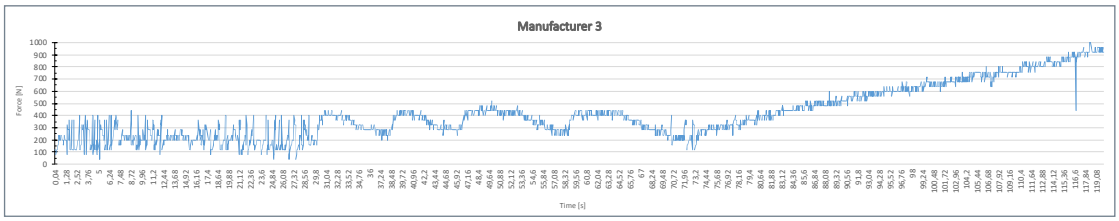
Strong fluctuations in wire feeding speed already from approx. 600 N braking force, power transmission stops at approx. 700 N braking force.

[1] Test report of the B.I.G. MC dated 26.01.2021: „WIRE FEEDING OF ALUMINUM WIRE WITH THREE DIFFERENT FEEDING SYSTEMS UNDER ONE DEFINED TEST CONDITION"

Test results
Results at 2.5 m/min

Product/ Manufacturer 3





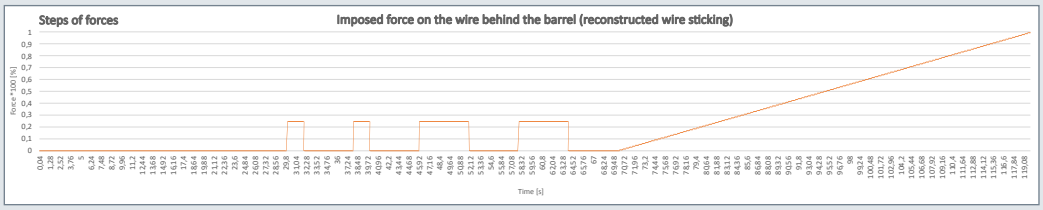
Source: Test setup from the original test report[1]

Generally large fluctuations in wire feeding speed regardless of braking force, no visible effect of braking force on wire feeding speed.

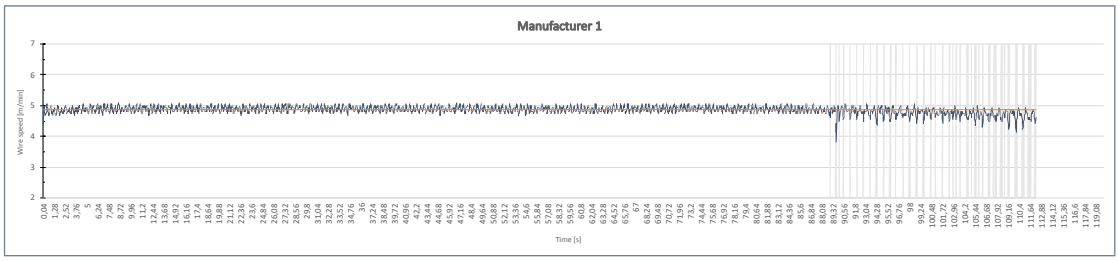
[1] Test report of the B.I.G. MC dated 26.01.2021: „WIRE FEEDING OF ALUMINUM WIRE WITH THREE DIFFERENT FEEDING SYSTEMS UNDER ONE DEFINED TEST CONDITION“

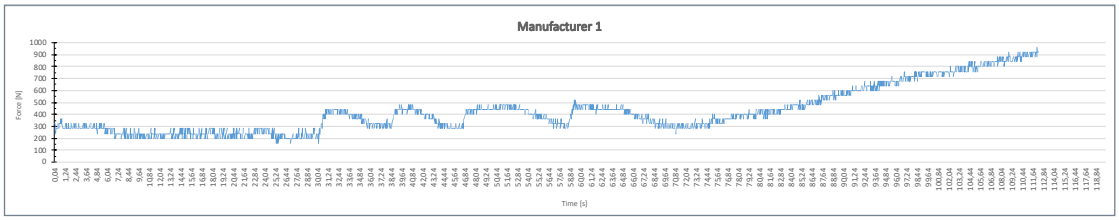
Test results
Results at 5 m/min

Braking force interval over time at wire feeding speed of 5 m/min for all three tests



MFS-V3.1/ Manufacturer 1 (Alexander Binzel Schweisstechnik GmbH & Co. KG)

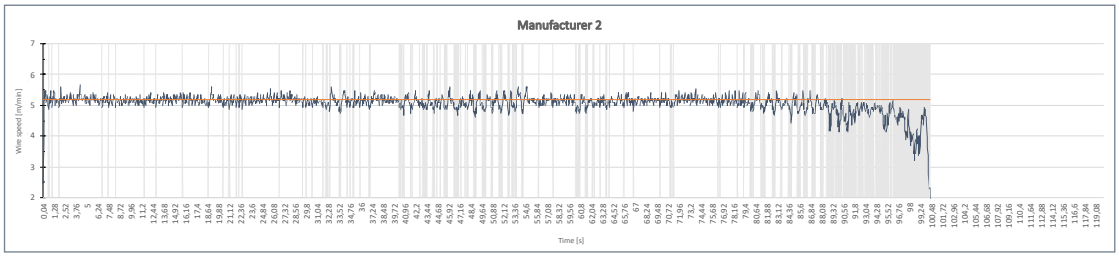


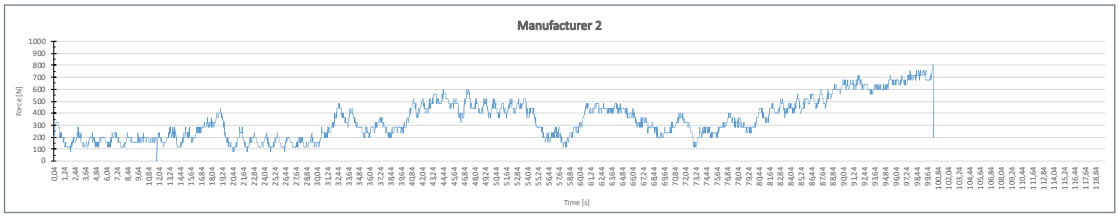


Source: Test setup from the original test report[1]

Good power transmission at constant wire feeding speed up to approx. 900 N braking force.

Product/ Manufacturer 2





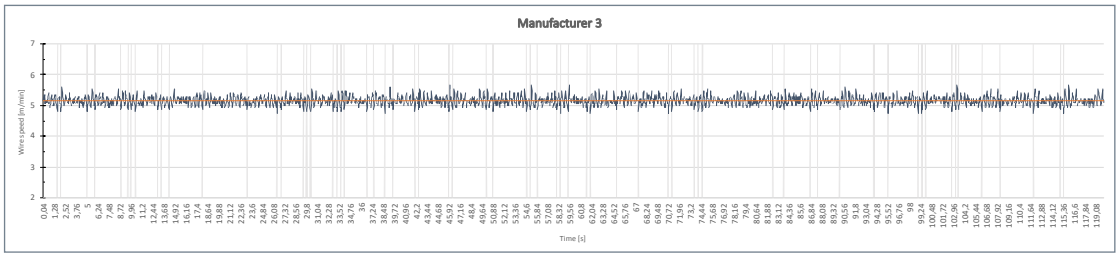
Source: Test setup from the original test report[1]

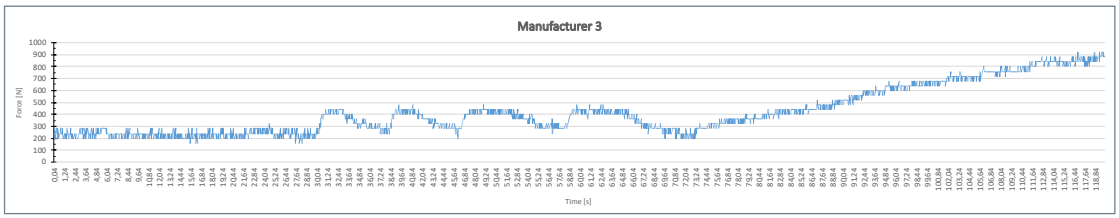
Braking intervals can be noticed by fluctuations in the wire feeding speed, power transmission is possible up to approx. 700 N braking force, from approx. 700 N braking force strong drops in wire feeding speed, stop of wire feeding at approx. 800 N braking force.

[1] Test report of the B.I.G. MC dated 26.01.2021: „WIRE FEEDING OF ALUMINUM WIRE WITH THREE DIFFERENT FEEDING SYSTEMS UNDER ONE DEFINED TEST CONDITION"

Test results
Results at 5 m/min

Product/ Manufacturer 3





Source: Test setup from the original test report[1]

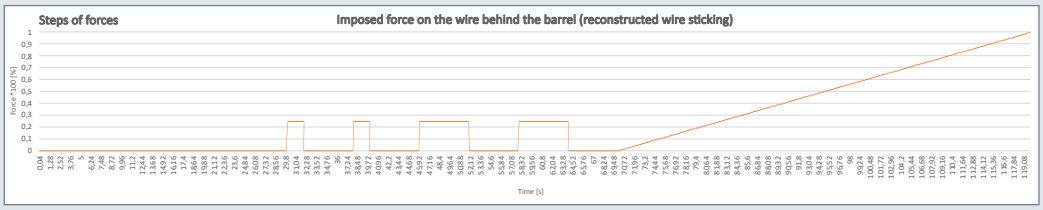
Strong fluctuations in wire feeding speed in general, independent of braking force, no visible effect of braking force on the wire feeding speed, very good power transmission.

[1] Test report of the B.I.G. MC dated 26.01.2021: „WIRE FEEDING OF ALUMINUM WIRE WITH THREE DIFFERENT FEEDING SYSTEMS UNDER ONE DEFINED TEST CONDITION"

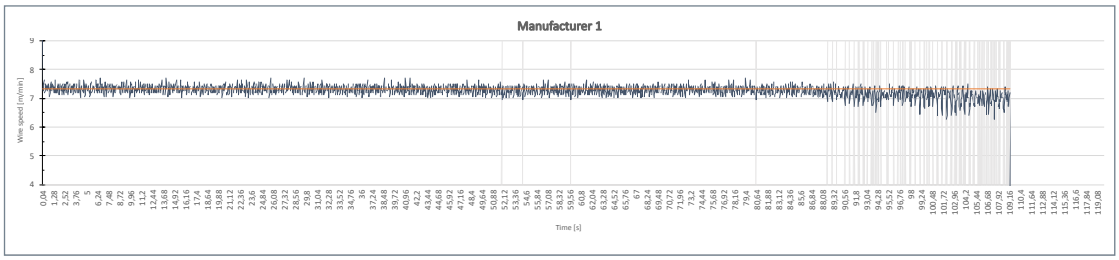
Test results

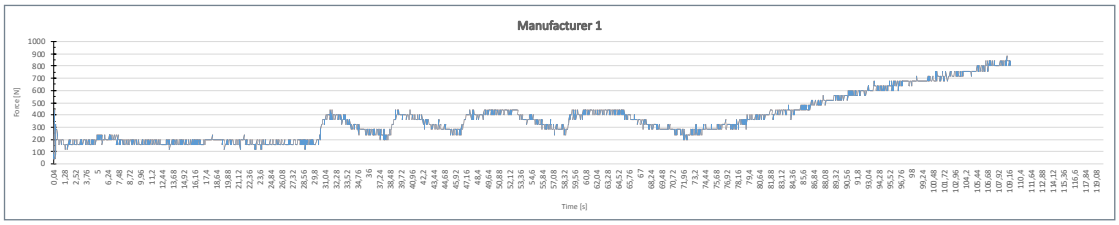
Results at 7.5 m/min

Braking force interval over time at wire feeding speed of 7.5 m/min for all three tests



MFS-V3.1/ Manufacturer 1 (Alexander Binzel Schweisstechnik GmbH & Co. KG)

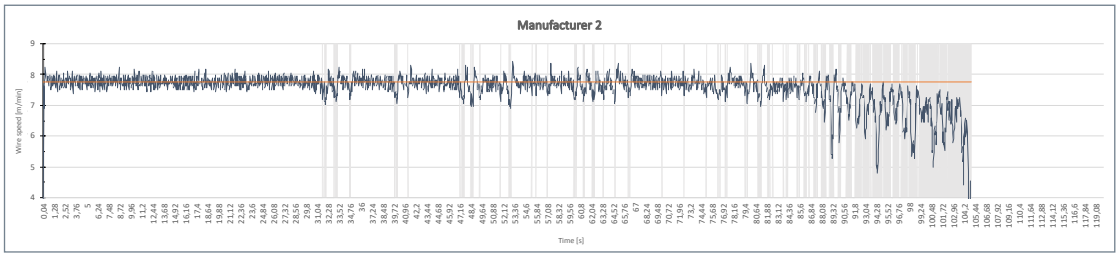


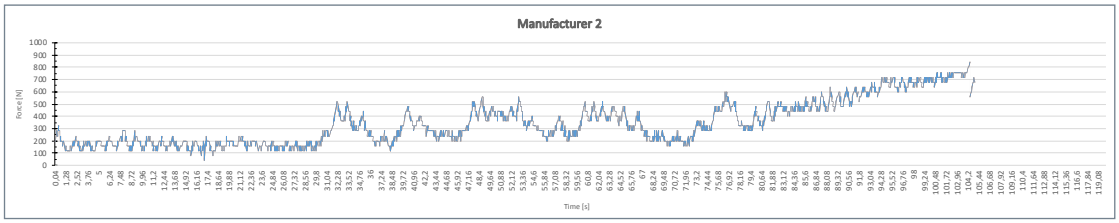


Source: Test setup from the original test report[1]

Drops in the wire feeding speed can be noticed from approx. 700 N braking force, and from approx. 900 N braking force wire feeding is no longer possible.

Product/ Manufacturer 2





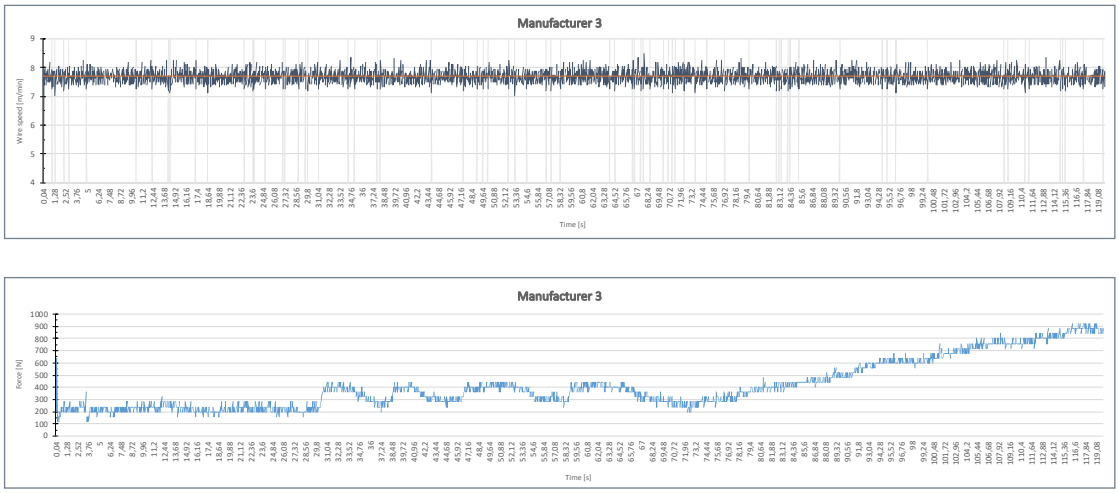
Source: Test setup from the original test report[1]

Braking intervals are noticeable through fluctuations in the wire feeding speed. Drops in the wire feeding can be noticed from approx. 600 N braking force, and from approx. 600 N braking force, strong drops in the wire feeding speed are noticeable. Power transmission is still possible up to approx. 800 N braking force.

[1] Test report of the B.I.G. MC dated 26.01.2021: „WIRE FEEDING OF ALUMINUM WIRE WITH THREE DIFFERENT FEEDING SYSTEMS UNDER ONE DEFINED TEST CONDITION"

Test results
Results at 7.5 m/min

Product/ Manufacturer 3

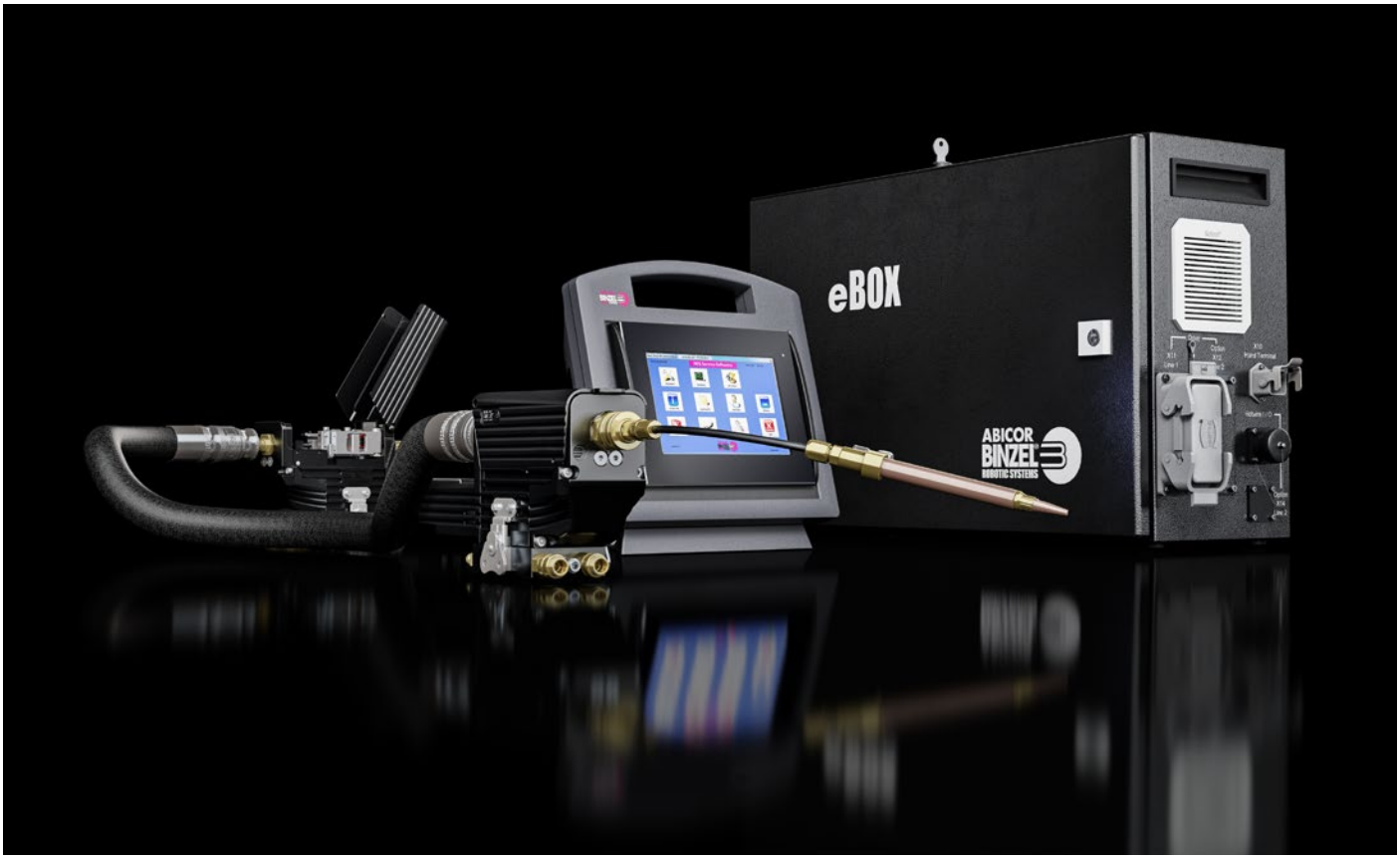


Source: Test setup from the original test report[1]

Strong fluctuations in the wire feeding speed independent of the braking force, no visible effect of the braking force on the wire feeding speed, very good power transmission.

[1] Test report of the B.I.G. MC dated 26.01.2021: „WIRE FEEDING OF ALUMINUM WIRE WITH THREE DIFFERENT FEEDING SYSTEMS UNDER ONE DEFINED TEST CONDITION“

Explanation / interpretation of the test results



MFS-V3.1 / Manufacturer 1 (Alexander Binzel Schweisstechnik GmbH & Co. KG)

- Best continuous wire feeding even with high tensile force due to system load.
- Best results in wire transport with comparatively minimal fluctuations, no noticeable fluctuations in braking interval, good power transmission without interruptions, very good results in wire feeding speed ACTUAL to TARGET and thus best in performance.

Manufacturer 2

- Good continuous wire feeding, however reacts sensitively to system load and thus shows a poor tensile force.
- Good results for wire transport, immediately recognisable fluctuation for braking interval, weak values for power transmission, good results for wire feeding speed ACTUAL to TARGET.

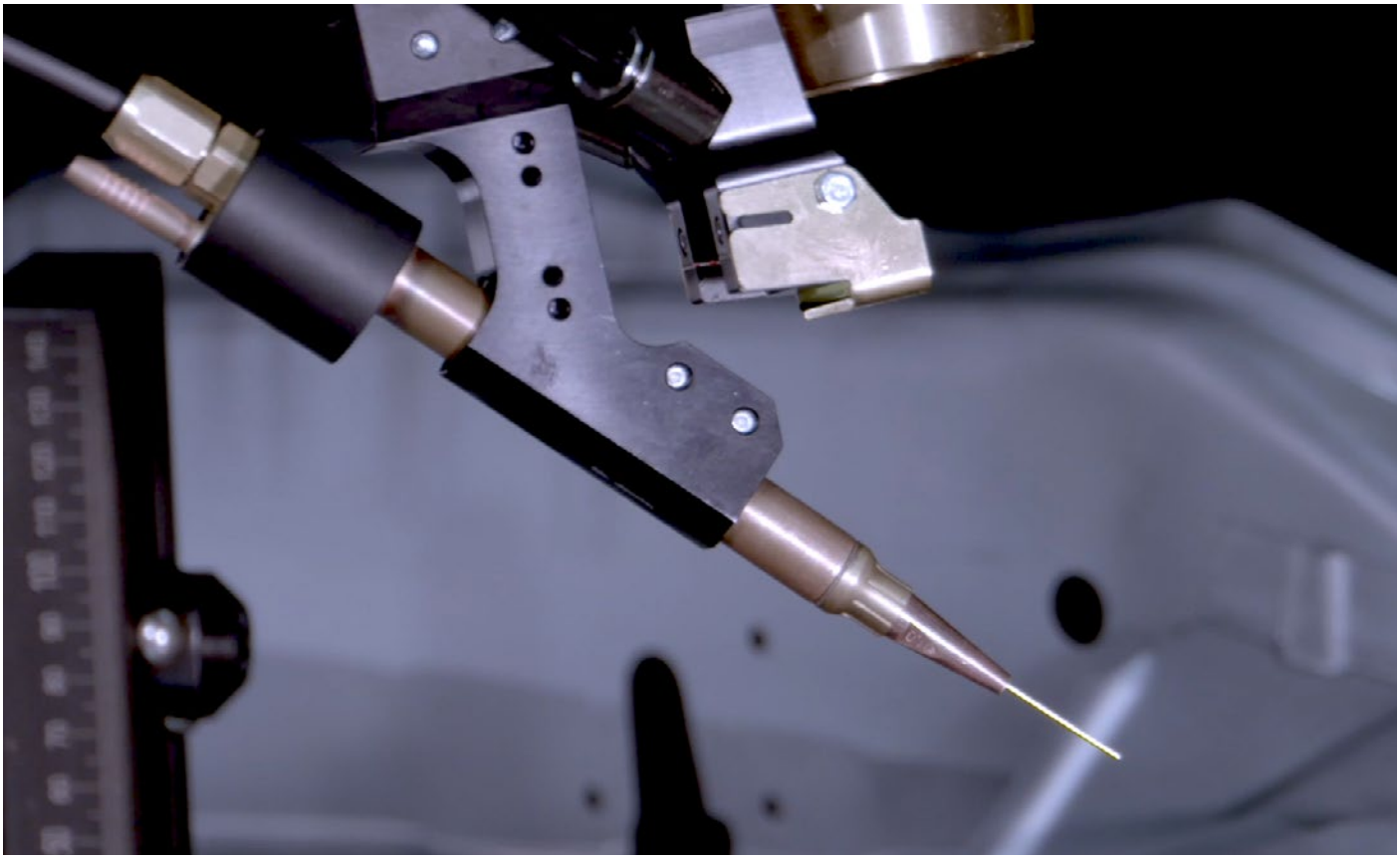
Manufacturer 3

- In comparison, slightly weaker continuous wire feeding due to excessive nominal deviation, but best tensile force due to system load.
- In comparison, slightly weaker results for wire transport, no noticeable fluctuations in braking interval, minor fluctuations in power transmission but best power transmission, good results for ACTUAL to TARGET wire feeding speed.

The original test report can be viewed here: www.binzel-abicor.com/uploads/Content/Germany/PDF-Files/PDF_Testreports_MFS_V3_1/2020_Test_Report_Wire_Feeder_EN.pdf

The confirmation letter of the testing laboratory stating that "Manufacturer 1" is the wire feeding system MFS-V3.1 of Alexander Binzel Schweisstechnik GmbH & Co. KG, can be viewed here: www.binzel-abicor.com/uploads/Content/Germany/PDF-Files/PDF_Testreports_MFS_V3_1/confirmation_wire_feeding_test_BINZEL_BIG_MC.pdf

Conclusion



Although in the present test as well as in the official report the concrete effects of the systems' wire feeding properties of the three different manufacturers on the laser seam were not investigated, from our point of view the results can definitely be interpreted in terms of the seam quality.

According to our assessment, the following conclusions can be drawn:

MFS-V3.1/ Manufacturer 1 (Alexander Binzel Schweisstechnik GmbH & Co. KG)
Due to the most consistent wire feeding in the test, we consider this product to be ideally suitable for feeding aluminum wires.

Manufacturer 2
The sensitive reaction to tensile stress and the resulting strong fluctuations in the wire feeding speed may have a negative effect on the seam quality in the visible area.

Manufacturer 3
Due to the very high tensile force, the system is very well suited to wire feeding. Because of the constantly high fluctuations in the wire feeding speed, the use of the system in the visible seam area should be critically examined.

Wire feeding system
»Master-Feeder-System MFS-V3.1«

Leading wire feeding system for excellent welding results

The **MFS-V3.1** wire feeding system was developed specifically for laser applications in car body construction, even for demanding materials and special wire types. The system was developed in close cooperation with leading premium car manufacturers.

This test report confirms that the **MFS-V3.1** from Alexander Binzel Schweisstechnik GmbH & Co. KG is currently the leading wire feeding system on the market for laser joining with filler material in the aluminum body construction. It combines precise and highly accurate control technology with powerful and robust mechanics that enable continuous wire feeding with excellent welding results.

The deciding factors for the great performance are the precise control technology in connection with the highly dynamic, digitally controlled drives and the associated know-how which we have been able to acquire over the last few decades in close cooperation with our development partners from the automotive industry.

Wire feeding system »Master-Feeder-System (MFS)« for continuous and precise wire feeding in the process.

- Very short and consistent reaction/control times (eBOX)
- Very smooth wire feeding (MF drive)
- Very low system friction (Masterliner/Rolliner)
- Very good process monitoring (Service Software)
- Early detection of maintenance requirements (Service Software)

TECHNOLOGY FOR THE WELDER'S WORLD.

ABICOR BINZEL®
LASER SYSTEMS

Alexander Binzel Schweisstechnik GmbH & Co. KG
Kiesacker · 35418 Buseck · GERMANY
T: +49 64 08 / 59-0
F: +49 64 08 / 59-191
info@binzel-abicor.com

www.binzel-abicor.com

IBG GROUP