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WOULD YOU LIKE MORE INFORMATION ABOUT OUR FRICTION AND MAGNETARC WELDING MACHINES? THEN JUST GIVE US A CALL: **TEL. +49 821 797-1532** – OR SEND AN E-MAIL TO: **FRICTIONWELDING@KUKA.DE**. WE ARE THERE FOR YOU WHENEVER YOU NEED US.

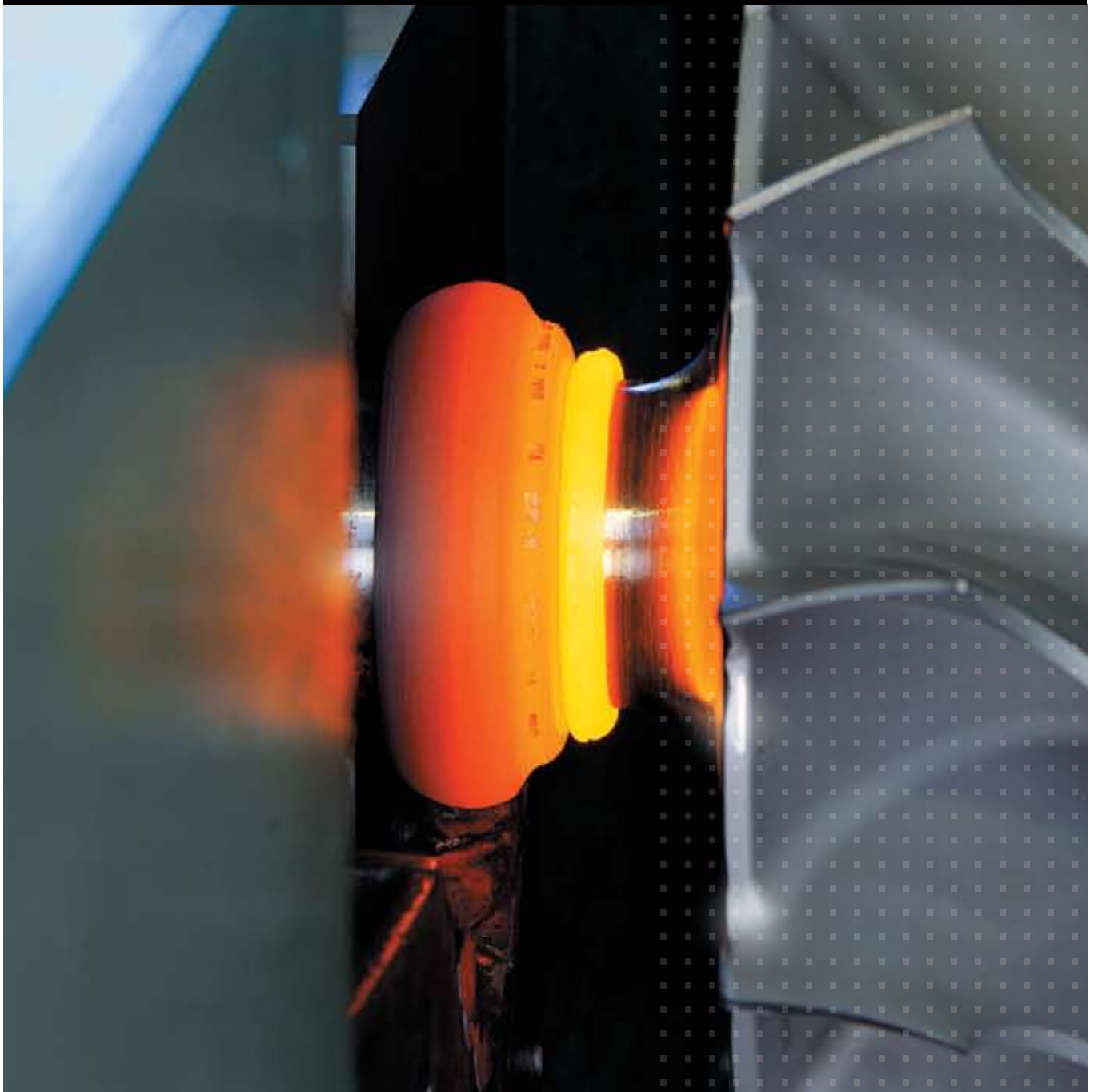
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KUKA

KUKA Friction and Magnetarc Welding Processes

**WELDING PRECISION
IN SUPERIOR QUALITY**



WELDING PRECISION – MAGNETARC WELDING

PERFECT JOINTS AT THE TOUCH OF A BUTTON

KUKA MAGNETARC WELDING JOINS COMPONENTS ...

- WITH ENCLOSED GEOMETRY
- WITH MAXIMUM SPEED
- WITH EXCELLENT PROCESS CONTROL
- WITH HIGHEST PRECISION
- WITH EXACTLY DEFINED QUALITY

THE PREREQUISITES FOR USING THE MAGNETARC PROCESS ARE ...

- CONDUCTIVE AND FUSIBLE MATERIALS
- COMPONENTS WITH TUBULAR CROSS-SECTIONS
- WALL THICKNESSES FROM 0.7 TO 6 MM

THE MAGNETARC WELDING PROCESS:



1. The clamped workpieces are brought into contact. The weld current is then switched on.



2. In a defined retract motion, the workpieces are moved apart, thereby striking the arc. The arc is rotated by means of a magnetic field.



3. The rotating arc melts the weld surface. Rotational speed and shaping of the arc, as well as progression and quantity of energy input, are precisely controlled.



4. The workpieces are joined by means of a forging operation. The forge velocity and forge force are defined for each specific component.





SEMI-INDEPENDENT SUSPENSION (STEEL / CAST IRON) FOR A 4X4 SUV



STEEL PROPSHAFT FOR AN OFF-ROAD VEHICLE



PRE-ASSEMBLED STEEL PROPSHAFT FOR A CAR



■ **THE NEW
MAGNETARC WELDERS
FROM KUKA:**

**DON'T MAKE DO WITH
ANYTHING LESS –
PRODUCT RECALLS
ARE JUST TOO COSTLY.**

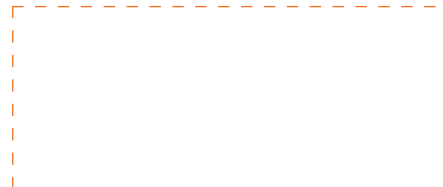
THE INNOVATION OF THE ORIGINAL

It was in 1972 that KUKA presented the first Magnetarc welding machine. Since then, the technique has been continually improved and developed. The latest generation, presented here, has taken a further giant step toward more process quality and more output. The optimized KUKA process monitoring and documentation system PCD gives the user even more control. And more productivity is ensured by countless enhancements in the design, together with maintenance and service intervals of unsurpassed length.

SAFETY AT THE TOUCH OF A BUTTON

When it comes to the production of axles, propshafts and drive shafts, why do a host of renowned car manufacturers rely on the Magnetarc welding process from KUKA?

Because there is probably no other process as fast and reliable for the joining of components which have to withstand constant high loads. Safety-relevant components – and not just these – are ideally suited to production in a KUKA Magnetarc machine; in batches of any size and in constant high quality.





■ MACHINE FEATURES:

PRECISION FROM THE WORD GO

Calibration markings integrated as standard and calibration logs ensure that every KUKA Magnetarc machine works with the maximum precision recorded at the factory. A quality certificate documents the precision of every machine.

SLIDE GUIDEWAY

Preloaded play-free rolling-contact bearings in the slide guideway ensure maximum stiffness and precision. This results in significant advantages with regard to maintenance, with extremely long servicing intervals.

ADJUSTING PLATE

An adjusting plate is provided for precision set-up and correction of the clamping equipment. This allows fixture and component tolerances to be compensated for quickly and easily.

HNC HYDRAULIC SYSTEM

Every KUKA Magnetarc machine is equipped with a NC-controlled hydraulic system for all process-related parameters, such as slide travel and forge pressure. The benefits can be seen in terms of operation, availability and diagnosis.

HIGH-TECH COILS AND PRECISION CLAMPING EQUIPMENT

Workpieces need not be inserted through the opening in the magnetic coil, as the split coil allows time-saving loading and unloading from above. Precision clamping equipment with component-specific exchangeable inserts makes it possible to retool fast for different component diameters. The coil itself is not subjected to any wear, since the magnetic field is aligned so that welding takes place in front of the coil. The process generates little spatter, and the welding gas supply ensures that the process area remains virtually particle-free. This not only contributes to a stable process, it also minimizes the maintenance cycles.

SAFETY

Maximum user safety is an integral part of the machine concept. For example, only certified safety windows are used.

NOISE PROTECTION / ENERGY SAVING

The new machines are extremely quiet. In most cases, the hydraulic system is completely integrated into the sound-proofed housing. And it goes without saying that all current noise protection regulations are complied with. All electrical components of the machines have been evaluated and chosen for their energy efficiency.

LEADING BY EXPERIENCE

KUKA SYSTEMS NOT ONLY BUILDS THE MACHINES, IT IS ALSO A PRACTICAL USER OF MAGNETARC TECHNOLOGY AS PART OF ITS JOB MANUFACTURING OPERATIONS. AREAS IN WHICH PROCESS KNOW-HOW HAS BEEN INTEGRATED INTO THE CURRENT KUKA MAGNETARC MACHINES INCLUDE ...

- JOINING OF STEEL / DUCTILE CAST IRON
- SHORT-CYCLE WELDING WITH PROCESS MONITORING (IN-TIME PROCESSES)
- JOINING OF PRE-MACHINED OR FINISH-MACHINED COMPONENTS

■ HIGH-SPEED FRICTION WELDING

THE FRICTION WELDING PROCESS:



1. INITIAL SITUATION:

Both workpieces are firmly clamped into the machine; one workpiece is rotated.



2. HEAT BUILD-UP:

The two workpieces are pressed together with a defined force; the rotation and contact force generate friction which causes the weld surfaces to heat up.



3. WELDING:

At a defined moment in time, the rotating workpiece is braked and the contact pressure is increased. This creates the friction-welded joint.

■ THE NEW FRICTION WELDERS FROM KUKA:

**EVEN FASTER.
EVEN MORE PRECISE.
EVEN MORE PRODUCTIVE.**

Four decades ago, KUKA established friction welding as an industrial joining process. Numerous KUKA innovations, such as short-cycle welding and defined-angle friction welding, have shaped this field ever since. Now, the generation of machines is opening up a whole new dimension. A multitude of technical innovations and superior control technology have resulted in absolute process and performance perfection.

The latest range is setting new standards not only in terms of precision, dynamics and process control, but also with its unrivaled price / performance ratio. No matter which markets you are active in, which customers you serve and which tasks you are faced with, you will find no friction welders more productive or more readily configured to your requirements than those presented here.



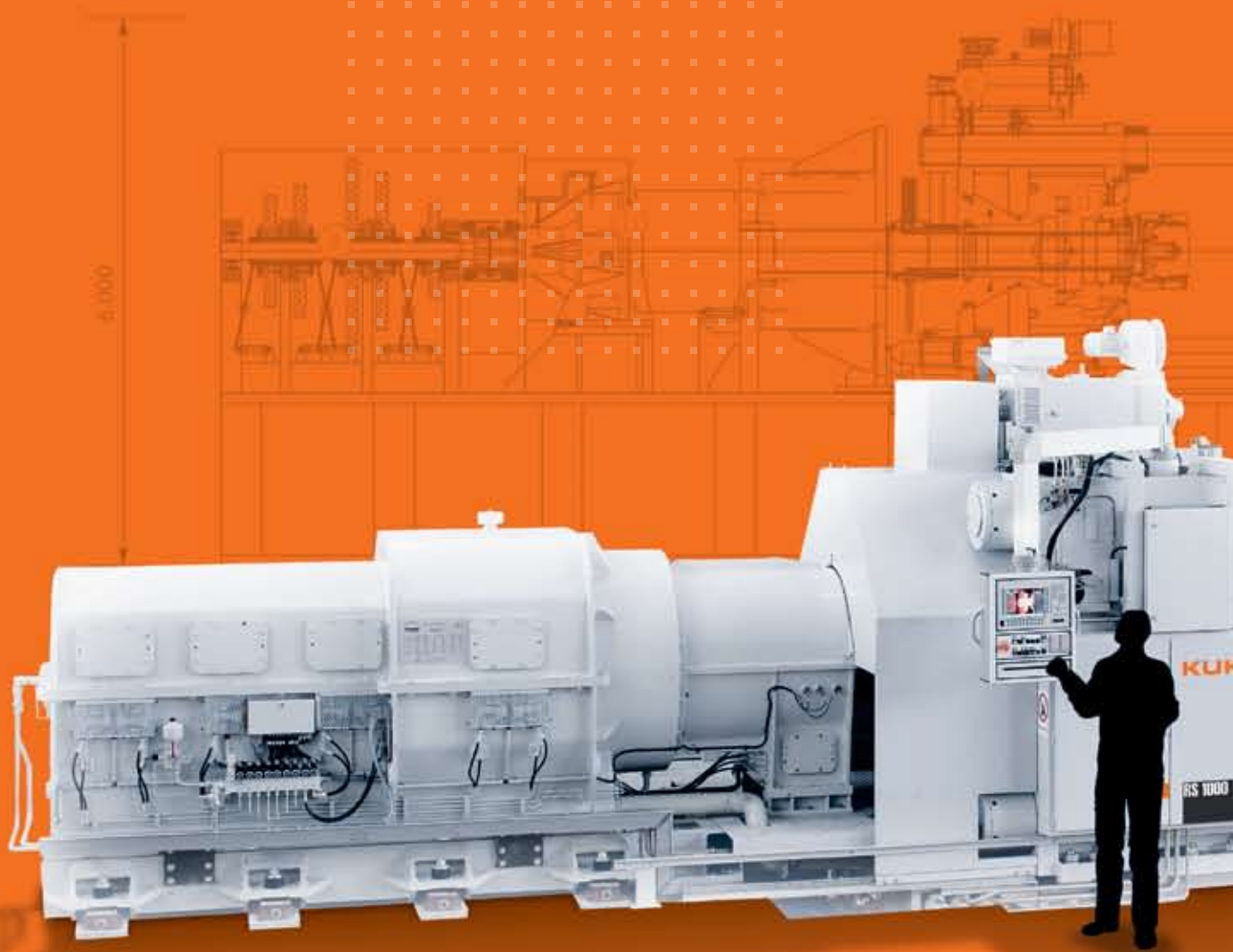
TURBINE ROTOR



TURBINE FOR AERO-ENGINE



HIGHLY SOPHISTICATED ALUMINUM SHOCK ABSORBER





FRICITION WELDING MACHINE RS 1000

Forge Force	50-1,000 t
Speed	max. 600 rpm
Welding Ranges	Titanium/Titanium: approx. 9,000 mm ² - approx. 70,000 mm ² Steel/Steel: approx. 5,000 mm ² - approx. 40,000 mm ² Inconel/Inconel: approx. 2,800 mm ² - approx. 20,000 mm ²
Clamping Diameter	max. 1,000 mm (depending on component geometry)
Flywheel Energy	450-450,000 kgm ² (fully automatic selection)
Energy Adjustment	n x 350 kgm ²
Weight	360 t
Length x Width x Height	20 x 4 x 6 m
Controller/PLC	PLC/PCD 305 (real-time monitoring)

- Fully automatic component measurement
 - Forge displacement control / length compensation
 - NC chuck adjustment
 - Double-spindle design
- Applications
 - Large-sized components
 - Engines
 - Turbines



■ MACHINE FEATURES:

MACHINE BED

Headstock, work slide and frame columns are supported on a shared, FEM-optimized machine bed. The extremely accessible working area has been generously enlarged.

MAIN SPINDLE

All machines have a main spindle with multiple bearings. The precision with which parts are joined, and thus the dimensional accuracy of each manufactured workpiece, remains permanently unaffected by the high forge forces. This is helped by the high-performance bearing combination manufactured exclusively for the new generation of machines.

SLIDE GUIDEWAY

Preloaded play-free rolling-contact bearings in the slide guideway ensure maximum stiffness and precision. They also provide significant advantages with regard to maintenance, with extremely long servicing intervals.

FLOATING SLIDE

A highly sensitive device for the automatic compensation of material elasticity, particularly in the case of long components. Tolerances in the case of manual loading are also compensated automatically.

HNC HYDRAULIC SYSTEM

Computer-controlled hydraulic system for precise joining, as there is exact control of pressure and position of the drive slide at all times.

SAFETY

Maximum user safety is an integral part of the machine concept. For example, only certified safety windows are used.

NOISE PROTECTION / ENERGY SAVING

The new machines are extremely quiet. Up to the RS 45, the hydraulic system is completely integrated into the sound-proofed housing. As standard, all machines are designed to comply with the current noise protection regulations. All electrical components of the machines have been evaluated and chosen for their energy efficiency.

DRIVE SYSTEM

Highly dynamic drives with frequency regulation enable variable spindle speeds and prevent jerky starting. This ensures smoother operation and increases the weld quality.

LASER MEASUREMENT POINTS

Calibration markings – integrated as standard – and calibration logs ensure that every machine can be installed with the maximum precision documented at the factory. Each machine naturally comes with a quality certificate verifying this precision.

	TYPE OF MACHINE	FORCE FORGE MAX. (kN)	WELD CROSS SECTION, MILD STEEL, SOLID DIAM.	
			MIN. (mm ²)	MAX. (mm ²)
SMALL SIZED MODELS	RS 2	20	20	170
	RS 5	50	40	410
MEDIUM SIZED MODELS	RS 12	120	100	1000
	RS 30	300	175	2500
	RS 45	450	400	3750
LARGE SIZED MODELS	RS 80	800	800	6700
	RS 125	1250	1500	10,500
	RS 300	3000	1600	25,000

SPECIAL SIZES AND DESIGNS (DOUBLE-HEAD MACHINES AND MACHINES OF VERTICAL DESIGN) ARE AVAILABLE ON REQUEST.

EXACT MONITORING, PRECISE CONTROL, WITH THE KUKA SYSTEMS PCD.

High-end welding calls for a high-end system for process control and monitoring.

The KUKA Systems PCD is a unique solution, guaranteeing maximum reproducible quality in real time. It enables highly accurate control over the decisive process parameters.

DISPLAY AS REQUIRED

The welding parameters are automatically displayed after each welding cycle.

Simultaneously with the process, the PCD system archives all the program and actual value data in an integrated database.

An Ethernet interface is available for data exchange and connection to the network. Rapid and user-friendly data entry will be done on a Panel PC.

INTERFACE FOR GREATER PRODUCTIVITY

A further plus point is the graphics capability and thus user-friendliness of the PCD system with its Windows-based user interface.

For example, the user can choose between a numerical and a graphical mode when entering the welding parameters.

HELPFUL NAVIGATOR

Before a fault can become a problem, the integrated process and machine diagnosis software ProAgent kicks in. It helps the user to localize malfunctions quickly and easily and, in most cases, to eliminate them straight away.



KUKA SYSTEMS PCD FEATURES:

- SWIVELING PANEL PC
- DISKLESS PC
- REAL-TIME OPERATING SYSTEM
- ETHERNET INTERFACE
- BUS CONNECTION TO MACHINE COMPONENTS
- CHOICE BETWEEN NUMERICAL AND GRAPHICAL ENTRY OF WELDING PARAMETERS
- ABILITY TO SAVE GRAPHICS
- GRAPHICAL DISPLAY OF PROCESS PARAMETERS
- POWERFUL USER MANAGEMENT
- DATABASE OPTION

PROCESS PARAMETERS MONITORED AND RECORDED:

- SPINDLE SPEED ⁽¹⁾
- FRICTION PRESSURE / TRAVEL / TIME ⁽¹⁾
- RETRACT ⁽²⁾
- WELDING TIME / CURRENT / VOLTAGE ⁽²⁾
- MAGNETIC COIL CURRENT ⁽²⁾
- STARTING POSITION ⁽³⁾
- TOTAL SHORTENING ⁽³⁾
- FORGE PRESSURE ⁽³⁾

(1) FOR FRICTION WELDING PROCESS
 (2) FOR MAGNETARC WELDING PROCESS
 (3) FOR FRICTION AND MAGNETARC WELDING PROCESSES

ONLINE TROUBLESHOOTING

A secure data line allows you to make full use, within seconds, of our worldwide online product support – as if we were with you on site.

The options range from remote diagnosis and process analysis through to software updates and preliminary information for service call-outs.

■ FROM THE MACHINE TO THE SYSTEM: TECHNOLOGICAL LEAP AS STANDARD.

KUKA Systems Friction and Magnetarc Welding is an integral part of the comprehensive KUKA spectrum of products and services. As a manufacturer of flexible systems for automated production, KUKA Systems has the experience and expertise to develop and implement cost-effective complete solutions with high process reliability.

With its open, easily-accessible working area and the network capability of the controller, the new generation of machines offers ideal conditions. The integration of linear axes or robotic handling of the workpiece could not be easier.



CUSTOMIZED AUTOMATION

Generally speaking, it is company-specific and production-specific factors that determine whether a Friction or Magnetarc Welding machine is fitted with additional automation components. All KUKA Machines are ready for integration into an automatic process, however. With its modular design, a Friction or Magnetarc Welder can be optimized to meet the specific requirements of the user.

THERE ARE THREE POSSIBLE LEVELS OF AUTOMATION:

- PARTIAL AUTOMATION WITH LINEAR AXES FOR WORKPIECE INFED AND REMOVAL
- ROBOTIC AUTOMATION FOR THE HANDLING OF WORKPIECES
- FULLY-AUTOMATED SOLUTION INTEGRATED INTO THE SPECIFIC WORKFLOW

RETROFITS MADE EASY

KUKA Friction and Magnetarc Welders can be automated simply at any time.

THINKING AHEAD

It may be useful to carry out a prior analysis before integrating a new machine into a work process – particularly in the case of robotic machine tending. 3D process simulations provide a realistic representation of the manufacturing cell. This makes it possible to optimize manufacturing processes, robot integration, human-machine interaction and ergonomic factors before the cell is commissioned.

THE MAIN ADVANTAGES OF KUKA FRICTION AND MAGNETARC WELDING MACHINES

COST REDUCTION

1

Modern Friction and Magnetarc processes allow the use of expensive material only where required on the component.

VERY HIGH WELD QUALITY

2

Avoid unnecessary problems – opt for a product process in which every component is validated.

COMPONENT OPTIMIZATION

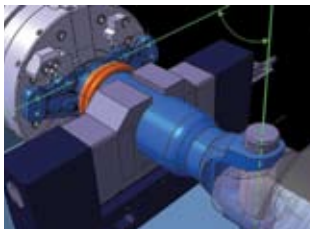
3

The automotive industry demands solutions that reduce weight – Friction and Magnetarc Welding pave the way for the mobility of the future.

ASK US – WE CAN JOIN IT!



OPTIONAL UPGRADES



DEFINED-ANGLE POSITIONING OF THE WORKPIECE



REMOVAL OF FRICTION WELDING FLASH BY TURNING



REMOVAL OF FRICTION WELDING FLASH BY STAMPING



COMPONENT LABELING