



NOVA GENERACIJA ROBOTA I ALATA ZA ZAVARIVANJE

THE NEW GENERATION OF ARC WELDING ROBOTS AND TOOLS

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Sažetak: Ponekad, napredak se događa skokovito, ne samo na području elektronike, nego i mehanike. To se ovaj trenutak događa s robotima za zavarivanje. Svi dobro poznati proizvođači robota sada nude novu generaciju robota za zavarivanje sa šupljim zglobovima. ABICOR BINZEL sa više od 3500 prodanih sustava za robote sa šupljim zglobovima tijekom prošlih godina je tržišni vođa kod aplikacija hlađenih zrakom i vodom ABICOR BINZEL može osigurati za nove robote sa šupljim zglobovima rješenja kao što su iSTM i iCAT (s integriranim senzorom kolizije). S ovim novim sustavima, kompletan paket kabela je integriran direktno u ruku robota. Sam pištolj za zavarivanje je montiran centralno u šestoj osi, koja je također konstruirana kao šuplji zglob. U uskoj suradnji s vodećim proizvođačima robota, ABICOR BINZEL je razvio pomoćne sustave za ove nove robote-alate za robotske pištolje za zavarivanje, pištolje za zavarivanje I priključke za kabele. Ovi proizvodi, kroz svoju interakciju sa novom generacijom robota, čine postupak zavarivanja sigurnijim, tehnološkičnijim i učinkovitijim. ABIDOT je novi "pametniji" alat za beskontaktno programiranje robota za zavarivanje. Slobodan kraj žice kod MAG/MAG pištolja za zavarivanje se često koristi za programiranje radnih komada. Sve tolerancije i netočnosti, kao što su odstupanja zbog toplog valjanja žica, varijacije duljine slobodnog kraja žice i uslijed gibanja robota, kao i savijanje žice prilikom dodirivanja radnog komada valja uzeti u obzir. Programska pomoć ABIDOT se jednostavno montira na pištolj za zavarivanje na robotu na mjestu sapnice plina i koristi se za programiranje procesa uz pomoć četiri laserske diode kako bi se odredio položaj ako je TCP točan. Ovaj rad daje kratki pregled različitih tipova robota i također pokazuje kako možete smanjiti troškove životnog ciklusa nove generacije robota u usporedbi sa standardnim sustavima koristeći nove razvijene sustave za hlađenje pištolja za zavarivanje zrakom i vodom. Osim toga, mogu se naći podaci o novo razvijenim sustavima kao što je ABIDOT programski alat i MFS V2 – Glavni sustav za dobavu verzije 2 – koji je odličan za korištenje kod laserskog zavarivanja sa vrlo preciznom dobavom žice.

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Abstract: Once in a while, progress happens in leaps and bounds, not only in electronics but also in the mechanical field. This is what is happening at the moment with welding robots. All of the well-known robot manufacturers now offer a new generation of welding robots with hollow wrist. ABICOR BINZEL is with more than 3500 sold systems for hollow wrist robots during the last years the market leader in air and water cooled applications. ABICOR BINZEL is able to provide for the new hollow wrist robots solutions like iSTM and iCAT (with integrated collision sensor). With these new systems, the complete hose package is integrated directly into the robot arm. The torch itself is mounted centrally in the 6th axis, which is also designed as a hollow wrist. In close collaboration with leading robot manufacturers, ABICOR BINZEL has developed the ancillary systems for these new robots – robot torch-mounts, welding torches and cable assemblies. These products make the welding process safer, more cost effective and more efficient through their interaction with the new generation of robots. ABIDOT is the new clever tool for touch less programming of welding robots. The free end of the wire in the MIG/MAG welding torch is often used for programming the work pieces. All tolerances and inaccuracies, such as deviations due to the temper rolling of wires (sprung mass of the wire), length variations in the free wire and due to traversing the robot, as well as bending the wire when touching the work piece. The programming aid ABIDOT is simply screwed onto the robot torch in place of the gas nozzle, and is used for the programming process using four laser diodes to get into one point if the TCP is right. This paper gives a short overview about the different types of robots and is also demonstrating how you can improve the live cycle costs of the new robot generation compared to the standard systems using the new developed air and water cooled torch systems. Additionally you find hints to the newest developments like the ABIDOT programming tool and the MFS V2 – Master feeder system version 2 – which is excellent for use in laser welding and bracing processes with the most precise wire feeding.

1. INTRODUCTION

IGM was the first robot manufacturer to go with the hollow axis principle, having developed and launched such a robot several years ago. MOTOMAN followed with the EA series, which differed in terms of having a different layout in axis design and in torch fixing with an integrated collision shutoff.

ABICOR BINZEL developed the safety shutoff for this, which is now also firmly established with many other well-known robot manufacturers and end-users, for example Thyssen Krupp or MAGNA. Recently, in order to satisfy diverse needs of users, the problems previously associated with the enlargement of application field of welding robots, such as, the required technology for sensing and controlling, the required technology for setting up work pieces and teaching the welding conditions, the requirement for highly efficient and compact robots, cooperative peripheral equipment have been gradually solved to enable arc welding robots with hollow wrist for practical use. Due to the success story of MOTOMAN with this technology other robot manufacturers launched similar kinds of robot models.

2. ADVANTAGES

At the same time, however, customer demands also increased. The work pieces had to meet increasingly tight tolerances. Even the welding speed and therefore the profitability became increasingly central issues. With the media channelling integrated into the robot arm, the equipment is particularly suitable for complex welding jobs – even under the harshest operation conditions.

Both on speed and on the structure of the movement sequence themselves; there is an increased danger of the robot arm and welding torch colliding with the work piece.



In the light of this, ABICOR BINZEL identified the future opportunities for these new robots as an early stage. Equally early on, work started on the development of new welding torches and fixing systems to provide useful additions to this new technology.

The advantages of the new technology were convincing from the first glance:

- Shorter, highly torsion resistant hose packages
- Improved component accessibility
- Longer equipment durability
- Simpler offline programming
- Higher process speeds.

For the welding are following aspects the most important topics:

- Reduction of the welding costs
- Improving the productivity of the robot
- Make the processes easier.

This can now be more detailed analysed:

- a) Reduction of the welding costs
 - Understand the real cost drivers of welding
 - Reduce the volume of the weld seam
 - Increase the live time of the spare parts
 - Reduce rework of the parts
 - Reduce unnecessary movements of the robot
 - Reduce the arc on time.
- b) Better productivity of the robot
 - ROI calculation
 - Analysis of the welding costs
 - Cost for energy and other medias
 - Minimizing the maintenance costs and -time
 - Minimizing the down time of the robot.

3. TORCH CONCEPTS

Together with MOTOMAN the iCAT for the EA series was developed. The robot support iCAT excludes a collision danger, because it connects the robot arm and welding torch in an extremely intelligent way. In the event of a collision between the welding torch and the work piece, the iCAT is subject to a mechanical excursion of up to 10° as quick as a flash. Through this, the iCAT takes over a "buffer function", thus avoiding damage to the welding torch, the peripherals and the robot itself. An additional safety aspect is the integrated switch-off fuse.

Together with ABB, Sweden and FANUC, Japan, the iSTM for robots with integrated collision software was developed. As a supplement to the collision software of the robot control system, it reacts directly in the event of a "crash" and stops the robot immediately. For robots with integrated collision software iSTM is used. With the same interfaces like iCAT this robust and TCP exact system succeeds in all applications.

The robot mounts iCAT and iSTM are available for air- and liquid-cooled torches. Additional features include the sturdy and straight forward design, easy installation and the extremely torsion-resistant cable assembly excursion +/- 240° in the 6th axis.

At the same time, this was also the time when the new ABIROB[®] W liquid cooled torch range with a completely new, highly torsion resistant hose package was born.

Furthermore, these torches also allow rapid changing of the torch neck and hose package components in the event of servicing needs, with a reproducible TCP.

In association with the new generation of robots new welding tasks were also increasingly arose in the automotive industry, particularly in the area of thin sheet welding. At ABICOR BINZEL, these specific requirements resulted in the use of the successful, air cooled ABIROB[®] A welding torch range even with hollow wrist robots – a logical extension to the product portfolio in order to cover all MIG/MAG welding applications.

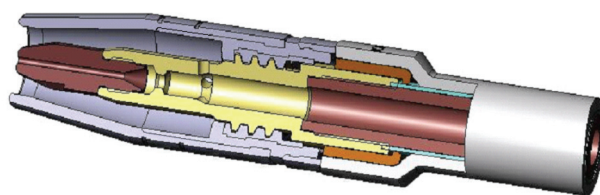


Figure 1. Air cooled torch

Both torch systems are outstanding in terms of a high level of crash stability and the long lifetime of the small number of robust wear parts.

In the case of the liquid cooled versions, the hybrid design prevents hose package failures, which could occur as the result of faults in the cooling system. The air cooled version has proved especially economical, as it incurs neither the acquisition nor maintenance costs of a cooling device, costs for the coolant liquid nor energy requirements for the cooling circuit, there are also no maintenance costs for the hose package.

ABICOR BINZEL now supplies four torch systems in various performance categories for hollow wrist robots:

- **ABIROB[®] A** – for air cooled applications in three different torch types (A300, A360, A500)
- **ABIROB[®] W** – for liquid cooled applications in two torch types (W300 and W500). A higher rated W600 torch is in the pipeline.
- **ABIROB[®] GC** – for the air cooled segment of the Asian market, in order to meet the special requirements for CO₂ welding.
- **WH** – air (A360 and A500) and liquid (242, W500 and 652DTS) cooled, with the proven WH interface, which enables automated replacement of the torch neck and has an integrated wire cut-off function.

The modular assembly system offers users a high level of interchange ability of components even with the mixed use of conventional robots and the new hollow wrist robots.

4. HOLLOW WRIST ROBOTS IN VARIOUS DESIGNS

The development of new generations of robots for welding technology reached his climax in 2008. Several companies including ABB, FANUC, KUKA, MOTOMAN, OTC, PANASONIC and REIS launched new robots for automated gas shielded arc-welding. All of the models are so-called process arm robots with hollow wrists, in which the hose packages are fed internally in axes 3 and 6. The fundamental differences are in the way of dealing with collisions shutoff.

Here, there are:

- a) Robots with integrated collision detection software, which work with the iSTM torch mount (for example ABB and FANUC)
- b) Robots without collision detection software, which need an iCAT safety shut-off for the EMERGENCY-STOP signal (for example MOTOMAN, OTC, KUKA, REIS).

Furthermore, the robots differ in terms of the mode of handling the hose package:

- a) The hose package is run between two parallel arms (MOTOMAN, KUKA, PANASONIC, OTC and REIS)
- b) The robot arm/process arm is open on one side and therefore accessible (ABB and FANUC).

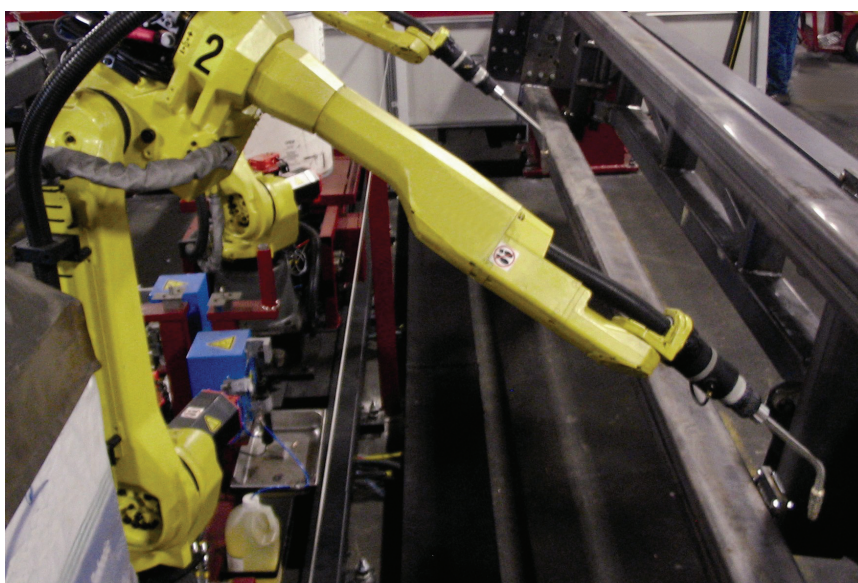


Figure 2. Example of a hollow wrist robot with water cooled torch



Figure 3. Hollow wrist robot air cooled (Source: ABB)



Irrespective of these differences, all hollow wrist robots of the latest generation offer clear advantages in practice.

- Quicker movement, faster reorientation and therefore higher productivity.
- More uniform movements as there are no interfering contours from an external hose package and therefore greater process reliability
- Less stress/wear on the hose package and therefore longer lifetimes
- Simple and quick offline programming
- Optimised wire feeding for higher seam quality
- Best accessibility even in confined constructions.

All this topics have a great impact on to economical aspects of the welding robot.

5. OUTLOOK

Further developments are planned for applications with hollow wrist robots. Fields of development include, for example welding torches for high performance welding up to 700 A, push-pull and pull systems for aluminium and other critical welding wire materials, solutions for TIG welding with and without cold wire-feeding and even components for laser welding.

6. CONCLUSION

The new generations of hollow wrist robots will increasingly replace previous robots. For the users, this means excellent opportunities for the near future. Today, ABICOR BINZEL is already the market leader for hollow wrist robots, with several thousand welding torch systems already sold. This applies both to air and to liquid cooled applications. The new system solutions for hollow wrist robots are a particularly good example of how positive the effects of constructive collaboration with robot manufacturers can be for the advancement of welding technology.

7. REFERENCES

Product data sheets of ABB[®], FANUC[®], KUKA[®], MOTOMAN[®], OTC[®], PANASONIC[®], REIS[®]