International Magnesium Association (IMA) Commercial (non-automotive) Cast Product Award

Mg Alloy Housing For an Industrial Robot

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1. Introduction

Name of Part: Mg Housing of An Industrial Robot

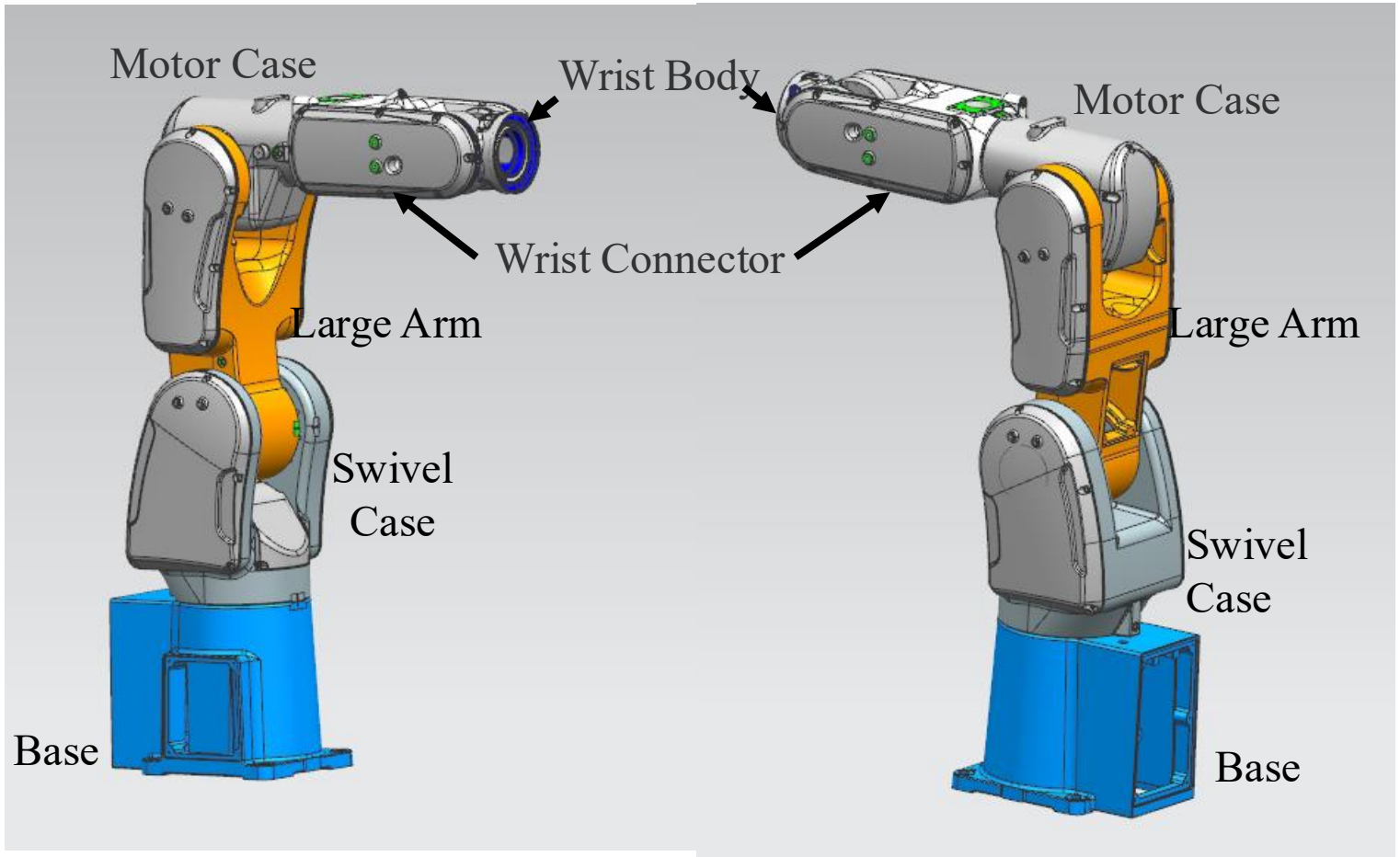
Product Using Part : ER4-550-MI Industrial Robot

Alloy Used: AZ91D and new Magnesium Alloy

Features: The magnesium housing of the ER4-550-MI Industrial Robot is the world's first fully magnesium housing for an industrial robot, setting a new standard in Mg application. Comprising 13 magnesium high-pressure die-cast (HPDC) components, this housing offers a 34.6% reduction in weight compared to its aluminum counterpart, leading to a 11% overall weight reduction in the robot. Additionally, it enhances performance in terms of speed (+5%), energy efficiency (-10%), stability, shock absorption, electromagnetic shielding.

1. Introduction

The robot housing contains 13 Mg HPDC components.

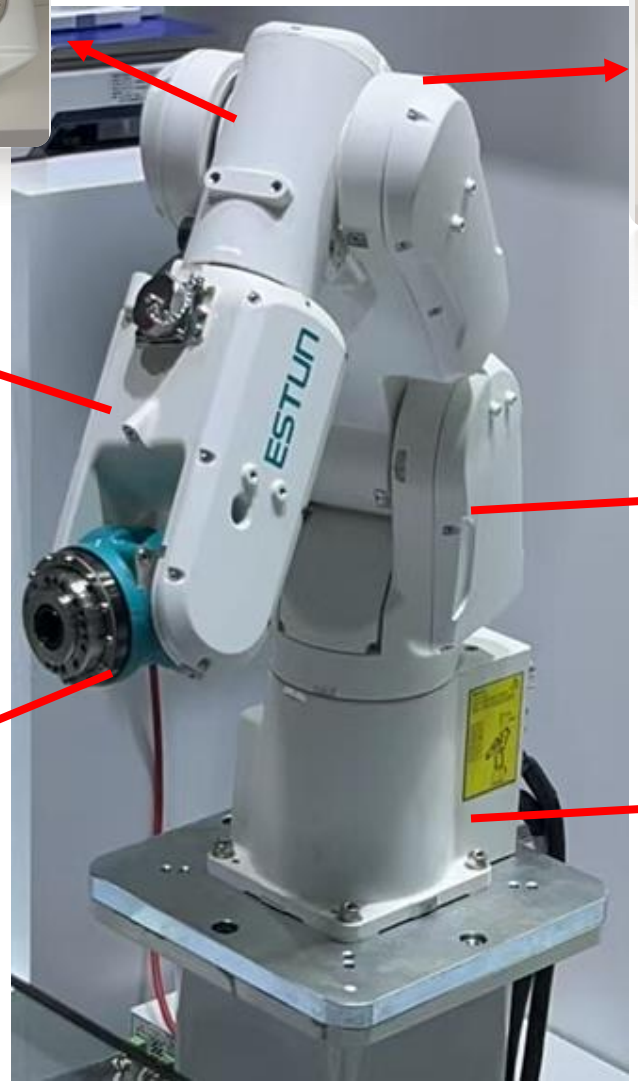


1. Introduction

Motor Case and Cover

Large Arm and Covers

Wrist Connector and Cover



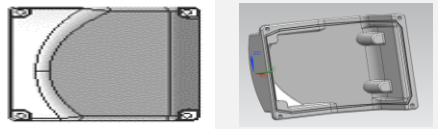
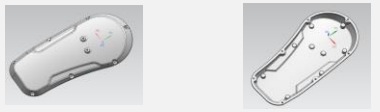
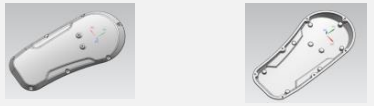
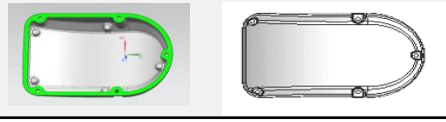
Swivel Case and Covers

Wrist Body

Base

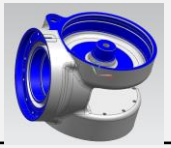
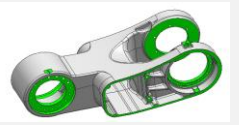
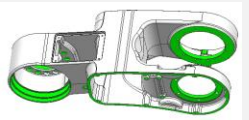
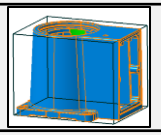
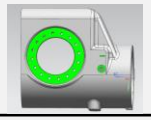
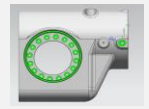
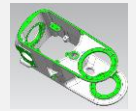
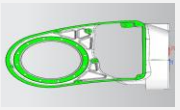
1. Introduction

The robot housing contains 13 Mg HPDC components.

Part Name	Size/mm	Weight of Original Al part/Kg	Weight of Mg part/Kg	Weight Reduction/%	Pictures
Front Cover of the Swivel Case	81.17×79.96×68.01	0.133	0.084	36.8	
Left Cover of the Swivel Case	158.6×205.9×20	0.234	0.145	38	
Right Cover of the Swivel Case	158.6×205.9×25	0.252	0.16	36.5	
Left Cover of the Large Arm	118.4×232.2×27	0.25	0.157	37.2	
Right Cover of the Large Arm	118.4×232.2×27	0.25	0.157	37.2	
Cover of the Small Arm	232.87×92×18	0.2	0.15	25	
Cover of the Motor Case	132.46×84.93×25	0.104	0.066	36.5	

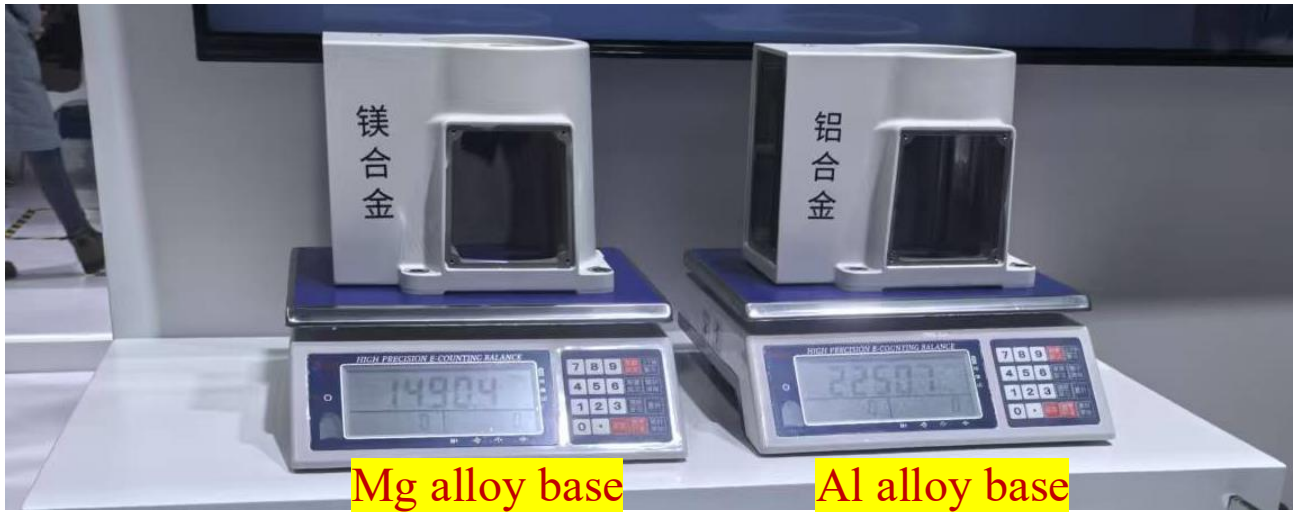
1. Introduction

The robot housing contains 13 Mg HPDC components.

Part Name	Size/mm	Weight of Original Al part/Kg	Weight of Mg part/Kg	Weight Reduction/%	Pictures
Wrist Body	99.5×85×84	0.432	0.32	25.9	
Large Arm	370×120×145	1.93	1.22	36.8	 
Base	163.00×211.95×175	2.118	1.452	31.4	
Motor Case	135×145.5×95	0.855	0.538	37.1	 
Wrist Connector	239.37×161.88×141	0.765	0.51	33.3	
Swivel Case	239.37*161.88*141	1.662	1.045	37.1	 

After replacement of original Al housings by Mg housings, the housing weight decreased from 9.185kg to 6.004kg, reaching a 34.6% reduction.

1. Introduction



Mg alloy base with coating: 1490.4g
Al alloy base with coating: 2250.7g

Weight reduction (casting and coating): **33.8%**

2. Advantages

(1) Innovation

- **Industry First :**It is the world's first fully magnesium housing for an industrial robot.
- **Application-Driven Redesign:** Components re-engineered for magnesium's unique properties and maximize weight reduction
- **Lighter (-34.6%):** Benefitting from light-weight magnesium alloy and better designed structure, the weight reduction of the whole housing reached **34.6%**, and the weight of the whole robot is reduced by **11%**.
- **Faster (+5%):** The double optimization of material lightweight and advanced control algorithm, the **beat speed is increased by 5%**, the response speed is swifter and the processing capacity is more efficient.
- **Energy Save (-10%):** Compared with traditional materials, the energy consumption of the whole robot machine operation is reduced by **10%**; Efficient configuration optimization and design to improve the robot performance and production work efficiency.
- **Stability:** Excellent heat conduction performance, longer service life of joint parts; strong vibration damping ability makes the robot maintain higher operating accuracy under high-speed operation; excellent electromagnetic shielding ability, effective resistance to external interference.

2. Advantages

(2) Technology

- **Light-Weight Redesign:** Each component has been meticulously redesigned to maximize weight reduction while maintaining structural integrity. The highest weight-reduction reaches ＞37% (2 covers of long arm, motor case and swivel case) which is much higher than the theoretical weight-reduction 33% when using Mg alloy to replace Al alloy (same structure).

(3) Competitive Material Displacement

- By replacing original Al robot by Mg robot, It receives a 11% weight reduction, 10% energy consumption reduction and 5% increasement of speed. It makes magnesium a highly competitive alternative to aluminum in the industry robot market.

(4) Economics

Both lower housing price and lower operating cost induced by Mg will result in a large volume potential for the magnesium industry and yield significant economic advantage against competitive Al alloys.

- **Lower housing price:** The weight reduction of the whole housing reached 34.6%. It brings a lower housing price.
- **Lower operating cost:** 10% energy consumption reduction and 5% increasement of operation speed brings lower operation cost.

Thanks