Wheatstone

Wheatstone Radiation-Resistant Vacuum Motors



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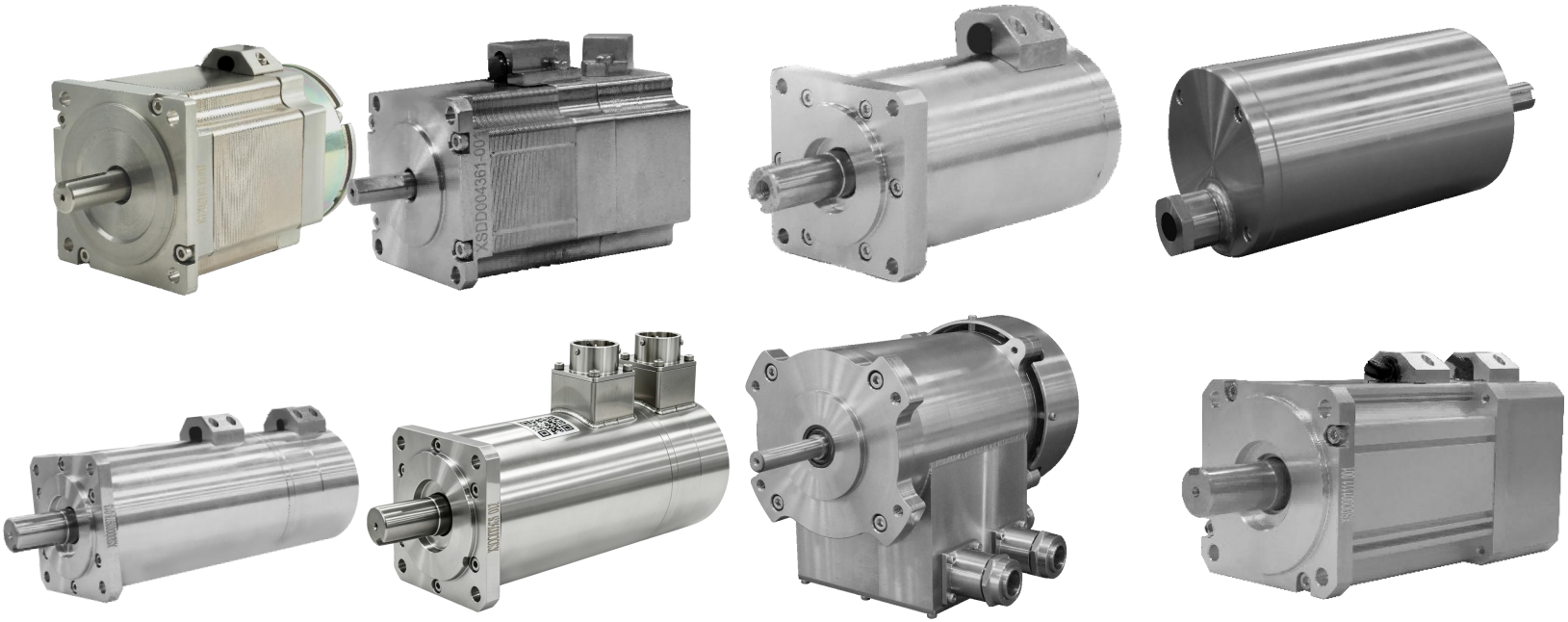
01 Nomenclature & Classification of Radiat



Wheatstone Radiation-Resistant Motor Classification

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Classified by Motor Type

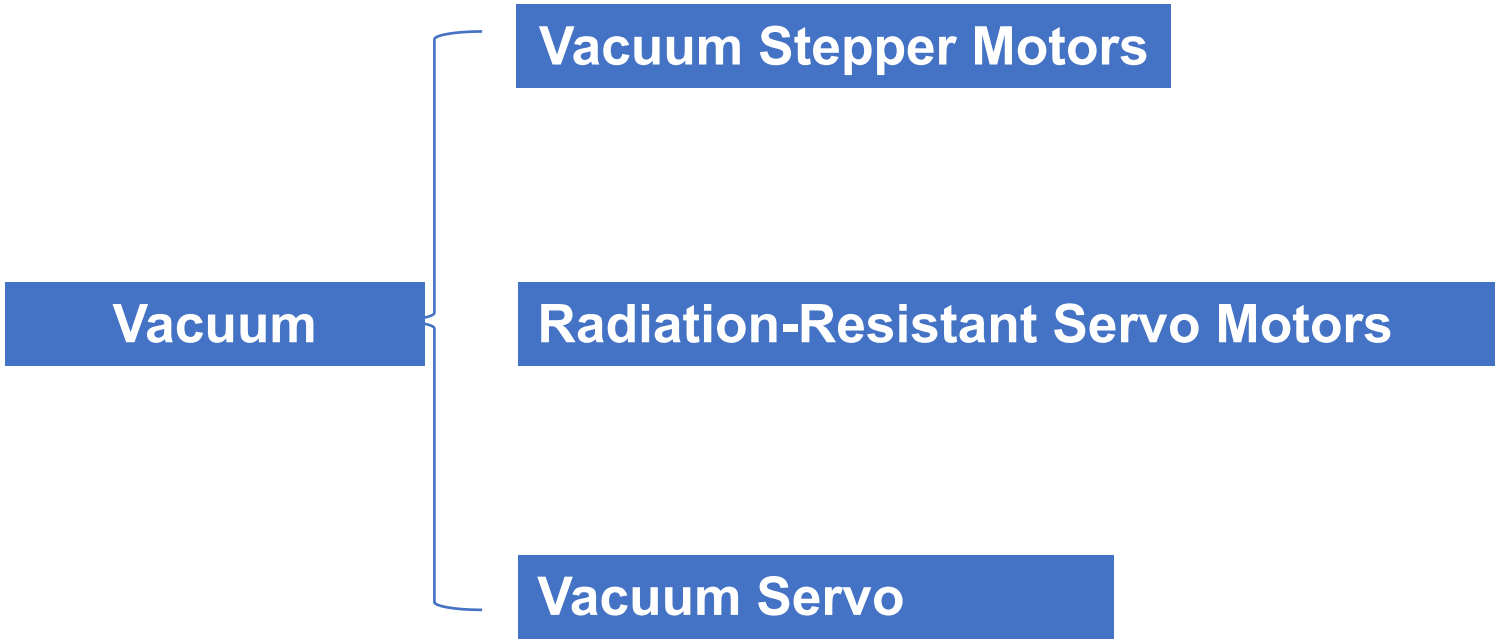
Radiation-Resistant Motors

- Radiation-Resistant Stepper Motors
- Radiation-Resistant Servo Motors
- Radiation-Resistant Permanent Magnet Motors
- Radiation-Resistant Asynchronous Motors

Wheatstone Vacuum Motor Classification

Wheatstone

Classified by Motor Type



Wheatstone Radiation-Resistant Vacuum Motor Nomenclature

130	ST	X	100	30	B	EX	XXV	C	T6	J/H/Y
1	2	3	4	5	6	7	8	9	10	11

No.	Item	Detailed Description
1	Motor Frame Size	40 = 40x40 mm; 40 Ex = 45x45 mm; 60 = 60x60 mm; 60 Ex = 65x65 mm; 80 = 80x80 mm; 90 = 90x90 mm; 110 = 110x110 mm (incl. Ex); 130 = 130x130 mm (incl. Ex); 150 = 150x150 mm (incl. Ex); 180 = 180x180 mm (incl. Ex); 220 = 220x220 mm (incl. Ex); 260 = 265x265 mm (incl. Ex); 400 = 400x400 mm
2	Servo Motor Type	ST denotes a sine-wave-driven permanent magnet synchronous motor; BYG denotes a stepper motor
3	Feedback Element (Encoder)	M = incremental encoder; H = Hall sensor; X = resolver; J = absolute encoder
4	Torque	Indicates rated torque; value = three digits x 0.1, unit Nm
5	Speed	Indicates rated speed; value = two digits x 100, unit rpm
6	Brake	B = motor with brake; default means no brake

Wheatstone Radiation-Resistant Vacuum Motor Nomenclature

130	ST	X	100	30	B	EX	XXV	C	T6	J/H/Y
1	2	3	4	5	6	7	8	9	10	11

No.	Item	Detailed Description
7	Motor Type	EX = flameproof; MA = coal-mine safe; *GW = high temperature; *DW = low temperature; *F = radiation resistant; *FTZ = radiation-resistant high-temperature vacuum motor; *TZ = special; *SS = deep water; Z = vacuum motor
8	Voltage	AC: 220 VAC, 380 VAC, 660 VAC, 1140 VAC, 3000 VAC; DC: 96 VDC, 72 VDC, 48 VDC, 36 VDC, 24 VDC, 12 VDC
9	Explosion-Proof Type	C indicates explosion-proof category II C; default indicates category II B
10	Temperature Class	T5 indicates explosion-proof control motor with temperature class 100 C; T6 indicates 85 C; default indicates temperature class T4
11	Series	J = explosion-proof terminal block series; H = explosion-proof aviation connector series; Y = integrated series

Wheatstone Radiation-Resistant Vacuum Motor Nomenclature

H1-L1 -F1 -Z1
1 2 3

No.	Item	Detailed Description
1	Temperature Range	H1 = up to 80 C; H2 = 120 C; H3 = 150 C; H4 = 180 C; H5 = 200 C; H6 = 300 C; L1 = down to -40 C; L2 = -55 C; L3 = -96 C; L4 = -196 C (customizable on request)
2	Radiation Resistance Level	F1 = 10^3 Gy; F2 = 10^5 Gy; F3 = 10^6 Gy; F4 = 10^7 Gy (customizable on request; neutron radiation resistant)
3	Vacuum Level Class	Z1 = low vacuum 10^5-10^2 Pa; Z2 = medium vacuum 10^2-10^-2 Pa; Z3 = high vacuum 10^-1-10^-5 Pa; Z4 = ultra-high vacuum <10^-5 Pa (customizable on request; vacuum better than 10^-7 Pa)

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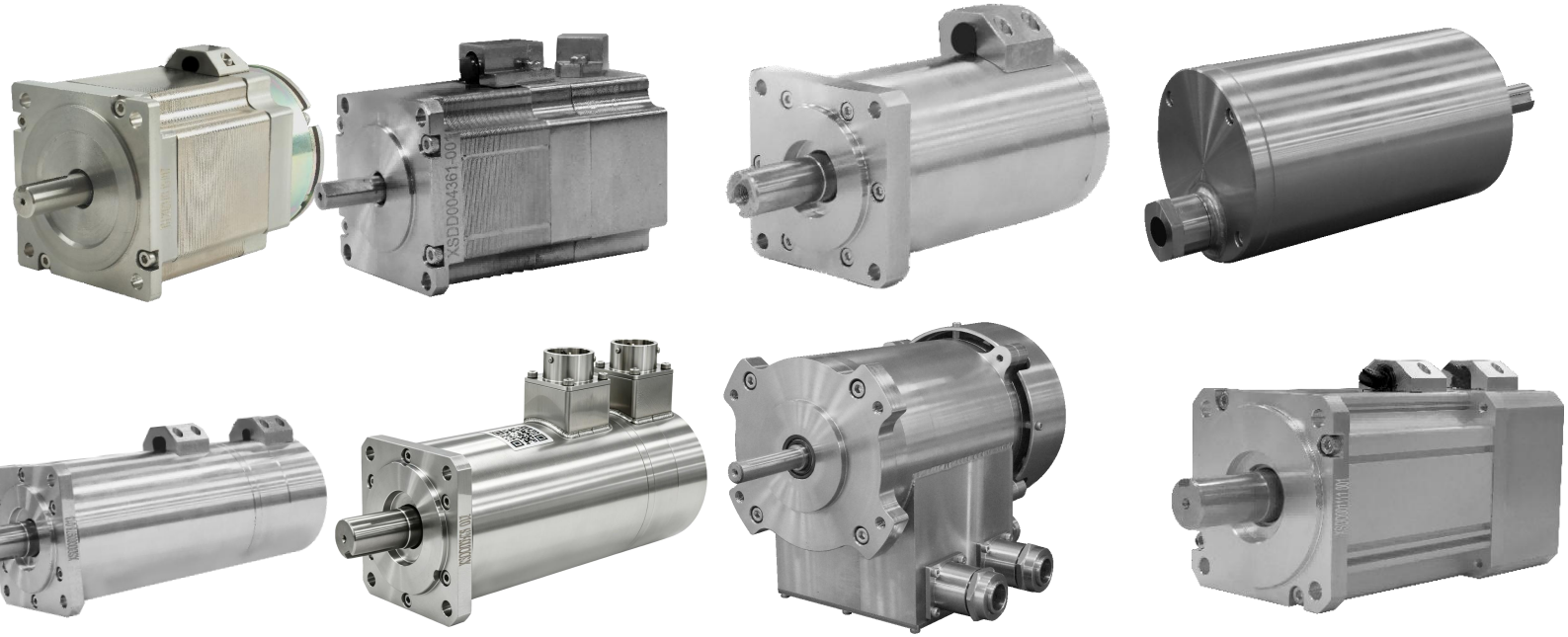
02

Radiation-Resistant & Vacuum Motor Testing Equipment



Type Testing Lab & Cleanroom



Type Testing Lab



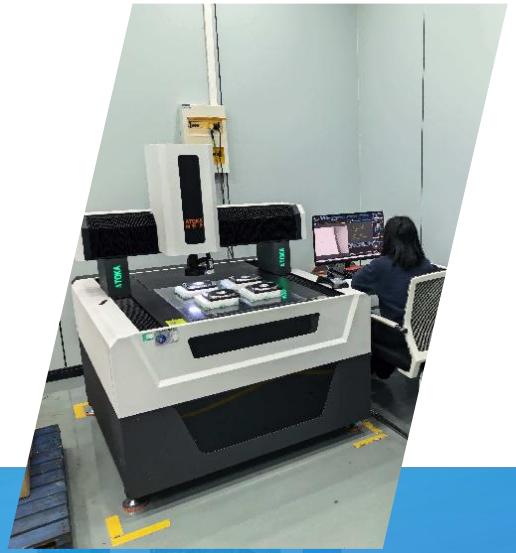
Cleanroom

High/low-temperature operation and storage, thermal shock, constant and alternating damp heat, low air pressure (25 kPa), temperature cycling + random vibration, and bulk road transportation. Fully compliant with GB/T 28046.3, GJB 150A and other standards, verifying structural integrity, insulation reliability and functional stability under multi-stress coupling of extreme temperature and humidity, high-altitude low pressure, mechanical vibration and long-distance transportation.

Type Testing Lab Equipment



High/Low-Temperature
Alternating Damp Heat Test Chamber



Fully Automatic Gantry
Vision Flash Measuring Instrument



9K Rain Spray Test Chamber









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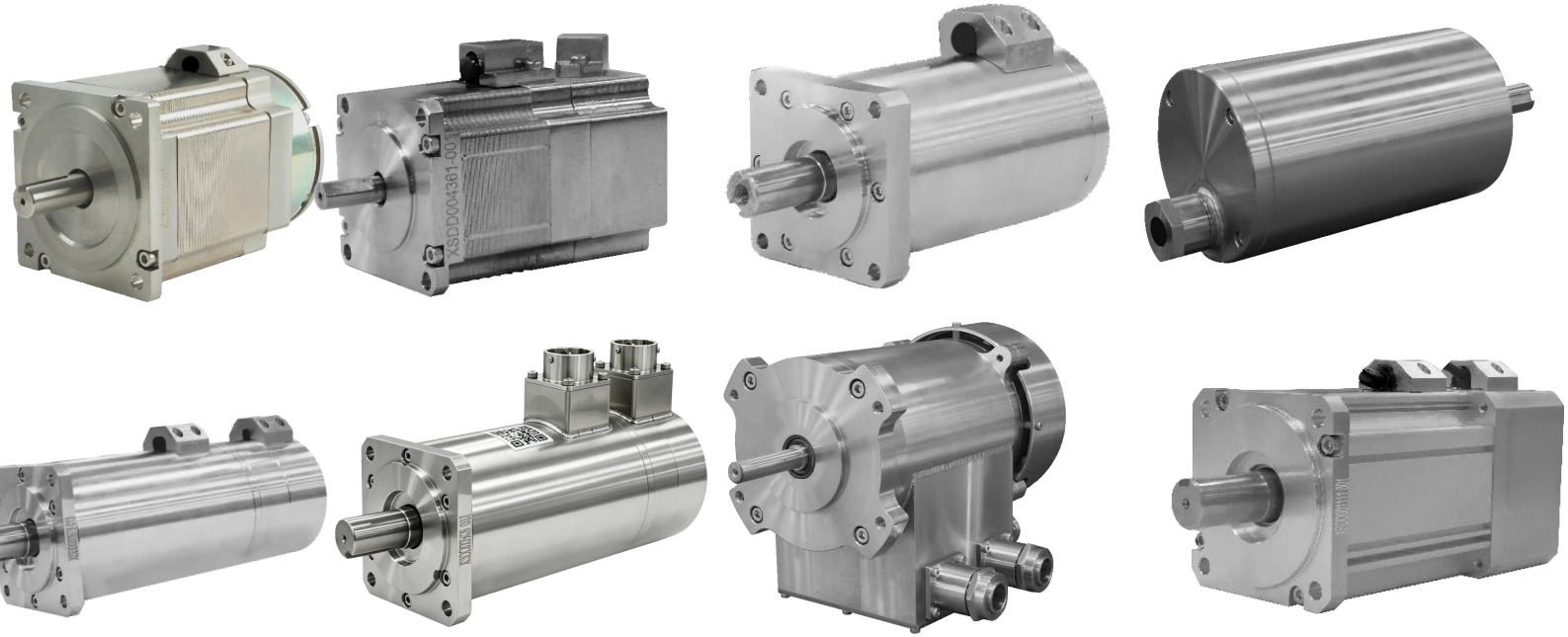
03 Third-Party Radiation-Resistant Motor Test Report



Radiation Resistance Test Report - Cumulative Dose 10^5 Gy

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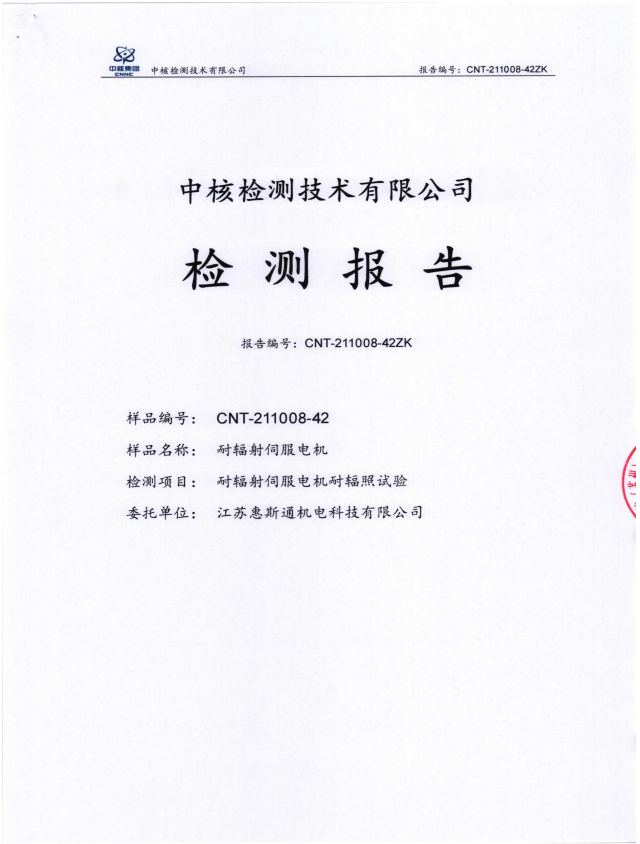


中核检测技术有限公司　　报告编号：CNT-211008-42ZK

中核检测技术有限公司

检 测 报 告

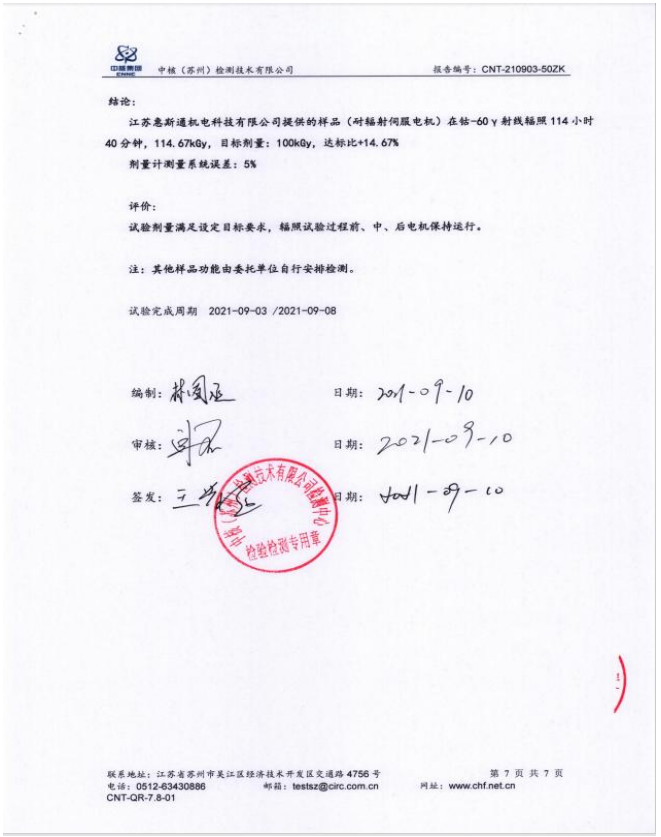
报告编号：CNT-211008-42ZK

样品编号：　CNT-211008-42

样品名称：　耐辐射伺服电机

检测项目：　耐辐射伺服电机耐辐照试验

委托单位：　江苏惠斯通机电科技有限公司



中核（苏州）检测技术有限公司　　报告编号：CNT-210903-50ZK

结论：

江苏惠斯通机电科技有限公司提供的样品（耐辐射伺服电机）在钴-60 γ 射线辐照 114 小时 40 分钟，114.67kGy，目标剂量：100kGy，达标比+14.67%

剂量计测量系统误差：5%

评价：

试验剂量满足设定目标要求，辐照试验过程前、中、后电机保持运行。

注：其他样品功能由委托单位自行安排检测。

试验完成周期　2021-09-03 /2021-09-08

编制：　　日期：2021-09-10

审核：　　日期：2021-09-10

签发：　　日期：2021-09-10

检验检测专用章

联系地址：江苏省苏州市吴江区经济技术开发区交通路 4756 号　　第 7 页 共 7 页
电话：0512-63430886　　邮箱：testsz@circ.com.cn　　网址：www.chf.net.cn
CNT-QR-7.8-01

Radiation Resistance Test Report - Cumulative Dose 10^6 Gy

Wheatstone



中核辐照技术有限公司 报告编号：ZHXH-ZK-23051901

中核辐照技术有限公司

辐照测试报告

报告编号：ZHXH-ZK-23051901

样品编号： ZHXH-230504

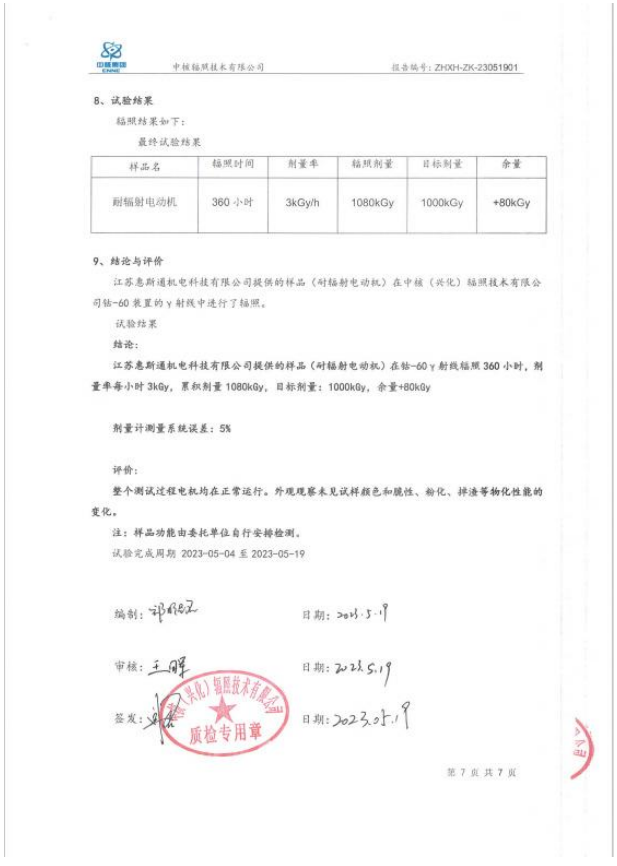
样品名称： 耐辐射电动机

检测项目： 辐照老化实验

委托单位： 江苏惠斯通机电科技有限公司

委托单位地址： 江苏省常州市武进区雪堰镇雪东工业园西掌巷103号

第 1 页 共 7 页



中核辐照技术有限公司 报告编号：ZHXH-ZK-23051901

8、试验结果

辐照结果如下：

最终试验结果

样品名	辐照时间	剂量率	辐照剂量	目标剂量	余量
耐辐射电动机	360 小时	3kGy/h	1080kGy	1000kGy	+80kGy

9、结论与评价

江苏惠斯通机电科技有限公司提供的样品（耐辐射电动机）在中核（兴化）辐照技术有限公司钴-60 装置的 γ 射线中进行了辐照。

试验结果

结论：

江苏惠斯通机电科技有限公司提供的样品（耐辐射电动机）在钴-60 γ 射线辐照 360 小时，剂量率每小时 3kGy，累积剂量 1080kGy，目标剂量：1000kGy，余量+80kGy

剂量计测量系统误差：5%

评价：

整个测试过程电机均在正常运行。外观观察未见试样颜色和脱性、粉化、掉渣等物化性能的变化。

注：样品功能由委托单位自行安排检测。

试验完成周期 2023-05-04 至 2023-05-19

编制： 日期：2023.5.19

审核： 日期：2023.5.19

签发： 日期：2023.05.19

质检专用章

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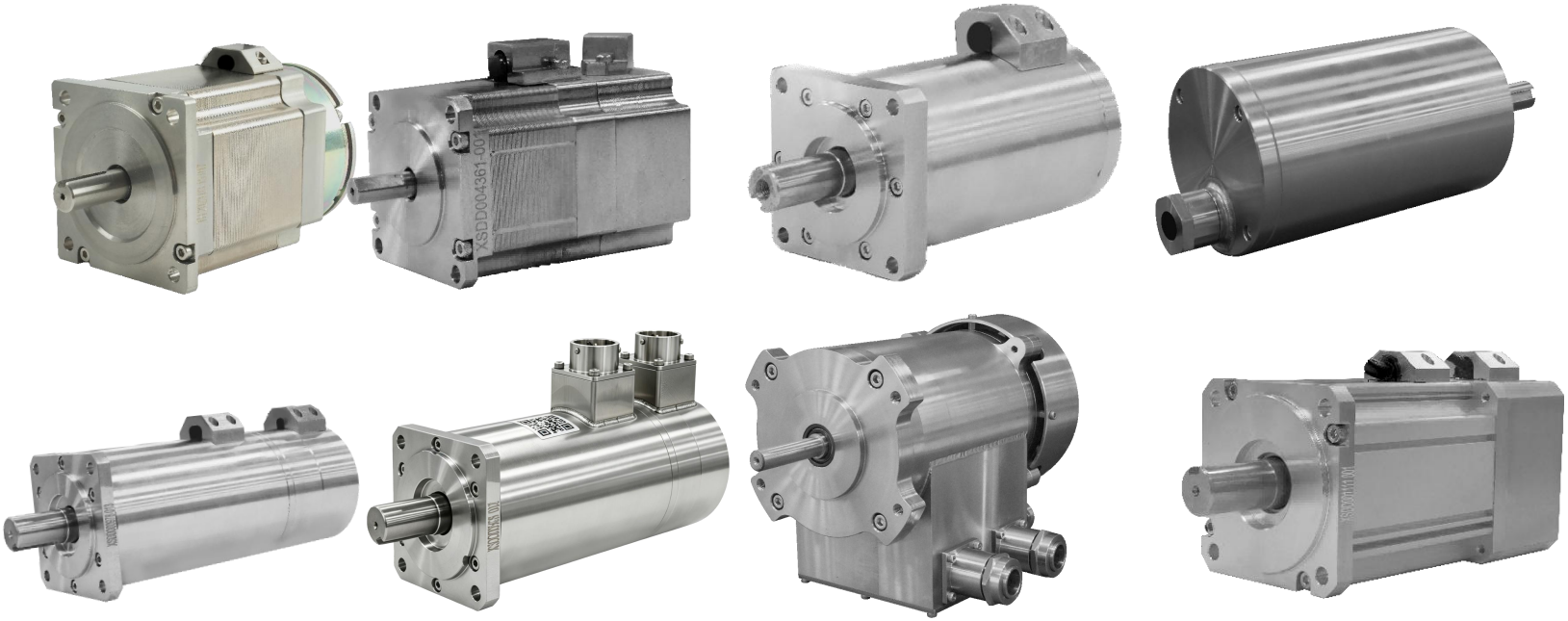
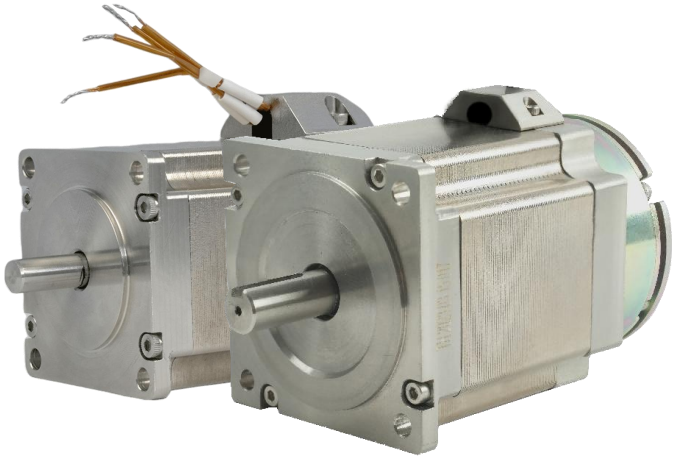
Wheatstone

04 Radiation-Resistant Vacuum Motor Products



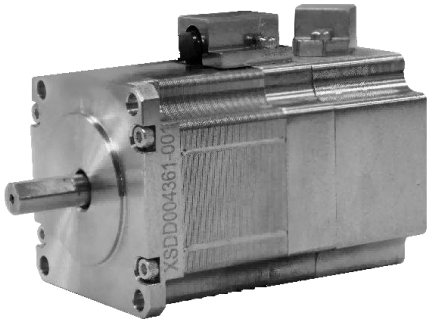
Wheatstone Radiation-Resistant Stepper Motor



Item	Motor Parameters
Motor Frame Size	42mm/57mm/86mm
Holding Torque	0.6NM/1.3NM/2NM
Rated Current	1.96A/3.5A/6A
Insulation Class	H 180℃
Cumulative Radiation Dose	10^6Gy

Wheatstone Radiation-Resistant Stepper Motor (with Encoder)





Item	Motor Parameters
Motor Frame Size	42mm/57mm
Holding Torque	0.6NM/1.3NM
Rated Current	1.96A/3.5A
Insulation Class	H 180℃
Cumulative Radiation Dose	10^6Gy

Wheatstone Radiation-Resistant Stepper Motor (with Encoder) Test Data

57BYG450C-F

Motor Model	57BYG450C-F 001
Speed rpm/min	Torque Nm
3	0.754
10	0.947
15	1.005
20	1.09
25	1.115
30	1.084
35	1.044
40	1.015
50	1.074
100	1.071
200	1.027
300	0.894
400	0.8
500	0.67
600	0.57
Holding Torque	1.321 1.325
Resistance	0.8219 0.8288
Inductance	2.712 2.649
Back EMF	18.83

Motor Model	57BYG450C-F 002
Speed rpm/min	Torque Nm
3	1.024
10	1.066
15	1.079
20	1.123
25	1.074
30	1.079
35	1.069
40	1.028
50	1.117
100	1.124
200	1.048
300	0.842
400	0.765
500	0.624
600	0.559
Holding Torque	1.396 1.395
Resistance	1.7086 1.7036
Inductance	2.657 2.656
Back EMF	18.8

Wheatstone Radiation-Resistant Stepper Motor (with Encoder) Test Data

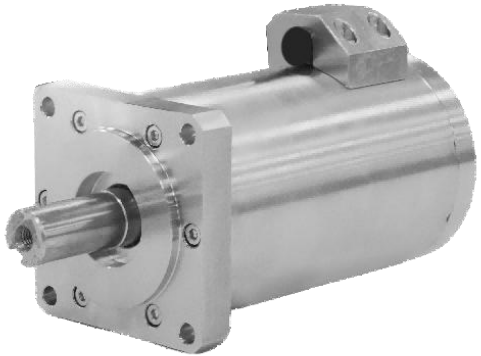
42BYG450C-F

Motor Model	42BYG450C-F-003
Speed rpm/min	Torque Nm
3	0.318
10	0.456
15	0.477
20	0.489
25	0.488
30	0.504
35	0.546
40	0.544
50	0.564
100	0.406
200	0.301
300	0.402
400	0.337
500	0.329
600	0.305
Holding Torque	0.632
Resistance	2.6466
Inductance	3.586
Back EMF	14.98

Motor Model	42BYG450C-F-004
Speed rpm/min	Torque Nm
3	0.334
10	0.451
15	0.474
20	0.479
25	0.481
30	0.514
35	0.526
40	0.542
50	0.566
100	0.426
200	0.311
300	0.414
400	0.335
500	0.334
600	0.315
Holding Torque	0.643
Resistance	2.6568
Inductance	3.546
Back EMF	14.96

Motor Model	42BYG450C-F-005
Speed rpm/min	Torque Nm
3	0.365
10	0.431
15	0.478
20	0.48
25	0.485
30	0.516
35	0.528
40	0.554
50	0.564
100	0.435
200	0.354
300	0.425
400	0.329
500	0.336
600	0.314
Holding Torque	0.665
Resistance	2.6618
Inductance	3.856
Back EMF	14.89

Wheatstone Radiation-Resistant Permanent Magnet Motor



Item	Motor Parameters
Motor Model	40ST-H00330-F
Motor Frame Size	40/60/80/110/130/150/180/220/260
Rated Torque	0.32NM~280NM
Rated Current	1A~150A
Rated Voltage	72V~380V
Insulation Class	H 180℃
Cumulative Radiation Dose	10^6Gy

Customized Wheatstone Radiation-Resistant Permanent Magnet Motor



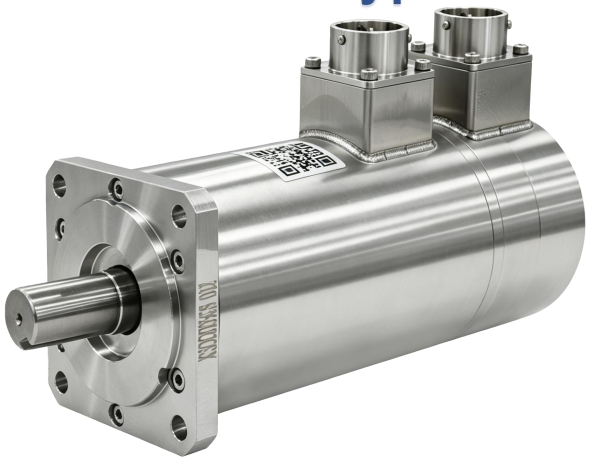
Item	Motor Parameters
Motor Model	80ST-H02030-F-310V-A0JXB
Rated Torque	2NM
Rated Current	3.8A
Rated Voltage	DC310V
Rated Speed	4000RPM
Insulation Class	H 180℃
Cumulative Radiation Dose	10^6Gy
Duty Cycle	S2

Wheatstone Radiation-Resistant Servo Motor - Pressed-Wire Type



Item	Motor Parameters
Motor Frame Size	60/80/110/130
Rated Torque	0.6NM~15NM
Rated Current	1.3A~12A
Rated Voltage	220V 380V
Insulation Class	H 180℃
Cumulative Radiation Dose	10^6Gy

Wheatstone Radiation-Resistant Servo Motor - Aviation Connector Type



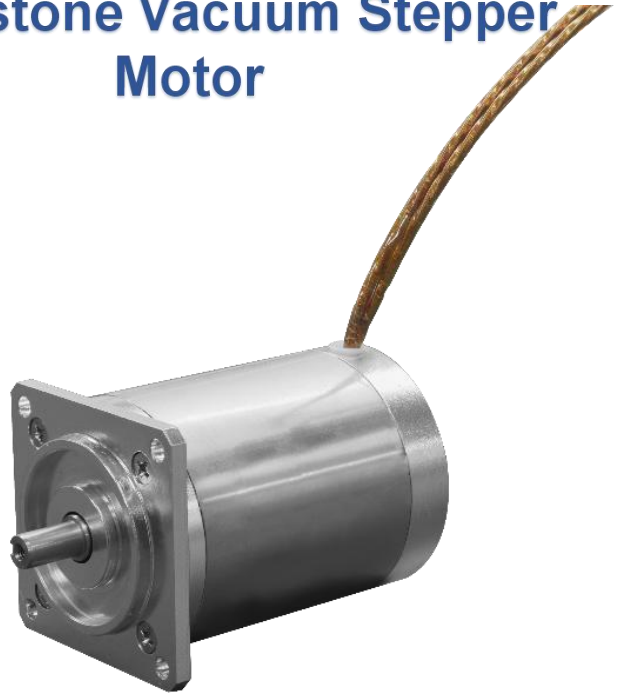
Item	Motor Parameters
Motor Frame Size	60/80/110/130
Rated Torque	0.6NM~15NM
Rated Current	1.3A~12A
Rated Voltage	220V 380V
Insulation Class	H 180℃
Cumulative Radiation Dose	10^6Gy

Wheatstone Radiation-Resistant Asynchronous Motor



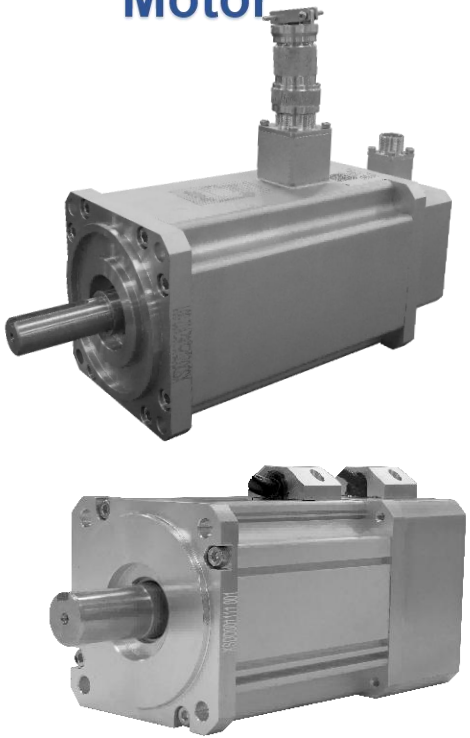
Item	Motor Parameters
Motor Model	105Y-H01313-380V-F
Rated Torque	0.18NM
Rated Speed	1310RPM
Rated Voltage	380V
Insulation Class	F 155℃
Protection Rating	IP55
Cumulative Radiation Dose	2*10^6Gy

Wheatstone Vacuum Stepper Motor



Item	Motor Parameters
Motor Frame Size	42mm/57mm/86mm
Holding Torque	0.6NM/1.3NM/2NM
Insulation Class	Class B / Class C
Protection Rating	IP54/IP68
Vacuum Level	Z3

Wheatstone Vacuum Servo Motor



Item	Motor Parameters
Motor Model	40/60/80/110/130/150/180/220
Rated Torque	0.3NM~72NM
Rated Speed	3000RPM
Rated Voltage	220V 380V
Insulation Class	H 180℃
Protection Rating	IP54
Vacuum Level	Z1 Z2

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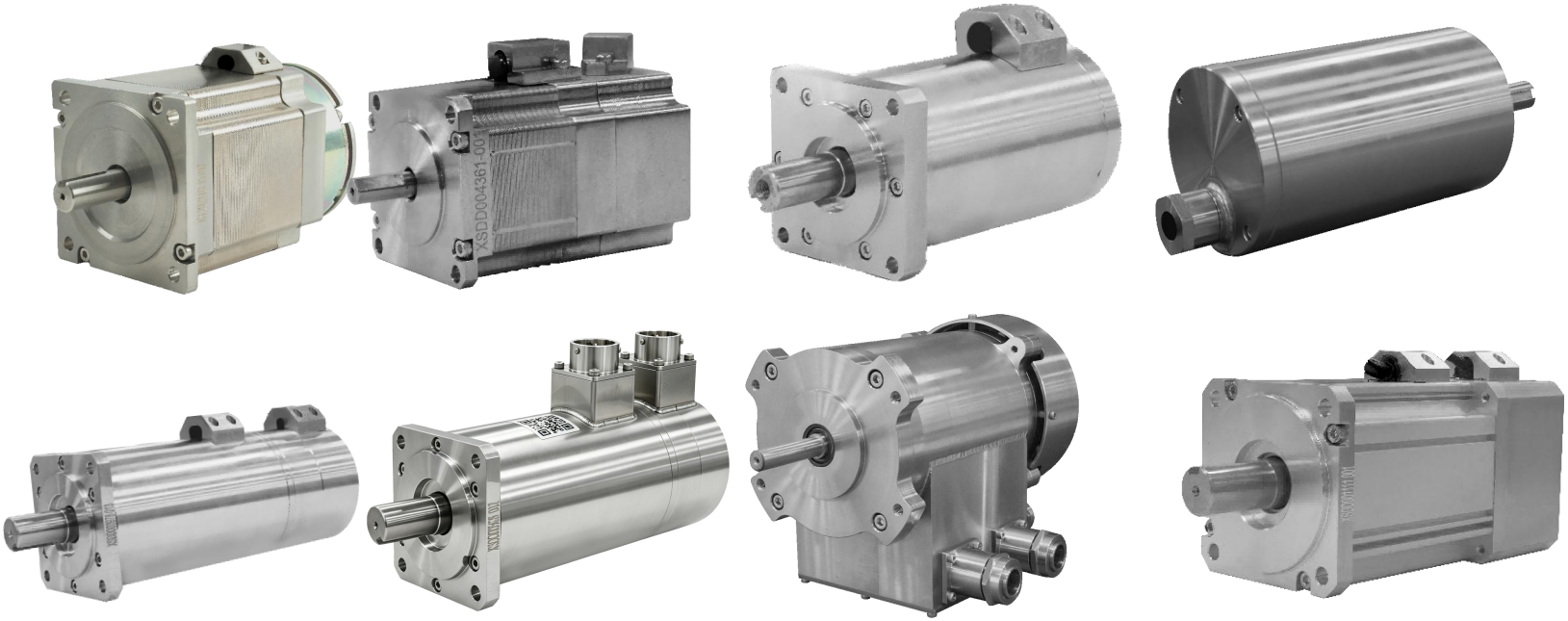
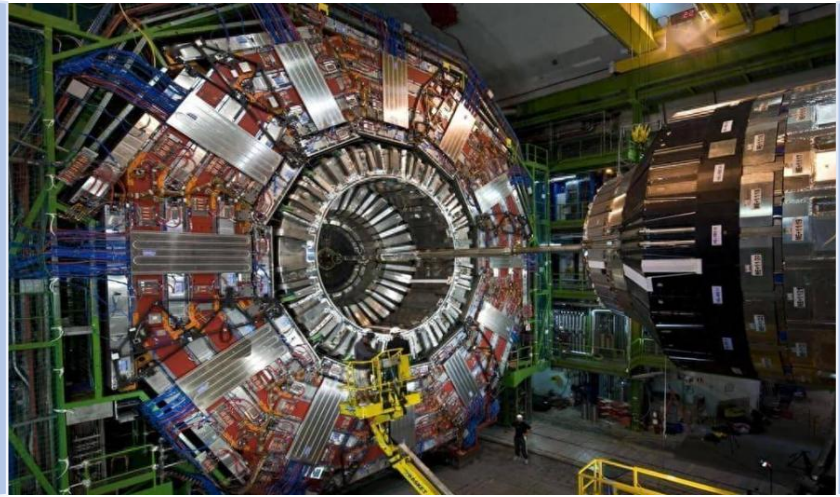
05 Radiation-Resistant Vacuum Motor Applications



Radiation-Resistant Vacuum Motors for Nuclear Physics Research Facilities - Accelerators



Radiation-Resistant Motors for CNNC Hot Cell Carts / Manipulators



- In automatic mode, the system allows setting acceleration/deceleration time, movement speed and travel distance.
- In manual mode, the system offers two control modes: a conventional cross joystick and a

Key Technical Points of the Project

- Swing Amplitude Control During Suspension Point Movement
- Weighing Function
- Use and Selection of Redundant Servo Motors
- Electrical Signal Interface Between Hot Cell and Safe Area

Vacuum Motors for Model Attitude Control Systems in Aerospace Wind Tunnel Testing

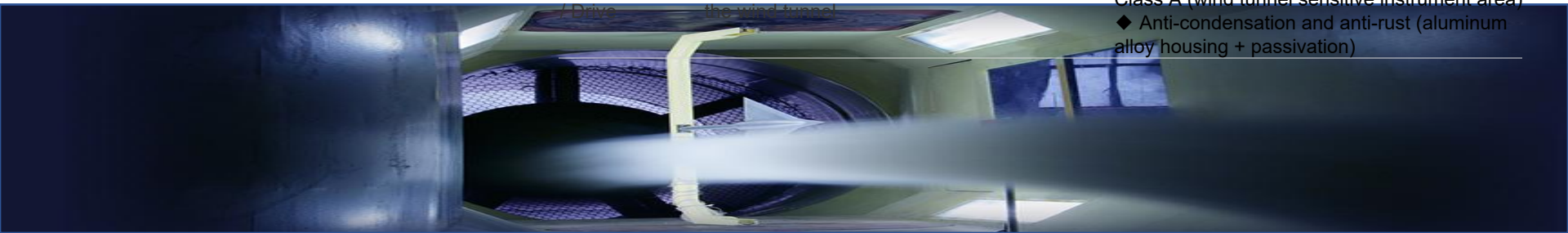
Used in variable-pressure wind tunnels (e.g. continuous or intermittent variable-pressure test sections) to drive scaled aircraft models with high precision for pitch / roll / yaw / control-surface deflection motions

Application Component: Plug Pin

Power: 2 kW - 14 kW

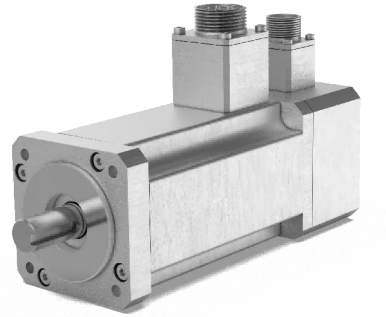


Component	Actual Function in Wind Tunnel	Wheatstone Motors (vs. Ordinary Industrial Motors)
Plug Pin / FLAP	Fast deflection actuator for model control surfaces (elevator, rudder, flap)	◆ Millisecond-level response (bandwidth >=50 Hz) ◆ Resists aerodynamic load disturbances (sudden airflow torque at wind tunnel start/stop) ◆ High zero-position holding stiffness (anti-flutter)
Panel Angle	Pitch/roll joint of a 6-DOF support platform (sting mount)	◆ Smooth ultra-low-speed operation (<0.1 deg/s, no crawling) ◆ High repeat positioning accuracy (+/-0.01 deg) ◆ Stable torque output over a wide pressure range (air pressure changes affect the motor magnetic circuit - compensation required)
Half Model	Flip/docking positioning table for a detachable half-model (e.g. wing/fuselage section)	◆ Power-off brake holding torque >=2x rated torque (prevents model slippage) ◆ IP65+ and anti-condensation (high-humidity wind tunnel environment)
Wheel Steering / Drive	Chassis drive for a mobile survey cart inside the wind tunnel	◆ Low-noise design (avoids interference with PIV / hot-wire anemometry) ◆ EMC level >= Class A (wind tunnel sensitive instrument area) ◆ Anti-condensation and anti-rust (aluminum alloy housing + passivation)



Tele-Operated Maintenance Robotic Arm for Divertor / First Wall in Nuclear Fusion Experimental Devices

- ☑ **Strong magnetic field environment (50-60 Gs)**
- ☑ **Extreme short-circuit current (20 kA)**
- ☑ **Continuous high-temperature operation (90 C)**
- ☑ **Explosion-proof requirement (Ex d IIB T4 Gb)**
- ☑ **Brake required; insulation provided by customer**
- ☑ **INVT PN servo drive included for precision positioning contro**



Parameter	Corresponding Basis
50-60 Gs Magnetic Field	The central magnetic field of a tokamak is typically 2-5 T (20,000-50,000 Gs), but near the divertor and vacuum vessel wall, due to flux leakage and induced current, measured stray fields are stable in the 30-80 Gs range (confirmed by public test reports from ITER, EAST, HL-2M and other devices)
20 kA Short-Circuit Current	In tokamaks, the neutral beam injection (NBI) system, magnet power supply and fast-control coils have transient short-circuit capability in the 10-50 kA range; if an arc fault occurs in the divertor cooling circuit or diagnostic window power cable, 20 kA is a typical design basis
90 C Operating Temperature	Near the divertor, plasma radiant heat and neutron irradiation can raise the steady-state vacuum vessel wall temperature to 80-100 C (measured in EAST campaign 12); the motor is mounted on the outside of the shielding layer, with combined conduction and radiation temperature rise of approximately 90 C
Explosion-Proof + Brake + Custom Insulation	The vacuum vessel contains a deuterium-tritium gas mixture (explosive Class IIA gas) with a risk of hydrogen evolution; the robotic arm must lock absolutely on power loss (to prevent falling under gravity and damaging the first wall); the customer's "self-provided insulation" refers to high-voltage isolation at the vacuum feedthrough/system level, not the motor itself)

