

Intelligent Robots with FANUC Force Sensors

Basic Description

Until now, robotic assembly has been dominated by 2-D applications using SCARA robots. FANUC Robotics' Intelligent Robots with integrated FANUC Force Sensors provide 3-D assembly with six degrees of freedom. These robots are engineered for precision assembly applications and the most demanding mechanical assembly and material removal operations.

The Intelligent Robots include a standard FANUC robot (LR Mate 200iB, M-16iB/20, M-710iB/45 or R-2000iA/165), a FANUC Force Sensor (FS-30 or FS-60) and advanced force control software.

Standard sensor setup schedules and process specific force control instructions make the Intelligent Robots easy to program and operate via the FANUC *i*Pendant.

Intelligent Robots provide process solutions for:

- Clutch insertion (intermediate, forward, reverse and triple clutch).
- Valve, bearing and shaft insertion.
- 3-D assembly applications including spline matching and gear assembly.
- Flexible part feeding.
- Material removal applications including polishing, cutting, grinding, deburring and deflashing.
- Spin welding, hotplate & ultrasonic welding.
- Product life cycle tests (e.g. automotive door operation, switching operation etc.) requiring constant force application.



Component Assembly



Gear Assembly

Features and Benefits

- **High reliability** – Intelligent Robots are built on standard mechanical arms with a high degree of reliability and proven performance records.
- **Simple to use** – Simple data setup menus for force control and standard teach pendant programming for application development make the Intelligent Robots simple to operate.
- ***i*Pendant with available touch screen** – Multiple color window interface allows simultaneous display of robot program, force setup and real-time force/moment (F_x , F_y , F_z , M_x , M_y , M_z) information during production operation.
- **Force data chart on *i*Pendant** – Allows continuous display of actual force variations during the force control operation.
- **Safe to operate** – Intelligent Robots are compliant with RIA 15.06 safety standards. Low speed teach mode switch and dual channel E-STOP interface make Intelligent Robots safe to operate in a production environment.

- **Easy to communicate with PC** – Built-in Ethernet communication capability allows Intelligent Robots to communicate relevant process data to a PC via Ethernet.

Process Control Functions

- **Clutch insert** – Provides force and motion control to insert a clutch unit into the automatic transmission unit of an automobile. Clutch insert force schedule includes insert direction, contact force, approach velocity, push force, rotation limits, search frequency and search amplitude to perform the insert operation. Once the force schedule is set, a simple force control instruction is added to the robot program to perform the insertion operation.
- **FANUC Force Sensor** – Is optimized for robotics, including small size and robust design.

- Phase match** – Performs variable spline matching prior to an insertion operation. Phase match force schedule includes initial contact force, push force, phase match torque, the rotation velocity, phase match depth and phase match time data.
- Face match** – Provides uniform alignment between a robot held component and contact surface of a sub-assembly. It is useful for flexible machine loading, hotplate welding and spin welding applications.
- Contouring** – Applies a constant force on the part surface while the robot-held tool moves along a path during polishing, cutting, grinding or deflashing operations. Contouring force schedules include approach velocity, contact force, push force and push direction information. Taught robot positions are dynamically shifted during the removal operation to provide the programmed force along the specified direction.
- Constant push** – Provides uniform pushing force while assembling or welding (e.g. hotplate or spin welding) a workpiece to a sub-assembly.
- Built-in Diagnostics** – Monitors sensor data and provides an alarm message to replace the sensor if the sensor data is out of range.



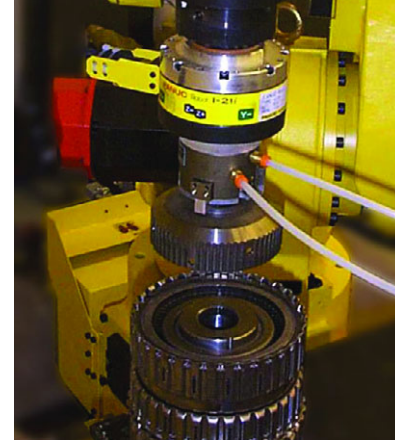
Shaft Insertion

FANUC Force Sensor Specifications

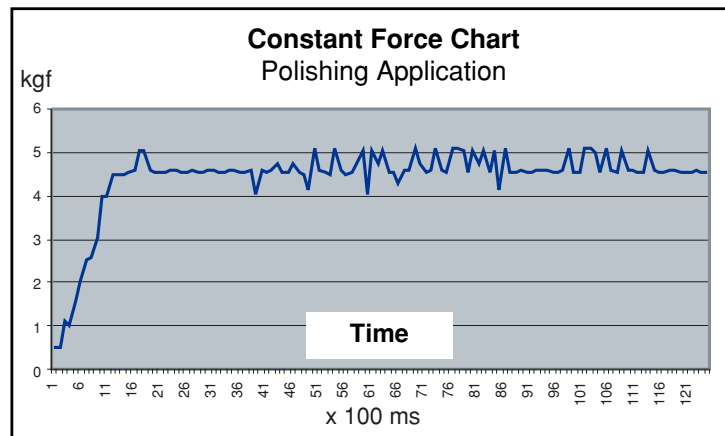
Items	FS-30	FS-60
Dimensions (mm)	108 x 75	152 x 80
Weight (kg)	1.3	2.8
Rated load		
Fx, Fy, Fz (kgf)	30	60
Mx, My, Mz (kgf-cm)	300	1200
Static Overload Tolerance		
Fx, Fy, Fz (kgf)	150	300
Mx, My, Mz (kgf-cm)	1500	6000
Resolution		
Fx, Fy, Fz (kgf)	0.15	0.24
Mx, My, Mz (kgf-cm)	0.5	1.4
Accuracy		
Fx, Fy, Fz	2% or less	2% or less
Mx, My, Mz		



Polishing Application



Clutch Assembly



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