JYT Corp, Beijing, China
Phone: +86-10-80803017
Fax:+86-10-80803017
Web: www.jytcorp.com

Represented by

VacSol GmbH, Germany
Phone: +49 7025 895020
Fax: +49 7025 895021
Web: www.vacsol.com
Mail: info@vacsol.com

JYT Corporation
Product Specifications

Czochralski Crystal Growing System

JD-1040
Technical Specification

1.0 STANDARD AND OPTIONAL SUB-ASSEMBLIES

1.0 Standard Sub-Assemblies

Sub-Assembly Name	Part Number	Function
Machine Frame	032-01	Provides support to crystal grower
Crucible Lift	032-02	Supports, lifts, and rotates crucible
Base Chamber	032-03	Bottom section of growing chamber
Grow Chamber	032-04	Center section of growing chamber
Transition	032-05	Upper section of growing chamber
Gas Ring	032-06	Distributes gas to the growing chamber
Isolation Valve	032-07	Separates receiving chamber and growing chamber, flop type
Receiving Chamber	032-08	Receives and stores crystal
Top Plate	032-09	Supports pull head, distributes gas
Pull Head	032-10	Pulls crystal
Main Hoist	032-11	Lifts and rotates receiving chamber w/ or w/o transition & isolation valve
Grow Chamber Hoist	032-12	Lifts and rotates grow chamber
Water Cooling System	032-13	Provides and distributes cooling water
Upper Vacuum System	032-14	Creates vacuum in receiving chamber
Lower Vacuum System	032-15	Creates vacuum in growing chamber
Gas System	032-16	Regulates and distributes gas
Heater Power Supply	032-17	Supplies power to main & bottom heaters
Control Console	032-18	Controls the crystal grower
PLC Software Package	032-19	Responsible for process control
MMI Software Package	032-20	Operator – machine interface

2.0 Optional Sub-Assemblies

Sub-Assembly Name	Part Number	Function
24” Hot Zone	032-21	Heats and melts silicon charge
Cone Lift	032-22	Lifts cone for loading and maintenance
Magnet Lift	032-23	Lifts and lowers cusp magnet
Feeder Hoist	032-24	Lifts and rotates poly-silicon feeder
CUSP Magnet	032-25	Copper cable type or superconductor type
Poly-Silicon Feeder	032-26	Recharges granular poly-silicon into melt
Feeder Dock System	032-27	Links poly-silicon feeder to crucible
Safety Pin	032-28	Prevents crystal from dropping out of R/C
Isolation Valve, Gate Type	032-29	Lower profile iso-valve with rotating gate
Laser Melt Level Sensor	032-30	Measures position of melt surface
UPS	032-31	Maintain power for DC motors and controls for 10 minutes
Pumps w/ Filter Tank	032-32	Creating vacuum

2.0 MECHANICAL SPECIFICATIONS

2.1.0 Growing Chamber

The growing chamber houses hot zone, crucible, and silicon charge during crystal growing process. It consists of three sections: base chamber, grow chamber and transition. The construction of all sections is double wall stainless steel with cooling water channels. The interior surfaces are hand and electro polished. The exterior surfaces are machined (flanges) and painted (typically white).

Inside Diameter	1042 mm
Inside Height:	1494 mm
Max. Outer Diameter:	1182 mm
Max. Water Pressure:	4.0 kg/cm^2
Leak Rate:	Less than 5 x 10^{-8} cc/sec He

2.1.1 Base Chamber

Construction: 300 Series stainless steel using double tank head configuration.

Inner Wall Material:	316L SS
Outer Wall Material:	304L SS
Inside Height:	311 mm
Inside Diameter:	1042 mm

2.1.1.1 Power Feedthrough Ports

Diameter:	80(+0.2/+0.1) mm
Quantity:	6

2.1.1.2 Power Feedthroughs

Size:	70/89 mm dia. x 350 mm long
Material:	Copper
Quantity	6

2.1.1.3 Pump-out Ports

Diameter	73.0 mm
Quantity:	4

2.1.2 Grow Chamber

Construction: 300 Series stainless steel using double roll-up cylinder and flange configuration.

Inner Wall Material:	316L SS
Outer Wall Material:	304L SS
Height:	726 mm
Inside Diameter:	1042 mm

2.1.2.1 Pyrometer Ports

Size:	9.5 mm dia.
Quantity:	2

2.1.3 Transition

Construction: 300 Series stainless steel using double tank head configuration.
Inner Wall Material: 316L SS
Outer Wall Material: 304L SS
Height: 457 mm
Inside Diameter: 1042 mm

2.1.3.1 Large Camera Viewport
- Diameter: 90 mm
- Quantity: 1
- Material: Quartz, 13 mm thick

2.1.3.2 Small Camera Viewport
- Diameter: 70 mm
- Quantity: 1
- Material: Quartz, 13 mm thick

2.1.3.3 Pyrometer Viewport
- Diameter: 70 mm
- Quantity: 1
- Material: Quartz, 13 mm thick

2.1.3.4 Operator Viewport
- Size: 63.5 mm X 317.5 mm
- Quantity: 1
- Material: Quartz, 20 mm thick
- Coated Cover: Quartz, 3 mm thick

2.1.3.5 Laser Detector Port:
- Size: 70 mm X 80 mm
- Quantity: 1

2.1.3.6 Laser Source Viewport:
- Size: 18 mm X 80 mm
- Quantity: 1
- Material: Quartz, 13mm thick

2.1.3.7 Feeder Port
- Diameter: 78 mm
- Quantity: 1
- Including: Water Cooled Cap

2.1.3.8 Auxiliary Ports
- Diameter: 40 mm (with NW40 flange)
- Quantity: 2

2.2.0 Frame And Supports

Construction:	Mild steel plate, rectangular tubing and structural wide flange beams.
Finish:	Painted finish on all parts (white standard)
Height:	2635 mm
Width:	1980 mm
Depth:	2335 mm
Leveling Mount:	Leveling Pads (6)

2.3.0 Crucible Lift

Consists of dual guide rods with linear ball bearings and ball screw. The ball screw is driven by a servo motor for growing; fast lift by driving ball screw nut with a variable speed servo motor for setup. A Ferrofluidic rotary hollow shaft seal provides crucible shaft support and rotation. Shaft rotation is by belt drive and servo motor. Vertical movement sealing employs stainless steel bellows. The lift includes a water cooled bellows spacer between bellows and base.

Vertical Lift: 588 mm

2.3.1 Crucible Shaft

Construction:	Water cooled 304L stainless steel cone end configuration.
Diameter:	150 mm
Bellows:	160 ID X 200 OD X 819 mm 660 mm Stroke Stainless Steel

2.3.2 Servo Lift System for Growing

Lift Speed:	.01 - 1.0 mm/min
Motor :	Brushless DC Servo
Ball Screw:	40 dia. X 5 mm lead
Position Encoder:	1000 pulses per revolution, absolute encoder, (10 Pulse per mm Lift.)

2.3.3 Fast Lift System for Setup

Lift Speed:	90 – 280 mm/min
Motor:	DC Servo Motor

2.3.4 Crucible Rotation

Rotation Speed:	1 - 30 rpm
Motor :	Brushless DC Servo
Seal:	Ferrofluidic 3" dia. Hollow Shaft.

2.3.5 Water Cooled Bellows Spacer

Height:	101.6 mm (4.00")

2.4.0 ISOLATION VALVE (Flop Type)

2.4.1 Flop Valve
Construction 304L stainless steel, disks, upper body and flanges are water cooled.
Clear opening Diameter: 350 mm

2.4.2 Open/Close Actuator: Electro-Pneumatic/Manual

2.5.0 RECEIVING CHAMBER

Construction: 300 searies stainless steel using a double tubing configuration
Inner Wall Material: 316L SS
Outer Wall Material: 304L SS
Inside Diameter 350 mm
Length: 2545 mm

2.5.1 Sight Port - Lower
Diameter: 85 mm
Quantity: 1
Material: Quartz, 8 mm thick

2.5.2 Upper Cleanout Port with Viewport
Port Size: 140 mm dia.
View Port Size: 80 mm dia.
Quantity: 1
Material: Quartz, 8 mm thick

2.5.3 Crystal Support Pin Ports
Allowable Pin Size: 25 mm X 50 mm
Port Material: Stainless Steel

2.6.0 TOP PLATE ASSEMBLY

The Top Plate refers to the water cooled interface plate between the Receiving Chamber and the Pull Head. This carries the upper gas distribution channels, vacuum sensing gages, and adjustable mounting for pull head.

2.7.0 PULL HEAD

This cable-type design uses a rotating, translating cable drum driven through a hollow shaft Ferrofluidics(R) seal. The upper assembly is mounted on and rotated using a second hollow shaft seal.

A tension strain gauge is located in the pull head assembly. It is coupled directly to the cable lifting mechanism via a near frictionless idler pulley and measures the crystal weight directly. The weight signal is temperature and lead length compensated and is transmitted through shielded multi-conductor cable through slip rings. The weight signal is then filtered and input to the control computer. The control software then permits tare and offset adjustments.

2.7.1 Main Housing: Aluminum

2.7.2 Cable
Material: Tungsten
Size: 3.5 mm dia. 5000 mm length
Load Capacity: 250 Kg Working/Continuous

2.7.3 Servo Lift System for Growing
Lift Speed: 0.05 - 10.0 mm/min
Position Encoder: 1000 pulses per revolution, quadrature encoder (100 Pulse per mm)
Upper Seal: Ferrofluidic Hollow Shaft

2.7.4 Fast Lift System for Setup
Lift Speed: 300 - 5000 mm/min
Motor 2500 RPM 90VDC

2.7.5 Seed Rotation
Rotation Speed: 0.6 - 48.0 rpm
Lower Rotation Seal: Ferrofluidic Hollow Shaft
Electrical Slip Rings: Silver Rings, Silver Graphite Brushes

2.7.6 Crystal Weight Measure
Load Cell: S Beam Load Cell
Display Resolution: 1 gram
Accuracy: 0.1% Full Scale
Hysteresis: 0.15% Full Scale

2.8.0 LOWER VACUUM SYSTEM

This system consists of manifolds and valves to connect from base pump ports to the pumping system. It includes a main vacuum valve, pressure transducers and a blow-off port mounted on the main manifold.

2.8.1 Manifold Size
Base Plate to Main Line: DN 65 mm
Main Line: DN 100 mm
Main Vacuum Valve: DN 100 mm Power Actuated Ball Valve

2.8.2 Vacuum Pumps and Control - Not Included
The control console is designed to function with isolated motor control starters which are provided by the Customer.

2.8.3 Ball Valve
Size: 100 mm with actuator, opening adjustable per process requirement
Quantity: 1

2.8.4 Safety Relief Valve
When chamber internal pressure reaches certain level, this valve opens automatically to assure the safety of the furnace.
Size: 100 mm dia.
Quantity: 1

2.8.5 Pressure Transducers
Capacitance Transducer: 0 - 1 Torr
Capacitance Transducer: 0 - 1000 Torr

2.9.0 UPPER VACUUM SYSTEM

This system consists of tubing, connections, transducers and Ferrofluidic rotary feedthru assembly for evacuation of the upper chamber.

2.9.1 Vacuum Lines: 40 mm dia.

2.9.2 Vacuum Valve
Size: 40 mm

2.9.3 Vacuum Pumps and Control - Customer Supplied
(Same as 2.8.2)

2.9.4 Pressure Transducers:
Capacitance Transducer: 0 - 1000 Torr

2.10.0 GAS SYSTEM

The gas system provides process gas (Argon) distribution and control. It includes two(2) mass flow controllers for upper and lower chamber control, and bellows sealed valves mounted on a panel. Valves and all connectors are O-ring VCO type. Full flow bypass for upper chambers are provided. Manual valve override to main chamber is included.

2.10.1 Mass Flow Controller: 200 SLPM

2.10.2 Line Size: 12.7 mm

2.10.3 Argon Filter:
Location : At points of entry.
Size .01µm 3/8" VCR
Quantity: 1

2.10.4 Air Filter:
Size: 12.7 mm 0.02-0.2 MPa
Quantity: 1

2.10.5 Gas Control Valves: Air Operated, Bellows Sealed
Size: 1/2"
Quantity: 5

2.10.6 Air Control Valves:
Size: 1/8” 24VDC
Quantity: 6

2.11.0 WATER COOLING SYSTEM

The system consists of inlet and outlet manifolds for distribution of cooling water to the individual circuits. Ball valves regulate flow at inlet. Inlet and outlet pressure and temperature indicators are manifold mounted. An overall minimum flow switch is provided in the outlet manifold main water line. A pressure relief valve is installed on the inlet manifold. Working surface temperature 60° C max., except adjacent to viewports. No single circuit should have a temperature rise more than twice the average increase in the overall water circuit.

2.11.1 Manifolds
Pipe Size: 80x80 mm Square Pipe
Connection Size: 2" NPT
Material: Stainless Steel

2.11.2 Valves:
Major cooling: 19.1 mm
Intermediate Cooling: 12.7 mm
Low flow: 9.5 mm
Relief: 60psi, 19.1 mm

2.11.3 Gauges:

Capacity:	100 psi
Size:	2"
Material:	Stainless Steel
Quantity:	2

2.11.4 Thermometers:

Scale:	0-100° C
Quantity:	2

2.11.5 Thermal Couples

Size	NPT 1/8"
Location:	Inlet/Outlet Main
Quantity:	2

2.11.6 Thermal Switches

Scale:	50°C Normally Closed
Location:	Every Water Outlet

2.11.7 Flow Switches: Installed to every water circuit, with filter.

2.12.0 HOISTS

2.12.1 Main Hoist
The main hoist raises and rotates the receiving chamber with or without the transition. A ball screw based electrical lifting mechanism provides lift. Rotation is provided by another motor through a reducer and a chain mechanism.

2.12.1.1 Lift Mechanism

Speed:	Adjustable between 180 – 420 mm/min
Lift Height:	725 mm Max
Ball Screw:	50 mm dia. X 10 mm lead
Brake Motor:	0.75 KW, 1400 rpm, 380V/50Hz

2.12.1.2 Rotation

Speed:	0.15 rpm, adjustable
Positioning:	Absolute encoder and limit switches
Motor:	0.37 KW, 1400 rpm, 380V/50Hz

2.12.2 Grow Chamber Hoist
The grow chamber hoist raises the grow chamber above the hot zone using a ball screw, worm gear reducer, and fail safe brake motor. The chamber is rotated to the side by a second gearhead motor. Rotation about the horizontal axis for cleaning is manual.

2.12.2.1 Grow Chamber Lift

Speed:	1000 mm/min
Lift Height:	740 mm
Ball Screw:	40 mm dia. X 5 mm lead
Brake Motor:	0.55 KW, 1400 rpm, 380V/50Hz

2.12.2.2 Rotation

Speed:	0.14 rpm, adjustable
Positioning:	Absolute encoder and limit switches
Motor:	0.12 KW, 1400 rpm, 380V/50Hz

3.0 ELECTRICAL SPECIFICATIONS

3.1.0 CONTROL CONSOLE

A control console provides all necessary hardware and software interfaces to facilitate the manual, semi-automatic or automatic control of the furnace system. It combines operator interface systems and a process control computer to accomplish this task. A service mode allows control of all vacuum pumps, valves, heater power supply, lift and rotation servo motors, gas delivery, and furnace hoist systems aiding equipment maintenance and emergency system control.
The control console is powered by either a 380VAC 3 phase 50 Hz customer supplied source. It provides power distribution and disconnect with lock out capability. Circuit breakers protect logically separated circuits. Step-down/up transformers and DC power supplies are also contained within the control console.

3.1.1 Control System Hardware

Feature	**Specification**
CPU	KOYO DL260
Discrete Inputs:	24VDC (60 point modules)
Outputs:	24VDC (60 point modules)
Analog Inputs:	+/- 5 VDC/0-10 V (selectable) 12-bit resolution (8 point modules)
Analog Outputs:	+/- 5 VDC/0-10 V (selectable) 12-bit resolution (8 point modules)
I/O Mounting Base:	3x9 slot DL 205 backplane base.
Expansion:	Over 15% of the base is available for expansion.

3.1.2 Operator Interface Terminal

The Operator Interface Terminal consists of an industrial computer with a flat panel Touchscreen. The Operator Interface Software is a Windows based application that is developed using C++ software. This provides an environment that can be customized to meet the unique requirements of each installation.

The Operator Interface also provides electronic "strip charting" and sophisticated recipe storage and retrieval options with Touch screen control. Process run data can be saved to local disk storage and recalled for analysis at a later date.

Operator Interface Computer System Hardware

Feature	Specification
CPU:	Intel Core/Windows XP
Memory:	1 Gigabyte On-Board

Hard Drive: 160 Gigabyte

Communication Ports: 2 – RJ45
4-USB
2 – RS-232

Graphics Adapter: KEYENCE CV5501, resolution 2 Megabyte

Monitor: Industrial VGA Graphics Display with TouchScreen

Keyboard: Standard Industrial Keyboard
(101 keys)

3.1.3 Manual Controls

The service mode control panel is designed primarily to aid in system maintenance, but it can be used to maintain the system in the event of an emergency. The following manual controls are available:

Seed Lift	Seed Rotation	Vacuum Pumps
Crucible Lift	Crucible Rotation	Vacuum Valves
Gas Flow	Heater Power	Isolation Valve
Main Hoist	Grow Chamber Hoist	

In the unlikely event of a computer failure, the service mode can be selected by depressing and holding the "Service mode" pushbutton.

All of the valve (open/close), pump (on/off), heater (on/off), servo (on/off) and gas flow (on/off) states will be retained even with the loss of the computer. The operator can manually operate the equipment when the computer is not available. The operator interface allows restart of the process at the point of interruption.

The PLC offers optically isolated I/O with status indicators. In the event of a point failure the system provides diagnostic failure routines which indicate the point and card at fault.

3.2.0 MELT TOUCH SYSTEM

A state of the art seed-melt contact sensor is built into the system. It utilizes stray currents present in the system to sense the seed-melt contact. Using stray, induced currents for this purpose solves many problems observed in systems which impose an electrical charge to the seed chuck for melt touch sensing. The seed-melt contact signal is constantly monitored to inform the operator of crystal to melt separation. This information together with the seed position from the optical encoder allows crystal length determination. The computer software also utilizes the melt touch signal as a back-up system to avoid accidental dipping of the seed chuck into the melt.

3.3.0 DIAMETER SCANNING CAMERA

The crystal diameter is monitored via two CCD camera coupled with the main PLC to form closed loop feedback controlling crystal diameter. One CCD camera is used for neck growth while the other is used for body growth

3.3.1 Camera: KEYENCE CV-200C
Resolution: 2 million pixels

3.4.0 TEMPERATURE MEASUREMENT

3.4.1 Melt Surface Pyrometer
Type: 2-Color Ircon
Range: 700 - 1700° C
Accuracy: +/- 1% Full Scale
Repeatability: 0.5%
Location: Top of Transition Chamber

3.4.2 Heater Temperature Pyrometer
Type: MT-111-0
Location: Side of Grow Chamber

3.5.0 HEATER POWER SUPPLY

Feature	Specification
Output Power:	220KW/50KW
Input Voltage:	380 VAC +/- 5%, 50/60 Hz
Output Voltage:	0-50 VDC
Output Current:	5500 / 1000 Amps maximum
Cooling:	Air cooled main transformer, water cooled SCR assemblies and output cables

3.6.0 SYSTEM MECHANICAL/ELECTRICAL INTERLOCKS

Interlocks are provided to protect personnel and equipment in potential hazard areas.

3.6.1 Control Console: Lockable Rear Access disconnects incoming 380 VAC from console.

3.6.2 Circuit Breakers: Provided for logically grouped individual circuits.

3.6.3 Main Hoist: Limit Switches
Motor Fail Safe Brakes
Torque Slip Clutch

3.6.4 Pullhead: Limit Switches
Slip Clutch

4.0 HOT ZONE

Customer Supplied.

5.0 ACCEPTANCE CRITERIA

Crystal Growing Furnace: Acceptance Test Specification

6.0 OVERALL SPECIFICATIONS

6.1.0 Physical Dimensions

Height	Refer to Drawing
Floor Area	Refer to Drawing
Total Weight	Approximately 15,000 kg
Furnace	Approximately 12,000 kg
Power Supply	Approximately 2,000 kg
Console	Approximately 1,000 kg

6.2.0 Utility Requirements

Power Input	380VAC, 50 Hz, 3 phase, 600 AMP maximum
Water	Total hardness of 50 mg/liter (soft water) 454 Liters/Min (120 gpm) with minimum inlet to outlet differential of 3.0 kg/cm^2 with a maximum inlet temperature of 30° C and max. pressure 4.0 kg/cm^2
Air	7.05 kg/cm^2
Argon	Regulated line capable of supplying 200 SLPM at 2.8 kg/cm^2 (40 psi)

6.3.0 Interconnect Details

Air	1/4" NPT Female
Argon	1/2" VCR Gland with adapter
Water	2-1/4 NPT female (inlet and outlet)

Main Vacuum	DN 100 mm flange - To be determined
Upper Vacuum	NW40 ISO-QF (40mm) connector

7.0 DOCUMENTATION

Not later than 1 month prior to delivery date the Supplier shall deliver the following documentation:

1. Operation - and Service manual
2. All necessary drawings and diagrams needed in the installation.
3. Recommended spare part list with pricing.

With the delivery the following documentation shall follow:

4 Revised versions listed in items 1, 2 and 3 if any

5. All electrical wiring diagrams and circuit diagrams
6. Software documentation
7. Control loop drawings
8. All necessary drawings needed in the service and assembly of the Equipment

Note: Unless signed by an authorized JYT officer, this document is for discussion purpose only and can be changed any time without notice.