HEAT SPREADER PROCESS OVERVIEW

ELECTRONICS AND CHEMICALS

Honeywell

HONEYWELL OVERVIEW

NASDAQ: **HON** | ~**750** sites | ~**99,000*** employees | **Charlotte, NC** headquarters | **Fortune 500** | 2022 Revenue: **~$35 B**

AEROSPACE

Our products are used on virtually every commercial and defense aircraft platform worldwide and include aircraft propulsion, cockpit systems, satellite communications, and auxiliary power systems.

HONEYWELL BUILDING TECHNOLOGIES

Commercial building owners and operators use our hardware, software and analytics to help create safe, efficient and productive facilities. Our solutions and services are used in more than 10 million buildings worldwide.

PERFORMANCE MATERIALS & TECHNOLOGIES

We provide performance chemicals and materials, process technologies, and automation controls. By supporting the global transition towards renewable energy and low-carbon economy, we're accelerating a more sustainable future to help change the world.

SAFETY & PRODUCTIVITY SOLUTIONS

We develop and deploy an innovative range of solutions, software, and services that help keep people healthy, workers and workplaces safer and more productive, and supply chains and assets more efficient, accurate, and reliable.

HONEYWELL CONNECTED ENTERPRISE

Across our segments, we empower those who make, move and operate the world's critical resources to grow responsibly. HCE develops software that securely unites OT and IT data to make better decisions and improve operational performance. Our flagship suite of applications, Honeywell Forge unites real-time data across assets, people and processes to drive intelligent operations growth, productivity and risk mitigation.

Shaping the Future Across Industries

ADVANCED MATERIALS

Honeywell Advanced Materials is an industry leading solutions provider, playing a crucial role in advancing industries worldwide through diverse applications, revolutionary inventions, and pioneering technologies focused on high growth mega-trends.

Our science and technology experts create solutions that enable our customers to overcome their challenges today and into the future.

OUR SOLUTIONS / SERVICES

- AIR CONDITIONING & REFRIGERATION
- BUILDING AND APPLIANCE INSULATION
- PERSONAL CARE AND PHARMA
- SPECIALTY ADDITIVES
- THERMAL MANAGEMENT MATERIALS
- HIGH PURITY CHEMICALS

AM ADDRESSING KEY MACRO TRENDS

400+
Technologists and Engineers

5,100
Active patents and applications

3,000+
Employees globally

Impact of **Solstice** technologies globally equals to removing emissions of **62 million cars** from a road for one year.

*Figures represent 2022 STRAP

Driven by need for sustainable solutions for climate change

Solutions:
Solstice refrigerants, foam blowing agents, propellants

Driven by need to convert to clean, renewable energy sources

Solutions:
Nuclear, Battery Chemicals

Driven by an acceleration in consumption of data in connected solution

Solutions:
Targets, Heat Spreaders

Driven by aging population and a transition to biologics

Solutions:
Aclar, Medical Fibers, Research Chemicals

A high-performing, material-science-driven business

AM A GLOBAL MATERIALS AND TECHNOLOGY BUSINESS

INDUSTRY INNOVATOR

- Offers solutions based on Honeywell's Solstice HFO technology, enabling customers to lower their carbon footprint without sacrificing end-product performance.
- **Products:** Refrigerants, blowing agents, aerosol propellants and cleaning solvents
- **Key End Markets:**
  - Air Conditioning & Refrigeration
  - Building and Appliance Insulation
  - Personal Care and Pharma

TECHNOLOGY LEADER

- **Spectra light-weight-high-strength fiber** used in military, law enforcement, medical and industrial applications
- **Aclar barrier protection** material offered as: consumer-friendly film for blister packs; bottles and vials for use in the animal and healthcare space
- Leading **Additives** manufacturer of Polyethylene waxes used as rheology modifiers, lubricants or dispersing agents in construction, e.g. pipe extrusion; inks and coatings applications

QUALITY & APPLICATIONS LEADER

- **High purity chemicals** for the personal care, auto, pharma, and semiconductor industries
- Sputtering **targets** for chip metallization
- Heat spreaders, TIMs, thermocouples and electrical interconnect materials
- High reliability **phase change materials** for thermal management
- Manufacturer of **high-purity solvents and reagents** for laboratory research and testing applications
- Manufacturer of **taggants and detectors** for high security currency and document authentication

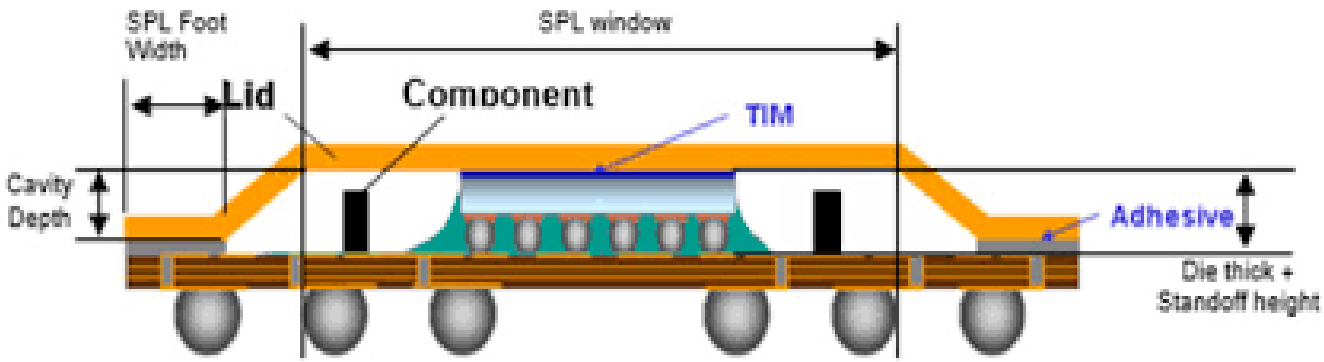
Delivering Strong Innovation And Applications Development For Customers

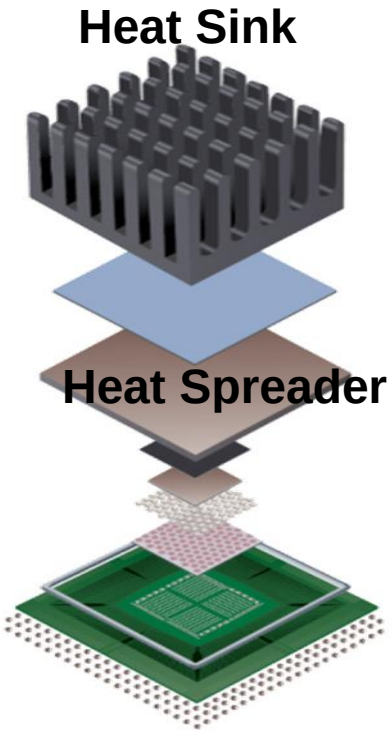
HEAT SPREADERS | OVERVIEW

Heat Spreader (aka 'lid') used to dissipate heat away from the chip

Designed for moderate to high performance applications (e.g., high-end desktop and server CPUs)

Also used in other applications: memory and power devices (e.g.. Inverters)





HONEYWELL HEAT SPREADERS | RANGE, RELIABILITY, AND QUALITY

- Full range of stamping technologies
  - From coining, high-speed progressive stamping to multi-stage, high tonnage transfer die stamping to achieve large, complex geometries for Cu Integrated Heat Spreaders
  - Capable of manufacturing other precision stamped products

- Highly reliable plating technologies to achieve consistency in surface finish
  - Continuous Ni plating lines
  - Au spot plating (Mil. Standard)

- Manufacturing plant located in Chonburi, Thailand
  - Good infrastructure and proximity to customers in Southeast Asia & Greater China
  - High-quality talent pool
  - Strong and reliable vendor base

- Robust quality management system backed by Honeywell Operating System (HOS) principles
  - Comprehensive suite of metrology and testing tools
  - ISO 9001 certification

HEAT SPREADERS | CHONBURI SITE OVERVIEW

Location

Chonburi Province, Bo-win City
Chonburi Industrial Park (Bo-Win)

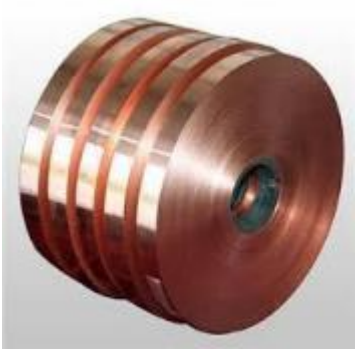
Site Facts

- Owned site – 300K sq.ft.
- Built up area – 138.5K SF (Production – 103K sq.ft. Office – 7.5K sq.ft. W/H & Other – 28K sq.ft.)
- Empty area for further expansion – estimated 60K sq.ft.

Proximity to customers in Southeast Asia & Greater China

HEAT SPREADERS | EQUIPMENT AND CAPABILITY

Raw Material



Coil form
- Copper
- Aluminum
- S Steel

Stamping

Transfer Press
- 3x - 300 Ton
- 2x - 600 Ton
- 1x - 800 Ton
- 1x - 1200 Ton

Coining
- 2x - 330 Ton

Stamping
- 1x - 110 Ton

Plating

Nickel
- 2x-Legacy CPL
- 5x-New CPL

Gold spot
- 3x - Automated
- 1x - Semi Auto

Final Inspection

Instrument
- CMM – Contact measure
- ZYGO – Surface scan
- OGP – Non-Contact
- XRF – Ni/Au Thickness
- 3D scan – Surface Scan
- Visual inspection – AOI & Manual type

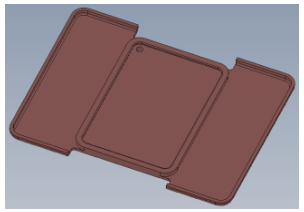
Well equipped to manufacture & deliver quality products to our customers

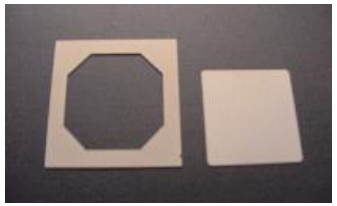
HEAT SPREADERS | STAMPING CAPABILITY OVERVIEW

Advanced Stamping Techniques for Complex Geometries

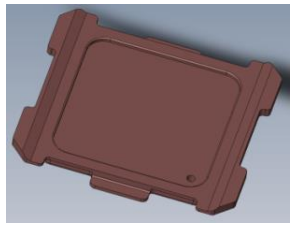
Complex Geometries

- Transfer die & progressive stamping to achieve complex features (multiple cavities, wings, flanges, etc.)
- Hybrid approach (stamping + machining) to achieve very complex geometries





Parts With Varying Complexity



- Significant experience with Cu-based, Al-based & stainless-steel materials
- Capable of stamping large parts. Experience w/ part thicknesses from 0.5mm to 3.5mm and above
- Tight tolerances for critical parameters:
  - Outer & Inner Diameter (± 0.05mm); Cavity depth (±0.05mm); Surface profiles (±0.003mm); Top/cavity flatness tolerances

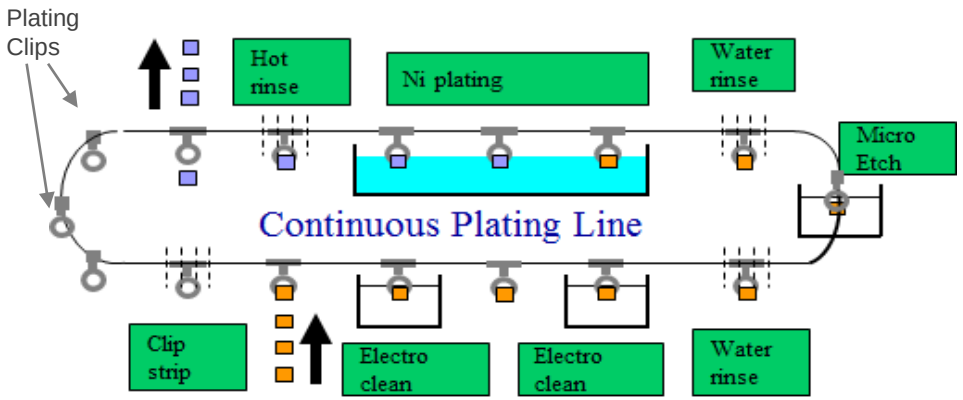
Capable of Complex Designs with Tight Tolerances

HEAT SPREADERS | PLATING CAPABILITY OVERVIEW

Continuous Plating for repeatability and consistency in high volume manufacturing

Plating Processes Surface Finishes

- **Nickel (Ni)** (semi-bright / dull)
- **Gold (Au)** (selective spot plating / 24K / Mil spec.)
- High speed continuous plating lines for repeatability and consistency
- Control over critical parameters:
  - Brightness & Gloss; Roughness – Ra & Ry; Ni & Au thicknesses, etc.



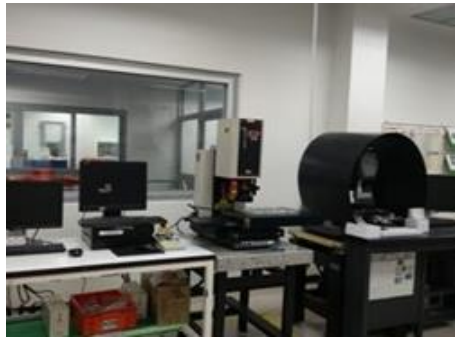
In continuous plating, parts are attached to clips and travel through each process cell in sequence, ensuring consistent surface finish across all parts

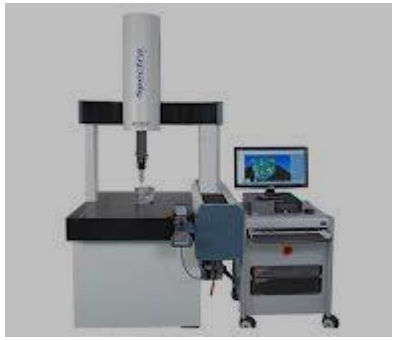
Reliability & Consistency in Plating

HEAT SPREADERS | METROLOGY & QUALITY ASSURANCE

Metrology

- **Full-scale testing & chemical analysis lab**
- **Robust suite of metrology**
  - Coordinate measurement machine (CMM); XRF (Ni/Au thickness); Non-contact laser profile scanner (OGP); White light interferometer (Zygo); X-rite (brightness); Gloss meter; Tensile strength testing (Instron)





HOS & Quality Management System

- QMS structure defines global responsibilities for standardized approach to quality management
- Aligned to ISO9001 requirements, conversion to ISO9001:2015 in process
- Honeywell Operating System (HOS) ensures a broad application of Lean and Six Sigma tools against a construct of standardized work, rapid problem solving, continuous improvement and knowledge sharing
- Employee skills maintained through enrollment in seminars and continuing education programs

QMS Structure

Best-in-class Quality Assurance

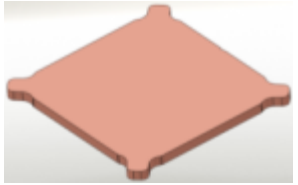
STAMPING AND PLATING PROCESS

Honeywell

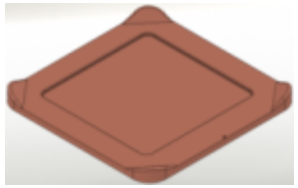
HEAT SPREADERS | PROGRESSIVE STAMPING/PLATING PROCESS

Progressive Stamping- Simple Parts

Copper (Cu) Strip

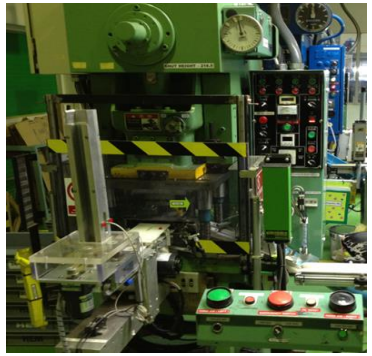


Blanking



Coining

Trimming



Metal Plating

Nickel (Ni) Plating*

Gold (Au) Plating **

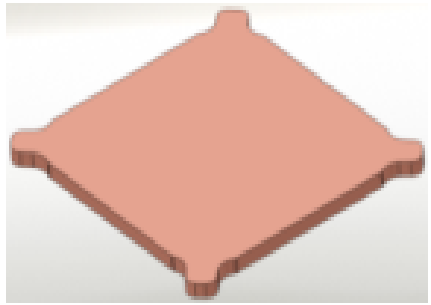
Foundational Technology:

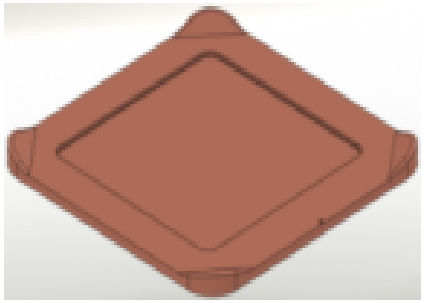
- Individual Press for each step
- Can produce Small Form Factor (SFF) & Medium Form Factor (MFF) Parts
  - 40-50mm sq max
- Low Volume – semi batch processes
- Simplified Part Design

**All Parts Ni plated*
***Only some parts are Au plated*

HEAT SPREADERS | PROGRESSIVE STAMPING/PLATING CAPABILITY

- Max size: 46.5mm x 50mm
- OD & ID: ± 0.05mm
- Radii: > 0.30mm
- Seal band Width: ± 0.050mm
- Thickness: ±0.050mm (<3mm); ± 0.1mm (>3mm)
- Topside & Cavity Flatness by Part Area:
  - 0.04mm @ 40x40 mm^2
  - 0.07mm @ 50x50 mm^2
- Flange Width: ±0.10mm
- Cavity Depth: ±0.05mm
- Surface profile: ±0.003mm





ADVANCED STAMPING/PLATING

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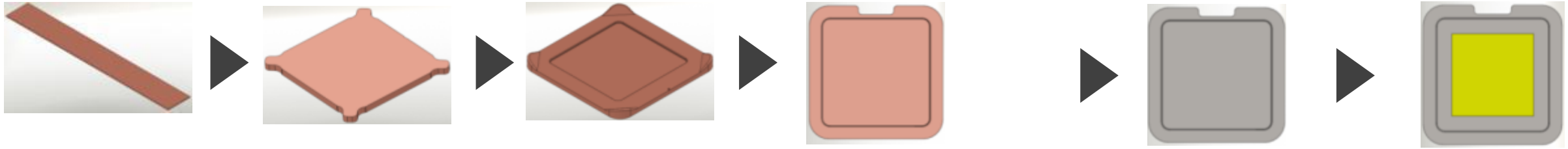
HEAT SPREADERS | PROGRESSIVE VS TRANSFER DIE

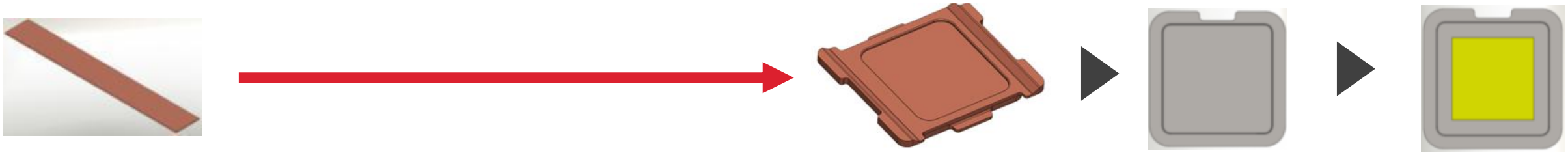
Progressive Stamping- Simple Parts

Metal Plating



Copper (Cu) Strip → Blanking → Coining → Trimming → Nickel (Ni) Plating* → Gold (Au) Plating **

Transfer Die Stamping – Complex Parts



Copper (Cu) Strip → Stamped Part → Ni Plating* → Au Plating**

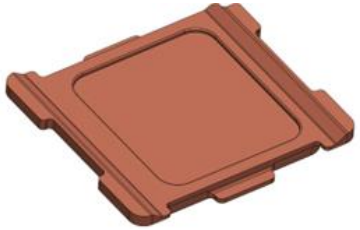
Transfer Die offers streamlined, modern process

*All Parts Ni plated
**Only some parts are Au plated

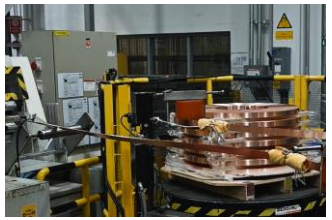
HEAT SPREADERS | ADVANCED STAMPING/PLATING PROCESS

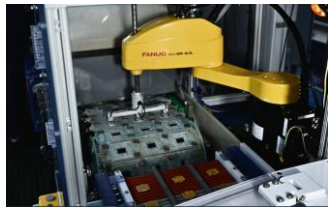
Transfer Die Stamping – Complex Parts

Metal Plating



Copper Strip | **Stamped Part** | **Nickel Plating*** | **Gold Plating****





Advanced Lines:

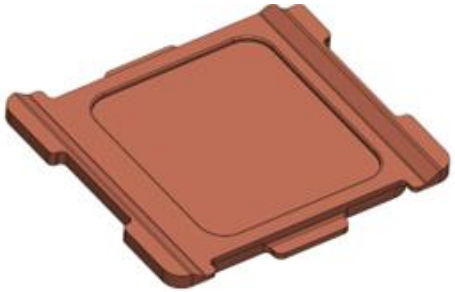
- Cutting-Edge Technology
- High Volume - Continuous Processes (vs. batch/semi-batch)
  - Transfer Die Stamping – Multiple stations within 1 press
    - Can produce SFF-XLFF (130mm sq max)
- Wide range and volume of parts that can be processed
- Complex parts/shapes

**All Parts Ni plated*
***Only some parts are Au plated*

HEAT SPREADERS | ADVANCED STAMPING LINE CAPABILITY /TOLERANCES

- Max size: 130mm x 130mm
- OD & ID: ± 0.05mm
- Radii: > 0.30mm
- Seal band Width: ± 0.040mm
- Thickness: ±0.050mm (<3mm); ± 0.05mm (>3mm)
- Topside & Cavity Flatness by Part Area:
  - 0.04mm @ 40x40 mm^2
  - 0.07mm @ 50x50 mm^2
  - 0.12mm @ 60x60 mm^2
  - 0.20mm @ 70x70 mm^2

- Flange Width: ±0.10mm
- Cavity Depth: ±0.05mm
- Surface profile: ±0.003mm
- Pedestal Depth: ±0.050mm
- Pedestal X,Y: ±0.050mm



SUMMARY

- **Experts & leaders in the stamping and plating industry**
- **Decades of knowledge and experience**
- **Positioned to maximize and optimize process performance to meet our customers' needs**

We are committed to meeting your needs. How can we help you?

THANK YOU

Honeywell

HEAT SPREADERS | PROGRESSIVE STAMPING/PLATING

Coining Presses

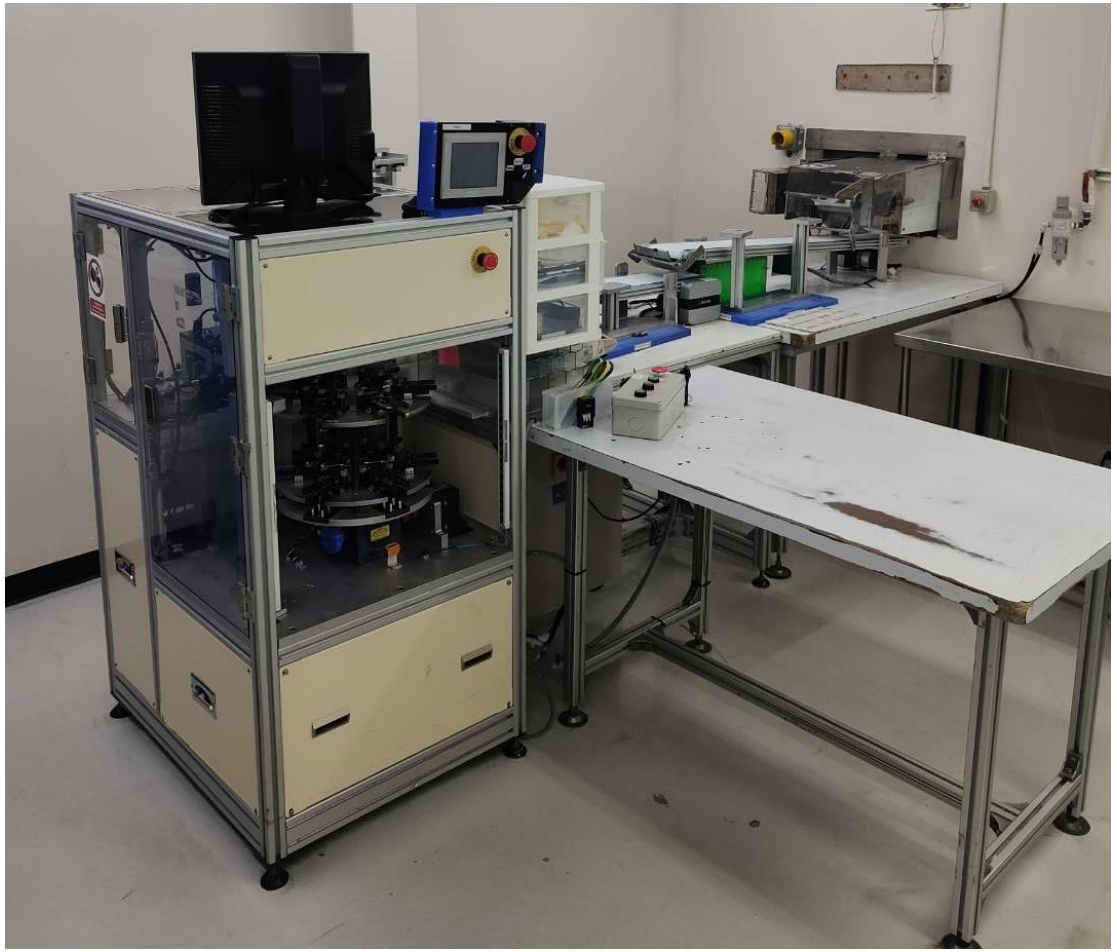
Trimming Press

HEAT SPREADERS | LEGACY NICKLE PLATING

Nickle Plating

Nickle Plating

HEAT SPREADERS | LEGACY GOLD PLATING & INSPECTION



HEAT SPREADERS | ADVANCED LINES STAMPING
300 TON PRESS - TOTAL 3 UNITS

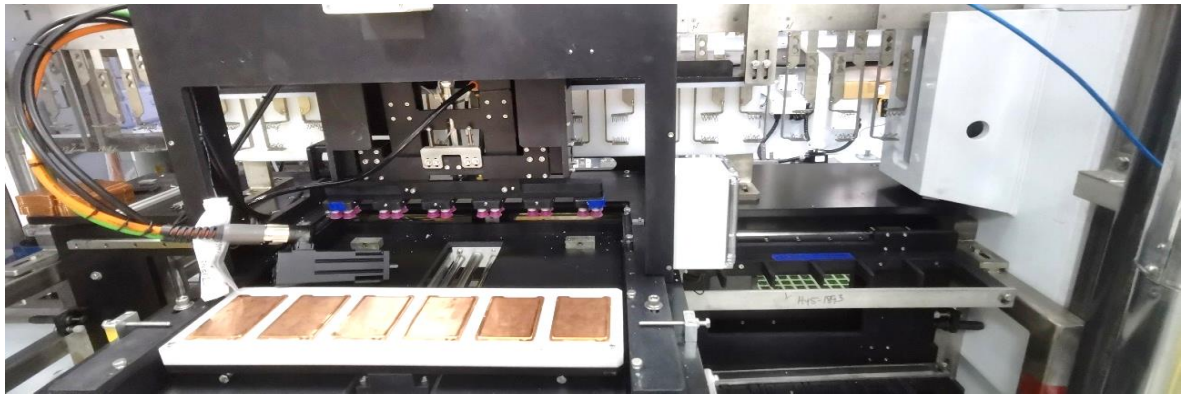
HEAT SPREADERS | ADVANCED LINES STAMPING 600T PRESS - TOTAL 2 UNITS

HEAT SPREADERS | ADVANCED LINES STAMPING
800T PRESS - 1 UNIT

HEAT SPREADERS | ADVANCED LINES STAMPING
1200T PRESS - TOTAL 1 UNIT

HEAT SPREADERS | ADVANCED LINES NI PLATING 4 LINES (SFF-LFF)

HEAT SPREADERS | ADVANCED LINES NI PLATING
XLFF CAPABLE - NI PLATING LINE - 1 LINE



HEAT SPREADERS | ADVANCED LINES AU PLATING
CONTINUOUS GOLD PLATING - 2 LINES

HEAT SPREADERS | ADVANCED LINES AU PLATING
SEMI AUTO GOLD PLATING LINE

HEAT SPREADERS | ADVANCED LINES INSPECTION