



BOYD
TRUSTED INNOVATION

Engineering Material Solutions

Core Capabilities for Engineered Materials

Noise, Vibration, Harshness (NVH) and Shock Absorption
Silicon Extrusion and Moulding
Gaskets and Seals
FR V-0 Thermal Interface Materials (TIM's)
Multilayer Graphite Heat Spreaders
FR V-0 EMI Shielding Solutions

Boyd Confidential

European Boyd Facilities Supporting A&D

Mass production sites across continents for localized in-region production, responsiveness to geopolitical impact and regionalization strategies



UK/EU Facilities

Thermal Management

- Ashington, UK
- Gliwice, Poland
- Bologna, Italy

Engineering Materials

- Nivelles, Belgium
- Syke, Germany
- Weiler-Simmerberg, Germany
- Stochov, Czech Republic

Boyd Facilities - Europe

Facility	Size	Certification	Solutions		Capabilities	
Ashington, UK	2,800 m ²	ISO 14001 ISO 9001 OHSAS	- Advanced Liquid Cold Plates - Heat Pipes - Thermosiphons - Vapor Chambers	3D Vapor Chambers - Encapsulated Graphite Solutions - Heat Pipe Assemblies	- CNC Machining - Vacuum Brazing - Heat Pipe and Vapor Chambers – Filling and Sealing - K-Core	- Design and Engineering - Advanced Thermal Testing - Clean Room Manufacturing - Prototyping - Metal Heat Treating
Bologna, Italy	4,800 m ² + 2,000 m ²	IATF 16949 ISO 9001	- Heat Sinks - Extruded, Stamped, Advanced Fin Types - Liquid Cold Plates - Heat Pipe Assemblies - Chassis		- CNC Machining - Finishing - Metal Joining and Heat Treating - Cut to Length Extrusion	- Design and Engineering - Advanced Thermal Testing - Prototyping - CAB Brazing
Nivelles, Belgium	9,500 m ²	ISO 9001	- Insulating (SOLIMIDE) Solutions - Elastomers and Thermoplastics	- Gaskets, Seals, Dampers - Air Blockers and Gap Fillers - Tapes, Films, and Adhesives	- CNC Machining (of Plastics and Composites) - Molding and Extrusion	- Thermoforming (of Foams) - Cutting and Stamping - Bonding and Assembly - Skiving
Gliwice, Poland	12,600 m ²	IATF 16949 ISO 9001 ISO 14001	- Liquid Cold Plates - Chillers - Gaskets and Seals - Shields and TIMs	- Integrated Liquid Systems - Machined Heat Sinks - Thermosiphons	- High Speed Flatbed Die-Cutting 5 Chamber Cab Brazing - CNC Machining	- Design Engineering - Sandblasting - Rapid Prototyping - Metal Heat Treating - Chiller assembly
Stochov, Czech Republic	3,500 m ²	ISO 9001	Silicone Solutions		- Molding and Compression of Silicone - Assembly	
Syke, Germany	6,588 m ²	IATF 16949 ISO 13485 ISO 14001 ISO 9001	- Adhesives - Pads - Gaskets and seals - Shields - TIMs	- Lens Protect and Adhesives - Display Films - Insulators - Speaker Mesh and Felt	- Rotary Die Cutting - Flat Bed Die Cutting - Kiss Cutting - Laminating - Ultra-sonic Welding	- Slitting - Eccentric Pressing - Laser Prototyping - Clean Room Manufacturing
Weiler-Simmerberg, Germany	7,100 m ²	ISO 13485 ISO 9001	- Silicone Tubes, Cords, and Profiles - Silicone O-Rings and Seals - Silicone Molded Parts		- Silicone Extrusion - Injection and Compression Molding - Rapid Prototyping - Assembly	

Core Capabilities for Engineered Materials

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Converting



- Rotary Die-Cutting
- Flat-Bed Die-Cutting
- Laser Cutting
- Knife on Plotter
- Water-Jet Cutting
- Clean Room Mfg
- Island Placement
- Lamination and Slitting

Extrusions



- Rubber
 - Bulb Seals
- Silicone
 - Medical Tubing
- Plastics

Molding/Forming



- O-Rings
- Injection Molded Plastics (Decorative)
- Compression Molding
- Thermoforming

Printing



- Information and Labeling
- Branding
- Graphic Overlays
- Switches and User Interfaces
- Front Panel Integration
- Capacitive Switch Technology
- Backlighting

Noise, Vibration, Harshness (NVH) and Shock Absorption

Increased durability, reliability, and overall performance in ruggedized applications



Dampers



Absorbers/ Barriers



Isolators

Boyd Solution Advantages



Treatment design and optimization, damping material property testing, acoustic absorption coefficient testing, etc.



CAD design support and Quick turn prototyping



UL94 approved/RoHS compliant material options

Materials

- **Open cell foams:** polyester & polyether-based polyurethanes, polyimide, polyethylene, melamine, PVDF
- **Solid & foamed rubber:** EPDM, butyl, neoprene, nitrile, TPE's, silicones
- **Damping adhesives:** acrylic & rubber-based pressure sensitive adhesives (PSA), heat activated adhesives, silicone PSA
- **Densified materials:** filled PVC, masticated rubbers
- **Woven synthetic, stainless steel or sintered metal** wire mesh screens
- **Stamped metal** dampers

Silicon Extrusion and Moulding

Enhanced silicone extrusion, molding, compression and custom in-house compounding capabilities



Silicone Extrusion and Molding Capabilities

- In-house compounding
- Silicone tubes, seals, profiles, and cords in various Shore hardness and dimensions
- Sophisticated geometries, co-extruded and fabric-reinforced products produced in addition to standard products
- Comprehensive options for process capability review from Cpk analyses to complete IQ/OQ/PQ implementations
- Design and technical support

Gaskets and Seals

Boyd utilizes foam and molded gaskets due to their conformability, high material compatibility and versatility for a broad range of usage parameters.



Boyd offers several foam, gasket, and sealing options to create optimized sealing force and with enough compression force deflection. *We Optimize performance, waterproof and seal while considering compression set and force deflection, NVH and other mechanical factors.*

Solutions are designed for simplified customer assembly, DFM throughput & material optimization.

Common Foam Options

- Polyurethane
- Silicone
- Polyimide
- EPDM
- Nitrile

FR V-0 Thermal Interface Materials (TIM's)

Facilitate heat transfer from board level components to the heat sink/cold plate for improved cooling



Thermal Interface Materials help minimize resistance of heat flow into, through and out of an interface.

Boyd offers a wide range of thermal interface material options that maximize heat transfer from silicon to heat sinks or cold plates for improved cooling efficiency.

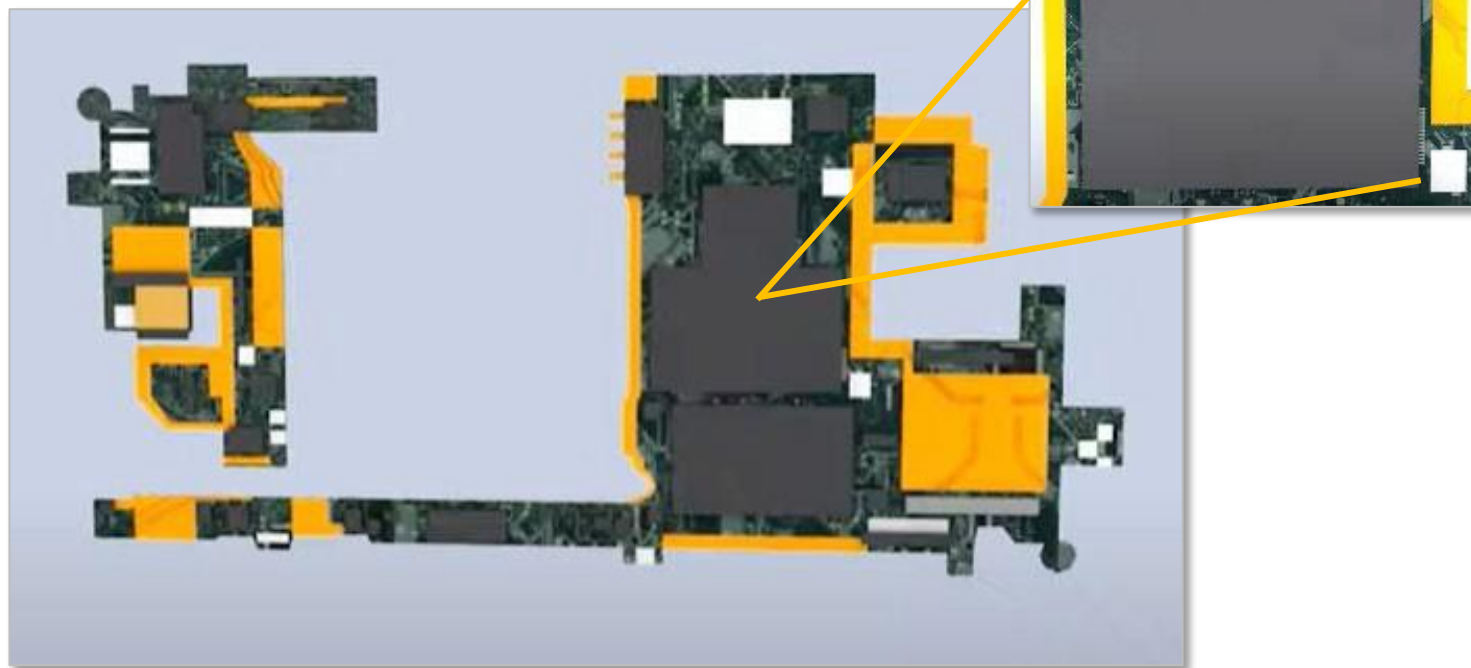
Boyd's Thermal Interface Material Solutions

- *Gap fillers*
- *Putties*
- *Phase Change Materials*
- *Thermally Conductive Insulators*
- *Heat spreaders*
- *Thermally Conductive Tapes*

Multilayer Graphite Heat Spreaders

Facilitate heat transfer from board level components to the heat sink/cold plate for improved cooling

Maintain safe touch temperatures and prevent overheating with lightweight, low profile heat spreaders.



BOYD Solutions

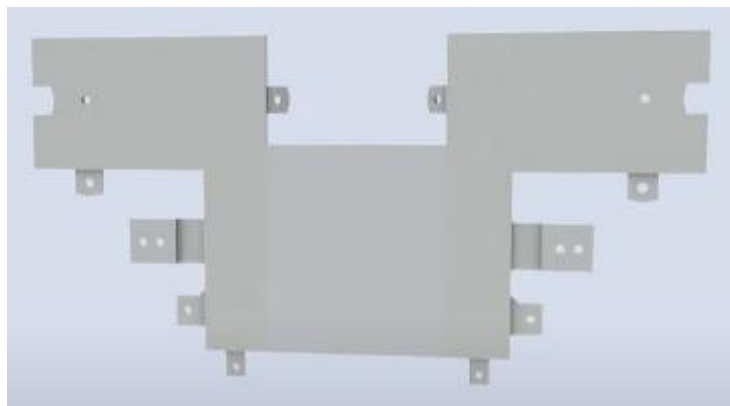
Different materials integration in ONE process

Multi-layers stack up as part of display module

- Complex sheet with thermal spreading and insulation
- Complex sheet with EMI function
- Complex sheet with cushion protection
- Proper interface between display and device body
- Simplify assembly process
- Improve stock / parts management

FR V-0 EMI Shielding Solutions

Reduce electronic malfunction and improve device signal reliability by blocking unwanted electromagnetic interference



Boyd's conductive foams, elastomers, adhesives, and metal foils are designed to manage EMI, improving reliability and efficiency in device performance.

EMI SOLUTIONS

Boyd's LectroShield conductive foams, elastomers, adhesives, and metal foils are designed to manage interference energy, improving reliability and efficiency in device performance

- High shielding effectiveness
- EMI/RFI absorbing with custom permeability
- Meets multiple frequency ranges and applications
- UL94 & NEMA flame retardant ratings

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