CNZHENBO 臻博机械 | MP Sonic
Welding and cutting system

NO. MP220228001

Instruction

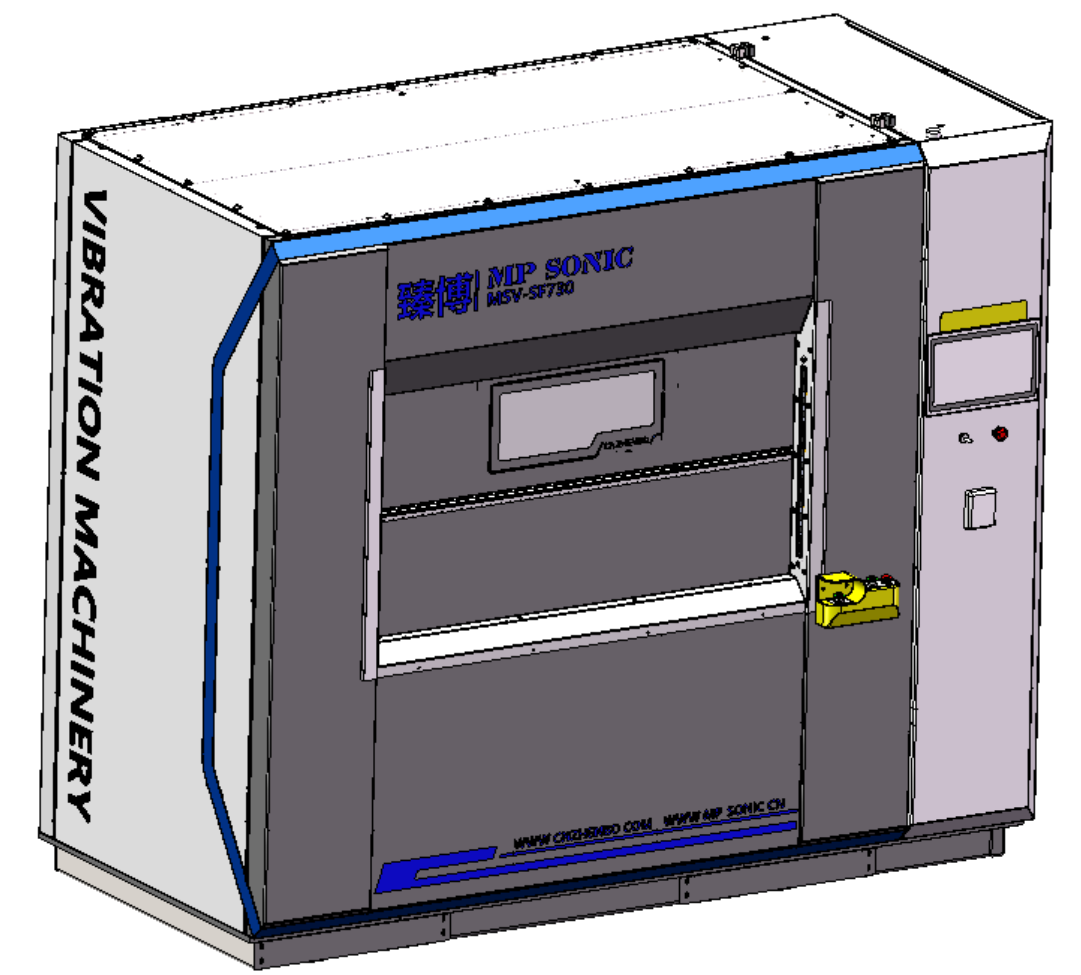
Jointing Design for Vibration Welding

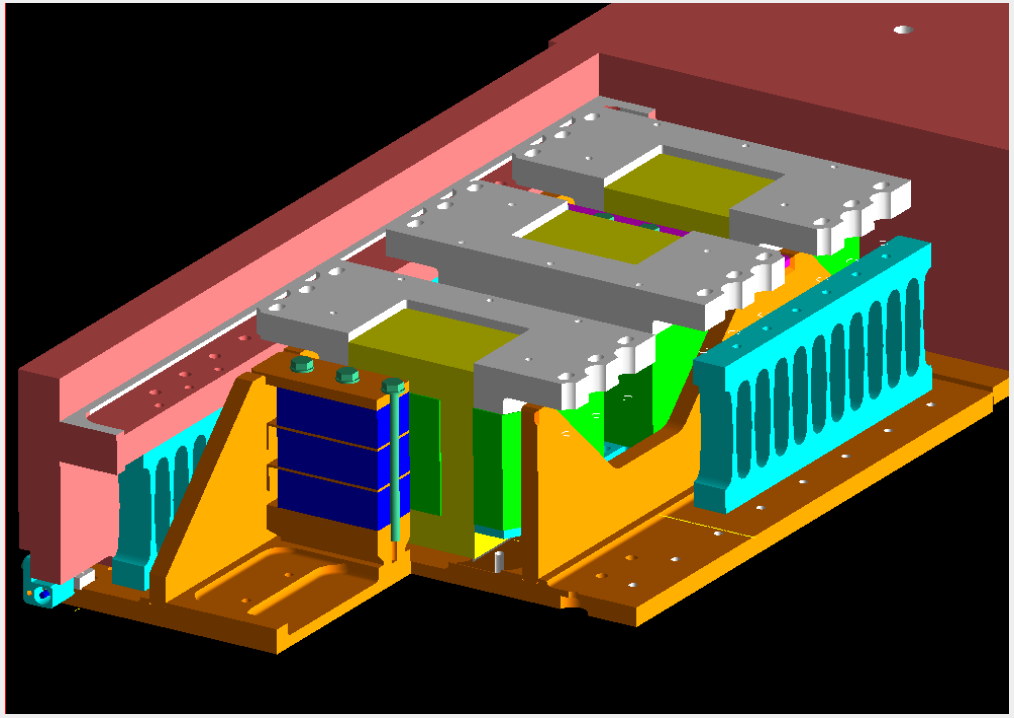
by CNZHENBO | MP Sonic

Zhejiang Zhenbo Precision Machinery Co.,Ltd

by Alex Lee

Liner vibration Working Modules





Welding design concept

- Measurement of welding line;
- The parts holding design at vibration oscillation direction;
- At least 1/2 width of joining area should be supported by vibration welding fixture;
- At least 0.8mm space for the moving distance of oscillation (120Hz:1.8mm);
- Reinforcement at vibration direction:(0.8mm * 2) + α(above2mm)
  Side: aobve1mm;
  Reinforcement for 120Hz welding : about twice of that for 240Hz welding;
- Space for melting flow: melting volume*20~30%。
- Design angle reinforcement to avoid shake at vibration direction;
- Consider the deformation after molding;
- Ensure that the surface slope at vibration direction no over than 10 degree.

Welding design concept--Construction

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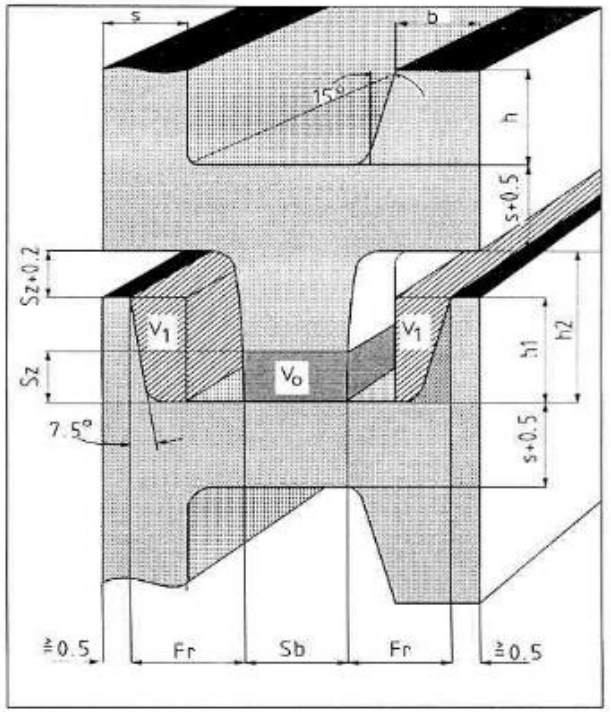
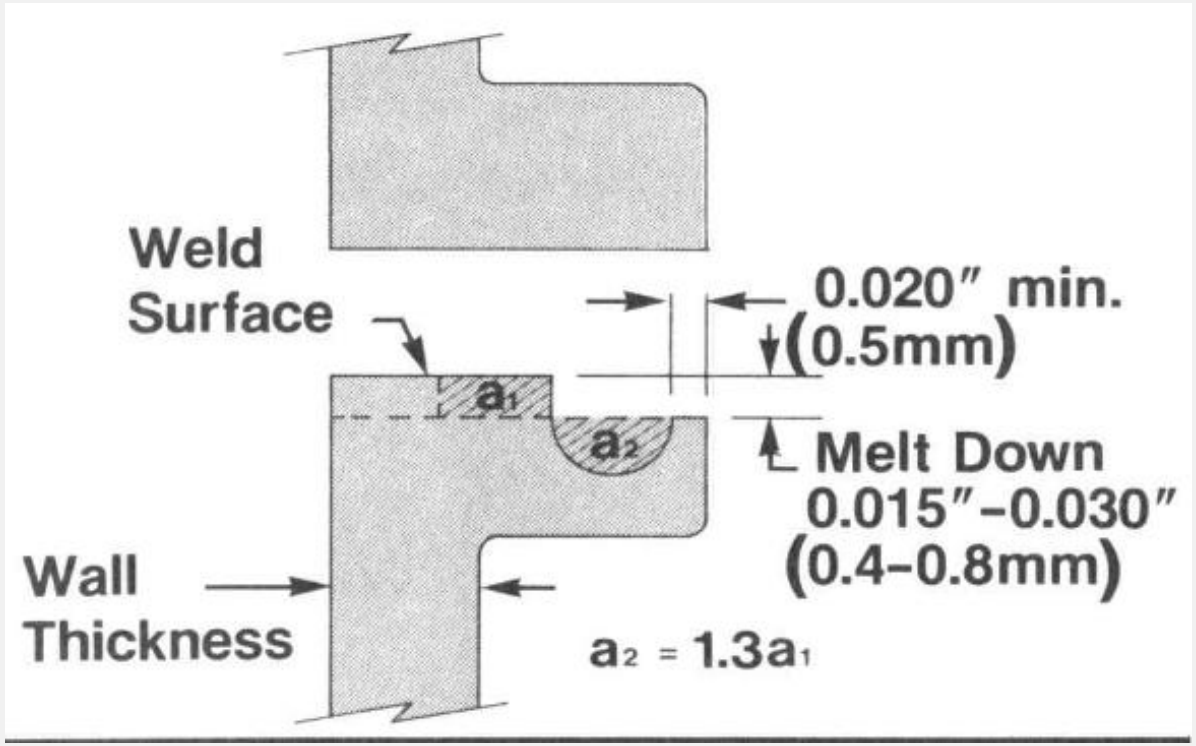
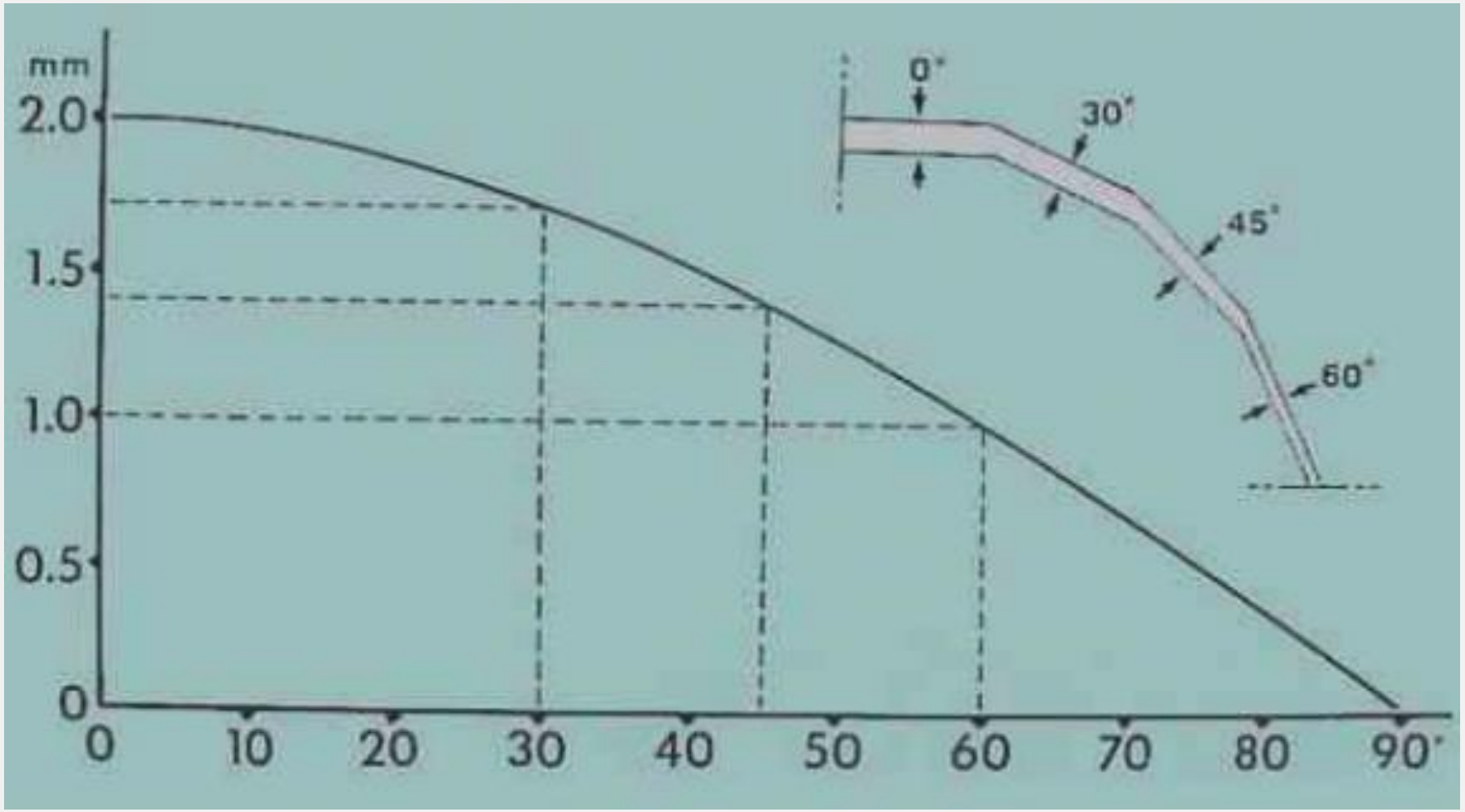
4.2.4 Exemplary design of a modified butt joint in the vibratory direction

This weld joint design is intended to cover up flash and debris by means of appropriate flash traps.

- S = Wall thickness
- S_z = Weld allowance about 0.5 – 1.5 mm
- h = Height of the retaining lugs
- h_1 = Groove depth about 2 mm
- h_2 = $h_1 + S_z + 0.2$ mm
- b = Width of retaining lugs about 1.2 mm
- V_1 = Flash section $\frac{V_o}{2}$
- V_o = Weld section
- Fr = Flash trap = V_1+20%

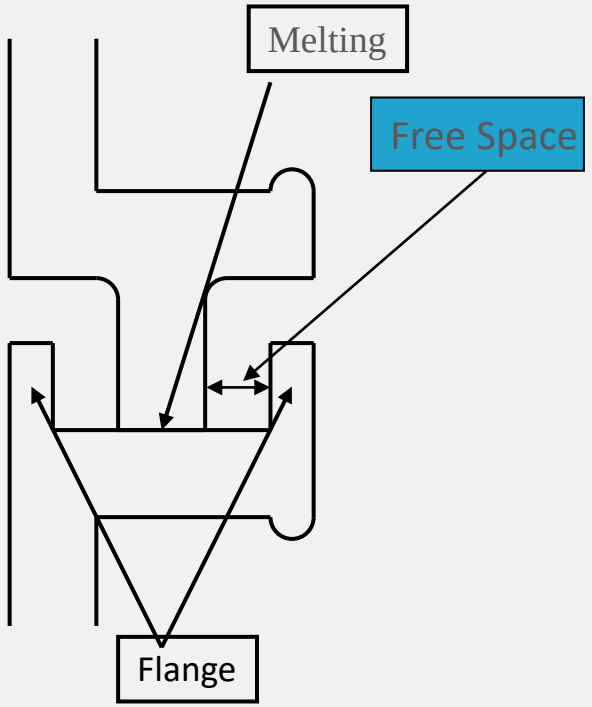


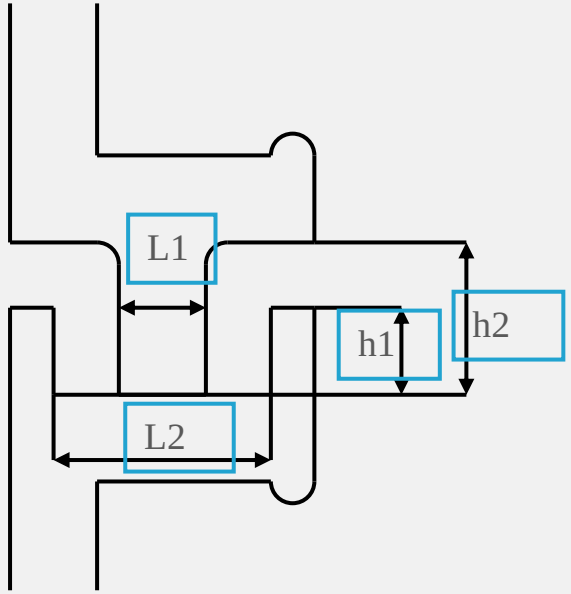


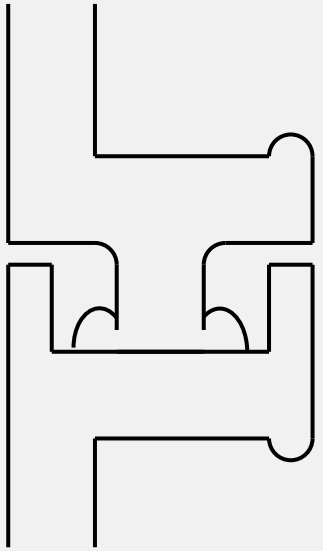


Amplitude

Bevel Angle





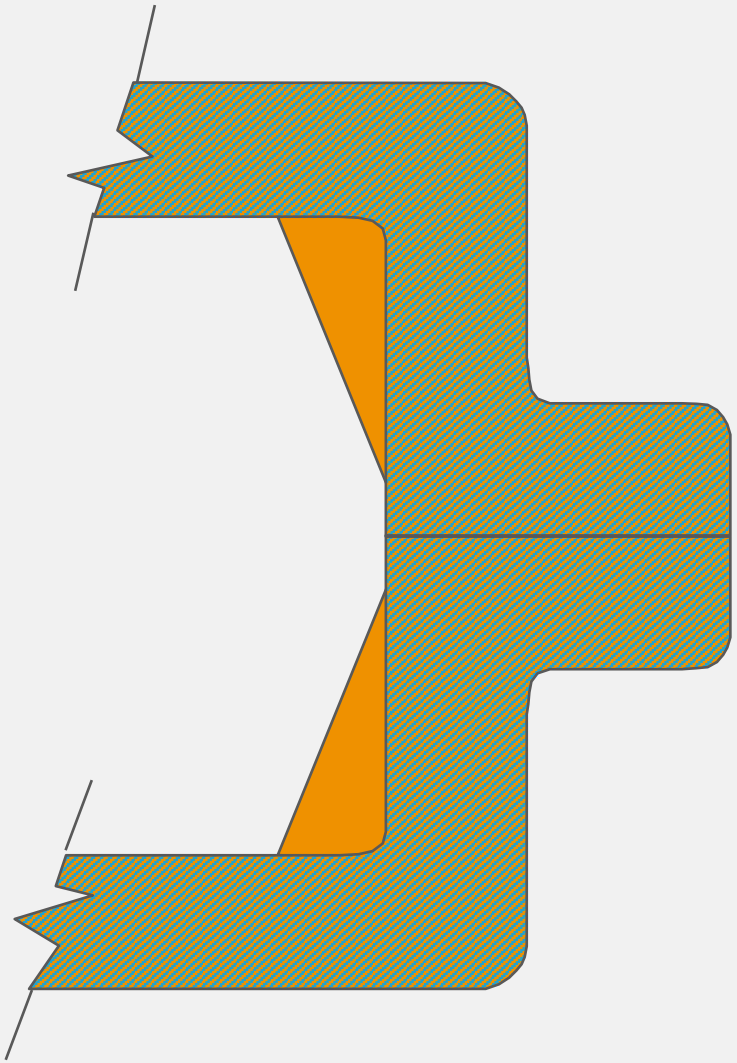


p = h2 −h1 −αα; Welding Margin (about 0.2mm)

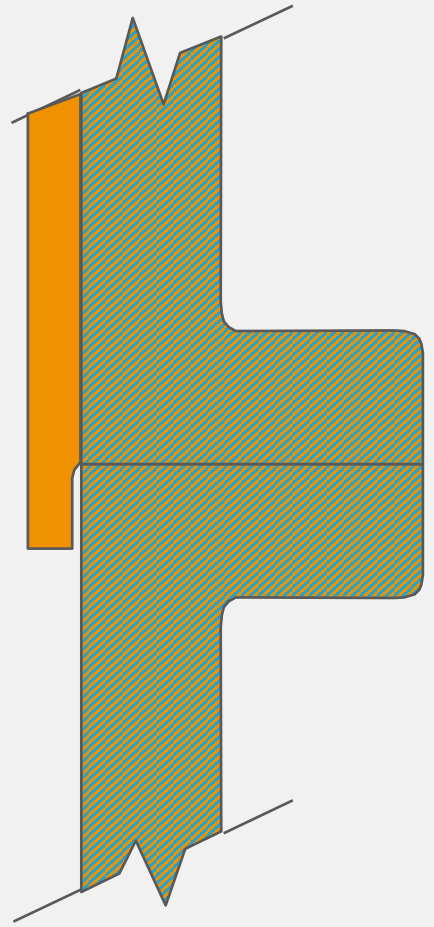
Welding Volume（L1×p） ＜ Internal Space((L2−L1)×h1)

Butt Welding Design

Tongue Welding Design

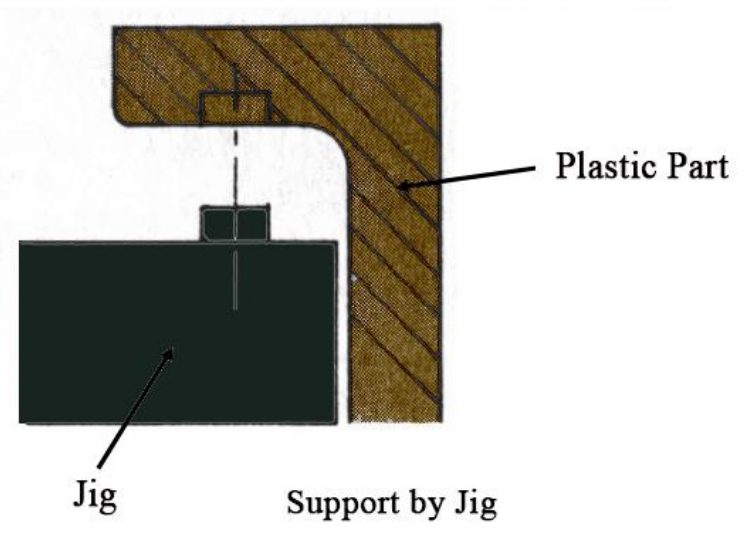


Internal Triangle Reinforcement

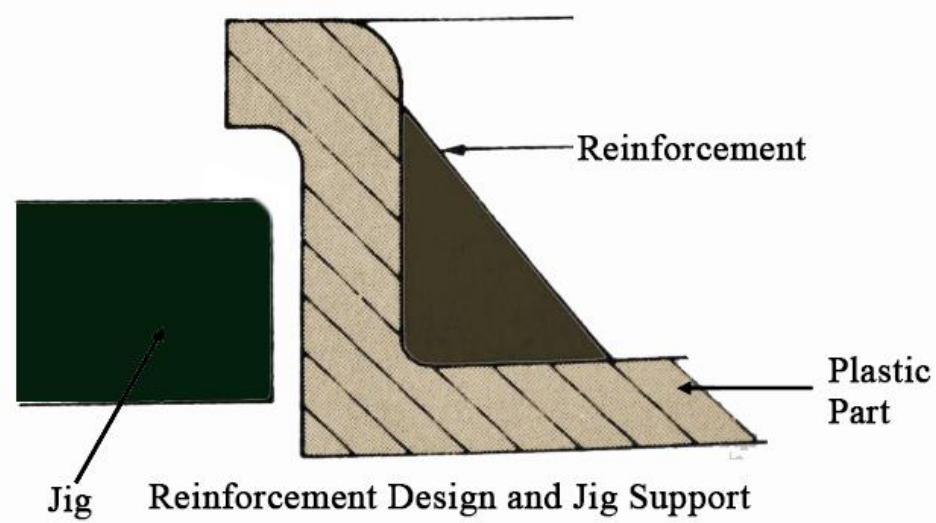


Internal Reinforcement

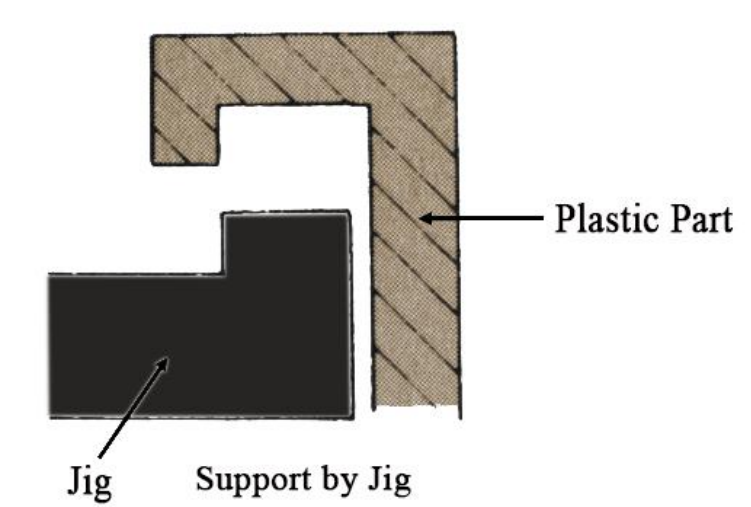
Welding design concept—Holding & Supporting



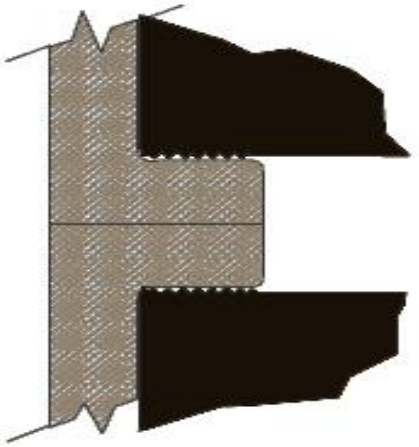
Support by Jig



Reinforcement Design and Jig Support



Support by Jig



Tooth on Jigs

Welding design concept—Holding & Supporting

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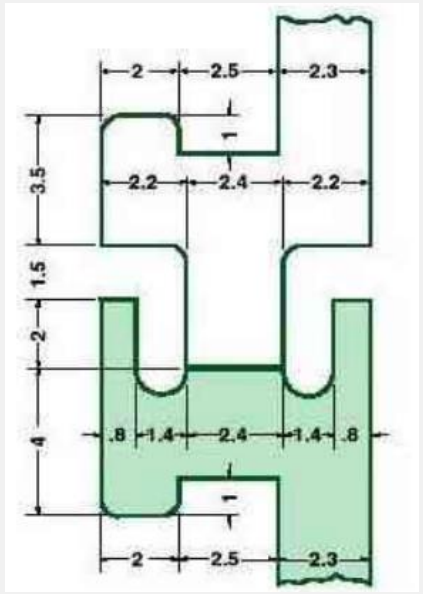

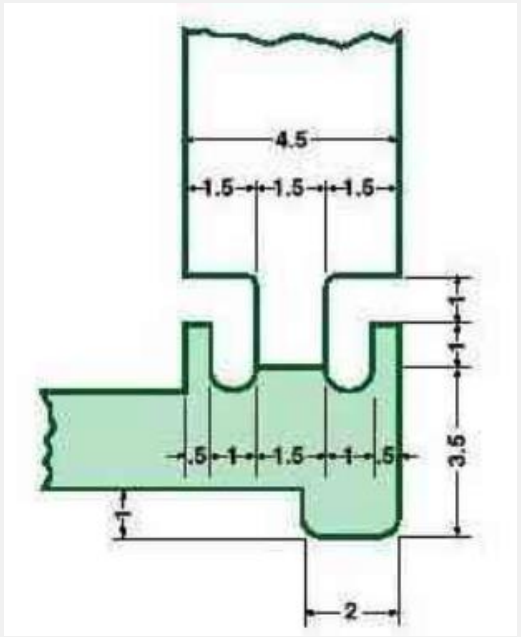

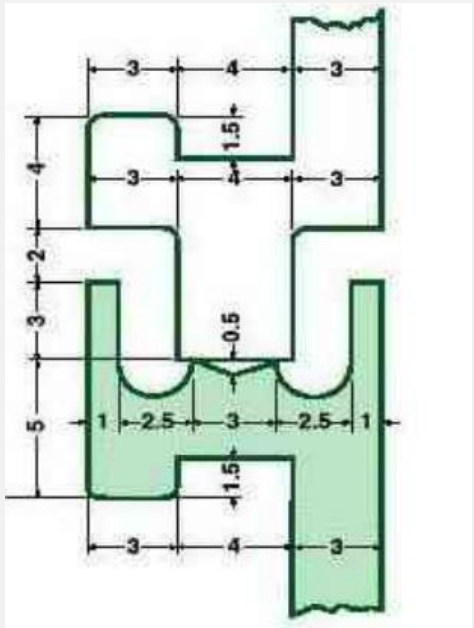

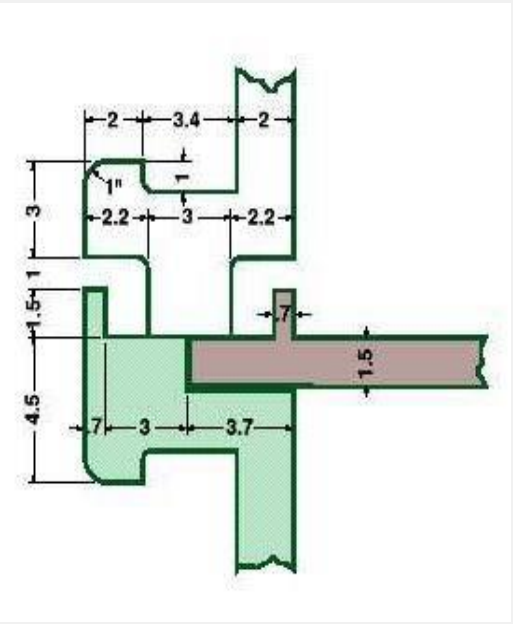

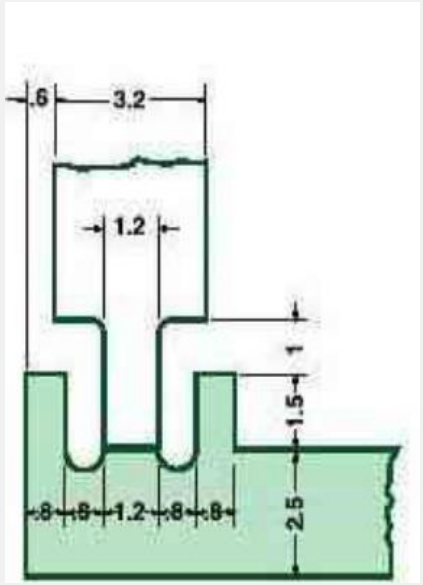

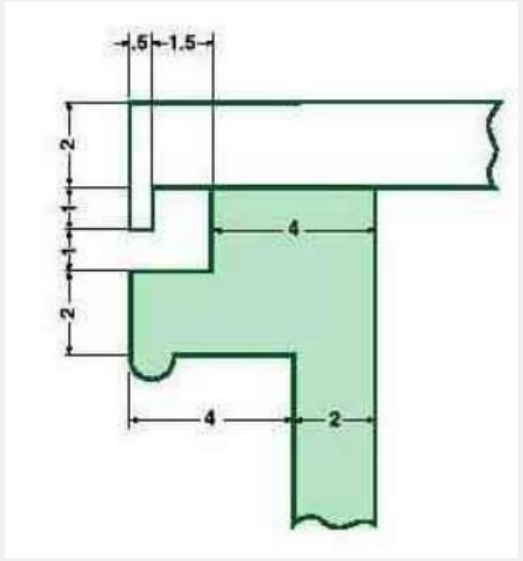

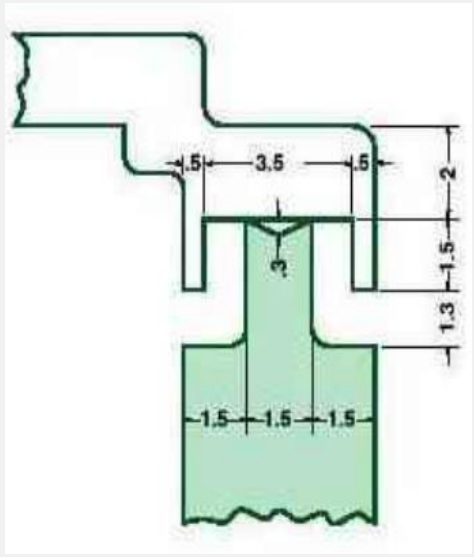

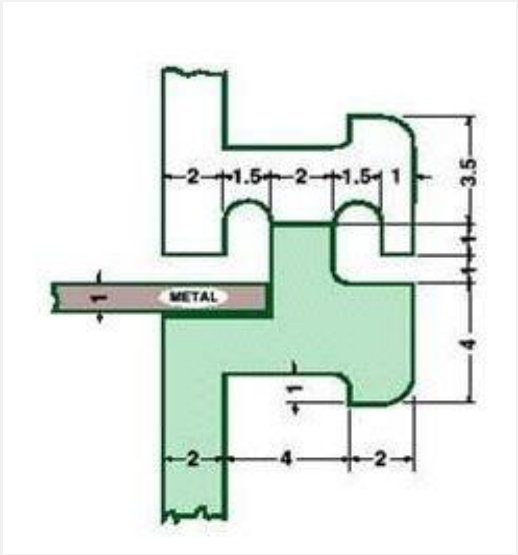

Liner vibration welding operation parameters

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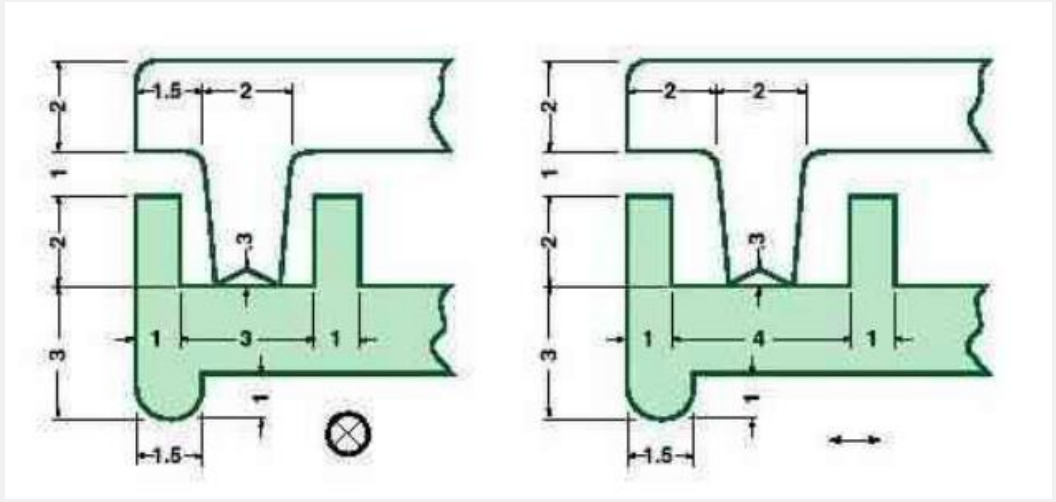
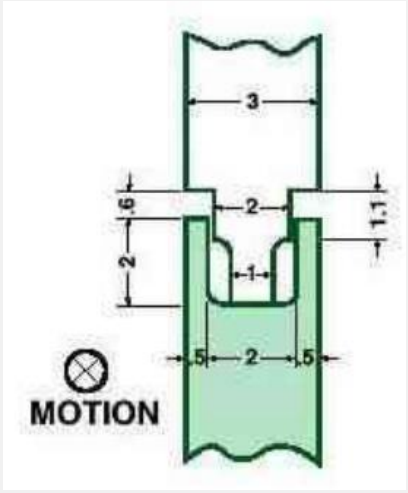
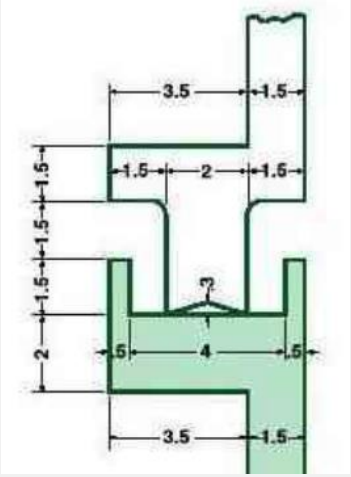
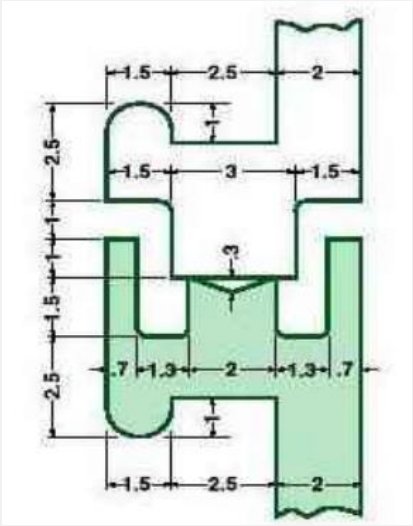
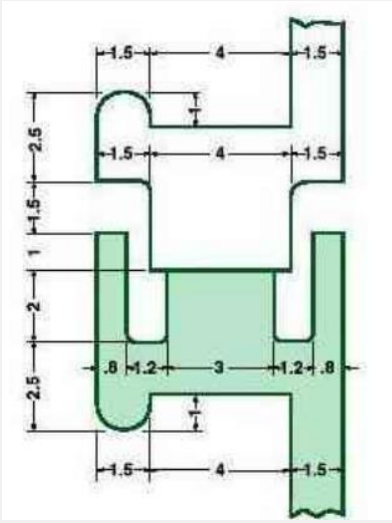
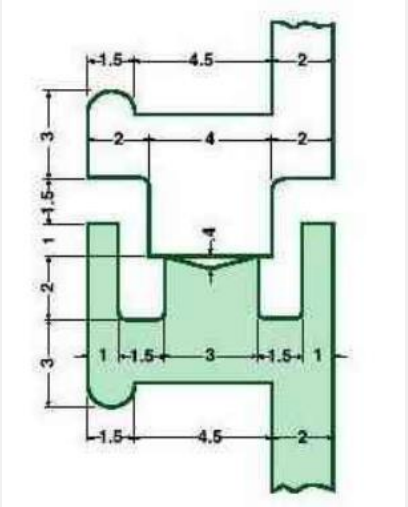


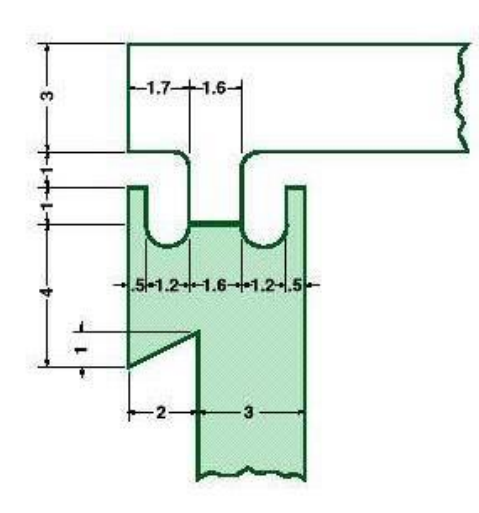




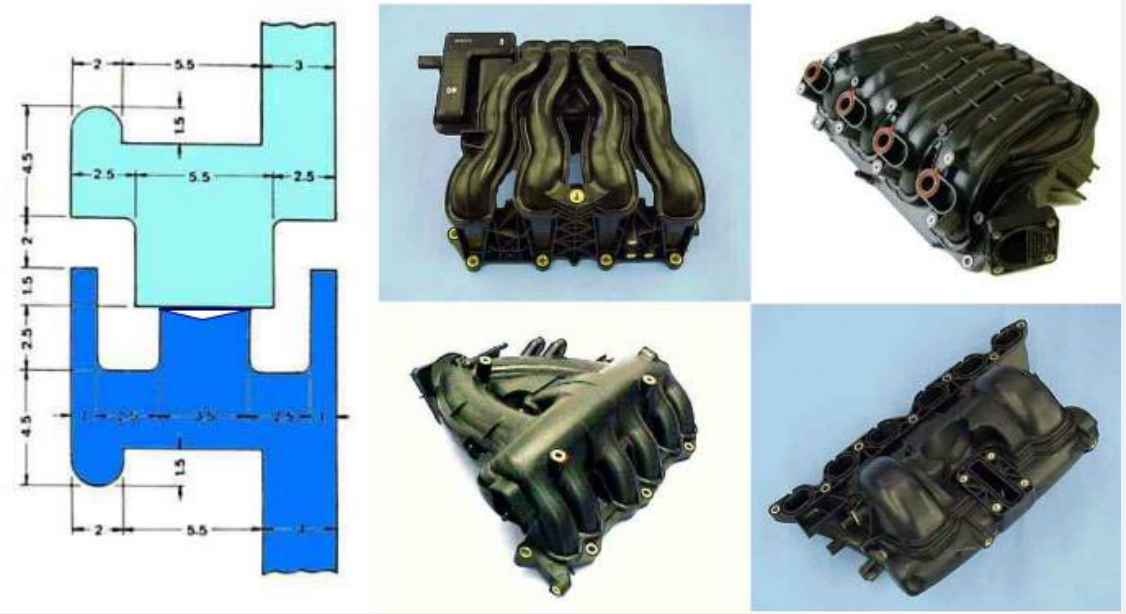


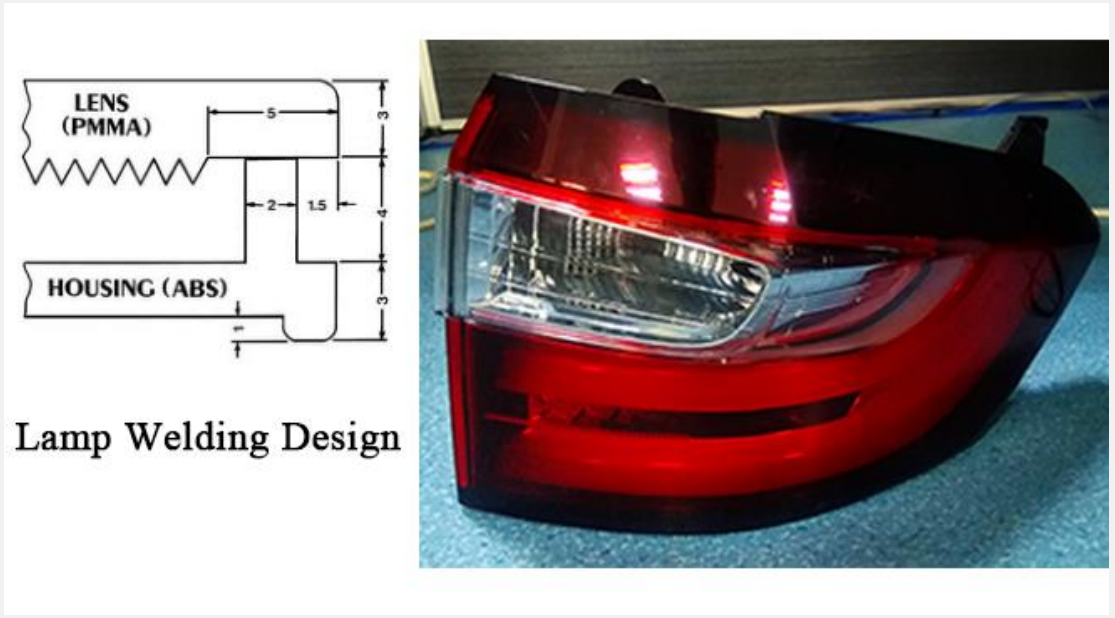






Liner vibration welding operation parameters





Lamp Welding Design

Joint Performance of Different Thermoplastic Material

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THERMOPLASTICS 热塑性塑胶 / PRPPOSED WELDING METHOD 焊接方法		Ultrasonic 超声波焊接					Hot-plate 热板			Vibration 震动	Spin 旋转	Radio Freq. 高频
		Near filed welding 近距离	Far filed welding 远距离	Inserting 埋接	Staking 铆接	Spot welding 点焊	On contact 接触 * Low temp. 低温	On contact 接触 ** High temp. 高温	Non-contact 不接触 ***			
Acrylic/Styrene/Acrylonitrile(ASA)	丙烯酸 - 苯乙烯 - 丙烯	2-3	2 △	2	2	2	2-3	3	3	2	2	4
Acrylonireile/Butadiene/tyrene(ABS)	丙烯腈 - 丁二烯 - 苯乙烯（超不碎胶）	1	1 △	1-2	1	1	1-2	2	3	2	1-2	4
Cellulose Acetate(CA)	纤维	2	2-3 △	2	2-3	2	3-4	3-4	3-4	2	2	3-4
Methacrylate(Acrylic)(PMMA)	甲基丙烯酸酯（亚加力）	1-2	1-2 △	1-2	2	2	2	1	2-3	2-3	2	3-4
PA-Blends	尼龙混合物	3	3-4 △	3-4	3-4	3-4	2	3-4	3	2	2-3	4
PC-ABS-Blends	PC/ABS 混合物	2-3	3 △	3-4	3	2-3	2	3	3	2	2	4
PC-ABT-Blends	PC/ABT 混合物	2-3	3-4 △	3-4	3-4	2-3	2	3	3	2	2	4
Polyacetal(POM)	聚甲荃（赛钢）	2	2	2-3	2-3	2-3	1-2	2	2	2	2	4
polyamide(Nylon 6)	尼龙 6	2-3	2-3	2-3	2-3	2-3	3-4	3-4	2-3	1-2	1-2	3-4
polyamide(Nylon 6/6)	尼龙 6/6	2-2	2-3	2-3	3	3	2-3	2	2-3	1-2	2	3-4
polyamide-Copolymer(Nylon 6-3-T)	尼龙 6-3-T	2	2	2	2	2	2-3	3	3	2	2	3-4
Ploybutylene terephthalate(PBT)	聚丁烯酸脂	3molded parts 注塑件	2-3	2	2-3	2-3	3-4	3	3	2	2	4
		1foils 加薄胶膜										
Polycarbonate(PC)	聚碳酸酯（防弹胶）	2	2 △	2	2	2	2-3	2-3	2	2	1-2	4
Ploybutylene(PE)	聚乙烯（软胶）	3	4	3	3	2	1	2	3	3	2	4
Ploybutylene terephthalate(PET)	聚乙烯酸酯（宝特胶）	3molded parts 注塑件	2-3	2-3	3	3	3-4	3	3	2	2-3	4
		1foils 加薄胶膜										4
Ploybutylene oxide(PPO)	聚氧化亚苯	2	2 △	2-3	2-3	2-3	2	2	3	2	2	4
Ploybutylene sulifide(PPS)	聚硫苯	2	2	2	2	2	2	3	3	2	2	4
Ploybutylene (PP)	聚丙烯（百折胶）	3	4	3	3	2	1	2	3	2	2	4
Ploystyrene(PS)	聚苯乙烯（硬胶）	1	1 △	1	1	1	1	2	3	2	1-2	4
Ploysulfone(PSO)	聚佩	2	2	2-3	2-3	2	2-3	2-3	3	2	2	4
Plovinyl chloride(PVC)	聚氯乙烯	2-3with foils 加薄胶膜	3 △	2-3	2-3	2-3	1-2	3	3-4	2-3	2	1
PP-EPDM-Blends	PP/EPDM 混合物	3	3-4 △	2-3	2-3	2	2	2-3	2-3	2	2	4
PPO-Blends	聚氧化亚苯混合物	3 with foils 加薄胶膜	3-4 △	3-4	3-4	3	2	2-3	2-3	2	2	4
Styrene/Butadiene(SB)	苯乙烯 - 丁二烯	1	1 △	2	2	1	3	3	3	2	1-2	4

List of Symbols 符号代表：1=very good 非常好 2=good 良好 3=limited 尚可 4=not possible 不可能

=Exhaust fan recommended 建议加排气扇
△ =Energy director recommended 建议焊接面加焊线
=Knurl faced horn recommended 建议焊头表面刻滚花纹
=Shear joint recommended 建议焊接面造剪切面

* Hot plate temperature up to 290°C，Heat platens incontact with parts to be welded. 热板温度达到 290°C，热板要与工件接触。
** Hot plate temperature above 290°C，many applications with temperature ranges above 340°C ,Heat platens incontact with parts to be welded. 热板温度在 290°C以上，热板要与工件接触，很多次实例都要用约 340°C范围温度。
*** Temperature ranges from 400°C to 650°C .NO contact between heat platens and parts to be welded. 热板温度在 400°C -650°C，热板与工件不用接触。

Joint Performance of Different Thermoplastic Material

Amorphous Resin	Joining Performance	Crystalline Resin	Joining Performance
ABS	E	POM (Polyacetal)	E
ABS/PC ALLOY(Cycoloy-800)	E	Fluorine-containing resin	G-F
PMMA (Acrylic)	E	A thermoplastic polyester	E
CA,CAB,CAP	E	PE (Polyethylene)	G-F
Improved PPO(Noryl)	E	PMP (Polymethylpentene)	E
PA(Polyamide-Imide)	G	PPS(Polyphenylene sulfide)	G
PC (Polycarbonate)	E	PP (Polypropylene)	E
PS(Polystyrene)	E		
PSF/PSU (Polysulfone)	E		
SAN , NAS , ASA	G	remark：E. Excellent; G. Good; F. Fault	

1) Fault concerned to vibration welding process

Fault Fild	Fault Phenomenon	Source of Fault	Solution
Over Welding	.Over volume of melted material flow	. Over-long vibration time	. reduce vibrition time
	Products measurement becomes smaller after welding	. Over deep welding . Wrong welding desing (Melting flow design)	. Reduce the welding depth . improve the welding area and welding design
Welding is not enough	. Weak elding strength . Measurement at welding area become bigger	.Vibration time is not enough .Welding depth is not enough .Impacted by low friction coefficient	. Increase vibration time . Increase welding depth . change thermoplastic material
Welding performance is not stable	. over-volume of melting flow around welding area	. Plastic parts distortion or fault in moulding . Ireggular welding area or joining line.	. Check mouled plastic parts condition . Check moulding condition
	. Joining strength is not enough after welding	. The matching condition between plastic parts and jig is not good	. Modify vibration welding tooling if necessary . Check and ensure jig condition . Check and ensure moulded parts geometric condition
	. Fault in leakage test	. Folding in joining line outforward	. Reinforce the wall of plastic parts; Add U-type clip design

		. Weak support by jigs (Polyurethane)	. Improve vibration welding tooling to keep plastic wall from distrotion outward; . Reinforce the support at critical area; . If vibration jig distorted along the longer side direction, please reinforce the rigidity of jig; . Check if there is related replacement bewteen plastic parts and jigs during vibration welding; . Check and ensure the positioning between upper jig and lower jig.
		The measurement tolerance of plastic parts geometric shape	. Check plasstic parts measurement;
			. Check the moulding condition.
			. Adjust the measurement toleranve of plastic parts.
		Demoulding agent is sticki on the surface of welding area	. Check and ensure right moulding process; . Clean agent by detergent at welding area; . Change demoulding method if necessary.
		Additive material	Reduce the volume of additive (redyce by 10~20% per time and check the result)

Metling flow	Too much melting flow around welding area	. Defect in melting flow design.	. Redesign the melting flow slot
		. Over welding.	. refer to the solution to over-long vibration time
		. Fault in welding location.	. Inspect injection condition.
Plastic dislocation after welding	. Dislocation at terminal of plastic parts.	. Parts wall distorte outward during vibration welding.	. Add reinforcement to injection plastic parts; . Add U-type clip design to plastic parts at related welding area.
		. Erro free tolerance or unqualified injection moulding.	. Mange free tolerance; . Check and ensure injection moulding condition.
		. Relative dislocation bewteen upper jig and lower jig.	. redress vibration jigs.
		. Welding pressure is over-high.	. Add reinforcement to injection plastic parts; . Adjust vibration welding parameters.

Welding performance is not stable	Weak welding strength cased due to bad thermoplastic parts	Difference cased by multi-cavities moulding.	. Check and analysis the difference between unqualified parts; . Inspect the free tolerance of plastic parts; . Check the wearing condition of injection mould; . Inspect the moulding condition.
		.Recycled or low quality thermoplastic material used.	. Change the recycled material percentage; . Apply material in higher quality.
		.Problem in additive supply system.	. Inespect the injection condition.
		. Material used in low fusibility or incompatibility.	. Confirm together with thermoplastic material suppliers.
		. Plastic with heavy moisture (eg. nylon)	. Weld parts as soon as possible once injection moulding; . Do dry processment before welding.
		. Low compressed air pressure.	. Increase the outpur pressure of air compressor; . Apply suitable air tank.

2) Fault converned to thermoplastic parts design

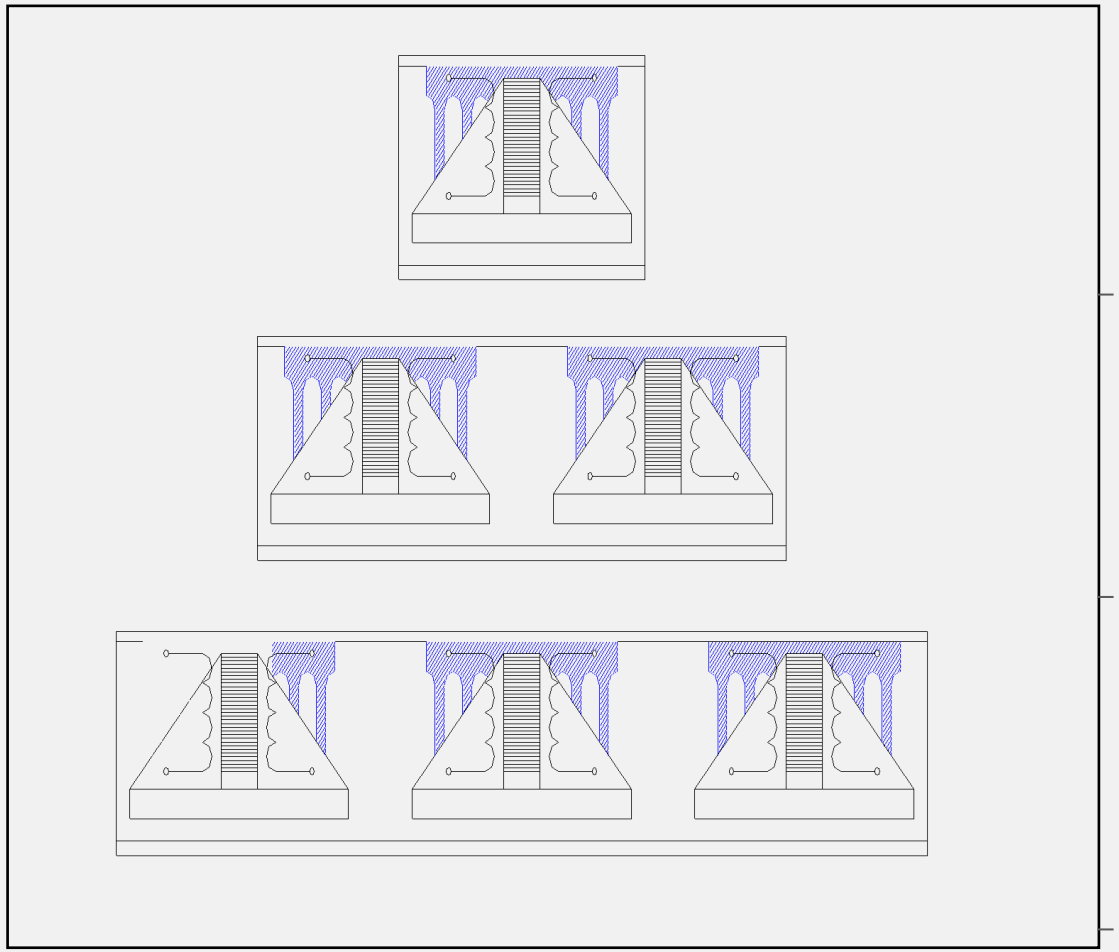
Fault	Source of Fault	Solution
Accssories inside parts damaged	. Over-long vibration time.	. refer to the solution to over-long vibration time.
	. Unreasonable location design of accessories inside plastic parts (too close to vibration welding location).	. Redesign the location of accssories inside of plastic parts; . Design clapboard between the accessories and wall of plastic parts.
Non-welding area around welding place is welded or damaged.	. Over-long vibration time.	. refer to the solution to over-long vibration time.
	. Internal stress remain along with plastic parts.	. Check and ensure moulding condition; . Improve plastic part design.
	. Over-high welding pressure.	. Reduce welding pressure and improve plastic part design.
Welding happens between to inside accessories and plastic parts.	. The accessoies is in the same material with welding plastic parts.	. Ensure the material of each parts/accessory; . Lubricate the accessories inside parts; . Improve plastic part design.
Hurt or pressure mark on plastic parts surface.	.Inaccurate positioning of plastic parts in jigs;	. Check and ensure the jig suport the plastic parts well; . Check and ensure the matching between plastic parts and vibrtion tooling; . Improve plastic part design.
	. Parts shifts during vibration welding.	.Improve vibration jig design to ensure the parts positioning.

Fault	Source of Fault	Solution
Welded thermoplastic products is lose from vibration welding jig.	Thermoplastic parts has not been located in right position	Improve the vibration welding tooling design.
	Deformation of jig	Design reinforcement to vibration welding jig.
	Error in measurement tolerance of thermoplastic parts	Control the moulding measurement of thermoplastic parts.
Always low vibration amplitude and weak output.	Vibration module or frequency converter / amplifier error.	1. Check and ensure the position of thermoplastic parts; 2. Check and ensure if there is lose or crack on vibration module. 3. Test frequency convertor.

Fault	Source of Fault	Solution
Over Melting	Over high friction energy heating at welding area; excessive energy concentration at welding are.	1. Reduce pressure 2. Reduce vibration time 3. Reduce vibration amplitude
Melting not enough	Friction heating energy is not enough	1. Increase pressure. 2. Increase vibration time. 3. Increase vibration amplitude.
	Jig loose	adjust or improve vibration welding tooling
Irregular welding surface	Deformation of thermoplastic parts (Didtortion)	1. Check and ensure thermoplastic part mensurement 2. Ensure molding condition 3. Increase pressure for vibration welding
	Deformation fo thermoplastic part wall	Design reinforcement to wall of thermoplastic parts;
	Problem in Horizontal welding	1. Cheng position to avoiding deformation; 2. Apply tooling holding parts;
	The two thermoplastic parts are not parallel with each other at the welding surface	1. Check and ensure thermoplastic part mensurement; 2. Adjust the lower vibration welding tooling position if necessary; 3. Ensure the pressure value during vibration welding
	Thermoplastic parts is loose (not held in position tightly)	1. Ensure the critical area is held steadily; 2. Adjust the position.

Fault	Source of Fault	Solution
Hurt the surface of thermoplastic part.	Tolerance of degomeic shape of themoplastic parts	1. Ensure the tolerance of thermoplastic parts; 2. Check and ensure the wearing condition inside cavities of vibration weldong jigs; 3. Check and ensure the molding condition.
	Recycled thermoplastic material used	1. Reduce the ratio of recycled thermoplastic matal used; 2. Check and ensure the quality recycled thermoplastic material.
	Uneven distribution of additive	1. Check and ensure the molding condition. 2. Ensure the storing condition after molding.
	Error joning surface cased	1. Adjust and ensure the condin of vibration welding jigs; 2. Apply new welding design.
	Two thermoplastic parts can not match well	Check and ensure the measurement of thermoplastic parts and moulding condition
	Thermoplastic parts and vibration jig matching error, the surfance or coating of thermoplastic parts it hurt.	1. Check and ensure the loactiong; 2. Ensure that the jig material is suitable for thermoplastic parts condition; 3. If vacuum is applied in upper jig, please check and ensure the vacuum suction condition at related area; 4. Apply clip-type holding if necessary; 5. Keep jig clean.
	Hurt at back of welding surface	1. Reduce welding time; 2. Reduce welding pressure; 3. Increase the thickness of thermoplastic parts.

Frequency：90-360 Hz



25 kg. (1) x 25 Kg.	
50 kg. (2) x 25 Kg.	
50 kg. (3) x 25 Kg.	

CNZHENBO 臻博机械 | MP Sonic
Welding and cutting system

Thanks

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