Application Process:

Rock Thin Section Production

Thin sections of rock are prepared for a number of different tests, such as porosity determination, inclusion analysis, mineral composition. However, preparing high quality thin sections of rock can present significant challenges due to: the combination of soft cement and hard aggregates; cement phases being water sensitive; preventing the use of aqueous abrasive carrier fluids; thin sections requiring production at 20μm thickness level if fine grained cement is to be studied; and large area thin sections are generally more useful and representative of the true morphology of the sample under investigation.

The Logitech rock thin section preparation system provides full solutions to these problems and offers unrivalled performance to the thin section preparation laboratory.

Process Notes:

A. Impregnation
The sample to be sectioned must be impregnated with epoxy resin using the **IU30 Vacuum Impregnation Unit.** In porosity testing, fluorescent or blue dye can be added to the resin to aid pore definition. The dye resin fills all the pores and makes them easily distinguishable from the surrounding material.

B. Bonding
After lapping to generate a flat surface, some surface impregnation may be required prior ro bonding the sample(s) with epoxy resin to a glass slide. This operation is normally conducted with a **BJ Bonding Jig** at room temperature to avoid any excess heat generation and sample distortion.

C. Trimming
Following bonding, excess sample material is trimmed off using the **GTS1 Thin Section Cut-off and Trim Saw**, leaving approximately 500μm sample thickness on the glass slide.

D. Lapping
The sample is lapped to its final thickness on an **LP50** or **LP50***auto* machine and is mounted on a PLJ Precision Lapping Jig. These jigs provide automatic thickness control and thickness uniformity, and can accommodate samples up to 150mm x 100mm. Sample thickness to 30μm or less, with uniformity within 2μm, can be automatically achieved.

E. Technology Transfer
All Logitech thin section preparation systems include comprehensive operator training. This allows full **technology transfer** and, where appropriate, further detailed process development of a process route for specific customer applications.

F. System Benefits
High volume sample throughput with low abrasive consumption to give low operating costs. Minimal operator supervision is required as unique Logitech features such as **automatic thickness control** and **automatic lapping plate flatness** allow the operator to leave the unit unattended, leading to increased efficiency .

A large selection of accessories, components and consumables are available to enhance and support Logitech systems.

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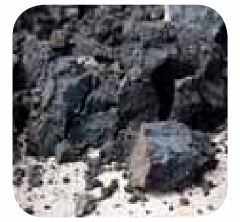
Geological Thin Section Preparation

A wide range of versatile systems for Trimming, Lapping and Polishing Geological Thin Sections.



Introduction

Logitech UK Limited has a wealth of knowledge and problem solving skills in producing high quality geological thin sections. Our team of experts will work with you to integrate the relevant processes and systems to meet your output requirements.

Established in 1965, Logitech has many years experience in design and manufacture of high precision equipment and in sophisticated materials processing. Logitech provides a quick and effective route to complete success in thin section preparation.

Logitech equipment is globally recognised as the industry standard for the preparation of Geological Thin Section samples. This brochure provides details of the direct relationship between Logitech precision equipment and each stage of the thin section production. As well as the standard process route, a number of special techniques are illustrated for some of the more difficult materials.

Comprehensive Technology transfer and customer support is provided by Logitech with every full system purchased.

Application Analysis

Our technical team work, in confidence, with customers to identify the most relevant system for optimum results on their particular thin section preparation problems. Initial discussions provide a detailed understanding of materials to be processed, outputs required, surface finish and geometric tolerance requirements.

Generally the standard thin section production can be broken down into the following basic steps:

1 Slabbing and trimming of field specimens
2 Impregnating soft, porous or friable material (where required)
3 First face lapping of cut material
4 Preparation of slides to uniform thickness & flatness
5 Bonding specimens to prepared slides
6 Thinning bonded specimens
7 Lapping specimens to chosen thickness
8 Polishing specimens (where required)

Logitech's unique consultative approach ensures that customers achieve the best possible results from the advanced Logitech machine system and application processes.

Client Support

Support is provided directly by Logitech and via an extensive global network of, Logitech trained, dealers. This enables us to provide a consistently high level of localised support and services from our technical base in Scotland.

A 12 month warranty is provided for all Logitech machines purchased. The client support policy at Logitech aims to resolve any client issues, be it mechanical, electrical or technological, in a fast and effective manner. The "no quibble" policy for replacement of faulty components ensures that any response to client difficulty is immediate.

Standard Process Route

Products & Services

Logitech offer a range of machine systems which cover the complete thin section preparation process for geological applications. The range of equipment is capable of meeting all output requirements from a few sections per week to over 200 per section.

Logitech Systems

Logitech systems are designed to be flexible with changing production requirements in terms of accuracy and outputs. The family of products enable customers to start with a single workstation machine and add other single or multi workstation machines as necessary. This approach provides two major benefits:

- Low initial investment during the development stages
- Ability to create a multi-machine production unit instead of relying on a single machine.

1. Slabbing & Trimming

If the material is solid and not liable to disintegrate, the first operation is to trim the bulk material down for slide mounting. A slice should be cut and trimmed to fit the required slide. A Logitech GTS1 Thin Section Cut-off and Trim Saw is a compact bench-top solution, ideal for geological production and research environments. A key feature of the saw is the ability to control the speed at which samples move through the blade, minimising damage to the sample. Thin sections up to 150 x 100mm can be repeatedly trimmed down to 200µm, saving lapping time and increasing productivity.

2. Impregnating


IU30 Unit

Where material is liable to disintegrate, it is first impregnated with resin. The IU30 (illustrated here) is a self contained unit designed to meet the needs of researchers for high quality encapsulation and impregnation of specimens with synthetic resins, while offering both simplicity and ease of cleaning. The IU30 allows the sample to be outgassed for as long as is needed in the right hand chamber, whilst the resin is outgassed in the left hand chamber before being transferred under vacuum to the samples. The large sample chamber has been designed to accept samples of up to 150mm x 100mm or a number of smaller samples. Once the resin has cured, the material can be trimmed as above.

3. First Face Lapping

A standard thin section is 30µm thick uniformly over the slice area. To achieve a flat reference surface for subsequent bonding to the slide, one face of the prepared chip is lapped flat in a conditioning ring under a pressure block and 3.5kg load on a grooved, cast iron lapping plate. This can be achieved using a Logitech PM5, LP50 or CL50 Precision Lapping and flat Polishing System.

4. Preparing Slides to Uniform Thickness

The glass slides for supporting the specimen material must be parallel and of a known thickness. One face of the slide is lapped flat and parallel on either a PLJ2, PLJ7 or CJ30 Precision Lapping Jig, which can be set to stop the lapping action automatically at the required thickness. Standard PLJ2 jigs hold 26x76mm, 28x48mm, 51x76mm, 110x76mm, 30x45mm, 45x60mm or 60x90mm slides depending on model being used. Standard PLJ7 jigs hold 152x102mm or 76x51mm slides. The CJ30 holds 28x48mm or 26x76mm slides.

5. Bonding Specimens to Prepared Slides

The lapped specimens may now be bonded to the glass slides. Epoxy resin with an appropriate refractive index is used (e.g. Epoxy-Pack 301). A thin layer of resin is spread on the dried, lapped face of the chips and the lapped side of the slide is placed on the sample surface. Once bubbles have been eliminated, the slide and chip are placed in a bonding jig. This ensures an even load and parallelism, effectively zero bond (<1µm thick).

6. Thinning Bonded Specimens

The chips are still too thick for final lapping and need trimming to a thickness of 300-500µm. This is achieved on saws such as GTS1, Model 15 or CS30.

7. Lapping Specimens to Final Thickness

The thinned bonded specimens can now be mounted onto a Logitech Precision Lapping Jig and lapped to the final desired thickness - 30µm for a standard thin section, or 40µm if the section is to be polished. The lapping action stops automatically as soon as the desired thickness is reached and the design of the jig ensures repeatability and uniformity of thickness across the whole section.

8. Polishing (If required)

For polishing specimens to a very high standard (high reflectivity), low relief, ultra flat surfaces, minimum edge roll off etc, the WG2 Polishing System offers excellent results. Used with a PM5 or PM5*auto* system, the WG2 rotates samples independently of the polishing plate using a power driven carousel and speed potentiometer. This ensures high quality sections are quickly and easily produced. The WG4 Polishing Head on the CL50 (Compact 50 Polishing System performs a similar function on a smaller scale), for further information please visit our website at: **www.logitech.uk.com**

Geological Thin Section Preparation: System Range								
	Trim		Dimensions		Max Sample Capacity			
Trimming & Thinning								
GTS1 Saw	down to 200 µm		510x400x720mm		up to 102 x 76mm or smaller multiples up 12 28 x 48mm			
CS30 Saw	down to 500 µm		530x240x300mm		1 26 x 76mm or 2 28 x 48mm			
Model 15 Saw	10mm cuts		480x280x440mm		50 x 55mm			
Impregnation								
			Vacuum		Sample Capacity			
IU30 (RV3 Pump)			Down to 0.002 m bar		from 25mm x 45mm up to 100mm x 150mm			
CitoVac			Down to 100 m bar		28mm x 48mm or 26mm x 76mm			
First Face Lapping: Sample Capacity								
Machine	28X48mm		26X76mm		51X76mm		152X102mm	
	Standard	Impregnated	Standard	Impregnated	Standard	Impregnated	Standard	Impregnated
LP50 Auto & PLJ2	102	66	68	44	32	22	-	-
LP50 Auto & 2 PLJ2	168	120	112	80	56	38	-	-
LP50 Auto & 3 PLJ2	222	144	148	98	72	48	-	-
LP50 Auto & PLJ7	-	-	-	-	66	44	16	11
LP50 Auto & 2 PLJ7	-	-	-	-	112	76	28	19
PM5 Auto & PLJ2	102	66	68	44	32	22	-	-
CL50	30	25	20	15	-	-	-	-
Preparing Slides to Uniform Thickness								
	Achievable Parallelism		Finished Thickness		Max Sample Capacity			
PLJ2	2 µm		±2 µm		75x110mm or smaller multiples			
PLJ7	4 µm		±2 µm		100x150mm or smaller multiples			
CJ30	2 µm		±2 µm		26x76mm			
Bonding Specimens to Prepared Slides								
Bonding Jigs	Sample Diameter Sizes							
BJ2/BJ6/BJ9/BJ12	28mm x 48mm; 50mm x 76mm; 76mm x 110mm; 26mm x 76mm; 102mm x 152mm							
Polishing Heads								
		Sample Capability						Sample Height
WG2		6 of 28mm x 48mm; 3 of 51mm x 76mm; 1 of 143mm x 143mm; 1 of 100mm x 175mm						0-25mm (0.98")
WG4		3 of 28mm x 48mm; 2 of 26mm x 76mm						

One of the Benefits of Automated Lapping


LP50 system

One of the most important developments in thin section making, in recent years, has been the introduction by Logitech of automatic lapping plate flatness control with the PM5 and LP50 auto Precision Lapping Machines. This almost completely eliminates the most difficult task of the lapping process - controlling the plate shape. Changes in plate shape during processing can cause edge rounding and taper on samples and plates. Previously this had to be checked and conditioned at least once per day.

Lapping plate flatness control improves the quality and repeatability of the thin sections produced. It is of tremendous advantage to the operator - freeing a large amount of the time which would be spent on machine supervision for other tasks, such as analysis, and improving the overall productivity of the thin section production system.

Ultra Thin Sections

Ultra-thin sections require to be polished on both faces. Trimmed chips are first free lapped according to the standard process route up to step 3. Then they must be "free" polished under load in a conditioning ring on a Logitech lapping and polishing machine, such as the LP50*auto* or PM5*auto*.

When polishing is complete, the chips can be mounted, polished side down, on a prepared glass slide (step 5), thinned (step 6) and lapped to 25-30µm (step 7). Thereafter the lapped section is polished using a WG polishing head on a Geochem plate to the required final thickness, down to less than 10µm in some cases.

Special Techniques & Processes

In addition to standard thin section production, Logitech systems are versatile enough to accommodate materials requiring special techniques such as ultra-thin sections, concretes, fluid inclusions, coal and soils, described below. Non-geological materials such as bone implants, teeth are also catered for.

Soil

Before any processing can begin, water must first be removed from the soil. Normally the sample is left in a well ventilated area for several days until a constant weight is achieved and then dried on a hotplate at 40°C for 48 hours. The soil is ready for impregnating on the IU30 Vacuum Impregnation Unit (step 2 of the standard process route). Once the resin has cured, the sample is trimmed on the GTS1 or CS30 saw. A non-aqueous solution, for example ethylene glycol, can be used as a coolant to avoid damaging the soil. Water should NOT be used. The samples are then 'free' lapped on the sawn face using the technique described at Step 3 of the standard route.


GTS1 Saw

Aluminium Oxide abrasive must be used with impregnated material and it must be in a carrier fluid with a low water content, e.g. ethandiol. As the soil particles retain large volumes of resin two or three stage lapping may be necessary, i.e. start with 15µm, continue with 9µm and finish with 3µm abrasives.

The lapped face is then cleaned and bonded immediately to avoid any distortion effects. Bonding is carried out according to step 5 of the standard process route, but for larger specimens it is necessary to use the high pressure stations of the BJ6 or BJ12 Bonding Units.

Once bonded, the sample is thinned as at step 6 using ethylene glycol as a coolant. Lapping then follows as per step 7 and again three stage lapping may be necessary. Abrasive carrier fluid should be non-aqueous such as ethandiol. Final Polishing is achieved on a Pellon pad with the sample held in a vacuum chuck holder.

Concrete

Thin sections of concrete are prepared for a number of different tests: porosity determination, inclusion analysis, mineral composition for example. To make analysis easier, in particular for porosity testing, the pores in the concrete are defined more clearly by impregnating them with dyed resin. Normally the dye is mixed with the resin before being used to impregnate the specimen in the IU30 Vacuum Impregnation Unit (step 2 of the standard route). As a result of impregnation, the dyed resin fills all the pores and makes them easily distinguishable from the surrounding material. Fluorescent dyes can be used if required. Whether dyed or not, concrete specimens must be either fully or surface impregnated to permit further processing.

Thereafter, the standard process route is followed with some minor alterations to produce the finished thin section. Trimming the specimen is carried out as per step 1, but to prevent water damage, a non-aqueous liquid such as ethylene glycol is used as a coolant. This also applies at the thinning stage (step 6). To avoid any damage and contamination during lapping (steps 3 and 7) Aluminium Oxide abrasive should be used instead of Silicon Carbide, and in view of the susceptibility of concrete to water, the abrasive is a non-aqueous carrier fluid such as ethandiol.

Fluid Inclusion Studies

Specimens used for fluid inclusion analysis require to be polished on both sides as the inclusions are so small that they would be obscured by the larger surface features of the lapped surface. First the chips are trimmed and free lapped (as Steps 1 and 3 of the standard route). After lapping, the chips are also free polished (i.e. under load on a polishing pad or soft metal plate). They can be mounted, polished side down, on a prepared glass slide, either with resin if the finished section is not to be demounted (as per step 5) or with wax or other "temporary" adhesive if the specimen is to be demounted later. Final thinning, lapping and polishing can then be carried out, exactly as for a standard thin section (steps 6-8) if the finished thickness requirement is in the normal 80 to 250µm range or using the techniques described for ultra-thin section preparation.

Coal

Coals are particularly difficult materials to process. They are generally friable, prone to distortion under small stresses, heat sensitive and opaque, thus requiring a section less than 10µm thick to define the structure clearly under the microscope.

A special steel base is inserted in a 25mm diameter plastic mould, into which the coal specimen is then placed for impregnation (step 2). Once the resin has cured, the impregnated specimen is removed from the mould and the top is trimmed off using the GTS1 or CS30 saw. The trimming face is then lapped and polished, with the option of processing using either a conditioning ring (step 3) or the WG2 Polishing Head with an appropriate PM5 system.

A suitable number of resin "pips" are placed on an untapped slide. These serve as support pillars to the coat section. The pips are lapped to a thickness of 50-80µm on the PLJ2 Precision Lapping Jig, co-planar and parallel to the back of the glass slide and with the slide still mounted on the jig, the polished face of the specimen is bonded to the pips. Once the resin has cured, the excess material, including the metal mould base is cut off and the specimen lapped and polished according to the standard process route (steps 6-8) but to a final thickness of 8-12µm.

Technology Transfer

Training and process technology trials at Logitech cover; sample handling, equipment use, cleaning, bonding, gauging and process adjustments, with which the operator needs to be familar. We are dedicated to complete success and through training at our purpose built laboratories or at client premises, the team ensures that training is provided at a level relevant to the clients process needs.

Years of experience has identified that instruction manuals alone do not provide operators with the levels of knowledge and success that are achieveable through personal training and practical experience. Logitech are so committed to this programme of technology transfer that it provides a full three day training course, with all material processing systems purchased. Courses cover all aspects of system operation, maintenance and customer focussed process trials. This unique approach ensures successful installation, optimum use and maintenance of Logitech systems.