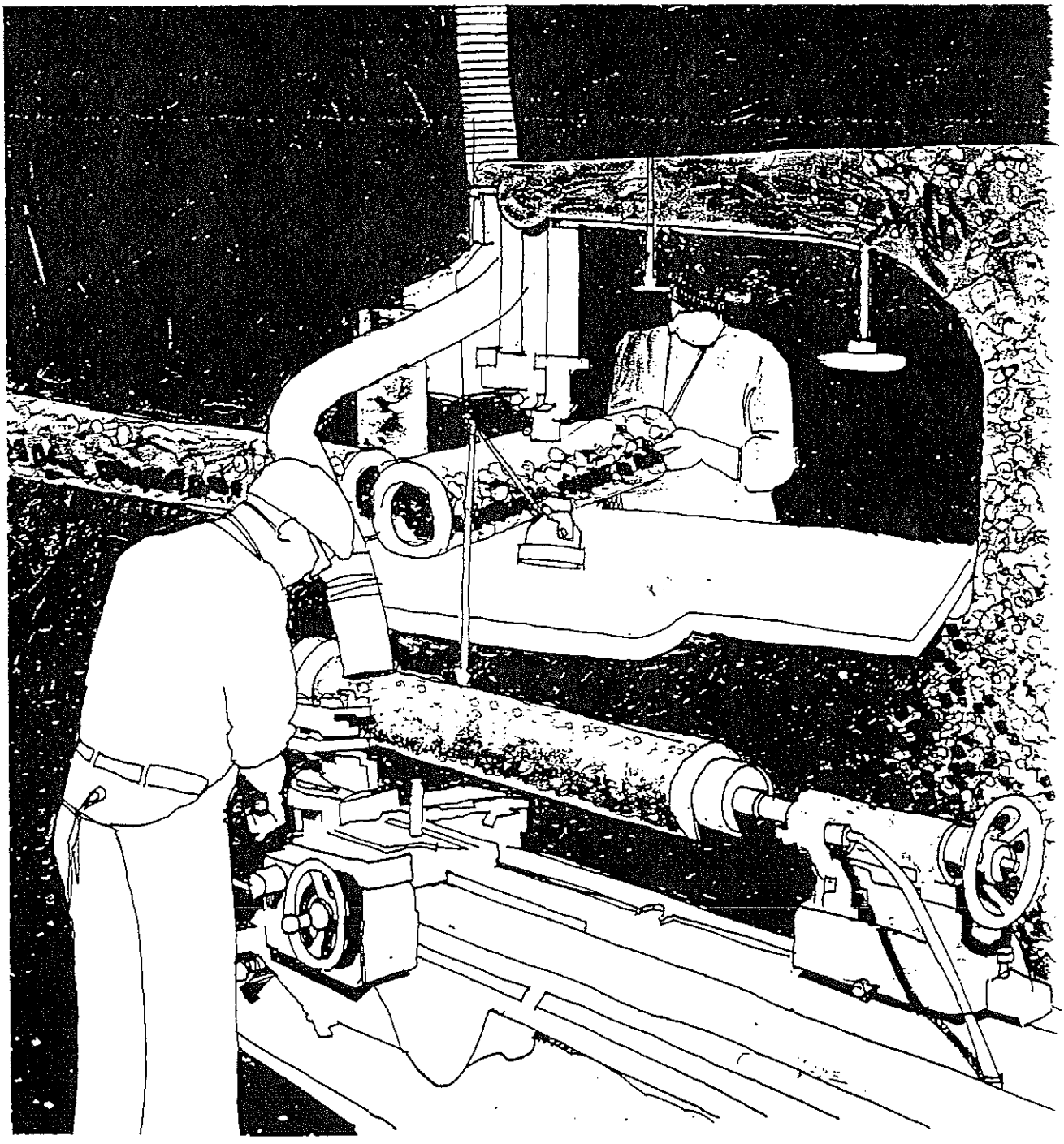
FORMICA

industrial laminates

MACHINING



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Formica industrial laminates consist of layers of paper, fabric, asbestos cloth, wood or glass cloth impregnated and bonded together with synthetic resins to form a material that can be machined or punched to fine limits as intricate forms.
This guide is intended to help users achieve the best possible results when machining industrial grade laminates.
Formica's technical advisers are available at all times for on-the-spot consultations with users and to provide general machining and product information.

Design recommendations

Formica industrial laminates are easily machined by standard shop methods. These design recommendations are intended to simplify the work of production departments and help users keep rejects and costs to a minimum.

Machining with standard tools

Try to design parts so that machining can be done with standard tools. Wherever possible, specify standard size holes and slots.

Holes parallel to laminations

Avoid large holes parallel to laminations where any subsequent pressure (from a screw, for example) might separate the laminations. If holes parallel to laminations are necessary, clamp the material tightly when drilling and tapping.

Distance between punched holes

To prevent the laminate from cracking between holes, allow a space at least 1.5 times the thickness of the material between holes or between a hole and the edge of the piece.

Tapping into blind holes

Allow a clearance of 2 or 3 times the thread pitch at the bottom of a blind hole. This will prevent the threads from stripping and any slight delamination.

Inserts

Where a stronger thread is required or where screws will be repeatedly screwed in and out, fit self tapping or Helicoil inserts in the part.

Spacing of milled slots

The space between slots (A) or between edge of slot and end of material should be greater than the depth of the cut (B).
A narrower edge ridge between slots can split or break off.

Gears

Wide gears can be made up from multiple sheets or bolted together. Lay up the laminations in different directions.

Threads

Good threads can be produced in most standard thread forms by following standard brass machining practices.

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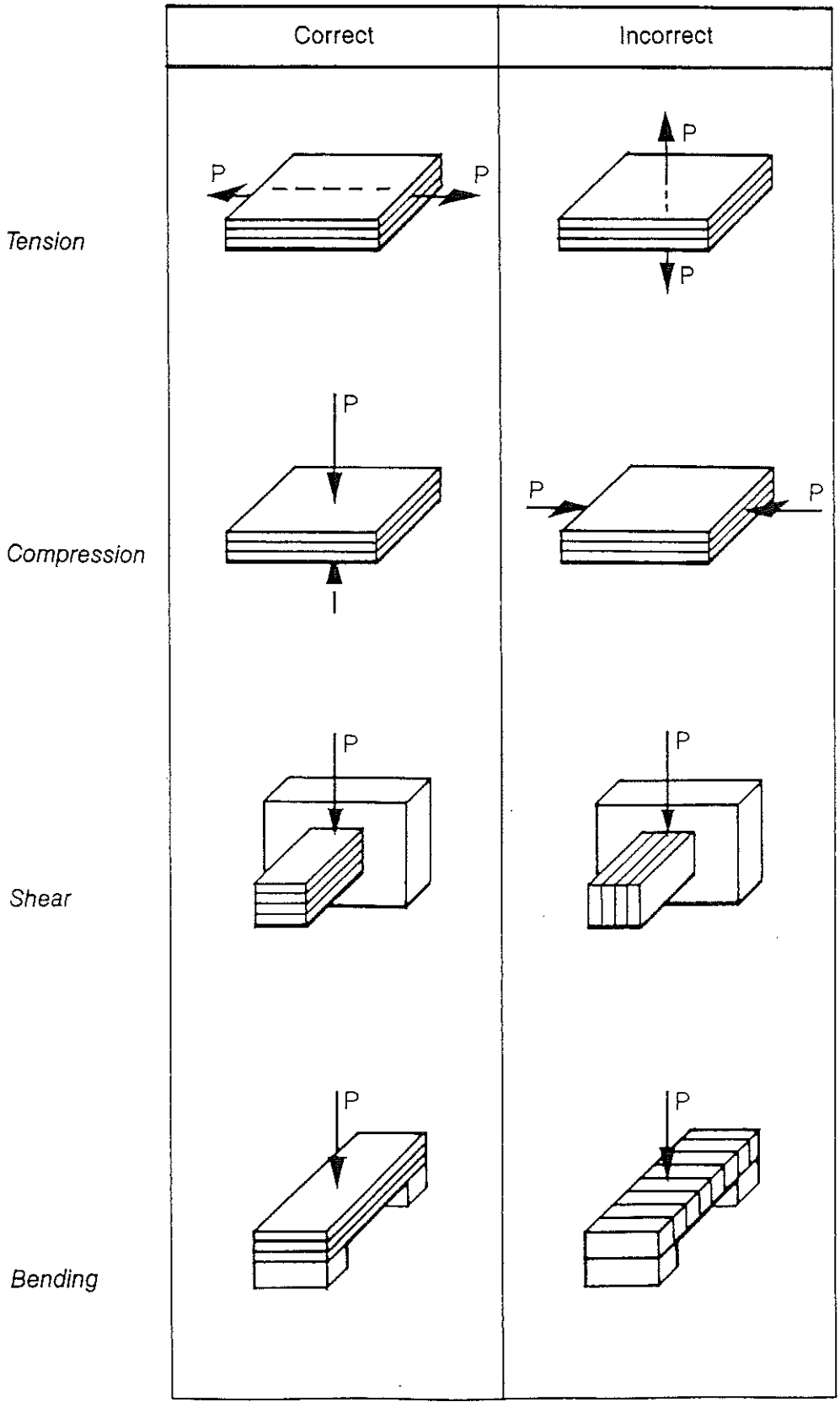
Design for correct direction of loading

Note the direction of laminations in the following diagrams.



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Recommended machining methods — General information

Standard metal and woodworking machines with an appropriate revision of speeds and feeds can be used when fabricating industrial grade laminates.
When sawing, drilling and tapping blind holes, keep tools free from swarf as clogged tools will spoil the quality of the work.
If machining in quantity, it is advisable to install an efficient dust extraction plant. Formica also recommends cemented carbide tipped tools and cutters for quantity work.
It is a good idea to reserve tools specifically for machining laminates. This has two important benefits.
It enables users to take advantage of the most suitable degrees of set for each operation.
It ensures that the electrical insulation properties of the laminate are not impaired. (If tools are used for both metal and laminate work, metal particles can transfer and embed in the laminate and impair its electrical insulation properties.)
Because laminated plastics are poor conductors of heat, it is important when fabricating to cut down the amount of heat generated, or to provide for its removal to protect both product and tools.

Broaching

Broach irregular holes or keyways on a broaching machine or a press. Support material at rear by backing plate to avoid chipping or delaminating the reverse side.

Cutting by guillotine

Shear industrial laminates on power operated guillotines.
The clearance between the blades of the machine should be ground with a 5° angle of rake. Fabric based grades can be sheared cold up to 3.2mm *(1/8in)* thick. Paper grades can be sheared cold up to 1.2mm *(0.04in)* thick but normally require heating. Warm laminate to the correct temperature (normally 40°C) as quickly as possible, taking care not to scorch the material.

Sawing (circular saw)

For best results saw industrial laminates at a peripheral speed or surface speed of 43 to 48 m/s *(131 to 146ft/sec)*.
Formica recommends standard saw-bench machines with a moving table and rise-and-fall saw spindle. The bench must be steady with sufficient power on the spindle to prevent binding the saw.
Surplus rather than adequate power is an advantage.
Take care that the spindle is true to prevent a poor cut.
Look after the bearings as a shake will give an inferior finish.
Saw blades constructed of high speed steel are NOT recommended for cutting laminates, as misuse may cause a saw to fracture or burst.
For small quantities, use hollow ground alloy steel saws 350mm diameter × 3.2mm thick *(14in × 1/8in)* with 5-6 teeth per 25mm *(1in)* and on thin material up to 1.6mm *(1/16in)* thick 9-10 teeth per 25mm *(1in)*.
For production runs, carbide-tipped saws are recommended — 300mm diameter *(12in)* saw with 96 teeth.

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Frequent mechanical sharpening of saw gives better results as this maintains the form of tooth and guarantees the concentricity with the bore.
For cutting Formica glass based laminates you need special abrasive saws and proper equipment to control and remove dust.

Bandsawing

If finish is not important and irregular profiles are required, or when subsequent machining will be carried out bandsaws are effective. The bandsaw recommended should run at a speed of 27 to 44m/s *(83 to 133ft/sec)*.
The width of the blade depends on the thickness of the material and the radius of the curve. The blade should have approximately 6 to 8 teeth per 25mm *(1in)*.

Drilling

High speed steel drills specially designed for drilling laminated plastics give maximum efficiency. These drills have a high helix angle flute with a cutting angle of 60° and slight flat ground on the cutting edge.
Use carbide tipped drills for long life and maintenance of constant hole size.
Jigs with top and bottom plates clamped together prevent breakaway when drilling through. When drilling and tapping parallel to the laminations, securely clamp the material to prevent splitting. When tapping use a suitable cutting lubricant.

Milling

Use standard machines and cutters to mill industrial laminates. Cemented carbide tipped cutters are well worth the extra cost. High speeds and feeds give the best results.
Single or double bladed fly cutters can be used. A backing plate helps prevent breakout of the laminate during machining.

Punching

Punching industrial laminates is similar to punching metal.
As the laminates contract fractionally after punching, the punches for piercings should be approximately 0.05mm to 0.07mm *(0.002in to 0.003in)* above the maximum dimension of the hole required, and the die aperture for producing the blanks, minus 0.07mm *(minus 0.003in)* under the required drawing size.
Flat punches are simplest and most suitable. Allow a minimum clearance between punch and die of 0.07mm *(0.003in)*.
The die should have a taper clearance of 10° inclusive to within 1.6mm *($^1/_{16}$in)* from the top.
Allow a minimum clearance between punch and stripper to avoid edgelift in stripping. For better results on complicated blanks Formica recommends compression strippers.
Each progression should be piloted. When accuracy is required between punched holes and blank edge side cutting stops or trigger stops are adequate.
Avoid prolonged heating prior to punching. Infra-red elements will heat the laminate satisfactorily.

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Reaming

For best results use an expansion reamer in a floating holder which centres itself in the work.
When the job warrants the expense, tungsten carbide tip reamers are worthwhile.
Reaming at speeds similar to those for reaming steel is most effective.

Routing

For irregular profiles and shapes use a power operated router and rise-and-fall head and moving table. The spindle speed should be 18,000-22,000 r.p.m. Jigs and fixtures are similar to those used in wood.
Use cemented carbide cutters. Take care that the material is fed against the rotation of the cutter so that it is not dragged in, causing damage to the cutter and to the work.
Standard speeds are satisfactory. Take cuts approximately 3mm *(1/8in)* deep when cutting into the material with the full diameter of the cutter.

Spindle moulding

Use standard wood working spindle machines. The top speed of the spindle moulder is the best speed at which to cut the material. It is essential that cemented carbide tools are used to maintain a productive run without re-grinding and to give a good finish. Use English head or French head depending on the type of spindling. Take care that all cutting edges are doing equal work when more than one blade is being used.
Check that bearings are good and without shake to prevent chattered finish.

Tapping

Tap by hand or with the usual machine tapping attachments.
Taps should have 3 or 4 flutes and must be kept sharp.
Holes should be slightly larger than for tapping metal to leave approximately 80% of full depth of thread.

Trepanning

Use drilling machines with standard width trepanning cutters.
For large holes it is advisable to drill a pilot hole and then open out with a trepanning fly cutter or counterbore. This must be done from both sides.
The speed of the cutter is dependent on the size of the holes to be drilled. For small diameters, normal fast drilling speeds can be used. Use slower speeds for larger holes.

Turning

Turning Formica industrial laminates is similar to turning wood, but the highest possible speeds should be used.
Cutting tools should be sharp. Carbide tipped cutters are recommended.