– Satisloh GmbH –

The Right Mix for a Finishing Lab

Thomas W. Pfleging, Product Management
06.04.2016

Version; V4

The aim of this document is to show the right combination of various edging technologies based on job mix to give a lab a competitive advantage. Any given information is not binding, can and will be changed without further notice. If you have further questions contact the owner of the document: thomas.pfleging@satisloh.com.

Table of contents

1. WET EDGING (GRINDING)............ - 4 -

1.1 Key features............ - 5 -

2. DRY EDGING (MILLING)............ - 6 -

2.1 Key features............ - 7 -

3. THE RIGHT MIX............ - 8 -

3.1 Cost Analysis............ - 8 -

3.2 Edger Mix............ - 9 -

3.3 Redundancy............ - 9 -

3.4 Automated Versus Manual Edgers............ - 10 -

3.5 Blockless Edgers............ - 10 -

INTRODUCTION

Edging, or finishing, has undergone tremendous changes over the last decade. Two major events lead to these changes:

- The introduction of CNC technology in the mid 80's
- The introduction of milling technology commonly referred to as dry-cut.

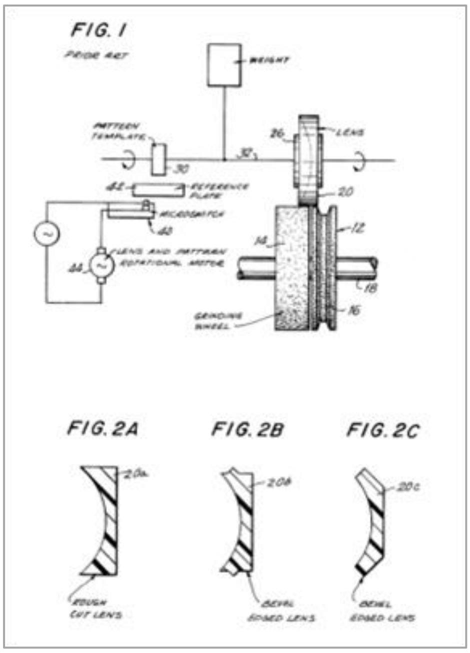
Shifts in lens product demand, primarily the switch from mineral lenses to organic lenses with coatings, helped fuel these changes.

Labs around the world started offering edging services to expand and grow their businesses. At first this was done by using labor-intensive tabletop set ups.

Industrial type edging equipment became available at the beginning of the 21st century and changed the industry again. 4-axes or 5-axes edgers enabled labs to expand their product range covering new frame designs, especially sports goggles.

The result: faster customer service, and better, more consistent quality lenses.

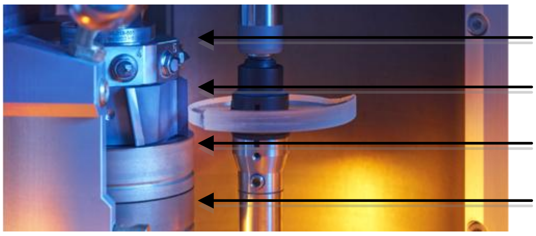
1. Wet edging (Grinding)



Edging began with ceramic wheels, then moved to diamond wheels. The principal edging technology is based on grinding, which generates heat on the lens surface. Because of this, water or a coolant is used to keep the wheels and work piece cool.

Grinding (edging) wheels typically have a diameter between 60 mm and 150 mm. The smaller the diameter, the better the bevel control.

Tools are mounted on a spindle, consisting of a roughing wheel, finishing wheel and polishing wheel. Depending on the edger's design, it could also be a combination of millers for roughing plus bits for special applications such as grooving or safety beveling.



Grooving /safety bevel bits

Roughing blades

Wheel geometry usually consists of a flat bevel area and a V-bevel area.

V-bevels have an angle between 110° and 120°. This angle corresponds to the typical frame geometry.

The edging process consists of both a roughing cycle and a finishing cycle. The roughing cycle edges the lens down to the final shape leaving enough material, approximately 2 mm to 3 mm, for the finishing wheel to apply the required bevel type.

In the manufacturing process of finishing wheels, a thin layer of diamond particles is bonded onto a steel or metal body. In the finishing cycle, these diamond particles chip away the edge surface of the lens and take down the remaining material to the final lens size while creating a smooth bevel.

Additional features such as drill holes, grooves or polish can now be applied.

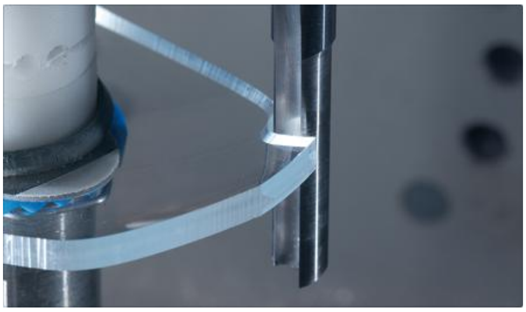
1.1 Key features

Wet edging uses diamond wheels, which give a brilliant edge finish. This is especially the case if the lens is also polished with a smooth polishing wheel that only removes a minimum amount of lens material. The larger surface area of the wheels reduces vibration for better control of the bevel surface.

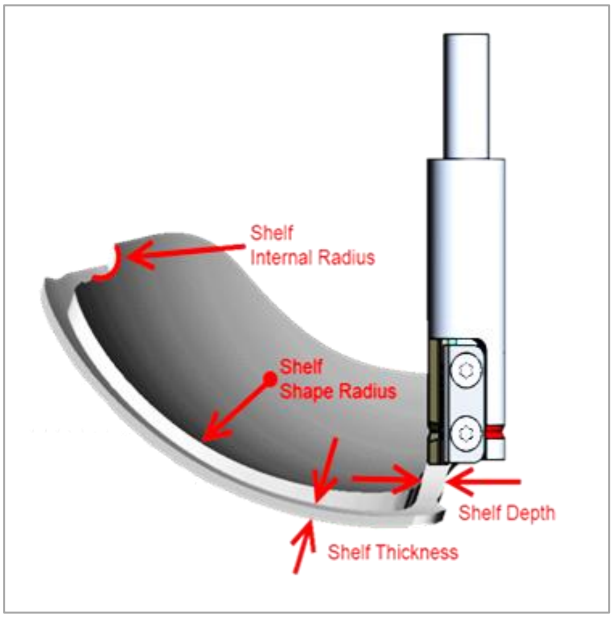
Life of the diamond wheels is another key advantage. Due to the wheels' long life, the cost per lens with wet edging technology is much lower than with other technologies.

2. Dry Edging (Milling)

The dry edging process uses millers instead of diamond wheels. Milling is a machining process that uses rotary cutters to remove material from a work piece advancing (or feeding) in a direction at an angle with the axis of the tool.



Dry-cut edgers are frequently 4 or 5 axes machines. Due to multiple axes, in conjunction with small tool diameters, dry cutting enables labs to cut shapes and special features (i.e. small radii, step bevel, etc.) formerly not possible to process with conventional edgers.



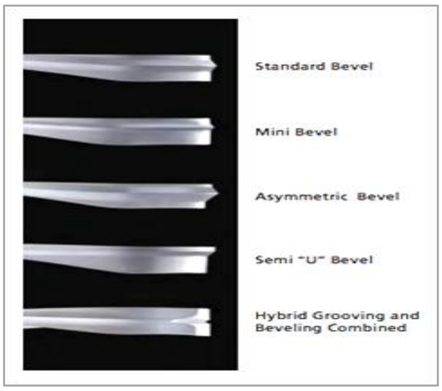
2.1 Key features

Dry cutting allows multiple tools to be installed in a machine for maximum flexibility and features. These tools are stored on board and typically changed automatically during the processing of a lens, e.g. a process may start by using a milling tool, then switch to a finishing tool and finally to a drill.

On-board tool storage options:

Magazines

Carousels or Turrets

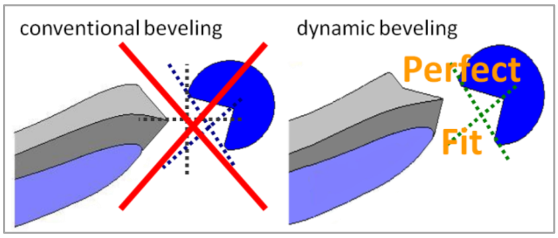


Tools are configured and exchanged based on specific features, i.e.: mini bevel, small radii, t-bevel, etc.

Dry-cut machines can easily be adapted to process new features or lens materials. Shapes and materials that formerly could not be processed now can be with relative ease. Only minor modifications need to be made to the set up.

Some benefits of 4 and 5-axes edgers:

- Dynamic beveling for perfect fit of the lenses
- Sectional inclination of bevels based on frame geometry
- Multiple edging features such as grooving, beveling and/or drilling



Debris removal requires either a built-in or central vacuum system.

3. The Right Mix

Changes in lens materials, shifts in trends, and new frame designs create challenges as well as opportunities for a lab.

The right mix of edgers is key to address these challenges. Specialty frames/shapes, typically used with sports goggles, require step bevels, mini bevels, inclined bevels and special drill features and account for approximately 15% of all frames fitted with RX lenses.

However, the majority of edging jobs still consists of either standard V-bevels or flat bevels with groove or drill features. The key to processing these frame types is consistent and reproducible quality with minimum maintenance and low tool costs. Conventional (wet technology) industrial edgers are best suited for operations producing primarily standard V-bevels or flat bevels.

Dry-cut edgers are needed once special features, as stated above, are introduced to the product mix.

3.1 Cost Analysis

The following charts show the cost differences between wet-cut and dry-cut edging. Numbers are based on average tool life and cost.

Lenses per day	400	**Lenses per year**	100.000
Working days (year)	250		

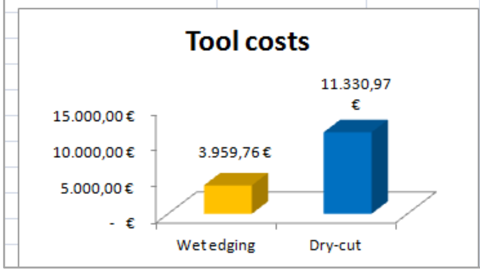
Job Types

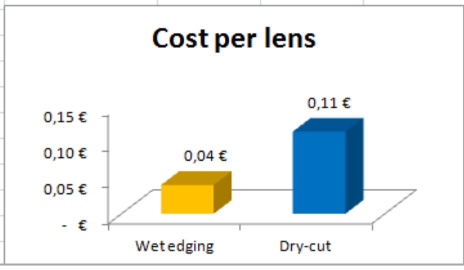
Full rim	Drill mounts	Groove
60%	20%	20%
Full rim		60.000
Drill mounts		20.000
Groove / Nylor		20.000
	Total	100.000

Material Mix %

	CR	HI	Poly	Trivex
	45%	20%	30%	5%
Full rim	27000	12000	18000	3000
Drill mounts	9000	4000	6000	1000
Groove / Nylor	9000	4000	6000	1000

	Wet edging	Dry-cut
Tool costs per year	3.959,76 €	11.330,97 €
Cost per lens	0,04 €	0,11 €

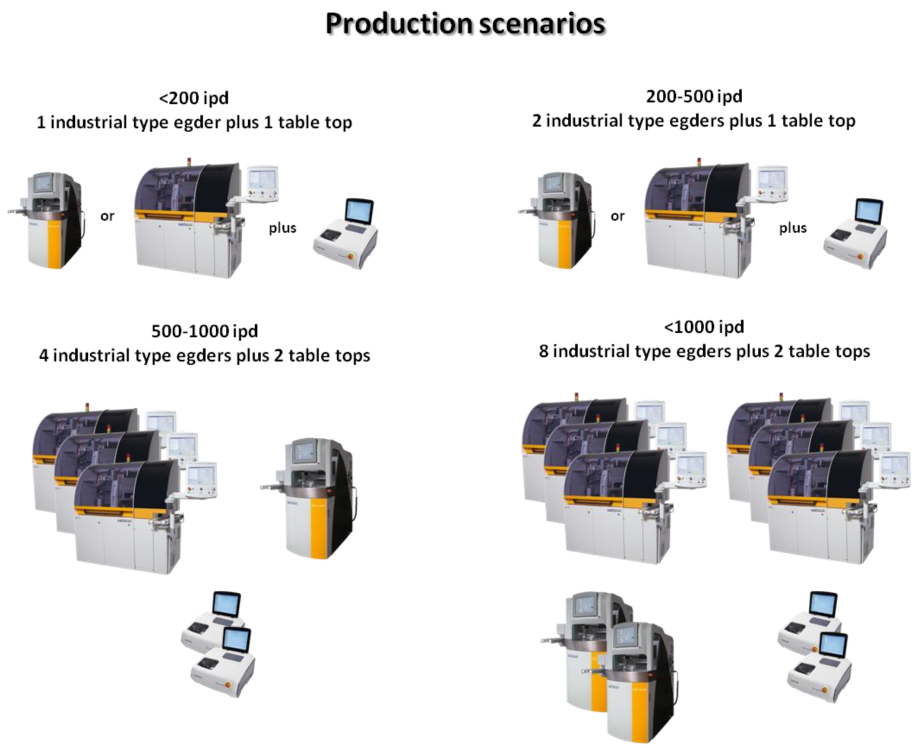




3.2 Edger Mix

Cost of operating edgers is only one of the deciding factors. Depending on product mix and quality requirements, a combination of various edger types is recommended.

Following is a set up based on number of jobs.



To run an efficient lab accounting for today's and tomorrow's requirements, an LMS (Lab Management System) is a key factor. Separating work based on material or job type is a must.

The mix of edgers is influenced by overall volume as well as the number of specialty jobs, such as lenses for sports goggles. A higher number of specialty jobs require adding more dry edgers that are capable of processing this work, like Satisloh's ES-curve.

3.3 Redundancy

Planning for redundancy is another key factor. As a rule of thumb, the average load factor of all edgers should be approximately 80% of their capacity. This allows labs to deal with peaks without running into a backlog and delivery delays. Machine service and maintenance can be performed without jeopardizing on-time delivery.
Tabletop edgers are still a valuable and cost effective addition for back-up and redundancy.

Once a lab reaches consistently 75% to 80% of their edging production capacity, adding edgers should be considered.

3.4 Automated Versus Manual Edgers

The decision whether to use automated or manual equipment depends on various factors:

- Labor cost
- Job complexity
- Customized jobs (special design offerings)
- Cost of automation
- Volume of jobs

Automation is preferred in labs with a high degree of standardized jobs because it ensures consistent and repeatable quality. Depending on the level of customized work, manual edgers might be a valuable addition.

3.5 Blockless Edgers

Blockless edging is the latest innovation in edging. It is available for both dry and wet cutting edgers.

Blockless edging improves production flow, quality and efficiency. It eliminates the need for blockers and consumables.

For details on blockless edging refer to the white paper "Blockless Edging Technology" available on www.satisloh.com/ophthalmic/whitepapers

CONCLUSION:

The right mix of edgers depends on what services and products a lab wants to offer.

Key decision factors are:

- Throughput
- Lens product mix
- Operator involvement
- First fit rate / reproducible quality
- Environmental requirements / waste management
- Flexibility considering new materials and coatings
- Percentage of specialty shapes
- Cost per lens

The right mix of edgers provides maximum performance, throughput, and machine utilization combined with reproducible, consistent quality, and lowest cost per lens.