

OPTOFORM[®] 80

ENGINEERING SPECIFICATIONS



Overview and Description

The OPTOFORM[®] 80 is an ultra-precision, two axis, continuous path CNC contouring and edging lathe for the direct machining of:

- (a) All non-ferrous metal molds (inserts);
- (b) Contact Lenses (spherical, aspheric and toric);
- (c) Intra-Ocular Lenses (spherical, aspheric and toric)

When equipped with the optional Fast Tool Servo attachments (such as the FTS-1000, VARIMAX or VARIFORM[®]) it produces a wide range of complex non-rotationally symmetrical parts in both polymers and non-ferrous metals.

In addition, user-defined edge configurations can be specified, and incorporated into the lens / mold design, and directly machined.

Continuous path CNC machining can generate axisymmetrical shapes, which can be mathematically defined as a surface of revolution. Machined surfaces can range from flats, to spheres, and aspherics with up to 14th order polynomial departures or any combination of these.

A 10,000 RPM air bearing spindle (water-cooled) with 5 second acceleration / deceleration cycle time, when combined with oil hydrostatic X and Z slides capable of 3000mm / minute traverse rates, allows for consistent high speed production of work pieces, up to 25 mm (1 inch) in diameter.

The machine is built on a natural granite base and supported with a steel frame. The granite base is isolated from the frame with a passive three-point pneumatic vibration isolation system designed to attenuate environmental disturbances. In addition, the granite base provides excellent thermal stability and vibration dampening.

The slides are mounted to the natural granite base and are positioned in a "T" configuration. The X-axis slide represents the cross arm of the T, and carries up to six tools simultaneously as well as the front surface probe, to allow for roughing, finishing and edging in one set-up. The Z-axis slide represents the stem of the T, and carries the high-speed air-bearing spindle. The work-piece is mounted in an air actuated collet mechanism within the air-bearing spindle.

The fully constrained hydrostatic oil bearing slide-ways use linear brushless AC servomotors. Slide position feedback is obtained from ultra-precision linear scales, which operate at a resolution of 8.6 nanometers. The X-axis slide-way provides 193mm (7.6") of travel and the Z-axis slide-way provides 102mm (4"). The hydrostatic slide-way provides extremely smooth friction-free motion, with precise geometrical accuracies, high stiffness, and excellent dampening characteristics.

A variety of (optional) Fast Tool Servo attachments can be quickly and easily connected in minutes for the machining of non-axisymmetrical surfaces (see FTS-1000, VARIMAX and VARIFORM attachments)

ACCEPTANCE TESTING

On a 7.5mm concave radius, 10mm diameter PMMA blank, the following results are guaranteed:

Radius accuracy	+/- .005 mm
Surface roughness	11nm / 16 cutoffs Rq
Surface roughness	8nm / 5 cutoffs Rq
Delq	0.03 degrees
Figure	0.25mm short part
Figure	0.50mm long part

Center Pip

0.002 mm

MACHINE FRAME AND BASE

The fabricated steel frame has the electrical cabinet incorporated into the frame, 115 VAC electrical outlets are conveniently located at the rear of the machine for use with support equipment. The pneumatic panel is located under the granite on the side of the machine.

The machine is constructed on a laboratory grade natural granite base. The base is 560mm x 1016mm x 150mm (22" x 40" x 6"), and utilizes a three point kinematic mount.

The granite base and its frame are supported through the use of a passive pneumatic vibration isolation system. (An option exists to add an automatic, self-adjusting leveling system which maintains pressures in the pneumatic isolation system, rather than leaving this task to scheduled maintenance.)

Leveling-type feet under the machine base with casters (wheels) are standard for easy movement of machine. The machine height is designed to permit standard pneumatic pallet-jack access under machine.

The hydrostatic power unit and the spindle chiller are accessed through an opening at the rear of the machine.

MACHINE SLIDES

Fully preloaded, dovetail type, hydrostatic oil bearing slide-ways are utilized on both axes. This slide design provides a high degree of stiffness, friction-free motion, and precise geometrical accuracies.

The Z-axis (work spindle) and X-axis (tool) slide carriages are 300mm x 300mm (12" x 12").

Slides are constructed in a "T" configuration allowing for convenient part loading and unloading, and have the ability to machine work-pieces from either side of center.

Position feedback is provided by ultra-fine pitch glass scales, which are mounted to the slide's carriage. Feedback resolution is 8.6 nm.

Total X-axis slide travel of 193mm (7.6"). Total Z-axis slide travel of 102mm (4").

Slides are driven through the use of, non-contacting, linear AC servomotors integrally mounted to the slide table and rail. All electrical connections are made through a multi-pin connector.

Slide speed is programmable up to 3000 mm / min (120 IPM).

The Z-axis slide-way is fully protected by collapsible rubber way covers underneath solid covers. The X-axis slide-way is protected by solid covers.

Horizontal straightness:

X-axis: 0.50 mm / 150mm

Z-axis: 0.50 mm / 100mm

X to Z-axis horizontal squareness:

5.0 arc seconds (24 mm / 1")

X and Z-axis horizontal stiffness:

750,000 lbs. / inch

X and Z-axis vertical stiffness:

1,100,000 lbs. / inch

SPINDLE

The OPTOFORM 80 is equipped with a high-speed air-bearing spindle with an integral; liquid cooled AC Drive Motor. Spindle rotation is variable up to 10,000 RPM with acceleration and deceleration times of less than 5 seconds. The spindle design accommodates air-actuated collets (spring close) for holding the lens button or block (arbor) during the machining cycle. The spindle horizontal alignment is 30 arc seconds and vertical alignment is 5 arc seconds.

Optional collets can be supplied with various bore diameters in standard or fixed-stop configurations.

CONTROL SYSTEM

The OPTOFORM 80 is equipped with a PC based computer system and a state-of-the-art motion controller specifically designed for ultra-precision ophthalmic applications.

The system software monitors and controls all machine functions and provides a user friendly, flexible, production-oriented interface for both the machine set-up technician and the operator. A color assisted Run Cycle screen and continually updated Production and Maintenance files ensure that critical process management information is instantly available. Initial set-up is greatly simplified by the use of appropriate Set-Up and Tool Change screens. Viewing a color-coded I/O Status screen can also check basic machine diagnostics.

The lathe has Digital Signal Processor (DSP) based machine control with a high speed DOS compatible computer for the operator interface.

The operator panel includes a fully sealed flat panel color display with touch screen. A keyboard is included as standard. It is detachable as it is not required since all functions can be controlled via touch-screen. There are industrial quality switches for critical

operator functions.

There is complete opto-isolation of signals between computer and machine. All electronics are protected by an isolation power transformer and by a noise suppressor. Many hardware and software safety features are built-in, to protect both the operator and the machine.

A built-in hard disk drive provides part program storage, and there is a 3.5" floppy disk drive for program storage and transfer. High capacity storage drive is optional.

An external connector panel provides a serial communications port, parallel printer port, and there is an Ethernet port for networking a group of machines to a host computer.

A built-in modem for remote tele-diagnostic functions is available as an option.

DESIGN / MOLD DESIGN SOFTWARE PACKAGES

LENS DESIGN SOFTWARE PACKAGES (see [SOFTWARE section](#) for details.)

A wide range of lens design software packages is available for the OPTOFORM 40 machines. (These packages run on all OPTOFORM machines.)

The package supplied with the machine is suited to the end-user's applications.

These software design packages create either job files (.JFL files which describe data points in 2 or 3 dimensions) or MiniFiles, which use arcs and lines to describe the geometry of the surfaces being lathed.

Examples of these packages include:

[Lens Design Software \(version 3\) "LDS-3"](#) for contact lens design. All aspherics, spheres, multi-curves and edge designs.

[MCG \(Multi Curve Generator\)](#) programming software creates part programs from user specified coordinate points or geometrical data. Commonly used for mold tool design and IOL designs.

[OPTO-CAD](#) converts AutoCad generated designs (.DXF files) into MiniFiles, which the Optoform machines can process. Used mainly by IOL and mold tool producers.

[TURBO-LENS](#) – for spherical, multi-spherical, bifocal contact lenses in both RGP and Soft materials.

[MiniFile Path Editor \(MPE\)](#) software for programming non-rotationally symmetrical surfaces.

[GP Power Suite](#) covers all spherical, aspheric designs, toric designs, slab-off and edges.

[SOFT Power Suite](#) is a very powerful software tool for the design of soft contact lenses of all kinds, including non-rotationally symmetrical designs.

[MiniGen](#) compatible. MinGen software directly connects the laboratory's Order-Entry system to the Optoform machines on the laboratory production floor

Focal Points modules for IOL, soft and RGP contact lens design.

IOL Generic: an Excel sheet based generic program suitable for many IOL designs.

PNEUMATIC AND HYDRAULIC CONTROLS

The lathe has built-in coarse and fine air filters and a precision air regulator with external gage for the spindle air supply.

It has a built-in hydraulic supply system with reservoir, filters, and gages to monitor output pressure, intake vacuum, and oil level.

There is an operator warning for hydraulic pressure fault and automatic shut down for low hydraulic pressure and low oil level

There is automatic shut down for extremely low air pressure.

The built-in regulators and gages for pneumatic accessories are easily accessible.

HOME REPEATABILITY (X & Z Axes)

0.25 microns / or 10 micro inches over 5 runs.

UTILITIES REQUIRED

10.1 Electrical Power: 230 Volts

50/60 Hertz

Single Phase

2.1 KVA

10.2 Compressed Air: 7 bar (100 PSI)

3 liters / sec. (6 SCFM)

Filtered to 0.3 micron solid particle size; and

Dry to 50 degrees F pressure dew point.

SIZE AND WEIGHT

Machine size: 1295mm wide x 1041mm deep x 1600mm high (51" x 41" x 63").
The machine can be easily converted to fit through 36" doorway.

Machine weight: 975 Kg (2150 lbs.)

OPTIONS AND ACCESSORIES FOR OPTOFORM 80

Tooling Package (included as standard)

The machine will accept up to three separate dual tool holders (each accommodating two tools), and each holder facilitates fine height adjustment of the diamond tools. Tools for back and front surface generation can be simultaneously installed so that convex-to-concave switching can be done via a simple keyboard stroke. These three dual tool holders accommodate the roughing diamonds, the finish diamonds, and an edging diamond tool. First, the roughing diamond removes the bulk of the material from the lens blank. The finish diamond then follows, taking the final cut on the lens surface. After completing the generation of the optical surface, the edging tool machines the desired edge configuration, blocking diameter, and any required reference face prior to the work-piece being removed from the machine.

Front Surface Probe (included as standard)

The probe is mounted in a fixture on the X-axis table. This probe is used automatically to establish the relative Z-axis position of the lens prior to machining, thereby assuring precise and repeatable center thickness from piece to piece.

Options

- LVDT Tool Set Station (highly recommended – see details below)
- Calibration Artifacts – (mounted to X-slide for tool setting references – see details below)
- VariForm™ or VariMax or FTS-1000 or FTS-500 (Fast Tool Servo Systems – see [Fast Tool Servo](#) pages)
- Diamond Tooling (special tooling available – see [Diamond Tools](#))
- Height gage (Mechanical Height Indicator (recommended for tool setting). Mounts into dual tool holder and is readily transferred to other tool holders on the gang tooling system)
- Foot switch operated collet release
- Note: Water-cooled spindle and chiller option is standard on the Optoform 80
- Auto-loader (load and unload: see [Auto Loader](#))
- Toric Marking Attachment (marks axis automatically for toric manufacturing: See [Toric Marker](#))
- Safety enclosures
- CNC Controlled Spray Misting Attachment (prolongs diamond life, improves surface finish. Recommended for mold production and 'no-polish' GP lenses).

- Auto Leveling System for maintaining required pressure in pneumatic isolation system
- On Machine Milling Attachment, fully programmable. Suitable for milling IOL haptics
- On machine Freezing Device for cryogenic lathing
- Refrigerant Air Dryer & Air Tank
High Capacity Storage Drive – not required if machine is networked.
- Recommended spare parts package
- Annually renewable Maintenance Contract (preventative maintenance and complete inspection. See [Service](#) for service schedules.)
- Advanced Maintenance Training program and documentation (see [Training](#) section)

Tool Set Station (not included as standard since one Tool Set Station can be used on multiple OPTOFORMS)

A spindle mounted L.V.D.T. Tool Set Station is available as an option. It kinematically mounts to the face of the spindle and is completely interchangeable from machine to machine. Therefore, only one Tool Set Station is needed to service any number of machines.

Calibration Artifacts are available as an option, and can be used quickly and easily to qualify the Tool Set Station each time it is placed on the machine. This insures consistent repeatability from one set-up to the next. (These artifacts are installed on the gang tooling system beyond the 3 dual tool holders.)

Tool setting is accomplished through the use of two air-bearing LVDT probes (linear variable differential transducers) located on the Tool Set Station. A vertical probe is used to establish the height of the tool relative to the spindle centerline; and a horizontal probe is used to automatically establish the X (lateral) centerline position of the tool, and calculate the tool radius.