

CAPABILITIES GUIDE

THIN FILMS AND OPTICS



A Vacuum Science and Technology Company

THE COMPANY

Hind High Vacuum (HHV) is India's premier thin film and vacuum technology company with over 50 years of expertise in the design and manufacture of high vacuum equipment for optical, decorative, functional coatings and astronomical telescope mirrors. HHV also manufactures special purpose vacuum equipment for complex metallurgical applications.

HHV's Thin Films and Optics division is a leading manufacturer of high precision optical components and thin film coatings. It's manufacturing unit includes facilities for optical polishing, high end metrology, thin film coatings and testing capabilities.

HHV manufactures dichroic coated optics, laser filters, narrow band interference filters, hybrid micro circuits, periscope prisms, thin film heaters and infrared optics for variety of applications in industrial, space and defence technologies.

WHY HHV

HHV has multiple manufacturing facilities in Bengaluru, India. These manufacturing facilities are equipped with ISO 7, ISO 8 clean rooms to manufacture and coat high precision optical components.

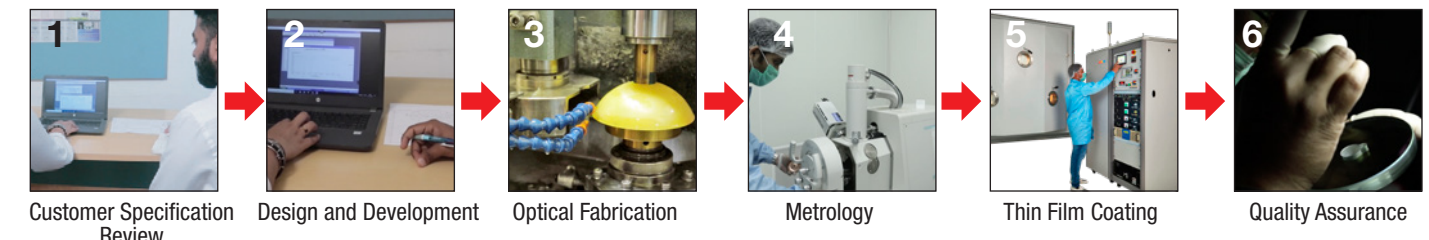
HHV produces over 100,000 optical components every year for domestic and international markets. With sales offices in the United Kingdom and global distributor presence HHV exports its products to the USA, UK, Germany, Italy, Turkey, Switzerland, South Korea, Singapore and China.

HHV maintains close collaborative links with premier research institutions such as the Indian Institute of Science, the Indian Institutes of Technology, National University of Singapore, Northwestern University and the University of Oxford. HHV has extensive working experience with India's premier defence & space institutions such as ADA, BEL, RCI, DRDL, BARC, and ISRO.

HHV is an ISO 9001:2015, ISO 14001:2015 and OSHAS 18001:2007 certified company.

HHV awarded a 'Certification of Qualification' by the Indian Space Application Center, ISRO for its Thin Film Metalized substrates, and also received the prestigious National R&D award for the same.

DESIGN TO PRODUCTION



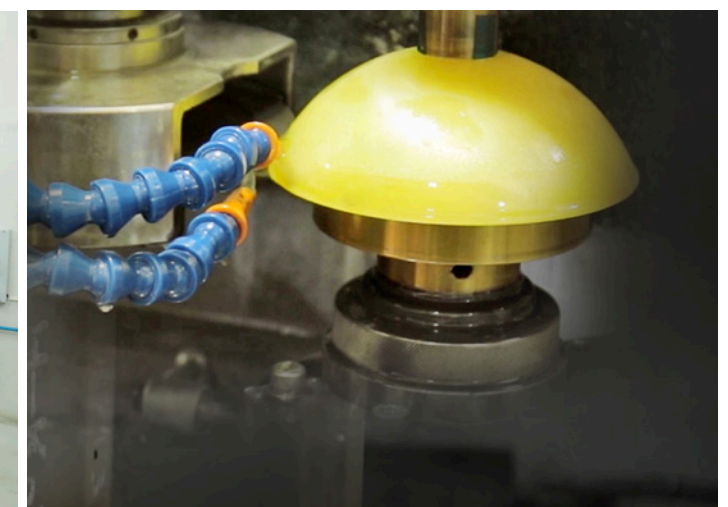
RESEARCH AND DEVELOPMENT

HHV's Research and Development team consists of scientists and engineers who are uniquely qualified to provide a variety of application integration services to customers. Our R&D team is equipped to develop products through our extensive design and manufacturing resources to create products that meet customer needs. We utilize several software programs including Essential Macleod, TF-Calc and CODE for design, optimization and sensitivity analysis of thin film coatings.

OPTICS FABRICATION

HHV's precision Optics Fabrication Lab is equipped with state-of-the-art technology and machinery to fabricate high precision optical components in the visible and infrared spectrum. We have expertise in delivering complex optical component requirements for space and defence applications using high precision machines.

Processes	Specifications
Curve generation	To generate radius of curvatures up to 200 mm diameter
Single side Polishing with Optical Contact	For polishing of optical components up to 300 mm diameter with flatness up to $\lambda/10$
Double side Lapping Machines	For lapping of optical components up to 180 mm diameter and up to 1 mm thickness with parallelism of 10 arc seconds
Double side Polishing Machines	For polishing of optical components up to 180 mm diameter and up to 0.5 mm thickness with parallelism of 10 arc seconds
Centring and Edging for Spherical and Optics	Centering of lenses within 2-micron accuracy and OD turning up to 200 mm diameter using a diamond wheel
Aspheric Generation	High precision SPDT systems to generate aspheric upto 250 mm in diameter diffractive capability of 25 ± 4 microns



OPTICS MATERIAL AND PRECISION

HHV has extensive knowledge on handling materials such as Quartz, Fused Silica, Zerodur, BK7, Crown and Flint Glasses for the UV-Visible Spectrum and Silicon, Germanium, Zinc Sulphide for the Infra-Red spectrum.

Specifications	Plano Windows	Prisms & Wedges	Spherical Lenses	Domes	Aspherics
Flatness	Upto $\lambda/10$	Upto $\lambda/4$	Upto $\lambda/6$	Upto $\lambda/6$	Upto $\lambda/4$
Surface Quality (S/D)	10-5	40-20	40-20	60-40	40-20
Parallelism	<10 arc sec	-	<30 arc sec	1 arc min	<30 arc sec
Maximum size	Ø300mm	300mm	Ø200mm	Ø 200mm	Ø 250mm
Minimum size	Ø 5mm	10mm	Ø10mm	-	Ø 5mm
Minimum Thickness	0.5 mm	-	1mm	3mm	0.5 mm
Centering	-	-	1 arc min	-	-
Radius Tolerance	-	± 0.1mm	± 0.05mm	± 0.05mm	± 0.02mm

OPTICS METROLOGY

1. ZYGO Interferometer with transmission spheres to measure surface figures up to 1/10th lambda
2. Trioptics Spherometer to measure the radius of curvature of various components to an accuracy of one micron
3. Davidson Autocollimator to measure the surface angles and parallelism to an accuracy of less than one arc second
4. Talysurf PGI Freeform allows for high resolution measurement of high precision freeform optics with measurement accuracy from 100 nm (PV), and resolution down to 0.8 nm.



To learn more visit www.hhv.in

OPTICAL COATINGS

HHV's Thin Films production facility has over twenty five systems with accessories and processes that are clean room compliant. HHV can handle substrate sizes of upto 600 mm for thermal evaporation and 1000 mm for sputtering deposition processes.

COATING TECHNOLOGY

1. Magnetron Sputtering systems
2. Ion-Assisted E-Beam Deposition systems
3. Resistance Evaporation systems
4. Plasma Enhanced Chemical Vapour Deposition systems
5. Atomic Layer Deposition systems



Coating	Substrate Material	Spectral Range	Spectral Performance	Substrate Size
UV Coatings	Borosilicate Glass, Quartz	220 - 400 nm	Reflection $\geq$ 92%	Upto 1200 mm
		400 - 700 nm	Reflection $\leq$ 10%	
		700 - 1100 nm	Reflection $\leq$ 10%	
	Stainless Steel, Aluminium	220 - 400 nm	Reflection $\geq$ 85%	
		400 - 700 nm	Reflection $\leq$ 20%	
UV Transmitter Coatings	Quartz	700 - 1100 nm	Reflection $\leq$ 30%	Upto 600 mm
		220 - 400 nm	Transmission $\geq$ 84%	
		580 nm	Transmission $\leq$ 45%	
AR Coatings	BK7, UVFS, Quartz	600 - 2500 nm	Transmission $\leq$ 85%	
Filter Coatings	BK7, Borofloat, UV Fused Silica, Quartz	400 - 700nm, 1064nm	Reflection $\leq$ 1%	Upto 600 mm
Laser Safety Coatings	BK7, Borofloat, UV Fused Silica, Quartz	400 - 700 nm	Transmission $\geq$ 70%	Upto 25 mm
High Reflector Coatings	Borofloat KG5	400 - 1200 nm	OD $\geq$ 7 VLT $\approx$ 30-40%	Upto 200 mm
Infrared Coatings	UV Fused Silica, Quartz, BK7	532nm, 632 nm and 1064 nm	Reflection $\geq$ 99.5%	Upto 50 mm
	Silicon	3600 - 4900 nm	Reflection $\leq$ 1%	Upto 250 mm
	Germanium	3600 - 4900 nm	Reflection $\leq$ 1%	Upto 250 mm
	ZnS	8000 - 12000 nm	Reflection $\leq$ 1%	Upto 350 mm
DLC Coatings		3600 - 4900 nm	Transmission $\geq$ 92% Reflection $\leq$ 1%	Upto 350 mm
Silver Coatings	Silicon, Germanium	3600 - 4900 nm	Transmission $\geq$ 93%	Upto 250 mm
ITO Coatings	Borofloat	400 - 700 nm	Reflection $\geq$ 94%	Upto 600 mm
Black Absorber Coatings	Borofloat, Stainless Steel	400 - 800 nm	Transmission $\geq$ 82%	Upto 1000 mm
		400 - 850 nm	Reflection $\leq$ 1 %	Upto 200 mm

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HYBRID MICRO CIRCUITS

HHV’s Hybrid Micro Circuit (HMC) Lab is approved by the Indian Space Research Organisation for the production of Flight Mode components. HHV develops and produces metallized and patterned alumina substrates for space and defence applications. The HMC Lab produces multi-layer metallization using Chromium, Copper, Gold, Nickel, TiW, Pt and NiCr.



HHV is equipped with a laser writer for mask fabrication, UV exposure systems, an etching room with a chemical wet bench, dicing machines to cut metallized substrates to required sizes and high-performance microscopes and profile projectors for inspection and measurement of the plain and patterned substrates. The HMC Lab has ISO 7, ISO 8 clean rooms and ISO 5 laminar flow stations that allow us to achieve resolutions up to 40 microns.

Processes	Specifications
Metallization	Substrate size up to 2” with thickness up to 25 mil
Lithography	Can achieve line resolutions of up to 40 µm
Spin Coating	Maximum substrate size of 6” in diameter
UV Exposure	Line resolution up to 1µm with a maximum substrate size of 3” in diameter
Laser Writing	Line resolution up to 1µm with a maximum substrate size of 4”x4”
Chromium Mask Patterning	Pattern up to 3”x3” in size
Dicing	Minimum substrate size of 0.07” to a maximum substrate size of 6” in diameter

To learn more visit www.hhv.in

COATING METROLOGY

1. Scratch-dig comparator
2. Perkin Elmer Spectrophotometer - wavelength range of 190-3300 nm
3. Fourier Transform Infrared (FTIR) Spectrophotometer - wavelength range of 1.3 µm-30 µm
4. Agilent - Cary 6000 Spectrophotometer - wavelength range 0.175 µm - 1.8 µm can measure upto optical densities OD8
5. SEM (Scanning Electron Microscope) with an EDX module for composition analysis of samples up to 160 mm diameter and resolution of 3 nm
6. Optical microscope in the range of 6 X to 100 X magnification
7. Environmental chamber - temperature range from -40°C to +150°C and humidity from 30% to 95% RH
8. Salt spray chamber to analyze corrosion resistance
9. Stylus Profiler to measure the thickness and roughness of films using a diamond tip of 12.5 micron radius



QUALITY ASSURANCE

HHV performs a wide variety of testing and measurements to ensure products are compliant with all applicable customer specifications, as well as military and aerospace standards. Spectrophotometers and optical measuring instruments are tested, controlled, calibrated and maintained to meet the requirements of our Quality System.

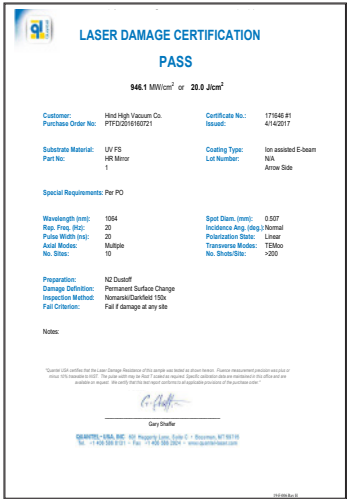
MIL Standards:

MIL-C-48497A, MIL-C-675C, MIL-STD-810E, TS-1888, MIL-STD-810F, MIL-C-675A, MIL-M-13508C

CERTIFICATION

ISO Standards:

ISO 14001:2015, ISO 9001: 2015, BS OHSAS 18001:2007



Laser Damage Certification



Space Qualification for HMC Metallization



Space Qualification for Lithography

To learn more visit www.hhv.in



CONTACT US FOR YOUR THIN FILMS AND OPTICS NEEDS TODAY

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