

# CAPABILITIES GUIDE

## THIN FILMS AND OPTICS



A Vacuum Science and Technology Company

## THE COMPANY

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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. Its 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

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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.

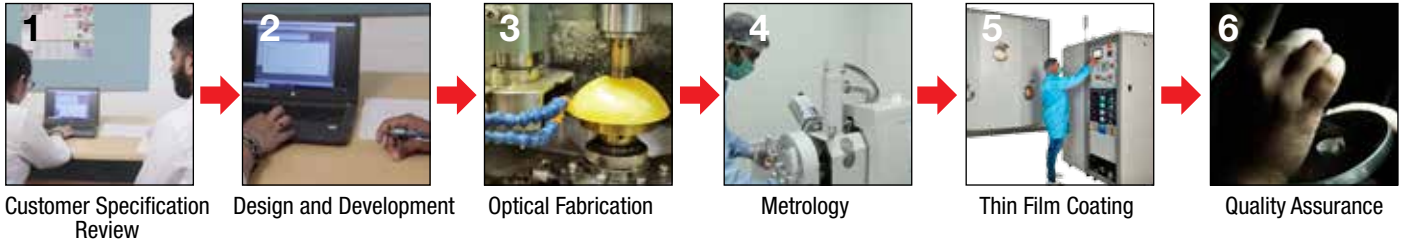
HHV produces over 100,000 optical components every year for domestic and international markets. With sales offices in the United Kingdom and global distributor presence HHV exports its products to the USA, UK, Germany, Italy, Turkey, Switzerland, South Korea, Singapore and China.

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 150 mm diameter
Single side Polishing with Optical Contact	For polishing of optical components up to 250 mm diameter with flatness up to $\lambda/10$
Double side Lapping Machines	For lapping of optical components up to 150 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 150 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 150 mm diameter using a diamond wheel



To learn more visit [www.hhv.in](http://www.hhv.in)

# 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
Flatness	Upto $\lambda/10$	Upto $\lambda/4$	Upto $\lambda/6$	Upto $\lambda/6$
Surface Quality (S/D)	10-5	40-20	40-20	60-40
Parallelism	<10 arc sec	-	<30 arc sec	1 arc min
Maximum size	Ø250mm	250mm	Ø150mm	Ø 200mm
Minimum size	Ø 5mm	15mm	Ø15mm	-
Minimum Thickness	0.5 mm	-	1mm	3mm
Centering	-	-	1 arc min	
Radius Tolerance	-	± 0.1mm	± 0.05mm	± 0.05mm

## 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



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# 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	Reflectance $\geq$ 92%	Upto 600 mm
		400 - 700 nm	Reflectance $\leq$ 10%	
		700 - 1100 nm	Reflectance $\leq$ 10%	
	Stainless Steel, Aluminium	220 - 400 nm	Reflectance $\geq$ 85%	
		400 - 700 nm	Reflectance $\leq$ 20%	
UV Transmitter Coatings	Quartz	700 - 1100 nm	Reflectance $\leq$ 30%	
		220 - 400 nm	Transmittance $>84\%$	
		580 nm	Transmittance $<45\%$	
		600 - 2500 nm	Transmittance $\leq 85\%$	
AR Coatings	BK7, UVFS, Quartz	400 - 700nm, 1064nm	Reflection $<1\%$	Upto 600 mm
Filter Coatings	BK7, Borofloat, UV Fused Silica, Quartz	400 - 700 nm	Transmittance $\geq 70\%$	Upto 25 mm
Laser Safety Coatings	Borofloat	400 - 1200 nm	OD $\geq 6$ VLT $\approx 30-40\%$	Upto 150 mm
High Reflector Coatings	UV Fused Silica, Quartz, BK7	532nm, 632 nm	Reflectance $\geq 99.5\%$	Upto 50 mm
		and 1064 nm		
Infrared Coatings	Silicon	3600 - 4900 nm 3600 - 4900 nm	Reflectance $< 1\%$	Upto 150 mm
	Germanium	3600 - 4900 nm	Reflectance $< 1\%$	Upto 150 mm
		8000 - 12000 nm	Reflectance $< 1\%$	
	ZnS	3400 - 4900 nm 3400 - 4900 nm	Transmittance $\geq 92\%$ Reflectance $\leq 1\%$	Upto 200 mm
Silver Coatings	Borofloat	400 - 700 nm	Reflection $\geq 94\%$	Upto 600 mm
ITO Coatings	Borofloat, Polycarbonate, Acrylic	400 - 800 nm	Transmission $\geq 82\%$	Upto 250 mm
Black Absorber Coatings	Borofloat, Stainless Steel	400 - 850 nm	Reflection $<1\%$	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 $\mu\text{m}$
Spin Coating	Maximum substrate size of 6" in diameter
UV Exposure	Line resolution up to 1 $\mu\text{m}$ with a maximum substrate size of 3" in diameter
Laser Writing	Line resolution up to 1 $\mu\text{m}$ 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

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# 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  $\mu\text{m}$ -30  $\mu\text{m}$
4. Agilent - Cary 6000 Spectrophotometer - wavelength range 0.175  $\mu\text{m}$  - 1.8  $\mu\text{m}$  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.

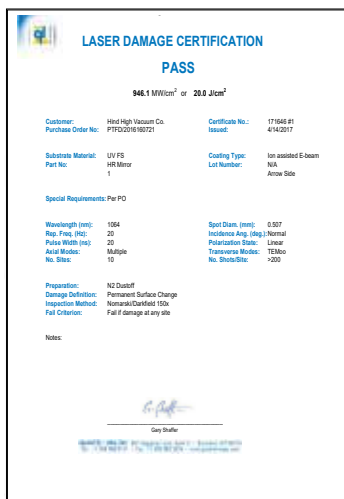
## MIL Standards:

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**

To learn more visit [www.hhv.in](http://www.hhv.in)



## **CONTACT US FOR YOUR THIN FILMS AND OPTICS NEEDS TODAY**

### **INDIA**

Site No. 31 - 34 & 37, KIADB Industrial Area,  
Phase 1, Dabaspeta, Nelamangala Taluk,  
Bengaluru Rural District – 562111, Karnataka, India  
Phone: +91-80-66703700, Fax: +91-80-66703800  
Email: [infotfd@hhv.in](mailto:infotfd@hhv.in) | Website: [www.hhv.in](http://www.hhv.in)

### **INTERNATIONAL**

Unit 2, Stanley Business Centre, Kelvin Way,  
Crawley, West Sussex, RH10 9SE, United Kingdom  
Phone : +44 (0) 1293 611898  
Email: [info@hhv ltd.com](mailto:info@hhv ltd.com) | Website: [www.hhv ltd.com](http://www.hhv ltd.com)

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