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HHV WORLD

VACUUM EQUIPMENT • SPV EQUIPMENT • SPV MODULES • THIN FILMS & HOROLOGY

Innovation drives HHV

As the world is going through a serious recession, it is the responsibility of every industry to overcome this by innovation and developing marketable technology. HHV is no exception to this practice.

It is a matter of pride for HHV that it has recently designed and supplied a Cabin Environment Simulation system (CES) for the Department of Space. This specialized equipment is used to test the reliability of the hardware and sub-systems used in a space vehicle in a simulated space environment.

At the instance of M/s Valeo, a world leader in manufacturing automobile parts, HHV took up the development of a high productive sputtering system for metallization of lamp reflectors and allied parts. It is recognized that the sputtering technique offers a dense and thick coating, adding strength to withstand environment impacts. The inclusion of polymerization process enhances the protective life of the coated products.

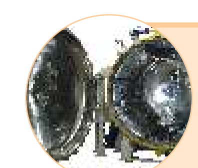
HHV has proved its international technical competitiveness by developing a complex sputter coater to deposit multi-layer, thin, reflective film of aluminum or silver metals on a large size (2.55m diameter), heavy weight (3.0 tonne), telescope mirror. It will be installed at the Caucasus mountain observatory in Sternberg, Russia, which is reputed for its research in extra-galactic astronomy.

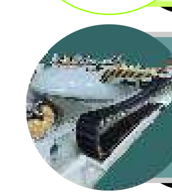
Scarcity of precious tungsten metal encourages the recycling of scrapped Tungsten Carbide (WC) tools. HHV has engineered a Tungsten Carbide recycling system with an updated design for an international tooling giant, M/s Sandvik Asia, Pune. Used Tungsten Carbide tools are exposed to liquefied zinc in a high temperature vacuum furnace. The liquefied zinc permeates into the heated Tungsten Carbide tools and ultimately the solid Tungsten Carbide tools are transformed into porous material which can be pulverized for recycling.

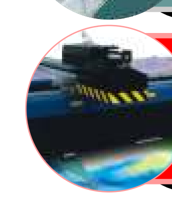
HHV's technology development capability has been recognized by Department of Science and Technology (DST) of the Government of India which has sanctioned a major project to the company to develop large area Zinc Oxide based substrates for thin film solar photovoltaic applications.

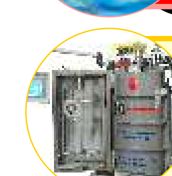
HHV will continue on this path of research and development to further self-reliance for India in high technology equipment.

INSIDE









Cabin Environment Simulation System

India has, in the last few decades, successfully launched scores of satellites for itself and a dozen other countries. It has recently sent a probe to the moon that detected evidence of water on the lunar surface for the first time. India is now planning more ambitious space missions such as landing a rover on the moon and sending a spaceship to Mars.

All these will require specialized ground-based test facilities of a very high caliber. HHV is a unique Indian company which has been designing, evolving and commissioning a variety of technologically advanced ground based test facilities for the Indian space programme for over four decades.

Recently, the Vikram Sarabhai Space Centre (VSSC), Thiruvanthapuram, placed an order on HHV to develop a Cabin Environment Simulation System (CESS) to carryout functional evaluation of space oriented modules.

It is a horizontally mounted cylindrical chamber of 2100mm diameter and I200mm cylindrical length with two tori-spherical dome enclosures-with opening at one end. It has been designed for maintaining an internal vacuum level of 10^{-2} m.bar and insulated such that the outside surface temperature remains within 40 deg C when the internal maximum temperature is at 100 deg C. This large main chamber has been provided with a pumping system to maintain any pressure level between 1.3 mbar to 1200 mbar inside the chamber.

Ancillary chamber

An ancillary chamber of size 300mm diameter and 300mm (L) is placed inside the CESS on a trolley. It has been designed for an operating pressure of maximum 3 bar, operating temperature of 10 to 80 deg C and a volume of 20 litres.

The modules to be tested are placed inside this chamber and their behavior is recorded with in-built sensors for wide ranges of pressure, temperature and humidity. The prescribed pressure versus other parameters of the simulation can be set by PLC and PC controlled data acquisition system.

A gas supply system with a two stage regulator with flow meter helps to simulate CO_2 concentration inside the simulation chamber from 0.5 to 1.5 m.bar. A microprocessor based

programmer indicates the temperature and humidity. The humidity level is maintained inside the chamber by injecting water vapor from a low pressure vaporizer.

HHV has demonstrated the effectiveness of this system by simulating the space environment conditions and tested it for the various parameters specified by the customer.

High Productivity Tungsten Carbide Recycling System

The advancement in powder metallurgy has led to the development of high performance cutting tools made of Tungsten Carbide. These tools are used in a variety of applications like drilling, cutting, boring etc.

Recycling of Tungsten Carbide (WC) tools

Since Tungsten is a very limited mineral resource, available only in a few countries, & as the disposal of carbide tools has an impact on the environment, there is a large demand for recycling of used tungsten carbide tools.

HHV has designed, developed & commissioned Tungsten Carbide tools recycling systems for global tooling leaders for more than two decades.

Recently, HHV has commissioned a Tungsten Carbide tools recycling plant at M/s Sandvik production centre at Pune. It is a second plant made for them by HHV with updated engineering and design.

WC recycling plant

HHV's carbide recycling high productivity plant has a vacuum furnace of 2200mm diameter & 2550mm ht. The furnace is designed for a maximum temperature of 980 deg C using Kanthal heating elements with a special grade of Fibrothal insulation to heat the vacuum bell and charge bell. The temperature is precisely monitored with thermocouples, protection system & control system with a temperature uniformity of 5 deg C.

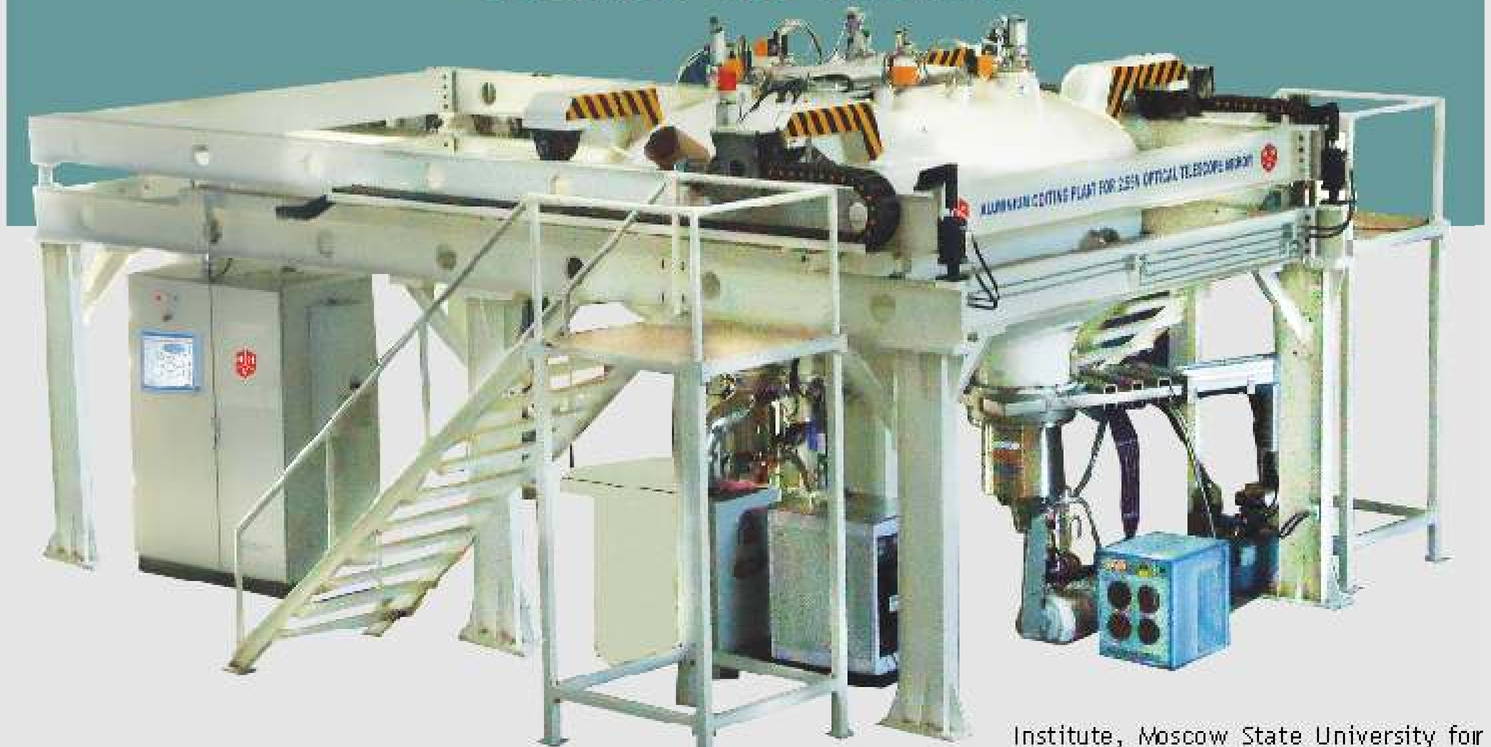
An independent mechanical pump based vacuum system has been designed to create a vacuum level of 300 mbar in the charge bell and 0.01mbar in the vacuum bell. Vacuum level is measured with a high precision digital measuring gauge. The whole system is provided with safety interlocks, PC based control instrumentation and SCADA system for data acquisition of the entire processes.

Tungsten Carbide recycling

A Zinc ingot will be placed over the scrapped WC tools in a graphite boat inside the charge bell of size 940mm diameter and 1545 mm height. The charge bell will be heated to the required temperature to melt the Zinc ingot and the scrapped WC tool is exposed to the liquefied Zinc. The liquefied Zinc permeates into the heated WC tools, and then the liquefied Zinc evaporates when the vacuum bell which is placed over the charge bell is under vacuum. The evaporated Zinc will be cooled and condensed in the form of an ingot with a specially designed water cooled condenser. Ultimately, the solid WC is transformed into a sponge-like porous cake which can be easily pulverized and can be recycled.

As the use of Tungsten Carbide tools in various industries is increasing exponentially in recent years, HHV's recycling system is bound to gain popularity in the years to come.

HHV Supplies Telescope Mirror Coater To Russia



HHV has reached a high level of expertise in engineering, manufacturing and commissioning of very complex and highly precise coaters for large size, heavy weight and thin telescope mirrors

High precision optical telescope & mirror

High precision telescope is the foremost facility in any astronomical observatory. Mirrors are the heart of these telescopes. The mirrors are originally coated with a thin, reflective film of aluminium or silver. Over time, this film gets damaged by oxidation, dust and impact of charged particles from space. The old coated film must be removed and a new film re-coated. Since the telescopes are usually located in remote sites, the recoating has to be done in situ.

Telescope mirror coater

This coating is to be done under high vacuum and very controlled conditions, so that the deposit is spotlessly clean, highly accurate and very uniform. In case of large telescopes, the coater needs to employ specially designed technologically advanced facilities for safety and accurate handling of the heavy mirrors of large diameters. HHV is one of the few companies in the world with a capability of designing and evolving such equipment.

Designing, engineering and evolving complex sputter coaters with mirror handling and cleaning facilities are not new to HHV. It has been supplying such equipment to several observatories in India since 2004.

Multi-layer sputter coater to Moscow

Recently, the company has secured an order from Sternberg Astronomical Institute, Moscow State University for a large size multilayer sputter coater to re-coat a telescope mirror of size 2.55 meter diameter and a weight of 3.0 tonnes against global competition. Sternberg Astronomical Institute is a pioneer and a reputed organization for its research in extra-galactic astronomy. This sputter coater will be installed at the Caucasus mountain observatory in Russia.

Reflectivity of the telescope mirror

The telescope mirror coaters designed and made by HHV conform to stringent international specifications of the coatings with respect to parameters like reflectance, hardness, adherence and the like as can be seen from the table as shown.

Mirror Cleaning Facility

Reflection coefficient value

Reflection coefficient value (Al+SiO_2)		
Muti-layer Aluminum based coating		
	0, 32 – 0, 38 µm :	> 80%
	0, 38 – 0, 78 µm :	85%
	1, 00 – 2, 50 µm :	< 90%
Muti-layer Silver based coating (NiCr +Ag+SiO_2)		
	0, 38 – 0, 78 µm :	94%
	1, 00 – 2, 50 µm :	< 94%
Total coating thickness on the reflecting surface is		< 350 nm
Uniformity thickness of the coatings is		< 5%.

Table 1: Reflection coefficient value of coated mirrors

Mirror handling facility

The primary mirror is positioned during the coating process on a special support mechanism called the Whiffle Tree. Arms from a central hub lead to three 9-point kinematic supports with soft pads on which the mirror will rest during the recoating process.

The location of these supports is critical since they have to take the weight of the mirror while it is being rotated at around 3 to 5 RPM during the coating process. Since the mirror is quite thin , any small misplacement of the support will result in the mirror cracking. The mathematical technique of Finite Element Analysis is used to determine the optimal position of the mirror supports.

Telescope mirror sputter coater

The coating of the mirror is done in a vacuum chamber of approximately 3100mm dia x 1500mm height. The chamber is made up of two torrispherical dished ends. The inner surface of the chamber is suitably polished to minimise entrapment of any gases.

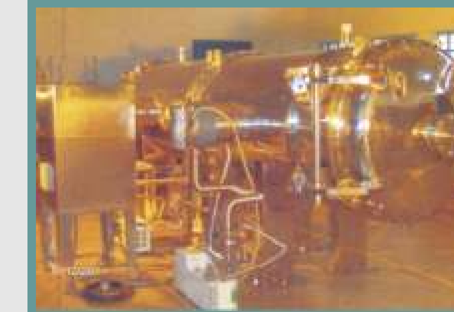
Three 20 KW water - cooled Rectangular Magnetrons are used to actually deposit materials on to the mirror surface. A new version of HHV magnetrons with the magnets totally isolated from cooling water has been used. These have a wider erosion area and improved target utilization.

An target material of size 180mm (W) x 1000mm (L) is provided. It is supported on the inner side of the top lid with suitable supports and mechanisms to adjust the distance and angle for sputtering the material on to the telescope mirror. A silica based protective layer is deposited using an ion assisted reactive sputtering. Sensors are provided to check the coating thickness, reflectivity and uniformity.

A cryo pump based vacuum system with Roots and dry vacuum pumps enables evacuation of the process chamber to a vacuum level of 5 x 10^{-6} m.bar. A mass flow regulator permits argon gas into the chamber with a flow rate of 1 to 500cm3/min.

HHV Expertise

HHV's foray in engineering, manufacturing and supplying coaters for telescope mirrors goes way back to 2004 when it supplied its first such coater to the Indian Institute of Astrophysics for the Hanle observatory located in the Ladakh region of the Himalayas, at a height of 4570 metres above sea level. In 2006, HHV supplied a coater to the Inter University Centre for Astronomy and Astrophysics (IUCAA) for its telescopic mirror at Girawali near Ghodegaon on the Pune-Mumbai high way at an altitude of 1000 metres above sea level. In the first half of 2012, HHV supplied a coating machine to the Aryabhatta Research Institute of Observational Sciences at Devasthal, situated at an altitude of 2500 meters above sea level, about 60 kms away from the town of Nainital in the lower Himalayas.



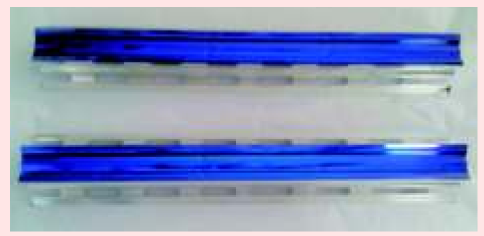
High vacuum system to find the best focal plane of an integrated UV telescope and to fix the right focal plane with a detector, in a laboratory-created space environment

First telescope mirror coater at the Hanle observatory to coat the 2.1 metre diameter telescopic mirror of 1 tonne weight

A telescope mirror coater at Girawali to coat the concave, 2.2 metre dia. mirror has a thickness of 200mm & weighs about 2.50 tone

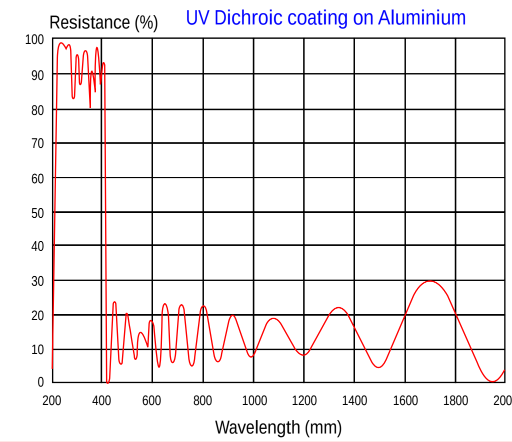
HHV telescope mirror coater at Devasthal to coat 3.7 diameter metres mirror, a thin cross section only 12 cm thick and a large weight 4.5 tonnes

Dichroic UV Reflectors To Cure Complex 3D Substrates



SPECTRAL CHARACTERISTICS

UV	220-400 nm	Reflection >= 85%
Visible	400-750 nm	Reflection <= 20%
Infrared	750-2000nm	Reflection <= 30%



UV Reflector coating on Aluminium Extrusions and its spectral characteristics

Ultraviolet (UV) curing technique has become a safe & mature technology which cannot be ignored any more in processing of temperature sensitive substrates in printing, graphics, and industrial applications.

Ultraviolet curing

Ultraviolet (UV) curing is a photochemical process in which high-intensity ultraviolet light is used to cure inks, coatings or adhesives in seconds. UV curing has been shown to increase production speed, reduce reject rates, improve scratch and solvent resistance, facilitate superior bonding and environment friendly. The important component of UV curing system is the lamp and reflector. The reflection material, quality of the reflector surface and the reflector's geometry play a major role to define a good reflector.

Elliptical and parabolic reflectors

HHV supplies elliptical and parabolic dichroic UV reflectors across the globe. They have been appreciated for their high efficiency in curing two dimensional (2D) and three dimensional (3D) surfaces by the users. These reflectors are extremely effective at increasing the amount of reflected UV energy at the irradiation zone while simultaneously reducing the visible and infrared energy.

UV Curing of complex 3D substrates

HHV has designed, evolved and produced UV reflector coatings on aluminium extrusions. The aluminium extrusion is designed in such a way that all rays are reflected and thus avoid unnecessary losses. As it is a dichroic coating, these reflectors have 50 or more layers on the surface.

The aluminium extrusion can be made and coated into any complex shape matching to the requirements of complex three dimensional parts that need to be cured. It can also be re-polished and re-coated, thereby minimising the material cost and fabrication costs.

HHV dichroic UV reflectors on aluminium extrusions enhance the quality of finished products, improve durability, reduce reject rates and cause no environmental pollution.

HHV is offering customized dichroic UV reflectors to suit specific applications from its state-of-the-art production centre which also has the facility for testing and ensuring the quality of the end products.

UV Reflectors used in the printing industry.

High Production Rate Sputter Coater

The automotive industry as a whole is being driven to manufacture cost effective, environmentally friendly, light weight and more sophisticated automobiles. In this effort, one aspect is to replace metallic parts, such as lamp reflectors, with less expensive, light weight plastics, which are coated with a thin film of a desired reflective metal.

HHV is currently a leading supplier of state-of-the-art, high production, twin door vacuum metalizing systems for the automotive industry across the globe. These current systems have been designed to deposit suitable material, utilizing thermal evaporation, on the automobile parts without distinction of shape, structure & size.

Recently, HHV has taken up a challenging task for M/s Valeo, a world leader in manufacturing automobile parts, to introduce sputtering technique based vacuum metallising which enhances the quality, reliability and durability and offers a dense and thick coating, adding strength to withstand environment conditions.

Twin door sputtering system for automobile industry

HHV's vacuum metallization system with sputtering technique is suitable for metalizing automobile parts made of plastics. Base-coated front substrate of surface size from 50 mm x 50mm to 200mm x 900mm and depth from 2mm to 100mm, the twin door mechanism reduces the cycle time and hence increases productivity.

The system has been designed with a vertically mounted chamber of size 800mm (ID) x 1580mm (Ht) and two numbers of high power, water cooled, rectangular magnetron sources to hold a metal target of size 173mm (W) x 1392mm (Ht) on either side.

Flexible process cycle

The system has unique features of inbuilt process cycle parameters which can be selected as required and they are: (a) Plasma pre-treatment of substrates using the process gases, (b) Plasma CVD pre-treatment of substrates using HMDSO (c) Sputtering of Al and (d) Plasma CVD protective coating of substrates using HMDSO. This polymerization guarantees a protection of the substrate by preventing deterioration/corrosion.

The cryo refrigerator extracts the moisture condensed on the substrate which enhances the reflectivity of the reflectors. The dual pumping system helps to enhance the productivity of the equipment.

User friendly operations and safety

There are two independent gas inlet systems, one for air/ oxygen/ nitrogen/argon to carryout glow discharge cleaning process and other for the monomer to carry out plasma polymerization process for base coat and top coat of the reflectors.

A dual pumping system has been provided. The high vacuum system enables to achieve a ultimate vacuum of 10^{-5} m.bar. Rotary work holders of size 710mm (ID) x 1220mm (Ht), located one in each door, rotate during the process. A glow discharge cleaning system has been provided for plasma pre-treatment.

A HMI enables complete automation of vacuum and sputtering cycle. Necessary safety, alarms and control systems have been provided to ensure safety and ease of operation.

On the whole, the twin door metallization system with sputtering technique enhances the value of the product, increases productivity by reducing cycle times with user-friendly and safety-enhanced operational processes.

Mr. Marc Brassier and Mr. Thomas J. Nolan of M/s Valeo with HHV team of Mr.J.Claude Justin and Mr. S. Thanigaimalai

ISRO Lauds HHV's Role In Hypersonic Wind Tunnel Facility

Indian Space Research Organisation chairman Dr. Radhakrishan presenting a momento to Mr. Nagarjun Sakhamuri – Managing Director HHV

Dr. Radhakrishan, Chairman of the Indian Space Research organization (ISRO) recently inaugurated the Hypersonic Wind Tunnel facility at Thiruvanthapuram in Kerala. He appreciated the excellent contribution made by HHV towards establishment of this crucial ground based testing facility which will significantly increase the country's self-reliance in space science and exploration. Dr. Radhakrishan expressed confidence that specialist Indian companies will take up even more challenging assignments to provide crucial equipment for future missions of ISRO.

HHV has played the lead role in designing and developing the three Horton spheres of 16.13 metre diameter with a pumping speed of 1,20,000 cubic metres per hour coupled to the hypersonic wind tunnel. This hypersonic wind tunnel facility is capable of simulating speeds upto mach-12 (12times speed of sound).

Annual Education Scholarship

HHV cares deeply for its employees & consider each and every one as a part of the family. Various welfare schemes are in place in keeping with this spirit such as long service awards, best performance award, emergency assistance, etc.

As part of its social responsibility, HHV instituted an educational scholarship scheme in 2004 for the children of needy employees for management or engineering courses, graduation and engineering diploma courses, and up to school education subject to their maintaining excellent academic performance.

For the awardees of academic year 2012 -13 a function was organized on 24th November 2012 and the selected children were invited to the function along with their family members. Senior managers and executives of the HHV group graced the occasion.

Mr. Prasanth Sakhamuri – Managing Director dispersing the educational scholarships to the awardees

Mr. Prasanth Sakhamuri – Managing Director addressed the gathering and emphasized the importance of children's education at the grass root level and in higher education in order that they grow up to be responsible citizens of the country.

Mr. Nagarjun Sakhamuri and Mr. Prasanth Sakhamuri, Managing Directors of HHV, dispersed the educational scholarships to the awardees.

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