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OBJECTIVES

The **PAKVACUUM** is a quarterly newsletter published by the Pakistan Vacuum Society, devoted exclusively to the rapid dissemination of news and literature, information related to the research, development and applications of vacuum science and technology in Pakistan. For the beginners in the field, the **PAKVACUUM** provides a concise and systematic source of information and background needed for the selection of instrumentation or the development of new methodology. For the experienced scientists, it offers a single source reference to current developments and literature of vacuum science and technology in Pakistan.

FOR WHOM

This newsletter is particularly intended for all users of vacuum technology as well as the designers of process plants in Pakistan, who plan to engage vacuum pumping techniques or equipment in their systems. This newsletter is opening vistas of knowledge and better comprehension in the field of vacuum science and technology all over the country.

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The **PAKVACUUM** is edited by Dr. Syed Wilayat Husain, with the assistance of an Editorial Board, composed of leading vacuum technologists. The Board members report news, viewpoints, and developments to Dr. Syed Wilayat Husain who has vast experience in conducting research in vacuum related fields.

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Classification & Calibration Techniques of Pressure Gauges

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Pakistan Vacuum Society - Islamabad

The pressure gauge is one of the integral parts of both industrial and lab scale systems, for instance ; hydraulic presses, injection molding machines, air and hydraulic supply lines, gas storage & supply units, power plants, gas regulators and so on. The accurate working of the gauges plays a vital role in performance monitoring and quality control of the plant units & industrial systems. The pressure gauges are classified with respect to their application i.e: hydraulic, pneumatic and vacuum gauges. The hydraulic and pneumatic gauges indicate positive pressure whereas vacuum gauges are used for measuring negative pressure commonly known as vacuum.

The gauges are classified as dial type or digital type depending upon the indicating systems. The dial type gauges have elastic element known as bourden tube of different shapes e.g.; C-type, spiral type or diaphragm type. The gauge connection end maybe at bottom side called as stem mounted gauges or back side of the dial known as surface mounted. Most frequently, the standard male threads are used for installation and mounting of the gauges i.e.; metric thread, NPT etc. The adaptors having standard female threads may also be utilized for connection between gauge and machine/ plant.

The accuracy of gauge is defined as conformity of gauge indication to an accepted standard or true value. (ASME B40.7, section 2.30) The accuracy is ensured via calibration techniques.

Depending upon accuracy grades, gauges are categorized as Lab precision grades, industrial grade and commercial grades, e.g.; 4A is lab precision test gauge which is one of the most accurate grades of gauges having permissible error ±0.1% of the span ; whereas grade 1a gauges are industrial gauges having ±1 permissible error. Grade B, C and D are commercial grades having accuracy lower than industrial gauges. (ASME B40.1, ASME B40.7)

The calibration of gauges is process of graduating the pressure scale or adjusting the mechanism to cause the gauge to indicate within specified limits (ASME B40.100). Hence,

"Calibration is defined as mechanism for comparing the test gauge indication against some standard pressure indication and evaluating the error or correction values."

The standards used for calibration shall have nominal error not greater than ¼ of permissible error of test gauge e.g.; when testing a 400 psi grade 1A gauge (1% error), the standard must have error less than ¼ of 1% or 1 psi. Moreover, the standards for pressure, weight, density and linear dimensions used in manufacturing shall conform to equivalent measuring traceable to NIST (ASME B40.1, AME B40.1, section 6.1). The standard gauges used with calibrators shall be tested for accuracy regularly and frequency of testing will depend upon demonstrated ability of gauge to retain accuracy after repeated use (ASME B40.1, section 6.1.3). Other standards like DKD/DAkkS, DIN EN 10204 are also implemented for calibrating the pressure calibrators.

The reference temperature of calibration is 23±1 °C and reference barometric pressure is 29.92 in Hg (ASME B40.1, section 6.1.4). The results are more reliable if calibration process is executed in clean room having controlled environment temperature and relative humidity. Moreover, the relative humidity, operational and storage temperature mentioned in manual of the test gauge must be followed.

The master equipment, also known as “calibrator” or “calibration standard” should have such design that hydraulic or pneumatic pressure may be developed and monitored accordingly against some traceable standards. Pressure calibration by dead weights is one of the most commonly used techniques for calibration of pressure gauges.

The working principle of the dead weight pressure tester is based on the balance action between two pressures. One of them is developed by the weight of the piston itself and the dead weights, which exercise the force on the effective area of the piston. The other pressure is developed in hydraulic container by application of hand wheel. Standardized hydraulic oil is used herein as pressure transmission medium. The pressure developed may be monitored via calibrated master pressure gauge also known as reference pressure gauge. There exists an option whether to use reference pressure gauges as calibration standard or not, as dead weights are also standard source of calibration process.

Another very common technique for calibrating the pneumatic pressure gauges is based on principle of hand pump. Air is used as pressure transmission media in pneumatic pressure tester. The pneumatic pressure is initially developed using hand pressing lever and regulated through lowering/lifting hand wheel for adjustment and fine tuning.

The general precautions prior to calibration process are enlisted as following.

a) The calibrator should be placed at leveled surface, free of dust, rust, oil, noise and vibrations.

b) The environmental conditions should be noted down prior to calibration activity.

c) The dead weights, test gauge, reference standard gauge and adaptors must be free of oil and rust.

d) The details of test gauge are to be noted down including make, model, Identification number and working range.

e) Reference standard gauge should be mounted first and then test gauge.

While calibrating hydraulic pressure gauges by dead weight tester, hydraulic oil is filled inside oil container as oil cup. The dead weights are placed over the platform and hand wheel is rotated to develop and control the pressure. The pressure indicated by test gauge is then compared with the reference standard gauge installed at other adjacent port in series. The pressure is increased gradually and indicated pressure is compared with dead weights or with reference standard gauge. Hence, error and correction values can be investigated. (Instructions manual for Dead Weight Hydraulic Tester, Model # YS-600, XIYI Group Co. Ltd China)

In case of calibrating pneumatic pressure gauges, the test gauge and reference standard gauge, both are mounted on corresponding ports. The release valve is closed and hand wheel is rotated to develop air pressure inside pressure lines towards gauges. The indications on reference gauge is noted and compared with that indicated by test gauge. The pressure, increased gradually, is continuously monitored and noted down. The pressure on decreasing side may also be monitored by moving the hand wheel backward. Once indications are noted up-to full scale deflection of the gauge, the pressure is released by releasing valve. Ultimately error and correction values are determined (Instructions manual for pneumatic pressure calibrator XY-2002c, Xia'n She'lok Inst. Technology China).

After completion of the measurements, the calibration sticker is affixed over the equipment with clear indication of calibration date, next date of calibration and signature of the operator. If gauge was found faulty, apply corresponding stickers for indicating it as “FAULTY”.

At the end of calibration activity, calibration certificate is generated addressing the details of calibrating department, customer's details, nomenclature of test gauge along with its code, make, model and range of test gauge, environmental conditions of calibrations, traceability of calibration standards & method date, frequency of calibration, standard & measured values and error or correction values. It is assigned a unique traceable certificate number and duly signed by the corresponding operator and authority.

High Vacuum Oil Diffusion Pumps

Muhammad Ibrahim
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1. Introduction

In industrial setup and educational institutions, there are certain processes, which take place under reduced pressure environment or negative pressure conditions. To achieve required environment /conditions, different types of pumps are used.

Diffusion pump is one of them, which is being used to achieve reduced pressure environment, ranging between (1.33×10^{-3} mbar - 1.33×10^{-7} mbar).

It is a vapor jet pump or fluid entertainment pump, whose pumping action is assumed to be due to diffusion of the pumped gas into the vapor stream and subsequent removal by the mechanical pump (called backing pump) in a section where the vapors were condensed .

In this article, the working principle, construction and some other important parameters of an oil diffusion pump are briefly discussed.

2. Construction

Figure 1, shows a cross section of a four stage diffusion pump. The cylindrical Diffusion pump body "PB" terminates at the top in the high vacuum inlet flange F_{in}. A baffle "BA" is attached to the upper baffle flange. The impact plates of the baffle prevent vapor from entering into the attached chamber. At the bottom, the pump body is sealed with a ground plate "PG". It forms the heated boiling chamber "BC" for the pump fluid. The fore-vacuum line "FV" is attached to the side and contains a small flange "F_{FV}" for connecting the fore pump. Above the fore-vacuum line, water flows through cooling tubes "CT" that cools the pump body. Cooling effect can also be provided by a cooling jacket or, in case of air cooling, by cooling fins. The pump body holds the internal part of the pump including the nozzle system. The image shows a four-stage pump with one high-vacuum stage (A), two medium-vacuum stages (B and C), and one fore vacuum stage (D). Diffusion pumps with fewer or more stages are also available .

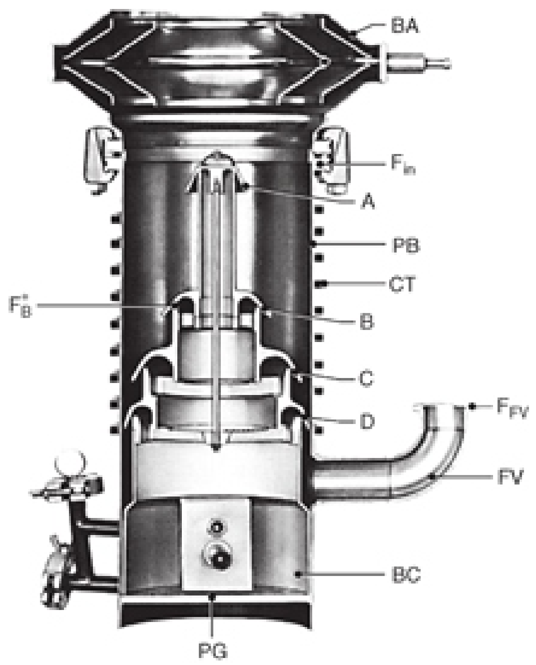

Figure 1: Geometry of a four stage Diffusion Pump

3. Working and Operation

Figure 2, shows a cross section of a four stage diffusion pump. Diffusion pumps are vapor jet pumps that works on the basis of momentum transfer phenomenon, from a heavy high speed vapor molecules to the gas molecules. This results in the gas molecules being moved downward through the pump. The bottom of pump contains an electric heater that is used to produce the vapor by heating the pumping (motive) fluid to its boiling point at a reduced pressure. This means that before the pump is started, it must be rough pumped down and must be held at an acceptable pressure, typically 1.33×10^{-1} mbar, otherwise it will result in no pumping action and possible damage to the pumping fluids. Once boiling of the fluid has begun, the vapor is forced up the central columns of the jet assembly. It then exits at each downward direction jet in the form of a molecular shower that impacts the water cooled pump body. Here, the vapor condenses and runs back down to the boiler. This refluxing action continues as long as proper heat and fore pressure are maintained. As gas molecules from the system randomly enter the pump (molecular flow conditions), they encounter the inside of the pump is designed in such a way that the annular pump surface between the individual nozzle systems and the wall of the pump body decreases from one stage to the next .

Figure (03), shows the flow diagram of a diffusion pump. For a diffusion pump it is required to be rough pumped before starting. The system to be evacuated by

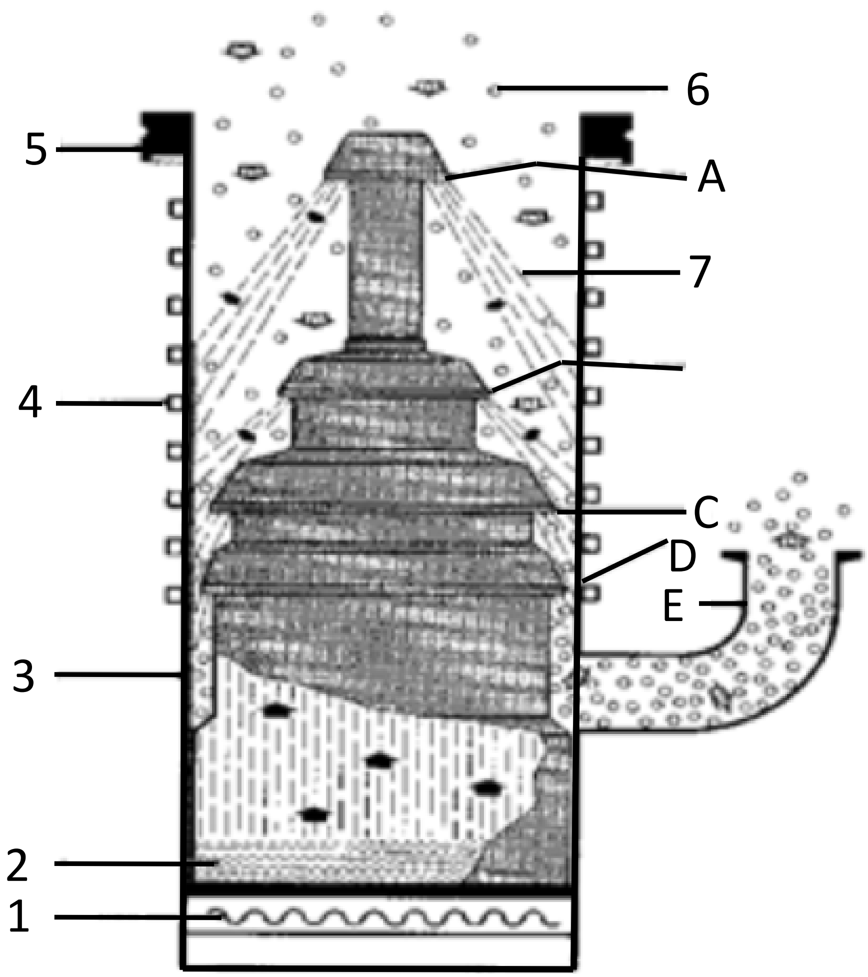

Figure 2: Mode of Operation; 1 - Heater, 2 - Boiler, 3-Pump body, 4 - Cooling coil, 5-High vacuum flange, 6 - Gas molecules, 7 - Vapor jet, 8 - Backing Vacuum Connection & A, B, C, D are Nozzles

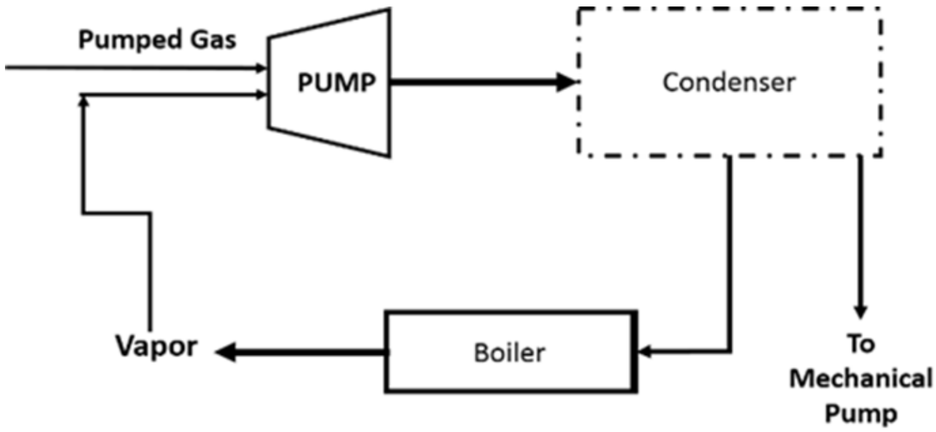

Figure 3: Flow diagram for Diffusion Pump Cycle

pumping prior to exposure to the diffusion pump. Exposing a hot pump to a rush of air at atmospheric pressure could be catastrophic for the equipment and possibly explosive, depending upon the pump fluid being used.

High vacuum systems should be designed with interlocks, fail-safe valve arrangements, or clearly marked instructions to prevent the possibility of exceeding the tolerable fore-pressure..

Each stage of the vapor diffusion pump has a characteristic speed and pressure drop. Since the jets are in series, the gas flow Q is the same through each stage. The flow Q = ΔSΔP, is the product of the speed of the jet times the pressure drop across the jet. The top jet has the largest speed (and the largest aperture) and the lowest pressure drop. The vapor density in the top jet is less than that in the lower jets. Because the gas flow through a series of jets is the same, each successive jet can have a larger pressure drop and a smaller pumping speed.

Compression Ratio (K):

By definition, it is basically the ratio of "Fore-line/Exhaust pressure to the inlet pressure across the diffusion pump".

Vacuum pump with greater compression ratio will be greater efficient. It can be optimized by using given the relationship;

$$K = P_{foreline} / P_{inlet}$$
$$= P_2 / P_1$$

where $P_{foreline}$ is the foreline pressure (pressure at the outlet of the diffusion pump) and P_{inlet} is the pressure at the inlet of the diffusion pump. The diffusion pump is similar in character to the other compression pumps in that, it develops a relatively high exhaust/fore-line pressure compared to the inlet pressure. For most of the gases, the value of K may be one million (10^{+6}) to one ($10^{+0} = 1$) or greater.

The pumping action in a diffusion pump results from collisions between vapor and gas molecules. It is more difficult for gas molecules to cross the vapor stream in the counter flow direction. Thus a pressure or molecular density difference is created across the each vapor stream from each stage. Thus maximum compression ratio created by the vapor stream can be approximately expressed by;

$$K = P_2 / P_1$$
$$= \ln (\rho VL/D)$$

Where;

ρ = Density of pumping fluid

V = Velocity of pumping fluid

L = Width of the jet nozzle

D = Diffusion coefficient

D can be obtained by molecular weights M_a, M_b and molecular diameters σ_a, σ_b of working fluid "a" and evacuating gas "b" as;

$$D = [3/(8(2\pi)^{1/2})][RT(M_a + M_b)/(M_a M_b))^{1/2}(\sigma_a + \sigma_b/2)^{-2}]$$

It is concluded that, if a working fluid of an optimum higher density is used then the compression ratio of that diffusion pump will get increased.

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Use of Vacuum as an Insulation in Cryogenics

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1. Introduction

The term "Cryogenics" is defined by various authors in different ways; however, in general cryogenics is "the science that addresses the production and effects of very low temperatures on matter." The word originates from the Greek words 'kryos' meaning "frost" and 'genic' meaning "to produce." Under such a definition it could be used to include all temperatures below the freezing point of water (0°C). However, Prof. Kamerlingh Onnes of the University of Leiden in the Netherlands first used the word in 1894 to describe "the art and science of producing much lower temperatures." He used the word in reference to the liquefaction of permanent gases such as oxygen, nitrogen, hydrogen, and helium [1] which have very low liquefaction points (<-150°C).

When dealing with cryogenics, an immediate observation is evident: this is a technology in which man has largely surpassed nature. Figure 1 shows the range of temperature existing in nature and obtainable in laboratory: note that the range covers 15 decades! In nature, the lowest temperature existing in the universe is -270.45°C (2.7 K). On the other hand, in laboratory, it is possible to freeze samples of materials down to about -273.149999°C (10^{-6} K) [2].

This technology is nowadays fundamental in different areas, from the familiar conservation of food by freezing to the most advanced scientific as well industrial and medical applications.

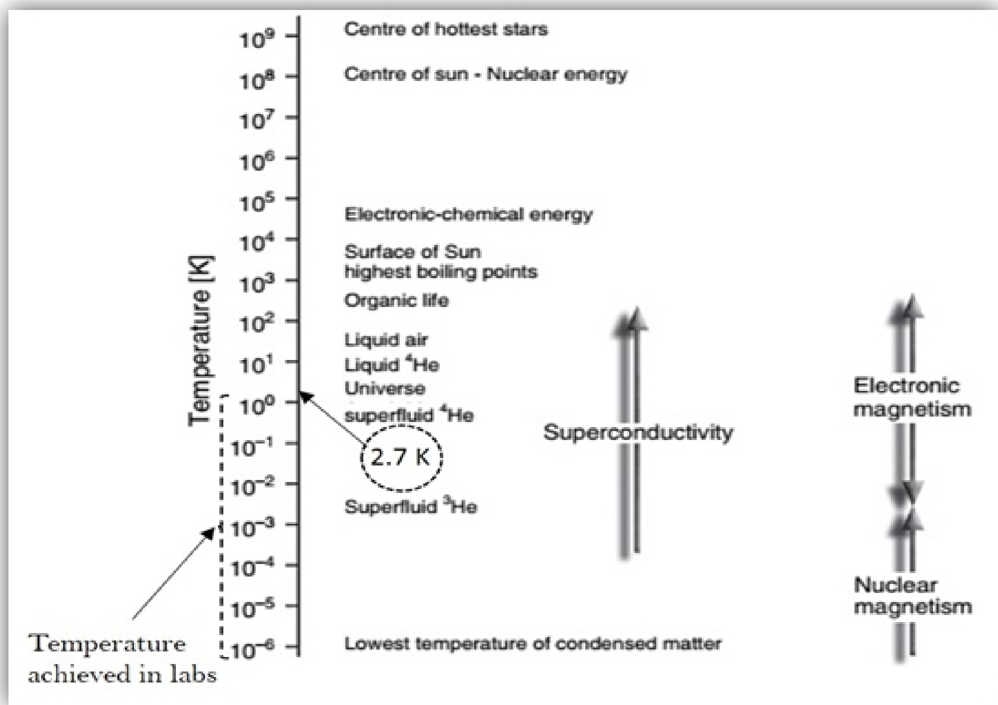


Figure 1: Range of temperature existing in nature and obtainable in the laboratory [2]

Since liquid gases are very expensive, their safe handling are made possible with specially designed containers known as "cryogenic liquid containers". These containers which are also referred to as liquid cylinders (Figure 2), are double-walled vacuum vessels with multilayer insulation in the annular space (Figure3). They are designed for the reliable and economic transportation and storage of liquefied gases at cryogenic temperatures, below -150°C.

There are two primary advantages of a liquid container. The first is that it contains a large volume of gas at a relatively low pressure compared to a compressed gas cylinder. The second is that it provides a source of cryogenic liquids which can be easily handled.

According to [3], cryogenic liquid containers are often incorrectly referred to as dewars. Dewars are open, non-pressurized vessels for holding cryogenic liquids.

LN_2 is widely used in medical and livestock industry of our country, so its important to mention a few of its most important physical properties [4];

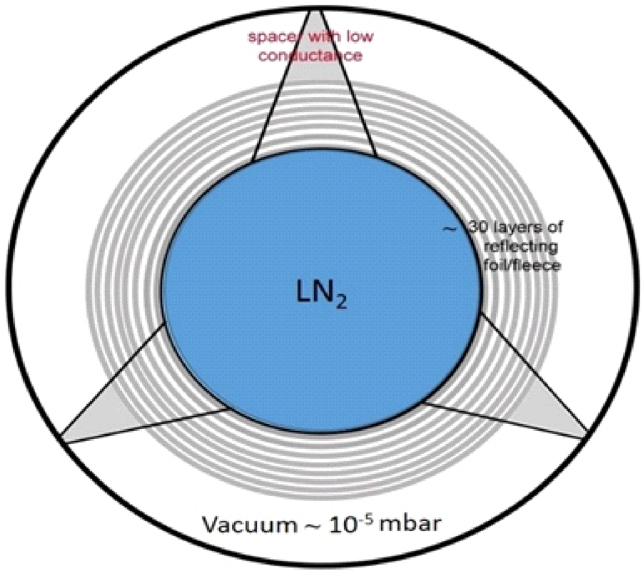


Figure 3: Top view of a cryogenic vessel showing the cryogen (LN_2, say), multilayer insulation (reflecting foil/insulation) and vacuum range

- ✓ Boils at -196.2 °C
- ✓ Its density is 807 kg/m^3 (compared to water which is 1,000 kg/m^3)
- ✓ Heat of vaporization is 215.3 kJ/kg (very small compared to water 2,257 kJ/kg)

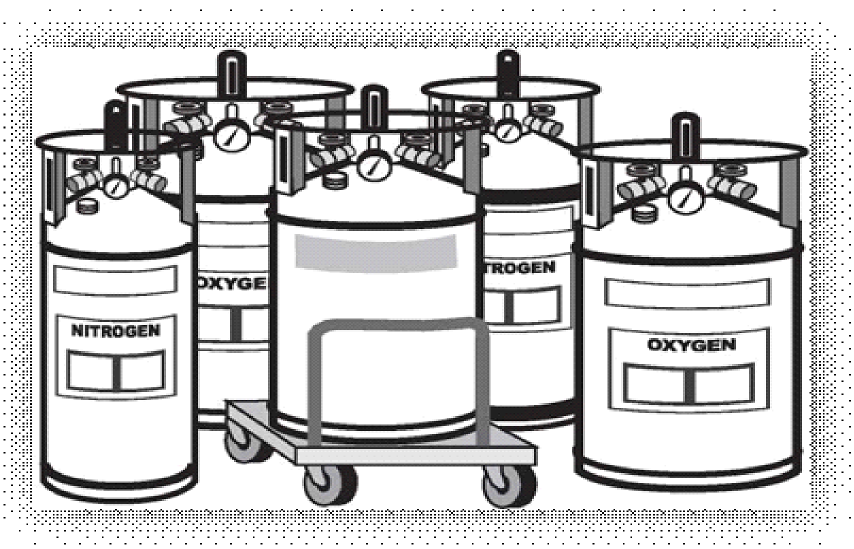


Figure 2: Various types of cryogenic cylinders

Since, the heat of vaporization of LN_2 is very small; they require special care to avoid its loss / vaporization for which, usually, double-walled containers/shells with multilayer insulation and evacuated to high vacuum range (~ 10^{-5} mbar) are used. In this way the vaporization rate is reduced and LN_2 is maintained for longer time in the vessel.

In the following sections, the theory of heat transfer in cryogenics and minimizing the effects of various types of heat is discussed in brief.

2. Heat Flow Theory in Cryogenics; A Brief Summary

The transfer of heat and thermal isolation are extremely important in low-temperature apparatus and experiments. These problems become more serious as the temperature decreases because the retaining of the low temperature liquid for a long time by controlling the heat transfer is a difficult task.

The introduction in the late 1950's of multi-layer insulations (MLIs) or 'superinsulation' for use in vacuum insulated dewars, vessels, and tanks for cryogenic liquids has revolutionized the design and construction of the low boil-off containers in a wide range of applications. The principle behind the operation of a MLI was first established experimentally by Peterson in 1951 [5]. Same principle is used until now with different MLIs developed by different companies around the world.

As the interior of a LN_2 vessel is at very low temperature while the outside temperature is very high, there will always exist a heat flux from outside to inside because of different temperatures. Furthermore, as LN_2 is a highly volatile liquid which evaporate vigorously when exposed to heat, the indigenously developed vessels, with full efforts, are designed so as to provide high thermal insulation from its surroundings.

The total thermal load ΣQ transmitted to the cold surface of a vessel consists of the sum of heat flow rates produced by; thermal conductivity of the solids, gas heat conduction (convection), and thermal radiation [6-8] and can be written as;

$$\Sigma Q = Q_K + Q_C + Q_R$$

For prolonged storage of cryogens in a vessel, ΣQ must be minimized. Efforts have been made in the field of cryogenics to determine the best methods of minimization of heat transfer. At ambient temperatures, both conduction and convection when present tend to be much more important than radiation as the energy flow through these paths is much greater than through radiation alone [8]. In the following, these heat flow processes are discussed briefly.

A. Thermal Conduction (Q_K)

The transfer of energy through a media, usually in reference to a solid material is termed as conduction and is related to properties of the material. Based on this, the ease of energy transfer through the material is called its thermal conductivity or simply "conductivity". In the LN_2 vessels, thermal conduction arises mainly from heat conducted through the body and neck pipe of the vessel which joints the inner and outer shells.

Heat conduction in solids is represented by Fourier's law, expressing proportionality of heat flux with thermal gradient. In one dimension, this reads [9];

$$Q_k = k(T)A\frac{dT}{dx}$$

where *k(T)* is the thermal conductivity of the material, which varies with temperature. Conduction along a solid rod of length *L*, cross section *A* spanning a temperature range $[T_1, T_2]$, is then given by the integral form

$$Q_k = \frac{A}{L}\int_{T1}^{T2} k(T)\,dT$$

Thermal conductivity integrals $\int_{T1}^{T2} k(T)dT$ of standard materials are tabulated in various literatures. Here, a few examples are given in Table 1, showing the large differences between good and bad thermal conducting materials.

Minimizing Conduction: Conduction can be minimized by simply using low thermal conductivity materials for body (shells) and piping between the inner and outer shells. At cryogenic level, various types of materials both conductor as well as nonconductor are used. It has been shown that the most suitable material, in metals, is the stainless steel while composite materials are preferred in the nonconducting materials. They both have low thermal conductivities in their groups. Besides, void space between the inner and outer shells is usually filled with non-conducting material which are either microspheres and/or Multilayer Insulations [10].

Microspheres have been recognized as a legitimate insulation material for decades. The performance and life-cycle-cost advantages previously predicted have now been proven for this material. Most bulk cryogenic storage tanks are insulated with either multilayer insulation or perlite. Microsphere insulation, consisting of hollow glass bubbles, combines in a single material the desirable properties that other insulations only have individually. The material has high crush strength, low density, is noncombustible, and performs well in soft vacuum [11].

B. Thermal Convection (Q_c)

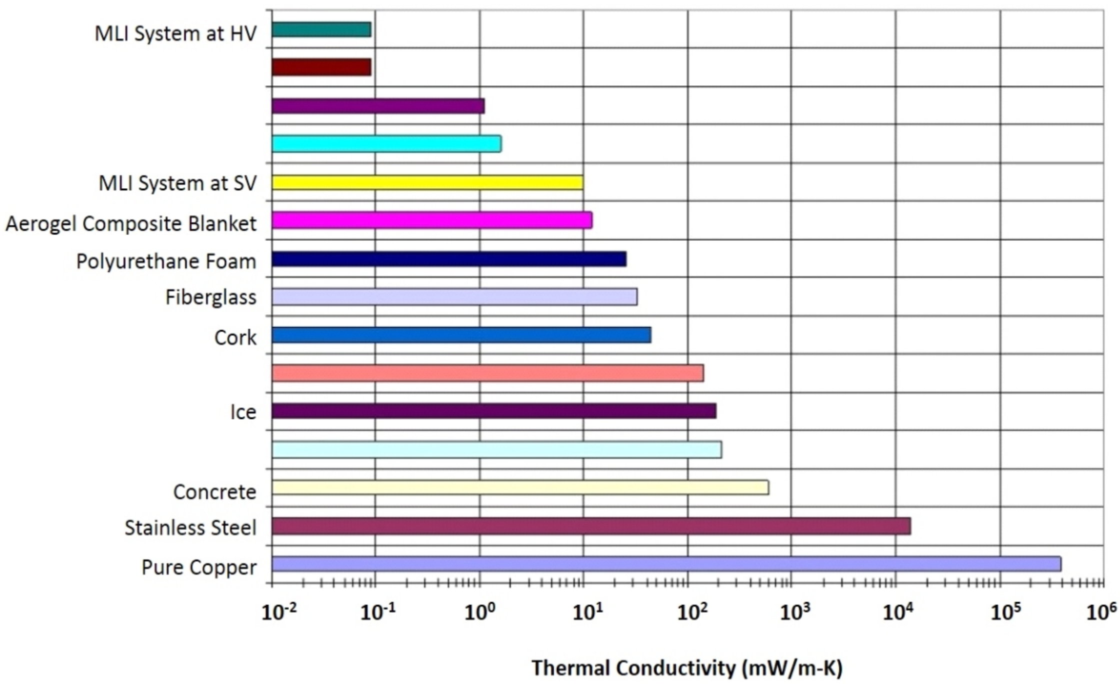
Thermal convection is the heat transfer from a solid or liquid surface by the collision and movement of gas molecules. Usually, thermal convection arises at three different areas;

a. Top of the vessels (flask/ jacket) where the cryogen is open to atmosphere
b. Body of the vessels which is usually at low temperature than surrounding and exposed to atmosphere

Table 1; Thermal conductivity of some selected conducting materials [W/m]

Material	-253 °C	-193 °C	17 °C
OFHC copper	11,000	60,600	152,000
Aluminum1100	2,740	23,300	72,100
2024 aluminum alloy	160	2,420	22,900
AISI 304 stainless steel	16.3	349	3,060
G-10 glass-epoxy composite	2	18	153

Figure 5: Thermal insulation performance (conductivity) of various conducting and non-conducting materials [12]



c. Heat transfer between the outer and inner shells via gas molecular collisions

Minimizing Convection: In the aforesaid processes, heat is transferred from atmosphere to the cryogen inside the vessel through gas collisions that causes the vaporization of LN_2. The first process i.e. (a) can be controlled if the surface of the LN_2 open to the atmospheric gases is minimized. However, it is worth to mention that, above the liquid surface there exists a cloud of vapors which acts as barrier to the incoming gas molecules and as a result, offers resistance to heat flow through atmospheric gases.

Besides, the body of the vessel is always at lower temperature than ambient temperature owing to which gas molecules continuously strikes at the body surface and transfer heat to it. To reduce this effect, the ambient temperature should be kept near the standard room temperature (23±2°C). At higher temperatures, more heat transfer will occur and hence evaporation rate will be high.

The third factor can be minimized by reducing the gas density between the two shells of the vessel. It is a common phenomenon that when the gas density is high, collisions of gas molecules are more frequent. This causes more heat transfer from one point to another. However, as the density is reduced, the frequency of collision also reduces and the same reduce the heat transfer [7]. At very low pressures, or one can say in the high vacuum range, the mean free path Λ between two particle hits is considerably larger than the characteristic vessel dimension *d*. In this case, the collisions between molecules become less frequent and the molecules collide predominantly with the vessel walls. To characterize this effect and for division into different regimes of flow, the Knudsen number *Kn* is used, which is defined as the ratio of the mean free path Λ to a to a characteristic dimension *d* of the system (like, for example, the vessel diameter);

$$Kn = \frac{\lambda}{d}$$

According to figure 6, there are four regimes of gaseous heat transfer such that; The regime with *Kn* >> 1 is called the molecular flow regime, where the influence of gas heat conduction can be neglected. Table 2 gives a hint as to what pressures are needed to establish molecular flow conditions for different gases at different temperatures.

C. Thermal Radiation (Q_R)

Radiation is caused by the transfer of photons through space. It does not require media through which to travel. Various surfaces have properties called optical properties, that determine the propensity of the surface to emit (or generate or reflect, as in a source) photons, to absorb (as in a sink) photons, or to transmit photons (allow them to pass through). These properties are respectively as Emmisvity, Absorptivity, and Transmitivity, and are on a scale from zero to one, representing the percentage of photons acting in each

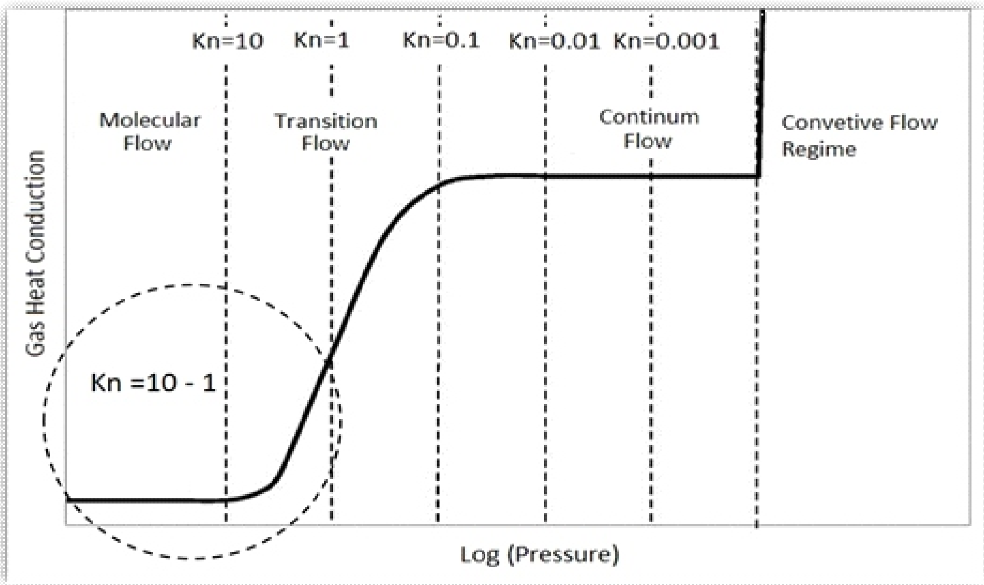


Figure 6: The four regimes of density dependent gaseous heat transfer [6]

Table 2: Gas pressures (in mbar) corresponding to *Kn* = 10 for a vessel with 1 m diameter

Temperature (°C)	He	H_2	N_2	CO_2
27	1.9×10^{-5}	1.3×10^{-5}	6.7×10^{-6}	4.4×10^{-6}
-193	4.4×10^{-6}	2.6×10^{-6}	1.1×10^{-6}	----------
-269	1.2×10^{-7}	C O N D E N S A T I O N		

case. Because heat transfer is related to the reaction of these photons between surfaces, radiation can be generally represented as follows;

The radiation heat exchange between two surfaces A_1 and A_2 with emissivities ε_1 and ε_2 respectively (for example 1 is the chamber wall, 2 the cryosurface), is given by [6];

$$Q_R = \sigma\,\varepsilon\,(T_1^4 - T_2^4) \qquad \text{W.cm}^{-2}$$

where σ is Stefan's constant (and is equal to 5.678×10^{-12} $\text{W.cm}^{-2}\cdot\text{K}^{-4}$) and ε is;

$$\frac{\varepsilon_1\,\varepsilon_2}{\varepsilon_2 + \varepsilon_1(1-\varepsilon_2)}$$

The radiative heat flux is considerably reduced if the emmisivity of the two surfaces is low, when, for example the surfaces are silvered or aluminized (ε for silver =0.008 approx; and for Aluminum = 0.02). If a number of n parallel sheets of highly reflective material with low emissivity ε is positioned in the vacuum space between the surfaces at T_1 and T_2 in such a way that the sheets are thermally insulated from each other, then the radiative exchange between the surfaces will approach an equilibrium distribution such that the net heat flow by radiation is;

$$Q_n = \frac{\sigma\,\varepsilon\,(T_1^4 - T_2^4)}{2(n+1)}$$

In practice the reflective sheets are insulated from each other by introducing a spacer material of low thermal conductivity such as glass fiber, or nylon net etc. so that physical contact between neighboring sheets is reduced to a minimum.

Minimizing Radiation: In fact electromagnetic waves/ radiations transfer heat from hot body to cold body even in vacuum. Some of electromagnetic waves reach inner vessel, where it loses its energy as heat. This heat causes boiling/ loss of LN_2. Radiation is reduced by introducing the radiation shields in the path of radiation heat transfer. As stated above, a combination of thin aluminum sheet and an insulator, usually fiberglass, called as multi layered insulation (MLI) is used to minimize radiation [13, 14]. MLI is wrapped around the inner vessel in the void space which acts as a baffle for the radiation and, hence, heat transfer is minimized.

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NEWS: NATIONAL / INTERNATIONAL

Proposals invited under NTIF to develop new technologies

Pakistan Science Foundation (PSF) has invited innovative proposals from researchers from academia or industry for developing economically viable new technology, product and system of processes under the National Technology Innovation Fund (NTIF).

NITF is an initiative of PSF to bring together Academia, Research Centre and Industry for economic growth through innovations, applications of emerging technologies and subsequent commercialisation of value-added products, an official from PSF told APP on Sunday. Pakistan Science Foundation under NTIF intends to provide funding upto 25 millions to individual researcher or group of researchers from academia and/or industry with innovative proposals in 4th Industrial Revolution Technologies. The applicant proposal may result in developing economically viable new technology, product and system of processes. Through this initiative, the academia, research centre and industry are twining for successful commercialization through innovation. The proposal related to product development and their commercializations, utilizing one or more of the thematic areas to solve local community problems and targets to reach global standards of innovation will be preferred. Proposals focusing on basic research will not be entertained, the official informed.

Principal Investigator must be a researcher from Public Sector institution. Project team may include researcher from industry or private sector. However funds will be released to public sector organizations by PSF. Application proforma must clearly mention name of the product or technology or process to be developed. Industry/private sector partner share should be highlighted in application. They should also provide letter of intent along with business plan on separate proforma specified by Pakistan Science Foundation, the official said.

NUST Institute Of Policy Studies Hold Intl Webinar On Role Of Universities

Professor David Sampson, Pro-Vice-Chancellor Research And Innovation At University Of Surrey, UK, Highlighted Crucial Role Of Universities.

"The government is keenly aware that long-term growth of the country depends on successful development of national systems of innovation and a mature knowledge economy based on a favourable economic and institutional regime, high-quality human resource development, multi-type innovation driven by science and technology, and promotion and utilisation of advanced information and communications technologies." Federal Minister for Science & Technology expressed these views at international webinar on the "Role of S&T Universities in Promoting National High-Tech Growth" at NUST. The minister urged universities to play their part in science and knowledge diplomacy. He further stated that universities were helping shift the focus of the world slowly but gradually from geopolitical competition to knowledge-based cooperation. In today's world, there is an urgent need to promote peace-enhancing diplomacy rather than diplomacy driven by war and conflict," he added.

Dr Atta-ur-Rahman, Chairman Prime Minister's Task Force on Science & Technology, shared his vision for improving the S&T landscape of Pakistan. He said that innovation is transforming economies and a comprehensive S&T-based apparatus is a crucial determinant of long-run growth, competitive edge, and economic autarky of a state. He stated that universities serve as the critical nodes of new growth through their inherent diversity, dynamism and the unmatched ability to introduce new ideas and talent.

Their key performance indicators must be the promotion of policy research and technological evolution of the production function of industry. The process may comprise scientific research, foresight exercises, and networking, combined with the direct and indirect facilitation of new industrial clusters like business and technology incubators, science and technology parks, high technology zones, and innovation areas.

Professor David Sampson, Pro-Vice-Chancellor Research And Innovation At The University Of Surrey, UK, Highlighted The Crucial Role Of Universities In National Development. While narrating several innovative success stories of past and the achievements of his own institute, he underscored the significance of industry-academia linkages; production, encouragement and cultivation of top talent; emphasis on team work; and rational management of openness and secrecy issue of research. He hoped that Pakistan utilises its vast and raw human resource through greater focus and spending in S&T-based pursuits.

Air Vice Marshal (Retd) Dr Rizwan Riaz, Pro-Rector Research, Innovation and Commercialisation at NUST, stressed the need for leveraging all channels of science and technology for high-tech national growth. Pakistan, in his view, is full of talent that should be nurtured and encouraged through better opportunities. Problems such as brain drain, bureaucratic hurdles, and restricted import of tech-based goods and technologies should be addressed. He also pointed out the responsibility of global north for development of tech- and R&D-based human resource to ensure collective gains.

Dr Malcolm Parry OBE, pointed out that in terms of capacity, the global population of university graduates was expected to nearly double over this decade and reach 300 million by 2030. The levels of global investment in R&D tripled from $676 billion in 2000 to $2.0 trillion in 2018. Although government is a major funder of research in many countries, it tends to be a minor performer in undertaking research. That said, national and international policy decisions sit at the heart of the win-win model for science and technology.

Outputs of the process can be anyways translated into commercial success by stimulating and supporting entrepreneurship among young people that pass through universities and help them create or find worthwhile employment by connecting science that includes Engineering, Technology, and Social Science, to a market. He said that the role for scientific knowledge translators – including policymakers, analysts, engineers, business entrepreneurs, and sometimes scientists themselves – was crucial if their advances were to improve welfare. This needs to be supported with policies that encourage investment and help drive technology entrepreneurship.

COMSATS workshop highlights remedies for mental health issues

To highlight the significance of mental health in youth and to observe this year's mental health day, the Commission of Science and Technology for Sustainable Development in the South (COMSATS) and its Centre of Excellence, COMSATS University Islamabad (CUI) jointly organised a workshop on 'Engaging University Faculty for Mental Health Wellbeing of Youth' at the Islamabad Campus of the later.

On behalf of the two organisations, Comsats Telehealth Desk and Departments of Psychology and Health Informatics Department at CUI arranged the hybrid workshop. The event is also in the backdrop of efforts to achieve Sustainable Development Goal (SDG) – 3 and 4 regarding quality education through healthy minds and bodies. Federal Secretary to Ministry of Science and Technology, Dr. Akhtar Nazir, who is also the incumbent Executive Director Comsats , lauded this initiative by Comsats Secretariat Telehealth Desk and CUI.

"Mental health is one of the most underserved fields of health sciences in developing world. Debates and deliberations about it are crucial in view of the far-reaching implications of mental health that affect society through physical health, their social, economic and civic impact", opined Dr. Akhtar Nazir. In the light of key global stats on mental health in youth that he found alarming, Dr. Nazir considered it important to give this field of medical science due importance for ensuring healthier societies. While speaking at the closing ceremony, Prof. Dr. Tabassum Afzal, Rector Comsats University Islamabad (CUI), considered the subject event very timely owing to increasing stress and other mental health related issues since the advent of COVID-19.

Considering cultural and societal norms an important factor in dealing with mental illnesses, Prof. Afzal cited examples of stress management from the early Islamic history and life of Prophet Muhammad (Peace Be Upon Him). He urged the faculty to take initiatives for the wellbeing of youth's mental health. He also acknowledged the long-standing Comsats – CUI relationship and suggesting furthering of cooperation between the two organisations.

HBL, NUST enter into strategic alliance

KARACHI: HBL and National University of Science and Technology (NUST) entered into a strategic partnership to identify and bridge the gaps between academia and industry. The partnership is in line with the Bank's commitment to strengthen its connection with its academic partners present in Pakistan and internationally.

The agreement was signed by Jamal Nasir, Chief Human Resources Officer - HBL and Anwar Fareid, Chief Innovation and Commercialization Officer - NUST. Senior members from both the organizations were also present on the occasion.

Through this alliance, HBL will work closely with NUST to get insights on the cutting-edge technologies in addition to offering students the opportunity to experience real life industry challenges through structured internships, projects, workshops and regular interaction with HBL professionals.

The Bank will also mentor NUST students in their new entrepreneurial ventures focused on diversity and inclusion.

Commenting on the occasion, Jamal Nasir, Chief Human Resources Officer - HBL said, "HBL is committed to working with the academia to keep abreast with the latest research methodologies. This collaboration will enable the Bank to make use of various interventions and work with students from NUST, providing them with innumerable learning opportunities as well as foster their professional development and growth."

Nobel Prize in Physics Awarded for Study of Humanity's Role in Changing Climate

The work of Syukuro Manabe, Klaus Hasselmann and Giorgio Parisi "demonstrate that our knowledge about the climate rests on a solid scientific foundation," the committee said.

Syukuro Manabe of Princeton University, Klaus Hasselmann of the Max Planck Institute for Meteorology in Hamburg, Germany, and Giorgio Parisi of the Sapienza University of Rome were awarded the prize in Physics in Stockholm

Three scientists received the Nobel Prize in Physics on Tuesday for work that is essential to understanding how the Earth's climate is changing, pinpointing the effect of human behavior on those changes and ultimately predicting the impact of global warming.

The winners were Syukuro Manabe of Princeton University, Klaus Hasselmann of the Max Planck Institute for Meteorology in Hamburg, Germany, and Giorgio Parisi of the Sapienza University of Rome.

NASA Launches New Mission to Monitor Earth's Landscapes

Landsat 9, a NASA satellite built to monitor the Earth's land surface, successfully launched at 2:12 p.m. EDT Monday from Vandenberg Space Force Base in California.

A joint mission with the U.S. Geological Survey (USGS), Landsat 9 lifted off on a United Launch Alliance Atlas V rocket from Vandenberg's Space Launch Complex 3E. Norway's Svalbard satellite-monitoring ground station acquired signals from the spacecraft about 83 minutes after launch. Landsat 9 is performing as expected as it travels to its final orbital altitude of 438 miles (705 kilometers).

"NASA uses the unique assets of our own unprecedented fleet, as well as the instruments of other nations, to study our own planet and its climate systems," said NASA Administrator Bill Nelson. "With a 50-year data bank to build on, Landsat 9 will take this historic and invaluable global program to the next level. We look forward to working with our partners at the U.S. Geological Survey and the Department of the Interior again on Landsat Next, because we never stop advancing our work to understand our planet."

"Today's successful launch is a major milestone in the nearly 50-year joint partnership between USGS and NASA who, for decades, have partnered to collect valuable scientific information and use that data to shape policy with the utmost scientific integrity," said Secretary of the Interior Deb Haaland. "As the impacts of the climate crisis intensify in the United States and across the globe, Landsat 9 will provide data and imagery to help make science-based decisions on key issues including water use, wildfire impacts, coral reef degradation, glacier and ice-shelf retreat, and tropical deforestation."

The first Landsat satellite launched in 1972. Since then, NASA has always kept a Landsat in orbit to collect images of the physical material covering our planet's surface and changes to land usage. Those images allow researchers to monitor phenomena including agricultural productivity, forest extent and health, water quality, coral reef habitat health, and glacier dynamics.

"The Landsat mission is like no other," said Karen St. Germain, director of the Earth Science Division at NASA Headquarters in Washington. "For nearly 50 years, Landsat satellites observed our home planet, providing an unparalleled record of how its surface has changed over timescales from days to decades. Through this partnership with USGS, we've been able to provide continuous and timely data for users ranging from farmers to resource managers and scientists. This data can help us understand, predict, and plan for the future in a changing climate."

Landsat 9 joins its sister satellite, Landsat 8, in orbit. Working in tandem, the two satellites will collect images spanning the entire planet every eight days.

"Landsat 9 will be our new eyes in the sky when it comes to observing our changing planet," said Thomas Zurbuchen, associate administrator for science at NASA. "Working in tandem with the other Landsat satellites, as well as our European Space Agency partners who operate the Sentintel-2 satellites, we are getting a more comprehensive look at Earth than ever before. With these satellites working together in orbit, we'll have observations of any given place on our planet every two days. This is incredibly important for tracking things like crop growth and helping decision makers monitor the overall health of Earth and its natural resources."

The instruments aboard Landsat 9 – the Operational Land Imager 2 (OLI-2) and the Thermal Infrared Sensor 2 (TIRS-2) – measure 11 wavelengths of light reflected or radiated off Earth's surface, in the visible spectrum as well as other wavelengths beyond what our eyes can detect. As the satellite orbits, these instruments will capture scenes across a swath of 115 miles (185 kilometers). Each pixel in these images represents an area about 98 feet (30 meters) across, about the size of a baseball infield. At that high a resolution, resource managers will be able to identify most crop fields in the United States.

"Launches are always exciting, and today was no exception," said Jeff Masek, NASA Landsat 9 project scientist. "But the best part for me, as a scientist, will be when the satellite starts delivering the data that people are waiting for, adding to Landsat's legendary reputation in the data user community."

The USGS Earth Resources Observation and Science (EROS) Center in Sioux Falls, South Dakota, processes and stores data from the instruments, continuously adding that information to the five decades of data from all of the Landsat satellites.

All Landsat images and the embedded data are free and publicly available, a policy that has resulted in more than 100 million downloads since its inception in 2008.

NASA manages the Landsat 9 mission. Teams from NASA's Goddard Space Flight Center in Greenbelt, Maryland, also built and tested the TIRS-2 instrument. NASA's Launch Services Program, based at the agency's Kennedy Space Center in Florida managed the launch of the mission. EROS will operate the mission and manage the ground system, including maintaining the Landsat archive. Ball Aerospace in Boulder, Colorado, built and tested the OLI-2 instrument. United Launch Alliance is the rocket provider for Landsat 9's launch. Northrop Grumman in Gilbert, Arizona, built the Landsat 9 spacecraft, integrated it with instruments, and tested it.

Black hole found hiding in star cluster outside our galaxy

Using the European Southern Observatory's Very Large Telescope (ESO's VLT), astronomers have discovered a small black hole outside the Milky Way by looking at how it influences the motion of a star in its close vicinity. This is the first time this detection method has been used to reveal the presence of a black hole outside of our galaxy. The method could be key to unveiling hidden black holes in the Milky Way and nearby galaxies, and to help shed light on how these mysterious objects form and evolve.

The newly found black hole was spotted lurking in NGC 1850, a cluster of thousands of stars roughly 160 000 light-years away in the Large Magellanic Cloud, a neighbour galaxy of the Milky Way.

"Similar to Sherlock Holmes tracking down a criminal gang from their missteps, we are looking at every single star in this cluster with a magnifying glass in one hand trying to find some evidence for the presence of black holes but without seeing them directly," says Sara Saracino from the Astrophysics Research Institute of Liverpool John Moores University in the UK, who led the research now accepted for publication in Monthly Notices of the Royal Astronomical Society. "The result shown here represents just one of the wanted criminals, but when you have found one, you are well on your way to discovering many others, in different clusters."

This first "criminal" tracked down by the team turned out to be roughly 11 times as massive as our Sun. The smoking gun that put the astronomers on the trail of this black hole was its gravitational influence on the five-solar-mass star orbiting it.

Astronomers have previously spotted such small, "stellar-mass" black holes in other galaxies by picking up the X-ray glow emitted as they swallow matter, or from the gravitational waves generated as black holes collide with one another or with neutron stars.

However, most stellar-mass black holes don't give away their presence through X-rays or gravitational waves. "The vast majority can only be unveiled dynamically," says Stefan Dreizler, a team member based at the University of Göttingen in Germany. "When they form a system with a star, they will affect its motion in a subtle but detectable way, so we can find them with sophisticated instruments."

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