

*Optical Tables,
BreadBoards &
Vibration Isolation
Systems*



// SPEIRS ROBERTSON //

TABLES AND SUPPORTS

- **Ultra low reflectivity CarbonBlack table top**
- **Double sealed holes, triple plus skins and multi-layer core construction**
- **Revolutionary highly dampening Normalex core**
- **Four grades: HiSpec, Research, LiteLine and Breadboards in most sizes and thicknesses**
- **Laboratory and clean room workstations**
- **Round leg and frame supports with choice of HiSpec Rolling diaphragm 1Hz, Cushion 3Hz or Buffer 9Hz isolators**
- **Options including self-levelling, laser ports, non-magnetic surfaces and many more**



Optical tables provide the base on which precision optical and laser work is performed. **Speirs Robertson** optical tables are made in four grades to suit most applications: HiSpec; Research; LiteLine and Breadboard. Table performance improves with increased table and skin thickness. For the maximum in performance the HiSpec series features laminated $\frac{1}{4}$ " (6mm) skins and a 12" (300mm) core depth. For smaller area, non-critical applications where cost may also be a consideration, our 2" (50mm) thick Breadboards provide a good solution.

We also supply a wide range of laboratory workstations. Choice of grade of table depends very much upon the application and the environment.

THEORY

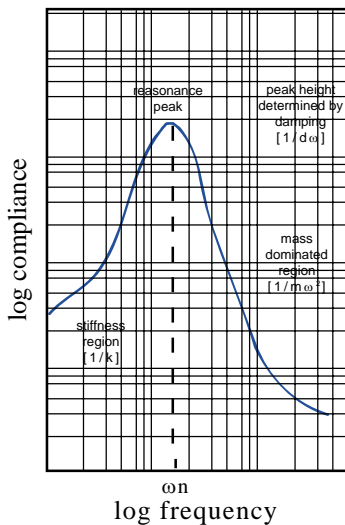
Advances in technology have made it possible to measure and observe at the nanometer level, opening up new possibilities in many fields. This has led to a demand for work surfaces which are free from the smallest movements; surfaces where external vibrations and noise are isolated out and disturbances on the working surface are rapidly damped away.

The criteria for an optical table surface is that it should be very rigid and have excellent damping characteristics.

We have developed a range of state-of-the-art tables to meet these requirements.

Compliance

Compliance indicates how a table surface will deflect at different frequencies under varying external forces. The compliance of a system with one degree of freedom is shown in the compliance graph (figure 1).



Theoretical Compliance (figure 1)

The peak in Compliance at a resonance is limited by the damping coefficient and at high frequencies is dominated by mass and frequency ($C = 1/m\omega^2$).

A good table should have its multiple order resonance peaks at frequencies as high as possible and these peaks should be minimised in amplitude through effective damping.

Compliance is measured with an impact hammer and an accelerometer. We use a real time FFT analyser to collect the data and produce the Compliance curve.

The data collected by the analyser also enables us to obtain complex computer modelled modal analysis of tables.

Vibrational Resonance Modes

Table boundaries reflect surface disturbances (energy waves) and set up standing waves at resonant frequencies. The velocities of these waves (Shear waves, Rayleigh waves etc.) depends principally on the ratio of the Youngs modulus (E) to the density (ρ) of the material through which they are travelling. In general terms the higher these velocities the higher the frequencies at which these principal modes occur.

The peaks in the resonances are determined by the damping of the table materials. Table skins being made of metal are elastic in behaviour and poor at damping.

However our core is non-metallic and has an E/ρ ratio greater than that of steel. It has the advantage of being highly damping and is much lower in density with correspondingly higher shear velocities.



Static Rigidity

Static Rigidity indicates how much a table top will deflect under static load. Table static stiffness is principally determined by the separation of its steel skins, as it is the restoring force of these skins under deformation that is the dominating factor, hence Static Rigidity increases with the table thickness (as in an I section beam).

We measure Static Rigidity by placing a known load on a table and using displacement sensors to measure deflection.

DESIGN

Customer requirements were paramount when it came to designing our new series of optical tables and so we took the broad range of our customer requirements into account.

We understood that choice of materials and method of construction are critical to table performance. The tables needed to be as rigid as possible and should feature a working surface tailored to the users requirements.

Starting with the theory above and from our long experience in the field we developed both our **CarbonBlack** top and the **NORMALEX** core construction to meet these criteria. The result is a series of tables that are not only at the leading edge of technology but also very cost competitive.

We manufacture the tables in four grades. The principal difference being the table thickness; 12" (300mm) for the HiSpec series down to 2" (50mm) for the breadboard series. Greater thickness improves performance but also increases price. Standard tables are made in a range of sizes from 2x2ft up to 12x5ft and selection of thickness may be governed by choice of size when set against a certain level of performance.

We will be pleased to advise you on the correct choice of table for your individual requirements.

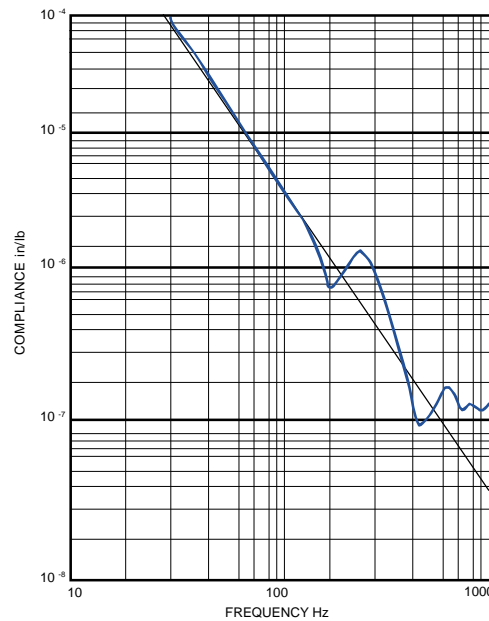
CONSTRUCTION

Our tables are laminated in large flat bed hydraulic presses which bonds ferromagnetic steel top and bottom plates to *NORMALEX* core using aerospace grade adhesives.

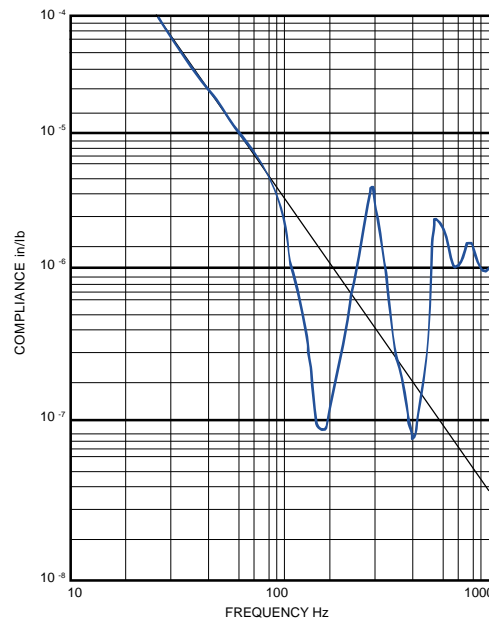
Tables are assembled and finished by a highly skilled workforce and rigorous quality control is applied throughout. An important indicator of a table's rigidity is its stiffness to weight ratio. Cores should have the highest stiffness to weight ratio combined with high damping characteristics. It has been found that lighter cores generally give better dynamic rigidity. A highly damping non-metallic ultra-light weight core fulfils all the above criteria.

All **Speirs Robertson** tables use *NORMALEX* core, a highly damping non-metallic honeycomb material which is waterproof and acid resistant. This state-of-the-art core is widely used in the aerospace industry, as it combines very

light weight with high strength. Sharp high peaks in compliance in steel core tables are a result of the elasticity of steel; whilst steel has to be used for table skins because of its magnetic qualities is not a good material for table core.



HiSpec Compliance Curve



BreadBoard Compliance Curve

Regular steel rings when struck whereas super deadened steel used in our HiSpec range has an ultra-thin specially

developed viscoelastic membrane which soaks up surface vibrational energy. We also use acoustically damping multi-laminate side panels.

Table Surface

Stray light reflections are widely acknowledged as the major source of error in many experimental arrangements. Our ultra-low reflective **CarbonBlack** top working surface was specially developed to minimise stray light reflections. The top plate undergoes a 16 stage process in which a hard ultra-thin coating is chemically bonded to the specially treated ferromagnetic steel surface. This extremely hard surface is then further processed, producing our very low reflectivity, highly absorbing **CarbonBlack** finish.

Tops are normally supplied with a choice of 1/4" 20UNC or M6 mounting holes on a 1", 25mm, 2" or 50mm grid. Untreated ferromagnetic stainless steel tops, non-magnetic tops and tops without holes are all available on request.

All **Speirs Robertson** tables feature **DoubleSealed** countersunk holes. The bottom of the tapped holes are sealed directly by a membrane which can be broken through as required.

A **Multi-Layer Core** construction is used in HiSpec and Research tables to produce a small cavity below this membrane which localises any spillages for easy removal. HiSpec tables also feature SDS type **super deadened** laminated skins which give the ultimate in damping.

SELECTING A TABLE

We make tables to customer size on request and various options include: laserports, laser shelves, support bars, jointing of tables and screens. To select a table you must first decide on the size of working surface you require and then the sensitivity of the experiment to vibrations; from this you can determine the table thickness required. As a rough guide the static deflection of a table increases as a cube of length and decreases roughly as a square of thickness. Thus for comparable performance the larger a table is, the thicker it needs to be.

HI-SPEC TABLES (HS SERIES)

These tables offer the ultimate in performance, with $\frac{1}{4}$ " (6mm) top skins and 12" (300mm) thickness. They are suitable for the most demanding experiments, such as holography, laser interferometry and spectroscopy.

***Hi-Spec Tables
(HS SERIES)***



RESEARCH TABLES (RS SERIES)

Our Research Series are suited for the widest range of applications where a stiff working surface is essential and vibrations need to be kept to a minimum. They feature $\frac{1}{5}$ " (5mm) ferromagnetic top skins and are made in both 8" (200mm) and 12" (300mm) thickness (recommended for the largest tables).

***Research Tables
(RS SERIES)***



LITE-LINE TABLES (LL SERIES)

For less critical applications where internal tuned damping is unnecessary these tables offer the advantages of less bulk and lower cost while still providing a very stiff surface on which to work.

***Lite-Line Tables
(LL SERIES)***



BREADBOARDS (BB SERIES)

Breadboards are ideal for applications that do not require large working surfaces or in quiet environments where vibrations are not a concern.

***BreadBoards
(BB SERIES)***



TABLE SUPPORT

We offer a choice of free standing round legs or rigid frames. Both types can be supplied with HiSpec, Cushion or Buffer isolators as preferred. Round legs are recommended for tables 6' x 4' or over and frames for smaller tables and BreadBoards.

Supports have a satin-black hard-baked powder coating finish and all C-frames are fitted with levelling feet with castor/levelling feet as an option.

ISOLATION THEORY

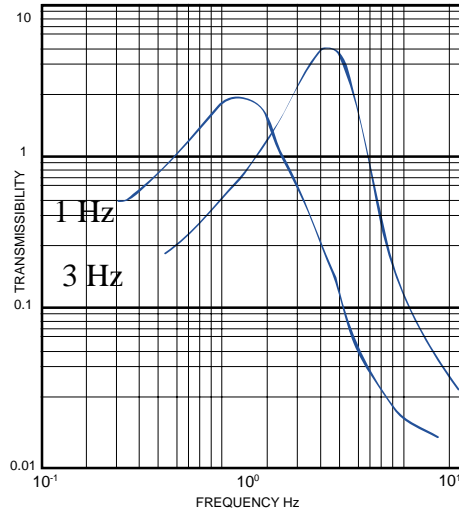
Elimination of movements from a working surface is achieved by isolating it from any external influences and by ensuring that the structure itself is rigid and damps out induced surface distortions. The major sources of external disturbances are vertical and horizontal floor movements and airborne vibrations. The latter are usually less problematic and can be dealt with by enclosing the table. Floor vibrations can be severe and isolating them requires well designed table supports.

Floor vibrations are caused by many things; road traffic, trains, large machinery, building sway etc. A metal frame building of height (h) has a resonance of roughly $46/h$ Hz. Thus on the fifth floor one might expect both horizontal and vertical displacements at around 3Hz, with building sway in the range 1 to 10Hz.

Before deciding on a vibration isolation system it is important to establish the level of isolation required.

We offer a very wide range of isolation products and will be pleased to assist you in choosing the correct system for your application.

The measure of the effectiveness of an isolation system is given by its transmissibility, (figure 2).



Transmissibility of Isolators (figure 2)

The height of the peak at resonance depends predominately on mass and frequency and is reduced as damping is increased. A 1Hz isolator will begin to isolate around 2Hz. An approximate rule is that the resonance frequency of the isolator should be at least 2 - 3 times lower than the lowest frequency it needs to isolate. In most of our isolators the horizontal and vertical isolation is of a comparable level.

Working Range (in)	Load (lb)	Pressure (PSIG)	Natural Frequency (Hz)
LOWER	150	21	1.72
	300	39	1.50
	500	62	1.33
	700	87	1.20
	800	99	1.12
MID	150	21	1.62
	300	39	1.37
	500	60	1.18
	700	82	1.15
	800	92	1.17
UPPER	150	19	1.65
	300	36	1.33
	500	57	1.42
	700	79	1.48
	800	90	1.52

HiSpec Isolator Performance

ISOLATORS

We offer three grades of isolator; HiSpec, Cushion and Buffer with resonances of 1, 3 and 9Hz respectively. Our HiSpec series isolators feature a high performance rolling diaphragm and have an extremely low 1.1Hz natural frequency which is almost independent of mass. We use a low isolation volume to damping volume ratio and specially developed tuned dampening pinholes to absorb system energy and remove the overshoot and oscillations which are an unwanted feature in many of the products marketed by our competitors.

In applications where large loads are frequently moved over the surface of a table, it is best to select the self levelling option. Leg mounted sensing arms touching the underside of the table control leg pressures and so ensure precise control of the table level.



HiSpec Round Leg

Versions with Schrader valves are supplied for static use. Our range of pneumatic-cushion isolators with 3Hz resonance frequency are ideal for less demanding applications, and when minimum isolation is required we supply our buffer 9Hz rubber isolators as standard.

SELECTING A SUPPORT SYSTEM

In choosing an isolation system it is important to bear in mind that generally isolation will improve as load increases and to ascertain the level of disturbances that needs to be isolated away.

ROUND LEG SUPPORTS

Normally used for tables 6x4ft and over and purchased in sets of four, however additional legs may be used for very large tables or high loads. Standard heights are 24"/600mm and 28"/700mm, however we can supply to almost any height as required.

*Self-Levelling
Round Leg*



FRAME SUPPORTS

Frames are ideal for small tables, breadboards and workstation applications. Stainless steel versions are available for cleanroom use. Specify if non-standard working height is required.

9Hz C-frame



LABORATORY WORKSTATION

Our range of laboratory workstations provide a stable base for sensitive instruments. They comprise C-frames with a choice of HiSpec, Cushion or Buffer isolator and worktops in electrofinished stainless, white laminate or **CarbonBlack** finish. Options include self levelling, arm rests, sliding shelves and castor/levelling feet. Fixing hole patterns to order as required.

*Basic
Laboratory
Workstation*



CLEAN ROOM SERIES

For clean environment applications we manufacture our table tops and supports in electrofinished stainless under controlled conditions. Products are thoroughly cleaned and double wrapped so they can be introduced into clean environments without fear of contamination.

*Laboratory
Workstation
with white
laminate top*



SPECIFICATIONS

Tables & Breadboards

	HiSpec	Research	LiteLine	Breadboard
Standard Sizes (ft)	6x4 to 12x5	6x3 to 12x5	2x3 to 12x5	1x2 to 5x10
Table Thickness (inches/mm)	12"/300 mm	8"/200 or 12"/300mm	4"/100mm	2 1/4"/56mm
Top Skin (inches/mm)	1/4"/6mm laminate	1/5"/5mm	1/5"/5mm	1/5"/5 or 1/8"/3mm
Flatness over 1sq metre (mm/in.)	± 0.15mm / 0.006"	± 0.15mm / 0.006"	± 0.15mm / 0.006"	± 0.2mm / 0.007"
Core	Multi-layer <i>NORMALEX</i>		Mono-layer <i>NORMALEX</i>	
Threaded Holes	Metric M6 on 25 or 50mm centres. Imperial 1/4-20UNC 1" or 2" centres			
Hole Type	Double Sealed			
Weight kg/cm ²	0.01	0.01	0.01	0.01
Static Deflection µm/100kg	0.1	0.15	0.15	0.2
Ordering Details: Specify Table Series - Size (L x W x H) Metric or Imperial - Hole Spacings				

Support & Vibration Isolation

	ROUND LEG			C-FRAME		
	HiSpec	Cushion	Buffer	HiSpec	Cushion	Buffer
Isolation Type	Rolling Diaphragm	Air	Rubber	Rolling Diaphragm	Air	Rubber
Natural Frequency (Hz)	1	3	9	1	3	9
Light Duty load (lbs/kg) *	264lb/120kg	300lb/136kg	220lb/100kg	264lb/120kg	300lb/136kg	220lb/100kg
Heavy Duty load (lbs/kg) **	693lb/315kg	598lb/272kg	484lb/220kg	693lb/315kg	598lb/272kg	484lb/220kg
Air Pressure (bar)	5.5 typical - 7.0 maximum					
Height Adjustment Range (in/mm)	2/3"/15mm	1/2"/12mm	1"/25mm	1 1/5"/30mm	1 1/5"/30mm	1 1/5"/30mm
Self Levelling	✓	✗	✗	✓	✗	✗
Castors	✗	✗	✗	✓	✓	✓
Support shape (in./mm)	10 3/4"/273mm diameter			4 3/4 x 4 3/4"/120x120mm sq leg		
Ordering Information: Specify Support Type, Isolator Type, Table Size & Load and Working Height						

* at 5.5 bar for pneumatic types

** NOTE: Heavier duty versions can be supplied non-standard.

// SPEIRS ROBERTSON //

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