MODEL SC-V

of the

Signature Collection

DELUXE REFERENCE-STANDARD MONITOR

— — —

by

Dunlavy Audio Labs

USER HANDBOOK

CONTENTS

I. INTRODUCTION

A. BACKGROUND

Congratulations!

With performance exceeded only by DAL's "Flagship" SC-VI loudspeaker, your new DAL SC-V Reference-Monitors are truly without peer in the marketplace. As a very prestigious member of the Dunlavy *Signature Collection*™ of loudspeakers, they are documentably one of the most accurate reproducers of sound available anywhere, regardless of price or size. In many respects, they are more accurate than the best and most expensive Digital-to-Analog Converters (DACs). As a consequence of this significant advance in accuracy, the loudspeaker has been effectively removed as the "weak link" in the chain of audiophile components.

Although many manufacturers talk about the accuracy of their loudspeakers, only DAL provides full documentation of all relevant performance parameters, measured in one of the world's best-equipped laboratories by a highly competent staff of engineers and technicians. The accuracy of this documentation is backed by a guarantee from DAL certifying it to be limited only by the accuracy of the best available measurement equipment. (Talk is cheap - accurate documentation and measurements are expensive).

Your SC-V loudspeakers were personally designed by John Dunlavy, a Registered Professional Engineer who has earned an international reputation since 1950 for his many inventions, patents, technical papers and books in the fields of antenna design, electromagnetic theory and acoustics. His contributions to the field of loudspeaker design have achieved more "best-sound at the show" reviews in major trade journals since the mid-1970s than perhaps those of any other designer.

B. A NEW PERFORMANCE STANDARD FOR REFERENCE MONITORS

The DAL model SC-V was designed to be an ultra-accurate, true "reference-standard loudspeaker", suitable for use by recording studios and audiophiles requiring the most accurate reproduction possible within the current state-of-the art. No other known brand of loudspeakers utilize the advanced technology and level of design sophistication as those of the DAL Signature Collection. As such, the DAL Signature Collection truly sets a new standard for performance among loudspeakers specified for studio monitor applications.

Indeed, within a good listening environment, a pair of SC-V monitors can re-create well-recorded music with an ultra-flat spectral-balance and a precise, stable soundstage that is nothing short of breathtaking - a remarkably close encounter with the original live performance. The unique accuracy of the SC-V is traceable to the meticulous attention given to design goals such as extremely flat amplitude and phase response, very low distortion, true "time/space collimation" and pulse-coherent™ operation, point-source radiation, inaudible cabinet diffraction, symmetrical radiation patterns, broad vertical/horizontal dispersion and precise pair matching. Also, DAL's manufacturing process requires 100% Q.C. testing of every driver, component, sub-assembly and each assembled loudspeaker. Crossovers use only the highest-quality components like MIL-Spec P.C. boards, air-core inductors and hi-Q polypropylene capacitors.

At DAL, the manufacture of loudspeakers is more than a mere job - it is a genuine labor of love involving the dedicated efforts of every employee!

II. DESIGN

A. FEATURES

As a true reference-standard monitor loudspeaker, the SC-V has no known rival in its price and size class with respect to performance attributes and unique features. Among these are the following:

WELL-DOCUMENTED, ACCURATE MEASUREMENT OF EVERY PERFORMANCE PARAMETER IMPORTANT TO ACCURATE REPRODUCTION. (see Appendix)

EXTREMELY-FLAT AMPLITUDE AND PHASE RESPONSE VERSUS FREQUENCY.

IMPULSE RESPONSE THAT RIVALS THE BEST CD PLAYERS AND D/A CONVERTERS.

VIRTUALLY NO DIFFRACTION DISTORTION. *

EFFECTIVE POINT-SOURCE RADIATION.**

BROAD AND SYMMETRICAL RADIATION PATTERNS, IN BOTH VERTICAL AND HORIZONTAL PLANES.

VERY SMOOTH ROOM (POWER) RESPONSE.

ULTRA-LOW NON-LINEAR DISTORTION, EVEN AT HIGH LEVELS.

VERY-HIGH EFFICIENCY/SENSITIVITY (APPROX. 91 DB SPL, RE: 1 METER & 2.83 VOLTS/RMS).

LOW-Q SEALED-ENCLOSURE WITH OPTIMAL BASS-DRIVER DAMPING.

SPECIALLY-MADE, ACOUSTICALLY-TRANSPARENT GRILL-CLOTH.

A LARGELY-RESISTIVE INPUT IMPEDANCE THAT VARIES ONLY FROM 2.5 TO 5 OHMS OVER THE FULL 20-20,000 HZ RANGE.

WIDE, ON-AXIS. LISTENING RANGE FOR ACCURATE PERFORMANCE SPANS 8-40 ft.

HIGHEST-QUALITY COMPONENTS (AIR-CORE INDUCTORS, HI-Q CAPACITORS, PRECISION RESISTORS AND FIBERGLASS PCB).

100% Q.C. MEASUREMENT OF EVERY COMPONENT AND SPEAKER, WITH ACCURATE PERFORMANCE-MATCHING OF EACH PAIR.

---

* U.S. PATENT # 4,167,985, covering the generic use of efficient absorbing material to reduce the effects of edge diffraction, issued to John Dunlavy on 9/18/79 .

** The use of a "point-source" array of drivers, symmetrically disposed above and below a central tweeter, was first pioneered by Mr. Dunlavy and introduced at the 1978 WCES in Las Vegas.

B. SPECIFICATIONS

ELECTRICAL (Measured, as applicable, at a distance of 10 feet on the tweeter axis and at an ambient temperature of 73 deg. F.)

AMPLITUDE/FREQUENCY RESPONSE: +/- 2.0 dB from 23-20,000 Hz.(Approx. -3 dB at 22 Hz.)

PHASE/FREQUENCY RESPONSE: within less than about +0, -15 degrees from approx. 200-20,000 Hz.

SENSITIVITY: approximately 91 dB SPL for 1 watt input (2.83 Volts/RMS)

IMPEDANCE: Nominal 4 Ohms (min. = 2.5 Ohms and max. = 5.0 Ohms, incl. bass-resonance)

PULSE COHERENCE™: Impulse response is equal to or better than most CD players and DACs.

RADIATION PATTERNS: Precisely symmetrical in both vertical and horizontal planes.

DRIVER CONFIGURATION: Simulated "point-source" radiation from a symmetrical driver array.

DIFFRACTION DISTORTION: Virtually eliminated by use of highly-efficient acoustical absorption materials located on all relevant surfaces.

LOW-FREQUENCY DAMPING: The bass drivers and chamber are optimally-damped with a Q of approximately 0.6 (with an initial low-end rolloff of 6-8 dB/octave).

CROSSOVER DESIGN: Minimum-phase type (6 dB/octave), compensated for driver response anomalies and resonance/phase variations.

HARMONIC DISTORTION: Less than about 0.3 % for an SPL of 90 dB (re: 1 meter) at all frequencies above about 40 Hz.

POWER: All drivers and crossover components are designed to handle peak powers up to approximately 250 watts for 10 milliseconds or an average (pink-noise) power of 25 watts.

PAIR-MATCHING: Speakers are matched as pairs to within less than about +/- 0.5 dB up to 15 kHz to obtain extremely accurate and stable imaging (even when spaced apart up to 110 degrees).

DRIVERS: Two 12" long-throw woofers, two 7" long-throw basses, two 3" diameter high-definition dome-mids and one 1" diameter pulse-compensated silk-dome tweeter.

INPUT CONNECTORS: Dual, heavily gold-plated, 5-way binding posts in a recessed housing.

SEE APPENDIX FOR DOCUMENTED MEASUREMENTS OF KEY PERFORMANCE PARAMETERS.

PHYSICAL/MECHANICAL

SIZE (approx.): 75" (1905 MM) high x 15 (381 mm) wide x 27" (686 mm) deep.

WEIGHT: Each loudspeaker weighs approximately 305 pounds (139 kilos).

MATERIAL: MDF with selected wood veneers.

STANDARD FINISHES : Light or black American Oak, DALWOOD Rose' and DALWOOD Cherry. (Other finishes are available on special order, at a small additional cost.)

III. UNPACKING

A. CHECKING THE SHIPPING BOX

Every effort was made to properly package the SC-V loudspeakers in a manner designed to ensure their safety during shipment. However, mishandling can take place during shipment, resulting in damage.

Therefore, it is important to examine the exterior of the shipping boxes upon arrival for any visible damage before proceeding with unpacking. Any apparently serious damage to the exterior of the boxes should be immediately brought to the attention of the company responsible for the delivery so that, if necessary, an appropriate claim for loss can be lodged. If it seems reasonable that damage may have occurred to the speakers inside the box, both the exterior and interior boxes should be opened in the presence of a representative of the delivery company. In the event of damage, failure to immediately file appropriate claim forms may result in non-payment for any damage incurred during shipment.

B. UNPACKING

Handling loudspeakers the size and weight of your SC-Vs (about 300 pounds each) can be dangerous and should be undertaken with extreme care to preclude damage to the loudspeaker and/or possible physical injury. It is recommended that you consult your dealer or a competent mover (such as one experienced with moving and setting up a grand piano) before undertaking the task. Suitable equipment and personnel will be required to ensure proper unpacking and transporting to the listening room.

Your SC-V loudspeakers, and their respective bases, have been shipped in separate containers strapped atop two sturdy wooden pallets. Each loudspeaker base is packaged separately atop its matching loudspeaker container. Like the loudspeakers, the bases are heavy (each weighing about 50 pounds) and require careful handling to avoid injury. To ensure maximum protection from damage during shipment, each loudspeaker was covered in polywrap and packaged in an "inner-box", housed within a sturdy "outer-container", with the two boxes separated from each other by large shock-absorbing foam panels and blocks. The outer container is secured to the pallet by a substantial number of large screws and lag bolts.

Because of the size and weight of each pallet and box, it is generally best to remove the loudspeakers and their bases from each pallet before moving them inside. The steps below are offered only as suggestions for unpacking the loudspeakers under typical conditions, out-of-doors (weather permitting). Your own location and situation may require a deviation from these suggestions. Therefore, before proceeding, it is always best to carefully consider all of the steps involved and the problems that might be encountered in unpacking and carrying the loudspeakers to their listening location, to prevent the wood veneer from becoming scratched or marred.

(If bad weather necessitates, the outer-boxes can be unpacked indoors, but generally with more effort required because of limited clearances and space.)

STEP # 1

At a location convenient for the initial stage of unpacking, cut the metal straps and remove the screws and lag bolts securing the bottom "outer flap" of the exterior cardboard box to the wooden pallet. Then, remove the top box housing the loudspeaker base and set it aside out of the way. Follow this by lifting up and removing the outer cardboard covering, exposing the interior cardboard box. Open the top flaps of the interior box and carefully remove the upper and side foam panels protecting the loudspeaker.

DO NOT PUSH ON OR TOUCH THE GRILL SINCE THIS COULD RESULT IN DAMAGE TO THE FRAGILE DRIVERS LOCATED BENEATH IT. Next, remove the inner cardboard box surrounding the loudspeaker. Being cautious not to damage or mar the exterior surfaces of the loudspeaker, use a sharp knife or other suitable instrument to slit and remove the polywrap material covering the loudspeaker.

STEP # 2

Remove the loudspeaker bases from their respective boxes and attach them to the bottom of each loudspeaker (the end with the holes) using the long "shoulder bolts" provided. The orientation of the base should be such that its front end projects several inches forward of the front of the loudspeaker, while the back side of the base is essentially flush with the rear side of the loudspeaker. When properly aligned, the bolt holes in the base should exactly match the location of the holes at the bottom of the loudspeaker.

Place a bolt (with its flat washer) through one of the holes in the bottom of the base and into its matching hole on the bottom of the loudspeaker enclosure. Begin to carefully thread the bolt into the "Tee-nut" located inside the bottom end of the loudspeaker enclosure, exercising care not to cross-thread it. Each bolt should engage its matching tee-nut in a smooth manner when both are correctly aligned. Before tightening this first bolt, insert each of the other bolts into their respective holes. Make sure that the base is accurately aligned (visually) to the bottom of the loudspeaker enclosure and then proceed to securely tighten each of the bolts (using a suitable socket wrench).

STEP # 3

Once the bases are securely attached, the loudspeakers may be raised to a vertical position, being careful not to scratch the back side of the enclosure against the pallet during lifting. The bases should sit on a relatively level and smooth surface, free of any material that might scratch or mar their surface.

STEP # 4

With an appropriate number of personnel and proper equipment, such as a large size hand-truck used for moving pianos or refrigerators, transport the loudspeakers to the listening room and locate them as close as possible to their desired location.

Lifting and moving the loudspeakers should always be accomplished by avoiding all contact with the grill and/or its frame. The specially-designed, acoustically-transparent grill is not intended to protect the drivers behind it. The high-tech cones of the loudspeaker drivers and the silk dome of the tweeter are extremely delicate and fragile. Therefore, never touch them or push against them (even lightly) - both are very easily damaged and expensive to replace. (The DAL Limited Warranty does not cover any damage incurred by improper touching or handling.)

IV. SYSTEM CONSIDERATIONS

A. GENERAL

As mentioned in the introduction, the loudspeaker is usually the "weakest link" in the chain of audiophile system components. This is because loudspeakers are electro-mechanical transducers posing several highly-complex design challenges and because proper loudspeaker measurements require an extensive laboratory equipped with a large amount of expensive equipment operated by competent engineering personnel. But other system components, and the listening room itself, interact with loudspeakers in a way that is often poorly understood - even by many professionals. And, while your SC-V loudspeakers are designed to extract the best performance from all other system components, it may be possible to optimize your system by utilizing these interactions in the most advantageous way available. Thus, an attempt will be made in this chapter to explain some of the more important system parameters and interactions using language that should be familiar to most audiophiles.

The information supplied below is intended to assist you in obtaining the level of performance you anticipate and deserve from your DAL loudspeakers. Because the application of engineering and scientific principles to practical situations can be very complex and easily misunderstood when translated into terms comprehensible to the average layman, DAL offers the following guidelines only in the context of suggestions and accepts no responsibility for their failure to satisfy any expectations, whether expressed or implied herein.

B. SYSTEM COMPONENTS

The components of an audiophile system may be envisioned as a "chain", consisting of several individual links. As such, the weakest-link establishes the integrity of the entire chain. The ability of an audiophile system to achieve its full potential for accurate reproduction depends primarily on three important factors: 1) the quality of the individual components comprising the system; 2) the complex interaction between those components; and 3) the quality of the listening environment and its interaction with the loudspeakers.

In order of descending importance, regarding their relative contribution to overall system accuracy, the components of an audiophile system are:

1. Loudspeakers.
2. Listening environment.
3. Source of music or program material (quality of recording, etc.).
4. Playback system (CD, LP, Tape, D/A processor, etc.).
5. Amplification equipment (Pre-amp, power-amp, etc.).
6. Loudspeaker cables.
7. Interconnect cables.

This proposed order of relative importance is based upon a typical audiophile system using components of approximately equal quality. The same order may not apply to systems where an imbalance exists with respect to component quality. Loudspeakers were given the leading position because they usually contribute more audible distortion and coloration than any of the other components or parts of the total system. (As such, when a system upgrade is contemplated, consideration should be given to allocating a large portion of the intended expenditure to better loudspeakers as a means of obtaining the most audible improvement per dollar.)

The acoustical properties of the listening environment and the proper placement of the loudspeakers within the room are the second most important consideration in optimizing the performance of an audiophile system. Either poor room acoustics or a poor location for the loudspeakers within a room can seriously degrade sound quality. And, it is interesting to note, accurate loudspeakers usually suffer the most from a poor listening environment. (This will be covered in more detail below.)

Not all CD's, LP's and tapes are created with equal sound quality. A truly accurate audiophile system will frequently reveal one or more types of distortion to those with discriminating ears. Distortion is most often encountered with recording labels whose producers give scant attention to pleasing critical listeners (caveat emptor). Therefore, when choosing recorded material for demonstrating the accuracy of your system, it is advisable to select from among labels which have earned a reputation for consistently maintaining the highest quality of reproduction. Labels such as Chesky, Delos, DMP, Dorian, Harmonia Mundi, GRP, Reference Recordings, Sheffield Labs and Telarc are but a few of those recognized in audiophile circles for their devotion to capturing and preserving the intricate details and spectral-balance of the live performance. But even these respected labels occasionally produce a recording that does not measure up to their usual standard of fidelity to the sound of the live source.

Today's better quality CD players generally have the capability of reproducing music with an accuracy only imagined a few short years ago. This is especially true if a high-quality D/A processor is used with a high-quality CD transport system. However, improvements and refinements are still possible with this medium and are evident in the latest CD's and processors utilizing quasi-20 bit digital architecture (or other means of "linearizing" or extending the dynamic range of the digital path). Although third on the priority list of components, the playback system is deserving of due attention.

When driving accurate loudspeakers having a nearly resistive impedance with variations of less than about 2:1, virtually all of today's "state-of-the-art", high-current/high slew-rate power-amps, with power ratings exceeding 100 watts into 8 ohms, are capable of reproducing even the finest musical details and nuances with very high accuracy. However, even though the differences between power-amps are relatively small, they can still be detected with systems using good loudspeakers and other quality components. Power-amp specifications quoting levels of distortion into 4 or 8 ohm loads provide little indication of the audibility of complex distortion components when the amplifier is connected to a loudspeaker whose impedance curve (and reactive components) fluctuates wildly with frequency. For example, a well-designed amplifier rated at 100 watts into an 8 ohm load should be able to deliver 200 watts into 4 ohms and 400 watts into 2 ohms, if it is to remain "linear" under the load conditions presented by many of today's loudspeakers. Also, some amplifiers exhibit an instability when used with high-quality, low-loss loudspeaker cables and interconnect cables, requiring caution when configuring a system.

Loudspeaker cable is a subject almost guaranteed to elicit a "spirited" discussion among typical audiophiles. Frankly, while a few well-designed cables are available in audiophile stores at reasonable prices, the majority are not designs based upon sound engineering theory or principles. Such cables gain popularity based upon flawed subjective listening comparisons rather than by comparisons involving relevant measured performance and objective "blind" listening tests. Also, there is virtually no correlation between price and performance, with some of the most expensive being the worst performers. For lengths of less than about 8-10 feet, high-quality, stranded #6 AWG copper wire with a polypropylene jacket (available at most electrical stores) can be used with good results if twisted together as a pair to lower the impedance. For longer lengths, heavy gauge electric-welding cable may be satisfactory, again keeping the pair of conductors close together (preferably twisted). The ends of each wire should be stripped and thoroughly cleaned of any oxidation before installing low-loss connectors (preferably gold-plated banana pins or lugs). The connectors may be soldered to the wire or "crimped" if a professional type crimping tool is available. Actually, most audible problems encountered with loudspeaker cables can be traced to poor quality connectors (pins or lugs) and/or poor connections. If mating connectors are made of dissimilar metals that are galvanically incompatible, the surfaces can form oxidation layers that exhibit a non-linear or semi-conducting resistance, resulting in measurable and audible levels of distortion. For those in quest of a well-engineered cable with incomparable performance, DAL has designed two extremely wideband, ultra-low loss cables with a true 6 or 8 ohm impedance (type Z-6 and Z-8) which is available from better audio stores at a very affordable price. (Z-6 and Z-8 cables can even reproduce 1 MHz square-waves with little or no waveform distortion, a feat which few, if any, competitive cables can match.)

Much like loudspeaker cable, many audiophiles have their favorite interconnect cables. But how does one discern which cables possess the characteristics needed to insure best performance? To begin, well-understood engineering and scientific principles teach that the following design criteria fully and accurately describe all of the meaningful performance attributes of a good interconnect cable:

1) A characteristic impedance of greater than about 150 ohms, along with a capacitance of less than about 10 pF per foot (to minimize loading of the source impedance and a potential roll-off of the frequency response at high frequencies.)

2) A highly conductive ground-return lead (a shield or wire which provides good rejection of hum and noise fields).

3) High-quality connectors, with pins and shield connections made of the same metal as that of the mating connectors on the equipment to which the cables will be attached (to prevent distortion due to possible "non-linear" contact resistance between dissimilar metals).

4) Minimal "microphonic" properties (to prevent "acoustically-induced" noise).

Cable "loss" normally has no relevance when applied to interconnect cables where the "load impedance" typically exceeds 10,000 ohms. Therefore, beyond meeting these four design goals, virtually all else represents parameters of questionable merit. DAL type ULC-DF Interconnect Cable, with only 8.4 pF of capacitance per foot (the lowest known capacitance in the industry), an ultra-low loss shield, immeasurable microphonics, very high quality connectors and flat frequency response to beyond 1 MHz (in most systems) represents a very good choice for informed audiophiles wanting the best - at an affordable price.

C. SPECIAL ACOUSTICALLY-TRANSPARENT GRILLS

DAL has developed special grill cloth that is almost perfectly transparent throughout the audio spectrum. The fabric is a specially-designed, custom-made double-knit material, fabricated of a select grade of polyester material possessing optimally configured interstices that permit sound waves at all audible frequencies to pass without measurable attenuation, reflection or diffraction. The very small effect of the grills and fabric was taken into consideration during design, such that the performance of the loudspeaker has been optimized with the grills installed.

As a consequence, the grills should be left in place and should not be removed to obtain best performance.

D. LOUDSPEAKER BREAK-IN FACTS

The highly-compliant "suspension system" used to keep both the voice-coil and the cone or dome of loudspeaker drivers properly centered plays a major role in establishing what is called the driver's "free-air resonance". This free-air resonance usually occurs at or near the frequency at which the driver's amplitude vs. frequency response curve begins to roll off below its average level. It is directly related to the combined moving-mass (voice-coil and cone or dome) and the mechanical compliance of the suspension system. Since the suspension system of a driver is usually fabricated of an impregnated cloth or foamed-plastic material, whose "mechanical stiffness" becomes slightly more compliant as it vibrates and flexes over time, usage tends to gradually lower the resonant frequency of the driver - a desirable trait that improves, to a small degree, a loudspeaker's performance.

The bass-woofer system-resonance of a loudspeaker is determined by the combination of the free-air driver-resonance and the resonance of the bass-enclosure. In fact, to a good, first-order approximation, the system-resonance of a loudspeaker is simply the square-root of the product of the driver-resonance and the enclosure-resonance. Thus, it may be seen that low-frequency bass performance of a loudspeaker will generally improve somewhat with usage.

All DAL loudspeaker models use speaker drivers that are partially broken-in at the factory. The tweeter does not require a break-in period. The mid-range drivers require only a few additional hours of listening at moderate sound levels to fully complete their break-in period. The woofer drivers require a more extended break-in period, averaging about 12 to 15 hours of listening to fully lower the system resonance to its specification value. Contrary to popular opinion, crossover networks, utilizing quality capacitors, inductors and resistors, do not require any "breaking in" time.

V. LOUDSPEAKER BASICS

Misinformation has led many audiophiles to wrongly believe that the accuracy of loudspeakers can be determined only by means of subjective listening tests performed within a familiar room. Such misinformation has also frequently nurtured the opinion that measurements of loudspeaker performance do not correlate very well with how a given loudspeaker will sound. This falsehood is usually traceable to conclusions drawn from the use of either incomplete or inaccurate measurements of loudspeaker performance.

Unfortunately, for reasons of convenience or because of equipment limitations, performance measurements are frequently made at a distance of only 36 to 45 inches (even by well-meaning audiophile magazines). Of course, such short-distance measurements can hardly be trusted to reliably predict the sound quality of loudspeakers at typical listening distances, except for those models whose largest dimension is less than about 18 inches. This is because the frequency response, phase response, impulse response and many other important performance properties that affect the accuracy of a loudspeaker are dependent upon the relative path distance between each of the speaker drivers (tweeter, mid-range and woofer) and the listener.

Considerable research performed during the past several years has clearly demonstrated that a complete set of credible measurements can reliably forecast how accurate and realistic a given loudspeaker will sound when properly located within a good listening environment. Indeed, in the same context that most knowledgeable audiophiles require that their amplification equipment and CD players exhibit near-perfect measured performance, it seems strange that the same requirement should not be applied to loudspeakers. Otherwise, the loudspeaker potentially becomes the weak-link in the reproduction chain.

Loudspeaker performance properties that are most important to our perception of realism are:

1. DISTORTION

   a. Linear

      (1) Variation of amplitude (SPL) versus frequency (popularly called "frequency response").
      (2) Variation of phase versus frequency (popularly called "phase response")
      (3) Variation of amplitude versus time (impulse-response and step-response)
      (4) Diffraction (re-radiation from enclosure edges, etc.)

   (It is interesting to note that these four basic types of linear distortion are usually related to each other by common causes and are easily identified by a measurement of the impulse-response and step-response.)

   b. Non-linear (generation of amplitude components at frequencies not present in the original signal)

      (1) Harmonic
      (2) Intermodulation and Cross-modulation (Doppler)
      (3) Mechanical (vibration, rattling, etc.)

2. DIRECTIVITY (radiation patterns)

   a. Type of radiator (uni-directional, bipolar, dipolar or omni-directional)

   b. Angular dispersion (beamwidth in both vertical and horizontal planes)

   c. Radiation pattern symmetry (symmetrical point-source or asymmetrical type radiation)

   d. Off-axis response (side-lobe levels, "room-response", etc.)

3. INPUT IMPEDANCE

   a. Resistive component vs. frequency

   b. Reactive component vs. frequency

4. EFFICIENCY

With regard to the two basic categories of distortion, linear distortion is almost always the least audible and least objectionable. This is generally true for two reasons:

1. We are conditioned to hearing the linear distortion produced naturally by most musical instruments by virtue of their size and shape (frequency response), edges (diffraction), etc., which usually affects their timbre and harmonic structure in a complex but pleasing manner).

2. We learn to aurally compensate for the peaks and valleys in frequency and phase response caused by reflections from various surfaces within the listening room.

There are many sources of linear distortion in a loudspeaker. Among the most obvious are:

1. Inaccurate loudspeaker drivers or drivers with response properties inappropriate for the use intended, e.g. inadequate overlap through the important "crossover region".

2. Poor crossover design (non-minimum phase properties - not pulse-coherent).

3. Incorrect time-domain (path) alignment of drivers.

4. Improper enclosure design (wrong overall dimensions, internal volume and/or incorrect height-to-width-to depth ratios).

5. Incorrect internal damping of enclosure (wrong Q, improper type or quantity of damping material, etc.).

6. Insufficient stiffness and damping of enclosure walls.

7. Lack of proper means for eliminating the effects of edge diffraction

8. Large fluctuations of input impedance versus frequency and/or a large reactive component.

9. Poor radiation patterns (incorrect ratio of on-axis response to room response versus frequency, a main lobe whose shape is asymmetrical with respect to the listening axis, in either the horizontal or vertical plane, etc.).

Linear distortion is also created when sound reflections from the walls, floor and ceiling of the listening room combine with the direct sound from the loudspeakers, resulting in alternate peaks and valleys in the curve of amplitude (and phase) versus frequency, as measured at the listening position (often referred to as a "comb-filter" response). If these reflected sounds encounter delays exceeding about 35 milliseconds relative to the direct sound (distances exceeding 40 feet), the perception will usually be that of listening in a "large hall". However, reflected sounds with delays of less than about 10 milliseconds (approximately 11 feet) are usually perceived as objectionable peaks and valleys in the frequency response of the system, especially at frequencies below a few hundred Hertz.

By contrast, non-linear forms of distortion originating within the loudspeaker always generate "new" and "un-natural" sounds at one or more frequencies which did not exist within the frequency spectrum of the original sound being reproduced. Because such distortion does not correlate very well with the live musical sounds we have experienced and stored in our subconscious memory, they tend to attract our attention much more readily than linear distortion components.

Of the three forms of non-linear distortion mentioned above, mechanically induced types (severe cabinet vibrations, rattling components, voice-coil rubbing, etc.) are usually the easiest to detect and the most aurally displeasing. Such distortion is usually perceived as a buzzing, scraping, squawking or rasping sound.

In a similar manner, intermodulation distortion is generally more audible and objectionable than harmonic and cross-modulation (Doppler) components because the latter two types appear in the spectrum of virtually all musical instruments.

The impulse response of a loudspeaker, i.e. its ability to reproduce a short duration cosine pulse (or its integral, the transfer function) with little "overshoot" and "ringing", is important because it defines performance in several categories, including:

1) Variation of amplitude versus frequency.

2) Variation of phase versus frequency.

3) Collimation of path-lengths between each of the loudspeaker drivers and the listener.

4) Performance of the crossover network with respect to minimum-phase operation and time-domain pulse-coherency.

5) Diffraction and or reflections from enclosure edges, protruding driver flanges/edges, etc.

6) Production of anomalous sounds due to enclosure resonances, vibrations, etc.

Accurate loudspeakers should exhibit nearly perfect impulse response (transfer function), with little negative overshoot and almost no ringing.

Diffraction or reflection of sound waves from the edges of the enclosure or protruding objects, produces the following types of distortion:

1) Serious peaks (> 3 dB) and nulls (> 10 dB) in the amplitude-versus-frequency response.

2) Ringing of the impulse response (and musical transients).

3) Blurring of the impulse response (and musical transients).

Diffraction distortion can only be diminished by two means: a) the use of efficient acoustical absorbing material located between the affected driver and the offending edge of the enclosure*, or b) curving the offending enclosure edges with a radius exceeding about one-sixth wavelength at the frequency for which the width or height of the loudspeaker is about one-wavelength. For enclosures of average size, this lowest frequency usually occurs between about 500 to 1,000 Hertz, corresponding to a minimum required radius of from 2.3 to 4.5 inches (a radius too large for most designs). Some loudspeaker designers have succeeded in mitigating the diffraction problem by locating the mid-range and tweeter drivers on the front baffle surface in an asymmetrical manner so that the distance from the center of a driver to each of the enclosure edges is not divisible into any of the other distances by a "whole number" (integer). While this "solution" may result in a reasonably smooth curve of on-axis frequency response, the off-axis frequency response is usually riddled with peaks and valleys, and the directivity patterns become asymmetrical (with lobes at undesirable angles), often no more than a few degrees off-axis.

The directivity properties (radiation patterns) of a loudspeaker significantly affect the realism of the sound it reproduces, quite apart from its measured on-axis performance. This is because much of the off-axis radiation is reflected from the walls, floor and ceiling of the listening room, after which it eventually reaches the ears of the listener. The total sound energy radiated by a loudspeaker versus frequency, i.e. the sound intensity "averaged" (integrated) over the surface of an imaginary sphere surrounding the speaker, is referred to as its "Power Response". While an ideal loudspeaker would exhibit a flat curve of on-axis amplitude-versus-frequency, its power response curve would exhibit a smooth roll-off with increasing frequency in a manner approximating the average of the power responses of the majority of musical instruments. Although the majority of musical instruments exhibit different radiation patterns, their power responses are remarkably similar. This feature permits the design of loudspeakers that exhibit flat on-axis response while simulating the "average" off-axis power response of musical instruments with sufficient accuracy to create the illusion of live music in a good listening environment. (Your SC-V has this capability.)

Since most musical instruments exhibit radiation which is essentially unidirectional at frequencies above about 500 Hertz (especially horn and string instruments), loudspeakers intended to emulate their sound within the average listening room should exhibit similar unidirectional properties. Also, the back-radiation from bipolar and dipolar type loudspeakers (with bi-directional radiation) usually creates a wide but diffuse soundstage, with poor center-imaging on well-recorded center-stage vocals, etc.

* U.S. PATENT # 4,167,985, covering the generic use of efficient absorbing material to reduce the effects of edge diffraction, issued to John Dunlavy on 9/18/79 .

Further, compelling reasons related to the geometry of typical rooms (and the radiation properties of many musical instruments) dictate the superiority of radiation which simulates a hypothetical, unidirectional, point-source of radiation having symmetrical radiation patterns in all planes. (The SC-V was designed to meet these requirements.)

The input impedance of a loudspeaker is important because of interaction that occurs between it and the output circuit properties of the power amplifier. This interaction can adversely affect system performance in two ways:

1) It can alter the amplitude-versus-frequency response.

2) It can produce non-linear distortion products.

Take, for example, an audiophile system with a poorly-designed loudspeaker having an input impedance that varies from 2 ohms to 30 ohms (all resistive), connected through a length of cable having a resistive loss of 0.25 ohms to a power amplifier with an internal output impedance of 0.25 ohms (resistive). At frequencies where the loudspeaker impedance drops to 2 ohms, the system loss becomes 1.94 dB, which reduces to only 0.14 dB at frequencies where the impedance rises to 30 ohms, a +/- 0.9 dB variation. This additional loss may convert a loudspeaker response curve from +/- 2 dB to one approaching +/- 3 dB. The SC-V, by contrast, with an impedance fluctuation of from only about 2.5 to 6 ohms, will have its frequency response curve altered by no more than about +/- 0.3 dB.

Perhaps worse, such swings in loudspeaker impedance are often accompanied by the presence of a reactive component that is much larger than the resistive component. Such large reactive components, especially if they occur at higher frequencies, can cause some amplifiers to become unstable, resulting in audible non-linear distortion (or even oscillation). The impedance of the SC-V is almost entirely resistive, making it easy for almost any amplifier to drive with no interaction or instability problems.

If all of the above information sounds a bit complex, it is - even for many engineers! If it were simple and easy to implement, the market would be full of accurate loudspeakers. That is why DAL maintains what is believed to be one of the best-equipped audio measurement facilities in the world, with a competent staff of engineers and technicians under the leadership of John Dunlavy.

Proof that your SC-V's meet or exceed all of DAL's published specifications is provided by the full set of accurate performance measurements (made on-axis at a distance of 10 feet) which can be found in the Appendix of this manual. DAL invites you to compare these measurements (of guaranteed accuracy) with those of all other brands of loudspeakers, regardless of cost. We sincerely believe you will discover that the performance of your loudspeakers is truly without peer, regardless of price or size.

Loudspeaker "sensitivity" is commonly referred to as the sound-pressure-level in dB (SPL) that a loudspeaker will produce at one meter (on-axis) with an input signal of 2.83 volts, RMS (1 watt into 8 ohms). Sensitivity/efficiency is relatively important because it is a measure of how large an amplifier will be needed to drive a given loudspeaker to normal listening levels. And, since it is easier to design a better-performing lower-power amplifier (at a lower selling price per watt) than one of higher-power, loudspeaker sensitivity and efficiency can be important. Further, a loudspeaker which exhibits above average sensitivity often produces significantly less distortion since it is converting less power into heat.

Your SC-V loudspeakers will produce a SPL of approximately 91 dB for an input of 2.83 volts, RMS (1 watt into 8 ohms), which is about 4 to 5 dB higher than most other high-quality loudspeakers. As a consequence, the SC-V requires only about one-third as much amplifier power as most competitive loudspeakers to achieve the same sound level.