

# Your High Fidelity Music System

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HIGH FIDELITY has been defined in many different ways. The words mean "extremely faithful" and could apply in audio to reproduced sound which is "extremely faithful" to the original. Another interpretation is that high fidelity brings to the listener the same kind of sensations he would experience if present at the original live performance. Still another view is that high fidelity is that attribute of the whole reproducing system which tends to make the listener unaware that the sound is coming from a loudspeaker.

It is clear that human hearing and human sensations and emotions are part and parcel of high fidelity. It is also evident that there are *degrees of fidelity* ranging all the way from that which *most people* would recognize as *very poor* up to that which *many people* would classify as *outstandingly good*. Thus "high fidelity" is a relative thing, depending on our impression of "goodness." This is important to the purchaser of high fidelity equipment because engineering specifications cannot measure "goodness" as it will be interpreted by the listener. This is the reason that there are no generally accepted engineering standards for the term "high fidelity." It is one of the reasons that frequency range figures such as "30 to 22,000 cycles" cannot possibly convey an idea to the listener of the degree of "goodness" of a loudspeaker, nor even how a loudspeaker so described will sound in comparison to another for which different figures might be given.

In the early days of high fidelity, there was a tendency toward a harsh, brittle effect, perhaps combined with considerable boom in the bass. Today (when the best loudspeakers are used) true high-fidelity reproduction is clean, smooth and well balanced; artificial and spurious effects have been eliminated to the point where the music is enjoyable, realistic and comfortable to live with.

## THE MEANING OF HIGH FIDELITY

In practical terms, high fidelity means the reproduction of *music* in such a way as to afford a high degree of pleasure to a discriminating listener. Music is sound which is artistically organized to stir the human emotions. To accomplish this, rhythm, melody, har-

mony, *tone quality* and form are used by the composer, conductor and musicians.

When we attend a symphony concert, or dance to the live music of a favorite band, all of the original elements of the music are present to stimulate us; it is the real thing . . . thrilling and satisfying. We hear the individual voices of the instruments, the characteristic sounds of the percussion—in short, it is good listening.

Good listening is an important part of good living. Music in your home can be soothing, diverting, stimulating or entertaining as you choose—but it must be alive or fall short of its enormous potential for pleasure.

When we reproduce music in the home from records or radio (AM, FM or TV sound), something is missing from the performance unless we are fortunate in possessing equipment capable of better than average results. Today superior equipment is available and at moderate cost.

Tone quality is missing to a greater or lesser degree from mass produced radio or phonograph reproduction. How does a deficiency in tone quality show up, and what does it mean to the listener?

The rhythm, melody, harmony and form of the music still remain (though poorly expressed), with even the poorest quality of reproduction. But it is a type of music reproduction in which most of the beauty is lost and in the main only the mechanical elements survive. There is no resemblance to reality, only a distorted caricature of the original. Degraded tone quality shows up in a blurring of the tones, suppression of important details of overtone structure which differentiate the instruments, alteration of the balance between low and high tone sections of the orchestra, and introduction of boomy, dull, harsh or shrill effects, possibly in combination.

It is in the tone quality that much of the artistry and beauty of music is expressed. It is mainly in tone quality that one musical instrument is distinguished from another. It is the tone quality of the individual instruments which the composer uses to introduce infinite variations in mood and harmony. It is tone quality which is responsible for much of the thrilling stimulation of the emotions of the listener.

## THE MEANING OF FREQUENCY RANGE

Frequency range is *one* of the factors that importantly affects the fidelity of reproduction.

A relatively wide frequency range is essential to really good tone quality. The question is "How wide should the range be?" If the frequency range is too narrow, the music will sound dull and lifeless, some of the percussion will be entirely lost, and other instruments will merge and lose their identity. As the frequency range is widened, the music clears up and the individual instruments begin to stand out and become recognizable. As the widening is continued, the beauty and detail of the overtone structure becomes apparent and the music comes to life! After this point is reached, no matter how much the range is widened, there will be almost no noticeable improvement in the quality of the music under typical home listening conditions. The reason for this is that while there are components of music out to about 15,000 cycles which can be detected by sensitive instruments, those above 8,000 to 11,000 cycles are so faint that they are barely heard by most ears at the volume at which the music is normally reproduced in the home. A few loudspeakers with a wider frequency range have been developed; some have additional features such as wider angular distribution of sound or smoother response, which will more than justify their selection. Only a very little should be expected in the way of audible results from the additional range—unless you like your reproduction LOUD and have better than average ears.

Widening the frequency range adds detail to the reproduction. A visual analogy is the comparison of narrow range with a coarse screen halftone which suppresses all the fine detail.\* A fine screen halftone which is a "wide range" illustration gives a great deal of added detail and portrays many visual shades of tone. But like the finally diminishing effect of widening the frequency range on sound quality, there is a limit beyond which increasing the fineness of the halftone screen fails to be appreciated by the eye.

How does wide range reproduction sound in contrast to narrow range? The comparison is shown in the table for a

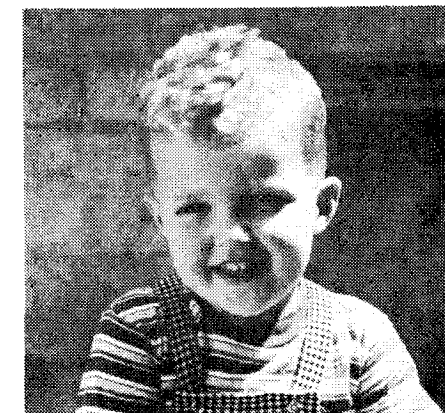
\*See figures on opposite page.



WIDE RANGE  
(High Fidelity)



MEDIUM RANGE  
(Medium Fidelity)



NARROW RANGE  
(Low Fidelity)

few "key" instruments which are good indicators of quality.

| COMPARISON OF INSTRUMENTAL QUALITIES WITH NARROW AND WIDE RANGE REPRODUCTION |   |   |
|--|---|---|
| INSTRUMENT   | NARROW RANGE  | WIDE RANGE  |
| Triangle   | Heard faintly or barely audible at low volume.  | Has clear, sustained ringing sound.   |
| Cymbals  | Dull sounding as though wrapped in cloth or made of soft metal.   | Hard initial crashing sound, followed by sustained "shimmering" sound.  |
| Trumpet and Trombone   | May be shrill or dull sounding. Lacks true incisiveness and timbre.   | Has typical "biting" quality, neither shrill nor dull. Attack and overtone structure well defined.  |
| Gourds   | Faint, dull rattling sound.   | Natural "swishing" and "hissing" sound.   |
| Singing Voice  | Muffled. Seems submerged in instrumental background. Lacks character and intimacy.                          | Vocalization techniques and timbre accurately portrayed, reflecting artist's personality. Seems to be out in front of accompaniment. Clear but not overly crisp or artificially sibilant. |
| Bass Viol and Tuba   | Difficult to distinguish apart. Dull, characterless, toneless thumping quality, often with fuzzy hang-over. | String bass easily distinguished from brass. Notes have tonal identity and clear spacing.   |

It is not possible to judge the relative excellence of a loudspeaker from a frequency range rating such as "30 to 11,000 cycles." The difficulty is that measurements methods differ so much that different manufacturers would select very different rating for the *same loudspeaker*. Some speaker manufacturers have ceased to publish frequency figures for their products because of the lack of uniform standards and the recognition that balance, smoothness and low distortion are also vitally important in determining the "goodness" of a loudspeaker.

## OTHER THINGS OF IMPORTANCE TO HIGH FIDELITY

It is not enough for the high fidelity system merely to cover the required wide frequency range. The frequency response must be *balanced properly within the range*. If this is not accomplished skillfully, the treble tones of the orchestra may be overemphasized and the bass register weak with a resulting shrill effect that is very annoying, accompanied by a "covering-up" of the high overtones. Or the bass and middle tones may be exaggerated, resulting in an overpowering dull, boomy quality, lacking brilliance because of the relatively insufficient level of the "highs."

In a properly designed loudspeaker, the low (bass) and high (treble) frequencies are reproduced with equal effectiveness as judged by the listener in a typical room. This is what we mean by *balance*. Balance shows up in the ability of the loudspeaker to reproduce widely different kinds and arrangements of music without false emphasis and distortion of the conductor's use of the various instruments. It is also manifested in the clarity with which voice is endowed, and particularly in the effect of bringing the soloist "out in front" of the orchestra accompaniment (and without introducing a "hissing" or objectionable over-crisp quality to the voice).

Good balance is one of the most important attributes of a good loudspeaker.

For a high fidelity system to "wear well" . . . to be increasingly easy to live with, it must have smooth response. *Smoothness* is best defined as the absence of *roughness*, and this word does convey a suggestion of the way in which this objectionable characteristic affects us when listening to music. Roughness is particularly irritating in wide-range

loudspeakers and the irritation grows with acquaintance with the speaker which displays it. Roughness imparts a "hard" or "harsh" quality to music reproduction, although it may not be noticed at first and it is more evident on some types of music than on others. Some trained listeners consider that roughness is also responsible in part for an effect which sounds as though somewhat unmusical material had been inserted in the reproduction as a background to the music itself. Another accompaniment of roughness may be a sort of high pitched "ringing" sound which hangs on in the background of the music and seems to color the reproduction with its high monotone.

Smoothness is an achievement worthy of the best efforts of the design engineer who strives to attain it. With it (granting all else is as it should be) the music has the richness of reality. Without smoothness the illusion is impaired no matter what other desirable attributes the speaker may possess.

The sound we hear from a loudspeaker in a room consists of two parts: (1) the sound that arrives directly from the loudspeaker and (2) that which reaches the ear later after one or more reflections from walls, ceiling and floor.

Long experience indicates that the illusion of reality is enhanced if the direct sound is radiated over a wide angle so that all the listening positions in the room are covered.

All loudspeakers radiate uniformly over a wide angle at *low frequencies*. But at *high frequencies* the uncorrected tendency is for the sound to be more concentrated along the axis of the speaker. In such a case, *all* of the listeners receive the full benefit of the direct sound at low frequencies, but those outside the high frequency "beam" area hear much of the high frequency sound after reflections from the room surfaces.

Such a loudspeaker is likely to sound "bright" at close listening positions directly on the center line, and somewhat "dull" at a position toward the side of the speaker. In effect we have a shift in the balance of low and high frequencies with change in position, in addition to a change in the proportions of direct and reflected sound.

Where more performance is wanted, and the cost can be increased, the *loudspeaker system principle*, wherein the frequency range is sub-divided with separate radiating systems for each portion of the range, has important advantages. It makes it possible to use a small unit for the high frequencies and a large unit for the low frequencies, thus not only extending the frequency range at both ends, but reducing the beam effect as well. There are still other advantages in the use of the multiple system principle.

Distortion is the term used by engineers to mean marring of the tone quality by breaking down the structure of the tones, or by introduction of spurious effects not in the original music.

Distortion is a highly technical subject, and so we shall merely mention a few of its audible consequences. Needless to say distortion must be kept down to the point where the ear of the trained listener cannot hear it. (We do not say "No Distortion" in the interests of accuracy. But for this discussion "Low Distortion" means the same thing.)

Some forms of distortion lead to "hashing up" the music, with "squeaks" and "rattles" introduced for good measure. In others, extra tones are actually added to the music and, unfortunately, they are inharmonic in nature. Then there is the type in which the bass notes "hang over," a sort of fuzzy unwanted sustaining of the tones so that they seem to fall on top of the following passage. Another form introduces a perceptible "ringing" which adds an annoying, false color to the music. There are other forms of distortion (equally unpleasant) and your loudspeaker should be free from them all.

#### SELECTING COMPONENTS FOR YOUR HIGH-FIDELITY SYSTEM

If you have decided to acquire a high-fidelity music system, the next problem is to select the component parts which go to make up the system. Nearly everyone will want phonograph record playing facilities and this should be the first consideration in selecting com-



Display of Hi-Fi Components Photo courtesy of Cap Kierulff of Kierulff Sound Corp.

ponents for the Basic System. Some will want to add (at once or later) an F-M tuner, tape recorder, T-V, and possibly extension speakers to cover other rooms in the house. But consideration of the Basic Phonograph System should come first in the process of planning the system: in its elements the degree of fidelity for the whole installation will be largely established, for some of the components (amplifier and loudspeaker) will also be used with whatever other sources of sound (F-M, tape, T-V) you may add.

#### FIRST THINGS FIRST!

The selection of the components for the basic phonograph may look like a complicated and confusing proposition to the music lover without technical background, but this need not be so if the selection proceeds in an orderly manner following the steps outlined later. There are certain basic facts

which need recognition first of all, and these are briefly covered to eliminate much of the mystery and misunderstanding which is found in High Fidelity. If you run into difficulties, both the equipment manufacturer and your high-fidelity supplier stand ready to give you advice and suggestions.

#### THE LIST OF COMPONENTS

The Basic Phonograph requires record-playing facilities, an amplifier, a loudspeaker and a loudspeaker cabinet.

There is a choice to be exercised as to whether (1) a record changer or (2) a turntable (no automatic changing of records) will be used. The record changer is convenient and generally the least expensive; many experts feel that a good turntable gives superior reproduction because of greater freedom from wavering pitch, "wow" and rumble—but the cost is higher than that of a record changer.

The record changer will need pickup cartridges, one for large groove (78 rpm) records and one for fine-groove (33-1/3 and 45 rpm). Or you may want a combination or "turnover" cartridge which will play both. The turntable will require the purchase of a separate tonearm and the necessary cartridges. Comments on these alternatives will aid in establishing your choice.

The factors which influence the selection of amplifier, loudspeaker and loudspeaker cabinet will be evident from the discussion relating to these components.

#### STEP. 1. THE BUDGET

First decide about how much you wish to spend for the basic phonograph. Neglecting cabinet work (which can be eliminated if equipment is mounted on bookshelves) but including speaker cabinet, the minimum cost for a basic phonograph with legitimate claims to high-fidelity performance is just about \$150 at current prices. Performance is good, but a discriminating listener would want to improve it. At around \$250 we attain the quality of reproduction demanded by those who know their way around in high fidelity. \$400 to \$450 will provide superior high-fidelity results. An investment of \$550 to \$600 will give the music lover or audiophile reproduction which approaches practical perfection in the present state of the art and which is not likely to be obsoleted by developments in the foreseeable future.

All of the above figures represent practical representative *minimum* figures and are based on the use of a record changer; a turntable will increase the cost about \$100.

#### STEP 2. THE LOUDSPEAKER AND ITS CABINET

The loudspeaker, when used with well-chosen (but easier to select) record playing facilities and amplifier, has the key role in the high-fidelity system. No system can possibly be better than the loudspeaker. No portion of the system is as capable of introducing blatant or subtle distortions or colorations of the music. On the other hand, no choice is more rewarding in musical enjoyment than a well-chosen loudspeaker. The cabinet must be included in considering the speaker problem, because the bass reproduction from the speaker is affected by the choice of cabinet.

There is a wide variety of types, makes and models and prices cover a wide range from a few dollars up to many hundreds. All too often the description of the speaker in catalogs only increases the confusion and misleads the

buyer. Some speakers achieve a semblance of a high-fidelity effect by acoustical "tricks"; their shortcomings may elude the ear, upon a first brief listening, only to be discovered later because of the pattern of tonal deficiency, harshness, false coloration and irritating sensations which they impose upon the music. *In no type of product is the standing, reputation and experience of the maker of greater importance.*

Price alone is not a measure of loudspeaker value but it is a fact that the very best speakers are relatively expensive. Well-designed less expensive speakers are, however, capable of giving good to excellent performance and are quite suitable for lower budget systems even for discriminating listeners. As a rough guide, it is helpful to have an idea of representative costs as an aid to a suitable choice for a given Basic Phonograph budget.

The minimum system (approximately \$150 with record changer) can be appropriately and effectively equipped with a 12-in. coaxial speaker and an inexpensive bass reflex cabinet for just under \$60. Considerably more can be paid for the speaker and cabinet in some makes with results which are substantially less listenable.

In the next bracket (about \$250 with changer or \$350 with turntable) an excellent choice would be a 12-in. coaxial with compression driver hornloaded high frequency unit (integral part of the speaker), in a back loading folded horn cabinet, totalling a little over \$110.

For a still better system (\$400 to \$450 with changer or \$500 to \$550 with turntable), outstanding results are obtainable with a 15-in. coaxial with compression driver horn loaded h-f unit (integral part of the speaker) in a back loading folded horn cabinet; this will cost about \$210.

The loudspeaker for the very best reproduction obtainable (total system cost of \$600-\$650 with record changer, \$700-\$750 with turntable) should incorporate the multiple channel system principle at its very best. Here the complete frequency range is divided among a number of speaker elements in order to cover the complete range of audibility with maximum smoothness and minimum distortion. With proper design, 3 channels are capable of accomplishing the result to standards of performance not likely to be exceeded for practical use in the home. Speaker systems are available in which the 3 channels have been incorporated into a single unitary speaker assembly, as well as the type which employs physically separated units (available factory assembled). Costs, in a back

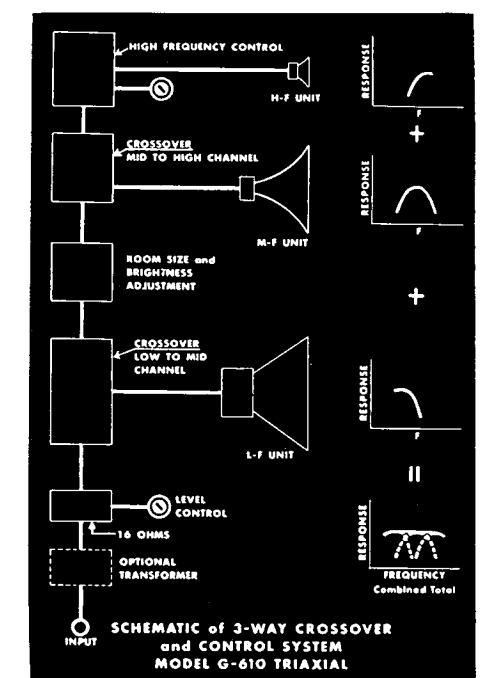
loading folded horn cabinet, will run \$300 to \$350.

Selecting the cabinet is a matter of satisfying size, degree of performance, style and cost requirements.

If you decide to buy a complete factory assembled loudspeaker system, the problem is solved; otherwise you will want to make a selection coming within the rough cost suggestions covering speaker-plus-cabinet in the discussion of "BUDGET." The two recommended speaker sizes are 12-inch and 15-inch and a variety of bass-reflex and back-loading folded-horn cabinets are available. A bass-reflex is the least expensive recommended type, but does not give as good *low* bass as the back-loading folded-horn type.

Unusually small enclosures (smaller than normal bass-reflex size) are invariably deficient in true *low* bass, and are not recommended (whether bought or built) if you expect really good low frequency reproduction. They are incapable of accurately reproducing the very low notes of string, reed and horn bass, thus handicapping the system at the start and defeating the very concept of high fidelity at one end of the musical range. The blurred illusion of bass which they may give is due to over-accentuation of bass harmonics one or two octaves above the fundamentals. Continuing acoustic research indicates an exactly opposite trend . . . cabinets need to be bigger to be better. *Good* commercial designs represent modest (but not *undue*) compromises in size.

If you want to build or build-in your



loudspeaker enclosure in lieu of a free-standing manufactured cabinet, suggestions are given later. However, it is suggested that your first estimate be based on a purchased cabinet to provide a cost reference and to facilitate the selection of the loudspeaker from the speaker-plus-cabinet allowances in the various budgets referred to previously.

If you intend to have a sound demonstration of equipment, be sure to read the later section on "How to Listen to a High Fidelity Demonstration." If, in consulting catalogs, the descriptions do not give you all the information you wish, ask your supplier or write the speaker manufacturer.

This service is freely extended by those speaker manufacturers who are genuinely interested, not merely in making a sale, but in seeing that you are completely satisfied with your high fidelity loudspeaker.

### STEP 3. RECORD CHANGER OR TURNTABLE?

The next decision to be made is whether a record changer or a turntable is to be used.

The record changer is by all odds the popular choice. It is the least expensive way of revolving the disc and it is complete with arm which bears the pickup cartridge. While the changer requires a modicum of intelligence in handling, it is preferred by many for family use because the automatic set-down of the arm tends to protect both stylus and record against the damage which may be caused by careless handling of a manually positioned arm. The record changing feature, of course, speaks for itself. It will pay to buy a high quality record changer, if that is to be your choice.

The best changers are likely to exhibit to a lesser degree the shortcoming that is commonly found in this type of record playing device . . . unevenness of speed which shows up as a "wow" or wavering of pitch especially noticeable on piano and sustained notes. You will undoubtedly want a 3-speed type and it is suggested that catalog descriptions be read carefully to insure that the changer will accommodate the pickup cartridge which you decide to use.

The turntable and arm combination is the choice of many audio experts and music critics because of the extreme constancy of speed and excellent reproduction that can be obtained with high grade components. There is no question that a more technically flawless reproduction of disk music can be obtained by this method than with a record changer. Besides the extreme

constancy of pitch made possible by the drive, powerful motor, and heavy turntable, high grade units have extremely low "rumble" noise. Since the separate tonearm does not have to be compromised by limiting factors necessary in the arm of a record changer, it can be designed to handle more perfectly the function of supporting the pickup cartridge in an acoustically correct manner as it passes across the record. It is probable that only the advanced audiophile who lays the utmost stress on the highest quality of musical rendition will fully appreciate the superiorities of the turntable and arm record reproducing system. The arm must be operated manually, being gently and precisely lowered to the starting groove; the arm must be raised from the record at the end and carefully returned to its rest. It is easy to damage records with clumsy handling; with expert handling, records are treated with the least wear and damage of any method.

Choices of turntables are few in the really good category. Probably nothing less than the "deluxe" type will deliver the performance which will justify use of this method. As to the separate pickup arm which must be independently chosen, there are a number available of known technical excellence. Here again, check the product description to insure that the arm is well adapted to the pickup cartridge of your choice.

### STEP 4. THE PICKUP CARTRIDGE

The pickup cartridge has the very important function of translating the music mechanically inscribed in the record grooves into corresponding electrical variations which are strengthened by the amplifier to a sufficient power to operate the loudspeaker. Coupling the cartridge to the groove is a precisely shaped stylus; to resist wearing its tip so it may precisely fit the groove and remain smooth to avoid damage to its walls, the stylus tip is made of sapphire or diamond. The sapphire is the least expensive of the two and the least hard, showing definite signs of wear in as little as 5 hours of playing and prohibitive wear at 50 hours. The diamond stylus on the other hand lasts about 100 times as long, and costs about 6 times as much as the sapphire. A little arithmetic will quickly show that the higher first cost of the diamond is an excellent investment, for one will spend about 16 times as much for sapphire replacements as for diamond over a period of time.

For fine groove records, the stylus tip is rounded to a radius of .001"; for

large groove (78 rpm) a radius of either .0025" or .0027" is a satisfactory value.

The problem of supplying the correct stylus to the record which calls for its use is accomplished in one of two ways; (a) The use of two complete cartridges with different styli which are plugged into the arm as required, or (b) a combination cartridge which may be turned over to present the other stylus to the record. The latter method is more convenient, but many experts consider that they get better results by using separate cartridges.

At this writing, the magnetic pickup cartridge and particularly the variable reluctance type, is the most popular among audiophiles. While other equally satisfactory or even more meritorious types may be developed, the prospective audiophile will make no mistake in this case in following the choice of the majority.

### STEP 5. THE AMPLIFIER

Amplifiers cover a wide price range. It has been pointed out by music critics who have made extensive listening comparisons of amplifiers that, assuming both are adjusted (by controls) to the same frequency response, the difference between relative inexpensive and relative expensive amplifiers is audibly very little indeed. There certainly is far and away less audible difference between amplifiers than between loudspeakers. A relatively inexpensive amplifier is a far safer purchase than an inadequate speaker. Yet it must be emphasized that there are substantial advantages in flexibility and in other features important to the audio enthusiast and critical music lover in the more costly amplifiers. But if a compromise must be made with some sacrifice of flexibility and a shade perhaps of performance difference, it can be done here without doing violence to the general system quality. It is therefore reasonable and satisfactory to use an inexpensive amplifier in connection with a low budget high fidelity system. It is likewise satisfactory to retain such an amplifier for the time being when making system improvements, giving higher priority to items with more evident audible dividends such as loudspeakers and enclosure.

When the highest quality of musical performance is wanted, the more costly amplifiers have much to offer the music lover. The advantages lie in more flexible "controls" which can more precisely adapt the system to the widely varying requirements of the records of the past and those of the present from different record makers. Sometimes

these controls are placed in a separate "package", a unit which may be conveniently located near the easy chair while the main unit is elsewhere out of the way. Catalog descriptions will make clear such features and the buyer can determine readily those features which appeal to him.

From an acoustical point of view, a ten watt amplifier will provide a greater volume of sound (when turned to high volume) than can be tolerated in the average home. For normal listening, less than a watt will be supplied by the amplifier. It is sound practice to buy an amplifier of not less than 10-watt rating, however. Many of the more elaborate (and more expensive) amplifiers have a higher rated maximum output than this and this is justified on grounds which may be roughly compared to using a high powered motor car in city driving. Theoretically, since it operates at a very small fraction of its rated maximum output, the higher power amplifier may have somewhat lower distortion at the actual normal operating level. The difference is small, however, and in itself may be inaudible under conditions of practical use.

Another factor of tangible importance in favor of a more expensive amplifier is in noise level. In periods of silence between musical passages, there is always some system noise part of which is contributed by the record playing equipment and part by the amplifier. If a record changer is relied upon solely for the record playing function, even a moderate amount of amplifier noise will be "masked" by noise arising in the changer plus "needle hiss".

When a very quiet turntable and exceptionally good record are in operation, or a magnetic tape recorder on playback, the case for the quiet amplifier becomes stronger.

An important point in selecting an amplifier is to make certain that it is designed to accommodate a magnetic pickup. In effect this means that the "preamplification" so often referred to in connection with magnetic pickups must be available, although it may be "built-in" the main amplifier and hence really not properly termed a preamplifier at all.

### RECONCILING THE BUDGET

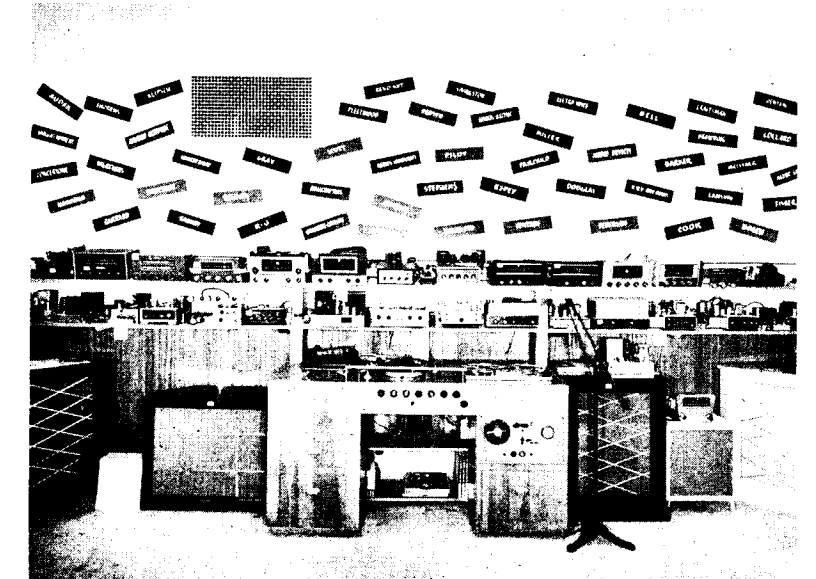
By now you will have selected your high fidelity components for the Basic Phonograph System. If you have met your budget, all is well financially. If not, compromises are in order and the

(Continued on Page 22)

SARGENT-RAYMENT PICKERING THORENS STEPHENS STROMBERG-CARLSON WEATHERS R-J

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(Continued from Page 9)

previous text contains some suggestions as to places where corners may be cut if necessary.

#### ADDITIONS TO THE SYSTEM

Now it is logical to investigate the matter of adding FM-AM Tuner for radio program reception, a TV Chassis, tape recorder, extra loudspeakers and the like. These services should not compromise the Basic Phonograph System budget or the end result is more than likely to be substandard performance all around instead of high fidelity.

#### HOW TO LISTEN TO A HIGH FIDELITY DEMONSTRATION

Understandably you may wish to hear the results you can expect to get from your high fidelity system before buying. Because high fidelity is actually a relatively new field and is in the throes of establishing itself in a position to serve adequately the music lover as well as the knowledgeable audiophile, it is well to know what to expect in seeking a demonstration that will clarify your problems.

High-fidelity equipment is being sold in the principle cities by suppliers of electronic and sound equipment. Many of them are in a position to give satisfactory demonstrations while others are less well equipped. In some sections of the country it is not yet possible to have high fidelity equipment demonstrated. Without in any way reflecting on the many excellent high fidelity suppliers, the prospective buyer can eliminate much confusion when he goes to a demonstration by having the subject matter of this article in mind and considering the suggestions that follow. You may be confronted by a discouraging array of equipment and a salesman who is very eager to display his wares. In the interests of getting on with your problem, it is important to have an elementary idea of what makes things sound different and what may be disregarded in the listening. Assume that you have made tentative choices of the items that go to make up the Basic Phonograph System. Ask the salesman if he can demonstrate the items you have selected and if he has them you are ready to listen. If not, ask him to demonstrate the loudspeaker of your choice with any good magnetic pickup and any good amplifier. By all means listen to other loudspeakers too, but do not for the time being introduce pickup and amplifier variations, for no matter if these are not the exact items you wish to buy, the chances are that there will be relatively little difference in the way the music will

sound; as pointed out before, loudspeakers are likely to account for the major differences between different combinations of equipment assuming, of course that high quality components are being used.

When listening comparatively to a number of loudspeakers it is important to recognize at least a few basic principles which concern the loudspeaker and the human hearing process. You can believe your ears but it is well to know what to listen for, what to watch out for.

In the first place the sound should be smooth and well balanced, not shrill or harsh. But it should also have a complete frequency range with true low bass (which you will have to concentrate on in the presence of higher bass in the music) and the realistic, but not overly exaggerated very high frequencies. Hear several selections because the record may influence the apparent result. For example, a very brassy dance band may well be a shrill production in itself. True low bass sounds dull but clean and should not be boomy.

Listen to the various instruments of the orchestra and to a vocal soloist with orchestral accompaniment. The various instruments should be cleanly separated, not merged or run together in fuzzy combination. The soloist should be "out in front of the band," not merged with the instruments. Watch for "ringing" noises which seem to pervade the music, and hollow or guttural effects in the background of the music. In judging the extreme highs, listen to smooth treble

without harshness, brittleness or blatant tinkle.

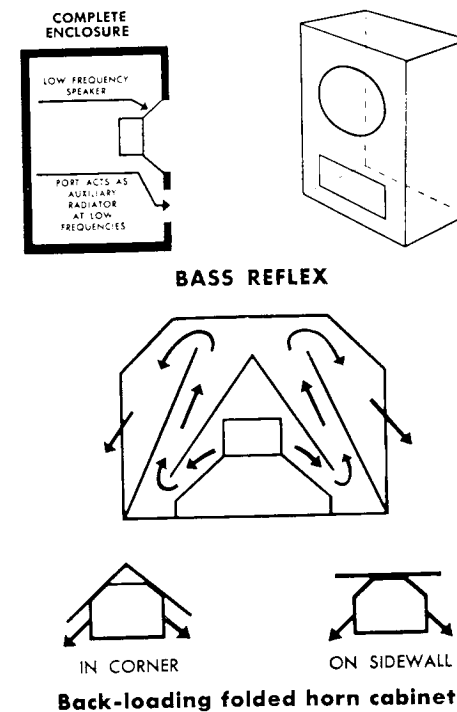
Be sure that the speakers are about equally loud when you listen. If one sounds louder than the other turn down the volume control when listening to the otherwise louder one. If this is not done your ears may falsely tell you that the louder one has more bass and more treble. The loudness difference itself has no practical significance. If remaining in one listening position results in different distances and angles to speakers being compared, it is better to move from speaker to speaker as you listen. You should stay back at least six to ten feet from the speaker when listening. Listen at normal and comfortable volume. Disregard apparent differences in bass and treble as the volume is changed. This will only prove that your ears are normal: the speaker (contrary to the impression of some) cannot possibly change characteristics with volume.

There is much more that could be said on the interesting and complex subject of listening. Remember, you are the one to be pleased and there is a wealth of pleasure in store for you in true high fidelity.

#### CHOOSING AN ENCLOSURE FOR YOUR LOUSPEAKER

The Enclosure or cabinet for the loudspeaker is a portion of the loudspeaker system, for it will have a profound influence on the system response in the bass region below 200 or 300 cycles: a poor cabinet can entirely eliminate low bass tones which the speaker itself is inherently capable of reproducing.

You may want to integrate the enclosure with a custom home entertainment center involving special cabinet work to your order. Suggestions as to how to go about this are given later. If you prefer to have the enclosure separate from your other equipment, you will either purchase or build it yourself, and choices as to the acoustic principle, styling and cost are in order.



#### Back-loading folded horn cabinet

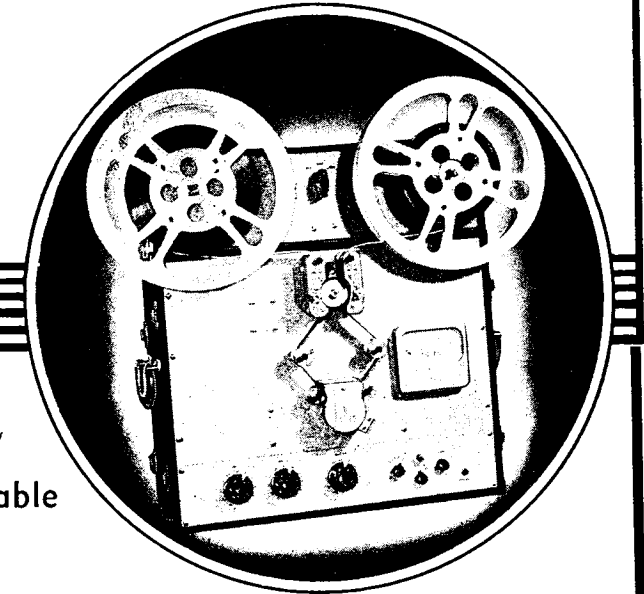
Whether you buy or build an enclosure, bass reflex is the least expensive type giving good performance. The diagram shows how bass reflex works. The cabinet has an opening or port in the enclosure, and this port is placed rather close to the speaker at the front. Sometimes two "half ports" are used, one on either side of the speaker. The area of the port must be properly related to the enclosure volume and the speaker resonance; when these relationships are correct, the low frequency response of the system is carried down more uniformly into the bass region than can be accomplished in any other simple way. Toward the "bottom" range of the speaker, the port acts as a second "speaker," both together giving an augmentation. Especially when space requirements dictate a very small enclosure, bass reflex is the choice; this is a factor of importance when circumstances will not permit larger enclosures—which always give better results.

The back-loading folded-horn enclosure has the advantage of better bass response because it provides a more effective load for the loudspeaker diaphragm, and actually increases the effi-

(Continued Next Page)

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ciency of the speaker by giving closer "coupling" to the air. This can be visualized from the diagrams. The speaker (back side) drives a continuously expanding air column, which gives better loading down to the lowest frequencies. The horn is "folded" for compactness, and has mouth sections on both sides. Horn loading not only gives better bass, but distortion is reduced and speaker resonant effects are minimized. The speaker diaphragm only has to move a fraction of the distance which would otherwise be necessary. The most generally useful type of back loading folded horn cabinet is designed not only for outstanding performance in a corner where walls act as extensions of the horn, but will also work well on a side wall—which means flexibility in positioning and adaptability to a different home or apartment if you move.

**BUILDING OR BUILDING-IN YOUR SPEAKER ENCLOSURE**

If you have a home workshop, plus reasonable skill, or have a good cabinet making or millwork connection, there is no reason why you cannot build or build-in your loudspeaker enclosure. If you are building a new home, or providing cabinet work while remodeling or renovating, this is an ideal time to consider building-in your home entertainment center, including perhaps, the loudspeaker enclosure.

In building your own enclosure, or in laying-out specifications for contract woodwork, it is important to remember a few practical acoustical pointers. Speaker enclosure should be rigid, using, say, 3/4-inch plywood, braced where necessary to avoid panel drumming. All joints should be tight; screwing and gluing or equivalent is recommended for insurance here. A joint may be structurally satisfactory from the woodworker's point of view, but still utter embarrassing and hard-to-fix buzzes if this is not watched.

Your choice of home built or built-in enclosures will probably be either (a) bass-reflex, the simplest form with rectangular sides and a minimum of problems, or (b) the folded-horn type which is more difficult to construct, but which provides better bass response than bass-reflex. Bear in mind that it is far better to build a successful bass-reflex enclosure (easy to do) than a poor folded-horn (somewhat more difficult).

A loudspeaker enclosure is easily integrated with built-in shelves, a portion of which may serve to house the record playing equipment and amplifier (including a radio tuner if you wish); doors may enclose these components, being opened for access during record

changing and volume adjustments. Bear in mind that the loudspeaker enclosure should face the living space where you will be listening. Incidentally, a purchased loudspeaker cabinet can be adapted to the shelving with a minimum of compromise to decor and sometimes an actual enhancement thereof. There are, of course, numerous other possibilities for blending the home entertainment center with the functional and decorative schemes.

Conversion of a cupboard or a closet

for acoustic and equipment housing purposes is easily within the realm of possibility. So is the custom creation or purchase of free-standing pieces in tune with your other furnishings to house speaker and other equipment. There is a real wealth of possibilities open to those who are interested in the appointments in keeping with fine living.

**HIGH FIDELITY**  
 Technical Terms and Definitions  
 page 30



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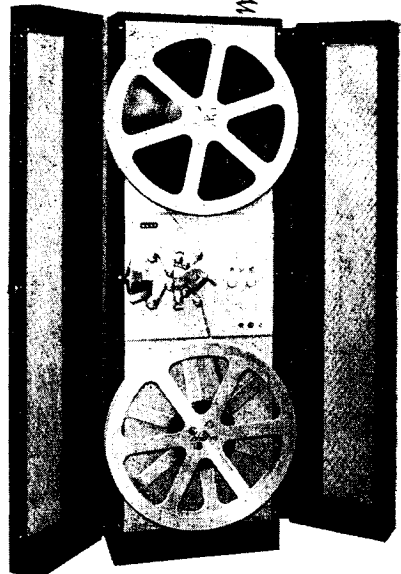
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## HIGH FIDELITY

### Technical Terms and definitions

**Two-way System:** Applies to a loudspeaker in which low and high frequencies are separately reproduced by two electrically independent speaker elements, each provided with a suitable sound radiating system.

**Three-Way System:** Applies to a loudspeaker in which the low, middle and high frequencies are separately reproduced by three electrically independent speaker elements with suitable sound radiating systems.

**Coaxial Loudspeaker:** In technically accepted usage, a two-way system unitary assembly in which the high frequency unit is mounted approximately on the axis of the low frequency unit. (Note: The definition given here corresponds to usage in the text of this article. The term "Coaxial" has recently been used to describe a speaker with a single electrical driving system and a compound direct radiator system, a part of which tends to augment the high frequency range in a limited frequency region. Such speakers can be differentiated from true coaxials because the direct radiators are driven by a single common voice coil. The more expensive true coaxial speakers employ a horn-loaded compression-driver high-frequency unit instead of a direct radiator unit.)

**Divided System:** A multiple channel system in which the loudspeaker elements are distinct and separated (rather than being combined as in coaxial and Triaxial\* types.)

**Compression Driver Unit:** A loudspeaker driver unit which does not radiate directly from the vibrating surface, but which requires acoustic loading from a horn which connects through a small throat to an air space adjacent to the diaphragm.

**Horn Loading:** The coupling of a loudspeaker diaphragm to the listening space by means of an expanding air column with a relatively small throat and a relatively large mouth.

**"Woofer" (Low frequency unit):** The loudspeaker unit reproducing the lowest frequencies in a two-way or three-way system. In current practice, the "woofer" is a direct radiator type (cone) speaker, which however has its low frequency performance augmented by a bass reflex or horn loading enclosure.

**Low-Frequency Unit:** See "Woofer".  
**"Tweeter":** In audio jargon, the name to the high frequency unit (speaker) in a two-way system, and to the mid-frequency unit and high frequency unit in a three-way system. Sometimes the

term "supertweeter" is applied to the speaker handling the highest frequencies in a three-way system.

**High-Frequency Unit:** See "Tweeter". The term is generally applied to all units except the low frequency unit ("Woofer") in a two or three way system.

**Bass Reflex:** A loudspeaker cabinet or enclosure in which a port or opening is provided, so proportioned to the interior volume of the cabinet and the speaker characteristics that the port acts acoustically as an auxiliary speaker at low frequencies, thus augmenting the bass reproduction and reducing distortion common to non-ported total enclosures. (Bass reflex is the simplest practical form of enclosure and is the best method known when the enclosure must be very small.)

**Back Loading:** A form of horn loading, particularly applicable to low frequency speakers, in which the rear radiating surface of the speaker feeds the horn, while the front part of the speaker is directly exposed to the room. An ideal method of providing low frequency loading for a coaxial or Triaxial\* speaker in which the speaker front must be unobstructed to prevent loss of high-frequencies.

**Folded Horn:** A method of constructing a horn with long length in small space so as to avoid undue bulk in the cabinet.

**Triaxial\* Loudspeaker:** A three-way system in which the three speaker elements are combined into one unitary assembly.

**Amplifier:** The electronic device which increases the minute electrical impulses from the phonograph pickup (or FM-AM tuner or TV chassis) to sufficient power output to operate the loudspeaker system to the desired maximum volume level. (Note: amplifiers offered for high fidelity home music applications have a volume control, treble control and bass control. Certain output connections are provided to match the loudspeaker impedance. Additional features that may or may not be provided are: adjustments for easy adaptation of bass and treble to match the recording characteristics of various American and European records (independent of individual "preference" controls of bass and treble); "remote" mounting of controls so they may be placed within more easy access to the listening position; noise suppressor, an electronic system for reducing the audible objectionableness of record scratch and hiss. Amplifiers vary in "gain", that is the relative weakness of the sig-

nal which will provide the full rated power output; some will work only from crystal phono pickup and tuner (FM-AM or TV chassis) while others will accommodate the weaker output of a magnetic pickup (of which the variable reluctance type is one) as well as the stronger signals from tuner, etc. For home use, from the standpoint of the loudspeaker, a rated maximum power output of 10 watts is sufficient, though many excellent amplifiers offering additional features in the way of controls, special circuits for low distortion, etc., are offered only in higher output power ratings.

**Record Changer:** A device which will automatically play a number of phonograph records successively. To play all current types of records, the turntable of the changer will need to provide for 33-1/3, 45 and 78 rpm speeds. The automatically operated tonearm of the changer handling all record speeds will need to be equipped with either a universal type pickup cartridge (adaptable to the different stylus requirements of the finegroove (33-1/3 and 45 rpm) and large groove (78 rpm) records, or interchangeable cartridges.

**Turntable:** A motor driven device for revolving the record at the required speed. As distinguished from the turntable of the record changer, the deluxe turntable is capable of a precise average speed with such small instantaneous deviations from this desired speed that there is no perceptible wavering in pitch or "wow". This type of turntable is also capable of being designed to produce extremely low "rumble" noise arising from vibration of the motor and mechanism. A separate tonearm (pickup arm or "arm") is required for the pickup cartridges.

**Pickup Cartridge:** The device, which when mounted in a tonearm to support it against the record in an acoustically correct manner, translates the mechanically inscribed variations in the record groove into corresponding electrical variations which go to the amplifier for amplification and thence to the loudspeaker for ultimate reproduction in the form of music for your listening. (Note: pickups have undergone great developmental improvements in recent years. It is now a far cry from the needle (see "stylus") formerly used in acoustical phonographs to the modern pickup with its integral stylus which is so marvelously adapted to the fantastically incredible task of tracing the intricate geometrical pattern traced in the record groove with changes in amplitude and direction occurring many

thousands of times each second. This stylus motion acts as a tiny generator of electrical impulses which require further amplification to produce sound. The generator may work on either of two principles (1) piezo-electric or crystal, or (2) magnetic. Of the two the magnetic principle is the most used today, and the "variable reluctance" type is the most popular magnetic pickup. Though compromise designs have been developed, the same stylus will not serve in high fidelity for both fine groove (33-1/3 and 45 rpm) and large groove (78 rpm) records. This means that the pickup cartridge needs to be equipped with two styli, or two cartridges, each fitted with the correct stylus, must be provided in order to play all types of records. Since the electrical impulses from the magnetic pickup are so "weak", it means that extra amplification or gain must be provided in the amplifier to handle them. Many modern amplifiers have the "preamplifier" for this purpose built-in: some amplifiers manufactured in the past have only sufficient gain to operate from a crystal pickup and in this case, a separate additional preamplifier is needed to work with a magnetic pickup.

**Large Groove:** In phonograph records, refers to the groove size originally used for the older original 78 rpm records. The stylus point for use with these records must have a radius of .0025" to .0027" approximately in order to fit the groove properly.

**Fine Groove:** Refers to the groove size used in the new "microgroove". "L-P" and other long playing type records which may be identified by their playing speed of 33 1/3 or 45 rpm. A pickup stylus radius of .001" is required for records of both speeds. To play records of this groove size, not only must the stylus offer the proper fit to the record, but the entire pickup system must present light weight and relative ease of lateral motion of the stylus if high quality reproduction is to be obtained and record wear kept to a minimum. Specially designed pickup cartridges and arms incorporate these features.

**Turnover Cartridge ("Universal" type):** A pickup cartridge, adapted by the use of two styli, to the playing of both large groove and fine groove records. The turnover type, as its name implies, actually is revolved a half-turn in the arm to present the other stylus. There are of course other possible ways of adapting the pickup system to the playing of both types of records.

**Tonearm (arm of pickup arm):** The arm which supports the pickup cartridge is found as an integral part of a record changer, but must be selected separately when a plain turntable mechanism is employed. The functions of the arm are: (1) to allow the pickup to move freely across the record, guided by the record groove only, and maintaining "tracking" or tangency to the groove; (2) to provide sufficient lateral inertia to the pickup, yet allowing for the almost inevitable eccentricity of the center hole of the record; (3) to provide the proper needle pressure to keep the stylus in the groove, yet permit the arm to accommodate an "unflat" record without undue noise or record damage; (4) to accomplish these things without introducing arm vibrations or "jerkiness" of motion in bearings or pivots. The arms best meeting all of the above requirements are usually separate devices specially designed for the purpose. A good working compromise is achieved in the arm of the best record changers which must take into account conflicting factors due to the need for automatic control of the arm in the record changing cycle.

**Stylus:** The portion of the pickup cartridge which rests in the groove of the record. Its function is to drive the mechanism of the pickup as a generator, producing electrical impulses corresponding accurately to the inscribed variations in the record groove. To accomplish this, the stylus point must accurately fit the groove and must maintain this fit throughout the useful life of the stylus. Different size stylus tips are required for large groove and fine groove records. The stylus must maintain its spherical tip section or undue record wear and distorted reproduction will result. The music lover interested in high fidelity reproduction and kindness to his records will recognize the importance of "permanence" in the stylus of the pickup. The pickup cartridges which best qualify are either sapphire or diamond tipped. Of these, the diamond is far and away the more economical because, resisting wear far longer, it will require very infrequent replacement.

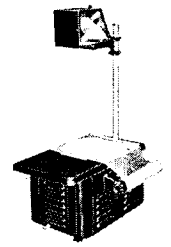
**Impedance:** In nontechnical terms, the impedance of a loudspeaker is stated in ohms and the value of the impedance for any particular loudspeaker indicates the amplifier output terminals which should be selected for connection to that particular speaker. Common values of speaker impedance are: 3-4 ohms (sometimes 3.2 ohms); 6-8 ohms; and 16 ohms. A speaker with an impedance of 3-4 ohms is connected to the 4-ohm

output of the amplifier, a speaker of 6-8 ohms to the 8-ohm output, and one of 16 ohms to the 16-ohm amplifier output terminals. Most amplifiers are equipped with all of the above output impedance connections and it is only necessary to select the proper terminals for the speaker involved. If the amplifier should by chance have available only output impedances which differ considerably from that of the speaker, it will be desirable to use an impedance-adjusting transformer between the speaker and amplifier; normally this will not be necessary with most amplifiers currently available. If more than one speaker is to be connected to the amplifier, consult your high fidelity supplier or the speaker manufacturer for the proper connections to use for amplifier operational compatibility and to make sure that appropriate power is allocated to the various loudspeakers.

**Power Rating:** In an amplifier, this is the maximum power which the amplifier will deliver without exceeding a specified distortion of the electrical impulses passing through it. In a loudspeaker, the power rating indicates the amount of power which the speaker is capable of converting into sound without objectionable distortion or damage to the speaker.

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