

## CD changer

CD systems in motor vehicles represent a relatively new technology with which service technicians in the automotive industry must concern themselves. At the start of the 1980s, the CD as a medium began to conquer the market. It took a few years before development had progressed to the stage that CD players were also available for mobile use.

### Basic principles of CD technology

The music information (audio data) is stored on the CD in digital form (value 0 and 1). The data is scanned by the reflection of beams of light. The pick-up sends a strongly bundled beam of infrared light to the CD surface. This is reflected by the silver or gold metallised surface then picked up and evaluated by an optical sensor. From a purely physical point of view, the length of peaks and valleys change the reflection in certain patterns so that the values 0 and 1 can be distinguished.

The audio data is stored in concentric circles and not in a spiral as on a conventional vinyl disc. In addition to the music, the CD tracks therefore contain further information which serves the purpose of pick-up tracking. This also makes it possible to jump from one track to another during playback. Bear in mind here that 30 of these information tracks are more or less as wide as a human hair. We are therefore dealing with microscopic dimensions.

However, not only the track must be scanned; irregularities in the CD surface must also be balanced out. This is why the focus of the reflected infrared beam is permanently monitored and corrected by raising and lowering the pick-up lens. This operation is referred to as focussing.

If data is lost during the pick-up procedure (due to scratches, impact etc.), to a certain extent, this data can be reconstructed. For this purpose, the last value read is compared with the next readable value. From both values, the error correction facility calculates a kind of mean value. This procedure cannot be perceived by the human ear.

### The CD changer in mobile applications

In a car CD changer, various conditions occur which are frequently misconstrued as faults. Many phenomena are, however, system-related and therefore cannot be avoided.

The mechanism of the CD changer must be mounted on springs, but it must not vibrate; it must be able to compensate for (dampen) impacts. For instance, unevenness in the road surface can be compensated for in this way.

The CDs are held in a 6-compartment magazine. Only the CD which is to be played is located completely within the mechanical part. The CD is transported from the magazine into the play position by means of 2 rubber rollers which pull the CD out of the magazine. Once the CD has reached the play position, it is lowered and fixed on a cone in the centre hole (clamping). Playback can now begin. The CD is transported back into the magazine in the reverse order. 3 photoelectric barriers are installed in the changer in order to determine the CD within the mechanical part. The order in which these beams are interrupted indicates the precise position of the CD.

### Malfunctions caused by CDs

Due to the particular conditions under which a mobile CD changer operates, CDs which are outside or right at the limit of the manufacturing tolerance can give rise to the following problems (among others).

Many undesirable effects can be caused by CDs with edges which are inadequately deburred or too thick:

- The transport rollers cannot grip the CD since it is too thick.
- Plastic burrs can break away during transport through the rollers and adhere to the CD surface. The same problem can also occur in the case of a poorly deburred centre hole. Plastic burrs are pressed out by fixing on the cone (clamping); as a result they enter the mechanism and soil the CDs and magazine. These plastic chips (burrs) have 2 negative effects:  
The plastic chips can cause fine scratches on the surface of CDs if they enter the magazine. Under unfavourable conditions, larger pieces of plastic (5-7 mm) can cause scanning faults (jumping) or they may render the CD table of contents (TOC) unreadable. The CD cannot be played in such cases.
- If several CDs in the magazine are too thick, return of CDs to the magazine is made difficult. On the one hand, a higher force is required in order to push the CD back into the magazine. It can also occur that the partitions that separate the individual CD compartments from one another are displaced in

such a way that return transport of the CD to the original position is not possible.

### Note

Do not use CDs which are inadequately deburred. Extremely thick CDs may be used only if there are not several such CDs in the same magazine.

Single CDs (8 cm) with single adapter, protective films and protective paint or with stabiliser rings:

- The CDs are thicker than normal (see above).
- Singles may come apart from the adapter while being transported and thus jam the mechanism. Stabiliser rings can get trapped in the transport rollers.

### Note

Do not use such CDs with accessories in the vehicle.

Transparent CDs:

- Unfortunately, it occurs now and again that the protective coat of CDs has been poorly metallised. Such discs are more transparent, in part or completely, than normal. Although these CDs can still be played, they no longer facilitate optical position monitoring by the photoelectric light barriers. In concrete terms, this means that the CD is detected as a CD.

In individual cases, CDs will have manufacturing defects. This concerns the layer on which the information is stored. It is sometimes possible to play such CDs on the home system but not in the car. This is not a fault in the CD changer, rather a property resulting from the fact that the error correction in the vehicle makes different demands than in stationary operation. A home player reacts very sensitively to impact and vibration. No one complains if a device of this kind no longer works properly if it is shaken. The laser tracking can be optimised to pick up surface errors. A compromise has to be made with mobile applications, on the other hand. Due to the possible vibrations, the control range of the laser tracking must be limited in its capacity to compensate for surface flaws. And this is exactly what makes mobile applications possible.

It is rare that CDs are not completely flat, i.e. have an axial runout as often occurred with vinyl records. As a CD is scanned from inside to outside, on such CDs there are rare cases in which error correction is overtaxed when playing the last track. This can lead to a CD changer being very sensitive to vibrations when playing the last track.

## Notes on pick-up errors

In stationary vehicle:

- Check the CDs for impurities or scratches
- If the CDs are in perfect order and function satisfactorily in other devices, the changer should be sent back to the factory for inspection. If applicable, enclose CDs that are not played as well as a brief description of when the fault occurs. For example: "No playback as of track 5, 1:34 minutes".

While driving:

- Dirty CDs can increase the sensitivity to vibration and impact. Please check accordingly.
- Have the transport screws been removed?
- Are the mounting springs in the correct position?
- Are the springs in the same position on both sides?
- There are, of course, also limits in the case of extremely hard chassis or high speeds. At the latest in the event of vibrations that cause the mechanism to touch the housing, the electronic error correction can do nothing more or the pick-up tracking can no longer regulate due to a lack of correction data.

## Summary

Many customer complaints are attributed to other causes than the CD changer. These causes may include poor quality CDs, other, external effects or simply misguided expectations.