BASF tape formulas

Type IV - metal pigment (MP) [or metal evaporated (ME) tape whose extremely thin coating rendered it poor for analogue audio recording]. TDK made the official IEC reference tape. The pigment is such a small crystal that it can oxidize extremely quickly, enough to cause spontaneous combustion or explosions at any point in the milling/coating operation unless extreme precautions are taken, such as submersion in alcohol and a nitrogen-based environment. The particles were passivated with molecules of oxygen around the metal crystal to stabilize them because early metal tapes oxidized and lost magnetic properties. There were other experiments to modify the crystals with other metallic alloys either to enhance magnetic properties or to stabilize the crystals. Metal tapes are relatively environmentally stable with the lowest amount of print-through. They generally have the highest MOL and SOL values, but also the highest noise, so in practice they exceed Type II tapes only in low print and better high frequency dynamic range. Headwear is no different from that of any other magnetic pigment.

Type III -ferric-chrome tapes. Sony made the IEC reference tape. Thicker coatings increased MOL, and the "underbiased" thin layer of chromium dioxide brought low noise. However, the disparity in bias points between the two layers meant a sagging mid-frequency sensitivity that had to be compensated by boosting record EQ to such a degree that SOL values were very poor. (This was common to double-coated tapes but far less pronounced when the optimum bias points were closer, as in BASF Superchrome tapes and TDK SA-X.) Type III tapes were never very popular and disappeared with the arrive of Type IV formulations. Headwear was the same as that for pure chrome tapes: lowest of all tapes for soft heads; higher initial wear on hard heads until the granular ferrite surface was polished, then very low with little to no gap erosion over the life of the head (except for some Sendust heads were chemical, not mechanical, erosion was observed similar to that induced by some ferric-cobalt formulations.)

Type II - chromium dioxide or ferric-cobalt pigment. BASF made all Type II reference tapes, despite what TDK claimed in its misleading advertising. These tapes used either DuPont's invention of chromium dioxide (manufactured only by DuPont of BASF because of the enormous expense in heat/pressure reactors required to form the particle) or ferric oxides enhanced by the addition of magnetic cobalt to the crystal structure. Chrome was the first Type II tape, but Sony's exclusive distribution deal with DuPont forced other Japanese tape manufacturers to find an alternative in ferric-cobalt (an Agfa-Gevaert invention that they were never able to stabilize properly until the Japanese figured how to do it.) Chrome had the lowest noise because of its perfect particle size and near perfect uniformity that allowed easy distribution in dispersions and excellent alignment under orientation magnets in coaters, but the first chromes also broke in milling and were susceptible to high print-through. Ferric-cobalts allowed higher packing densities that increased tape sensitivity at the lower frequencies--a compatibility point that the Japanese used as a "quality" issue against chrome tapes--and allowed higher MOL values. The tapes, however, suffered from higher noise levels, which actually increased over time as delta noise, and from magnetostrictive effects that reduced high frequency signals under pressure from the capstan/pinch roller combination. Chrome suffered from neither and actually had its noise level decrease over time--along with output--so the dynamic range stayed the same while Dolby noise reduction tracking was compromised a bit--with a slight loss in accuracy but a pleasant increase in treble response. BASF redesigned its milling operations to reduce print-through to levels equal to or better than ferric-cobalt tapes and improved MOL and SOL values with new particles and finally, the introduction of ferric-cobalt oxides with chrome for the "Chrome Extra" formulations. The same improvements were made to the double-coated Superchromes and Chrome Maxima tapes. TDK, frustrated by chrome's claims to be the "world's quietest tape," introduced double-coated SA-X with a very fine ferric-cobalt particle coated on top of the standard SA formulation. This lowered noise levels about a decibel or so below that of pure chrome tapes (before delta noise set it) but brought the curse of increased print-through due to the presence of para-magnetic particles among the finely milled top layer particles. All producers of ferric-cobalt tapes made improvements to formulations that slowly increased output levels with few compromises to dynamic range. BASF itself introduced a ferric-cobalt tape in a heat-resistant housing for car stereo use because chrome's low Curie point meant that signals could be lost if the tape were subjected to high levels of heat. (This worked to chrome's advantage when used in highs-speed TMD thermal magnetic video duplication.) Barium ferrite was an alternative pigment considered for audio but seldom used except for some video applications. Despite the nasty headwear scare used to dissuade people from using chrome tape, there is little difference in the amount of wear induced by any Type II tape that is properly calendered and finished. (All lubricant, emulsifiers, static reducers, and fungicides are in the magnetic dispersion. They are not added later in the manufacturing process.) There were some Type II metal tapes in the market to offer metal recording for older tape decks without Type IV settings, but the lower MOL and SOL values along with the very high noise levels and inability to be erased eventually killed these interlopers. The best ferric-cobalts and chromes easily outperformed these metal pigment products. Chrome tapes had their greatest day in audio duplication because BASF encouraged duplicators to use a playback EQ of 120 microseconds and back off the record pre-emphasis to improve SOL values by almost 5 decibels. (The 70-microsecond EQ setting came about when no one expected Dolby NR to become standard. Had the engineers known Dolby would be so successful, they would have left playback EQ the same for Type II tapes as for Type I. Chrome/Dolby NR/70 microseconds were all introduced at the same time to reduce tape hiss--but any two of the three options would have been sufficient. All 3 at the same time was overkill.)

Type I - ferric oxide, cobalt-modified ferric oxide. BASF made the official reference tape. These are the first and most common tapes. The range of quality levels is greatest in this class because the oxides can vary so much and because reject computer tape designed for digital signals, not audio, sometimes made its way into cheaper brands. Some of the best Type I tapes could offer low frequency signal-to-noise ratios that matched or slightly exceeded Type II and IV tapes, but their high frequency performance was never as good because of the lower coercivity of the oxides. These tapes, with their less sophisticated particles, tend to be the most environmentally stable over time as long as the binder formulations are stable. (Polyurethane binder breakdown is a plague among ferric reel-to-reel formulations from Ampex and Agfa; acid ooze is more common in cassette binder failures.) Headwear varies among tapes only because of different levels of quality in finishing the tapes: the better quality of tapes have no problem. Some ferric-cobalt Type I tapes have shown some chemical erosion on some Sendust heads, but one could argue whether it is the fault of the tape or the head design. In general, headwear is not a problem. (As a topic, headwear is a fascinating topic, rife with misinformation and rumors.)

DIN Type II Reference Tape C 401 R BASF 100% pure chrome

IEC Type II Reference Tape S 4592A BASF 100% pure chrome

IEC Type II Reference Tape U 564 W (replaced S 4592 A in October, 1987, in the IEC meeting in Prague)

Magnetic Media Information Services, Volume XIII, No. 5 (August 20, 1993) discusses the technical work of Dr. Manfred Ohlinger, BASF's chief of pigment development. Dr. Ohlinger discussed work on CK60/XH, a chrome pigment with a coercivity beyond 1000 oersteds. He had already produce CK/75/230X with a value of 900 oe. and CK57/200X with a value of 670 oe. BASF was in full development of advanced pure chrome pigments for new 3480 cartridges and other media.

BASF had been producing pure chromium dioxide pigments in a huge reactor in Ludwigshaven, Germany, since the late 1960s. In 1995 the oxide lineup included:

CK 40-14 for audio tape

CN 43-11 for high performance, single-coat audio tapes

CK 37-11 for the lower coating of high performance chrome audio tapes. This pigment was designed for non-cross-linked binders.

CK 48-21 was for the upper layer in cross-linked dispersions. These oxides were used in Chrome Super and Chrome Maxima tapes. The tapes were identical and differed only in the housing and the tighter specs for Chrome Maxima. Most Chrome Super performed exactly the same as Chrome Maxima.

CK 50-21 was pure chrome used in VHS, S-VHS, TMD, and DCC formulations. (BASF made the only DCC tape. It was the tape in TDK and every other DCC cassette made.)

There were CC variations of these pigments. They differed in that oxygen molecules were attached to the crystal surface to prevent degradation to hexavalent chrome in the presence of water.

BASF used 100% pure chrome formulations for its EE reel-to-reel tape and for Loop Bin Master 920 and 921 used in the duplication industry before digital bins arrived. The only "hybrid" chrome/cobalt audio formulations appeared with the introduction in 1993/94 of "Chrome Plus" duplicator tape that had a small percentage of cobalt-ferric pigment added to raise AT315/MOL315. Its AT315 was 2-3 dB better than competing chrome tapes. Chrome Plus was also used in Chrome Extra audio cassettes from that point forward.

In 1992 world-wide production of magnetic powder by weight was 11% for chromium dioxide, 55% for co-fe, 32% for standard ferric, and 2% for metal powder. This total includes all applications: audio, video, computer data.

In 1994 BASF used a high-performance plastic that could withstand 95 degrees C. (203 degrees F.) without deformation. This plastic was used in the sonically welded Reference Maxima series. The tape was BASF ferric-cobalt because the heat resistance of the plastic would be wasted on a tape that had a much lower Curie point. (It was chrome's low Curie point that made it the only choice for thermal duplication--TMD--that was used for high-speed video tape duplication.) BASF kept Chrome Maxima and Chrome Super in the cassette lineup as 100% pure chromium dioxide tapes and the 85/15 Chrome Extra as its first and only hybrid chrome audio tape.

As for "audiophile" opinions, I remember reading a discussion in The Absolute Sound condemning the process. It was obvious that the writer, an editor at the magazine, had little idea of magnetic recording. If you want an audiophile journalist's perspective on high-speed duplication, you would have to turn to John Borwick or Angus MacKenzie's work in British publications.

DCC tape

Quote:

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The tape formulations supplied by manufactures was actually from video tape stock rather than casse
tte stock, i.e. mostly chromium tapes but cobalt doped ferric formulations were also available at t
he least in the early days of DCC, for archival purposes the ferric formulations have a longer life
times despite the lower price, this use of video tape stock explains why metal tape playback is not
 officially supported in the DCC standard. A few chromium audio cassette formulations are very simi
lar to video tape formulations so that it's theoretically possible to force some audio cassettes to
 work in a DCC recorder by modifying the enclosure and tape pad (if you need to seriously over-
bias a chrome tape to make it sound right on an analogue recorder, chances are that it's video stoc
k), but no audio cassette ferric formulations are similar to the video type ferric formulations tha
t DCC expects.
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It's hard to make sense out of what the author is writing, partly because of poor grammar and punctuation, partly because of misinformation. DCC was NOT video tape "stock." It was audio base film coated with CK 50-21 pure chrome pigment, which was also used for VHS, S-VHS, and TMD video formulations in different dispersions and different processing. TDK, Panasonic, and other Japanese tape manufacturers didn't bother with producing ferric-cobalt DCC tape. They bought pancakes from BASF because they wanted a hand in the DCC jar just in case consumer demand picked up, but they didn't want to invest too much in risky development. (BASF initially did the same with DAT. We sourced the first BASF DAT tape. Tape manufacturers were being cautious at the time because there were too many formats to develop all of them and too many losses from the VHS consumer market.)

The sentence fragment starting with "for archival purposes...." makes no sense to me. The same is true regarding metal tape playback. The author is probably British judging from the language used, so I don't know where he or she got the information.

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