INTERNATIONAL STANDARD

ISO 12606

First edition
1997-06-15

Cinematography — Care and preservation of magnetic audio recordings for motion pictures and television

Cinématographie — Soins et préservation des enregistrements sonores magnétiques pour la cinématographie et la télévision

Reference number
ISO 12606:1997(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12606 was prepared by Technical Committee ISO/TC 36, *Cinematography*.

Annexes A and B of this International Standard are for information only.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

Cinematography — Care and preservation of magnetic audio recordings for motion pictures and television

1 Scope

This International Standard recommends storage conditions for stabilization and preservation of magnetic audio recordings for motion-picture and television production.

It recommends the desirable storage conditions for magnetic audio recordings, as they may remain in library or vault storage between periods of intermittent reproduction or duplication.

It describes the care and handling of magnetic media intended to be introduced into, or removed from, storage.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ANSI/NAPM IT9.11-1993: *American National Standard for Imaging Media - Processed Safety Photographic Films - Storage.*

3 Storage hazards and concerns

Useful and acceptable reproduction of records removed from inactive storage requires attention to, and precautions against, all three of the following hazards: chemical degradation, physical distortion, and magnetic corruption [2, 3, 10, 11, 23]. Analog and digital recordings are on media with the same susceptibilities to chemical degradation and physical distortion. They do respond somewhat differently to magnetic corruption effects. The recommendations for storage conditions minimize each of these risks.

4 Summation of storage recommendations

4.1 Desired useful life of the recordings

4.1.1 Medium-term storage conditions

Storage conditions suitable for the preservation of recorded information for a minimum of ten years.

4.1.2 Extended-term storage conditions

Storage conditions suitable for the preservation of recorded information having a permanent value.

4.2 Recommended storage environments

Atmospheric temperature and humidity conditions for magnetic media storage are summarized and tabulated in table 1.

Table 1 — Storage conditions

	Medium-term	Extended-term
Equilibrium temperature, °C	23 max.	20 max.
Equilibrium relative humidity, %	20-45	20-30
Alternative 1: Temperature, °C	—	15 max.
Alternative 1: Relative humidity, %		20-40
Alternative 2: Temperature, °C		10 max.
Alternative 2: Relative humidity, %		20-50
Physical status:		
Winding	Co-planar	Co-planar
Enclosure	Protective	Protective
Roll orientation	Vertical	Vertical
External magnetic field		
DC: Oe	50 max.	50 max.
AC: Oe	10 max.	10 max.

5 Derivation of recommended storage conditions

The values in table 1 have been derived from the extensive practical experience with photographic films, as recommended by ANSI IT9.11 for the minimization of various degradations in monochrome photographic films. Most of the same polymers and modifiers are the major components of magnetic media. Existing data on magnetic media show that the two media are subject to the same degenerative reactions, with reaction rates that are similarly controlled by storage conditions [10, 11, 23, 30].

5.1 Application of the recommendations of table 1

5.1.1 Cycling

Cycling of temperature and/or humidity increases the severity of the storage conditions, and should be minimized.

5.1.2 Environmental purity

Control of air-entrained solid particles and gaseous impurities such as sulfur compounds, acidic vapors, ozone, peroxides, nitrogen oxides, ammonia, etc. are observed to accelerate chemical degradation.

5.1.3 Alternative storage recommendations

For extended-term storage, the three correlated temperature/humidity environments of table 1 provide essentially equivalent protection to the media. The choice among the three may be based upon convenience and existing structures.

6 Chemical stability

The stability of the organic carrier-matrix bearing the magnetic particles must hold the composite in its as-recorded structure to maintain the reproducibility of the record. Although specific audio magnetic records may incorporate additional chemical compounds not normally found in processed photographic films, it is perhaps fortunate that the chemical stabilities of the major components are controlled by the same environmental factors, thereby justifying parallel recommendations.

6.1 Moisture content and temperature of the media

All of the studies on chemical stability confirm that it is the precise moisture content and temperature of the actual media that controls the stability [2, 10]. When first placed in storage, the media may require considerable time to equilibrate to the surrounding storage environment.

6.1.1 Equilibration rates

A compact roll of tape or film can achieve temperature equilibrium with its environment rather quickly, but can achieve moisture equilibrium only by the slow molecular diffusion of moisture into or out of the face of the roll, all the way to the midplane of the tape or film [32].

6.1.2 Media enclosures

Media in storage should be in a protective enclosure or in a cassette. Such enclosed recordings will require even more time to achieve a different equilibrium relative humidity.

6.2 Nature of chemical instabilities

6.2.1 Polymeric hydrolysis

A major chemical degradation mechanism for most of the organic compounds present, both in photographic films and in magnetic recording media, is hydrolysis paced by the moisture content and temperature of the medium and possibly also catalyzed by some industrial pollutants[1] [3, 4, 10, 28, 29].

6.2.2 Magnetic particle chemical stability

The inorganic magnetic materials in the media may include oxides of extended thermodynamic stability, or metallic elements potentially subject to oxidation which is also facilitated by increased moisture content and/or increased temperature [23, 26, 27, 30].

6.3 Optimum extended-term storage

Inasmuch as the rate effects of temperature and of equilibrium relative humidity (i.e. actual moisture content of the media itself) upon chemical degradation are cooperative, it is desirable, when maximum useful life of the recordings is important, to attempt reconditioning of the media before storage and to store at the lower range of recommended relative humidities and temperatures.

7 Magnetic corruption

Magnetic recording is a reversible process and the magnetic pattern representing information in a record remains capable of alteration by subsequent exposure to an appropriate magnetic field.

7.1 Environmental effects on magnetic corruption

All mechanisms contributing to magnetic corruption increase in activity and significance with increasing temperature.

7.1.1 Temperature effect

The temperature recommendations of table 1 have been chosen for minimizing chemical degradation over several years storage. Elevated temperatures limited to several weeks, or even days, however, can induce magnetic corruption, and should also be avoided.

7.1.2 Thermal energy effects

Randomized distribution of thermal energy among the particles over time can, with some probability, assist additional particles to change their magnetic sense, possibly even as directed by the juxtapositioned fields of the recording itself

---

1) The actual moisture content of the media, either photographic or magnetic, increases with increasing partial pressure of water in the atmosphere (the absolute humidity), and decreases with increasing temperature of the medium. For most materials of interest over temperature ranges near "room temperature," this relationship, by pure chance, correlates approximately with relative humidity of the atmosphere. Thus ANSI IT9. 11 and related guides recommend equilibrium relative humidity ranges.

7.1.3 Magnetic field effect

External magnetic fields provide an additional potential for magnetic corruption of the recordings.[2)]

7.1.3.1 External DC fields with a magnitude no greater than 50 oersteds (4 kA/m), acting upon audio magnetic records in storage, have generally shown no degrading effect upon analog or digital recordings.[3)]

7.1.3.2 External AC fields are capable of assisting a larger number of particles to change magnetization sense, and therefore the somewhat lower AC field level of 10 oersteds (800 A/m) should be observed.

7.1.3.3 External fields not only increase the level of the noise floor, but also increase the print-through effect (see 7.2.1). An external AC field has been shown to be particularly effective in accelerating growth in the level of the printed signal.

7.1.4 External magnetic fields

External magnetic fields are most frequently observed near motors and transformers (e.g. commercial building elevator installations). Most of these installations are localized and therefore the field intensity falls off rapidly with separation; a few feet of separation from the source may provide protection. External fields of a more unanticipated nature may be produced by audio speakers, by cabinet latches, by magnetized tools, etc.

7.2 Analog recording mode

Analog audio recordings strive for a signal-to-noise ratio of 60 dB-80 dB and are therefore most sensitive to low-level corrupted information.

7.2.1 Print-through is a significant problem in the storage of analog magnetic audio recordings. The imprinting field that is acting upon the most susceptible particles is coming from the adjacent layer of the recording itself. The "added noise" is thus not random but recognizable music or dialog, and therefore most distracting.

7.3 Digital recording mode

Digital audio recordings provide quality reproductions from magnetic signal-to-noise ratios of about 20 dB. Accordingly, the reputed insensitivity of digital recordings to magnetic corruption has some foundation, but since digital systems usually take advantage of higher information densities, and work close to the limiting ratio, the margin may not be as great as is generally assumed.

8 Physical distortion

Reproduction of magnetic recordings (as well as the original recording process itself) requires consistent, intimate contact of the magnetic head with the media surface. Physical distortions interfere with achieving this requirement and thus degrade the reproduction.

8.1 Plastic flow

The deformation thresholds for plastic materials such as magnetic recording media are greatly dependent upon time. The yield point stress, beyond which nonelastic and irrecoverable deformation occurs, will be nearly as high as the break stress for suddenly applied shock loads and may be nearly zero for stresses maintained over a period of years.

8.2 Quality of roll winding

Since the prior use of the recording may have resulted in an irregularly wound roll, a full-length rewind is desirable to provide a uniform roll before storage.

---

2) The earth's magnetic field is of the order of one oersted (80 A/m) and is below the level of concern.

3) Magnetic flux meters reading in this range have recently become commercially available at prices an audio archive could consider. Most meters read in gauss (technically the field induced in the meter's sensor). This is numerically equal to the value in oersteds (technically the applied field) because of the design of the meter.