iasa

international association of sound archives
association internationale d'archives sonores
internationale vereinigung der schallarchive

phonographic bulletin

secretariat: david g. lance, c/o imperial war museum, london

no.18/july 1977

PHONOGRAPHIC BULLETIN

Journal of the International Association of Sound Archives IASA

Organe de l'Association Internationale d'Archives Sonores IASA

Zeitschrift der Internationalen Vereinigung der Schallarchive IASA

Editor: Dr. Rolf Schuursma, Foundation for Film and Science SFW, Utrecht.

Technical Editor: Dr. Dietrich Schüller, Phonogrammarchiv der Oesterreichischen Akademie der Wissenschaften, Wien.

The PHONOGRAPHIC BULLETIN is published three times a year and is sent to all members of IASA. Applications for membership of IASA should be sent to the Secretary (see list of officers below). The annual dues are at the moment $ 10,00 Canadian for individual members and $ 25,00 Canadian for institutional members. Back copies of the PHONOGRAPHIC BULLETIN from 1971 are available at $ 5,00 Canadian for each year's issue, including postage. Subscriptions to the current year's issues of the PHONOGRAPHIC BULLETIN are also available to non-members at a cost of $ 10,00 Canadian.

Le journal de l'Association internationale d'archives sonores, le PHONOGRAPHIC BULLETIN, est publié trois fois l'an et distribué à tous les membres. Veuillez envoyer vos demandes d'adhésion au secrétaire dont vous trouverez l'adresse ci-dessous. Les cotisations annuelles sont en ce moment de 10 dollars canadiens pour les membres individuels et de 25 dollars canadiens pour les membres institutionnels. Les numéros précédents (à partir de 1971) du PHONOGRAPHIC BULLETIN sont disponibles au coût de 5 dollars canadiens par année (frais de port inclus). Ceux qui ne sont pas membres de l'Association peuvent obtenir un abonnement au PHONOGRAPHIC BULLETIN pour l'année courante au coût de 10 dollars canadiens.

Das PHONOGRAPHIC BULLETIN erscheint dreimal pro Jahr und geht allen Mitgliedern der IASA zu. Aufnahmeanträge für die Mitgliedschaft in der IASA sollten an den Sekretär (Anschrift siehe unten) gerichtet werden. Des Jahresbeitrag beläuft sich z. Zt. auf 10 kanadische Dollar für Einzelmitglieder; korporative Mitglieder zahlen 25 kanadische Dollar pro Jahr. Ältere Hefte des Bulletins von 1971 an sind zum Preise von 5 kanadischen Dollar pro Jahrgang erhältlich, einschliesslich Porto. Abonnement für Nicht-Mitglieder der IASA sind erhältlich zum Preise von 10 kanadischen Dollar pro Jahrgang.

EDITORIAL

For the first time reports from national branches of IASA are included in the Bulletin, introduced by an article about the establishment of national branches by IASA's Secretary, David Lance. In future issues of the PHONOGRAPHIC BULLETIN I look forward to an increasing number of annual reports from national branches.

The greater part of the present number of the Bulletin is taken up with articlesand reports on technical matters, published under the Editorship of Dr. Dietrich Schüller, Chairman of the Technical Committee of IASA. I wish to thank him and the authors for their important contributions which will certainly result in lively discussions during the Mainz conference and thereafter. I am especially grateful to Mr. Dietrich Lotichius, Chairman of the Radio Sound Archives Sub-commission of the International Association of Music Libraries, for his permission to print in full Mr. Wiegel's article on the BASF Professional 1/4" Cassette Unisette.

The contents of the articles by Mr. Wiegel (BASF) and Mr. Knight (EMI) are in our opinion extremely interesting for the readers of the Bulletin. This does, however, not mean that IASA is responsible for their information and views. By publishing the articles IASA does not express its preference for any industry or any industrial product.

Dr. Rolf Schuursma
Editor

PROGRAMME OF THE ANNUAL MEETING OF IASA TOGETHER WITH THE INTERNATIONAL ASSOCIATION OF MUSIC LIBRARIES (IAML)
MAINZ, 11-17 September 1977

Sunday 11 September:

11 - 13	IASA: Executive Board (members only).
18	IAML and IASA: Opening Session.

Monday 12 September:

9 - 11	IASA: General Assembly Part 1.
11 - 13	IASA: Technical Committee (members only). IASA: Copyright Committee (members only).
12 - 12.30	Record Libraries Commission of IAML: Recorded music presentation to mark the Edison Centenary.
18	Reception in the Townhall of Mainz.

Tuesday 13 September:

9 - 11	Record Libraries Commission of IAML: The Literature on recordings (papers).
11 - 13	IASA: Sound Archives in the Federal Republic of Germany. Chairman Dietrich Lotichius (Norddeutscher Rundfunk). Speakers Friedrich Kahlenberg (Bundesarchiv), Heinz Lanzke (Deutsche Musikarchiv), Gustav Mohrlüder (Zweites Deutsches Fernsehen), Helmut Müller (Hessischer Rundfunk).
16 - 18	IASA: Ethnomusicological sound archives. Chairwoman Ann Briegleb (University of California, L.A.). Speakers Frank Gillis (University of Indiana), Judy Kaufman (State University of New York), Bernard Broere (University of Amsterdam).
20	IASA: Social evening (members only) at the Haus des Deutschen Weines.

Wednesday 14 September:

9 - 11	IASA: Edison Centenary celebration. Chairman Dietrich Schüller (Phonogrammarchiv der Österreichischen Akademie der Wissenschaften) Speakers Rolf Schuursma (Stichting Film en Wetenschap) on "The World in which the phonograph was born", Wilfried Zahn (Deutsches Rundfunk Archiv ea)on "Edison's reproduction problems - discussions and demonstrations".
11 - 13	IASA Record Libraries Commission and Public Libraries Commission of IAML: joint session on preservation and storage of modern sound recordings.
afternoon	Excursion.

Thursday 15 September:

9 - 11	Radio Sound Archives Commission of IAML: Hundred years of recording.
11 - 13	IASA Record Libraries Commission and Public Libraries Commission of IAML: joint session on preservation and storage of old sound recordings.
14 - 16	IASA: Open session Chairman Rolf Schuursma Speakers 1. Lou Hoefnagels (Theater Klank en Beeld, Amsterdam) on "The recording and preservation in sound and picture of new developments in the Theatre" 2. Rainer Hubert (Österreichischer Phonothek) on "Ideas on methodology in historical sound documentation" 3. Léo La Clare (Public Archives of Canada) on "Acquisition arrangements between research and radio sound archives; a Canadian precedent and its application for other countries"

4. Samuel Proctor (University of Florida) on "New developments in the oral history project at the University of Florida".
5. Joop Van Dalfsen (N.O.S. Fonotheek, Hilversum) on "The use of the computer in the documentation systems of the N.O.S. Sound Archives".
6. Robert Werba (Österreichischer Rundfunk) on "The importance of acoustic sources for music history; with special reference to composers rendering their own music".

16 - 18	IASA: Executive Board (members only).
20	Concert in the Townhall of Mainz.

Friday 16 September

9 - 11	Record Libraries Commission of IAML: the literature on recordings (cont. from Tuesday).
11 - 12	Representatives of IAML Commissions and IASA: planning and coordinating activities for 1978.
13 - 15	IASA: General Assembly Part II.
15 - 17	IAML and IASA: Closing Session.
19	IAML and IASA: Farewell Dinner.

Saturday 17 September

9	IASA: Executive Board (members only).
7.30-22	Excursion to Heidelberg.

IASA COMMITTEES

Technical Committe	: Chairman	- Dietrich Schüller, Vienna
	Members	- Robert Carneal, Washington
		Lloyd Stickells, London
		Wilfried Zahn, Frankfurt
Copyright Committee	: Chairman	- Robert Ternisien, Montreal
	Members	- Gerald Gibson, Washington
		Claudie Marcel-Dubois, Paris
		Ulf Scharlau, Stuttgart

Conference Organising Committee: Ulf Scharlau (IASA's representative).

IASA ANNUAL CONFERENCE

PORTUGAL 1978

AN APPEAL FOR PAPERS

1. If there are any subjects which you would like to suggest for the 1978 conference please make your proposals in writing to the Secretary. Your suggestions are more likely to be accepted if you are also willing to present a paper on the subject of your choice and, in this case, you should also send an outline of your contribution to the Secretary. Finally, if you know any other sound archivists who can speak authoritatively on the subject you have proposed, please send their names to the Secretary.

2. A number of possible subjects for the 1978 conference are listed below. If you would like to present a paper on any of these topics please write to the Secretary accordingly, enclosing an outline of the paper you would be prepared to contribute. Any subjects which are well supported with offers of papers are very likely to be included in the final programme.

   a. Sound archives in the West Mediterranean countries - Portugal, Spain, Southern France and Italy.

   b. Exploitation of research sound archives eg research, educational use, broadcasting, audio publications, etc.

   c. The international sound archives movement -its history,present state and future prospects (a debate).

   d. Conditions for the exchange and use of unpublished recordings between sound archives.

   e. Field recording - methods and equipment.

   f. The assistance of computer systems for the technical control and preservation of sound recordings.

All proposals and offers in response to 1. and 2. above must be submitted to the Secretary by the end of November 1977.

iasa national branches

1976-1977

THE STATE OF THE NATIONS: NATIONAL BRANCHES AND NATIONAL REPRESENTATIVES

David Lance, Imperial War Museum, London.

In 1976 the formation of IASA's first national branch in the United Kingdom marked an important new development within the Association. It provided an opportunity and a means for sound archivists, and others with a serious interest in sound recordings, to meet professionally in a national setting. Since many of the individuals in the UK who have supported the new Branch have little prospect of attending IASA's international conferences, the creation of a national group in the UK also provided a motive - in fact the raison d'être - for individuals and institutions, who might otherwise have felt unable to justify a subscription, to join the Association.

The successful establishment of a national branch in the UK demonstrated that IASA, as the primary association for sound archivists, has become sufficiently well established both to justify and support groups and programmes at a national level. In confirmation of this fact, national branches have also subsequently been formed in Austria and the Netherlands. It is to be hoped that this demonstration of the need for and the value of national branches (in three countries which are by no means the predominant member countries of IASA) will encourage comparable developments in those other parts of the world in which sound archives are numerous and well established. Clearly, what has been achieved in Austria, the Netherlands and the United Kingdom, could be paralleled in - for example - Canada, the United States and Western Germany.

While national branches cannot be expected to develop at an equal pace in all IASA's member countries, it would be unfortunate if evolution proceeded at dissimilar rates within countries of comparable potential. It would be equally regrettable if, in other countries where sound archives are not sufficiently numerous at this stage to allow the constitution of national branches, IASA failed to establish contact with and meet the needs of colleagues working in relative isolation.

So as to establish an impetus for the creation of new national branches in countries where this is already feasible, and to provide a superstructure in other areas on which to build branches at some later date, the Executive Board would like to invite sound archivists who wish to further the interests of our profession within their own countries, to act as National Representatives of IASA.

Initially, the functions of a national representative would be:

1. To act as an agent through whom IASA can obtain information about sound archives in their particular country.

2. To provide a channel for communicating information about IASA to their national colleagues.

3. To seek actively to recruit new members for IASA.

4. To work towards the creation of a national branch of IASA.

The Board will give the fullest possible support to any members prepared to act as national representatives, and any colleagues who would like to consider this possibility are invited to contact the Secretary of the Association.

IASA UNITED KINGDOM BRANCH 1977 ANNUAL MEETING

The UK Branch of IASA held its second national meeting on Wednesday 9th March, 1977, at the British Institute of Recorded Sound.

At the business meeting, with which the day's programme began, the Secretary reported on the encouraging growth of IASA's membership in the UK, pointing out that there were now twenty members as compared with eight when the Branch was formed in 1976. Since twenty members from various parts of Britain attended the meeting at the BIRS, there was ample evidence of the interest in and the need for the UK national branch of the Association. It was also interesting to note that only three or four UK members expected to be able to attend the international conference at Mainz. This clearly demonstrated that, as a means of enlarging the Association and of providing local programmes of activity for sound archivists, the creation of national branches is an important step in IASA's development.

A report was given on the Bergen Conference, the work of the IASA Committees and the various official projects which are currently in hand.

The Chairman announced that David Lance had resigned as Secretary to the Branch and that he would be succeeded by Diana Hull, Chief Cataloguer of the BIRS.
Members were asked to consider the question of electioning the Branch's officers and, after discussion of various methods, Yvonne Renouf (British Universities Film Council) proposed that the existing officers should nominate their successors. This proposal was approved by a substantial majority vote. It was further agreed that the Chairman and Secretary should serve for two years, with one officer retiring annually. The Secretary would be responsible for circulating the names of new officers to all members at least two months in advance of the Annual Branch Meeting.

After the two successful meetings at institutions in London, it was announced that the next gathering of the UK group would be hosted by the South Yorkshire Country Archives at Sheffield in the Spring of 1978.

Patrick Saul, the Director of the British Institute of Recorded Sound, opened the professional part of the day's programme with a talk about the history, objects, constitution and work of the Institute. He then introduced several senior members of his staff who described the work and methods of the departments for which they were responsible. Among the many interesting presentations Bob Walters demonstrated some of the Institute's technical problems and procedures; Ron Kettle played examples from the Institute's Library of Wildlife Sounds; and Diana Hull described current cataloguing developments towards a computer based system.

The itinerary also included a tour of the Institute and an excellent lunch.

IASA NETHERLANDS BRANCH 1976-1977

The Netherlands Branch of IASA was established during a meeting in the Foundation for Film and Science SFW on December 16, 1976. Representatives of the State Archives, several Municipal Archives, the NOS Netherlands Broadcasting Foundation, Theater Klank en Beeld (The Theater Picture and Sound Foundation), the Institute for Dialectology of the Academy of Sciences and the SFW, under the chairmanship of Dr. Rolf Schuursma, decided to meet regularly to discuss not only cooperation between sound archives in the Netherlands and problems related with their work but also to take part in the work of IASA. (The Ethnomusicological Centre "Jaap Kunst" of Amsterdam University, the Amsterdam Public Library and Donemus were also invited but were unable to send a representative). It was also decided to give the Branch the character of a working group with a president and a secretary as executive officers. Those taking part agreed to apply for membership of IASA (several institutes have been a member for some time).

A second meeting took place on June 29, 1977, in the NOS at Hilversum. During the first part Mr. T. Tonkes of the Municipal Archive, Rotterdam was selected as Secretary, while Mr. Schuursma agreed to continue as President.
An explanation was given of the programme of the Annual Meeting of IASA in Mainz which will be attended by several members. This was followed by a discussion in relation with the Report of the SAVA (Audiovisual Archive Foundation) Committee which was recently presented to the Government. The report contains proposals for a national depot of audiovisual media and a national documentation centre for the use of municipal archives and other institutes in the Netherlands with collections of recordings (Phonographic Bulletin, No. 16, December 1976, p. 33 and 34). Several members of the Netherlands Branch of IASA participated in the committee. There was also some discussion about a report of a Governmental committee on documentation and distribution of audiovisual media in the Netherlands (the WAM committee) and the continuation of its work. During the second part of the meeting Mr. L. van Dalfsen gave an interesting talk about the NOS Sound Archives which was followed by a vivid discussion of problems of preservation, copy-rights and cataloguing. The meeting ended with a tour of the Sound Archives with special attention for the computerized catalogue on which Mr. van Dalfsen will report during the Open Session in Mainz.

A third meeting will take place in the beginning of 1978 with reports about the Mainz conference. During the third meeting the President and the Secretary will propose some projects including a Directory of Sound Archives in the Netherlands. A drive for membership will be taken up by the Secretary during the fall of 1977.
The Netherlands Branch now consists of 14 member institutes.

DAS SCHALLARCHIV

INFORMATIONSBLATT DER ARBEITSGEMEINSCHAFT ÖSTERRFICHISCHER SCHALLARCHIVE
APRIL 1977 Nr. 1

(The Sound Archive. Journal of the Working Group of Austrian Sound Archives)

From 1974 several Austrian sound archives have had occasional meetings to discuss problems of organisation, copyright and technology. This was followed in 1976 by the establishment of the Working Group of Austrian Sound Archives (AGÖS) - the Working Group acts also as the Austrian Branch of IASA - and recently by the publication of the first volume of its Journal, Editor Dr. Rainer Hubert, Österreichischer Phonothek. The first issue consists of an introductory article by

Dr. Dietrich Schüller and contributions by

Dr. Armgard Schiffer (The Picture and Sound Archive of the Landesmuseum Joanneum in Graz)

Dr. Rainer Hubert (The Austrian Phonothek)

Dr. Gerhard Jagschitz und Dr. Rainer Hubert (On the methodology of historical sound records)

Dr. Dietrich Schüller (Sound recordings in Austrian Libraries, Museums and Collections).

The Journal contains also communications from the Working Group AGÖS and short reports from several Austrian institutes.
The Journal will be published two times a year. Subscription S 100,— per year.
Further information: Arbeitsgemeinschaft Österreichischer Schallarchive, A 1090 WIEN, Rotenhausgasse 6, Austria.

THE SOUND ARCHIVE OF THE IMPERIAL WAR MUSEUM OPENS TO THE PUBLIC

In July 1977, the Imperial War Museum's collection of oral history and other sound archive recordings will be opened to public access. The recordings are administered by the Museum's Department of Sound Records which, since it was created in 1972, has built up a collection amounting to 3,500 recorded hours.

The Department of Sound Records has been collecting material from two main sources. First, by arrangement with various agencies, recordings made by radio and television broadcasting organisations. Secondly, through its own oral history programme, the recorded reminiscences of various civilian and service groups.

Two major groups of recordings have been fully processed and organised for public use from July. Namely, broadcast recordings obtained from the BBC Sound Archive covering the years 1939 to 1945 and including war reports, commentaries, actualities, interviews and personal narrations. Most of these are contemporary recordings made during or immediately after the events they cover.

The second major groups of material which will be made available consist of the interviews which the Department has recorded in several projects broadly covering the First World War period. This group deals with the experiences of men and women who were personally involved in the following areas of activity:

- Military and Naval Aviation 1914-1918
- Life and Operations on the Western Front 1914-1918
- Life on the Lower Deck of the Royal Navy 1910-1922
- The Anti-War Movement (pacifists and conscientious objectors) 1914-1918
- War Work (non-combatant and mainly civilian) 1914-1918

Most of the interviews recorded in these projects have been fully transcribed.

In addition to the recordings described above there are several other groups of material in the collection, some of which can be made available in a somewhat more primitive state of organisation. From broadcasting sources, there are the interviews which were recorded by the BBC during the production of the Corporation's television series The Great War; by Rediffusion during the production of the Life and Times of Lord Mountbatten; and by Thames Television during its production of The World at War. There are contemporary recordings of, for example, the wartime speeches of Nazi leaders and the proceedings of the International Military Tribunal at Nuremburg. The Department's own recording programme has progressed to the inter-war period and further projects have been carried out relating to the Spanish Civil War, the British Army in India and the Mechanisation of the Army (eg the cavalry's transition from horse to tank).
Finally, there are recordings of and interviews with war artists and war poets; sound effects; recorded lectures and speeches; and ENSA broadcasts.

From July, listening and reading facilities will be provided in the Museum for personal visitors. Copies of those recordings and transcripts of which the Museum holds the copyright can be purchased by the public and other material will be available for cirulation outside the Museum under conditions laid down by the appropriate copyright holders. Applications to use the collection will be welcome from the 1 July, when lists of catalogues, conditions of access and terms of sale will also be available on request.

Enquiries should be addressed to the Department of SoundRecords, Imperial War Museum, Lambeth Road, LONDON SE1 6HZ, England. Telephone 01-735 8922.

ASSOCIATION FOR RECORDED SOUND COLLECTIONS

The Editor received the following communication from the Association for Recorded Sound Collections in the United States, dated June 1, 1977.

The Association for Recorded Sound Collections is pleased to announce the receipt of a grant from the National Endowment for the Humanities.
The purpose of this grant is to plan a project to create an international, standardized, computer-produced union catalog of recordings from worldwide sources.
The present planning, while attempting to accomodate all recorded subjects and media into its final recommendations, will concentrate upon commercially issued classical music and spoken word pre-lp recordings. Other subjects and media such as jazz, vernacular, and country music, as well as noncommercial recordings, were considered. However, areas of greatest mutual experience were chosen since the project is envisioned as the model for an eventual union list of all sound recordings.
The six archives and their representatives participating in this study are the Library of Congress (Gerald Gibson), New York Public Library (David Hall), Stanford University (Garrett Bowles), Syracuse University (Donald Seibert), the University of Toronto (James Creighton), and Yale University (Richard Warren). These collections have chosen to work together because of the extent of duplicate holdings of their collections, their experience in providing cataloging access to sound recordings, and the advantages of a union catalog.
The significance of this project is three-fold: 1) it will furnish a means to union catalog access to some of the recordings of major historical, social, and artistic worth held by the above collections, materials which are little known today because of the present lack of bibliographic access; this, in turn, will provide 2) a machine-readable data base of quality cataloging available to other collections and 3) a pilot project for the creation of a machine-readable union catalog of ALL recordings located throughout the world.
In addition, several research tools of major proportions in the field of sound recordings will be created during the grant period. Included in these are a union list of periodical literature related to recordings, a union list of record manufacturers' catalogs, and a standard for the archival cataloging of sound recordings, regardless of content.
The present plan calls for seven meetings of the participants. During the eighteen-month period of the grant, the group will 1) develop an archival standard for the cataloging of sound recordings 2) test the procedures and rules developed; 3) perform certain time-motion studies; and 4) complete the various inventories as assigned. The study is expected to develop cataloging standards and specific rules pertaining to them based upon the current Anglo-American Cataloging Rules; develop procedures to effectively produce the data base; select a computer system capable of implementing the MARC format for music and sound recordings to host the pilot project; and estimate the time, personnel and equipment required for the proposed cataloging project on the basis of the above three items.
In an attempt to make the catalog standards applicable to all subjects of recorded sound (spoken materials, music in all its forms and interests, sound effects, etc.), the working group is in contact with subject specialists at such collections as the Country Music Hall of Fame, Archive of Folk Song in the Library of Congress, the Ethnomusicology Archive at the University of California at Los Angeles, the Archive of Traditional Music at Indiana University, and the Rutgers Institute of Jazz Studies.

Additional information may be obtained from Mr. Garrett H. Bowles, Music Library, The Knoll, Stanford University, Stanford, California 94305, U.S.A., phone 415/497-2463.

JOURNAL OF THE CANADIAN ORAL HISTORY ASSOCIATION
VOL. 2 1976-77 (ISSN: 0383-6894)

The Second Volume of the Journal of the Canadian Oral History Association, published Spring 1977, contains three speeches delivered during the 1976 Canadian Oral History Conference and the following articles.

"A visual dimension to oral history"
by Don Page.

"Family studies as an approach to oral history"
by Laurel Doucette.

"Oral history and the history of Canadian art"
by Charles C. Hill.

"Archivistes, historiens d'art et documents oraux"
par Raymond Vézina.

"Theatre history and oral history"
by Don Rubin.

"Preparation for an oral biography of Gweneth Lloyd, teacher of dance"
by Esmé Crampton.

"The CBC radio drama project and its background"
by Howard Fink.

"De Christian Leden et de ses recherches au Canada, dans l'optique de l'utilisation du phonographe"
par Jacques Gagné.

"Proposal for a Saskatchewan oral history project"
by Robert C. Cosbey.

The Journal is published annually and is available on request at $ 3.00 Canadian per copy. The publication is included with membership in the Association.
Editor of the Journal is Léo LaClare, Public Archives of Canada.
Further information: Canadian Oral History Association, P.O. Box 301, Station "A", OTTAWA, Ontario K1A 0N3, Canada.

TONDOKUMENTE ZUR ZEITGESCHICHTE
1888 - 1932

Bild- und Tonträger-Verzeichnisse
Herausgegeben vom Deutschen Rundfunkarchiv
Nr. 8
Zusammengestellt und bearbeitet von
Walter Roller
Frankfurt am Main 1977

The new catalogue is a revised and enlarged edition of Hans-Joachim Weinbrenner's "Tondokumente zur Zeitgeschichte.
Politik/Wirtschaft 1901 - 1933" 1958 and the issued supplement-catalogue "Tondokumente zur Zeitgeschichte. Politik 1900 - 1945. Nachtrag" issued in 1973. In 487 entries a rich and colourful history unfolds itself trough sound recordings from the Deutsches Rundfunkarchiv in Frankfurt am Main. Eight recordings date from before 1900, including talks by the very unknown Baron Stanley of Preston at the opening of the Industrial Fair in Toronto (1888), and better known personalities like Engelbert Humperdinck, the composer (ca. 1899), and Emile Berliner (1899). As Mr. Roller justly remarks in his introduction many recordings from the period before the Deutsche Rundfunk started to make its own recordings (1929) bear a more or less arbitrary character, being in fact testimonies in sound of happenings which are not systematically related with the political and social history of Germany of those days. Things are different after 1930 when the tragic last phase of the Weimarrepublik has been registered in many valuable recordings.
These entries amount to more than 350, the greater part of the catalogue.
Mr. Roller and his assistants have done their work with great care, summarizing the contents of the recordings under the title descriptions.
The catalogue is supplemented with indexes on persons, geographical names and subjects.

RLS

technical problems

three articles

CONTROLLING MAGNETIC TAPE FOR ARCHIVAL STORAGE

Robert B. Carneal, Library of Congress, Washington D.C. (Paper read during the annual meeting of IASA in Bergen, August 1977)

Introduction

There have been many speed and format changes since audio recording began in earnest in 1890. The cylinder and disc formats gave us many combinations in the past and will continue to do so in the future.
The magnetic tape recording industry seems dedicated to introducing at least one new format a year. Since the beginning in 1944 (a total of 32 years), I can count approximately 40 different combinations of speed and format changes introduced thus far. These changes generally arrive as consumer products where economy of price and expected consumer demand dictate the product and its associated equipment. Each and every one is heralded as a major innovation and a step forward in technical excellence. Archives who receive these products as a matter of statute, must decide whether to service the product in its original form, or because of expected preservation difficulties, change the format to one more compatable with existing formats standard within the organization.
The expense involved in changing formats generally persuades the archive to service the originals by purchasing equipment on which to play the innovative product, with fervent hopes that later preservation problems will not appear. This approach is consistent with practices involving disc recordings with the exception that most archives want disc recordings in duplicate. This duplication gives archivists a feeling of security.

What about archive practices when dealing with magnetic tape? Are we leaving its preservation to chance? Will the ideal medium come that will hold the intellectual information permanently, safely and economically?
At this particular time it is difficult to say, but I believe we should be more careful in controlling what we store at the time we record it for storage. Let's take a look at current industry practices to see what there is that can be controlled by the archivist.

Magnetic tape-physical properties in storage

It is becoming increasingly apparent that physical damage to magnetic tape is by far the leading factor in its deterioration. A discourse on the manufacture and use of the tape at this point in time seems useless since it is already well documented. The most pressing problems that need attention are reel design and storage box design.

The reel

The inner hub diameter contains a slit put there for initially placing tape ends to grab as the second layer of tape overlaps the first.
The stress patterns created across this slit can been seen in acetate based tape by holding the tape between a light source and the eye. In storage, this stress causes the tape to become permanently set and on playing-back the tape weaves its way through the heads of the machine. Polyester tape also receives the same treatment with the same results, although it is not as easily seen because the tape is not translucent. This stress becomes more severe as the diameter of the hub is decreased.
Stress patterns are created in other points of the tape pack but are not usually the fault of the reel design. These patterns are created by improper machine tensions during normal operations through a badly adjusted machine. These will be mentioned in another section.

Reel flanges that are out of plane or that have dents contact the tape when under use, forcing the tape into unnatural positions in the packed tape. This becomes severe in any fast motion of the tape transport. Tapes stored in this manner will exhibit edge damage on replay.

Storage boxes

It becomes important in long-term storage that the tape reel be supported in the center of the tape box, and not resting on the edges of the reel itself. Both plastic and metal reels exhibit deformation when under a continuous load for long periods of time. The boxes also need to be acid free, stable, dust protective and contain enough labeling room to hold all desirable information. Paper suspected to have high acid content should not be placed in the box with the reel and tape.

Splicing tape

As trivial as it seems to include the storage of splicing-tape among and adhering to the magnetic tape, its importance has reared its ugly head time after time. Magnetic tape older then 1959 is becoming a major problem if it contained splices when stored originally. It has been found that the newer specially treated backing tapes do not hold up if spliced with other then splicing tapes made for them. The rule seems to be not to use tapes that have splices in them for archival storage.

Identification of reels

Incoming tape shipments seem to carry only the most elementary information. Technicians seem to dislike writing and leave out such information as original recording media, date of original recording, place, notes pertaining to equipment used or special circumstances surrounding the event. If you receive all the information, where is the proper place to put it? On the leader with associated splicing tape? On the reel itself? On the storage box? All of the above? It seems that each institution has its own methods, and no two seem alike.

Under this heading of magnetic tape, it seems there are only two items we can control: (a) the tape purchased for storage in our archive, and (b) the operating parameters in using the tape in our own work environment.

Magnetic tape-electrical observation

In August, 1958, and in conjunction with the production of magnetic tapes for a study under the title "Preservation and Storage of Sound Recordings" by A.G. Pickett and M.M. Lemcoe, published by the Library of Congress in 1959, we produced duplicate sets of the standard tapes to place on our shelves for later study. In July, 1976 we decided to begin our investigation of the untouched tapes to see what we could learn about tapes in storage under normal storage conditions. Though the studies are just underway and will form the basis of another paper I hope to present to the next session of I.A.S.A., I did some preliminary work investigating the print-thru phenomena exhibited by three tapes of different thickness.

The signal to print ratio of the Scotch 111-A6 (1.5 mil acetate tape) was measured at 400 hertz and 1 kilohertz. The print-thru signal on the first turn after the primary signal measured 42 dB below the 3% distortion level of the primary signal for both frequencies. The print-thru signal of the second turn of tape measured 47.5 dB below the same reference level. In the Pickett-Lemcoe report mentioned above, the chart displayed on page 59 gave a projection of print-thru to be expected from a general coated tape in 20 years as 47 dB below signal level. This expected level has been exceeded in 18 years by 5 dB on this tape.

The signal to print-thru ratio on the second tape, Scoth 150-9 (1.0 mil polyester tape) was measured at the same frequencies. The original 3% distortion level occurred at a level 2 dB lower then the former 1.5 mil tape and hence the original recorded level was lower by 2 dB. The print-thru signal on the first turn of the tape after the primary signal measured 45.5 dB below the 3% distortion level of the original signal. The second turn measured 43 dB below the same reference level. An explanation as to why the second turn of the tape produced a print-thru level higher then that of the first turn is still to be found.

The signal to print-thru ratio on the third tape, Irish doubleplay number 5-1200 (.5 mil polyester tape) was measured at the same frequencies. The print-thru signal on the first turn of the tape after the primary signal was 33 dB below the 3% distortion level reference level. The second turn of the tape exhibited print-thru tones out of sequence and at varying levels indicating both post-print and

pre-print signals were interfering to such an extent that measurement was all but impossible. In fact, all ten layers of tape between primary signals gave very high readings of random print-thru.
Evidently, this preliminary investigation supports the concept of not using full recording level for recordings that are to be made part of an archive. It also supports the suggestion of using thicker tape then .5 mil for maximum protection.
The newer magnetic oxides and magnetic orientation of the particles during manufacture will certainly effect print-thru characteristics. The new tapes are consistently being recorded with test frequencies and placed on shelve for future investigation.
Both the physical and electrical problems are ours to control within our archives. Cooperation between us will lead to more complete understanding and control of these enemies.

Magnetic tape machines

Except for those archives which have special purposes, most of us are obliged to purchase tape machines from the open market. These may be professional, semi-professional or home entertainment types. The definition of one type in reference to another is becoming less clear as years come and go.
The professional machine gives more control over the operating adjustments then do most of the other categories.
The internal electronics of the equipment is dictated by the manufacturer and the association responsible for setting standards in his interest group. There are at least seven of these standards groups operating in Europe, America and Japan. Their primary interest is that all manufacturers in the same interest group make machines that are compatible. Since the groups have different clients, they have different standards. Fortunately for archivists, and with few exceptions, the product from each interest group is compatible as far as the audio on the tape is concerned. If you use the correct equipment to play the product and re-record onto another machine, the recorded product should be a flat recording onto the new medium. The exception to this compatibility is pre-recorded tapes produced on hi-speed duplicating equipment for the consumer market. The producers of these items fudge the hi and low end of the frequency spectrum to gain a little assurance that noise generated in less expensive equipment will not be objectionable to the consumer.

Magnetic tape machine alignment

This is the most important part of a tape operation, and it is absolutely controlled by the technicians in each archive. It is very important to know that our machines produce a tape that will play-back exactly as it is supposed to in the archive.
Standard operating levels for tape machines have varied from country to country. They vary as well within a country over a period of time. European archives associated with radio networks use slightly higher reference levels then U.S. archives.
The speeds and track formats and all the accessory equipment demands are compatible, so the problem is minimal. Tapes that are exchanged between them, however, should carry that information on the label in flux in nano-webers per meter. Indeed, since the particulars of the recording is so important to correct play-back, it would be nice to have all available information of a technical nature.
One step further, it would be ideal to have recorded on the tape itself a signal of 100 hertz, 1 kilohertz and 10 kilohertz so that the recipient can align his play-back head to your azimuth signal. This would tend to standardize tapes between the archives that participated. Any tape duplicated from the second generation tape would be of maximum fidelity.

Conclusion

Factors that we can control within the individual sound archive are:

1. Magnetic tape purchased for use in the archive.
2. The operating parameters of that tape in the archive.
3. Manufacturer of purchased tape recording equipment.
4. Price paid for the recording equipment.
5. Operating levels of the purchased equipment.
6. Maintenance of the purchased equipment.
7. Reels and boxes used for archival storage.

8. Identification of tapes put into the archive.
9. History of the item stored.

Surprisingly, this is quite a lengthy list.

The basic problem seems to be that we are not consistent with each other, and at times excercise no control at all. I can, however, think of no other organization aimed primarily at sound archives, international in scope, and maintaining the calibre of membership needed to standardize items like those mentioned above to the benefit of all sound archives.

IASA TECHNICAL COMMITTEE

EXCHANGE TAPE STANDARD

As a result from the publication in the December 1976 issue of the Phonographic Bulletin (No. 16, p.36-37) several suggestions to the draft have been made. The most important are:

The azimuth-term should be 15 kHz instead of 10 kHz as an additional indicator for high frequency stability.

Instead of the "peeps"-separation of the different items on one tape a 50 or 60 Hz-term should be used, 50 Hz indicating CCIR, 60 Hz indicating NAB-equalisation.

All suggestions will be considered by the Technical Committee at its session in Mainz.

Dr. Dietrich Schüller
Chairman.

FACTORS RELATING TO THE LONG TERM STORAGE OF MAGNETIC TAPE

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February 1977

This report was prepared by the Central Research Laboratories of EMI Ltd.
The Editor likes to thank EMI and Mr. Knight for their kind permission to reprint the report in the present issue of the Phonographic Bulletin.

FACTORS RELATING TO LONG TERM STORAGE OF MAGNETIC TAPE

By G. A. KNIGHT

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1. INTRODUCTION AND SUMMARY

Firm recommendations have been made in the past concerning optimum storage and safe transit conditions for magnetic tape. The objects of this study were to review these in the light of long-term experience and note the penalties of non-compliance or of adopting relaxed procedures. The main lines of approach were:

i) a brief literature survey with particular reference to recent publications.

ii) to examine a cross-section of tapes from EMI's own sound archives in order to assess the condition of various materials of differing age.

iii) to contact other organisations with experience in tape archiving and exchange information of mutual interest.

Reports were received highlighting problems due to storage in uncontrolled environments and mishandling which included physical damage, shedding of the magnetic coating, deterioration of the base film and, in a few cases, fungal attack.

Most of the recommended procedures have varied little throughout the period during which tape has been used and there is no doubt that strict adherence to these procedures would have resulted in minimal problems.

It is impossible to avoid the conclusion that for maximum longevity tapes should be stored and used under fairly stringent environmentally controlled conditions. It appears from experience, however, that some relaxation can be permitted without serious consequences particularly when more modern tape materials are used. It is suggested, therefore, that an alternative to fully environmentally controlling the whole archive would be to seal the tapes into moisture-proof plastic bags in a temperature and humidity controlled "preparation room". The main storage area would thus require temperature stabilisation only whilst sealed bags offer the added advantage of protection against such hazards as sprinkler damage.

The study was mainly "audio tape orientated" but much of the information and recommendations are applicable to other classes of tape.

Those organisations who co-operated are listed in section 6. Few written reports were available and most of the information was obtained as a result of verbal discussion.

2. LITERATURE SURVEY

Although a number of papers on the subject of tape storage have been published, few are either of recent origin or updated to incorporate long term experience. One report, however, by the European Broadcasting Union (EBU)[1] dated March 1971 contains a survey of the practices in force in eighteen organisations,gives details of their experience and makes recommendations for tape storage.

One of the most comprehensive reports is "Preservation and Storage of Sound Recordings" by Pickett and Lemcoe[2] which was written as the result of a study for the Library of Congress, Washington. This paper deals at great length with the storage of discs as well as tape and fortunately extends into the early polyester tape era. PVC materials however, receive virtually no mention. Although produced in 1959, the report is still of great interest.

A BSI specification[3] dealing with the storage and transportation of tape for data interchange, has been in existence for several years. Its requirements are somewhat stringent in common with most documents concerning computer tape and libraries.

Other documents dealing with specific facets of interest to the tape user are detailed in the bibliography and are numerically referenced in the relevant sections of this report.

3. RESULTS OF THE SURVEY AND DISCUSSION

3.1 General

Although it is almost impossible to avoid some degree of deterioration - particularly with older tape materials - organisations

who came close to maintaining optimum conditions and procedures were able to state that many very old recordings were still usable. These included some pre-war tapes although a number of early post-war types appeared to be inferior from a survival aspect. In many organisations, however, strigent and somewhat expensive precautions were not taken- often because the value of the tapes did not warrent such measures or, occasionally, because the potential value of early recordings was not fully appreciated. Some users are now experiencing severe degradation resulting in tapes being unplayable and several organisations are progressively copying their older recordings in anticipation of further deterioration.

Most organisations retain one or more copies of valuable recordings - in some cases in metal matrix form and often stored in different locations for additional safety. Many possess libraries for tapes in day-to-day use in addition to those in the actual archives - the archived tapes being used only for making further working copies.

Libraries and recording areas are usually maintained at comfortable working temperature by air conditioning but with little or no control over humidity - exceptions being computer tape libraries which are nearly always fully controlled. It appears that few attempts are made to exclude normal atmospheric dust. Many of the libraries and archives have been air conditioned from the earliest days of tape recording whilst many are below ground or at the centre of large buildings where temperature stability is at its best. This factor probably accounts for the comparatively satisfactory condition of many old tapes although underground storage has attendant risks such as flooding in the event of water pipe breakage or inherent dampness accompanied by excessive humidity.

3.2 Environmental Conditions

The ideal environmental conditions are not identical for all tape materials which may account for some differences of opinion regarding actual figures, particularly for archives. However all specialists recommend tight control of temperature and humidity in both the recording and storage environments - typically 21°C ± 3°C (70°F) in working areas

and libraries and $10^{o}C \pm 3^{o}C$ ($50^{o}F$) for long term storage in special vaults. The usual recommendation regarding humidity in all locations is 50% ±10% RH. There is also general agreement that wide and/or frequent changes of temperature and humidity and thermal shock are to be avoided.

The film industry, which faces similar problems to those of the tape archivist particularly where acetate materials are concerned, appears to maintain a greater degree of control over temperature and humidity. Embrittlement of cellulose tri-acetate is accelerated by low humidity whilst high humidity encourages fungal growth. Kodak[4] suggests a temperature range of $15^{o}C$ to $27^{o}C$ for acetate materials although values close to $20^{o}C$ are prefered. 40% to 50% RH is considered to be an ideal humidity range for acetate cine film.

3.3 Quality of Reproduction

Most users judge the reproduction quality of carefully stored old recordings to be good and, although print-through, increase in noise and some non-linear distortion is reported, it is difficult to assess the degradation over the years as conditions and equipment have changed considerably. In general, subjective evaluation suggests that, provided the tape has remained in fairly good physical condition, there are few serious problems regarding signal quality.

Signal loss due to chemical attack by acid forming constituents in the atmosphere was reported by one authority[5] but other researchers suggest that this may apply to a few varieties of tape only and that atmospheric pollutants do not constitute major hazards[6].

3.4 Degradation of Base Film and Coatings

A number of archivists reported serious deterioration of the old cellulose tri-acetate or (even older) di-acetate based tapes. One organisation had suffered catastrophic failure due to curl and embrittlement, of acetate materials which had been stored in a "cool dry area", after only eight years. In other instances serious problems were experienced with acetate tapes which had been kept under normal working conditions, i.e., with no control of humidity and little or no temperature control during holiday or other "shut-down" periods.

Very few cases of deterioration of PVC materials were reported whilst the modern polyester base film is considered to be at little risk in conditions of either low or high humidity. Calculations indicate that very little degradation might be expected in environments of 75% RH and normal working temperatures even after a period of 100 years. The coatings, on the other hand, are unknown entities and, unless or until manufacturers are able to state categorically a long shelf life, a regular audit on sample tapes of each type in the archives is indicated.

Instances of "oxide shedding" (i.e., loss of coating adhesion and/or cohesion), without apparent base film deterioration, were reported. Although the occurrence was rare the results were usually catastrophic and necessitated identifying the type(s) of tape involved and carefully copying those which could still be salvaged.

3.5 Fungal Attack

A number of cases of biodegradation were reported. These were thought to be due mainly to attack by fungi (figures 1 & 2) whose primary targets were often the cardboard boxes in which the tapes were stored. Catastrophic failures in the form of oxide shedding were reported, especially where some of the older materials were involved. Unfortunately many of the more recent coating binders (even modern urethanes) are biodegradable in varying degrees. A number of tapes which were found to be contaminated after storage in unsealed plastic bags in underground vaults were examined. Many of these had been untouched for more than ten years. In some cases the fungus attack appeared to be very slow or to have become inhibited with little consequent damage. It should be noted, however, that these were mainly older full width, monophonic recordings at either 38 cm/s (15 ips) or 76 cm/s (30 ips). Problems of a more serious nature could occur after further deterioration, especially with multi-track systems and slower tape speeds.

Since moisture is a major requirement for fungal growth, it is not unexpected to find that most infestations occurred in underground vaults where (unless controlled) the humidity is often high. It has been suggested that, in the absence of high humidity some fungi can obtain the necessary moisture from fatty substances which may be constituents of some of the older tape coatings. It has also been suggested that dust and lint particles may hold moisture and that finger prints often contain cultural media.

The unsealed polyethylene bags in which tapes are often stored afford a high degree of protection from moisture but this material is slightly permeable. An accelerated temperature/humidity cycling test indicated that a desiccant inside such a bag (thickness 75μm - 0.003") absorbed one tenth of that of a similar sample in free air. This does not, of course, imply that the risk is proportionally reduced by the use of bags. The reverse might apply if moisture had been sealed in.

Although it is probable that most of the bags in which tapes are supplied are made from polyethylene, other, and possibly more suitable materials, are available and the use of sealable plastic laminates for moisture proof packaging prior to archiving is being considered by at least two organisations.

Lack of success in culturing fungi taken from many of the tapes mentioned above may have indicated non-viability. In some instances however, results were positive and growth occurred on both agars and - very slowly - on samples of modern tapes of different types. Unfortunately a long term study was impracticable. It was noted, however, that viable fungi were still to be found on tapes sealed into plastic bags after a period of six months. The relative humidity within the bags was artificially maintained at a high level.

The viable fungi were mainly different strains of Penicillia but Alternaria alternata and Aspergillus versicolor were also found.

The photograph (figure 2) indicates the results of a severe fungus attack on tapes, stored in a domestic environment, which had accidently become damp. It should be noted that the plastic spool is also affected.

A brief study was carried out in order to ascertain the practicability of introducing a small quantity of fungicide into the storage bags. Most of the common biocides were considered and many were rejected for toxicity, difficulty of handling or their unpredictable effect on the tape constituents. The ultimate choice was the well tried biocide formaldehyde in the forms of formalin (aqueous solution) and paraformaldehyde. Although formaldehyde has an adverse chemical effect on many plastics, the quantity required to sterilize the tape in a

sealed bag was considered to be too small to cause noticeable deterioration although, if a tape received frequent dosing, problems might occur. The fungicide must not, of course, be allowed to contact the tape. The amount required to constitute a lethal dose is debatable being affected by variables such as temperature and humidity and - probably to a greater degree - absorption by the tape itself. After some study of the subject it was decided that 0.5 cc of 0.4% aqueous solution was sufficient for a large reel in a plastic bag. Tests using ten times this concentration indicated no discernable deleterious effects on the tape after six months. In the case of paraformaldehyde, 100 mg was felt to be a quantity which could be conveniently handled. This also appeared to have no effect on the tape after six months. The paraformaldehyde was contained in a paper sachet whilst the formaldehyde solution was used to impregnate a piece of paper which was immediately placed into the bag and sealed in. Since paraformaldehyde breaks down slowly (releasing formaldehyde), the sachets could be prepared some hours before use.

The tapes under test were heavily contaminated with active fungus spores and sealed into bags in high humidity. No growth was discernable after six months on six tapes treated with fungicide whilst slight growth occurred on several unsterilized control samples.

The tapes used in the above tests were all modern varieties and probably less susceptable to attack than the older types. The growth was mainly across the surface of the tape pancake with very little penetration into the coating. The time scale was short however and it is possible that, over a longer period and especially with older materials, the disasterous coating failures experienced by some users might have been repeated. Unfortunately old tape was not available in sufficient quantity for worth-while testing.

The potential user of fungicides is recommended to obtain the advice of the tape manufacturer before their introduction into archiving procedures and, since most fungicides are toxic (often generating noxious vapours), due safety precautions must be observed. Useful information on biocides may be obtained from "The inhibition and destruction of the microbial cell" by Hugo[7].

The possibilities of sterilising tapes with various forms

of radiation were considered. It was felt, however, that the accumulative effect of repeated doses might result in tape damage and involve more complex procedures.

In concluding this section it may be stated that, although many types of tape can support fungal growth, this study produced insufficient evidence to firmly recommend the use of fungicides provided the relative humidity of the atmosphere surrounding the tape can be maintained below 60% RH. There may be little risk at 65% RH but 75% RH is definitely a danger level. Lowering the temperature to the bottom practical limit for tape storage will tend to slow down the growth but this could be offset by the accompanying increase in humidity when using sealed plastic bags.

3.6 Physical Damage

A number of archivists reported problems due to users exercising insufficient care when handling tapes. Tapes were often returned to the archives badly spooled and therefore easily damaged (figures 3, 4 and 5).

The recommended practice of allowing tapes to thermally and hygroscopically stabilise for some hours on their return to the archives prior to carefully rewinding them, appears to be commonly adopted. Stabilisation is particularly important in the case of acetate based tapes. It has been stated that hygroscopic expansion and contraction of such materials can result in stresses which exceed the yield point of the film.

Twelve hours is a typical recommended acclimatisation period for modern tapes, although Kodak[4] suggest that reels of acetate film may require several weeks to reach complete hygroscopic stability. This could, presumably, apply to tapes and it is probably advisable, therefore, to allow those with acetate substrate to stabilise for a minimum of one week before preparing for archiving. At the user end, there is little indication that a long period of stabilisation is necessary. A few hours acclimatisation is, however, a wise precaution.

The stress pattern in a tape pack is complex even under normal ambient conditions. Most tape transports wind at constant tension

onto a rigid hub and, as successive layers are added, the inner layers are compressed thereby reducing their original tensile stresses. When sufficiently large numbers of layers are involved these stresses can become zero near the middles of the pack and negative (compressive) towards the hub. The compressive stresses which are accompanied by outward pressures often lead to deformation of the tape pack, particularly in the low stress regions. Wrinkling or cinching of the tape (figure 4) due to the intertia of the outer part of the pack coupled with slippage also occurs in this area. The longer tape is stored the more permanent physical distortion becomes whilst plastic flow causes changes in the stress pattern over a period of time. There can be little doubt that rewinding at regular intervals is advisable if the recording warrants the expense involved. However, only five of the organisations associated with the EBU carried out such a process and three of these did so at irregular intervals, whilst very few other organisations found it a viable proposition - chiefly because of the vast number of tapes involved.

Periodic rewinding is generally considered to reduce the effects of print-through and many authorities recommend that the process is carried out at 6 to 12 monthly intervals. Since increase in print-through declines logarithmically with time, tapes which have not been rewound for several years are less likely to benefit from the introduction of regular rewinding procedures than freshly recorded material. (Print is further discussed in Section 3.10).

Tapes for storage should be wound at fairly slow speed with the end of the recording on the outside i.e. as if played but not rewound. This also tends to minimise print-through problems and enables the condition of the tape to be ascertained during respooling before use.

3.7 Spools and Packaging

Many authorities favour the use of double flanged spools. These certainly remove the risk of a loose tape pack falling apart and give some added protection to badly wound tapes. To be really effective, however, the spools should have rigid precision flanges. These appear to be seldom used for audio tape but are quite common for instrumentation and video types. It is generally agreed that rigid metal hubs without slots afford the best support to the tape pack although many video tapes

are supplied on hubs with compressible synthetic rubber or plastic sleeves. Aluminium alloys have a coefficient of expansion fairly close to that of polyester thus hubs of such materials cause fewer problems due to differential expansion. Some commonly used plastics, however, have a very different expansion coefficient from that of the tape and give rise to trouble in the absence of a sleeve of compressible material around the hub.

Many organisations store their audio tape reels in cardboard boxes whilst video tape is frequently kept in plastic containers. Computer tape is nearly always stored in plastic cases. In some instances aluminium boxes are used but few organisations appear to use steel cases although these have the merits of high strength and of affording considerable protection from stray magnetic fields. (See Section 3.11 and Appendix A).

3.8 Splices

Most users reported problems with splices such as the joint creeping open during storage with consequent adhesion to the next layer. Many organisations consider it advisable to produce splice-free masters for archiving.

3.9 Contamination

It is doubtful if tobacco smoke forms a serious contaminant in well ventilated rooms but the same cannot be said for tobacco ash. Smoking is usually forbidden in tape libraries and archives and actively discouraged in other areas.

Fibres from clothing and dust are often attracted electrostatically to tape and may become a source of unacceptable dropouts, particularly to video, instrumentation and computer tape users. Debris rubbed from the oxide coating and the edges of the base film are other frequent contaminants. The use of special clothing, tape cleaning devices and air filtration appear to be seldom adopted except in computer areas.

Chemical contamination from the hands can cause degradation and ideally tape should only be handled whilst wearing lint free gloves.

In practice, however, few reports of such damage to audio tape were received although it is common practice to avoid touching the surfaces of computer and instrumentation tapes.

The introduction of slower tape speed, decreased track width and shorter recorded wavelengths or increased packing density necessitate improved handling and cleanliness disciplines resulting in an increasing number of users adopting such measures as tape cleaning. This is usually performed by passing the tape over special wiping tissues (cleaning both back and front) either on the recorder or on a special cleaning/rewinding machine. Some organisations carry out reclamation procedures on special machines which clean, test and carefully respool the tape.

Food and drink are possible sources of contamination - the latter by accidental spillage - and neither should be consumed in recording rooms or storage areas.

The experience of users regarding cleaning of heads and other parts of recorders was not specifically sought. There is, however, little doubt that the best methods of cleaning equipment entail wiping with 'lint free' fabric moistened with a chemically inert fluid such as alcohol or preferably one of the proprietary hydro-carbon cleaners such as Arklone P by ICI. It is important, also, to observe the equipment manufacturers recommendations.

3.10 Print-through

Whilst the measured or mean coercivity of a tape coating may be relatively high there is an associated distribution function accommodating particles with very low coercivities. These, being somewhat magnetically unstable, are easily magnetised or demagnetised and are responsible for undesirable layer-to-layer print phenomena which increase with time and temperature.

The inherent instability of print signals often enables some improvement in signal-to-print ratio by simply rewinding the tape and thereby re-distributing the "master signals" throughout the pancake. Thus archived tapes are often stored on the takeup spool and rewound shortly before reproducing. As stated earlier, a reduction in print is

also one of the objectives when adopting routine rewinding procedures.

Another method of reducing print is "selective erasure". Here the tape is passed through a decaying a.c. field - prior to the reproduce head - whose peak field strength is much lower than the mean tape coercivity but high enough to achieve considerable erasure of the weak print signals. The success of the operation is very much dependent on the type of tape and its magnetic properties and is often more effective on older materials. Daniel and Axon[8] reported improvements up to 10 dB in signal-to-print ratio (1 kHz at 38 cm/s) with negligible loss in master signal.

It should be noted that the more modern tapes have improved print properties.

3.11 Stray Magnetic Fields (see also Appendix A)

Magnetic fields of sufficient strength may result in de-magnetisation (erasure), print-through and - in the case of unidirectional or d.c. fields - increased background noise and harmonic distortion.

No reports of serious degradation of archived tapes due to stray magnetic fields were received. It should be noted, however, that unexpectedly high fields may exist in the vicinity of a number of items which are often in juxtaposition to tapes. Fields in excess of 800 A/m (10 oe) are generally considered to constitute a risk, although some authorities quote 400 A/m as a maximum safe limit - a figure well below some of the following measurements which were made on typical pieces of recording room equipment:

Loudspeaker enclosure:-	(top)	2,240 A/m
	(back & front)	4,800 A/m
	(sides)	650 A/m
Moving coil meter (large VU instrument)		10,000 A/m
Moving coil meter (small VU instrument)		800 A/m
Moving coil or ribbon microphone	(in contact)	16,000 A/m
	(at 3 cm)	800 A/m

It was, also noted that a thin (0.3 mm) steel box reduced most of the above fields by a factor of at least six.

Some authorities recommend and use racks constructed from non-magnetic materials. This may be a wise precaution although the chances of introducing detrimental stray fields into steel shelf structures are probably very low.

Normal power supplies carry both line and neutral and therefore have a virtually zero magnetic field. Widely spaced high power lines might present problems and should be avoided. There is, likewise, some risk from the field surrounding a lightning conductor during a lightning stroke which may also find a path to ground via service pipes, power lines and other metal parts of the building structure. This subject and the effects of magnetic fields in general are further discussed in Appendix A.

3.12 Ionising Radiations

Although ionising radiations could cause tape damage, massive doses would be required and professional users of audio tape are very unlikely to encounter such dangers unless the tape is deliberately subjected to an irradiation process for such purposes as sterilisation. Likewise data tape users, who can tolerate far greater signal degradation than their audio counterparts, are unlikely to suffer problems. The probability of information loss due to radar signals and X-ray surveillance systems such as those used at airports has been studied and found to be negligible (Geller S.B.[9]).

3.13 Batch Variations

Several users reported unacceptable batch variations in types previously regarded as reliable. The most serious problems being caused by premature failure of the cohesion or adhesion of the coating. This type of defect is difficult to guard against as it may not become apparent until after a period of storage. These occurrences, though fortunately rare, reinforce the argument for regular inspection of at least a small cross section of all types of tape in the archive and/or different batches of the same type.

4. RECOMMENDATIONS

4.1 General

The optimum storage conditions for tapes of different ages and types can be quite clearly defined. Unfortunately they often entail considerable expense which can only be justified where very valuable recordings are involved and/or when very long survival is required. Since the requirements will differ in various organisations, the user must apply his own weighting to the individual recommendations below.

Most handling procedures, on the other hand, are entirely a matter of good disciplines the practice of which may well save time and money in the long run.

4.2 Environmental Conditions

Ideally the temperature and humidity of libraries, working areas and archives should be tightly controlled, maintaining a comfortable $21^{o}C \pm 3^{o}C$ ($70^{o}F$) in the former two and $10^{o}C \pm 3^{o}C$ ($50^{o}F$) in the archives. The humidity in all cases being 50% ± 10% RH.

Where this is impracticable consideration should be given to sealing the tapes into moisture proof plastic bags under as near suitable environmental conditions as possible. This suggests a small "preparation room" which could be both temperature and humidity controlled during periods when tape is being handled. Removal of dust and other atmospheric contaminants should also be considered.

The main archive should have a free air circulation to avoid hot or stagnant areas including localised heat from radiators or convector heaters.

The archive should be maintained cool but never allowed to become very cold whilst high temperature must also be avoided. A range from $15^{o}C$ ($60^{o}F$) to $24^{o}C$ ($75^{o}F$) with a design aim nearer $15^{o}C$ is suggested. The actual temperature within these limits is less important than the avoidance of temperature cycling which is often the cause of undesirable changes in the stress pattern within the tape pack.

The preparation room should be, ideally, at the same temperature

as the archive but this would constitute an unreasonable demand on personnel working long periods in the area and the previously mentioned figure of 21°C ± 3°C (70°F) is suggested. RH between 40% and 50% would ensure a non-condensing atmosphere in bags which were sealed at 24°C and stored at 15°C. Alternatively, with tighter control of temperature to 21°C ± 1°C the humidity tolerance could be increased to 40% - 60% RH. There will obviously be a likelihood of exceeding 75% RH - stated earlier to be a danger level for fungal growth but, if most of the air is expelled from the bag, it is unlikely that there will be sufficient residual moisture to cause serious damaging growth. The lower limit of 40% is suggested to retard embrittlement of acetate tapes and possibly coatings.

The tape must be protected from direct sunlight when either outside or within its container. This is mainly to prevent heating with consequent distortion and increased print-through. Sunlight can also cause deterioration of tape constituents.

4.3 Packaging

The use of plastic bags (even if unsealed but with the open end folded over) is strongly recommended. Polyethylene, although slightly permeable to moisture, provides a high degree of protection if sufficiently thick (0.12 mm - 0.005"). Unfortunately there is a present tendency by manufacturers to supply tapes in much thinner bags (0.025 mm -0.001") which are considered unsuitable for long term storage. Currently available heat sealable laminated materials, which are stated to be highly impervious, are worthy of consideration.

Tapes should always be boxed and, although many organisations have stored in cardboard containers without experiencing major problems the use of metal boxes is recommended. Steel is preferred for reasons of strength and protection of the tape from stray magnetic fields.

4.4 Fungicides

Although even modern materials are able to support fungus growth, it is felt that, provided precautions are taken to avoid high humidity, the use of fungicides cannot be fully justified without further evidence to the contrary. The archivist should, however, regularly inspect for fungus and be prepared to take counter measures.

4.5 Preparation for Archiving

Tapes for archiving should be acclimatised for at least twelve hours (longer for acetate tapes - see 3.6) prior to thorough inspection and rewinding if necessary. They should be wound at either constant tensions of 75g to 110g or, preferably, constant torque starting with a tension near the hub of 120g to 150g. (The ideal starting tension varies with the diameter of the hub but the range given is suitable for both NAB and European spools). Cleaning devices consisting of 'self advancing' tissues can with advantage be fitted to winding machines. The tapes should be reverse wound (see 3.6) at speeds of 76 cm/s (30ips) or less.

Note: The above figures apply to 6.25 mm (0.25") wide tape with base film thickness in the region of 37μm (0.0015") and should be varied pro rata for other widths and thicknesses.

4.6 Storage

Tapes should always be stored with the tape pack vertical, i.e. on edge.

4.7 Spools

Spools with solid aluminium hubs without slots (preferably with two precision flanges) are recommended.

4.8 Splices

As splices are a source of much trouble during reproduction, archival tapes should be splice-free.

4.9 Control Tapes

It is recommended that control tapes be stored in the archives at intervals. These should be recorded with high level, low frequency tone bursts to assess print-through and signal degradation. They should be long samples so that test pieces can be removed to ascertain physical deterioration. This can often be judged by an experienced user, without equipment, who should look for curl, embrittlement or loss of flexibility and tensile strength and breakdown of the oxide coating. The properties

of the control tape should be measured and a record retained in the box. Control tapes of each type in use should be stored but in the case of old and/or obsolete materials, it is suggested that an individual master is selected, copied and the original used as a control.

The period between examinations of control tapes should be determined in the light of future experience and may ultimately vary for different classes of tape. One year is suggested at the start.

4.10 Routine Inspection

Ideally all tapes should be inspected regularly and those showing signs of failure copied making use of the latest techniques. Since this is sometimes impracticable, a progressive examination is recommended. Tapes which have been removed from the archives for use should be inspected and their condition noted for future guidance. After the establishment of a range of control tapes, it should be necessary to check only these at regular intervals.

4.11 Documentation

A logbook is an asset for future assessment. It should include notes regarding tapes which may be showing early signs of deterioration. The actual user is in a good position to judge these and it might be of value to include a "Condition of Tape" note in the boxes when returned to the archive. It is often useful to know the dates of removal from and return to the archives whilst the practice of indicating the tape type and batch reference on the box is considered invaluable. Doubt regarding the identity of some tape materials was a handicap during this study and could cause serious problems if, for example, it was found necessary to copy all tapes of a particular type because of deterioration. It is also considered advisable to file copies of manufacturers data sheets in the archives as they are often unobtainable a few years after the product has become obsolete.

4.12 Cleanliness

Important archival tapes should receive a minimum of handling (preferably with gloved hands) and users should avoid blowing onto the tapes or into their storage bags.

Food, drink and smoking should be forbidden in recording rooms and storage areas.

Machines and rooms should be cleaned with vacuum equipment and/or (in the case of the former) lint free material moistened with an approved inert cleaning fluid.

4.13 Periodic Rewinding

This should be carried out at least annually if practicable. However tapes which have not been rewound for several years are unlikely to benefit greatly from such a routine particularly if the temperature has remained fairly constant and low. Rewinding should be carried out at the tensions and speeds mentioned in 4.5.

4.14 Transit

Tapes should be transported with a minimum of delay during the journey. They should not remain in a vehicle for such a length of time that they become either very cold or very hot. The conveyance should not be left in an exposed area and direct sunlight should not be allowed to fall on the tapes.

It is important to examine them immediately prior to transit and re-spool if any wind defects are noted. They should be packed on edge and suitable precautions taken to protect them from physical shock or vibration and magnetic fields.

4.15 Copying of Masters

Many users will find that their oldest tapes are still usable but the experience of others who have suffered catastrophic failure of the earlier materials should instil caution. Where practicable, an evaluation should be made with a view to copying those of greatest importance. Cellulose acetate based tapes must always be considered "at risk".

4.16 Code of Practice

It became apparent during the study that many sound engineers and other users failed to practice good disciplines - perhaps through

being unaware of some of the pitfalls in handling archival tape. It is considered, therefore, that individual organisations are well advised to produce and enforce a strict code of practice for the handling and use of their valuable masters.

4.17 Choice of Tape for Archiving

The present day, thick polyester based, professional audio tapes using iron oxide (gamma Fe_2O_3) with matt backing have proved reliable for medium term storage. They will obviously have to await the passage of time before long term effects can be ascertained. The stability of some of the high-coercivity materials, such as cobalt modified Fe_2O_3, is questionable and accelerated life testing on such materials before using them for archival purposes is advisable. Chromium dioxide (CrO_2) is also considered to be slightly less stable than Fe_2O_3. At the present time, therefore, Fe_2O_3 tapes are preferred for archive use.

5. FUTURE DEVELOPMENTS

Although most modern tapes are very stable, longevity is not a primary consideration of the tape maker and it is doubtful whether the life span of any of the popular types is known. They will almost certainly last well beyond the period during which they have already survived. (Up to eight years in the case of many manufacturers' latest formulations). Since an increasing amount of information is being stored on tape for long periods, it is suggested, that development of a long-life tape might be a viable proposition. The incorporation of fungicides or inhibitors into the coating of such a tape could also be of value.

6. ACKNOWLEDGEMENTS

Acknowledgements and thanks are due to members of the staff of the following organisations for their assistance during this study:

British Broadcasting Corporation
British Institute of Recorded Sound
British Museum, Research Laboratories
Commonwealth Mycological Institute
Decca Recording Company Limited
Eastman Kodak Company, New York
Edinburgh University, School of Scottish Studies
Kodak Limited, London
National Film Archives
Paint Research Association
Royal Aircraft Establishment, I & T Department
Royal Radar Establishment
United Nations, Sound Archives
University of Aston in Birmingham

and the following within the EMI Group of Companies:

Abbey Road Recording Studios
Central Research Laboratories
Elstree Film Studios
EMItape
EMI Tape Records
Thames Television

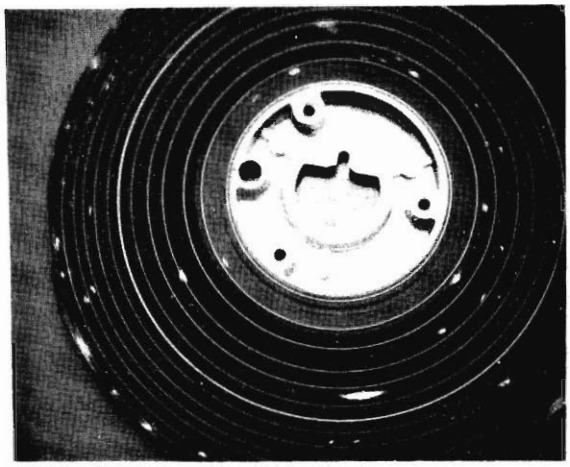

Figure 1. FUNGUS GROWTH

(Underground archive in unsealed plastic bag)

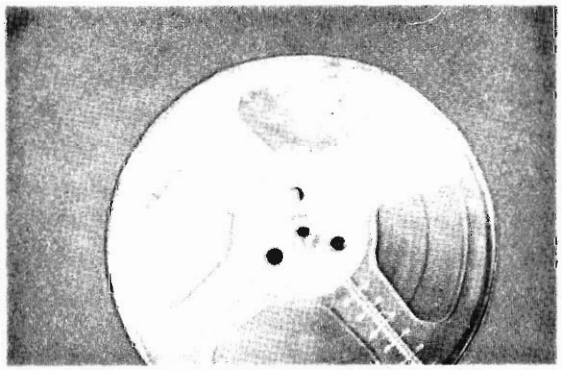

Figure 2. FUNGUS GROWTH

(Domestic environment in cardboard box)

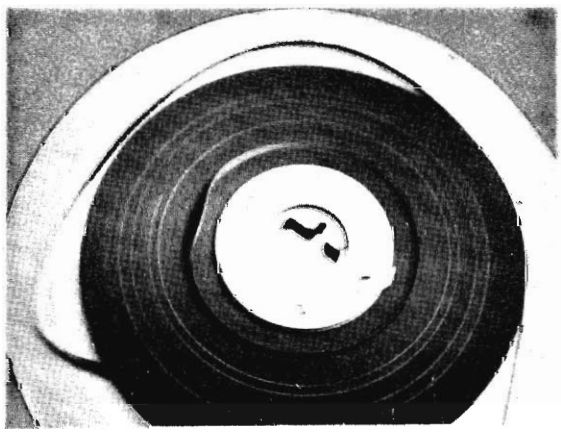

Figure 3. DISPLACED TURNS

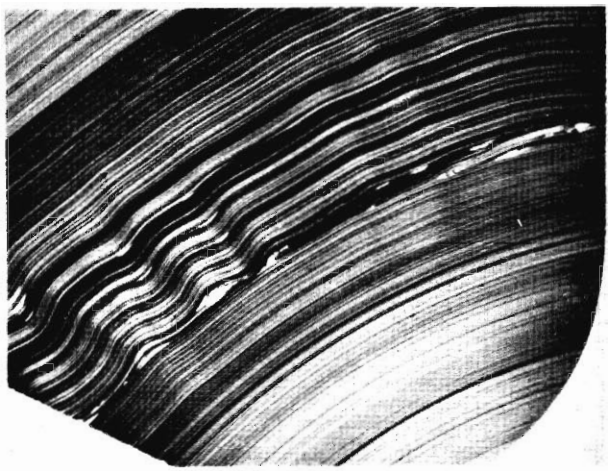

Figure 4. WRINKLING AND CINCHING

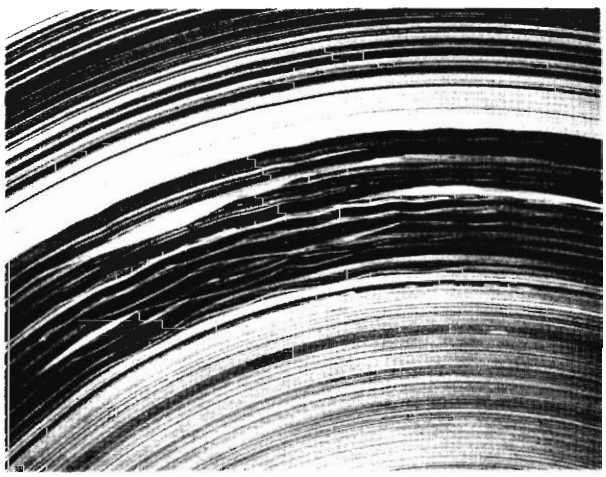

Figure 5. DAMAGED TURNS

APPENDIX 'A'

Report Reference RM71

STRAY MAGNETIC FIELDS

A.1 General

This appendix was compiled to meet a requirement for more information (as evidenced by a number of queries from recipients of the original report) regarding the effects of stray magnetic fields including those surrounding a lightning conductor during a lightning stroke. The latter was not discussed in the original report which was mainly applicable to certain specific archives in areas where the lightning risk is comparatively low. Whilst extensive treatment of the subject is impracticable herein, an endeavour has been made to impart sufficient information to enable the user to assess the magnitude of problems in relation to his own set of circumstances and to indicate where specialist advice may be required.

A.2 Effects of Stray Fields

Most users will be well aware that stray magnetic fields can have deleterious effects on tape recordings varying from slight print-through in the presence of weak fields to complete demagnetisation (erasure) by stronger fields. In addition, unidirectional (d.c.) fields may introduce background noise and harmonic distortion - the former being particularly noticable on blank tape. Problems are "product dependent" to a large degree and cannot be readily quantified therefore. Modern, high coercivity materials are at less risk than older types whilst the thinner the tape, the greater the susceptibility to print-through. The type of magnetic powder used is also relevant.

Tests were carried out on a cassette tape with a thin base film which was chosen for its liability to exhibit some of the worst results likely to be observed by users of present day materials. The

magnetometer measurements, graphically illustrated in Figure A1, demonstrate the effects of submitting this tape (coercivity greater than 24,000 A/m - 300 oersted) to various magnetic fields. From the d.c. magnetisation curve (A) it will be noted that the effects of fields less than 8,000 A/m (100 oe) are small but are of some consequence where good signal/noise and print-through ratios must be maintained. Likewise curve 'B' indicates that a similar field strength is required before noticeable demagnetisation occurs. Curve 'C' demonstrates the combined effect of two fields - one a.c. and the other d.c. - namely a.c. anhysteretic magnetisation.

This anhysteretic curve indicates the residual magnetisation after a sample of tape has been subjected to a.c. fields of increasing amplitude in the presence of a d.c. field of 1,600 A/m (20 oe). The removal of the a.c. component followed by the d.c. field or the reduction of both simultaneously, leaves the tape with relatively high residual magnetisation. This is similar to the normal audio recording process where the signal is applied to the recording head in the presence of strong a.c. bias field. The d.c. field approximates to that due to lower recorded frequencies which are the root cause of print-through between layers if the tape is subjected to stray fields. This anhysteretic print-through is similar to the normal print phenomena which takes place over a period of time, without the presence of stray fields, and mainly effects the more easily magnetisable particles. Curve 'C' represents the ultimate case when the two coating layers are in intimate contact i.e. with a base film of zero thickness. Except for a few homogeneous tapes this condition does not exist and the separation due to the base film reduces the print - one reason for using thicker substrates for professional audio tapes. The subject is somewhat complex and the predominant frequency of the printed signal decreases with increasing coating separation obeying the law $\lambda = 2\pi d$ where λ is the recorded wavelength (which depends on frequency and tape speed) and d is the separation. This is illustrated by Figure A2 which shows the printed signal in the first and second tape layers following the 'master' signal. Print also occurs in the presence of d.c. fields and in tape layers preceding the 'master'. The frequently discussed topic of print-through is dealt with comprehensively by Daniel and Axon[8].

Print increases with increasing stray field strength until demagnetisation effects reduce - and finally erase - both the original and printed signal. Curve 'F' (figure A3) shows the print-through caused by the field from a small hand type eraser which was selected as being a possible source from which an a.c. signal could be accidentally applied to a tape. The field from such an implement decreases rapidly with distance and, apart from being difficult to measure over a small portion of the field, is not uniform across the tape. The figures for field strength must therefore be taken as an approximate average over the track width. It should be noted that an eraser of this type should not be switched off while adjacent to the tape as, if the circuit is opened while the cycle of a.c. is near a peak, the effect of d.c. magnetisation can occur.

Curve 'G' shows the increase in background noise from an unrecorded sample of the same tape after being subjected to d.c. magnetisation. The analysis of broad band noise is dependent on measuring methods and the system used[11]. These results were obtained from a spectrum analyser having a filter network weighted in accordance with IEC 179, British Standard 3489-1962 (A curve) and ASA Standard SI-4-1961 (A curve) which bears a close relationship to the frequency response of the ear. Measurements in accordance with standards such as DIN 45405 would yield a lower (worse) signal/noise ratio. It must also be emphasised that this can be regarded only as an example of noise degradation since other tapes running at different speeds would give quite different results. As evidenced by Figure A4 in which comparable print and noise curves are shown but, in this case, using professional tape running at 38 cm/s (15 ips) compared with 4.76 cm/s ($1\frac{7}{8}$ ips) in the former instance.

A.3 Fields From a.c. Equipment

The closed magnetic circuit of most motors, generators and transformers allows very little leakage whilst measurements indicated that physical size often bore little relationship to the leakage field - one $\frac{1}{3}$ hp motor produced a 1600 A/m (20 oe) field at one point on its casing while a generator of several mega-watts gave only 800 A/m (10 oe). At a distance of 15 cm none of the machines measured showed more than 160 A/m (2 oe). Other electrical equipment may generate higher leakage fields but there is no easy method of ascertaining these short of taking actual measurements.

(Fields from several typical studio equipments are given in the Section 3.11 of the report).

A.4 Lightning Conductors

The subject of demagnetisation by the fields emanating from lightning conductors is complicated by such variables as the locality and climate, the immediate environment and the construction of the building and materials used. It is difficult to lay down general rules other than to state the required precautions for the worst case. The path of the lightning stroke may not be confined to the lightning conductor but could be distributed throughout other metalwork to which the special conductor may be bonded. In some countries service pipes and metal 'down' parts of the building are used as integral parts of the lightning protection system. There is also the possibility that such metal objects as water pipes, although not physically connected, may be inductively coupled to a nearby lightning conductor. Extensive information on the subject may be obtained from "Lightning Protection" by Golde[10].

The number of thunderstorm-days may vary between one per annum towards the poles and 200 near the equator (5 to 20 for U.K.). Although peak currents up to 270 kA have been recorded (Berger 1971) it is suggested that higher figures cannot be ruled out. Most of the strokes, however, generate much lower currents with only a very small percentage exceeding 100 kA.

The magnetic field surrounding a conductor obeys the law:

$$\text{Field strength } (H) = \frac{i}{2\pi r} \text{ A/m or } \frac{2i}{r \times 10^3} \text{ oe}$$

where i is the current in amps and r the distance from the conductor in metres. Thus, to reduce the field from a 270 kA stroke to 2000 A/m (25 oe) a spacing of over 21 metres would be required. This is probably impracticable and in most cases unnecessary since the risk of such a stroke is statistically very low. The number of earth flashes per square kilometre may be accepted as between 0.1 and 0.2 per thunderstorm-day (Golde) although the existence of nests or pockets, where the risk of earth flashes is higher, is suspected. It is probable that only 5% of the earth strokes

generate currents in excess of 80 kA, thus - accepting that some risks must be taken and that a field of 4000 A/m (50 oe) is unlikely to cause serious degradation to most modern tapes - a practical figure for a comparatively safe distance could be about 3 metres without magnetic shielding. For the user who must reduce risks to a minimum, a specially designed lightning conductor system may be necessary. The possibility of metal shelving or even metal storage containers accidentally forming part of the earth path should, of course, be taken into consideration.

A.5 Protection From Stray Fields

Although it has often been stated that fields of 800 A/m (10 oe) constitute a risk to magnetic tape it may be inferred from the forgoing that this figure could be increased for most modern tapes and, where a tape has a specified coercivity of 22,400 A/m (280 oe) and above, it is suggested that 2000 A/m (25 oe) may be accepted as a level below which very little degradation is likely to occur. Thus in most environments few risks from stray fields are incurred.

Maintaining a safe distance - only a few centimetres in most cases - is probably the simplest and least expensive precaution. For added safety storage cases made from a high permeability metal may be used. Most types of mild steel will give a useful degree of magnetic shielding - particularly when annealed and with welded joints to prevent leakage fields. They also have the advantage of being inexpensive. However users whose tapes may be at serious risk from stray fields should seek specialist advice.

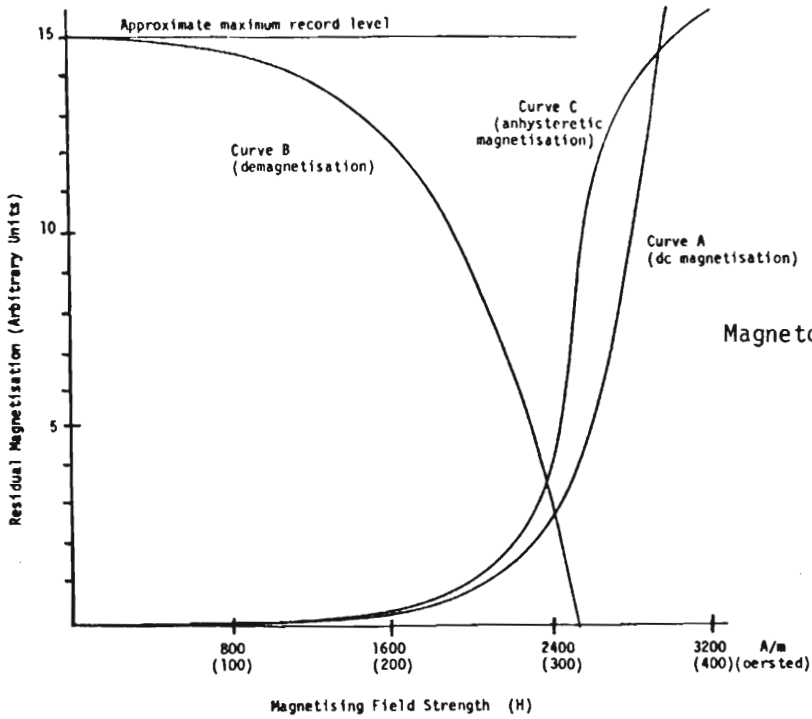

FIGURE A1
Magnetometer measurements

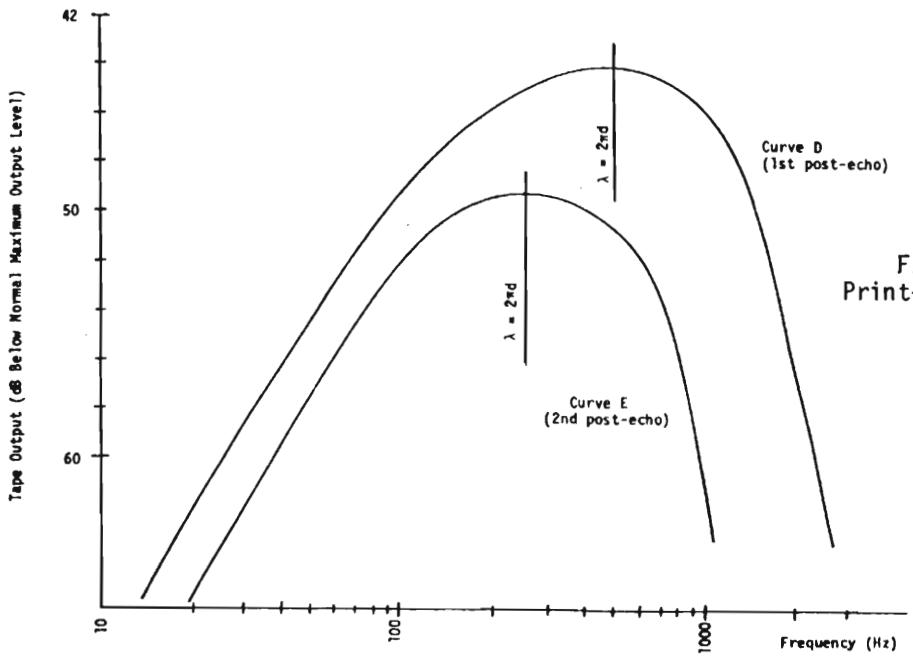

FIGURE A2
Print-through in ac field

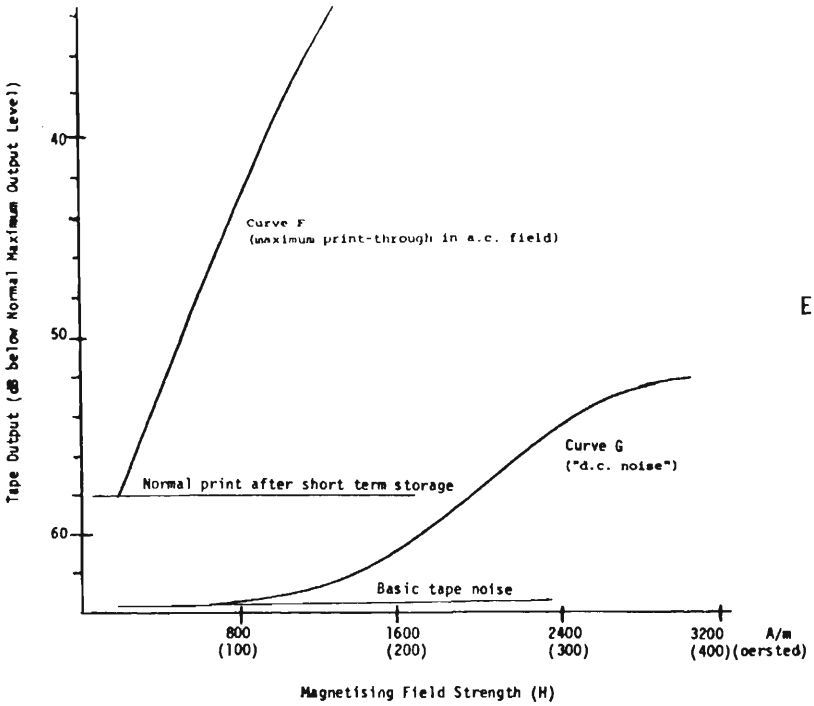

FIGURE A3
Effect of stray fields
(cassette tape)

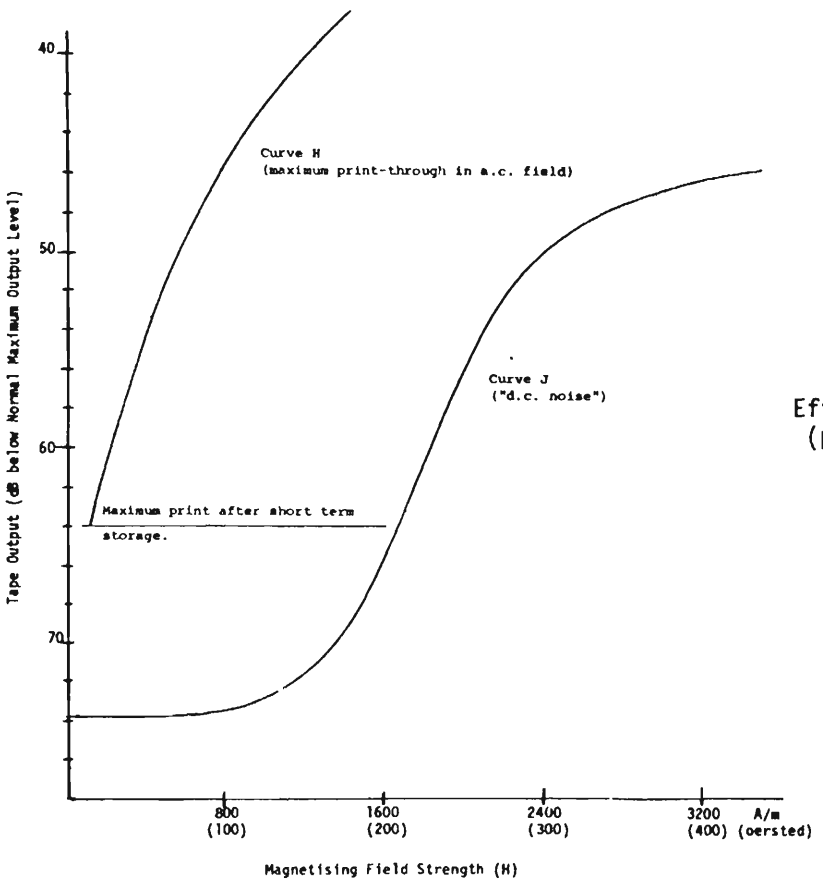

FIGURE A4
Effect of stray fields
(professional tape)

REFERENCES

1. European Broadcasting Union - Study of the storage of sound programmes recorded on magnetic tape. (1971 Reference GV/b1 R.1-G).

2. Pickett A.G. and Lemcoe M.M. - Preservation and storage of sound recordings (1959 - report for Library of Congress, Washington, U.S.A.).

3. British Standards Institution - Recommendations for the care and transportation of magnetic tape (BS4783).

4. Kodak Limited (London) - Storage and preservation of motion picture film. (Undated).

5. Murray J.K. - A cause of recording-tape deterioration (1956 - Sound Recording and Reproduction 4-318).

6. Radocy F. - Tape storage problems (Journal of the Audio Engineering Society 5 32).

7. Hugo W.B. (ed) - Inhibition and destruction of the microbial cell (1971 - Academic Press).

8. Daniel E.D. and Axon P.E. - Accidental printing in magnetic recording (1950-1 - BBC Quarterly).

9. Geller S.B. - Erasing myths about magnetic media (1976 - March "Datamation" 65).

10. Golde R.H. - Lightning protection (1973 - Edward Arnold).

11. Trendell E.G. - Measurement and subjective assessment of modulation noise in magnetic sound recording (1969 - Journal of the Audio Engineering Society 17 - 6).

THE BASF PROFESSIONAL 1/4" CASSETTE UNISETTE

Wolfgang Wiegel, BASF Ludwigshafen

Paper presented at the Subcommission Radio Sound Archives of
the Record Libraries Commission of the
International Association of Music Libraries
Bergen, 18 August 1976

The Editor likes to thank Mr. Wiegel and Mr. Dietrich Lotichius, President of the Subcommission Radio Sound Archives of IAML, for their kind permission to print this paper in the present issue of the Phonographic Bulletin.

IASA is not responsible for the information and the views expressed by Mr. Wiegel.

THE BASF PROFESSIONAL 1/4" CASSETTE UNISETTE

Wolfgang Wiegel, BASF Ludwigshafen

Cassettes for audio application are in wide distribution and have captured a very large portion of the open reel amateur market. However, if the point is to meet the most exacting standards of sound recording, conventional cassettes cannot really compete with the open reel technique. I would like to analyse the main reasons for that and will then discuss in detail a new cassette system which guarantees the advantages of both, cassette and open reel.

The disadvantage of the known cassettes in comparison to reel tapes is, that normally the electro-acoustical quality attainable is lower, and the reproducibility is of particular importance. That means that equipment manufacturers are more limited in respect to development of high quality machines. Some of the reasons for this are as follows:

1. Reduction of tape speed
2. Reduction of track width (reduced tape width)
3. Reduction of tape thickness (base film and magnetic coating)
4. Tape guidance influenced by the cassette housing
5. Tape run influenced by the cassette housing

Discussing these reasons in detail, it is quite obvious that tape speed, track width and tape thickness are reduced to achieve both small size of the cassette and sufficient playing time as well. Reduction of tape speed results in reduction of the maximum recording level, particularly in the high frequency range. This, of course, can be balanced to a certain extent by increasing the playback equalization and the introduction of tapes having considerably improved high frequency performance, for example chromium dioxide tape.

Reduction of track width results in reduction of the signal-to-noise ratio over the whole frequency range, at the same time the danger of drop-outs increases.

The loss in signal-to-noise ratio, which was still extended in the low frequency range by the before mentioned increase of the playback equalization and the reduction of the magnetic coating thickness, could be balanced to a great extent by using improved tapes and noise reduction systems.

Reducing the tape thickness, the mechanical properties of the tape became more critical. Apart from the influence over the high frequency performance, the danger of jamming also increased. By improving both the mechanical properties of these thin tapes and the tape guidance (for example by special tape guides), the problem of high frequency performance and jamming could mostly be solved. However, as not only the base film but also the magnetic coating was reduced, the maximum level in the low frequency range decreased as well.

When the tape guidance is influenced by the cassette housing, azimuth difficulties in general will arise. This means intolerable deviation of the magnetization vector of the recorded signal from the perpendicular position to the replay head gap. This is particularly critical for interchangeability of cassettes, that is recording and reproduction of one and the same cassette on different machines.

Tape guidance is influenced for example if the tape passes around roller guides, pins, posts or pressure rollers whose vertical positions are affected by the cassette housings. To guarantee accurate parallel position of these guides in reference to the head gap, the axles of all these means of tape guidance must be exactly perpendicularly positioned in the lower cassette half. Furthermore, the surfaces of the cassette must be exactly plane and parallel to each other and the tape hubs and roller guides must always be positioned in the same height. Also the pressure pad for the head-to-tape contact may influence the azimuth by impairing its reproducibility.

When the tape run is influenced by the cassette housing, the danger of increased wow and flutter is particularly high. The reason for this is, that the frictional

forces on the tape wind change more or less quickly, resulting in irregular tape tension and consequently wow and flutter. Sources for such friction are given for example when the tape wind touches parts of the cassette housing or slip sheets. In case of endless tape cartridges the main source is the layer-to-layer friction, increasing with the number of passes.

As explained, quality of cassettes has been improved by different means so that today we have reached a standard which seemed impossible some time ago. Nevertheless, there are still disadvantages mainly in respect to the azimuth as well as wow and flutter. A cassette for broadcasting use must do away with these disadvantages to fulfil the requirements of professional sound recording and apart from this, such a cassette must even have other important properties, for example with regards to the possible head configuration. Finally, it must be guaranteed, that the electro-acoustical quality can be reproduced without special or frequent adjustments of the machines.

Consequently, BASF developed a new cassette to suit all these requirements, allowing the equipment manufacturers a high degree of freedom for the design of high quality machines. The name of the cassette is UNISETTE because of its universal range of applications. The dimensions are 94 x 148 x 19,5 mm. Width of the magnetic tape is quarter inch, a narrower tape did not come into the question because of the correlated loss of dynamics and the danger of more drop-outs.

The main feature of the UNISETTE is the type of tape guidance used. According to the aforementioned the task was that the cassette housing should not influence guidance and run of the tape at all, and only under this condition proper, reproducible azimuth setting as well as low wow and flutter can be achieved. This exactly is the point, where we took particular care in the design of the UNISETTE.

The tape in the UNISETTE is only in contact with two roller guides and two hubs, but at no time with the housing. When the UNISETTE is placed in the machine, these roller guides and hubs are automatically adjusted into the correct position by the machine itself. The accuracy of the tape guidance, that is the horizontal and vertical position, is determined by the machine only and remains unchanged for all cassettes used. To demonstrate this, the shells of the UNISETTE could be removed during operation without any influence on the performance: The machine would just work like a conventional hub to hub machine.

The automatic positioning of the roller guide is easily achieved by an axle together with a pressure pin pivoted for example on a hinged lid. The pin presses the roller guide against a stop at the axle so that the exact height is guaranteed. In the case of the hubs, the spoke wheels allow both drive and automatic positioning by a hook like carrier.

When the UNISETTE is taken off the machine the tape winds are automatically locked by toothed wheel rims on each hub with which springs engage, thus preventing tape loops or loose winds. Furthermore, there are two non-magnetic metal plates protecting the wind so that no single layers can protrude during transport or because of rough handling. During operation, the two plates are taken off the wind, and they are very close to the wind when the UNISETTE is outside the machine.

Particular care was also taken in the design of the front openings to ensure maximum freedom for the equipment manufacturers who are often limited in their designs by the small dimensions of the conventional cassette.

The UNISETTE can be recorded from both sides. If it should be recorded on one side only, a switch can be activated by a slot provided on one side of the housing.

The UNISETTE can easily be stored in piles and it has furthermore four special grooves on each side for automatic handling.

The size of the label is 56 x 119 mm and leaves enough room for short identifications. It includes a quarter inch magnetic tape of 119 mm for identification or control signals and particularly for automatic operation.

There are two more plugs which can be inserted to prevent accidental erasing of the recordings.

At the proposed speed of 3.3/4 ips = 9,5 cm/s·maximum playing time of the UNISETTE is 60 min when loaded with triple play tape and using both sides.

Today, one of the main tasks also in broadcasting is automation. The change from open reel to any system fit for automation must not influence todays electro-acoustical quality standards negatively. BASF's UNISETTE meets all requirements, it fulfils the ARD-specifications of the German broadcasting stations, using the tape speed of 3.3/4 ips, a special tape, for example chromium dioxide, and an approved noise reduction system, for example DOLBY. The result can be reproduced without any special or frequent adjustments of the machines.

The UNISETTE can also replace the NAB cartridge avoiding all of the inherent disadvantages. Tape length is completely independent from the length of the programme by using a cue tone at the end of the recording and very fast rewind speeds of up to 800 ips = 20 m/s.

For stationary application, STUDER have developed a studio machine, production of the first 10 machines is already under way.

The company of NORDISK, Denmark, and the German EMT/FRANZ have jointly

developed another machine for sound and logging application. A first series of some 26 machines incorporated in an automatic traffic information system will be delivered in the fall of this year to one of the largest European airports. The production of the studio version of this machine will be taken up in February of next year.

Needless to say that BASF is ready to supply the required quantities of the UNISETTE.

To cover the requirements of the broadcasting stations completely, a portable machine is also necessary, especially for TV field reporting purposes. We do hope, that in the not too distant future there will be a manufacturer offering a UNISETTE portable, combining convenient handling and studio quality for direct broadcasting without the necessity of transcribing the message on to another medium.

To summarize the outlook the target is to offer a complete computerized system consisting of automated archives, transport, reproduction, transport back and automated filing again in the archives. Basic investigations have been made by the SDR and the IRT.

More detailed information on BASF UNISETTE can be obtained from

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DIE BASF PROFESSIONELLE 1/4" KASSETTE UNISETTE

Cassetten für die Audio-Anwendung sind weit verbreitet und haben zu einem großen Teil das Spulentonband auf dem Amateurmarkt verdrängt. Wenn jedoch höchste Ansprüche der Tonaufzeichnung erfüllt werden sollen, können die herkömmlichen Cassetten mit dem Spulentonband nicht konkurrieren. Ich möchte die Hauptgründe analysieren und werde anschließend im Detail ein neues Kassetten-System diskutieren, welches die Vorteile sowohl der Kassette als auch des Spulentonbandes gewährleistet.

Die bekannten Kassetten haben im Vergleich zum Spulentonband den Nachteil, daß die erreichbare elektro-akustische Qualität geringer und die Reproduzierbarkeit besonders kritisch ist. Dies bedeutet, daß den Geräteherstellern hinsichtlich der Entwicklung von hochqualifizierten Maschinen Grenzen gesetzt sind. Die Gründe hierfür sind:

1. Verringerung der Bandgeschwindigkeit
2. Verringerung der Spurbreite (als Folge der verringerten Bandbreite)
3. geringere Banddicke (sowohl Träger als auch magnetische Beschichtung)
4. Bandführung wird durch das Kassetten-Gehäuse beeinflußt
5. Bandlauf wird durch das Kassetten-Gehäuse beeinflußt

Die Verringerung der Bandgeschwindigkeit, Spurbreite und Banddicke war notwendig, um die Abmessungen der Kassette klein zu halten und trotzdem ausreichende Spielzeit zu erzielen. Die Verminderung der Bandgeschwindigkeit führt zur Verminderung der Aussteuerbarkeit, besonders im Bereich hoher Frequenzen. Dies konnte durch Erhöhung der Wiedergabe-Zeitkonstante und die Einführung von Bändern mit verbesserter Höhenaussteuerbarkeit z/B CrO_2 Bändern zum Teil wieder ausgeglichen werden.

Die Reduzierung der Spurbreite führt zu einer Reduzierung des Signal-Geräuschabstandes im gesamten Frequenzbereich, außerdem nimmt die drop-out-Anfälligkeit zu. Der Verlust an Signal-Geräuschabstand im niederfrequenten Bereich,

welcher durch die erwähnte Erhöhung der Wiedergabe-Zeitkonstante und die Reduzierung der Schichtdicke noch vergrößert wurde, konnte zu einem großen Teil durch verbesserte Bänder und die Einführung von Rauschunterdrückungs-Systemen wieder ausgeglichen werden.

Wenn man die Banddicke reduziert, werden die mechanischen Eigenschaften des Bandes kritischer. Abgesehen vom Einfluß auf die Wiedergabe hoher Frequenzen steigt die Gefahr des Festlaufens. Durch Verbesserung sowohl der mechanischen Eigenschaften dieser dünnen Bänder und als auch der Bandführung (z.B. durch Spezial Mechanik), konnte das Problem der Höhenwiedergabe sowie des Festlaufens weitgehendst gelöst werden. Da jedoch nicht nur die Trägerfolie, sondern auch die Magnetschicht reduziert wurde, verminderte sich auch die Aussteuerbarkeit im Bereich der niedrigen Frequenzen.

Wenn die Bandführung durch das Kassetten-Gehäuse beeinflußt wird, treten im allgemeinen Azimuth-Schwierigkeiten auf. Das bedeutet unzulässige Abweichungen des Magnetisierungs-Vektors des aufgezeichneten Signals bezogen auf die Senkrechtstellung des Wiedergabekopfspaltes. Dies ist besonders kritisch bei Austausch von Kassetten, d.h. wenn Aufnahme und Wiedergabe derselben Kassetten auf verschiedenen Geräten erfolgt.

Die Bandführung wird z.B. beeinflußt, wenn das Band von Führungsrollen, Stiften, Stegen oder Andruckrollen geführt wird, deren vertikale Lage vom Kassetten-Gehäuse abhängt. Um eine genaue parallele Lage dieser Führungs-Elemente in bezug auf den Kopfspalt zu garantieren, müssen die Achsen all dieser Bandführungs-Elemente in der unteren Kassettenhälfte ausgerichtet sein. Außerdem müssen die Oberflächen der Kassette exakt plan und parallel zueinander sein und die Bandwickel sowie Führungsrollen immer in derselben Höhe gelagert werden. Auch der für den Bandkopfkontakt notwendige Andruckfilz kann die Reproduzierbarkeit der genauen Azimuth-Einstellung beeinflussen.

Wenn der Bandlauf durch das Kassetten-Gehäuse beeinflußt wird, ist die Gefahr von Gleichlaufschwankungen besonders hoch. Der Grund dafür ist, daß die auf den Bandwickel wirkenden Reibungskräfte mehr oder weniger schnellen Änderungen unterworfen sind, was zu unregelmäßigem Bandzug und folglich zu Gleichlaufschwankungen führt. Quellen für eine derartige Reibung treten z.B. auf, wenn das Band Teile des Gehäuses oder die Beilagefolie berührt. Im Falle einer Endlos-Kassette ist die Hauptursache hierfür die Reibung von Windung zu Windung, welche mit der Zahl der Durchläufe zunimmt.

Wie ausgeführt, wurde die Qualität der Kassetten durch verschiedene Maßnahmen verbessert, so daß wir heute einen Standard erreicht haben, der vor einiger Zeit noch unmöglich schien. Trotzdem gibt es noch Nachteile, hauptsächlich hinsichtlich der Azimuth-Einstellung und der Gleichlaufschwankungen. Eine Kassette für den Gebrauch im Rundfunk darf diese negativen Eigenschaften nicht aufweisen, da sie die Erfordernisse der professionellen Tonaufzeichnung erfüllen muß; außerdem muß eine solche Kassette noch andere Eigenschaften aufweisen, z.B. hinsichtlich der möglichen Kopf-Konfiguration. Schließlich muß garantiert sein, daß die elektro-akustischen Eigenschaften ohne spezielle und häufige Maschinen-Einstellungen reproduziert werden können.

Folglich entwickelte die BASF eine neue Kassette, die allen diesen Anforderungen entspricht und dem Gerätehersteller viel Spielraum für die Entwicklung von Studio-Maschinen läßt. Der Name der Kassette ist UNISETTE, welcher wegen ihrer universellen Anwendbarkeit gewählt wurde. Die Abmessungen sind 94 x 148 x 19,5 mm. Die Breite des Magnetbandes ist 1/4"; ein schmaleres Band kam wegen des damit verbundenen Verlustes an Dynamik und der Gefahr erhöhter drop-outs nicht infrage.

Das Hauptmerkmal der UNISETTE ist die Art der darin verwendeten Bandführung. Gemäß dem Vorgenannten sollte das Kassetten-Gehäuse keinesfalls die Bandführung und den Bandlauf beeinflussen, da nur unter dieser Bedingung reproduzierbare Azimuth-Einstellungen sowie niedrige Tonhöhenschwankungen erreicht werden können. Diesen Punkt hatten wir bei der Entwicklung der UNISETTE besonders zu beachten.

In der UNISETTE berührt das Band nur 2 Führungsrollen und die beiden Wickelkerne und hat darüber hinaus keinerlei Kontakt mit irgendwelchen Gehäuseteilen. Wenn die UNISETTE in das Gerät eingelegt ist, werden diese Führungsrollen und Wickelkerne automatisch durch die Maschine selbst in die richtige Position gebracht. Die Genauigkeit der Bandführung, d.h. horizontale als auch vertikale Führung, wird nur von der Maschine bestimmt und bleibt für alle verwendeten UNISETTEN unverändert. Um dies vorzuführen, könnte man die beiden Kassetten-Hälften während des Laufs entfernen, ohne dabei die Betriebsbedingungen zu beeinflussen: Die Maschine arbeitet genau so wie eine herkömmliche Hub/Hub-Maschine.

Die automatische Einstellung der Führungsrollen kann leicht erreicht werden durch die Achse und den Andruckstift, der z.B. an einem Klappdeckel drehbar angebracht ist. Der Andruckstift drückt die Führungsrolle gegen einen Anschlag an der Achse, womit die genaue Höhe garantiert ist. Den Hub betreffend, erlaubt das Speichenrad sowohl den Antrieb als auch automatische Positionierung durch eine mit "Haken" versehene Kernaufnahme.

Wird die UNISETTE aus der Maschine genommen, werden die Bandwickel automatisch durch 2 Zahnkränze im Zusammenspiel mit 2 Federn arretiert, was Bandschleifen oder losen Wickel verhindert. Außerdem sind 2 nicht magnetische Metallplatten vorhanden, die die Wickel schützen, so daß keine einzelnen Bandlagen während des Transportes oder durch unsachgemäße Behandlung hervorstehen können. Während des Betriebs haben die beiden Platten relativ zum Wickel einen großen Abstand, welcher sich wieder automatisch verringert, sobald die UNISETTE aus der Maschine genommen ist.

Besondere Aufmerksamkeit wurde auf die Gestaltung der Öffnungen auf der Vorderseite gelegt, um dem Gerätehersteller ein Höchstmaß an Gestaltungs-

freiheit zu bieten, welche ihm bei herkömmlichen Cassetten durch deren kleine Abmessungen nicht geboten wurde.

Die UNISETTE kann von beiden Seiten bespielt werden. Wenn nur eine Seite bespielt werden soll, kann ein Schalter durch einen Schlitz betätigt werden, der auf einer Seite des Gehäuses angebracht ist.

Die UNISETTE kann leicht im Stapel gelagert werden und hat außerdem 4 spezielle Nuten auf jeder Seite zur automatischen Handhabung.

Die Etikettengröße ist 56 x 119 mm und läßt genug Platz für Kurzbezeichnungen. Es beinhaltet ein 1/4"-Band von 119 mm zur Kennzeichnung oder Kontrollsignale und besonders bei automatischem Betrieb.

An der UNISETTE sind 2 Stecker angebracht, die eingesetzt werden können, um ungewolltes Löschen der Aufzeichnung zu verhindern.

Bei der vorgeschlagenen Geschwindigkeit von 3.3/4 ips = 9,5 cm/s ist die max. Spieldauer der UNISETTE 60 min. wenn sie mit Dreifachspielband bestückt ist und beidseitig bespielt wird.

Heute ist eine der Hauptaufgaben bei den Rundfunkanstalten die Automation. Der Wechsel vom Spulensystem zu irgendeinem anderen, das für die Automation geeignet ist, darf die heutigen elektro-akustischen Qualitätsnormen nicht negativ beeinflussen. Die UNISETTE der BASF genügt diesen Anforderungen, sie erfüllt die ARD-Spezifikationen der deutschen Rundfunkanstalten, wenn bei einer Bandgeschwindigkeit von 3.3/4 ips ein spezielles Band , z.B. CrO_2 und ein bewährtes Rauschunterdrückungssystem, z.B. DOLBY verwendet wird. Die Ergebnisse sind reproduzierbar ohne irgendwelche speziellen und häufigen Neueinstellungen der Geräte.

Die UNISETTE kann auch die NAB-Cartridge ersetzen und alle ihr innewohnenden Schwächen vermeiden. Die Bandlänge ist vollkommen unabhängig von der Länge des Programms, wenn man am Ende der Aufzeichnung einen Cue-Ton (Befehlston) aufspielt und mit hoher Rückspulgeschwindigkeit (bis zu 800 ips = 20 m/s) arbeitet.

Für den stationären Betrieb hat STUDER eine Studio-Anlage entwickelt; die Produktion der ersten 10 Maschinen ist bereits angelaufen.

Die dänische Firma NORDISK und die deutsche EMT/FRANZ haben gemeinsam eine andere Maschine für Studio- und Dokumentationsanwendung entwickelt. Eine erste Serie von 26 Geräten, die in ein automatisches Verkehrsinformationssystem integriert werden soll, wird im Herbst d.J. an einen der größten europäischen Flughäfen geliefert. Die Produktion der Studioversion wird im Februar des nächsten Jahres aufgenommen.

Um die Bedürfnisse der Rundfunkanstalten vollständig zu decken, ist auch ein tragbares Gerät notwendig, besonders bei TV-Außenaufnahmen. Wir hoffen, daß in einer nicht zu entfernten Zukunft einer der Gerätehersteller eine tragbare Maschine für die UNISETTE herstellen wird, die Studioqualität und leichte Bedienbarkeit miteinander vereint.

Das Ziel ist, ein komplettes computer-gesteuertes System anzubieten, das aus automatisiertem Archiv, Transporteinrichtung, Wiedergabe und automatischem Rücktransport besteht mit automatischer Rückeinlagerung ins Archiv. Grundsätzliche Untersuchungen wurden vom SDR gemacht.

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BASF Unisette

Professional 6,3 mm-Cassette

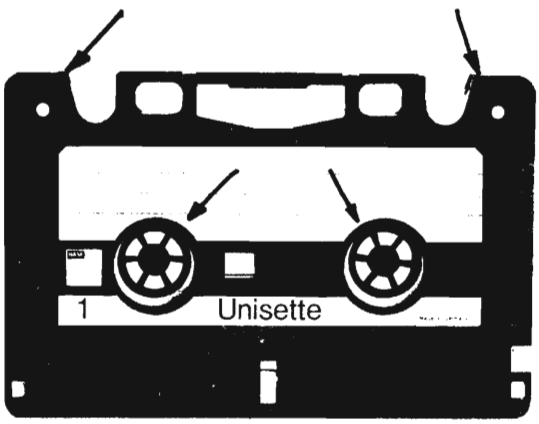
In the last few years, we witnessed a tremendous trend towards the use of cassettes. This trend however was for the most part only found in the amateur field. The reasons for this are the technical limitations set by the design of the present cassettes. In contrast, the BASF **Unisette** is designed to meet the most exacting standard of professional sound recording:

Magnetic tape 6,3 mm (¼")
Accurate tape guidance, controlled only by the machine
Uniform tape run, controlled only by the machine
High density of recording
Convenient storage
High degree of freedom for the design of machines

Main features of the BASF Unisette

Tape guidance

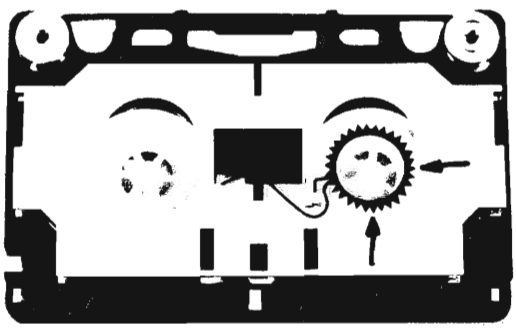
With conventional cassettes, the tape guidance is carried out by the cassette itself; this is disadvantageous to azimuth as well as wow and flutter. With the BASF Unisette, the tape guidance is exclusively controlled by the machine. When the BASF Unisette is placed in the machine, those parts which are in contact with the tape, are automatically put in the correct position by the machine. These parts are the two roller guides and the two hubs. The accuracy of the tape guidance is adjusted on the machine and remains invariable for all the Unisettes used, (fig. 1).



(fig. 1)

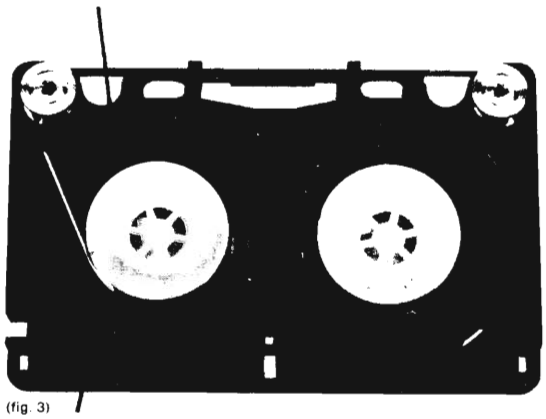
Hub brake

When the Unisette is not in the machine, the hubs are automatically locked, so that no tape loop or loose tape can arise, (fig. 2).



(fig. 2)

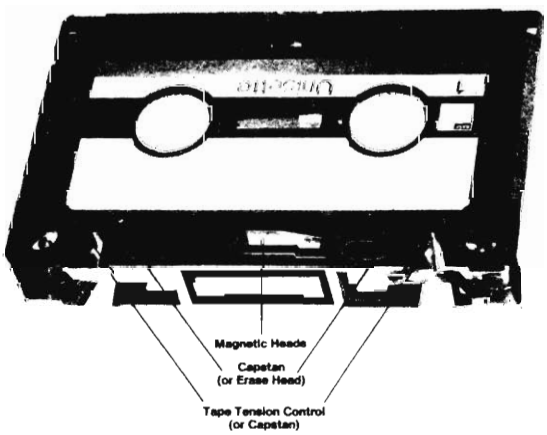
Furthermore there are two non-magnetic metal plates to protect the wind, that no layers will come off during transport or from rough handling. The protection is achieved by a change in the plates' distance from each other, (fig. 3).



(fig. 3)

Tape drive

The BASF Unisette is designed for a tape drive with 1 or 2 capstans with a maximum diameter of 7 mm. There are two other openings, which can be used for tape tension control, (fig. 4).



(fig. 4)

Head configuration

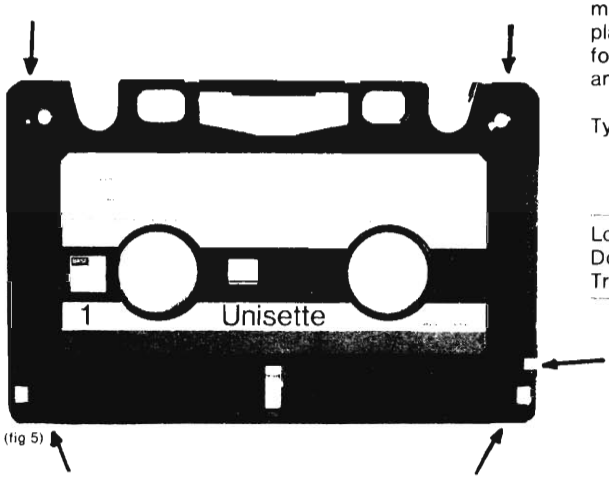
A large symmetrical opening is provided for the head configuration, so that, for example, separate record- and playback-heads can be used, (fig. 4).

Head to tape contact

The head to tape contact can be achieved either by tape tension together with a suitable wrapping angle or by pressure pads mounted on the machine.

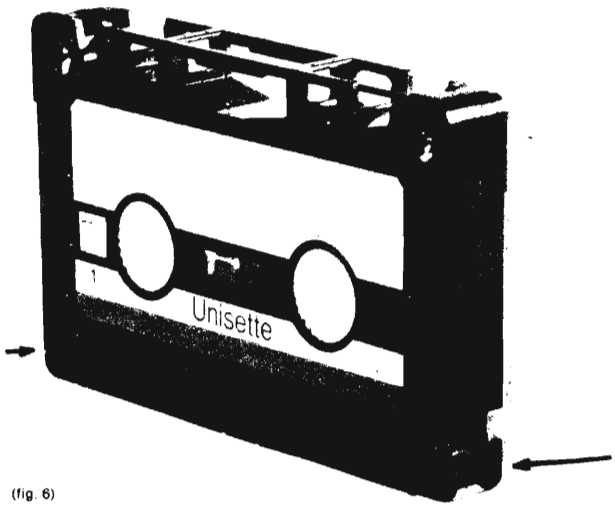
Handling

The BASF Unisette can be recorded from both sides. If it should be recorded on one side only, a safety device can be brought into operation in a slot provided on one side of the casing, (fig. 5).



(fig 5)

The BASF Unisette can be easily stored in piles; furthermore it has 8 guide grooves (4 on each side) for automatic handling, (fig. 5).



(fig. 6)

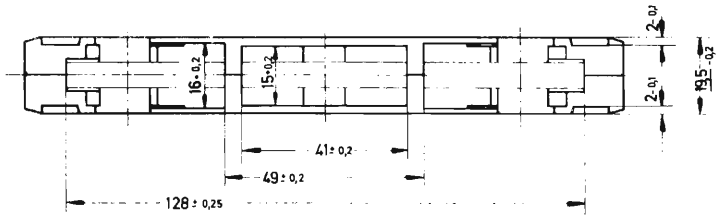
The BASF Unisette has two removable pins, that can block the recording device and thus prevent accidental erasing, (fig. 6)

The BASF Unisette is designed for universal application. It is particularly suitable for:
Automation of radio programmes
Professional portable recorders
High quality amateur recorders
Language laboratories
Talking books for blind poeple

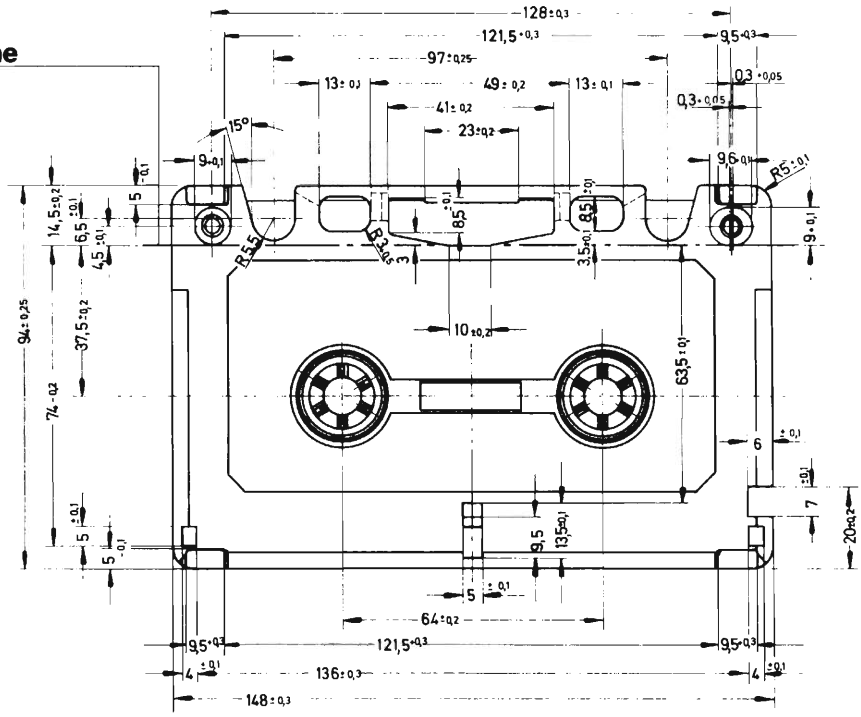
The BASF Unisette can be loaded with different types of tape corresponding to the requirements in question. The maximum tape length together with the corresponding playing time for a tape speed of 9,5 cm/sec (3 3/4 ips) are found in the table below for different types of tape (double- and single-sided operation):

Type of tape	maximum tape length (m)	maximum playing time (min) at a tape speed of 9,5 cm/s (3 3/4 ips)
Long play tape	86	30 (15)
Double play tape	114	40 (20)
Triple play tape	171	60 (30)

Cassette dimensions



Prime reference line



Dimensions in millimeters

Apart from the main application of the BASF Unisette, i.e. substitution of open reel due to its outstanding electroacoustic properties, the BASF Unisette can also replace any kind of endless tape cartridge, avoiding all the inherent disadvantages of these.

The main disadvantages of the endless tape cartridge principle are shown below:

It is necessary to use a special tape (lubricated tape).

Wow and flutter increases with the number of passes.

The lubricant transfers partly to the surface of the magnetic coating, impairing the high frequency response.

The length of the tape will normally correspond to the length of the program, so that a change in program length needs a change in tape length.

Since the cartridge casing influences the tape guidance, the well-known azimuth difficulties can occur.

The BASF Unisette can replace an endless tape cartridge due to the fact, that an exceptionally high rewind speed can be applied to it. The principle works as follows:

When the program is recorded on the tape, a cue tone will also be recorded indicating the end of the program. On playback, the machine starts fast rewind as soon as the cue tone appears and rewinds up to the beginning of the program. Examinations have been made with rewind speeds up to 20 m/sec (≙ 800 ips), still obtaining a smooth wind; the whole tape length of 114 m (≙ 375 ft) double play tape is rewound in 6 seconds.

The advantages of this principle are obvious:

- A change in program length no longer causes a change in tape length. The maximum tape length can always be loaded into the Unisette, because the program end is always indicated by the cue tone.

- Wow and flutter is no longer dependent on the lifetime and reaches values, which till now are only known from open reel operation (for example at 9,5 cm/sec ≙ 3 3/4 ips = 0,04 % corresponding to DIN 45 507).

- A normal 1/4" tape can be used. Apart from the absence of the lubricant, another advantage is that each new type of tape can be used, for example chromium dioxide tape.

- The casing of the BASF Unisette has no influence over the tape guidance, which means that no azimuth difficulties are caused by the casing.

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