

DIN SPEC 15587 – the New Standard for the Digitization of Cinematographic Film

In the past, a film digitization project usually focused on a single, precise intention to exploit the digitized material, but in recent years the systematic digitization of analog film materials with the aim of long-term digital preservation has gained considerable momentum. This is especially true against the background of the constantly decreasing possibilities of so-called photochemical preservation.

Yet, digital preservation can only claim to replace its analog predecessor if a number of specific criteria regarding the quality and durability of long-term archiving are met. Throughout the entire digitization and processing chain, clear guidelines must be defined for the conservation framework to be observed and compliance with these must be monitored during the execution of such a process.

DIN SPEC 15587—the new set of specifications for the digitization of analog film—does just that. It defines the minimum requirements that must be met for sustainable film digitization. The experts from industry, archives and science involved in the preparation of DIN SPEC have jointly developed these requirements in a three-year consensus process.

Concept

DIN SPEC evolves around four functionally separate processing steps called “packages”. The first package is the digitization result, i.e. the RAW-Scan Package, the second is called the Processing Package, the third the Distribution Package, and the fourth the Deliverable Package. The most critical step is the one where the material is processed—the Processing Package.

With a detailed description of the processes involved in obtaining the RAW-Scan and Processing Packages, one can be confident that a solution for long-term storage of digitized analog film has, at last, been found.

DIN SPEC 15587 adopts the established classification schema of possible deviations from the carriers, or indeed the audio-visual recordings, ideal condition, by means of three different causes:

- *Flaw*
- *Error*
- *Damage*

While flaw refers to a state attributable to the limited technical capabilities at the time of recording, an error points to a faulty registration or duplication process. Damage, finally, refers to alterations caused during recording, duplication or usage. Errors and damages, or their consequences, need to be cured during the creation of a restoration process at the Processing Package stage, provided this is possible without creating artifacts. To preserve the authenticity of archived footage, flaws must not be eliminated at this stage. The requirements for the Distribution Package, on the other hand, are defined by the intended use.

The first two processing steps thus emphasize conservational features, especially ways of eliminating the risk of newly added errors. In addition, all processing steps need to be documented in the most objective way possible. The last two processing stages, on the other hand, are aimed at providing maximum support for various utilization scenarios.

The four aforementioned packages are accompanied by four new technical terms^[1]. The goal for these

new concepts is to allow the client to better describe the requirements that need to be met by outfits providing digitization/restoration services. Together with the expected documentation for irrefutable technical traceability, the list of requirements will make life easier for service providers and needs to be stored as an integral part of the Processing Package. This is further supported by the requirement regarding the swift and definitive identification of the causes of newly added errors, as this is indispensable for envisaging error-free, repetitive digital archiving format migration scenarios.

The most important step is the one where the material is processed—the Processing Package. Thanks to a detailed description of the processes involved in obtaining the RAW-Scan and Processing Packages, the proposed solution for long-term storage of digitized analog film is a far more potent alternative to DCDM, i.e. the Distribution Package scenario required to qualify for backing for digitization efforts by the German Film Heritage fund.

In addition, DIN SPEC aims to provide also guidance for digitization projects that focus more on the publication or presentation (e.g. for TV) than on the durability of digitized results.

While the “digitization” concept is discussed in great detail in DIN SPEC, aspects related to file formats are touched upon in the informative appendix (which is therefore not normative). Technologies for “long-term storage” are not discussed at all, the reason being that DIN SPEC should be seen as a part of other European and international standards.

Structure of DIN SPEC 15587

DIN SPEC is subdivided into three topics:

- Basics for handling cinematographic film material
- Description of the digitization workflow
- Further processing of the digitized results

These topics are described in separate chapters of up to ten pages.

The “Basics for Handling Cinematographic Film Material” section describes technical and legal requirements that need to be met throughout the workflow performed on the film material in question. Among the aspects mentioned are the description of the film container, climate change processes, shipment and temporary storage as well as possible pitfalls related to direct handling within the man-machine-film context. In other words: this section is of universal

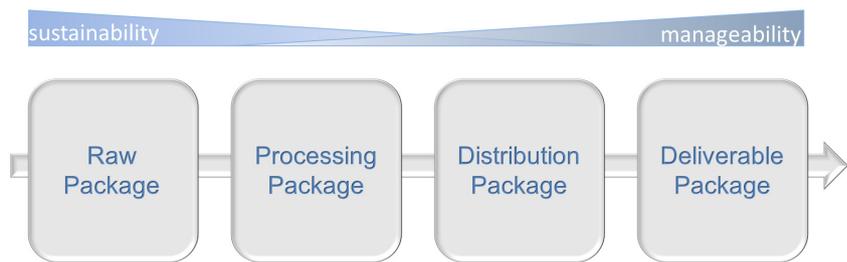


Illustration 1: DIN SPEC 15587 divides digital processing into four logical and physically separate stages. Unless specified otherwise, all illustrations were created by the authors.

significance and could have been part of a standard for the photochemical—i.e. analog—preservation of films. All subsections essentially focus on rules related to handling nitrocellulose carriers.

The “Description of The Digitization Workflow” section covers two topics: a description of the nature of the activities to perform prior to the digitization process based on a corresponding preliminary analysis and the digitization itself. It is important to realize

the interaction between these two steps. At the earliest stage possible of the preparatory work, one must be clear about the mechanical condition of the film rolls in order to predict which digitization devices will be best suited to carry out these jobs—essentially repairs—in accordance with the device’s characteristics. It has to be said, however, that in some cases the remaining options for the digitization process can only be identified at the repair stage. DIN SPEC 15587 is expected to provide support for this

About The Creation of DIN SPEC 15587

The emergence of digital movie theaters has led to a dramatic loss of interest in analog film. The time has therefore come to ensure that the cultural movie heritage will remain accessible to current and future generations. The digitization of analog film and long-term storage of digital data is considered the only viable way to achieve this goal.

The digital preservation of cinematographic films entails a major challenge. The experts of the DIN working committee NA 149-00-03 AA “Production, Reproduction and Archiving of Audio-Visual Media” under Dr. Siegfried Föβel (Fraunhofer IIS) in the DIN Standards Committee for Picture and Movie Entertainment Technology (NVBF) are rising to this challenge.

The NVBF is in charge of developing and regularly monitoring norms for entertainment technology, photography and cinematography. Cooperation in DIN bodies is accessible to all interested parties, provided the DIN regulations are met. The business office of NVBF provides counseling

within the framework of the standardization process and project management. This allows to steer the standardization process efficiently. DIN takes care of the organizational chores of the standardization process and of providing the required infrastructure. It also supervises the drafting process of the documents and their layout. This allows the team headed by Dr. Siegfried Föβel to focus on the document’s content.

In addition to national standards projects, NVBF also supervises the activities for CEN/TC 457 “Preservation of Digital Cinema Movies” and takes care of its secretariat. The mission of this European Technical Committee set up in early 2018 is to define and standardize a format for long-term digital preservation of movies. Additional tasks include the development of methods for ensuring data integrity. The format is expected to be applicable to both analog film and born digital content.

In the aftermath of a workshop in 2014 about “Digital Film Archives”, several topics were explored. A first result of the national standardization is scheduled to be published soon as DIN SPEC 15587

“Recommendations for The Digitization of Cinematographic Film”.

Under the umbrella of DIN, experts from different areas contributed to this standard in order to lay out the requirements for a durable digitization workflow for cinematographic film and magnetic movie carriers.

Within the framework of the development of DIN SPEC, the public was invited to comment by means of a concept survey released in mid 2018. Experiences and preferably concrete feedback regarding DIN SPEC and summarized in tables can nevertheless still be e-mailed to nvbf@din.de.

This new DIN standard establishes the state of the art of digitization for analog film and serves as a set of recommendations. The following contribution provides an overview and tackles a number of core aspects of this standard.

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adjustment stage. Among the recommended means are tables listing the effects a given damage type is likely to have on the digitization process and the device characteristics that may alleviate such issues. DIN SPEC contains fundamental parameter requirements with respect to the digitization process.

As mentioned earlier, the last third of DIN SPEC ("Further Processing of The Digitized Results") describes processing phases whose results qualify for storage and long-term archiving processes, as distribution masters or as presentation format. This is based on the product features.

Below please find a presentation and discussion of a number of topics covered by DIN SPEC.

The Digitization Phase

For the description of the performance of various technologies used by film scanners, DIN SPEC looks at the feature sets of several film scanners, e.g. film transport, photographic features, sensor types, light sources, etc., and provides tips regarding essential issues for durable film digitization. The features under review make a distinction between mechanical and photographic requirements as well as between image and audio scanning.

DIN SPEC 15587 details the requirements for digitization processes, i.e. the transition from an analog storage medium to a digital file format. In most instances, the analog storage medium is photographic film. The soundtrack, for its part, may be located on a magnetic stripe, magnetic film or magnetic tape. The process for capturing digital audio information on film or the control signal for the synchronization of external digital audio sources is not covered by DIN SPEC.

Readers are informed about the differences among commercially available digitization technologies for pictures and audio, followed by the requirements to be met by a durable digitization solution.

If the ultimate goal is durable digitization, the aim must inherently be to avoid any quality-related limitations with respect to the analog storage medium at the digitization stage. In other words: the RAW-Scan Package needs to be the digital equivalent of the analog original.

Earlier efforts regarding media digitization for preservation purposes used to focus on lossless storage formats. The actual optical or magnetic extraction of picture and audio elements is usually performed using proprietary sensor technologies and subsequent proprietary signal processing inside a manufacturer-defined "black box". Given that most of these approaches are both complex and based on technologies that are difficult to evaluate, users had to resort to comparative, subjective evaluations of the scanned results. DIN SPEC aims at providing objective criteria for measuring the transfer quality by requiring the inspection and documentation of the calibration stage for the device in question. DIN SPEC states: "For durable film digitization, the current photographic and mechanical transmission characteristics of the movie picture scanner used shall be documented in such a way as to allow outsiders to identify the performance limitations without

reference to the scanner in use." If the scanners limitations have not been documented in a reproducible way, the digitized result can only be checked against the analog original to identify flaws, errors and damages already present in the original, and for pinpointing transmission errors, which would be substandard.

This statement can be represented by means of the following equation: $X + Y = Z$, where X represents the severity of the error in the analog film material, Y the magnitude of the transmission error and Z the total error size in the digitized result. If Y is unknown, there is no way of determining X based on the Z value^[2].

DIN SPEC gives no recommendations for how to measure and document a film scanners transmission characteristics. First manufacturers have started providing calibration films that allow operators to easily determine and document a film scanners transmission characteristics.

DIN SPEC does, however, provide clear indications regarding the resolution and bit depth. These depend on the film material that needs to be scanned and its resolution: an original camera negative, for instance contains more detail than the projection copy and therefore needs to be

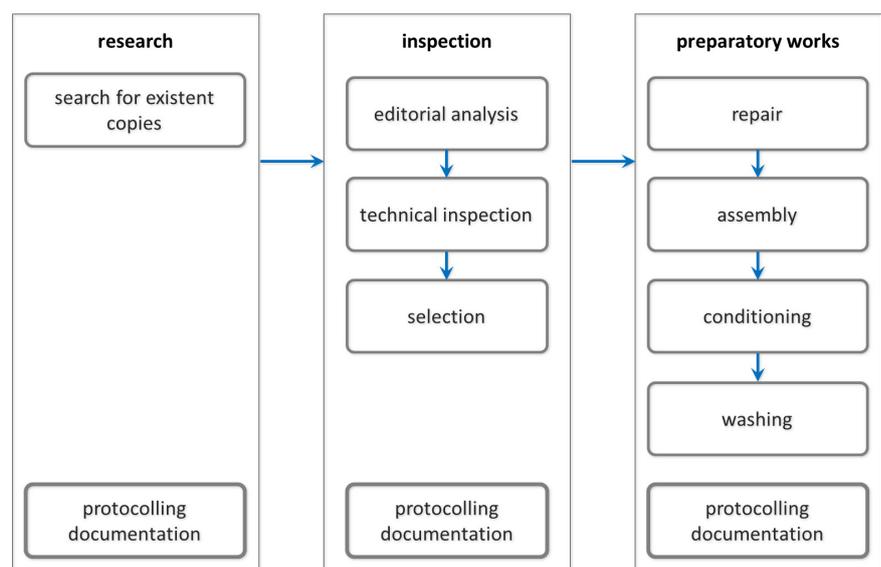


Illustration 2: Preliminary stages for digitizing analog film

[2] Even though this example is based on a simple linear error summation, it also holds true for rather more complex error relationships.

digitized at a higher resolution. In the same way, a film scanner's dynamic range needs to be such that the full bandwidth of the optical depth can be digitized without clipping in the highlight and shadow areas. All necessary measurements need to be made to document that no limiting occurred at the digitization stage.

If an operator manages to prove that a given film roll can be scanned at a lower resolution or dynamic range than the one prescribed by DIN SPEC, operators are allowed to use that lower resolution, provided they provide irrefutable proof of the resolution or dynamic range measurement along with the digitized result. For mass transfers, it may therefore be helpful to start out by classifying film material with an inspection scanner.

The next section looks at subsequent processing steps.

Subsequent Processing Steps

The aim of defining four separate package types (RAW-Scan Package, Processing Package, Distribution Package and Delivery Package) was not to specify the exact data formats to be used but rather to clearly define the intermediary products and ways of obtaining them. With reference to the classification used in native digital film productions—Camera RAW, Digital Source Master (DSM), Digital Cinema Distribution Master (DCDM), Digital Cinema Package (DCP)—the main preoccupation was to find an adequate alternative to DSM for RAW Scans of analog legacy films.

Given the intention to start transferring massive amounts of analog movies to the digital realm in 2019, it was deemed important to leave some leeway. One of the considerations leading to this decision was indeed that it is as yet uncertain whether the available financial resources will suffice for the high-quality restoration of all RAW scans. Irrespective of the justifiable decision to faithfully reproduce flaws, errors and damages in

Glossary

DCDM	Digital Cinema Distribution Master according to ISO 26428-x
DCP	Digital Cinema Package according to ISO 26429-x
DSM	Digital Source Master, non-standard master format
RAW-Scan	refers to the process and the data that results from a digitization process without post-processing contains sound, image and metadata

the digital realm, it would be all but realistic to assume that the quality of a restored product can be described objectively. This indeed first and foremost depends on the sophistication of the restoration software used. That is precisely why two types have been defined for the Processing Package stage: Type 1 refers to a so-called approximation, i.e. the deliberate intention to preserve and represent the consequences of flaws, errors and damages, with the aim—as mentioned earlier—to provide an authentic representation of the state of the analog film material or the recording it contains. This does not necessarily mean that no reconstruction is performed on the content side. One example that springs to mind is the reconstruction of the original scene sequence based on several RAW-Scan Packages. Type 2 refers to a restored version that needs to be created in strict accordance with the ethical requirements for restoration work. For both Type 1 and Type 2, any errors that were introduced at the digitization stage need to be cured as long as this is possible without creating artifacts. In any case, such errors need to be documented.

For both types, it is important to preserve the geometric resolution, dynamic range and bit depth of the RAW-Scan footage. The scope of the scanned film section also needs to be included in the Processing Package. The same applies to the soundtracks sampling rate and bit depth. The scope and type of the processing stage—and hence the differences with respect to the RAW-Scan Package or the Distribution Package product derived further down the line—are clearly defined by DIN SPEC.

Irrespective of the fact that the “Digital Archive Master” is never to be used for any of the defined products, illustration 1 shows an evolution where the growing “distance” from a RAW Scan also diminishes the durability and hence the suitability for long-term storage of a processed product.

In addition to the necessity of long-term storage of the RAW-Scan Package, a high-quality result of a Processing Package Type 2 product with durable restoration tweaks may also qualify for long-term storage. Unlike derived products, these two product types require a lot of storage capacity^[3]. This explains why mathematically lossless data reduction schemes are explicitly allowed.

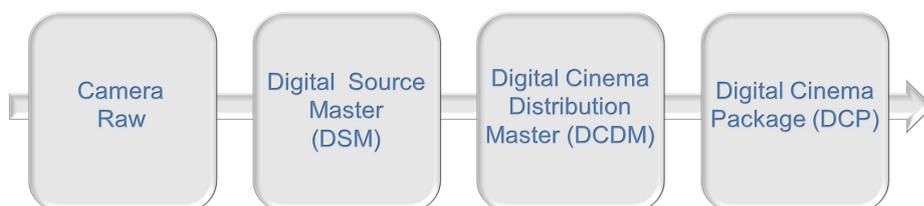
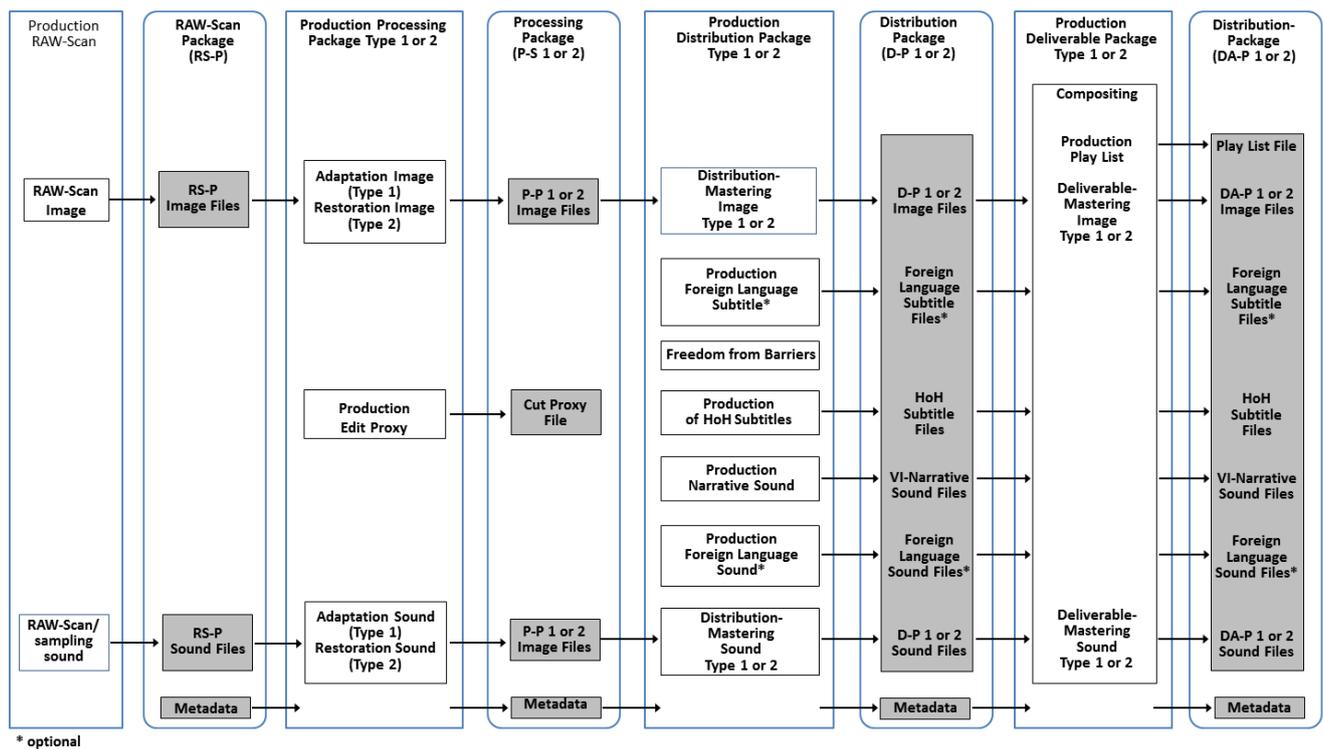


Illustration 3: Classic processing steps of a natively digital film production

[3] Given the low access frequency, consider storing it on digital magnetic tape (e.g. LTO-8).



* optional

Illustration 4: Digitization and subsequent processing

Source: DIN Deutsches Institut für Normung e.V.

The distribution package, for its part, already exhibits lossy data reduction or compression (due to picture cropping or a scaled resolution) and is therefore unsuitable as a substitute for RAW-Scan and Processing Packages for long-term storage purposes.

Format recommendation for the various package stages can be found in the attached table.

Outlook

For the durable digitization of cinematographic film, DIN SPEC 15587 is an important milestone for a standardization process that will need to be refined. On the one hand, new concepts and other standardization considerations will have to be included in future updates. On the other, there is still ample room for more precise definitions of practical requirements and processes, such as digitization parameters or calibration values for film scanners. Formalizing the metadata format structure is another major topic. In any case, the authors will keep listening closely to what future users would like to be standardized.

Where to Find It

DIN SPEC 15587 is 50 pages long and refers to over 100 relevant standards and guidelines, features a glossary and invaluable tips for further reading. DIN SPEC was published March 2019 by Beuth Verlag, both as an electronic PDF document and hardcopy^[4].

References:

- [1] DIN SPEC 15587:2019-04, Beuth Verlag: see <https://www.beuth.de/de>
- [2] Houpert, J. From Acetate to Archive File—New Technologies for Old Movies, FKT, May 2017



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[4] Note: The authors have developed DIN SPEC pro bono.