Guidelines for Specifying Quality and Determining Compliance of MICR, OCR, and OMR

Quality Assurance

Through Attributes Program

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Guidelines for Specifying Quality and Determining Compliance of MICR, OCR, and OMR
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Introduction

This instruction provides recommended guidance for determining customer requirements and specifying machine-readable forms which use magnetic ink character recognition (MICR), optical character recognition (OCR), and optical mark read (OMR) printing. It also outlines procedures for determining compliance to specifications. It is intended for account representatives, specification writers, quality assurance specialists, Contracting Officers, and others involved in procuring such forms. Only the boxed sections are intended for inclusion in contracts.

If any questions arise, please contact GPO's Quality Systems Division for assistance as soon as possible. It can take days or weeks to assemble technical information, especially when the equipment involved is no longer manufactured, or when the reader manufacturer has been sold or is no longer in business.

Synopsis

This instruction contains guidelines addressing a number of common factors pertaining to MICR, OCR, and OMR. These guidelines are not mandatory actions; they are only recommendations. Each contract is unique, and some guidelines may not apply to a particular application. Many problems may, however, be prevented by using the guidelines as a checklist to ensure that all pertinent factors have been considered in determining customer requirements and writing specifications. The applicability of a particular guideline is a Contracting Officer's decision. The major points are outlined below.

The specification of MICR printing is governed by the current applicable ANSI standards. These have been universally adopted in the banking industry and by the Federal Government. For this reason, ANSI standards are referenced in the recommended MICR specification clauses.

A requirement for MICR durability has been added to address the problems associated with ribbon and toner-based nonimpact printing. This requirement is based on a recommendation made by the Chairman of the ANSI subcommittee on MICR. (See Exhibit 2.)

Conformance of MICR printing to specifications is determined directly by measuring the form against ANSI requirements and through a test for durability and document contamination. MICR print quality assessment must be provided by an independent testing laboratory.

There has been no comparable universal adoption of the ANSI standards for OCR. OCR reader manufacturers have relied on the ANSI standards in product development, but they have not used them verbatim to define print quality specifications for their equipment. Therefore the recommended OCR specification clause states a performance requirement which does not reference the ANSI standards or the reader manufacturers specifications.

Conformance of OCR printing to performance specifications is established through onsite testing. In case of disputes regarding performance, the product can be evaluated against the reader manufacturer's specifications or, in their absence, against the ANSI standards.

If an agency insists on specifying OCR printing by reference to the ANSI standards, every effort must be made to verify that their processing equipment is fully ANSI compliant. The Quality Systems Division can assist in drafting alternative specifications requirements if this situation arises.
There are no industry standards applicable to OMR. Some manufacturers make their forms specifications readily available while others do not. Therefore, the recommended OMR specification clause states a performance requirement, and preaward or prior-to-production samples are strongly recommended. Forms compliance is established through performance testing. The Quality Systems Division may be able to examine image placement for some families of OMR forms if performance testing is inconclusive.

Forms design greatly affects the processing efficiency of all machine readable forms. Forms design for most MICR is straightforward since ANSI standards govern the placement of MICR printing. While OCR reader manufacturers may not have rigid requirements, they often have recommended guidelines. Forms design for OMR has exact image placement requirements, and, except for the most recent generation, there is no interoperability among readers. When it is feasible, the account representative should determine from the agency if the manufacturer's forms design guidelines were considered.

The use of departmental random copies whenever feasible has been recommended throughout. Even in the few cases where the use of departmental random copies will require some additional administrative work, this effort is outweighed by the advantages provided by the ready availability of a random sample for use in assessing product quality. Appendix I addresses some of the issues raised by the use of departmental random copies and provides sample clauses.

Finally, the use of nontraditional printing methods should be approached with caution if the technology has not previously been applied to a given application. In all such cases we recommend the consideration of prior-to-production samples and practical testing.
Guidelines for specifying MICR printing

These guidelines apply to Magnetic Ink Character Recognition (MICR) printing of financial instruments and similar documents to be read on automated MICR readers. MICR printing uses ink which is capable of being magnetized and sensed by special read heads. Some typical applications are checks, bonds, and loan coupons. These guidelines apply only to the E13B MICR font. Please contact the Quality Systems Division regarding the use of any other MICR font. Only the section entitled "MICR specification clauses" is intended for inclusion in contracts.

MICR applications such as checks are generally processed several times on different readers. For this reason it is not possible to specify a particular reader in the contract. All widely-used MICR readers are, however, ANSI compatible. We define an ANSI-compatible MICR reader to be one which is specifically designed to read ANSI-compliant MICR printing and which references the ANSI standards for MICR as part of its forms requirements.

Guidelines
The ANSI standards governing MICR are used to specify MICR printing.1 These standards have been adopted throughout the banking industry and by the Federal Government. They reflect practices agreed to by industry, including check printers and check reader manufacturers, for producing and processing MICR documents.

The majority of MICR printing is done using conventional impact printing methods. Application of other technologies to MICR printing, particularly those which are toner or ribbon based, have had varying results. If there is any doubt regarding a contractor's ability to produce or his method of production, it is recommended that preaward or prior-to-production test samples be required.

The chairman of the ANSI subcommittee on MICR has recommended the inclusion of a requirement for durability of MICR printing (See Exhibit 2). A related clause addresses document contamination and is intended to prevent equipment stoppage caused by poorly-fixed toner.

If the MICR forms are to be processed through other equipment, it may be necessary to incorporate additional specifications. For example, checks are usually marginally punched for use with high-speed line printers and bursters which may have specific paper requirements. Special care must be taken to see that additional specifications do not conflict with the requirements of the ANSI standards.

Checklist
When determining customer requirements and writing specifications the following issues should be considered:

1. **Paper**
   Consult the Paper and Physical Testing Division for assistance in addressing the paper requirements of ANSI X9.27 as well as those of any additional equipment.

2. **MICR printing**
   MICR printing must conform to the requirements set forth in ANSI X9.27. This standard provides complete specifications for the E13B MICR font and for both magnetic and optical print quality characteristics.

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1 Note: Quality Systems Division maintains a library of ANSI standards which is available for reference. Because of copyright restrictions, they may not be photocopied. See Appendix II for ordering information.
3. **Durability**
MICR printing must be machine readable for up to and including 30 passes through typical MICR processing equipment. Throughout these 30 passes, the quality of the MICR printing must conform to all applicable ANSI standards.

4. **Ink**
There are no explicit specifications for MICR ink. Rather, the ink used for MICR printing must be such that the MICR printing satisfies the requirements set forth in ANSI X9.27 and the additional requirement for durability stated above.\(^2\)

Particular attention must be given to the use of background inks. ANSI X9.7 states the requirements for background printing. Consult the Chemical and Environmental Division for assistance with ink requirements.

5. **Forms design**
MICR forms must conform to the requirements of ANSI X9.3, X9.7, and X9.13. These govern check size, endorsement areas, convenience amount (numeric) field location, and MICR printing placement and location.

6. **Preaward tests, prior-to-production samples**
It is recommended that bidders who propose to produce MICR printing, in whole or in part, using nonimpact methods such as toner-based printing demonstrate the ability of their product to meet specifications, especially regarding durability.

Such bidders should be required to pass a preaward test or to provide prior-to-production samples. The submitted materials would then be subjected to onsite testing and evaluation (see guidelines for determination of compliance to print specifications below).

7. **Quantity and variable data accuracy**
Quantity and data accuracy are critical for most applications with variable data. It is recommended that contractors be required to demonstrate the completeness of production runs and to devote particular attention to any interruption of the numbering process.

8. **Quality systems**
When feasible (e.g., when time permits), it is recommended that invitations for bid (IFB's) require the contractor to submit a written quality system. Contact the Quality Systems Division if a quality system requirement is needed.

9. **Departmental random copies**
It is recommended that departmental random copies be ordered whenever feasible. The use of departmental random copies provides a firm basis for assessing all product quality-related issues. It simplifies sampling when it is necessary for the Quality Assurance Section to conduct a performance test. See Appendix I for guidance.

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\(^2\) Note: Inks from ribbon-printed characters can cause problems when exposed to high temperature and pressure. If the form is expected to be processed through such equipment (e.g., the IBM 3800 MICR printer), contact the Quality Systems Division for further information.
10. **Quality assurance random copies**

Most MICR printing uses mechanical impact printers to print variable data. This type of printer does not allow the generation of duplicate or quality assurance samples. Computer-driven MICR printers can be programmed to generate duplicate forms. When feasible (e.g., when security requirements permit), it is recommended that IFB's for critical applications and IFB's allowing contractors to use toner-based MICR printing require quality assurance random copies. Please contact the Quality Systems Division for assistance.

**MICR specification clauses**

The clauses below are the recommended specifications requirements for MICR printing. (Sample specification clauses for ordering departmental random copies are provided in Appendix I.) Contact the Quality Systems Division if a quality system requirement is needed.

<table>
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<th>Magnetic Ink Character Recognition (MICR) printing shall comply with the specifications set forth in the following ANSI Standards:</th>
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<td>ANSI X9.7 American National Standard. Bank Check Background and Convenience Amount Field</td>
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<tr>
<td>ANSI X9.13 American National Standard for Placement and Location of MICR Printing -- Specifications</td>
</tr>
<tr>
<td>ANSI X9.27 Print Specifications for Magnetic Ink Character Recognition (MICR)</td>
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The revisions of these standards which are effective as of the date of this contract are those which shall apply.

The durability of MICR printing shall be such that it remains in compliance with ANSI X9.27 for up to and including 30 passes through typical, ANSI-compatible MICR processing equipment.

Acceptability of the lot for compliance with the above-referenced ANSI standards shall be based on the number of critical defects in a sample of the size specified in MIL-STD-105E, General Inspection Level I. For MICR evaluation, the sampling unit of product shall be an individual form (single part or multipart). A critical defect shall be assigned for each noncompliance with an ANSI standard. MICR evaluations are independent of tests and evaluations of all other product characteristics and have separate AQL's and sample sizes.

Acceptability of the lot for durability shall be based on the number of critical defects in a sample of the size specified in MIL-STD-105E, Special Inspection Level S-4. Each sample item shall be passed 30 times through a typical, ANSI-compatible MICR reader which is correctly maintained, adjusted, and operated. A critical defect shall be assigned for noncompliance with ANSI X9.27 after the item has completed 30 passes. A total of four critical defects may be assigned to MICR printing on a single item. The acceptable quality level (AQL) for critical defects is 1.0 defects per 100 items. At the option of the Government, a sample may consist of sequential items from one or more portions of the lot rather than a random sample.

MICR printing shall not cause contamination of other MICR documents or of processing equipment to a degree that interferes with normal equipment operation. The entire lot is subject to rejection if contamination occurs during a durability test or during normal operation.
Determining MICR compliance

Two tests may be performed on MICR forms. The first is a test of MICR readability which uses a MIL-STD-105E, General Inspection Level I sample. It does not determine the compliance of MICR printing to specifications. It is performed only to assist in verifying problems with MICR printing and to cull questionable forms. A forgiving reader may read noncompliant printing. For this reason, compliance is determined through evaluation against applicable ANSI requirements and other contract specifications.

The second is a test of durability and document contamination which uses a MIL-STD-105E, Special Inspection Level S-4 sample. This test is specified by the contract as the basis for determining compliance to durability and contamination requirements only. Normally, it is necessary only on toner-based nonimpact printing or ribbon printing.

In general, MICR printing complies with contract specifications if it satisfies all applicable ANSI requirements before, during, and after 30 passes through typical, ANSI-compliant MICR processing equipment and if the MICR printing does not contaminate the processing equipment or other forms. Always check the contract specifications for exact requirements.

An ANSI-compatible MICR reader is one which is specifically designed to read ANSI-compliant MICR printing and which references the ANSI standards for MICR as part of its specifications. The preferred reader for these tests is the IBM 3890 Document Processor in any E13B MICR configuration.

Test conditions
Reference to the appropriate documentation for the reader and related equipment is required to assess the following conditions. All conditions must be satisfied before a test begins.

1. Sample
   The sample must be selected in accordance with contract specifications and modifications. Only new, unused, unhandled forms taken from their original packing may be sampled. The sample should be selected from the departmental random copies if they are available.

2. Storage of forms
   Prior to processing, all forms must be stored in their unopened containers for at least 72 hours at the temperature and humidity at which they will be run (e.g., in the same room in which the equipment is located).

3. Equipment
   The MICR forms must be run upon a commonly-used, ANSI-compatible MICR reader. The preferred equipment for this test is an IBM 3890 Document Processor in any E13B MICR configuration.

4. Equipment maintenance and calibration
   The MICR reader must be maintained and calibrated in accordance with the manufacturer's recommended schedule and procedures.
5. **Equipment operation**  
The MICR reader must be operated in accordance with the manufacturer's instructions. This includes set-up, adjustment, and operation. The manufacturer may also specify operating environmental conditions. The equipment must be operated by qualified personnel, preferably the usual operator.

6. **Statement of test conditions**  
The customer must have objective evidence that the requirements of items 1 through 5 above have been met. The customer must also have the equipment manufacturer's technical representative available onsite during the test or available for consultation by telephone.

**Readability test**

1. The test may proceed only when all of the test conditions are satisfied. The Printing Procurement Quality Assurance Section representative is responsible for overseeing all aspects of the test. The equipment should be operated by the regular operator and may only be run at rated speeds as documented in the operation manual. If the contract specifies a speed, run only at that speed.

2. Select a sampling plan per MIL-STD-105E, General Inspection Level I. Select the sample from the departmental random copies if they are available. The sample may consist of sequential items from one or more portions of the lot rather than a random sample. Select the sample from as many portions as the situation allows. A single sequential sample is satisfactory if conditions do not permit sampling from more than one portion of the lot. Only new, unused, unhandled forms taken from their original packing may be run.  
   Note: If both readability and durability tests are to be performed, run the readability test first and take the durability test samples from the readability test samples.

3. Run each sample one time through the reader.

4. Set aside any forms which are kicked out or do not read correctly. Record any problems encountered during the test.

5. The shipment is unacceptable if there is any equipment stoppage due to contamination of the equipment or forms from the MICR printing during the test. The reader manufacturer's technical representative has primary responsibility for determining if the stoppage is caused by toner contamination. Note any stoppage and its cause.

6. At the completion of the test, mark and pack separately the forms that were kicked out or read incorrectly. If the durability test also is to be performed, select a sample from the remaining forms, otherwise pack them and forward all of the test sample forms to the Quality Systems Division for evaluation.

7. The Quality Systems Division will evaluate optical print quality and forms design requirements. Magnetic print quality requirements will be evaluated on suitable MICR testing equipment by an independent testing laboratory. Compliance to paper specifications will be determined separately by the Paper and Physical Testing Division.
Durability and document contamination test

1. The test may proceed only when all of the test conditions are satisfied. The Quality Assurance Section representative is responsible for overseeing all aspects of the test. The equipment may only be run at rated speeds as documented in the operation manual. If the contract specifies a speed, run only at that speed.

2. Select a sampling plan per MIL-STD-105E, Special Inspection Level S-4. Select the sample from the departmental random copies if they are available. The sample may consist of sequential items from one or more portions of the lot rather than a random sample. Select the sample from as many portions as the situation allows. A single sequential sample is satisfactory if conditions do not permit sampling from more than one portion of the lot.

   Note: If both readability and durability tests are to be performed, run the readability test first and take the durability test samples from the readability test samples which were not kicked out.

3. Run each sample 30 times through the reader (29 times if the readability test was performed first).

4. During each run, set aside any forms which are kicked out or do not read correctly. Record any problems encountered during the test.

5. There shall be no equipment stoppage due to contamination of the equipment or forms from the MICR printing during the test. The reader manufacturer's technical representative has primary responsibility for determining if stoppage is due to toner contamination. Note any stoppage and its cause.

6. At the completion of the test, mark and pack separately the forms that were kicked out or read incorrectly. Forward all of the test sample forms to the Quality Systems Division for evaluation.

7. The Quality Systems Division will evaluate optical print quality and forms design requirements. Magnetic print quality requirements will be evaluated on suitable MICR testing equipment by an independent testing laboratory. Compliance to paper specifications will be determined separately by the Paper and Physical Testing Division.
Guidelines for specifying OCR printing

These guidelines apply to Optical Character Recognition (OCR) forms intended for use on high-volume, dedicated OCR readers of the type for which the ANSI standards for OCR were developed. This class of equipment generally handles only a narrow range of fonts and print quality but is capable of providing extremely low reject and error rates. The guidelines are not intended to apply to forms which will be used on small OCR systems (for example, a desktop scanner used in conjunction with OCR software running on a personal computer) or on systems specifically designed to accommodate a wide variety of fonts and print quality (for example, Postal Service mail sorters and scanners), although ANSI-compliant printing should function well on such systems. Only the section entitled "OCR specification clause" is intended for inclusion in contracts.

Guidelines

It is recommended that contract specifications for OCR printing state only a performance standard and an acceptable reject rate. In the absence of a documented statement by the manufacturer regarding the performance of the reader, the recommended reject rate is 1.5 percent. No part of the manufacturer's print quality specifications or the ANSI standards should be included or referenced in the contract. When determining customer requirements and writing specifications the following items should be considered. Items 1 and 2 must be provided in the departmental requisition.

1. Equipment
   Specify the exact make and model of the equipment upon which the OCR printing is to be read. Include reference to any equipment options or modifications which may affect OCR reading or forms processing.

2. Font
   OCR printing is done almost exclusively with either the OCR-A or OCR-B typeface. Contact the Quality Systems Division if a different typeface is requested.
   OCR-A and OCR-B are further classified by size: size I, size III, or size IV. (There is no American standard for size II.) Size must be specified.
   Note: Customers may also specify the ANSI quality level range, x, y, or z, when stating the requirements for a given performance level. Contact the Quality Systems Division for amended specifications if quality level range is specified.

3. Performance
   The recommended reject rate is 1.5 percent. Contact the Quality Systems Division if a reject rate other than 1.5 percent is requested. A form is a reject when the reader cannot correctly decipher the OCR print on the first pass.
4. **Paper**

Paper specifications must conform to the reader manufacturer's stated requirements, if any. There may be additional paper requirements if the product is to be used with other reading, sorting, and printing equipment. Paper specifications must satisfy the requirements of all applicable equipment. Consult the Paper and Physical Testing Division to assure that the paper specifications are adequate.

5. **Ink**

The two types of ink used in OCR forms are read inks and dropout inks. Dropout inks are also referred to as nonread or background inks. Each application has precise requirements for the responses of both types in the visible and near, mid, or far infrared (IR) parts of the spectrum. Generally, carbon black pigments can be present in read inks but not in dropout inks.

Read ink is used to print the OCR characters. Specifications for read inks are not usually needed because the contractor must use correct inks in order to meet the performance requirement.

Dropout inks may be called for in the forms design requirements. These inks must conform to the reader manufacturers requirements, if any. Inks that do not conform may cause erroneous readings and may also affect performance. Furthermore, dropout inks that meet specifications do not all perform equally well. Dropout inks may be equated to those Pantone, Flint (formerly Sinclair and Valentine), or Standard Register ink specifications which have been recommended by the reader manufacturer.

Consult the Chemical and Environmental Division for assistance with ink requirements.

6. **Quantity and variable data accuracy**

Quantity and data accuracy are critical for most applications with variable data. When this is the case, it is recommended that contractors be required to demonstrate the completeness of production runs and to devote particular attention to any interruption of the numbering process.

7. **Quality systems**

When the product has a critical application and when the situation permits (e.g., when time permits), it is recommended that invitations for bid (IFB's) require the contractor to submit a written quality system. Contact the Quality Systems Division if a quality system requirement is needed.

8. **Preaward tests, prior-to-production samples**

The use of preaward tests or prior-to-production samples should be considered for critical applications or in cases where problems could easily arise. Such cases include first-time uses of unconventional printing (e.g., toner-based printing), processes with intrinsic weaknesses (e.g., multipart carbon forms), and applications with a history of problems.

9. **Departmental random copies**

It is recommended that departmental random copies be ordered whenever feasible. The use of departmental random copies provides a firm basis for assessing all product quality-related issues. It simplifies sampling when it is necessary for the Quality Assurance Section to conduct a performance test. See Appendix I for guidance.
10. **Quality assurance random copies**
The use of mechanical impact printers for printing variable OCR data generally precludes the generation of duplicate or quality assurance samples. Computer-driven OCR printers can be programmed to produce duplicate or specially coded forms. When feasible (e.g., when security requirements permit), it is recommended that IFB's for critical applications require quality assurance random copies.

**Forms design**
Manufacturers may have specific guidelines for the layout and design of OCR forms, which should be complied with. These guidelines are closely tied to the performance of the system. The customer should make sure that these guidelines are met.

**ANSI standards**
ANSI standards should *not* be referenced. There are ANSI standards addressing character sets (font), character position, print quality, paper, and ink. (See Appendix II) In the absence of reader manufacturer specifications, the ANSI standards may be used as a baseline for evaluating OCR forms which fail the performance test (quality range y will apply). The reader manufacturer's specifications will always take precedence.

**OCR specification clause**
The clause below is the recommended specifications requirement for OCR printing. (Sample specification clauses for ordering departmental random copies are provided in Appendix I.)

The reject rate should be 1.5 percent unless otherwise requested by the customer. Consult the Quality Systems Division if a different reject rate is required or if a quality system is needed.

The scanline shall be printed using the [*OCR-A or OCR-B*, Size [*I, III, or IV*] font. The OCR printing shall read continuously on [*specified equipment*]. The reject rate due to manufacturing deficiencies shall not exceed 1.5 percent of the items when run on the specified reading equipment. A form is a reject when its OCR print cannot be correctly deciphered on the first pass through the specified reading equipment. Acceptability of the lot for OCR readability shall be based on the number of rejected items in a sample of the size specified in MIL-STD-105E, General Inspection Level I, with AQL equal to 1.5 percent. For OCR evaluation, the sampling unit of product shall be an individual form (single part or multipart). OCR tests are independent of tests and evaluations of all other product characteristics and have separate AQL's and sample sizes. At the option of the Government, the sample may consist of sequential items from one or more portions of the lot rather than a random sample.
Determining OCR compliance

Performance testing of OCR materials does not involve the direct measurement of OCR print quality or assessment of the printing against any ANSI standards for OCR printing. The performance test determines if the lot meets the reject rate specified by the contract.

Test conditions
The forms must be run in accordance with contract provisions. Reference to the documentation for the OCR reader and related equipment is necessary to assess the following items. All conditions must be satisfied before the test begins.

1. Sample
   The sample must be selected in accordance with the contract specifications and modifications. Only new, unused, unhandled forms taken from their original packing may be sampled. The sample should be selected from the departmental random copies if they are available.

2. Storage of forms
   Prior to processing, all forms must be stored in their unopened containers for at least 72 hours at the temperature and humidity at which they will be run (e.g., in the same room in which the equipment is located).

3. Equipment
   The OCR forms being tested may be run only on the specified equipment. OCR readers may be supplied with additional, modules, options, or modifications. Note their presence or absence, particularly if the contract specifications make reference to them. The test should be performed using the equipment for which processing problems have been reported. Confirmatory tests on similar machines of the same make, model, or configuration may be necessary if there are doubts about the equipment with which the problems were encountered.

4. Equipment maintenance and calibration
   The equipment must be maintained and calibrated in accordance with the manufacturer's recommended schedule and procedures.

5. Equipment operation
   The equipment must be operated in accordance with the manufacturer's instructions. This includes set-up, adjustment, and operation. The manufacturer may also specify operating environmental conditions. The equipment must be operated by qualified personnel, preferably the usual operator.

6. Statement of test conditions
   The customer must have objective evidence that the requirements of items 1 through 5 above have been met. The customer must also have an equipment manufacturer's technical representative available onsite during the test or available for consultation by telephone.
Readability test

1. The test may proceed only when all of the test conditions are satisfied. The Printing Procurement Quality Assurance Section representative is responsible for overseeing all aspects of the test. The equipment should be operated by the regular operator and may only be run at rated speeds as documented in the operation manual. If the contract specifies a speed, run only at that speed.

2. Select a sampling plan per MIL-STD-105E, General Inspection Level I. The AQL equals the specified reject rate. Select the sample from the departmental random copies if they are available. The sample may consist of sequential items from one or more portions of the lot rather than a random sample. Select the sample from as many portions as the situation allows. A single sequential sample is satisfactory if conditions do not permit sampling from more than one portion of the lot. Only new, unused, unhandled forms taken from their original packing may be sampled.

3. Run each sample once through the reader.

4. Set aside any forms which are kicked out or do not read correctly. Record any problems encountered during the test.

5. Compare the test results to the acceptance criterion from the sampling plan.

6. At the completion of the test, mark and pack separately the forms that were kicked out or read incorrectly.

7. Return all of the test forms to GPO.

8. If corroboration is needed, the Quality Systems Division will assist in evaluating conformance of the forms to the reader manufacturer's specifications, or, in their absence, the ANSI standards. The manufacturer's specifications take precedence over the ANSI standards.
Guidelines for specifying OMR printing

There are no industry standards applicable to Optical Mark Read (OMR) forms. In general, each reader has unique forms, paper, and ink requirements. It is the responsibility of the printing contractor to know these requirements in order to meet the performance requirement described below. Only the section entitled "OMR specification clause" is intended for inclusion in contracts.

Guidelines

It is recommended that contract specifications for OMR printing state only a performance requirement. The recommended reject rate is 0.65 percent. No part of the reader manufacturer's forms specifications should be included or referenced in the contract. When determining customer requirements and writing specifications the following issues should be considered. Item 1 must be provided in the departmental requisition.

Checklist

When determining customer requirements and writing specifications the following issues should be considered:

1. Equipment
   The exact make and model of the equipment upon which the OMR printing is to be read must be specified. Include reference to any equipment options or modifications which may affect OMR reading or forms processing.

2. Performance
   The recommended reject rate is 0.65 percent. Contact the Quality Systems Division if a reject rate other than 0.65 percent is requested. A form is a reject when the reader cannot correctly process a properly marked form on the first pass.

3. Paper
   Paper specifications must conform to the reader manufacturer's stated requirements, if any. There may be additional paper requirements if the product is to be used with other reading, sorting, and printing equipment. Paper specifications must satisfy the requirements of all applicable equipment. Consult the Paper and Physical Testing Division for assistance with paper specifications.

4. Ink
   The two types of ink used in OMR forms are read inks and dropout inks. Dropout inks are also referred to as nonread or background inks. Each application has precise requirements for the responses of both types in the visible and near, mid, or far infrared (IR) parts of the spectrum. Generally, carbon black pigments can be present in read inks but not in dropout inks.

   Read ink is used to print timing marks, premarked response positions, and other machine-readable marks. Specifications for read inks are not usually needed because the contractor must use correct inks in order to meet the performance requirement.

   The marking area of the form is printed with dropout ink. This ink must conform to the reader manufacturers requirements, if any. Inks that do not conform may cause erroneous readings and may also affect performance. Furthermore, dropout inks that meet specifications do not all perform equally well. Dropout inks may be
equated to those Pantone, Flint (formerly Sinclair and Valentine), or Standard Register ink specifications which have been recommended by the reader manufacturer.

Consult the Chemical and Environmental Division for assistance with ink requirements.

5. **Quantity and variable data accuracy**
   Quantity and data accuracy are critical for most applications with variable data. When this is the case, it is recommended that contractors be required to demonstrate the completeness of production runs and to devote particular attention to any interruption of the numbering process. OMR forms usually use specially encoded patterns for serial numbering in lieu of alphanumeric text.

6. **Quality systems**
   When the product has a critical application and when the situation permits (e.g., when time permits), it is recommended that invitations for bid (IFB's) require the contractor to submit a written quality system. Contact the Quality Systems Division if a quality system requirement is needed.

7. **Preaward tests, prior-to-production samples**
   Prior-to-production samples should be considered for all OMR applications. Preaward tests may also be needed if the bidder does not have strong history with close-tolerance printing.

8. **Departmental random copies**
   It is recommended that departmental random copies be ordered whenever feasible. The use of departmental random copies provides a firm basis for assessing all product quality-related issues. It simplifies sampling when it is necessary for the Quality Assurance Section to conduct a performance test. See Appendix I for guidance.

9. **Quality assurance random copies**
   It is recommended that departmental random copies be ordered whenever feasible. The use of departmental random copies provides a firm basis for assessing all product quality-related issues. It simplifies sampling when it is necessary for the Quality Assurance Section to conduct a performance test. See Appendix I for guidance.

**Forms design**
Manufacturers have precise specifications for the placement of all readable parts of the form. If the agency is providing artwork or camera copy, the account representative should determine if it conforms to the manufacturers specifications and how this was verified. Proper layout cannot be determined from previous printed versions of a form.
OMR specification clause
The clause below is the recommended specifications requirements for OCR printing. (Sample specification clauses for ordering departmental random copies are provided in Appendix I.)

The reject rate should be 0.65 percent unless otherwise requested by the customer. Consult the Quality Systems Division if a different reject rate is requested or if a quality system is needed.

| The form shall read continuously on [specified equipment]. The reject rate due to manufacturing deficiencies shall not exceed 0.65 percent of the items when run on the specified reading equipment. A form is a reject when it cannot be correctly processed on the first pass through the specified reading equipment. Acceptability of the lot for readability shall be based on the number of rejected items in a sample of the size specified in MIL-STD-105E, General Inspection Level II, with AQL equal to 0.65 percent. For evaluation of readability, the sampling unit of product shall be an individual form (single part or multipart). Readability tests are independent of tests and evaluations of all other product characteristics and have separate AQL's and sample sizes. At the option of the Government, the sample may consist of sequential items from one or more portions of the lot rather than a random sample. |
Determining OMR compliance

Performance testing of OMR forms does not involve the direct measurement of OMR forms to determine conformance to manufacturer's specifications. The performance test determines if the lot meets the reject rate specified by the contract. The Quality Systems Division maintains a library of forms specifications materials and can examine forms which fail the performance test if the manufacturer's specifications are available.

Test conditions
The forms must be run in accordance with contract provisions. Reference to the documentation for the OMR reader and related equipment is necessary to assess the following items. All conditions must be satisfied before the test begins.

1. Sample
   The sample must be selected in accordance with the contract specifications and modifications. Only new, unused, unhandled forms taken from their original packing may be sampled. If additional samples are required for preliminary analysis, they should be taken from the remainder of the lot after the sample for the performance test has been pulled. The sample should be selected from the departmental random copies if they are available.

2. Storage of forms
   Prior to processing, all forms must be stored in their unopened containers for at least 72 hours at the temperature and humidity at which they will be run (e.g., in the same room in which the equipment is located).

3. Equipment
   The forms being tested may be run only on the specified equipment. The test should be performed using the equipment for which processing problems have been reported. Confirmatory tests on similar machines of the same make, model, or configuration may be necessary if there are doubts about the equipment with which the problems were encountered.

4. Equipment maintenance and calibration
   The equipment must be maintained and calibrated in accordance with the manufacturer's recommended schedule and procedures.

5. Equipment operation
   The equipment must be operated in accordance with the manufacturer's instructions. This includes set-up, adjustment, and operation. The manufacturer may also specify operating environmental conditions. The equipment must be operated by qualified personnel, preferably the usual operator.

6. Statement of test conditions
   The customer must have objective evidence that the requirements of items 1 through 5 above have been met. The customer must also have an equipment manufacturer's technical representative available onsite during the test or available for consultation by telephone.
Preliminary analysis

Performance testing is usually conducted in response to problems experienced with live forms. In order to identify specific problems areas, exploratory analysis, inspection, and testing prior to the performance test is strongly recommended.

1. After the performance test sample is selected, take an additional sample large enough to identify problem areas or to test all response positions on the form if necessary. These forms must be properly marked and handled. (See section 3 under Forms selection below.)

2. Identify problem areas from the operator's experience with rejected forms or by visual examination. The manufacturer's forms inspection template should also be used if it is available. If problem areas are not readily apparent, mark the forms exhaustively so that all response positions are tested. (See section 3. (d) under Forms selection below for additional details.)

3. If necessary, run the forms and note those response positions which do not read correctly. These positions are to be marked on the sample forms for the performance test.

4. Identify the preliminary analysis forms and set them aside. Do not include them in the performance test.

Forms selection, preparation, and testing

1. The performance test may proceed only when all of the test conditions are satisfied. The Printing Procurement Quality Assurance Section representative is responsible for overseeing all aspects of the test. The equipment should be operated by the regular operator and may only be run at rated speeds as documented in the operation manual. If the contract specifies a speed, run only at that speed.

2. Select a sampling plan per MIL-STD-105E, General Inspection Level II. The AQL equals the specified reject rate. Select the sample from the departmental random copies if they are available. The sample may consist of sequential items from one or more portions of the lot rather than a random sample. Select the sample from as many portions as the situation allows. A single sequential sample is satisfactory if conditions do not permit sampling from more than one portion of the lot. Only new, unused, unhandled forms taken from their original packing may be sampled. Do not use forms used for preliminary testing.

3. To test the readability of the forms, the response positions, also called lozenges, must be filled in exactly as the reader manufacturer specifies. If the forms will be filled in by hand, the correct marking instrument must be used. It may be possible to fill in the forms with a laser printer or line printer. Again, the toner or ink used must satisfy the manufacturer's requirements. In all cases, the lozenges must be completely filled, with no stray marks outside the lozenge wall or elsewhere on the form.

The exact pattern of lozenges to be filled depends on the application and on the software limitations of the reader. Use option a, b, c, or d in that order of preference.

a) If the reader has a standard test pattern program to test all possible response positions, mark the lozenges on each test sheet as required for the test program. If this option is to be used, each lozenge must be marked on at least one test form.
b) If the reader can easily be programmed to test each response position on a form simultaneously, fill each lozenge on each form in the sample.

c) If standard or specially programmed test patterns are not available, use the live forms processing program to run the performance test. If specific problem areas on the forms have been identified, first be sure that each form is marked in the problem areas and then mark other areas on the form as described in (d) below.

d) If specific problem areas on the forms cannot be identified, use the live forms processing program and mark the forms for maximum feasible coverage as follows.

Usually only one lozenge in the response group for each question can be marked. If this is the case, a separate form is needed to test each response to a question. The response area for a question may extend over several lines or columns. The question with the largest number of response positions determines the number of copies needed to completely test a form.

If the sample is large enough, mark each response position on the form at least once.

If the sample is not large enough to mark each lozenge once, it will be necessary to mark selected response positions. The distribution of the lozenges marked on the forms should be stratified. Lozenges should be selected from extreme parts of the form, such as the top and bottom and the sides. Diagonals or columns evenly distributed across the form can also be marked. The sample patterns shown in Exhibit 1 illustrate these guidelines.

For further information on marking OMR forms for the performance test, contact the Quality Systems Division.

4. Run each sample once through the reader.

5. Set aside any forms which are kicked out or do not read correctly. Record any problems encountered during the test.

6. Compare the test results to the acceptance criterion from the sampling plan.

7. At the completion of the test, mark and pack separately the forms that were kicked out or read incorrectly.

8. Return all of the test forms to GPO.

9. If corroboration is needed, the Quality Systems Division may be able to assist in evaluating conformance of the forms to the reader manufacturer's specifications when they are available.
**Figure 1: First test form in a series**
Figure 2: Second test form in a series
## UNITED STATES NAVAL ACADEMY
### CANDIDATE PERSONAL DATA RECORD

This form comes under the purview of the Privacy Act of 1974. See reverse side.

### READ INSTRUCTIONS TO CANDIDATE CAREFULLY BEFORE COMPLETING THIS FORM

- Completely fill bubbles
- Make no stray marks
- Make clean erasures
- Write only in designated areas

### PERMANENT ADDRESS
(Street, City, County, State and Zip Code)

### MAILING ADDRESS (if different than Permanent Address)

- Father
- Stepfather
- Guardian

### PHONE NUMBER

### AREA CODE

### NAME OF:

### ADDRESS (if different than Permanent Address)

### OCCUPATION

### 1. PRINT NAME

- First
- Middle
- Suffix (Jr., Sr., Jr., IV)

### USE NO. 2 PENCIL ONLY

### CorrectMarks Incorrect Marks

### DATE OF BIRTH

### MONTH DAY YEAR

### REPORTED TO BUSINESS OR MILITARY Employer

### HEIGHT

### WEIGHT

### SEX

### BLOOD GROUP

### Figure 3: Third test form in a series

Known problem area
Figure 4: Last test form in a series
From the desk of . . .

Roy N. Van Denburgh
Chairman, Accredited Standards Committee X9B
(responsible for MICR and check processing standards)

STOP! LOOK! LISTEN!

An Open Letter to anyone thinking of purchasing, or using, a non-impact printer to print checks with E13B Magnetic Ink Characters.

To date, the experience in the financial services industry processing checks produced from MICR laser or other non-impact printers has been marginal at best, unless they have been substantially modified to print durable MICR characters. By "substantially modified", I mean that the printer has incorporated some mechanism beyond the simple addition of magnetic toner and MICR font to prevent the MICR characters from deteriorating during the check clearing process. Although under laboratory environments unmodified printers have the capability of producing satisfactory MICR printing, in real life the uncontrolled environment coupled with unskilled operators where these printers are installed are producing an excessive number of rejects or items requiring exception item processing far in excess of conventional letterpress, offset, or ribbon printed checks.

The reasons for this are many, but foremost is the fact that MICR laser printer toner, in the form of E13B characters, when subjected to the multiple passes required in the check clearing system, is impermanent and will deteriorate. Sometimes smearing, other times being removed as extra bits of ink which contaminate other documents and even the transports of the MICR reading equipment, causing severe problems. While some checks are processed a relatively few number of times, the fact is that bankers feel that any MICR printed item should be able to be processed 20 times without rejecting as long as it has been printed to spec. This is why the ANSI accredited committee on Paper Document Payment Processing ASC X9B has insisted on the stress test of survival of 30 passes.

The field experience to date indicates that unmodified non-impact MICR printers vary from day to day in their capability to produce satisfactory MICR printing from a permanence standpoint. The ambient environmental conditions where these printers are used, the quality of the paper, particularly the moisture content, all play an important part in the quality of the MICR printing produced. Since no printer manufacturer can control these factors, the result, for the most part, has been deteriorating MICR quality over the continued life use of the device in the customers hands.

First, from a banker’s perspective, the cost of handling rejects that occur as a result of this subsequent pass deterioration is more expensive than if the reject occurred on the first pass (capture) of the MICR data from an item. The industry has an efficient capture pass reject repair system that is largely automated. Subsequent pass rejects such as are seen from unmodified non-impact MICR printers, however, require expensive labor-intensive manual intervention.

Second, since the character shapes (dimensions) in a non-impact printing system are created by software and depend on the resolution of the print device, often the character shape, radii, stroke widths, and even proper character spacings do not meet ANSI specifications for MICR printing.

Third, the code line; that is, the specific requirements by field of the "check", are established by the paying institution. Many non-impact printed MICR documents do not contain the proper data by MICR field. Banks do not always tell their customers all the data required for successful processing.

The use of non-impact MICR printers by people who are not familiar with MICR printing requirements or bank check processing requirements, coupled with the various weaknesses of unmodified non-impact technology in printing quality MICR has been described as a “processing disaster waiting to happen”.

Don’t purchase or use a non-impact printer for MICR printing without first speaking with your bank, a reader/sorter manufacturer, or someone else who has years of proven experience in printing quality MICR.

Sincerely,

Roy N. Van Denburgh
Appendix I

Departmental random copies

The use of departmental random copies (blue box samples) is recommended for all machine-readable forms whenever feasible. Because the blue box sample is set aside to be used last by the agency, a random sample remains available for inspection and performance testing throughout the life of the product.

The sampling unit for departmental random copies depends on the type of product. For marginally-punched continuous forms, it is an individual carton. Otherwise it is an individual form. Samples of individual forms are packed together in separate containers. In either case the sample is randomly selected by the contractor and cartons are marked with the special blue label.

Although the GPO Printing Procurement Regulations enjoin their use for classified and numbered printing, departmental random copies have been ordered successfully for such products in the past. The approval of the ordering agency must, however, be obtained if departmental random copies are to be ordered for these products, and their handling must be given close attention. The disposition of these departmental random copies must be clearly accounted for by the contractor in accordance with the agency's instructions. Each carton in the order should be numbered and there should be a complete list identifying the exact forms which comprise the departmental random copies, the number of the blue label carton containing them, and their final disposition. This insures that the end user will not misconstrue a lapse in serial data as missing data. The contract must clearly indicate that missing variable data is not acceptable. The sample clauses below do not address missing variable data.

Marginally-punched MICR, OCR, and OMR forms

The following contract clauses are for use when the product is marginally-punched forms containing no variable data.

<table>
<thead>
<tr>
<th>Number of Cartons in Order</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 500</td>
<td>5</td>
</tr>
<tr>
<td>501 - 35,000</td>
<td>20</td>
</tr>
<tr>
<td>35,001 - 500,000</td>
<td>32</td>
</tr>
<tr>
<td>500,001 or more</td>
<td>50</td>
</tr>
</tbody>
</table>

These randomly selected samples shall be kept together and shall be identified by special Government-furnished blue labels (GPO Form 2678) one of which shall be affixed to the outside of each sample container. These samples shall be recorded separately on all shipping documents and sent in accordance with the distribution list. If the shipping list does not specify a destination, the departmental random copies shall be sent to the destination receiving the largest quantity. The departmental random copies constitute a part of the total quantity ordered and no additional charge will be allowed.

In addition, a copy of the "Specifications" or "Print Order" (GPO Form 2511) along with the signed "Selection Certificate" (GPO Form 917), which will be furnished, shall be included with the samples.
The following contract clauses are for use when the product is marginally-punched forms containing variable data.

When departmental random copies are ordered, the total number of cartons in the order shall be divided into equal sublots in accordance with the chart shown below. A random sample carton shall be selected from each subplot. A carton represents one (1) sample item. Each sample shall be chosen from a different general area of each subplot.

<table>
<thead>
<tr>
<th>Number of Cartons in Order</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 500</td>
<td>5</td>
</tr>
<tr>
<td>501 - 35,000</td>
<td>20</td>
</tr>
<tr>
<td>35,001 - 500,000</td>
<td>32</td>
</tr>
<tr>
<td>500,001 or more</td>
<td>50</td>
</tr>
</tbody>
</table>

A complete account of the exact variable data on these random samples shall be maintained. These randomly selected samples shall be kept together and shall be identified by special Government-furnished blue labels (GPO Form 2678) one of which shall be affixed to the outside of each sample container. A unique carton number shall be assigned to each sample container. These samples shall be recorded separately on all shipping documents and sent in accordance with the distribution list. If the shipping list does not specify a destination, the departmental random copies shall be sent to the destination receiving the largest quantity. A list of the departmental random copy containers shall be included with each container in the order. The list shall include the unique number for each departmental random copy container, the range of variable data in that container, and its destination. The departmental random copies constitute a part of the total quantity ordered and no additional charge will be allowed.

In addition, a copy of the "Specifications" or "Print Order" (GPO Form 2511) along with the signed "Selection Certificate" (GPO Form 917), which will be furnished, shall be included with the samples.
Individual MICR and OCR forms
The following contract clauses are for use when the product is individual MICR or OCR forms containing no variable data.

<table>
<thead>
<tr>
<th>Number of Forms in Order</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 150,000</td>
<td>80</td>
</tr>
<tr>
<td>150,001 or more</td>
<td>200</td>
</tr>
</tbody>
</table>

When departmental random copies are ordered, the total number of forms in the order shall be divided into equal sublots in accordance with the chart shown below. A random sample form shall be selected from each sublot. A form represents one (1) sample item. Each sample shall be chosen from a different general area of each sublot.

These randomly selected samples shall be packed together and shall be identified by special Government-furnished blue labels (GPO Form 2678) one of which shall be affixed to the outside of each container of samples. These samples shall be recorded separately on all shipping documents and sent in accordance with the distribution list. If the shipping list does not specify a destination, the departmental random copies shall be sent to the destination receiving the largest quantity. The departmental random copies constitute a part of the total quantity ordered and no additional charge will be allowed.

In addition, a copy of the "Specifications" or "Print Order" (GPO Form 2511) along with the signed "Selection Certificate" (GPO Form 917), which will be furnished, shall be included with the samples.
The following contract clauses are for use when the product is individual MICR or OCR forms containing variable data.

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<td>200</td>
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When departmental random copies are ordered, the total number of forms in the order shall be divided into equal sublots in accordance with the chart shown below. A random sample form shall be selected from each subplot. A form represents one (1) sample item. Each sample shall be chosen from a different general area of each subplot.

A complete account of the exact variable data on these random samples shall be maintained. These randomly selected samples shall be kept together and shall be identified by special Government-furnished blue labels (GPO Form 2678) one of which shall be affixed to the outside of each sample container. A unique carton number shall be assigned to each sample container. These samples shall be recorded separately on all shipping documents and sent in accordance with the distribution list. If the shipping list does not specify a destination, the departmental random copies shall be sent to the destination receiving the largest quantity. A list of the departmental random copy containers shall be included with each container in the order. The list shall include the unique number for each departmental random copy container, the variable data in that container, and its destination. The departmental random copies constitute a part of the total quantity ordered and no additional charge will be allowed.

In addition, a copy of the "Specifications" or "Print Order" (GPO Form 2511) along with the signed "Selection Certificate" (GPO Form 917), which will be furnished, shall be included with the samples.
Individual OMR forms
The following contract clauses are for use when the product is individual OMR forms containing no variable data.

When departmental random copies are ordered, the total number of forms in the order shall be divided into equal sublots in accordance with the chart shown below. A random sample form shall be selected from each sublot. A form represents one (1) sample item. Each sample shall be chosen from a different general area of each sublot.

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<td>125</td>
</tr>
<tr>
<td>3201 - 35,000</td>
<td>315</td>
</tr>
<tr>
<td>35,001 - 500,000</td>
<td>800</td>
</tr>
<tr>
<td>500,001 or more</td>
<td>1,250</td>
</tr>
</tbody>
</table>

These randomly selected samples shall be packed together and shall be identified by special Government-furnished blue labels (GPO Form 2678) one of which shall be affixed to the outside of each container of samples. These samples shall be recorded separately on all shipping documents and sent in accordance with the distribution list. If the shipping list does not specify a destination, the departmental random copies shall be sent to the destination receiving the largest quantity. The departmental random copies constitute a part of the total quantity ordered and no additional charge will be allowed.

In addition, a copy of the "Specifications" or "Print Order" (GPO Form 2511) along with the signed "Selection Certificate" (GPO Form 917), which will be furnished, shall be included with the samples.
The following contract clauses are for use when the product is individual OMR forms containing variable data.

When departmental random copies are ordered, the total number of forms in the order shall be divided into equal sublots in accordance with the chart shown below. A random sample form shall be selected from each sublot. A form represents one (1) sample item. Each sample shall be chosen from a different general area of each sublot.

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A complete account of the exact variable data on these random samples shall be maintained. These randomly selected samples shall be kept together and shall be identified by special Government-furnished blue labels (GPO Form 2678) one of which shall be affixed to the outside of each sample container. A unique carton number shall be assigned to each sample container. These samples shall be recorded separately on all shipping documents and sent in accordance with the distribution list. If the shipping list does not specify a destination, the departmental random copies shall be sent to the destination receiving the largest quantity. A list of the departmental random copy containers shall be included with each container in the order. The list shall include the unique number for each departmental random copy container, the variable data in that container, and its destination. The departmental random copies constitute a part of the total quantity ordered and no additional charge will be allowed.

In addition, a copy of the "Specifications" or "Print Order" (GPO Form 2511) along with the signed "Selection Certificate" (GPO Form 917), which will be furnished, shall be included with the samples.
Appendix II

Related publications

The following publications are available for reference in the Quality Systems Division. Because of copyright restrictions, they may not be photocopied. Copies of ANSI standards may be ordered through:

American National Standards Institute
1430 Broadway
New York City, NY 10018
212-642-4900

ANSI X3.17 American National Standard. Character Set for Optical Character Recognition (OCR-A)

ANSI X3.49 American National Standard. Character Set for Optical Character Recognition (OCR-B)

ANSI X3.62 American National Standard for Information Systems -- Optical Character Recognition (OCR) -- Paper Used in OCR Systems

ANSI X3.86 American National Standard for Optical Character Recognition (OCR) Inks

ANSI X3.93M American National Standard for Optical Character Recognition (OCR) Character Positioning

ANSI X3.99 American National Standard for Information Systems -- Optical Character Recognition (OCR) -- Guidelines for OCR Print Quality

ANSI X3.111 American National Standard for Information Systems -- Optical Character Recognition (OCR) -- Matrix Character Sets for OCR-MA


ANSI X9.3 American National Standard for Check Endorsements -- Specifications

ANSI X9.7 American National Standard. Bank Check Background and Convenience Amount Field

ANSI X9.13 American National Standard for Placement and Location of MICR Printing -- Specifications

ANSI X9.18 Paper Specifications for Checks

ANSI X9.27 Print Specifications for Magnetic Ink Character Recognition (MICR)

ANSI X9/TG-2 Understanding and Designing Checks