(new X3.2.3/191)

Proposed USA Standard
Punched Card Code

FOREWORD

(This Foreword is not a part of the USA Standard Hollerith Card Code.)

This USA Standard presents the standard Hollerith Card Code representation of the 128 characters of USASCII in twelve-row punched cards.

Other standards specify the dimensions and quality of punched paper cards, and the dimensions and locations of the holes punched in the cards.

This coded representation of the USASCII character set for the twelve row punched card was developed from research, review of historical work and careful consideration of the use of punched cards in information processing and communication. Resolution of several conflicting requirements is reflected herein.

This standard was approved as USA Standard by the USA Standards Institute on

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to the USA Standards Institute, Incorporated, 10 East 40th Street, New York, New York 10016.

The USASI Sectional Committee on Computers and Information Processing, X3, had the following personnel at the time of approval:

At the time the proposal was developed and processed through USASI X3.2 the Subcommittee membership was as follows:

At the time this standard was processed by USASI X3.2.3, the Task Group membership was as follows:

Others who contributed to the development of this standard are:

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USA STANDARD HOLLERITH PUNCHED CARD CODE

1. SCOPE

This standard specifies hole-patterns in twelve-row punched cards for the 128 characters of USASCII (USA Standard Code for Information Interchange, X3.4-196x). The hole-pattern assignments incorporate the commonly used "Hollerith" hole-patterns for the numerals and a single case of letters.

2. STANDARD HOLLERITH PUNCHED CARD CODE

2.1 CODE TABLE

Col. Row	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	`	p
	12-0-9-8-1	12-11-9-8-1	no punches	0	8-4	11-7	11-8-1	12-11-7
1	SOH	DC1	!	1	A	Q	a	q
	12-9-1	11-9-1	12-8-7	1	12-1	11-8	12-0-1	12-11-8
2	STX	DC2	"	2	B	R	b	r
	12-9-2	11-9-2	8-7	2	12-2	11-9	12-0-2	12-11-9
3	ETX	DC3	#	3	C	S	c	s
	12-9-3	11-9-3	8-3	3	12-3	0-2	12-0-3	11-0-2
4	EOT	DC4	$	4	D	T	d	t
	9-7	9-8-4	11-8-3	4	12-4	0-3	12-0-4	11-0-3
5	ENQ	NAK	%	5	E	U	e	u
	0-9-8-5	9-8-5	0-8-4	5	12-5	0-4	12-0-5	11-0-4
6	ACK	SYN	&	6	F	V	f	v
	0-9-8-6	9-2	12	6	12-6	0-5	12-0-6	11-0-5
7	BEL	ETB	'	7	G	W	g	w
	0-9-8-7	0-9-6	8-5	7	12-7	0-6	12-0-7	11-0-6
8	BS	CAN	(	8	H	X	h	x
	11-9-6	11-9-8	12-8-5	8	12-8	0-7	12-0-8	11-0-7
9	HT	EM	)	9	I	Y	i	y
	12-9-5	11-9-8-1	11-8-5	9	12-9	0-8	12-0-9	11-0-8
10	LF	SUB	*	:	J	Z	j	z
	0-9-5	9-8-7	11-8-4	8-2	11-1	0-9	12-11-1	11-0-9
11	V	ESC	+	;	K	[	l	{
	12-9-8-3	0-9-7	12-8-6	11-8-6	11-2	12-8-2	12-11-2	12-0
12	FF	FS	,	<	L	\	k	|
	12-9-8-4	11-9-8-4	0-8-3	12-8-4	11-3	0-8-2	12-11-3	0-8-1
13	CR	GS	—	=	M	]	m	}
	12-9-8-5	11-9-8-5	11	8-6	11-4	11-8-2	12-11-4	11-0
14	SO	RS	.	>	N	^	n	~
	12-9-8-6	11-9-8-6	12-8-3	0-8-6	11-5	11-8-7	12-11-5	12-8-1
15	SI	US	/	?	O	_	o	DEL
	12-9-8-7	11-9-8-7	0-1	0-8-7	11-6	0-8-5	12-11-6	12-9-7

(handwritten annotations: "12-11" beside row 12, col 7; "11-0-1" beside row 14, col 7)

Notes: 1. ┌─ ─ ─ ─ ┐ ←— Character represented---above dotted line
         └─────────┘ ←— Hole-pattern   ---below dotted line

2. See section 3.4

2.2 The standard row positional order and notation for the twelve-row
punched card is shown in Figure 1. The card code hole-patterns in
the Code Table represent punches in the corresponding rows of the
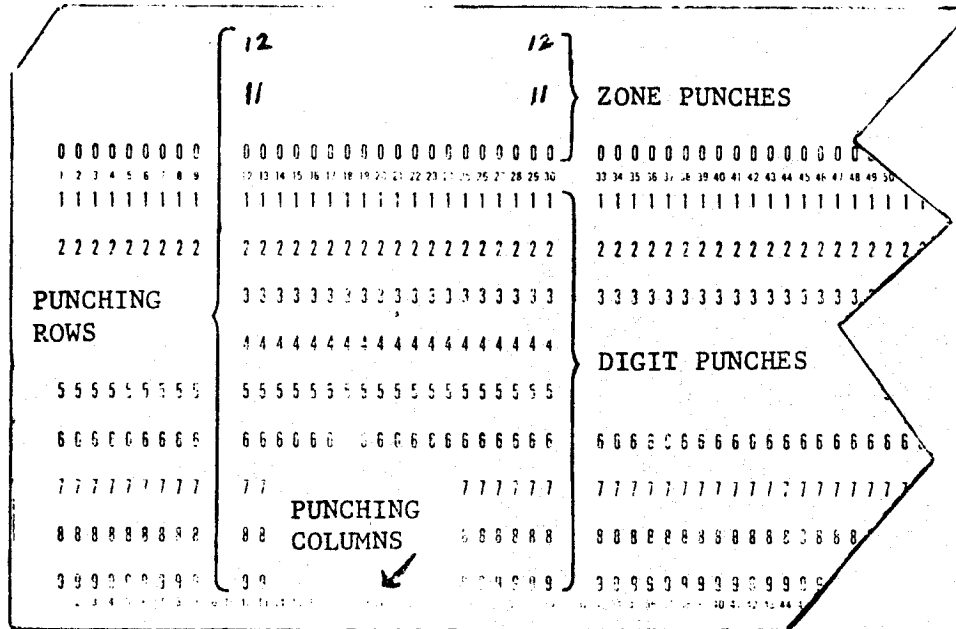card.

Figure 1

LAYOUT OF PUNCHING POSITIONS

2.3 This standard specifies the Hollerith card hole-patterns for repre-
senting the characters of the USASCII when punched in the standard
twelve-row punched card. A single hole-pattern (such as 12-2, or
11-8-6, or 11-9-8-6) is to be punched in a single column of the
standard twelve row punched card.

2.4 A particular hole-pattern may be referred to as being in Code Table
position x/y, where x is the table column and y is the table row.
The vertical columns (x) in the body of the Code Table (not to be
confused with columns on a punched card) are designated column 0,
1, 2, 3, 4, 5, 6, and 7 for reference purposes only. The horizontal
rows (y) in the body of the Code Table (not to be confused with rows
on the punched card) are designated row 0, 1, 2, 3, ---, and 15 for
reference purposes only.

Example: Hole pattern 12-9-8-4 is in Code Table position 0/12.

3. QUALIFICATIONS

3.1 This standard does not include any redundancy, or define techniques for error control.

3.2 This standard does not specify a standard card sorting sequence.

3.3 This standard does not specify the relationship of the Hollerith hole-patterns to any bit-representations of the USASCII characters. For convenience, the Code Table is arranged in the same row-numbers and column-numbers as in USASCII.

3.4 In specific applications it may be desirable to stylize the graphics in code table positions 2/1 and 5/14 into those frequently associated with Logical OR (1) and Logical NOT (⌐) respectively. Other graphics may be similarly stylized in specific applications, as provided for in X3.4-196X.

3.5 Punched card systems have used the convention of overpunching digits with 12 or 11 to represent signed numbers or for other purposes. This standard does not provide a simple translation of overpunched digits to the USASCII representation of digits. Where possible, signs of numbers should be in separate card columns. Overpunched digits should be used in information interchange only by specific agreement between sender and receiver.

3.6 Deviations from the standard may create serious difficulties in general information interchange. Such deviation should be used only with full cognizance of the parties involved. The use of hole-patterns not defined in this standard is considered a deviation from the standard. (See Appendix A.)

4. SUBSET

Recognizing that many existing equipments provide 63 characters (including space), a standard subset is defined, consisting of the characters in columns 2, 3, 4 and 5 except the character "Reverse Slash" (position 5/12) of the Code Table.

APPENDICES

(These Appendices are not a part of the USA Standard Hollerith Punched Card Code USASI X3-___, 196_ but are included to facilitate its use)

APPENDIX A - DESIGN CONSIDERATIONS

A.1 INTRODUCTION

The standard Hollerith representation was designed to provide for representation of the full USASCII character set in punched cards, in a code which incorporated and extended commonly used Hollerith practices. Such a code would thus permit continued use in many applications of existing equipment, files, tabulating procedures and data code structures based on a subset of the full USASCII. The potential benefits of a capability for full interchange of cards and data from users of the subset to the full set and limited interchange in the reverse direction are thus extended to the large body of producers and users of current card equipment.

The punch card is unique as an input/output medium for data processing systems, in the variety of types of usage to which it is put. In some applications it serves as the unit record for storage of data, being created, processed, stored and reprocessed repeatedly over a long life cycle in a single machine facility and handled exclusively by trained operators. In other applications it is punched solely for the purpose of a single reading into an electronic data processing system, and having served that purpose is immediately destroyed. In a different situation, it is punched as a result of a data processing operation, distributed to clerical staffs or the general public and after considerable manual handling is returned to a data processing facility, not necessarily its originator, to serve as an input medium to further processing. The majority of cards used for these various purposes have to date been punched with Hollerith coding, which had thus acquired the status of a de-facto standard. The ability of the code to serve this variety of purposes, together with the large investment in hardware and software based on the code, warrants its extension to provide capacity for interchange between the USASCII world and the Hollerith world.

A.2 COMMONLY USED HOLLERITH CODES

The Hollerith code in general usage had many requisites of a standard specification. The majority of punched card equipments and hence the applications employing them had a set of 48 characters. This set provided:

Blank or space	-	1 character
Digits 0-9	-	10 characters
Letters A-Z	-	26 characters

for a total of 37 characters, leaving eleven character positions for assignment to punctuation or other special symbols. For the basic 37 characters there was almost complete uniformity in the hole-pattern assigned to each graphic.

Further assignments of hole-patterns were then made to accommodate the remaining USASCII graphics. The previous Hollerith practices had not contained the USASCII control characters. However, EBCDIC, which is an extension of Hollerith practices used on a number of existing equipments (Appendix B), contains a number of controls. For those control characters contained in both USASCII and EBCDIC, the EBCDIC hole-patterns were selected. The remaining USASCII control characters were assigned hole-patterns having a translation relationship to USASCII.

The hole-patterns were assigned to the USASCII graphics according to a design by which none of these graphics fall in Block 4 of the EBCDIC code chart (Appendix B). This block is thereby left open for use of non-Latin alphabets, such as the Katakana symbols in Japan.

A.4 SUBSET OF 63 CHARACTERS

The use of devices such as typewriter keyboards connected directly to computers or tape units, and optical character reading of typewritten data, makes desirable a subset of the card code which is compatible with these devices.

The great majority of typewriter keyboards have a space bar and 44 character keys. The Shift doubles the capacity so that there are 88 graphics plus space, or a total of 89 characters provided by such devices. Most automatic data processing systems (ADP) currently use only a single case of letters. Thus, deducting the 26 lower case letters, current typewriter keyboards can provide to ADP systems 63 characters (89 less 26). Since the USASCII was designed to yield a dense subset of 64 widely used graphics in columns 2, 3, 4 and 5, this subset was considered as the basis for the standard Hollerith card code subset. In order to accommodate the 63-character restriction of the common typewriter devices, it was necessary that the Hollerith card code subset not include one graphic of the USASCII subset. The Reverse Slant, code table position 5/12, is the least commonly used, and therefore can be omitted with minimum loss of the subset's usefullness.

15. *[handwritten note, illegible]*

To accommodate the requirements of 8-bit systems for 256 hole-patterns, a chart of 256 positions follows, in which the 128 hole-patterns and character assignments of the chart in Section 2 of this standard are embedded, leaving 128 additional hole-patterns unassigned.

| Zone → / Digit ↓	(none)	12	11	12-11	0	12-0	11-0	12-11-0	9	12-9	11-9	12-11-9	0-9	12-0-9	11-0-9
	SP	&	-		0	{	}		9	I	R	r	Z	i	z
1	1	A	J	j	/	a				SOH	DC1				
2	2	B	K	k	S	b	s		SYN	STX	DC2				
3	3	C	L	l	T	c	t			ETX	DC3				
4	4	D	M	m	U	d	u								
5	5	E	N	n	V	e	v			HT			LF		
6	6	F	O	o	W	f	w				BS		ETB		
7	7	G	P	p	X	g	x		EOT	DEL			ESC		
8	8	H	Q	q	Y	h	y				CAN				
8-1		~	`		¦		-				EM	DLE		NUL	
8-2	:	[	]		\										
8-3	#	"	$		,					VT					
8-4	@	<	*		%				DC4	FF	FS				
8-5	'	(	)		_				NAK	CR	GS		ENQ		
8-6	=	+	;		>					SO	RS		ACK		
8-7	"	!	^		?				SUB	SI	US		BEL		

APPENDIX B. – EBCDIC CARD CODE

The following chart showing the relationship of the Standard Hollerith Punched Card Code to EBCDIC is provided for reference:

Column headers — **Bit Positions 0,1** (groups of 4): 00 | 01 | 10 | 11
Bit Positions 2,3: 00, 01, 10, 11 (repeated under each group)
First Hexadecimal Digit: 0 … F (see table header row)

Bit 4,5,6,7	2nd Hex	Digit Punch	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	Digit Punch
0000	0	8-1	NUL [1]	DLE [2]	[3]	[4]	SP [5]	& [6]	- [7]	[8]					{ [9]	} [10]	\ [11]	0 [12]	8-1
0001	1	1	SOH	DC1		[13]			/		a	j	~		A	J	[14]	1	1
0010	2	2	STX	DC2		SYN					b	k	s		B	K	S	2	2
0011	3	3	ETX	DC3							c	l	t		C	L	T	3	3
0100	4	4									d	m	u		D	M	U	4	4
0101	5	5	HT		LF						e	n	v		E	N	V	5	5
0110	6	6			BS	ETB					f	o	w		F	O	W	6	6
0111	7	7	DEL		ESC	EOT					g	p	x		G	P	X	7	7
1000	8	8		CAN							h	q	y		H	Q	Y	8	8
1001	9	8-1		EM							i	r	z		I	R	Z	9	9
1010	A	8-2			[	]			- [15]	:									8-2
1011	B	8-3	VT				.	$	,	#									8-3
1100	C	8-4	FF	FS		DC4	<	*	%	@									8-4
1101	D	8-5	CR	GS	ENQ	NAK	(	)	—	'									8-5
1110	E	8-6	SO	RS	ACK		+	;	>	=									8-6
1111	F	8-7	SI	US	BEL	SUB	!	^	?	"									8-7

(Top and bottom bands of the chart show the **Zone Punches** — the 9, 12, 11 and 0 punch rows — at top of table for the left blocks and at bottom for the right blocks; the left and right outer columns show the **Digit Punches**.)

Card Hole Patterns

① 12-0-9-8-1	⑤ No Punches	⑨ 12-0	⑬ 0-1
② 12-11-9-8-1	⑥ 12	⑩ 11-0	⑭ 11-0-9-1
③ 11-0-9-8-1	⑦ 11	⑪ 0-8-2	⑮ 12-11
④ 12-11-0-9-8-1	⑧ 12-11-0	⑫ 0	

Card Hole Patterns

In the 16 x 16 Table, the heavy lines partition the table into four blocks as follows:

1	3
2	4
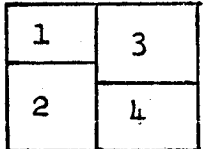
Block 1: Zone punches at top, digit punches at left, of table.
Block 2: Zone punches at bottom, digit punches at left, of table.
Block 3: Zone punches at top, digit punches at right, of table.
Block 4: Zone punches at bottom, digit punches at right, of table.

APPENDIX C - RELATED STANDARDS

C. 1   Proposed Revised USA Standard Code for Information Interchange:
X3.2/411, July 15, 1966

C. 2   USA Standard Specification for General Purpose Paper Cards for
Information Processing: X3.11-1966, March 7, 1966

C. 3   Proposed USA Standard Specification for Rectangular Holes in
Twelve-Row Punched Cards: X3.2/410, July 15, 1966

APPENDIX D - VOCABULARY

D1. Bit Representation

A bit-representation is a group of bits in a binary code used to represent a single character of the coded character set.

D2. Card Code

A card code is a set of hole-patterns (representing a character set) defined by a set of rules.

D3. Card Column

A card column is a single line of punching positions parallel to the short edge of the card.

D4. Card Field

A card field is a group of card column(s) used for a unit of information.

D5. Card Row

A card row is a single line of punching positions parallel to the long edge of the card.

D6. Character

In this standard, a character consists of both the hole-pattern, and the assigned meaning (alphabetic, numeric, special, control).

D7. Digit Punch

A digit punch is a punch in rows 1, 2, ... 9 of a card.

D8. Graphic

A graphic is a written or printed form or shape; for example

3	A	e	%	,

D9. Hole-Pattern

A hole-pattern is a group of punching positions within a card column used to represent a single character of a coded character set.

D10. Mechanical Sorting

Mechanical sorting is in general the process by which cards are grouped by recognition of one hole only in a card column, rather than by recognition of the entire hole-pattern in that column.

D11. Numeric Punch

A numeric punch is a punch in rows 1, 2, 3, 4, 5, 6, 7, 8, or 9 of a card.
A punch in row 0 or row 9, when occurring alone in a card column is a
numeric punch.

D12. Representation

A representation is a set of patterns by which the assigned meanings of the
characters of a code are recorded on a medium; for example, hole-patterns
on a punched card.

D13. Translation

A translation is a process by which the representation of data is changed
from one form to another; for example, a translation from hole-patterns to
bit-representations.

D14. Zone Punch

A zone punch is a punch in rows 12, 11 or 0 of a card. A punch in row 9,
when occurring in a single card column in combination with another punch,
is also a zone punch.

EXPOSITORY REMARKS

ON THE

PROPOSED USA STANDARD

HOLLERITH PUNCHED CARD CODE

CONTENTS

SECTION I

SUBCOMMITTEE REPORT

The X3.2 Subcommittee was assigned the responsibility for developing recommendations for: (1) a standard coded character set and recording formats for the general interchange of information among information processing systems, communications systems and associated equipment, and (2) the representation of the standard coded character set in the principal media (punched tape, magnetic tape and punched card) of general information interchange.

The standard code character set achieved the status of an USA Standard (Document X3.4-1963) on June 17, 1963. At the present time, there are three X3.2 task groups actively developing proposals for the representation of the USA Standard Code for Information Interchange (USASCII) in the three principle media. These are X3.2.1, Magnetic Tape; X3.2.2, Punched Paper Tape, and X3.2.3, Punched Card.

Task Group X3.2.3 held its first meeting on December 12, 1961. Subsequent to the formation of this Task Group, the development of standards for punched cards was transferred to the Joint Working Group on Punched Card, drawing together members from X3.2.3, X4-A4, and EIA TR 27.6.1, the first meeting was held on May 15, 1962. After a period of Joint Working Group activity, the responsibility for the development of a proposed American Standard for punched cards was reassigned to X3.2.3, the first meeting of the reactivated Task Group was held on March 6, 1963.

The initial effort of X3.2.3 was directed towards the representation of USASCII in punched card. The existing punched card codes were reviewed as well as several alternate representations which included (1) binary representation of USASCII and (2) a decimal ASCII representation. These representations are described in Section II on Code Development.

The decision to proceed with a Hollerith punched card code representation of the USASCII character set was made after the decimal - ASCII was rejected by X3. The Hollerith representation was selected because it provides (1) maximum compatibility with the punched card codes in widespread use today and (2) the most convenient punched card interface between Hollerith data processing systems and USASCII.

A separate Standard describes the physical requirements for the Twelve-Row punched cards to be used with this punched card code.

SECTION II

CODE DEVELOPMENT

1. DIRECT BINARY

In the direct binary representation the bits of the USASCII were placed in the corresponding numbered rows of the card, i.e., b_1 of USASCII in row 1, b_2 in row 2, etc. The "check" or "Parity" bit included for error control would be placed in row 8. The bit for expansion to a 256 character code set would be placed in row 0.

The primary considerations which guided this arrangement were:

1) It requires minimum, if any, hardware translation to and from other media using the USASCII code.

2) This placement leaves the top of the card free for printing. Applications exist which require the top area of the card to be without a concentration of punched holes.

3) The arrangement of the bits in card rows 1-7 with parity in row 8 conform to 1 inch, eight track paper tape coding.

A strong disadvantage of this arrangement is the serious weakening of the punched card due to a large increase in the number of holes and the lacing caused by always having rows 5 and 6 punched for numeric data.

The punched card is unique as an input/output medium for data processing systems. Paper tape and magnetic tape are continuous media which are normally only handled by trained operators. The punched card, however, is an individual unit record and is physically handled by many types of people, both trained operators and the general public. After human handling, the card is placed in feeding mechanisms where it must be fed from a deck of cards, aligned, rapidly accelerated past reading stations and/or punching stations and finally stacked in a selected pocket all without reading or punching errors and without jamming along the card transport. To achieve the required reliability over the humidity range of 10% to 80% requires that the card be physically as strong as possible. To insure maximum reliability of card handling and to minimize the wear of the punch and die units, the card should have as few holes placed in it as possible for the data to be recorded.

A second approach to Direct Binary representation was also considered in order to minimize the disadvantage above. This method was inverting the 5 and 6 bits to zero when bit 7 was a zero. Some relief is obtained, but overall the problems caused by the increase of punched holes remain.

2. DECIMAL ASCII REPRESENTATION

Another punched card code representation for USASCII which was considered is the Decimal-ASCII representation which is shown in Figure 1.

In this code the numerals are represented by a single punch in a column of the card. To accomplish this, no zone punches in the card were associated with column 3 of the USASCII Code Table (the column which contains the numerals). The numerals in Decimal-ASCII are represented in the punched card in the same manner that the numerals are represented in the Hollerith representation.

The upper case alphabetic data which is the next most significant data to be placed in punched cards is represented by a single zone punch in combination with one or two digit punches. The lower case alphabet is obtained by placing a second zone and the one or two digit punches used to represent the corresponding upper case alphabetic characters.

A primary consideration which guided the arrangement of the Decimal-ASCII punched card code was the objective to achieve minimal translation between the representation of USASCII in punched cards and its representation in other media. Decimal-ASCII requires less translation than the Hollerith representation and more translation than the Direct Binary.

The more simple translation of Decimal-ASCII to USASCII was not found sufficient to warrant its adoption. In this representation, the letters and special symbols were assigned different hole-patterns than in existing punched card systems. Only the numerals and, by coincidence, a few letters and symbols, retained their current representation. The cost and dislocation of converting existing punched card files and equipment, and data codes and procedures based on them, were considered to outweigh the logical translation advantage of Decimal-ASCII

FIGURE 1

Decimal ASCII Twelve-Row Punched Card Code Table

PUNCH POSITIONS

			COL 0	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7
Zone Area		12 11 0	12	12 11			12		12	
				11 0		0		11	11	11
									0	0
USASCII	Bits	b_7	0	0	0	0	1	1	1	1
		b_6	0	0	1	1	0	0	1	1
		b_5	0	1	0	1	0	1	0	1

Digit Area 1 2 3 4 5 6 7 8 9	b_4	b_3	b_2	b_1	ROW	0	1	2	3	4	5	6	7
	0	0	0	0	0			*	*				
1	0	0	0	1	1								
2	0	0	1	0	2								
3	0	0	1	1	3								
4	0	1	0	0	4								
5	0	1	0	1	5								
6	0	1	1	0	6								
7	0	1	1	1	7								
8	1	0	0	0	8								
9	1	0	0	1	9								
2 8	1	0	1	0	10								
3 8	1	0	1	1	11								
4 8	1	1	0	0	12								
5 8	1	1	0	1	13								
6 8	1	1	1	0	14								
7 8	1	1	1	1	15								

The characters contained in the USASCII Code Table are placed here.

*Exceptions:

USASCII Code		Card Code	Graphic
2/0	0100000	No Punch	Space
3/0	0110000	0	0 (Zero)

Note 1: The row, column and bit notations shown correspond to the row, column and bit notation of the USASCII Code Table.

Note 2: The zone and digit punch positions identify the individual rows in the 12-row punched card.

3. HOLLERITH REPRESENTATION

The Hollerith punched card code was not developed in its entirety at one time, but rather it has been developed in conjunction with the system and application requirements placed on it. In the beginning, the code consisted merely of twelve individual punches which represented the ten numeric digits and provided for two control signals. Recently the punched card code had grown to represent as many as 256 characters. A summary of the development of the Twelve-Row punched card code from the representation of ten numerics to the 128 characters of USASCII follows:

1. SPACE (BLANK)

    The absence of any data in a given column of the card is called a "blank" or "blank column." The blank is used to provide separation between data fields and to space printers and punches one position without printing or punching. In addition, a field containing no data is left blank. It is always possible, therefore, to add data to a blank field during a later operation. The fact that the punched card is typically a formatted record with pre-determined locations for recording data makes it possible and desirable to use the blank column as a separator between alphabetic words, as well as to reflect the absence of data in an entire field.

2. NUMERALS

    The first phase in the development of the Hollerith punched card code was the placement of the ten numeric digits in ten separate rows of the cards. Two additional rows were assigned for control functions. Even today, punched cards containing Hollerith codes are frequently referred to as "twelve-row" punched cards, based on the original design of the card for twelve individual rows of data. The use of an individual punch for each numeric digit facilitated the development of equipment to physically sort and collate the cards as well as an aid in the sight verification of numeric fields. In addition, the use of individual rows for numeric digits has permitted the development of mark-sensed cards and manual single hole punching using the same size card.

3. LETTERS

    A. Upper Case

    In order to store alphabetic data for names and addresses, descriptions of parts, mixed alpha-numeric fields, etc., it was necessary to develop a coding system to represent the 26 upper case alphabetics. This was accomplished by placing two punches in a given column of the card, a numeric digit punch and a zone punch. The pattern selected is:

> 12 zone plus 1-9 digit for alphabetics A-I
> 11 zone plus 1-9 digit for alphabetics J-R
> 0 zone plus 2-9 digit for alphabetics S-Z

This representation in the punched card for the alphabetic characters has been traditionally referred to as the "Hollerith Representation." The Hollerith method of representing alphabetic characters by zone punches over digits makes it very easy and economical to adapt numeric sorting machines to the sorting of Hollerith alphabetic characters.

B.   Lower Case

In recent years, there has been an increasing interest in equipment and systems capable of handling business correspondence as well as business records. Business correspondence requires the use of both upper and lower case alphabetic characters. The USASCII code includes both cases of the alphabet. The addition to the Hollerith punched card code to accommodate the lower case alphabet was accomplished by adding a second zone punch to the codes already used for the upper case alphabet as shown below:

> 12-0 zones plus 1-9 digit for alphabetics a-i
> 12-11 zones plus 1-9 digit for alphabetics j-r
> 11-0 zones plus 2-9 digit for alphabetics s-z

4.   SPECIAL SYMBOLS

A.   In the printing of normal accounting records, invoices, checks, etc., it was necessary to provide a selected number of special graphic symbols. The ones initially selected and the code assignments given them are:

Card Code	Graphic	Card Code	Graphic
12	&	12-8-3	.
11	-	12-8-4	⌷
0-1	/	11-8-3	$
8-3	#	11-8-4	*
8-4	@	0-8-3	,
		0-8-4	%

The above 11 special symbols, the 26 alphabetics, the 10 numerics and Space comprise the initial 48 character set of the Hollerith punched card code. Eventually, the punched card was applied to scientific computing applications. The scientific users wanted some different graphic symbols than were previously provided for accounting applications. Initially, those graphics were provided by substituting them for several of the eleven shown above. The most common pairing or dualing was:

Card Code	Basic Graphic	Scientific Graphic
12	&	+
8-3	#	=
8-4	@	'
12-8-4	⋈	)
0-8-4	%	(

Numerous other variations were also developed. The Hollerith punched card code no longer had a unique graphic associated with ease hole-pattern.

With the development of USASCII and data processing systems capable of handling 7 and 8-bit codes, it was desirable and feasible to separate the duals shown above. The graphics shown under the scientific graphic option were assigned new card codes as follows:

Card Code	Graphic
8-5	'
8-6	=
12-8-5	(
12-8-6	+
11-8-5	)

B. Additional Special Symbols. In USASCII there are a number of additional special symbols and national usage graphics included beyond the special symbols described above. The card codes assigned to these graphics use the remaining 8-digit combinations. These are:

Card Code	Graphic	Card Code	Graphic
12-8-7	!	11-8-1	`
11-8-7	^	12-0	{
12-8-2	[	0-8-1	|
0-8-2	\	11-0	}
11-8-2	]	12-8-1	~
0-8-5	—		

5. CONTROL CHARACTERS

The operation of communications systems and equipment requires the use of a number of special control characters. USASCII has made provision for 32 unique control characters. To accommodate these controls in the Hollerith representation, it was determined that the use of the 9-punch as an additional zone control would be used. This is similar to the method used with the 8-punch in combination with other digit punches to obtain additional special symbols. The codes selected are shown in columns 0 and 1 of the chart. (Also see Appendix A)

SECTION III

INTERNATIONAL CONSIDERATIONS

At the March 1967 meeting of ISO/TC97/SC2, three countries (France, Nether-
lands, U.S.A.) submitted proposals or working papers embodying a 128-
character Hollerith card code. In these three documents, there was exact
agreement on 120 of the 128 characters. ISO/TC97/SC2 voted to issue a
Hollerith card code document for study and comment of member countries.

The Hollerith card code in the ISO document is in exact agreement with the
Hollerith card code of the present pUSAS for 124 of the 128 characters. It
is felt that resolution of the four remaining differences will be achieved.

Interim considerations by various national standards bodies will address
themselves to the disposition of substitutions currently practiced in
countries requiring alphabetic extenders. These involved the characters
£ , $, and @.

SECTION IV

CONCLUSIONS

The preponderance of punched card equipment in use today employs Hollerith coding. The preponderance of data processing punched card applications today are based on Hollerith card equipment; viz., manual card punching and verifying, manual single hole-punching, sorting, collating, mark conversion, interpreting, report or document preparation, summarizing, calculating, paper tape conversion, card-to-card transmission, statistical counting-editing, card readers and punches as input/output for computers, data collection.

Most manufacturers have made the same assignments of hole-patterns to graphics for numeric, alphabetic, and some special characters. There are variations in different manufacturer's equipment in the assignment of card codes to many of the special characters. See the chart "Some Hollerith Related Card Codes in Use Today," that follows. These variations have developed because there has been no official Hollerith standard in the past.

This standard for the Hollerith representation of USASCII characters will provide a blueprint for the industry so that punched card equipment with a common Hollerith code can be produced and the interchange of cards between these equipments will be easily and economically accomplished. The establishment of this standard fulfills an objective of the X3.2.3 Task Group to develop a punched card code standard which would serve the best interests of users, manufacturers and general interest groups. The Hollerith representation has the advantage of providing the link between the many Hollerith card applications which have developed over the years and the information interchange environment of USASCII in the future.

In its future program of work, the Subcommittee will address the representation of USASCII in unit documents.

ASCII Code Table Position (Column/Row)	ASCII Symbol and Meaning	Burroughs Common Language	CDC 3200	GE 225	GE 425/435	H 200	H 400	IBM 024 026	IBM 407	IBM 407 A H Set	IBM 1403 A Set	IBM 1403 H Set	IBM 1410	IBM BCD Set	IBM BCD A H Set	IBM 1443 63 ch. Set	IBM 1650	IBM 1443 N1	NCR 315	RCA 301	UNIVAC 1004	UNIVAC 1050	Consensus (No. Companies)	ZZ	ASCII Symbol
2/1	! Exclamation Point	070				E50	E58				078		E0	E0		E0		E28	76	E0	E0	E0			!
2/2	" Quotation Marks				068	E50				078		078	078				78	58				T78	38 (6)		"
2/3	# Number or Pound	38	38	38	38	E28	E28	38	38	38	38	38	38	38	38	38	30	38	38	38	38	E38 (8)		#
2/4	$ Dollar	E38	E38	E38	E38	E38	E38	E38	E38	E38	E38	E38	E38	E38	E38	E38	E38	E38	E38	E39	E38	E38 (8)		$
2/5	% Percent	048	048	048	048	T58	T58	048	048	048	048	048	048	048	048	048	049	048	048	048	058	048 (6)		%
2/6	& Ampersand	T	T	T	T	78	78	T	T	T	T	T	T	T	T	T	T	T	T	T	28	T (5)		&
2/7	' Apostrophe	T58		E78	E78	28	28		48			48	58	58		50	E78	79	43				'
2/8	(Left Paren.	T58	048	T58	T58	048	048		048	048	048	048	048	048	048	048	T58	345	058	043	E38 (8)		(
2/9	) Right Paren.	E58	T48	E58	E58	T48	T48		T48	T48	T48	T48	T48		E58	078	T09	69	078	T40	048 (6)		)
2/10	* Asterisk	E48	E48	E48	E48	E48	E48	E48	E48	E48	E48	E48	E48	E48	E48	E48	T68	E48	E48	E48	E48 (8)		*
2/11	+ Plus	T0	T	T0	T0	T	T	T	T	T	T	T	T	T60	T68	T	E0	T	T	T	039 (8)		+
2/12	, Comma	038	038	038	038	038	038	038	038	038	038	038	038	038	038	038	038	038	038	038		,
2/13	- Minus or Hyphen	E	E	E	E	E0	E	E	E	E	E	E	E	E	E	E	T68	E	E	E	E	E		-
2/14	. Period	T38	T38	T38	T38	T38	T38	T39	T39	T38	T38	T38	T38	T38	T38	T38	T38	T38	T38	T38	T38 (8)		.
2/15	/ Slash	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01 (8)		/
3/10	: Colon	58		58	58	48	48				58	58	58	28	58	53	58	58 (5)		:
3/11	; Semicolon	E68		E68	T28	T28	E68	E68	E68	E63	E60	E60	E63	E60	E68 (4)		;
3/12	< Less Than	T68		T68	T68	T48	T68	T68	T68	T68	T68	T68	T68	T68 (4)		<
3/13	= Equal	058	38	058	058	38	38	48	38	058	38	38	38	058	T78	058	38	38 (4)		=
3/14	> Greater Than	68		68	68	68	68	68	68	68	T0	68	68	68 (4)		>
3/15	? Question Mark	28		T0	T0	T0	T0	T0	T0	127	078	T0	T0 (4)		?
4/0	@ At				028								039	058	068			@
5/11	[Left Bracket	T48	058		T58 T58	T58 T58	T18	E58	T58	T58		[
5/12	\ Reverse Slash				068 068	068 068	T59	068	063		\
5/13	] Right Bracket	068	068	28	E58 E58	E58 E58	18	078	E58	E58		]
5/14	^ Circumflex						028		^
5/15	` Grave						018		`
6/0	@ At	48	40	40	40	48	48	48	48	48	48	48	48	48	43	40	40	48 (6)		@
7/11	{ Left Brace						E0			{
7/12		Vertical Line			T78			T70					
7/13	} Right Brace						T0		}
7/14	¬ Logical Not						E78		¬
TOTAL	32	22	10	12	22	18	17	10	11	12	13	20	19	10	31	25	18	24	24	15		

NOTE:
(1) Only those codes relating to ASCII Symbols are shown.
(2) Column 17 reflects the proposal in document X3.2.3/75, January 18, 1964.
(3) For brevity, T stands for 12 and E stands for 11.

FIGURE 1   SOME HOLLERITH RELATED CARD CODES IN USE TODAY

Excerpted from document X3.2.3/69/Nov. 10, 1964

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       posal of 2 Dec 66, by Mr. R. Brown.

132.   Document X3.2.3/158, December 1, 1966. Proposed Compromise
       Between ASCII, EBCDIC, and PL/I, by Mr. E. H. Clamons.

133.   Document X3.2.3/159, December 12, 1966. pAS Hollerith Card
       Code (X3.2.3/144, revised).

134.   Document X3.2.3/191, April 3, 1967, Proposed USAS Hollerith Punched
       Card Code.