Check Digit Algorithms

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Section 1 - Check Digit Algorithm Description for Subscriber IDs

Use the following algorithms to verify the check digit for Medi-Cal subscriber IDs.

Transactions sent through the Medi-Cal Point of Service (POS) network contain a Beneficiary Identification (BID), Medi-Cal Eligibility Determination System (MEDS) ID, Client Index Number (CIN) or Benefits Identification Card (BIC) ID. Internal to the transaction generation software, the subscriber ID check digit calculations detailed below can be used to verify the accuracy of an ID that includes the check digit (the 15-character BID, 14-character BIC or 10-character MEDS and CIN IDs). The BIC, CIN and MEDS ID use the same check digit algorithm.

The following table shows the check digit calculations for Medi-Cal subscriber IDs:

Table Offset	0	1	2	3	4	5	6	7	8	9
CIN, MEDS ID, BIC ID	0	9	8	7	6	5	4	3	2	1
BID	0	2	4	6	8	1	3	5	7	9

The check digit is calculated by adding the sum of all odd-positioned digits (alpha characters are converted to zero) to the sum of the table entry values corresponding to all even-positioned digits, then dividing the total by 10. The check digit is the remainder. Refer to the following examples.

2.1 MEDS ID Check Digit Example

ID = 123456789

Perform a numeric check on each of the characters, and convert any non-numeric characters to zero.

<u>Odd</u>-positioned digits = 25 (sum of odd-positioned digits)
(1 + 3 + 5 + 7 + 9)

<u>Even</u>-positioned digits (used as column numbers)
2, 4, 6, 8

Corresponding values from table
(8 + 6 + 4 + 2) = 20 (sum of even-positioned values)

$45 \div 10 = 4$ with a remainder of 5

5 is the check digit

The MEDS ID with the check digit = 123456789**5**

2.1 CIN Check Digit Example

ID = 92432149X

Perform a numeric check on each of the characters, and convert any non-numeric characters to zero.

Odd-positioned digits = 19 (sum of odd-positioned digits)
(9 + 4 + 2 + 4 + 0)

Even-positioned digits (used as column numbers)
2, 3, 1, 9

Corresponding values from table
(8 + 7 + 9 + 1) = 25 (sum of even-positioned values)

44 ÷ 10 = 4 with a remainder of 4

4 is the check digit

The CIN with the check digit = 92432149X**4**

2.1 HAP ID Check Digit Example

ID = 92432149Y

Perform a numeric check on each of the characters, and convert any non-numeric characters to zero.

Odd-positioned digits = 19 (sum of odd-positioned digits)
(9 + 4 + 2 + 4 + 0)

Even-positioned digits (used as column numbers)
2, 3, 1, 9

Corresponding values from table
(8 + 7 + 9 + 1) = 25 (sum of even-positioned values)

44 ÷ 10 = 4 with a remainder of 4

4 is the check digit

The HAP ID with the check digit = 92432149Y**4**

2.1 BID Check Digit Example

BID = 12345678901234

Odd-positioned digits (1 + 3 + 5 + 7 + 9 + 1 + 3)	=	29 (sum of odd-positioned digits)

Even-positioned digits (used a column numbers)
2, 4, 6, 8, 0, 2, 4

Corresponding values from table (4 + 8 + 3 + 7 + 0 + 4 + 8)	=	34 (sum of even-positioned values)
		63 ÷ 10 = 6 with a remainder of 3
		3 is the check digit

The BID with the check digit = 12345678901234**3**

2.1 BIC ID Check Digit Example

BIC = 92432149X44001

The first nine characters of the BIC ID are the CIN. Perform a numeric check on each CIN and convert any non-numeric characters to zero. Next, apply the CIN check digit algorithm to the converted first nine characters.

Odd-positioned digits (9 + 4 + 2 + 4 + 0)	=	19 (sum of odd-positioned digits)

Even-positioned digits (used as column numbers)
2, 3, 1, 9

Corresponding values from table (8 + 7 + 9 + 1)	=	25 (sum of even-positioned values)
		44 ÷ 10 = 4 with a remainder of 4
		4 is the check digit

After calculating the check digit, validate that the character in the eleventh position is numeric (0 through 9) and the twelfth through fourteenth characters are in the range 001 through 366.

The BIC ID with the check digit = 92432149X**4**4001

Section 2 - LUHN Formula (Mod 10) Check Digit Algorithm

The LUHN formula is an industry standard algorithm currently used by several large organizations to validate account numbers. As in the previous examples, the check digit is a digit added to a number that validates the accuracy and validity of the number. Generally, the check digit is the last digit in the validated number. Currently, the Attachment Control Number (ACN) is validated using the LUHN check digit algorithm.

Use the following steps to validate a number using the LUHN formula.

Step 1: Starting with the next-to-last digit and moving left, double the value of every other digit. The calculation starts with the next-to-last digit because the last digit is the check digit.

- When selecting every other digit, always work right-to-left and do not start with the rightmost digit (since that is the check digit).
- The last digit (check digit) is considered #1 (odd number) and the next-to-last digit is #2 (even number). You will only double the values of the even-numbered digits.

Step 2: Add all unaffected digits to the values obtained in Step 1.

- If any of the values resulting from Step 1 are double-digits, do not add the double-digit value to the total, but rather add the two digits, and add this sum to the total.

Result: The total obtained in Step 2 must be a number ending in zero (exactly divisible by 10) for the number to be valid.

2.1 Attachment Control Number (ACN) Check Digit Example

ID = 49927398716

The ACN consists of 11 numeric digits, with the last being the check digit.

Step 1:

4	9	9	2	7	3	9	8	7	1	6
	x 2		x 2		x 2		x 2		x 2	
	18		**4**		**6**		**16**		**2**	

Step 2:

4 + (1+8) + 9 + (4) + 7 + (6) + 9 + (1+6) + 7 + (2) + 6

Result: Sum = 70: The number is valid.

Note: The number is valid because 70 divided by 10 yields no remainder (70 mod 10 = 0).

Section 3 - Check Digit Algorithm Description for National Provider Identifier (NPI)

The National Provider Identifier check digit is calculated using the Luhn formula for computing the modulus 10 “double-add-double” check digit. This algorithm is recognized as an ISO standard and is the specified check digit algorithm to be used for the card issuer identifier on a standard health identification card. When an NPI is used as a card issuer identifier on a standard health identification card, it is preceded by the prefix 80840, in which 80 indicates health applications and 840 indicates the United States. The prefix is required only when the NPI is used as a card issuer identifier. However, in order that any NPI could be used as a card issuer identifier on a standard health identification card, the check digit will always be calculated as if the prefix is present. This is accomplished by adding the constant 24 in step 2 of the check digit calculation (as shown in the second example below) when the NPI is used without the prefix.

Section 4 - LUHN Formula for Modulus 10 “double-add-double” Check Digit

The Luhn check digit formula is calculated as follows:

1. Double the value of alternate digits beginning with the rightmost digit.
2. Add the individual digits of the products resulting from step 1 to the unaffected digits from the original number.
3. Subtract the total obtained in step 2 from the next higher number ending in zero. This is the check digit. If the total obtained in step 2 is a number ending in zero, the check digit is zero.

Section 5 - Example of Check Digit Calculation for NPI used as Card Issuer Identifier

Assume the 9-position identifier part of the NPI is 123456789. If used as a card issuer identifier on a standard health identification card the full number would be 80840123456789. Using the Luhn formula on the identifier portion, the check digit is calculated as follows:

Card issuer identifier without check digit:
8 0 8 4 0 1 2 3 4 5 6 7 8 9

Step 1:

Double the value of alternate digits, beginning with the rightmost digit:
0 8 2 6 10 14 18

Step 2:

Add the individual digits of products of doubling, plus unaffected digits.
8 + 0 + 8 + 8 + 0 + 2 + 2 + 6 + 4 + 1 + 0 + 6 + 1 + 4 + 8 + 1 + 8 = 67

Step 3:

Subtract from next higher number ending in zero.
70 – 67 = 3
Check digit = 3

Result: Card issuer identifier with check digit = **808401234567893**

Section 6 - Example of Check Digit Calculation for NPI used without Prefix

Assume the 9-position identifier part of the NPI is 123456789. Using the Luhn formula on the identifier portion, the check digit is calculated as follows:

NPI without check digit:
1 2 3 4 5 6 7 8 9

Step 1:

Double the value of alternate digits, beginning with the rightmost digit.
2 6 10 14 18

Step 2:

Add constant 24, to account for the 80840 prefix that would be present on a card issuer identifier, plus the individual digits of products of doubling, plus unaffected digits.
24 + 2 + 2 + 6 + 4 + 1 + 0 + 6 + 1 + 4 + 8 + 1 + 8 = 67

Step 3:

Subtract from next higher number ending in zero.
70 – 67 = 3
Check digit = 3

Result: NPI with check digit = **1234567893**