

Storage
Subsystem
Library

GX26-1678-4

**IBM 3380
Direct Access
Storage:
Reference
Summary**



Fifth Edition (October 1987)

This edition makes obsolete, GX26-1678-3.

This reference summary is based on information in the *IBM 3380 Direct Access Storage Introduction*, GC26-4491, and *IBM 3380 Direct Access Storage Direct Channel Attach Model CJ2 Introduction and Reference*, GC26-4497.

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Space Calculation Formulas

The number of equal-length physical records that can be stored on a track can be determined as follows:

$$\text{Equal-length records per track} = \frac{1499}{C + K + D} \quad (\text{with fractional remainder dropped})$$

1499 is the number of 32-byte cells per track available for physical records. (Without the IBM standard R0 record, track capacity is 1515 32-byte cells.)

C is the number of 32-byte cells used for gaps and for the count area. C always equals 15.

K is the number of 32-byte cells used for the key area and for the gap between the key area and the data area. K = 0 if there is no key area. If there is a key area, then:

$$K = G + \frac{\text{key length} + E}{32} \quad (\text{rounded to the next higher integer})$$

where G = Gap before key field = 7
E = ECC bytes = 12

D is the number of 32-byte cells used for the data area.

$$D = \frac{\text{data length} + E}{32} \quad (\text{rounded to the next higher integer})$$

where E = ECC bytes = 12
and Inter-record gaps for "data length" are included in C = 15

For unequal length physical records, the length for a record can be determined as follows:

$$\text{Record length} = C + K + D$$

where C, K, and D are defined as in the above formula for equal-length records.

IBM Direct Access Storage Device Comparisons

Note: ms (milliseconds) equals 10⁻³ seconds, Mb equals 10⁶ bytes and Gb

	3350	3375	3380 A04 AA4 B04
PERFORMANCE CHARACTERISTICS			
Single cylinder seek time (ms)	10	4	3
Average seek time (ms)	25	19	16
Maximum seek time (ms)	50	38	30
Full track rotation (ms)	16.7	20.2	16.6
Average rotational delay (ms)	8.3	10.1	8.3
Data transfer rate (Mb/sec)	1.198	1.859	3.0

MAXIMUM CAPACITY SPECIFICATIONS			
Bytes per track	19 069	35 616	47 476
Bytes per cylinder	572 070	427 392	712 140
Mb per device	317.5	409.8	630
Mb per HDA	317.5	819.7	1 260
Mb per Unit	635	819.7	2 520
Gb per 4-unit string	2.54	3.27	10.08
Mb per fixed head unit	2.28	-	-

PHYSICAL CHARACTERISTICS			
Head and disk assemblies per unit	2	1	2
Devices (volumes) per head and disk assembly	1	2	2
Data read/write heads per device (volume)	30	12	15
Servo heads per device (volume)	1	1	1
Data cylinders per device	555	959	885
Alternate cylinders per device	5	1	1
Service cylinders per device	1	1	1
Tracks per cylinder	30	12	15
Data tracks per device	6 650	11 508	13 275
Alternate tracks per device	150	12	15
Ratio of devices (volumes) to approximate equivalent capacity	6.0	4.5	3.0

¹ Assumes string composed of J-units only.

² Assumes string composed of K-units only.

Seek time, or access motion time: The time required to move the access arm from one cylinder to another. More precisely defined, the seek time is the time interval beginning when the channel issues a Seek command (requiring access motion) and ending when the 3380 responds with a Seek Complete indication to the storage control.

Average seek time: The seek time is obtained by moving the access arm from each individual cylinder to every other individual cylinder and then taking the average move time for all combinations.

IBM Direct Access Storage Device Comparisons

Note: ms (milliseconds) equals 10⁻³ seconds, Mb equals 10⁶ bytes and Gb equals 10⁹ bytes. Capacity figures assume use of standard R0.

PERFORMANCE CHARACTERISTICS	3350	3375	3380 A04 AA4 B04	3380 A04 B04	3380 AE4 BE4	3380 CJ2	3380 AJ4 BJ4	3380 AK4 BK4
Single cylinder seek time (ms)	10	4	3	3	3	2	2	2
Average seek time (ms)	25	19	16	15	17	12	12	16
Maximum seek time (ms)	50	38	30	28	31	21	21	29
Full track rotation (ms)	16.7	20.2	16.6	16.6	16.6	16.6	16.6	16.6
Average rotational delay (ms)	8.3	10.1	8.3	8.3	8.3	8.3	8.3	8.3
Data transfer rate (Mb/sec)	1.198	1.859	3.0	3.0	3.0	3.0	3.0	3.0

MAXIMUM CAPACITY SPECIFICATIONS

Bytes per track	19 069	35 616	47 476	47 476	47 476	47 476	47 476	47 476
Bytes per cylinder	572 070	427 392	712 140	712 140	712 140	712 140	712 140	712 140
Mb per device	317.5	489.8	630	630	1 260	630	630	1 890
Mb per HDA	317.5	819.7	1 260	1 260	2 520	1 260	1 260	3 780
Mb per Unit	635	819.7	2 520	2 520	5 041	1 260	2 520	7 562
Gb per 4-unit string	2.54	3.27	10.08	10.08	20.16	8.82 ¹	10.08 ¹	30.24 ²
Mb per fixed head unit	2.28	-	-	-	-	-	-	-

PHYSICAL CHARACTERISTICS

Head and disk assemblies per unit	2	1	2	2	2	1	2	2
Devices (volumes) per head and disk assembly	1	2	2	2	2	2	2	2
Data read/write heads per device (volume)	30	12	15	15	15	15	15	15
Servo heads per device (volume)	1	1	1	1	1	1	1	1
Data cylinders per device	555	959	885	885	1 770	885	885	2 655
Alternate cylinders per device	5	1	1	1	1	1	1	1
Service cylinders per device	1	1	1	1	1	1	1	1
Tracks per cylinder	30	12	15	15	15	15	15	15
Data tracks per device	6 650	11 508	13 275	13 275	26 550	13 275	13 275	39 825
Alternate tracks per device	150	12	15	15	15	15	15	15
Ratio of devices (volumes) to approximate equivalent capacity	6.0	4.5	3.0	3.0	1.5	3.0	3.0	1.0

¹ Assumes string composed of J-units only.

² Assumes string composed of K-units only.

Seek time, or access motion time: The time required to move the access arm from one cylinder to another. More precisely defined, the seek time is the time interval beginning when the channel issues a Seek command (requiring access motion) and ending when the 3380 responds with a Seek Complete indication to the storage control.

Average seek time: The seek time is obtained by moving the access arm from each individual cylinder to every other individual cylinder and then taking the average move time for all combinations.

Average rotational delay: The average time required for the disk to rotate, to position the desired data record under the read/write head so data transfer can begin. This is sometimes called *average latency*. Average rotational delay is one half of the time for a full track rotation.

Data transfer rate: The rate at which data is transferred between the 3380 and a storage control.

**Storage Subsystem Library:**

IBM 3380 Direct Access Storage Introduction	GC26-4491
IBM 3380 Direct Access Storage Direct Channel Attach Model CJ2 Introduction and Reference	GC26-4497
Using the IBM 3380 Direct Access Storage in an MVS Environment	GC26-4492
Using the IBM 3380 Direct Access Storage in a VM Environment	GC26-4493
Using the IBM 3380 Direct Access Storage in a VSE Environment	GC26-4494
Maintaining IBM Storage Subsystem Media	GC26-4495
IBM 3390 Storage Control Introduction	GA32-0098
IBM 3390 Storage Control Planning, Installation, and Storage Administration Guide	GA32-0100
IBM 3390 Storage Control Reference	GA32-0099

Space Calculation Tables

Use the following tables to determine the number of equal-length physical records of a specific size that can fit on a track or cylinder. Find the length range that includes the specific record size in the column at the left. Read across to find:

- The percentage of space utilized with the maximum record size in the range
- The number of equal-length records of the specific size that can fit on a track or cylinder
- The number of bytes of user data on the track or cylinder when the maximum record size in that range is used

Table 1 shows calculated data for records without keys.

Example: Three hundred 4000-byte physical records (that might consist of 80-byte records blocked 50:1) are to be moved to a 3380 volume. Table 1 shows that 10 records (in the range 3861 - 4276) can fit on a track and 150 on a cylinder.

For data set allocation:

$$\begin{array}{r} \text{Number of} \\ \text{cylinders} \end{array} = \frac{300 \text{ (total number of records)}}{150 \text{ (number of records/cylinder)}} = 2$$

The amount of user data per track is equal to:

$$\begin{array}{r} 4000 \text{ (physical record size)} \\ \times 10 \text{ (number of records/track)} \\ \hline \end{array}$$

40 000 bytes per track

The amount of user data per cylinder is equal to:

$$\begin{array}{r} 40\,000 \text{ (bytes of user data/track)} \\ \times 15 \text{ (number of tracks/cylinder)} \\ \hline \end{array}$$

600 000 bytes per cylinder

Tables 2 and 3 show calculated data for records with keys. Use Table 2 for key lengths from 1 to 20 and Table 3 for key lengths from 21 to 52. For key lengths greater than 52, see additional tables in *IBM 3380 Direct Access Storage Introduction*, GC26-4491. **Example:** A partitioned data (PDS) directory is to be moved to a 3380 volume. The directory is to contain 6000 records, each of which has an 8-byte key field and a 256-byte data area. Table 2 shows that 46 records (in the range 245 - 276) can fit on a track, 690 on a cylinder.

For directory allocation:

$$\begin{array}{r} \text{Number of} \\ \text{cylinders} \end{array} = \frac{6000 \text{ (total number of records)}}{690 \text{ (number of records/cylinder)}} = 8 + = 9$$

The amount of directory data per track is equal to:

$$\begin{array}{r} 256 \text{ (physical record size)} \\ \times 46 \text{ (number of records/track)} \\ \hline \end{array}$$

11 776 bytes per track

The amount of directory data per cylinder is equal to:

$$\begin{array}{r} 11\,776 \text{ (bytes of directory data/track)} \\ \times 15 \text{ (number of tracks/cylinder)} \\ \hline \end{array}$$

176 640 bytes per cylinder

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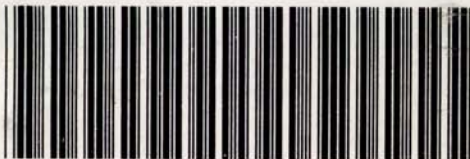


Table 1

Equal-Length Physical Records Without Keys

Data Length Range		Percent Space Used *	Maximum Track Capacity *		Maximum Cylinder Capacity *	
Min	Max		Records	Bytes	Records	Bytes
23 477	47 476	100.0	1	47 476	15	712 140
15 477	23 476	98.9	2	46 952	30	704 280
11 477	15 476	97.7	3	46 428	45	696 420
9 077	11 476	96.6	4	45 904	60	688 560
7 477	9 076	95.5	5	45 380	75	680 700
6 357	7 476	94.4	6	44 856	90	672 840
5 493	6 356	93.7	7	44 492	105	667 380
4 821	5 492	92.5	8	43 936	120	659 040
4 277	4 820	91.3	9	43 380	135	650 700
3 861	4 276	90.0	10	42 760	150	641 400
3 477	3 860	89.4	11	42 460	165	636 900
3 189	3 476	87.8	12	41 712	180	625 680
2 933	3 188	87.2	13	41 444	195	621 660
2 677	2 932	86.4	14	41 048	210	615 720
2 485	2 676	84.5	15	40 140	225	602 100
2 325	2 484	83.7	16	39 744	240	596 160
2 165	2 324	83.2	17	39 508	255	592 620
2 005	2 164	82.0	18	38 952	270	584 280
1 877	2 004	80.2	19	38 076	285	571 140
1 781	1 876	79.0	20	37 520	300	562 800
1 685	1 780	78.7	21	37 380	315	560 700
1 589	1 684	78.0	22	37 048	330	555 720
1 493	1 588	76.9	23	36 524	345	547 860
1 397	1 492	75.4	24	35 808	360	537 120
1 333	1 396	73.5	25	34 900	375	523 500
1 269	1 332	72.9	26	34 632	390	519 480
1 205	1 268	72.1	27	34 236	405	513 540
1 141	1 204	71.0	28	33 712	420	505 680
1 077	1 140	69.6	29	33 060	435	495 900
1 045	1 076	67.9	30	32 280	450	484 200
981	1 044	68.1	31	32 364	465	485 460
949	980	66.0	32	31 360	480	470 400
917	948	65.8	33	31 284	495	469 260
853	916	65.6	34	31 144	510	467 160
821	852	62.8	35	29 820	525	447 300
789	820	62.1	36	29 520	540	442 800
757	788	61.4	37	29 156	555	437 340
725	756	60.5	38	28 728	570	430 920
693	724	59.4	39	28 236	585	423 540
661	692	58.3	40	27 680	600	415 200
629	660	57.0	41	27 060	615	405 900
597	628	55.5	42	26 376	630	395 640
565	596	55.2	44	26 224	660	393 360
533	564	53.4	45	25 380	675	380 700
501	532	51.5	46	24 472	690	367 080
469	500	50.5	48	24 000	720	360 000
437	468	48.3	49	22 932	735	343 980
405	436	46.8	51	22 236	765	333 540
373	404	45.1	53	21 412	795	321 180
341	372	43.1	55	20 460	825	306 900
309	340	40.8	57	19 380	855	290 700
277	308	38.2	59	18 172	885	272 580
245	276	36.0	62	17 112	930	256 680
213	244	33.4	65	15 860	975	237 900
181	212	30.3	68	14 416	1 020	216 240
149	180	26.9	71	12 780	1 065	191 700
117	148	23.0	74	10 952	1 110	164 280
85	116	19.0	78	9 048	1 170	135 720
53	84	14.6	83	6 972	1 245	104 580
21	52	9.6	88	4 576	1 320	68 640
1	20	3.9	93	1 860	1 395	27 900

* Calculations are made using maximum size record in range.

Table 2

Equal-Length Physical Records With Key Length 1 to 20 Bytes

Data Length Range		Percent Space Used *	Maximum Track Capacity *		Maximum Cylinder Capacity *	
Min	Max		Records	Bytes	Records	Bytes
23 221	47 220	99.5	1	47 220	15	708 300
15 221	23 220	97.8	2	46 440	30	696 600
11 221	15 220	96.2	3	45 660	45	684 900
8 821	11 220	94.5	4	44 880	60	673 200
7 221	8 820	92.9	5	44 100	75	661 500
6 101	7 220	91.3	6	43 320	90	649 800
5 237	6 100	89.9	7	42 700	105	640 500
4 565	5 236	88.2	8	41 888	120	628 320
4 021	4 564	86.5	9	41 076	135	616 140
3 605	4 020	84.7	10	40 200	150	603 800
3 221	3 604	83.5	11	39 644	165	594 660
2 933	3 220	81.4	12	38 640	180	579 600
2 677	2 932	80.3	13	38 116	195	571 740
2 421	2 676	78.9	14	37 464	210	561 960
2 229	2 420	76.5	15	36 300	225	544 500
2 069	2 228	75.1	16	35 648	240	534 720
1 909	2 068	74.1	17	35 156	255	527 340
1 749	1 908	72.3	18	34 344	270	515 160
1 621	1 748	70.0	19	33 212	285	498 180
1 525	1 620	68.3	20	32 400	300	486 000
1 429	1 524	67.4	21	32 004	315	480 060
1 333	1 428	66.2	22	31 416	330	471 240
1 237	1 332	64.5	23	30 636	345	459 540
1 141	1 236	62.5	24	29 664	360	444 960
1 077	1 140	60.0	25	28 500	375	427 500
1 013	1 076	58.9	26	27 976	390	419 640
949	1 012	57.6	27	27 324	405	409 860
885	948	55.9	28	26 544	420	398 160
821	884	54.0	29	25 636	435	384 540
789	820	51.8	30	24 600	450	369 000
725	788	51.5	31	24 428	465	366 420
693	724	48.8	32	23 168	480	347 520
661	692	48.1	33	22 836	495	342 540
597	660	47.3	34	22 440	510	336 600
565	596	43.9	35	20 860	525	312 900
533	564	42.8	36	20 304	540	304 560
501	532	41.5	37	19 684	555	295 260
469	500	40.0	38	19 000	570	285 000
437	468	38.4	39	18 252	585	273 780
405	436	36.7	40	17 440	600	261 600
373	404	34.9	41	16 564	615	248 460
341	372	32.9	42	15 624	630	234 360
309	340	31.5	44	14 960	660	224 400
277	308	29.2	45	13 860	675	207 900
245	276	26.7	46	12 696	690	190 440
213	244	24.7	48	11 712	720	175 680
181	212	21.9	49	10 388	735	155 820
149	180	19.3	51	9 180	765	137 700
117	148	16.5	53	7 844	795	117 660
85	116	13.4	55	6 380	825	95 700
53	84	10.1	57	4 788	855	71 820
21	52	6.5	59	3 068	885	46 020
1	20	2.6	62	1 240	930	18 600

* Calculations are made using maximum size record in range.

Table 2

**Equal-Length Physical Records
With Key Length 1 to 20 Bytes**

Data Length Range		Percent Space Used *	Maximum Track Capacity *		Maximum Cylinder Capacity *	
Min	Max		Records	Bytes	Records	Bytes
23 221	47 220	99.5	1	47 220	15	708 300
15 221	23 220	97.8	2	46 440	30	696 600
11 221	15 220	96.2	3	45 660	45	684 900
8 821	11 220	94.5	4	44 880	60	673 200
7 221	8 820	92.9	5	44 100	75	661 500
6 101	7 220	91.3	6	43 320	90	649 800
5 237	6 100	89.9	7	42 700	105	640 500
4 565	5 236	88.2	8	41 888	120	628 320
4 021	4 564	86.5	9	41 076	135	616 140
3 605	4 020	84.7	10	40 290	150	603 000
3 221	3 604	83.5	11	39 644	165	594 660
2 933	3 220	81.4	12	38 640	180	579 600
2 677	2 932	80.3	13	38 116	195	571 740
2 421	2 676	78.9	14	37 464	210	561 960
2 229	2 420	76.5	15	36 300	225	544 500
2 069	2 228	75.1	16	35 648	240	534 720
1 909	2 068	74.1	17	35 156	255	527 340
1 749	1 908	72.3	18	34 344	270	515 160
1 621	1 748	70.0	19	33 212	285	498 180
1 525	1 620	68.3	20	32 400	300	486 000
1 429	1 524	67.4	21	32 004	315	480 060
1 333	1 428	66.2	22	31 416	330	471 240
1 237	1 332	64.5	23	30 636	345	459 540
1 141	1 236	62.5	24	29 664	360	444 960
1 077	1 140	60.0	25	28 500	375	427 500
1 013	1 076	58.9	26	27 976	390	419 640
949	1 012	57.6	27	27 324	405	409 860
885	948	55.9	28	26 544	420	398 160
821	884	54.0	29	25 636	435	384 540
789	820	51.8	30	24 600	450	369 000
725	788	51.5	31	24 428	465	366 420
693	724	48.8	32	23 168	480	347 520
661	692	48.1	33	22 836	495	342 540
597	660	47.3	34	22 440	510	336 600
565	596	43.9	35	20 860	525	312 900
533	564	42.8	36	20 304	540	304 560
501	532	41.5	37	19 684	555	295 260
469	500	40.0	38	19 000	570	285 000
437	468	38.4	39	18 252	585	273 780
405	436	36.7	40	17 440	600	261 600
373	404	34.9	41	16 564	615	248 460
341	372	32.9	42	15 624	630	234 360
309	340	31.5	44	14 960	660	224 400
277	308	29.2	45	13 860	675	207 900
245	276	26.7	46	12 696	690	190 440
213	244	24.7	48	11 712	720	175 680
181	212	21.9	49	10 388	735	155 820
149	180	19.3	51	9 180	765	137 700
117	148	16.5	53	7 844	795	117 660
85	116	13.4	55	6 380	825	95 700
53	84	10.1	57	4 788	855	71 820
21	52	6.5	59	3 068	885	46 020
1	20	2.6	62	1 240	930	18 600

* Calculations are made using maximum size record in range.

Table 3

**Equal-Length Physical Records
With Key Length 21 to 52 Bytes**

Data Length Range		Percent Space Used *	Maximum Track Capacity *		Maximum Cylinder Capacity *	
Min	Max		Records	Bytes	Records	Bytes
23 189	47 188	99.4	1	47 188	15	707 820
15 189	23 188	97.7	2	46 376	30	695 640
11 189	15 188	96.0	3	45 564	45	683 460
8 789	11 188	94.3	4	44 752	60	671 280
7 189	8 788	92.6	5	43 940	75	659 100
6 069	7 188	90.8	6	43 128	90	646 920
5 205	6 068	89.5	7	42 476	105	637 140
4 533	5 204	87.7	8	41 632	120	624 480
3 989	4 532	85.9	9	40 788	135	611 820
3 573	3 988	84.0	10	39 880	150	598 200
3 189	3 572	82.8	11	39 292	165	589 380
2 901	3 188	80.6	12	38 256	180	573 840
2 645	2 900	79.4	13	37 700	195	565 500
2 389	2 644	78.0	14	37 016	210	555 240
2 197	2 388	75.4	15	35 820	225	537 300
2 037	2 196	74.0	16	35 136	240	527 040
1 877	2 036	72.9	17	34 612	255	519 180
1 717	1 876	71.1	18	33 768	270	506 520
1 589	1 716	68.7	19	32 604	285	489 060
1 493	1 588	66.9	20	31 760	300	476 400
1 397	1 492	66.0	21	31 332	315	469 980
1 301	1 396	64.7	22	30 712	330	460 680
1 205	1 300	63.0	23	29 900	345	448 500
1 109	1 204	60.9	24	28 896	360	433 440
1 045	1 108	58.4	25	27 700	375	415 500
981	1 044	57.2	26	27 144	390	407 160
917	980	55.7	27	26 460	405	396 900
853	916	54.0	28	25 648	420	384 720
789	852	52.0	29	24 708	435	370 620
757	788	49.8	30	23 640	450	354 600
693	756	49.4	31	23 436	465	351 540
661	692	46.6	32	22 144	480	332 160
629	660	45.9	33	21 780	495	326 700
565	628	45.0	34	21 352	510	320 280
533	564	41.6	35	19 740	525	296 100
501	532	40.3	36	19 152	540	287 280
469	500	39.0	37	18 500	555	277 500
437	468	37.5	38	17 784	570	266 760
405	436	35.8	39	17 004	585	255 060
373	404	34.0	40	16 160	600	242 400
341	372	32.1	41	15 252	615	228 780
309	340	30.1	42	14 280	630	214 200
277	308	28.5	44	13 552	660	203 280
245	276	26.2	45	12 420	675	186 300
213	244	23.6	46	11 224	690	168 360
181	212	21.4	48	10 176	720	152 640
149	180	18.6	49	8 820	735	132 300
117	148	15.9	51	7 548	765	113 220
85	116	13.0	53	6 148	795	92 220
53	84	9.7	55	4 620	825	69 300
21	52	6.2	57	2 964	855	44 460
1	20	2.5	59	1 180	885	17 700

* Calculations are made using maximum size record in range.