

IEEE Recommended Practices for Broadband Local Area Networks

Sponsor

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Abstract: IEEE 802.7-1989, IEEE Recommended Practices for Broadband Local Area Networks (LANs) specifies the design, installation, and test parameters for a broadband cable medium. The medium supports the communication of IEEE 802.3b, IEEE 802.4, video, and narrow-band radio frequency (RF) modem devices. The broadband bus topology consists of amplifiers, coaxial cable, and directional couplers that create a full duplex directional medium. Inbound signals flow from user outlet transmitters to a central headend location. The headend processes the signals and then transmits the signals via an outbound path to all the user outlets. The medium utilizes frequency division multiplexing (FDM), which supports the simultaneous coexistence of services. Each service is assigned a unique inbound and outbound channel frequency.

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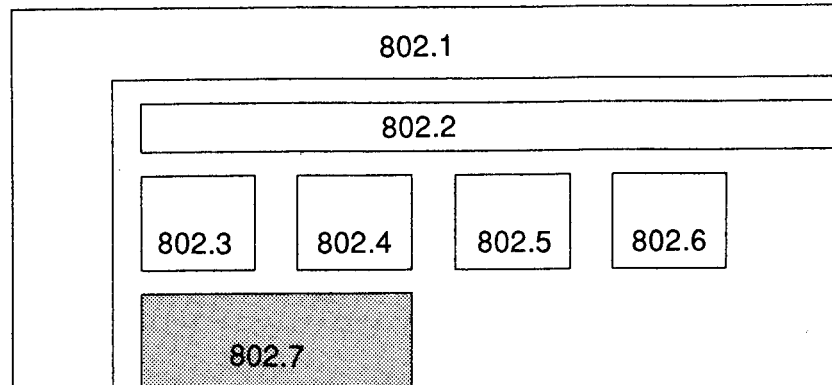
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Foreword

(This Foreword is not a part of IEEE Std 802.7-1989, IEEE Recommended Practices for Broadband Local Area Networks.)

This recommended practices document is part of a family of standards for Local Area Networks (LANs). The relationship between this recommended practices document and other members of the IEEE 802 family is illustrated and described below.



Note—The numbers refer to IEEE standards.

P802.1 P802.1 describes the relationship among 802 standards and their relationship to the ISO Open Systems Interconnection Reference Model. This document will contain network management and interconnection standards.¹

802.2 IEEE Std 802.2-1989 (ISO 8802-2), logical link control protocol.

802.3 ANSI/IEEE Std 802.3-1988 (ISO 8802-3), a bus utilizing CSMA/CD as the access method.

802.4 ANSI/IEEE Std 802.4-1985 (ISO 8802-4), a bus utilizing token passing as the access method.²

802.5 IEEE Std 802.5-1989 (ISO 8802-5), a ring utilizing token passing as the access method.

802.7 IEEE Std 802.7-1989, This document provides information pertaining to establishing and maintaining a broadband cable medium. The purpose for the medium is to transport communications of IEEE 802.3b and 802.4 broadband services.

The following participants were members in the Recommended Practices effort of the IEEE Project 802.7 Working Group. Those names followed by an asterisk(*) were voting members at the time of approval of Revision 8 of this document:

¹Project currently under development.

²Publication of this standard's revision, IEEE Std 802.4-1990 (ISO 8802-4), is anticipated in the Spring of 1990.

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IEEE Recommended Practices for Broadband Local Area Networks

1. Introduction

1.1 Scope

This document specifies the physical, electrical, and mechanical characteristics of a properly designed IEEE 802.7 broadband cable medium. The characteristics described herein are intended as the minimum acceptable parameters for the design, installation, and test of an IEEE 802.7 cable plant. Single and dual cable systems are specified for the support of existing IEEE 802.3b[1]³ and 802.4[2] broadband devices.

NOTE—IEEE 802.7 specifications may not be appropriate for cable plants that do not support IEEE 802.3b and 802.4 devices. These recommended practices are inappropriate for cable TV (CATV) systems, MATV systems, and wide area broadband networks.

1.2 Assumptions

IEEE 802.7 specifies the media performance necessary to support IEEE 802.3b, IEEE 802.4, video, and narrow-band services.

NOTE—The words *shall* or *must* indicate a requirement of IEEE 802.7. The words *should* or *may* indicate a recommendation of IEEE 802.7.

1.3 Document organization

This document is organized into the following sections:

Introduction: The introduction section describes the organization, presentation, and content of the document.

Medium Specifications: The medium specifications section establishes the minimum performance required to support the simultaneous operation of IEEE 802.3b and 802.4 services. The specifications will allow the coexistence of video and narrow-band modems on the same network.

Medium Utilization: This section establishes proper spectrum planning and channel allocation practices for the broadband medium.

Documentation: This section addresses documentation requirements of the broadband cable system.

Installation Guidelines: The installation guidelines section provides information related to construction and safety guidelines for a broadband cable plant.

³The numbers in brackets correspond to those of the references listed in 1.6; when preceded by B, they correspond to those of the Bibliography (Appendix C).

Testing: The test section specifies the processes necessary to validate and certify the cable plant.

Maintenance: The maintenance section provides guidance in establishing the controls and practices necessary to maintain a broadband medium.

Appendixes: The appendix sections contain reference material related to the broadband cable medium.

1.4 Definitions

The following terms are used synonymously in this document:

CABLE SYSTEM TERMINOLOGY

Cable Plant
Coaxial Cable System
Broadband Cable System
Broadband Coaxial Cable System
Broadband Medium
Physical Medium
Medium

Terms that are critical in developing an understanding of this document are defined below.

NOTE—Terms other than those found here are defined in the Glossary (Appendix D). Abbreviations and acronyms can be found in Appendix A.

1.4.1 directional coupler (tap): A passive device used in cable systems to divide and combine RF signals. It has at least three ports: line in and line out ports with a loss referred to as the *insertion loss*. A small portion of the signal power applied to the line in port passes to the tap port. A signal applied to the tap port is passed to the line in port less the tap attenuation value. The tap signals are isolated from the line out port to prevent reflections. A signal applied to the line out port passes to the line in port and is isolated from the tap port. Some devices provide more than one tap port (multi-taps).

1.4.2 headend: The physical location where the inbound and outbound paths are accessible. The headend is also called the central retransmission facility.

1.4.3 headend port(s): An interface where connection(s) may be made to insert signals or remove signals from the cable plant. The headend ports are usually referred to with a direction (inbound or outbound). Headend ports provide central access to the cable system.

1.4.4 inbound: The direction of RF signal flow towards the headend location from the user outlet ports.

1.4.5 outbound: The direction of RF signal flow away from the headend and towards the user outlet ports.

1.4.6 user outlet port(s): A connection port, located at a user location, which provides user access to the cable system.

1.5 Medium overview

The medium consists of coaxial cable, amplifiers, directional couplers, and passive devices that establish characteristics through which radio frequency (RF) signals may be transmitted and received. The medium has two types of locations where signals enter and leave the medium. These are the headend and user locations. The ports at the headend and user outlet locations provide points of attachment for devices such as Medium Attachment Units (MAUs) and headend equipment.

The connector most commonly found at the user outlet port as well as on RF modems is an F-type connector. While this connector has become a defacto standard for CATV outlets, improvements are still evolving for broadband Local Area Networks (LANs). Furthermore, in dual cable broadband LANs, variations in the normal “F” design have been used to distinguish between the transmit and receive ports. It is essential in dual cable systems to permanently cue the user, so that the transmit and receive ports are not confused.

Broadband systems use directional couplers to route signals in a desired direction. This directional aspect establishes signal paths and attenuates undesired reflections. The directional aspect establishes a signal flow that is different from the signal flow associated with the baseband bus technology. The broadband bus has two directions of travel, called *paths*.

The topology of the broadband network is a branched directional bus that is termed a *tree*. The tree topology depicts a multiple bus hierarchy that contains a central location (headend) and multiple node locations (outlets). Signals flow in two separate paths to establish two-way communication. To establish communication, the signals are directed to one central location (headend) that is capable of receiving transmissions from any port. The path that carries transmissions from any node to the headend is referred to as the *inbound path*. The headend processes the signals if required and then transmits the signals into the *outbound path*.

The outbound path distributes signals to all user outlet ports on the system, while the inbound path collects signals from all the user outlet ports. Throughout the evolution of broadband technology, several terms have evolved to represent the directional concept. In this document the terms inbound and outbound path will be used to describe the flow of RF signals. Terms such as the following have also been used to describe signal direction:

PATH TERMINOLOGY	
<u>INBOUND</u>	<u>OUTBOUND</u>
Uplink	Downlink
Reverse	Forward
Transmit	Receive
Upstream	Downstream
Return	

A broadband coaxial cable system serves as a wide bandwidth communications medium that is capable of transporting independent and simultaneous applications including data, video, voice, security, and energy management. Simultaneous operation of different services is accomplished by using different channels for each application. The signals of each service are designated to reside in a defined area of spectrum called a channel. Channels identify the frequency band through which devices establish a unique physical connection.

1.5.1 Path loss

Path loss is defined as signal attenuation between the user outlets and the headend. The path attenuation is specified for the inbound and outbound paths for all frequencies within the “system bandwidth.” Inbound “path loss” is the signal attenuation from any user outlet to the headend inbound port(s). Outbound “path loss” is the signal attenuation between any headend outbound port(s) and any user outlet port.

1.5.2 Loop loss

Loop loss is the signal level difference (attenuation) between the transmit and receive frequencies at the user outlet ports. The loop loss specification identifies the cable plant attenuation for dual cable systems, or the device (service) transmitter to receiver signal level difference on single or dual cable systems.

1.5.3 Frequency division multiplexing (FDM)

FDM is the technique of assigning different services to different channels. FDM is used on both single and dual cable systems. Multiple services are capable of coexisting on a cable plant when services are assigned to different channel frequencies. Services operate independently, provided the signal energy stays within the designated operating channel.

Data communication equipment connected to a broadband cable system usually requires a two-way communication path. On a dual cable system, a single designated channel may be used on the inbound and outbound cable to establish a full loop path between the devices. The assigned channel is different for every service and is, therefore, frequency division multiplexed.

In a single cable system, inbound and outbound transmissions must be carried on different channels of the same cable. The outbound signals are usually assigned to the higher channels, and the inbound transmissions are assigned to the lower channels. A two-way communication path for a single cable system requires two channel selections for a service. One channel is assigned for the inbound path, and another channel is assigned for the outbound path. The assignment of two channels is therefore required to designate the requirements for frequency division multiplexed services on a single cable system.

1.6 Referenced standards

These recommended practices have utilized existing standards and codes to establish consistency within related disciplines. The most current approved revision of each should be used as the accurate source of information. The standards and codes are as follows:

[1] ANSI/IEEE Std 802.3–1988 (ISO 8802-3 : 1989), Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications, and ANSI/IEEE Std 802.3b, c, d, e (1989 Edition), Supplements (with particular reference to Supplement b: Type 10BROAD36).⁴

[2] ANSI/IEEE Std 802.4–1985 (ISO 8802-4), Token-Passing Bus Access Method and Physical Layer Specifications.

[3] EIA-IS6 (1983), Recommended Cable TV Channel Identification Plan.⁵

[4] IEC Publication 716 (1981), Expression of the Properties of Signal Generators.⁶

[5] *NCTA Recommended Practices for Measurements on Cable Television Systems*. National Cable Television Association, Washington, DC, 2nd Edition, 1990.⁷

[6] NCTA/SCTE. *Graphic Symbols for Cable Television Systems*. National Cable Television Association. Washington, DC, August 1985.

⁴ANSI/IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, Piscataway, NJ 08855-1331, or from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.

⁵EIA publications are available from the Electronic Industries Association, Standard Sales Department, 2001 Eye St., NW, Washington, DC 20006.

⁶IEC publications are available in the U.S. from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.

⁷NCTA publications are available from the Industry Communications Department, National Cable Television Association, 1724 Massachusetts Ave., NW, Washington, DC 20036.

[7] United States FCC Rules and Regulations, Vol. II, Part 15: Radio Frequency Devices; Part 76: Cable TV Service Rules, Subpart K, Sections 76.601–76.619; Part 78: Cable TV Service Relay Rules.⁸

[8] United States FCC Second Report & Order in Docket 21006, October 1, 1984, and modified in June 1985.

1.6.1 Connectors

F-type connector standards have been considered by the EIA-550 Committee for use on local area networks. An FD-type connector has been developed for use on local area network devices employing F-type connectors. To date, IEEE 802.7 has not established a position relative to the use of FD-type connectors.

2. Medium specifications

This section provides the recommended design and operational specifications for a broadband coaxial cable system, the primary purpose of which is the support of IEEE 802 standards for local area networks.

It is not the intention of these recommendations to preclude the transmission of other services, and indeed the specifications have been designed with compatibility and coexistence issues in mind. In particular, the possibility that broadband LANs may be required to support significant numbers of video channels has been considered, and specific recommendations concerning such signals are given.

2.1 Purpose

These recommended practices may be used by the system purchaser as the basis for a purchase specification, by the system designer as the minimum set of design goals, and by testing and maintenance personnel to ensure adherence to the original requirements. The total anticipated system requirements (including future expansions) should be considered when defining the original system requirements. This ensures that future expansions will meet the specifications of the standard.

It will be noted that unless otherwise stated, all specifications apply to the performance exhibited at user outlet port(s). By choosing this interface as a reference, a clear relationship is established between the specifications of the coaxial cable system and the characteristics of the attached devices. Furthermore, the internal operating characteristics of the cable plant may be chosen as to take advantage of particular architectures or types of hardware which may be more applicable in some installations than in others.

2.2 Frequency range

Most data communication equipment connected to a broadband coaxial cable system requires the use of channels in the inbound and outbound signal paths, to establish two-way communication. The frequency range of the cable system is defined to be the usable range(s) from the lowest to highest system frequencies. See Section 3 for further details of frequency offsets and allocations.

The bandwidth of the medium may vary from one coaxial cable system to another. It is recommended that the minimum bandwidth shown in Table 1 be certified for use.

⁸ US Government publications are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

2.3 Path loss and loop loss

2.3.1 Single cable inbound

The total inbound path loss, measured between any user outlet port and the input of any headend remodulating/translating/amplifying device, shall be 44 dB, with a permissible uncertainty due to all factors of ± 5 dB.

Table 1—Minimum system bandwidth

	Inbound (MHz)	Outband (MHz)
Dual cable:	54-400	54-400
Single cable, mid-split:	10-108	174-400
Single cable, high-split:	10-174	234-400

NOTE—IEEE 802.3b extends the dual cable inbound/outbound lower band-edge frequency to 36 MHz.

2.3.2 Single cable outbound

The total outbound path, measured between the output of any headend remodulating/translating/amplifying device and any user outlet port, shall be 44 dB, with a permissible uncertainty due to all factors of ± 5 dB.

2.3.3 Looped dual cable system

The total loop loss between any transmit and receive user outlet ports shall be 44 dB, with a permissible uncertainty due to all factors of ± 10 dB.

2.4 Transmit signal levels

The nominal Carrier Wave (CW) signal within 6 MHz used for the purposes of design or certification shall be +54 dBmV when injected into any user outlet port or transmitted from any headend device. In no case shall the CW signal level exceed +56 dBmV.

2.4.1 Derating formula

When more than one carrier is contained in a 6 MHz channel, each carrier shall be adjusted in amplitude according to the following equation:

$$C = +54 - 10 \log_{10} N$$

where

- N the number of carriers contained in a 6 MHz channel
- C the signal level for each carrier in dBmV

2.5 Carrier-to-noise ratio (CNR)

For the purpose of carrier-to-noise specifications, a 4 MHz noise bandwidth shall be used.

2.5.1 Single cable inbound CNR

The carrier-to-noise ratio of a CW signal injected into any inbound user outlet port at a +54 dBmV level shall be no less than 41 dB measured at any headend translator/remodulator input port.

2.5.2 Single cable outbound CNR

The carrier-to-noise ratio of a CW signal at +54 dBmV that originates at any headend outbound port, and is unaffected by the accumulation of inbound noise, shall have no less than a 43 dB CNR at any user outlet port.

2.5.3 Dual cable CNR

The carrier-to-noise ratio of a CW signal injected at any transmit user outlet port at +54 dBmV shall be no less than 40 dB measured at any receive user outlet port.

2.6 Intermodulation distortion

All intermodulation distortion specifications apply when the fundamental carriers are placed into the system at a nominally rated signal level of +54 dBmV. Along with the fundamental carriers, an additional CW signal shall be injected into the system near the frequency of the discrete intermodulation distortion product to be measured. All carrier-to-distortion specifications are to be referenced to this “nearby” carrier.

In a single cable system, the distortion specifications apply to the individual inbound and outbound paths. In a dual cable system, the specifications apply to the total system, including the contributions of the inbound and outbound paths.

2.6.1 Second order distortion

The carrier-to-discrete second order distortion ratio shall be greater than or equal to 60 dB.

2.6.2 Third order distortion

The carrier-to-discrete third order intermodulation distortion ratio shall be greater than or equal to 78 dB.

2.7 Channel frequency response

Frequency response describes the amplitude vs. frequency characteristic within a specified channel bandwidth, due to the broadband coaxial cable system only. Peak-to-valley response is defined to be the maximum minus the minimum response level within the channel bandwidth. In a single cable system, it is measured from any user outlet port to the input of any headend remodulating/translating/amplifying device, and from the output of any headend remodulating/translating/amplifying device to any user outlet port. In a dual cable system, the response is measured from any transmit user outlet port to any receive user outlet port. The channel frequency response is specified in Table 2.

The instantaneous rate of change of amplitude with respect to frequency across the specified channel bandwidth shall not exceed 0.33 dB per any 1 MHz for dual cable loop, or 0.17 dB per 1 MHz for single cable paths.

2.8 Incidental modulation (Hum)

This specification describes the amplitude modulation of a CW signal, principally at frequencies corresponding to that of the power supply and harmonics thereof. It is specified in terms of the percentage of peak-to-average level of the amplitude modulation with respect to the average level of the desired CW signal. The maximum permissible value is 2%.

Table 2—Channel response table

Specified channel bandwidth (MHz)	Permissible amplitude variation (peak-to-valley) (dB)	
	Path (single)	Loop (dual)
6	1	2
12	1.5	3
18	2	4

2.9 Characteristic impedance

The nominal impedance of the broadband coaxial cable system shall be 75 Ω .

2.10 Outlet return loss

The return loss of the system user outlet ports shall be greater than or equal to 16 dB within the specified bandwidth.

2.11 Outlet isolation

The minimum isolation between any two user outlet ports measured at any frequency within the system bandwidth (see Table 1) shall be 25 dB.

2.12 Cable system signal leakage

The permissible amount of cable plant leakage shall not exceed the current recommendations for CATV leakage specified in Table 3.

2.13 Environmental

All specifications shall be maintained over the operating environment range of the medium.

2.14 Terminations

All unused ports of components of the broadband coaxial cable system, including couplers, taps, splitters, and user outlet ports, shall be terminated with terminating resistors to minimize internal signal reflections and noise ingress/egress.

2.15 Drop cables

Cable routing and tap location shall permit servicing access. All drop cables shall be constructed of multiple braid/foil shielding to minimize noise ingress and signal leakage from the system.

Table 3—Cable system signal leakage

Frequency	Leakage level	Measurement distance	
	$\mu\text{V/m}$	ft	m
Less than or equal to 54 MHz	15	100	30
From 54 to 216 MHz	20	10	3
Greater than 216 MHz	15	100	30

NOTE—Where more stringent regulatory constraints apply, they shall take precedence. (Also, refer to FCC Rules and Regulations, Parts 15, 76, and 78 [7] and FCC Docket 21006 [8].)

3. Medium utilization

3.1 Spectrum management

This section provides recommendations for resource management of a broadband communications system. The allocation of cable spectrum requires a frequency plan. The frequency plan allocates portions of the spectrum for use. The spectral planning process may require that areas of the spectrum remain vacant, either for future use or to avoid conflict with sensitive regulated frequencies.

Section 3 presents issues related to the operation of a broadband cable medium. The recommended practices for the activation, monitoring, and diagnosis of the medium are located at the end of Section 3. (Refer to 3.6.)

3.1.1 Usable spectrum

The frequency spectrum of a broadband medium should be utilized in a logical and consistent manner to achieve the maximum potential from the system. A portion of the spectrum must be reserved for pilot frequencies, monitoring channels, and other cable plant support systems. The remaining spectrum is usable for system services.

3.1.2 Spectrum allocation

Broadband systems may support multiple applications, including two-way video (VSB-AM) signals, point-to-point and point-to-multipoint transmissions, and networking (multiple access) services. In recognition of the fact that this Technical Advisory Group (TAG) was formed under the aegis of the IEEE 802 Standards Project, particular emphasis has been placed upon the spectral allocation related to IEEE 802.3b and 802.4 broadband services.

3.2 Organization of the spectrum

3.2.1 Channel conventions

Broadband cable systems evolved from CATV cable technology. It is expected that CATV technology and equipment will continue to influence the planning and design of broadband networks. It is for these reasons that standard CATV channel designators are used for spectrum allocation planning.

3.2.2 The CATV frequency plan

The current NCTA 6 MHz video channel definitions are the result of evolution within the CATV industry. The EIA-IS6 [3] channel plan (Channels 1 through 100) evolved and changed to exploit the majority of the current technology in use today (550 MHz). This evolution has led to the addition of channel capacity and the exploitation of the mid-VHF band (Channels A-2 to I), and superband (Channels J to W). Recently the hyperband channels AA to ZZ and frequencies beyond 456 MHz have been allocated. The channel conventions that are relevant to current broadband technology are illustrated in Tables 4-6.

Table 4—Standard CATV channel assignments

	Standard channel mnemonic	EIA-IS6 [3] channel mnemonic	Lower channel boundary (MHz)	Upper channel boundary (MHz)	Picture carrier frequency (MHz)	Color carrier frequency (MHz)	Audio carrier frequency (MHz)
S	T-7		5.75	11.75	7.00	10.58	11.50
U	T-8		11.75	17.75	13.00	16.58	17.50
B	T-9		17.75	23.75	19.00	22.58	23.50
	T-10		23.75	29.75	25.00	28.58	29.50
V	T-11		29.75	35.75	31.00	34.58	35.50
H	T-12		35.75	41.75	37.00	40.58	41.50
F	T-13		41.75	47.75	43.00	46.58	47.50
	T-14		47.75	53.75	.	.	.
L	2	2	54.00	60.00	55.25	58.83	59.75
O	3	3	60.00	66.00	61.25	64.83	65.75
W	4	4	66.00	72.00	67.25	70.83	71.75
	A-8	1	72.00	76.00	.	.	.
V	5	5	76.00	82.00	77.25	80.83	81.75
H	6	6	82.00	88.00	83.25	86.83	87.75
F							
	A-5	95	90.00	96.00	91.25	94.83	95.75
	A-4	96	96.00	102.00	97.25	100.83	101.75
	A-3	97	102.00	108.00	103.25	106.83	107.75
	A-2	98	108.00	114.00	109.25	112.83	113.75
	A-1	99	114.00	120.00	115.25	118.83	119.75
M	A	14	120.00	126.00	121.25	124.83	125.75
I	B	15	126.00	132.00	127.25	130.83	131.75
D	C	16	132.00	138.00	133.25	136.83	137.75
B	D	17	138.00	144.00	139.25	142.83	143.75
A	E	18	144.00	150.00	145.25	148.83	149.75
N	F	19	150.00	156.00	151.25	154.83	155.75
D	G	20	156.00	162.00	157.25	160.83	161.75
	H	21	162.00	168.00	163.25	166.83	167.75

Table 4—Standard CATV channel assignments (*continued*)

	Standard channel mnemonic	EIA-IS6 [3] channel mnemonic	Lower channel boundary (MHz)	Upper channel boundary (MHz)	Picture carrier frequency (MHz)	Color carrier frequency (MHz)	Audio carrier frequency (MHz)
	I	22	168.00	174.00	169.25	172.83	173.75
H	7	7	174.00	180.00	175.25	178.83	179.75
I	8	8	180.00	186.00	181.25	184.83	185.75
G	9	9	186.00	192.00	187.25	190.83	191.75
H	10	10	192.00	198.00	193.25	196.83	197.75
	11	11	198.00	204.00	199.25	202.83	203.75
V	12	12	204.00	210.00	205.25	208.83	209.75
H	13	13	210.00	216.00	211.25	214.83	215.75
F							
S	J	23	216.00	222.00	217.25	220.83	221.75
U	K	24	222.00	228.00	223.25	226.83	227.75
P	L	25	228.00	234.00	229.25	232.83	233.75
E	M	26	234.00	240.00	235.25	238.83	239.75
R	N	27	240.00	246.00	241.25	244.83	245.75
B	O	28	246.00	252.00	247.25	250.83	251.75
A	P	29	252.00	258.00	253.25	256.83	257.75
N	Q	30	258.00	264.00	259.25	262.83	263.75
D	R	31	264.00	270.00	265.25	268.83	269.75
	S	32	270.00	276.00	271.25	274.83	275.75
	T	33	276.00	282.00	277.25	280.83	281.75
	U	34	282.00	288.00	283.25	286.83	287.75
	V	35	288.00	294.00	289.25	292.83	293.75
	W	36	294.00	300.00	295.25	298.83	299.75
H	AA	37	300.00	306.00	301.25	304.83	305.75
Y	BB	38	306.00	312.00	307.25	310.83	311.75
P	CC	39	312.00	318.00	313.25	316.83	317.75
E	DD	40	318.00	324.00	319.25	322.83	323.75
R	EE	41	324.00	330.00	325.25	328.83	329.75
B	FF	42	330.00	336.00	331.25	334.83	335.75
A	GG	43	336.00	342.00	337.25	340.83	341.75
N	HH	44	342.00	348.00	343.25	346.83	347.75
D	II	45	348.00	354.00	349.25	352.83	353.75
	JJ	46	354.00	360.00	355.25	358.83	359.75
	KK	47	360.00	366.00	361.25	364.83	365.75
	LL	48	366.00	372.00	367.25	370.83	371.75
	MM	49	372.00	378.00	373.25	376.83	377.75
	NN	50	378.00	384.00	379.25	382.83	383.75
	OO	51	384.00	390.00	385.25	388.83	389.75
	PP	52	390.00	396.00	391.25	394.83	395.75