



**Deriving NBB0 & Quote Bars
from US CQS Level 1 Quote Data**

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Summary

This document describes the logic used by Tick Data Inc. to derive a National Best Bid and Offer (NBBO). The intention of the NBBO is to show the “prevailing” market for U.S. equities disseminated on the Consolidated Quotation System (CQS). The CQS is processed by the Securities Industry Automation Corporation (SIAC) and published by NYX Data. The Quote data published by NYX Data is Level I data by exchange and does not represent an actual NBBO. This document also describes the building of Quote Bars because Quote Bars are derived from the NBBO data.

The NBBO Process

Building List of Prevailing Quotes

To build the NBBO, a prevailing list of Bids and a prevailing list of Offers are maintained for each equity. Each list contains only the most recent entry per exchange and the Time, Price, and Size of the entry.

CQS Level I quotes are processed by equity in chronological order. Each CQS Level I quote has Bid and Offer information for a single exchange. Each Level I quote always replaces any previous information for the exchange it represents.

Each two sided CQS Level I quote is separated into a Bid and an Offer. Separately, a determination is made if the quote should be added to the respective prevailing list. If the price or size of a side is zero (0), then that side of the quote will not be added to its respective prevailing list. Additionally, the condition code will be examined to determine if the side should be added to the prevailing list. See Appendix A for details for how condition codes impact the prevailing lists. As mentioned previously, but is important to mention in more detail, any Level I quote for an exchange first removes all information for that exchange from the prevailing lists and then conditionally adds the new quote to the prevailing lists.

Tables 1 and 2 below show CQS Level I quotes and the resulting prevailing lists.

Table 1 - CQS Level I Quotes - INTC

Date	Time	Exc.	Bid	Ask	Bid Size	Offer Size	Code
5/14/2015	9:30:03.525	T	32.85	32.87	2	1	R
5/14/2015	9:30:03.617	P	32.85	32.88	2	3	R
5/14/2015	9:30:03.717	J	32.85	32.89	1	2	R
5/14/2015	9:30:03.717	J	32.85	32.89	2	2	R
5/14/2015	9:30:03.718	P	32.85	32.88	3	3	R
5/14/2015	9:30:03.797	M	32.75	32.97	27	9	R
5/14/2015	9:30:04.035	K	32.85	32.88	1	1	R
5/14/2015	9:30:04.035	T	32.85	32.87	4	1	R
5/14/2015	9:30:04.035	J	32.85	32.89	1	2	R
5/14/2015	9:30:04.050	A	32.46	32.99	1	2	O

Table 2 Prevailing Lists built from CQS Quotes for INTC

Bids

Date	Time	Exc	Bid	Size
5/14/2015	9:30:03.718	P	32.85	3
5/14/2015	9:30:03.797	M	32.75	27
5/14/2015	9:30:04.035	K	32.85	1
5/14/2015	9:30:04.035	T	32.85	4
5/14/2015	9:30:04.035	J	32.85	1
5/14/2015	9:30:04.050	A	32.46	1

Offers

Date	Time	Exc	Bid	Size
5/14/2015	9:30:03.718	P	32.88	3
5/14/2015	9:30:03.797	M	32.97	9
5/14/2015	9:30:04.035	K	32.88	1
5/14/2015	9:30:04.035	T	32.87	1
5/14/2015	9:30:04.035	J	32.89	2
5/14/2015	9:30:04.050	A	32.99	2

Creating the NBBO

As each CQS Level I bid or ask is processed and impacts the prevailing lists of prices, a determination is made if there is a new NBBO. A new NBBO occurs when the highest prevailing Bid price or lowest prevailing Offer differ from the previous NBBO. When one side of the NBBO improves a “first in” selection method is used to determine the exchange that is the “best” at the improved price level. The resulting NBBO will reflect the selected “best” exchange along with the size of the bid or offer on that exchange. As long as that price level is maintained, that chosen exchange will remain on the respective side of the NBBO.

Date	Time	Bid	Exchange	Bid Size	Offer	Offer Exchange	Offer Size
05/14/2015	09:30:04.050	32.85	T	4	32.87	T	1

Once an exchange is chosen as “best” for a side, that exchange will remain as “best” until the price level improves or that exchange is removed from the prevailing list on that side.

The Opening Quote and First NBBO Print

The CQS begins broadcasting Level I Quotes at 04:00. However, these quotes are often “stub” quotes and do not reflect a true market. The table below shows stub quotes entered by NASDAQ (T)

Table 3 - Example Stub Level I Quotes - INTC

Date	Time	Exchange	Bid	Offer	Bid Size	Offer Size	Condition Code
5/14/2015	7:00:02.669	T	0.01	200000	2	1	R
5/14/2015	7:00:02.669	T	0.01	2000	2	1	R

To reduce the influence of stub quotes on the NBBO, Tick Data prints the first NBBO to coincide with the opening quote per equity. NYSE listed equities, broadcast an “Open” Quote which is used to trigger the first NBBO print for that equity. NASDAQ listed equities do not broadcast an “Open” and since the market is electronic, the first NBBO print is the prevailing market at 09:30:00.000. It is important to note that the opening NBBO print can and will be made from pre-market quotes.

Handling Halts

Occasionally an equity will be halted for news or limit circuit breakers. When an equity halts, each exchange will broadcast a message indicating that it is no longer participating in the market for that equity. This broadcast can be one of many halt or close messages but are always accompanied by a size of zero and a price of zero.

The following pages show actual halts for AVP on 5/14/2015. The first table is referenced from www.NasdaqTrader.com and shows the details of the halt. The next table is the CQS Quotes around the first halt at 11:36:40. Finally the last table shows the NBBO values calculated and printed around the halt.

Halt Announcement - www.NasdaqTrader.com

Halt Date	Halt Time	Issue Symbol	Issue Name	Market	Reason Code	Resumption Date	Resumption Quote Time	Resumption Trade Time
05/14/2015	11:36:40	AVP	Avon Products, Inc. Common Stock	NYSE	M	05/14/2015	11:44:51	11:44:51

CQS Level I Quotes Around This Halt

Date	Time	Market	Bid Price	Offer Price	Bid Size	Offer Size	Condition Code
05/14/2015	11:36:40.006	K	6.97	6.99	273	4	R
05/14/2015	11:36:40.006	T	0	0	0	0	R
05/14/2015	11:36:40.006	K	6.97	0	104	0	R
05/14/2015	11:36:40.006	K	6.97	0	31	0	R
05/14/2015	11:36:40.006	K	0	0	0	0	R
05/14/2015	11:36:40.006	X	0	0	0	0	R
05/14/2015	11:36:40.006	B	0	0	0	0	R
05/14/2015	11:36:40.008	P	0	0	0	0	R
05/14/2015	11:37:41.647	N	6.5	7.5	0	0	M
05/14/2015	11:40:36.421	N	7	8	0	0	M
05/14/2015	11:44:51.011	N	0	0	0	0	T
05/14/2015	11:44:51.011	N	7.55	7.6	20	126	R

Tick Data Calculated NBBO Around This Halt

Date	Time	Bid	Bid Exchange	Bid Size	Offer Price	Offer Exchange	Offer Exchange
05/14/2015	11:36:40.005	6.97	T	1234	6.98	P	6
05/14/2015	11:36:40.006	6.97	B	432	6.98	P	6
05/14/2015	11:36:40.006	6.97	P	127	6.98	P	6
05/14/2015	11:36:40.008	0		0	0		0
05/14/2015	11:44:51.011	7.55	N	20	7.6	N	126

We must print the zero to inform customers that the NBBO existing at 11:36:40.006 cannot be persisted. The NBBO between 11:36:40.008 - 11:44:51.011 is, in fact, zero. This creates a challenge to building one minute bars from NBBO which is discussed later in the document.

Handling No Interest

Frequently, the interest on one side or both will be non-existent. This typically occurs for small and micro capitalization companies. When there is no interest on a particular side of the NBBO, it will be represented with a price of 0.0, size of 0, and blank (no value) for the exchange field. This is very similar to the print for a halt.

One Minute Quote Bars

One Minute Quote Bars are a summary NBBO prints that occurred in the minute prior to the Quote Bar time stamp. For example, the 10:01 Quote Bar will include the NBBO prints from 10:00:00.000 to 10:00:59.999. Quote bars contain 25 fields per minute as detailed in our *File Format Guide*.

It is important to note that the Quote Bar represents actual prints and that the open of the quote bar represents the market at that timestamp. Until that open timestamp the market is represented by the close of the previous Quote bar.

Quote Bars continue to meet our standard of research quality institutional data. **However, quote bars differ from traditional trade-based O,H,L,C,V bars.** Quote bars, in short, are messy and are not ideal for charting since they will include the zeros that represent the NBBO during halts and periods of low interest. The existence of zeroes does not diminish the quality of the data because to exclude the zeroes would imply a degree of continuity across a one minute bar that did not exist in real time.

When a halt occurs or there no interest resulting in no NBBO for the duration of a minute, then no Quote Bar will be printed to represent that absent minute. The following table shows the Open columns of our Quote Bars during the Halt detailed earlier in the document. As you can see, there are no Quote Bars from 11:37 until 11:45.

Date	Minute	OPEN				
		Timestamp	Bid Price	Bid Size	Ask Price	Ask Size
5/14/2015	11:36	11:35:00.100	6.59	103	6.6	29
5/14/2015	11:37	11:36:00.551	6.67	79	6.68	5
5/14/2015	11:45	11:44:51.011	7.55	20	7.6	126

Lastly, to retain the research readiness of our Quote Bar data, we exclude crossed NBBO prints from quote bars.

Appendix A – Quote Condition Codes

Codes Excluded from NBBO

Code	Description
C	Closing Quote
D	News Dissemination
G	Trading Range Indication
I	Order Imbalance
J	Due To Related Security-News Dissemination
K	Due To Related Security-News Pending
L	Market Maker Quotes Closed
M	Limit Up-Limit Down (LULD) Trading Pause
N	Non-Firm Quote
P	News Pending
Q	Undefined
S	Due To Related Security
T	Resume
U	Slow Quote Due to a NYSE LRP
V	In View of Common
X	Equipment Changeover
Z	No Open/No Resume
0	Limit Up-Limit Down (LULD) Price Bands MODE - Invalid
1	Market-Wide Circuit Breaker Level 1 – Breached
2	Market-Wide Circuit Breaker Level 2 – Breached
3	Market-Wide Circuit Breaker Level 3 – Breached
9	Republished Limit Up-Limit Down (LULD) Price Band

Codes that are Include for NBBO

Code	Description
A	Slow Quote on the Offer Side
B	Slow Quote on the Bid Side
E	Slow Quote Due to a LRP - Only OFFER SIDE is eligible for BBO
F	Slow Quote Due to a LRP - Only BID SIDE is eligible for BBO
H	Slow Quote on the Bid and Offer Sides
O	Opening Quote
R	Regular
W	Slow Quote Due to Set Slow List
Y	Sub-Penny Trading