



Cboe Compression Service User Manual

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Contents

1	Introduction.....	4
2	CCS Service Description	5
2.1	CCS Workflow Description	5
2.2	Security and Data Privacy	7
2.3	Service Availability	8
2.4	Intraday Service Timeline	8
2.4.1	Coincident Multilateral Compression and Match Data Service Dates.....	8
2.4.2	Match Data Service Only Service Dates	9
2.5	Service Registration	9
2.6	Certification Process	10
3	CCS Input File Specification.....	12
3.1	Input File Validation	12
3.2	Required File Preamble.....	13
3.3	Required Position Specification Format.....	14
3.4	Multilateral Compression Input Specification.....	15
3.4.1	Compression Regulatory Capital Benefit Specification.....	16
3.4.2	Specifying Constraint Minimum and Maximum Values	16
3.4.3	Maximum Cost and Cost Per Unit of Benefit Constraints	16
3.4.4	Custom Risk Profile Constraints	18
4	CCS Output File Specifications.....	21
4.1	Multilateral Compression Portfolio Output Files	21
4.1.1	Compression Portfolio Trade File.....	21
4.1.2	Compression Portfolio Detail File.....	22
4.2	Match File Specification	25
4.2.1	Outright Match File Format.....	25
4.2.2	Spread Match File Format.....	26
4.2.3	Combo Match File Format	26
4.2.4	Box Spread File Format.....	27

Tables

<i>Table 1 - Required position specification format</i>	<i>14</i>
<i>Table 2 - Compression trade file field definition</i>	<i>21</i>
<i>Table 3 - Compression detail file field definition.....</i>	<i>22</i>
<i>Table 4 - Outright match file field definition.....</i>	<i>25</i>
<i>Table 5 - Spread match file field definition</i>	<i>26</i>
<i>Table 6 - Combo match file field definition.....</i>	<i>26</i>
<i>Table 7 - Box spread match file field definition</i>	<i>27</i>

Figures

<i>Figure 1 - Cboe Compression Service workflow</i>	<i>5</i>
<i>Figure 2 - Multilateral compression and match file intraday timeline</i>	<i>8</i>
<i>Figure 3 - Intraday timeline on match data service only dates.....</i>	<i>9</i>
<i>Figure 4 - Required CSV input file preamble.....</i>	<i>13</i>
<i>Figure 5 - Example CSV input file preamble.....</i>	<i>13</i>
<i>Figure 6 - Example complete CCS input file for match data service only.....</i>	<i>15</i>
<i>Figure 7 - Multilateral compression input file preamble example.....</i>	<i>18</i>
<i>Figure 8 – Example CCS input with custom risk constraints.....</i>	<i>19</i>
<i>Figure 9 - CSV formatted example CCS input with custom risk constraints</i>	<i>20</i>
<i>Figure 10 - CSV formatted example trade output file.....</i>	<i>21</i>
<i>Figure 11 - Example compression detail output file.....</i>	<i>23</i>
<i>Figure 12 - CSV formatted compression detail output file.....</i>	<i>24</i>
<i>Figure 13 - Example outright match file</i>	<i>25</i>
<i>Figure 14 - Example outright match file</i>	<i>26</i>
<i>Figure 15 - Example combo match file.....</i>	<i>27</i>
<i>Figure 16 - Example box spread match file.....</i>	<i>27</i>

1 Introduction

The Cboe Compression Service (CCS) is a hybrid multilateral-bilateral service used by Cboe TPHs to manage capital requirements associated with portfolios of SPX and SPXW index option positions¹. The CCS provides TPHs with two methods of position compression; multilateral compression in which the system computes and automatically clears (after TPH approval) a portfolio of trades that provides maximum compression benefit to all participating TPHs, and bilateral in which match data is provided to TPHs that is used to bilaterally consummate trades (no trades are automatically cleared). TPHs can use one or both modes of compression.

TPHs participate in the service through the [Cboe Customer Web Portal](#) where they access the Cboe Compression Service application. They upload files that specify positions for compression, regulatory capital benefit associated with closing contracts of each submitted position, and cost and risk constraints on the portfolio of compression trades they are willing to accept. At the time of file upload, TPHs opt-in to multilateral compression, match data service (bilateral), or both.

TPHs that opt-in to multilateral compression join a process that determines a portfolio of position closing trades among participating TPHs that maximizes regulatory capital delivered to each TPH while satisfying all constraints specified by all TPHs. In this document, TPHs are provided with detail regarding the compression portfolio that enables them to efficiently analyze the portfolio benefit and constraint satisfaction, after which they approve the multilateral portfolio. On unanimous approval of the portfolio by all participating TPHs, the trades comprising the portfolio are automatically cleared at the OCC, printed to OPRA, and disseminated on data feeds and FIX Drop connections to firms and their clearing providers in real-time.

Following multilateral compression, TPHs that opt-in to match data service (bilateral) participate in a process that computes and disseminates match files that identify contra firms with which they can bilaterally trade out of outright option positions and various structures including spreads, combos, and box spreads. Match files use originally submitted position details for TPHs that opt-in to match files only, whereas TPHs that opt-in to both multilateral and match data service will use post multilateral compression residual positions (i.e., originally submitted positions with position reducing compression trades removed) as input to the match data service.

This document begins with the Cboe Compression Service description. It provides a high-level introduction to the full scope of TPH interaction with the service to affect position compression. Other topics covered include:

- Intraday timing of service operation
- Scheduling of service availability and user notification
- Registration and TPH profile information
- Certification required to access the production service
- Compression position and constraint specification
- Multilateral compression detail and trade level output file specification
- Match file output file specification

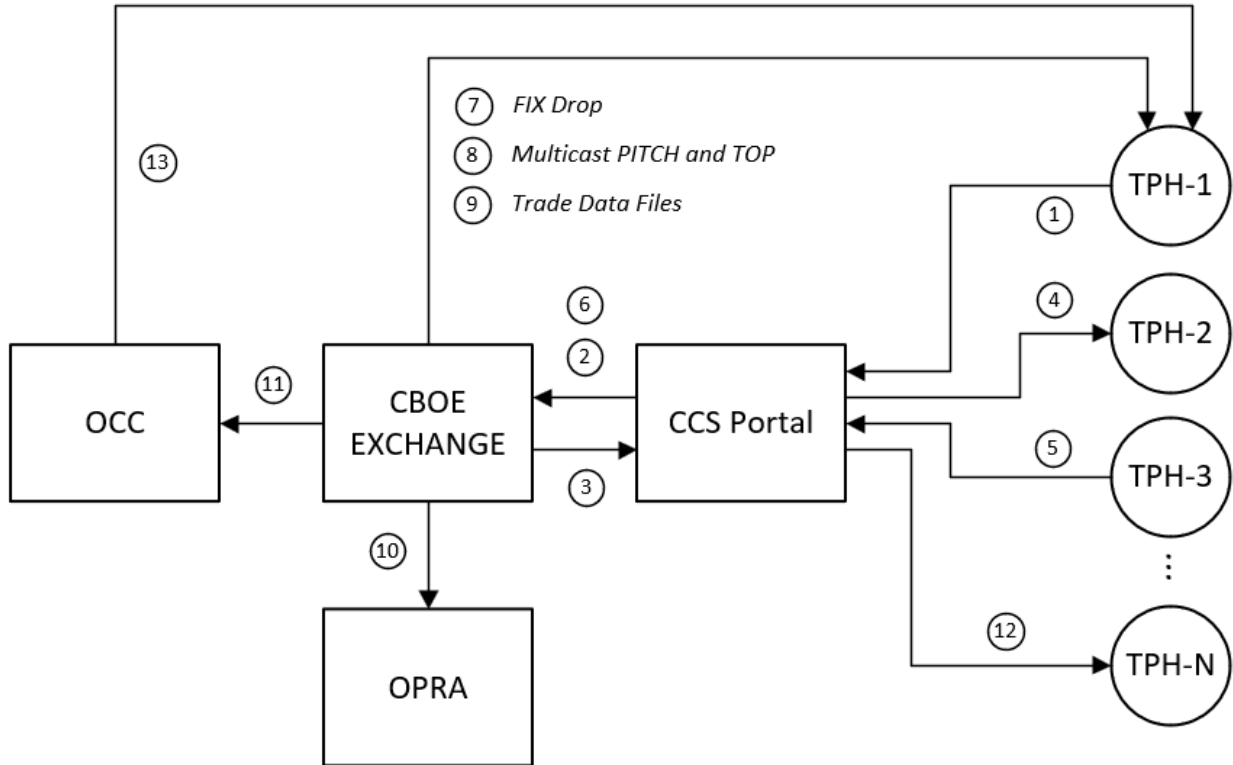
¹ FLEX option positions not supported

2 CCS Service Description

2.1 CCS Workflow Description

Figure 1 below presents the high-level CCS workflow from the TPH perspective, followed by a description of the numbered steps. Service availability scheduling and intraday timing of each workflow step is presented later in this document.

Figure 1 - Cboe Compression Service workflow



- 1) TPHs upload position specification files to the CCS through the CCS portal, which is accessed through the secure firm login used to access all other exchange services and administration functions. TPH submissions contain a specification of each position being submitted for multilateral compression and/or match data dissemination. Checkboxes are presented for multilateral compression and/or match data for TPHs to choose which or both services. For TPHs that opt-in to multilateral compression, cost and risk constraints are optionally specified by TPHs to constrain the cost of compression relative to TPH-specified theoretical values and the acceptable risk profile of compression portfolios. The input file format to specify position and constraint specifications is presented later in this document.
- 2) At the end of the input submission window, TPHs are notified via email that the submission window has closed, and the system has started computing a candidate multilateral compression portfolio for those TPHs that opt-in to multilateral compression. The CCS portal interface changes from input submission to an informational message indicating that multilateral compression computation is in-progress and to standby

for results. TPHs that opt-in to match data service only (i.e., no multilateral compression) wait for the multilateral compression to complete, after which they participate in the bilateral match data service.

- 3) When the system has completed calculating a candidate multilateral compression portfolio, TPHs that opt-in for multilateral compression will see the CCS portal change from ‘stand by’ to ‘candidate portfolio ready for download, analysis and approval’. Additionally, email notifications are sent to participating TPHs announcing that results are available for download. This event starts the ‘approval window’, which is a time period during which TPHs are expected to download and analyze portfolio files.
- 4) TPHs use links presented in the CCS portal to download detail and trade level output files specifying their subset of the candidate multilateral compression portfolios. The detail file presents a decorated version of the originally submitted input file that adds traded quantities of each position, system prescribed compression prices used for each option trade, and details of all cost and risk constraint calculations. TPHs use the detail file to efficiently confirm that all specified constraints are satisfied. The trade file is a simple trade blotter presenting details of the trades that will be cleared upon unanimous approval by all participating TPHs.
- 5) Having analyzed the candidate compression portfolio trades, risk profile, and cost constraints, TPHs use the CCS portal to approve or reject the candidate multilateral compression portfolio. Approving or rejecting a portfolio requires the entry of an approval token, which is embedded in the detail output file. This step confirms that the TPH has opened and reviewed the detail output file corresponding to the compression portfolio being approved. If a TPH fails to approve or reject the portfolio by the end of the approval window, the system will consider the TPH to have rejected the candidate portfolio. Any TPH that receives zero compression trades in their compression portfolio will be automatically deemed to have accepted the portfolio. In the event that one or more TPHs reject or fail to approve or reject during the approval window (i.e., times out), TPHs are notified via email that the compression portfolio has not been unanimously approved and no trades will be consummated as a result.
- 6) When all participating TPHs have approved the candidate compression portfolio, the system begins to process the trades comprising portfolio through the Cboe Exchange trading system. While the trading system is processing compression portfolio trades, the CCS portal interface will indicate that the system is computing post-compression match data for those TPHs that opt-in to the match data service (see step 10 below).
- 7) TPHs are notified of CCS compression trades with Execution Report messages over FIX Drop ports in real-time. CCS trades are identified using the *TradeLiquidityIndicator(9730)* and *Compression(22006)* fields. The value “C” in the 2nd character of the *TradeLiquidityIndicator(9730)* field uniquely identifies compression trades resulting from the CCS system. Note that the FIX Drop port attribute “Send 2nd Liquidity Character” must be configured to “Yes” (default value is “No”) in order to receive the 2nd character. This confirmation is necessary to differentiate CCS trades from compression trades executed as a result New Order Cross messages with CrossType set to 4 (PCC) submitted over an order entry port.
- 8) CCS compression trades are disseminated on exchange Multicast PITCH and TOP feeds as Trade Messages with Trade Condition set to “u”.
- 9) CCS compression trades are available in standard daily Trade Data files and monthly Trade Detail files accessible through the firm portal.
- 10) CCS compression trades are reported to OPRA using a type code of “u” which represents “Multilateral Compression Trade of Proprietary Products”.

- 11) CCS compression trades are submitted to the OCC for clearing same day (day of trade) using information provided by TPHs when registering to use multilateral compression functionality of the CCS.
- 12) TPHs that opt-in to the match data service are notified via email that match files are available on the CCS portal for download. The CCS portal will present links to download match files for outright, spread, combo, and box spreads.
- 13) Consummated compression trades will be reported via the standard trade reporting files with all other trades by the Clearing TPHs housing the positions on the business day following the associated compression cycle.

2.2 Security and Data Privacy

In the CCS workflow presented in Figure 1, TPHs submit position information for compression. Information regarding TPH positions is treated as private and sensitive information, the same as all other data managed by the Exchange on behalf of the TPH including instructions received over order entry port connections and TPH execution information from live trading. TPHs upload positions and download compression portfolio and match data service through the same secure firm portal through which all other secure information exchanges are conducted.

Multilateral compression uses advanced computational algorithms to compute a portfolio that delivers maximum value, while satisfying constraints, to participating TPHs in a completely anonymous manner. No identifiable TPH information is used in the process of computing traded quantities for each participating TPH during compression portfolio construction. TPHs receive information regarding their trades only, without information on contra TPHs on the other side of their trades. Throughout the entire process, TPHs do not have access to other TPH positions, nor are they presented with information regarding the other side of any trade within the portfolio. Only after trades have cleared do TPHs receive standard trade reporting information from the OCC on the business day following the compression cycle, which includes contra TPH information.

The match data service (bilateral) presents match data files to TPHs that contain a list of position crossing opportunities with other submitting TPHs. Only the crossable amounts, not the size of the submitted position, is revealed to contra TPHs. For example, if TPH1 is long 1,000 contracts of an option, and TPH2 is short 100 contracts of the same option, both TPH1 and TPH2 would be presented with an opportunity to cross 100 contracts, and TPH2 would know only that TPH1 is long 100 or more contracts. As a result, position information is communicated to contra TPHs with opposite side crossable positions. TPHs that opt-in to use the match data file service are explicitly authorizing the presentation of this information to contra TPHs.

2.3 Service Availability

The CCS is configured for match data service on normal exchange trading days. Match data service does not run on partial trading days resulting from holiday trading hours².

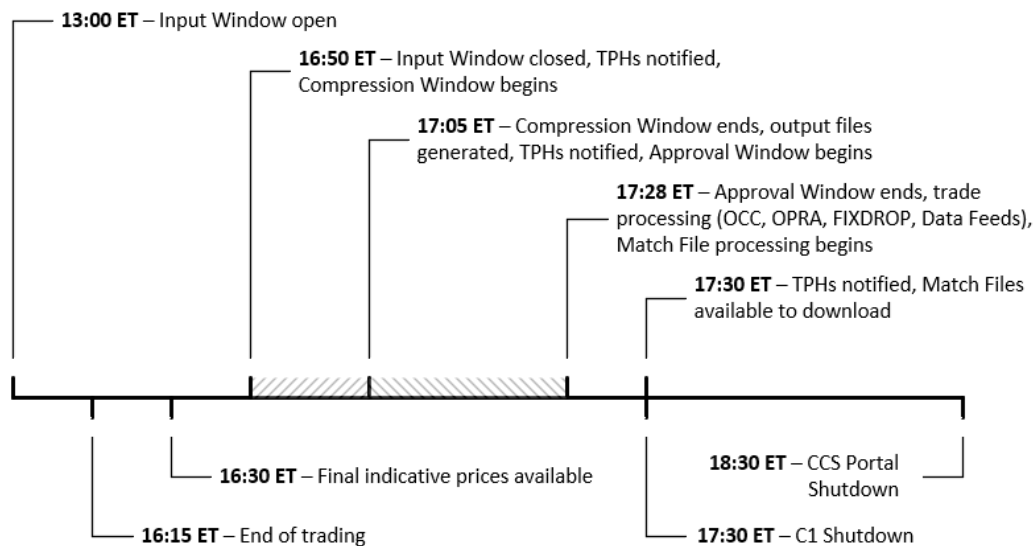
Multilateral compression service, on the other hand, will be available only on exchange specified normal trading dates and will be announced in advance via direct communication with certified TPHs.

2.4 Intraday Service Timeline

2.4.1 Coincident Multilateral Compression and Match Data Service Dates

Figure 2 below presents the intraday timeline of the CCS workflow on days which both multilateral compression and match data service is configured to run. The indicated times are approximate and in practice the timeline can and will vary based on certain events and conditions as indicated in the description below.

Figure 2 - Multilateral compression and match file intraday timeline



TPHs can upload position files starting at 13:00 ET. On dates when both multilateral compression and match data services are configured to run, TPHs are presented with multilateral compression and match file check boxes to express which (or both) services the TPH is submitting for. TPHs submitting for multilateral compression may choose to wait until after trading in proprietary index options stops at 16:15 ET to submit position files. At 16:50 ET TPHs are notified that input files are no longer being accepted, and in the event that there are two or more TPHs submitting for multilateral compression, the notification will indicate that the compression window has begun. If fewer than two TPHs have submitted for multilateral compression, TPHs are notified that multilateral compression will not occur on the current date and the system proceeds immediately to match data file service.

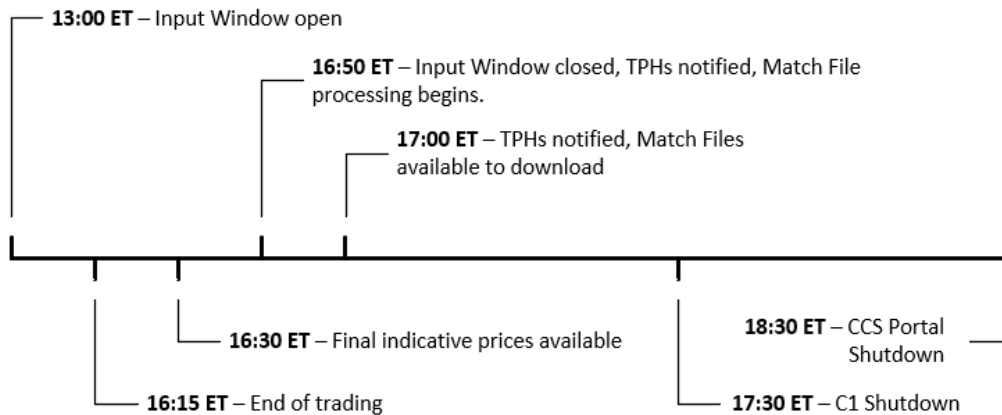
² Cboe reserves the right to limit dates on which match data service is available in order to better consolidate participation on dates that the participating TPH community generally agrees are preferred compression dates.

For 15 minutes between 16:50 and 17:05 ET, the system executes compression analytics to determine a multilateral portfolio of trades to present to TPHs. At 17:05 ET the system prepares detail and trade output files to present to TPHs and notifies via email when output files are available for download and analysis. TPHs have 23 minutes between 17:05 and 17:28 ET to return to the CCS portal and approve or reject the portfolio. If all participating TPHs approve prior to 17:28 ET, the system determines there is no need to wait and immediately notifies TPHs that the portfolio is approved and trade processing has begun. Beginning at 17:28 ET or earlier, if two or more TPHs have opted-in for match data, the system computes match data files and notifies participating TPHs when files are available for download on the CCS portal. If only a single TPH has opted-in for match data, that TPH will receive a courtesy email notifying that match data files will not be disseminated. Match data files remain available for TPHs to download until 18:30 ET, at which time the CCS portal becomes unavailable to TPHs.

2.4.2 Match Data Service Only Service Dates

Figure 3 below presents the intraday timeline of workflow milestones on days when only match data service is configured to run.

Figure 3 - Intraday timeline on match data service only dates



TPHs can upload position files starting at 13:00 ET. When the input window closes at 16:50 ET and two or more TPHs have uploaded position files, the system immediately proceeds to match data file generation and dissemination by 17:00 ET. If only a single TPH has submitted by 16:50 ET, that TPH receives a courtesy email indicating that match files will not be generated. Match files remain available for TPHs to download until 18:30 ET, at which time the CCS portal becomes unavailable to TPHs.

2.5 Service Registration

TPHs that wish to use the CCS for either multilateral compression or match data service should first contact [Membership Services](#). Membership services will instruct registering TPHs on required registration profile information depending on the TPHs intended use of the service.

If a TPH wishes to register for only match data service and does not intend to participate in multilateral compression, Membership Services will request only a notification email address and email addresses of firm logins to be granted access to the CCS. As a result of this limited registration, such firms will not be able to opt-in to multilateral compression since profile information required to clear trades will not be available.

TPHs that register for multilateral compression functionality will provide profile information that is used for clearing trades resulting from an unanimously approved compression portfolio. In addition to the notification email address and authorized firm logins, the following information must be provided for TPHs registering to use multilateral compression:

- **EFID** – A single Cboe Executing Firm ID, which uniquely identifies the firm's OCC ID that will be used to clear all CCS trades. Firms are not provided with the ability to clear to multiple EFIDs; only a single EFID is specified.
- **Clearing Capacity** – Allowed Cboe Capacity codes are M (Market Maker), N (Away Market Maker) and F (Firm)
- **Market Maker Clearing Account** – Required only if Clearing Capacity is set to M or N. Maps to OCC Sub Account ID
- **Account** – Maps to OCC Customer ID
- **OCC Clearing Optional Data**

Registering TPHs will be instructed that in order to access multilateral compression in the production Cboe Exchange environment, they will need to contact the Cboe Trade Desk to coordinate execution of a certification process described below.

2.6 Certification Process

TPHs must separately certify to use match data and multilateral compression services in the production environment. Certification is accomplished by interacting with the CCS in the Cboe Exchange certification environment under the direction of the Cboe Trade Desk. TPHs must demonstrate the ability to properly construct formed position and constraint input files as specified later in this document. Prior to successful certification for match file or multilateral compression service, TPHs will be unable to interact with the CCS in the production Cboe Exchange firm portal. Once TPHs have certified for match file service use, they will be able to select the match data option while uploading compression submission files, otherwise the option will be disabled. Similarly, once TPHs have certified for multilateral compression use, they will be able to select multilateral compression while uploading compression submission files, otherwise the option will be disabled.

The certification processes for match data and multilateral compression must be completed by at least one authorized firm login. Certification does not require that all registered firm logins complete the certification process. It is assumed that knowledge is distributed at the certifying firm and that all authorized firm logins are able to use and operate the service as a result of successful certification. It is assumed that firm-side systems used to generate formatted input to the CCS are generally automated, and once demonstrated compatible with the CCS service they will remain so. TPHs are advised to test major firm-side input file generation changes in the Cboe Exchange certification environment.

TPHs registered to use only match file services will submit position files to the certification environment that don't include custom risk constraints. If constraints are provided, they must pass validation checks, but will be ignored by the match data service processing. On successful upload to the certification environment CCS, the input file has passed strict validation checks confirming TPH ability to construct properly formed input files for the match data service only. TPHs then must successfully download match files from the CCS portal and confirm

understanding of their content. At this point, the TPH has successfully certified to use the CCS match data service functionality in the production environment.

Certifying to use the multilateral compression service is more involved than certifying to use the match data service. First, TPHs will not be allowed to begin certification unless they have provided clearing information as part of the registration process (see above section on Service Registration). TPHs submitting files for multilateral compression will be expected to specify valid theoretical option prices for each position, max cost and max cost per unit benefit constraints, and one or more custom constraints demonstrating the ability to specify per-expiration and cross-expiration (e.g., full portfolio or bucketed expirations) risk exposure constraints with reasonably specified minimum and maximum values.

As part of certification for multilateral compression, TPHs will join a multilateral compression process running in the certification environment to demonstrate the ability to upload properly structured input files, the ability to download detail and trade level output files (specified later in this document) and to successfully approve the portfolio through CCS portal functionality. Successful approval of the portfolio requires a form of two-factor authentication where TPHs enter an approval token embedded in the detail output file as described later in this document.

3 CCS Input File Specification

TPHs use the single comma separated value (CSV) file format specified in this section to participate in both multilateral compression and match data service functions of the CCS. The file specification comprises required and optional elements.

The required elements comprise the minimum required input file content necessary to submit positions to the CCS match data service. Optional constraint specification is not relevant for TPHs that certify for and use the match data service only. Certification to use match data service only validates the TPHs ability to construct properly structured input files using required elements, and an understanding of the resulting match files, presented later in this document.

The optional elements enable TPHs using the multilateral compression service to specify cost and risk constraints that enable fine-grained specification of the attributes of compression portfolios they are willing to accept from the compression process. The certification process for multilateral compression validates TPH ability to construct properly structured input files with cost and risk constraints. TPHs that certify for multilateral compression typically also certify for match data service as the match data input file is a subset of the more expressive constrained compression input file specification.

The CSV file format specification that follows comprises both numeric and non-numeric data. Embedded whitespace is not permitted at any location within an input record. Certain fields contain required or optional “null” values, which is represented by consecutive commas. Numeric precision of numeric fields is significant and is presented in detail below.

3.1 Input File Validation

When TPHs upload files through the CCS application in the firm portal, strict validation checks are applied to validate compliance with all requirements of the input file specification below. For example, expiration dates are required to be provided in YYYY-MM-DD format. A single expiration date among thousands specified in an incorrect format, or representing an invalid date, will cause the upload to fail. TPHs are presented with detailed error messages describing all validation errors contained in an upload (not just the first validation error) facilitating a straightforward process to update the file and re-upload.

Common causes of input file validation errors include the following:

- Invalid expiry date format (e.g., MM/DD/YYYY specified rather than the required YYYY-MM-DD). This is the most common formatting error as input CSV files opened and saved in Excel will convert dates formatted YYYY-MM-DD to MM/DD/YYYY automatically.
- Wrong number of tokens in the header row (i.e., fewer than 11)
- Incorrectly formatted second or third row (typically one too many or one too few consecutive commas)
- Invalid class value – only SPX and SPXW are supported
- Expired options – expiration dates on current or prior date not allowed
- Invalid or nonlisted strike price – only currently listed strikes are allowed

- Null value (consecutive commas) provided where non-null values are required, or vice versa
- Leading, trailing or embedded whitespace
- Commas embedded in integer values
- Double-quotes output by some systems to escape values containing commas are not supported
- All zero values provided for close_benefit when opting in for multilateral compression
- No custom risk constraints defined for a multilateral compression submission

3.2 Required File Preamble

Users of both the match data and multilateral compression service must supply the first three rows of the input file formatted as shown in Figure 4 below, where the column indexes 1-12 indicate one-referenced token position, and row indexes 1-3 indicate one-referenced row position. The indicated column and row indexes are not part of the file and are shown for positional reference only.

Figure 4 - Required CSV input file preamble structure

	1	2	3	4	5	6	7	8	9	10	11
1	class	expiry	strike	put_call	qty	theo	close_benefit	reserved	reserved	cost	cost_benefit
2	null	null	null	null	null	null	null	null	null	null	null
3	null	null	null	null	null	null	null	null	null	0.0	0.0

All values in rows 2 and 3 are null (i.e., consecutive commas) except for positions 10 and 11 in row 3, which are non-negative floating point values. These values are ignored for the match data service. Even though these two values are ignored for the match data service, valid non-negative floating point values must be specified in all input files. As a result, zeros are a reasonable value for TPHs using only the match data service, though any non-negative floating point value will be accepted. In practice, the first 3 rows of input file for users of match data service only will be specified exactly as presented in Figure 5 below. For users of multilateral compression, the only difference in the first three rows, columns 1 through 11, will be that the *cost* and *cost_benefit* column values in row 3 will typically be values other than zero (though values of zero are valid and accepted for reasons described in subsequent sections of this document).

Figure 5 - Example CSV input file preamble

```
class,expiry,strike,put_call,qty,theo,close_benefit,reserved,reserved,cost,cost_benefit
,,,,,,,,,
,,,,,,,,,0.0,0.0
```

Note the actual strings used in the header line are not validated, and only the count matters. It is recommended that the standard values presented above be used for clarity, but it is not required. That said, whitespace and embedded commas are not allowed in header string tokens. In certain examples below “rsvd” is used rather than “reserved” in example header lines to save space. Such headers are accepted since the header tokens are not required to match the above specified values.

3.3 Required Position Specification Format

In both match data and multilateral compression, rows 4 and higher are used to specify option positions submitted for compression. Every position record must contain the 11 comma separated tokens with no embedded whitespace specified in Table 1 below.

Table 1 - Required position specification format

Field	Description
class	Case sensitive SPX or SPXW. Single-leg non-FLEX options only are supported.
expiry	Expiration date in YYYY-MM-DD format. Must be a valid currently listed non-expired SPX or SPXW expiration date. Expired or option positions expiring on the day of submission are not allowed.
strike	Option price as a floating point numeric value. Must correspond to the strike price of currently listed option in the specified class and expiry.
put_call	Case sensitive P or C.
qty	Signed integer contract position where positive integer is a long position and negative integer is a short position. Zero values are accepted but are discouraged as they are currently ignored by the CCS.
theo	Non-negative floating point value representing the TPH assessment of the theoretical value of one long contract of the associated option (i.e., contract multiplier of 100 applied). This value is not used for the match data file service. Users of match data file service only will typically provide zeros. <u>Two decimal points of precision</u> are accepted and higher precision inputs are rounded.
close_benefit	Non-negative floating point value representing the TPH assessment of the capital requirements benefit resulting from reduction of the position by one contract (long or short). Two decimal points of precision are accepted and higher precision inputs are rounded. Files containing all zero values for close_benefit when the TPH opts-in to multilateral compression will fail validation at upload time, whereas all zero values is accepted for TPHs opting in to match data service only. This value is not used for the match data file service, and users of match data file service only will typically provide zeroes.
reserved	Must be null (i.e., consecutive commas)
reserved	Must be null (i.e., consecutive commas)
cost	Must be null (i.e., consecutive commas)
cost_benefit	Must be null (i.e., newline immediately after preceding comma)

Figure 6 below presents an example of a complete input file for match data service, including the formatted first three rows and several option position rows. This example input file is suitable for match data file service only as the *theo* and *close_benefit* values are specified as zero. Non-zero *theo* and *close_benefit* values will be specified when submitting for multilateral compression. Note the ellipsis at the end of the example below represents continuation and is not part of the file. In practice, input files can contain thousands of position rows on 30 or more distinct class expirations.

Figure 6 - Example complete CCS input file for match data service only

```

class,expiry,strike,put_call,qty,theo,close_benefit,reserved,reserved,cost,cost_benefit
,,,,,,,,,
,,,,,,,,,0.0,0.0
SPXW,2021-05-28,4175.0,C,22,0.0,0.0,,,,,
SPXW,2021-05-28,4200.0,C,42,0.0,0.0,,,,,
SPXW,2021-05-28,4300.0,C,50,0.0,0.0,,,,,
SPXW,2021-05-28,4900.0,C,-100,0.0,0.0,,,,,
SPXW,2021-05-28,5200.0,C,-20,0.0,0.0,,,,,
SPX,2021-06-18,4000.0,C,25,0.0,0.0,,,,,
SPX,2021-06-18,4000.0,P,-100,0.0,0.0,,,,,
SPX,2021-06-18,4200.0,C,-20,0.0,0.0,,,,,
SPX,2021-06-18,4200.0,P,-50,0.0,0.0,,,,,
SPX,2021-06-18,4300.0,P,250,0.0,0.0,,,,,
...

```

3.4 Multilateral Compression Input Specification

A single format specification is shared by match data and multilateral compression services. Whereas columns 10 (*cost*) and 11 (*cost_benefit*) of row 3 (maximum values row) are typically zero for match data service only, users of multilateral compression will specify non-zero values to express limits on compression cost and maximum cost per unit of capital requirement benefit as describe below. Whereas users of match data service only typically provide zero values for *theo* and *close_benefit* in option position rows, since they are ignored for match data purposes, users of multilateral compression typically provide non-zero values for both for each option position in an input file.

TPHs add custom risk profile constraints by adding columns to the file beyond the required columns (11) presented previously in this document. Each additional column in the input file represents a TPH-defined custom constraint. Note that input files generated with or without custom constraints (i.e., additional columns) can be used with match service as they are ignored for match data file generation purposes.

The following sections present the input file features used specifically for multilateral compression. Users of match data service only can skip the remainder of this section.

Note on precision – TPHs that wish to be able to exactly replicate reported constraint values computed by the system and represented in the detail output file presented in section 4.1.2 must provide floating point numeric values to the precision as is underlined below. If values are provided to higher precision, they will be rounded by the system and as a result, due to floating point number representation differences between platforms, TPHs might not be able to exactly replicate aggregated constraint values (though discrepancies will be very small).

3.4.1 Compression Regulatory Capital Benefit Specification

Multilateral compression produces a portfolio of trades that attempts to deliver maximum value to all participating TPHs while satisfying all cost and risk constraints specified by all TPHs. The analytics that are used to determine the “best” compression portfolio require that TPHs assign a “benefit” to closing one contract of positions in each option presented in the input file. The compression analytics use the benefit value to preference closing positions with higher benefit when selecting among alternatives that satisfy all constraints. The regulatory capital benefit for each position is specified by TPHs in the *close_benefit* field associated with each position row in the input file (rows 4 and above).

The *close_benefit* value is a TPH-specified measure of the regulatory capital benefit to the TPH for closing one contract (i.e., accounting for the 100 contract multiplier of SPX/SPXW) of the position in the associated option. TPHs are free to express the regulatory capital benefit in units meaningful to the TPH, which may be CEM, RWA, SA-CCR or other proprietary measure that expresses relative value realized from closing positions in options in the positions submitted for compression. The value provided in the input file must be a non-negative floating point value with two decimal point precision. Values provided with additional precision are rounded to two decimal points. Zero values are allowed for *close_benefit* for a subset of options positions. When TPHs opt-in to multilateral compression, a submission with all zero values for *close_benefit* will be rejected at upload time. Note this is not the case when users opt-in for match data service only as *close_benefit* is ignored in the match data generation process; i.e., all zero values for *close_benefit* is allowed for uses of match data service only.

The total regulatory capital benefit provided to a TPH as a result of a compression portfolio is the sum of the absolute traded contract quantity (which may be zero) multiplied by the TPH-specified *close_benefit* for all options comprising the portfolio. Regardless of whether a traded quantity is negative (a sell trade to close or partially close a long position) or positive (a buy trade to close or partially close a short position) the accrued benefit is positive.

For example, an option position with a size (*qty*) of 100 and *close_benefit* of 5,000 that trades -20 (i.e., closes 20 of the 100 contract long position). The contribution to the total benefit for the option will be $20 * 5,000 = 100,000$. Similarly, for an option position with a size (*qty*) of -50 and a *close_benefit* of 4,000 that trades +20 (i.e., closes 20 of the 50 contract short position) the contribution to the total benefit for that option will be $20 * 4,000 = 80,000$.

3.4.2 Specifying Constraint Minimum and Maximum Values

TPHs specify minimum and maximum values for cost constraints and for TPH defined custom constraints using rows 2 and 3 of the file format. Row 2 is used for specifying constraint minimum values, and row 3 is used for specifying constraint maximum values.

The following two sections describe the use of input file format features for specifying cost and risk constraints, both of which make use of row 2 and 3 values to place lower and upper bounds for constraint values respectively.

3.4.3 Maximum Cost and Cost Per Unit of Benefit Constraints

This section defines the cost of compression, cost per unit of benefit, and the input specification features TPHs use to specify maximum values for cost and cost per unit of benefit they are willing to incur in a multilateral compression.

TPHs participate in multilateral compression to realize maximum regulatory capital benefit while satisfying constraints, which includes cost constraints. The cost of compression is the total mark to market cost of a portfolio of trades allocated to a TPH. TPHs can place an upper limit on the total cost they are willing to pay in a multilateral compression.

The CCS system uses final indicative prices that are disseminated to OPRA as the prices at which CCS compression trades will clear. Compression trade prices are derived from live markets trading at 16:00 ET. The degree to which these prices deviate from TPH internal views of the theoretical value (*theo*) of the options comprising the compression portfolio determines the overall compression cost to the TPH. For example, if a TPH is buying to close a short position and the compression price is higher than the TPH view of the option theoretical value, the trade will incur a mark to market debit. Conversely, if the compression price is lower than the TPH specified theoretical value of the option, the TPH would incur a net mark to market credit as a result of the trade.

TPHs specify the theoretical value of one contract of an option in the *theo* field of the position specification rows (see field 6 in Table 1) specified to two decimal point precision. Values specified to higher precision are rounded to two decimal points. The cost of a single trade is computed as the signed traded quantity in contracts multiplied by the compression price minus the TPH specified *theo* value of the option. Since both the TPH-specified *theo* and the exchange sourced compression prices are expressed per contract, the trade cost is the contracts-traded weighted difference of the compression price and TPH specified *theo*. The total cost of the multilateral compression portfolio to a participating TPH is the sum of the cost of all trades in the compression portfolio in which the TPH participates.

TPHs specify the maximum cost (net debit) they are willing to incur in a multilateral compression. The CCS does not provide the ability to specify a minimum cost (net credit) they are willing to receive. It is assumed that TPHs are willing to book any level of mark to market gain while receiving capital regulatory benefit that satisfies risk constraints. To specify the maximum cost (debit) TPHs provide a non-negative value in cost field (10) of the maximum value row (3), where a value of zero indicates they are not willing to accept any net debit and a positive value is the maximum net debit they would be willing to incur in a multilateral compression. The CCS accepts the maximum cost value with two decimal point precision (i.e., cost in dollar terms). Values specified with higher precision are rounded to two decimal points.

In addition to specifying a limit to the net cost that a TPH is willing to incur in a compression portfolio, TPHs further specify a limit on the cost per unit of regulatory capital benefit received. In the event that the maximum cost is not reached, the maximum cost per unit of benefit ensures that TPHs receive a minimum amount of benefit for each dollar “spent” in a compression. TPHs specify the maximum cost per unit of benefit by providing a non-negative value in the *cost_benefit* field (11) of the maximum value row (3), where a value of zero indicates they are not willing to accept any net debit regardless of the amount of benefit delivered. The CCS accepts the maximum cost per unit of benefit value with six decimal point precision. Values specified to higher precision are rounded to six decimal points.

Consider a TPH that is willing to incur up to \$10,000 net debit in a compression. Further, the TPH wishes to constrain the maximum cost per unit of benefit such that \$1 of cost delivers \$1,000 of capital regulatory benefit. The maximum cost per unit of benefit in this example is 0.001000 (i.e., 1 / 1,000). The first three lines of the TPH input file encoding these maximum cost and maximum cost per unit of benefit constraints is shown in Figure 7 below:

Figure 7 - Multilateral compression input file preamble example

```

class,expiry,strike,put_call,qty,theo,close_benefit,reserved,reserved,cost,cost_benefit
,,,,,,,,,
,,,,,,,,,10000.00,0.001000

```

3.4.4 Custom Risk Profile Constraints

In addition to placing limits on mark to market cost of compression, TPHs require the ability to constrain the risk profile of compression portfolios to suit TPH-specific risk tolerance and methodology for expressing risk limits. Rather than imposing a predefined regimen that limits the manner in which TPHs can specify risk constraints to a set of predefined methods, algorithms and analytics, Cboe has designed a unit and algorithm agnostic mechanism that allows TPHs to specify risk constraints in any manner they choose and at any level of granularity, effectively without limits.

TPHs can specify an unlimited number³⁴ of custom constraints by adding columns to the required 11 column specification presented above. Each new column represents a new custom constraint. The header row (1) element in a new column is the constraint label, or name, that will be used to uniquely identify the custom constraint in output files presented below. Custom constraint labels must be unique among the set of custom constraints, and like all other fields in the input file specification, cannot contain embedded commas, and the use of double-quotes to escape label strings with embedded commas is not supported. The row 2 and row 3 values in a new column contain the TPH specified minimum and maximum value for the custom constraint respectively, specified to two decimal point precision. Values specified with higher precision are rounded to two decimal points. Custom constraint minimum values must be <= 0.0 and maximum values must be >= 0.0. The reason for this requirement is to ensure that zero traded contracts assigned to an over-constrained submission will satisfy all custom risk constraints without exception. The position row (rows 4 and above) values in a custom constraint column contain a signed floating point value representing the contribution to the constraint of one long contract traded in the option associated with the position row, specified to six decimal point precision. Values specified to higher precision are rounded to six decimal points. Every position row must contain a value for every custom constraint with zeros indicating the associated option does not contribute to the constraint. The result is that every row in the input file contains the same number of comma separated values, which is one of many validation checks applied to input files uploaded to the CCS.

The following simple example introduces the custom constraint design using a hypothetical input file comprising two distinct expirations (SPXW expiring 2021-12-31 and SPX expiring 2022-03-18). The *theo* and custom constraint values in the example use the Black76 model with underlying of 4,000, time to maturity of 0.50 and 0.75 for the

³ TPHs that opt-in to multilateral compression are required to specify at least one custom constraint. Submissions for multilateral compression with no custom constraints are indicative of an operator or system error and are thus prevented from participating. Risk constraints to specify boundaries for acceptable portfolio risk and imbalance are a critical aspect of ensuring that all participants receive only portfolios they are willing to accept, and as a result, unconstrained input submissions are disallowed at upload time.

⁴ CCS imposes a maximum of 1,000 custom risk constraints to ensure system integrity. Cboe reserves the right to change the limit on the maximum number of custom constraints in the future in the interest of delivering maximum compression benefit to all participating TPHs in the relatively short compression window. Any change to the maximum number of custom constraints will be announced in a Trade Desk notice.

two expirations, implied volatility of 20% and an interest rate of zero. The *close_benefit* values are computed using a common RWA-based formula. The position quantity is arbitrarily set to long 50 contracts for all options in the example. Maximum cost and cost per unit benefit constraint values of \$10,000 and 0.001 from the above example are specified.

In this example, the TPH wishes to constrain the delta of the compression portfolio trades in each expiration to within +/-500 and across the entire portfolio (i.e., all expirations) to +/-750. In order to constrain the net delta on the first expiration (2021-12-31) to within +/-500, the TPH defines a custom constraint labeled “c_1” with minimum and maximum values specified as -500 and 500 respectively, and the values associated with each option of the 2021-12-31 expiration are assigned the Black76 delta multiplied by the contract multiplier of 100. Zeros are specified for the constraint value associated with any expiration other than 2021-12-31. Likewise, in order to constrain the net delta on the second expiration (2022-03-18) to within +/- 500, the TPH defines a second custom constraint labeled “c_2” with minimum and maximum values specified as -500 and 500 respectively, and the values associated with each option of the 2022-03-18 expiration are assigned the Black76 delta multiplied by the contract multiplier of 100. Zeros are specified for the constraint value associated with any expiration other than 2022-03-18. Finally, in order to constrain the overall portfolio net delta to within +/-750, the TPH defines a third custom constraint labeled “c_3” with minimum and maximum values of -750 and 750 respectively, and the values associated with all options set to their respective Black76 delta multiplied by the contract multiplier of 100.

Figure 8 – Example CCS input with custom risk constraints

class	expiry	strike	put_call	qty	theo	close_benefit	rsvd	rsvd	cost	cost_benefit	c_1	c_2	c_3
									10000.00	0.001000	-500.00	-500.00	-750.00
											500.00	500.00	750.00
SPXW	2021-12-31	3500	C	50	51578.16	5964.00					91.702175	0.000000	91.702175
SPXW	2021-12-31	3500	P	50	1578.16	5964.00					-8.297825	0.000000	-8.297825
SPXW	2021-12-31	4000	C	50	15951.04	6816.00					51.993881	0.000000	51.993881
SPXW	2021-12-31	4000	P	50	15951.04	6816.00					-48.006119	0.000000	-48.006119
SPXW	2021-12-31	4500	C	50	2488.42	7668.00					12.969579	0.000000	12.969579
SPXW	2021-12-31	4500	P	50	52488.42	7668.00					-87.030421	0.000000	-87.030421
SPX	2022-03-18	3000	C	50	100378.58	5112.00					0.000000	84.492807	98.235130
SPX	2022-03-18	3000	P	50	378.58	5112.00					0.000000	-15.507193	-1.764870
SPX	2022-03-18	4000	C	50	22548.79	6816.00					0.000000	52.818599	52.818599
SPX	2022-03-18	4000	P	50	22548.79	6816.00					0.000000	-47.181401	-47.181401
SPX	2022-03-18	5000	C	50	1545.57	8520.00					0.000000	22.298788	6.588579
SPX	2022-03-18	5000	P	50	101545.57	8520.00					0.000000	-77.701212	-93.411421

Figure 8 above is a table-based presentation of a CCS input file. The actual formatted CSV file content of the example is shown in Figure 9 below.

Figure 9 - CSV formatted example CCS input with custom risk constraints

```
class,expiry,strike,put_call,qty,theo,close_benefit,rsvd,rsvd,cost,cost_benefit,c_1,c_2,c_3
,,,,,,,,,-500.00,-500.00,-750.00
,,,,,,,,,10000.00,0.001000,500.00,500.00,750.00
SPXW,2021-12-31,3900,C,50,21253.36,6645.60,,,,,61.912292,0.000000,61.912292
SPXW,2021-12-31,3900,P,50,11253.36,6645.60,,,,,-38.087708,0.000000,-38.087708
SPXW,2021-12-31,4000,C,50,15951.04,6816.00,,,,,51.993881,0.000000,51.993881
SPXW,2021-12-31,4000,P,50,15951.04,6816.00,,,,,-48.006119,0.000000,-48.006119
SPXW,2021-12-31,4100,C,50,11639.87,6986.40,,,,,42.194267,0.000000,42.194267
SPXW,2021-12-31,4100,P,50,21639.87,6986.40,,,,,-57.805733,0.000000,-57.805733
SPX,2022-03-18,3900,C,50,27622.19,6645.60,,,,,0.000000,59.860371,59.860371
SPX,2022-03-18,3900,P,50,17622.19,6645.60,,,,,0.000000,-40.139629,-40.139629
SPX,2022-03-18,4000,C,50,22548.79,6816.00,,,,,0.000000,52.818599,52.818599
SPX,2022-03-18,4000,P,50,22548.79,6816.00,,,,,0.000000,-47.181401,-47.181401
SPX,2022-03-18,4100,C,50,18177.18,6986.40,,,,,0.000000,45.862735,45.862735
SPX,2022-03-18,4100,P,50,28177.18,6986.40,,,,,0.000000,-54.137265,-54.137265
```

Figures 8 and 9 are a complete, albeit trivial, example of a TPH upload to the CCS for multilateral compression that specifies cost constraints and risk exposure constraints comprising per-expiration and portfolio-level delta bounds. In practice, input files may contain 30 or more distinct expirations, each with 500 or more distinct listed option positions. TPHs will generally add custom constraints to manage other Greek exposures (e.g., gamma, vega, etc.) proprietary measures. Constraints can be defined by expiration, by strike region within expirations, across groups of nearby expiration, etc. In practice, it is not uncommon for TPHs to specify well over 100 custom constraints, and much more for some TPHs requiring fine-grained control of acceptable compression portfolio exposure profiles.

It should be noted that in the specification of custom constraints, no assumptions have been made other than a constraint has TPH-specified value associated with one long contract executed in the option, with zeros indicating the constraint does not apply to a particular option. As a result, TPHs can constrain portfolios using any metrics, whether option model based or any other measure. For example, using a nonsensical example, if a TPH wanted to limit the number traded contracts to 100,000, they could add a custom constraint with values of -1.0 for long positions and 1.0 for short positions with a minimum value of 0 and a maximum value of 100,000. The traded quantity weighted sum of the constraint values would then be equal to the total number of contracts traded, which would be limited to 100,000 by the CCS multilateral compression algorithm for the TPH specifying the constraint. As a result of the CCS unit-agnostic approach to custom constraint specification, TPHs can implement any constraint regimen that fits their internal risk processes and quantitative methods rather than being required to operate within a prescriptive exchange specified framework.

4 CCS Output File Specifications

This section specifies the content and format of output files that are provided to TPHs in the workflow presented in Figure 1 above.

4.1 Multilateral Compression Portfolio Output Files

TPHs that opt-in to multilateral compression are presented with trade and detail output files at the end of the compression window. The output files contain detail sufficient for TPHs to quickly analyze the trades comprising a compression portfolio, and to confirm that all specified constraints are satisfied by the set of trades.

The following sections present the format and content of each type of multilateral compression output file. The output file examples presented below are output from a hypothetical compression using the CCS input file presented in Figure 9 above.

4.1.1 Compression Portfolio Trade File

The compression portfolio trade file is a CSV formatted file summarizing the non-zero traded quantities of each option comprising a compression portfolio in simple trade blotter form. The trade file contains one line per option that trades in the compression portfolio and options with zero traded quantity are not represented. Table 2 below presents the field definition of the compression trade output file.

Table 2 - Compression trade file field definition

Field	Description
class	SPX or SPXW.
expiry	Expiration date in YYYY-MM-DD format.
strike	Option strike price.
put_call	P or C.
trade_qty	Signed integer traded quantity in contracts where positive is buy and negative is sell.
trade_price	Unsigned floating point trade price.

Figure 10 below presents an example CSV formatted output from a hypothetical compression using the TPH input from Figure 9 above. The trade file output in Figure 9 is the trade-level output corresponding to the detail level output presented in the next section.

Figure 10 - CSV formatted example trade output file

```
class,expiry,strike,put_call,trade_qty,trade_price
SPXW,2021-12-31,3900.000,C,-20,214.06
SPXW,2021-12-31,3900.000,P,-25,114.06
SPXW,2021-12-31,4000.000,C,-50,161.10
SPXW,2021-12-31,4000.000,P,-50,161.10
SPX,2022-03-18,4000.000,C,-50,223.46
SPX,2022-03-18,4000.000,P,-50,223.46
SPX,2022-03-18,4100.000,C,-10,179.75
SPX,2022-03-18,4100.000,P,-10,279.75
```

Note on trade_qty vs. actual trade fills – The trade file contains one row per option that trades in the compression portfolio. The value of trade_qty is the total contracts that the TPH will trade in the associated option long or short. The traded quantity may be filled with a single crossing trade fill with a single contra TPH or may be allocated to

multiple fills with multiple contra TPHs. Regardless, the total traded quantity across one or more fills will sum to the value represented in the trade file, and the price of all trades for the one or more fills will be the value of trade_price contained in the trade file. In other words, the number of rows in the trade file may not match the trade fill count cleared as a result of the compression portfolio.

4.1.2 Compression Portfolio Detail File

The compression portfolio detail file is a CSV formatted file that TPHs use to access all quantitative details behind the compression portfolio. All constraint value calculations are presented in a manner that allows TPHs to quickly confirm that constraints are satisfied, which constraints may be up against specified limits, and trade and portfolio cost details. This file is an indispensable tool for TPHs to understand their specific contribution to a multilateral compression portfolio, and how their constraint specification is controlling the regulatory capital benefit they receive from a compression. Careful analysis of this file enables TPHs to quickly determine that they can approve the portfolio based on the portfolio details and their specified constraints.

The detail output file contains nearly the same content as the TPH input file with additional columns and calculations added to enable the TPH to observe and easily reproduce all constraint calculations. The detail output file contains exactly the same number of rows as the input file, presented in the same order as the positions in the original input file, with addition of one new row. A new row –the aggregate value row - inserted immediately after the header row (i.e., row 2) contains the calculated value of cost, cost_benefit and all custom constraints. Four new columns (fields) –traded_qty, residual_qty, compression_price and total_benefit – are added to the detail file to provide complete transparency on constraint calculations. The fields with “(ADDED)” at the beginning of the description correspond to the new columns.

Table 3 - Compression detail file field definition

Field	Description
class	SPX or SPXW.
expiry	Expiration date in YYYY-MM-DD format.
strike	Option price as a floating point numeric value.
put_call	P or C.
qty	Signed integer contract position where positive is a long position and negative is a short position.
traded_qty	(ADDED) Signed integer traded quantity in contracts. Zero indicates no trade in the option.
residual_qty	(ADDED) Remaining contracts of original position after compression (i.e., qty – traded_qty).
theo	TPH specified non-negative floating point value one long contract of the associated option.
compression_price	(ADDED) CCS system sourced compression trade prices derived from options markets at 16:00 ET.
close_benefit	Non-negative floating point value representing the TPH assessment of the capital requirements benefit resulting from reduction of the position by a single contract (long or short).
reserved	Reserved for future use, will be null
reserved	Reserved for future use, will be null
total_benefit	(ADDED) Position row values contain the absolute traded quantity weighted close_benefit for each option. The aggregate value row contains the sum of the position row values, which is the total benefit delivered to the TPH as a result of the compression portfolio.
cost	Column contains the TPH-specified max cost constraint in the maximum value row (3). Option position rows contain the traded quantity weighted compression_price minus theo, which is the mark to market cost of the trade on each option. The aggregate value row contains the sum of the position row values, which is the total mark to market cost of the portfolio accrued by the TPH. Comparison of the total cost value to the TPH-specified max cost value confirms max cost constraint is met.

cost_benefit	Column contains the TPH-specified max cost per unit of benefit value in the maximum value row. The aggregate value row contains the total portfolio cost divided by the total benefit, which is the cost per unit of benefit of the portfolio. Comparison of this value to the TPH-specified max value confirms that the max cost per unit of value constraint is met.
[custom constraints]	A column will appear in the detail output file for each custom constraint defined by the TPH in the input file. The minimum and maximum values for each custom constraint are written to the minimum (2) and maximum value (3) rows respectively. The option position row values contain the traded quantity weighted value of the TPH-specified constraint value for the option in the input file. The aggregate value row contains the sum of the position row values, which is the value of the TPH-specified constraint resulting from the compression portfolio. Comparison of this value to the TPH-specified minimum and maximum values confirms the custom constraint is satisfied by the portfolio.

Figure 11 below corresponds to a hypothetical compression portfolio resulting from a TPH submitting the input from Figures 8 and 9 above and comprising trades in the example trade level output file in figure 10 above. Note the reserved columns that would be present in an actual file have been removed to save space.

Important – To approve or reject a portfolio, the TPH must enter an “approval token” found in the first token in the second row (aggregate value row) of the detail output file. The reason for this step is to ensure that the TPH approver has accessed, opened and processed the content of the detail file before approving the compression portfolio.

Aside from the shaded aggregate value row and the shaded columns, the structure of the file is exactly the same as the structure of the input file. The added row immediately after the header row contains computed constraint values that can be visually compared to TPH specified constraint minimum and maximum values in the next two rows to confirm constraints are satisfied. The italicized values are computed values that replace the associated values specified in the input file. Specifically, the values in the cost column associated with each option position, which were null in the input file, are replaced with the cost of the option trade computed as the traded quantity in contracts (*traded_qty*) multiplied by the difference between the compression price (*compression_price*) and the TPH specified *theo* value. The sum of each trade cost, which is the total portfolio cost to the TPH, is contained in the aggregate value row (2) of the cost column. The option position values associated with each custom constraint have been replaced with signed traded quantity (*traded_qty*) multiplied by the TPH specified constraint value, which represented the constraint contribution associated with one long contract executed in the associate option. The sum of the traded quantity weighted constraint values is contained in the aggregate value row for each custom constraint.

Figure 11 - Example compression detail output file

class	expiry	strike	put_call	qty	traded_qty	residual_qty	theo	compression_price	close_benefit	total_benefit	cost	cost_benefit	c_1	c_2	c_3
1079										1801980.00	1502.35	0.000834	-485.44	-199.11	-684.56
											10000.00	0.001000	500.00	500.00	750.00
													-500.00	-500.00	-750.00
SPXW	2021-12-31	3900	C	50	-20	30	21,253.36	21,405.81	6,645.60	132912.00	-3049.11		-1238.245847	0.000000	-1238.245847
SPXW	2021-12-31	3900	P	50	-25	25	11,253.36	11,405.81	6,645.60	166140.00	-3811.39		952.192691	0.000000	952.192691
SPXW	2021-12-31	4000	C	50	-50	0	15,951.04	16,110.42	6,816.00	340800.00	-7968.78		-2599.694029	0.000000	-2599.694029
SPXW	2021-12-31	4000	P	50	-50	0	15,951.04	16,110.42	6,816.00	340800.00	-7968.78		2400.305971	0.000000	2400.305971
SPXW	2021-12-31	4100	C	50	0	50	11,639.87	11,796.43	6,986.40	0.00	0.00		0.000000	0.000000	0.000000
SPXW	2021-12-31	4100	P	50	0	50	21,639.87	21,796.43	6,986.40	0.00	0.00		0.000000	0.000000	0.000000
SPX	2022-03-18	3900	C	50	0	50	27,622.19	27,425.34	6,645.60	0.00	0.00		0.000000	0.000000	0.000000
SPX	2022-03-18	3900	P	50	0	50	17,622.19	17,425.34	6,645.60	0.00	0.00		0.000000	0.000000	0.000000
SPX	2022-03-18	4000	C	50	-50	0	22,548.79	22,346.19	6,816.00	340800.00	10130.28		0.000000	-2640.929944	-2640.929944
SPX	2022-03-18	4000	P	50	-50	0	22,548.79	22,346.19	6,816.00	340800.00	10130.28		0.000000	2359.070056	2359.070056
SPX	2022-03-18	4100	C	50	-10	40	18,177.18	17,975.19	6,986.40	69864.00	2019.92		0.000000	-458.627345	-458.627345
SPX	2022-03-18	4100	P	50	-10	40	28,177.18	27,975.19	6,986.40	69864.00	2019.92		0.000000	541.372655	541.372655

The detail file in Figure 11 shows that as a result of the trades in 8 of the 12 submitted options, the total cost of the portfolio is \$1,502.35, which satisfies the max cost constraint of \$10,000. The cost per unit of benefit is 0.000834, which satisfies the max cost per unit benefit value of 0.001. The custom constraint c_1 value of -485.44, c_2 value of -199.11, and c_3 value of -684.56 all satisfy the TPH specified minimum/maximum values of +/-500, +/-500 and +/-750 respectively.

When the TPH returns to the CCS portal to approve the portfolio, they are prompted to enter the approval token. The TPH uses the value of the first field in the aggregate value row as the approval token. In the example in Figure 11 above, the TPH would enter the value 1079.

Figure 11 above is a table-based representation of a detail output file. Figure 12 below is the actual CSV formatted content with that would correspond to Figure 11.

Figure 12 - CSV formatted compression detail output file

```
class,expiry,strike,put_call,qty,traded_qty,residual_qty,theo,compression_price,close_benefit,reserved,reserved,total_benefit,cost,cost_benefit,c_1,c_2,c_3
1079,,,,,,,,,1801980.00,1502.35,0.000834,-485.44,-199.11,-684.56
,,,,,,,,,-500.00,-500.00,-750.00
,,,,,,,,,10000.00,0.001000,500.00,500.00,750.00
SPXW,2021-12-31,3900,C,50,-20,30,21253.36,21405.81,6645.60,,132912.00,-3049.11,-1238.245847,0.000000,-1238.245847
SPXW,2021-12-31,3900,P,50,-25,25,11253.36,11405.81,6645.60,,166140.00,-3811.39,952.192691,0.000000,952.192691
SPXW,2021-12-31,4000,C,50,-50,0,15951.04,16110.42,6816.00,,340800.00,-7968.78,-2599.694029,0.000000,-2599.694029
SPXW,2021-12-31,4000,P,50,-50,0,15951.04,16110.42,6816.00,,340800.00,-7968.78,2400.305971,0.000000,2400.305971
SPXW,2021-12-31,4100,C,50,0,50,11639.87,11796.43,6986.40,,0.00,0.00,0.000000,0.000000,0.000000
SPXW,2021-12-31,4100,P,50,0,50,21639.87,21796.43,6986.40,,0.00,0.00,0.000000,0.000000,0.000000
SPX,2022-03-18,3900,C,50,0,50,27622.19,27425.34,6645.60,,0.00,0.00,0.000000,0.000000,0.000000
SPX,2022-03-18,3900,P,50,0,50,17622.19,17425.34,6645.60,,0.00,0.00,0.000000,0.000000,0.000000
SPX,2022-03-18,4000,C,50,-50,0,22548.79,22346.19,6816.00,,340800.00,10130.28,0.000000,-2640.929944,-2640.929944
SPX,2022-03-18,4000,P,50,-50,0,22548.79,22346.19,6816.00,,340800.00,10130.28,0.000000,2359.070056,2359.070056
SPX,2022-03-18,4100,C,50,-10,40,18177.18,17975.19,6986.40,,69864.00,2019.92,0.000000,-458.627345,-458.627345
SPX,2022-03-18,4100,P,50,-10,40,28177.18,27975.19,6986.40,,69864.00,2019.92,0.000000,541.372655,541.372655
```


4.2 Match File Specification

TPHs that opt-in to match data service receive four match files containing details on contra TPHs with which they can cross the following structure positions:

- Outright match file containing all possible outright option crossings
- Spread match file containing all possible put spread and call spread crossings
- Combo match file containing all possible combo crossings (synthetic long and short positions)
- Box spread match file containing all possible box spread crossings

The following sections present the format of each of the four match file types. In each of the file format specifications, the first field (*option_id*) is an opaque identifier for each match structure within the match file. Note that an *option_id* value may appear multiple times in a match file if the identical structure can be crossed with multiple contra TPHs. The combination of *option_id* and *tph_2* will be unique in each file. TPHs should not attempt to parse *option_id* as Cboe reserves the right to change the design of the *option_id* value.

4.2.1 Outright Match File Format

Table 4 presents the definition and format of the fields of the outright match File. The values in the Field column are exactly the values contained in the header row for the associated field.

Table 4 - Outright match file field definition

Field	Description
option_id	Opaque unique identifier for the outright match associated with the row.
class	SPX or SPXW.
expiry	Expiration date in YYYY-MM-DD format.
strike	Strike price as floating point numeric value.
put_call	P or C.
tph_1	TPH firm identifier.
tph_2	Firm identifier of the contra TPH.
tph_1_size	Outright position size in TPH submission where positive is long and negative is short.
compress_qty	Unsigned crossing quantity possible between TPH and contract TPH. By definition, the contra TPH position is the opposite sign of the TPH position, and the compress_qty is the minimum of the TPH and contra TPH absolute size.

Figure 13 below is an example of the outright match file format.

Figure 13 - Example outright match file

```
option_id,class,expiry,strike,put_call,tph_1,tph_2,tph_1_size,compress_qty
SPXW202012243700C,SPXW,2020-12-24,3700,C,TPH1,TPH2,100,20
SPXW202012243700C,SPXW,2020-12-24,3700,C,TPH1,TPH3,100,50
SPXW202012243700P,SPXW,2020-12-24,3700,P,TPH1,TPH2,-100,20
SPXW202012243700P,SPXW,2020-12-24,3700,P,TPH1,TPH3,-100,50
SPXW202012243800C,SPXW,2020-12-24,3800,C,TPH1,TPH2,-100,20
SPXW202012243800C,SPXW,2020-12-24,3800,C,TPH1,TPH3,-100,50
SPXW202012243800P,SPXW,2020-12-24,3800,P,TPH1,TPH2,100,20
SPXW202012243800P,SPXW,2020-12-24,3800,P,TPH1,TPH3,100,50
...
```

4.2.2 Spread Match File Format

Table 5 presents the definition and format of the fields of the spread match File. The values in the Field column are exactly the values contained in the header row for the associated field.

Table 5 - Spread match file field definition

Field	Description
option_id	Opaque unique identifier for the spread match associated with the row.
class	SPX or SPXW.
expiry	Expiration date in YYYY-MM-DD format.
strike_1	Lower strike price of the spread (always < strike_2).
strike_2	Upper strike price of the spread (always > strike_1).
put_call	P or C, P indicates Put Spread and C indicates Call Spread.
tph_1	TPH firm identifier.
tph_2	Firm identifier of the contra TPH.
tph_1_size	Size of the spread position contained in TPH submission. Positive value indicates long strike_1 and short strike_2. Negative value indicates short strike_1 and long strike_2. The magnitude of the value will be the minimum of the TPH absolute position on strike_1 and strike_2 as spreads are defined as equal and opposite size on each leg.
compress_qty	Unsigned crossing quantity possible between TPH and contract TPH in the spread position. By definition the contra TPH position is opposite sign of the TPH position and the compress_qty is the minimum of the TPH and contra TPH absolute size.

Figure 14 below is an example of the spread match file format.

Figure 14 - Example outright match file

```
option_id,,class,expiry,strike_1,strike_2,put_call,tph_1,tph_2,tph_1_size,compress_qty
SPXW202012243700CSPXW202012243800C,SPXW,2020-12-24,3700,3800,C,TPH1,TPH2,100,20
SPXW202012243700CSPXW202012243800C,SPXW,2020-12-24,3700,3800,C,TPH1,TPH3,100,50
SPXW202012243700PSPXW202012243800P,SPXW,2020-12-24,3700,3800,C,TPH1,TPH2,-100,20
SPXW202012243700PSPXW202012243800P,SPXW,2020-12-24,3700,3800,C,TPH1,TPH3,-100,50
...
```

4.2.3 Combo Match File Format

Table 6 presents the definition and format of the fields of the combo match File. The values in the Field column are exactly the values contained in the header row for the associated field.

Table 6 - Combo match file field definition

Field	Description
option_id	Opaque unique identifier for the combo match associated with the row.
class	SPX or SPXW.
expiry	Expiration date in YYYY-MM-DD format.
strike	Lower strike price of the combo.
tph_1	TPH firm identifier.
tph_2	Firm identifier of the contra TPH.
tph_1_size	Size of the combo position contained in TPH submission. Positive value indicates long call and short put on the strike (i.e., synthetic long). Negative value indicates short call and long put (i.e., synthetic shot). The magnitude of the value will be the minimum of the TPH absolute position on put and call as combos are defined as equal and opposite size on the put and call at same strike.

compress_qty	Unsigned crossing quantity possible between TPH and contract TPH in the combo position. By definition the contra TPH position is opposite sign of the TPH position and the compress_qty is the minimum of the TPH and contra TPH absolute size.
--------------	---

Figure 15 below is an example of the combo match file format.

Figure 15 - Example combo match file

```
option_id,class,expiry,strike,tph_1,tph_2,tph_1_size,compress_qty
SPXW202012243700CSPXW202012243700P,SPXW,2020-12-24,3700,TPH1,TPH2,100,20
SPXW202012243700CSPXW202012243700P,SPXW,2020-12-24,3700,TPH1,TPH3,100,50
SPXW202012243800CSPXW202012243800P,SPXW,2020-12-24,3800,TPH1,TPH2,100,20
SPXW202012243800CSPXW202012243800P,SPXW,2020-12-24,3800,TPH1,TPH3,100,50
...
```

4.2.4 Box Spread File Format

Table 7 presents the definition and format of the fields of the Box Spread Match File. The values in the Field column are exactly the values contained in the header row for the associated field.

Table 7 - Box spread match file field definition

Field	Description
option_id	Opaque unique identifier for the box spread match associated with the row.
class	Case sensitive SPX or SPXW.
expiry	Expiration date in YYYY-MM-DD format.
strike_1	Lower strike price of the box spread.
strike_2	Upper strike price of the box spread.
tph_1	TPH firm identifier.
tph_2	Firm identifier of the contra TPH.
tph_1_size	Size of the box spread position contained in TPH submission. Positive value indicates long call and short put on strike_1, and short call and long put on strike_2. Negative value indicates short call and long put on strike_1, and long call and short put on the strike_2. The magnitude of the value will be the minimum of the TPH absolute position on all four legs box spreads are defined as equal absolute size on all four legs.
compress_qty	Unsigned crossing quantity possible between TPH and contract TPH in the combo position. By definition the contra TPH position is opposite sign of the TPH position and the compress_qty is the minimum of the TPH and contra TPH absolute size.

Figure 16 below is an example of the box spread match file format.

Figure 16 - Example box spread match file

```
option_id,class,expiry,strike_1,strike_2,tph_1,tph_2,tph_1_size,compress_qty
SPXW202012243700CSPXW202012243700PSPXW202012243800CSPXW202012243800P,SPXW,2020-12 24,3700,3800,TPH1,TPH2,100,20
SPXW202012243700CSPXW202012243700PSPXW202012243800CSPXW202012243800P,SPXW,2020-12-24,3700,3800,TPH1,TPH3,100,50
...
```

Revision History

Version	Date	Description
1.0.0	05/05/21	Initial major revision corresponding to the introduction of Multilateral Compression functionality in the Cboe Compression Service.
1.0.1	05/21/21	Clarified guidance on floating point numeric input precision required for TPHs to be able to exactly replicate constraint values in compression detail output files. Added separate step to Figure 1 workflow to separate FIX Drop from Multicast PITCH and TOP compression trade dissemination.
1.0.2	06/07/21	Clarified that FLEX options not supported. Clarified that expired or contracts expiring the day of compression are not allowed for both Multilateral Compression and Match Data Service input files. Specified at least one custom risk constraint required in Multilateral Compression input. All zero close_benefit values not allowed in Multilateral Compression input. Custom risk constraint minimum values must be ≤ 0.0 and maximum values must be ≥ 0.0 . Clarified that the Multilateral Compression trade output file presents total traded quantity for each option, whereas actual trades may comprise multiple fills per option.
1.0.3	06/18/21	Updated intraday timeline for hybrid multilateral and match data service, and match data service only days to reflect additional 10 minutes to upload files (cutoff now 16:50 ET). For multilateral dates, after 15 minutes of computation time, TPHs have 23 minutes between 17:05 and 17:28 to approve the compression portfolio.
1.0.4	07/02/21	Clarified that specification of max_cost_benefit value is required and not optional.
1.0.5	07/28/21	Added Clearing Capacity with allowed values M, N and F to the Service Registration section. Clarified that Market Maker Clearing Account required only if Clearing Capacity is M or N. Updated workflow to add Trade Data and Trade Details files to the methods by which TPHs can access CCS trade information from the exchange.
1.0.6	08/12/21	Removed document effective date as multilateral compression is now in production.
1.0.7	10/12/21	Indicated that compression schedule changes will be announced to certified TPHs via direct communication. Narrative regarding use of unconstrained mirror compression as part of the certification process was removed and will be updated in a future release.