Coastal Oceanographics, Inc.

Technical Note:

HSX Format - Hysweep Text (ASCII) Logging

Hysweep survey has a Text logging option (HSX format), allowing raw data to be stored in a format that can be inspected and modified by most editing program (Windows Wordpad for example). Easy inspection of files is the advantage of text logging - the disadvantage is larger files and slower load time. If file size and load time are important to you, it is best to choose the Hysweep binary format (HS2).

HSX files are generally compatible with Hypack Survey raw format, allowing Hypack programs (Hypack Max, Hyplot, etc.) to work with HSX files. The differences involve logging and processing of multibeam data, which is by the Hysweep extensions to Hypack.

Each file contains two sections; a header, which is written when data logging starts, and a data section, which is written as data is collected. Most records starts with a three character tag.

HSX Format Versions:

29-Mar-2000	0	Hypack Max Release 0.4
11-Sep-2000	1	Hypack Max Release 0.5
18-Jun-2001	2	Hypack Max Release 0.5B
05-Jun-2003	3	Hypack Max Release 2.12A Remove TFP (tow fish position) records.
09-Mar-2004	4	Hypack Max Release 4.3 Add HVF records
18-Sep-2004	5	Hypack flag “SVP corrected” to MBI and RMB records.
24-Aug-2005	5	Correct mistakes in RMB examples.
24-Jan-2007	6	Add sonar settings to RMB records.
10-Oct-2007	6	Add sonar frequency (0 or 1) to RSS records.
07-Nov-2007	6	Add sonar ID to HSP records - Appendix A.
07-Nov-2007	6	Add SNR (sonar runtime settings) records – Appendix B.
18-May-2009	6	Add PSA records (pitch stabilization angle)
26-Jan-2010	7	Add Seabat 7K sonar runtime settings (Appendix B).

Tags:

Header

DEV – Hypack Device Information
DV2 – Hysweep Device Information
EOH - End of Header
EOL - End of Planned Line
FTP – File Type (Hypack File Identifier)
HSP – Hysweep Survey Parameters
HSX – HSX File Identifier
HVF – Hysweep View Filters
INF - General Information
LBP - Planned Line Begin Point
LIN - Planned Line Data follows
LNN - Planned Line Name
MBI – Multibeam / Multiple Transducer Device information
0F2 – Hysweep Device Offsets
PRI - Primary Navigation Device
PTS - Planned Line Waypoint
SSI – Sidescan Device Information
SVC – Sound Velocity Correction
TND - Survey Time and Date

Data

DFT – Dynamic Draft (Squat) Correction
FIX - Fix (Event) Mark
HCP - Heave Compensation
EC1 - Echo Sounding (single frequency)
GPS – GPS Measurements
GYR - Gyro Data (Heading)
POS - Position
PSA – Pitch Stabilization Angle.
RMB – Raw Multibeam data
RSS – Raw Sidescan data
SNR – Sonar Runtime Settings
TID – Tide Correction

Header Section

DEV - Device Information
DEV dn dc “name”

dn: Device Number
dc: Hypack device capabilities (bit code):
1, 2, 4, 8 – Position
16 – depth
32 – heading
512 – MRU
32768 – extended capabilities

name: Device Name

Example (GPS positions, speed and heading):
DEV 0 100 "GPS"

DV2 – Hysweep Device Information
DV2 dn dc tf en

dn: device number
dc: Hysweep device capabilities (bit coded hexadecimal – Appendix C)
0001 - Multibeam Sonar
0002 - Multiple Transducer sonar
0004 - GPS (Boat Position)
0008 - Sidescan Sonar
0010 - Single Beam Echosounder
0020 - Gyro (boat heading)
0040 - Tide
0200 - MRU (heave, pitch and roll compensation)

tf: 1 if device is mounted on a tow fish
en: 1 if device is enabled

Example:
DV2 0 1 0 1

EOH - End of Header
This tag simply indicates end of header and has no data.

EOL - End of Planned Line
This tag simply indicates end of planned line information - no data.

FTP – File Type (Hypack File Identifier)
FTP NEW 2
Identifies Hypack 8.9 raw file. Always 1st record in file.

HSP – Hysweep Survey Parameters
HSP p1 p2 p3 p4 p5 p6 p7 p8 p9 p10 p11 p12
p1: minimum depth in work units
p2: maximum depth in work units
p3: port side offset limit in work units
p4: starboard side offset limit in work units
p5: port side beam angle limit in degrees
p6: starboard side beam angle limit in degrees
p7: high beam quality; codes >= this are good
p8: low beam quality: codes < this are bad
p9: sonar range setting in work units
p10: towfish layback in work units
p11: work units: 0=meters, 1=us foot, 2=int’l foot
p12: sonar id for advanced processing (appendix A)

Example:
HSP 5.0 45.0 160.0 150.0 60 60 3 1 328.0 0.0 1

HSX – HSX File Identifier
HSX vn
vn: HSX format version number. Always 2nd record in file.

HVF – Hysweep View Filters
HVF dn tt p1 p2 p3 p4 p5 p6
dn: dummy device number, always = 99
tt: time tag this filter set became active (in seconds past midnight)
p1: minimum depth in work units
p2: maximum depth in work units
p3: port side offset limit in work units
p4: starboard side offset limit in work units
p5: minimum beam angle limit, 0 to -90 degrees
p6: maximum beam angle limit, 0 to 90 degrees

Example:
HVF 99 59695.039 10.0 50.0 100.0 100.0 -90.0 90.0

INF - General Information
INF "surveyor" "boat" "project" "area" tc dc sv

tc: initial tide correction
dc: initial draft correction (boat)
sv: sound velocity

example:
INF "steve" "LCH 19" "mcmillen" "617.6 to 618.2" -0.70 0.00 1500.0

LBP - Planned Line Begin Point.
LBP x y
x: x grid position
y: y grid position

Example:
LBP 5567222.42 3771640.72

LIN - Planned Line Data follows
LIN nw
nw: Number of waypoints

Example:
LIN 5

LNN - Planned Line Name
LNN text
text: line name or number

Example:
LNN 14

MBI – Multibeam / Multiple Transducer Device information
MBI dn st sf bd n1 n2 fa ai

dn: device number
st: sonar type code
0 – invalid
1 – fixed beam roll angles (e.g., Reson Seabat)
2 – variable beam roll angles (e.g., Seabeam SB1185)
3 – beam info in spherical coordinates (e.g., Simrad EM3000)
4 – multiple transducer (e.g., Odom Miniscan)

sf: sonar flags (bit coded hexadecimal – Appendix C)
0001 – roll corrected by sonar
0002 – pitch corrected by sonar
0004 – dual head

0008 – heading corrected by sonar (version 1)
0010 – medium depth: slant ranges recorded to 1 dm res. (version 2)
0020 – deep water: slant ranges divided by 1 m resolution (ver 2)
Note – default is shallow water: 1 cm resolution.
0040 – SVP corrected by sonar (version 5).
0080 - topographic device; upgoing beams accepted (version 6).

bd: beam data (bit coded hexadecimal – Appendix C)
0001 – beam ranges are available (work units)
0002 – sounding point easting available (work units)
0004 – point northing available (work units)
0008 – point corrected depth available (work units)
0010 – along track distance available (work units)
0020 – across track distance available (work units)
0040 – beam pitch angles available (degrees, TSS convention)
0080 – beam roll angles available (degrees, TSS convention)
0100 – beam takeoff angles available (degrees from vertical)
0200 – beam direction angles available (degrees from forward)
0400 – ping delay times included (milliseconds)
0800 – beam intensity data available
1000 – beam quality codes (from sonar unit) available
2000 – sounding flags included
4000 - spare
8000 – spare

n1: number of beams, head 1 (multibeam)
or number of transducers (multitransducer)

n2: number of beams, head 2 (multibeam)
fa: first beam angle is for sonar type = fixed angle (degrees, TSS convention)
ai: angle increment is for sonar type = fixed angle (degrees, TSS convention)

0F2 – Hysweep Device Offsets
OF2 dn on n1 n2 n3 n4 n5 n6 n7

dn: device number
on: offset number
0 – position antenna offsets
1 – gyro heading offset
2 – MRU device offsets
3 – Sonar head 1 / Transducer 1 offsets
4 – Sonar head 2 / Transducer 2 offsets
5 - Transducer 3 offsets
.
131 – Transducer 128 offsets

n1: Starboard / port mounting offset. Positive starboard.
n2: Forward / aft mounting offset. Positive forward
n3: Vertical mounting offset. Positive downward from waterline.
n4: Yaw rotation angle. Positive for clockwise rotation.
n5: Roll rotation angle. Port side up is positive.
n6: Pitch rotation angle. Bow up is positive.
n7: Device latency in seconds.

Example:
OF2 0 3 6.2 –1.3 6.1 2.15 -0.27 1.00 0.000

PRI - Primary Navigation Device
PRI dn
dn: device number

Example:
PRI 0

PTS - Planned Line Waypoint

PTS x y
x: waypoint easting in work units
y: waypoint northing in work units

Example:
PTS 5569134.63 3774182.61

SSI – Sidescan Device Information
SSI dn sf np ns

dn: device number
sf: sonar flags (bit coded hexadecimal – Appendix C)
0100 – amplitude is bit-shifted into byte storage

np: number of samples per ping, port transducer
ns: number of samples per ping, starboard transducer

SVC – Sound Velocity Correction
SVC bd ed sv

bd: layer begin depth in work units, referenced to water surface.
ed: layer end depth in work units
sv: layer sound velocity in **meters/second**

Normally, there will be many of these records contained in the file header. One for each layer (velocity zone) measured by the sound velocity profiler.

Example:
SVC 0.0 1.0 1481.66

TND - Survey Time and Date
TND t d
t: time string
d: date string

Example:
TND 15:54:33 08/28/95

Data Section

DFT – Dynamic Draft (Squat) Correction
DFT dn t dc
dn: device number or 99
t: time tag (seconds past midnight)
dc: draft correction

Example – draft correction of -0.30:
DFT 99 57273.81 –0.30

FIX - Fix (Event) Mark
FIX dn t n
dn: device number or 99
t: time tag (seconds past midnight)
n: event number

Example – event number 156:
FIX 99 57273.81 156

HCP - Heave Compensation
HCP dn t h r p
dn: device number
t: time tag (seconds past midnight)
h: heave in meters
r: roll in degrees (+ port side up)
p: pitch in degrees (+ bow up)

Example:
HCP 2 57273.81 0 3.61 0

EC1 - Echo Sounding (single frequency)
EC1 dn t rd
dn: device number
t: time tag (seconds past midnight)
rd: raw depth

Example:
EC1 0 48077.365 13.20

GPS – GPS measurements
GPS dn t cog sog hdop mode nsats
dn: device number
t: time tag (seconds past midnight)
cog: course over ground (degrees)
sog: speed over ground (knots)
hdop: GPS hdop
mode: GPS mode
0 – unknown
1 – stand alone
2 – differential
3 – rtk

nsats: number of satellites

Example:
GPS 0 57274.044 124.4 5.66 2.1 2 4

GYR - Gyro Data (Heading)
GYR dn t h
dn: device number
t: time tag (seconds past midnight)
h: ship heading angle

Example:

GYR 0 57274.04 193.71

POS - Position
POS dn t x y
dn: device number
t: time tag (seconds past midnight)
x: easting
y: northing

Example:
POS 0 57274.042 5569070.02 3774080.46

PSA – Pitch Stabilization Angle
PSA dn t pn a0 a1
dn: device number
t: time tag (seconds past midnight)
pn: ping number (or 0 if not tracked)
a0: projector (head 0) pitch angle.
a1: projector (head 1) pitch angle.

Note: PSA records are recorded only when pitch stabilization is active. They immediately proceed corresponding RMB records.

RMB – Raw Multibeam data
RMB dn t st sf bd n sv pn psa
dn: device number
t: time tag (seconds past midnight)
st: sonar type code (see MBI above)
sf: sonar flags (see MBI above)
bd: available beam data (see MBI above)
n: number of beams to follow
sv: sound velocity in m/sec
pn: ping number (or 0 if not tracked)

Immediately following the RMB record is a record containing slant ranges (multibeam) or raw depths (multiple transducer). Following the ranges are 0 to n additional records depending on the bd (beam data) field.

Example (Seabat 9001 storing slant ranges and quality codes):
RMB 1 27244.135 1 0 1001 1500.00 0 60
19.50 19.31 18.60 1.66 18.47 … (60 slant ranges in work units)
3 3 3 0 3 … (60 quality codes)

Example (multiple transducer storing 8 raw depths):
RMB 1 27244.135 4 0 1 1500.00 0 60
31.44 33.01 32.83 32.80 … (8 raw depths in work units)

Example (Dual-head Seabeam SB1185 storing range, beam pitch and roll angles, ping delay times, beam quality code and sounding flags):
RMB 1 27244.135 2 5 1481 1500.00 0 108
93.18 88.30 84.74 80.46 … (108 slant ranges in working units)
-69.72 -68.53 -67.36 -66.15 … (108 beam roll angles in degrees)
0 0 0 67 … (108 ping delay times in msecs)
7 7 7 7 … (108 beam quality codes)

RSS – Raw Sidescan
RSS dn t sf np ns sv pn alt sr amin amax bs freq

dn: device number
t: time tag (seconds past midnight)
sf: sonar flags (bit coded hexadecimal)
0100 – amplitude is bit-shifted into byte storage

np: number of samples, port transducer (down-sampled to 4096 max)
ns: number of samples, starboard transducer (down-sampled to 4096 max)
sv: sound velocity in m/sec
pn: ping number (or 0 if not tracked)

alt: altitude in work units
sr: sample rate (samples per second after down-sample)
amin: amplitude minimum
amax: amplitude maximum
bs: bit shift for byte recording
freq: frequency 0 or 1 for simultaneous dual frequency operation

Immediately following the RSS record are two records containing port and starboard amplitude samples.

Example:
RSS 3 61323.082 100 341 341 1460.00 0 10.75 4983.47 0 4096 4 0
109 97 84 95 120 111 … (341 port samples)
106 93 163 106 114 127 … (341 starboard samples)

SNR – Sonar Runtime Settings
SNR dn t pn sonar ns s0 … s11
dn: device number
t: time tag (seconds past midnight)
pn: ping number (or 0 if not tracked)
sonar: sonar ID (see Appendix A)
ns: number of settings to follow
s: up to 12 settings (see Appendix B)

Example – Five settings for the EdgeTech 4200 system:
SNR 1 65751.781 218 9 5 100 107 11400 12600 8

TID – Tide Correction
TID dn t dc
dn: device number or 99
t: time tag (seconds past midnight)
tc: tide correction

Example – tide correction of -1.30:
TID 99 57273.814 –1.30

Appendix A: Sonar ID codes

Specific sonar identification for advanced post-processing programs such as Geocoder.

```
{ "*Not Specified" },                 // 0
{ "Reson Seabat 8101 - 150 Deg" },    // 1
{ "Atlas Fansweep 20" },              // 2
{ "Benthos C3D" },                    // 3
{ "CMAX CM-2" },                      // 4
{ "EdgeTech 272" },                   // 5
{ "EdgeTech 4100" },                  // 6
{ "" },                               // 7 used to be the EdgeTech 4125
{ "EdgeTech 4150" },                  // 8
{ "EdgeTech 4200" },                  // 9
{ "EdgeTech 4300" },                  // 10
{ "GeoAcoustics GeoSwath" },          // 11
{ "Imagenex Sportscan" },             // 12
{ "Imagenex Yellowfin" },             // 13
{ "Klein 595" },                      // 14
{ "Klein 2000" },                     // 15
{ "Klein 3000" },                     // 16
{ "Klein 3900" },                     // 17
{ "Klein 5000" },                     // 18
{ "Odom CV3" },                       // 19
{ "Odom Echoscan 2" },                // 20
{ "Odom ES3" },                       // 21
{ "Reson Seabat 7125" },              // 22
{ "Reson Seabat 8111" },              // 23
{ "Reson Seabat 8124" },              // 24
{ "Reson Seabat 8125" },              // 25
{ "Reson Seabat 9001" },              // 26
{ "Reson Seabat 9003" },              // 27
{ "SEA Swathplus" },                  // 28
{ "Seabeam 2100" },                   // 29
{ "Seabeam SB1185" },                 // 30
{ "Simrad EA400" },                   // 31
{ "Simrad EM102" },                   // 32
{ "Simrad EM1002" },                  // 33
{ "Simrad EM2000" },                  // 34
{ "Simrad EM3000" },                  // 35
{ "Simrad EM3000D" },                 // 36
{ "Simrad EM3002" },                  // 37
{ "Simrad EM3002D" },                 // 38
{ "Reson Seabat 8101 - 210 Deg" },    // 39
{ "Imagenex Delta T" },               // 40
{ "Atlas Hydrosweep MD2" },           // 41
{ "Simrad SM2000" },                  // 42
{ "Simrad EM710" },                   // 43
{ "Simrad EM302" },                   // 44
{ "Blueview MB1350-45" },             // 45
{ "Blueview MB2250-45" },             // 46
{ "Blueview MB1350-90" },             // 47
{ "Blueview MB2250-90" },             // 48
{ "GeoAcoustics Digital Side Scan" },//49
{ "Benthos 1624" },                   // 50
{ "Benthos 1625" },                   // 51
{ "Marine Sonic Sea Scan" },          // 52
{ "Reson Seabat 7101" },              // 53
{ "FURUNO HS-300F" },                 // 54
{ "FURUNO HS-600" },                  // 55
{ "FURUNO HS-600F" },                 // 56
{ "Tritech StarFish" },               // 57
{ "Reson Seabat 8150" },              // 58
{ "Reson Seabat 8160" },              // 59
{ "Reson Seabat 7150" },              // 60
{ "EdgeTech 4600" },                  // 61
```

```
{ "Reson Seabat 7111" },            // 62
{ "R2Sonic SONIC 2024" },           // 63
{ "MDL Dynascan" },                 // 64
{ "WASSP Multibeam" },              // 65
{ "Atlas Hydrosweep MD/50" },       // 66
{ "Atlas Hydrosweep MD/30" },       // 67
{ "Atlas Hydrosweep DS" },          // 68
{ "Innomar SES" },                  // 69
{ "Seabeam 3012" },                 // 70
{ "Seabeam 3020" },                 // 71
{ "Seabeam 3050" },                 // 72
```

Appendix B: Dynamic Sonar Settings

Up to 12 fields are included in SNR records, providing sonar runtime settings. Not available for all systems. Defined differently depending on sonar model and manufacturer.

For Seabat 81XX Serial and 81XX Network Drivers:
Sonar id: 1, 23, 24, 25, 39
P0: Sonar range setting in meters.
P1: power setting, 0 - 8
P2: gain setting, 1 – 45
P3: gain modes: bit 0 = TVG on/off, bit 1 = auto gain on/off.

For Seabat 7K drivers (7125, 7101, 7150, 7111)
Sonar id: 22, 53, 60, 62
P0: Sonar range selection in meters.
P1: Transmit power selection in dBs relative to 1 uPa.
P2: Receiver gain selection in 0.1 dBs.
P3: Transmitter frequency in KHz.
P4: Transmit pulse width in microseconds.

For EdgeTech 4200 Driver
Sonar id: 7-10
P0: Pulse power setting, 0 to 100 percent.
P1: ADC Gain factor.
P2: Start Frequency in 10 * Hz.
P3: End Frequency in 10 * Hz.
P4: Sweep length in milliseconds.

Appendix C: Making Sense of Hexadecimal Bit Coding in HSX Files

One good thing about the HYSWEEP® HSX file format is that information is saved as text and can be viewed in a text editor. The value is diminished however, if you can't make sense of what you see. That could easily be the case for certain bit coded values, so here comes an explanation.

What is Bit Coding?
Bits (Binary digits) are what computers are about. 1 or 0. On/Off, True/False, Yes/No. Everything is a 1 or a 0 to a computer. Since most people aren't computers, bits are usually viewed in groups, making them easier to work with; 8 bits is a byte, 16 bits is a word, 32 bits is a double word, and so on. So when you see the character "A" on the screen, the computer sees the 8-bit number 0100 0001 and computer user and computer are both happy. (Base 2 numbers such as 0100 0001 are somewhat unwieldy and alternatives are discussed below).

Back to bit coding. Suppose there are a number of multibeam data attributes, and that each attribute is independent of the others. For example, data is roll corrected; true or false, data is pitch corrected; true or false, dual head system; true or false, and so on. Each attribute is a bit and combining the bits into a byte (8 bits) or word (16 bits) is bit coding. Simple, right? Right!

Example of Bit Coding in the HSX Format
Using the Sonar Flags field of MBI and RMB records, we provide data attributes using bit coding:

```
0000 0001 – roll corrected by sonar.
0000 0010 - pitch corrected by sonar.
0000 0100 - dual head system.
0000 1000 - heading corrected by sonar.
0001 0000 - medium depth: slant ranges recorded to 1 dm resolution.
0010 0000 - deep water: slant ranges divided by 1 m resolution.
0100 0000 - SVP corrected by sonar.
1000 0000 - topographic device; upgoing beams accepted.
```

So, if data is roll, pitch and heading corrected in medium depth water, the bit code is 0001 1011 base 2.

Base 2 numbers are not very convenient. They tend to have too many digits. Base 10 is nice for counting and math, but not so useful with bit coding. Base 16, called hexadecimal, is a good compromise.

Hexadecimal
In base 2, the digits are 0 and 1. In the familiar base 10, digits are 0 – 9. In base 16 hexadecimal, where each digit represents one of 16 values, the digits 0 – 9 are used plus six extras. The extras are A – F. The conversion table shows how base 2, 10 and 16 are related.

Conversion Table

Base 2	Base 10	Base 16
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F

Going back to the example, Sonar Flags 0001 1011 base 2 can easily be seen to equal 1B in hexadecimal. Well, maybe after a little practice. It's not easy to see how the flags equal 27 base 10, and that's why base 10 isn't used for bit coding.