

ZCHEX messages from EXFOR Master 2023-04-24 (A58)

(N. Otsuka, 2023-05-08, Memo CP-D/1082 Rev.)

I received from Viktor Zerkina a full ZCHEX (Ver. 2023-04-24) error output from EXFOR Master Ver. 2023-04-11 and analysed it. For two messages on obsolete codes and illegal date (e.g., two-digit year), the number of entries having such problems is summarized in Appendix 1 without further analysis as they are legal until their next transmission. For other messages, I counted the number of entries and analysed the situations for the 10 most frequently appearing messages.

1. Possible missing required keyword ERR-ANALYS

Not very clear when ZCHEX prints this message. I would like to have this message when an uncertainty in the dependent variable (e.g., DATA-ERR) is coded without its definition under ERR-ANALYS (e.g., 10526.002). However, this message typically appears when any uncertainty is absent in the dataset (e.g., 10089.003) or NODATA is used (e.g., 10091.007). The Formats manual does not explain when it must be given, and this could be also responsible for the situation.

Suggested conclusion for the Formats Manual “ERR-ANALYS”

To revise the item 1 of the description to

Must be present with coded information when error fields associated to the dependent variable (e.g., DATA-ERR, ERR-S, ERR-1) are given. Otherwise, presence is optional and free text or coded information, with or without free text, may be given. Coded information is preferably not given for the error fields other than those associated to the dependent variable when its free text does not add information to the code expansion.

Suggested action to ZCHEX:

Update ZCHEX so that it prints this message only when an error field associated to the dependent variable is given without its definition under ERR-ANALYS.

2. Incorrect units, should be dimension YLD Y-fld:DATA

This comment appears when the dimension (“unit family”) of the quantity does not agree with the dimension of the unit code. The ZCHEX outputs from EXFOR Master are typically for one of the following cases:

- Combination of , SPC (or , SPC, , RES) with PRT/REAC. (e.g., 10053.053, 10065.006)
This combination is correct, but ZCHEX complains since these quantities are defined with YLD in Dictionary 236. MLT must replace YLD.
- Combination of , ETA with (or , ETA, , RES) with NO-DIM. (e.g., 10100.004)
This combination is wrong. The relevant entries must be revised (17 entries in area 1, 8 entries in area 2, 6 entries in area 4).
- Combination of , ETA with (or , ETA, , RES) with PRT/REAC. (e.g., 11310.013, 20917.032)
This combination is correct, but ZCHEX complains since these quantities are defined with YLD in Dictionary 236. MLT must replace YLD.

Suggested action to NNDC, NEA DB and CJD:

Retransmit η values coded with NO-DIM after its replacement with a correct unit code. (See Appendix 3.)

Suggested action to myself:

Replace the unit family code `YLD` with `MLT` for the quantities with `SF6=SPC` or `ETA` in Dict. 236.

3. Illegal independent variable ENERGY

This comment appears when `EN` (or its derivative) is coded for a quantity requiring a resonance energy `EN-RES`. (e.g., 10002.025, 10032.004). This is typically seen for average resonance parameters such as level spacing (`, D`) and strength function (`, STF`) for which `EN-MIN/MAX-RES` must replace `EN-MIN/MAX`. This combination is seen in area 1 (95 entries), 2 (52 entries), 3 (7 entries) and 4 (32 entries).

4. Check use of heading THICKNESS

This comment appears when `THICKNESS` is coded for a quantity which should not depend on the target thickness. When the neutron total cross section or capture cross section (`, SIG`) shows the thickness dependence and it is due to absence of corrections for sample effects (e.g., 21109.004), the compiler should check if the quantity is derived with thin target approximation (e.g., capture cross section \sim capture yield / areal sample density). If yes, addition of `SF8=STA` makes presence of `THICKNESS` legal. Otherwise move the thickness to free text under the keyword `SAMPLE` or add `SF8=RAW`.

Suggested conclusion (reminder to compilers):

`THICKNESS` is coded only when the quantity requires it as an independent variable.

5. Illegal independent variable SEC.ENERGY

This comment appears when secondary energy is coded for a quantity which does not require the secondary energy as an independent variable. I see two typical cases:

- presence of secondary energy is questionable, and the entry requires review and retransmission (e.g., 10919.002, 12800.006, 21054.069, 21086.004, 21105.002),
- level density (`LD`) which requires the excitation energy as a secondary energy, but `ZCHEX` complains because energy dependence is not indicated properly in Dict. 213 (e.g., 14184.003), (3) level density parameter (`LDP`) applicable for a particular excitation energy range (e.g., 20971.004).

Suggested action to NDS:

Introduce a new reaction type (say, `NQE`) for nuclear quantities requiring secondary energy such as the level density (`LD`).

6. Incorrect units, should be dimension YLD Y-fld:DATA-ERR

This comment usually appears with a similar comment for `DATA`. See my comment #3 above.

7. Illegal code in field 4

This comment appears when an unknown nuclide code is in `REACTION SF4`. There are three cases:

- a metastable state which presence was observed by the author but is currently unknown (e.g., 10142.002),

- a newly discovered nuclide which is still missing in the nuclide dictionary 227 (e.g., S0279.002),
- quasi-metastable state coded with -M instead -L (e.g., 10361.002).

We can ignore the messages for the first two case, but the isomeric flag must be corrected for the third case. I believe all such cases are included in Memo CP/D-1052 (Rev.) and registered in the Feedback List.

Suggested action to NNDC, NDS, JCPRG, CNPD, CDFE:

Correct the wrong isomeric flags listed in Memo CP-D/1052 (Rev.).

8. Illegal code in field 7

This comment is typically irrelevant to REACTION SF7 (e.g., E2339.020), and often appears when ZCHEX finds a problem under EN-SEC or MOM-SEC (e.g., when particle combination is defined as the particle considered under these keywords. See Case 10.).

Example:

```

** Illegal code in field 7
** End of code string not found 14055004
   EN-SEC (E,LF+HF) kinetic energy of fission fragment pairs 14055004
           ^^^^^

** Illegal code in field 7
** End of code string not found E2339020
   (E,ELEM) E2339020
           ^^^^^

```

Suggested action to ZCHEX:

Update ZCHEX so that it prints an error message only when there is something wrong in REACTION SF7.

9. End of code string not found

This comment typically appears when a particle combination (particle codes connected by +) is defined under EN-SEC.

Example:

```

** End of code string not found A0848002
   EN-SEC (E-RL,N+T) A0848002
           ^^^

```

Suggested action to ZCHEX:

To update ZCHEX so that it recognizes a particle combination as a legal particle considered defined under EN-SEC etc.

10. Missing code in field 4

This comment appears when a nuclide code is missing in REACTION SF4. There are two typical cases:

- neutron scattering coded with REACTION SF3=EL, SCT or THS (e.g., 11205.004, 11511.003) for which the nuclide code in SF1 must be repeated in SF4.

- resonance parameters with a general quantity modifier (e.g., 21794.002, 23496.004, 40410.002).

Suggested action to ZCHEX:

Update ZCHEX so that it does not print this message when a resonance parameter is coded with a general quantity modifier in SF8.

Appendix 1: Number of entries having obsolete codes and illegal date (e.g., two-digit years)

Area	Obsolete code	Illegal date
1	366	1728
2	266	1048
3	118	2
4	177	157
A	397	13
B	102	
C	156	128
D	176	
E	112	57
F	92	
G	6	
K	8	
L	4	38
M	32	
O	398	135
P	20	
R	6	3
S	7	
T	23	
V	7	

Appendix 2: Number of error message appearance

Message	Entries
1 Possible missing required keyword ERR-ANALYS	214
2 Incorrect units, should be dimension YLD Y-fld:DATA	111
3 Illegal independent variable ENERGY	109
4 Check use of heading THICKNESS	90
5 Illegal independent variable SEC.ENERGY	83
6 Incorrect units, should be dimension YLD Y-fld:DATA-ERR	79
7 Illegal code in field 4	51
8 Illegal code in field 7	50
9 End of code string not found	50
10 Missing code in field 4	44
11 Missing independent variable NUCLIDE	42
12 Illegal code in field 1	42

13	Illegal code field		40
14	Check use of heading	TEMP	36
15	Missing data heading	MASS	31
16	Multiply defined HEADING or FLAG		27
17	Check use of heading	HL	26
18	Incorrect units, should be dimension	FY Y-fld:DATA-ERR	23
19	Missing required keyword	STATUS	23
20	Missing data heading	ELEMENT	23
21	Possible missing required keyword	TITLE	23
22	Illegal field identification for	field 2	22
23	METHOD,DETECTOR,ANALYSIS or FACILITY needed		21
24	Incorrect units, should be dimension	MLT Y-fld:DATA	19
25	DG: Intensity without Energy		18
26	Missing independent variable	ENERGY	17
27	Missing independent variable	ANGLE	17
28	Missing data heading	MASS 2	16
29	Illegal independent variable	ANGLE	16
30	REACTION fields 5-8 not in dictionary		15
31	Variable duplicated in subentry 1	ANGLE	15
32	Ind. var. link to REACTION not checked		14
33	Missing independent variable	SEC.ENERGY	14
34	Incorrect units, should be dimension	YLD Y-fld:ERR-S	14
35	Variable duplicated in subentry 1	SEC.ENERGY	14
36	Missing data heading	MASS 1	13
37	Outgoing particle sequence incorrect		12
38	Missing code field(s)		12
39	Illegal floating point number in	field 2	12
40	Missing data heading	MONIT2 2	11
41	Nucleus is stable		11
42	Incorrect units, should be dimension	FY Y-fld:DATA	11
43	Incorrect units, should be dimension	YLD Y-fld:DATA-MAX	11
44	Incorrect units, should be dimension	B Y-fld:DATA-ERR	10
45	Nonmonatonic data field	THICKNESS	10
46	Missing data heading	MONIT 2	10
47	Illegal independent variable	RES.ENERGY	10
48	Incorrect units, should be dimension	NO Y-fld:DATA	10
49	Incorrect units, should be dimension	MAE Y-fld:DATA	9
50	Incorrect units, should be dimension	MLT Y-fld:DATA-ERR	9
51	Missing data heading	ELEMENT 2	9
52	Incorrect units, should be dimension	NO Y-fld:DATA-ERR	9
53	Missing data heading	MONIT1 2	9
54	Missing data heading	FLAG 1	8
55			7
56	Code too long		7
57	Incorrect units, should be dimension	YLD Y-fld:ERR-T	7
58	Variable duplicated in subentry 1	ENERGY	7
59	Incorrect units, should be dimension	THK X-fld:THICKNESS	7
60	Missing data heading	ELEMENT 1	7

61	Incorrect units, should be dimension	B	Y-fld:DATA	7
62	Incorrect units, should be dimension	E	Y-fld:DATA	6
63	Incorrect units, should be dimension	E	Y-fld:DATA-ERR	6
64	Incorrect units, should be dimension	MLT	Y-fld:ERR-T	6
65	Incorrect units, should be dimension	NO	X-fld:POL-BM-ERR	6
66	Missing data heading	ASSUM	2	6
67	Date out of legal range			6
68	Missing data heading	MONIT1		6
69	Input/output particles do not add up			6
70	Common1.ResPrm require SF5-8 reac-type	RP=[.]	in Dict-236	6
71	Illegal code separator			5
72	Incorrect units, should be dimension	NO	Y-fld:ERR-T	5
73	Field value undefined	FLAG		5
74	Missing data heading	E		5
75	Missing data heading	FLAG	2	5
76	Expected Family Flag /vs.Dict-24/		LVL-INI:[E][]	5
77	Incorrect units, should be dimension	YLD	Y-fld:DATA-APRX	5
78	Incorrect units, should be dimension	NO	Y-fld:ERR-S	5
79	Incorrect units, should be dimension	MDA	Y-fld:DATA	4
80	Missing data heading	FLAG	4	4
81	Nonmonatonic data field	E		4
82	Missing data heading	MONIT2		4
83	Nonmonatonic data field	E-MIN		4
84	Missing data heading	MONIT	1	4
85	Expected Family Flag /vs.Dict-24/		LVL-FIN:[E][]	4
86	Incorrect units, should be dimension	YLD	Y-fld:+DATA-ERR	3
87	Nonmonatonic data field	E2		3
88	Missing data heading	MONIT2	1	3
89	Pointer not linked to REACTION or VCom	2		3
90	Missing data heading	MONIT3		3
91	Nonmonatonic data field	E-LVL		3
92	Incorrect units, should be dimension	FY	Y-fld:ERR-T	3
93	Dependent variable missing on record			3
94	Missing data heading	E-LVL		3
95	Missing data heading	FLAG	3	3
96	Incorrect units, should be dimension	YLD	Y-fld:-DATA-ERR	3
97	Incorrect units, should be dimension	MLT	Y-fld:DATA-MAX	3
98	Incorrect units, should be dimension	FY	Y-fld:ERR-S	3
99	Heading not expected from REACTION	EN-NM		2
100	Missing data heading	MISC	1	2
101	Nonmonatonic data field	E-EXC-MIN		2
102	Incorrect units, should be dimension	MLT	Y-fld:ERR-DIG	2
103	Incorrect units, should be dimension	B*E	Y-fld:ERR-T	2
104	Check use of heading	GRP-NUM		2
105	Incorrect units, should be dimension	DAE	Y-fld:ERR-S	2
106	Missing independent variable	OTHER		2
107	Incorrect units, should be dimension	MAE	Y-fld:ERR-T	2
108	Nonmonatonic data field	ANG1		2

109	Illegal independent variable	NUCLIDE		2
110	Missing data heading	MONIT1	1	2
111	Missing data heading	ASSUM	3	2
112	Incorrect units, should be dimension	DA	Y-fld:ERR-S	2
113	Incorrect units, should be dimension	DAE	Y-fld:DATA	2
114	Missing data heading	MONIT3	1	2
115	Dict236.ResFlg conflicts with code in	field	4	2
116	Missing data heading	LVL-NUMB		2
117	Incorrect units, should be dimension	B*E	Y-fld:DATA-ERR	2
118	Missing data heading	MONIT5	2	2
119	Incorrect units, should be dimension	DA	Y-fld:DATA	2
120	Nonmonatonic data field	ISOMER		2
121	Incorrect units, should be dimension	DA	Y-fld:DATA-ERR	2
122	Illegal leading blanks	field	7	2
123	Check use of heading	HL-MIN		2
124	Missing data heading	MONIT4	2	2
125	Incorrect units, should be dimension	NO	Y-fld:ERR-SYS	2
126	Duplicate record			2
127	Nonmonatonic data field	S		2
128	Missing required keyword	REACTION		2
129	Nonmonatonic data field	EN-MIN		2
130	Missing data heading	MOM-SEC		2
131	Pointer not linked to REACTION or VCom	R		1
132	Incorrect units, should be dimension	1/A	Y-fld:DATA-ERR	1
133	Missing code for	field	1	1
134	Incorrect units, should be dimension	DA	Y-fld:ERR-T	1
135	Incorrect units, should be dimension	BE2	Y-fld:DATA	1
136	Expected Family Flag /vs.Dict-24/	MOM-TR:	[E] [G]	1
137	Illegal DATA HEADING or UNIT			1
138	Expected Family Flag /vs.Dict-24/	E-NRM:	[E] []	1
139	Expected Family Flag /vs.Dict-24/	LVL-INI2:	[E] []	1
140	Pointer not linked to REACTION or VCom	1		1
141	Nonmonatonic data field	EN		1
142	Missing data heading	MASS	H	1
143	Missing data heading	ELEMENT	R	1
144	Missing data heading	ASSUM2	5	1
145	Missing data heading	E-LVL-FIN		1
146	Incorrect units, should be dimension	TIMEX-fld:	ERR-HL	1
147	Nonmonatonic data field	ANG-CM-MIN		1
148	Illegal character			1
149	No entries in COMMON Section for	field	3	1
150	Expected Family Flag /vs.Dict-24/	LVL-INI1:	[E] []	1
151	Incorrect units, should be dimension	BE2	Y-fld:DATA-ERR	1
152	Pointer not linked to REACTION or VCom	B		1
153	Missing data heading	ELEMENT	L	1
154	Incorrect units, should be dimension	MAE	Y-fld:ERR-S	1
155	Pointer not linked to REACTION or VCom	3		1
156	Heading not expected from REACTION	EN-DUM-DN		1

157	Incorrect units, should be dimension	NO	Y-fld:DATA-ERR1	1
158	Missing data heading	ASSUM3	3	1
159	Incorrect units, should be dimension	E	Y-fld:-DATA-ERR	1
160	Incorrect units, should be dimension	BRE	Y-fld:DATA	1
161	Missing data heading	E-LVL-NM	1	1
162	Missing data heading	MONIT4		1
163	Missing data heading	ASSUM1		1
164	Missing data heading	MASS	R	1
165	Nonmonatonic data field	ELEMENT		1
166	Incorrect units, should be dimension	B	Y-fld:+DATA-ERR	1
167	Expected Family Flag /vs.Dict-24/		LVL:[E][]	1
168	Incorrect units, should be dimension	E	X-fld:KT-ERR	1
169	Incorrect units, should be dimension	E	Y-fld:DATA-MAX	1
170	Incorrect units, should be dimension	YLD	Y-fld:ERR-SYS	1
171	Heading not expected from REACTION	EN-DN		1
172	Incorrect units, should be dimension	E	X-fld:E-EXC-C-MX	1
173	Incorrect units, should be dimension	YLD	Y-fld:DATA-MIN	1
174	Expected Family Flag /vs.Dict-24/		ANG1:[E][G]	1
175	Incorrect units, should be dimension	YDA	Y-fld:DATA-ERR	1
176	Missing data heading	ELEMENT	H	1
177	Incorrect units, should be dimension	NO	X-fld:POL-TR-ERR	1
178	Incorrect units, should be dimension	TTY	Y-fld:DATA	1
179	Incorrect units, should be dimension	MDA	Y-fld:ERR-T	1
180	Incorrect units, should be dimension	B	Y-fld:-DATA-ERR	1
181	Missing data heading	MASS	L	1
182	Missing data heading	ASSUM1	4	1
183	Missing data heading	MISC	2	1
184	Missing data heading	MONIT3	3	1
185	Heading not expected from REACTION	EN-RES-NM		1
186	Incorrect units, should be dimension	E	X-fld:E-LVL	1
187	Nonmonatonic data field	LVL-NUMB		1
188	Missing data heading	E2		1
189	Expected Family Flag /vs.Dict-24/		LVL-FIN2:[E][]	1
190	Incorrect units, should be dimension	E	Y-fld:+DATA-ERR	1
191	Missing data heading	ASSUM2		1
192	Expected Family Flag /vs.Dict-24/		ANG2:[E][G]	1
193	Missing data heading	FLAG	5	1
194	Missing data heading	E1		1
195	Expected Family Flag /vs.Dict-24/		E-RSL:[E][F]	1
196	Incorrect units, should be dimension	MDA	Y-fld:ERR-DIG	1
197	Incorrect units, should be dimension	DA	Y-fld:-DATA-ERR	1
198	Incorrect units, should be dimension	DA	Y-fld:+DATA-ERR	1
199	Missing data heading	MONIT2	3	1
200	Check use of heading	HL1		1
201	Incorrect units, should be dimension	L	Y-fld:DATA-ERR	1
202	Missing data heading	MONIT		1
203	Missing data heading	MONIT1	3	1
204	Incorrect units, should be dimension	NO	X-fld:ERR-IDD	1

205	Incorrect units, should be dimension	YDA Y-fld:DATA	1
206	Missing data heading	E-LVL-DN 1	1
207	Heading not expected from REACTION	MONIT-DN	1
208	Heading not expected from REACTION	MONIT-NM	1
209	Missing data heading	E-LVL 2	1
210	Heading not expected from REACTION	EN-RES-DN	1
211	Incorrect units, should be dimension	FY Y-fld:ERR-1	1
212	Incorrect units, should be dimension	NO Y-fld:ERR-DIG	1
213	Nonmonatonic data field	EN-MAX	1
214	Missing data heading	ASSUM2 2	1
215	Expected Family Flag /vs.Dict-24/	LVL-FIN1:[E][]	1
216	Incorrect units, should be dimension	YLD Y-fld:ERR-1	1
217	Incorrect units, should be dimension	FYDEY-fld:ERR-DIG	1

Appendix 3: The eta values wrongly coded with NO-DIM.

Retrieved on x4Pro trial (2022-12-22) with the following query:

```
SELECT REACSTR.ReacodeID, REACSTR.Code
FROM REACSTR, REACODE, x4pro_hdr
WHERE
REACSTR.SF6 like '%ETA%'
AND x4pro_hdr.hdr = 'DATA'
AND x4pro_hdr.units='NO-DIM'
AND REACODE.nReacstr=1
AND REACSTR.ReacodeID = x4pro_hdr.DatasetID
AND REACSTR.ReacodeID = REACODE.ReacodeID
```

Dataset ID	REACTION
10100.004	92-U-233 (N, ABS) , , ETA
10207.011.2	92-U-233 (N, ABS) , , ETA , , MXW
10207.012.2	94-PU-239 (N, ABS) , , ETA , , MXW
10207.015	94-PU-239 (N, ABS) , , ETA
10208.005	92-U-233 (N, ABS) , , ETA , , MXW
10208.006	92-U-235 (N, ABS) , , ETA , , MXW
12317.002	92-U-233 (N, ABS) , , ETA
12319.008	92-U-233 (N, ABS) , , ETA , , MXW
12327.002.2	92-U-233 (N, ABS) , , ETA , , MXW
12327.003	94-PU-239 (N, ABS) , , ETA
12327.004.2	94-PU-239 (N, ABS) , , ETA , , MXW
12327.005.2	94-PU-241 (N, ABS) , , ETA , , MXW
12330.002	92-U-233 (N, ABS) , , ETA
12347.002	92-U-233 (N, ABS) , , ETA , , MXW
12348.002	92-U-233 (N, ABS) , , ETA
12348.003	92-U-233 (N, ABS) , , ETA
12349.002	92-U-233 (N, ABS) , , ETA
12349.003	92-U-235 (N, ABS) , , ETA
12361.002	92-U-233 (N, ABS) , , ETA , , MXW
12361.003	92-U-235 (N, ABS) , , ETA , , MXW
12361.004	94-PU-239 (N, ABS) , , ETA , , MXW
12411.002	92-U-235 (N, ABS) , , ETA
12508.002	94-PU-239 (N, ABS) , , ETA
12518.003	94-PU- 239 (N, ABS) , , ETA , , REL, DERIV

12518.004	94-PU-239 (N, ABS) , , ETA , , REL
12554.002	94-PU-241 (N, ABS) , , ETA
12554.003	92-U-233 (N, ABS) , , ETA
12554.004	92-U-235 (N, ABS) , , ETA
12554.005	94-PU-239 (N, ABS) , , ETA
12793.002	94-PU-239 (N, ABS) , , ETA
14083.002	92-U-233 (N, ABS) , , ETA
21066.002	94-PU-239 (N, ABS) , , ETA , , REL
21197.002	92-U-233 (N, ABS) , , ETA
21202.002	92-U-235 (N, ABS) , , ETA
21202.004	94-PU-239 (N, ABS) , , ETA
21428.002	92-U-233 (N, ABS) , , ETA , , MXW
21428.003	92-U-235 (N, ABS) , , ETA , , MXW
21755.002	92-U-238 (N, NON) , , ETA
22194.002	92-U-235 (N, ABS) , , ETA
22194.003	92-U-235 (N, ABS) , , ETA
22550.002	94-PU-239 (N, ABS) , , ETA , , MXW
22567.002	94-PU-239 (N, ABS) , , ETA
40087.0092	94-PU-239 (N, ABS) , , ETA
40156.002	92-U-235 (N, ABS) , , ETA
40426.005.1	92-U-233 (N, ABS) , , ETA
40426.005.2	92-U-233 (N, ABS) , , ETA