

# LISE<sup>++</sup> file format: practical manual editing guide

Focused on primary beam, FOI, target/wedge thickness, and dipole Bp

**Scope.** This document describes the practical text-format fields that a user can safely edit in a LISE .lpp file. It is based on the two uploaded examples, and on the uploaded c\_Config read/write source. It is not a complete formal specification of every LISE<sup>++</sup> option.

**Basic rule.** For manual editing, change the right-side value after the equals sign and keep section names, parameter names, commas, and comments intact. Save a copy first, then reopen the file in LISE<sup>++</sup> and save it again to let LISE<sup>++</sup> normalize the formatting.

## 1. Quick reference

What to edit	Section	Field	Example value	Comment
Primary beam isotope and charge	[settings]	A,Z,Q	70Zn30+	Mass-element-charge format
Beam energy	[settings]	Energy	230 MeV/u	Kinetic energy per nucleon
Beam intensity	[settings]	Intensity	1 pnA	Allowed units include enA, pnA, pps, kW
FOI nucleus	[settings]	Settings on A,Z	59Cr	Fragment of interest for settings and output
Production target material	[target]	Target contents	0,6,1,12.011	Component slot, Z, relative atoms, mass
Production target thickness	[target]	Target thickness	4,5,1.89,0,0,0	In the examples: 5 mm C target
Wedge material	[W#_Compound]	contents1	0,13,977,26.982	Al in the examples
Wedge thickness	[W#_Compound]	thickness	4,2.5,2.7,0,0,0	In the examples: 2.5 mm Al
Wedge angle	[W#_WedgeSettings]	Angle	-10.142 mrad	Wedge slope for ProfileMode 0
Dipole magnetic rigidity	[D#_DipoleSettings]	Brho	5.04600 Tm	Use the dipole block number you intend to change

## 2. File structure

A LISE .lpp file is plain text. The top **Info Part** is a human-readable summary of the current calculation. The editable input values are in the **Main Part** under bracketed section headers such as [settings], [target], [W1\_Compound], and [D1\_DipoleSettings].

```
Version 18.3.0

{===== Info Part =====}
70Zn (230 MeV/u, 1 pnA) + C (5 mm) --> PF;   dP/P=4.01%
FOI --> 59Cr
...

{===== Main Part =====}
[settings]
      A,Z,Q = 70Zn30+                ; Mass ElementName Charge+ Beam
      Energy = 230                    MeV/u
      Intensity = 1                    pnA                ; enA,pna,pps,kw
      Settings on A,Z = 59Cr          ; Mass ElementName Charge+ Beam
```

- The Info Part is useful for checking, but manual edits should be made in the Main Part

- Comments after a semicolon are for readability; keep them when possible
- Whitespace alignment is cosmetic; LISE<sup>++</sup> rewrites the alignment when the file is saved
- Do not edit BlockStructure or NumberOfBlocks unless you are adding/removing blocks intentionally

### 3. Safe manual editing workflow

1. Make a copy of the .lpp file before editing
2. Use a plain-text editor such as Notepad<sup>++</sup>, VS Code, or another editor that preserves text without formatting
3. Search for the exact section name and field name rather than editing the summary at the top
4. Change only the numeric/isotope value needed for the test
5. Reopen the edited file in LISE<sup>++</sup> and check the GUI values
6. Save from LISE<sup>++</sup> once to normalize spacing and to confirm that the parser accepted the edit

**Practical warning.** Material definitions, isotope lists, curved wedge profiles, and optics matrix blocks can contain many coupled values. For quick manual changes, prefer changing thickness and Bp values only. For a new material or new optics block, it is safer to make the change in LISE<sup>++</sup> first and then compare the generated text.

## 4. Primary beam and FOI

### 4.1 Primary beam isotope and charge

```
[settings]
      A,Z,Q = 70Zn30+                ; Mass ElementName Charge+ Beam
      Energy = 230                    MeV/u
      Intensity = 1                   pnA      ; enA,pnA,pps,kW
      Settings on A,Z = 59Cr         ; Mass ElementName Charge+ Beam
```

The A,Z,Q line is read as a LISE element/projectile string. In the examples, 70Zn30+ means a beam nucleus with A = 70, element Zn, Z = 30, and charge state 30+.

Beam string	A	Element	Charge	Meaning
70Zn30+	70	Zn	30+	Example in both uploaded files
238U92+	238	U	92+	Fully stripped uranium example
144Sm62+	144	Sm	62+	Fully stripped samarium example

### 4.2 Beam energy

Edit the numeric value on the Energy line. The written unit in these files is MeV/u.

```
Before:
      Energy = 230                    MeV/u

After changing to 193 MeV/u:
      Energy = 193                    MeV/u
```

### 4.3 Beam intensity

The intensity line stores a number plus a unit. The reader recognizes the LISE intensity units shown in the comment: enA, pnA, pps, kW.

```

Before:
      Intensity = 1                pnA                ; enA,pna,pps,kw

Examples:
      Intensity = 5                pnA                ; enA,pna,pps,kw
      Intensity = 1e+09           pps                ; enA,pna,pps,kw
      Intensity = 2                kW                 ; enA,pna,pps,kw

```

## 4.4 FOI: fragment of interest

The FOI used for settings is stored on the Settings on A,Z line in the [settings] section. In the uploaded files, the FOI is 59Cr.

```

Before:
      Settings on A,Z = 59Cr                ; Mass ElementName Charge+ Beam

After changing FOI to 60Cr:
      Settings on A,Z = 60Cr                ; Mass ElementName Charge+ Beam

```

Charge-state details for the FOI may also appear in the Info Part summary, for example FOI --> 59Cr 24+ 24+ 24+ 24+. Treat that line as output, not the primary place to edit.

## 5. Production target

The production target is defined in the [target] section. In both uploaded files it is carbon with thickness 5 mm and density 1.89 g/cm<sup>3</sup>.

```

[target]
      Target contents = 0,6,1,12.011                ; Nomer,Z,Atoms,Mass
      Target thickness = 4,5,1.89,0,0,0             ; State,Thickness,density,angle,SolidGas,..

```

### 5.1 Target contents

Value in 0,6,1,12.011	Meaning
0	Component slot used internally by the compound definition; valid source code range is 0 to 4
6	Atomic number Z; 6 is carbon
1	Relative stoichiometric coefficient for the component
12.011	Atomic or isotope mass used for this component

For routine rate studies, do not change Target contents by hand unless the material is very simple. If the material changes, create or verify it in LISE++ and then use the generated line as the template.

### 5.2 Target thickness

Value in 4,5,1.89,0,0,0	Meaning
4	Thickness state/unit mode. In the uploaded examples this state corresponds to the mm value shown in the Info Part
5	Thickness value, here 5 mm
1.89	Density in g/cm <sup>3</sup>
0	Target angle in degrees
0	SolidGas flag. The reader code treats 0 as solid and nonzero as gas
0	Gas formula/mix flag; leave unchanged for solid targets

```

Change C target from 5 mm to 4 mm, keeping density and other flags:
      Target thickness = 4,4,1.89,0,0,0             ; State,Thickness,density,angle,SolidGas,..

```

**Useful conversion.** For a solid target, areal density and geometrical thickness are related by

$$\text{areal density [mg/cm}^2\text{]} = 100 \times \text{density [g/cm}^3\text{]} \times \text{thickness [mm]}$$

Example: C with density 1.89 g/cm<sup>3</sup> and thickness 5 mm gives 945 mg/cm<sup>2</sup>.

## 6. Wedge thickness and wedge angle

Wedges are block objects. Their sections use the block number, for example [W1\_Compound] and [W1\_WedgeSettings]. In both uploaded files, W1 is an Al wedge with 2.5 mm thickness and angle -10.142 mrad.

```
{===== BLOCK W1 - Wedge =====}

[W1_General]
      Name = PS_wdg,1                      ; Name of Block, Constant name 1/0

[W1_Compound]
      contents1 = 0,13,977,26.982          ; Nomer,Z,Atoms,Mass
      thickness = 4,2.5,2.7,0,0,0         ; State,Thickness,density,angle,SolidGas,..

[W1_WedgeSettings]
      ProfileMode = 0                      ; 0-Wedge,1-Homo,2-Curved,3-Custom
      Angle = -10.142                      mrad ; wedge slope for the mode (0-Wedge)
      Direction = 0                        ; x=0, y=1
      CalculateForBlock = BTS03
```

### 6.1 Wedge material

The example line `contents1 = 0,13,977,26.982` describes Al because Z = 13 and mass = 26.982. The stoichiometric coefficient is relative; for a pure element, keep the generated value unless you are deliberately rebuilding the compound definition.

### 6.2 Wedge thickness

For simple thickness scans, change the second number in the `thickness` line and keep the rest unchanged. In the examples, `4,2.5,2.7,0,0,0` means 2.5 mm Al with density 2.7 g/cm<sup>3</sup>.

```
Change Al wedge from 2.5 mm to 2.0 mm:
      thickness = 4,2.0,2.7,0,0,0         ; State,Thickness,density,angle,SolidGas,..
```

### 6.3 Wedge angle

For a normal wedge profile, `ProfileMode = 0` and the wedge slope is the `Angle` value in mrad. A negative sign is meaningful; keep it unless the geometry is intentionally reversed.

```
Change wedge angle from -10.142 mrad to -9.500 mrad:
      Angle = -9.500                      mrad ; wedge slope for the mode (0-Wedge)
```

## 7. Dipole Bp

Each dipole block has a section named like [D1\_DipoleSettings], [D2\_DipoleSettings], etc. The Bp value is read from the Brho line in Tm.

```
[D1_DipoleSettings]
      Brho = 5.04600                      Tm           ; magnetic rigidity
      Angle = 30                          degrees
      Radius = 4                           m
```

**Relation.** Magnetic rigidity is momentum per charge. In practical accelerator units:

$$B\rho [\text{Tm}] = 3.33564095 \times p [\text{GeV}/c] / q$$

Manual edit example:

Before:	Brho = 5.04600	Tm	; magnetic rigidity
After:	Brho = 5.02000	Tm	; magnetic rigidity

## 7.1 Bp values in the uploaded examples

File	Dipole Bp values found
c_F1S1a0-k3.lpp	D1 = 5.04600 Tm, D2 = 3.87099 Tm, D3 = 3.87099 Tm, D4 = 5.04600 Tm, D5 = 4.00000 Tm, D6 = 3.87099 Tm, D7 = 4.65142 Tm, D8 = 4.65142 Tm
e_PSk3a0.lpp	D1 = 5.04600 Tm, D2 = 5.04600 Tm, D3 = 5.04600 Tm, D4 = 4.65142 Tm, D5 = 4.65142 Tm

## 8. Values observed in the two uploaded files

File	Beam	Energy	Intensity	FOI	Target thickness	Wedge	Wedge thickness	Wedge angle
c_F1S1a0-k3.lpp	70Zn30+	230 MeV/u	1 pA	59Cr	4,5,1.89,0,0,0	PS_wdg	4,2.5,2.7,0,0,0	-10.142 mrad
e_PSk3a0.lpp	70Zn30+	230 MeV/u	1 pA	59Cr	4,5,1.89,0,0,0	PS_wedge	4,2.5,2.7,0,0,0	-10.142 mrad

## 9. Source-code map for the fields used here

Source file	Structure / function	Fields
c_ConfigPP1.h	v_settings	A,Z,Q, Energy, Intensity, Settings on A,Z
c_ConfigPP1.h	v_target	Target contents, Target thickness, Degradar contents, Degradar thickness
c_ConfigPP2.h	v_compound	Block material contents and block thickness, including W1_Compound
c_ConfigPP2.h	v_wedge	ProfileMode, Angle, Direction, CalculateForBlock, polynomial/profile fields
c_ConfigPP2.h	v_dipole	Brho, Angle, Radius
c_ConfigPP_read.cpp	read_cfg_stringPP	Parser behavior for numeric values, intensity units, compound thickness, and Brho
c_ConfigPP_write.cpp	write functions	Output formatting such as field alignment, precision, comments, and dimensions

**A helpful mental model.** The source defines a list of allowed fields for each section. The reader searches for the section header, then reads recognized field names. This is why editing a value in the correct section works, while changing only the Info Part does not change the calculation input.

## 10. Common edit recipes

Task	Edit
Change only beam energy	[settings] -> Energy = new_value MeV/u
Change only beam intensity	[settings] -> Intensity = new_value unit
Change only FOI	[settings] -> Settings on A,Z = new_AElement
Change production target thickness	[target] -> Target thickness = same_state,new_thickness,same_density,same_angle,same_flags

Task	Edit
Change W1 wedge thickness	[W1_Compound] -> thickness = same_state,new_thickness,same_density,same_angle,same_flags
Change W1 wedge angle	[W1_WedgeSettings] -> Angle = new_angle mrad
Change D1 Bp	[D1_DipoleSettings] -> Brho = new_value Tm

## 11. Troubleshooting checklist

- The file opens in LISE++ without a warning
- The GUI shows the intended beam, energy, intensity, and FOI
- The target and wedge thicknesses match the intended units
- The Bp value changed in the intended dipole block, not just in the Info Part summary
- After saving from LISE++, the modified line is still present and formatted normally
- A quick calculation gives a physically reasonable transmission/rate change for the edit

**Most common mistake.** Editing a summary line in the Info Part changes only the displayed text and will be overwritten. Always edit the field in the appropriate section of the Main Part.

## 12. BlockStructure line and block abbreviations

The BlockStructure field in the [general] section is the compact block map for the LISE optical line. LISE++ writes one character per block, in beam-line order. During reading, the code first creates the block list from this string, then reads the matching block sections below it.

Example from c\_F1S1a0-k3.lpp:

```
BlockStructure = ASSSSODDDSSASSDDDDMSWAMDDSMASAMMMO
BlockNumber   = 33
```

The block number in a section name is a counter within one block letter, not the absolute position in the full line. For example, [D3\_General] means the General section for the third D/Dipole block. In the example above it is the 9th character overall, because the first six blocks are A S S S S O, then D1, D2, D3.

Overall position	1	2	3	4	5	6	7	8	9
Letter in BlockStructure	A	S	S	S	S	O	D	D	D
Resulting section prefix	A1	S1	S2	S3	S4	O1	D1	D2	D3
Main meaning	FaradayCup	Drift	Drift	Drift	Drift	Rotate	Dipole	Dipole	Dipole

Therefore, to edit a dipole magnetic rigidity, first identify the correct D-number from BlockStructure or from the block header, then edit the Brho value in the corresponding [D#\_DipoleSettings] section.

### 12.1 Block abbreviation table used in the uploaded files

This table covers all block letters appearing in the two uploaded example files. The section prefix is always letter + counter, for example W1 or D3.

Letter	Block kind written in file header	Typical section prefix	Sections commonly associated with this block	Manual-editing notes
A	FaradayCup	[A1_General]	[A#_Compound] [A#_BlockCalibration]	Faraday-cup style block. It may contain a compound definition and detector/calibration fields. Usually not part of simple beam/FOI/Bp edits.
S	Drift	[S1_General]	[S#_slits] [S#_optics] [S#_AngAcceptance] [S#_DriftSettings]	Standard beam-line / drift block. May carry slits, optics matrices, acceptance, and drift settings. Edit cautiously; many optics fields are coupled.
O	Rotate	[O1_General]	[O#_optics] [O#_RotateSettings]	Coordinate rotation block. Usually not edited for simple rate scans.

Letter	Block kind written in file header	Typical section prefix	Sections commonly associated with this block	Manual-editing notes
D	Dipole	[D1_General]	[D#_DipoleSettings] [D#_DipoleTransport] [D#_optics]	Dipole block. For Bp changes, edit Brho in [D#_DipoleSettings].
M	Material	[M1_General]	[M#_Compound] [M#_ProdTarget] [M#_BlockCalibration]	Material block, for example detector/degrader material. Thickness is in [M#_Compound]. ProdTarget flags whether it is treated as a production target.
W	Wedge	[W1_General]	[W#_Compound] [W#_ProdTarget] [W#_WedgeSettings] [W#_CurvedProfile] or [W#_CustomShape] if used	Wedge block. Material and thickness are in [W#_Compound]; wedge angle/profile options are in [W#_WedgeSettings].
H	Shift	[H1_General]	[H#_ShiftBlockSettings]	Shift block. Stores transverse position and angle offsets, e.g. ShiftX, AngleX, ShiftY, AngleY.

## 12.2 How block sections are connected to BlockStructure

For every character in BlockStructure, LISE<sup>++</sup> writes a group of sections. The first section is always the general block description:

```
[D3_General]
Name      = c0_WDG,1
Official  = SCD2-entr_to_1184
Length    = 8.636 m
```

The same prefix is then reused for the type-specific sections. For a dipole this includes [D3\_DipoleSettings] and [D3\_DipoleTransport]. For a wedge this includes [W1\_Compound] and [W1\_WedgeSettings].

## 12.3 Rules for manual editing

- Do not change BlockStructure for routine manual edits of beam, FOI, target thickness, wedge thickness, or dipole Bp.
- If a block is intentionally added or removed, BlockStructure, BlockNumber, and the complete group of block sections must remain consistent.
- A section with no matching character in BlockStructure is unsafe: LISE<sup>++</sup> creates the block list from BlockStructure first.
- A character in BlockStructure without its corresponding sections is also unsafe: the block may be created but read with default or incomplete values.
- For Bp, search for [D#\_DipoleSettings], not only for the word Brho, because multiple dipoles are usually present.
- For a wedge, search for [W#\_Compound] for material/thickness and [W#\_WedgeSettings] for wedge angle/profile settings.

## 12.4 Other c\_Config-supported block-specific sections

The uploaded c\_Config source also contains read/write definitions for additional block classes. Their one-letter initials are defined in the main LISE block-class code, while c\_Config defines the section suffixes and fields. If these blocks appear in another LISE file, use the same rule: letter + counter is the section prefix, and the suffix gives the block-specific data.

Block class / suffix in c_Config	Typical section suffix written by c_Config	Purpose
Electric dipole	ElectricDipoleSettings	Electric-field bend settings, including field, gap, angle, radius, and reference Ep.
GFS	GFS_Settings	Gas-filled separator settings and associated compound handling.
Wien filter	WienSettings	Electric and magnetic fields for a Wien filter block.
Kicker	KickerSettings	RF/electrostatic kicker geometry, phase, gap, electric field, voltage, and tuning flags.
Buncher	BuncherSettings	RF buncher geometry, phase, RF mode, gap, voltage, and transit-time-factor options.
Solenoid	SolenoidSettings	Solenoid current/field, coil geometry, bore, correction flags, and matrix options.
Delay	EffStruct_Time / EffStruct_Eff / EffStruct_Rate	Time-, efficiency-, and rate-dependent correction tables.
Fit	FitSettings	Constraint/operand/value/precision fields for a fitting block.