# The zref-clever package implementation[*]

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## Contents

[*]This file describes v0.1.0-alpha, released 2021-09-13.
[†]https://github.com/gusbrs/zref-clever

## 1 Initial setup

Start the DocStrip guards.

```
⟨*package⟩
```

Identify the internal prefix (LaTeX3 DocStrip convention).

```
⟨@@=zrefclever⟩
```

Taking a stance on backward compatibility of the package. During initial development, we have used freely recent features of the kernel (albeit refraining from l3candidates, even though I'd have loved to have used `\bool_case_true:...`). We presume xparse (which made to the kernel in the 2020-10-01 release), and expl3 as well (which made to the kernel in the 2020-02-02 release). We also just use UTF-8 for the translations (which became the default input encoding in the 2018-04-01 release). Hence, since we would not be able to go much backwards without special handling anyway, we make the cut with the inclusion of the new hook management system (ltcmdhooks), which is bound to be useful for our purposes, and was released with the 2021-06-01 kernel.

```
\providecommand\IfFormatAtLeastTF{\@ifl@t@r\fmtversion}
\IfFormatAtLeastTF{2021-06-01}
  {}
  {%
    \PackageError{zref-clever}{LaTeX kernel too old}
      {%
        'zref-clever' requires a LaTeX kernel newer than 2021-06-01.%
        \MessageBreak Loading will abort!%
      }%
    \endinput
  }%
```

Identify the package.

```
\ProvidesExplPackage {zref-clever} {2021-09-13} {0.1.0-alpha}
  {Clever LaTeX cross-references based on zref}
```

## 2 Dependencies

Required packages. Besides these, zref-hyperref may also be required depending on the presence of hyperref itself and on the `hyperref` option.

```
\RequirePackage { zref-base }
\RequirePackage { zref-user }
\RequirePackage { zref-counter }
\RequirePackage { zref-abspage }
\RequirePackage { translations }
```

## 3 zref setup

For the purposes of the package, we need to store some information with the labels, some of it standard, some of it not so much. So, we have to setup zref to do so.

Some basic properties are handled by zref itself, or some of its modules. The `page` and `counter` properties are respectively provided by modules zref-base and zref-counter. The zref-abspage provides the `abspage` property which gives us a safe and easy way to sort labels for page references.

But the reference itself, stored by zref-base in the `default` property, is somewhat a disputed real estate. In particular, the use of `\labelformat` (previously from varioref, now in the kernel) will include there the reference "prefix" and complicate the job we are trying to do here. Hence, we isolate `\the`⟨*counter*⟩ and store it "clean" in `zc@thecnt` for reserved use. Based on the definition of `\@currentlabel` done inside `\refstepcounter` in 'texdoc source2e', section 'ltxref.dtx'. We just drop the `\p@...` prefix.

```
\zref@newprop { zc@thecnt } { \use:c { the \@currentcounter } }
\zref@addprop \ZREF@mainlist { zc@thecnt }
```

Much of the work of zref-clever relies on the association between a label's "counter" and its "type" (see the User manual section on "Reference types"). Superficially examined, one might think this relation could just be stored in a global property list, rather than in the label itself. However, there are cases in which we want to distinguish different types for the same counter, depending on the document context. Hence, we need to store the "type" of the "counter" for each "label". In setting this, the presumption is that the label's type has the same name as its counter, unless it is specified otherwise by the `countertype` option, as stored in `\l__zrefclever_counter_type_prop`.

```
\zref@newprop { zc@type }
  {
    \prop_if_in:NVTF \l__zrefclever_counter_type_prop \@currentcounter
      {
        \exp_args:NNe \prop_item:Nn
          \l__zrefclever_counter_type_prop { \@currentcounter }
      }
      { \@currentcounter }
  }
\zref@addprop \ZREF@mainlist { zc@type }
```

Since the `zc@thecnt` and `page` properties store the "*printed* representation" of their respective counters, for sorting and compressing purposes, we are also interested in their numeric values. So we store them in `zc@cntval` and `zc@pgval`. For this, we use `\c@`⟨*counter*⟩, which contains the counter's numerical value (see 'texdoc source2e', section 'ltcounts.dtx').

```
\zref@newprop { zc@cntval } [0] { \int_use:c { c@ \@currentcounter } }
\zref@addprop \ZREF@mainlist { zc@cntval }
\zref@newprop* { zc@pgval } [0] { \int_use:c { c@page } }
\zref@addprop \ZREF@mainlist { zc@pgval }
```

However, since many counters (may) get reset along the document, we require more than just their numeric values. We need to know the reset chain of a given counter, in order to sort and compress a group of references. Also here, the "printed representation" is not enough, not only because it is easier to work with the numeric values but, given we occasionally group multiple counters within a single type, sorting this group requires to know the actual counter reset chain (the counters' names and values). Indeed, the set of counters grouped into a single type cannot be arbitrary: all of them must belong to the same reset chain, and must be nested within each other (they cannot even just share the same parent).

Furthermore, even if it is true that most of the definitions of counters, and hence of their reset behavior is likely to be defined in the preamble, this is not necessarily true. Users can create counters, newtheorems mid-document, and alter their reset behavior along the way. Was that not the case, we could just store the desired information at `begindocument` in a variable and retrieve it when needed. But since it is, we need to store the information with the label, with the values as current when the label is set.

Though counters can be reset at any time, and in different ways at that, the most important use case is the automatic resetting of counters when some other counter is stepped, as performed by the standard mechanisms of the kernel (optional argument of `\newcounter`, `\@addtoreset`, `\counterwithin` and related infrastructure). The canonical optional argument of `\newcounter` establishes that the counter being created (the mandatory argument) gets reset every time the "enclosing counter" gets stepped (this is called in the usual sources "within-counter", "old counter", "supercounter" etc.). This information is a little trickier to get. For starters, the counters which may reset the current counter are not retrievable from the counter itself, because this information is stored with the counter that does the resetting, not with the one that gets reset (the list is stored in `\cl@`⟨*counter*⟩ with format `\@elt{countera}\@elt{counterb}\@elt{counterc}`, see section 'ltcounts.dtx' in 'source2e'). Besides, there may be a chain of resetting counters, which must be taken into account: if 'counterC' gets reset by 'counterB', and 'counterB' gets reset by 'counterA', stepping the latter affects all three of them.

The procedure below examines a set of counters, those included in `\l__zrefclever_counter_resetters_seq`, and for each of them retrieves the set of counters it resets, as stored in `\cl@`⟨*counter*⟩, looking for the counter for which we are trying to set a label (`\@currentcounter`, passed as an argument to the functions). There is one relevant caveat to this procedure: `\l__zrefclever_counter_resetters_seq` is populated by hand with the "usual suspects", there is no way (that I know of) to ensure it is exhaustive. However, it is not that difficult to create a reasonable "usual suspects" list which, of course, should include the counters for the sectioning commands to start with, and it is easy to add more counters to this list if needed, with the option `counterresetters`. Unfortunately, not all counters are created alike, or reset alike. Some counters, even some kernel ones, get reset by other mechanisms (notably, the `enumerate` environment counters do not use the regular counter machinery for resetting on each level, but are nested nevertheless by other means). Therefore, inspecting `\cl@`⟨*counter*⟩ cannot possibly fully account for all of the automatic counter resetting which takes place in the document. And there's also no other "general rule" we could grab on for this, as far as I know. So we provide a way to manually tell zref-clever of these cases, by means of the `counterresetby` option, whose information is stored in `\l__zrefclever_counter_resetby_prop`. This manual specification has precedence over the search through `\l__zrefclever_counter_resetters_seq`, and should be handled with care, since there is no possible verification mechanism for this.

__zrefclever_get_enclosing_counters:n
__zrefclever_get_enclosing_counters_value:n

Recursively generate a *sequence* of "enclosing counters" and values, for a given ⟨*counter*⟩ and leave it in the input stream. These functions must be expandable, since they get called from `\zref@newprop` and are the ones responsible for generating the desired information when the label is being set. Note that the order in which we are getting this information is reversed, since we are navigating the counter reset chain bottom-up. But it is very hard to do otherwise here where we need expandable functions, and easy to handle at the reading side.

```
\__zrefclever_get_enclosing_counters:n {⟨counter⟩}
\__zrefclever_get_enclosing_counters_value:n {⟨counter⟩}
```

```
\cs_new:Npn \__zrefclever_get_enclosing_counters:n #1
  {
    \cs_if_exist:cT { c@ \__zrefclever_counter_reset_by:n {#1} }
    {
      { \__zrefclever_counter_reset_by:n {#1} }
      \__zrefclever_get_enclosing_counters:e
        { \__zrefclever_counter_reset_by:n {#1} }
    }
  }
\cs_new:Npn \__zrefclever_get_enclosing_counters_value:n #1
  {
    \cs_if_exist:cT { c@ \__zrefclever_counter_reset_by:n {#1} }
      {
        { \int_use:c { c@ \__zrefclever_counter_reset_by:n {#1} } }
        \__zrefclever_get_enclosing_counters_value:e
          { \__zrefclever_counter_reset_by:n {#1} }
      }
  }
```

Both e and f expansions work for this particular recursive call. For the time being, I'll stay with the e variant, since conceptually it is what I want (x itself is not expandable), and this package is unlikely to be used within the context of older kernels for which the performance penalty of the e expansion would ensue (see also https://tex.stackexchange.com/q/611370/#comment1529282_611385, thanks Enrico Gregorio, aka 'egreg').

```
\cs_generate_variant:Nn \__zrefclever_get_enclosing_counters:n { V , e }
\cs_generate_variant:Nn \__zrefclever_get_enclosing_counters_value:n { V , e }
```

(*End definition for* `\__zrefclever_get_enclosing_counters:n` *and* `\__zrefclever_get_enclosing_counters_value:n`.)

__zrefclever_counter_reset_by:n

Auxiliary function for `\__zrefclever_get_enclosing_counters:n` and `\__zrefclever_get_enclosing_counters_value:n`. They are broken in parts to be able to use the expandable mapping functions. `\__zrefclever_counter_reset_by:n` leaves in the stream the "enclosing counter" which resets ⟨*counter*⟩.

```
\__zrefclever_counter_reset_by:n {⟨counter⟩}
```

```
\cs_new:Npn \__zrefclever_counter_reset_by:n #1
  {
    \bool_if:nTF
      { \prop_if_in_p:Nn \l__zrefclever_counter_resetby_prop {#1} }
      { \prop_item:Nn  \l__zrefclever_counter_resetby_prop {#1} }
      {
        \seq_map_tokens:Nn \l__zrefclever_counter_resetters_seq
          { \__zrefclever_counter_reset_by_aux:nn {#1} }
      }
  }
\cs_new:Npn \__zrefclever_counter_reset_by_aux:nn #1#2
  {
    \cs_if_exist:cT { c@ #2 }
      {
        \tl_if_empty:cF { cl@ #2 }
          {
            \tl_map_tokens:cn { cl@ #2 }
              { \__zrefclever_counter_reset_by_auxi:nnn {#2} {#1} }
          }
      }
  }
\cs_new:Npn \__zrefclever_counter_reset_by_auxi:nnn #1#2#3
  {
    \str_if_eq:nnT {#2} {#3}
      { \tl_map_break:n { \seq_map_break:n {#1} } }
  }
```

(*End definition for* `\__zrefclever_counter_reset_by:n`.)

Finally, we create the `zc@enclcnt` and `zc@enclval` properties, and add them to the `main` property list.

```
\zref@newprop { zc@enclcnt }
  { \__zrefclever_get_enclosing_counters:V \@currentcounter }
\zref@newprop { zc@enclval }
  { \__zrefclever_get_enclosing_counters_value:V \@currentcounter }
\zref@addprop \ZREF@mainlist { zc@enclcnt }
\zref@addprop \ZREF@mainlist { zc@enclval }
```

Another piece of information we need is the page numbering format being used by `\thepage`, so that we know when we can (or not) group a set of page references in a range. Unfortunately, `page` is not a typical counter in ways which complicates things. First, it does commonly get reset along the document, not necessarily by the usual counter reset chains, but rather with `\pagenumbering` or variations thereof. Second, the format of the page number commonly changes in the document (roman, arabic, etc.), not necessarily, though usually, together with a reset. Trying to "parse" `\thepage` to retrieve such information is bound to go wrong: we don't know, and can't know, what is within that macro, and that's the business of the user, or of the documentclass, or of the loaded packages. The technique used by cleveref, which we borrow here, is simple and smart: store with the label what `\thepage` would return, if the counter `\c@page` was "1". That does not allow us to *sort* the references, luckily however, we have `abspage` which solves this problem. But we can decide whether two labels can be compressed into a range or not based on this format: if they are identical, we can compress them, otherwise, we can't. To do so, we locally redefine `\c@page` to return "1", thus avoiding any global spillovers of this trick. Since this operation is not expandable we cannot run it directly from the property definition. Hence, we use a shipout hook, and set `\g__zrefclever_page_format_tl`, which can then be retrieved by the starred definition of `\zref@newprop*{zc@pgfmt}`.

```
\tl_new:N \g__zrefclever_page_format_tl
\cs_new_protected:Npx \__zrefclever_page_format_aux: { \int_eval:n { 1 } }
\AddToHook { shipout / before }
  {
    \group_begin:
    \cs_set_eq:NN \c@page \__zrefclever_page_format_aux:
    \exp_args:NNx \tl_gset:Nn \g__zrefclever_page_format_tl { \thepage }
    \group_end:
  }
\zref@newprop* { zc@pgfmt } { \g__zrefclever_page_format_tl }
\zref@addprop \ZREF@mainlist { zc@pgfmt }
```

Still another property which we don't need to handle at the data provision side, but need to cater for at the retrieval side, is the `url` property (or the equivalent `urluse`) from the zref-xr module, which is added to the labels imported from external documents, and needed to construct hyperlinks to them.

# 4 Plumbing

## 4.1 Messages

```
\msg_new:nnn { zref-clever } { option-not-type-specific }
  {
    Option~'#1'~is~not~type-specific~\msg_line_context:.~
    Set~it~in~'\exp_not:N \zcDeclareTranslations'~before~first~'type'~switch~
    or~as~package~option.
  }
\msg_new:nnn { zref-clever } { option-only-type-specific }
  {
    No~type~specified~for~option~'#1'~\msg_line_context:.~
    Set~it~after~'type'~switch~or~in~'\exp_not:N \zcRefTypeSetup'.
  }
\msg_new:nnn  { zref-clever } { key-requires-value }
  { The~'#1'~key~'#2'~requires~a~value. }
\msg_new:nnn { zref-clever } { missing-zref-titleref }
  {
    Option~'ref=title'~requested~\msg_line_context:.~
    But~package~'zref-titleref'~is~not~loaded,~falling~back~to~default~'ref'.
  }
\msg_new:nnn { zref-clever } { hyperref-preamble-only }
  {
    Option~'hyperref'~only~available~in~the~preamble. \iow_newline:
    Use~the~starred~version~of~'\noexpand\zcheck'~instead.
  }
\msg_new:nnn { zref-clever } { missing-hyperref }
  { Missing~'hyperref'~package. \iow_newline: Setting~'hyperref=false'. }
\msg_new:nnn { zref-check } { check-document-only }
  { Option~'check'~only~available~in~the~document. }
\msg_new:nnn { zref-clever } { missing-zref-check }
  {
    Option~'check'~requested~\msg_line_context:.~
    But~package~'zref-check'~is~not~loaded,~can't~run~the~checks.
  }
\msg_new:nnn { zref-clever } { counters-not-nested }
  { Counters~not~nested~for~labels~'#1'~and~'#2'~\msg_line_context:. }
\msg_new:nnn { zref-clever } { missing-type }
  { Reference~type~undefined~for~label~'#1'~\msg_line_context:. }
\msg_new:nnn { zref-clever } { missing-name }
  { Name~undefined~for~type~'#1'~\msg_line_context:. }
\msg_new:nnn { zref-clever } { single-element-range }
  { Range~for~type~'#1'~resulted~in~single~element~\msg_line_context:. }
```

## 4.2 Translations

Some wrappers around translations functions, so that we can generate variants with expansion control for arguments, or for convenience.

__zrefclever_if_transl:nnTF Conditional to check if a translation of ⟨*key*⟩ exists for language ⟨*lang*⟩.

```
\__zrefclever_if_transl:nnTF {⟨lang⟩} {⟨key⟩} {⟨true⟩} {⟨false⟩}
```

```
\prg_new_conditional:Npnn \__zrefclever_if_transl:nn #1#2 { TF }
```

```
  {
    \IfTranslation {#1} {#2}
      { \prg_return_true:  }
      { \prg_return_false: }
  }
\prg_generate_conditional_variant:Nnn \__zrefclever_if_transl:nn { xx } { TF }
```

(*End definition for* `\__zrefclever_if_transl:nnTF`.)

`\__zrefclever_get_transl:nnn` Retrieves the translation of ⟨*key*⟩ for the language ⟨*lang*⟩ and saves it in ⟨*macro*⟩.

```
\__zrefclever_get_transl:nnn {⟨macro⟩} {⟨lang⟩} {⟨key⟩}
```

```
\cs_new_protected:Npn \__zrefclever_get_transl:nnn #1#2#3
  { \SaveTranslationFor{#1}{#2}{#3} }
\cs_generate_variant:Nn \__zrefclever_get_transl:nnn { nxx }
```

(*End definition for* `\__zrefclever_get_transl:nnn`.)

`\__zrefclever_declare_transl:nnn` Defines the translation of ⟨*key*⟩ for the language ⟨*lang*⟩. The ⟨*key*⟩ here is the full key, including package prefix, type, and internal key name (i.e. the "key" from the perspective of translations).

```
\__zrefclever_declare_transl:nnn {⟨lang⟩} {⟨key⟩} {⟨translation⟩}
```

```
\cs_new_protected:Npn \__zrefclever_declare_transl:nnn #1#2#3
  { \declaretranslation {#1} {#2} {#3} }
\cs_generate_variant:Nn \__zrefclever_declare_transl:nnn { xxn }
```

(*End definition for* `\__zrefclever_declare_transl:nnn`.)

`\__zrefclever_declare_default_transl:nnn` Defines the translation of ⟨*key*⟩ for the language ⟨*lang*⟩. The ⟨*key*⟩ here is the internal key name (i.e. the name of the option).

```
\__zrefclever_declare_default_transl:nnn {⟨lang⟩} {⟨key⟩} {⟨translation⟩}
```

```
\cs_new_protected:Npn \__zrefclever_declare_default_transl:nnn #1#2#3
  { \declaretranslation {#1} { zrefclever-default- #2 } {#3} }
```

(*End definition for* `\__zrefclever_declare_default_transl:nnn`.)

`\zcDicDefaultTransl` `\zcDicTypeTransl` Functions for providing translations in dictionary files. We refrain from using `expl3` names and "atletter", so that we don't have to control catcodes in those files (as far as I can tell, translations itself doesn't cater for this), even if these commands are only really meant for internal use. The ⟨*key*⟩ here is always the internal key name (i.e. the name of the option). The language does not need to be specified, it is automatically retrieved from the dictionary's declaration done by `\ProvideDictionaryFor`. Since `\ProvideDictTranslation` is restricted by translations to the preamble, we inherit this restriction here.

```
\zcDicDefaultTransl {⟨key⟩} {⟨translation⟩}
\zcDicTypeTransl {⟨type⟩} {⟨key⟩} {⟨translation⟩}
```

```
\NewDocumentCommand \zcDicDefaultTransl { m m }
  { \ProvideDictTranslation { zrefclever-default- #1 } {#2} }
\NewDocumentCommand \zcDicTypeTransl { m m m }
  { \ProvideDictTranslation { zrefclever-type- #1 - #2 } {#3} }
\@onlypreamble \zcDicDefaultTransl
\@onlypreamble \zcDicTypeTransl
```

(*End definition for* `\zcDicDefaultTransl` *and* `\zcDicTypeTransl`.)

## 4.3 Options

### Auxiliary functions

__zrefclever_prop_put_non_empty:Nnn If ⟨*value*⟩ is empty, remove ⟨*key*⟩ from ⟨*property list*⟩. Otherwise, add ⟨*key*⟩ = ⟨*value*⟩ to ⟨*property list*⟩.

```
\__zrefclever_prop_put_non_empty:Nnn ⟨property list⟩ {⟨key⟩} {⟨value⟩}
```

```
\cs_new_protected:Npn \__zrefclever_prop_put_non_empty:Nnn #1#2#3
  {
    \tl_if_empty:nTF {#3}
      { \prop_remove:Nn #1 {#2} }
      { \prop_put:Nnn #1 {#2} {#3} }
  }
```

(*End definition for* `\__zrefclever_prop_put_non_empty:Nnn`*.*)

### countertype option

`\l__zrefclever_counter_type_prop` is used by `zc@type` property, and stores a mapping from "counter" to "reference type". Only those counters whose type name is different from that of the counter need to be specified, since `zc@type` presumes the counter as the type if the counter is not found in `\l__zrefclever_counter_type_prop`.

```
\prop_new:N \l__zrefclever_counter_type_prop
\keys_define:nn { zref-clever / label }
  {
    countertype .code:n =
      {
        \keyval_parse:nnn
          {
            \msg_warning:nnnn { zref-clever }
              { key-requires-value } { countertype }
          }
          {
            \__zrefclever_prop_put_non_empty:Nnn
              \l__zrefclever_counter_type_prop
          }
          {#1}
      } ,
    countertype .value_required:n = true ,
    countertype .initial:n =
      {
        subsection    = section ,
        subsubsection = section ,
        subparagraph  = paragraph ,
        enumi         = item ,
        enumii        = item ,
        enumiii       = item ,
        enumiv        = item ,
      } ,
  }
```

### counterresetters option

\l__zrefclever_counter_resetters_seq is used by __zrefclever_counter_reset_-by:n to populate the zc@enclcnt and zc@enclval properties, and stores the list of counters which are potential "enclosing counters" for other counters. This option is constructed such that users can only *add* items to the variable. There would be little gain and some risk in allowing removal, and the syntax of the option would become unnecessarily more complicated. Besides, users can already override, for any particular counter, the search done from the set in \l__zrefclever_counter_resetters_seq with the counterresetby option.

```
\seq_new:N \l__zrefclever_counter_resetters_seq
\keys_define:nn { zref-clever / label }
  {
    counterresetters .code:n =
      {
        \clist_map_inline:nn {#1}
          {
            \seq_if_in:NnF \l__zrefclever_counter_resetters_seq {##1}
              {
                \seq_put_right:Nn
                  \l__zrefclever_counter_resetters_seq {##1}
              }
          }
      } ,
    counterresetters .initial:n =
      {
        part ,
        chapter ,
        section ,
        subsection ,
        subsubsection ,
        paragraph ,
        subparagraph ,
      },
    typesort .value_required:n = true ,
  }
```

### counterresetby option

\l__zrefclever_counter_resetby_prop is used by __zrefclever_counter_reset_-by:n to populate the zc@enclcnt and zc@enclval properties, and stores a mapping from counters to the counter which resets each of them. This mapping has precedence in __zrefclever_counter_reset_by:n over the search through \l__zrefclever_-counter_resetters_seq.

```
\prop_new:N \l__zrefclever_counter_resetby_prop
\keys_define:nn { zref-clever / label }
  {
    counterresetby .code:n =
      {
        \keyval_parse:nnn
          {
            \msg_warning:nnn { zref-clever }
            { key-requires-value } { counterresetby }
          }
          {
            \__zrefclever_prop_put_non_empty:Nnn
              \l__zrefclever_counter_resetby_prop
          }
          {#1}
      } ,
    counterresetby .value_required:n = true ,
    counterresetby .initial:n =
      {
```

The counters for the `enumerate` environment do not use the regular counter machinery for resetting on each level, but are nested nevertheless by other means, treat them as exception.

```
        enumii  = enumi   ,
        enumiii = enumii  ,
        enumiv  = enumiii ,
      } ,
  }
```

### `ref` option

`\l__zrefclever_ref_property_tl` stores the property to which the reference is being made. Currently, we restrict `ref=` to these two (or three) alternatives – `zc@thecnt`, `page`, and `title` if zref-titleref is loaded –, but there might be a case for making this more flexible. The infrastructure can already handle receiving an arbitrary property, as long as one is satisfied with sorting and compressing from the default counter. If more flexibility is granted, one thing *must* be handled at this point: the existence of the property itself, as far as `zref` is concerned. This because typesetting relies on the check `\zref@ifrefcontainsprop`, which *presumes* the property is defined and silently expands the *true* branch if it is not (see https://github.com/ho-tex/zref/issues/13, thanks Ulrike Fischer). Therefore, before adding anything to `\l__zrefclever_ref_property_tl`, check if first here with `\zref@ifpropundefined`: close it at the door.

```
\tl_new:N \l__zrefclever_ref_property_tl
\keys_define:nn { zref-clever / reference }
  {
    ref .choice: ,
    ref / zc@thecnt .code:n =
      { \tl_set:Nn \l__zrefclever_ref_property_tl { zc@thecnt } } ,
    ref / page .code:n =
      { \tl_set:Nn \l__zrefclever_ref_property_tl { page } } ,
    ref / title .code:n =
      {
        \AddToHook { begindocument }
          {
            \@ifpackageloaded { zref-titleref }
              { \tl_set:Nn \l__zrefclever_ref_property_tl { title } }
              {
                \msg_warning:nn { zref-clever } { missing-zref-titleref }
                \tl_set:Nn \l__zrefclever_ref_property_tl { zc@thecnt }
              }
          }
      } ,
    ref .initial:n = zc@thecnt ,
    ref .value_required:n = true ,
    page .meta:n = { ref = page },
    page .value_forbidden:n = true ,
  }
\AddToHook { begindocument }
  {
    \@ifpackageloaded { zref-titleref }
      {
        \keys_define:nn { zref-clever / reference }
          {
            ref / title .code:n =
              { \tl_set:Nn \l__zrefclever_ref_property_tl { title } }
          }
      }
      {
        \keys_define:nn { zref-clever / reference }
          {
            ref / title .code:n =
              {
                \msg_warning:nn { zref-clever } { missing-zref-titleref }
                \tl_set:Nn \l__zrefclever_ref_property_tl { zc@thecnt }
              }
          }
      }
  }
```

**typeset option**

```
\bool_new:N \l__zrefclever_typeset_ref_bool
\bool_new:N \l__zrefclever_typeset_name_bool
\keys_define:nn { zref-clever / reference }
 {
  typeset .choice: ,
  typeset / both .code:n =
    {
      \bool_set_true:N \l__zrefclever_typeset_ref_bool
      \bool_set_true:N \l__zrefclever_typeset_name_bool
    } ,
  typeset / ref .code:n =
    {
      \bool_set_true:N \l__zrefclever_typeset_ref_bool
      \bool_set_false:N \l__zrefclever_typeset_name_bool
    } ,
  typeset / name .code:n =
    {
      \bool_set_false:N \l__zrefclever_typeset_ref_bool
      \bool_set_true:N \l__zrefclever_typeset_name_bool
    } ,
  typeset .initial:n = both ,
  typeset .value_required:n = true ,

  noname .meta:n = { typeset = ref },
    noname .value_forbidden:n = true ,
  }
```

**sort option**

```
\bool_new:N \l__zrefclever_typeset_sort_bool
\keys_define:nn { zref-clever / reference }
  {
    sort .bool_set:N = \l__zrefclever_typeset_sort_bool ,
    sort .initial:n = true ,
    sort .default:n = true ,
    nosort .meta:n = { sort = false },
    nosort .value_forbidden:n = true ,
  }
```

**typesort option**

`\l__zrefclever_typesort_seq` is stored reversed, since the sort priorities are computed in the negative range in `\__zrefclever_sort_default_different_types:nn`, so that we can implicitly rely on ‘0’ being the “last value”, and spare creating an integer variable using `\seq_map_indexed_inline:Nn`.

```
\seq_new:N \l__zrefclever_typesort_seq
\keys_define:nn { zref-clever / reference }
  {
    typesort .code:n =
      {
        \seq_set_from_clist:Nn \l__zrefclever_typesort_seq {#1}
        \seq_reverse:N \l__zrefclever_typesort_seq
      } ,
    typesort .initial:n =
      { part , chapter , section , paragraph },
    typesort .value_required:n = true ,
    notypesort .code:n =
      { \seq_clear:N \l__zrefclever_typesort_seq } ,
    notypesort .value_forbidden:n = true ,
  }
```

**comp option**

```
\bool_new:N \l__zrefclever_typeset_compress_bool
\keys_define:nn { zref-clever / reference }
  {
    comp .bool_set:N = \l__zrefclever_typeset_compress_bool ,
    comp .initial:n = true ,
    comp .default:n = true ,
    nocomp .meta:n = { comp = false },
    nocomp .value_forbidden:n = true ,
  }
```

**range option**

```
\bool_new:N \l__zrefclever_typeset_range_bool
\keys_define:nn { zref-clever / reference }
  {
    range .bool_set:N = \l__zrefclever_typeset_range_bool ,
    range .initial:n = false ,
    range .default:n = true ,
  }
```

**hyperref option**

```
\bool_new:N \l__zrefclever_use_hyperref_bool
\bool_new:N \l__zrefclever_warn_hyperref_bool
\keys_define:nn { zref-clever / reference }
  {
    hyperref .choice: ,
    hyperref / auto .code:n =
      {
        \bool_set_true:N \l__zrefclever_use_hyperref_bool
        \bool_set_false:N \l__zrefclever_warn_hyperref_bool
      } ,
    hyperref / true .code:n =
      {
        \bool_set_true:N \l__zrefclever_use_hyperref_bool
        \bool_set_true:N \l__zrefclever_warn_hyperref_bool
      } ,
    hyperref / false .code:n =
      {
        \bool_set_false:N \l__zrefclever_use_hyperref_bool
        \bool_set_false:N \l__zrefclever_warn_hyperref_bool
      } ,
    hyperref .initial:n = auto ,
    hyperref .default:n = auto
  }
\AddToHook { begindocument }
  {
    \@ifpackageloaded { hyperref }
      {
        \bool_if:NT \l__zrefclever_use_hyperref_bool
          { \RequirePackage { zref-hyperref } }
      }
      {
        \bool_if:NT \l__zrefclever_warn_hyperref_bool
          { \msg_warning:nn { zref-clever } { missing-hyperref } }
        \bool_set_false:N \l__zrefclever_use_hyperref_bool
      }
    \keys_define:nn { zref-clever / reference }
      {
        hyperref .code:n =
          { \msg_warning:nn { zref-clever } { hyperref-preamble-only } }
      }
  }
```

**nameinlink option**

```
\str_new:N \l__zrefclever_nameinlink_str
\keys_define:nn { zref-clever / reference }
  {
    nameinlink .choice: ,
    nameinlink / true .code:n =
      { \str_set:Nn \l__zrefclever_nameinlink_str { true } } ,
    nameinlink / false .code:n =
      { \str_set:Nn \l__zrefclever_nameinlink_str { false } } ,
    nameinlink / single .code:n =
      { \str_set:Nn \l__zrefclever_nameinlink_str { single } } ,
    nameinlink / tsingle .code:n =
      { \str_set:Nn \l__zrefclever_nameinlink_str { tsingle } } ,
    nameinlink .initial:n = tsingle ,
    nameinlink .default:n = true ,
  }
```

### cap and capfirst options

```
\bool_new:N \l__zrefclever_capitalize_bool
\bool_new:N \l__zrefclever_capitalize_first_bool
\keys_define:nn { zref-clever / reference }
  {
    cap .bool_set:N = \l__zrefclever_capitalize_bool ,
    cap .initial:n = false ,
    cap .default:n = true ,
    nocap .meta:n = { cap = false },
    nocap .value_forbidden:n = true ,

    capfirst .bool_set:N = \l__zrefclever_capitalize_first_bool ,
    capfirst .initial:n = false ,
    capfirst .default:n = true ,

    C .meta:n =
      { capfirst = true , noabbrevfirst = true },
    C .value_forbidden:n = true ,
  }
```

### abbrev and noabbrevfirst options

```
\bool_new:N \l__zrefclever_abbrev_bool
\bool_new:N \l__zrefclever_noabbrev_first_bool
\keys_define:nn { zref-clever / reference }
  {
    abbrev .bool_set:N = \l__zrefclever_abbrev_bool ,
    abbrev .initial:n = false ,
    abbrev .default:n = true ,
    noabbrev .meta:n = { abbrev = false },
    noabbrev .value_forbidden:n = true ,

    noabbrevfirst .bool_set:N = \l__zrefclever_noabbrev_first_bool ,
    noabbrevfirst .initial:n = false ,
    noabbrevfirst .default:n = true ,
  }
```

### lang option

`\l__zrefclever_current_language_tl` is an internal alias for translations's internal macro `\@trnslt@current@language` which, in turn, is an alias for `\languagename` used by both babel and polyglossia, but translations ensures it always exists, even if no language package is loaded. `\l__zrefclever_main_language_tl` is an internal alias for babel's `\bbl@main@language` or for polyglossia's `\xpg@main@language`, as the case may be. `\l__zrefclever_ref_language_tl` is the internal variable which stores the language in which the reference is to be made.

The overall setup here seems a little roundabout, but this is actually required. In the preamble, we (potentially) don't yet have values for the "main" and "current" document languages, this must be retrieved at a `begindocument/before` hook. And it must be `before`, since `\LoadDictionaryFor` is preamble only. The `begindocument/before` hook is responsible to get values for `\l__zrefclever_main_language_tl` and `\l__zrefclever_current_language_tl` and load zref-clever dictionaries for all languages loaded by babel or polyglossia, or directly specified by the user. After this information is retrieved, the preamble options are executed, and this is handled by the internal `zref-clever/reflanguage` hook, which is called at this point. This hook handles two things: it executes the preamble options and, in sequence, it redefines the `lang` option key, since in the document body, we can handle "main" and "current" language options immediately. This redefinition is added to the `zref-clever/reflanguage` hook, but `\AtEndOfPackage` so that it comes after `\ProcessKeysOptions`. In other words, this is how we ensure the preamble options are executed before the `lang` key is redefined.

For the babel and polyglossia variables which store the "main" and "current" languages, see https://tex.stackexchange.com/a/233178, including comments, particularly the one by Javier Bezos. For the babel and polyglossia variables which store the list of loaded languages, see https://tex.stackexchange.com/a/281220, including comments, particularly PLK's.

```
\tl_new:N \l__zrefclever_ref_language_tl
\tl_new:N \l__zrefclever_main_language_tl
\tl_new:N \l__zrefclever_current_language_tl
\NewHook { zref-clever / reflanguage }
\keys_define:nn { zref-clever / reference }
  {
    lang .code:n =
      {
        \AddToHook { zref-clever / reflanguage }
          {
            \str_case:nnF {#1}
              {
                { main }
                {
                  \tl_set_eq:NN \l__zrefclever_ref_language_tl
                    \l__zrefclever_main_language_tl
                }

                { current }
                {
                  \tl_set_eq:NN \l__zrefclever_ref_language_tl
                    \l__zrefclever_current_language_tl
                }
              }
              {
                \tl_set:Nn \l__zrefclever_ref_language_tl {#1}
```

If the user specified a language in the preamble, make sure it is loaded. There's no need to worry with redundancy with babel and polyglosssia loaded languages, since `\LoadDictionaryFor` does not reload a dictionary if it's already been loaded.

```
                \exp_args:Nx \file_if_exist:nTF
                  { zref-clever- \@trnslt@language {#1} .trsl }
                  { \LoadDictionaryFor {#1} { zref-clever } }
                  {
                    \exp_args:Nx \file_if_exist:nT
                      { zref-clever- \baselanguage {#1} .trsl }
                      { \LoadDictionaryFor {#1} { zref-clever } }
                  }
              }
          }
      } ,
    lang .initial:n = main ,
    lang .value_required:n = true ,
  }
```

Redefinition of the lang key option for the document body.

```
\AtEndOfPackage
  {
    \AddToHook { zref-clever / reflanguage }
      {
        \keys_define:nn { zref-clever / reference }
          {
            lang .code:n =
              {
                \str_case:nnF {#1}
                  {
                    { main }
                    {
                      \tl_set_eq:NN \l__zrefclever_ref_language_tl
                        \l__zrefclever_main_language_tl
                    }

                    { current }
                    {
                      \tl_set_eq:NN \l__zrefclever_ref_language_tl
                        \l__zrefclever_current_language_tl
                    }
                  }
                  { \tl_set:Nn \l__zrefclever_ref_language_tl {#1} }
              } ,
            lang .value_required:n = true ,
          }
      }
  }
\AddToHook { begindocument / before }
  {
    \tl_set_eq:NN \l__zrefclever_current_language_tl
      \@trnslt@current@language
    \@ifpackageloaded{babel}
      {
        \tl_set_eq:NN \l__zrefclever_main_language_tl
          \bbl@main@language
        \clist_map_inline:Nn \bbl@loaded
          {
```

Funny enough, translations also loads its basic dictionaries for all languages loaded by babel or polyglossia. First, there is no way to disable this, even if we don't need them at all here. Second, translations sends messages of its own missing dictionaries to `info` and everyone else's to `warning`... So we have to control ourselves for missing dictionaries and load them only if available.

```
            \exp_args:Nx \file_if_exist:nTF
              { zref-clever- \@trnslt@language {#1} .trsl }
              { \LoadDictionaryFor {#1} { zref-clever } }
              {
                \exp_args:Nx \file_if_exist:nT
                  { zref-clever- \baselanguage {#1} .trsl }
                  { \LoadDictionaryFor {#1} { zref-clever } }
              }
          }
      }
      {
        \@ifpackageloaded{polyglossia}
          {
            \tl_set_eq:NN \l__zrefclever_main_language_tl
              \xpg@main@language
            \clist_map_inline:Nn \xpg@loaded
              {
                \exp_args:Nx \file_if_exist:nTF
                  { zref-clever- \@trnslt@language {#1} .trsl }
                  { \LoadDictionaryFor {#1} { zref-clever } }
                  {
                    \exp_args:Nx \file_if_exist:nT
                      { zref-clever- \baselanguage {#1} .trsl }
                      { \LoadDictionaryFor {#1} { zref-clever } }
                  }
              }
          }
          {
            \tl_set:Nn \l__zrefclever_main_language_tl { english }
            \LoadDictionaryFor { english } { zref-clever }
          }
      }
```

*Then* we execute the package options stored in the `zref-clever/reflanguage` hook.

```
    \UseHook { zref-clever / reflanguage }
  }
```

### note option

```
\tl_new:N \l__zrefclever_zcref_note_tl
\keys_define:nn { zref-clever / reference }
  {
    note .tl_set:N = \l__zrefclever_zcref_note_tl ,
    note .value_required:n = true ,
  }
```

### check option

Integration with zref-check.

```
\bool_new:N \l__zrefclever_zrefcheck_available_bool
\bool_new:N \l__zrefclever_zcref_with_check_bool
```

```
\keys_define:nn { zref-clever / reference }
  {
    check .code:n =
      { \msg_warning:nn { zref-clever } { check-document-only } } ,
  }
\AddToHook { begindocument }
  {
    \@ifpackageloaded { zref-check }
      {
        \bool_set_true:N \l__zrefclever_zrefcheck_available_bool
        \keys_define:nn { zref-clever / reference }
          {
            check .code:n =
              {
                \bool_set_true:N \l__zrefclever_zcref_with_check_bool
                \keys_set:nn { zref-check / zcheck } {#1}
              }
          }
      }
      {
        \bool_set_false:N \l__zrefclever_zrefcheck_available_bool
        \keys_define:nn { zref-clever / reference }
          {
            check .code:n =
              { \msg_warning:nn { zref-clever } { missing-zref-check } }
          }
      }
  }
```

### Reference options

```
\tl_new:N \l__zrefclever_ref_typeset_font_tl
\keys_define:nn { zref-clever / reference }
  { font .tl_set:N = \l__zrefclever_ref_typeset_font_tl }
```

Only not necessarily type-specific options are pertinent here.

```
\prop_new:N \l__zrefclever_ref_options_prop
\clist_map_inline:nn
  {
    % Not type-specific options.
    tpairsep ,
    tlistsep ,
    tlastsep ,
    notesep ,
    % Possibly type-specific options.
    namefont ,
    namesep ,
    pairsep ,
    listsep ,
    lastsep ,
    rangesep ,
    reffont ,
    refpre ,
    refpos ,
    reffont-in ,
    refpre-in ,
    refpos-in ,
  }
  {
    \keys_define:nn { zref-clever / reference }
      {
        #1 .default:V = \c_novalue_tl ,
        #1 .code:n =
          {
            \tl_if_novalue:nTF {##1}
              { \prop_remove:Nn \l__zrefclever_ref_options_prop {#1} }
              { \prop_put:Nnn \l__zrefclever_ref_options_prop {#1} {##1} }
          } ,
      }
  }
```

**Package options**

```
\keys_define:nn { }
  {
    zref-clever / zcsetup .inherit:n = zref-clever / label ,
    zref-clever / zcsetup .inherit:n = zref-clever / reference ,
  }
```

`\zcsetup` Provide `\zcsetup`.

```
\NewDocumentCommand \zcsetup { m }
  { \keys_set:nn { zref-clever / zcsetup } {#1} }
```

(*End definition for* `\zcsetup`.)

Process load-time package options (https://tex.stackexchange.com/a/15840).

```
\RequirePackage { l3keys2e }
\ProcessKeysOptions { zref-clever / zcsetup }
```

## 5 Type format

### 5.1 \zcRefTypeSetup

`\l__zrefclever_setup_type_tl` `\l__zrefclever_setup_language_tl` Variables storing the language and type to be used in `\zcRefTypeSetup` and `\zcDeclareTranslations`.

```
\tl_new:N \l__zrefclever_setup_type_tl
\tl_new:N \l__zrefclever_setup_language_tl
```

(*End definition for* `\l__zrefclever_setup_type_tl` *and* `\l__zrefclever_setup_language_tl`.)

`\zcRefTypeSetup` Provide `\zcRefTypeSetup`.

```
\NewDocumentCommand \zcRefTypeSetup { m m }
  {
    \prop_if_exist:cF { l__zrefclever_type_ #1 _options_prop }
      { \prop_new:c { l__zrefclever_type_ #1 _options_prop } }
    \tl_set:Nn \l__zrefclever_setup_type_tl {#1}
    \keys_set:nn { zref-clever / typesetup } {#2}
  }
```

(*End definition for* `\zcRefTypeSetup`*.*)

Inside `\zcRefTypeSetup` any of the options *can* receive empty values, and those values, if they exist in the property list, will override translations, regardless of their emptiness. In principle, we could live with the situation of, once a setting has made `\l__zrefclever_type_<type>_options_prop` or `\l__zrefclever_ref_options_prop` it stays there forever, and can only be overridden by a new value at the same precedence level or a higher one. But it would be nice if an user can "unset" an option at either of those to go back to the lower precedence level of the translations at any given point. So both in `\zcRefTypeSetup` and in setting reference options, we leverage the distinction of an "empty valued key" (`key=` or `key=`) from a "key with no value" (`key`). This distinction is captured internally by the lower-level key parsing, but must be made explicit at `\keys_set:nn` by means of the `.default:` property of the key in `\keys_define:nn`. For the technique, see https://tex.stackexchange.com/q/614690 (thanks Jonathan P. Spratte, aka 'Skillmon', and Phelype Oleinik).

Not type-specific options.

```
\clist_map_inline:nn
  {
    tpairsep ,
    tlistsep ,
    tlastsep ,
    notesep ,
  }
  {
    \keys_define:nn { zref-clever / typesetup }
      {
        #1 .code:n =
          {
            \msg_warning:nnn { zref-clever } { option-not-type-specific } {#1}
          } ,
      }
  }
```

Possibly or necessarily type-specific options.

```
\clist_map_inline:nn
  {
    % Possibly type-specific options.
    namefont ,
    namesep ,
    pairsep ,
    listsep ,
    lastsep ,
    rangesep ,
    reffont ,
    refpre ,
    refpos ,
    reffont-in ,
    refpre-in ,
    refpos-in ,
    % Necessarily type-specific options.
    Name-sg ,
    name-sg ,
    Name-pl ,
    name-pl ,
    Name-sg-ab ,
    name-sg-ab ,
    Name-pl-ab ,
    name-pl-ab ,
  }
  {
    \keys_define:nn { zref-clever / typesetup }
      {
        #1 .default:V = \c_novalue_tl ,
        #1 .code:n =
          {
            \tl_if_novalue:nTF {##1}
              {
                \prop_remove:cn
                  { l__zrefclever_type_ \l__zrefclever_setup_type_tl _options_prop }
                  {#1}
              }
              {
                \prop_put:cnn
                  { l__zrefclever_type_ \l__zrefclever_setup_type_tl _options_prop }
                  {#1} {##1}
              }
          } ,
      }
  }
```

## 5.2 \zcDeclareTranslations

\zcDeclareTranslations Provide \zcDeclareTranslations.

```
\NewDocumentCommand \zcDeclareTranslations { m m }
  {
    \tl_set:Nn \l__zrefclever_setup_language_tl {#1}
    \tl_clear:N \l__zrefclever_setup_type_tl
    \keys_set:nn { zref-clever / translations } {#2}
  }
```

(*End definition for \zcDeclareTranslations.*)

```
\keys_define:nn { zref-clever / translations }
  {
    type .code:n =
      {
        \tl_if_empty:nTF {#1}
          { \tl_clear:N \l__zrefclever_setup_type_tl }
          {
            \prop_if_exist:cF { l__zrefclever_type_ #1 _options_prop }
              { \prop_new:c { l__zrefclever_type_ #1 _options_prop } }
            \tl_set:Nn \l__zrefclever_setup_type_tl {#1}
          }
      } ,
  }
```

Not type-specific options.

```
\clist_map_inline:nn
  {
    tpairsep ,
    tlistsep ,
    tlastsep ,
    notesep ,
  }
  {
    \keys_define:nn { zref-clever / translations }
      {
        #1 .value_required:n = true ,
        #1 .code:n =
          {
            \tl_if_empty:NTF \l__zrefclever_setup_type_tl
              {
                \__zrefclever_declare_transl:xxn { \l__zrefclever_setup_language_tl }
                  { zrefclever-default- #1 } {##1}
              }
              {
                \msg_warning:nnn { zref-clever }
                  { option-not-type-specific } {#1}
              }
          } ,
      }
  }
```

Possibly type-specific options.

```
\clist_map_inline:nn
  {
    namesep ,
    pairsep ,
    listsep ,
    lastsep ,
    rangesep ,
    refpre ,
    refpos ,
    refpre-in ,
    refpos-in ,
  }
  {
    \keys_define:nn { zref-clever / translations }
      {
        #1 .value_required:n = true ,
        #1 .code:n =
          {
            \tl_if_empty:NTF \l__zrefclever_setup_type_tl
              {
                \__zrefclever_declare_transl:xxn { \l__zrefclever_setup_language_tl }
                  { zrefclever-default- #1 } {##1}
              }
              {
                \__zrefclever_declare_transl:xxn { \l__zrefclever_setup_language_tl }
                  { zrefclever-type- \l__zrefclever_setup_type_tl - #1 } {##1}
              }
          } ,
      }
  }
```

Necessarily type-specific options.

```
\clist_map_inline:nn
  {
    Name-sg ,
    name-sg ,
    Name-pl ,
    name-pl ,
    Name-sg-ab ,
    name-sg-ab ,
    Name-pl-ab ,
    name-pl-ab ,
  }
  {
    \keys_define:nn { zref-clever / translations }
      {
        #1 .value_required:n = true ,
        #1 .code:n =
          {
            \tl_if_empty:NTF \l__zrefclever_setup_type_tl
              {
                \msg_warning:nnn { zref-clever }
                  { option-only-type-specific } {#1}
              }
              {
                \__zrefclever_declare_transl:xxn { \l__zrefclever_setup_language_tl }
                  { zrefclever-type- \l__zrefclever_setup_type_tl - #1 } {##1}
              }
          } ,
      }
  }
```

## 6 \zcref

\zcref

`\zcref⟨*⟩[⟨options⟩]{⟨labels⟩}`

```
\NewDocumentCommand \zcref { s O { } m }
  { \zref@wrapper@babel \__zrefclever_zcref:nnn {#3} {#1} {#2} }
```

(*End definition for* `\zcref`.)

\l__zrefclever_zcref_labels_seq
\l__zrefclever_link_star_bool

```
\seq_new:N \l__zrefclever_zcref_labels_seq
\bool_new:N \l__zrefclever_link_star_bool
```

(*End definition for* `\l__zrefclever_zcref_labels_seq` *and* `\l__zrefclever_link_star_bool`.)

__zrefclever_zcref:nnnn

An intermediate internal function, which does the actual heavy lifting, and places {⟨*labels*⟩} as first argument, so that it can be protected by `\zref@wrapper@babel` in `\zcref`.

`\__zrefclever_zcref:nnnn {⟨labels⟩} {⟨*⟩} {⟨options⟩}`

```
\cs_new_protected:Npn \__zrefclever_zcref:nnn #1#2#3
  {
    \group_begin:
      \keys_set:nn { zref-clever / reference } {#3}
      \seq_set_from_clist:Nn \l__zrefclever_zcref_labels_seq {#1}
      \bool_set:Nn \l__zrefclever_link_star_bool {#2}
      % Integration with 'zref-check'.
      \bool_lazy_and:nnT
        { \l__zrefclever_zrefcheck_available_bool }
        { \l__zrefclever_zcref_with_check_bool }
        { \zrefcheck_zcref_beg_label: }
      \bool_lazy_or:nnT
        { \l__zrefclever_typeset_sort_bool }
        { \l__zrefclever_typeset_range_bool }
        { \__zrefclever_sort_labels: }
      \__zrefclever_typeset_refs:
      % Typeset \texttt{note}.
      \l__zrefclever_notesep_tl
      \l__zrefclever_zcref_note_tl
      % Integration with 'zref-check'.
      \bool_lazy_and:nnT
        { \l__zrefclever_zrefcheck_available_bool }
        { \l__zrefclever_zcref_with_check_bool }
        {
          \zrefcheck_zcref_end_label_maybe:
          \zrefcheck_zcref_run_checks_on_labels:n
            { \l__zrefclever_zcref_labels_seq }
        }
    \group_end:
  }
```

(*End definition for* `\__zrefclever_zcref:nnnn`*.*)

## 7 \zcpageref

\zcpageref

`\zcpageref⟨*⟩[⟨options⟩]{⟨labels⟩}`

```
\NewDocumentCommand \zcpageref { s O { } m }
  {
    \IfBooleanTF {#1}
      { \zcref*[#2, ref = page] {#3} }
      { \zcref [#2, ref = page] {#3} }
  }
```

(*End definition for* `\zcpageref`*.*)

## 8 Sorting

```
\int_new:N \l__zrefclever_sort_prior_a_int
\int_new:N \l__zrefclever_sort_prior_b_int
```

\l__zrefclever_label_a_tl
\l__zrefclever_label_b_tl
\l__zrefclever_label_type_a_tl
\l__zrefclever_label_type_b_tl
\l__zrefclever_label_enclcnt_a_tl
\l__zrefclever_label_enclcnt_b_tl
\l__zrefclever_label_enclval_a_tl
\l__zrefclever_label_enclval_b_tl

Aux variables, for use in sorting and typesetting. I could probably let go some of them in favor of `tmpa`/`tmpb`, but they do improve code readability.

```
\tl_new:N \l__zrefclever_label_a_tl
\tl_new:N \l__zrefclever_label_b_tl
\tl_new:N \l__zrefclever_label_type_a_tl
\tl_new:N \l__zrefclever_label_type_b_tl
\tl_new:N \l__zrefclever_label_enclcnt_a_tl
\tl_new:N \l__zrefclever_label_enclcnt_b_tl
\tl_new:N \l__zrefclever_label_enclval_a_tl
\tl_new:N \l__zrefclever_label_enclval_b_tl
```

(*End definition for* `\l__zrefclever_label_a_tl` *and others.*)

\l__zrefclever_label_types_seq

Stores the order in which reference types appear in the label list supplied by the user in `\zcref`. This order is required as a "last resort" sort criterion between the reference types, for use in `\__zrefclever_sort_default:nn`.

```
\seq_new:N \l__zrefclever_label_types_seq
```

(*End definition for* `\l__zrefclever_label_types_seq`*.*)

__zrefclever_sort_labels:

The main sorting function. It does not receive arguments, but it is expected to be run inside `\__zrefclever_zcref:nnnn` where a number of environment variables are to be set appropriately. In particular, `\l__zrefclever_zcref_labels_seq` should contain the labels received as argument to `\zcref`, and the function performs its task by sorting this variable.

```
\cs_new_protected:Npn \__zrefclever_sort_labels:
  {
```

Store label types sequence.

```
    \seq_clear:N \l__zrefclever_label_types_seq
    \tl_if_eq:NnF \l__zrefclever_ref_property_tl { page }
      {
        \seq_map_function:NN
          \l__zrefclever_zcref_labels_seq \__zrefclever_label_type_put_new_right:n
      }
```

Sort.

```
    \seq_sort:Nn \l__zrefclever_zcref_labels_seq
      {
        \zref@ifrefundefined {##1}
          {
            \zref@ifrefundefined {##2}
              {
                % Neither label is defined.
                \sort_return_same:
              }
              {
                % The second label is defined, but the first isn't, leave the
                % undefined first (to be more visible).
                \sort_return_same:
              }
          }
          {
            \zref@ifrefundefined {##2}
              {
                % The first label is defined, but the second isn't, bring the
                % second forward.
                \sort_return_swapped:
              }
              {
                % The interesting case: both labels are defined.  The
                % reference to the "default" property/counter or to the page
                % are quite different from our perspective, they rely on
                % different fields and even use different information for
                % sorting, so we branch them here to specialized functions.
                \tl_if_eq:NnTF \l__zrefclever_ref_property_tl { page }
                  { \__zrefclever_sort_page:nn {##1} {##2} }
                  { \__zrefclever_sort_default:nn {##1} {##2} }
              }
          }
      }
  }
```

(*End definition for* `\__zrefclever_sort_labels:`.)

`\__zrefclever_label_type_put_new_right:n` Auxiliary function used to store "new" label types (in order) as the sorting proceeds. It is expected to be run inside `\__zrefclever_sort_labels:`, and stores new types in `\l__zrefclever_label_types_seq`.

`\__zrefclever_label_type_put_new_right:n {⟨label⟩}`

```
\cs_new_protected:Npn \__zrefclever_label_type_put_new_right:n #1
  {
    \tl_set:Nx \l__zrefclever_label_type_a_tl
      { \zref@extractdefault {#1} { zc@type } { \c_empty_tl } }
    \tl_if_empty:NF \l__zrefclever_label_type_a_tl
      {
        \seq_if_in:NVF \l__zrefclever_label_types_seq \l__zrefclever_label_type_a_tl
          {
            \seq_put_right:NV
              \l__zrefclever_label_types_seq \l__zrefclever_label_type_a_tl
          }
      }
  }
```

(*End definition for* `\__zrefclever_label_type_put_new_right:n`.)

`\l__zrefclever_sort_decided_bool` Auxiliary variable for `\__zrefclever_sort_default:nn`, signals if the sorting between two labels has been decided or not.

```
\bool_new:N \l__zrefclever_sort_decided_bool
```

(*End definition for* `\l__zrefclever_sort_decided_bool`.)

`\tl_reverse_items:V` Variant not provided by the kernel.

```
\cs_generate_variant:Nn \tl_reverse_items:n { V }
```

(*End definition for* `\tl_reverse_items:V`.)

`\__zrefclever_sort_default:nn` The heavy-lifting function for sorting of existing labels for "default" references (that is, a standard reference, not to "page"). This function is expected to be called within the sorting loop of `\__zrefclever_sort_labels:` and receives the pair of labels being considered for a change of order or not. It should *always* "return" either `\sort_return_same:` or `\sort_return_swapped:`.

`\__zrefclever_sort_default:nn {⟨label a⟩} {⟨label b⟩}`

```
\cs_new_protected:Npn \__zrefclever_sort_default:nn #1#2
  {
    \tl_set:Nx \l__zrefclever_label_type_a_tl
      { \zref@extractdefault {#1} { zc@type } { \c_empty_tl } }
    \tl_set:Nx \l__zrefclever_label_type_b_tl
      { \zref@extractdefault {#2} { zc@type } { \c_empty_tl } }

    \bool_if:nTF
      {
        % The second label has a type, but the first doesn't, leave the
        % undefined first (to be more visible).
        \tl_if_empty_p:N \l__zrefclever_label_type_a_tl &&
        ! \tl_if_empty_p:N \l__zrefclever_label_type_b_tl
      }
      { \sort_return_same: }
      {
        \bool_if:nTF
          {
            % The first label has a type, but the second doesn't, bring the
            % second forward.
            ! \tl_if_empty_p:N \l__zrefclever_label_type_a_tl &&
            \tl_if_empty_p:N \l__zrefclever_label_type_b_tl
          }
          { \sort_return_swapped: }
          {
            \bool_if:nTF
              {
                % The interesting case: both labels have a type\dots{}
                ! \tl_if_empty_p:N \l__zrefclever_label_type_a_tl &&
                ! \tl_if_empty_p:N \l__zrefclever_label_type_b_tl
              }
              {
                % Here we send this to a couple of auxiliary functions for no
                % other reason than to keep this long function a little less
                % unreadable.
                \tl_if_eq:NNTF \l__zrefclever_label_type_a_tl \l__zrefclever_label_type_b_tl
                  {
                    % \dots{} and it's the same type.
                    \__zrefclever_sort_default_same_type:nn {#1} {#2}
                  }
                  {
                    % \dots{} and they are different types.
                    \__zrefclever_sort_default_different_types:nn {#1} {#2}
                  }
              }
              {
                % Neither of the labels has a type.  We can't do much of
                % meaningful here, but if it's the same counter, compare it.
                \exp_args:Nxx \tl_if_eq:nnTF
                  { \zref@extractdefault {#1} { counter } { } }
                  { \zref@extractdefault {#2} { counter } { } }
                  {
                    \int_compare:nNnTF
                      { \zref@extractdefault {#1} { zc@cntval } {-1} }
                        >
                      { \zref@extractdefault {#2} { zc@cntval } {-1} }
                      { \sort_return_swapped: }
                      { \sort_return_same:    }
                  }
                  { \sort_return_same: }
              }
          }
      }
  }
```

(*End definition for* `\__zrefclever_sort_default:nn`.)

`\__zrefclever_sort_default_same_type:nn`

```
\cs_new_protected:Npn \__zrefclever_sort_default_same_type:nn #1#2
  {
    \tl_set:Nx \l__zrefclever_label_enclcnt_a_tl
      { \zref@extractdefault {#1} { zc@enclcnt } { \c_empty_tl } }
    \tl_set:Nx \l__zrefclever_label_enclcnt_a_tl
      { \tl_reverse_items:V \l__zrefclever_label_enclcnt_a_tl }
    \tl_set:Nx \l__zrefclever_label_enclcnt_b_tl
      { \zref@extractdefault {#2} { zc@enclcnt } { \c_empty_tl } }
    \tl_set:Nx \l__zrefclever_label_enclcnt_b_tl
      { \tl_reverse_items:V \l__zrefclever_label_enclcnt_b_tl }
    \tl_set:Nx \l__zrefclever_label_enclval_a_tl
      { \zref@extractdefault {#1} { zc@enclval } { \c_empty_tl } }
    \tl_set:Nx \l__zrefclever_label_enclval_a_tl
      { \tl_reverse_items:V \l__zrefclever_label_enclval_a_tl }
    \tl_set:Nx \l__zrefclever_label_enclval_b_tl
      { \zref@extractdefault {#2} { zc@enclval } { \c_empty_tl } }
    \tl_set:Nx \l__zrefclever_label_enclval_b_tl
      { \tl_reverse_items:V \l__zrefclever_label_enclval_b_tl }

    \bool_set_false:N \l__zrefclever_sort_decided_bool
    % CHECK should I replace the tmp variables here?
    \tl_clear:N \l_tmpa_tl
    \tl_clear:N \l_tmpb_tl
    \bool_until_do:Nn \l__zrefclever_sort_decided_bool
      {
        \tl_set:Nx \l_tmpa_tl
          { \tl_head:N \l__zrefclever_label_enclcnt_a_tl }
        \tl_set:Nx \l_tmpb_tl
          { \tl_head:N \l__zrefclever_label_enclcnt_b_tl }

        \bool_if:nTF
          {
            % Both are empty, meaning: neither labels have any (further)
            % ‘‘enclosing counters’’ (left).
            \tl_if_empty_p:V \l_tmpa_tl &&
            \tl_if_empty_p:V \l_tmpb_tl
          }
          {
```

```
  \exp_args:Nxx \tl_if_eq:nnTF
    { \zref@extractdefault {#1} { counter } { } }
    { \zref@extractdefault {#2} { counter } { } }
    {
      \bool_set_true:N \l__zrefclever_sort_decided_bool
      \int_compare:nNnTF
        { \zref@extractdefault {#1} { zc@cntval } {-1} }
          >
        { \zref@extractdefault {#2} { zc@cntval } {-1} }
        { \sort_return_swapped: }
        { \sort_return_same:    }
    }
    {
      \msg_warning:nnnn { zref-clever }
        { counters-not-nested } {#1} {#2}
      \bool_set_true:N \l__zrefclever_sort_decided_bool
      \sort_return_same:
    }
}
{
  \bool_if:nTF
    {
      % ‘a’ is empty (and ‘b’ is not), meaning: ‘b’ is (possibly)
      % nested in ‘a’.
      \tl_if_empty_p:V \l_tmpa_tl
    }
    {
      \tl_set:Nx \l_tmpa_tl
        { {\zref@extractdefault {#1} { counter } { }} }
      \exp_args:NNx \tl_if_in:NnTF
        \l__zrefclever_label_enclcnt_b_tl { \l_tmpa_tl }
        {
          \bool_set_true:N \l__zrefclever_sort_decided_bool
          \sort_return_same:
        }
        {
          \msg_warning:nnnn { zref-clever }
            { counters-not-nested } {#1} {#2}
          \bool_set_true:N \l__zrefclever_sort_decided_bool
          \sort_return_same:
        }
    }
    {
      \bool_if:nTF
        {
          % ‘b’ is empty (and ‘a’ is not), meaning: ‘a’ is
          % (possibly) nested in ‘b’.
          \tl_if_empty_p:V \l_tmpb_tl
        }
        {
          \tl_set:Nx \l_tmpb_tl
            { {\zref@extractdefault {#2} { counter } { }} }
          \exp_args:NNx \tl_if_in:NnTF
            \l__zrefclever_label_enclcnt_a_tl { \l_tmpb_tl }
```

```
                      {
                        \bool_set_true:N \l__zrefclever_sort_decided_bool
                        \sort_return_swapped:
                      }
                      {
                        \msg_warning:nnnn { zref-clever }
                          { counters-not-nested } {#1} {#2}
                        \bool_set_true:N \l__zrefclever_sort_decided_bool
                        \sort_return_same:
                      }
                  }
                  {
                    % Neither is empty, meaning: we can (possibly) compare the
                    % values of the current enclosing counter in the loop, if
                    % they are equal, we are still in the loop, if they are
                    % not, a sorting decision can be made directly.
                    \tl_if_eq:NNTF \l_tmpa_tl \l_tmpb_tl
                      {
                        \int_compare:nNnTF
                          { \tl_head:N \l__zrefclever_label_enclval_a_tl }
                            =
                          { \tl_head:N \l__zrefclever_label_enclval_b_tl }
                          {
                            \tl_set:Nx \l__zrefclever_label_enclcnt_a_tl
                              { \tl_tail:N \l__zrefclever_label_enclcnt_a_tl }
                            \tl_set:Nx \l__zrefclever_label_enclcnt_b_tl
                              { \tl_tail:N \l__zrefclever_label_enclcnt_b_tl }
                            \tl_set:Nx \l__zrefclever_label_enclval_a_tl
                              { \tl_tail:N \l__zrefclever_label_enclval_a_tl }
                            \tl_set:Nx \l__zrefclever_label_enclval_b_tl
                              { \tl_tail:N \l__zrefclever_label_enclval_b_tl }
                          }
                          {
                            \bool_set_true:N \l__zrefclever_sort_decided_bool
                            \int_compare:nNnTF
                              { \tl_head:N \l__zrefclever_label_enclval_a_tl }
                                >
                              { \tl_head:N \l__zrefclever_label_enclval_b_tl }
                              { \sort_return_swapped: }
                              { \sort_return_same:    }
                          }
                      }
                      {
                        \msg_warning:nnnn { zref-clever }
                          { counters-not-nested } {#1} {#2}
                        \bool_set_true:N \l__zrefclever_sort_decided_bool
                        \sort_return_same:
                      }
                  }
              }
          }
      }
  }
```

(*End definition for* `\__zrefclever_sort_default_same_type:nn`.)

_zrefclever_sort_default_different_types:nn

```
\cs_new_protected:Npn \__zrefclever_sort_default_different_types:nn #1#2
  {
    \int_zero:N \l__zrefclever_sort_prior_a_int
    \int_zero:N \l__zrefclever_sort_prior_b_int
    % \cs{l__zrefclever_typesort_seq} was stored in reverse sequence, and we compute
    % the sort priorities in the negative range, so that we can implicitly
    % rely on `0' being the ``last value''.
    \seq_map_indexed_inline:Nn \l__zrefclever_typesort_seq
      {
        \tl_if_eq:nnTF {##2} {{othertypes}}
          {
            \int_compare:nNnT { \l__zrefclever_sort_prior_a_int } = { 0 }
              { \int_set:Nn \l__zrefclever_sort_prior_a_int { - ##1 } }
            \int_compare:nNnT { \l__zrefclever_sort_prior_b_int } = { 0 }
              { \int_set:Nn \l__zrefclever_sort_prior_b_int { - ##1 } }
          }
          {
            \tl_if_eq:NnTF \l__zrefclever_label_type_a_tl {##2}
              { \int_set:Nn \l__zrefclever_sort_prior_a_int { - ##1 } }
              {
                \tl_if_eq:NnT \l__zrefclever_label_type_b_tl {##2}
                  { \int_set:Nn \l__zrefclever_sort_prior_b_int { - ##1 } }
              }
          }
      }
    \bool_if:nTF
      {
        \int_compare_p:nNn
          { \l__zrefclever_sort_prior_a_int } <
          { \l__zrefclever_sort_prior_b_int }
      }
      { \sort_return_same: }
      {
        \bool_if:nTF
          {
            \int_compare_p:nNn
              { \l__zrefclever_sort_prior_a_int } >
              { \l__zrefclever_sort_prior_b_int }
          }
          { \sort_return_swapped: }
          {
            % Sort priorities are equal for different types: the type that
            % occurs first in \meta{labels}, as given by the user, is kept (or
            % brought) forward.
            \seq_map_inline:Nn \l__zrefclever_label_types_seq
              {
                \tl_if_eq:NnTF \l__zrefclever_label_type_a_tl {##1}
                  { \seq_map_break:n { \sort_return_same: } }
                  {
                    \tl_if_eq:NnT \l__zrefclever_label_type_b_tl {##1}
                      { \seq_map_break:n { \sort_return_swapped: } }
                  }
              }
        }
      }
  }
```

(*End definition for* `\__zrefclever_sort_default_different_types:nn`.)

`\__zrefclever_sort_page:nn` The sorting function for sorting of existing labels for references to "page". This function is expected to be called within the sorting loop of `\__zrefclever_sort_labels:` and receives the pair of labels being considered for a change of order or not. It should *always* "return" either `\sort_return_same:` or `\sort_return_swapped:`. Compared to the sorting of default labels, this is a piece of cake (thanks to `abspage`).

```
\__zrefclever_sort_page:nn {⟨label a⟩} {⟨label b⟩}
```

```
\cs_new_protected:Npn \__zrefclever_sort_page:nn #1#2
  {
    \int_compare:nNnTF
      { \zref@extractdefault {#1} { abspage } {-1} }
        >
      { \zref@extractdefault {#2} { abspage } {-1} }
      { \sort_return_swapped: }
      { \sort_return_same:    }
  }
```

(*End definition for* `\__zrefclever_sort_page:nn`.)

## 9 Typesetting

About possible alternatives to signal compression inhibition for individual labels, see https://tex.stackexchange.com/q/611370 (thanks Enrico Gregorio, Phelype Oleinik, and Steven B. Segletes). Yet another alternative would be to receive an optional argument with the label(s) not to be compressed. This would be a repetition, but would keep the syntax "clean". All in all, and rethinking this here, probably the best is simply to not allow individual inhibition of compression. We can already control compression of each individual call of `\zcref` with existing options, this should be enough. I don't think the small extra flexibility this would grant is worth the syntax disruption it entails. Anyway, I have kept a "handle" to deal with this in case the need arises, in the form of `\l__zrefclever_range_inhibit_next_bool`, which is currently no-op, but is in place.

### Typesetting variables

`\l__zrefclever_typeset_last_bool`
`\l__zrefclever_last_of_type_bool`

Auxiliary variables for `\__zrefclever_typeset_refs:`. `\l__zrefclever_typeset_last_bool` signals if the label list is over so that we can leave the loop. `\l__zrefclever_last_of_type_bool` signals if we are processing the last label of the current reference type.

```
\bool_new:N \l__zrefclever_typeset_last_bool
\bool_new:N \l__zrefclever_last_of_type_bool
```

(*End definition for* `\l__zrefclever_typeset_last_bool` *and* `\l__zrefclever_last_of_type_bool`.)

\l__zrefclever_typeset_labels_seq
\l__zrefclever_typeset_queue_prev_tl
\l__zrefclever_typeset_queue_curr_tl
\l__zrefclever_type_first_label_tl
\l__zrefclever_type_first_label_type_tl

Auxiliary variables for `\__zrefclever_typeset_refs:`. They store, respectively the "previous" and the "current" reference type information while they are being processed, since we cannot typeset them directly, given we can only know certain things when the (next) type list is over. The "queue" stores all references but the first of the type, and they are stored ready to be typeset. The "first_label" stores the *label* of the first reference for the type, because the name can only be determined at the end, and its (potential) hyperlink must be handled at that point.

```
\seq_new:N \l__zrefclever_typeset_labels_seq
\tl_new:N \l__zrefclever_typeset_queue_prev_tl
\tl_new:N \l__zrefclever_typeset_queue_curr_tl
\tl_new:N \l__zrefclever_type_first_label_tl
\tl_new:N \l__zrefclever_type_first_label_type_tl
```

(*End definition for* `\l__zrefclever_typeset_labels_seq` *and others.*)

\l__zrefclever_label_count_int
\l__zrefclever_type_count_int

Main counters for `\__zrefclever_typeset_refs:`. They track the state of the parsing of the labels list. `\l__zrefclever_label_count_int` is stepped for every reference/label in the list, and reset at the start of a new type. `\l__zrefclever_type_count_int` is stepped at every reference type change.

```
\int_new:N \l__zrefclever_label_count_int
\int_new:N \l__zrefclever_type_count_int
```

(*End definition for* `\l__zrefclever_label_count_int` *and* `\l__zrefclever_type_count_int`*.*)

\l__zrefclever_range_count_int
\l__zrefclever_range_same_count_int
\l__zrefclever_range_beg_label_tl
\l__zrefclever_next_maybe_range_bool
\l__zrefclever_next_is_same_bool
\l__zrefclever_range_inhibit_next_bool

Range related auxiliary variables for `\__zrefclever_typeset_refs:`. `\l__zrefclever_range_count_int` counts how many references/labels are in the current ongoing range. `\l__zrefclever_range_same_count_int` counts how many of the references in the current ongoing range are repeated ones. `\l__zrefclever_range_beg_label_tl` stores the label of the reference that starts a range. `\l__zrefclever_next_maybe_range_bool` signals whether the next element is in sequence to the current one. `\l__zrefclever_next_is_same_bool` signals whether the next element repeats the current one. `\l__zrefclever_range_inhibit_next_bool` allows to control/track compression inhibition of the next label.

```
\int_new:N \l__zrefclever_range_count_int
\int_new:N \l__zrefclever_range_same_count_int
\tl_new:N \l__zrefclever_range_beg_label_tl
\bool_new:N \l__zrefclever_next_maybe_range_bool
\bool_new:N \l__zrefclever_next_is_same_bool
\bool_new:N \l__zrefclever_range_inhibit_next_bool
```

(*End definition for* `\l__zrefclever_range_count_int` *and others.*)

Aux variables for `\__zrefclever_typeset_refs:`. Store separators and refpre/pos options.

```
\tl_new:N \l__zrefclever_namefont_tl
\tl_new:N \l__zrefclever_reffont_out_tl
\tl_new:N \l__zrefclever_reffont_in_tl

\tl_new:N \l__zrefclever_namesep_tl
\tl_new:N \l__zrefclever_rangesep_tl
\tl_new:N \l__zrefclever_pairsep_tl
\tl_new:N \l__zrefclever_listsep_tl
\tl_new:N \l__zrefclever_lastsep_tl
```

```
% ‘t’ for ‘‘type’’
\tl_new:N \l__zrefclever_tpairsep_tl
\tl_new:N \l__zrefclever_tlistsep_tl
\tl_new:N \l__zrefclever_tlastsep_tl
\tl_new:N \l__zrefclever_notesep_tl
\tl_new:N \l__zrefclever_refpre_out_tl
\tl_new:N \l__zrefclever_refpos_out_tl
\tl_new:N \l__zrefclever_refpre_in_tl
\tl_new:N \l__zrefclever_refpos_in_tl
```

(*End definition for* .)

\l__zrefclever_type_name_tl
\l__zrefclever_name_in_link_bool
\l__zrefclever_name_format_tl
\l__zrefclever_name_format_fallback_tl

Auxiliary variables for `\__zrefclever_get_ref_first:` and `\__zrefclever_type_-name_setup:`.

```
\tl_new:N \l__zrefclever_type_name_tl
\bool_new:N \l__zrefclever_name_in_link_bool
\tl_new:N \l__zrefclever_name_format_tl
\tl_new:N \l__zrefclever_name_format_fallback_tl
```

(*End definition for* `\l__zrefclever_type_name_tl` *and others.*)

## Main typesetting functions

__zrefclever_typeset_refs:

Main typesetting function for `\zcref`.

```
\cs_new_protected:Npn \__zrefclever_typeset_refs:
  {
    \seq_set_eq:NN \l__zrefclever_typeset_labels_seq \l__zrefclever_zcref_labels_seq
    \tl_clear:N \l__zrefclever_typeset_queue_prev_tl
    \tl_clear:N \l__zrefclever_typeset_queue_curr_tl
    \tl_clear:N \l__zrefclever_type_first_label_tl
    \tl_clear:N \l__zrefclever_type_first_label_type_tl
    \tl_clear:N \l__zrefclever_range_beg_label_tl
    \int_zero:N \l__zrefclever_label_count_int
    \int_zero:N \l__zrefclever_type_count_int
    \int_zero:N \l__zrefclever_range_count_int
    \int_zero:N \l__zrefclever_range_same_count_int

    % Get not-type-specific separators and refpre/pos options.
    \__zrefclever_get_option_with_transl:nN {tpairsep} \l__zrefclever_tpairsep_tl
    \__zrefclever_get_option_with_transl:nN {tlistsep} \l__zrefclever_tlistsep_tl
    \__zrefclever_get_option_with_transl:nN {tlastsep} \l__zrefclever_tlastsep_tl
    \__zrefclever_get_option_with_transl:nN {notesep}  \l__zrefclever_notesep_tl

    % Set the font option for this zcref call.
    \l__zrefclever_ref_typeset_font_tl

    % Loop over the label list in sequence.
    \bool_set_false:N \l__zrefclever_typeset_last_bool
    \bool_until_do:Nn \l__zrefclever_typeset_last_bool
      {
        \seq_pop_left:NN \l__zrefclever_typeset_labels_seq \l__zrefclever_label_a_tl
        \seq_if_empty:NTF \l__zrefclever_typeset_labels_seq
          {
            \tl_clear:N \l__zrefclever_label_b_tl
        \bool_set_true:N \l__zrefclever_typeset_last_bool
      }
      { \seq_get_left:NN \l__zrefclever_typeset_labels_seq \l__zrefclever_label_b_tl }

    \tl_if_eq:NnTF \l__zrefclever_ref_property_tl { page }
      {
        \tl_set:Nn \l__zrefclever_label_type_a_tl { page }
        \tl_set:Nn \l__zrefclever_label_type_b_tl { page }
      }
      {
        \tl_set:Nx \l__zrefclever_label_type_a_tl
          {
            \zref@extractdefault
              { \l__zrefclever_label_a_tl } { zc@type } { \c_empty_tl }
          }
        \tl_set:Nx \l__zrefclever_label_type_b_tl
          {
            \zref@extractdefault
              { \l__zrefclever_label_b_tl } { zc@type } { \c_empty_tl }
          }
      }

    % First, we establish whether the ‘‘current label’’ (i.e. ‘a’) is the
    % last one of its type.  This can happen because the ‘‘next label’’
    % (i.e. ‘b’) is of a different type (or different definition status),
    % or because we are at the end of the list.
    \bool_if:NTF \l__zrefclever_typeset_last_bool
      { \bool_set_true:N \l__zrefclever_last_of_type_bool }
      {
        \zref@ifrefundefined { \l__zrefclever_label_a_tl }
          {
            \zref@ifrefundefined { \l__zrefclever_label_b_tl }
              { \bool_set_false:N \l__zrefclever_last_of_type_bool }
              { \bool_set_true:N \l__zrefclever_last_of_type_bool  }
          }
          {
            \zref@ifrefundefined { \l__zrefclever_label_b_tl }
              { \bool_set_true:N \l__zrefclever_last_of_type_bool }
              {
                % Neither is undefined, we must check the types.
                \bool_if:nTF
                  % Both empty: same ‘‘type’’.
                  {
                    \tl_if_empty_p:N \l__zrefclever_label_type_a_tl &&
                    \tl_if_empty_p:N \l__zrefclever_label_type_b_tl
                  }
                  { \bool_set_false:N \l__zrefclever_last_of_type_bool }
                  {
                    \bool_if:nTF
                      % Neither empty: compare types.
                      {
                        ! \tl_if_empty_p:N \l__zrefclever_label_type_a_tl &&
                        ! \tl_if_empty_p:N \l__zrefclever_label_type_b_tl
                      }
```

```
                          {
                            \tl_if_eq:NNTF
                              \l__zrefclever_label_type_a_tl \l__zrefclever_label_type_b_tl
                              { \bool_set_false:N \l__zrefclever_last_of_type_bool }
                              { \bool_set_true:N \l__zrefclever_last_of_type_bool  }
                          }
                          % One empty, the other not: different ‘‘types’’.
                          { \bool_set_true:N \l__zrefclever_last_of_type_bool }
                      }
                  }
              }
          }

        % Handle warnings in case of reference or type undefined.
        \zref@refused { \l__zrefclever_label_a_tl }
        \zref@ifrefundefined { \l__zrefclever_label_a_tl }
          {}
          {
            \tl_if_empty:NT \l__zrefclever_label_type_a_tl
              {
                \msg_warning:nnx { zref-clever } { missing-type }
                  { \l__zrefclever_label_a_tl }
              }
          }

        % Get type-specific separators, refpre/pos and font options, once per
        % type.
        \int_compare:nNnT { \l__zrefclever_label_count_int } = { 0 }
          {
            \__zrefclever_get_option_plain:nN {namefont}        \l__zrefclever_namefont_tl
            \__zrefclever_get_option_plain:nN {reffont}         \l__zrefclever_reffont_out_t
            \__zrefclever_get_option_plain:nN {reffont-in}      \l__zrefclever_reffont_in_tl
            \__zrefclever_get_option_with_transl:nN {namesep}   \l__zrefclever_namesep_tl
            \__zrefclever_get_option_with_transl:nN {rangesep}  \l__zrefclever_rangesep_tl
            \__zrefclever_get_option_with_transl:nN {pairsep}   \l__zrefclever_pairsep_tl
            \__zrefclever_get_option_with_transl:nN {listsep}   \l__zrefclever_listsep_tl
            \__zrefclever_get_option_with_transl:nN {lastsep}   \l__zrefclever_lastsep_tl
            \__zrefclever_get_option_with_transl:nN {refpre}    \l__zrefclever_refpre_out_tl
            \__zrefclever_get_option_with_transl:nN {refpos}    \l__zrefclever_refpos_out_tl
            \__zrefclever_get_option_with_transl:nN {refpre-in} \l__zrefclever_refpre_in_tl
            \__zrefclever_get_option_with_transl:nN {refpos-in} \l__zrefclever_refpos_in_tl
          }

        % Here we send this to a couple of auxiliary functions for no other
        % reason than to keep this long function a little less unreadable.
        \bool_if:NTF \l__zrefclever_last_of_type_bool
          {
            % There exists no next label of the same type as the current.
            \__zrefclever_typeset_refs_aux_last_of_type:
          }
          {
            % There exists a next label of the same type as the current.
            \__zrefclever_typeset_refs_aux_not_last_of_type:
          }
```

```
      }
  }
```

(*End definition for* `\__zrefclever_typeset_refs:`.)

__zrefclever_typeset_refs_aux_last_of_type: Handles typesetting of when the current label is the last of its type.

```
\cs_new_protected:Npn \__zrefclever_typeset_refs_aux_last_of_type:
  {
    % Process the current label to the current queue.
    \int_case:nnF { \l__zrefclever_label_count_int }
      {
        % It is the last label of its type, but also the first one, and that's
        % what matters here: just store it.
        { 0 }
        {
          \tl_set:NV \l__zrefclever_type_first_label_tl \l__zrefclever_label_a_tl
          \tl_set:NV \l__zrefclever_type_first_label_type_tl \l__zrefclever_label_type_a_tl
        }

        % The last is the second: we have a pair (if not repeated).
        { 1 }
        {
          \int_compare:nNnF { \l__zrefclever_range_same_count_int } = {1}
            {
              \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
                {
                  \exp_not:V \l__zrefclever_pairsep_tl
                  \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
                }
            }
        }
      }
      % If neither the first, nor the second: we have the last label
      % on the current type list (if not repeated).
      {
        \int_case:nnF { \l__zrefclever_range_count_int }
          {
            % There was no range going on.
            {0}
            {
              \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
                {
                  \exp_not:V \l__zrefclever_lastsep_tl
                  \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
                }
            }
            % Last in the range is also the second in it.
            {1}
            {
              \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
                {
                  % We know 'range_beg_label' is not empty, since this is the
                  % second element in the range, but the third or more in the
                  % type list.
                \exp_not:V \l__zrefclever_listsep_tl
                \__zrefclever_get_ref:V \l__zrefclever_range_beg_label_tl
                \int_compare:nNnF { \l__zrefclever_range_same_count_int } = {1}
                  {
                    \exp_not:V \l__zrefclever_lastsep_tl
                    \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
                  }
              }
          }
        }
        % Last in the range is third or more in it.
        {
          \int_case:nnF
            { \l__zrefclever_range_count_int - \l__zrefclever_range_same_count_int }
            {
              % Repetition, not a range.
              {0}
              {
                % If 'range_beg_label' is empty, it means it was also the
                % first of the type, and hence was already handled.
                \tl_if_empty:VF \l__zrefclever_range_beg_label_tl
                  {
                    \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
                      {
                        \exp_not:V \l__zrefclever_lastsep_tl
                        \__zrefclever_get_ref:V \l__zrefclever_range_beg_label_tl
                      }
                  }
              }
              % A ``range'', but with no skipped value, treat as list.
              {1}
              {
                \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
                  {
                    % Ditto.
                    \tl_if_empty:VF \l__zrefclever_range_beg_label_tl
                      {
                        \exp_not:V \l__zrefclever_listsep_tl
                        \__zrefclever_get_ref:V \l__zrefclever_range_beg_label_tl
                      }
                    \exp_not:V \l__zrefclever_lastsep_tl
                    \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
                  }
              }
            }
            {
              % An actual range.
              \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
                {
                  % Ditto.
                  \tl_if_empty:VF \l__zrefclever_range_beg_label_tl
                    {
                      \exp_not:V \l__zrefclever_lastsep_tl
                      \__zrefclever_get_ref:V \l__zrefclever_range_beg_label_tl
                    }
                  \exp_not:V \l__zrefclever_rangesep_tl
                  \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
                }
            }
        }
    }

  % Handle ``range'' option.  The idea is simple: if the queue is not empty,
  % we replace it with the end of the range (or pair).  We can still
  % retrieve the end of the range from \cs{l__zrefclever_label_a_tl} since we know to
  % be processing the last label of its type at this point.
  \bool_if:NT \l__zrefclever_typeset_range_bool
    {
      \tl_if_empty:NTF \l__zrefclever_typeset_queue_curr_tl
        {
          \zref@ifrefundefined { \l__zrefclever_type_first_label_tl }
            { }
            {
              \msg_warning:nnx { zref-clever } { single-element-range }
                { \l__zrefclever_type_first_label_type_tl }
            }
        }
        {
          \bool_set_false:N \l__zrefclever_next_maybe_range_bool
          \zref@ifrefundefined { \l__zrefclever_type_first_label_tl }
            { }
            {
              \__zrefclever_labels_in_sequence:nn
                { \l__zrefclever_type_first_label_tl } { \l__zrefclever_label_a_tl }
            }
          \tl_set:Nx \l__zrefclever_typeset_queue_curr_tl
            {
              \bool_if:NTF \l__zrefclever_next_maybe_range_bool
                { \exp_not:V \l__zrefclever_pairsep_tl }
                { \exp_not:V \l__zrefclever_rangesep_tl }
              \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
            }
        }
    }

  % Now that the type is finished, we can add the name and the first ref to
  % the queue.  Or, if ``typset'' option is not ``both'', handle it here
  % too.
  \__zrefclever_type_name_setup:
  \bool_if:nTF
    { \l__zrefclever_typeset_ref_bool && \l__zrefclever_typeset_name_bool }
    {
      \tl_put_left:Nx \l__zrefclever_typeset_queue_curr_tl
        { \__zrefclever_get_ref_first: }
    }
    {
      \bool_if:nTF
        { \l__zrefclever_typeset_ref_bool }
```

```
          {
            \tl_put_left:Nx \l__zrefclever_typeset_queue_curr_tl
              { \__zrefclever_get_ref:V \l__zrefclever_type_first_label_tl }
          }
          {
            \bool_if:nTF
              { \l__zrefclever_typeset_name_bool }
              {
                \tl_set:Nx \l__zrefclever_typeset_queue_curr_tl
                  {
                    \bool_if:NTF \l__zrefclever_name_in_link_bool
                      {
                        \exp_not:N \group_begin:
                        \exp_not:V \l__zrefclever_namefont_tl
                        % It's two '@s', but escaped for DocStrip.
                        \exp_not:N \hyper@@link
                          {
                            \zref@ifrefcontainsprop
                              { \l__zrefclever_type_first_label_tl } { urluse }
                              {
                                \zref@extractdefault
                                  { \l__zrefclever_type_first_label_tl }
                                  { urluse } {}
                              }
                              {
                                \zref@extractdefault
                                  { \l__zrefclever_type_first_label_tl }
                                  { url } {}
                              }
                          }
                          {
                            \zref@extractdefault
                              { \l__zrefclever_type_first_label_tl } { anchor } {}
                          }
                          { \exp_not:V \l__zrefclever_type_name_tl }
                        \exp_not:N \group_end:
                      }
                      {
                        \exp_not:N \group_begin:
                        \exp_not:V \l__zrefclever_namefont_tl
                        \exp_not:V \l__zrefclever_type_name_tl
                        \exp_not:N \group_end:
                      }
                  }
              }
              {
                % This case would correspond to "typeset=none" but should not
                % happen, given the options are set up to typeset at least one
                % of "ref" or "name", but a sensible fallback, equal to the
                % behavior of ‘‘both’’.
                \tl_put_left:Nx
                  \l__zrefclever_typeset_queue_curr_tl { \__zrefclever_get_ref_first: }
              }
          }
```

```
      }

    % Typeset the previous type, if there is one.
    \int_compare:nNnT { \l__zrefclever_type_count_int } > { 0 }
      {
        \int_compare:nNnT { \l__zrefclever_type_count_int } > { 1 }
          { \l__zrefclever_tlistsep_tl }
        \l__zrefclever_typeset_queue_prev_tl
      }

    % Wrap up loop, or prepare for next iteration.
    \bool_if:NTF \l__zrefclever_typeset_last_bool
      {
        % We are finishing, typeset the current queue.
        \int_case:nnF { \l__zrefclever_type_count_int }
          {
            % Single type.
            { 0 }
            { \l__zrefclever_typeset_queue_curr_tl }
            % Pair of types.
            { 1 }
            {
              \l__zrefclever_tpairsep_tl
              \l__zrefclever_typeset_queue_curr_tl
            }
          }
          {
            % Last in list of types.
            \l__zrefclever_tlastsep_tl
            \l__zrefclever_typeset_queue_curr_tl
          }
      }
      {
        % There are further labels, set variables for next iteration.
        \tl_set_eq:NN
          \l__zrefclever_typeset_queue_prev_tl \l__zrefclever_typeset_queue_curr_tl
        \tl_clear:N \l__zrefclever_typeset_queue_curr_tl
        \tl_clear:N \l__zrefclever_type_first_label_tl
        \tl_clear:N \l__zrefclever_type_first_label_type_tl
        \tl_clear:N \l__zrefclever_range_beg_label_tl
        \int_zero:N \l__zrefclever_label_count_int
        \int_incr:N \l__zrefclever_type_count_int
        \int_zero:N \l__zrefclever_range_count_int
        \int_zero:N \l__zrefclever_range_same_count_int
      }
  }
```

(*End definition for \__zrefclever_typeset_refs_aux_last_of_type:.*)

efclever_typeset_refs_aux_not_last_of_type: Handles typesetting of when the current label is not the last of its type.

```
\cs_new_protected:Npn \__zrefclever_typeset_refs_aux_not_last_of_type:
  {
    % Signal if next label may form a range with the current one (of
    % course, only considered if compression is enabled in the first
    % place).
    \bool_set_false:N \l__zrefclever_next_maybe_range_bool
    \bool_set_false:N \l__zrefclever_next_is_same_bool
    \bool_lazy_and:nnT
      { \l__zrefclever_typeset_compress_bool }
      % Currently no-op, but kept as ‘‘handle’’ to inhibit compression of
      % individual labels.
      { ! \l__zrefclever_range_inhibit_next_bool }
      {
        \zref@ifrefundefined { \l__zrefclever_label_a_tl }
          { }
          {
            \__zrefclever_labels_in_sequence:nn
              { \l__zrefclever_label_a_tl } { \l__zrefclever_label_b_tl }
          }
      }

    % Process the current label to the current queue.
    \int_compare:nNnTF { \l__zrefclever_label_count_int } = { 0 }
      {
        % Current label is the first of its type (also not the last, but it
        % doesn’t matter here): just store the label.
        \tl_set:NV \l__zrefclever_type_first_label_tl \l__zrefclever_label_a_tl
        \tl_set:NV \l__zrefclever_type_first_label_type_tl \l__zrefclever_label_type_a_tl

        % If the next label may be part of a range, we set ‘range_beg_label’
        % to ‘‘empty’’ (we deal with it as the ‘‘first’’, and must do it
        % there, to handle hyperlinking), but also step the range counters.
        \bool_if:NT \l__zrefclever_next_maybe_range_bool
          {
            \tl_clear:N \l__zrefclever_range_beg_label_tl
            \int_incr:N \l__zrefclever_range_count_int
            \bool_if:NT \l__zrefclever_next_is_same_bool
              { \int_incr:N \l__zrefclever_range_same_count_int }
         }
      }
      {
        % Current label is neither the first (nor the last) of its
        % type.
        \bool_if:NTF \l__zrefclever_next_maybe_range_bool
          {
            % Starting, or continuing a range.
            \int_compare:nNnTF
              { \l__zrefclever_range_count_int } = {0}
              {
                % There was no range going, we are starting one.
                \tl_set:NV \l__zrefclever_range_beg_label_tl \l__zrefclever_label_a_tl
                \int_incr:N \l__zrefclever_range_count_int
                \bool_if:NT \l__zrefclever_next_is_same_bool
                  { \int_incr:N \l__zrefclever_range_same_count_int }
              }
              {
                % Second or more in the range, but not the last.
                \int_incr:N \l__zrefclever_range_count_int
```

```
             \bool_if:NT \l__zrefclever_next_is_same_bool
              { \int_incr:N \l__zrefclever_range_same_count_int }
            }
          }
          {
           % Next element is not in sequence, meaning: there was no range, or
           % we are closing one.
           \int_case:nnF { \l__zrefclever_range_count_int }
            {
             % There was no range going on.
             {0}
             {
              \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
               {
                \exp_not:V \l__zrefclever_listsep_tl
                \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
               }
             }
             % Last is second in the range: if ‘range_same_count’ is also
             % ‘1’, it’s a repetition (drop it), otherwise, it’s a ‘‘pair
             % within a list’’, treat as list.
             {1}
             {
              \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
               {
                \tl_if_empty:VF \l__zrefclever_range_beg_label_tl
                 {
                  \exp_not:V \l__zrefclever_listsep_tl
                  \__zrefclever_get_ref:V \l__zrefclever_range_beg_label_tl
                 }
                \int_compare:nNnF { \l__zrefclever_range_same_count_int } = {1}
                 {
                  \exp_not:V \l__zrefclever_listsep_tl
                  \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
                 }
               }
             }
            }
            {
             % Last is third or more in the range: if ‘range_count’ and
             % ‘range_same_count’ are the same, its a repetition (drop it),
             % if they differ by ‘1’, its a list, if they differ by more,
             % it is a real range.
             \int_case:nnF
              { \l__zrefclever_range_count_int - \l__zrefclever_range_same_count_int }
              {
               {0}
               {
                \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
                 {
                  \tl_if_empty:VF \l__zrefclever_range_beg_label_tl
                   {
                    \exp_not:V \l__zrefclever_listsep_tl
                    \__zrefclever_get_ref:V \l__zrefclever_range_beg_label_tl
```

```
                              }
                            }
                          }
                          {1}
                          {
                            \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
                              {
                                \tl_if_empty:VF \l__zrefclever_range_beg_label_tl
                                  {
                                    \exp_not:V \l__zrefclever_listsep_tl
                                    \__zrefclever_get_ref:V \l__zrefclever_range_beg_label_tl
                                  }
                                \exp_not:V \l__zrefclever_listsep_tl
                                \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
                              }
                          }
                        }
                        {
                          \tl_put_right:Nx \l__zrefclever_typeset_queue_curr_tl
                            {
                              \tl_if_empty:VF \l__zrefclever_range_beg_label_tl
                                {
                                  \exp_not:V \l__zrefclever_listsep_tl
                                  \__zrefclever_get_ref:V \l__zrefclever_range_beg_label_tl
                                }
                              \exp_not:V \l__zrefclever_rangesep_tl
                              \__zrefclever_get_ref:V \l__zrefclever_label_a_tl
                            }
                        }
                    }
                  % Reset counters.
                  \int_zero:N \l__zrefclever_range_count_int
                  \int_zero:N \l__zrefclever_range_same_count_int
                }
            }
          % Step label counter for next iteration.
          \int_incr:N \l__zrefclever_label_count_int
        }
```

(*End definition for* `\__zrefclever_typeset_refs_aux_not_last_of_type:`.)

## Aux typesetting functions

`\__zrefclever_get_ref:n` Auxiliary function to `\__zrefclever_typeset_refs:`. Handles a complete “ref-block”, including “pre” and “pos” elements, and *hyperlinking*. It does not handle the reference type “name”, for that use `\__zrefclever_get_ref_first:`. It should get the reference with `\zref@extractdefault` as usual but, if the reference is not available, should put `\zref@default` on the stream protected, so that it can be accumulated in the queue. `\hyperlink` must also be protected from expansion for the same reason.

```
\cs_new:Npn \__zrefclever_get_ref:n #1
  {
    \zref@ifrefcontainsprop {#1} { \l__zrefclever_ref_property_tl }
      {
        \bool_if:nTF
        { \l__zrefclever_use_hyperref_bool && ! \l__zrefclever_link_star_bool }
        {
          \exp_not:N \group_begin:
          \exp_not:V \l__zrefclever_reffont_out_tl
          \exp_not:V \l__zrefclever_refpre_out_tl
          \exp_not:N \group_begin:
          \exp_not:V \l__zrefclever_reffont_in_tl
          % It's two '@s', but escaped for DocStrip.
          \exp_not:N \hyper@@link
            {
              \zref@ifrefcontainsprop {#1} { urluse }
                { \zref@extractdefault {#1} { urluse } {} }
                { \zref@extractdefault {#1} { url } {} }
            }
            { \zref@extractdefault {#1} { anchor } {} }
            {
              \exp_not:V \l__zrefclever_refpre_in_tl
              \zref@extractdefault {#1} { \l__zrefclever_ref_property_tl } {}
              \exp_not:V \l__zrefclever_refpos_in_tl
            }
          \exp_not:N \group_end:
          \exp_not:V \l__zrefclever_refpos_out_tl
          \exp_not:N \group_end:
        }
        {
          \exp_not:N \group_begin:
          \exp_not:V \l__zrefclever_reffont_out_tl
          \exp_not:V \l__zrefclever_refpre_out_tl
          \exp_not:N \group_begin:
          \exp_not:V \l__zrefclever_reffont_in_tl
          \exp_not:V \l__zrefclever_refpre_in_tl
          \zref@extractdefault {#1} { \l__zrefclever_ref_property_tl } {}
          \exp_not:V \l__zrefclever_refpos_in_tl
          \exp_not:N \group_end:
          \exp_not:V \l__zrefclever_refpos_out_tl
          \exp_not:N \group_end:
        }
    }
    { \exp_not:N \zref@default }
  }
\cs_generate_variant:Nn \__zrefclever_get_ref:n { V }
```

(*End definition for* `\__zrefclever_get_ref:n`.)

`\__zrefclever_type_name_setup:` Auxiliary function to `\__zrefclever_typeset_refs:`. Sets the type name variable `\l__zrefclever_type_name_tl`. When it cannot be found, clears it.

```
\cs_new_protected:Npn \__zrefclever_type_name_setup:
  {
    \zref@ifrefundefined { \l__zrefclever_type_first_label_tl }
      { \tl_clear:N \l__zrefclever_type_name_tl }
      {
        \tl_if_empty:nTF \l__zrefclever_type_first_label_type_tl
          { \tl_clear:N \l__zrefclever_type_name_tl }
          {
```

Determine whether we should use capitalization, abbreviation, and plural.

```
        \bool_lazy_or:nnTF
          { \l__zrefclever_capitalize_bool }
          {
            \l__zrefclever_capitalize_first_bool &&
            \int_compare_p:nNn { \l__zrefclever_type_count_int } = { 0 }
          }
          { \tl_set:Nn \l__zrefclever_name_format_tl {Name} }
          { \tl_set:Nn \l__zrefclever_name_format_tl {name} }
        % If the queue is empty, we have a singular, otherwise, plural.
        \tl_if_empty:NTF \l__zrefclever_typeset_queue_curr_tl
          { \tl_put_right:Nn \l__zrefclever_name_format_tl { -sg } }
          { \tl_put_right:Nn \l__zrefclever_name_format_tl { -pl } }
        \bool_lazy_and:nnTF
          { \l__zrefclever_abbrev_bool }
          {
            ! \int_compare_p:nNn { \l__zrefclever_type_count_int } = { 0 } ||
            ! \l__zrefclever_noabbrev_first_bool
          }
          {
            \tl_set:NV \l__zrefclever_name_format_fallback_tl \l__zrefclever_name_format
            \tl_put_right:Nn \l__zrefclever_name_format_tl { -ab }
          }
          { \tl_clear:N \l__zrefclever_name_format_fallback_tl }

        \tl_if_empty:NTF \l__zrefclever_name_format_fallback_tl
          {
            \prop_get:cVNF
              { l__zrefclever_type_ \l__zrefclever_type_first_label_type_tl _options_pro
              \l__zrefclever_name_format_tl
              \l__zrefclever_type_name_tl
              {
                \__zrefclever_if_transl:xxTF
                  { \l__zrefclever_ref_language_tl }
                  {
                    zrefclever-type- \l__zrefclever_type_first_label_type_tl -
                    \l__zrefclever_name_format_tl
                  }
                  {
                    \__zrefclever_get_transl:nxx { \l__zrefclever_type_name_tl }
                      { \l__zrefclever_ref_language_tl }
                      {
                        zrefclever-type- \l__zrefclever_type_first_label_type_tl -
                        \l__zrefclever_name_format_tl
                      }
                  }
                  {
                    \tl_clear:N \l__zrefclever_type_name_tl
                    \msg_warning:nnx { zref-clever } { missing-name }
                      { \l__zrefclever_type_first_label_type_tl }
                  }
              }
          }
          {
                \prop_get:cVNF
                  { l__zrefclever_type_ \l__zrefclever_type_first_label_type_tl _options_pro
                  \l__zrefclever_name_format_tl
                  \l__zrefclever_type_name_tl
                  {
                    \prop_get:cVNF
                      { l__zrefclever_type_ \l__zrefclever_type_first_label_type_tl _options
                      \l__zrefclever_name_format_fallback_tl
                      \l__zrefclever_type_name_tl
                      {
                        \__zrefclever_if_transl:xxTF
                          { \l__zrefclever_ref_language_tl }
                          {
                            zrefclever-type- \l__zrefclever_type_first_label_type_tl -
                            \l__zrefclever_name_format_tl
                          }
                          {
                            \__zrefclever_get_transl:nxx { \l__zrefclever_type_name_tl }
                              { \l__zrefclever_ref_language_tl }
                              {
                                zrefclever-type- \l__zrefclever_type_first_label_type_tl -
                                \l__zrefclever_name_format_tl
                              }
                          }
                          {
                            \__zrefclever_if_transl:xxTF
                              { \l__zrefclever_ref_language_tl }
                              {
                                zrefclever-type- \l__zrefclever_type_first_label_type_tl -
                                \l__zrefclever_name_format_fallback_tl
                              }
                              {
                                \__zrefclever_get_transl:nxx { \l__zrefclever_type_name_tl }
                                  { \l__zrefclever_ref_language_tl }
                                  {
                                    zrefclever-type- \l__zrefclever_type_first_label_type_tl
                                    \l__zrefclever_name_format_fallback_tl
                                  }
                              }
                              {
                                \tl_clear:N \l__zrefclever_type_name_tl
                                \msg_warning:nnx { zref-clever } { missing-name }
                                  { \l__zrefclever_type_first_label_type_tl }
                              }
                          }
                      }
                  }
              }
          }
      }
```

Signal whether the type name is to be included in the hyperlink or not.

```
      \bool_lazy_any:nTF
        {
          { ! \l__zrefclever_use_hyperref_bool }
        { \l__zrefclever_link_star_bool }
        { \tl_if_empty_p:N \l__zrefclever_type_name_tl }
        { \str_if_eq_p:Vn \l__zrefclever_nameinlink_str { false } }
      }
      { \bool_set_false:N \l__zrefclever_name_in_link_bool }
      {
        \bool_lazy_any:nTF
          {
            { \str_if_eq_p:Vn \l__zrefclever_nameinlink_str { true } }
            {
              \str_if_eq_p:Vn \l__zrefclever_nameinlink_str { tsingle } &&
              \tl_if_empty_p:N \l__zrefclever_typeset_queue_curr_tl
            }
            {
              \str_if_eq_p:Vn \l__zrefclever_nameinlink_str { single } &&
              \tl_if_empty_p:N \l__zrefclever_typeset_queue_curr_tl &&
              \l__zrefclever_typeset_last_bool &&
              \int_compare_p:nNn { \l__zrefclever_type_count_int } = { 0 }
            }
          }
          { \bool_set_true:N \l__zrefclever_name_in_link_bool }
          { \bool_set_false:N \l__zrefclever_name_in_link_bool }
      }
  }
```

(*End definition for* `\__zrefclever_type_name_setup:`.)

`\__zrefclever_get_ref_first:` Auxiliary function to `\__zrefclever_typeset_refs:`. Handles a complete “ref-block”, including “pre” and “pos” elements, *hyperlinking*, and the reference type “name”. For use on the first reference of each type.

```
\cs_new:Npn \__zrefclever_get_ref_first:
  {
    \zref@ifrefundefined { \l__zrefclever_type_first_label_tl }
      { \exp_not:N \zref@default }
      {
        \bool_if:NTF \l__zrefclever_name_in_link_bool
          {
            \zref@ifrefcontainsprop
              { \l__zrefclever_type_first_label_tl } { \l__zrefclever_ref_property_tl }
              {
                % It’s two ’@s’, but escaped for DocStrip.
                \exp_not:N \hyper@@link
                  {
                    \zref@ifrefcontainsprop
                      { \l__zrefclever_type_first_label_tl } { urluse }
                      {
                        \zref@extractdefault { \l__zrefclever_type_first_label_tl }
                          { urluse } {}
                      }
                      {
                        \zref@extractdefault { \l__zrefclever_type_first_label_tl }
                          { url } {}
                      }
                  }
                {
                  \zref@extractdefault { \l__zrefclever_type_first_label_tl }
                    { anchor } {}
                }
                {
                  \exp_not:N \group_begin:
                  \exp_not:V \l__zrefclever_namefont_tl
                  \exp_not:V \l__zrefclever_type_name_tl
                  \exp_not:N \group_end:
                  \exp_not:V \l__zrefclever_namesep_tl
                  \exp_not:N \group_begin:
                  \exp_not:V \l__zrefclever_reffont_out_tl
                  \exp_not:V \l__zrefclever_refpre_out_tl
                  \exp_not:N \group_begin:
                  \exp_not:V \l__zrefclever_reffont_in_tl
                  \exp_not:V \l__zrefclever_refpre_in_tl
                  \zref@extractdefault { \l__zrefclever_type_first_label_tl }
                    { \l__zrefclever_ref_property_tl } {}
                  \exp_not:V \l__zrefclever_refpos_in_tl
                  \exp_not:N \group_end:
                  % hyperlink makes it's own group, we'd like to close the
                  % 'refpre-out' group after 'refpos-out', but... we close
                  % it here, and give the trailing 'refpos-out' its own
                  % group.  This will result that formatting given to
                  % 'refpre-out' will not reach 'refpos-out', but I see no
                  % alternative, and this has to be handled specially.
                  \exp_not:N \group_end:
                }
              \exp_not:N \group_begin:
              % Ditto: special treatment.
              \exp_not:V \l__zrefclever_reffont_out_tl
              \exp_not:V \l__zrefclever_refpos_out_tl
              \exp_not:N \group_end:
            }
            {
              \exp_not:N \group_begin:
              \exp_not:V \l__zrefclever_namefont_tl
              \exp_not:V \l__zrefclever_type_name_tl
              \exp_not:N \group_end:
              \exp_not:V \l__zrefclever_namesep_tl
              \exp_not:N \zref@default
            }
        }
        {
          \tl_if_empty:NTF \l__zrefclever_type_name_tl
            {
              \exp_not:N \zref@default
              \exp_not:V \l__zrefclever_namesep_tl
            }
            {
              \exp_not:N \group_begin:
              \exp_not:V \l__zrefclever_namefont_tl
              \exp_not:V \l__zrefclever_type_name_tl
              \exp_not:N \group_end:
```

```
      \exp_not:V \l__zrefclever_namesep_tl
    }
  \zref@ifrefcontainsprop
    { \l__zrefclever_type_first_label_tl } { \l__zrefclever_ref_property_tl }
    {
      \bool_if:nTF
        {
          \l__zrefclever_use_hyperref_bool &&
          ! \l__zrefclever_link_star_bool
        }
        {
          \exp_not:N \group_begin:
          \exp_not:V \l__zrefclever_reffont_out_tl
          \exp_not:V \l__zrefclever_refpre_out_tl
          \exp_not:N \group_begin:
          \exp_not:V \l__zrefclever_reffont_in_tl
          % It's two '@s', but escaped for DocStrip.
          \exp_not:N \hyper@@link
            {
              \zref@ifrefcontainsprop
                { \l__zrefclever_type_first_label_tl } { urluse }
                {
                  \zref@extractdefault { \l__zrefclever_type_first_label_tl }
                    { urluse } {}
                }
                {
                  \zref@extractdefault { \l__zrefclever_type_first_label_tl }
                    { url } {}
                }
            }
            {
              \zref@extractdefault { \l__zrefclever_type_first_label_tl }
                { anchor } {}
            }
            {
              \exp_not:V \l__zrefclever_refpre_in_tl
              \zref@extractdefault { \l__zrefclever_type_first_label_tl }
                { \l__zrefclever_ref_property_tl } {}
              \exp_not:V \l__zrefclever_refpos_in_tl
            }
          \exp_not:N \group_end:
          \exp_not:V \l__zrefclever_refpos_out_tl
          \exp_not:N \group_end:
        }
        {
          \exp_not:N \group_begin:
          \exp_not:V \l__zrefclever_reffont_out_tl
          \exp_not:V \l__zrefclever_refpre_out_tl
          \exp_not:N \group_begin:
          \exp_not:V \l__zrefclever_reffont_in_tl
          \exp_not:V \l__zrefclever_refpre_in_tl
          \zref@extractdefault { \l__zrefclever_type_first_label_tl }
            { \l__zrefclever_ref_property_tl } {}
          \exp_not:V \l__zrefclever_refpos_in_tl
```

```
                      \exp_not:N \group_end:
                      \exp_not:V \l__zrefclever_refpos_out_tl
                      \exp_not:N \group_end:
                    }
                }
                { \exp_not:N \zref@default }
            }
        }
    }
```

(*End definition for* `\__zrefclever_get_ref_first:`.)

`\__zrefclever_get_option_with_transl:nN`

```
% \Arg{option} \Arg{var to store result}
\cs_new_protected:Npn \__zrefclever_get_option_with_transl:nN #1#2
  {
    % First attempt options stored in \cs{l__zrefclever_ref_options_prop}.
    \prop_get:NnNF \l__zrefclever_ref_options_prop {#1} #2
      {
        % If not found, try the type specific options.
        \bool_lazy_all:nTF
          {
            { ! \tl_if_empty_p:N \l__zrefclever_label_type_a_tl }
            {
              \prop_if_exist_p:c
                { l__zrefclever_type_ \l__zrefclever_label_type_a_tl _options_prop }
            }
            {
              \prop_if_in_p:cn
                { l__zrefclever_type_ \l__zrefclever_label_type_a_tl _options_prop } {#1}
            }
          }
          {
            \prop_get:cnN
              { l__zrefclever_type_ \l__zrefclever_label_type_a_tl _options_prop } {#1} #2
          }
          {
            % If not found, try the type specific translations.
            \__zrefclever_if_transl:xxTF
              { \l__zrefclever_ref_language_tl }
              { zrefclever-type- \l__zrefclever_label_type_a_tl - #1 }
              {
                \__zrefclever_get_transl:nxx {#2}
                  { \l__zrefclever_ref_language_tl }
                  { zrefclever-type- \l__zrefclever_label_type_a_tl - #1 }
              }
              {
                % If not found, try general translations.  We are not
                % controlling for their existence, but we must make sure all
                % options being retrieved with
                % \cs{__zrefclever_get_option_with_transl:nN} have their values set for
                % ‘English’ and ‘fallback’.
                \__zrefclever_get_transl:nxx {#2}
                  { \l__zrefclever_ref_language_tl }
                  { zrefclever-default- #1 }
              }
          }
      }
  }
```

(*End definition for* `\__zrefclever_get_option_with_transl:nN`.)

`\__zrefclever_get_option_plain:nN`

```
\cs_new_protected:Npn \__zrefclever_get_option_plain:nN #1#2
  {
    % First attempt options stored in \cs{l__zrefclever_ref_options_prop}.
    \prop_get:NnNF \l__zrefclever_ref_options_prop {#1} #2
      {
        % If not found, try the type specific options.
        \bool_lazy_and:nnTF
          { ! \tl_if_empty_p:N \l__zrefclever_label_type_a_tl }
          {
            \prop_if_exist_p:c
              { l__zrefclever_type_ \l__zrefclever_label_type_a_tl _options_prop }
          }
          {
            \prop_get:cnNF
              { l__zrefclever_type_ \l__zrefclever_label_type_a_tl _options_prop } {#1} #2
              { \tl_clear:N #2 }
          }
          { \tl_clear:N #2 }
      }
  }
```

(*End definition for* `\__zrefclever_get_option_plain:nN`.)

`\__zrefclever_labels_in_sequence:nn`

Sets `\l__zrefclever_next_maybe_range_bool` to true if label '1' comes in immediate sequence from label '2'. And sets both `\l__zrefclever_next_maybe_range_bool` and `\l__zrefclever_next_is_same_bool` if the labels are the "same".

```
\cs_new_protected:Npn \__zrefclever_labels_in_sequence:nn #1#2
  {
    \tl_if_eq:NnTF \l__zrefclever_ref_property_tl { page }
      {
        \exp_args:Nxx \tl_if_eq:nnT
          { \zref@extractdefault {#1} { zc@pgfmt } { } }
          { \zref@extractdefault {#2} { zc@pgfmt } { } }
          {
            \int_compare:nNnTF
              { \zref@extractdefault {#1} { zc@pgval } {-2} + 1 }
                =
              { \zref@extractdefault {#2} { zc@pgval } {-1} }
              { \bool_set_true:N \l__zrefclever_next_maybe_range_bool }
              {
                \int_compare:nNnT
                  { \zref@extractdefault {#1} { zc@pgval } {-1} }
                    =
                  { \zref@extractdefault {#2} { zc@pgval } {-1} }
                  {
                    \bool_set_true:N \l__zrefclever_next_maybe_range_bool
                    \bool_set_true:N \l__zrefclever_next_is_same_bool
                  }
              }
          }
      }
      {
        \exp_args:Nxx \tl_if_eq:nnT
          { \zref@extractdefault {#1} { counter } { } }
          { \zref@extractdefault {#2} { counter } { } }
          {
            \exp_args:Nxx \tl_if_eq:nnT
              { \zref@extractdefault {#1} { zc@enclval } { } }
              { \zref@extractdefault {#2} { zc@enclval } { } }
              {
                \int_compare:nNnTF
                  { \zref@extractdefault {#1} { zc@cntval } {-2} + 1 }
                    =
                  { \zref@extractdefault {#2} { zc@cntval } {-1} }
                  { \bool_set_true:N \l__zrefclever_next_maybe_range_bool }
                  {
                    \int_compare:nNnT
                      { \zref@extractdefault {#1} { zc@cntval } {-1} }
                        =
                      { \zref@extractdefault {#2} { zc@cntval } {-1} }
                      {
                        \bool_set_true:N \l__zrefclever_next_maybe_range_bool
                        \bool_set_true:N \l__zrefclever_next_is_same_bool
                      }
                  }
              }
          }
      }
  }
```

(*End definition for* `\__zrefclever_labels_in_sequence:nn`.)

## 10 Special handling

This section is meant to aggregate any "special handling" needed for LaTeX kernel features, document classes, and packages, needed for zref-clever to work properly with them. It is not meant to be a "kitchen sink of workarounds". Rather, I intend to keep this as lean as possible, trying to add things selectively when they are safe and reasonable. And, hopefully, doing so by proper setting of zref-clever's options, not by messing with other packages' code. In particular, I do not mean to compensate for "lack of support for zref" by individual packages here, unless there is really no alternative.

### 10.1 Appendix

Another relevant use case of the same general problem of different types for the same counter is the `\appendix` which in some document classes, including the standard ones, change the sectioning commands looks but, of course, keep using the same counter (`book.`

cls and report.cls reset counters chapter and section to 0, change \@chapapp to use \appendixname and use \@Alph for \thechapter; article.cls resets counters section and subsection to 0, and uses \@Alph for \thesection; memoir.cls, scrbook.cls and scrarticle.cls do the same as their corresponding standard classes, and sometimes a little more, but what interests us here is pretty much the same; see also the appendix package).

### 10.2 \newtheorem

### 10.3 enumitem package

TODO Option counterresetby should probably be extended for enumitem, conditioned on it being loaded.

## 11 Translations

### Fallback

All options retrieved with __zrefclever_get_option_with_transl:nN must have their values set for 'fallback', since this is what will be retrieved if babel or polyglossia is loaded and sets a language which zref-clever does not know. On the other hand type-specific options are not looked for in 'fallback'.

```
\__zrefclever_declare_default_transl:nnn { fallback } { namesep   } {\nobreakspace}
\__zrefclever_declare_default_transl:nnn { fallback } { pairsep   } {,~}
\__zrefclever_declare_default_transl:nnn { fallback } { listsep   } {,~}
\__zrefclever_declare_default_transl:nnn { fallback } { lastsep   } {,~}
\__zrefclever_declare_default_transl:nnn { fallback } { tpairsep  } {,~}
\__zrefclever_declare_default_transl:nnn { fallback } { tlistsep  } {,~}
\__zrefclever_declare_default_transl:nnn { fallback } { tlastsep  } {,~}
\__zrefclever_declare_default_transl:nnn { fallback } { notesep   } {~}
\__zrefclever_declare_default_transl:nnn { fallback } { rangesep  } {\textendash}
\__zrefclever_declare_default_transl:nnn { fallback } { refpre    } {}
\__zrefclever_declare_default_transl:nnn { fallback } { refpos    } {}
\__zrefclever_declare_default_transl:nnn { fallback } { refpre-in } {}
\__zrefclever_declare_default_transl:nnn { fallback } { refpos-in } {}
```

```
⟨/package⟩
```

```
⟨*lang-english⟩
```

### English

All options retrieved with __zrefclever_get_option_with_transl:nN must have their values set for 'English', since this is what will be retrieved if no language package is loaded.

```
\ProvideDictionaryFor{English}{zref-clever}

\zcDicDefaultTransl{namesep}{\nobreakspace}
\zcDicDefaultTransl{pairsep}{~and\nobreakspace}
\zcDicDefaultTransl{listsep}{,~}
\zcDicDefaultTransl{lastsep}{~and\nobreakspace}
\zcDicDefaultTransl{tpairsep}{~and\nobreakspace}
\zcDicDefaultTransl{tlistsep}{,~}
\zcDicDefaultTransl{tlastsep}{,~and\nobreakspace}
```

```
\zcDicDefaultTransl{notesep}{~}
\zcDicDefaultTransl{rangesep}{~to\nobreakspace}
\zcDicDefaultTransl{refpre}{}
\zcDicDefaultTransl{refpos}{}
\zcDicDefaultTransl{refpre-in}{}
\zcDicDefaultTransl{refpos-in}{}

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\zcDicTypeTransl{part}{Name-pl}{Parts}
\zcDicTypeTransl{part}{name-pl}{parts}

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\zcDicTypeTransl{chapter}{name-sg}{chapter}
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```

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```

```
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```

⟨/lang-english⟩

⟨*lang-german⟩

## German

```
\ProvideDictionaryFor{German}{zref-clever}

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\zcDicDefaultTransl{pairsep}{~und\nobreakspace}
```

```
\zcDicDefaultTransl{listsep}{,~}
\zcDicDefaultTransl{lastsep}{~und\nobreakspace}
\zcDicDefaultTransl{tpairsep}{~und\nobreakspace}
\zcDicDefaultTransl{tlistsep}{,~}
\zcDicDefaultTransl{tlastsep}{~und\nobreakspace}
\zcDicDefaultTransl{notesep}{~}
\zcDicDefaultTransl{rangesep}{~bis\nobreakspace}

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```

```
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```

⟨/lang-german⟩

⟨*lang-french⟩

## French

```
\ProvideDictionaryFor{French}{zref-clever}

\zcDicDefaultTransl{namesep}{\nobreakspace}
\zcDicDefaultTransl{pairsep}{~et\nobreakspace}
\zcDicDefaultTransl{listsep}{,~}
\zcDicDefaultTransl{lastsep}{~et\nobreakspace}
\zcDicDefaultTransl{tpairsep}{~et\nobreakspace}
\zcDicDefaultTransl{tlistsep}{,~}
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\zcDicDefaultTransl{notesep}{~}
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```

```
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⟨/lang-french⟩

⟨*lang-portuguese⟩

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⟨/lang-portuguese⟩

⟨*lang-spanish⟩

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⟨/lang-spanish⟩

## Index

The italic numbers denote the pages where the corresponding entry is described, numbers underlined point to the definition, all others indicate the places where it is used.