

Proposal for C23
WG14 N2745

Title: Range error definition
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Proposal category: Technical
Reference: N2596

7.12.1 defines a range error:

[4] Likewise, a *range error* occurs if and only if the mathematical result of the function cannot be represented in an object of the specified type, due to extreme magnitude. The description of each function lists any required range errors; an implementation may define additional range errors, provided that such errors are consistent with the mathematical definition of the function and are the result of either overflow or underflow.

Problem 1: This definition excludes the IEC 60559 underflows that are outside the normal range before but not after rounding. This is contrary to the footnote attached to 7.12.1:

249)The term underflow here is intended to encompass both "gradual underflow" as in IEC 60559 and also "flush-to-zero" underflow.

Problem 2: The use of "mathematical result" is problematic where correct rounding is not required. This is discussed in a separate paper which proposes removing all other such uses of "mathematical result".

Problem 3: The definition is vague, especially considering subnormal results which are inexact but correct to the full precision of type.

Problem 4: If a range error is a well-defined condition, what are the meanings of "required range errors" and "implementation-defined range errors"? We believe the following is intended:

(R) required range errors \cup impl-defined range errors \subseteq range errors =
overflow \cup underflow

And, the significance is that the required and implementation-defined range errors are the range errors that shall or may be reported, as specified in the subclause.

Problem 5: Given that range error is effectively a collective term for the defined terms overflow and underflow, it is unnecessary to have a different definition for range error.

The following suggested changes address these problems.

Suggested changes:

Changes in 7.12.1:

[4] Likewise, a *range error* occurs if and only if the ~~mathematical result of the function cannot be represented in an object of the specified type, due to extreme magnitude~~ overflows or underflows, as defined below. The description of each function lists any required range errors; an implementation may define additional range errors, provided that such errors are consistent with the mathematical definition of the function and are the result of either overflow or underflow. *)

*) Range errors that are required or implementation-defined shall or may be reported, as specified in this subclause.