

Oracle® Developer Studio 12.5: Numerical Computation Guide

Document Information

Using This Documentation

Chapter 1 Introduction

Chapter 2 IEEE Arithmetic

2.1 IEEE Arithmetic Model

2.2 IEEE Formats

2.3 Underflow

2.3.1 Underflow Thresholds

2.3.2 How Does IEEE Arithmetic Treat Underflow?

2.3.3 Why Gradual Underflow?

2.3.4 Error Properties of Gradual Underflow

2.3.5 Two Examples of Gradual Underflow Versus Abrupt Underflow

2.3.6 Does Underflow Matter?

2.4 IEEE Standard 754-2008

Chapter 3 The Math Libraries

Chapter 4 Exceptions and Exception Handling

Chapter 5 Compiler Code Generation

Appendix A Examples

Appendix B SPARC Behavior and Implementation

Appendix C x86 Behavior and Implementation

Appendix D Addendum to

Appendix E Standards Compliance

Appendix F References

Glossary

Index

English ▼

## 2.3 Underflow

Underflow occurs, roughly speaking, when the result of an arithmetic operation is so small that it cannot be stored in its intended destination format without suffering a rounding error that is larger than usual.

### 2.3.1 Underflow Thresholds

Table 11 shows the underflow thresholds for single, double, and double-extended precision.

Table 11 Underflow Thresholds

Destination Precision	Underflow Threshold	
single	smallest normal number	1.17549435e−38
	largest subnormal number	1.17549421e−38
double	smallest normal number	2.2250738585072014e−308
	largest subnormal number	2.2250738585072009e−308
quadruple	smallest normal number	3.36210314311209350626267784932
	largest subnormal number	3.36210314311209350626267784932
double-extended (x86)	smallest normal number	3.36210314311209350626e−4932
	largest subnormal number	3.36210314311209350590e−4932

The positive subnormal numbers are those numbers between the smallest normal number and zero. Subtracting two (positive) tiny numbers that are near the smallest normal number might produce a subnormal number. Or, dividing the smallest positive normal number by two produces a subnormal result.

The presence of subnormal numbers provides greater precision to floating point calculations that involve small numbers, although the