

WP4.D4 / REDOMMENDATION FOR THE USE OF STANDARDS FOR SOLAR FLUID PARAMETERS 1ST DRAFT

Author: Michel Haller and Peter Vogelsanger, SPF
Switzerland

Reviewer: Bouzid Khebchache, CSTB France
Nov 2005

CONTENTS

SUMMARY

Recommendations on properties to be published for solar fluids and standards to be used to determine fluid properties.

OVERVIEW OF PROPERTIES

List of properties and relevance of properties of solar fluids

GENERAL TERMS

Definitions within this document and general good declaration practice.

LIST OF PROPERTIES

Freezing point / setting point, boiling point, viscosity, thermal conductivity / diffusivity, specific heat, density, corrosivity, pH, reserve alkalinity, index of refraction, self ignition temperature, flash point, toxicity, ecotoxicity, environmental degradation

MISSING TESTING PROCEDURES

Compatibility with plastic materials, stability / lifetime, embodied energy

SUMMARY

In central and northern Europe, solar collectors are usually filled with an antifreeze fluid to prevent bursting of pipes and other containments during cold periods. This report gives recommendations on properties to be published for solar fluids and standards to be used to determine fluid properties.

Overview of properties

Table 1 gives an overview of relevant properties for solar fluids. Most of these properties are of immanent interest to the user of the product and should therefore be declared and published on a product datasheet as described in the following sections.

Property	Relevance
Freezing point / setting point	Freeze protection (protection against bursting of pipes)
Boiling point	Upper temperature limit of collector operation
Viscosity	Pressure drop in tubes (parasitic energy used for circulation of the fluid), heat transfer
Thermal conductivity / diffusivity / specific heat	heat transfer
Density	heat transfer / calculations
Corrosivity / pH / Reserve alkalinity	Compatibility with containment material used in the installation / durability of the installation
Durability / lifetime of the antifreeze	Maintenance cost / risk of failure because of fluid deterioration and/or material corrosion
Index of refraction	Concentration measurements of water/glycol mixtures
Self ignition temperature / flash point	Fire and explosion safety
Toxicity / ecotoxicity / environmental degradation	Safety of DHW-Systems / ecological product labelling / disposal
Embodied energy	Life cycle assessment

Table 1: Relevant properties of solar fluids

General terms

- Unless otherwise stated, the term "pure substance" refers to the concentrated mixture including all additives for corrosion protection and stabilisation.
- The term "mixture" refers to the pure substance mixed with water. If other water than tap water is used for the mixture (for example distilled / deionized water) it has to be declared.
- Unless explicitly stated, values must be determined for the product as it is sold. Calculations of mixture properties from the properties of its components are only applicable where indicated in these recommendations

Freezing point / Setting point

Importance	Units	Standards
Must	°C	ASTM D1177 for Freezing Point DIN EN 23015, DIN ISO 3016 for Setting point

Minimum number of values:

- Pure substance
- -20 °C freeze protection mixture

Boiling point

Importance	Units	Standards
Must	°C	ASTM D1120

Minimum number of values:

- Pressure dependent values for pure substance from 0-6 bar
- Pressure dependent values for -20 °C freeze protection mixture from 0-6 bar

Viscosity

Importance	Units	Standards
Must	mm ² /sec	DIN 51562

Minimum number of values:

- Temperature dependent values for pure substance from -20 to 100 °C
- Temperature dependent values for -20 °C freeze protection mixture from -20 to 100 °C

Thermal conductivity / diffusivity

Importance	Units	Standards
Must	W/mK	

Minimum number of values:

- Temperature dependent values for pure substance from -20 to 100 °C
- Temperature dependent values for -20 °C freeze protection mixture from -20 to 100 °C

Remarks:

- Calculations of mixture properties from the properties of its components acceptable?

Specific heat

Importance	Units	Standards
Must	kJ/kgK	

Minimum number of values:

- Temperature dependent values for pure substance from -20 to 100 °C
- Temperature dependent values for -20 °C freeze protection mixture from -20 to 100 °C

Remarks:

- Calculations of mixture properties from the properties of its components acceptable?

Density

Importance	Units	Standards
Must	g/cm ³	ASTM D4052, ASTM D1122, DIN 51757

Minimum number of values:

- Temperature dependent values for pure substance from -20 to 100 °C
- Temperature dependent values for -20 °C freeze protection mixture from -20 to 100 °C

pH

Importance	Units	Standards
Must	-	ASTM D1287, DIN 51369

Minimum number of values:

- pH at 20 °C of -20 °C freeze protection mixture

Exceptions:

- if a fluid is not based on glycol and the manufacturer can reasonably and scientifically supported claim that a pH-Measurement does not give valuable information for corrosion prevention.

Reserve alkalinity

Importance	Units	Standards
Must	-	ASTM D1121

Minimum number of values:

- pH at 20 °C of a -20 °C freeze protection mixture

Exceptions:

- if a fluid is not based on glycol and the manufacturer can reasonably and scientifically supported claim that the measurement of reserve alkalinity does not give valuable information for corrosion prevention.

Corrosion

Importance	Units	Standards
Must	g/m ²	ASTM1384

Minimum number of values:

- Data for -20 °C freeze protection mixture (Duration: 336h, T.min: 88°C, Air-Flow: 6 L/h)
- Data must be available for all metal containment materials that the manufacturer claims compatibility with his product

Index of Refraction

Importance	Units	Standards
Recommended	-	DIN 51423, DIN 51757

Minimum number of values:

- pure substance at 20 °C

Flash point

Importance	Units	Standards
Must	°C	51758, DIN EN ISO 2719

Minimum number of values:

- pure substance
- -20 °C freeze protection mixture

Self ignition temperature

Importance	Units	Standards
Must	°C	DIN 51794

Minimum number of values:

- pure substance
- -20 °C freeze protection mixture

Toxicity

Importance	Units	Standards
Must	LD50 mammal	??

Minimum number of values:

- pure substance, LD50 for at least one mammal

Remarks:

- Calculations of mixture properties from the properties of its components acceptable?

Ecotoxicity

Importance	Units	Standards
Recommended	NOEC LC50 Fish? LC50 aquatic vertebrates LC50 aquatic plants	??

Minimum number of values:

- pure substance

Remarks:

- Calculations of mixture properties from the properties of its components acceptable

Environmental degradation

Importance	Units	Standards
Recommended	%-degradaion	OECD 301

Minimum number of values:

- pure substance

Remarks:

- Calculations of mixture properties from the properties of its components acceptable

Missing testing procedures:

Compatibility with Plastic Materials?

Test methods? Results?

Importance	Units	Standards
Recommended	??	??

Minimum number of values:

- pure substance
- -20 °C freeze protection mixture

Stability / lifetime?

Test methods? Results?

Importance	Units	Standards
Recommended	??	??

Minimum number of values:

- pure substance
- -20 °C freeze protection mixture

Embodied energy?

Calculation methods? Results?

Importance	Units	Standards
Recommended	??	??

Minimum number of values:

- pure substance

Remarks:

- Calculations of mixture properties from the properties of its components acceptable

Literature

- /Hal04/ Haller M., NEGST WP4 Subtask 8: Results of a survey on standards for solar fluids testing, 2004
- /Hal05a/ Haller M., Vogelsanger P., NEGST WP4-8: Existing standards for solar fluid properties, July 2005
- /Hal05b/ Haller M., Vogelsanger P., NEGST WP4-8: Report on corrosion and lifetime tests for solar fluids