



ATIS-0600031.02

**Distributed Single Phase Cooling –
Standardized Infrastructure**

AMERICAN NATIONAL STANDARD FOR TELECOMMUNICATIONS



As a leading technology and solutions development organization, ATIS brings together the top global ICT companies to advance the industry's most-pressing business priorities. Through ATIS committees and forums, nearly 200 companies address cloud services, device solutions, emergency services, M2M communications, cyber security, ehealth, network evolution, quality of service, billing support, operations, and more. These priorities follow a fast-track development lifecycle — from design and innovation through solutions that include standards, specifications, requirements, business use cases, software toolkits, and interoperability testing.

ATIS is accredited by the American National Standards Institute (ANSI). ATIS is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a founding Partner of oneM2M, a member and major U.S. contributor to the International Telecommunication Union (ITU) Radio and Telecommunications sectors, and a member of the Inter-American Telecommunication Commission (CITEL). For more information, visit < www.atis.org >.

AMERICAN NATIONAL STANDARD

Approval of an American National Standard requires review by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made towards their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Notice of Disclaimer & Limitation of Liability

The information provided in this document is directed solely to professionals who have the appropriate degree of experience to understand and interpret its contents in accordance with generally accepted engineering or other professional standards and applicable regulations. No recommendation as to products or vendors is made or should be implied.

NO REPRESENTATION OR WARRANTY IS MADE THAT THE INFORMATION IS TECHNICALLY ACCURATE OR SUFFICIENT OR CONFORMS TO ANY STATUTE, GOVERNMENTAL RULE OR REGULATION, AND FURTHER, NO REPRESENTATION OR WARRANTY IS MADE OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. ATIS SHALL NOT BE LIABLE, BEYOND THE AMOUNT OF ANY SUM RECEIVED IN PAYMENT BY ATIS FOR THIS DOCUMENT, AND IN NO EVENT SHALL ATIS BE LIABLE FOR LOST PROFITS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES. ATIS EXPRESSLY ADVISES THAT ANY AND ALL USE OF OR RELIANCE UPON THE INFORMATION PROVIDED IN THIS DOCUMENT IS AT THE RISK OF THE USER.

| |
|--|
| <p>NOTE - The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to whether use of an invention covered by patent rights will be required, and if any such use is required no position is taken regarding the validity of this claim or any patent rights in connection therewith. Please refer to [http://www.atis.org/legal/patentinfo.asp] to determine if any statement has been filed by a patent holder indicating a willingness to grant a license either without compensation or on reasonable and non-discriminatory terms and conditions to applicants desiring to obtain a license.</p> |
|--|

ATIS-0600031.02, *Distributed Single Phase Cooling – Standardized Infrastructure*

Is an American National Standard developed by the **Network Physical Protection (NPP)** Subcommittee under the **ATIS Sustainability in Telecom: Energy and Protection Committee (STEP)**.

Published by

Alliance for Telecommunications Industry Solutions
1200 G Street, NW, Suite 500
Washington, DC 20005

Copyright © 2023 by Alliance for Telecommunications Industry Solutions
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher. For information contact ATIS at 202.628.6380. ATIS is online at < <http://www.atis.org> >.

American National Standard for Telecommunications

Distributed Single Phase Cooling – Standardized Infrastructure

Alliance for Telecommunications Industry Solutions

Approved April 7, 2023

American National Standards Institute, Inc.

Abstract

Equipment cooling infrastructure solutions have expanded and adapted to meet increasing equipment heat loads and improved energy efficiencies. Infrastructure solutions now include energy efficient Close-coupled cooling (C³) alternatives that bring the cooling (heat transfer) closer to the heat source. One C³ solution utilizes a single phase media, typically water, as a thermal transfer medium. As the industry adopts and integrates Distributed Single Phase Cooling (DSPC) systems, common infrastructure standards are needed to ensure interoperability and connectivity between manufacturers. This standard outlines design requirements for a standard single phase media distribution infrastructure.

Foreword

The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

As a leading technology and solutions development organization, the Alliance for Telecommunications Industry Solutions (ATIS) brings together the top global information and communications technology (ICT) companies to advance the industry's most-pressing business priorities. ATIS serves the public through improved understanding between carriers, customers, and manufacturers. The Sustainability in Telecom: Energy and Protection (STEP) Committee – formerly the Network Interface, Power, and Protection Committee (NIPP) – engages industry expertise to develop standards and technical reports for telecommunications equipment and environments in the areas of energy efficiency, environmental impacts, power and protection. The work products of STEP enable vendors, operators and their customers to deploy and operate reliable, environmentally sustainable, energy efficient communications technologies. STEP is committed to proactive engagement with national, regional and international standards development organizations and forums that share its scope of work.

ANSI guidelines specify two categories of requirements: mandatory and recommendation. The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages.

Suggestions for improvement of this standard are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, STEP, 1200 G Street NW, Suite 500, Washington, DC 20005.

At the time of consensus on this standard, STEP, which was responsible for its development, had the following roster:

- J. Jackson, STEP Chair (Southwire)
- E. Gallo, STEP Vice Chair (Ericsson)
- C. Von Hagel, STEP-NPP Chair (Intertek)
- M. Levitre, STEP-NPP Vice Chair (Southwire)

The Network Physical Protection (NPP) Subcommittee was responsible for the development of this standard.

Table of Contents

| | | |
|----------|---|-----------|
| 1 | SCOPE, PURPOSE, & APPLICATION | 1 |
| 1.1 | SCOPE..... | 1 |
| 1.2 | PURPOSE..... | 1 |
| 2 | NORMATIVE REFERENCES | 1 |
| 3 | DEFINITIONS, ACRONYMS, & ABBREVIATIONS..... | 2 |
| 3.1 | DEFINITIONS..... | 2 |
| 3.2 | ACRONYMS & ABBREVIATIONS | 4 |
| 4 | DISTRIBUTED SINGLE PHASE COOLING – GENERAL..... | 4 |
| 4.1 | GENERAL FUNCTIONALITY..... | 4 |
| 4.2 | POSITIVE AND NEGATIVE PRESSURE DISTRIBUTED SINGLE PHASE COOLING | 4 |
| 4.3 | DEW POINT CONTROL..... | 4 |
| 4.4 | CLOSE-COUPLED COOLING (C3) BENEFITS | 4 |
| 4.5 | MATERIAL FLAMMABILITY COMPLIANCE..... | 5 |
| 4.6 | BASIC CONSIDERATIONS FOR A SINGLE PHASE MEDIA..... | 5 |
| 5 | DISTRIBUTED SINGLE PHASE COOLING TYPICAL COMPONENTS..... | 5 |
| 5.1 | GENERAL..... | 5 |
| 6 | SINGLE PHASE MEDIA DISTRIBUTION PIPING INFRASTRUCTURE..... | 7 |
| 6.1 | PURPOSE..... | 7 |
| 6.2 | COMPONENTS | 7 |
| 6.3 | SUPPLY & RETURN PIPING GENERAL..... | 8 |
| 6.4 | CONSTRUCTION..... | 8 |
| 6.5 | LENGTH | 9 |
| 6.6 | SIZING | 9 |
| 6.6.1 | <i>Pump Connecting Pipe Sizing</i> | <i>9</i> |
| 6.6.2 | <i>Supply Header Pipe Sizing</i> | <i>9</i> |
| 6.6.3 | <i>Return Header Pipe Sizing</i> | <i>9</i> |
| 6.6.4 | <i>Copper Feed to C3 Units Sizing</i> | <i>9</i> |
| 6.6.5 | <i>Overall Equivalent Length Sizing.....</i> | <i>9</i> |
| 6.7 | COPPER FEED TO EQUIPMENT CHASSIS | 10 |
| 6.8 | DISTRIBUTION PIPING SLOPE | 10 |
| 6.9 | ISOLATION VALVES – SERVICE – SYSTEM EXPANDABILITY | 10 |
| 6.10 | PIPING CONNECTIONS – PLACEMENT..... | 11 |
| 6.11 | PIPING PLACEMENT – LOCATION | 11 |
| 6.11.1 | <i>Positive Pressure Systems</i> | <i>11</i> |
| 6.11.2 | <i>Negative Pressure Systems.....</i> | <i>14</i> |
| 6.12 | PIPING INSULATION..... | 14 |
| 6.13 | PIPE BONDING – GROUNDING | 15 |
| 6.14 | INSTALLATION PIPING PRESSURE TESTING & CHARGING | 16 |
| 6.15 | INSTALLATION PIPING LABELING | 16 |
| 7 | SINGLE PHASE MEDIA PORTS..... | 17 |
| 7.1 | PURPOSE..... | 17 |
| 7.2 | STANDARD DESIGN..... | 17 |
| 7.3 | SPECIFICATIONS..... | 17 |
| 7.4 | FLOW PERFORMANCE..... | 17 |
| 7.5 | PORT SPACING..... | 18 |
| 7.6 | MOUNTING | 19 |
| 7.7 | TORQUE CONSIDERATIONS | 19 |
| 7.8 | ALIGNMENT | 20 |
| 8 | FLEXIBLE HOSES..... | 20 |

| | | |
|----------|---|-----------|
| 8.1 | PURPOSE | 20 |
| 8.2 | COMPONENTS | 21 |
| 8.3 | MATERIALS | 21 |
| 8.4 | MOUNTING | 21 |
| 8.5 | MINIMUM BEND RADIUS | 21 |
| 8.6 | HOSE ROUTING | 22 |
| 8.7 | MAXIMUM PRESSURE DROP | 24 |
| 8.8 | MAXIMUM HOSE LINE LENGTH..... | 24 |
| A | CONSIDERATIONS FOR ENVIRONMENT CONTROLS IN EQUIPMENT SPACE | 26 |
| A.1 | DEW POINT | 26 |
| B | SYSTEM & PORT CAPACITY..... | 27 |
| B.1 | CAPACITY | 27 |
| C | SYSTEM DESIGN & DEPLOYMENT CONSIDERATIONS | 28 |
| C.1 | THERMAL EXPANSION | 28 |
| D | SYSTEM DESIGN & DEPLOYMENT CONSIDERATIONS | 29 |
| D.1 | SYSTEM LIFE EXPECTANCY | 29 |
| E | LIST OF INFORMATIVE REFERENCES | 30 |

Table of Figures

| | | |
|-------------|--|----|
| FIGURE 5.1: | EXAMPLE OF OVERHEAD DISTRIBUTED SINGLE PHASE COOLING INFRASTRUCTURE | 6 |
| FIGURE 5.2: | EXAMPLE OF UNDER FLOOR DISTRIBUTED SINGLE PHASE COOLING INFRASTRUCTURE | 7 |
| FIGURE 6.1: | ISOLATION VALVE PLACEMENT..... | 10 |
| FIGURE 6.2: | BULL HEAD (LEFT) & OFFSET “T” CONNECTION (RIGHT)..... | 11 |
| FIGURE 6.3: | PIPE CLEARANCES (SIDE VIEW)..... | 12 |
| FIGURE 6.4: | PIPE CLEARANCES (END VIEW) | 13 |
| FIGURE 6.5: | UNDER FLOOR – PIPE CLEARANCE REQUIREMENTS | 14 |
| FIGURE 6.6: | CLOSED CELL ELASTOMERIC INSULATION (TYPICAL)..... | 15 |
| FIGURE 6.7: | SYSTEM TAG | 17 |
| FIGURE 7.1: | TYPICAL PORT SPACING..... | 18 |
| FIGURE 7.2: | MINIMUM PORT SPACING – SINGLE PORT FEEDS..... | 18 |
| FIGURE 7.3: | MINIMUM PORT SPACING – MULTIPLE PORT FEEDS | 19 |
| FIGURE 7.4: | TYPICAL PORT ASSEMBLY | 19 |
| FIGURE 7.5: | PORT TORQUE TIGHTENING EXAMPLE..... | 20 |
| FIGURE 8.1: | FLEXIBLE HOSE PLACEMENT – MINIMUM BEND RADIUS | 22 |
| FIGURE 8.2: | FLEXIBLE HOSE PLACEMENT – LOOPING & POOLING | 22 |
| FIGURE 8.3: | FLEXIBLE HOSE PLACEMENT – EXTENSION OR COMPRESSION | 23 |
| FIGURE 8.4: | FLEXIBLE HOSE PLACEMENT – TORQUE CONSIDERATIONS | 23 |
| FIGURE 8.5: | FLEXIBLE HOSE PLACEMENT – TORQUE COMPRESSION | 24 |
| FIGURE 8.6: | FLEXIBLE HOSE PLACEMENT – SHARP BENDS | 24 |

American National Standard on –

Distributed Single Phase Cooling – Standardized Infrastructure

1 Scope, Purpose, & Application

1.1 Scope

This standard is part of a suite of standards supporting the installation design and material selection of distributed cooling systems for electronic equipment. More specifically, this standard addresses material and connectivity specifications for the deployment of a universal distributed single phase media infrastructure. DRC systems are typically comprised of three (3) primary common elements: 1) Thermal transfer system – Single phase media pumping unit; 2) single phase media distribution infrastructure; and 3) close-coupled cooling units.

Unless otherwise specifically identified, this standard supports single phase media systems incorporating water with or without glycol additives as the single phase media utilized in the distribution infrastructures between the pumping unit and close-coupled cooling units.

1.2 Purpose

The purpose of this standard is to provide support for the deployment of a universal application infrastructure for Distributed Single Phase Cooling (DSPC) systems. The universal application allows for the installation of a single, common infrastructure that is adaptable to support multiple vendors of DSPC. This infrastructure may be designed and installed within an equipment area prior to the placement of equipment and racking, without specificity of the DSPC vendor. This early placement may reduce overall installation costs and provides for more rapid deployment equipment build-outs in the supported space. The standard also provides for a designation of standard-single phase media infrastructure interface(s) or port(s). This commonality provides manufacturers of equipment-specific standards and specifications for connectivity to the core single phase media infrastructure. For the purposes of this standard, the primary cooling loop (e.g., chilled water, DX, etc.) is not included.

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

[Ref 1] ASME B 31, *Power Piping*.¹

[Ref 2] ASTM B 88-09, *Standard Specification for Seamless Copper Water Tube*.²

[Ref 3] ASTM B 280-08, *Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*.²

[Ref 3] ASTM D 2863, *Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)*.²

[Ref 4] ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*.²

¹ This document is available from ASME < <https://www.asme.org/> >.

² This document is available from the American Society for Testing and Materials (ASTM) < <http://www.astm.org> >