



CGA P-40—2017
CALCULATION METHOD FOR
THE ANALYSIS AND
PREVENTION OF
OVER PRESSURE DURING
REFILLING OF CRYOGENIC
TANKS WITH RUPTURE DISK(S)

FOURTH EDITION

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PREFACE

As part of a program of harmonization of industry standards, the Compressed Gas Association (CGA) has published CGA P-40, *Calculation Method for the Analysis and Prevention of Overpressure During Refilling of Cryogenic Tanks with Rupture Disk(s)*, jointly produced by members of the International Harmonization Council.

This publication is intended as an international harmonized standard for the worldwide use and application of all members of the Asia Industrial Gases Association (AIGA), Compressed Gas Association (CGA), European Industrial Gases Association (EIGA), and Japan Industrial and Medical Gases Association (JIMGA). Each association's technical content is identical, except for regional regulatory requirements and minor changes in formatting and spelling.

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Work Item 16-049
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NOTE—Technical changes from the previous edition are underlined.

NOTE—Appendix A (Normative) is a requirement.

NOTE—Appendices B, C, D, and E (Informative) are for information only.

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1 Introduction

Cryogenic transports often use pumping systems that discharge product at pressures exceeding the working pressure of the liquid storage tank being filled. In North America, pumping systems for transferring oxygen, nitrogen, or argon are typically capable of delivering pressures greater than 400 psi (2760 kPa).^{1,2} The cryogenic storage tank being refilled usually has a maximum allowable working pressure (MAWP) that is considerably less than the pump discharge pressure. Depending on the inherent tank design safety factors and the size and flow capacity of the tank pressure relief system, the potential to overpressure the tank during operator-attended manual refill operations exists. CGA P-59, *Prevention of Overpressure During Filling of Cryogenic Vessels* was written in response to overpressure events that occurred in the compressed gas industry [2]. CGA P-59 discusses the requirements necessary to ensure that cryogenic storage tanks are not overpressurized in manual refill operations [2].

It is the responsibility of each tank owner to complete a technical evaluation of the storage tank fill and relief device piping. This technical evaluation shall be repeated any time a change is made in either the pump flow and pressure capability or the tank fill and relief system flow capacities. The storage tank owner shall ensure that pump operators are trained and certified.

2 Scope

This publication provides technical guidance and the complete equation set needed to determine if a particular vessel can or cannot be overpressurized during the refill operation. Acceptable engineering controls for the protection of cryogenic storage tanks and transport tanks with rupture disk(s) as part of the relief system are provided. The application of these engineering controls constitutes a minimum standard.

The calculations in this publication may be used to evaluate each pumping system and cryogenic tank combination in use with oxygen, nitrogen, or argon. It applies to tanks filled either by pump from a cryogenic transport or by a ground-mounted pump. This applies to cryogenic tanks greater than 265 gal (1000 L) water capacity. This does not apply to cryogenic tanks with flat bottoms. For flat bottomed cryogenic tanks, refer to CGA P-8.9, *Bulk Liquid Oxygen, Nitrogen, and Argon Storage Systems at Production Sites* [3].

3 Definitions

For the purpose of this publication, the following definitions apply.

3.1 Publication terminology

3.1.1 **Shall**

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 **Should**

Indicates that a procedure is recommended.

3.1.3 **May**

Indicates that the procedure is optional.

3.1.4 **Will**

Is used only to indicate the future, not a degree of requirement.

3.1.5 **Can**

Indicates a possibility or ability.

¹ kPa shall indicate gauge pressure unless otherwise noted as (kPa, abs) for absolute pressure or (kPa, differential) for differential pressure. All kPa values are rounded off per CGA P-11, *Metric Practice Guide for the Compressed Gas Industry* [1].

² References are shown by bracketed numbers and are listed in order of appearance in the reference section.