

◆ G-4 NEWS ◆

Volume 7 Issue 1

The Newsletter for Oxygen Compatibility Practitioners.

Spring 2000

CGA/EIGA to Develop New Piping Guide

CGA and EIGA have begun to jointly develop a new International Piping Guide to replace CGA's Pamphlet G-4.4 on *Industrial Practices for Gaseous Oxygen Transmission and Distribution Piping Systems* and EIGA's Standard 13/82 on *The Transportation and Distribution of Oxygen by Pipeline*.

The joint harmonization task force was formed in mid 1999 and, as of the Spring G-4 meeting, has already met four times as part of an aggressive schedule to produce the document as quickly as possible. The fourth meeting of the Task Force was held in mid-February. This enterprise will have impact on many G-4 standards,

which cite these documents, as well as the G-4 TPT course, which includes the CGA approach to piping design in some detail.

At present, the changes are expected to be substantial. Task Force members include Sabine Sievers, Lars Spangberg and Ed McCorry (MG), Ed Simon and Terry Knight (BOC), Gerald B. Unger and Robert Zawierucha (PX), Herve Barthélémy, Eric Fortuit, Emmanuel Fano, Kim Dunleavy, and Larry Schmidt (AL), Stuart Hargreave, Mike Himes, Joe Slusser and Dave Castillo (APCI), and Herbert Hermann. The next meeting is in Paris on April 11-13, 2000. **G4N**

Final "Oxygen 2000" Symposium Status

Oxxygen 2000, officially titled: **NINTH INTERNATIONAL SYMPOSIUM ON FLAMMABILITY AND SENSITIVITY OF MATERIALS IN OXYGEN-ENRICHED ATMOSPHERES** is in excellent shape. Peer reviews are nearly complete and the availability at the symposium of the Committee's next Special Technical Publication which includes these papers seems highly likely.

Those papers from the publication scheduled to be presented are:

Keynote Address: A Review of Test Methods Used in the Selection of Materials for Oxygen Service—C. J. Bryan,

The Presence of Excess Oxygen in Burning Metallic Materials—D. B. Wilson, and T. Steinberg,

Promoted Ignition-Combustion Behaviour of Engineering Alloys at Elevated Temperatures and Pressures in Oxygen Gas Mixtures—R. Zawierucha and J. Million,

Promoted Ignition-Combustion Behaviour of Al-Si Alloys, Al-Si-C MMCs and Other Selected

(See *Final* on page 4)

Progress at Toronto:

.....*No Calm Before the Storm*

G-4 expected a breather in Toronto, knowing that there'll be little calm at the hectic Fall '00 symposium and meetings in Paris. But the breather did not materialize and there was *more* activity than usual.

The **Main Committee, G4.00**, approved a Nominating Committee to consider candidates for the Award of Merit in 2001.

Test Methods G4.01 reviewed the subcommittee ballot of the provisional medical oxygen regulator standard which will be rewritten (see article p. 3). Revision efforts for G 124 Promoted Combustion and G 125 (oxygen index) were assigned. G 72 (autoignition temperature) and G 74 (gas impact) are being revised for the removal of references to CFC 113. The status of ongoing PCTFE testing was reviewed (see article p. 2).

Practices G4.02 reported on testing

which has now begun both on testing of 0.5-in stainless steel rods in flowing oxygen under program 96-1, and for the first testing that is underway for metals at elevated temperature under program 98-1.

(See *Progress* on page 3)

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Seminar Proposes Fire Limits Practice

The Toronto meeting included an automated (nearly three-hour) mini-seminar delivered by computer entitled "**Fire Limits for Linearly Afflicted Minds, Everywhere**" by Barry Werley. It covered the origins, definitions, and interpretations of fire (i.e. flammability) limits of uniform gas, solid or liquid mixtures. Ternary and rectangular diagrams were reviewed. An apparently new parametric method to define and specify fire limits was proposed.

Commentary is being sought that would allow the seminar to be honed into a learning tool. Computer difficulties prevented demonstration of a PC program for the study of fire-limit systems. It should also be

(See *Seminar* on page 2)

ASTM/NASA Design Manual Issues

The NASA Safety Standard for Oxygen and Oxygen Systems has been successfully converted to an ASTM Manual. The new ASTM Manual 36 is entitled *Safe Use of Oxygen and Oxygen Systems*, Harold D. Beeson, Walter F. Stewart, and Stephen S. Woods, Editors. This manual contains guidelines for oxygen system design, materials selection, operations, storage, and transportation.

The publication of the manual is a first for G4 in two ways: first it is the first manual under the guidance of the

G4 committee, and second, it represents a successful transition of a government standard to industry. The manual is available from ASTM at a cost of \$54.00 in North America, \$60.00 Elsewhere.

This manual is a revision of the previously issued: Bond, A. C., Pohl, H. O., Chaffee, N. H., Guy, W. W., Allton, C. S., Johnson, R. L., Castner, W. L., and Stradling, J. S., *Design Guide for High Pressure Oxygen Systems*, NASA Reference Publication 1113, NASA Scientific and Technical Information Branch, Aug. 1983. **G4N**

PCTFE Task Force Progress Report

The task force has continued evaluations on PCTFE mechanical and dimensional instability. The task group is presently performing additional testing aimed at developing processing guidelines for use by manufacturers and molders.

The accomplishments to date include Autoignition Testing (AIT), Mechanical Impact Testing, Differential Scanning Calorimetry, and Thermal Mechanical Analysis (TMA) of valve seats, Kel-F rod stock, Kel-F sheet stock, Neoflon rod stock, and Neoflon sheet stock. The following conclusions have been developed:

1. The PCTFE tested by TMA exhibits high randomness in mechanical stability and behavior. The deflection of some test samples during loading is very large. The onset of deflection is occurring at relatively low temperatures (~40 to 60 °C). The best-behaved materials tested so far have been Kel-F materials.
2. All PCTFE tested has benefited from the thermal profile of the TMA test. In every case, the 2nd and 3rd heatings do not demonstrate mechanical instability. For this reason, additional effort at specifying an annealing procedure is being evaluated.
3. AIT and Mechanical Impact testing presently completed show no statistically significant differences between the Kel-F materials and the Neoflon materials.

Daikin has provided raw PCTFE resin to both Acutech and Afton Plastics for molding by different processes (i.e., extrusion and compression molding processes). This material will be characterized for mechanical, dimensional, and ignition behavior and supplied to several valve and regulator manufacturers for machining. The machined parts will also be characterized for mechanical, dimensional, and ignition behavior. Differences in the material behavior will be assessed and attempts to correlate the processing method and thermal history with the mechanical/ignition behavior will be attempted. **G4N**

IGC Publication on Toxicity Risks

The Industrial Gas Council has recently released a publication on the hazards of polymer toxicity in breathing systems titled: *High Pressure Breathing Gas Systems: Toxicity Risks of Using Nonmetallic Materials*.

Polymers are typically found in valve, regulator and non return valve seats, regulator diaphragms and flexible hoses and are among the most critical materials used in high pressure (HP) oxygen and oxygen mixture supply systems.

The risks of polymer fire has been well known for many years, and applies to any oxygen application, but more recently it has been realized, following serious accidents,

that toxic gases could be generated by ignition (or decomposition) of some non metallic materials in high pressure equipment. New international standards in preparation (prEN 13159 and ISO/DIS 15001) recommend how to address this toxicity risk.

This new IGC document is intended to help prevent accidents/incidents resulting from toxic products created by combustion of non metallic materials in HP breathing gas systems. Such toxic products in a breathing gas system are difficult to detect, therefore it is important to prevent them being generated. Design and comparative toxicity factors are reviewed. **G4N**

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available soon for comment.

The seminar and program were represented only as *technical opinion*. The program, especially, lacks peer commentary, and its use is not allowed for actual hazard analysis. Further, because the legal treatment of "computer program opinion" in other countries is unknown to the author, he will provide copies for comment in the U. S. only.

The approach might provide the basis for a standard and PC adjunct under the imprimatur of a group (such as ASTM G-4) that could take responsibility for content and global distribution. A draft standard is being prepared. G-4 is deciding whether such a

standard would be adequately close to its oxygen safety charter to develop, validate, and lock-in a version of this package, or to independently develop a different package to the same end.

Fire limits are central to the autogenous ignition tests, promoted combustion and oxygen index tests, and affect the hazards of volatiles released into oxygen systems and of oxygen dissolved into solids and liquids.

The seminar should be available in several months. The computer program should also be available (in the U.S. only) for comment in several months. Copies for comment may be requested by contacting the author at: bwerley@enter.net **G4N**

G-4 Web Site

<http://www.wstf.nasa.gov/oxcompat/>

(Progress from page 1)

Initial consideration on need for a fire-limits standards was begun (See **Seminar...p.1**).

Long Range Planning G4.04, did not meet but reported that the five-year plan and the future of G-4's computer tools will be examined next.

Education G4.05 reported 80 students attended the On-site TPT course, and since the Fall 99 meeting, there were also sessions at Brisbane and Singapore, and 35 students attended a session of the short course. Also, a new 6 hour version of the TPT Course was given to 60 students.

Two presentations were given in the continuing Seminar Series: Lori Kubinski gave an ASTM Terminology briefing entitled "Define Your Terms", and Barry Werley (assisted by Joe Slusser) presented a video on fire limits (See **Seminar Proposes...p.1**).

Symposia G4.06 continued its planning for its next symposium (See **Final O₂ 2000...p. 1**).

Research G4.92 did not meet.

Statistics G4.93 reported that four STPs (nos. 4 through 7) still need to be scanned into the searchable CDROM but copies of progress so far are being commented on. Completion is expected before the Fall meeting.

Publicity G4.94 is sending this issue of *G-4 News* by E-mail only. Please copy friends and associates who lack E-Mail. The Member Information Packet is being revised.

Executive G4.90 was addressed by Harvey Hack (Chairman of the ASTM Board), approved the purchase of 50 copies of ASTM Manual 36 *Safe Use of Oxygen and Oxygen Systems*, to be sold to members and visitors at \$27 a copy (See **ASTM/NASA...p.2**), circulated the proposed medical oxygen regulator performance standard and its negative ballots for review in the Test Methods meeting, approved the proposed charge for the G-4 Committee 25th Anniversary Banquet in Paris and that it be included in the Symposium Registration fee, and kept the noose tight on this Committee's neck.

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First Ballot Completed for Provisional Regulator Test Standard

G-4 is developing a provisional test standard for regulators used for medical and emergency oxygen at the request of the U. S. Food and Drug Administration (FDA) and the National Institute for Occupational Safety and Health (NIOSH). The request was prompted by a February 1999 FDA public health advisory regarding explosions and fires in aluminum oxygen regulators that had resulted in severe burns to 11 health care workers and patients.

The FDA was on the verge of mandating brass for all medical oxygen regulators. But rather than follow through with that mandate, G-4 members at the NASA White Sands Test Facility (WSTF) persuaded NIOSH to fund development testing and drafting of the provisional standard that would not restrict the materials of construction but would expose regulators to several phases of ignition sensitivity and fault tolerance testing.

A first-draft provisional standard was balloted at the subcommittee level that involves three phases of testing: initial gas impact testing for which failure results in rejection, then two phases of promoted ignition to gauge perfor-

mance during an actual fire. However, the ballot produced numerous persuasive technical comments and proposed changes to the draft standard.

Significant progress was made on this standard during the latest round of ASTM meetings in Toronto, Canada. However, after much discussion and with an extension granted by the FDA, the committee decided to withdraw the standard and form a larger task force involving members of the manufacturing community to address the persuasive technical comments.

A second-draft provisional standard has been distributed to the task force members, who will convene at WSTF in June to witness testing and to finalize the draft provisional standard so it can be reballoted in July.

The task force includes personnel from Air Liquide, Allied Healthcare Products, BOC Group, Contemporary Products, Essex Medical Systems, the FDA, James Davenport & Associates, Mallinckrodt, Praxair, Precision Medical, State University of New York, Tescom, Victor Equipment, Wendell Hull & Associates, Western Medical, and WSTF.

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G-4 News and all of its back issues are always available on the G-4 Web Site as downloadable Adobe Acrobat (.pdf) files.

(Final O₂2000 from page 1)

Metallic Materials—J. DeWit, T. Steinberg, and J. Haas,

Ignition of Aluminium by Impact in LOX: Influence of Contaminants—H. Barthélémy, D. Roy, and N. Mazloumian,

Igniter Wire Effects on Metals Combustion Testing—J. DeWit and T. Steinberg,

Failure Analysis of Aluminum Bodied Regulators—B. Newton and W. Hull,

Use of Emergency Oxygen in the U.S., Canada, and France: Assuring Responders are Properly Trained—L. Starr, and A. Derosi,

Failure Investigation of a Welding Regulator Fire—B. Newton and W. Hull,

Evaluation of Contaminant-Promoted Ignition in SCUBA Equipment and Breathing Gas Delivery Systems—E. T. Forsyth, R. Durkin, and H. D. Beeson,

Investigations for Oxygen Compatibility of Medical Devices—H. Kohl, R. Degenhart, and A. Morbach,

Risk Reduction In Liquid and High Pressure Oxygen Technology by Systematic Material Evaluation—F. Lienkamp,

Modelling the Burning of Buna-N O-Rings—B. Newton and D. B. Wilson,

A Fluid Flow Analysis of the Gaseous Impact Test—J. Ducrocq, D. Roy, and H. Barthélémy,

The Mechanisms of Smolder of Cellulosic Materials—A. Dyakonov, D. Grider, and A. Ihrig,

Analysis of the NASA White Sands Test Facility Test System for Friction-Ignition of Metallic Materials—M. Shoffstall, D. B. Wilson, and J. Stoltzfus,

Model of ASTM Flammability Test in Microgravity: Iron Rods—T. Steinberg, and D. B. Wilson,

Promoted Ignition-Combustion Tests of Brazed Aluminum Heat Exchanger Samples in Gaseous and Liquid Oxygen Environments—R. Zawierucha and J. Million,

Tests of combustion of Aluminium Packing and Trayed Columns—E. Fanno, H. Barthélémy, and J. Lehman,

Flame-Spreading and Violent Energy Release (VER) Phenomena of Aluminum Tubing Burning in Liquid and Gaseous Oxygen Environments—M. Mench, K. Kuo, J. Hansel, P. Houghton, and E. Rogusky,

Determination of the Hydrocarbon-Adsorption on Solid CO₂ and N₂O in LOX at Ambient Pressure—M. Meilinger and E. Lassmann,

Polymer-Oxygen Compatibility Testing: Effect of Oxygen Aging on Ignition and Combustion Properties—J. Waller, J. Haas, and H. Beeson,

Ignitibility in Air, Gaseous Oxygen, and Oxygen-Enriched Environments of Polymers Used in Breathing Air Devices, Final Report—

C. J. Bryan, D. Hirsch, and H. Beeson,

Ignition Resistance of Polymeric Materials to Particle Impact in High-Pressure Oxygen—E. T. Forsyth, and J. M. Stoltzfus,

Comparison of the Dimensional Stability of KEL-F 81 and Neoflon CTFE M400H Polychlorotrifluoroethylenes used in Valve Seat Applications—J. Waller, H. Beeson, and B. Newton,

Selection of Metal for Oxygen Valve Body—E. Fano, A. Faupin, and H. Barthélémy,

A Promoted Ignition-Combustion Test Apparatus for Evaluating the Flammability of Metallic Materials—T. Chou, N. Lemcoff, and R. Henningson,

Determination of Oxidizing Ability of Gases and Gas Mixtures—V. Schroder, B. Mackrodt, and S. Dietlen,

Flammability: A Review and Analysis—D. B. Wilson, T. Steinberg, and J. Stoltzfus,

Test System to Study the Ignition of Metals by Polymers in Oxygen—M. Shoffstall, and J. Stoltzfus,

An Analysis of Autoignition Temperature Round Robin Test Data—D. Hirsch, C. Bryan, H. Barthélémy, T. Chou, and C. Binder,

Predictability of Gaseous Impact Ignition Sensitivity from Autoignition Temperature Data—D. Hirsch, E. Skarsgard, H. Beeson, and C. J. Bryan.
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G-4 Events and Housekeeping

Regular meetings of the Committee G-4 have been scheduled as follows:

- Sept 25-26, 2000.....Paris
- Mar 28-29, 2001.....Phoenix, AZ
- Sept 19-20, 2001.....Panama City, FL
- Mar 13-14, 2002.....Pittsburg, PA

Contact Steve Mawn (610) 832-9726 for details or membership data. ASTM Membership is \$65 per year.

The next G-4 Symposium is:

- Sept 27-29, 2000Paris

For a Call for Papers or Program, call Steve Mawn (610) 832-9726.

Public offerings of the course: *Controlling Fire Hazards in Oxygen Handling Systems* are planned for:

- Sept 25-26, 2000.....Paris
- Mar 26-27, 2001.....Pheonix, AZ
- Sept 17-18, 2001.....Panama City, FL

Cost is \$675.00 (including text). It can be offered at your site for a negotiated

price. The course text: *Fire Hazards in Oxygen Systems* may be ordered separately for \$250 (2 volumes). Sessions of the "Operation and Maintenance" course are also being scheduled. Call Scott Murphy (610) 832-9685 for information/ brochure for either course.

A 210-page compilation of 23 1997 ASTM Standards on oxygen safety is available, Stock #FIRHAZ, \$68 in the USA, \$75 elsewhere, (610) 832-9585.

The G-4 Videotape *Oxygen Safety* PCN 12-700880-31 may be ordered from ASTM Customer Service at (610) 832-9585. Price \$75 (\$67 for members).

All G-4 standards appear in part 14.04 of the Book of Standards or may be ordered individually from ASTM Customer Service (610) 832-9585. Typical standard prices range \$15-30.

Details:

This newsletter is a product of ASTM Committee G-4. The editorial staff is the G-4 Committee Officers and ASTM Staff:

G4 Chair	John Cronk
G4 Vice Chair	Bill Royals
G4 Secretary	Ron Epstein
.01 Test Methods	Coleman Bryan
.02 Practices	Ting Chou
.03 Terminology	Harold Beeson
.04 Planning	Paul Klein
.05 Education	Michael Yentzen
.06 Symposia	Hervé Barthélémy
.90 Executive	John Cronk
.91 Editorial	Stephen Bonafazi
.92 Research	Theodore Steinberg
.93 Statistics	Barry Newton
.94 Publicity	Barry Werley
ASTM Staff	Steve Mawn

Mail to: **G-4 NEWS**, Steve Mawn, ASTM Committee G-4, 100 Barr Harbor Drive., West Conshohocken, PA 19428-2959, Phone (610) 832-9726, Internet: smawn@astm.org