Technique	Prior to venting a hydrogen (H_2) system, initiate a gaseous helium (GHe) sweep purge to evacuate air from the vent line. After venting operations are complete, initiate a second GHe sweep purge to evacuate the vent system of residual H_2. Use a flapper valve or check valve on the vent line to prevent air intrusion into the line during low or intermittent flow conditions.

GHe PURGING OF H_2 SYSTEMS

Purge a hydrogen system with gaseous helium to greatly reduce the chances of catastrophic events during venting

Benefits	This practice greatly reduces the possibility of a vent line fire and/or explosion during H_2 venting operations. It is impractical to supply the large quantities of GHe required to create a non-flammable H_2/He mixture during H_2 venting operations. The upper flammability limits of a gaseous H_2/air mixture is lower with no GHe present. This technique also provides substantial safety benefits.
Key Words	Purge, Hydrogen, H_2, Helium, GHe
Application Experience	National Space Transportation System (NSTS)
Technical Rationale	Use of dilution purges when venting explosive gases such as hydrogen is not necessarily desirable. • Mixtures of H_2/He do not become non-flammable until the mixture is 91% He. • For "fuel rich" hydrogen/helium mixtures in air, the flammability limit increases with increasing He content, until 85% He mixture is obtained.
Contact Center	**Kennedy Space Center (KSC)**

GHe Purging of H_2 Systems
Technique OPS-4

This technique recommends initiating a GHe sweep purge to evacuate air from a vent line prior to venting a H_2 system. After the initial venting operation is complete, a second GHe sweep purge should be conducted to evacuate the vent system of residual H_2. The upper flammability limits of a gaseous H_2/air mixture is lower with no GHe present (see Figure 1). A flapper valve or check valve used on the vent line will prevent air intrusion into the line during low or intermittent flow conditions.

This practice should be included in all new systems operating procedures and changes initiated to applicable existing procedures. System design should be reviewed to include the following as recommended by NASA TM X-52454 (Lewis Research Center):

- Include a check valve/flapper valve or other suitable mechanism to exclude air from vent stacks at low or intermittent flow conditions.

- Extend vent stacks 15 ft. above a building roof.

- Discontinue use of ordinary hydrocarbon flame arresters which are incapable of quenching a H_2 flame.

- Provide a minimum of a 3-volume exchange (pulse purges) to sweep system prior to introducing hydrogen.

Five to 10 volume exchanges to purge a vent system is a commonly acceptable industry practice.

Reference

H. Hannah, LSOC 32-30, *FCSS Hazardous Commodity Purge Study*, dated September 1991.

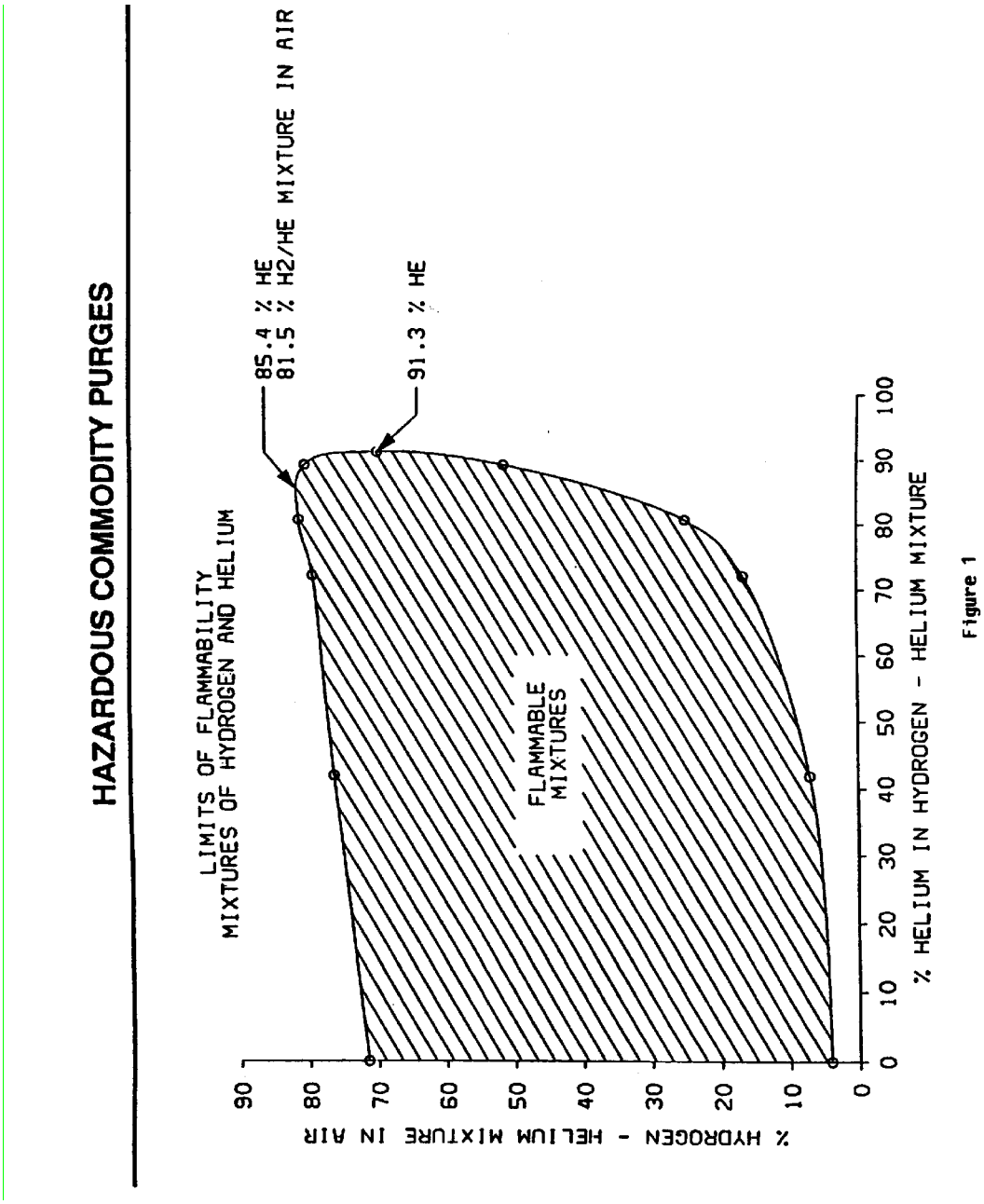

Figure 1. Limits of Flammability-Mixtures of H_2 and He

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