Survivability Evaluation of Mine Refuge Chambers

Report Date: Dec. 19, 2007

		Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4
	Chamber Name	Life Shelter	Fresh Air Bay	Kennedy Chamber	Mine Refuge Chamber
	Model Number	4042-20	MC36	MPRC-H12-8155-C	MMS - 26
	Manufacturer	ChemBio/AL Lee	Strata Products	Kennedy Metal Products	Modern Mine Safety Supply
	Street Address	968 Postal Road, Suite 320	3939 Roswell Road, NE Suite 100	P.O. Box 138	P.O. Box 480
	City	Allentown	Marietta	Taylorville	Huntington
	State	PA	GA	IL	UT
	Zip Code	18109	30062	62568	84528
	Telephone	610-266-6667	770-321-2501	217-287-7231	435-687-2244
Specs	**Chamber Type**	Inflatable	Inflatable	Steel	Steel
	Capacity (persons)	20	36	12	26
	CO2 Scrubbing System	Passive soda lime curtains	Powered soda lime cartridges	Passive lithium curtains	Powered soda lime
	Basis to Change Scrubbing Materials	Specified time - 96 hrs	Specified time - 24 hrs	Specified time - Variable	Specified time - 16 hrs
Evaluation	**Arrival Date**	10/29/07	11/02/07	10/26/07	11/30/07
	Set-up Date	10/29/07	11/05/07	11/09/07	12/03/07
	Evaluation Start Date	10/30/07	11/05/07	11/13/07	12/03/07
	Evaluation End Date	11/03/07	11/09/07	11/17/07	12/05/07
	Clean-up Date	11/03/07	11/09/07	11/17/07	12/06/07
Results	**CO_2 Scrubbing Criteria (0.51 l/min/man)** *(CO_2 level <= 0.5%)*	Exceeded	Met	Exceeded	Exceeded
	Comments	Exceeded 0.5% 42 hrs into test, remained above 0.5% from 44 hrs to end (See Comments C1, C2, C3)	Stabilized at between 0.35% and 0.40% (See Comments S1, S2)	Maximum reading was 0.72% (See Comments K1, K2, K3).	Maximum recorded reading was 1.34% (See Comments M1, M2, M3, M4)
	O_2 Supply Criteria (0.62 l/min/man) *(O_2 >= 19.5%)*	Insufficient	Met	Met	Insufficient
	Comments	O2 flow to zero at app. 71 hrs (See Comment C4)		O2 flow and conc. starting dropping at 94.5 hrs (See Comment K4).	O2 flow ended after 37 hrs (See Comment M5)
	Apparent Temperature Criteria *(< 95 deg F)*	Met	Met	Exceeded	Exceeded
	Comments	Stabilized at app. 70°F apparent temperature (73°F and 62% RH)	Stabilized at app. 70°F apparent temperature (70°F and 69% RH)	Apparent temperature app. 110°F (87°F and 86% RH).	Apparent temperature max. of 124°F (90.5°F and 92.6% RH)
	Duration Criteria *(96 hours)*	Less Than Required	Met	Met	Less Than Required
	Comments	O2 flow ran out prior to 96 hrs.			O2 quit, Failed scrubber containers and loose soda lime forced early termination.
	Early Termination Time (hours)	NA	NA	NA	56 (See Comment M6)
	Reason for Early Termination				CO2 levels to 2.0%, No O2

Comments from Spreadsheet

ChemBio/AL Lee Comments

C1 Tent began collapsing at 7 hrs due to cut in main air tube. No instructions on how to reinflate. Curtains were knocked over, absorbed water and reduced their scrubbing efficiency.
C2 CO2 concentration at 96 hours was 1.20%.
C3 Tent collapsing began again at 80 hrs and was nearly completely collapsed by 96 hrs.
C4 O2 flow rate between 10 and 18.5 l/min. For 20 man chamber, flow rate should have been app. 12.4 l/min.

Strata Products Comments

S1 CO2 above 0.5% for first 16 hrs because CO2 flow rate into chamber was 28% greater than needed for 36 man chamber (App. 23.4 l/min vs. 18.3 l/min). Once correct CO2 flow rate attained, CO2 conc. remained below 0.5%.
S2 Scrubber fan motor seized and was changed out 73.5 hrs. into test (extra motor and complete instructions were included).

Kennedy Comments

K1 CO2 ranged from 0.24 to 0.72%. Pattern was the CO2 level went above 0.5% just prior to curtain change. After new curtains were hung, CO2 level dropped below 0.5%, then slowly climbed above 0.5% until next curtain change.
K2 For the first 3 curtain change outs (12, 24 and 36 hrs) the CO2 level dropped below 0.5% for between 7 and 9 hours afterward then went above 0.5%.
K3 For remaining curtain change outs (48, 60, 72 and 84) CO2 was below 0.5% for 4 hrs or less before climbing above 0.5%.
K4 The valve on one O2 bottle was never opened, thus more than enough O2 was available for 12 man capacity.

Modern Mine Safety Comments

M1 Maximum CO2 recorded reading occurred during first soda lime change out (1.94% was observed but not recorded).
M2 CO2 levels went above 0.5% after initial 4 hours of evaluation, reaching 0.61 just prior to first change out.
M3 After first change out CO2 levels dropped to 0.25 within 30 minutes.
M4 CO2 levels remained below 0.5% for nearly 32 hours without a second change out of scrubbing material.
M5 O2 flow rate fluctuated between 10.5 and 12.5 l/min, only 4 of 11 O2 cylinders were empty.
M6 Battery powered blower ran the full 96 hrs.