APPENDIX 2

CALCULATED PRESSURES p.s.i.g.

COMMERCIAL PROPANE, COMMERCIAL BUTANE AND MIXTURES

°C	°F	Propane	Butane	10 / 90	20 / 80	30 / 70	40 / 60	
-30	-22	24.25	14.7	15.87	17.05	18.08	19.11	
-25	-13	30.13	14.7	16.61	18.52	20.28	21.90	
-20	-4	35.28	14.7	17.34	19.69	22.05	24.25	
-15	5	42.63	14.7	18.22	21.60	24.69	27.78	
-10	14	51.45	14.7	19.25	23.81	27.93	31.89	
-5	23	59.53	14.7	20.43	25.72	30.87	35.72	
0	32	71.29	14.7	21.90	28.66	34.98	41.16	
5	41	80.85	17.64	25.72	33.22	40.42	47.04	
10	50	94.08	20.58	29.40	38.66	47.04	54.97	
15	59	107.31	24.25	33.81	44.83	53.94	62.91	
20	68	120.54	27.93	39.69	50.86	61.74	70.56	
25	77	139.65	33.81	47.04	59.97	72.03	83.79	
30	86	160.23	39.69	55.12	69.53	83.79	97.02	
35	95	183.75	48.51	65.70	82.02	98.49	111.72	
40	104	205.80	58.80	77.16	95.10	111.72	127.89	
45	113	235.20	67.62	88.20	109.07	129.36	147.00	
50	122	260.19	79.38	102.90	124.21	145.53	164.64	*
55	131	294.00	91.14	117.60	141.41	164.64	186.69	**
60	140	327.81	107.31	135.24	161.70	196.98	219.03	

* Pressures (to nearest whole number) to be used for marking
** Pressures on which Test Pressures are based.

Test Pressures	Propane	Butane	10/90	20/80	30/70	40/60
p.s.i.g.	559	185	223	269	313	355

In all "mixes" the larger proportion is Butane

Burst Test = 1.9 x gauge pressure of contents at 55°C
(BS. 5329-1988) or 12.7 Bar (185 p.s.i.g.) whichever is greater.

Tables by courtesy of Shell U.K. and EPI Gas Ltd.

SUPPLEMENT
to
THE EXAMINATION & TESTING OF MINIATURE STEAM BOILERS
(Revised Edition 2012)

for use by member societies
of the
Northern Association of Model Engineers
and
Southern Federation of Model Engineering Societies.
including
SAFETY OF LPG TANKS

Issue 1August 2013

FOREWORD

'The Examination & Testing of Miniature Steam Boilers, i.e. the current 'Green Book' and all previous issues, does not cover all the sections in the previous booklet 'Guidelines for Boiler Safety Testing and Construction (including L.P.G. Tanks)' issue 5 dated April 2001 by the Northern Association of Model Engineers. This supplement aims to address the missing items which apply to members of the relevant Organisations.

Appendix 1.

Calculating the product bar litres for a boiler.

It is difficult to measure the volume of a boiler with any accuracy therefore quoting the bar litres to an accuracy of fractions of a whole unit cannot be justified. The Table below is provided to assist boiler testers when testing a boiler for the first time

	Pressure in psi.													
Volume in litres	30	40	50	60	70	75	80	85	90	100	110	120	150	175
1.5	3	4	5	6	7	7	8	8	9	10	11	12	15	17
2	4	5	6	8	9	10	10	11	12	13	14	16	20	23
2.5	5	6	8	10	11	12	13	14	15	17	18	20	25	29
3	6	8	10	12	14	15	16	17	18	20	22	24	30	35
3.5	7	9	11	14	16	17	19	20	21	23	26	28	35	41
4	8	10	13	16	19	20	21	23	24	27	29	32	40	47
4.5	9	12	15	18	21	22	24	26	27	30	33	36	45	53
5	10	13	17	20	23	25	27	28	30	34	37	40	51	59
6	12	16	20	24	28	30	32	34	36	40	44	48	61	71
7	14	19	23	28	33	35	38	40	42	47	52	57	71	83
8	16	21	27	32	38	40	43	46	48	54	59	65	81	95
9	18	24	30	36	42	45	48	52	55	61	67	73	91	107
10	20	27	34	40	47	51	54	57	61	68	74	81	102	119
12	24	32	40	48	57	61	65	69	73	81	89	97	122	142
14	28	38	47	57	66	71	76	80	85	95	104	114	142	166
16	32	43	54	65	76	81	87	92	97	108	119	130	163	190
18	36	48	61	73	85	91	97	104	110	122	134	146	183	214
20	40	54	68	81	95	102	108	115	122	136	149	163	204	238
25	51	68	85	102	119	127	136	144	153	170	187	204	255	297
30	61	81	102	122	142	153	163	173	183	204	224	244	306	357
35	71	95	119	142	166	178	190	202	214	238	261	285	357	416
40	81	108	136	163	190	204	217	231	244	272	299	326	408	476
45	91	122	153	183	214	229	244	260	275	306	336	367	459	535
50	102	136	170	204	238	255	272	289	306	340	374	408	510	595
60	122	163	204	244	285	306	326	346	367	408	448	489	612	714
70	142	190	238	285	333	357	380	404	428	476	523	571	714	833
80	163	217	272	326	380	408	435	462	489	544	598	653	816	952
90	183	244	306	367	428	459	489	520	551	612	673	734	918	1071
100	204	272	340	408	476	510	544	578	612	680	748	816	1020	1190

9. MARKING PROCEDURE

9.1. The inspector is under no obligation to test any tank or to undertake the marking of any tank. If marking is done by some person other than the inspector, it should preferably be done in his presence and if that is not possible it should be submitted to him for scrutiny as soon as possible. The position of the marking will need to be so selected that no danger of damage to the tank arises and similarly the form of marking will need to have regard to the space available at an approved surface.

9.2. The form of marking of a Gas Tank is the same as that introduced for marking boilers as agreed by the relevant Organisations at the time of issue of the Examination and Testing of Miniature Steam Boilers 2008 edition (Blue Book).

For the Southern Federation this is:-
The letters 'SF' followed by the Society's reference number in the Federation's records followed by the number of the first test certificate. e.g. SF123-100123.
Southern Federation Clubs and Societies should use the amended Small Boiler Test certificates for the Safeguard Test record purposes of LPG tanks. For privately constructed gas tanks the Initial hydraulic pressure test should be recorded on the Test Certificate provided by the Federation.

For the Northern Association this is:-
N12-145-ab123 where 12 is the NAME club number, 145 is the calculated pressure of the commercial propane-commercial butane mixture (obtained from the Table given in Appendix 2) and finally ab123 which is the identity unique within the issuing society. NAME societies must use the existing RED certificates and cards when testing LPG tanks.

7. TANK IDENTIFICATION

7.1. The Society issuing test certificates shall keep records by duplication of the certificates and also a register, which may be the Society's boiler register.

7.2. It is the owner's responsibility to ensure that the gas tank is indelibly marked with a unique identification number in a suitable place so located as to be readily visible when the gas tank is installed. The form and position of the marking shall not damage or compromise the structure of the gas tank. Once allocated and indelibly marked on the gas tank the identification number shall not be added to or amended and all certification shall use that number. Identification numbers for non-commercially built gas tanks are allocated by the builder. However, before allocating a permanent number it is recommended that the builder contacts his/her Federation or Association as they may have a preferred method of numbering. Refer also to paragraph 9.

8. TEST CERTIFICATES

8.1. A form of test certificate common to all societies is to be used on all occasions. Each certificate shall bear the following information:

- Name of Issuing Society
- Date of EXPIRY (which will be two years from the date of test and issue)
- To whom issued
- A statement that the certificate is personal to the owner of the tank and becomes invalid if the tank changes hands
- The tank identification particulars marked upon it
- Nature of the contents and the pressure at 50℃ as per the Appendix
- Test pressure on the test just completed
- Tank construction, material, type of solder etc
- Signature of the inspector who shall not be the owner or maker of the tank
- Signature of the Witness who may be the owner
- Notes and comments, where applicable, e.g., unusual construction, repaired damage etc

8.2. Note – construction should be straightforward, see Paragraph 2, above.

CODE OF PRACTICE TO ENSURE THE SAFETY OF LIQUID PETROLEUM GAS (L.P.G.) TANKS

1. SCOPE and INTENT

1.1. The provisions of this Code apply only to tanks made of copper or brass and NOT to steel tanks. The code applies to all forms of propulsion/motive power where heating by LPG, composed of commercial Butane and/or commercial Propane, is involved.

1.2. Testing and certification of refillable tanks made to contain LPG are necessary safeguards and Societies within the Organisations must ensure that the provisions of the Code are applied to the gas tanks of their members and of any others used at the Society's functions. A common test procedure is desirable in order to prove to the satisfaction of the Insurers that all reasonable precautions have been taken in event of any mishap.

THIS CODE DOES NOT PROHIBIT THE PROPER USE OF ANY COMMERCIAL NON-REFILLABLE CANISTER OF GAS.

2. CONSTRUCTION

2.1. LPG Tanks shall be designed and constructed such that they are fit for purpose with regard to the selection of material, selection of jointing materials and applicable pressure.

2.2. The internal volume shall not exceed 250 cubic centimetres. All joints and bushes shall be silver soldered.

3. TEST PROCEDURE

3.1. The owner shall complete and sign a statement on the Test Certificate setting out the gas or mixture of gases that the tank is intended to hold. If it is proposed to use a non-commercial mixture then the tank shall be subject to the test pressure appropriate to Propane.

3.2. The Initial test shall be hydraulic followed by a Safeguard test. See paragraph 4. The object of the hydraulic test is to verify that the integral structure of the tank is completely leak proof at the specified Test Pressure. **ANY LEAK SHALL BE REGARDED AS A FAILURE.**

3.3. The Tank should be without fittings for the Initial test and un-mounted, in order that it may be inspected all round. Any subsequent hydraulic test may also include the fittings.

3.4. THE SPECIFIED TEST PRESSURE**.** The Appendix 1, which forms part of this Code, sets out the pressure developed at various temperatures by Commercial Butane, Commercial Propane and mixtures thereof. The specified Test Pressure for the proposed contents of the tank shall be 1.9 times the pressure at 55℃, as quoted in the Appendix 1 for such contents, or 185 p.s.i.g., whichever is the greater.

3.5. At all tests the procedure shall consist of raising the hydraulic pressure from zero to the test pressure three times. The test pressure shall be held long enough to investigate any distortion of the vessel and to confirm that any fall in pressure is not caused by structural weakness, and that there are no leaks whatsoever.

3.6. The Owner's attention shall be drawn to his/her responsibility to ensure that the percentage Propane content quoted on the certificate is never exceeded. Also note that a Tank containing gas must not itself be warmed nor exposed to a temperature exceeding 50℃.

4. SAFEGUARD TEST

4.1. A Safeguard Test shall be carried out with all the fittings in place. If the Tank is remote from the boiler, the Tank shall be partially filled with the gas or gas mixture, as stated by the owner, and immersed in warm water (35℃ approx but not exceeding 45℃.) and check for any leaks from the fittings as indicated by a stream of bubbles.

4.2. If the Tank is fitted close to the boiler, a leak test shall be carried out on the tank fittings whilst the boiler is in service and at operating temperature using soapy water.

4.3. **Any leak shall be regarded as a failure.** After remedial action has been taken the Tank and fittings must be resubmitted for a further safeguard test.

4.4. The Safeguard Test shall be carried out annually.

4.5. The Tank may be marked and a certificate issued when both hydraulic and Safeguard tests have been passed.

5. INSPECTOR

5.1. Tests must be carried out and any certificates issued only by an inspector who will be a responsible person elected or appointed by the member Society, or that officer in another member Society able to offer facilities for testing.

5.2. Such arrangements shall be made between the Societies on behalf of the member(s) concerned and not directly between the member and the inspector.

6. TEST EQUIPMENT

6.1. The inspector must use a test gauge, which has, within the previous two years, been checked and calibrated either against a dead weight test apparatus or against other traceable equipment. The calibration record shall be available for examination.