Use of Metal in High Power Rocket Construction

Some of you have been wanting an official statement on this subject. Here it is, and you can copy this and paste it into your Handbook until it is changed by the Board of Directors:

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Tripoli allows certified members, as well as certified NAR members, to attend our launches and safely launch rockets that are "made of paper, wood, fiberglass, or plastic." Their rockets may also be made of a "minimum amount of metallic parts" in whatsoever percentages "necessary for airframe integrity dependent upon the installed total impulse, and whose primary use is for purposes of education, recreation, and sporting activities." Whatever material is used in the rocket's construction, the rocket and materials must conform "to the other requirements" of the Safety Code. Undergirding and overarching all of this, "a high power rocket shall be constructed in such a manner and with suitable materials to withstand the operating stresses and retain structural integrity under conditions expected or known to be encountered in flight." For the purposes of this policy, the flight includes placement on the launch pad, the launch sequence, flight to apogee, descent, and landing. The practice of constructing a rocket to withstand "operating stresses and retain structural integrity" while anticipating possible unknown conditions is not discouraged.

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DISCUSSION:

There are two parts of NFPA 1127 (HPR Safey Code) that mentions metal in rockets; 1-3 Definitions, High Power Rocket, (e), and 2-6 Rocket Airframe Materials.

The typical mistake made by most people is to "narrowly interpret" the Safety Code, focusing on a small part rather than the whole. For example, take both sections as quoted above (from the 1995 edition):

1-3 Definitions, High Power Rocket, (e) -- (High Power Rocket) That is made of paper, wood, fiberglass, or plastic with a minimum amount of metallic parts (Note: most people arguing for the non-use of metal in rocket construction stop right here.) necessary for airframe integrity dependent upon the installed total impulse, and whose primary use is for purposes of education, recreation, and sporting activities.

and

2-6 Rocket Airframe Materials -- A high power rocket vehicle intended to be propelled by one or more high power rocket motors shall be constructed using lightweight materials such as paper, wood, rubber, plastic, fiberglass, or, when necessary, ductile metal so that the rocket conforms to the other requirements of this code.

Now for the example of how people typically focus on a small part rather than the whole code when trying to promote a point of view. The very last sentence quoted says that the

rocket must conform "...to the other requirements of this code." Look at the paragraph in the Safety Code immediately above the one just quoted (2-5): "A high power rocket shall be constructed in such a manner and with suitable materials to withstand the operating stresses and retain structural integrity under conditions expected or known to be encountered in flight."

In reality, with the excepted mention of what the metallic material is to be (ductile material), we could end the chapter on rocketry construction with that statement. If we do not construct our rockets "in such a manner and with suitable materials to withstand the operating stresses and retain structural integrity under conditions expected or known to be encounteredin flight" we are, at best, unsafe both to ourselves and to others.

Here are most of the elements of everything referenced or quoted so far, including some obvious conclusions:

-- HP rockets made of many materials, including metal.

-- When made of metal, if complying with the Safety Code, HP rockets are made of ductile metal.

-- When made of ductile metal, HP rockets are made with a minimum amount of metallic parts.

-- When made of ductile metal, the HP rocket must have a minimum amount of metallic parts for the purpose of sustaining airframe integrity. Minimal may include whatsoever percentage of ductile metal NECESSARY TO ACCOMPLISH THAT REQUIREMENT.

-- The HP rocket using ductile metal to sustain airframe integrity must do so to withstand conditions expected or known to be encountered in flight. This will require a sufficient amount of ductile metal to accomplish that requirement.

-- The duration of the flight is from start to finish, which includes recovery. (Not quoted above, but a part of the safety Code. This means that the rocket must contain whatever materials are required, along with the recovery system, to withstand "the operating stresses and retain structural integrity under conditions expected or known to be encountered..." during recovery as well.)

-- Factors to consider when using ductile metal in HP rocket construction, and what amount of ductile metal to use for "airframe integrity" are (a) installed total impulse, (b) rocket to conform to the other requirements of this code, (c) rocket to withstand the operating stresses, and (d) rocket to retain structural integrity under conditions "expected" or "known" to be encountered in flight."

-- Since the rocket is to be recovered and reused as stated in this Safety Code, the rocketeer may determine that a particular rocket will be flown more than once, i.e. several times. A particular rocket may fly well one time using materials other than ductile metal, but continued use and the resultant stresses after the first flight may prove to render a non-metallic rocket unsafe. Such circumstances may include, but not be limited to, continual flights using M motors. Therefore, a particular rocket, in order to conform "to the other requirements of this code," shall be so constructed using any materials specified as being approved for use in a HP rocket, and in what ever amounts are required for compliance.

Keep in mind that this interpretation takes into account the "installed total impulse (continual use of M motors), and whose primary use is for purposes of education, recreation, and sporting activities."

-- Finally, note the use of the words "when necessary" [2-6]. This is subjective and really up to the interpretation of (a) the person building the rocket, weighing all the factors of the entire Safety Code, and (b) the RSO who will ultimately make the decision whether or not to allow the flight.