Mathematics on the Moon - The "Apollo" Pickett

Michael Freudiger, Shannon Freudiger,
Patrick Hawthorne and Dr. Robert Koppany

Figure 1. Apollo 11, Astronaut "Buzz" Aldrin.

Introduction

Many of us remember when mankind first landed on the moon. We know the joy of the technology that allowed us to visit our nearest neighbor in space a quarter of a million miles away. See Figure 1. When we think about slide rules and their long and important history, we can consider one of their achievement peaks was being used on the Apollo Space Mission, and being flown to the moon on five Apollo flights. At least one slide rule, and possibly two (one in the command module, one in the lunar module) were on each of the first five Apollo spacecraft. Both of them were Pickett 600 log log models.

It took a lot of fuel to get anything to the moon. The Saturn 5 launch vehicle first stage used 3,307,855 pounds (346,372 gallons) of liquid oxygen, 1,426,069 pounds (212,846 gallons) of kerosene to develop 7,653,854 pounds of thrust at liftoff. The second stage used 821,022 pounds (85,973 gallons) of liquid oxygen, 158,211 pounds (282,555 gallons) of liquid hydrogen to develop 1,157,707 pounds of thrust. The third stage used 193,023 pounds (20,107) gallons of liquid oxygen, 43,500 pounds (77,680) gallons of liquid hydrogen to develop 203,779 pounds of thrust [1]. The weights of the astronauts for Apollo 11 were 165 pounds for Neil Armstrong [2], 165 pounds for Michael Collins [3], and 165 pounds for Edwin Aldrin [4]. The three astronauts were typically less than 500 pounds of weight. The weight of the spacecraft was 6,484,200 pounds. [5]

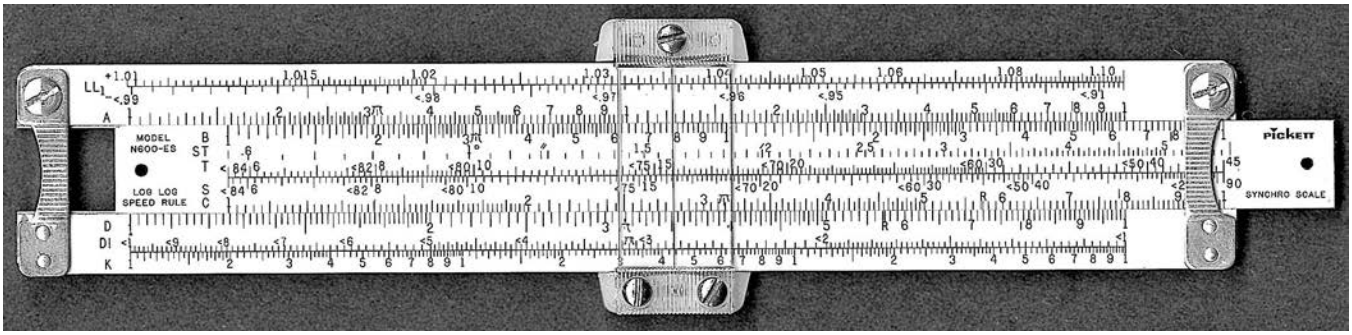

Figure 2. The Pickett 600-ES slide rule.

This means that approximately 13,000 pounds of fuel ultimately was used for every pound of astronaut sent to the moon. The Pickett 600-ES log log slide rule weighs approximately 1-1/4 ounces (35.4g). It is 15.4 cm long by 39 mm wide. This means that approximately 2,343 pounds of spacecraft fuel was occupied getting one slide rule to the moon. If two of them went to space, it would have taken approximately 4,687 pounds of fuel allocated to assure the slide rules got to the moon.

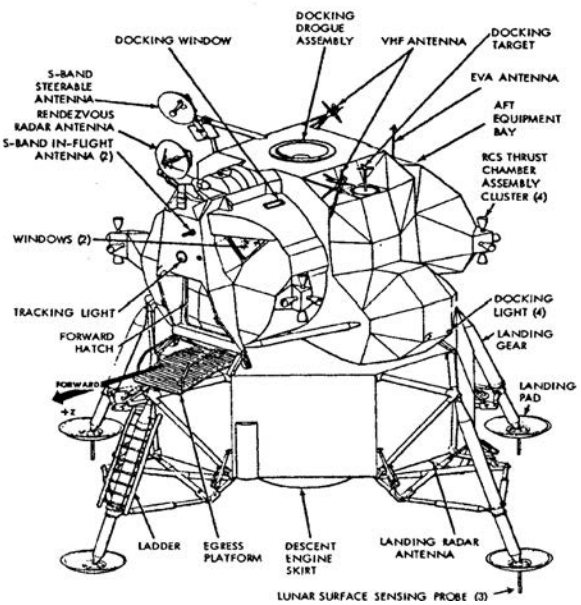

Figure 3. The Apollo lunar module. One slide rule might have been in this unit.

Purpose of the Slide Rules

Why would a slide rule need to be taken aboard the spacecraft to be at hand in the command module or in the lunar module? Well, If there were a problem with the guidance, navigation and control systems, that might indicate mathematics and the use of a slide rule to solve the problem of measuring and controlling the spacecraft position, attitude, trajectory, control of the propulsion system. If there were a problem with the stabilization and control system, which controlled the spacecraft rotation, translation and thrust maneuvers, a slide rule may have been needed if problems arose in the system. If there were a problem with the propulsion system and obtaining the 50-50 mixture of unsymmetrical dimethyl hydrazine and hydrazine fuel, a slide rule might also have been needed for calculations. [6]

Which Model Went to the Moon?

Then, we have to ask, which 600 model went to the moon? There were four Pickett models on the market at this time: the 600-ES, 600M-ES, 600-T, and 600M-T. These slide rules were metal, but there were no serial numbers or markings on each rule. Although the slide rules themselves were not magnetic, the screws for the cursors would respond to a magnetic field. Plus there were advantages to using each one. The 600- ES uses a yellow eye-saver tint which would cut down on glare. The 600M-ES had a magnifier which might help get another significant digit for measurements, but would be heavier than the basic unit. The 600-T would be of use when optimal contrast was the important factor, and the 600M-T would be of help when both contrast and magnification was important.

Figure 4. The outside front of the Pickett "Apollo" box.

As the Pickett Corporation is no longer in business, the only clue to which model was used was provided by a unique box the 600 rules were packaged in, called by many the "Apollo" box. These boxes were special. The outside front of the box had the Apollo lunar lander in a gold and black silkscreened design with the words "600 log/log - The rule carried aboard five apollo missions". See Figure 4. This means that possibly ten 600 slide rules went to the moon. The inner cover of the box was similarly designed with a different rendering of the lunar lander and the added information, "all metal construc-

tion, 22 scales, with leather clip-case and comprehensive manual". See Figure 5.

Figure 5. Inside cover to Pickett "Apollo" box.

It seems highly unlikely that the slide rules were kept in a clip case, but were possibly attached in a different manner for fast access and so that they would not be dislodged by harsh accelerations and zero gravity conditions. [7] Figure 6, below, shows the "normal" case included with the box.

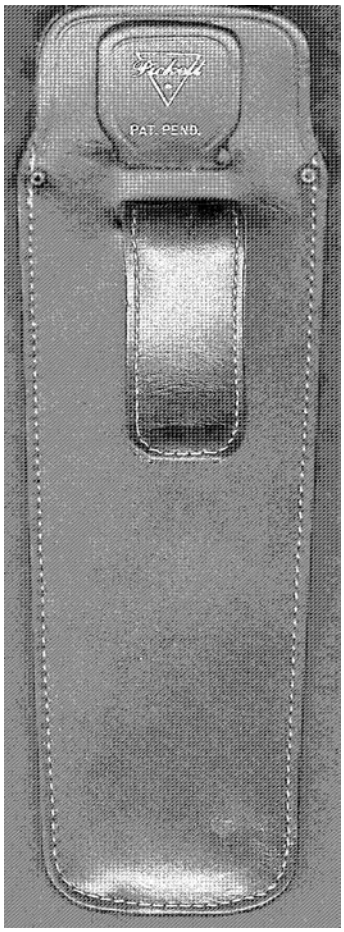

Figure 6. The 600-ES case.

It is only when we look on the side of the Pickett Apollo box where we see which of the 600 models ended up traveling to the moon and back. There were labels glued to the box for every model except the 600-ES. When we look at the 600-T label, below the description of the item within, we see a section discussing "about this rule". We see that it describes the 19 scales and 30-inch log/log range and trigonometry scales located on the slider. See Figure 7. The 600M-T has a line below the item that it is "with magnifier". The line announcing "About this rule" has been removed. The text is the same as that for the 600-T. See Figure 8. The 600M-ES has exactly the same lettering as that of the 600M-T. See Figure 9. However, the 600-ES identifier states, "This rule carried aboard 5 Apollo missions. 22 color-coded scales with 30- inch log log range. All trig scales on slide." See Figure 10. It seems obvious that although the Pickett 600 line of slide rules was involved with the NASA Apollo program, the only slide rule that went to the moon was the 600-ES. The company was very concerned about being exact in their representation of the NASA endorsement.

Figures 7, 8, 9, and 10, starting from the top.

It is also obvious that the Pickett Corporation was very proud about their involvement in the space program. In investigating twelve "Apollo" Pickett boxes we find that the warranty card can be used to date the items. See Figure 11. Each warranty card was numbered, and it is possible to surmise information from this data. See Table 1. One item that is observed is that there were three Apollo Picketts with the warranty number in the 999,XXX bracket. It is possible that the company made a group of similar rules at a time to avoid retooling, similar to car manufacturers. If they made over 775 in a batch, it would imply that the 999,XXX Picketts were all 600 models. Thus, it is "highly" likely that the one millionth Pickett slide rule was a 600 model, and quite probably a 600-ES model.

Table 1. Pickett Apollo Box Warranty Numbers

Warranty Number	600 Model
986,281	600M-ES
991,648	600M-T
991,936	600M-T
999,100	600M-ES
999,235	600-ES
999,239	600-ES
1,011,019	600M-T
1,041,862	600-T*
1,208,827	600-ES
1,208,846	600-ES
1,289,650	600-T

* Warranty numbers start using green ink. Prior to this, red ink was used.

It can also be observed from the table that the company retained the distinctive Apollo box until their demise. One of the items listed has the warranty card of 1,289,650, over a quarter million slide rules later than the millionth Pickett slide rule made. The company also used a label on other modules of their slide rules, stating the Apollo legacy. See Figure 12.

Figure 12.

In analyzing the Pickett involvement with the space program, it is interesting to note that in this case, the box and warranty cards for the slide rules are as important as the actual slide rule inside. If any of you readers have complete "Apollo" Pickett boxes with warranty cards in them, kindly notify Dr. Robert Koppany of the warranty number and 600 model number of your particular holdings; an update on this article might be possible in the future.

Bibliography

1. Godwin, Robert, *Apollo 11: The NASA Reports. Volume 1,* Ontario, Canada, Apogee Books, 1999, p63.
2. Godwin, Robert, Op cit., p76.
3. Godwin, Robert, Op. cit., p77.
4. Godwin, Robert, Op. cit., p78.
5. Godwin, Robert, Op. cit., p64.
6. Godwin, Robert, Op. cit., p53.
7. Personal correspondence from Mr. Randii Wessen, Jet Propulsion Laboratory, Pasadena, California, February 19, 2001.


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DEALER'S NAME
DEALER'S ADDRESS
DEALER'S CITY ZONE STATE
YOUR NAME
YOUR COMPANY OR SCHOOL
YOUR ADDRESS
YOUR CITY ZONE STATE

Figure 11. The Pickett guarantee.