U. S. ARMY NATICK LABORATORIES

NATICK, MASSACHUSETTS

MATERIAL EXAMINATION REPORT

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TITLE: Fabric Abrasion by a Sand Blast Method

BACKGROUND:

The abrasion resistance of fabrics may be evaluated by several laboratory instruments, but those using a grit or sand abradant, such as the Taber and Smith Sand Abraders, have been the most reliable for predicting field wear from laboratory data. These abraders impart a wear action referred to as "abrasive" which involves a penetration through the fabric by abradant particles and is unaffected by fabric lubricants.

PURPOSE:

This report is concerned with an investigation ~~investigation was conducted~~ to determine the feasibility of adapting a commercial spark plug cleaner for evaluating fabric abrasion characteristics. ( )

EXPERIMENTAL EQUIPMENT

A commercial (Champion) spark plug cleaner was used as the basic sand blast instrument. The spark plug was modified slightly (contact points removed) so that it could be used to hold the fabric securely in the plug adapter directly over the orifice through which the abradant is discharged. A fine sand abradant was substituted for the abradant normally used for cleaning spark plugs. This sand was screened through a no. 60 mesh sieve (250 micron openings). A controlled air supply variable up to about 100 psi was used in this investigation. The air is allowed to enter through the valve assembly and air lines and by a venturi action causes the sand to be drawn up the pick-up tube and discharged through the nozzle jet into the fabric held firmly by the spark plug in the adapter.

The details of the instrument are shown in Figure 1.

The fabrics tested in this study are listed below:

1. Cotton sateen 8.8 oz/yd^2 (VEE 727)
2. Cotton/nylon 8.0 oz/yd^2 (VEE 1266)
3. Experimental Fiber 6 - 8.0 oz/yd^2 (VEE 1011B)
4. Nylon (Filament) 8.3 oz/yd^2 (VEE 830)

These fabrics were tested using air pressures of 12.5, 25, 50, and 100 pounds per square inch.

RESULTS AND DISCUSSIONS:

The results of this investigation shown in Table I and Figure 2, indicate that a low air pressure (12.5 to 25 psi) is required to adequately reveal differences among the fabrics tested. At high air pressure, the abradant is forced against the fabric at excessive speeds which ruptured all of the fabrics tested in a few seconds.

At 12.5 psi air pressure, the ratio of the cotton/nylon fabric abrasion to the all cotton fabric abrasion is about 1.6 to 1 and at 25 psi this ratio becomes 1.7 to 1 whereas on the Smith Sand abrader a ratio between the abrasion cycles of these fabrics is 1.8 to 1. This data indicates that for these fabrics there is a correlation between the spark plug cleaner and the sand abrader. Figure 3 shows the relationship between these two abraders for the cotton, cotton/nylon and fiber 6 fabrics. The curves are practically linear for the cotton and cotton/nylon points but angles sharply with the fiber 6 data. This indicates that the fiber 6 fabric has an increased abrasion resistance on the spark plug cleaner that is disproportional to the abrasion resistance obtained on the sand abrader. However, at an air pressure of 25 psi this relationship is much more linear than at 12.5 psi.

Figure 4 shows the curves of the spark plug tester vs the Taber abrader. The curves are linear between the cotton and cotton/nylon samples but indicates a drop in abrasion cycles to less than that of the nyco sateen on the Taber abrader for the fiber 6 samples. The fiber 6 fabric was a plain weave construction while the cotton and cotton/nylon fabric were sateens and abraded on the filling flush side. This difference plus the fact that the fiber 6 fabric was of a slightly lighter weight could account for the drop in abrasion resistance with the type of action given by the Taber abrader.

Figures 5 and 6 show the relationship between abrasion on the spark plug cleaner and the Stoll and the BFT abraders respectively. The Stoll and BFT are flex type abraders and their relationship to the spark plug tester are similar. The BFT curves are more nearly linear especially at the 25 psi air pressure level than the Stoll curves.

Figure 7 shows the relationship between spark plug abrasion and the wear score results from the combat course at Ft. Lee. Wear scores are assigned according to a reverse number system, i.e., the lower the number, the better the fabric durability. Therefore to make a plot against a direct number system as used on abrasion testers, reciprocals of the wear scores were used. The general shape of these curves are very similar to those in Figures 3, 5, and 6.

A study of these figures show a linear relationship for the cotton and cotton/nylon fabrics, but a more severe action on the fiber 6 fabric with the spark plug tester than on the other laboratory abraders. This condition is more pronounced at the 12.5 psi air pressure than at 25 psi air pressure.

CONCLUSION:

There is a good correlation between the spark plug tester @25 psi and the other laboratory abraders as well as combat course wear for the cotton and cotton/nylon fabrics except for the Taber abrader. Although a 12.5 psi air pressure is best for differentiating among fabric abrasion, an air pressure of 25 psi yields the best results of those tested in relation to the other abrasion testers.

The instrument shows good potential as a laboratory abrader for screening fabrics for more extensive abrasion testing. It is simple to operate and end-points are reached in significantly reduced time periods. For example, it is at least 10 times faster than the Smith and Stoll abraders; 15 times faster than the Taber abrader and 5 times faster than the BFT abrader.

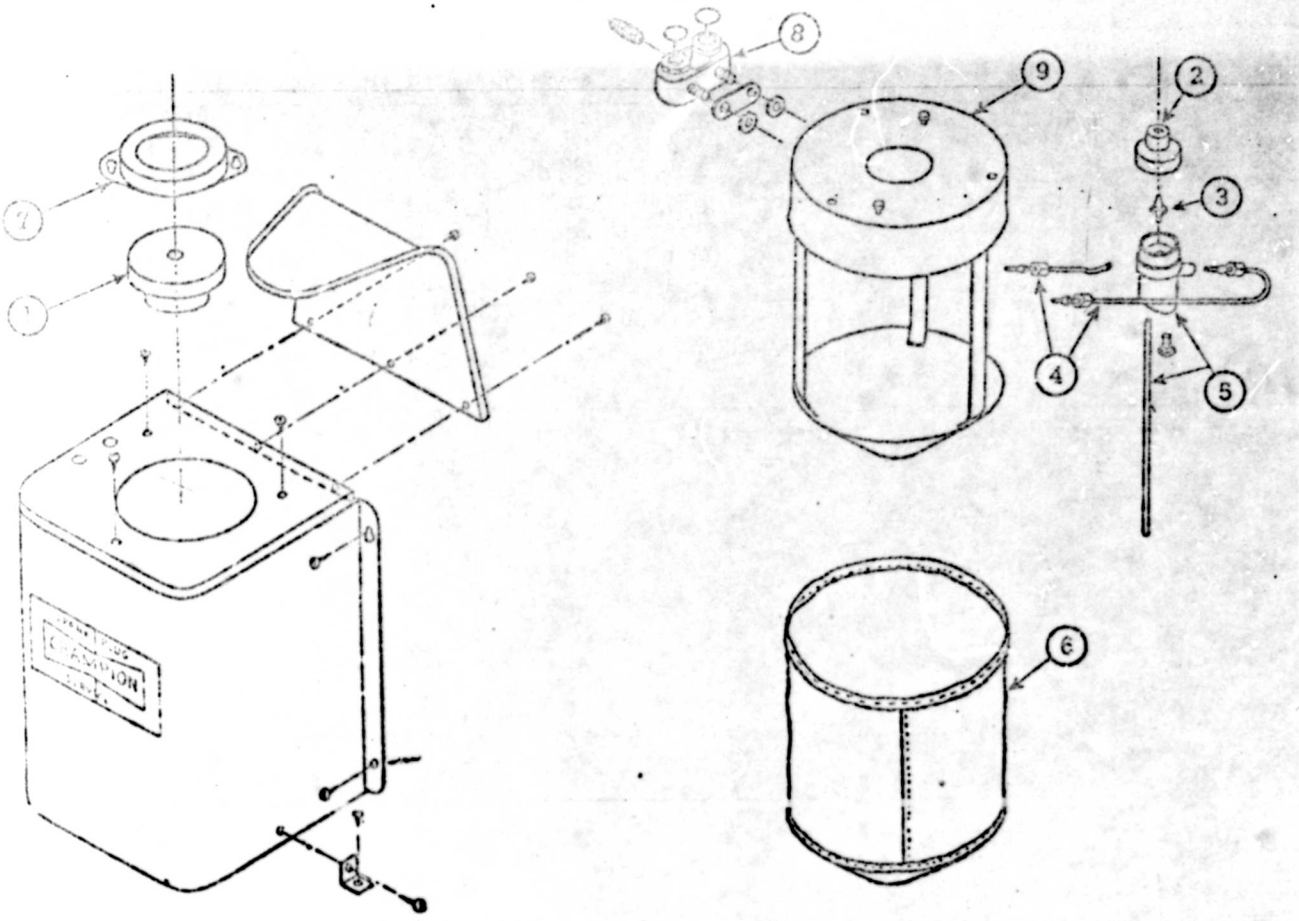
It is planned to conduct a more extensive study of this devise for abrasion testing. Different types of abradants, various distances between fabric and jet nozzle, additional air pressures and modified specimen holders should be investigated to determine the optimum conditions for testing materials for abrasion resistance to an air borne abradant.

Table I

Abrasion Resistance of Military Fabrics
Measured by a Sand Blast Method*

Fabric Code	Fiber Content (%)	Weave	Abrasion Resistance (Seconds to blast hole) 12.5 psi	25 psi	50 psi	100 psi
VEE 727	100 cotton	Sateen	60	19	6	1
VEE 1266	50 nylon 50 cotton	Sateen	98	32	10	2
VEE 1011B	100 Fiber 6	plain	475	100	9	5
VEE 830	100 Nylon	plain	800	505	40	5

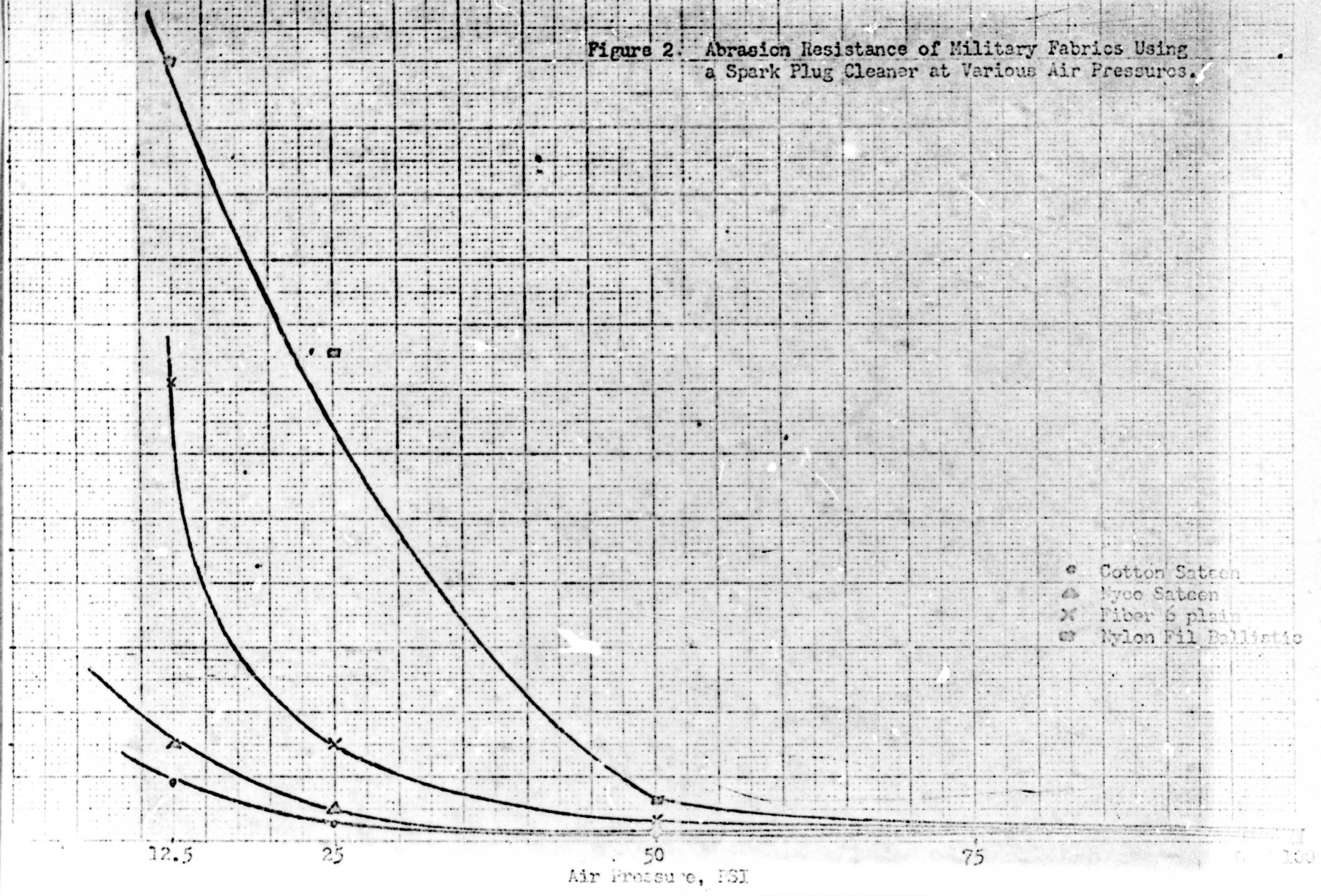
* Spark plug cleaner



DESCRIPTION	
1	RUBBER CLEANER ADAPTER
2	RUBBER NOZZLE TIP
3	STEEL NOZZLE JET
4	AIR LINE ASSEMBLIES (2 PCS.)
5	CLEANER CASTING AND PICKUP TUBE
6	CLEANER BAG
7	ADAPTER HOLD-DOWN CAP
8	CLEANER VALVE ASSEMBLY
9	CLEANER BAG FRAME ASSEMBLY

Figure 1. Details of the Spark Plug Cleaner.

Figure 2: Abrasion Resistance of Military Fabrics Using a Spark Plug Cleaner at Various Air Pressures.



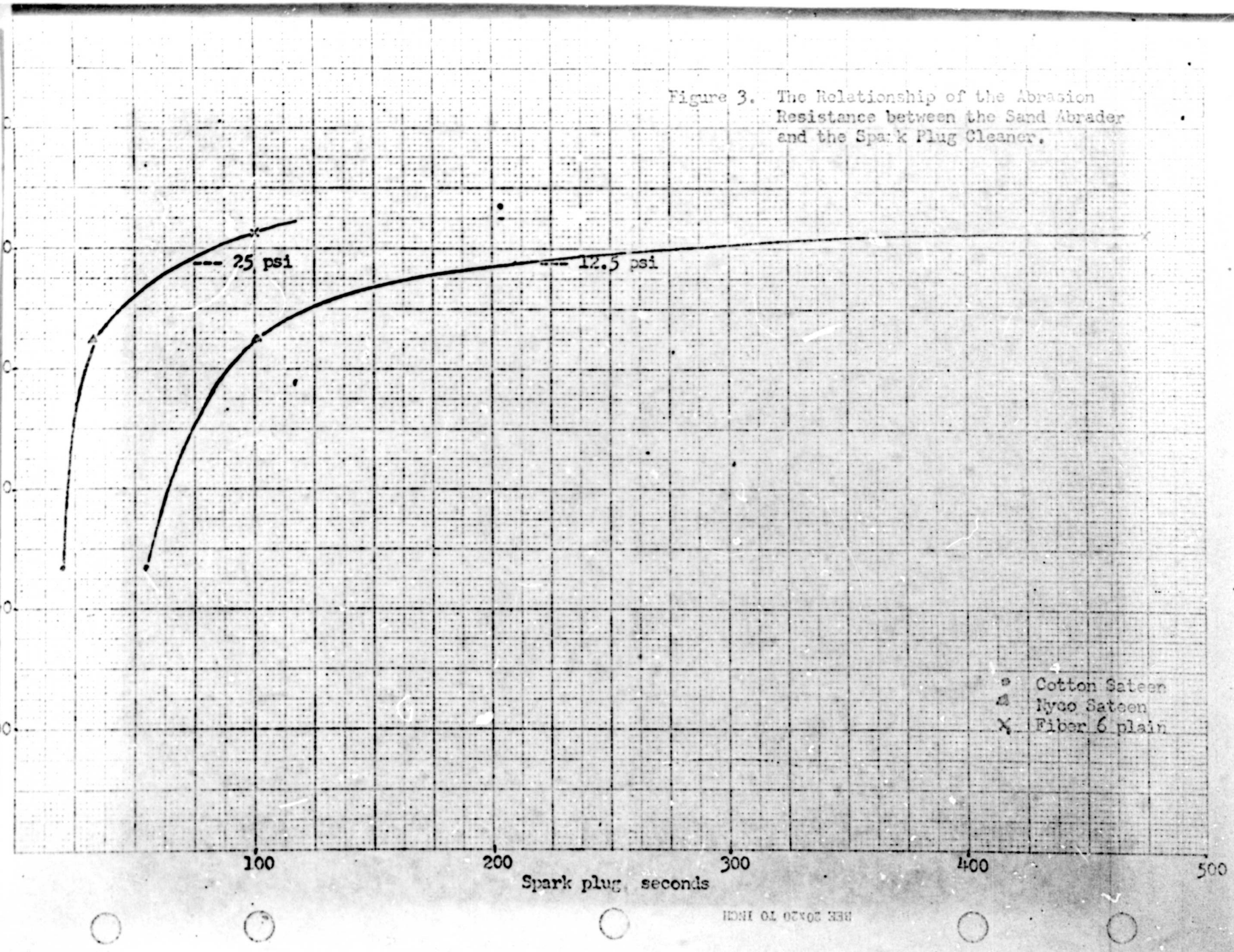


Figure 3. The Relationship of the Abrasion Resistance between the Sand Abrader and the Spark Plug Cleaner.

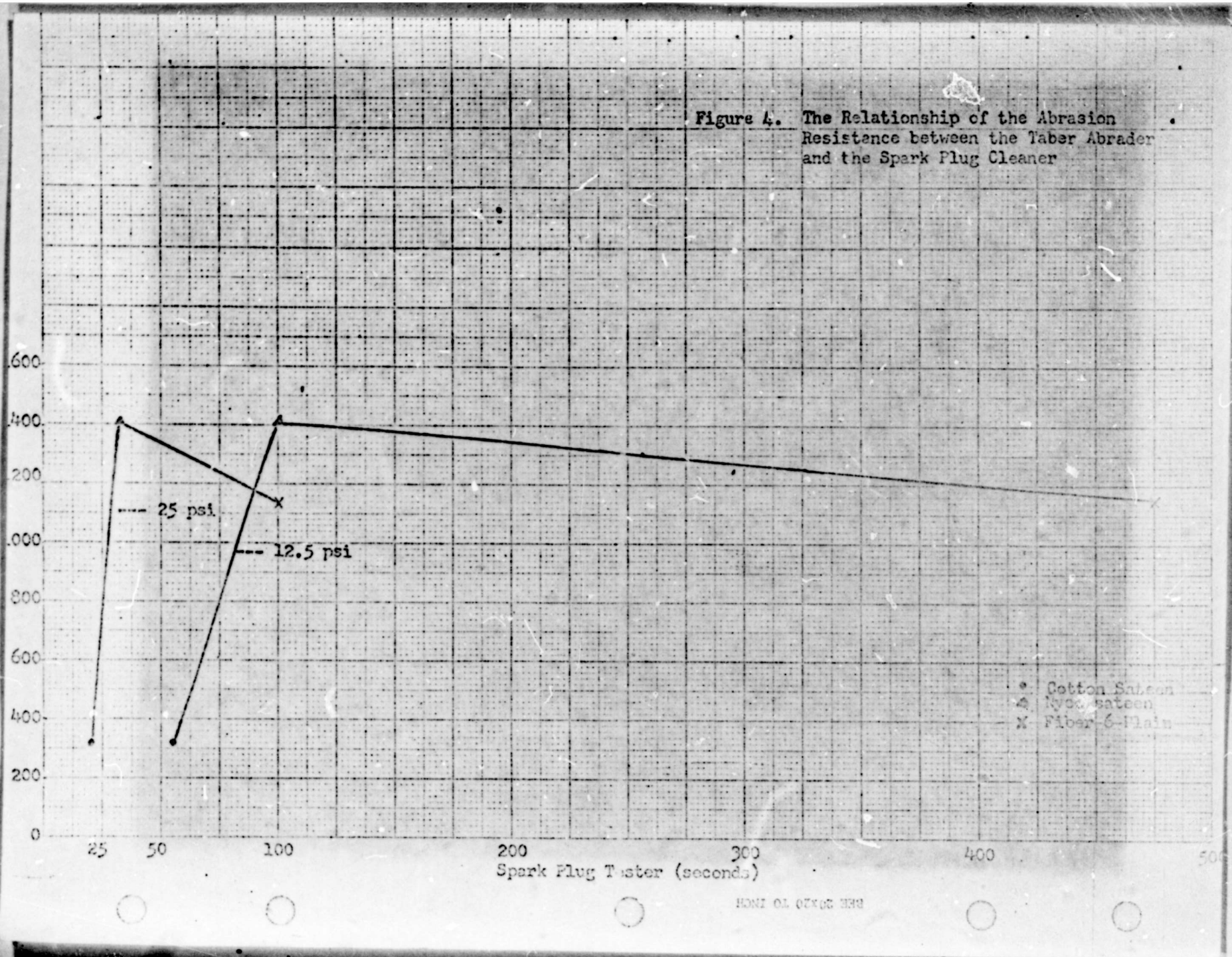


Figure 4. The Relationship of the Abrasion Resistance between the Taber Abrader and the Spark Plug Cleaner

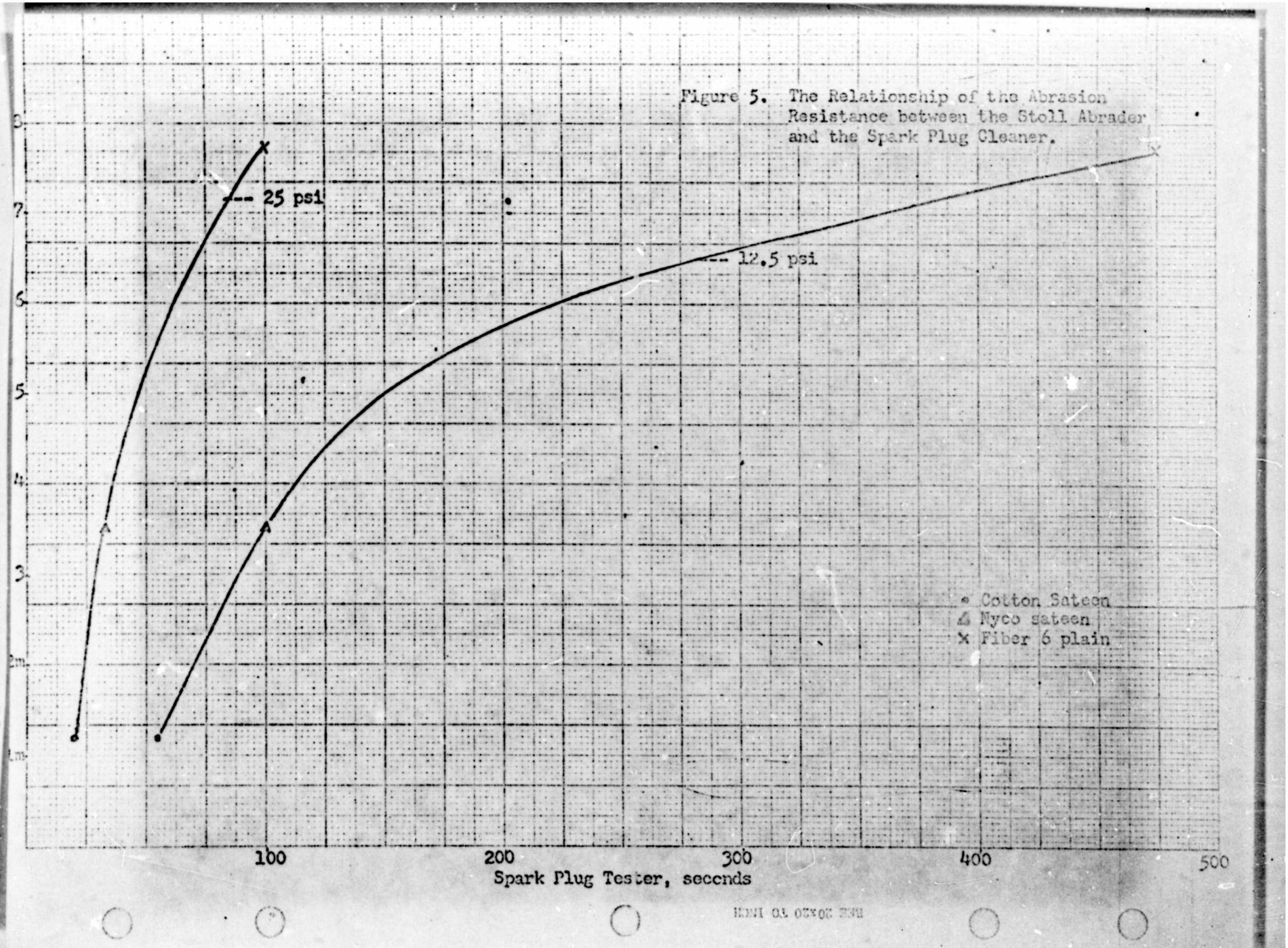
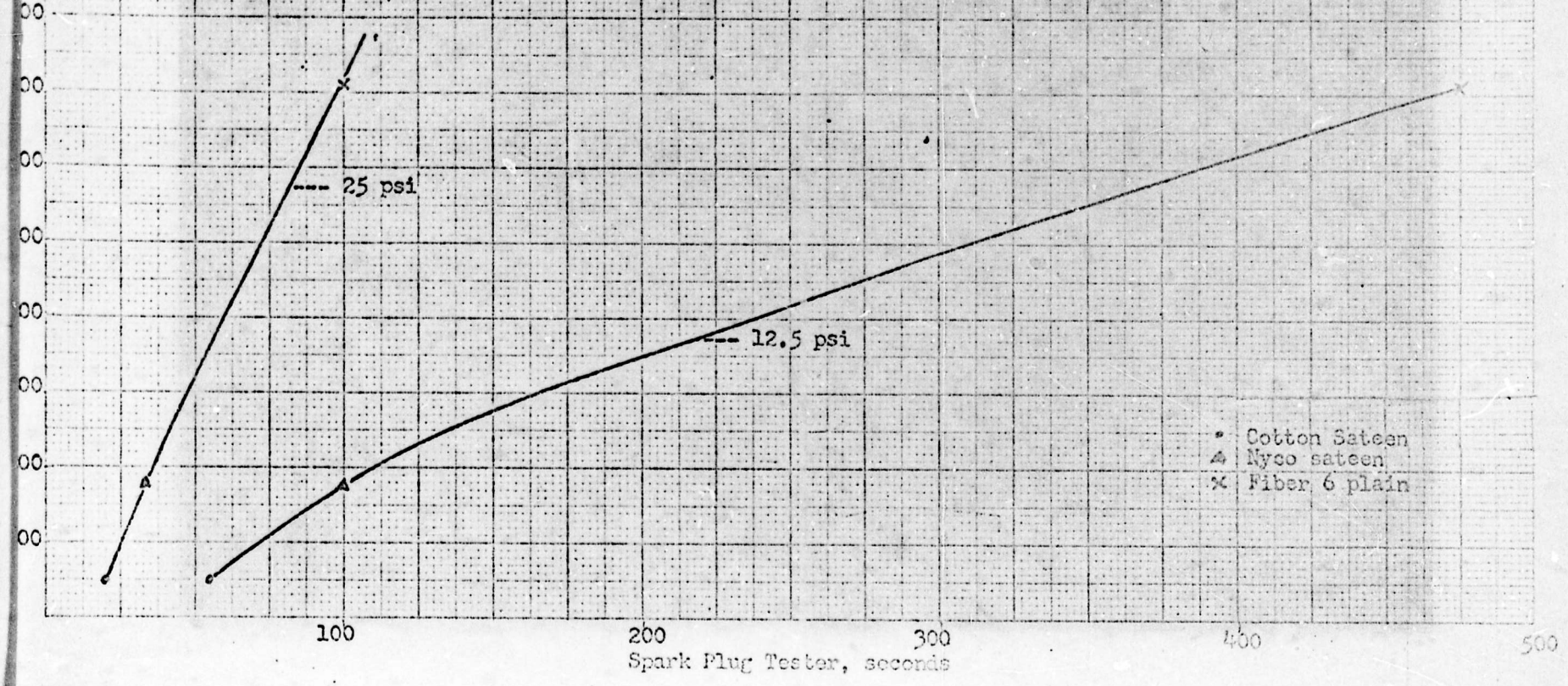


Figure 5. The Relationship of the Abrasion Resistance between the Stoll Abrader and the Spark Plug Cleaner.

Figure 6. The Relationship of the Abrasion Resistance between the BFT Abrader and the Spark Plug Cleaner.



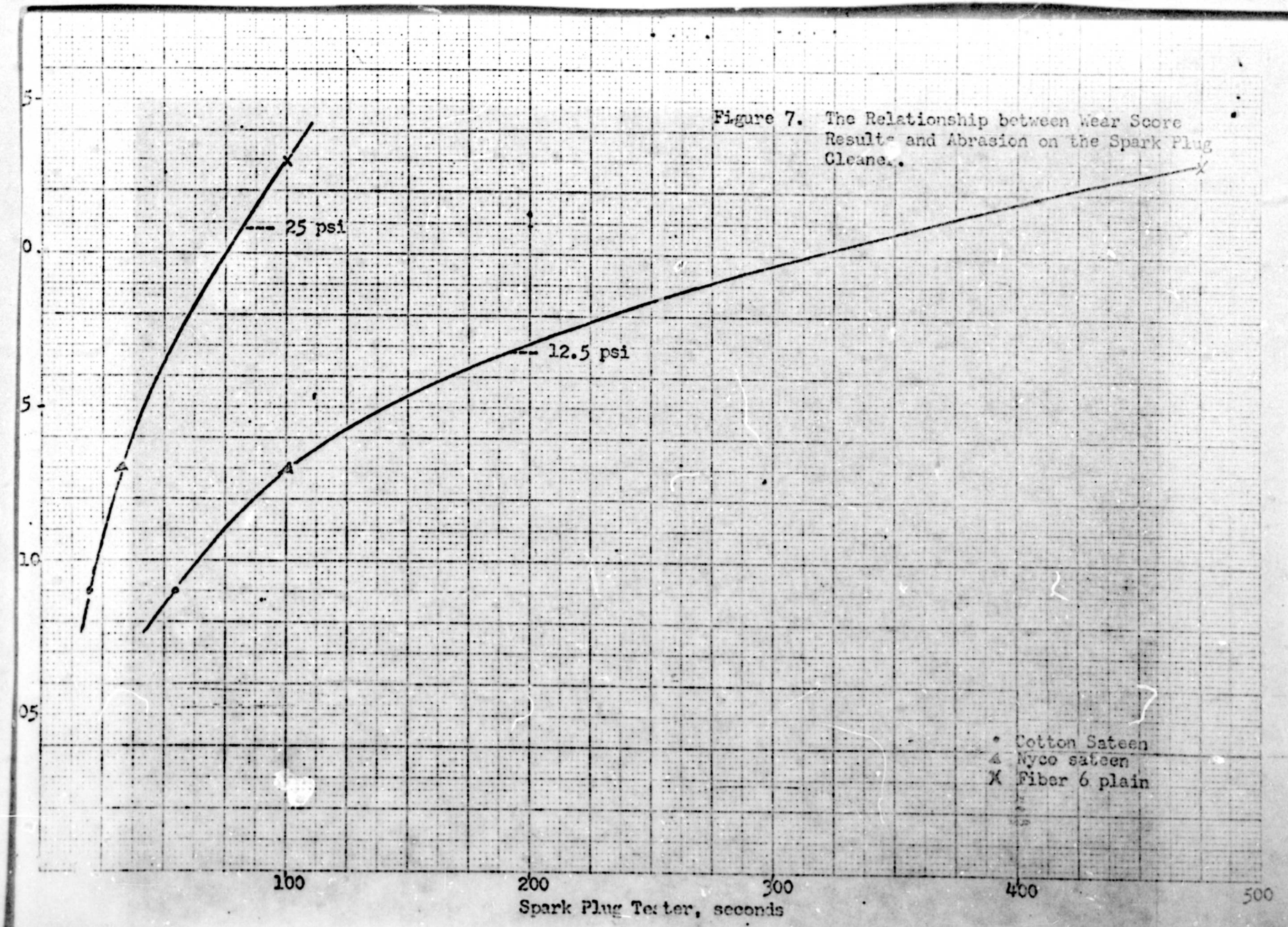


Figure 7. The Relationship between Wear Score Results and Abrasion on the Spark Plug Cleaner.