AOPA AIR SAFETY INSTITUTE

SAFETY HIGHLIGHTS

CESSNA CITATION

Introduction:

Cessna's Citation jet series was initially created as a light jet for the business market. The first aircraft entered service in the early 1970s. Since its inception, the Citation has grown to become the largest business jet fleet, with more than 7,000 produced. With such a large market share and importance to general aviation (GA), the Air Safety Institute (ASI) saw value in undertaking a safety analysis study of the legendary business jet series.

Cessna Citation Mustang (cover)
Cessna Citation CJ2 (this page)

This report also marks a first for the Air Safety Institute. Never has a business jet been selected for analysis and publication in a Safety Highlight. As ASI diversifies its reporting and refreshes the Safety Highlight series we have an opportunity to incorporate new safety analysis methods. With jet operators enjoying lower accident rates, this report presents new areas and findings otherwise not incorporated in previous Safety Highlights. Additionally, where possible, data is presented in a total (frequency) count and a rate (per 100 N registered aircraft).

Cessna **Citation:**

The Cessna Citation aircraft series is both diverse and extensive. The Citation was first flown in the late 1960s and certified in early 1970. Since that time Cessna has created several models and types under the Citation brand. The following are covered in this report:

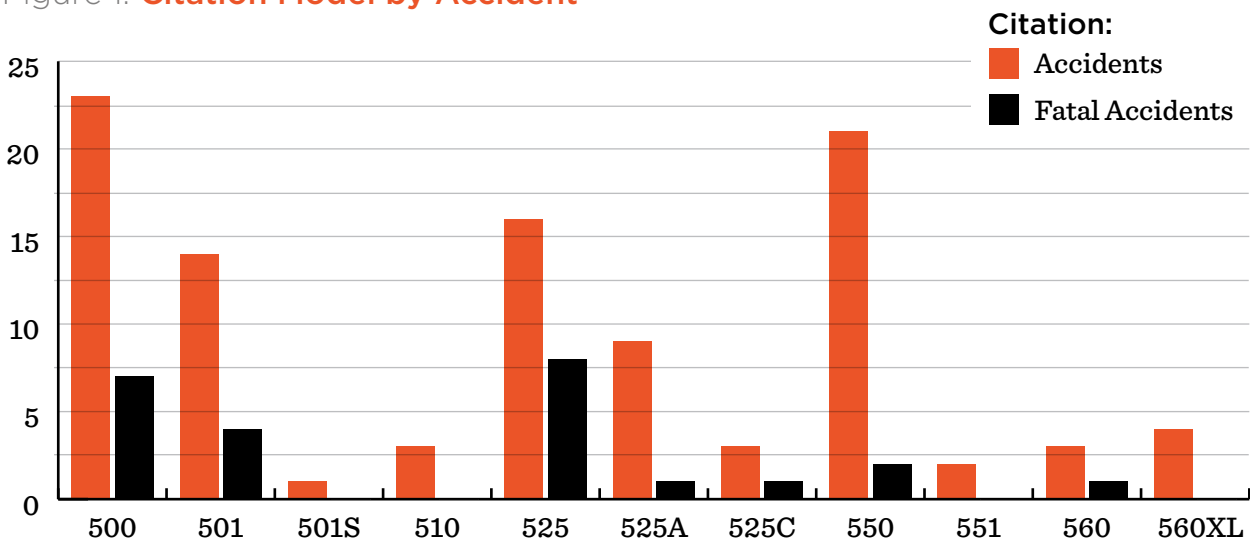
- CJ
- CJ1/CJ1+
- CJ2/CJ2+
- CJ3
- CJ4
- M2
- Mustang
- Citation I
- Citation II/S/SP
- Bravo
- Citation V/Ultra/ Encore/Encore+

At the time of this report there are more than 4,000 N registered aircraft in this group.

The data were collected from the National Transportation Safety Board (NTSB) data base and supplemented with the Air Safety Institute's accident database. The report is limited to N registered aircraft accidents that occurred in the United States. The basis for these criteria was to establish a consistent baseline to measure the results. Accidents for which the probable cause is not published, are classified based on preliminarily findings. When the data analysis occurred, there were 99 accidents and 24 fatal accidents since the inception of the Citation models assessed.

The purpose of this report is to provide a summary of the selected Citation fleet safety performance. A comparison group is provided for context. This report does not provide a detailed analysis of each model in the Citation or comparison fleet.

Figure 1: **Citation Model by Accident**



Comparison **Fleet:**

The selection of a comparison fleet provides some context for analysis. The selection of this fleet was based on feedback from an expert panel consisting of industry experts, pilots, operators, and researchers. The panel selected a diverse set of aircraft that are similar in operation to the Citation fleet selected for this study.

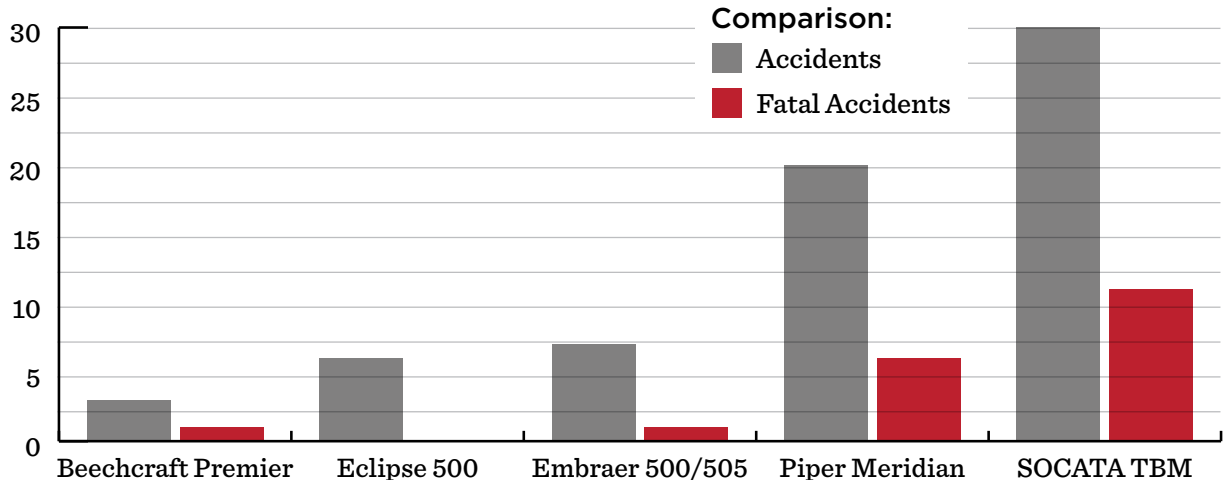
- Beechcraft/Hawker Premier
- Eclipse 500
- Embraer 500/505
- Piper Meridian
- Socata TBM

The comparison fleet is smaller in number, thus in this report, accident rates are stated per 100 N registered aircraft. Therefore, the proportions will be a better indicator for data analysis. The selection of an aircraft-based rate is explained later in this report.

Eclipse Aerospace EA500

The same data collection sources and methods were used in the comparison fleet as were used with the Citation fleet. At the time of data collection there were more than 1,900 N registered comparison fleet aircraft. When the data analysis occurred, there were 66 accidents and 19 fatal accidents considered for the comparison fleet.

Figure 2: **Comparison Models by Accident**

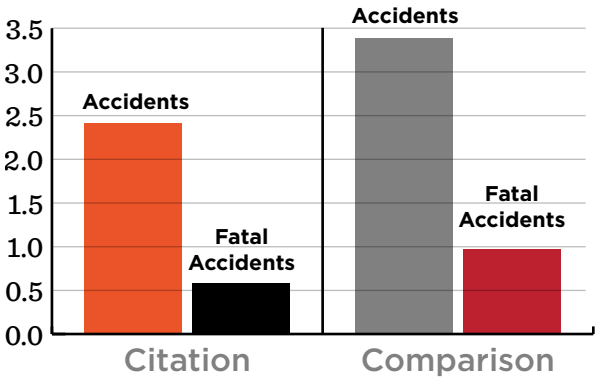


Accidents and **Accident rates:**

The most widely used benchmark of aircraft safety is the accident rate: the average number of accidents in some standard amount of flight time (usually in 100,000 hours); however, this measure is difficult to determine for specific aircraft models. The Federal Aviation Administration's (FAA) method of estimating flight activity does not provide the granularity necessary to determine the hours flown by aircraft model types. The best alternative is to standardize accident counts by the number of aircraft registered. This measure has some limitations. There are likely substantial differences between models in the number of flights, average annual flight hours, and type of activity, which can impact risk profiles and accident potential.

The Citation fleet had 99 total accidents of which 24 were fatal (24%). The comparison fleet had 66 total accidents of which 19 were fatal (29%). Figure 3, shows the results per 100 N registered aircraft.

Figure 3:
Accident Rate per 100 Aircraft



In addition to accident rates, other factors need to be evaluated to understand the causes affecting the fleet. An analysis follows.


Cessna Citation CJ3


Piper Meridian


Cessna Citation M2

Accident **Causes:**

More than 70 percent of accidents in the overall general aviation industry can be attributed to pilot error. Mechanical issues cause some 15 percent of accidents across GA and the cause of some 10 percent of accidents are not fully understood. Figures 4 and 5 provide a breakdown of these three broad accident categories for the Citation and comparison fleets. The data suggest that a smaller percentage of Citation accidents are pilot-related than in the overall GA fleet. The reasons are not easily discernible. However, a safe assumption would be the difference in the training required to operate a Citation and the experience level of the pilots operating them. The Citation models covered in this report require a type rating, which involves specific and extensive systems and flight training that enhances pilot skills and decision making.

Figure 4: **Major Accident Cause**

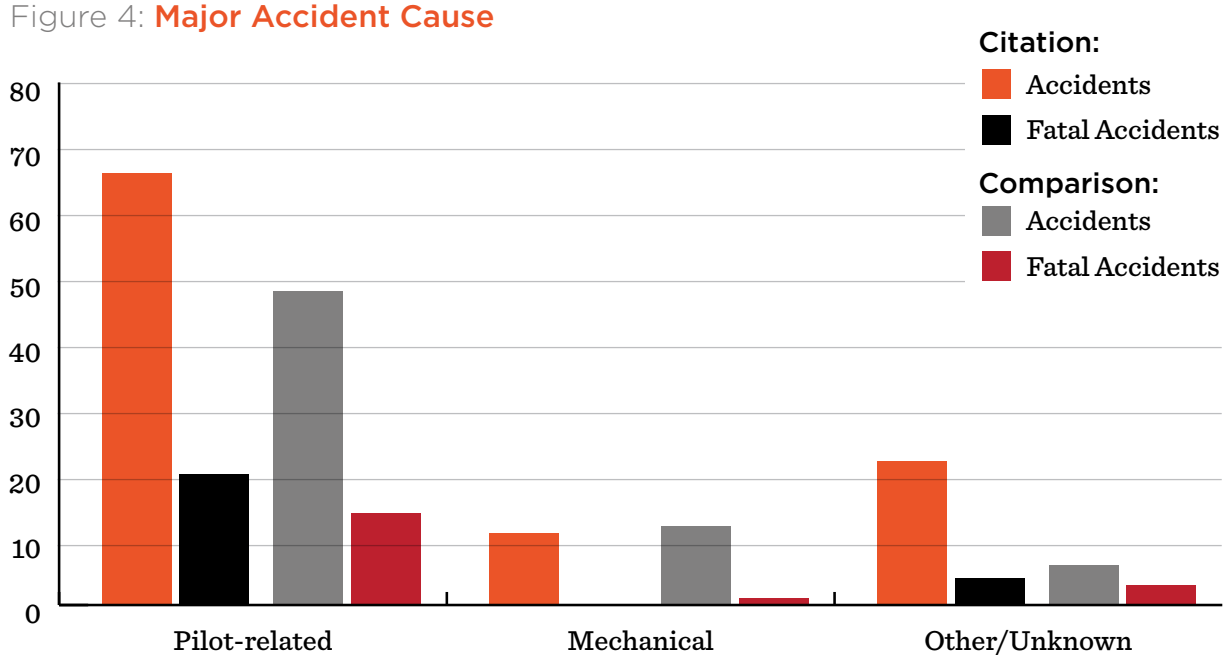
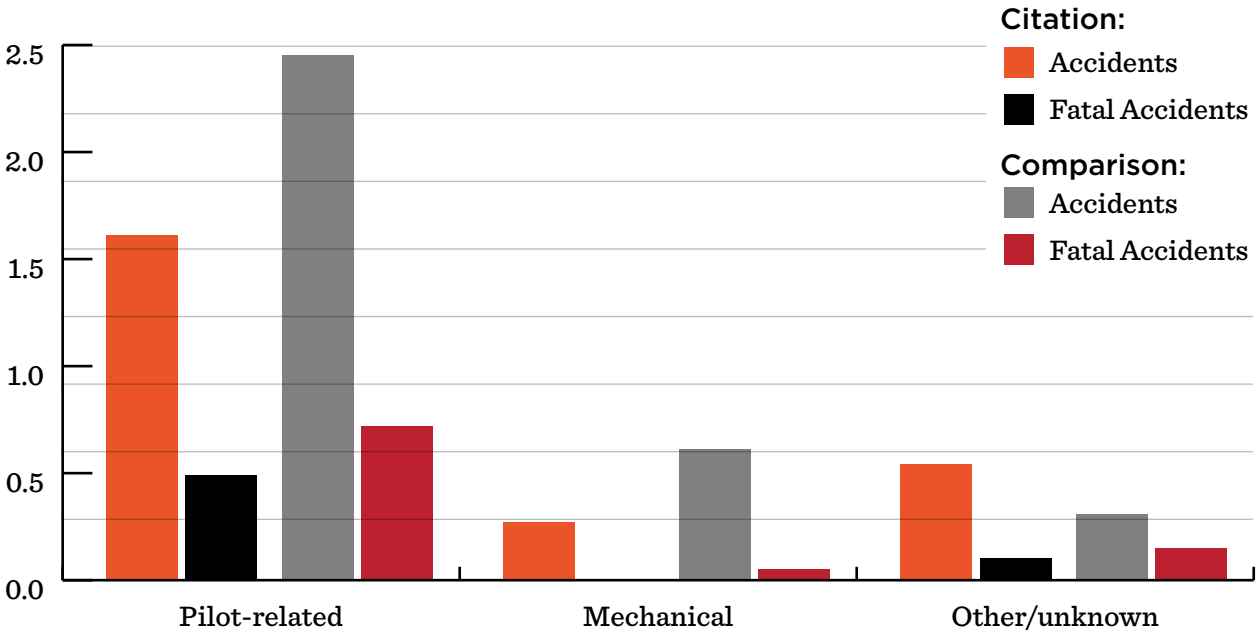


Figure 5: **Major Accident Cause Rate per 100 Aircraft**



Notably, there is a relatively high other/unknown category accident number. Upon closer inspection the majority (n=9) cases involved a bird or animal strike. Only one such accident involved a fatality, when one or more large birds collided with a Cessna Citation 500 just after takeoff. The impact damaged the wing structure, resulting in a loss of control of the airplane. The two pilots and three passengers were fatally injured in the accident. There are no fatal accidents attributed to mechanical issues in the Citation fleet, a significant contrast to some 15 percent of accidents in the overall GA fleet attributed to mechanical issues.


Embraer Phenom 100

Cessna Citation Bravo

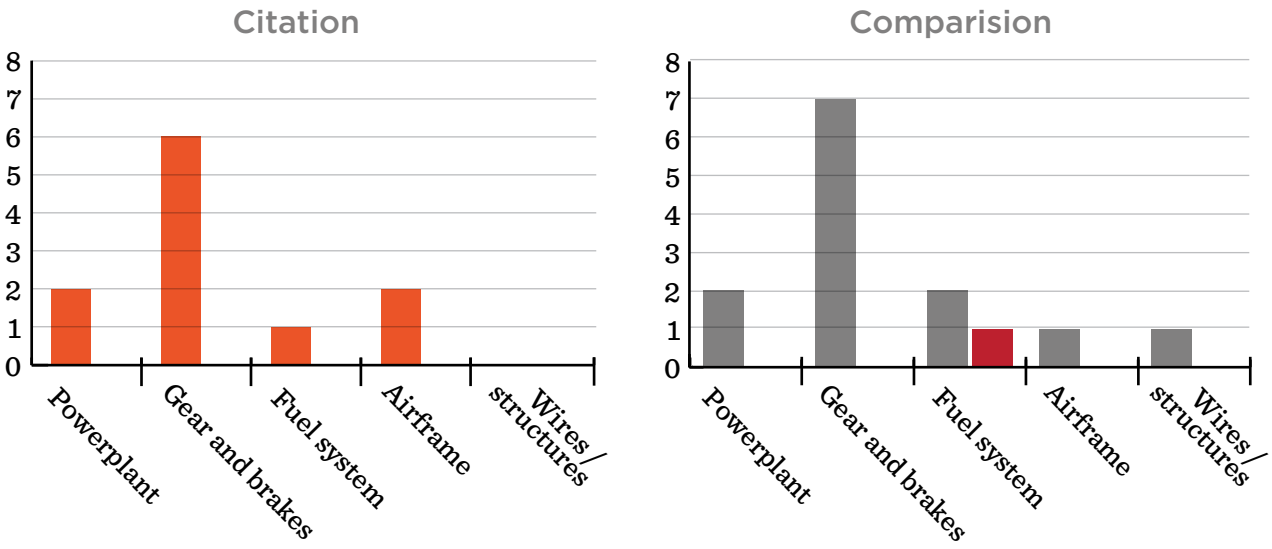
Mechanical **Accidents:**

Since mechanical accidents are proportionately the same for both fleet types, an analysis of event frequencies will suffice. The largest mechanical failure that leads to an accident is gear and brakes systems issues (see Figure 6). Half of the issues stemmed from uncommanded gear retractions and the other half were attributed to braking issues due to damage and/or wear to the brakes and brake lines.

A 2006 accident involving a Citation is indicative of the type of accidents associated with this category. The accident aircraft, a Citation 525A, swerved to the right during the landing rollout once the brakes were applied. The airplane departed the runway and was substantially damaged. The NTSB reported the left gear brake lines failed due to fatigue cracking.

While there is no definitive answer as to why the mechanical accident numbers are low, an educated guess suggests that the aircraft are on more rigorous maintenance schedules.

Figure 6: **Mechanical Accidents**



Cessna Citation CJ3

Pilot-Related Accidents:

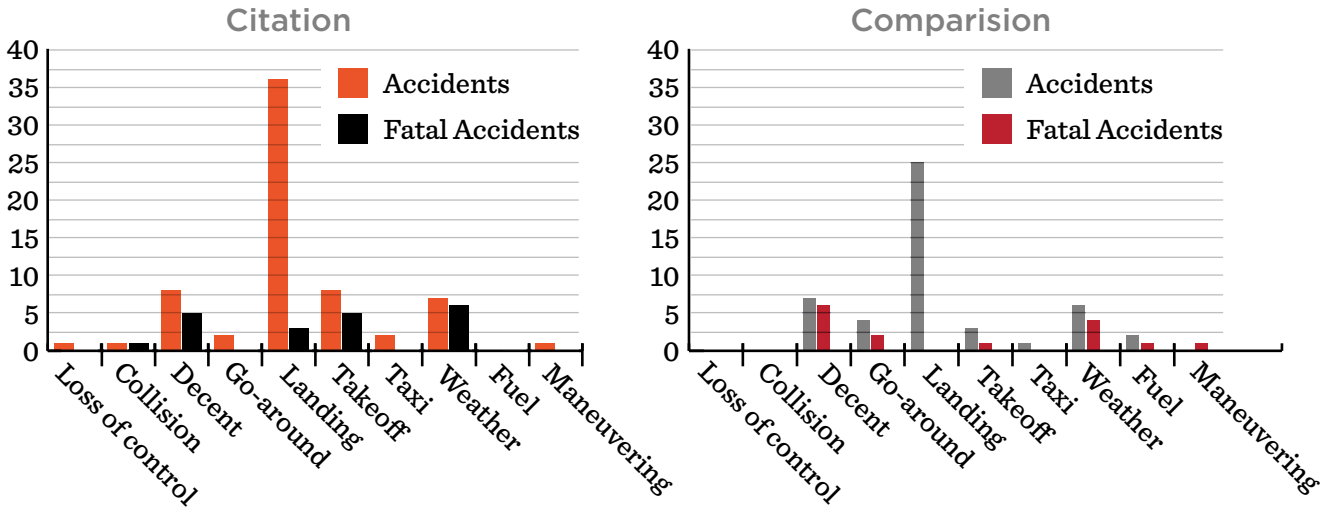
Pilot-related accidents account for more than half of all accidents in the Citation and comparison fleets, which stresses the importance of training and proficiency. Figure 7 shows the breakdown of the major pilot-related categories. Following larger GA trends, landing accidents make up the majority for both fleets. Most landing accidents resulted from unstabilized approaches.

A typical accident in this category involved a Citation 500 in 1998. The accident airplane—carrying excessive speed on an ILS approach in rain and fog—landed long and touched down with little runway remaining. The aircraft exited the runway and came to rest near a mobile home park. One passenger was seriously injured and a post crash fire consumed the aircraft.

Thirteen such accidents had airspeed management issues. The other landing accidents consisted of failure to maintain directional control (6), hard landings (4), improper gear operations (4), landing short of the runway (2), and contaminated runway issues (remainder).

Similar to the overall GA fleet, landing accidents may be in the majority, but relatively few of them are fatal. Descent, takeoff, and weather are the highest fatality accidents for the Citation. With such small overall numbers in comparison to the size of the fleets, the data suggest that these operations are safer in the Citation and comparison fleet than the same operations in the overall general aviation population.

Figure 7: **Pilot-Related Accidents**

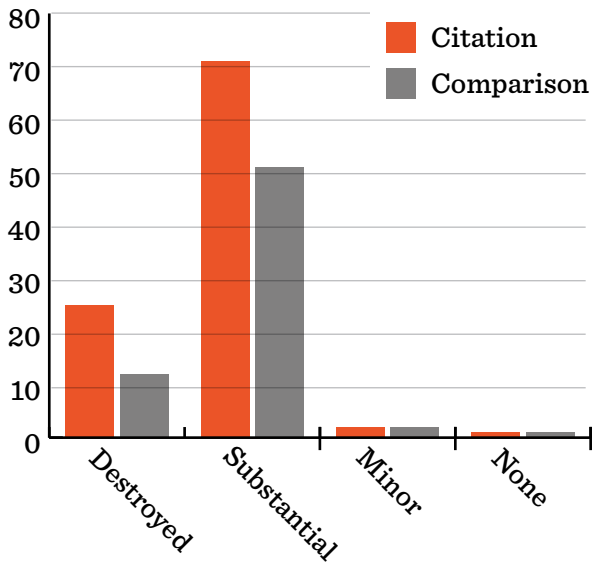


Cessna Citation Mustang

Damage:

The majority of accidents in the Citation and comparison fleets resulted in substantial or greater damage. This trend is typical of larger/faster aircraft, which operate at higher speeds, heavier weights, and carry more fuel. Figure 8 provides a breakdown of fleet damage.

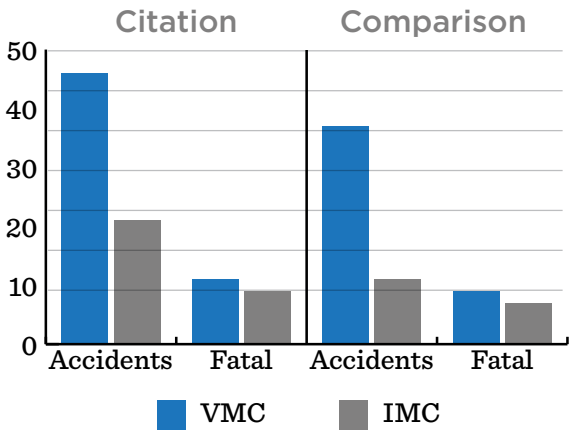
Figure 8: **Damage by Fleet Type**



WX **Conditions:**

Weather conditions follow a general trend for all GA aircraft. The majority of Citation accidents occurred during visual meteorological conditions (VMC). Most accidents occur in VMC since there is more flight activity in VMC. Unique to the Citation fleet is its larger percentage of accidents in instrument meteorological conditions (IMC) than the overall GA fleet and comparison fleet.

Figure 9:
Weather Conditions vs Fleet Type



SOCATA TBM 930

Cessna Citation CJ4

Conclusion:

The Citation series of aircraft have proven to be a safe, reliable form of transportation with substantially lower accident rates than the overall general aviation population. The strong safety performance is likely driven by a combination of design, maintenance, and operational elements. Design features include airframes designed for stability; cockpits that minimize pilot workload; and simple, reliable engines. Aircraft subsystems are reliable and routinely maintained by highly competent mechanics. Operationally, the fleet tends to be flown by experienced pilots, who are well-trained and who maintain good levels of proficiency.

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