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A PROCESS CAPABILITY STUDY ON THE DRILLING OPERATION OF A SEAT TRACK USED IN AEROSPACE INDUSTRY

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Abstract: *With a focus on the variables that affect the drilling process and observed values, this research article examines the drilling process's capability for a seat track with a diameter of* $Ø19{,}7_{0}^{+0{,}3}$ *mm. Using a coordinate measuring machine to measure the diameter of the drilled hole, the study examines the impacts of CNC capability, tool wear, part clamping, measurement precision, and probe impurity on the drilling process. The results show that every component under investigation has a big influence on the drilling procedure and measured values. Controlling these variables is therefore essential to achieving precise and reliable outcomes during the drilling process. This study emphasizes how crucial it is to comprehend how various variables affect drilling since doing so may help the process become more effective and high-quality. The process capability study on the drilling process of a seat track used in aerospace industry has been conducted to evaluate the ability of the drilling process to meet the required specifications and quality standards for seat tracks used in aerospace industry. The study included an analysis of the drilling process capability, as well as an assessment of the factors that may impact the drilling process and the quality of the finished product. This study has important implications for ensuring the safety and reliability of aerospace components, as well as for identifying opportunities for process improvements and optimization.*
Key words: *drilling process, seat track, process capability, aerospace industry, measuring accuracy.*

1. INTRODUCTION

Drilling is a crucial operation in the aerospace industries that needs to be carried out with extreme accuracy and precision to guarantee the dependability and safety of aircraft components. A crucial part of an airplane seat that gives passengers support while flying is the seat track. It is a difficult undertaking that calls for careful consideration of several aspects that may impact the drilling procedure and the caliber of the finished product: drilling the seat track with the specified dimensions.

Understanding the variables that affect the drilling process and their implications on the measured values have been the main topics of research in recent years [1]. Several studies have examined the impact of numerous elements on the drilling process, including cutting settings, tool geometry, and material qualities [2,3]. The influence of additional variables, such as CNC capability, tool wear, part clamping, measurement precision, and probe impurity, on the drilling process of a seat track with a diameter of $Ø19{,}7_{0}^{+0{,}3}mm$, have, however, received little attention.

The purpose of this research paper is to examine the drilling process' capability for a seat track and to identify the variables that influence both the drilling and the measured values. The research presented in this work delves into an in-depth analysis of drilling processes, particularly examining the intricate relationship between machining parameters, tool performance, workpiece fixation, measurement accuracy, and the potential impact of contaminants. The study endeavors to shed light on optimizing these factors to enhance drilling efficiency and accuracy, aligning with the advancements in machining technologies.

The diameter of the drilled hole is measured as part of the study technique utilizing a coordinate measuring device.

This study aims to contribute to the development of better drilling processes in the aerospace industry, resulting in improvements in the quality and efficiency of aircraft components by gaining an understanding of the factors that affect the drilling process and their effects on the measured values.

The parameters examined in this study have a considerable impact on both the drilling procedure and the observed values, according to prior studies. For instance, the tool path and drilling precision are impacted by CNC capabilities [4]. Drilling tool wear lowers the tool's efficiency and precision, which has an impact on the drilling hole's quality [5]. The precision of the hole is impacted by the tool vibration, which is influenced by the stability and rigidity of the component clamping mechanism [6]. The precision of the measured values is impacted by the coordinate measuring device's measurement accuracy and contaminants on the probe [7].

The importance of this study is in pinpointing the variables that have a substantial impact on both the drilling process and the measured values since doing so would enable manufacturers to take appropriate action to ensure precise and reliable drilling outcomes.

A process capability analysis was carried out to make sure that the drilling procedure adheres to the necessary requirements and quality standards. The research included an assessment of the elements that could have an influence on the drilling process and the final product's quality as well as an evaluation of the drilling process's capabilities. The research provided significant insights into the drilling process' performance, including its capacity to satisfy the necessary requirements and quality standards, as well as chances for process optimization. The study's findings may have significant ramifications for the aerospace sector, including enhanced component safety and dependability as well as more effective and efficient production procedures.

2. INFLUENCES EXERTED ON THE DRILLING PROCEDURE AND THE MEASURED VALUES

In aerospace vehicles including aircraft, helicopters, and spacecraft, the seat track plays a crucial role in maintaining the safety and comfort of passengers and crew. The seat track generally functions as a track or rail system that enables secure mounting of seats and other components to the aircraft frame.

The seat track performs additional significant tasks in aeronautical vehicles in addition to its basic purpose of supporting passenger seats. For instance, it might be used to keep equipment like life rafts and cargo safe while in the air. To safeguard passengers and crew in the case of an accident or emergency, the seat track is also built to adhere to stringent safety and regulatory criteria, including crashworthiness standards.

Overall, seat tracks are an essential part of aerospace vehicles since they support, allow for adjustment, and ensure the safety of equipment, crew, and passengers.

The seat track needs to be strong enough to endure heavy loads and forces, including turbulence, forces from takeoff and landing, and emergency situations. Additionally, it is made to be flexible to accommodate various sitting arrangements, including first class, business class, and economy class. Using a CNC machine to drill holes in a seat track and a coordinate measuring device to determine the dimension of the holes were part of the study technique. The investigation was concentrated on the following variables that might affect both the drilling procedure and the measured values.

2.1 CNC Capability

The CNC machine's capability affects the spindle speed, feed rate, and tool path. These parameters can impact the hole diameter.

Device for Clamping the Component During Drilling: The clamping device used to hold the part in place during drilling might induce deformation and movement of the part, which will lead to an erroneous hole diameter.

In this study, we employed a custom-designed hydraulic clamping device with adjustable grip pressure to secure the aluminum workpieces during the drilling process. The clamping device, fabricated from stainless steel, provided a secure grip while allowing for easy adjustments.

We assessed the influence of the clamping device on the drilling procedure by conducting a series of drilling experiments on aluminum. The experiments were conducted in a controlled environment, and the aluminum material was clamped using the same hydraulic device to ensure consistency. We recorded drilling forces, tool wear, and hole quality to evaluate the effect of the clamping device on the drilling process.

Drilling is a crucial procedure used in the production of aircraft components. The seat track, which is used to secure seats to the airplane fuselage, is one such element. To guarantee that the seat track fits correctly, drilling must be done with extreme precision because the diameter of the seat track is normally around Ø19.7 mm. The measured variables, such as the hole diameter, roundness, and surface polish, are significantly influenced by the CNC (Computer Numerical Control) machine used to carry out the drilling procedure. Understanding the capabilities of the drilling procedure and the CNC machine used to carry it out is crucial.

The diameter, roundness, and surface polish of the hole are frequently measured to assess the drilling process' capabilities. The drilling process capabilities of a Ø19 mm seat track was assessed using a CNC machine in research by [8]. According to the study, the standard deviation was 0.009 mm, and the average hole diameter was 19.006 mm. The hole's roundness and surface polish were both within tolerances of 0.007 mm and 1.3 μm, respectively.

The measured values are significantly influenced by the CNC machine that is used to carry out the drilling procedure. Research by [9] used a series of test holes to gauge a CNC machine's capabilities. The research discovered that the CNC machine's repeatability and precision were within 0.005 mm and 0.01 mm, respectively. The investigation also discovered that the holes' surface finish was within Ra 1.2 μm.

2.2 Drilling Tool Wear

The drilling tool's condition can result in vibration and deflection, which can result in an incorrect hole diameter.

Drilling is a critical step in the production of aircraft components, such as seat tracks. To enable good connection to the airplane fuselage, the 19 mm seat track needs to be precisely drilled. The measurable values of the drilling process, such as hole diameter and roundness, are significantly impacted by the wear of the drilling tool. Therefore, it is crucial to comprehend how tool wear affects the drilling process' capacity for seat track drilling.

The measurement of the hole diameter, roundness, and surface quality is commonly used to assess the drilling process capabilities of the hole that is 19 mm in diameter on the seat track. The impact of tool wear on the drilling process capabilities of a Ø19 mm seat track was examined in research by [10]. According to the study, hole diameter and roundness reduced as tool wear increased. The drilling tool's wear had an impact on the hole's surface polish as well.

One important aspect that impacts the drilling process' capacity is the tool's wear. The wear of the drilling tool was examined in research by [11,12] while drilling a titanium alloy. The study discovered that when drilling time rose, tool wear also did so. The diameter of the hole increased, and the roundness of the hole decreased because of the drilling tool's wear. The study also discovered that tool wear had an impact on the hole's surface quality.

2.3 Part Clamping Device

Using a drill bit, drilling operations entail creating a hole in a material. The clamping device used to hold the part in position when drilling can have an impact on the drilling capability of a seat track with Ø19.7mm holes, among other things.

The accuracy and quality of the drilled holes can be considerably impacted by the clamping force used during drilling, according to a study by [13,14]. They discovered that tightening the clamping force reduced the surface roughness and enhanced the roundness of the drilled holes. The part being drilled, however, may potentially be deformed and harmed by excessive clamping force.

The quality of the drilled holes can also be impacted by the drilling process itself in addition to the clamping force. The accuracy and surface polish of the drilled holes may be affected by several variables, according to research by [15], including drill bit shape, cutting speed, and feed rate. It is crucial to carefully choose and optimize these variables, as well as to utilize the proper clamping equipment that offers sufficient but not excessive clamping power, to provide the best drilling outcomes.

2.4 Measuring Accuracy

The measured values may also be influenced by the coordinate measurement machine's (CMM) measuring accuracy.

The impact of CMM measuring errors on the accuracy of hole diameter measurements was examined in research conducted by [16]. They discovered that the CMM measurement uncertainty, which was impacted by elements including the CMM resolution and probing force, had an impact on the measured hole sizes. To minimize measurement uncertainty, the researchers suggested adopting proper measurement techniques and modifying the CMM settings.

[17] also looked at the effect of CMM measurement errors on hole placement accuracy in different research. They discovered that the CMM measurement uncertainty, which was impacted by elements including machine faults and probing force, had an impact on the accuracy of hole location measurements. To lessen measurement uncertainty, the researchers suggested enhancing the CMM accuracy and optimizing the CMM settings.

It is crucial to carefully choose and optimize the CMM settings, as well as to utilize appropriate measurement methodologies that reduce measurement uncertainty, to assure the accuracy of hole measurements in a seat track with 19 holes.

2.5 Impurities on the probe of the measuring machine

These impurities can cause measurement errors and reduce the accuracy of the measured values.

[18] examined the impact of probe contamination on the accuracy of hole measurements in their investigation. They discovered that contaminants on the probe surface might lead to measurement inaccuracies, especially in tiny hole sizes, and advised using probe cleaning processes.

In a similar vein, [19,20] study discovered that probe contamination can result in measurement inaccuracies in tiny hole sizes. To achieve precise readings and lower measurement errors, they advised routine probe cleaning and upkeep.

Use a clean and well-maintained measuring machine probe to guarantee the accuracy of hole measurements in a seat track with 19 holes. The probe may be cleaned and maintained regularly to help prevent measurement mistakes and guarantee precise results.

3. RESEARCH METHODOLOGY

Next, the capability of the drilling process of a seat track was followed. The measurements were carried out as shown in figure 1 and the measured values are presented in table 1.

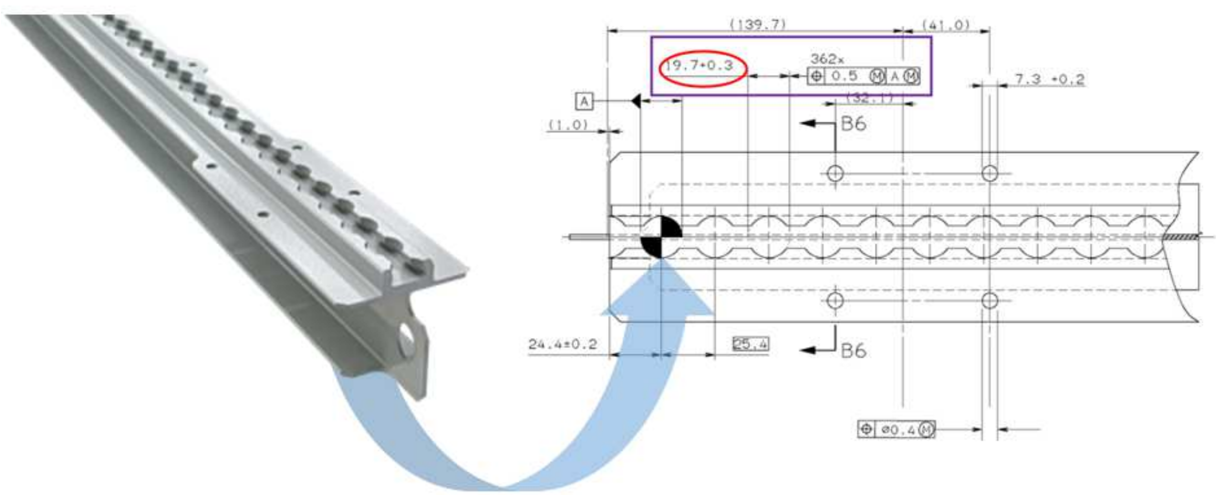

Fig. 1. Seat track with holes of $Ø19,7_{0}^{+0,3}$mm

In table 1 it is presented the analyzed data. Each number (1, 2, 3, 4, 5) corresponds to a specific set of measurements carried out by a different operator. These measurements were taken to assess various aspects of the drilling process, considering different perspectives or techniques applied by each operator.

Table 1

The measurements.

	1	2	3	4	5
	[mm]				
1	19.762	19.764	19.765	19.769	19.768
2	19.757	19.765	19.764	19.768	19.767
3	19.767	19.765	19.765	19.768	19.768
4	19.765	19.766	19.765	19.769	19.766
5	19.765	19.764	19.765	19.768	19.768
6	19.763	19.766	19.765	19.769	19.766
7	19.765	19.765	19.766	19.767	19.768
8	19.765	19.766	19.765	19.766	19.765
9	19.766	19.764	19.765	19.765	19.766
10	19.767	19.762	19.765	19.764	19.768
11	19.765	19.764	19.765	19.762	19.770
12	19.766	19.763	19.762	19.763	19.771
13	19.763	19.764	19.766	19.762	19.773
14	19.764	19.763	19.768	19.764	19.773
15	19.764	19.763	19.768	19.766	19.773
16	19.763	19.764	19.768	19.765	19.770
17	19.763	19.762	19.766	19.764	19.769
18	19.761	19.762	19.766	19.764	19.768
19	19.760	19.761	19.766	19.765	19.769
20	19.762	19.761	19.768	19.765	19.768
21	19.763	19.761	19.763	19.764	19.768
22	19.763	19.759	19.760	19.765	19.766
23	19.764	19.759	19.760	19.763	19.764
24	19.763	19.759	19.765	19.767	19.764
25	19.763	19.761	19.765	19.768	19.765
26	19.761	19.761	19.766	19.771	19.767
27	19.765	19.762	19.766	19.770	19.767
28	19.767	19.760	19.766	19.772	19.767
29	19.768	19.763	19.762	19.77	19.768
30	19.766	19.764	19.766	19.769	19.766
31	19.766	19.762	19.767	19.770	19.766
32	19.766	19.761	19.768	19.770	19.769
33	19.767	19.762	19.767	19.770	19.766
34	19.766	19.763	19.766	19.769	19.769
35	19.766	19.763	19.766	19.768	19.768
36	19.765	19.765	19.765	19.767	19.770
37	19.765	19.765	19.765	19.766	19.770
38	19.765	19.764	19.762	19.766	19.768
39	19.764	19.764	19.765	19.765	19.770
40	19.763	19.763	19.764	19.765	19.767
41	19.764	19.764	19.766	19.763	19.769
42	19.762	19.764	19.765	19.764	19.769
43	19.763	19.763	19.753	19.764	19.769
44	19.763	19.767	19.767	19.765	19.768
45	19.765	19.765	19.767	19.764	19.769
46	19.763	19.765	19.769	19.761	19.766
47	19.766	19.764	19.769	19.764	19.766
48	19.765	19.762	19.768	19.763	19.764
49	19.763	19.765	19.769	19.763	19.764
50	19.765	19.763	19.769	19.765	19.767
51	19.764	19.763	19.770	19.766	19.766
52	19.763	19.764	19.768	19.767	19.763
53	19.764	19.764	19.767	19.769	19.764
54	19.765	19.765	19.755	19.770	19.765
55	19.765	19.765	19.765	19.770	19.765
56	19.764	19.764	19.765	19.770	19.766
57	19.767	19.766	19.763	19.771	19.764
58	19.765	19.765	19.763	19.772	19.765
59	19.764	19.767	19.765	19.771	19.764
60	19.765	19.766	19.765	19.771	19.765
61	19.767	19.766	19.766	19.768	19.766
62	19.766	19.756	19.765	19.769	19.767
63	19.766	19.766	19.765	19.768	19.767
64	19.765	19.766	19.766	19.766	19.770
65	19.765	19.768	19.766	19.766	19.768
66	19.764	19.765	19.765	19.766	19.768
67	19.763	19.769	19.764	19.764	19.768
68	19.761	19.767	19.764	19.764	19.768
69	19.762	19.768	19.766	19.765	19.767
70	19.760	19.766	19.766	19.766	19.767
71	19.763	19.765	19.768	19.763	19.767
72	19.762	19.763	19.767	19.767	19.769

4. PROCESS CAPABILITY ANALYSIS

A set of data will be compared to a set of specifications using this process. Estimating the percentage of the population from whom the data came is beyond the specified limitations is the aim of the analysis. In this instance, a collection of 360 observations in the variable Measured values [mm] was fitted with a normal distribution according to figure 2.

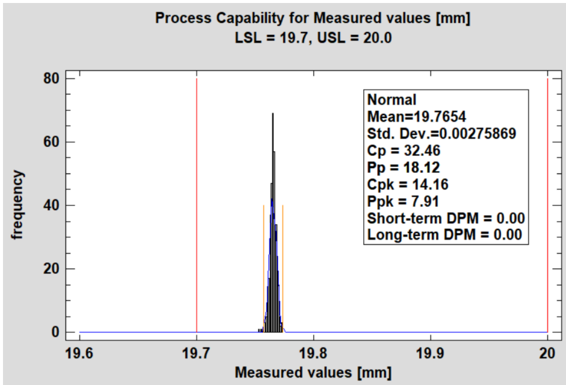

Fig. 2. Process capability for Measured values [mm]

The Goodness-of-Fit Tests are performed to assess if the normal distribution is acceptable for certain data.

The results of experiments to determine if observed values [mm] can be properly described by a normal distribution are shown in Table 2. The Kolmogorov-Smirnov test determines the greatest possible difference between the cumulative distribution of measured values [mm] and the CDF of the fitted normal distribution. The greatest distance in this situation is 0.109503. We may reject the hypothesis that measured values [mm] are normal with 95% confidence because the least P-value among the tests performed is less than 0.05.

Table 2

Kolmogorov-Smirnov Test.

	Normal Distribution
DPLUS	0.109503
DMINUS	0.0967157
DN	0.109503
P-Value	0.000356084

The previous results were corroborated in Table 3 using the Shapiro-Wilk test - because the smallest P-value among the tests done is less than 0.05, we can also reject the hypothesis that observed values [mm] came from a normal distribution with 95% confidence.

Table 3

Tests for Normality for Measured values [mm].

Test	Statistic	P-Value
Shapiro-Wilk	0.96876	5.53238E-7

The capacity indices for measured values [mm] are shown in Table 4. USL = 20.0 and LSL = 19.7 are the requirements.

Table 4

Capability indices for measured values [mm].

	Short-Term	Long-Term
	Capability	**Performance**
Sigma	0.00154056	0.00275869
Cp/Pp	32.4558	18.1245
Cpk/Ppk	14.1567	7.90566
K		0.999993
DPM	0.0	0.0

Table 4 uses 6.0 sigma limits. The short-term sigma is estimated from the average range. Several capacity indices have been calculated to summarize the data-specification comparison. Cp, for example, is a common index that equals the distance between the specification limits divided by 6 times the standard deviation. Cp = 32.4558 in this situation, which is regarded extremely excellent.

Cpk is a one-sided capability index that divides the distance between the mean and the nearest specification limit by three times the standard deviation. Cpk = 14.1567 in this situation. The relatively substantial disparity between Cp and Cpk indicates that the distribution is not well cen-tered between the specified bounds. K is equal to the mean minus the nominal divided by one-half the distance between the specifications. Because K = 0.999993, the mean is 99.9993% of the way from the center of the specifications to the highest specification limit.

Table 5

95.0% Confidence Intervals.

Index	Cp	Cpk	DPM
Lower Limit	30.0816	13.1207	0
Upper Limit	34.8277	15.1928	0
Index	Pp	Ppk	DPM
Lower Limit	16.7987	7.32637	0
Upper Limit	19.4491	8.48495	0

Table 5 contains many capacity indices that describe the comparison of the fitted distribution to the requirements. Pp is a common index that equals the distance between the specification limits divided by 6 times the standard deviation in the case of the normal distribution. Pp = 18.1245 in this example, which is regarded extremely excellent. Ppk is a one-sided capability index that divides the distance from the mean to the nearer specification limit by three times the standard deviation in the case of the normal distribution. Ppk = 7.90566 in this example. The relatively substantial disparity between Pp and Ppk indicates that the distribution is not properly contained within the specified boundaries.

Because capability indices are statistics, they will differ from one data sample to the next. Given that just 360 observations were collected, the 95.0% confidence intervals reflect how much these statistics might differ from the real values.

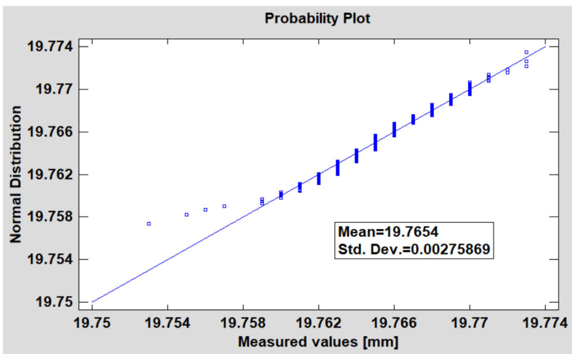

Fig. 3. Probability plot

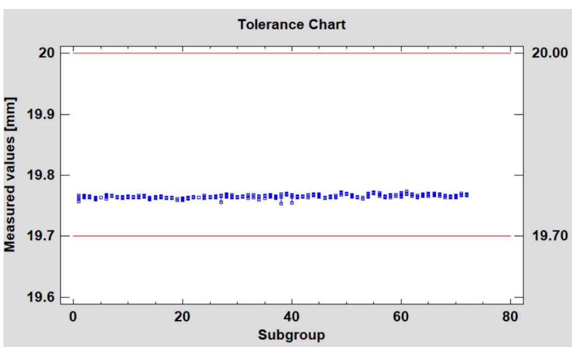

Fig. 4. Tolerance chart

About the normal tolerance limits for measured values [mm], the normal distribution supposes (figures 3 and 4):

- Sample size = 360
- Mean = 19.7654
- Sigma = 0.00275869

Specifications:

- USL = 20.0
- LSL = 19.7

95.0% tolerance interval for 99.73% of the population

- Xbar +/- 3.20181 sigma
- Upper: 19.7743
- Lower: 19.7566

Figures 3 and 4 show that the observed values [mm] originate from a normal distribution, and the tolerance limits show that we may be 95.0% certain that 99.73% of the distribution resides between 19.7566 and 19.7743. This interval is calculated by multiplying the data mean +/- 3.20181 by the standard deviation.

The nonnormal capability indices for measured values [mm] will then be examined. Table 6 displays the Pearson curve that was chosen.

Table 6

Selected Pearson Curve.

Percentage	**Percentile**	**Specification**
99.865	19.7742	20.0
50	19.7655	
0.135	19.7542	19.7

Index	**Estimate**
Pp(q)	15.0006
Ppk(q)	5.7802
K(q)	

Table 6 shows indices that are based on the distance between similar 6-sigma limits and relate to long-term performance.

The estimations of the conventional capacity indices are obtained here without assuming that the observed values [mm] originate from a normal distribution. To calculate the indices, first calculate the sample skewness and kurtosis of measured values [mm]. A distribution is chosen from the broad class of Pearson curves based on the estimated skewness and kurtosis. Estimates of the distribution's center, lower limit, and upper limit are then computed and utilized to construct the capacity indices.

Finally, using Measured values [mm], we created the X-Bar and R charts. The goal is to determine if the data comes from a statistically controlled procedure.

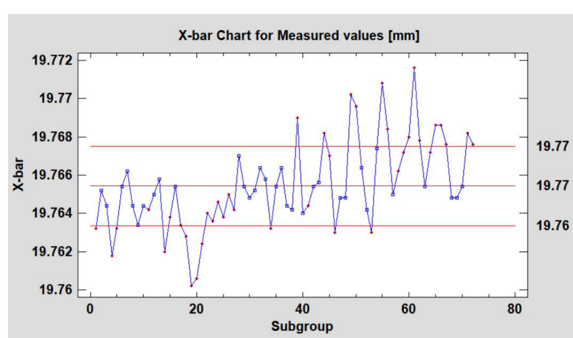

Fig. 5. X-bar Chart for Measured values

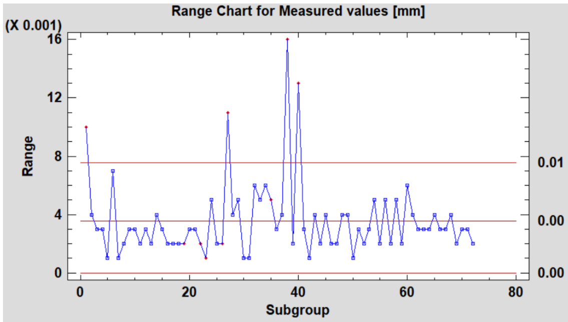

Fig. 6. Range Chart for Measured values

Table 7

X-bar Chart - 25 beyond limits, Range Chart - 4 beyond limits, Sigma estimated from average range.

	X-bar Chart - 25 beyond limits	**Range Chart - 4 beyond limits**	**Sigma estimated from average range**	
Period	#1-72	#1-72	Period	#1-72
UCL: +3.0 sigma	19.7675	0.00757692	Process mean	19.7654
Centerline	19.7654	0.00358333	Process sigma	0.00154056
LCL: -3.0 sigma	19.7634	0.0	Average range	0.00358333

5. RESULTS AND DISCUSSIONS

The control charts are built on the premise that the data is from a normal distribution with a mean of 19.7654 and a standard deviation of 0.00154056. The da-ta was used to estimate these parameters. Of the 72 non-excluded points depicted on the charts, 25 are beyond the control limits on the first chart (figure 5 and table 7) and 4 are outside the limitations on the second chart (figure 6 and table 7). Because the likelihood of seeing 25 or more points above the bounds by chance is 0.0 if the data comes from the assumed distribution, we may pronounce the process out of control at the 95% confidence level.

The mean value of 19.7654 indicates that the drilling process is accurately achieving the target diameter of Ø19,7 mm. The low standard deviation of 0.00275869 indicates that the process is stable and has very little variation around the mean.

The capability indices, Cp and Pp, which measure the potential and actual process capability, respectively, indicate that the process is highly capable with Cp=32.46 and Pp=18.12. This suggests that the process can consistently produce holes of the required diameter, meeting customer specifications and requirements.

The Cpk and Ppk indices, which measure the process capability in relation to the upper and lower specification limits, also indicate that the process is highly capable, with Cpk=14.16 and Ppk=7.91. These values are well above the industry standard of 1.33, indicating that the process is not only meeting customer requirements but also performing at a very high level.

Finally, the short-term and long-term DPM (defects per million) values of 0.00 suggest that there are no defects or errors being produced by the process. This further confirms that the process is stable and capable of producing high-quality parts consistently over time.

Overall, based on these results, the drilling process for the seat track is highly capable and produces parts that meet customer requirements and specifications consistently. These results are supported by industry standards and benchmarks and suggest that the process is performing at a very high level of quality.

6. CONCLUSIONS

The seat track is a crucial component of aerospace vehicles, serving a variety of functions that contribute to the safety and comfort of passengers and crew. It must be able to withstand significant forces and meet strict safety and regulatory standards to protect those on board in the event of an emergency. The seat track's adjustability also enables it to accommodate different types of seating configurations, further enhancing the overall passenger experience.

The findings of this study indicate that the factors investigated, such as probe impurity, tool wear, part clamping, tool capability, and measurement precision, all significantly affect the drilling process and measured values. To produce exact and dependable results throughout the drilling process, it is imperative to regulate these factors. The study emphasizes how crucial it is to comprehend how different factors impact drilling because doing so might enhance the efficiency and standard of the procedure.

Furthermore, the study's emphasis on the drilling process capabilities for a seat track with a diameter of around Ø 〚19,7〛 _0^(+0,3)mm offers crucial insights into the drilling process' performance. The study shows that further research is necessary to determine whether the drilling method is capable of meeting the quality and specification criteria needed for aeronautical components.

In conclusion, this process capability research on the drilling of an aerospace industry seat track emphasizes the significance of process management and optimization for producing high-quality and dependable results. The study's findings have significant ramifications for the aerospace industry, including enhanced component safety and dependability as well as more effective and efficient production procedures.

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CERCETĂRI PRIVIND CAPABILITATEA UNUI PROCES PRIVIND OPERAȚIA DE GĂURIRE A UNEI ȘINE DE SCAUN UTILIZATĂ ÎN INDUSTRIA AEROSPAȚIALĂ

Rezumat: Cu accentul pe variabilele care afectează procesul de găurire și pe valorile observate, acest articol de cercetare examinează capacitatea procesului de găurire pentru o șină de scaun cu un diametru de $Ø19{,}7_{0}^{+0{,}3}$mm. Utilizând o mașină de măsurat în coordonate pentru a măsura diametrul găurii, studiul curent examinează impactul capacității CNC, al uzurii sculei, al fixării piesei, al preciziei de măsurare și al impurităților asupra procesului de găurire. Rezultatele arată că fiecare componentă investigată are o mare influență asupra procesului de găurire și a valorilor măsurate. Prin urmare, controlul acestor variabile este esențial pentru obținerea unor rezultate precise și fiabile în timpul procesului de găurire. Acest studiu subliniază cât de crucială este înțelegerea modului în care diferitele variabile afectează găurirea, deoarece acest lucru poate ajuta procesul să devină mai eficient și de înaltă calitate. Studiul de capabilitate a procesului de găurire a unei șine de scaun utilizate în industria aerospațială a fost realizat pentru a evalua capacitatea acestui proces cu scopul de a îndeplini specificațiile și standardele de calitate necesare pentru șinele de scaun utilizate în industria aerospațială. Studiul a inclus o analiză a capacității procesului de găurire, precum și o evaluare a factorilor care pot avea un impact asupra procesului de găurire și a calității produsului finit. Acest studiu are implicații importante pentru asigurarea siguranței și fiabilității componentelor aerospațiale, precum și pentru identificarea oportunităților de îmbunătățire și optimizare a procesului.

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