NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, D.C. 20594

July 21, 2015

KCXO Runway 1 Examination Test Report

by John O'Callaghan

A. ACCIDENT

Location: Conroe, TX (Lone Star Executive Airport (KCXO))
Date: September 19, 2014
Time: 08:47 Central Daylight Time (CDT)
(13:47 Universal Coordinated Time (UTC))
Aircraft: Embraer EMB-505, N322QS
NTSB#: CEN14FA505

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C. HISTORY OF FLIGHT

On September 19, 2014, about 08:47 central daylight time[1], an Embraer EMB-505 airplane, N322QS, encountered soft terrain and mud after overrunning the runway while landing at the Lone Star Executive Airport (KCXO), Conroe, Texas. Neither of the airline transport rated pilots on board were injured. The airplane was substantially damaged. The airplane was operated by Net Jets as a 14 Code of Federal Regulations Part 91 positioning flight. Instrument meteorological conditions prevailed for the flight, which was operated on an instrument flight rules flight plan. The flight originated from the Nashville International Airport (BNA), Nashville, Tennessee, at 07:10.

[1] Local time at Conroe on the day of the accident was Central Daylight Time (CDT). CDT = UTC - 5 hours. Times in this *Test Report* are in CDT unless otherwise noted.

According to the air traffic controller who witnessed the accident, the pilots flew the area navigation (RNAV) runway 1 approach and broke out of the clouds at the minimums for the approach. The controller stated the airplane touched down just past the 1,000 foot marker on the runway but did not appear to decelerate as it continued down the runway. The airplane traveled off the departure end of the runway and continued about 400 feet through soft/muddy terrain before coming to rest half way down a ditch. The controller stated there was moderate to heavy rain at the time of the accident.

The role of the Aircraft Performance Specialist in the investigation is to determine and analyze the motion of the airplane and the physical forces that produce that motion. In particular, the Specialist attempts to define the airplane's position and orientation during the relevant portion of the flight, and determine the airplane's response to control inputs, external disturbances, ground forces, and other factors that could affect its trajectory.

The data used to determine and analyze the airplane motion includes the following:

- Wreckage location and condition.
- Ground scars / markings.
- Airport Surveillance Radar (ASR) data.
- Flight Data Recorder (FDR) data.
- Cockpit Voice Recorder (CVR) information.
- Runway macrotexture, cross-slope, and friction measurement information.
- Weather information.
- Airplane thrust and aerodynamic performance information.
- Output from aircraft performance computer programs and simulations.

This *Test Report* describes the objectives, methods, and results of an examination of runway 1 at KCXO performed on May 5, 2015, including the data gathered, the equipment used, and the test procedures. The examination was conducted according to the KCXO *Runway 1 Examination Test Plan* (Reference 1).

Appendix A contains an airport diagram and other useful information for KCXO.

D. DETAILS OF THE TEST

I. Test Objectives

The objectives of the test were to:

1. Measure the runway 1 macrotexture depth at 40 locations using the ELAtextur macrotexture laser scanner, per Reference 1. Due to time constraints and the threat of rain (which would have prevented additional measurements), macrotexture measurements were actually made at only 26 locations.
2. Measure the runway 1 cross-slope at 40 locations, per Reference 1. Because the cross-slope measurements could be made easily, measurements at 10 additional locations (for a total of 50) were made.

3. Measure the runway friction along the length of runway 1 using the Neubert Aero Corporation Dynamic Friction Tester (NAC DFT) trailer provided and operated by IAH personnel, at 4 different speeds and at 4 different distances from the runway centerline, as defined in Reference 1.
4. Examine the runway 1 edges for vegetation or other obstructions that would prevent proper water drainage from the runway.[2]

In addition, the runoff and drainage of rain from the edges of the runway was observed during a rain event the morning of May 5. No significant ponding or pooling of water at the runway edges was observed.

II. Test Location and Date

The test was performed on Tuesday, May 5, 2015, on runway 1 at KCXO. The street address of KCXO is:

Lone Star Executive Airport
10260 Carl Pickering Memorial Dr.,Conroe, TX 77303

The test team met at the KCXO airport offices at 8:00 CDT to brief the test plan for the day, and proceeded onto the runway at about 09:00. Macrotexture and cross-slope measurements were completed before the onset of light rain starting at about 10:38. DFT runs were performed starting at about 10:36, and were suspended at about 11:00 due to the onset of heavy rain. The runoff and drainage from the runway during the rain event were observed at about 11:20. DFT testing resumed at about 11:39, and was completed at about 13:30.

III. Test Equipment

- Trimble Geo7x survey GPS
- Measuring wheel for measuring off runway distances
- 250 ft. tape measure
- Chalk
- Levels (4 ft. and 8 ft.)
- Digital inclinometer
- ELAtextur macrotexture scanner[3]
- NAC DFT Continuous Friction Measurement Equipment (CFME) trailer[4] and truck
- Data log – macrotexture and cross slope measurements
- Run matrix and log – NAC DFT measurements
- Video / still camera (e.g., iPhone)
- VHF radio for ATC Tower communications operated by KCXO / IAH personnel
- Visibility vest for each participant

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[2] Reference 1 lists two additional objectives for the runway examination: (1) Use the measured DFT data to compute the wet runway braking coefficient as a function of ground speed for the EMB-505 airplane, using a method developed by NASA Langley; and (2) Use the measured macrotexture and cross-slope data to compute the expected water depth on the runway as a function of rainfall rate, per a drainage model developed by the Texas Transportation Institute (TTI). These computations are deferred to the *Aircraft Performance Study* for CEN14FA505 (Reference 2).
[3] See http://www.iwsmesstechnik.de/elatextur_en.htm (accessed 06/05/2015).
[4] See https://www.airportnac.com/nac-dynamic-friction-tester (accessed 06/05/2015).

IV. Runway 1-19 closure and coordination with the ATC Tower

Runway 1-19 was to be NOTAM'd "closed" prior to the test, and remained closed during the duration of the test. KCXO personnel monitored the VHF radio while the test team was on runway 1 performing the macrotexture and cross-slope measurements, and communicated as required with the ATC tower and advised the team when they could work within the 250 ft. safety zone on either side of the centerline of intersecting runway 14-32.[5]

During the DFT tests, the operator of the DFT vehicle communicated with the ATC tower and received a clearance from the tower prior to each run.

V. Test procedures & results: macrotexture and cross-slope measurements

Procedures

The procedures for the macrotexture and cross-slope measurements were performed as specified in Reference 1. Locations on the runway are identified using a Cartesian coordinate system centered on the centerline of the threshold of runway 1. The +x coordinate runs down the runway towards the threshold of runway 19. The +y coordinate runs towards the right edge of the runway. Note that the y coordinates of the measurement points are not centered about the centerline, but are biased toward the left side of the runway. This is to reflect the actual track of N322QS as evidenced by the skid marks left by the airplane.

Per Reference 1, the macrotexture and cross-slope measurements were performed as follows:

1. In advance of the test, waypoints were created in the Geo7x device locating the x runway coordinate of measurement points, as shown in Table 1. The accuracy of the Geo7x was confirmed at the start of the test by navigating to the threshold of runway 1, and confirming that the Geo7x point coincided with the actual threshold.

2. The Geo7x was used to navigate to the measurement x coordinate, and this location was double-checked with the measuring wheel. Then, the tape measure was used to locate the desired y coordinates.

3. The measurement points were marked and labeled with chalk. See Table 1 for the point names (the names are constructed from the x and y coordinates of the point).

4. Using the ELAtextur scanner, the macrotexture was measured and recorded three times, on and around the marked point.

5. The runway cross-slope was measured and recorded, using the digital inclinometer placed on both an 8-ft. and 4-ft. level. Positive slope is for the centerline higher than the runway edge. Negative slope is for the centerline lower than the runway edge.

6. The left and right runway edges were photographed to document vegetation or other obstructions that might cause runway drainage problems. In addition, the runoff and drainage from the runway during an actual rain event was observed and photographed.

[5] Runway 14-32 intersects runway 1-19 about 4170 ft. from the runway 1 threshold (see diagram in Appendix A).

7. Steps 2-6 were repeated until 26 macrotexture and 50 cross-slope points were measured and recorded. The threat of rain prevented the macrotexture from being measured at all 40 points in Reference 1 (the ELAtexture scanner will not work when the surface is wet or damp). The macrotexture measurement points were selected so as to cover as much of the length of the runway as possible; several x-coordinates are separated by 1,000 ft. intervals instead of the 500 ft. intervals specified in Reference 1 (see Table 1). The cross-slope measurements could be made much more quickly than the macrotexture measurements, and could be performed even on a wet surface; hence, the cross-slopes at all 40 points specified in Reference 1 were measured. The cross-slopes at 10 additional points on the right side of runway 1 (at y = +5 and +20 ft. at 5 x-coordinates) were also measured (see Table 1).

Results

The macrotexture and cross-slope measurement results are presented in Table 1. The Table shows the runway x and y coordinates of each measurement point, along with the three ELAtextur Estimated Texture Depth (ETD) readings taken at each macrotexture measurement point, and the cross-slopes measured with both the 4-ft. and 8-ft. levels at each cross-slope measurement point. The average of the three ETD readings at each point, and the average ETD and cross-slope at each x-coordinate, are also shown in Table 1. The overall average ETD (0.54 mm) and cross-slope (1.46% and 1.42%, corresponding to the 8-ft. and 4-ft. levels, respectively) of all the measured points are shown at the bottom of the Table.

The ELAtextur scanner also reports the Mean Profile Depth (MPD) of the surface texture. The MPD is the actual physical measurement taken by the device; the ETD is computed internally by the device according to the equation

$$ETD = 0.80*(MPD) + 0.20 \text{ mm} \qquad [1]$$

With both ETD and MPD in millimeters (Reference 3). Both the ETD and MPD are reported by the scanner and were recorded during the tests; however, only the ETD is presented in Table 1. If desired, the MPD can be computed from the ETD by inverting Equation [1]:

$$MPD = 1.25*(ETD – 0.20 \text{ mm}) \qquad [2]$$

The ETD and cross-slope measurements listed in Table 1 are also plotted in Figure 1 vs. the runway 1 x-coordinate. As shown in the Figure, the ETD measurements ranged from about 0.44 mm to about 0.71 mm, and the cross-slope measurements ranged from 0.6% to 2.3%. The ELAtextur device has a resolution of 0.01 mm, and the digital inclinometer has a resolution of 0.1% and a reported accuracy of 0.2° (0.35% slope).

The runway edges were examined for vegetation or other matter that could interfere with proper drainage from the runway and cause flooding. No obstructions were observed, and actual rain runoff from the runway was observed during a rain event, with no significant buildup of water at the edges (beyond approximately a foot from the edge; see Figures 2a-2b). A plot of the rainfall measured by the Automated Surface Observation System (ASOS) at KCXO, and the corresponding rainfall rate, is presented in Figure 3. At the time of the observations on the runway corresponding to the photographs in Figures 2a-2b (about 11:20 CDT), the rainfall rate was about 0.5 inches / hour. About 10 minutes earlier, the rainfall rate was as high as 2.1 inches / hour.

VI. Test Procedures and results: NAC DFT friction runs

Procedures

The DFT friction measurements were performed as described in Reference 1:

1. The DFT was set up per IAH's normal operating procedures / checklists.

2. The friction tire's inflation pressure was measured and recorded at the start of the day, and at the last water refill. The inflation pressure remained relatively constant throughout the period (measured at 30.0 and 29.5 psi; see Table 2).

3. Friction test runs were conducted in one direction only: starting from the threshold of runway 1, and testing towards the threshold of runway 19. The vehicle was driven back to the runway 1 threshold to start a new run.

4. The runs were conducted at the matrix of speeds and runway "y" coordinates shown in Table 3 (which is consistent with the test matrix specified in Reference 1). The time of the start of the run, the DFT output data file, the target test speed, the target y – coordinate, and other relevant notes were recorded and are listed in the run log presented in Table 4.

5. Runs 5 through 9 were conducted during or after the period of rain, and while the runway was naturally wet. For these runs, the DFT water supply to the test tire was turned off, which increased the number of runs between required water refills. The DFT water supply was resumed starting with Run 10.

6. The alignment of the DFT vehicle with the desired y-coordinate was estimated prior to each run (though on one run, at y = -35 ft., the initial estimate was confirmed by tape measurement). The y coordinate was offset as required to avoid driving over the wet track left by a previous run.

7. The actual track of the DFT vehicle during each run was recorded using the Geo7x GPS device, which logged GPS coordinates at one-second time intervals. No GPS track was recorded for Run 5. The recorded GPS coordinates were later differentially corrected using the *Trimble Pathfinder Office* software to increase the accuracy of the recorded points. The corrected GPS latitude and longitude coordinates were transformed into runway 1 x and y coordinates for presentation.

8. Run 1 contained bad data (negative friction coefficient (μ) values), and so was repeated (as Run 5). Runs 18 through 21 were planned repeat runs of earlier conditions, to ascertain the repeatability of the μ measurements.

Results

The DFT measurements are presented in Figures 4-11. Figures 4, 5, and 6 present the DFT runway y coordinates, run speeds, and μ measurements as a function of the runway x coordinate.[6] In each Figure, separate plots for the test speeds of 30, 40, 50, and 60 mph are presented. Figures 7-10 also present the DFT runway y coordinates, run speeds, and μ measurements as a function of the runway x coordinate, but with a different target runway y-coordinate presented in each Figure. Finally, Figure 11 presents plots showing the trends of the measured μ with ETD and speed.

Figure 4 indicates that, with the exception of the y = -5 ft. runs, the Geo7x recorded the DFT vehicle tracks about 5 to 10 ft. to the right of the target tracks. The "68% accuracy" values of the GPS coordinates recorded by the Geo7x (after correction), are shown in the legends of Figures 7-10. According to Reference 4, "the accuracy estimate has a 68% confidence level, which means that 68% of the time the position will be within the estimated value shown when the position was collected …." Each Geo7x track is a collection of GPS points over time; the "worst" accuracy values shown in the legends of Figures 7-10 are the worst accuracies reported for any single point in each collection, and the "avg." accuracy values are the average accuracies of all the points in each collection.

Runs 6 and 18 were both performed at 60 mph and y = +5 ft., and so theoretically should match well. However, there is a pronounced difference between the μ values recorded for these runs. The reason for this difference is unknown, though it should be noted that Run 6 was performed with the DFT water supply turned off, and Run 18 was performed with the water supply turned on. However, Runs 9 (water off) and 21 (water on) are also repeats (at 30 mph rather than 60 mph), and match each other better than do Runs 6 and 18. Runs 11 and 19, repeats at 50 mph and y = -20 ft. (both with water on) also match each other better. It may be that the difference in μ measurements between Runs 6 and 18 is the result of the combination of different water configurations, and higher speed, though additional testing would be required to confirm this theory.

Figure 5 shows that it takes about 200 ft. for the DFT vehicle to accelerate to 30 mph, 400 ft. to accelerate to 40 mph, 600 ft. to accelerate to 50 mph, and 1000 ft. to accelerate to 60 mph. Since the measured μ depends on speed, when determining an average μ for the length of the run, it is desirable to include in the calculation only the μ values measured when the speed is within a specified tolerance of the target speed. However, the DFT output file reports the μ averaged over all the measured points, including those when the vehicle speed is far below the target speed. This output average μ is listed as the "Avg. μ" in Table 4.

The "Tol. μ" in Table 4 is the measured μ averaged over those points for which the vehicle speed is within a 10% tolerance of the target speed. This "Tol. μ" is used in the plot of average μ shown in Figure 11.

The plots of measured μ corresponding to 40 mph and 60 mph in Figure 6 include horizontal lines labeled "NEW LEVEL," "MAINT LEVEL," and "MIN LEVEL." These lines indicate the

[6] Run 1 and Run 5 were both performed at 30 mph and y = -5 ft. However, Run 1 contained bad μ data, and no GPS track was recorded for Run 5. Hence, for the 30 mph & y = -5 ft. case, the Figures present the y-coordinates from Run 1, and the μ data from Run 5.

μ values corresponding to runway friction levels defined in the Federal Aviation Administration (FAA) Advisory Circular AC 150/5320-12C, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces* (Reference 5).[7] The AC describes these friction levels as follows:

> 3-20.EVALUATION AND MAINTENANCE GUIDELINES. The following evaluation and maintenance guidelines are recommended based on the friction levels classified in [Figure 6]. These guidelines take into account that poor friction conditions for short distances on the runway do not pose a safety problem to aircraft, but long stretches of slippery pavement are of serious concern and require prompt remedial action.
>
> a. Friction Deterioration Below the Maintenance Planning Friction Level [MAINT LEVEL] (500 ft). When the average Mu value on the wet runway pavement surface is less than the Maintenance Planning Friction Level but above the Minimum Friction Level [MIN LEVEL] in [Figure 6] for a distance of 500 feet (152 m), and the adjacent 500 foot (152 m) segments are at or above the Maintenance Planning Friction Level, no corrective action is required. These readings indicate that the pavement friction is deteriorating but the situation is still within an acceptable overall condition. The airport operator should monitor the situation closely by conducting periodic friction surveys to establish the rate and extent of the friction deterioration.
>
> b. Friction Deterioration Below the Maintenance Planning Friction Level (1000 ft). When the averaged Mu value on the wet runway pavement surface is less than the Maintenance Planning Friction Level in [Figure 6] for a distance of 1000 feet (305 m) or more, the airport operator should conduct extensive evaluation into the cause(s) and extent of the friction deterioration and take appropriate corrective action.
>
> c. Friction Deterioration Below the Minimum Friction Level [MIN LEVEL]. When the averaged Mu value on the wet pavement surface is below the Minimum Friction Level in [Figure 6] for a distance of 500 feet (152 m), and the adjacent 500 foot (152 m) segments are below the Maintenance Planning Friction Level, corrective action should be taken immediately after determining the cause(s) of the friction deterioration. Before undertaking corrective measures, the airport operator should investigate the overall condition of the entire runway pavement surface to determine if other deficiencies exist that may require additional corrective action.
>
> d. New Design/Construction Friction Level for Runways [NEW LEVEL]. For newly constructed runway pavement surfaces (that are either saw cut grooved or have a PFC overlay) serving turbojet aircraft operations, the averaged Mu value on the wet runway pavement surface for each 500 foot (152 m) segment should be no less than the New Design/Construction Friction Level in [Figure 6].

Figure 6 indicates that the μ values measured with the DFT trailer were generally between the "Maintenance Planning Friction Level" and "New Design/Construction Friction Level" at 40 and 60 mph throughout the length of the runway at the y = +5 ft. and y = -35 ft. coordinates. At the y = -5 ft. and y = -20 ft. coordinates, the measured μ values dipped between the ""Maintenance Planning Friction Level" and "Minimum Friction Level" between about x = 1000 ft. and x = 2000 ft., and between x = 4000 ft. and x = 4500 ft.

Figure 6 shows a consistent drop in μ across all speeds at y = -35 ft. between x = 1000 ft. and x = 1200 ft. This location is coincident with one of the large rectangular areas of white paint denoting the touchdown zone; the drop in μ is likely the result of the slipperiness of the paint when wetted with water.

Figures 6 and 8 also show dramatic drops in μ for Run 5 (y = -5 ft. & 30 mph) between about x = 1700 and 2000 ft., and between x = 2450 and 2600 ft. These drops might be associated

[7] AC 150/5320-12C defines these μ levels at CFME device speeds of 40 and 60 mph only.

with overrunning the yellow-painted taxi lines that appear near the runway centerline at these x locations, though the drops do not appear for any of the other runs at y = -5 ft.

Figure 11 shows the trend of μ with ETD and speed. The top plot in Figure 11 shows the measured μ at each combination of ETD and speed in Table 1. Different symbol shapes and colors are used for different speeds. The straight lines in the plot are linear fits of the data points for each speed, and show that μ tends to increase with increasing ETD and decrease with increasing speed, consistent with existing wet runway friction research (see, for example, Reference 6).

The bottom plot in Figure 11 shows the average μ over each DFT run as a function of speed. Different symbol shapes and colors are used for different runway y coordinates. The straight lines in the plot are linear fits of the data points for each y coordinate, and show that the average μ was lowest at the y = -5 and y = -20 coordinates. The lines also show the clear reduction in average μ with increasing speed.

VII. Conclusions

The test results documented in this report indicate that the examination of runway 1 at KCXO was conducted in a manner consistent with the plan outlined in Reference 1. The runway ETD and cross-slope measurements are presented in Table 1, and indicate that the overall average ETD measured on the runway was 0.54 mm (0.021 inches) and the overall average cross-slope was about 1.46%.

No obstructions were observed at the edges of the runway that would interfere with proper water drainage, and actual rain runoff from the runway was observed during a 0.5 inch/hour rain event, with no significant buildup of water at the runway edges.

The μ values measured with the DFT trailer were generally between the “Maintenance Planning Friction Level” and “New Design/Construction Friction Level” at 40 and 60 mph defined in AC 150/5320-12C throughout the length of the runway at the y = +5 ft. and y = -25 ft. coordinates. At the y = -5 ft. and y = -20 ft. coordinates, the measured μ values dipped between the “Maintenance Planning Friction Level” and “Minimum Friction Level” between about x = 1000 ft. and x = 2000 ft., and between x = 4000 ft. and x = 4500 ft.

The measured μ dipped below the “Minimum Friction Level” in an area where the touchdown zone paint may have decreased the available friction.

The measured data indicates that the measured μ tends to increase with increasing ETD and decrease with increasing speed, consistent with existing wet runway friction research.

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VII. References

1. National Transportation Safety Board, Office of Research and Engineering,KCXO *Runway 1 Examination Test Plan, Embraer EMB-505, registration N322QS, Lone Star Executive Airport, Conroe, TX, September 19, 2014.* NTSB Accident Number CEN14FA505 (Washington, DC: NTSB, May 1, 2015). (Contact NTSB at pubinq@ntsb.gov).

2. National Transportation Safety Board, Office of Research and Engineering, *Aircraft Performance Study, Embraer EMB-505, registration N322QS, Lone Star Executive Airport, Conroe, TX, September 19, 2014.* NTSB Accident Number CEN14FA505 (Washington, DC: NTSB, April 20, 2016). (Contact NTSB at pubinq@ntsb.gov).

3. IWS Messtchnik GmbH, *Evaluation software of the ELAtextur measuring device,* Version 20131120, ©2013.

4. Trimble Navigation Limited, *TerraSync Software Getting Started Guide,* Version 5.60, Revision B, June 2014.

5. Federal Aviation Administration, *Advisory Circular No. 150/5320-12C: Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces,* dated March 18, 1997.

6. Engineering Sciences Data Unit (ESDU), *Engineering Sciences Data Item Number 71026: Frictional and retarding forces on aircraft tyres, Part II: estimation of braking force (friction data updated – 1981).* Amendment D dated June 1, 1995. Sponsored by the Royal Aeronautical Society.

TABLES

NOTE: Gray cells are averages			Runway y (ft.)						
Station #	**Runway x (ft.)**		**-35**	**-20**	**-5**	**+5**	**+20**	**+35**	**Average**
1	300	Name	300-35	300-20	300-5	300+5	300+20	300+35	
		Macro 1 (mm)	0.66	0.51	0.53	0.44			
		Macro 2 (mm)	0.68	0.50	0.55	0.47			
		Macro 3 (mm)	0.59	0.35	0.46	0.45			
		Macro avg. (mm)	0.64	0.45	0.51	0.45			0.52
		Slope, 8-ft. level (%)	1.4	1.3	1.7	1.5	1.8	1.4	1.52
		Slope, 4-ft. level (%)	1.3	1.3	1.7	1.5	2.1	1.3	1.53
2	800	Name	800-35	800-20	800-5	800+5	800+20	800+35	
		Macro 1 (mm)	0.57	0.44	0.49	0.58			
		Macro 2 (mm)	0.57	0.49	0.52	0.56			
		Macro 3 (mm)	0.61	0.57	0.52	0.57			
		Macro avg. (mm)	0.58	0.50	0.51	0.57			0.54
		Slope, 8-ft. level (%)	1.2	1.1	1.6	1.5			1.35
		Slope, 4-ft. level (%)	1.1	1.0	1.5	1.4			1.25
3	1300	Name	1300-35	1300-20	1300-5	1300+5	1300+20	1300+35	
		No macrotexture measurements taken							
		Slope, 8-ft. level (%)	1.6	1.4	1.6	1.7			1.58
		Slope, 4-ft. level (%)	1.4	1.3	1.4	1.7			1.45
4	1800	Name	1800-35	1800-20	1800-5	1800+5	1800+20	1800+35	
		Macro 1 (mm)	0.60	0.42	0.51	0.64			
		Macro 2 (mm)	0.51	0.43	0.50	0.65			
		Macro 3 (mm)	0.57	0.46	0.46	0.62			
		Macro avg. (mm)	0.56	0.44	0.49	0.64			0.53
		Slope, 8-ft. level (%)	2.1	1.4	1.5	1.8	1.4	1.6	1.63
		Slope, 4-ft. level (%)	2.3	1.4	1.3	1.8	1.4	1.4	1.60

Table 1 (page 1 of 3). Macrotexture and cross-slope measurement results.

NOTE: Gray cells are averages			Runway y (ft.)						
Station #	**Runway x (ft.)**		**-35**	**-20**	**-5**	**+5**	**+20**	**+35**	**Average**
5	2300	Name	2300-35	2300-20	2300-5	2300+5	2300+20	2300+35	
		No macrotexture measurements taken							
		Slope, 8-ft. level (%)	1.5	1.2	1.8	1.7			1.55
		Slope, 4-ft. level (%)	1.4	1.2	1.6	1.8			1.50
6	2800	Name	2800-35	2800-20	2800-5	2800+5	2800+20	2800+35	
		Macro 1 (mm)	0.50	0.49	0.52	0.52			
		Macro 2 (mm)	0.56	0.48	0.47	0.48			
		Macro 3 (mm)	0.62	0.50	0.45	0.49			
		Macro avg. (mm)	0.56	0.49	0.48	0.50			0.51
		Slope, 8-ft. level (%)	1.4	1.4	1.8	1.7			1.58
		Slope, 4-ft. level (%)	1.3	1.2	1.7	1.6			1.45
7	3300	Name	3300-35	3300-20	3300-5	3300+5	3300+20	3300+35	
		No macrotexture measurements taken							
		Slope, 8-ft. level (%)	1.5	1.4	1.4	1.4	1.6	1.2	1.42
		Slope, 4-ft. level (%)	1.3	1.3	1.3	1.3	1.7	1.2	1.35
8	3800	Name	3800-35	3800-20	3800-5	3800+5	3800+20	3800+35	
		Macro 1 (mm)	0.60	0.59	0.49	0.52			
		Macro 2 (mm)	0.58	0.52	0.52	0.53			
		Macro 3 (mm)	0.61	0.58	0.45	0.55			
		Macro avg. (mm)	0.60	0.56	0.49	0.53			0.55
		Slope, 8-ft. level (%)	1.6	1.5	1.7	1.6	1.1	1.5	1.50
		Slope, 4-ft. level (%)	1.6	1.5	1.6	1.6	1.2	1.4	1.48

Table 1 (page 2 of 3) . Macrotexture and cross-slope measurement results.

NOTE: Gray cells are averages			Runway y (ft.)						
Station #	**Runway x (ft.)**		**-35**	**-20**	**-5**	**+5**	**+20**	**+35**	**Average**
9	4300	Name	4300-35	4300-20	4300-5	4300+5	4300+20	4300+35	
		Macro 1 (mm)	0.49	0.51					
		Macro 2 (mm)	0.49						
		Macro 3 (mm)	0.47						
		Macro avg. (mm)	0.48	0.51					0.50
		Slope, 8-ft. level (%)	1.2	1.2	1.1	0.6			1.03
		Slope, 4-ft. level (%)	1.4	1.3	1.2	0.8			1.18
10	4800	Name	4800-35	4800-20	4800-5	4800+5	4800+20	4800+35	
		Macro 1 (mm)	0.60	0.63	0.59	0.75			
		Macro 2 (mm)	0.70	0.69	0.63	0.75			
		Macro 3 (mm)	0.68	0.68	0.65	0.62			
		Macro avg. (mm)	0.66	0.67	0.62	0.71			0.66
		Slope, 8-ft. level (%)	1.8	1.2	1.7	1.5	1.1	1.5	1.47
		Slope, 4-ft. level (%)	1.6	1.1	1.6	1.4	1.1	1.4	1.37
		Overall average macrotexture (mm) =							0.54
		Overall macrotexture standard deviation (mm) =							0.04
		Overall average slope, 8-ft. level (%) =							1.46
		Overall average slope, 4-ft. level (%) =							1.42
		Overall average slope, 8-ft. & 4-ft. levels combined (%) =							1.44
		Overall slope standard deviation, 8-ft. & 4-ft. levels combined (%) =							0.11
		Note: + slope is centerline higher than runway edge							

Table 1 (page 3 of 3). Macrotexture and cross-slope measurement results.

Tire inflation pressures:	
Time (CDT)	**Pressure (psi)**
10:10	30
13:15	29.5

Table 2. DFT trailer measurement tire inflation pressures.

	*** Run numbers ***			
	Runway y coordinate (ft.)			
Speed (mph)	**-35**	**-20**	**-5**	**+5**
60	14	10	4	6,18
50	15	11,19	3	7
40	16,20	12	2	8
30	17	13	1,5	9,21

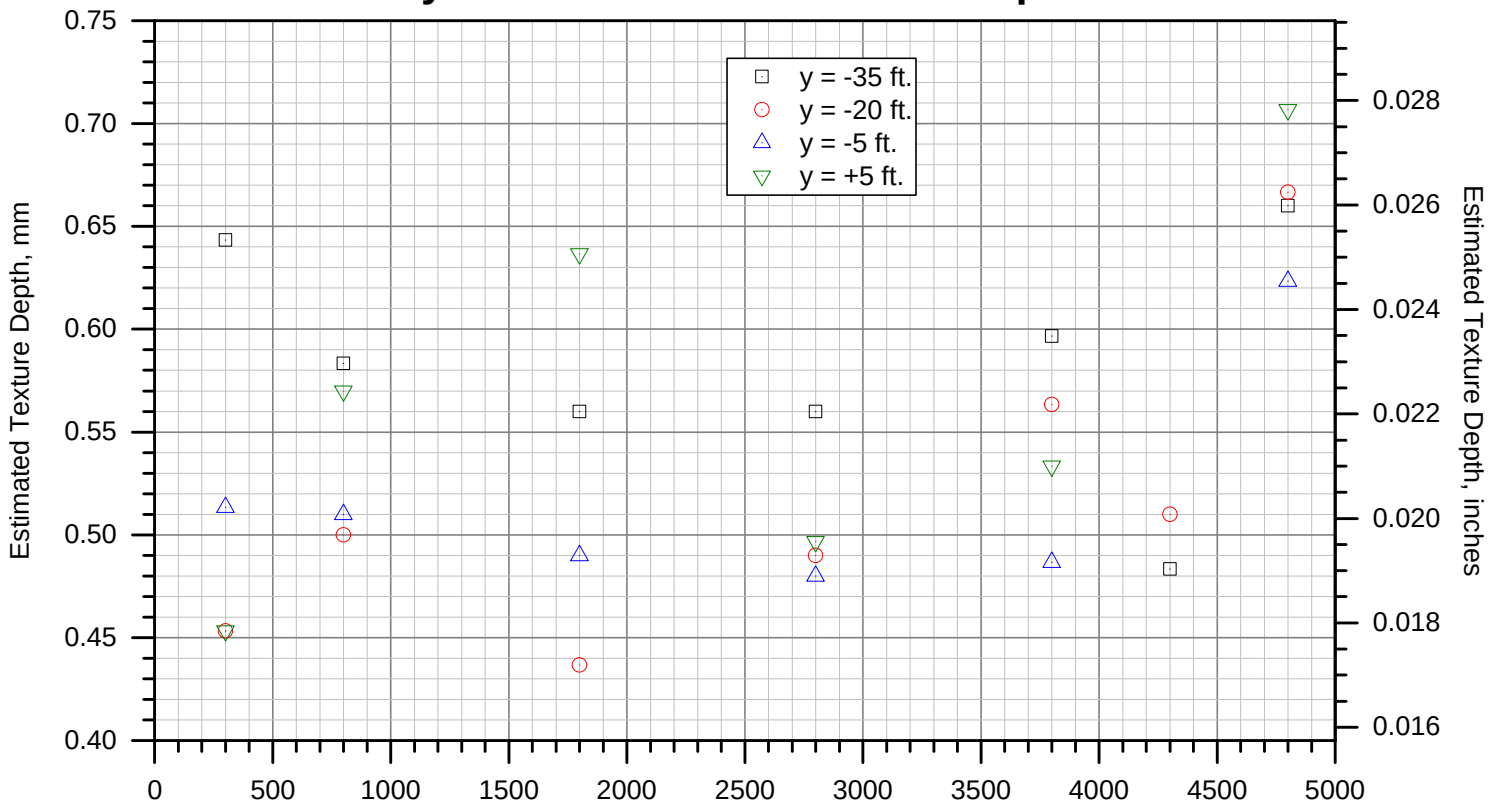
Table 3. DFT run matrix.

Run Log							
Run #	**Time (CDT)**	**Notes**	**Output File**	**Avg. μ**	**Tol. μ**	**V, mph**	**y, ft.**
1	10:36	Bad data - negative mu values	21_20150505_103647.csv	-	-	30	-5
2	10:47		20_20150505_104618.csv	0.496	0.495	40	-5
3	10:52		22_20150505_105125.csv	0.421	0.436	50	-5
4	10:55	Break for water refill and heavy rain	23_20150505_105503.csv	0.369	0.354	60	-5
5	11:39	No GPS track; no H2O; repeat of Run 1	24_20150505_113737.csv	0.562	0.564	30	-5
6	11:47	No H2O	27_20150505_114720.csv	0.530	0.511	60	+5
7	11:54	No H2O; large GPS error	26_20150505_115332.csv	0.588	0.584	50	+5
8	11:57	No H2O	25_20150505_115712.csv	0.600	0.601	40	+5
9	12:00	No H2O	24_20150505_120027.csv	0.620	0.621	30	+5
10	12:11	H2O back on	28_20150505_121102.csv	0.432	0.423	60	-20
11	12:17	Offset to avoid overrunning H2O track	29_20150505_121725.csv	0.479	0.473	50	-20
12	12:20	Offset again	30_20150505_122042.csv	0.527	0.524	40	-20
13	12:25	Offset other side; break for water refill	31_20150505_122437.csv	0.621	0.622	30	-20
14	12:48		32_20150505_124809.csv	0.548	0.526	60	-35
15	12:51		33_20150505_125136.csv	0.581	0.573	50	-35
16	12:55		34_20150505_125516.csv	0.614	0.606	40	-35
17	13:01	Break for water refill	35_20150505_130115.csv	0.705	0.705	30	-35
18	13:21		23_20150505_132105.csv	0.456	0.435	60	+5
19	13:24		29_20150505_132416.csv	0.511	0.502	50	-20
20	13:27		34_20150505_132718.csv	0.624	0.615	40	-35
21	13:30		21_20150505_133042.csv	0.592	0.581	30	+5

Table 4. DFT run log.

FIGURES

KCXO runway 1 examination, 05/05/2015
Runway macrotexture and cross-slope results



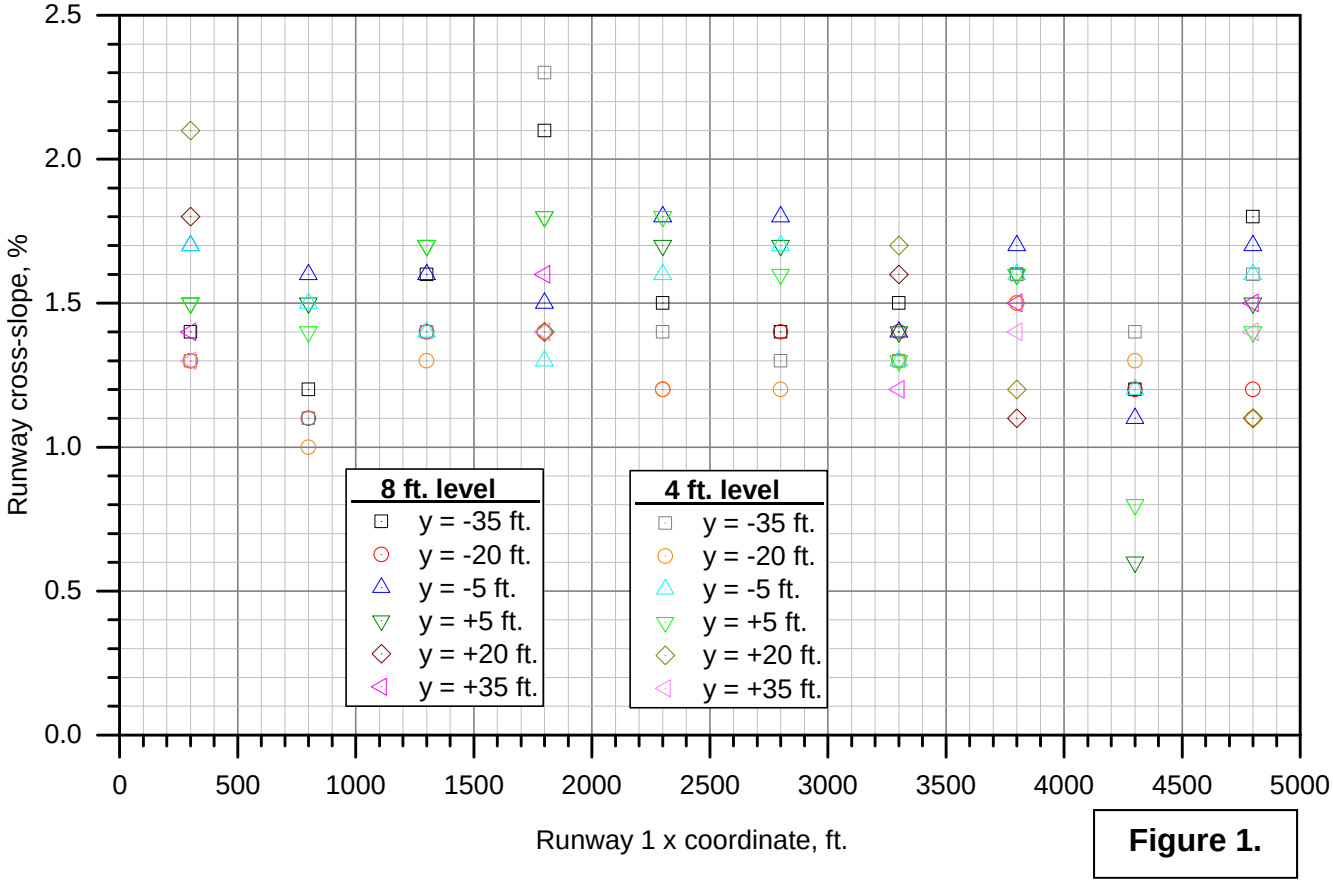


Figure 1.

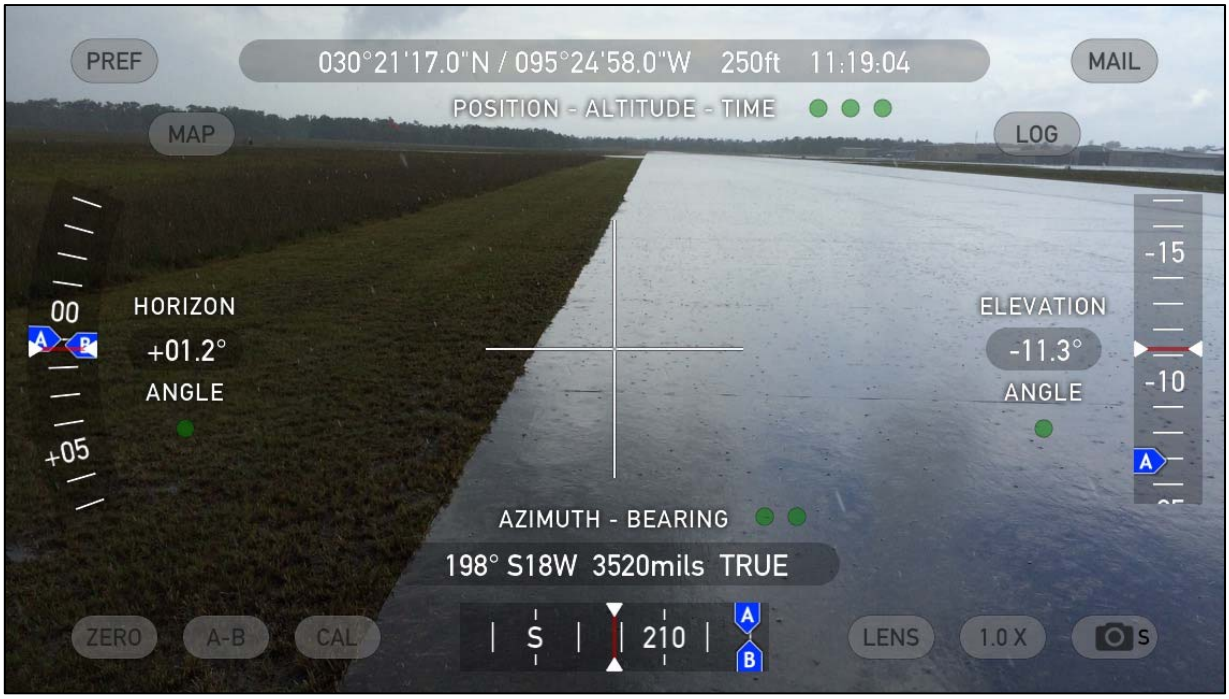


Figure 2a. Photo of east edge of KCXO runway 1 during a 0.5 in./hr. rain event.

Figure 2b. Photo of west edge of KCXO runway 1 during a 0.5 in./hr. rain event.

KCXO runway 1 examination, 05/05/2015
ASOS measured rainfall and computed rainfall rate

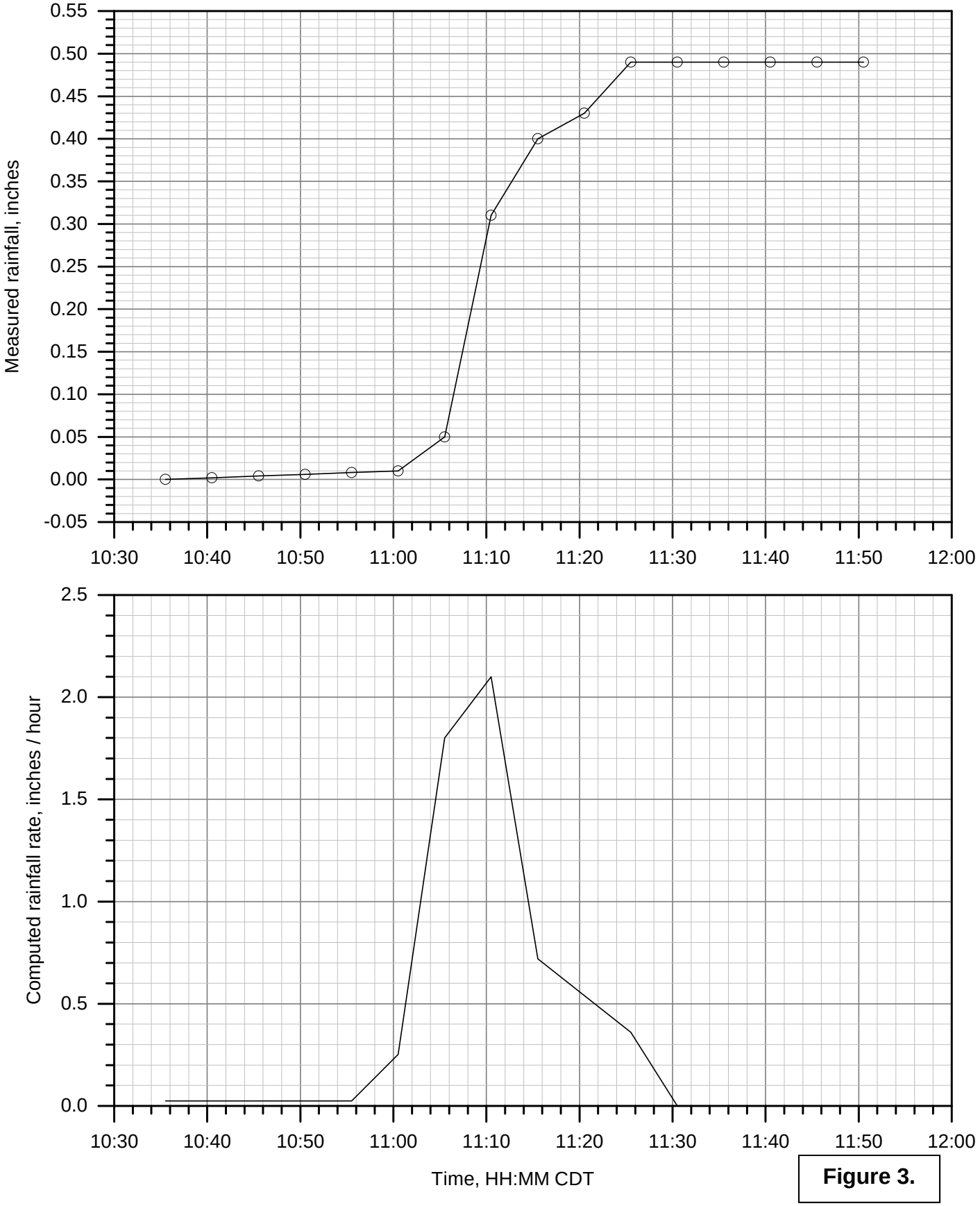


Figure 3.

KCXO runway 1 examination, 05/05/2015
DFT friction coefficient (μ) measurement results: y vs. x

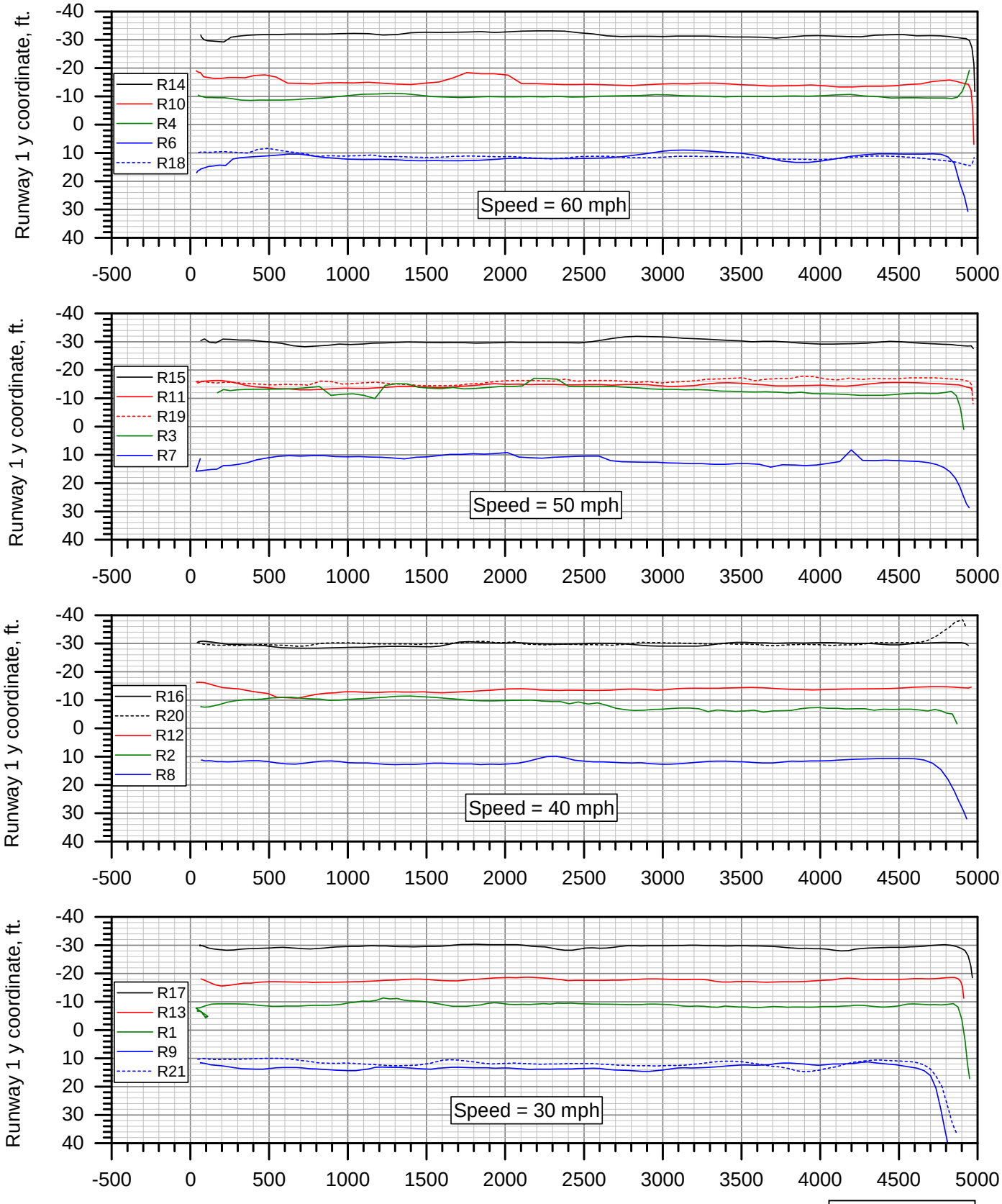


Figure 4.

KCXO runway 1 examination, 05/05/2015

DFT friction coefficient (μ) measurement results: V vs. x

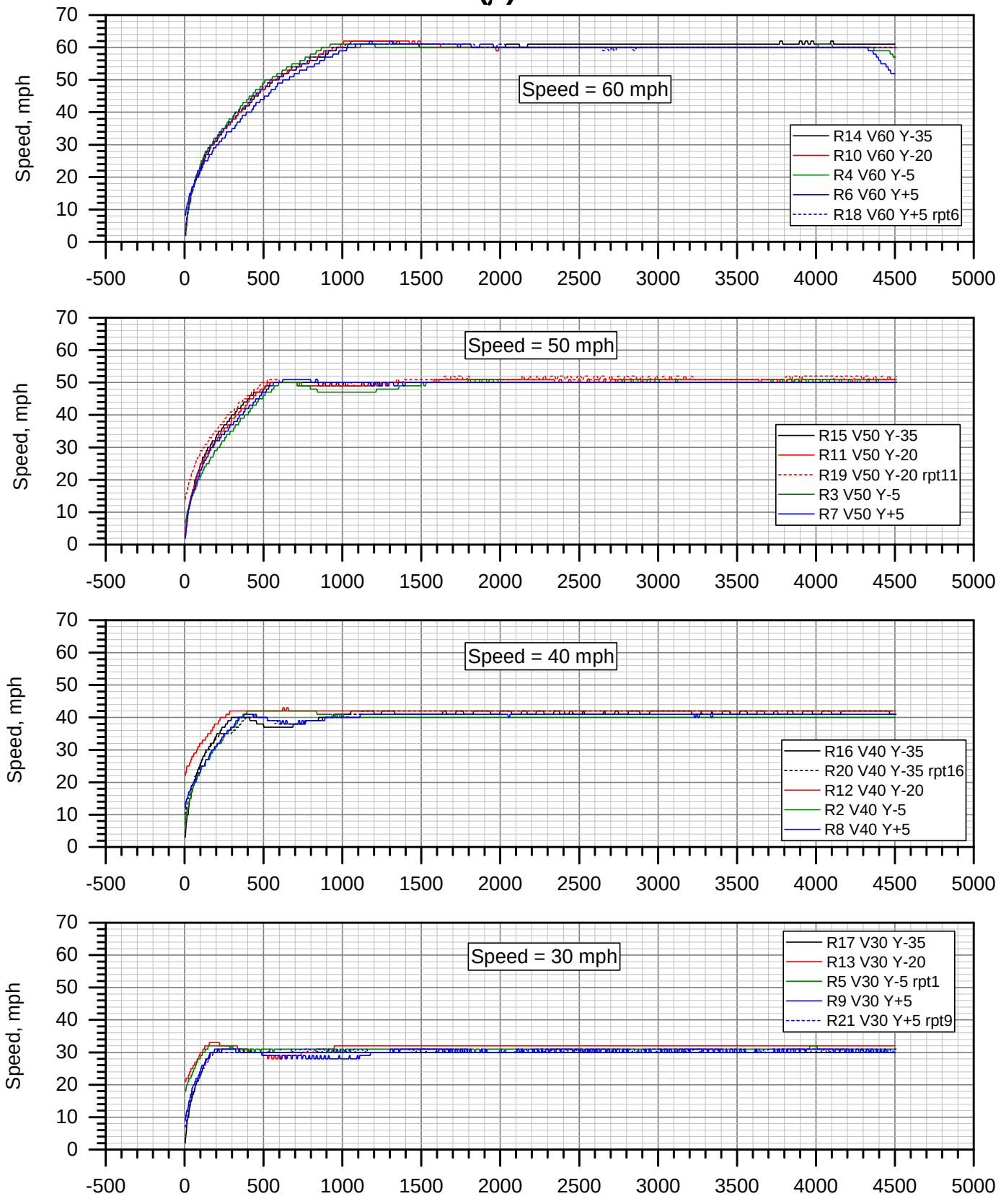


Figure 5.

KCXO runway 1 examination, 05/05/2015

DFT friction coefficient (μ) measurement results: μ vs. x

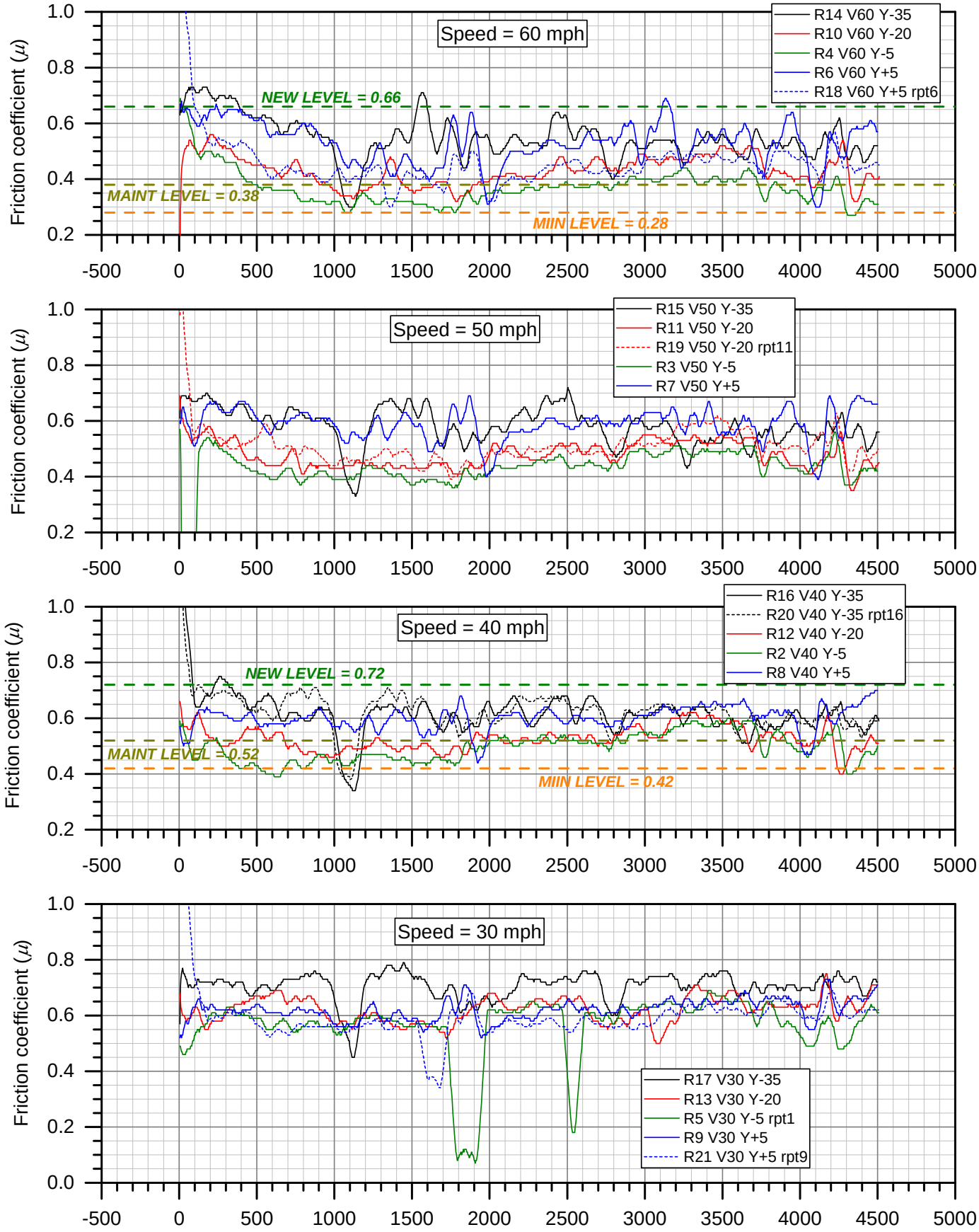


Figure 6.

KCXO runway 1 examination, 05/05/2015
DFT friction coefficient (μ) measurement results: y = +5 ft.

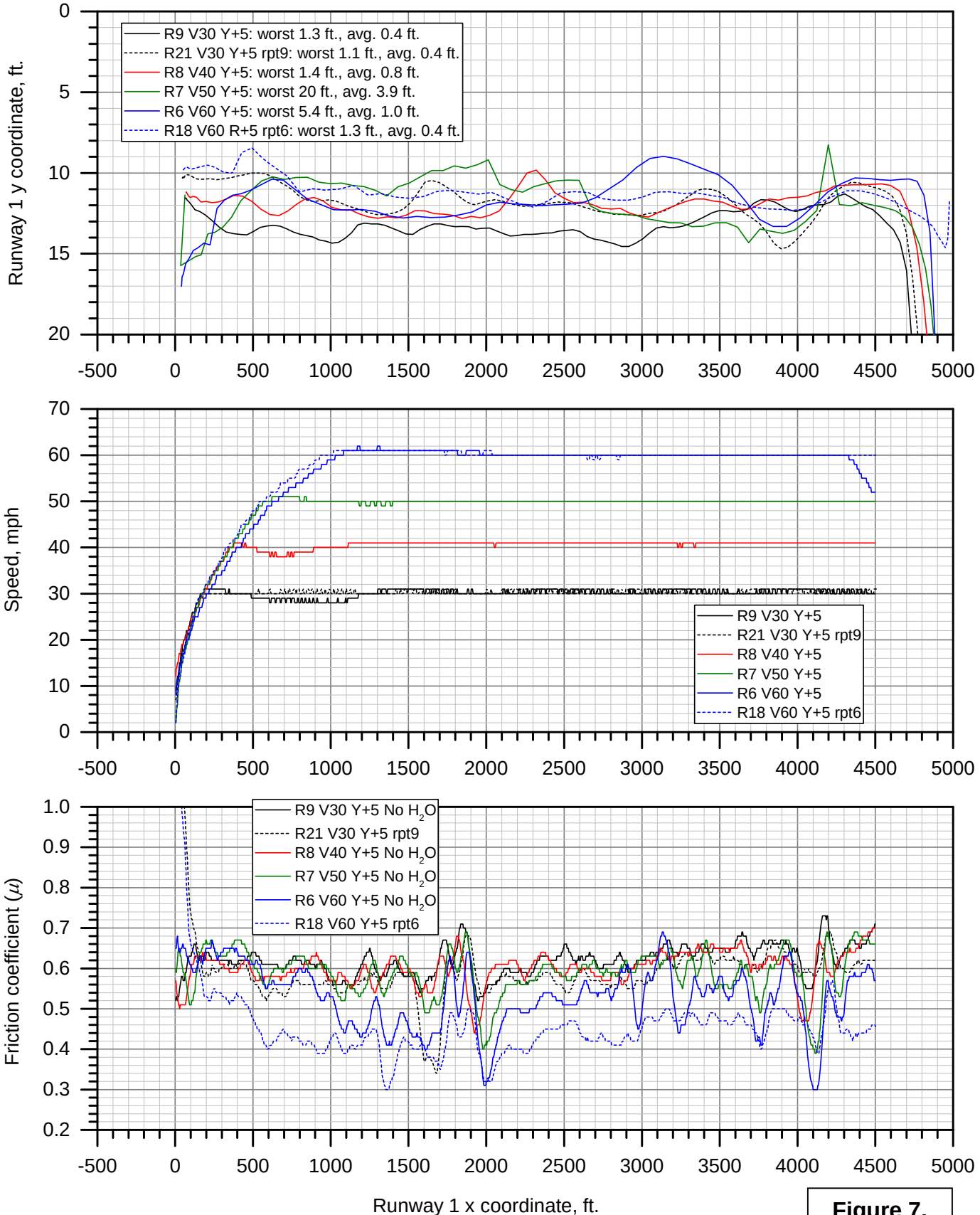


Figure 7.

KCXO runway 1 examination, 05/05/2015
DFT friction coefficient (μ) measurement results: y = -5 ft.

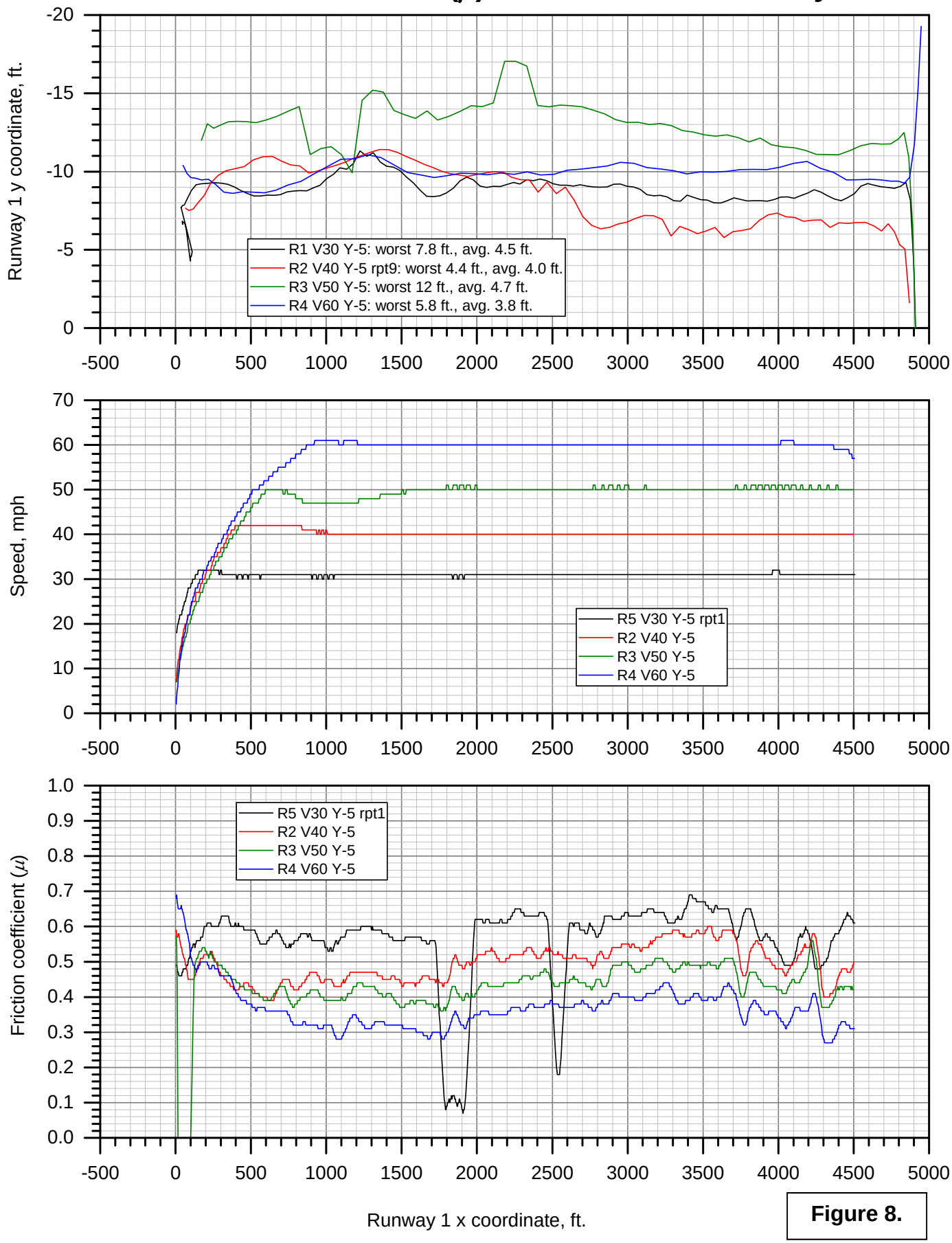


Figure 8.

KCXO runway 1 examination, 05/05/2015
DFT friction coefficient (μ) measurement results: y = -20 ft.

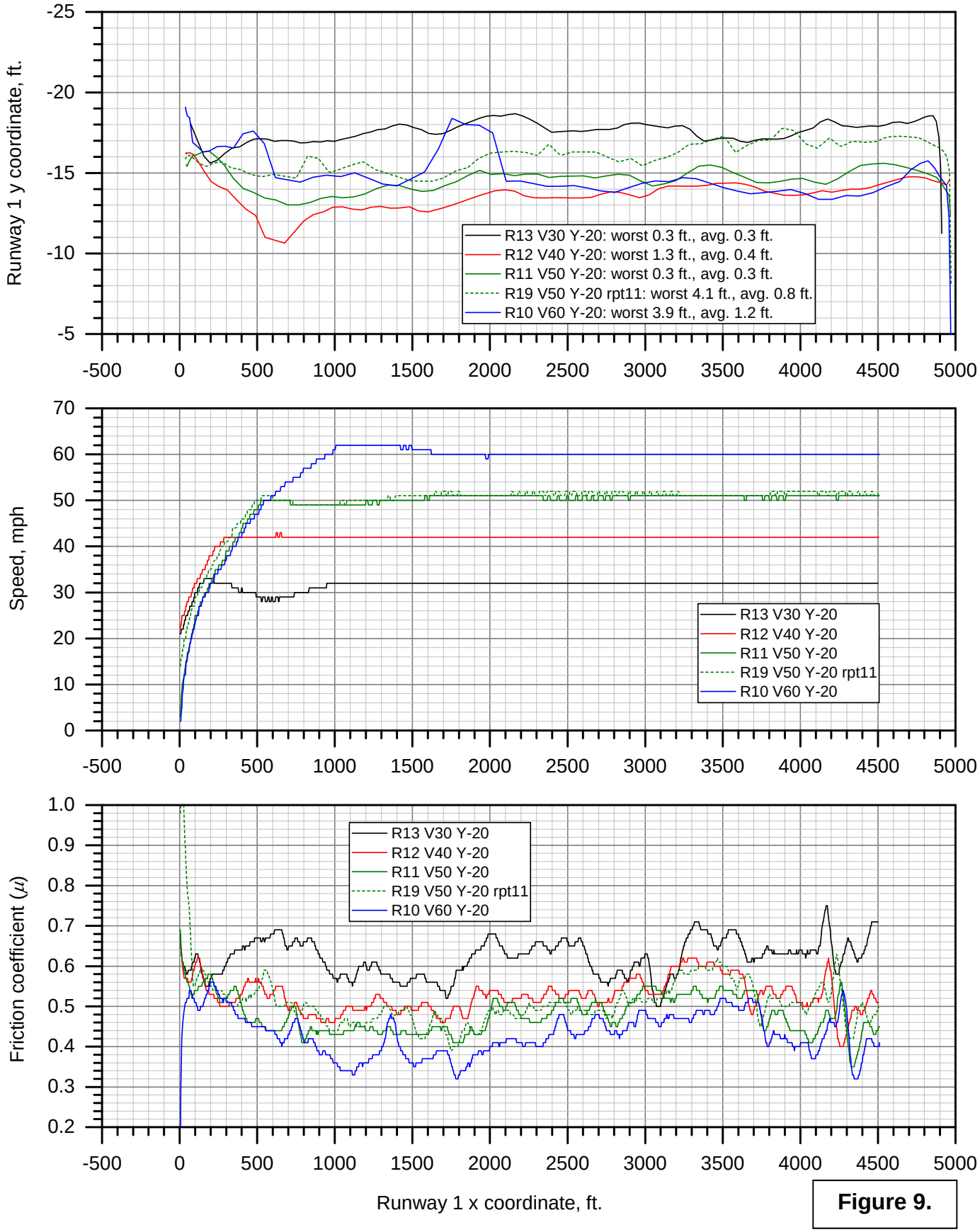


Figure 9.

KCXO runway 1 examination, 05/05/2015
DFT friction coefficient (μ) measurement results: y = -35 ft.

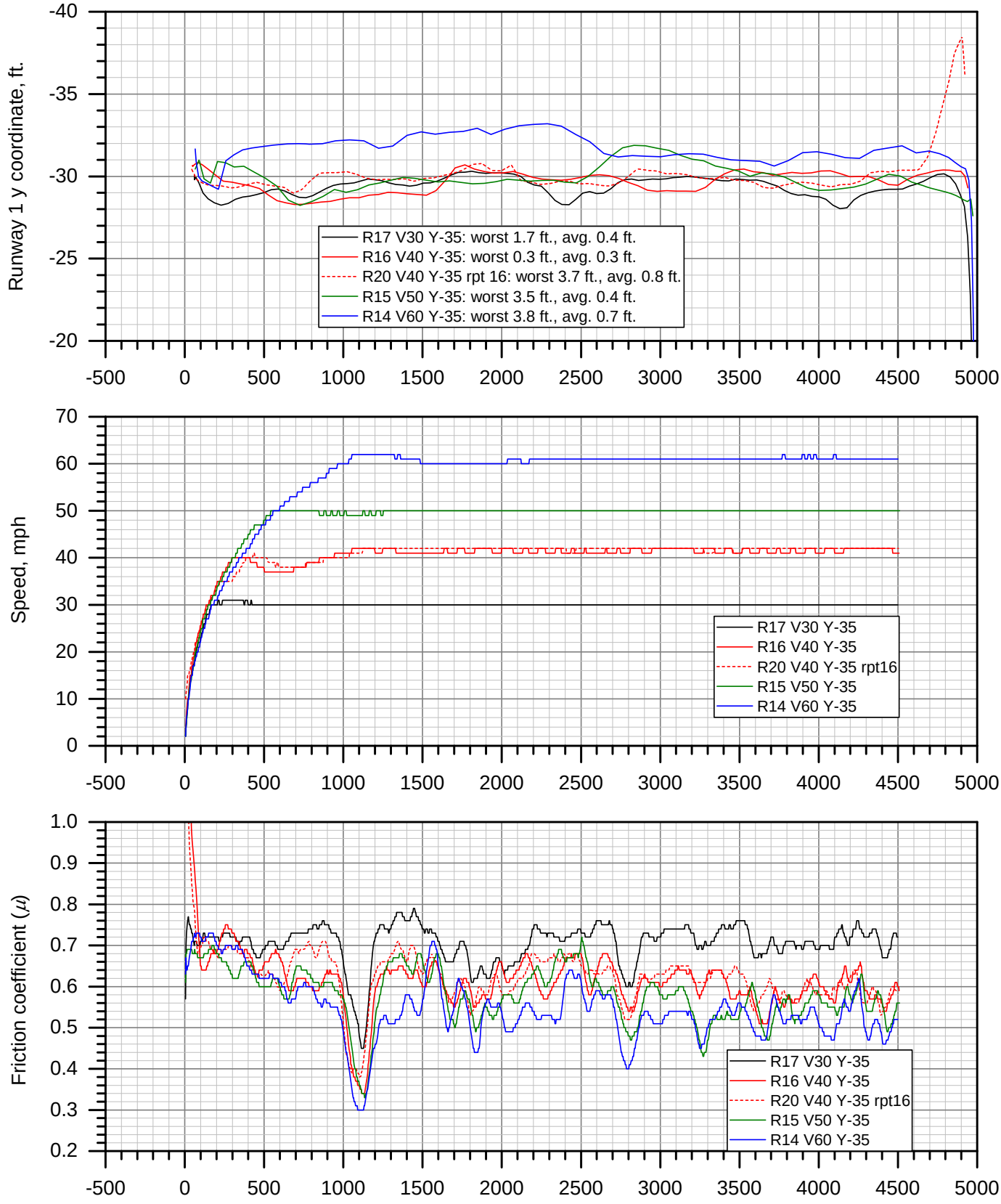
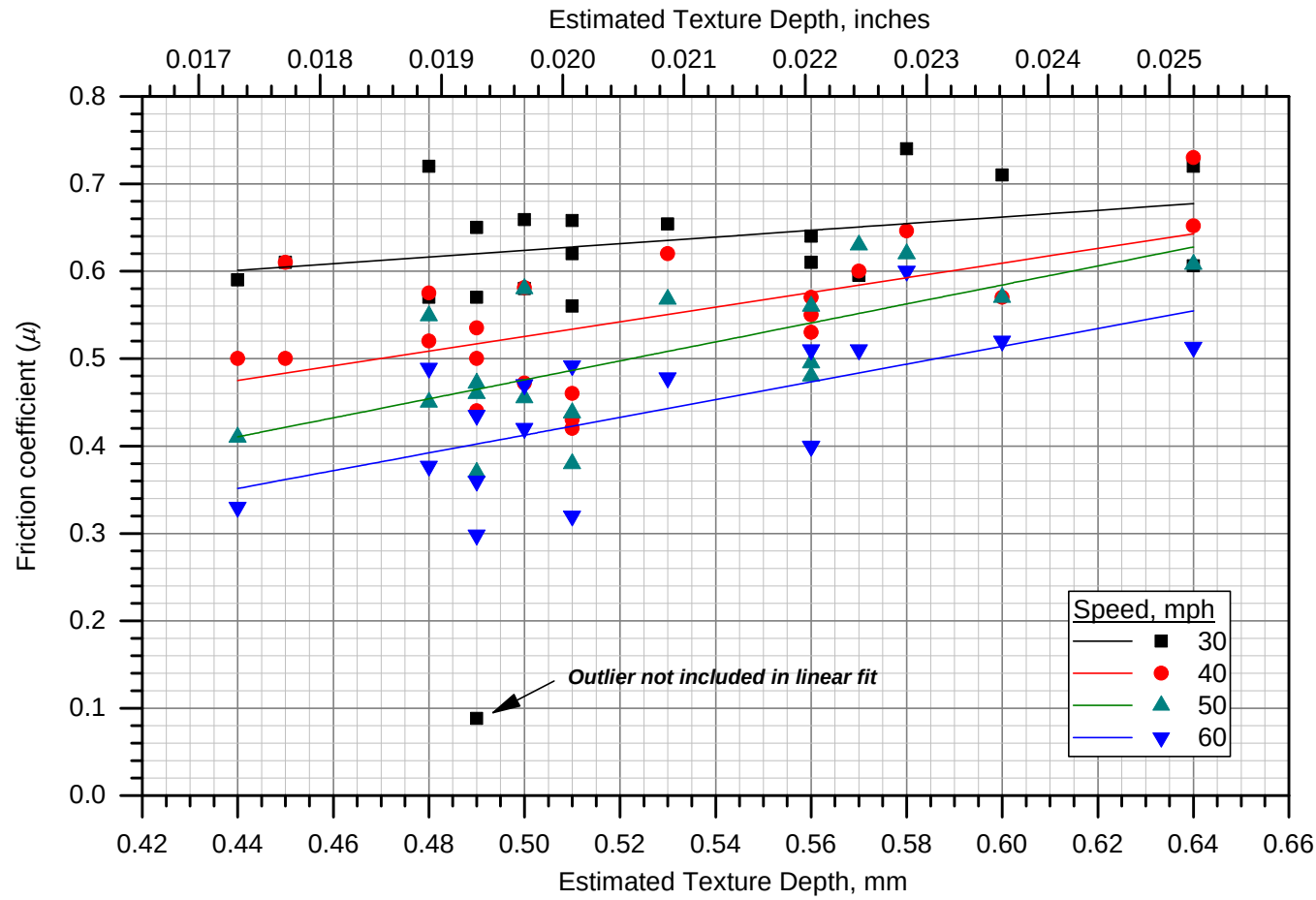


Figure 10.

KCXO runway 1 examination, 05/05/2015

DFT friction coefficient (μ) measurement results: μ vs. ETD & speed



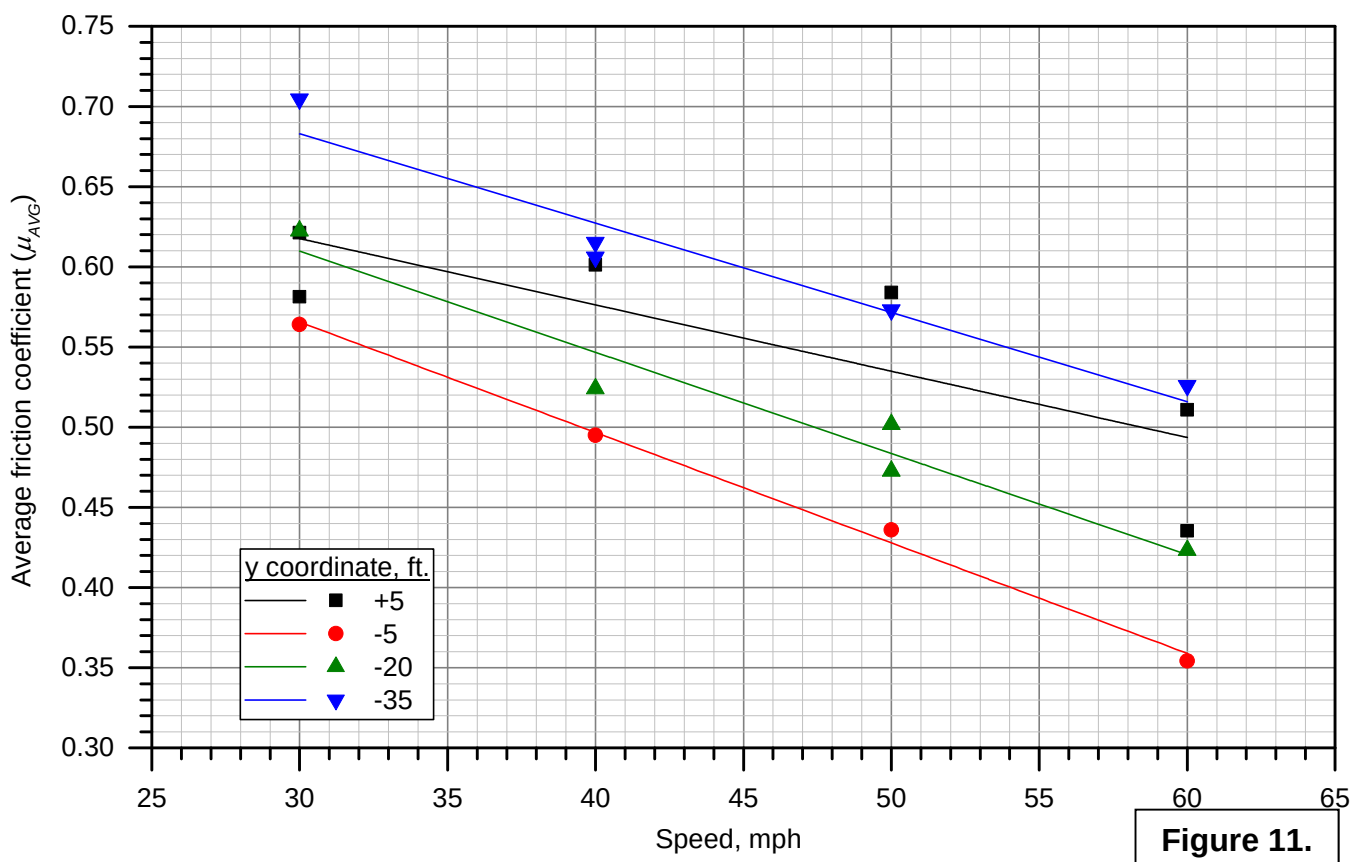


Figure 11.

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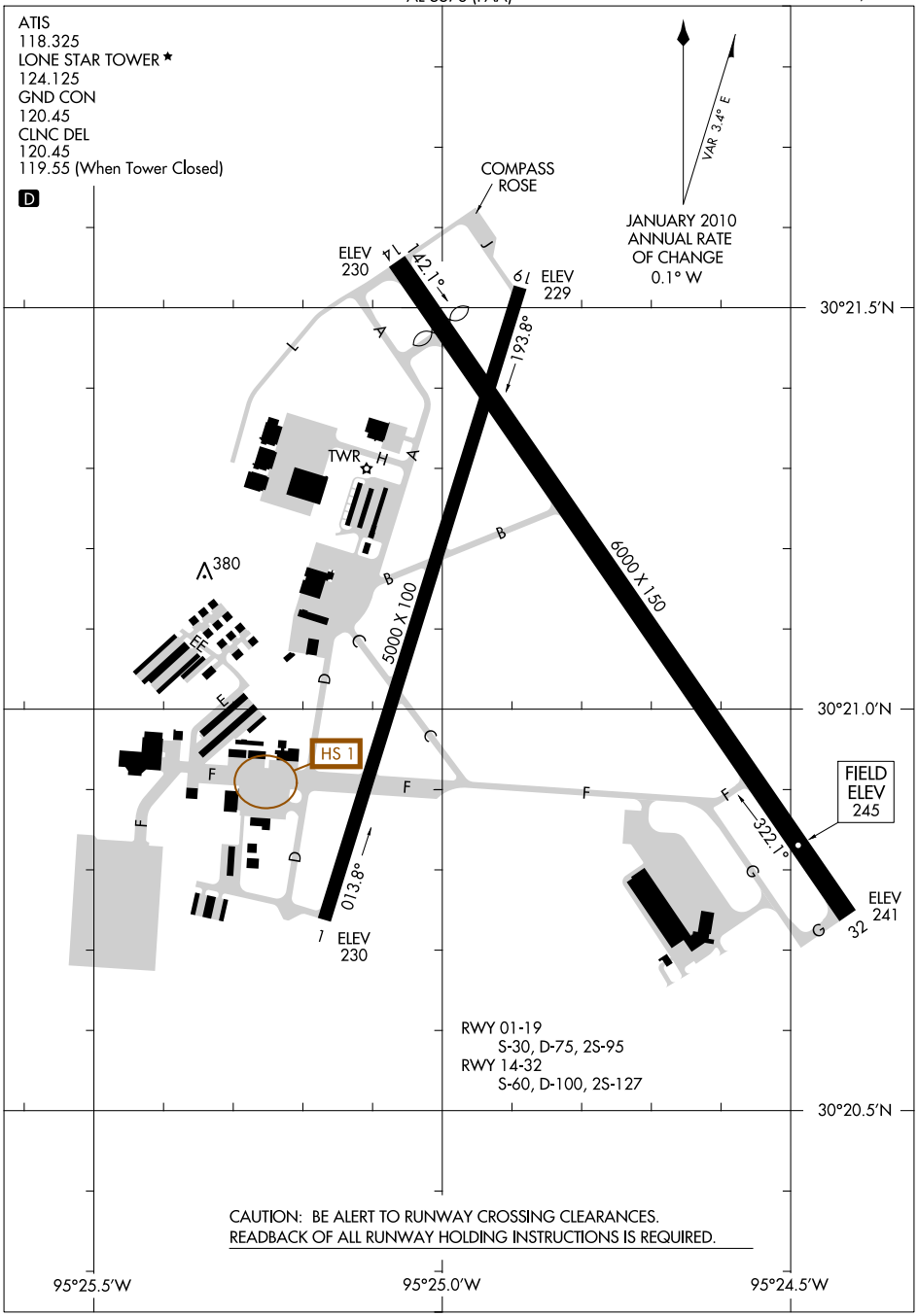
Appendix A: KCXO Airport Diagram and Other Information

AL-5573 (FAA)



SC-5, 13 NOV 2014 to 11 DEC 2014

SC-5, 13 NOV 2014 to 11 DEC 2014

Airport Details for KCXO - ACTIVE

Chart Date: 09/23/2010

LONE STAR EXECUTIVE

HOUSTON

AL #: 5573

State:	TEXAS	Magnetic Variation/Year:	E05/2000	Weather Station:	YES
Country:	United States	Site Nbr:	24072.1	Control Tower:	NO
Category:	AERODROME ONLY	Data Source:	405 NGS		
FAR Part 139:	NO	Owner:	NTL	Use:	CIVIL
				Military Type:	

Coordinates		Office		Local Auto Weather	
Latitutde:	N 30° 21' 08.5000"	Flight Inspection:	OKC	Weather Source:	ASOS
Longitude:	W 095° 24' 52.3000"	Procedure Development:	120	Type:	3
Field Elevation:	244.9	Region Code:	SW	Frequency:	
Ellipsoid Elevation:	154.5 E	Service Area:	CNTL	Service A:	N
Horizontal Datum:	NAD83	OCC Code:	MID		
Vertical Datum:	NAVD88	International:	NO		

CONTACTS

ALTIMETERS

Type	Primary	Airport ID	Field Alt Source	Latitude	Longitude	Operational Timing
L	YES	KCXO	ASOS	N 30° 21' 08.5000"	W 095° 24' 52.3000"	FULL-TIME
R	NO	KDWH	ASOS	N 30° 03' 42.6000"	W 095° 33' 10.0000"	FULL-TIME

ALTIMETER COMMENTS

RUNWAYS

01 (A) 19 (A) 01 (P) 19 (P) 14 (A) 32 (A) 14 (P) 32 (P)

RUNWAY DETAIL

Landing Strip

Chart Date: 02/06/2014	Publication Status: A	Pseudo Rwy:
Surface: ASPH GOOD	Width: 99	Physical Length: 5000

Rwy Number: 01

Use Category: RUNWAY ONLY
Chart Date: 09/20/2012 Pub. Status: A
Data Source: 405 03/03/2009 NGS
Markings: NPI-G

Threshold

Latitude:	N 30° 20' 44.2700"
Longitude:	W 095° 25' 10.1600"
Elevation:	229.6
Ellipsoid Elev:	139.3 S
Ellipsoid Elev Model:	WGS84
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

Displaced Threshold

Latitude:	
Longitude:	
Elevation:	
Ellipsoid Elev:	
Ellipsoid Elev Model:	
Horz. Datum:	
Vert. Datum:	

KCXO01

VGSI Lights

VGSI Lights Type:	PAPI-2L
Owner:	STATE
Pilot Cntl Freq:	
Th Cross Ht:	49.4
High Angle:	
Com. Date:	
Com. Angle:	3.15
DWB Elev:	
DWB Thres:	
Ref Pt Lat:	N 30° 20' 51.4400"
Ref Pt Long:	W 095° 25' 07.5600"
Ref Pt Elev:	236.8
Ref Pt Thres:	762
Height Group:	

Lights

Config	Len	Owner	Mil Type	Com Dt	Pilot Cntrl
MIRL		STATE			

Landing Length:	5000
Fl RWY Length:	5000
Fl RWY Height:	228.8
Tdz Elevation:	236.6
True Bearing:	17.17
Ft Disp Th:	
Gradient:	0.0%
RVRTouchdown:	
MidPoint:	
Rollout:	
Rail:	NO
OIS Data Source:	ANALPV 03/03/2009 NGS_SURVEY
Assoc. Fac.:	

Rwy Number: 19

Use Category: RUNWAY ONLY
Chart Date: 09/20/2012 Pub. Status: A
Data Source: 405 03/03/2009 NGS
Markings: NPI-G

Threshold

Latitude:	N 30° 21' 31.5500"
Longitude:	W 095° 24' 53.3100"
Elevation:	228.8
Ellipsoid Elev:	138.5 E
Ellipsoid Elev Model:	WGS84
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

Displaced Threshold

Latitude:	
Longitude:	
Elevation:	
Ellipsoid Elev:	
Ellipsoid Elev Model:	
Horz. Datum:	
Vert. Datum:	

KCXO19

VGSI Lights

VGSI Lights Type:	PAPI-2L
Owner:	STATE
Pilot Cntl Freq:	
Th Cross Ht:	48.6
High Angle:	
Com. Date:	
Com. Angle:	3.00
DWB Elev:	
DWB Thres:	
Ref Pt Lat:	N 30° 21' 24.2900"
Ref Pt Long:	W 095° 24' 55.8500"
Ref Pt Elev:	237.4
Ref Pt Thres:	763
Height Group:	

Lights

Config	Len	Owner	Mil Type	Com Dt	Pilot Cntrl
MIRL		STATE			

Landing Length:	5000
Fl RWY Length:	5000
Fl RWY Height:	229.6
Tdz Elevation:	236.6
True Bearing:	197.18
Ft Disp Th:	
Gradient:	0.0%
RVRTouchdown:	
MidPoint:	
Rollout:	
Rail:	NO
OIS Data Source:	ANALPV 03/03/2009 NGS_SURVEY
Assoc. Fac.:	

RUNWAY LANDING STRIP COMMENTS

RUNWAY LANDING STRIP COMMENTS

RUNWAY 01 COMMENTS

RUNWAY 19 COMMENTS

RUNWAY DETAIL

Landing Strip

Chart Date: 03/05/2015 | Publication Status: P | Pseudo Rwy:
Surface: ASPH GOOD | Width: 99 | Physical Length: 5000

Rwy Number: 01

Use Category: RUNWAY ONLY
Chart Date: 03/05/2015 Pub. Status: P
Data Source: THIRD_PARTY 06/26/2011
Markings: NPI-G

Threshold

Latitude:	N 30° 20' 44.2266"
Longitude:	W 095° 25' 10.1247"
Elevation:	229.6
Ellipsoid Elev:	139.3 S
Ellipsoid Elev Model:	NAVD88
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

Displaced Threshold

Latitude:	
Longitude:	
Elevation:	
Ellipsoid Elev:	
Ellipsoid Elev Model:	
Horz. Datum:	UNKNOWN
Vert. Datum:	UNKNOWN

KCXO01

VGSI Lights

VGSI Lights Type:	PAPI-2L
Owner:	STATE
Pilot Cntl Freq:	
Th Cross Ht:	49.4
High Angle:	
Com. Date:	03/21/2012
Com. Angle:	3.15
DWB Elev:	
DWB Thres:	
Ref Pt Lat:	N 30° 20' 51.4400"
Ref Pt Long:	W 095° 25' 07.5500"
Ref Pt Elev:	236.8
Ref Pt Thres:	762
Height Group:	

Lights

Config	Len	Owner	Mil Type	Com Dt	Pilot Cntrl
MIRL		STATE			

Landing Length:	5000
FI RWY Length:	5000
FI RWY Height:	228.7
Tdz Elevation:	236.7
True Bearing:	17.16
Ft Disp Th:	
Gradient:	0.0%
RVRTouchdown:	
MidPoint:	
Rollout:	
Rail:	NO
OIS Data Source:	VG 06/26/2011 THIRD_PARTY
Assoc. Fac.:	

Rwy Number: 19

Use Category: RUNWAY ONLY
Chart Date: 03/05/2015 Pub. Status: P
Data Source: THIRD_PARTY 06/26/2011
Markings: NPI-G

Threshold

Latitude:	N 30° 21' 31.5059"
Longitude:	W 095° 24' 53.2773"
Elevation:	228.7
Ellipsoid Elev:	138.5 S
Ellipsoid Elev Model:	NAVD88
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

Displaced Threshold

Latitude:	
Longitude:	
Elevation:	
Ellipsoid Elev:	
Ellipsoid Elev Model:	
Horz. Datum:	UNKNOWN
Vert. Datum:	UNKNOWN

KCXO19

VGSI Lights

VGSI Lights Type:	PAPI-2L
Owner:	STATE
Pilot Cntl Freq:	
Th Cross Ht:	48.6
High Angle:	
Com. Date:	03/21/2012
Com. Angle:	3.00
DWB Elev:	
DWB Thres:	
Ref Pt Lat:	N 30° 21' 24.2900"
Ref Pt Long:	W 095° 24' 55.8500"
Ref Pt Elev:	237.4
Ref Pt Thres:	763
Height Group:	

Lights

Config	Len	Owner	Mil Type	Com Dt	Pilot Cntrl
MIRL		STATE			

Landing Length:	5000
FI RWY Length:	5000
FI RWY Height:	229.6
Tdz Elevation:	236.7
True Bearing:	197.17
Ft Disp Th:	
Gradient:	0.0%
RVRTouchdown:	
MidPoint:	
Rollout:	
Rail:	NO
OIS Data Source:	VG 06/26/2011 THIRD_PARTY
Assoc. Fac.:	

RUNWAY LANDING STRIP COMMENTS

RUNWAY 01 COMMENTS

RUNWAY 19 COMMENTS

RUNWAY DETAIL

Landing Strip

Chart Date: 02/06/2014 | Publication Status: A | Pseudo Rwy:
Surface: CONC GOOD | Width: 150 | Physical Length: 7501

Rwy Number: 14

Use Category: RUNWAY ONLY
Chart Date: 07/29/2010 Pub. Status: A
Data Source: 405 03/01/1991 NGS
Markings: PIR-G

KCXO14

Threshold

Latitude:	N 30° 21' 33.4734"
Longitude:	W 095° 25' 03.9041"
Elevation:	230.1
Ellipsoid Elev:	139.9 S
Ellipsoid Elev Model:	WGS84
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

Rwy Number: 32

Use Category: RUNWAY ONLY
Chart Date: 07/29/2010 Pub. Status: A
Data Source: 405 03/03/2009 NGS
Markings: NPI-G

KCXO32

Threshold

Latitude:	N 30° 20' 44.5408"
Longitude:	W 095° 24' 25.1018"
Elevation:	241.3
Ellipsoid Elev:	151.0 S
Ellipsoid Elev Model:	WGS84
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

VGSI Lights

VGSI Lights Type:	PAPI-2L
Owner:	STATE
Pilot Cntl Freq:	
Th Cross Ht:	31.0
High Angle:	
Com. Date:	
Com. Angle:	3.00
DWB Elev:	
DWB Thres:	
Ref Pt Lat:	
Ref Pt Long:	
Ref Pt Elev:	
Ref Pt Thres:	
Height Group:	

Lights

Config	Len	Owner	Mil Type	Com Dt	Pilot Cntrl
MALSR		STATE			122.950
MIRL		STATE			122.950

Lights

Config	Len	Owner	Mil Type	Com Dt	Pilot Cntrl
MIRL		STATE			122.950
REIL		STATE			122.950

Displaced Threshold

Latitude:	N 30° 21' 28.6715"
Longitude:	W 095° 25' 00.0957"
Elevation:	230.6
Ellipsoid Elev:	140.4 S
Ellipsoid Elev Model:	WGS84
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

Landing Length:	5411
Fl RWY Length:	5411
Fl RWY Height:	241.3
Tdz Elevation:	242.8
True Bearing:	145.48
Ft Disp Th:	589
Gradient:	0.2%
RVRTouchdown:	
MidPoint:	
Rollout:	
Rail:	YES
OIS Data Source:	PIR 03/01/1991 NGS_SURVEY
Assoc. Fac.:	CXO ILS (A)

Displaced Threshold

Latitude:	
Longitude:	
Elevation:	
Ellipsoid Elev:	
Ellipsoid Elev Model:	
Horz. Datum:	
Vert. Datum:	

Landing Length:	6000
Fl RWY Length:	5411
Fl RWY Height:	230.6
Tdz Elevation:	244.9
True Bearing:	325.49
Ft Disp Th:	
Gradient:	-0.2%
RVRTouchdown:	
MidPoint:	
Rollout:	
Rail:	NO
OIS Data Source:	ANALPV 03/03/2009 NGS_SURVEY
Assoc. Fac.:	

RUNWAY LANDING STRIP COMMENTS

RUNWAY 14 COMMENTS

RUNWAY 32 COMMENTS

RUNWAY DETAIL

Landing Strip

Chart Date: 03/05/2015	Publication Status: P	Pseudo Rwy:
Surface: CONC GOOD	Width: 150	Physical Length: 7501

Rwy Number: 14

Use Category: RUNWAY ONLY
Chart Date: 03/05/2015 Pub. Status: P
Data Source: THIRD_PARTY 06/26/2011
Markings: PIR-G

Threshold

Latitude:	N 30° 21' 45.7165"
Longitude:	W 095° 25' 13.6157"
Elevation:	234.1
Ellipsoid Elev:	143.8 S
Ellipsoid Elev Model:	NAVD88
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

Displaced Threshold

Latitude:	
Longitude:	
Elevation:	
Ellipsoid Elev:	
Ellipsoid Elev Model:	NAVD88
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

Landing Length:	7501
Fl RWY Length:	7501
Fl RWY Height:	241.3
Tdz Elevation:	242.9
True Bearing:	145.48
Ft Disp Th:	
Gradient:	0.1%
RVRTouchdown:	

KCXO14

VGSI Lights

VGSI Lights Type:	PAPI-4L
Owner:	STATE
Pilot Cntl Freq:	122.950
Th Cross Ht:	47.0
High Angle:	
Com. Date:	
Com. Angle:	3.00
DWB Elev:	
DWB Thres:	
Ref Pt Lat:	N 30° 21' 38.0500"
Ref Pt Long:	W 095° 25' 07.5400"
Ref Pt Elev:	231.8
Ref Pt Thres:	941
Height Group:	

Lights

Config	Len	Owner	Mil Type	Com Dt	Pilot Cntrl
MIRL		STATE			122.950
MALSR		STATE			122.950

Rwy Number: 32

Use Category: RUNWAY ONLY
Chart Date: 03/05/2015 Pub. Status: P
Data Source: THIRD_PARTY 06/26/2011
Markings: NPI-G

Threshold

Latitude:	N 30° 20' 44.5408"
Longitude:	W 095° 24' 25.1015"
Elevation:	241.3
Ellipsoid Elev:	151.0 S
Ellipsoid Elev Model:	NAVD88
Horz. Datum:	NAD83
Vert. Datum:	NAVD88

Displaced Threshold

Latitude:	
Longitude:	
Elevation:	
Ellipsoid Elev:	
Ellipsoid Elev Model:	
Horz. Datum:	UNKNOWN
Vert. Datum:	UNKNOWN

Landing Length:	7501
Fl RWY Length:	7501
Fl RWY Height:	234.1
Tdz Elevation:	245.0
True Bearing:	325.48
Ft Disp Th:	
Gradient:	-0.1%
RVRTouchdown:	

KCXO32

VGSI Lights

VGSI Lights Type:	PAPI-2L
Owner:	STATE
Pilot Cntl Freq:	122.950
Th Cross Ht:	50.0
High Angle:	
Com. Date:	
Com. Angle:	3.00
DWB Elev:	
DWB Thres:	
Ref Pt Lat:	N 30° 20' 51.8100"
Ref Pt Long:	W 095° 24' 30.8700"
Ref Pt Elev:	245.0
Ref Pt Thres:	892
Height Group:	

Lights

Config	Len	Owner	Mil Type	Com Dt	Pilot Cntrl
REIL		STATE			122.950
MIRL		STATE			122.950

Rpt Date: **20:00:36 08/15/2014**
Rpt User: **dso**

MidPoint:		MidPoint:	
Rollout:		Rollout:	
Rail:	YES	Rail:	NO
OIS Data Source:	VG 06/26/2011 THIRD_PARTY	OIS Data Source:	VG 06/26/2011 THIRD_PARTY
Assoc. Fac.:	CXO ILS (P)	Assoc. Fac.:	

RUNWAY LANDING STRIP COMMENTS

RUNWAY 14 COMMENTS

RUNWAY 32 COMMENTS

COMMENTS

Topic	Priority	Date	Remark
SURVEY	1	11/05/1999	NGS 405 SURVEY DATED 04/18/98
ADDITIONAL_FLIGHT_DATA	1	06/26/2000	ASOS. 936-760-4237
NFDD	3	02/25/2004	PER NFDD #049 DATED 03/12/04, ARPT NAME CHANGED FROM LONE STAR RGNL TO LONE STAR EXECUTIVE, CITY FROM CONROE TO HOUSTON
LIGHTS	5	06/05/2006	RWY 14/32 TO CHANGE RWY 14 VASI TO PAPI PER NFDD #080 DATED 04/26/06
SURVEY	5	06/27/2007	ALTERNATE ALTIMETER SOURCE, KDWH, ADDED PER AVN-120
OWNER	2	10/15/2007	LIGHTS OWNED BY MONTGOMERY COUNTY
GENERAL	7	10/16/2007	RWY 01/19 BEING EXTENDED ON NORTH END. DATA PROVIDED BY LOCAL SURVEY. NFDD #217 DATED 11/08/07 RWY 19 PAPI DATA PROVIDED BY PROJECT MGR, 11/05/07 RWY 01 PAPI DATA TO CHANGE ANGLE & MODIFY DATA FORWARDED BY TX ADO FROM PROJECT MGR, 10/15/07 TDZE USED IN LIEU OF UNKNOWN RRP ELEVATION TCH IS A CALCULATED VALUE
NFDD	9	12/09/2008	PER NFDD # 238 DATED 12/10/08 RWY 32 4 BOX VASI DELETED.

SIAPS

Nav Ident	Nav Type	Description	FAS	Amendment	Type
		RNAV (GPS) RWY 32	329 / TREE / N30°20'43.08" / W095°24'14.66" 409 / TOWER / N30°17'30.60" / W095°21'41.30"	1	CIVIL
CXO	ILS	ILS OR LOC RWY 14	379 / TREE / N30°22'36.00" / W095°26'19.00"	2B	CIVIL
		RNAV (GPS) RWY 14	325 / TREE / N30°21'38.48" / W095°25'20.28" 553 / TOWER / N30°25'50.00" / W095°26'20.00"	ORG	CIVIL
		RNAV (GPS) RWY 19	374 / TREE / N30°22'12.18" / W095°24'17.43" 409 / TREE / N30°23'24.40" / W095°24'42.08"	ORG	CIVIL
		RNAV (GPS) RWY 1	395 / TOWER / N30°20'19.00" / W095°25'43.00"	ORG	CIVIL
CXO	ILS	NDB RWY 14	480 / TANK / N30°23'34.00" / W095°28'30.00"	2B	CIVIL

ASSOCIATED MONITORS

ASSOCIATED DGPS

AIRNAV.COM

Airports | Navaids | Airspace Fixes | Aviation Fuel | AIRBOSS | iPhone App | My AirNav

952 users online LOGIN

KCXO Lone Star Executive Airport
Houston, Texas, USA

GOING TO HOUSTON? Reserve a Hotel Room enterprise Reserve Online

FAA INFORMATION EFFECTIVE 18 SEPTEMBER 2014

Loc | Ops | Rwys | IFR | FBO | Links
Com | Nav | Svcs | Stats | Notes

Location

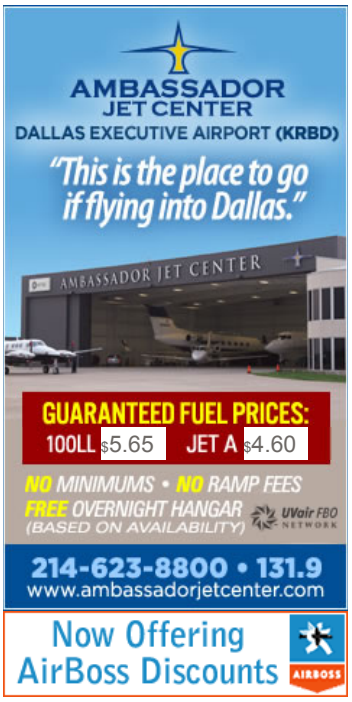
FAA Identifier: CXO
Lat/Long: 30-21-08.5000N / 095-24-52.3000W
30-21.141667N / 095-24.871667W
30.3523611 / -95.4145278
(estimated)
Elevation: 245 ft. / 74.7 m (surveyed)
Variation: 05E (2000)
From city: 37 miles N of HOUSTON, TX
Time zone: UTC -5 (UTC -6 during Standard Time)
Zip code: 77303

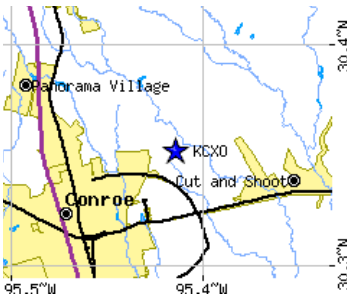
Airport Operations

Airport use: Open to the public
Activation date: 05/1944
Sectional chart: HOUSTON
Control tower: yes
ARTCC: HOUSTON CENTER
FSS: MONTGOMERY COUNTY FLIGHT SERVICE STATION
NOTAMs facility: CXO (NOTAM-D service available)
Attendance: 0700-2100
Wind indicator: lighted
Segmented circle: yes
Lights: DUSK-DAWN. MIRL RY 14/32 PRESET LOW INTST; TO INCR INTST & ACTVT MALSR RY 14 AND REIL RY 32 - CTAF.
Beacon: white-green (lighted land airport)
Operates sunset to sunrise.

Airport Communications

CTAF: 124.125
ATIS: 118.325
WX ASOS: 118.325 (936-760-4237)
LONE STAR GROUND: 120.45 [0700-2200]
LONE STAR TOWER: 124.125 [0700-2200]
HOUSTON APPROACH: 119.7
HOUSTON DEPARTURE: 119.7
CLEARANCE DELIVERY: 119.55 WHEN ATCT CLSD 120.45
BORRN DP: 119.7
DREMR DP: 119.7
INDIE DP: 119.7
KARRR DP: 119.7
LURIC DP: 119.7
MMALT DP: 119.7
STRYA DP: 119.7
STYCK DP: 119.7
WATFO DP: 119.7
WYLSN DP: 119.7
WX ASOS at DWH (19 nm S): PHONE 281-251-7853





Road maps at: MapQuest Bing Google Yahoo!

Aerial photo

WARNING: Photo may not be current or correct

Nearby radio navigation aids

VOR radial/distance	VOR name	Freq	Var
IAHr346/24.0	HUMBLE VORTAC	116.60	05E
TNVr075/33.6	NAVASOTA VORTAC	115.90	08E

NDB name	Hdg/Dist	Freq	Var	ID
DAVID HOOKS	025/15.7	521	05E	DWH -.. .-- ....
NIXIN	329/23.9	326	05E	BVP -... ...- .--.
HUNTSVILLE	153/25.0	308	06E	UTS ..- - ...
WEISER	019/27.7	286	06E	EYQ . -.-- --.-

Airport Services

Fuel available: 100LL JET-A
Parking: hangars and tiedowns
Airframe service: MAJOR
Powerplant service: MAJOR
Bottled oxygen: HIGH/LOW
Bulk oxygen: NONE

Runway Information

Runway 14/32

Dimensions: 6000 x 150 ft. / 1829 x 46 m
Surface: concrete, in good condition
Weight bearing capacity: Single wheel: 60.0
Double wheel: 100.0
Runway edge lights: medium intensity

	RUNWAY 14	RUNWAY 32
Latitude:	30-21.557890N	30-20.742347N
Longitude:	095-25.065068W	095-24.418363W
Elevation:	230.1 ft.	241.3 ft.
Gradient:	0.3%	0.3%
Traffic pattern:	left	left
Runway heading:	140 magnetic, 145 true	320 magnetic, 325 true
Displaced threshold:	589 ft.	no
Markings:	precision, in good condition	nonprecision, in good condition
Visual slope indicator:	2-light PAPI on left (3.00 degrees glide path)	
Approach lights:	MALSR: 1,400 foot medium intensity approach lighting system with runway alignment indicator lights	
Runway end identifier lights:		yes
Touchdown point:	yes, no lights	yes, no lights
Instrument approach:	ILS/DME	
Obstructions:	10 ft. road, 200 ft. from runway, 40 ft. left of centerline 10 FT ROAD FM THLD TO 200 FT.	9 ft. ant, 400 ft. from runway, 260 ft. left of centerline, 22:1 slope to clear

Runway 1/19

Dimensions: 5000 x 100 ft. / 1524 x 30 m
Surface: concrete, in good condition
Weight bearing capacity: Single wheel: 30.0
Double wheel: 75.0
Runway edge lights: medium intensity

	RUNWAY 1	RUNWAY 19
Latitude:	30-20.737833N	30-21.525833N
Longitude:	095-25.169333W	095-24.888500W
Elevation:	229.6 ft.	228.8 ft.
Gradient:	0.2%	0.2%
Traffic pattern:	left	left
Runway heading:	012 magnetic, 017 true	192 magnetic, 197 true
Declared distances:	TORA:5000 TODA:5000 ASDA:5000 LDA:5000	TORA:5000 TODA:5000 ASDA:5000 LDA:5000
Markings:	nonprecision, in good condition	nonprecision, in good condition
Visual slope indicator:		

Photo by Nigel Milligan / Kevin Williams
Photo taken 25-Sep-2014
looking west.

Do you have a better or more recent aerial photo of Lone Star Executive Airport that you would like to share? If so, please send us your photo.

Sectional chart

Airport diagram

CAUTION: Diagram may not be current

Airport distance calculator

Flying to Lone Star Executive Airport? Find the distance to fly.

From ____ to KCXO

CALCULATE DISTANCE

Sunrise and sunset

Times for 06-Oct-2014

	Local (UTC-5)	Zulu (UTC)
Morning civil twilight	06:55	11:55
Sunrise	07:19	12:19
Sunset	19:00	00:00
Evening civil twilight	19:24	00:24

Current date and time

Zulu (UTC)	06-Oct-2014 11:58:15
Local (UTC-5)	06-Oct-2014 06:58:15

METAR

KCXO 061153Z 00000KT 10SM CLR 18/18 A2988 RMK AO2 SLP113 T01830178 10189 20167 58001
KDWH 061053Z 00000KT 10SM CLR 20/18 19nm S A2987 RMK AO2 SLP114 T02000183

TAF

KCXO 060520Z 0606/0706 00000KT P6SM FEW025 FM061000 15005KT P6SM BKN020 FM061600 17009KT P6SM VCSH SCT030 BKN120 FM061900 17009KT P6SM VCSH SCT040 PROB30 0619/0623 TSRA BKN040CB BKN250

NOTAMs

Click for the latest **NOTAMs**

NOTAMs are issued by the DoD/FAA and will open in a separate window not controlled by AirNav.

	2-light PAPI on left (3.15 degrees glide path)	2-light PAPI on left (3.00 degrees glide path)
Touchdown point:	yes, no lights	yes, no lights
Obstructions:	none	4 ft. tree, 350 ft. from runway, 70 ft. right of centerline, 37:1 slope to clear

Airport Ownership and Management from official FAA records

Ownership: Publicly-owned
Owner: MONTGOMERY COUNTY
501 N. THOMPSON ST.
CONROE, TX 77301
Phone 936-539-7811
Manager: SCOTT SMITH
10260 CARL PICKERING MEMORIAL
CONROE, TX 77303
Phone 936-788-8311

Airport Operational Statistics

Aircraft based on the field:	329	Aircraft operations: avg 219/day *
Single engine airplanes:	234	58% local general aviation
Multi engine airplanes:	36	39% transient general aviation
Jet airplanes:	32	2% military
Helicopters:	3	<1% air taxi
Military aircraft:	24	* for 12-month period ending 30 July 2011

Additional Remarks

A23 HELICOPTERS USE RIGHT-HAND TRAFFIC.
- EXTENSIVE MILITARY HELICOPTER ACTIVITY ON ARPT.
- AVOID NOISE SENSITIVE AREA 10 MI SW QUADRANT OF ARPT.
- UNMANNED ACFT MAY BE OPERATING IN THE IMMEDIATE AREA DURING DALGT HRS.

Instrument Procedures

NOTE: All procedures below are presented as PDF files. If you need a reader for these files, you should download the free Adobe Reader.

NOT FOR NAVIGATION. Please procure official charts for flight.
FAA instrument procedures published for use between 18 September 2014 at 0901Z and 16 October 2014 at 0900Z.

STARs - Standard Terminal Arrivals

HUDZY TWO	2 pages: [1] [2]
OHIIO TWO	download
RIICE SEVEN	2 pages: [1] [2]
WHAEL ONE	download

IAPs - Instrument Approach Procedures

ILS OR LOC RWY 14	download
RNAV (GPS) RWY 01	download
RNAV (GPS) RWY 14	download
RNAV (GPS) RWY 19	download
RNAV (GPS) RWY 32	download
NDB RWY 14	download
NOTE: Special Alternate Minimums apply	download (12KB)

Departure Procedures

ALEXANDRIA SIX	2 pages: [1] [2]
BORRN ONE (RNAV) **CHANGED**	2 pages: [1] [2]
BOWFN FIVE (RNAV)	download
CRIED FIVE	download
DREMR ONE (RNAV) **CHANGED**	2 pages: [1] [2]
EL DORADO FOUR	2 pages: [1] [2]
GIFFA FIVE	2 pages: [1] [2]
INDIE ONE (RNAV) **CHANGED**	2 pages: [1] [2]
INDUSTRY FIVE	2 pages: [1] [2]
JUNCTION SEVEN	download
KARRR TWO (RNAV) **NEW**	2 pages: [1] [2]
LAKE CHARLES TWO	download
LEONA EIGHT	2 pages: [1] [2]
LUFKIN SEVEN	2 pages: [1] [2]

LURIC ONE (RNAV) **CHANGED**	2 pages: [1] [2]
MMALT ONE (RNAV) **CHANGED**	2 pages: [1] [2]
PALACIOS FIVE	2 pages: [1] [2]
STRYA ONE (RNAV) **CHANGED**	2 pages: [1] [2]
STYCK ONE (RNAV) **CHANGED**	download
WATFO ONE (RNAV) **CHANGED**	download
WYLSN ONE (RNAV) **CHANGED**	2 pages: [1] [2]
NOTE: Special Take-Off Minimums/Departure Procedures apply	download (70KB)

Other nearby airports with instrument procedures:

KDWH - David Wayne Hooks Memorial Airport (19 nm S)
6R3 - Cleveland Municipal Airport (21 nm E)
KIAH - George Bush Intercontinental/Houston Airport (22 nm S)
KUTS - Huntsville Municipal Airport (25 nm N)
KEYQ - Weiser Air Park (28 nm SW)

FBO, Fuel Providers, and Aircraft Ground Support

Business Name	Contact	Services / Description	Fuel Prices	Comments
General Aviation Services	123.30 936-760-1717 [web site] [email]	In business since 1982, General Aviation Services will provide you with the best FBO services in the area. We our located center field between taxi ways Bravo and Charlie,the best locaton on the field for a quick turn around and convenient to all runways, which allows for a smooth and hassle free arrival and departure. We have the best prices in the area. Our experienced, professional, and courteous staff will see to your every request. Make your next stop with us and see why our customers keep coming back for more!" More info and **photos** of General Aviation Services AIRBOSS, US Government CONTRACT FUEL, WSI, AVTRIP, COURTESY VAN, Budget, Diamond AIRCRAFT, MOONEY, AUTHORIZED CHART AGENT, NBAA	100LL Jet A FS $5.65 $5.10 SS $5.25 --- GUARANTEED MEMBERS ONLY Discounts Login Join	★★★★☆ 14 read write
Galaxy FBO	ASRI 130.525 936-494-4252 [web site] [email]	Come see what has made Galaxy the best reviewed FBO at the Lonestar Executive Airport! Our friendly and attentive staff is always ready to assist you during your stay at KCXO. Free courtesy cars, volume fuel discounts, maintenance, rental car reservations, oxygen/nitrogen services, hotel reservations, catering, aircraft detailing. More info and **photos** of Galaxy FBO AIRBOSS, SAFETY 1st, COLT International, UVair, WINGPOINTS, CREW CARS, Hertz, WiFi, NBAA	100LL Jet A FS $5.49 $5.19 GUARANTEED MEMBERS ONLY Discounts Login Join	★★★★★ 12 read write
Wing Jet Center, LLC	936-441-9555 toll-free 1-866-449-9555 [web site] [email]	Aviation fuel, Oxygen service, Aircraft parking (ramp or tiedown), Hangars, Hangar leasing / sales, GPU / Power cart, Passenger terminal and lounge, ... SAFETY 1st, US Government CONTRACT FUEL, US Government AIR Card, WSI, CREW CAR, NBAA More info about Wing Jet Center, LLC	EPIC 100LL Jet A FS $6.69 $5.25 GUARANTEED	not yet rated 2 read write

FS=Full service
SS=Self service
UPDATE PRICES

Where to Eat: Catering, Restaurants, Food shops

Business Name	Contact	Services / Description	Distance	Comments
Black Walnut Cafe	936-202-2824 [web site]	Restaurant More info about Black Walnut Cafe	on airport	not yet rated 1 read write

Where to Stay: Hotels, Motels, Resorts, B&Bs, Campgrounds

In this space we feature lodging establishments that are convenient to the Lone Star Executive Airport. If your hotel/inn/B&B/resort is near the Lone Star Executive Airport, provides convenient transportation, or is otherwise attractive to pilots, flight crews, and airport users, consider listing it here.

FEATURE A LODGING ESTABLISHMENT

AirNav users who flew into KCXO have stayed at...

	Miles	Price ($)
COURTYARD BY MARRIOTT HOUSTON THE WOODLANDS	12.8	110-111
SUPER 8 CONROE	4.1	48-64
BAYMONT INN AND SUITES	5.4	68-93
DAYS INN CONROE	4.9	47-60

Other hotels near Lone Star Executive Airport

	Miles	Price ($)
HOLIDAY INN EXPRESS HOTEL & SUITES CONROE INTERSTATE45 NORTH	3.9	116-117
HAMPTON INN & SUITES CONROE INTERSTATE 45 NORTH	3.9	125-135
COMFORT INN CONROE	4.0	89-90
FAIRFIELD INN & SUITES BY MARRIOTT HOUSTON CONROE/WOODLANDS	4.1	109-119
LA QUINTA INN & SUITES CONROE	4.2	95-96
DAYS INN CONROE	4.2	
RAMADA INN- CONROE/THE WOODLANDS	5.5	66-70

Distances are approximate, and may vary depending on the actual route traveled and the location of the travel start on the airport.

Hotels in other cities near Lone Star Executive Airport

9 in Conroe
2 in Willis
13 in The Woodlands
4 in Montgomery
3 in Magnolia
3 in Cleveland
2 in New Caney

Would you like to see your business listed on this page?

If your business provides an interesting product or service to pilots, flight crews, aircraft, or users of the Lone Star Executive Airport, you should consider listing it here. To start the listing process, click on the button below

ADD YOUR BUSINESS OR SERVICE

Other Pages about Lone Star Executive Airport

- www.co.montgomery.tx.us/air
- Page from the Texas Airport Directory (PDF)

UPDATE, REMOVE OR ADD A LINK

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