

KANSAS CITY
Aviation

Airport Master Plan

KANSAS CITY DOWNTOWN AIRPORT – WHEELER FIELD

Appendix D

EMAS Condition Report

APPENDIX D: MKC EMAS EVALUATION

Report prepared by Crawford, Murphy & Tilly, Inc.

May 2024

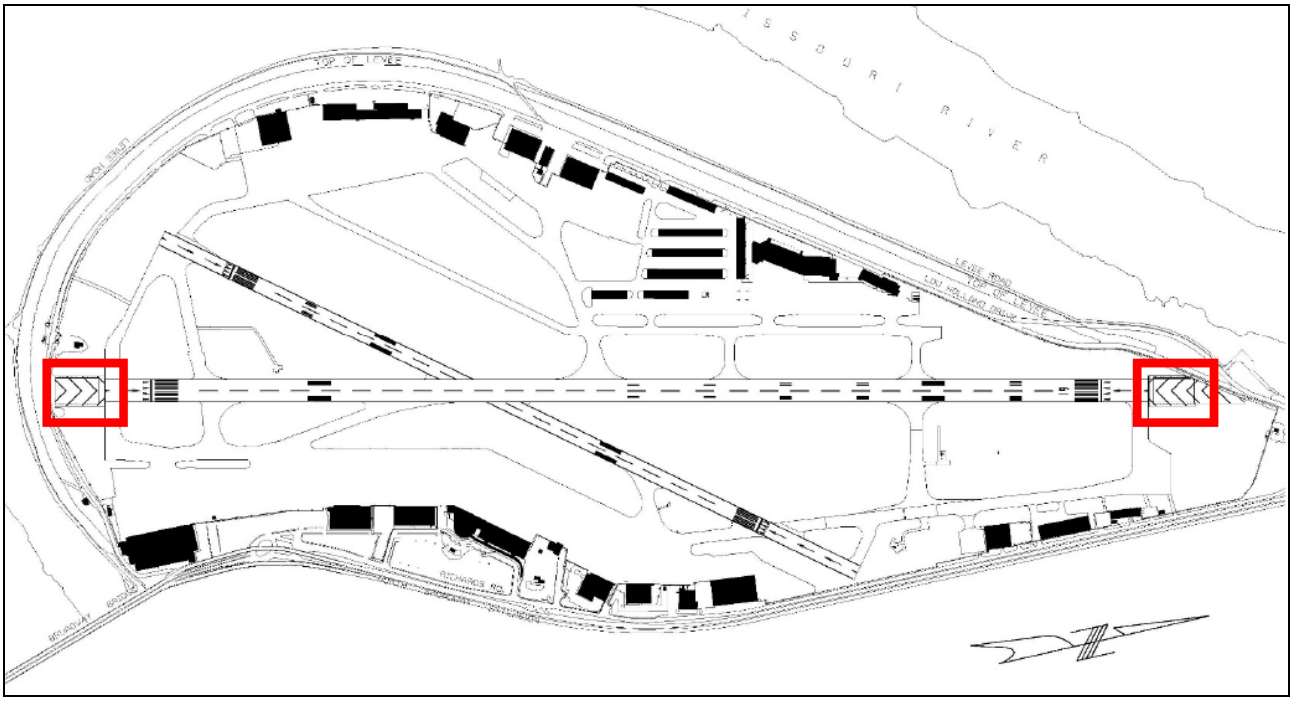
INTRODUCTION

This task consisted of the evaluation and recommendations for the preservation of the Engineered Arresting System (EMAS) located at both ends of Runway 01-19. This task included the coordination with the EMAS manufacture (Runway Safe) for evaluation of both EMAS beds, recommended courses of action, and cost estimation preparation based on the recommendations from Runway Safe.

EXISTING CONDITIONS

The Charles B. Wheeler Downtown Airport has two EMAS arrester beds comprised of cementitious blocks. Each cementitious block is 4 ft x 4 ft and they are spaced approximately ½ inch from each other. The Runway 19 departure EMAS is approximately 170 ft x 288 ft and contains 2982 total blocks. The Runway 01 departure EMAS is approximately 170 ft x 263 ft, with a "saw-tooth" configuration in the north west corner, and contains 2700 total blocks. These joints are currently covered with a silicone extrusion and adhered with silicone caulk. The side vertical surface of the EMAS, around the exterior perimeter, is covered with the same silicone extrusion of a larger width, and is also adhered with silicone caulk. In 2015 a full Seam Seal Rehabilitation was conducted on both EMAS beds.

Figure D1: EMAS Bed Locations at MKC



PROPOSED IMPROVEMENTS

The Evaluation by Runway Safe concluded that both EMAS beds are in satisfactory condition and no major rehabilitation is necessary. The report did not that the Seam Seals have weakened in many locations and a full Seam Seal Rehabilitation project is recommended. The last full Seam Seal Rehabilitation project was conducted in 2015 and both beds are due for replacement.

In general, this project would consist of removing the existing seam seal (top) and side coating and all silicone adhesive and re-sealing of all the seams and sides of the EMAS with extruded PVC.

DESIGN PARAMETERS

The new designs will conform to FAA standards where applicable. The design standards and specifications were provided by Runway Safe. removal of the existing sealant, repair as necessary and resealing of the EMAS in accordance with the Manufacturer's recommendations. The new designs will conform to FAA standards where applicable.

Runway Safe will provide all adhesive and extruded PVC material for the project. In addition, Runway Safe will provide training and supervision for the initial work of the project. This over-sight is to ensure the Contractor can demonstrate their competency in removing the existing seam seal and side coating, as well as applying the new materials to all the joints and sides.

During removal, any damage to the plastic lid or side of the block will require it to be either, fixed, patched, or replaced. Gouges can be fixed with the same silicon used to adhere the PVC to the blocks. Holes and cracks, up to a grapefruit size, can potentially be patched with a patch kit, available from Runway Safe.

Pavement marking improvement will consist of re-marking all chevrons within the jet blast pads and the runway demarcation bar at each end of Runway 01/19.

AIRFIELD CLOSURES AND SEQUENCE OF CONSTRUCTION

Construction Set Back Lines
Runway and taxiway set back lines are in accordance with FAA AC 150/5370-2G (Operational Safety on Airports During Construction), which requires construction activities not be permitted within 250-ft of the centerline of an active runway unless the runway is closed or restricted to aircraft operations. The guidelines for taxiway set back lines are as follows:

Unrestricted construction activity is permissible adjacent to taxiways when the taxiway is restricted to aircraft such that the available Taxiway Object Free Area (TOFA) is equal to the dimensions stated in AC 150/5300-13A Table 4-1. The TOFA has been set at 259-ft or 130-ft from the taxiway centerline. This distance will allow for an Airplane Design Group (ADG) IV to be operated safely during construction.

Runway and Taxiway Closures
FAA has allowed EMAS repair work to be conducted with an open runway in the past. However, this will require specific coordination with FAA and direct written approval. It must be noted that even with FAA approval, there may be reservations from contractor's bidding the work to operate in this condition.

Therefore, for the purpose of this report it is expected this project will require closures of Runway 1-19 while work in is progress, additionally Taxiway A will require closures as the work is situated inside the Taxiway A TOFA.

Work Schedule
Work for this project could be scheduled for nighttime non-peak hours to minimize the disruption to MKC, assuming Runway 1/19 would require closure with personnel working on the EMAS. Work in the EMAS would be expected to be scheduled to take place from 10:00pm to 06:00am daily, matching the hours scheduled for previous similar projects.

Two separate construction areas, at either end of the Runway, are required. In the last project, the two areas were constructed separately. But, each area could be worked at the same time, i.e. either conduct the same process (removal or

install) at both ends at the same time, or start re-sealing the joints of one side while overlapping the removal of existing seals at the other end. If both areas are constructed concurrently, access to both areas would require additional barricades to control air traffic at both ends. Even with the additional barricades, aircraft taxiing routes to Runway 4-22 at both the north and south side of the airfield would be available.

Lastly, the Runway Safe Representative will be providing training and over-sight, during the initial days of construction, for both the removal and re-installation of the joint seal. This project should be coordinated with Runway Safe well in advance to facilitate the availability of the on-site representative.

PROJECT CALENDAR DAYS

Based on the previous project, this project is expected to be completed within 28 nightly closures of the Notice to Proceed.

Per records, it is anticipated that the contractor will require 21 working days to complete all the work at both ends of the runway. It is estimated removal and cleaning of the existing joints will require 16 working days (8 days per phase). To re-seal all the joints, it is estimated 6 working days (approximately 3.0 days per phase) will be required.

The final 6 days are estimated for contingency/weather days, and to re-mark both the jet blast Pads and cleanup the project site.

SCHEDULE

It is recommended that this project be completed as soon as practical, within the next 1-3 years. for cost estimating purposes a construction date of 2027 was assumed based on the latest possible year recommended for a project to occur (within the next 3 years).

OPINION OF PROBABLE COST

The estimated cost of the construction is approximately $1,600,000, for design, construction and construction management services. The estimated cost of construction is presented in the table below. Costs of materials were provided directly from Runway Safe. Cost of Labor assumed premium hours for night and weekend work. Finally, all costs were estimated using inflated dollars assuming a 2027 construction period.

Table D1: Estimated Cost Seam Seal Rehabilitation (2027 Prices)

ITEM	DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL
1	MOBILIZATION (10%)	LS	$115,900.00	1	$ 115,900.00
2	AIRPORT PAVEMENT MARKINGS WATERBORNE - YELLOW	SF	$5.00	7450	$ 37,250.00
3	AIRPORT PAVEMENT MARKINGS WATERBORNE - BLACK	SF	$5.00	2750	$ 13,750.00
4	EMAS SEAM SEAL REMOVAL	LF	$4.00	50000	$ 200,000.00
5	RW1 DE EMAS SEAM SEAL REHABILITATION - MATERIALS	LS	$350,000.00	1	$ 350,000.00
6	RW19 DE EMAS SEAM SEAL REHABILITATION - MATERIALS	LS	$379,000.00	1	$ 379,000.00
7	RW1 DE EMAS SEAM SEAL REHABILITATION - INSTALLATION	LS	$86,000.00	1	$ 86,000.00
8	RW19 DE EMAS SEAM SEAL REHABILITATION - INSTALLATION	LS	$93,000.00	1	$ 93,000.00
				TOTAL =	**$ 1,274,900.00**

ESTIMATED BASE PROPOSAL CONSTRUCTION COST

Design Cost (10%)=	$127,490.00
Estimated Construction Total =	$1,274,900.00
Estimated Construction Services (10%) =	$127,490.00
TOTAL =	$1,529,880.00
TOTAL PROJECT BUDGET (ROUNDED) =	**$1,600,000.00**

Appendix: Runway Safe EMAS MAX Field Strength Test Report

Field Strength Test Report

MKC – Kansas City Downtown Airport
Runway 01/19 Departure Ends

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NOVEMBER 14, 2023
REV 0

RUNWAY SAFE EMASMAX®

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BACKGROUND

Runway Safe Group is the world leader in commercial aircraft arresting systems. It has over 25 years of experience in developing and supplying Engineered Materials Arresting Systems (EMAS) to safely decelerate aircraft in overrun emergencies.

In 1994, ESCO (Engineered Arresting Systems Corporation) joined with the FAA under a Cooperative Research and Development Agreement (CRDA) to develop an arresting system for the commercial aviation community. From 1994 to 1996, the FAA conducted a series of tests with ESCO's EMAS and, subsequently, approved the system for use at civil airports throughout the United States. In early 2020 the sale of the ESCO's EMASMAX product line to Runway Safe Group was completed. With this acquisition Runway Safe became the industry leader in commercial aircraft arresting systems.

EMAS consists of a material placed at the end of a runway that will predictably and reliably crush under the weight of an aircraft traveling off the end of the runway. The resistance provided by crushed material decelerates the aircraft and brings it to a safe stop within the confines of the overrun area.

EMAS is now part of US airport design standards and is described in FAA Advisory Circular 150/5220-22B "Engineered Material Arresting Systems for Aircraft Overruns" dated 9/27/2012. The EMAS product has been through several periods of refinement that have led to the development of the current EMAS generation JBR 503, known as EMASMAX™. Several different generations of EMAS products exist in the field as a result of continuous development efforts aimed at improving product performance, durability, and maintenance.

In order to determine that installed EMAS systems have maintained designed arresting capability, a Field Strength Test (FST) is needed to measure the strength of cellular concrete blocks, which should fall within the tolerance bands developed for use with the FST machine. Prior to the FST, no known method for verifying EMAS strength had been developed.

1. FIELD STRENGTH TEST METHOD AND PROCEDURE

The field strength test method and testing procedure is currently the only known EMAS test method that has been accepted by the FAA. Results are contained in this report.

All testing was conducted in accordance with the field strength testing procedure accepted by the FAA. Below is a summary of some of those requirements.

- A sample size of ten blocks was selected.
- A random sampling method was utilized to identify sample locations (as depicted in Appendix A).
- A total of three punches were made on each block.
- Resistive loads were measured in the field and then later analyzed by Runway Safe Engineers for strength correlation.
- Core samples were taken for moisture content analysis.
- A visual inspection of the bed was conducted and reported.

2. TEST RESULTS

2.1. EMAS Historical Facts

The EMAS at Kansas City Downtown Airport (MKC) RW19 and RW01 Departure Ends (DE) were installed in November of 2009 and September 2010, respectively. The EMAS at both ends are 50 strength and both underwent a seam seal retrofit (rehabilitation) in 2015.

2.1.1. RW01/19 DE Visual Observations

A brief visual inspection of the EMAS revealed that the seam sealant system appears to be in a state of deterioration. The seam sealant and side coating systems have holes throughout and delamination from the top trays. There were some soft blocks found in the systems, as well as some top trays with cracks developing in them. Although punctures in the seam sealant system were minimal, both systems do show signs of aging and should be considered for Seam Seal Rehabilitation. Further observation of the EMAS systems shows no damage to the debris deflector assembly.



Figure 1: Aerial view of RW19 DE EMAS.



Figure 2: Aerial view of RW01 DE EMAS.

2.2. Determination of Moisture Content

Cellular concrete core samples of each test block are taken during an FST. The moisture content of the core samples is determined in accordance with EMAS Lab SOP002 and ASTM D2216-05. Percent moisture content is calculated by the following equation,

$$mc = \left(\frac{M_{cms} - M_{cds}}{M_{cds} - M_c} \right) \times 100 \quad (1)$$

where,

mc = moisture content, %

M_{cms} = mass of container and moist specimen, g

M_{cds} = mass of container and dry specimen, g

M_c = mass of container, g.

Block testing locations were selected using a random number generator as discussed above and these locations are shown in Appendix A.

The analysis results for the EMAS at RW01 DE show an average moisture content of 78%, which is considered to be within normal range when compared against other EMAS of the same age range. Likewise, to the conclusion of the RW01 DE EMAS, the EMAS at RW19 DE shows an average moisture content of 79%.

2.3. Field Strength Data

Field strength data is collected by using Runway Safe's FST Machine. The data is collected from three punches on each block which are then averaged to calculate the average strength of the block. The collected data is analyzed to determine if the sample blocks' strength falls within the EMAS design's targeted strength bandwidth.

The target average strength for an EMAS is at the center between the Upper Limit and Lower Limit lines, regardless of whether the bed in question is rated at 50, 60 or 80-strength. In percent notation, the target is 50%, where the Upper Limit is 100% and Lower Limit is 0%.

The plot in Figure 3 shows the average core material strength for RW01 DE. The data indicates that the average block strength is within the 50-strength bandwidth, per the original design. The results show that the average strength is 22.6%, which is within the acceptable limits for this 50-strength EMAS and indicates that it will perform as originally designed.

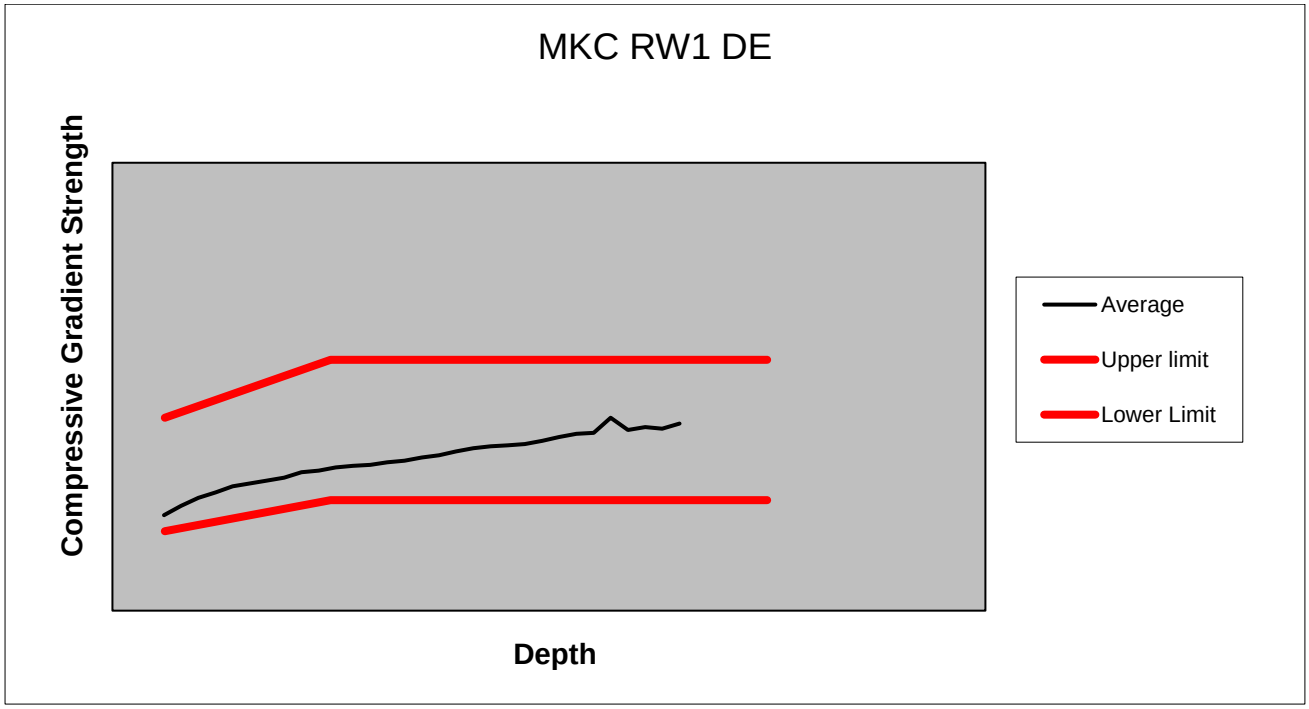


Figure 3: Average FST strength data for the RW01 DE EMAS.

The plot chart in Figure 4 shows the average core material strength for RW19 DE. The data indicates that the average block strength is within the 50-strength bandwidth, per the original design. The average strength is 32.8%, which, similar to the RW01 DE EMAS, is within the acceptable limits for this 50-strength EMAS and indicates that it will perform as originally designed.

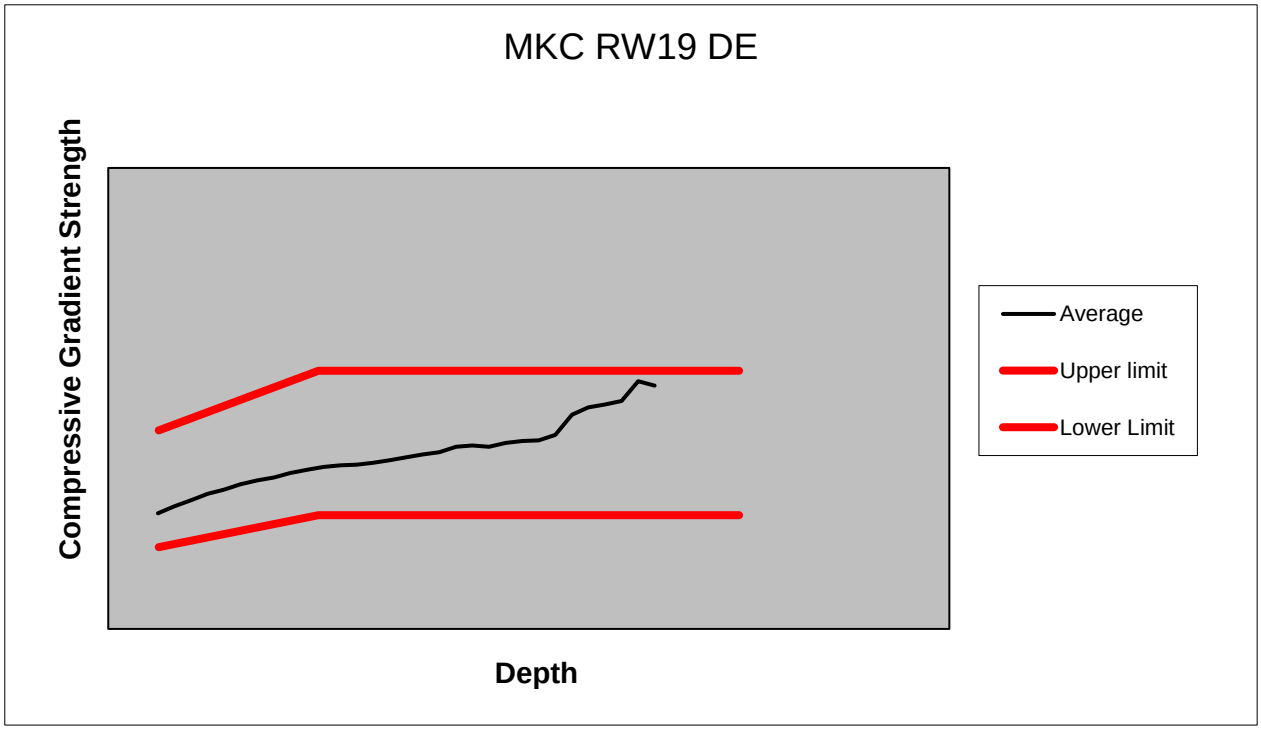


Figure 4: Average FST strength data for RW19 DE.

3. SUMMARY

A Field Strength Test was completed on the EMAS at RW01 and RW19 DE at MKC. Ten blocks from each system were randomly selected to serve as the test blocks as shown in Appendix A. Each block was punched three times with the FST machine, and a core sample was collected to measure moisture content. Appendix B contains photos of these blocks after testing was completed.

The moisture contents for both systems are within expected ranges when compared with systems of similar age, which is a good indication that excess moisture is being prevented from penetrating the system.

As well, both systems' average strength values are within the acceptable tolerance bandwidth limits, as seen in figures 3 and 4, which indicates the system will perform as intended.

Runway Safe recommends the following to extend the service life of both EMAS:

- Continue the normal inspections and maintenance by the airport crew to ensure that damage to blocks and block top trays is assessed and recorded.
- Another FST be performed on both systems within the next 3-5 years.

APPENDIX A: LOCATION OF FIELD-TESTED BLOCKS

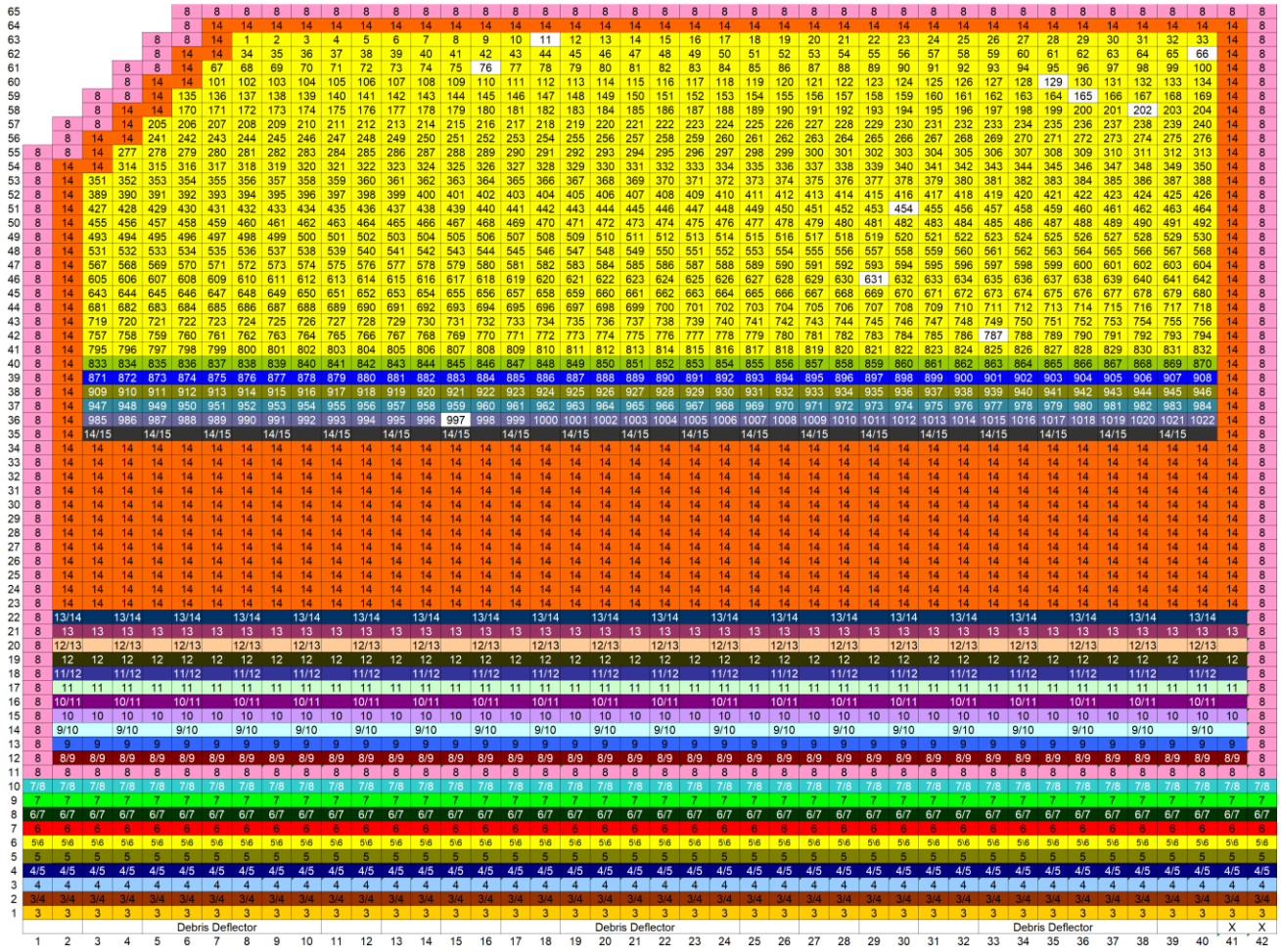


Figure 5: RW01 DE EMAS grids of blocks that were tested (highlighted in white).

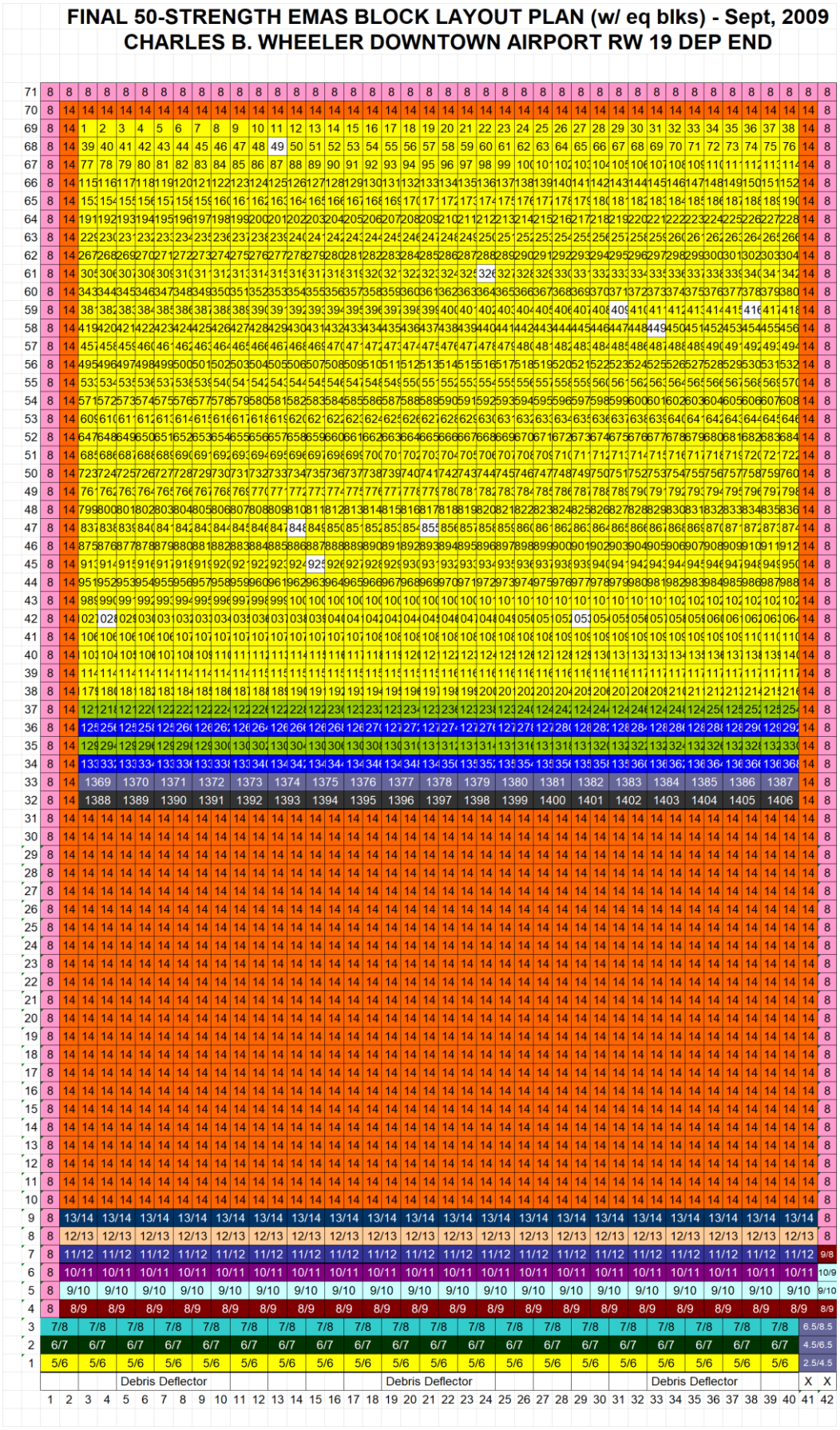


Figure 6: RW19 DE EMAS grids of blocks that were tested (highlighted in white).

Table 1. Tested blocks row and column location RW01 DE.

	Random Block #	Row	Column
Block 1	11	63	18
Block 2	66	62	40
Block 3	76	61	16
Block 4	129	60	35
Block 5	165	59	36
Block 6	202	58	38
Block 7	454	51	30
Block 8	631	46	29
Block 9	787	42	33
Block 10	997	36	15

Table 2. Tested blocks row and column location RW19 DE.

	Random Block #	Row	Column
Block 1	49	68	13
Block 2	326	61	24
Block 3	409	59	31
Block 4	416	59	38
Block 5	449	58	33
Block 6	848	47	14
Block 7	855	47	21
Block 8	925	45	15
Block 9	1028	42	4
Block 10	1053	42	29

Appendix B: Photographs



Figure 7: FST Testing Completed.



Figure 8: Top board cut-outs for testing.

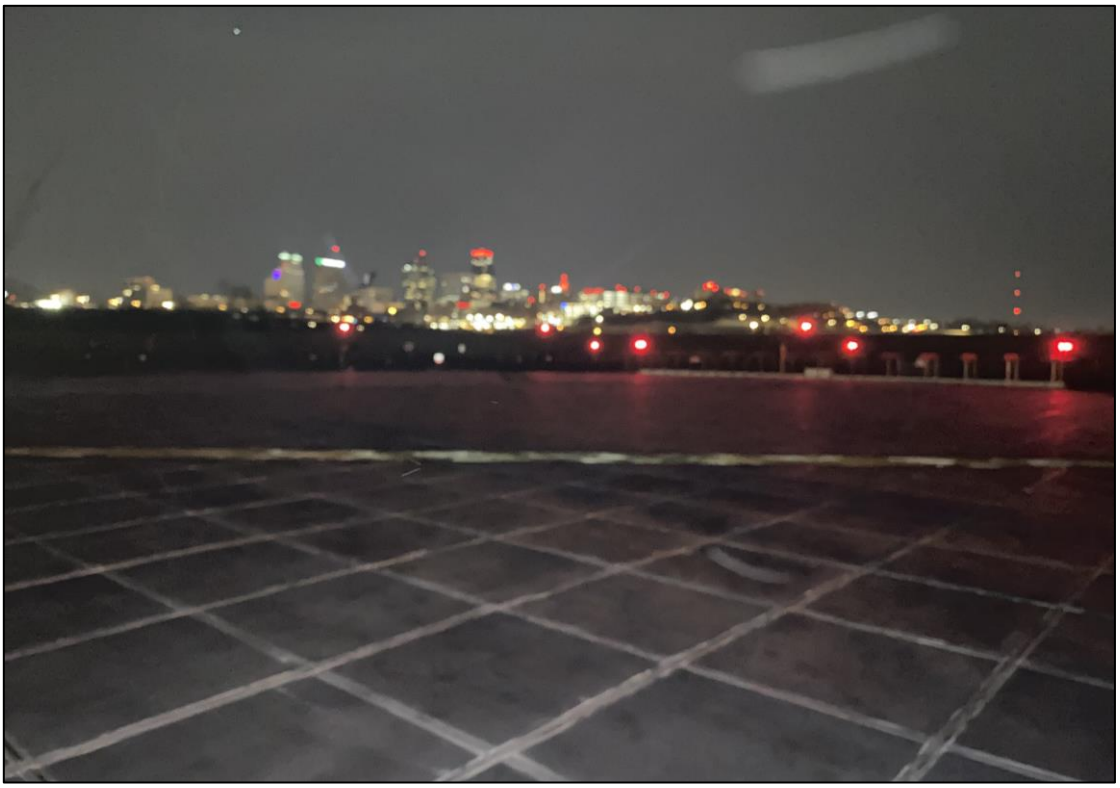


Figure 9: Overall seam seal view, RW01DE.



Figure 10: Seam seal issues.

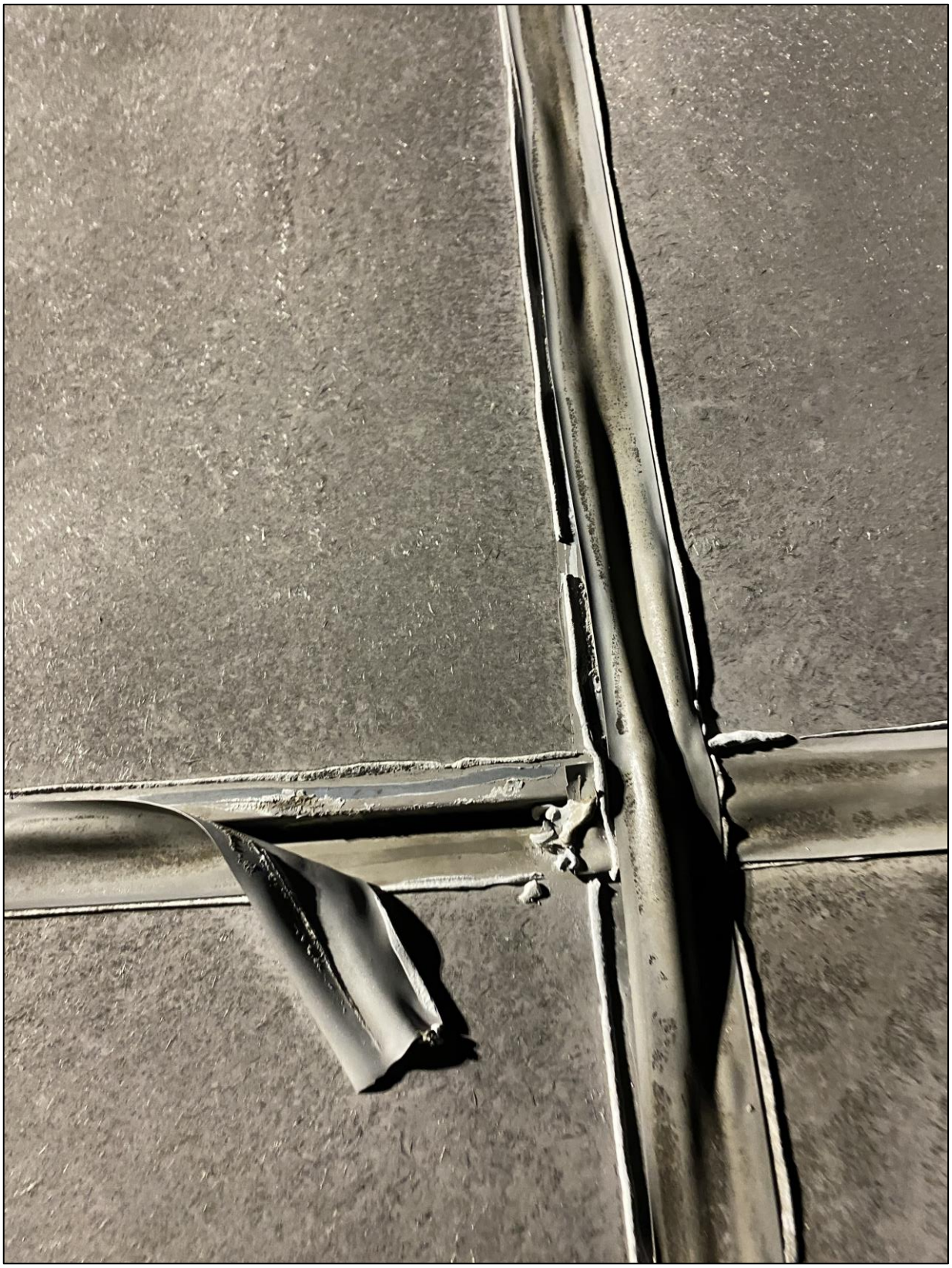


Figure 11: More seam seal issues.