



Federal Aviation
Administration

Depiction Altitude Restrictions

SID and STAR Charting

Presented to: Aeronautical Charting Forum

By: Jim Arrighi

FAA PBN Policy and Support Group

Date: April 24, 2013



Topic

- **21 DCPs to implement Climb Via procedures.**
- **Work group identified need to improve chart depiction of Altitude Restrictions on Standard Terminal Arrival (STAR) and Standard Instrument Departures (SIDs)**
- **Depiction of Top (Maintain) Altitudes on SIDs**

SID/STAR Altitude Restrictions

- **Increasing numbers of STAR and SID procedures contain charted altitude and speed restrictions.**
 - **The restrictions often provide an optimized vertical profile for arrivals and departures.**
 - **The restrictions are critical to ensuring separation of departing and arriving aircraft.**
- **ATC issues a ‘Descend Via’ clearance to require compliance with the published restrictions. ‘Climb Via’ procedures, under development since 2004 and scheduled for implementation in 2013, require compliance with the SID restrictions.**

Discussion

- **Although the STAR/SID charts graphically depict the crossing restrictions, there are continuing challenges with compliance with restrictions.**
 - **Attributed to procedure design, chart clutter, lack of standardization of notes, note location, misunderstanding of the ATC clearance, lack of standardization of PDC, etc.**
- **A common factor for both STAR and SID charts is that nowhere on the chart, other than the graphic is there any prompt to the pilot indicating the procedure has a stepped climb or descent profile.**

BAYLR ONE DEPARTURE (RNAV)
(BAYIRI .BOBBA) 13010

ATIS DEP
134.025
CLNC DEL
118.75
DENVER DEP CON
126.1 360.75

TAKEOFF OBSTACLE NOTES

Rwy 16L: Multiple signs beginning 126' from DER, 490' left of centerline, up to 7' AGL/5359' MSL.
Communication tower 4749' from DER, 1358' left of centerline, 107' AGL/5478' MSL.
Rwy 25: Sign 48' from DER, 450' right of centerline, 6' AGL/5354' MSL.

- NOTE: DME/DME/IRU or GPS required.
- NOTE: RNAV 1.
- NOTE: Turbojets only.
- NOTE: Takeoff Rwys 16L, 16R, 17L, 17R, 34L, 34R, 35L, 35R, 25-RADAR required for non-GPS equipped aircraft.
- NOTE: Accelerate to at or above 250K above 10000. If slower speed is required to meet crossing restrictions, advise ATC prior to departure.
- NOTE: Takeoff Rwy 8 - RADAR required.
- NOTE: For non-GPS equipped aircraft on the Blue Mesa Transition, GLL, DBL, and HBU DMEs must be operational.

TAKEOFF MINIMUMS

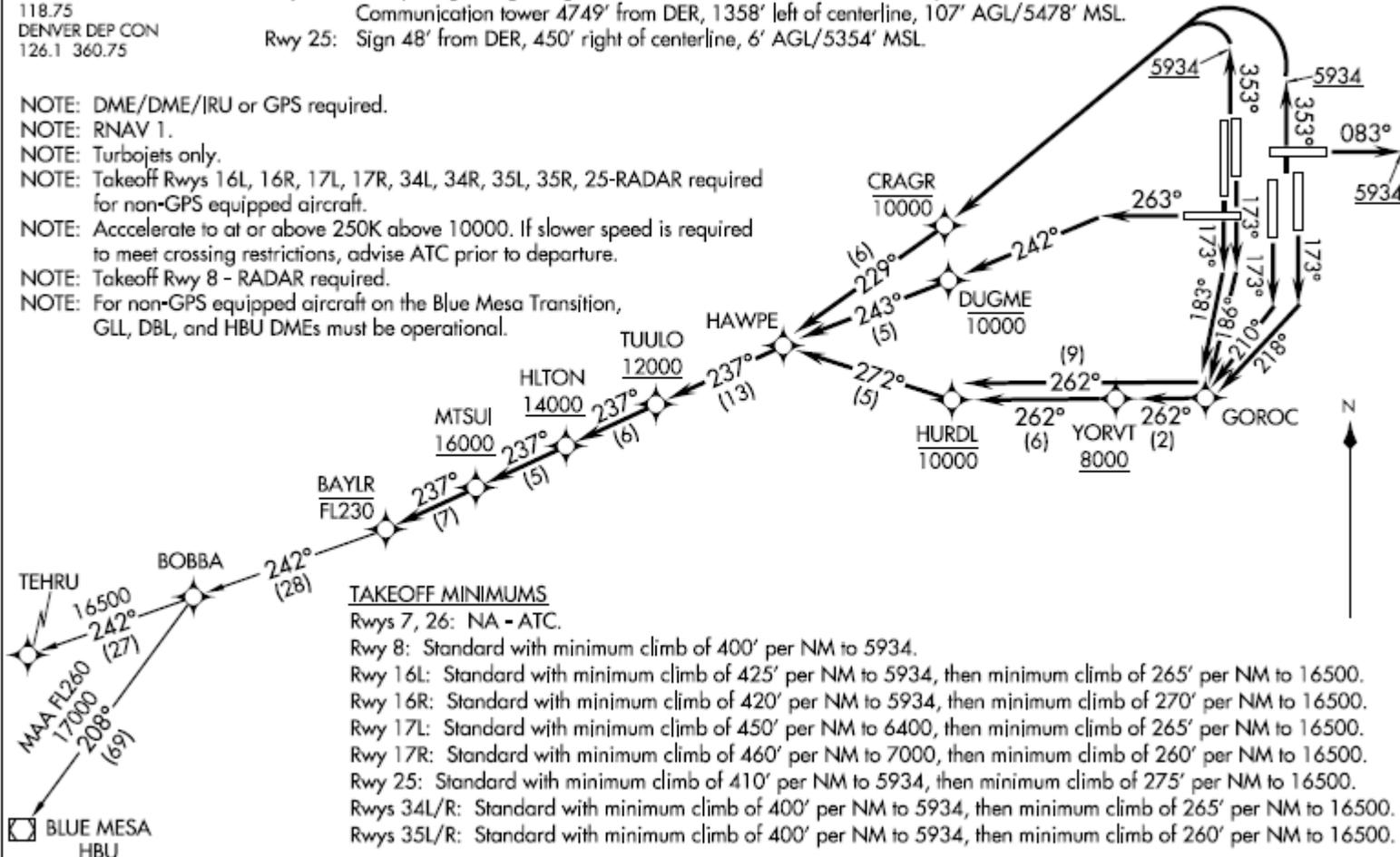
Rwys 7, 26: NA - ATC.
Rwy 8: Standard with minimum climb of 400' per NM to 5934.
Rwy 16L: Standard with minimum climb of 425' per NM to 5934, then minimum climb of 265' per NM to 16500.
Rwy 16R: Standard with minimum climb of 420' per NM to 5934, then minimum climb of 270' per NM to 16500.
Rwy 17L: Standard with minimum climb of 450' per NM to 6400, then minimum climb of 265' per NM to 16500.
Rwy 17R: Standard with minimum climb of 460' per NM to 7000, then minimum climb of 260' per NM to 16500.
Rwy 25: Standard with minimum climb of 410' per NM to 5934, then minimum climb of 275' per NM to 16500.
Rwys 34L/R: Standard with minimum climb of 400' per NM to 5934, then minimum climb of 265' per NM to 16500.
Rwys 35L/R: Standard with minimum climb of 400' per NM to 5934, then minimum climb of 260' per NM to 16500.

(NARRATIVE ON FOLLOWING PAGE)

NOTE: Chart not to scale.

(BAYIRI .BOBBA) 13010
BAYLR ONE DEPARTURE (RNAV)
SI-9077 (FAA)

DENVER INTL (DEN)
DENVER, COLORADO



DENVER, COLORADO
DENVER INTL (DEN)



BAYLR ONE DEPARTURE (RNAV)



DEPARTURE ROUTE DESCRIPTION

TAKEOFF RUNWAY 8: Climb heading 083° to 5934, then continue climb heading 083° or as assigned by ATC for RADAR vectors to BAYLR at/below FL230. Thence

TAKEOFF RUNWAY 16L: Climb heading 173° to intercept course 186° to GOROC, then on track 262° to cross HURDL at/below 10000, then on track 272° to HAWPE, then on track 237° to cross TUULO at/above 12000, then on track 237° to cross HLTON at/above 14000, then on track 237° to cross MTSUI at/above 16000, then on track 237° to cross BAYLR at/below FL230. Thence

TAKEOFF RUNWAY 16R: Climb heading 173° to intercept course 183° to GOROC, then on track 262° to cross HURDL at/below 10000, then on track 272° to HAWPE, then on track 237° to cross TUULO at/above 12000, then on track 237° to cross HLTON at/above 14000, then on track 237° to cross MTSUI at/above 16000, then on track 237° to cross BAYLR at/below FL230. Thence

TAKEOFF RUNWAY 17L: Climb heading 173° to intercept course 218° to GOROC, then on track 262° to cross YORVT at/above 8000, then on track 262° to cross HURDL at/below 10000, then on track 272° to HAWPE, then on track 237° to cross TUULO at/above 12000, then on track 237° to cross HLTON at/above 14000, then on track 237° to cross MTSUI at/above 16000, then on track 237° to cross BAYLR at/below FL230. Thence

TAKEOFF RUNWAY 17R: Climb heading 173° to intercept course 210° to GOROC, then on track 262° to cross YORVT at/above 8000, then on track 262° to cross HURDL at/below 10000, then on track 272° to HAWPE, then on track 237° to cross TUULO at/above 12000, then on track 237° to cross HLTON at/above 14000, then on track 237° to cross MTSUI at/above 16000, then on track 237° to cross BAYLR at/below FL230. Thence

TAKEOFF RUNWAY 25: Climb heading 263° to intercept course 242° to cross DUGME at/below 10000, then on track 243° to HAWPE, then on track 237° to cross TUULO at/above 12000, then on track 237° to cross HLTON at/above 14000, then on track 237° to cross MTSUI at/above 16000, then on track 237° to cross BAYLR at/below FL230. Thence

TAKEOFF RUNWAYS 34L/R, 35L/R: Climb heading 353° to 5934, then climbing left turn direct to cross CRAGR at/below 10000, then on track 229° to HAWPE, then on track 237° to cross TUULO at/above 12000, then on track 237° to cross HLTON at/above 14000, then on track 237° to cross MTSUI at/above 16000, then on track 237° to cross BAYLR at/below FL230. Thence

. . . . as depicted to BOBBA, thence via (transition) maintain FL230 or filed lower altitude. Expect higher filed altitude ten minutes after departure.

BLUE MESA TRANSITION (BAYLR1.HBU)

TEHRU TRANSITION (BAYLR1.TEHRU)

BAYLR ONE DEPARTURE (RNAV)
(BAYLR1.BOBBA) 13010

DENVER, COLORADO
DENVER INTL (DEN)

SW-1, 04 APR 2013 to 02 MAY 2013

SW-1, 04 APR 2013 to 02 MAY 2013



BAYLR ONE DEPARTURE (RNAV)



DEPARTURE ROUTE DESCRIPTION

TAKEOFF RUNWAY 8: Climb heading 083° to 5934, then continue climb heading 083° or as assigned by ATC for RADAR vectors to BAYLR at/below FL230. Thence

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TAKEOFF RUNWAY 16R: Climb heading 173° to intercept course 183° to GOROC, then on track 262° to cross HURDL at/below 10000, then on track 272° to HAWPE, then on track 237° to cross TUULO at/above 12000, then on track 237° to cross HLTON at/above 14000, then on track 237° to cross MTSUI at/above 16000, then on track 237° to cross BAYLR at/below FL230. Thence

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SW-1, 04 APR 2013 to 02 MAY 2013

SW-1, 04 APR 2013 to 02 MAY 2013

. . . . as depicted to BOBBA, thence via (transition) maintain FL230 or filed lower altitude. Expect higher filed altitude ten minutes after departure.



JUTES TWO DEPARTURE (RNAV)
(JUTES2.JUTES) 12264

JUTES TWO DEPARTURE (RNAV)
(JUTES2.JUTES) 12264

ATIS
127.05
CLNC DEL
135.2
GND CON
121.7 263.0
LAGUARDIA TOWER
118.7 263.0
NEW YORK DEP CON
120.4 263.0

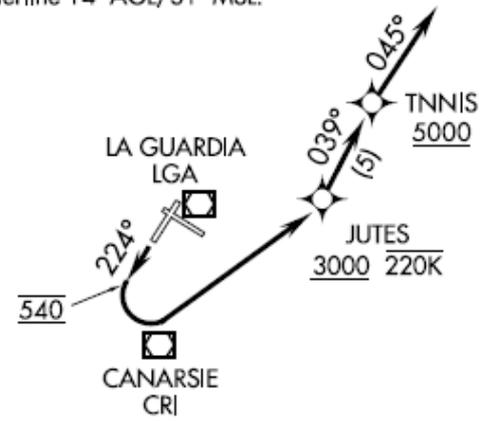
HUGUENOT HUO
GAYEL
HAAYS
NEION
COATE

GREKI
MERIT
BAYYS
BRIDGEPORT BDR

TAKEOFF OBSTACLES:
Rwy 22: Multiple trees and buildings beginning 165' from DER, 150' left of centerline up to 72' AGL/101' MSL. Multiple trees and buildings beginning 1731' from DER, 138' right of centerline up to 73' AGL/104' MSL. Localizer 421' from DER, 275' right of centerline 25' AGL/44' MSL. Fence 109' from DER, 335' right of centerline 14' AGL/31' MSL.

- NOTE: All Turbojets.
NOTE: Turboprops assigned by ATC only.
NOTE: DME/DME/IRU or GPS required.
NOTE: Radar required.
NOTE: RNAV 1.
NOTE: Do not exceed 220K until passing JUTES.
NOTE: Strict compliance to track and altitude restrictions is mandatory. Aircraft performance may require reduced airspeed to comply with altitude restrictions. Advise ATC on initial contact if unable to comply with climb gradient requirements.
NOTE: All aircraft expect vectors after TNNIS.
NOTE: Traffic filed BIGGY, ELIOT, LANNA, PARKE, ZIMMZ, NEWEL do not exceed 250K until reaching 11000.

NEWEL
ELIOT
ZIMMZ
PARKE
LANNA
BIGGY



TAKEOFF MINIMUMS:
Rwys 4, 13, 31: NA-ATC.
Rwy 22: Standard with minimum climb of 501' per NM to 540, then ATC climb of 356' per NM to 3000, then ATC climb of 374' per NM to 5000.

DEPARTURE ROUTE DESCRIPTION
TAKEOFF RWY 22: Climb heading 224° to 540, then climbing left turn direct JUTES, cross JUTES at or above 3000, then on track 039° to cross TNNIS at or above 5000, then on heading 045° for vectors on course. Maintain 5000 or as assigned by ATC. Expect clearance to filed altitude/flight level 10 minutes after departure.

NOTE: Chart not to scale.

NEW YORK, NEW YORK
NEW YORK/ LA GUARDIA (LGA)

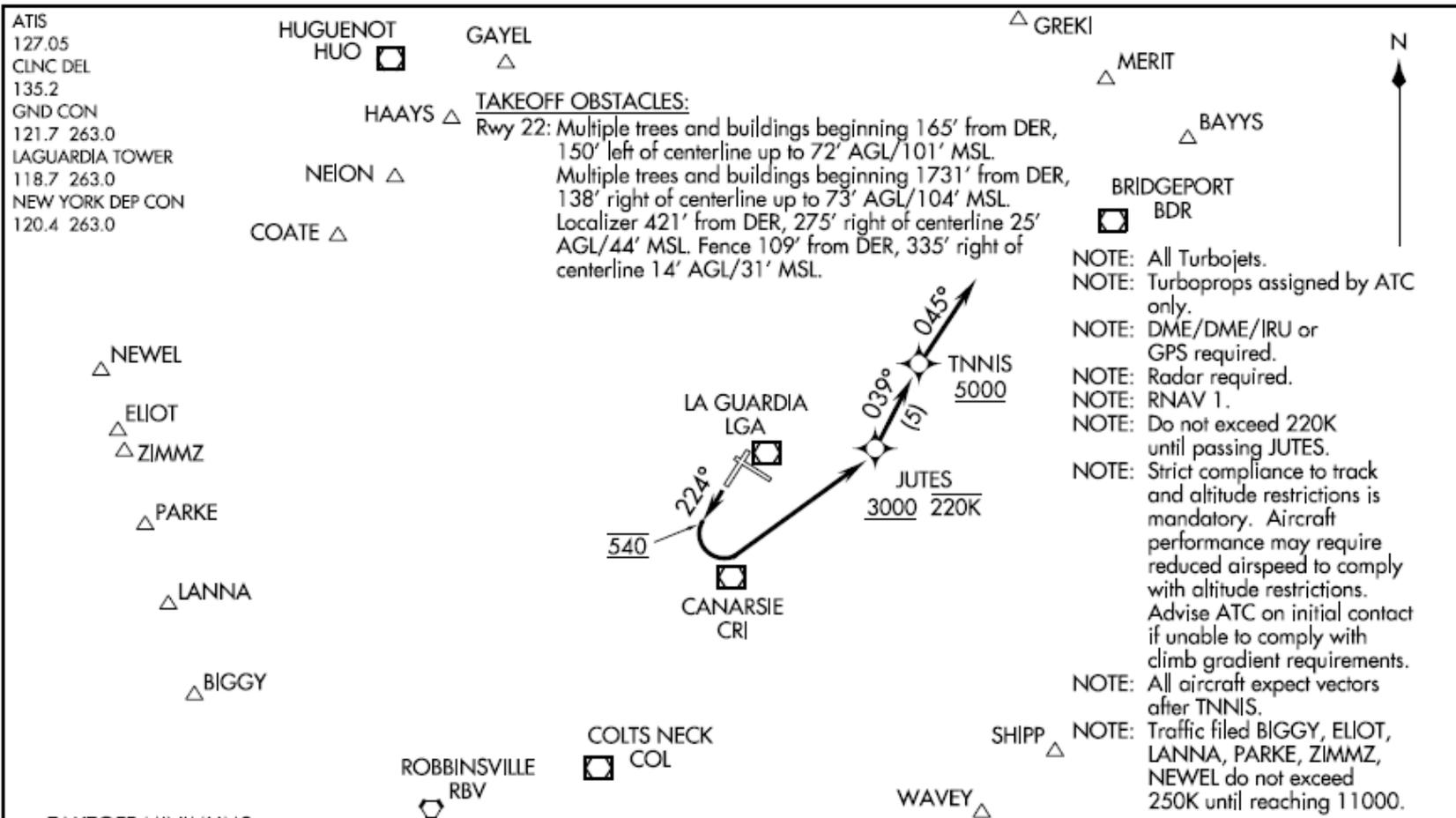
NEW YORK/ LA GUARDIA (LGA)
NEW YORK, NEW YORK

SI-289 (FAA)



JUTES TWO DEPARTURE (RNAV)
(JUTES2.JUTES) 12264

JUTES TWO DEPARTURE (RNAV)
(JUTES2.JUTES) 12264



TAKEOFF OBSTACLES:
 Rwy 22: Multiple trees and buildings beginning 165' from DER, 150' left of centerline up to 72' AGL/101' MSL. Multiple trees and buildings beginning 1731' from DER, 138' right of centerline up to 73' AGL/104' MSL. Localizer 421' from DER, 275' right of centerline 25' AGL/44' MSL. Fence 109' from DER, 335' right of centerline 14' AGL/31' MSL.

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- NOTE: Turboprops assigned by ATC only.
- NOTE: DME/DME/IRU or GPS required.
- NOTE: Radar required.
- NOTE: RNAV 1.
- NOTE: Do not exceed 220K until passing JUTES.
- NOTE: Strict compliance to track and altitude restrictions is mandatory. Aircraft performance may require reduced airspeed to comply with altitude restrictions. Advise ATC on initial contact if unable to comply with climb gradient requirements.
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DEPARTURE ROUTE DESCRIPTION
TAKEOFF RWY 22: Climb heading 224° to 540, then climbing left

vectors on course. Maintain 5000 or as assigned by ATC. Expect clearance to filed altitude/flight level 10 minutes after departure.

NOTE: Chart not to scale.



EAGUL FIVE ARRIVAL (RNAV) Arrival Routes
 (EAGUL.EAGUL5) 11349

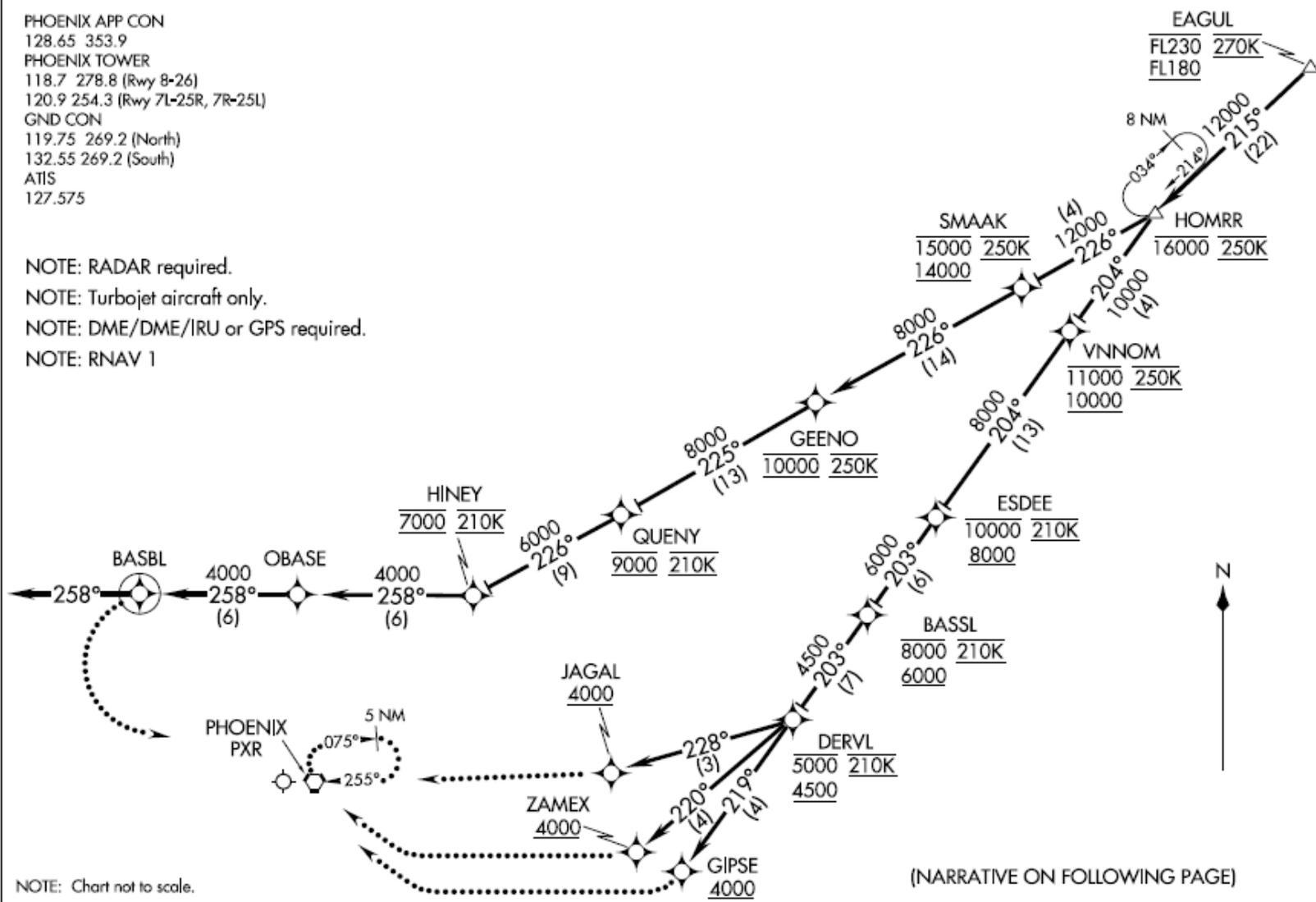
EAGUL FIVE ARRIVAL (RNAV) Arrival Routes
 (EAGUL.EAGUL5) 11349

ST-322 (FAA)

PHOENIX SKY HARBOR INTL
 PHOENIX, ARIZONA

PHOENIX APP CON
 128.65 353.9
 PHOENIX TOWER
 118.7 278.8 (Rwy 8-26)
 120.9 254.3 (Rwy 7L-25R, 7R-25L)
 GND CON
 119.75 269.2 (North)
 132.55 269.2 (South)
 ATIS
 127.575

NOTE: RADAR required.
 NOTE: Turbojet aircraft only.
 NOTE: DME/DME/IRU or GPS required.
 NOTE: RNAV 1



NOTE: Chart not to scale.

(NARRATIVE ON FOLLOWING PAGE)



Prior ACF Work

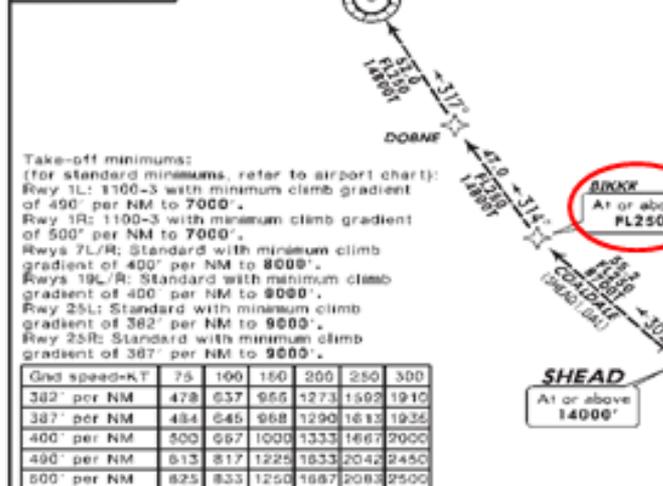
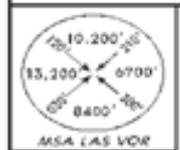
- **RD- 05-01-174, Top Altitude Note on Standard Instrument Departures (SIDs) proposed establishing a standard method of depicting the ATC “Top Altitude” on a SID graphic chart, the RD was transferred to the ATC/MCA Crossing Altitude subcommittee at Meeting 08-01 and closed. No action has been taken to date.**

Recommendation

- **Development of a standard depiction of stepped climb/descent and maintain altitude information box for the pilot briefing strip**
- **Highlight STAR stepped descent profile and compliance with altitude restrictions is mandatory when cleared to ‘Descend Via’.**
- **Highlight SID stepped climb profile and compliance with published restrictions is required.**
- **Standardize the location/format for the ‘Maintain’ altitude information on a SID, e.g., Maintain FLxxx, expect filed altitude 10 minutes after departure**

LAS VEGAS Departure (R): 125.9	Alt Elev 2181'	Trans level: FL180	Trans alt: 16000'
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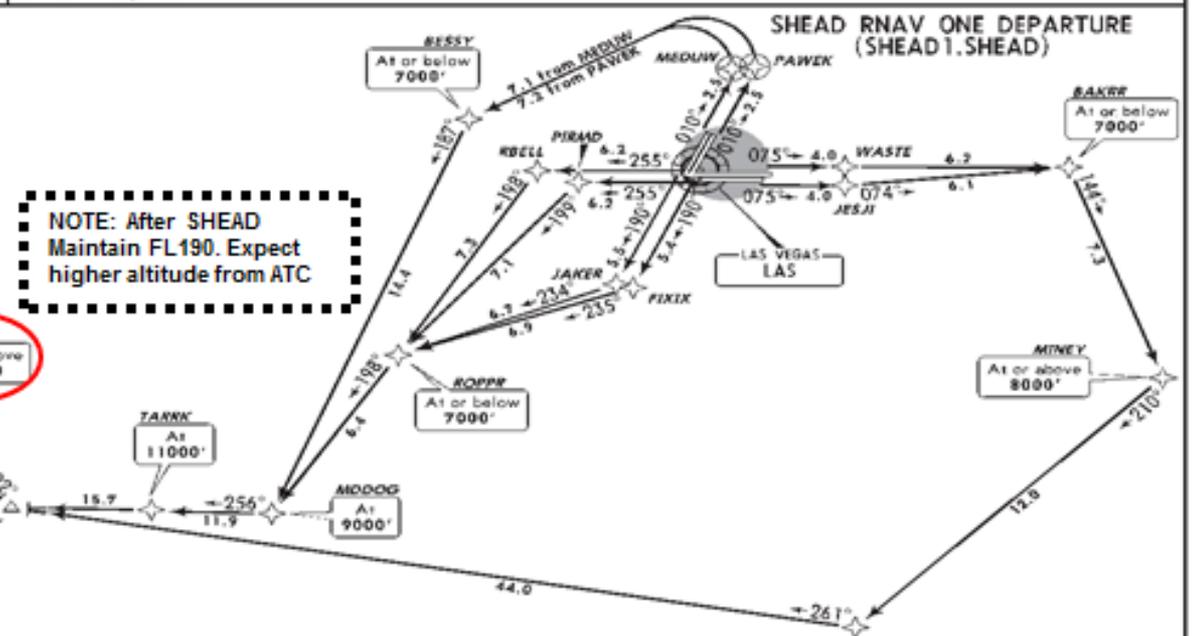
1. For use by /E, /F, /R (RNP 1.0) and /G-equipped aircraft only.
2. /E and /F aircraft are required to update navigation system at a known location within 30 minutes prior to takeoff.
3. /G aircraft with selectable course deviation indicator (CDI) must set CDI to 1 NM terminal sensitivity. Aircraft without selectable CDI must use flight director.
4. DME/DME RNP-1.0 authorized; LAS and BLD must be operational.
5. DME/DME assessment: SAT (RNP 1.0) with LAS and BLD operational.
6. RADAR required.



OBSTACLE
Rwy 1L/R: monument at 3189' MSL/1149' AGL, at 2.87 NM NORTH of DERL.
Rwy 19R: pole at 2249' MSL/40' AGL, at 1135' RIGHT of centerline from DER.

RWY	INITIAL CLIMB
1L	Climb via 010° course to MEDUW, then turn LEFT direct to BESSY, then via 187° course to MDDOG, then via 256° course to TARRK, then via 256° course to SHEAD.
1R	Climb via 010° course to PAWEK, then turn LEFT direct to BESSY, then via 187° course to MDDOG, then via 256° course to TARRK, then via 256° course to SHEAD.
7L	Climb via 075° course to WASTE, then via 075° course to BAKRR, then via 144° course to MINEY, then via 210° course to HITME, then via 261° course to SHEAD.
7R	Climb via 075° course to JESJI, then via 074° course to BAKRR, then via 144° course to MINEY, then via 210° course to HITME, then via 261° course to SHEAD.
19L	Climb via 190° course to FIXIX, then via 235° course to ROPPR, then via 198° course to MDDOG, then via 256° course to TARRK, then via 256° course to SHEAD.
19R	Climb via 190° course to JAKER, then via 234° course to ROPPR, then via 198° course to MDDOG, then via 256° course to TARRK, then via 256° course to SHEAD.
25L	Climb via 255° course to PIRMD, then via 199° course to ROPPR, then via 198° course to MDDOG, then via 256° course to TARRK, then via 256° course to SHEAD.
25R	Climb via 255° course to RBELL, then via 198° course to ROPPR, then via 198° course to MDDOG, then via 256° course to TARRK, then via 256° course to SHEAD.

ROUTING
Via transition. EXPECT filed altitude 10 minutes after departure.



LAS VEGAS Departure (R)
125.9

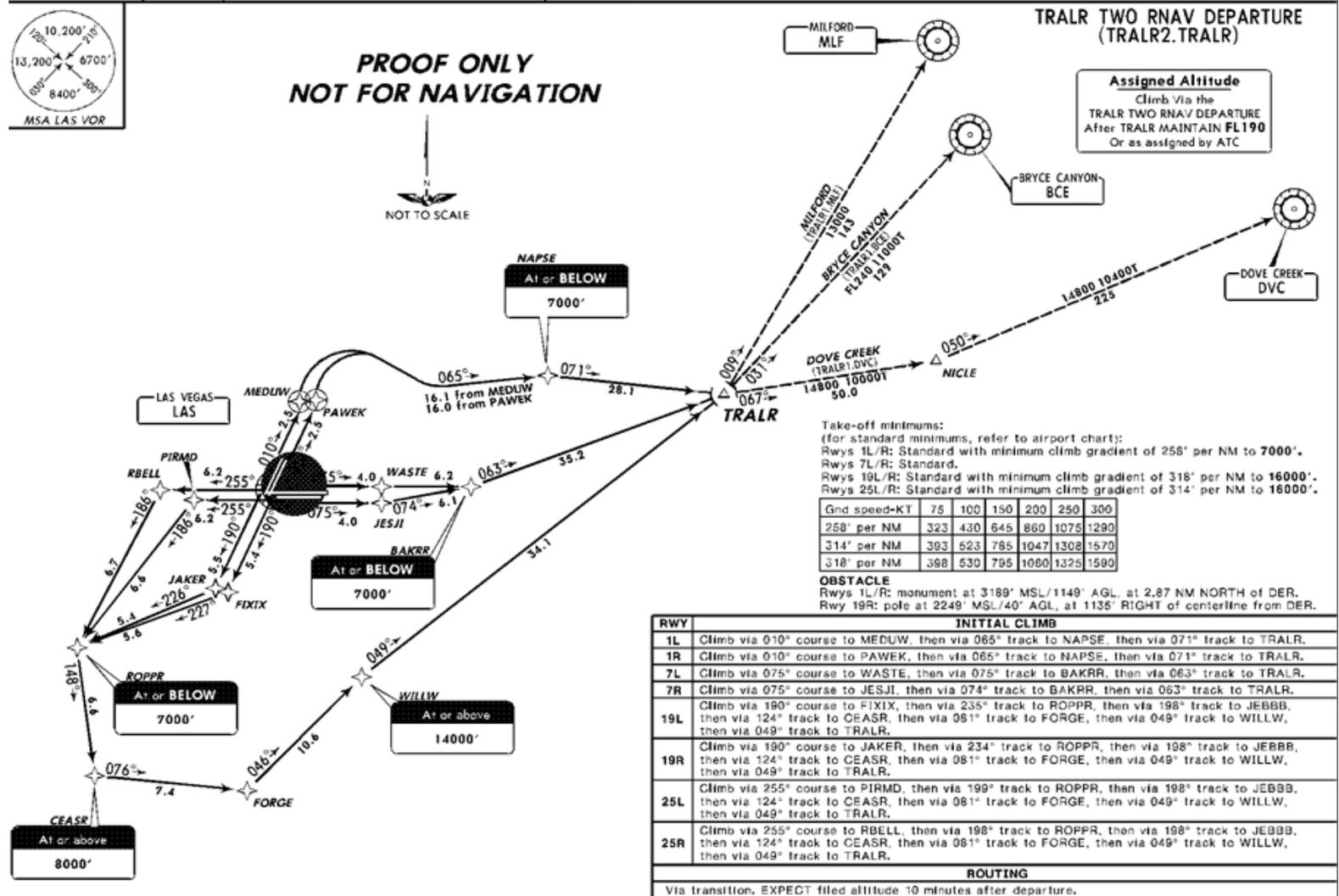
Apt Elev
2181'

Trans level: FL180 Trans alt: 16000'

1. For use by /E, /F, /R (RNP 1.0) and /G-equipped aircraft only.
2. /E and /F aircraft are required to update navigation system at a known location within 30 minutes prior to takeoff.
3. /G aircraft with selectable course deviation indicator (CDI) must set CDI to 1 NM terminal sensitivity. Aircraft without selectable CDI must use flight director.
4. DME/DME RNP-1.0 authorized: LAS and BLD must be operational.
5. RADAR required.



**PROOF ONLY
NOT FOR NAVIGATION**



Take-off minimums:
(for standard minimums, refer to airport chart):
Rwys 1L/R: Standard with minimum climb gradient of 258' per NM to 7000'.
Rwys 7L/R: Standard.
Rwys 19L/R: Standard with minimum climb gradient of 318' per NM to 16000'.
Rwys 25L/R: Standard with minimum climb gradient of 314' per NM to 16000'.

Gnd speed-KT	75	100	150	200	250	300
258' per NM	323	430	645	860	1075	1290
314' per NM	393	523	785	1047	1308	1570
318' per NM	398	530	795	1060	1325	1590

OBSTACLE
Rwys 1L/R: monument at 3189' MSL/1149' AGL, at 2.87 NM NORTH of DER.
Rwy 19R: pole at 2249' MSL/40' AGL, at 1135' RIGHT of centerline from DER.

RWY	INITIAL CLIMB
1L	Climb via 010° course to MEDLW, then via 065° track to NAPSE, then via 071° track to TRALR.
1R	Climb via 010° course to PAWEK, then via 065° track to NAPSE, then via 071° track to TRALR.
7L	Climb via 075° course to WASTE, then via 075° track to BAKRR, then via 063° track to TRALR.
7R	Climb via 075° course to JESJI, then via 074° track to BAKRR, then via 063° track to TRALR.
19L	Climb via 190° course to FIXIX, then via 235° track to ROPPR, then via 198° track to JEBBB, then via 124° track to CEASR, then via 081° track to FORGE, then via 049° track to WILLW.
19R	Climb via 190° course to JAKER, then via 234° track to ROPPR, then via 198° track to JEBBB, then via 124° track to CEASR, then via 081° track to FORGE, then via 049° track to WILLW.
25L	Climb via 255° course to PIRMD, then via 199° track to ROPPR, then via 198° track to JEBBB, then via 124° track to CEASR, then via 081° track to FORGE, then via 049° track to WILLW.
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ROUTING

Via transition, EXPECT filed altitude 10 minutes after departure.



Questions?

