Guidance on Towards-the-Crowd Manoeuvres (TCM) in Flying Displays

December 2025

1. Purpose and Scope

In light of operational experience and global safety data, the European Airshow Council (EAC) wishes to draw attention to the subject of Towards-the-Crowd Manoeuvres (TCMs). This bulletin is provided for the consideration of Display Pilots and teams, Civil Aviation Authorities (CAAs), Military Display Authorities and Flying Display Directors (FDDs). The intent is not to create new regulations, but to support the international display community in making informed decisions when designing routines and assessing risk.

2. Safety Context

Global airshow accident data over the last two decades suggests that risk tends to follow cycles rather than a linear decline. While regulation and safety culture have improved, several themes merit consideration:

- **Casualty Demographics:** While pilot fatalities remain the primary statistic, the potential for spectator or third-party casualties remains a critical safety focus.
- **Debris Spread:** Even if an impact point is away from the crowd, the kinetic energy of high-performance aircraft can result in significant debris spread, extending the hazard zone, as explored with the use of the EAC internally-developed simulation software airshow trajectory app (https://airshow-trajectory-app.streamlit.app/).
- **Causal Factors:** Common drivers continue to be Flight Into Terrain (FIT) and Loss of Control (LOC), often exacerbated by high mental and physical workload.
- **Operational Currency:** As the industry stabilizes post-pandemic, ensuring that display complexity matches pilot currency and proficiency is vital.

Within this context, manoeuvres that direct energy toward the crowd line—particularly at low altitude and high energy—warrant specific review regarding debris fields and error trajectories.

3. Defining TCM's

For the purposes of this guidance, a TCM is defined as any manoeuvre (or segment thereof) where the resultant energy vector, in the event of a failure or incomplete recovery, is oriented toward spectator areas. Examples typically include:

- **Vertical/Steep Downlines:** Where the projected pull-out or error path intersects the crowd line.
- **Descending Loops/Rolls:** Where a misjudged height or energy state could project the aircraft or wreckage toward the public.
- **High-Energy Repositioning:** Turns toward the crowd flown near display minima.
- **Formation Breaks/Re-joins:** "On crowd" presentations where a collision or failure could send trajectory debris across the display line.

4. Assessing the Risk vs. Benefit

When evaluating a TCM, stakeholders are encouraged to consider whether the visual spectacle justifies the increased level of risk.

Factors to Consider:

- **Trajectory Bias:** In a failure scenario (mechanical, bird strike, LOC), does the aircraft's natural path point toward or away from the protected area? Ideally, default failure trajectories should be directed away from the public.
- **Third Parties:** Consideration must be given not just to spectators, but to "third parties"—individuals outside the event boundary going about their normal business.
- **Margins:** Does the manoeuvre rely on tight energy and height margins? High-performance jets often have limited "spare" performance during vertical recoveries.
- **Public Acceptance:** An accident involving spectators or third parties can have severe consequences for the long-term acceptance of the airshow industry.

5. Thoughts for Consideration

Based on expert analysis and board deliberations, the EAC offers the following principles for display planning:

1. **Increased Exposure:** TCMs inherently create an increased level of exposure for the public compared to parallel or away-manoeuvres.

2. **Safety Case Approach**: Rather than adhering solely to minimum distances, it is best practice to build a safety case for TCMs. This involves asking:
   - *Is the energy profile fully validated?*
   - *Are the failure modes understood?*
   - *Are there credible mitigations (e.g., sterile areas) in place?*

3. **Reviewing Inclusion**: Pilots are encouraged to review the inclusion of TCMs in their routines. If a manoeuvre presents a high risk to the crowd in the event of a failure, consider if it can be re-oriented or redesigned.

To help assess debris spread of your manourvres , the EAC have developed the App below to assist in your planning and exploration of TCM's. The software has been created by Dr Manolis Karachalios, pilot, former F16 Demo Pilot and Airshow Accident expert.

Click on the icon to access

6. Guidance for Stakeholders

For Civil Aviation Authorities (CAAs)

- **Transparency:** Encourage the identification of TCMs in display authorisations grants and training events for pilots, to draw attention to the topic of TCM's and suitable assessment for their inclusion.

For Military Display Authorities

- **Profile Review:** Systematically review solo and team routines to identify embedded TCMs.
- **Data-Led Analysis:** Utilise test and operational data to analyse energy margins and recoverability, rather than relying solely on historical tradition.
- **Training Alignment:** Ensure that low-level, high-energy manoeuvres are trained under representative conditions with structured supervision.

For Flying Display Directors (FDDs)

- **Discussion:** Actively discuss TCMs with performers during planning.
- **Risk Transfer:** Be mindful that moving a manoeuvre away from the crowd line might shift the risk to third parties outside the venue. Ensure "fixing" one risk does not create another.

For Display Pilots and Team Leaders

- **Self-Assessment:** Take personal responsibility for assessing the risk of your routine. Regulatory approval is the minimum standard, not the sole measure of safety.
- **Geometry Engineering:** Where feasible, look for geometric alternatives (e.g., offset verticals, turn-away recoveries) that maintain the visual spectacle but shift error trajectories away from the crowd.
- **Triggers for Change:** Treat "near misses" or marginal recoveries as immediate triggers to adjust minima or redesign the manoeuvre.

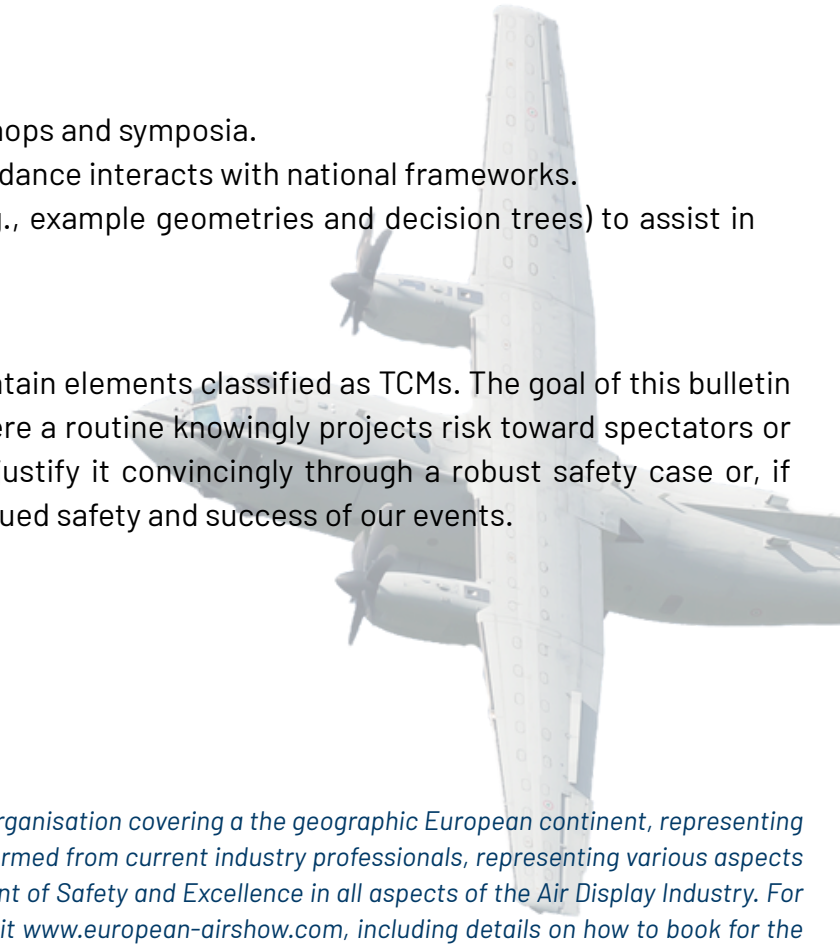
7. Implementation and Future Steps

To support the community, the EAC intends to:

- Discuss TCM risk factors at future safety workshops and symposia.
- Invite feedback from authorities on how this guidance interacts with national frameworks.
- Support the development of technical aids (e.g., example geometries and decision trees) to assist in planning.

8. Summary

The EAC recognizes that many popular routines contain elements classified as TCMs. The goal of this bulletin is to foster a culture of dialogue and evidence. Where a routine knowingly projects risk toward spectators or non-participants, the industry best practice is to justify it convincingly through a robust safety case or, if necessary, redesign the profile to ensure the continued safety and success of our events.



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