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VRS-TRN-201

Transportation / On-road Autonomous — AR Assessment Protocol

How the Transportation Application Rating letter is determined — sector criteria TRN-1…TRN-8, contributing intrinsic criteria, letter bands, tier ceilings and class applicability, with evidence by tier and underwriting use.

VEYRUM RESEARCH INSTITUTE

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Foreword. This Assessment Protocol determines the **Transportation Application Rating (AR)** letter for a robot model operating on public roads, in a declared operation class. It scores a **pool** of criteria — the eight sector criteria of Clause 6 (TRN-1…TRN-8, 100 points) plus the named intrinsic criteria of Clause 5, each scored once under its own standard and counted here — and expresses the earned points as a percentage of the applicable pool, which maps to a letter **C < B < A < AA < AAA (AAA best)** by the bands of VRS-GEN-006 §4. Every criterion is bounded by an evidence tier — Unverified, Verified, Certified — so the best attainable letter rises with substantiation, not assertion. This edition supersedes the re-weighted-mean model of the 0.x drafts: no weighting, no separate grade bands, no separate modifiers — the tier limits follow from the per-criterion ceilings of Clause 6. TRN is VRS's most regulated and most adjacent-covered sector: the safety-certification layer below the VRS position is crowded (type approval, AV safety cases, functional-safety and SOTIF regimes), so the posture is explicit — those outputs are **consumed as evidence inputs** and the economic-risk layer nobody owns is rated; VRS runs no road tests. The defining condition of the sector is **third-party harm to parties who did not choose the exposure**, including vulnerable road users, so a single event can generate a bodily-injury claim far exceeding the vehicle's own value; the rating is therefore bounded to the declared operation classes and their **operational design domain (ODD)**, and evidence obtained outside a declared class or ODD is inadmissible. A Transportation AR is an opinion above the compliance floor, not a certification, and nothing here implies that any real robot holds a Veyrum rating (ratings are not published). Requirements use "shall"; recommendations use "should".

1 1 Scope

1.1 This Protocol defines, for the **Transportation / On-road Autonomous** sector Application Rating: the determination method (Clause 4); the contributing intrinsic criteria drawn into the pool (Clause 5); the eight sector criteria TRN-1…TRN-8 with their point ladders and tier ceilings (Clause 6); the letter bands, pool ceilings and class applicability (Clause 7); the evidence admissible at each tier (Clause 8); underwriting and credit use (Clause 9); result recording (Clause 10); and the assessor checklist (Clause 11). A worked example is at Annex A.

1.2 The AR shall be issued **per application class**. The operation classes are **robotaxi**, **autonomous truck**, **low-speed shuttle** and **sidewalk delivery**, per VRS-TRN-001 §4.3. All eight sector criteria apply to all classes. Sector applicability, the on-road hazard taxonomy (H1–H6) and the TRN anchor regime are defined in VRS-TRN-001 and are not restated here.

1.3 The AR shall be assessed at one of three **tiers** — Unverified, Verified, Certified. Each criterion states the maximum points reachable at each tier (Clause 6); the AR tier is the tier whose evidence bar the assessed evidence meets and shall not exceed the model's Intrinsic Rating tier (VRS-GEN-006 §7). The underlying point aggregation and the letter bands are defined in VRS-GEN-005/006 and are not restated here.

2 2 Normative references

- **VRS-TRN-001**, Transportation / On-road Autonomous — Sector Standard — applicability, the operation classes, the on-road hazard groups H1–H6 and the TRN anchor regime.
- **VRS-GEN-005**, Intrinsic Rating — Methodology — point aggregation, tiers and the company-wide fallback rule (§6).
- **VRS-GEN-006**, Application Rating — Scheme — the letter bands, the applicable-pool percentage and the tier rule.
- **VRS-GEN-009**, Robot Risk Passport and Registry Schema — the record that carries the AR result.
- **VRS-GEN-012**, Evidence Grades and Data Requirements — evidence kinds and the tier evidence bars.
- **VRS-GEN-101 … VRS-GEN-107**, IR Category Standards — the intrinsic criteria contributed under Clause 5.
- **UL 4600:2023** (Edition 3) and **UN Regulation No. 157** (ALKS) — the recognised-safety-case anchors for TRN-1.
- **ISO 34503:2023** (ODD specification) and **ISO 21448:2022** (SOTIF) — the ODD-discipline and minimal-risk-manoeuvre anchors for TRN-2.
- **ISO 26262:2018** (functional safety) — the fallback/takeover anchor for TRN-4.
- **ISO/SAE 21434:2021** and **UN Regulations No. 155/No. 156** (CSMS/SUMS) — the fleet-cyber and software-update anchors for TRN-5.
- **Commission Implementing Regulation (EU) 2022/1426** — the EU market safety-floor and in-service incident-reporting anchor for TRN-1/TRN-7/TRN-8.
- Data twin: **VRS-TRN-501** (generated from this Protocol, never hand-edited).

3 3 Terms and definitions

Terms per VRS-GEN-001 (aligned to ISO 8373:2021) and VRS-TRN-001. Locally:

- **pool** — the set of criteria whose points determine the AR letter: the eight sector criteria of Clause 6 together with the contributing intrinsic criteria of Clause 5.
- **applicable pool** — the pool for a given operation class after criteria not applicable to that class are removed from both the earned points and the pool range (Clause 4; VRS-GEN-006 §6).
- **contributor** — an intrinsic criterion scored once under its own IR category standard and counted again in the sector pool at the same points (Clause 5).
- **tier** — the evidence stringency at which a criterion is assessed: **Unverified** (public evidence only), **Verified** (manufacturer evidence pack examined), **Certified** (behaviour witnessed).
- **ceiling** — the maximum points a criterion awards at a given tier; points earned are held at the ceiling of the assessed tier.
- **evidence bar** — the minimum evidence a criterion requires before any points are awarded; below it the criterion scores 0.
- **company-wide fallback** — the substitute points a criterion allows from manufacturer-wide evidence when model-specific evidence is unavailable (VRS-GEN-005 §6).

- **operation class** — a declared category of road use (robotaxi, autonomous truck, low-speed shuttle, sidewalk delivery), recorded as a protocol applicability field.
- **ODD** (operational design domain) — the declared road, traffic, speed and weather envelope within which the automated driving system is claimed to operate, specified per ISO 34503:2023.
- **exposure envelope** — the declared limits within which evidence is attributable and the letter is valid, recorded per operation class as the ODD and the operating jurisdictions.

4 4 Method of assessment

4.1 The Transportation AR shall be determined as a percentage of the **applicable pool** and mapped to a letter by the bands of VRS-GEN-006 §4 (Clause 7.1). The pool is the eight sector criteria of Clause 6 (TRN-1…TRN-8, 100 points) together with the contributing intrinsic criteria of Clause 5, each scored once under its own standard and counted here at the same points. For an operation class the assessor shall add the points earned across the applicable criteria and divide by the sum of the point ranges of those same criteria; a criterion not applicable to the class (Clause 6 Applicability row; VRS-GEN-006 §6) shall be removed from both the earned points and the pool range. No weighting is applied — each criterion's point range sizes its own importance — and no separate modifiers operate on the letter: the tier limits follow from the per-criterion ceilings of Clause 6 (Clause 7.2; VRS-GEN-006 §8).

4.2 Evidence shall be attributable to the declared **operation classes** of the assessed envelope (at minimum one of robotaxi, autonomous truck, low-speed shuttle, sidewalk delivery; Clause 1.2) and to each class's declared **ODD**; the AR letter covers only the assessed classes and their ODD.

4.3 Letters shall be issued **per operation class** where evidence diverges materially between classes; the displayed sector letter shall be the **lowest issued class letter**. A class for which no letter can be issued shall be displayed as *not covered*, and the assessed **exposure envelope shall contract** to the operation classes and ODD the evidence actually covers rather than the score being stretched to conditions never observed.

4.4 Evidence obtained outside a declared operation class or its ODD shall be **inadmissible** as support for that class and shall not raise the score. In particular, fair-weather daytime driving evidence shall not support a night-or-adverse-weather ODD claim, and highway driving evidence shall not support a dense-urban vulnerable-road-user claim: the unobserved condition is the risk being rated.

5 5 Contributing IR criteria

5.1 The sector pool consists of the sector criteria of Clause 6 and the following intrinsic criteria, scored once under their own standards and counted again here at the same points:

IR CRITERION	SCORED UNDER
SF-2	VRS-GEN-101 §6.2
SF-4	VRS-GEN-101 §6.4
SF-5	VRS-GEN-101 §6.5
SF-7	VRS-GEN-101 §6.7
SF-8	VRS-GEN-101 §6.8
RL-3	VRS-GEN-102 §6.3
RL-7	VRS-GEN-102 §6.7
SV-6	VRS-GEN-103 §6.6
CY-3	VRS-GEN-105 §6.3
CY-4	VRS-GEN-105 §6.4
CY-5	VRS-GEN-105 §6.5
CY-7	VRS-GEN-105 §6.7
MS-1	VRS-GEN-106 §6.1
MS-7	VRS-GEN-106 §6.7
SI-1	VRS-GEN-104 §6.1
SI-6	VRS-GEN-104 §6.5

5.2 No other intrinsic criterion contributes. Points, ceilings and applicability of a contributing criterion are those of its own standard; where a contributing criterion is not applicable to the assessed application class it is removed from the pool for that class (VRS-GEN-006 §6).

6 6 Sector criteria

6.0 Summary. Points and tier ceilings per criterion; totals reproduce by addition.

§	CRITERION	POINTS	UNVERIFIED CEILING	VERIFIED CEILING	CERTIFIED CEILING
6.1	TRN-1 Lawful-operation status and safety case	0–16	12	14	16
6.2	TRN-2 ODD discipline and minimal-risk manoeuvre	0–14	7	11	14
6.3	TRN-3 Vulnerable-road-user detection and response	0–14	8	11	14
6.4	TRN-4 Handover and remote-assistance quality	0–12	7	10	12
6.5	TRN-5 Fleet cyber and software-update governance (R155/R156)	0–12	9	10	12
6.6	TRN-6 Service availability and stranded-vehicle recovery	0–10	7	8	10
6.7	TRN-7 Data-recorder completeness and reporting compliance	0–10	8	9	10
6.8	TRN-8 Collision, disengagement and incident record	0–12	12	12	12
	Total	**100**	**70**	**85**	**100**

6.1 6.1 TRN-1 Lawful-operation status and safety case (0–16)

ROW	
What is measured	.
Ladder	16 = permits/type approval public + published safety case assessed by a third party (UL 4600 / notified body) · **14 = pack-evidenced (documents), not demonstrated** · 12 = permits public + safety case published · 8 = permits only · 0 = not established
Unverified — evidence & ceiling	Permit registers; published safety case. **Ceiling 12.**
Verified — evidence & ceiling	Safety case + permits + assessment reports. **Ceiling 14.**
Certified — evidence & ceiling	— (documentary). **Ceiling 16.**
Company-wide fallback	n/a
Evidence bar	Operating jurisdictions declared.
Applicability	robotaxi · autonomous truck · low-speed shuttle · sidewalk delivery. All criteria apply to all classes.

6.2 6.2 TRN-2 ODD discipline and minimal-risk manoeuvre (0–14)

ROW	
What is measured	Operation refused outside the declared ODD; MRM quality (pull-over, stop-in-lane behaviour) on fault or ODD exit.
Ladder	14 = witnessed on closed course · **11 = pack-evidenced (documents), not demonstrated** · 10 = validated + independently observed · **7 = publicly evidenced only (no pack, no demonstration)** · 6 = documented · 0 = not established
Unverified — evidence & ceiling	Published ODD; regulator reports. **Ceiling 7.**
Verified — evidence & ceiling	ODD spec + validation. **Ceiling 11.**
Certified — evidence & ceiling	Witnessed ODD-exit and fault → MRM on a closed course. **Ceiling 14.**
Company-wide fallback	n/a
Evidence bar	ODD declared.
Applicability	robotaxi · autonomous truck · low-speed shuttle · sidewalk delivery. All criteria apply to all classes.

6.3 6.3 TRN-3 Vulnerable-road-user detection and response (0–14)

ROW	
What is measured	Detection/response to pedestrian/cyclist targets at declared speeds incl. night/rain within ODD.
Ladder	14 = witnessed on closed course · **11 = pack-evidenced (documents), not demonstrated** · 10 = validated + independent tests · 8 = certified/tested ((public)) · 5 = documented · 0 = not established
Unverified — evidence & ceiling	Independent tests; regulator data. **Ceiling 8.**
Verified — evidence & ceiling	Validation evidence. **Ceiling 11.**
Certified — evidence & ceiling	Witnessed with soft targets on a closed course. **Ceiling 14.**
Company-wide fallback	n/a
Evidence bar	Speeds and conditions declared.
Applicability	robotaxi · autonomous truck · low-speed shuttle · sidewalk delivery. All criteria apply to all classes.

6.4 6.4 TRN-4 Handover and remote-assistance quality (0–12)

ROW	
What is measured	Takeover requests, remote-assistance latency and authority limits; failure of remote link → MRM.
Ladder	12 = witnessed · **10 = pack-evidenced (documents), not demonstrated** · 9 = documented in detail + validated · **7 = publicly evidenced only (no pack, no demonstration)** · 5 = documented · 0 = not established
Unverified — evidence & ceiling	Published descriptions; regulator filings. **Ceiling 7.**
Verified — evidence & ceiling	Design + latency data + validation. **Ceiling 10.**
Certified — evidence & ceiling	Witnessed remote-assist session and link-loss → MRM. **Ceiling 12.**
Company-wide fallback	n/a
Evidence bar	Remote-operation model declared.
Applicability	robotaxi · autonomous truck · low-speed shuttle · sidewalk delivery. All criteria apply to all classes.

6.5 6.5 TRN-5 Fleet cyber and software-update governance (R155/R156) (0–12)

ROW	
What is measured	Certified cyber-management and software-update systems; V2X spoof resistance; location-data controls.
Ladder	12 = shown + certificates · 10 = certificates public · **9 = publicly evidenced only (no pack, no demonstration)** · 6 = documented · 0 = not established
Unverified — evidence & ceiling	Public R155/R156 approvals; security page. **Ceiling 9.**
Verified — evidence & ceiling	CSMS/SUMS certificates + design. **Ceiling 10.**
Certified — evidence & ceiling	Witnessed signed update, access controls, logging. **Ceiling 12.**
Company-wide fallback	n/a
Evidence bar	None.
Applicability	robotaxi · autonomous truck · low-speed shuttle · sidewalk delivery. All criteria apply to all classes.

6.6 6.6 TRN-6 Service availability and stranded-vehicle recovery (0–10)

ROW	
What is measured	Recovery response times, depot logistics, traffic-blocking mitigation.
Ladder	10 = commitments + record + witnessed procedure · 8 = commitments + record · **7 = publicly evidenced or company-wide record** · 4 = documented · 0 = not established
Unverified — evidence & ceiling	Published commitments; reports. **Ceiling 7.**
Verified — evidence & ceiling	Commitments + record. **Ceiling 8.**
Certified — evidence & ceiling	Witnessed recovery procedure walk-through. **Ceiling 10.**
Company-wide fallback	Record company-wide → 7
Evidence bar	None.
Applicability	robotaxi · autonomous truck · low-speed shuttle · sidewalk delivery. All criteria apply to all classes.

6.7 6.7 TRN-7 Data-recorder completeness and reporting compliance (0–10)

ROW	
What is measured	Event data recorder scope, retention, regulator reporting compliance history.
Ladder	10 = shown + compliant record · **9 = pack-evidenced (documents), not demonstrated** · 8 = documented in detail + compliant record public · 5 = documented · 0 = not established
Unverified — evidence & ceiling	Regulator compliance records. **Ceiling 8.**
Verified — evidence & ceiling	EDR spec + reporting record. **Ceiling 9.**
Certified — evidence & ceiling	Recorder output shown for a session event. **Ceiling 10.**
Company-wide fallback	n/a
Evidence bar	None.
Applicability	robotaxi · autonomous truck · low-speed shuttle · sidewalk delivery. All criteria apply to all classes.

6.8 6.8 TRN-8 Collision, disengagement and incident record (0–12)

ROW	
What is measured	Regulator-reported collisions/disengagements normalised by disclosed miles.
Ladder	12 = low rate, all investigated · **10 = company-wide record in place of model-specific data** · 8 = moderate · 5 = elevated with corrective action · 0 = not established. · 0. **Regime-full at Unverified.**
Unverified — evidence & ceiling	Public regulator reports + disclosed miles. **Ceiling 12.**
Verified — evidence & ceiling	Fleet records + exposure. **Ceiling 12.**
Certified — evidence & ceiling	From Verified evidence. **Ceiling 12.**
Company-wide fallback	Company-wide → 10
Evidence bar	Exposure public or declared.
Applicability	robotaxi · autonomous truck · low-speed shuttle · sidewalk delivery. All criteria apply to all classes.

7 7 Letter bands, tier ceilings and class applicability

7.1 Bands (VRS-GEN-006 §4). AAA ≥ 90 % · AA ≥ 75 % · A ≥ 60 % · B ≥ 45 % · C below 45 % of the applicable pool.

7.2 Pool ceilings. Sector criteria alone: Unverified 70/100 (70 %) · Verified 85/100 (85 %) · Certified 100. With the contributing criteria of Clause 5 the pool ceilings are as recorded in VRS-TRN-501; in both forms the best attainable letter is A at Unverified, AA at Verified and AAA at Certified (VRS-GEN-006 §8).

7.3 Application classes. robotaxi · autonomous truck · low-speed shuttle · sidewalk delivery. All criteria apply to all classes… A criterion whose Applicability row excludes the assessed class is removed from both the numerator and the denominator; the letter is issued per class and the displayed letter is the lowest (Clause 4).

7.4 No modifiers, caps or gates operate on the letter other than the ceilings of Clause 6 and the tier rule of VRS-GEN-006 §7.

8 8 Evidence by tier

8.1 Unverified. The assessor works only from evidence obtainable without the manufacturer’s cooperation: permit and type-approval registers and any published safety case (TRN-1); the published

ODD and regulator reports of degraded-condition and minimal-risk-manoeuvre behaviour (TRN-2); independent vulnerable-road-user test results and regulator data (TRN-3); published descriptions and regulator filings of the handover/remote-assistance model (TRN-4); public UN R155/R156 approvals and the manufacturer security page (TRN-5); published availability commitments and recovery reports (TRN-6); regulator reporting-compliance records (TRN-7); and public regulator collision/disengagement reports with disclosed miles (TRN-8). Each criterion's Unverified ceiling (Clause 6) is the most an honest reading of such evidence shall earn; the AR tier is **Unverified**.

8.2 Verified. The assessor additionally examines a manufacturer evidence pack and shall accept, by mapping, the conformity artefacts the manufacturer already holds — adoption is a mapping, not new testing: the third-party-assessed safety case with permits and assessment reports (UL 4600:2023 / UN R157 / the safety-concept assessment under Implementing Regulation (EU) 2022/1426) (TRN-1); the ISO 34503:2023 ODD specification and ISO 21448:2022 (SOTIF) validation of degraded-condition and minimal-risk-manoeuvre behaviour (TRN-2, TRN-3); the ISO 26262:2018 functional-safety evidence for the fallback/takeover path with remote-assistance latency data (TRN-4); the ISO/SAE 21434:2021 CSMS and UN R155/R156 SUMS certificates for the fleet OTA/control plane (TRN-5); the availability commitments and recovery record (TRN-6); the event-data-recorder specification and reporting record (TRN-7); and the fleet collision/disengagement records with their exposure basis (TRN-8). Verified ceilings apply only to criteria whose pack items are present and examined; the AR tier is **Verified**.

8.3 Certified. The assessor witnesses the declared behaviour on the robot: an ODD-exit and fault resolving to the minimal-risk manoeuvre on a closed course (TRN-2); a vulnerable-road-user response with soft targets on a closed course (TRN-3); a remote-assist session and a link-loss resolving to the minimal-risk manoeuvre (TRN-4); a signed software update with its access controls and logging (TRN-5); a recovery procedure walk-through (TRN-6); and the recorder output shown for a session event (TRN-7). The documentary criteria (TRN-1, TRN-8) carry their Certified points from the Verified evidence. The AR tier is **Certified**.

8.4 Evidence bar. Each criterion states an **evidence bar** (Clause 6). Where the bar is not met the criterion shall score **0** — no evidence is 0 points, never a discard from the pool. A manufacturer self-declaration shall not earn points above the rung its independent corroboration (third-party assessment, regulator filing, public register) supports; the TRN-3 vulnerable-road-user case and the TRN-2 ODD case shall never be inferred from evidence transferred from a narrower or fair-weather envelope (Clause 4.4). Where the TRN-8 collision-and-incident evidence rests on operator recollection rather than an instrumented record with its exposure basis, the TRN-8 evidence bar is not met and the criterion shall not earn above its lowest substantiated rung.

8.5 Regime-full rule. The TRN-8 collision/disengagement criterion reaches its full range at the Unverified tier from public regulator reports and disclosed miles (Clause 6.8): the road-transport regulatory regime already publishes the exposure and event record, so no manufacturer pack or witnessed demonstration is required to substantiate it, and its Verified and Certified ceilings equal its Unverified ceiling.

8.6 Company-wide fallback. Where a criterion offers a company-wide fallback (TRN-6, TRN-8) and model-specific evidence is unavailable, manufacturer-wide records shall earn the stated fallback points (VRS-GEN-005 §6); the substitution shall be recorded per Clause 10.

8.7 AR tier. The AR tier is the lowest tier among the criteria that determined the letter, and shall not exceed the model's Intrinsic Rating tier (VRS-GEN-006 §7).

9 9 Underwriting and credit use

9.1 The letter is an opinion above the compliance floor, not a certification, and shall not be published or imply that any real robot holds a Veyrum rating. A rating is an opinion on the robot, not on the lawfulness of any deployment: absence of an evidenced lawful-operation status scores 0 on TRN-1 (§6.1) and the robot is still rated, with the missing permit/approval recorded on the result — it is not a gate on the letter.

9.2 The per-class letters and the recorded ODD envelopes are the underwriting hooks: the letter informs rate relativity, and the covered operation classes and ODD inform coverage scope, so that operation outside the assessed envelope is an exclusion or a condition rather than an implied covered risk. Loss drivers shall be surfaced separately so an underwriter can weigh them independently of the letter: the **third-party road-harm severity driver** (TRN-3 and TRN-8 — harm falls on parties who did not choose the exposure, including vulnerable road users, surfaced with respect to the vulnerable-road-user population the declared ODD admits rather than an average vehicle occupant); the **correlated fleet-cyber driver** (TRN-5 — where many units share one over-the-air update or control plane, one intrusion or one defective update can degrade the fleet at once, so the per-fleet accumulation attribute records whether that regime holds ISO/SAE 21434:2021 + UN R155/R156 evidence); and the **stranded-vehicle driver** (TRN-6 — third-party traffic-blocking exposure, surfaced so it is not hidden inside an availability metric).

9.3 For credit, the recoverability and residual drivers shall be readable from the recorded per-criterion points to inform loan-to-value, residual curves and end-of-support assumptions: TRN-4 handover/remote-assist reliability and TRN-6 recovery posture govern recoverability, while the TRN-5 software-support posture, the TRN-7 recorder/reporting record and the intrinsic support criteria drawn into the pool (Clause 5, the MS contributors) inform the obsolescence assumption.

10 10 Result recording

The rating record shall carry, per VRS-GEN-009: the displayed sector letter and the per-class letters with the ODD envelope each was issued at; the **per-criterion points** earned across the sector criteria (Clause 6) and the contributing intrinsic criteria (Clause 5); the **not-applicable set** removed for each class and the resulting applicable-pool range; the contributing intrinsic criteria used; the AR **tier**; the **edition** (VRS 2026); the VRS-TRN-501 data-twin version; the permits/type-approvals and safety-case identifiers relied on and the public-filing sources consumed; and the third-party road-harm, correlated fleet-cyber and stranded-vehicle attributes (Clause 9.2). Recording flows to the Passport per VRS-GEN-009; no personal information shall be stored (VRS-GEN-012 §5.2).

11 11 Assessor checklist

An assessor with this Protocol and the evidence shall reach the same result by executing the following in order; no step admits an unrecorded judgement call, and any deviation shall be recorded with its basis:

- [ ] Operation class(es) confirmed (robotaxi / autonomous truck / low-speed shuttle / sidewalk delivery) with each ODD envelope (Clause 1.2; VRS-TRN-001 §4.3).

- [ ] Assessment tier fixed (Clause 8); the not-applicable set recorded per class and the applicable-pool range computed (Clause 4); evidence outside a declared class or ODD discarded (Clause 4.4).
- [ ] Contributing intrinsic criteria drawn from their source standards at their own points and tiers (Clause 5).
- [ ] **TRN-1** lawful-operation status and safety case scored; operating jurisdictions are declared (evidence bar); absence scores 0 and the robot is still rated (Clause 9.1).
- [ ] **TRN-2** ODD discipline and minimal-risk manoeuvre scored; the ODD is declared (evidence bar).
- [ ] **TRN-3** vulnerable-road-user detection and response scored; speeds and conditions are declared (evidence bar); not inferred from a narrower or fair-weather envelope (Clause 4.4).
- [ ] **TRN-4** handover and remote-assistance quality scored; the remote-operation model is declared (evidence bar).
- [ ] **TRN-5** fleet cyber and software-update governance scored (R155/R156 CSMS/SUMS).
- [ ] **TRN-6** service availability and stranded-vehicle recovery scored; company-wide fallback recorded if used.
- [ ] **TRN-7** data-recorder completeness and reporting compliance scored.
- [ ] **TRN-8** collision, disengagement and incident record scored from public regulator reports and disclosed miles (Clause 8.5); the instrumented-record evidence bar checked (Clause 8.4); company-wide fallback recorded if used.
- [ ] Points added and divided by the applicable-pool range; letter read from the bands (Clause 7.1).
- [ ] Letters issued per class; the lowest displayed (Clause 4.3); each award held at its assessed-tier ceiling (Clause 6).
- [ ] Result recorded to the passport: per-criterion points, not-applicable set, contributors, tier, edition, twin version, permits/safety-case identifiers relied on and the loss-driver attributes of Clause 9.2 (Clause 10).

12 Annex A (informative) — Worked example

> **FICTIONAL EXAMPLE — not a real product; illustrates mechanics only.**

A fictional automated driving system, model code `TRN-ADS-01`, is assessed for the **robotaxi** operation class, declared to a dense-urban ODD (maximum 50 km/h, fair-weather daytime), at the **Verified** tier: a manufacturer evidence pack is examined and no behaviour is witnessed. The operator holds a public permit and a UL 4600:2023 safety case assessed by a third party for the robotaxi ODD; an ISO 34503:2023 ODD specification and ISO 21448:2022 SOTIF analysis; ISO 26262:2018 fallback/takeover evidence with remote-assistance latency logs; ISO/SAE 21434:2021 CSMS and UN R155/R156 SUMS certificates for the fleet OTA plane; an event-data-recorder specification with a compliant reporting record; and public regulator reports showing 3 at-fault contact events over 3,000,000 disclosed miles. All eight sector criteria apply, and the sixteen contributing intrinsic criteria of Clause 5 are drawn from their source standards at their own Verified points.

Sector criteria (Verified tier).

§	CRITERION	VERIFIED CEILING	POINTS EARNED
6.1	TRN-1	14	14
6.2	TRN-2	11	11
6.3	TRN-3	11	10
6.4	TRN-4	10	9
6.5	TRN-5	10	10
6.6	TRN-6	8	7
6.7	TRN-7	9	9
6.8	TRN-8	12	12
	Sector subtotal	**85**	**82**

Contributing intrinsic criteria (Verified tier). Drawn at their own points, the sixteen criteria of Clause 5 have a combined range of **136 points** and a combined Verified ceiling of **112**; this model earns **100** of them, each at or below its Verified ceiling (for example SF-4 at 10 of its 11-point Verified ceiling, RL-3 at 11 of 12, and the connectivity contributor CY-4 at 6 of 7).

Letter. The applicable pool for the robotaxi class is the sector range 100 plus the contributor range 136 = **236 points**. Points earned = 82 (sector) + 100 (contributors) = **182**. As a percentage of the pool, 182 ÷ 236 = **77.1 %**, which falls in the **AA** band (≥ 75 %, below AAA's 90 %). The result is **Transportation AR: AA (VRS 2026) — Verified**.

Tier ceiling by construction. At the Verified tier the pool's own ceiling is (85 + 112) ÷ 236 = 197 ÷ 236 = **83.5 %**, so AA is the best letter attainable without a witnessed demonstration (Clause 7.2); AAA would require Certified-tier evidence such as a witnessed ODD-exit → minimal-risk manoeuvre (TRN-2) and a witnessed vulnerable-road-user response on a closed course (TRN-3). No separate modifier is applied — the ceiling does the work.

Refusal variants. Had `TRN-ADS-01` held no evidenced lawful-operation status for the robotaxi class, TRN-1 would score **0** rather than 14, the letter would fall out of the reduced total, and the model would still be rated with the missing permit recorded on the result (Clause 9.1). Had the collision-and-incident evidence rested only on operator recollection rather than an instrumented record with disclosed miles, the TRN-8 evidence bar would not be met and TRN-8 would not earn above its lowest substantiated rung (Clause 8.4). Had recorder evidence been incomplete for a reported event, TRN-7 would score **0** until the record is reconciled. And had only fair-weather daytime evidence been offered for a night-or-adverse-weather ODD claim, Clause 4.4 / 8.4 would refuse it and the envelope would contract to the conditions actually evidenced. Numbers illustrate mechanics only.

13 Bibliography

The full TRN anchor regime is verified in VRS-TRN-001; the following are the specific anchors this Protocol's criteria and evidence tiers (Clauses 6 and 8) rest on, dated at point of use:

- UL 4600:2023 — Standard for Safety for the Evaluation of Autonomous Products, Edition 3 (2023-03-17; Ed.1 2020, Ed.2 2022) (ul.com; webstore.ansi.org/standards/ul/ul4600ed2023) — TRN-1 safety-case anchor.
- ISO 21448:2022 — Road vehicles — Safety of the intended functionality (SOTIF) (iso.org/standard/77490) — TRN-2/TRN-3 ODD/degraded-condition lane.
- ISO 26262:2018 — Road vehicles — Functional safety, 2nd edition (iso.org, PUB200262) — TRN-4 fallback/takeover functional-safety lane.
- ISO 34503:2023 — Road vehicles — Test scenarios for automated driving systems — ODD specification taxonomy (iso.org/standard/78952) — TRN-2 ODD-declaration lane.
- ISO/SAE 21434:2021 — Road vehicles — Cybersecurity engineering (2021-08) (iso.org/standard/70918) — TRN-5 fleet-cyber lane.
- ISO 8373:2021 — Robotics — Vocabulary (iso.org/standard/75539) — robot-term basis.
- UN Regulation No. 157 (ALKS), adopted 2021, amendments to 130 km/h (Amend.3 2023; Amend.4 2024) (unece.org) — TRN-1 information-document/safety-case pattern.
- UN Regulation No. 155 — Cybersecurity and CSMS for type approval ([2021/387]; consolidated [2025/5]) (eur-lex.europa.eu) — TRN-5 CSMS floor.
- UN Regulation No. 156 — Software update and software update management system (SUMS) ([2021/388]; in force 2021-01-22; EU-effective July 2022 via Reg (EU) 2019/2144) (unece.org; eur-lex.europa.eu) — TRN-5 SUMS floor.
- Implementing Regulation (EU) 2022/1426 — ADS type-approval of fully automated vehicles under Reg (EU) 2019/2144, adopted 2022; amended by (EU) 2026/481 (2026-03-03) (eur-lex.europa.eu) — TRN-1 EU market safety-floor; TRN-7/TRN-8 in-service-reporting lane.
- VRS-TRN-501 — machine-readable data twin of this Protocol (Clause 5/6/7 values).

14 Change history

DATE	VERSION	STATUS	CHANGE	AUTHORITY
2026-09-16	1.0.0	Draft	VRS 2026 rewrite: replaced the re-weighted-mean scoring (Clauses 4–8) with a point-summed pool — eight sector criteria TRN-1…TRN-8 (100 points; Clause 6) plus the named contributing intrinsic criteria (Clause 5), expressed as a percentage of the applicable pool and mapped to a letter by VRS-GEN-006 §4; added per-criterion tier ceilings, the letter-band/pool-ceiling/class-applicability clause (Clause 7), evidence-by-tier (Clause 8), a regenerated Verified-tier worked example (Annex A) and a per-criterion checklist (Clause 11); adopted the application classes (robotaxi / autonomous truck / low-speed shuttle / sidewalk delivery). Re-anchored the former §7 modifiers into criterion rungs and evidence bars (7.1 no-lawful-operation → TRN-1 = 0, robot still rated per §9.1; 7.2 no-recognised-safety-case → the TRN-1 upper rungs §6.1; 7.3 incomplete-recorder → TRN-7 = 0 §6.7, per §8.4 worked-example variant; 7.4 uninstrumented-evidence → the TRN-8 evidence bar §6.8/§8.4). Dropped the VMT exposure denominators from procedures; retired the earlier draft's confidence bands, provisional flags, renormalisation, weighted-mean, assessed-unrated and stage-prior markers; dropped the GEN-201/GEN-202 references. VRS-TRN-501 data twin regenerated by the dispatcher from Clauses 5–7; see GEN-005 §6.	VRS 2026 rewrite Stage 4
2026-09-14	0.3.0ε1	Draft	COHERENCE: corrected stale exposure cross-reference in §8.1 — "VRS-GEN-012 §4.1" (evidence-grade scale) → §7 (Exposure and denominators). Editorial only; no requirement, weight, band, or constant changed; twin VRS-TRN-501 unaffected.	Curator Run #159; charter COHERENCE
2026-09-13	0.3.0	Draft	ACTUARIAL: fitness review; added the §8.1.1 third-party-injury severity measure (MAIS/KABCO) closing a frequency-only gap on the sector's dominant driver; §10 bound the frequency inputs to the VRS-GEN-012 §5 evidence-record schema. No weight/band/sufficiency-constant value changed; twin version-tracked.	Curator Run #116; charter ACTUARIAL
2026-09-12	0.2.0	Draft	DEEPEN: brought the TRN AR protocol to publishable depth on the VRS-IND-201/SVC-201 exemplar — exposure denominator, evidence-lane conformity-artefact reuse (TRN anchors verified 2026-09-12), per-	Curator Run #77; charter DEEPEN

DATE	VERSION	STATUS	CHANGE	AUTHORITY
			criterion loss-driver mapping, refusal gates and caps, per-class letters, underwriting/credit use, passport recording, assessor checklist, worked example, dated Bibliography.	
2026-09-05	0.1.0	Draft	Initial draft — VMT denominators; recorder-completeness gate; consume-don't-duplicate traceability	CEO goal 2026-09-05

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