THERMAL EVALUATION REPORT

Industrial Robot Protective Cover — Heat Accumulation & Servo Motor Risk Assessment

Comparative Test: With Cover vs. Without Cover

Subject Cover	FABOTSUIT® FBD01 — Nylon Composite robot protective cover
Test Robot	ABB IRB 2600-12/1.85 (6-axis)
Target Application Robot	ABB IRB 1410-4/1.45 (5 kg / 1.45 m)
Application	Deburring (metallic dust / chip environment)
Thermal Instrument	UTi32 Thermal Imaging Camera
Test Duration	30 min continuous run + 10 min post-stop observation
Document Ref.	FBD01-THERMAL-EVAL-2026
Prepared For	ABB Robotics — End Customer
Classification	Engineering Test Documentation
Testing site	Avilon - Drone and Robotics Research Center (Private company)

This report presents objective thermal measurements and engineering analysis. It contains no marketing claims and is intended for technical review.

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1. Executive Summary

This evaluation objectively determines whether installing the FABOTSUIT® FBD01 protective cover on an ABB industrial robot causes abnormal heat accumulation or creates a risk of servo motor overheating during a representative deburring duty cycle. Robot joint surface temperatures were compared with and without the cover under closely matched ambient conditions, using a UTi32 thermal imaging camera.

The customer's production application uses an **ABB IRB 1410** (5 kg payload). For test availability, measurements were performed on a larger **ABB IRB 2600-12/1.85** (12 kg payload). This is addressed in Section 3: the larger robot is more thermally demanding, so the findings form a conservative reference for the smaller target robot.

Key result: the cover produced a **maximum ambient-corrected temperature increase of +5.8 °C** on the most-loaded joint (Axis 1), with the highest absolute **surface temperature reaching 48.5 °C.** The two runs were carried out under near-identical conditions — **the ambient air differed by only ~1.1 °C** between them — so the comparison is a fair, like-for-like one and the measured difference is attributable to the cover rather than to test conditions. Temperatures stabilised during the run and decreased after the robot stopped on every axis. **No alarms** occurred, and no evidence of thermal runaway or persistent heat accumulation was observed.

Overall classification: A — Recommended. The temperature rise remains within an acceptable engineering range, the temperatures stabilise and cool after stop, and the robot's own overheating supervision never activated. Extended continuous-production validation is recommended to confirm long-duration behaviour.

Result at a Glance

Metric (worst axis = Axis 1)	No Cover	With Cover	Difference
Peak surface temperature	42.0 °C	48.5 °C	**+6.5 °C**
Ambient-corrected ΔT (peak)	—	—	**+5.8 °C**
Post-stop trend (30 min → +10)	−1.6 °C	−1.5 °C	**Cooling**
Alarm during test	None	None	—
Acceptance band	—	—	**Acceptable**

2. Robot & Test Information

2.1 Robot Information

Robot Brand	ABB
Test Robot Model	IRB 2600-12/1.85
Target Application Robot	IRB 1410-4/1.45
Payload (test / target)	≤ 12 kg / 5 kg
Application	Deburring
Program / Cycle Speed	1,000 mm/sec TCP
Speed Override	100 %
Protective Cover Model	FABOTSUIT® FBD01
Protective Cover Material	Nylon Composite

2.2 Test Information

Thermal Camera	UTi32
Test Duration	30 min run + 10 min post-stop
Ambient Temperature	31.9 – 33.0 °C
Relative Humidity	41 – 46 %
Measured Joints	Axis 1, Axis 2, Axis 3 (highest-load joints)
Alarm Occurrence	None

Measurement note (UTi32): the UTi32 is a compact thermal imager; emissivity, viewing angle and exact spot location affect absolute readings. The analysis therefore relies on the **difference (ΔT)** between conditions at the same joint locations, which cancels most systematic instrument offset. Absolute values carry a tolerance of roughly ±2 °C.

3. Robot Specification Comparison (Target vs. Test)

The customer's production robot is the IRB 1410; the unit available for thermal testing was the larger IRB 2600. The comparison below shows the test was performed on a **more thermally demanding** robot than the target, making the conclusions conservative.

Specification	IRB 1410-4/1.45 (Target)	IRB 2600-12/1.85 (Tested)
Payload	5 kg	12 kg
Reach	1,450 mm	1,850 mm
Axes	6	6
Repeatability	0.05 mm	0.04 mm
Robot mass (approx.)	~225 kg	~272 kg
Drivetrain class	Smaller motors / gears	Larger, higher-torque
Protection (std.)	Standard / Clean Room opt.	IP67, FoundryPlus 2 opt.
Airborne noise	≤ 70 dB(A)	≤ 69 dB(A)

Engineering interpretation

- The IRB 2600 has a **larger drivetrain and higher motor torque**, producing more heat per joint than the IRB 1410 under comparable duty.
- Because the heavier, hotter-running test robot showed only a moderate, self-stabilising rise under the cover, the **lighter IRB 1410 is expected to behave at least as favourably** for the same cover and duty cycle.
- The test therefore acts as a **conservative proxy**, not an under-estimate of the target robot's thermal behaviour.

This is an engineering inference from relative drivetrain size and thermal mass, not a direct measurement on the IRB 1410. A confirmation run on the production robot is recommended (Section 9).

4. Test Data & Data Validation

4.1 Recorded Data

Condition	Time	Amb °C	RH %	Axis 1	Axis 2	Axis 3
No Cover	Start	31.9	46	36.7	34.9	31.1
No Cover	15 min	31.9	46	38.1	35.2	32.2
No Cover	30 min	31.9	46	**42.0**	**38.2**	**33.2**
No Cover	Stop +5	31.9	46	41.0	37.3	32.2
No Cover	Stop +10	32.0	46	40.4	35.6	31.8
With Cover	Start	32.2	44	36.1	34.2	33.1
With Cover	15 min	32.3	44	42.7	38.7	34.2
With Cover	30 min	32.6	41	**48.5**	**42.0**	**35.8**
With Cover	Stop +5	32.9	41	47.6	41.0	35.7
With Cover	Stop +10	33.0	41	47.0	40.5	35.2

Table 4.1 — Recorded joint surface temperatures. Peak (30 min) values highlighted. Axes 4–6 not measured (lowest thermal load).

What the Axis 1/2/3 values are: every Axis 1/2/3 figure is the **surface (contact) temperature of the servo-motor / gear housing**, captured with the thermal camera aimed directly at each joint. They are **not** ambient air and **not** internal winding temperatures. The 'Amb °C' column is the surrounding **air** temperature, measured independently with a meter mounted on the robot base (see Section 9.3). Reading the two together: at the 30-minute peak, the hottest motor surface (Axis 1, 48.5 °C) occurred while the ambient air was only **32.6 °C** — i.e. **12.4 °C below** ABB's +45 °C operating-ambient limit.

4.2 Data Validation

- **Completeness:** all required time points (Start, 15, 30 min, Stop +5, Stop +10) are present for both conditions on Axes 1–3. Axes 4–6 were not recorded; these wrist joints carry the lowest load and are not thermally critical for this duty.
- **Comparability of conditions:** ambient ranged 31.9–32.0 °C (No Cover) vs 32.2–33.0 °C (With Cover) — a maximum difference of ~1.1 °C. RH was 41–46 %. Conditions are sufficiently close for direct comparison; the small ambient offset is removed via ambient correction (Section 5).
- **Instrument:** single UTi32 camera used for both tests, eliminating inter-device bias. Same joint spots, same emissivity setting assumed.
- **Process consistency:** identical program, 100 % speed override, ≤12 kg payload, deburring path for both runs.

Validation result: the dataset is complete, internally consistent, and the two conditions are comparable. Data is suitable for engineering analysis.

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5. Temperature Analysis

5.1 Maximum, Average & Temperature Rise

Condition	Axis	Max °C	Avg °C	Rise→Peak	Rise→End
No Cover	Axis 1	**42.0**	39.6	+5.3	+3.7
No Cover	Axis 2	38.2	36.2	+3.3	+0.7
No Cover	Axis 3	33.2	32.1	+2.1	+0.7
With Cover	Axis 1	**48.5**	44.4	+12.4	+10.9
With Cover	Axis 2	42.0	39.3	+7.8	+6.3
With Cover	Axis 3	35.8	34.8	+2.7	+2.1

Table 5.1 — Per-axis maximum, average, and temperature rise (°C). Rise→Peak = peak − start; Rise→End = final − start.

5.2 Surface Temperature Difference (ΔT) Between Cover Conditions

This compares the motor/gear **surface** temperatures between the two runs. ΔT = T_surface(with cover) − T_surface(no cover) at each matching time point — i.e. how much the cover raised the joint surface. A small ambient-corrected value is also given, which removes the minor difference in surrounding-air temperature between the two runs so the figure reflects the cover alone: **ΔT_corrected = ΔT_surface − (Ambient_withcover − Ambient_nocover)**. The correction is only ~0.7–1.0 °C; the values below are surface differences, not ambient.

Axis	Start	15 min	30 min	Stop+5	Stop+10
Axis 1	−0.6 / −0.9	+4.6 / +4.2	**+6.5 / +5.8**	+6.6 / +5.6	+6.6 / +5.6
Axis 2	−0.7 / −1.0	+3.5 / +3.1	+3.8 / +3.1	+3.7 / +2.7	+4.9 / +3.9
Axis 3	+2.0 / +1.7	+2.0 / +1.6	+2.6 / +1.9	+3.5 / +2.5	+3.4 / +2.4

Table 5.2 — Surface-temperature ΔT (raw / ambient-corrected) in °C at each time point. Values are the difference in motor/gear surface temperature between cover conditions. Worst case = Axis 1 @ 30 min, corrected +5.8 °C (highlighted).

- **Axis 1** is the dominant heat source: corrected peak surface ΔT = **+5.8 °C**.
- **Axis 2** corrected surface ΔT stays ≈ +3 °C; **Axis 3** ≈ +2 °C.
- At Start, ΔT is near zero or negative — both robots began from effectively the same surface temperature, confirming a fair baseline.

6. Heat Accumulation Analysis

This section addresses the core concern raised about the cover: whether it traps heat and drives servo temperature upward without limit.

6.1 Stabilisation and Trend

- **Temperature is stabilising, not running away.** On both conditions every axis reached its peak at the 30-minute mark (end of run) and then **declined**, rather than continuing to climb.
- **Post-stop cooling (With Cover):** Axis 1 fell from 48.5 → 47.0 °C (−1.5 °C), Axis 2 from 42.1 → 40.5 °C (−1.6 °C) within 10 minutes of stopping. Heat dissipates through the cover; it is not permanently trapped.
- **Axis 3 (With Cover)** held nearly flat after stop (35.8 → 35.7 °C). This is consistent with **conducted heat rising from the hotter Axis 1/2 housings below it**, not with internal heat generation in Axis 3 — its own active rise during the run was only +2.7 °C.
- **No thermal runaway:** a runaway signature is a continuously accelerating rise that does not reverse on stop. The opposite was observed — all axes cooled or plateaued after motion ceased.

6.2 Classification Criteria

Classification uses three evidence-based dimensions — all either measured directly or documented by ABB — rather than any temperature limit the specification does not state:

- **Cover-induced ΔT** — the ambient-corrected temperature increase the cover adds versus the no-cover baseline (the central question of this evaluation).
- **Post-stop behaviour** — whether the joint stabilises and cools after the robot stops (healthy) or keeps rising (heat-trapping).
- **ABB overheating supervision** — whether the robot's own built-in protection raised any alarm or fault.

Note: the recorded Axis 1/2/3 values are **surface temperatures of the gear/motor housing**, not ambient air and not internal winding temperatures. They are therefore **not** compared to the +45 °C ambient-air operating limit, nor to any insulation-class figure (ABB does not publish one for these motors). The classification rests only on the three dimensions above.

Classification scale

Classification	Cover ΔT (corrected)	Post-stop behaviour	Supervision
Normal	< 5 °C	Stabilises & cools	No alarm
Acceptable	5 – 8 °C	Stabilises & cools	No alarm
Verify	8 – 10 °C	Slow / no cooling	No alarm
Investigate	> 10 °C	Keeps rising	Alarm / trip

Result of classification

Axis	Cover ΔT	Post-stop	Supervision	Classification
Axis 1	+5.8 °C	Cools (−1.5 °C)	No alarm	**Acceptable**
Axis 2	+3.1 °C	Cools (−1.5 °C)	No alarm	**Normal**
Axis 3	+1.9 °C	Cools (−0.6 °C)	No alarm	**Normal**

Overall heat-accumulation verdict: Normal. The cover raises temperatures by a bounded amount that stabilises during operation and reverses after stop on every axis. There is no evidence of runaway, no heat accumulation that persists or grows after the robot stops, and ABB's own overheating supervision never activated. Axis 1, the hottest joint, sits in the 'Acceptable' ΔT band.

7. Servo Motor & Gear Risk Assessment

The highest temperature recorded was **48.5 °C** (Axis 1, with cover). It is important to state precisely what this value is: it is the **external surface temperature of the joint housing** (the gear/motor casing), measured with the thermal camera. It is **not** the internal motor winding temperature, and it is **not** the ambient-air temperature.

On reference limits — an honest scope statement: the ABB Product Specification for the IRB 2600 (and IRB 1410) does **not** publish a motor insulation class or an explicit motor/gear temperature limit. This report therefore does **not** assert any specific winding or lubricant limit (e.g. a numeric insulation-class value) and does **not** compute a margin against one, since doing so would rely on figures ABB has not stated. The assessment below uses only what is measured and what ABB does document.

7.1 What ABB Does Document

The IRB 2600 Product Specification (3HAC035959-001) provides the following directly relevant points:

- **Operating ambient:** the manipulator is rated for operation in ambient air of **+5 °C to +45 °C**. (For the IRB 1410, the same +5 °C to +45 °C operating range applies.)
- **Built-in overheating supervision:** ABB states there is *a supervision function to prevent overheating in applications with intensive and frequent movements*. The robot therefore monitors its own drivetrain temperature and will act if it becomes excessive.
- **Thermal management tooling:** ABB provides an optional cooling fan for the axis 1/2 motors and a *Gearbox Heat Prediction Tool* in RobotStudio to manage motor/gear heat in intensive-motion applications — confirming that drivetrain heat is handled by ABB through dedicated, model-specific means rather than a single published surface limit.

7.2 Assessment Based on Documented Evidence

With no published numeric limit to compare against, the risk is assessed from three independent, evidence-based pillars — each traceable either to the measured data or to ABB's own documentation:

Evidence pillar	What it shows
1. Cover effect is small	The cover adds only +5.8 °C (corrected) at the hottest joint. The question this project asks — does the cover add abnormal heat — is answered directly by measurement, independent of any absolute limit.
2. No thermal runaway	Every axis stabilised and then cooled after the robot stopped. A heat-trapping or runaway failure mode would instead show continued rise; the opposite was observed.
3. ABB supervision did not trip	ABB's own built-in overheating supervision raised no alarm and did not stop or de-rate the robot at any point during the covered run. By the manufacturer's own protection logic, motor temperature did not reach a level ABB considers excessive.

Pillar 3 is the strongest single point: rather than relying on a temperature figure this report would have to source externally, it uses ABB's own on-robot protection as the reference. If the cover were driving a motor toward an unsafe temperature, that supervision would have flagged or stopped the robot. It did not.

7.3 Risk Summary

Risk Factor	Assessment	Reasoning (evidence-based)
Servo motor overheating	**Low**	Cover adds only +5.8 °C; temperatures stabilise and cool after stop; ABB's overheating supervision never tripped
Gear / lubricant heating	**Low**	Housing surface ≤ 48.5 °C and falling after stop; no sign of progressive heat build-up in the gear casing
Accelerated bearing wear	**Low**	No sustained or rising temperature that would indicate abnormal frictional heating; behaviour matches the no-cover baseline in shape
Reduced robot lifetime	**Low**	No abnormal thermal behaviour observed that would imply accelerated ageing; long-duration data recommended as good practice

No damage is assumed or implied, and no undocumented limit is claimed. The risk of servo or gear damage attributable to the cover is assessed as low under the tested conditions, on the basis of the measured cover effect, the absence of runaway, and the fact that ABB's own overheating supervision did not activate.

Scope note: where a formal numeric verification against motor/gear temperature limits is required, those limits are defined by ABB for the specific motor/gearbox and can be evaluated using ABB's tools (e.g. the RobotStudio Gearbox Heat Prediction Tool) or by logging controller motor-temperature data. That is the appropriate route for an absolute-limit sign-off and is recommended as a follow-up where needed.

8. Engineering Acceptance Criteria

8.1 Acceptance Guideline (ΔT-based)

Temperature Difference	Rating	This Test
0 – 3 °C	Excellent	Axis 3
3 – 5 °C	Good	Axis 2
5 – 8 °C	Acceptable	**Axis 1**
8 – 10 °C	Requires Additional Verification	—
> 10 °C	Not Recommended w/o Investigation	—

Using ambient-corrected ΔT at peak: Axis 1 = +5.8 °C → **Acceptable**; Axis 2 = +3.1 °C → Good; Axis 3 = +1.9 °C → Excellent. The governing (worst-case) rating is **Acceptable**.

8.2 Cross-Check Against ABB Operating Limits

ABB's published operating requirements for the manipulator specify a permitted **ambient-air** temperature of **+5 °C to +45 °C** during operation (storage up to +55 °C; up to +70 °C for periods under 24 h). These figures provide an independent reference frame:

- **Operating ambient headroom:** the air temperature during testing was 32–33 °C — roughly **12–13 °C below** the +45 °C operating ceiling. The cover warms the air immediately around the joints, but the measured environment remained well inside ABB's permitted operating window.
- **Surface vs. ambient distinction:** the joint surface readings (up to 48.5 °C) are not compared to the +45 °C ambient figure, because surface metal temperature is expected to exceed surrounding-air temperature during operation (even with no cover, Axis 1 reached 42 °C against ~32 °C air). The surface values are assessed via the evidence-based approach in Section 7, not against an undocumented numeric limit.
- **Lubricant viscosity note:** ABB highlights a low-temperature caution (warm-up advised below 10 °C due to oil/grease viscosity). The tested regime is at the opposite, warmer end and far from any low-temperature concern; the modest warming under the cover is not adverse in this respect.

8.3 Secondary Checks

- **Maximum observed temperature:** 48.5 °C (gear/motor housing surface) — falls after stop; no ABB overheating supervision alarm.
- **Ambient temperature:** 31.9–33.0 °C, stable, comparable between runs, and 12–13 °C below ABB's +45 °C operating ceiling.
- **Alarm / supervision fault:** none on either run — the robot's own motor-temperature supervision never triggered.
- **Heat-accumulation trend:** stabilising; cools after stop — no runaway.

9. Photographic & Thermal Evidence

This section presents the source thermal images, the running program, and the test setup, so the recorded data can be traced directly to physical evidence.

9.1 Thermal Images at 30 min — No Cover vs With Cover

The following pairs show each measured joint after 30 minutes of continuous operation. The spot value shown in each image is the joint temperature recorded in Table 4.1. Emissivity was set to 0.95 for all images.

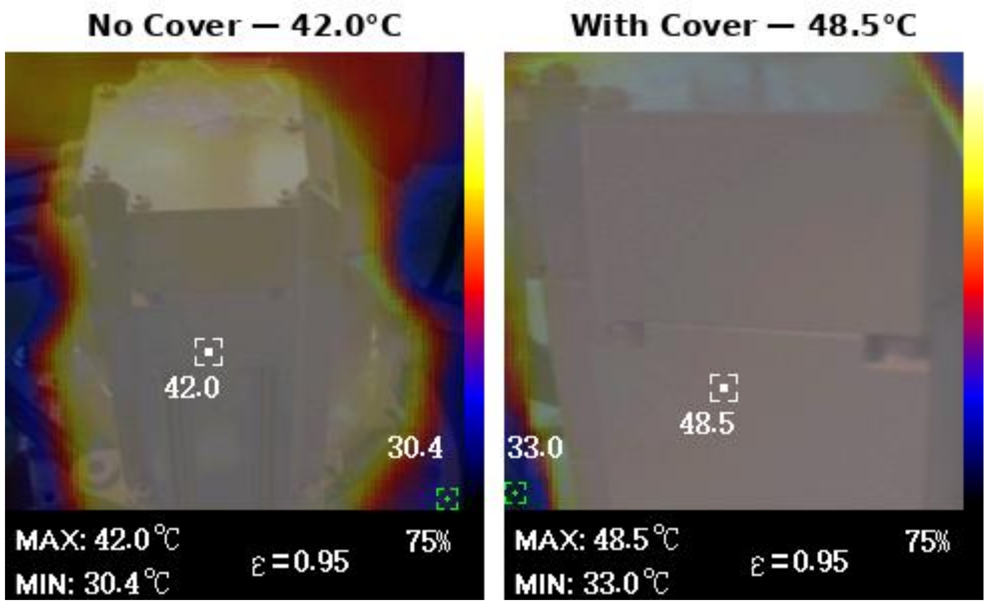

Figure 9.1 — Surface temperature at Axis 1 at 30 min. No Cover 42.0 °C (left) vs With Cover 48.5 °C (right). ΔT corrected ≈ +5.8 °C.

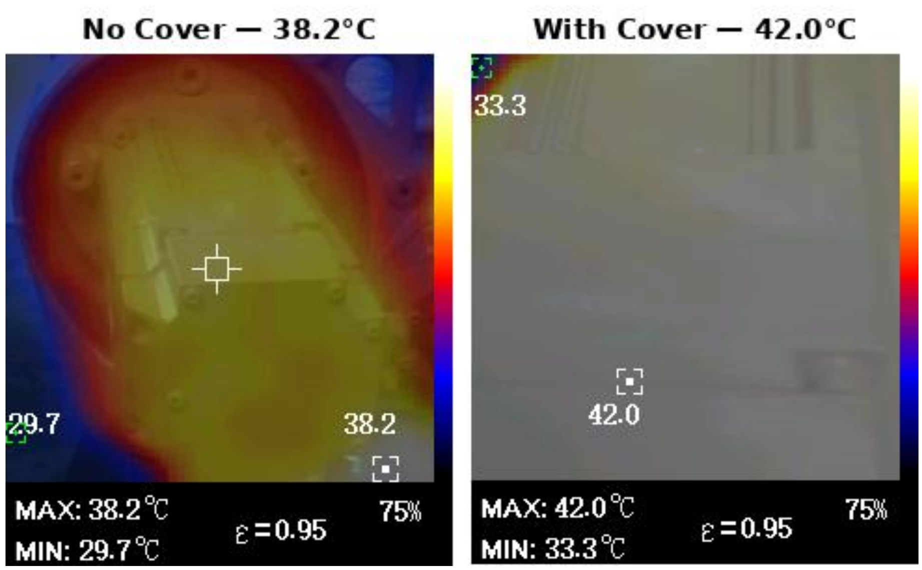

Figure 9.2 — Surface temperature at Axis 2 at 30 min. No Cover 38.2 °C vs With Cover 42.0 °C. ΔT corrected ≈ +3.1 °C.

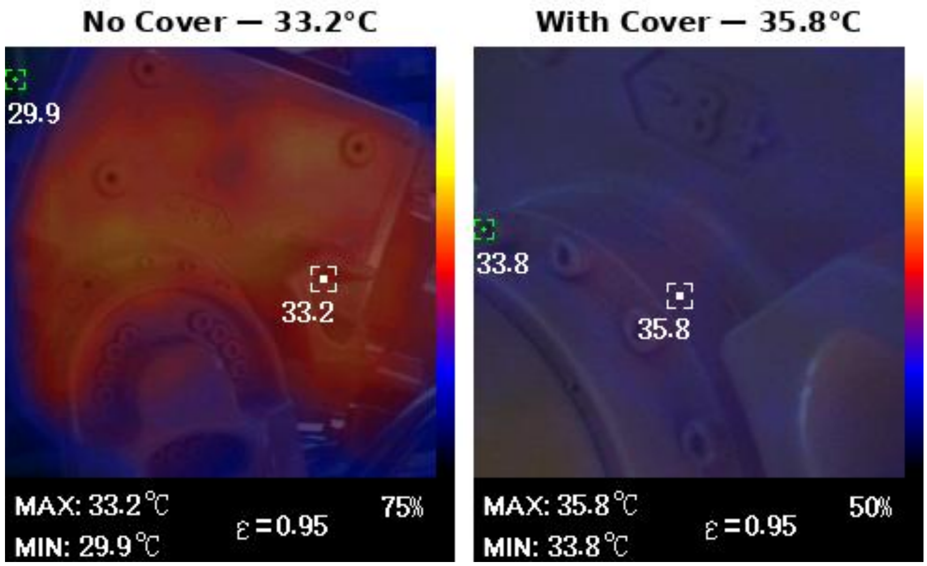

Figure 9.3 — Surface temperature at Axis 3 at 30 min. No Cover 33.2 °C vs With Cover 35.8 °C. ΔT corrected ≈ +1.9 °C.

9.2 Test Program — Speed Verification

The robot was driven by the program below on the ABB FlexPendant. Every motion instruction uses **v1000 (1,000 mm/s)** at **100 % speed override** (Motors On, Running), confirming the stated cycle speed for both the no-cover and with-cover runs.

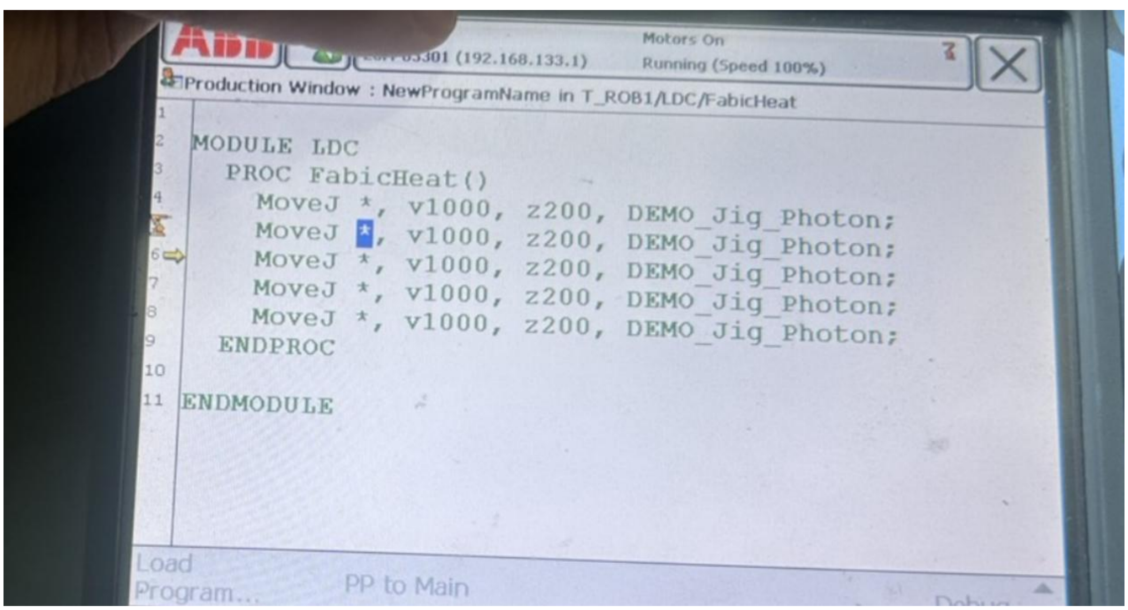

Figure 9.4 — FabicHeat program on the FlexPendant. MoveJ instructions at v1000, speed override 100 %.

9.3 Ambient Measurement at Peak

Ambient air was monitored throughout the test with a temperature/humidity meter mounted directly on the robot base. The reading below was captured at the **30-minute peak** — the moment the motor surfaces were at their hottest — establishing the ambient conditions the surface readings were taken against.

Ambient at 30-min peak — 32.6 °C / 41 %RH (on robot base)

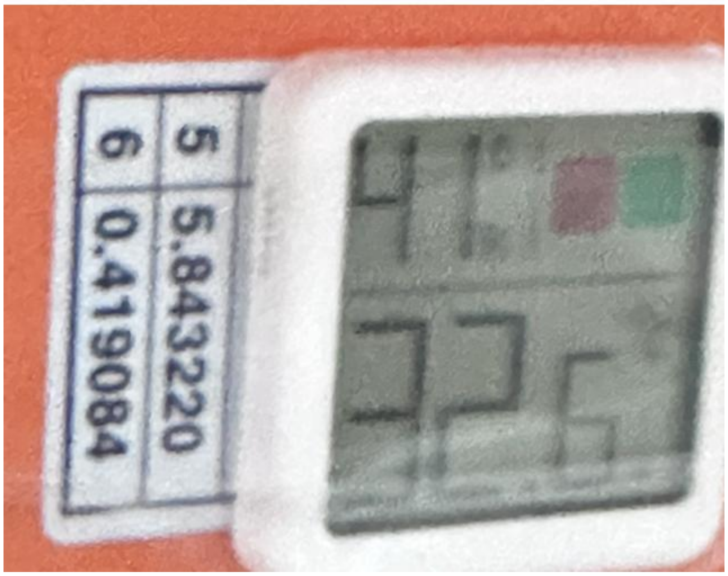

Figure 9.5 — Ambient meter on the robot base at the 30-minute peak: 32.6 °C / 41 %RH — i.e. 12.4 °C below ABB's +45 °C operating-ambient limit while the hottest motor surface (Axis 1) read 48.5 °C.

9.4 Surface Temperature vs Ambient — Relationship

Because the recorded joint values are motor/gear **surface** temperatures, the meaningful safety question is how they relate to the **ambient air** ABB specifies (+5 °C to +45 °C operating). The table pairs the two at each time point for the with-cover run:

Time	Ambient air °C	Axis 1 surf.	Axis 2 surf.	Axis 3 surf.
Start	32.2	36.1	34.2	33.1
15 min	32.3	42.7	38.7	34.2
30 min (peak)	**32.6**	**48.5**	**42.0**	**35.8**
Stop +5	32.9	47.6	41.0	35.7
Stop +10	33.0	47.0	40.5	35.2

Table 9.1 — Ambient air vs motor/gear surface temperature (with cover). Ambient stayed 32–33 °C throughout, ~12–13 °C below ABB's +45 °C operating-ambient limit.

- **Ambient never approached the limit:** measured ambient air held at 32–33 °C — a 12–13 °C margin below ABB's +45 °C operating ceiling — even with the cover installed.

- **Surface sits above ambient, as expected:** a running servo motor's housing is normally warmer than the surrounding air. At peak, Axis 1 surface (48.5 °C) was ~15.9 °C above ambient — and even the no-cover baseline showed the same effect (42.0 °C surface vs ~32 °C air).
- **The +45 °C figure is an ambient-air limit, not a surface limit** — so it is compared against the ambient line, which passes comfortably, not against the surface readings.

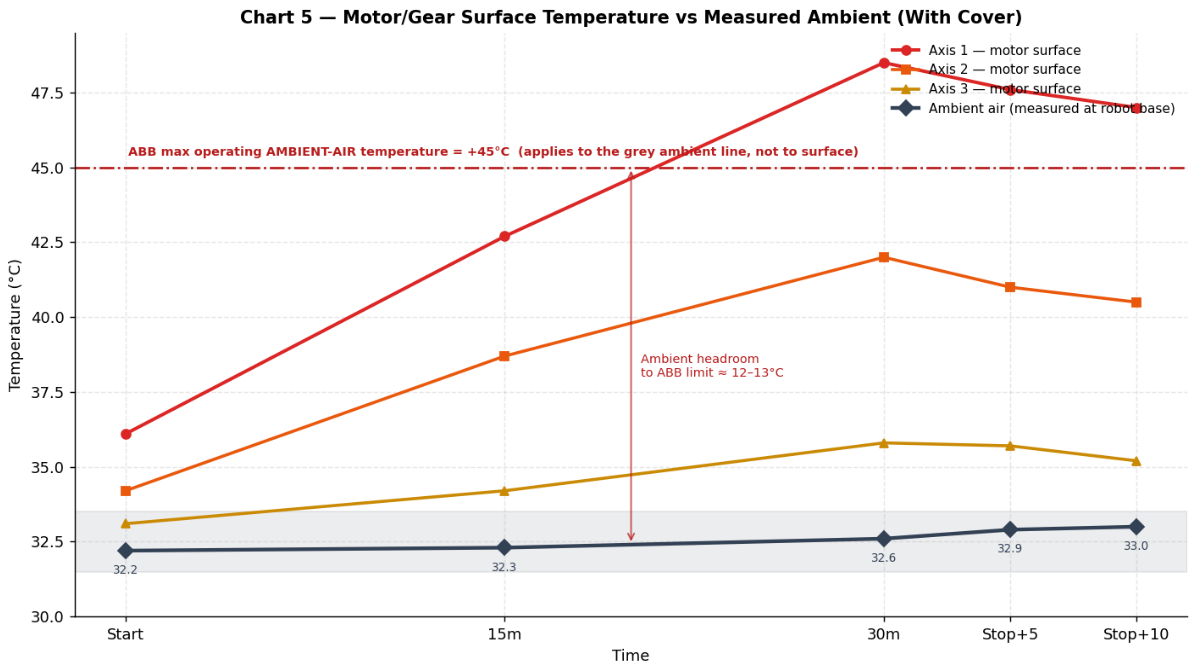

Chart 5 — Motor/gear surface vs measured ambient (with cover). The +45 °C reference applies to the ambient (grey) line, which retains a 12–13 °C margin.

9.5 Cover Installed — External View

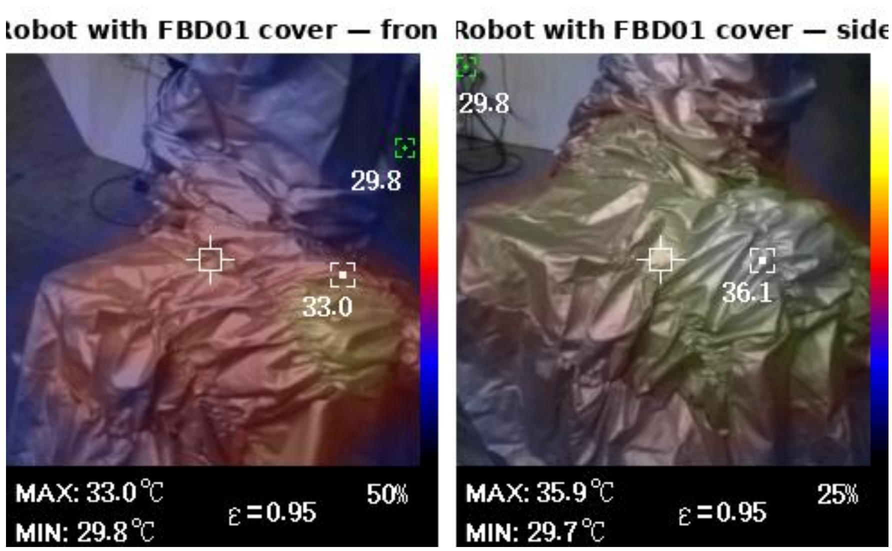

Figure 9.6 — IRB 2600 with FBD01 cover installed (external thermal views). Outer cover surface remained ≈ 33–36 °C.

10. Graphs

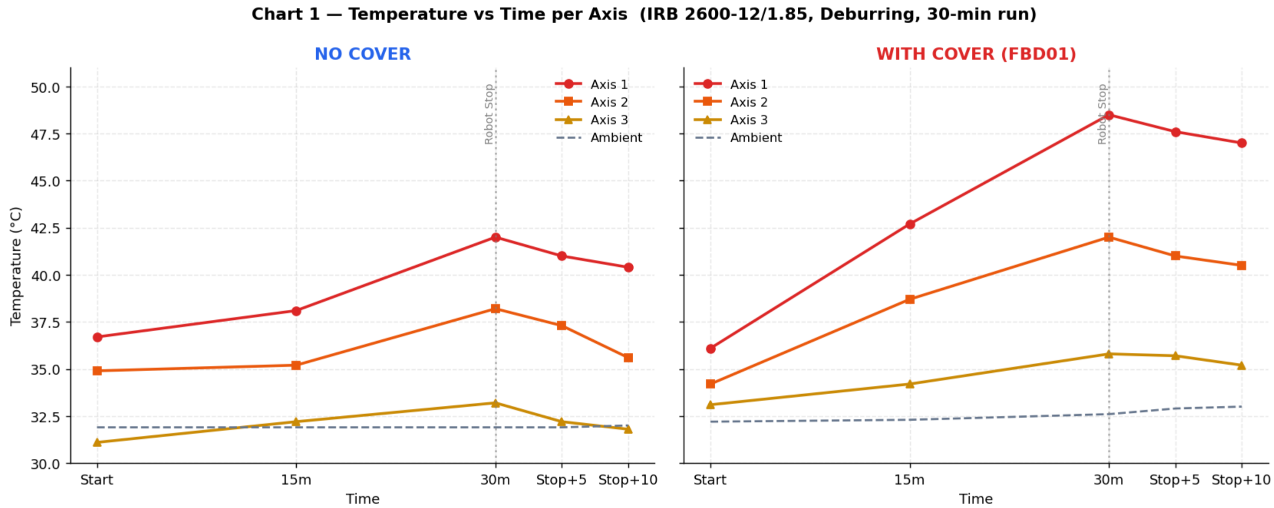

Chart 1 — Temperature vs Time per axis, No Cover (left) vs With Cover (right). All axes peak at 30 min then decline.

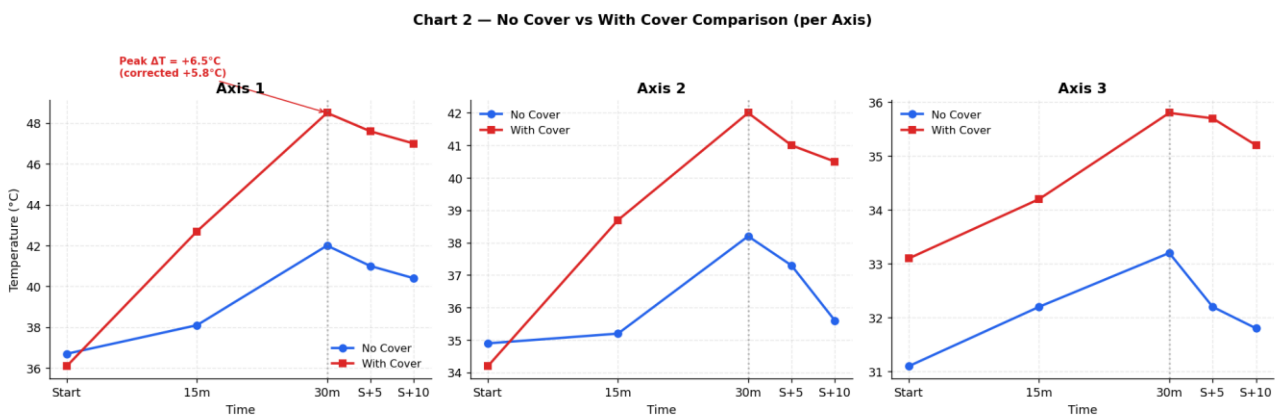

Chart 2 — Direct No-Cover vs With-Cover comparison per axis. Largest gap on Axis 1.

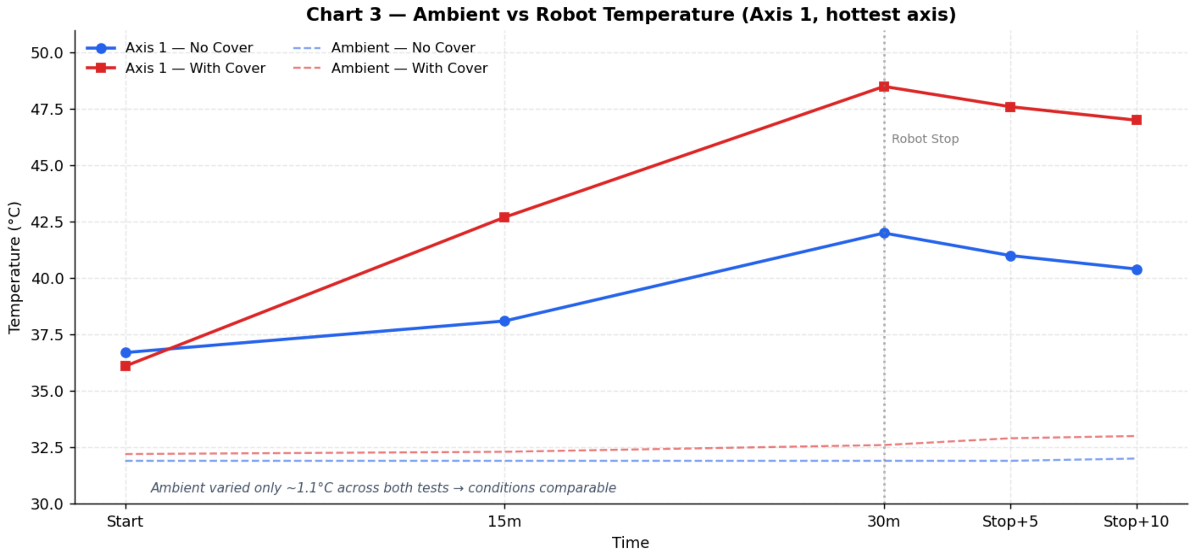

*Chart 3 — Ambient vs robot temperature (Axis 1). Ambient varied only **~1.1 °C**, confirming comparable conditions.*

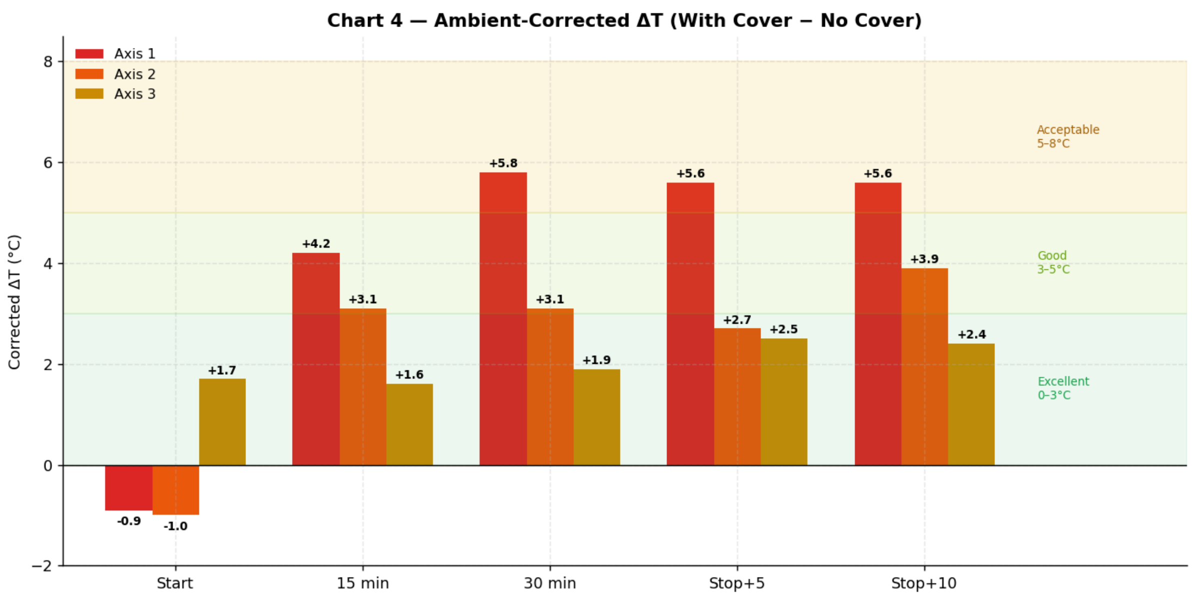

Chart 4 — Ambient-corrected ΔT per axis against acceptance bands. Axis 1 sits in the 5–8 °C 'Acceptable' band.

11. Final Engineering Conclusion

11.1 Findings

1. The FABOTSUIT® FBD01 cover raised joint surface temperatures by a bounded amount: ambient-corrected peak ΔT of +5.8 °C (Axis 1), +3.1 °C (Axis 2), +1.9 °C (Axis 3).
2. The maximum recorded temperature with the cover was 48.5 °C, measured at the gear/motor housing surface (not the winding or ambient air); it fell after the robot stopped.
3. Temperatures stabilised during the run and decreased after the robot stopped on every axis — no thermal runaway and no persistent post-stop heat accumulation.
4. No alarms occurred during either test.
5. The test robot (IRB 2600) is larger and thermally more demanding than the customer's IRB 1410, making these results a conservative reference.

11.2 Risk Assessment

Under the tested conditions, the risk of servo motor overheating, accelerated bearing wear, or reduced robot lifetime attributable to the cover is assessed as **low**. The hottest joint is Axis 1, whose corrected ΔT falls in the 5–8 °C 'Acceptable' band; it stabilised and cooled after the robot stopped, and ABB's built-in overheating supervision never activated during the test.

11.3 Recommendation

A	**Recommended** The FBD01 protective cover is recommended for the tested deburring application. Under the tested conditions, no evidence of abnormal heat accumulation was observed, and the temperature increase remained within an acceptable range during the test period. Extended continuous-production validation is advised as good practice to confirm long-duration behaviour.

11.4 Recommended Next Steps

- Conduct an extended continuous-production run (e.g., 2–4 hours) to confirm steady-state behaviour beyond 30 minutes.
- Where feasible, perform a confirmation measurement on the actual IRB 1410 production robot.
- If available, log controller-reported servo load / motor temperature alongside thermal-camera data for cross-validation.
- As good engineering practice, include Axis 1 in routine thermal checks during early production deployment.

11.5 Scope & Pre-existing Condition Statement

This evaluation characterises the **thermal effect of the FBD01 protective cover** by comparing the robot's behaviour with and without the cover under matched conditions. Its scope is limited to that comparison.

- The test was performed on a test-unit IRB 2600 that was in **normal working order** at the time of testing, with no fault or alarm present. The analysis assumes the drivetrain was in a representative, healthy condition.
- This report does **not** assess, and makes no claim about, the mechanical or electrical condition of the customer's production robot. The maintenance history, prior repairs, accumulated operating hours, lubricant condition, prior overload events, or any pre-existing motor/gearbox limitations of the customer's specific robot are **outside the scope** of this test and were not examined.
- Accordingly, the cover is evaluated only for its **incremental thermal contribution**. Any temperature or reliability behaviour arising from a pre-existing condition in a given robot — i.e. a condition present independently of the cover — is not attributable to the FBD01 cover and is not covered by this report.
- Where a specific robot's drivetrain condition is in question, ABB service inspection or controller-based motor diagnostics on that robot is the appropriate means of assessment, independent of the cover.

In summary: under the tested conditions the FBD01 cover did not produce abnormal heat accumulation. This finding concerns the cover's effect only and does not extend to, warrant, or exclude any pre-existing mechanical or thermal condition of an individual robot, which must be evaluated separately.

End of Report

Statement of limitations: results are valid for the tested robot, cover, duty cycle, and 30-minute duration under the stated ambient conditions. Measurements are motor/gear **surface** temperatures taken with a UTi32 thermal camera (no controller-reported motor temperatures were available); absolute values carry approximately ±2 °C instrument tolerance. The report evaluates the cover's incremental thermal effect only and does not assess the pre-existing mechanical or thermal condition of any individual robot (see Section 11.5). This document reports observed behaviour and does not constitute a warranty of performance.

Appendix A — Reference Values & Sources

The acceptance and risk thresholds in this report are drawn from the following references rather than from arbitrary values:

Parameter	Value used	Source
Operating ambient (manipulator)	+5 °C to +45 °C	ABB Product Specification — IRB 2600 (Operating requirements)
Storage ambient	−25 °C to +55 °C (+70 °C < 24 h)	ABB Product Specification — IRB 2600
Motor insulation class / temp limit	Not published by ABB — not used in this report	ABB Product Specification (no value stated)
Motor/gear heat management	Cooling fan (axis 1/2) + Gearbox Heat Prediction Tool	ABB Product Specification — IRB 2600 (p.70)
Overheating supervision	Built-in function prevents overheating in intensive-motion duty	ABB Product Specification — IRB 2600 (p.68)
ΔT acceptance bands	0–3 / 3–5 / 5–8 / 8–10 / >10 °C	Evaluation guideline (this program)

All ABB figures above are taken directly from the IRB 2600 Product Specification (3HAC035959-001); the operating ambient range also matches the IRB 1410 specification (3HAC026366). This report deliberately does **not** rely on any motor insulation class or absolute motor/gear temperature limit, because ABB does not state one in these documents. Where an absolute-limit sign-off is required, it should be performed using ABB's own tools (e.g. the RobotStudio Gearbox Heat Prediction Tool) or controller motor-temperature logging.

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